I.2 Present Status and Policy of Science and Technology Development in Malaysia

I.2.1 Present status of science and technology development in Malaysia

The present status of science and technology development in Malaysia is outlined below in regard to the costs, human resources, and organizations related to R & D and science and technology.

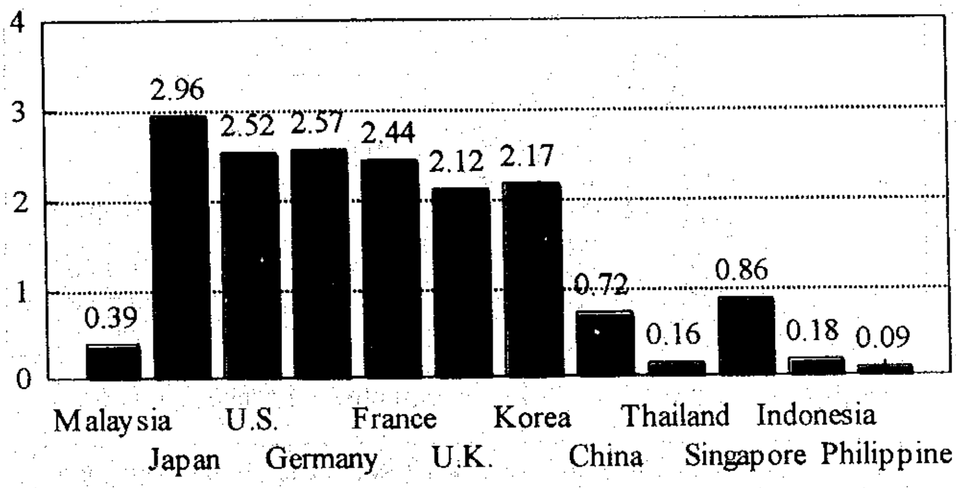
(1) Present status of science and technology development

No statistics are available regarding science and technology development and R & D activities in Malaysia. The following analysis is based on research carried out by MASTIC in 1992 (1992 National Survey of Research & Development, Dec. 1994, MASTIC, MOSTE):

Expenditure for R & D and science and technology development activities

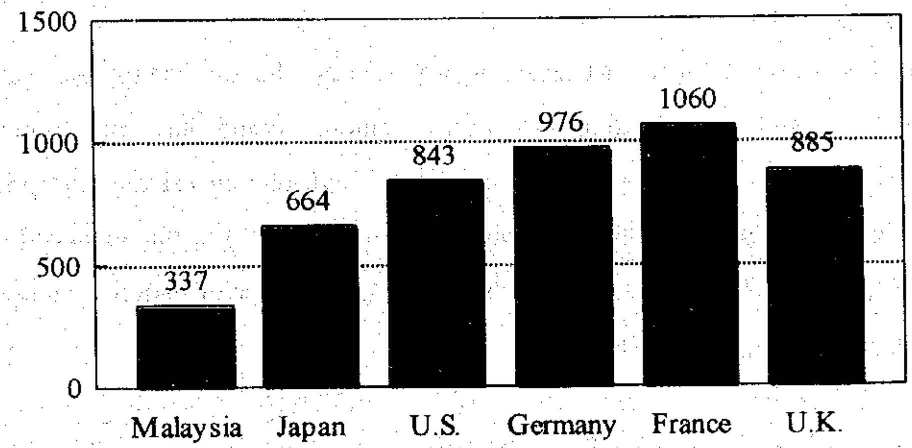
The expenditure for R & D and science and technology development activities (hereinafter referred to as "research expenditure") in Malaysia during 1992 totaled RM551 million, representing 0.39% of GNP. This ratio is higher than that of neighboring Thailand (0.16%), but about 1/2 that of China (0.72%). The ratio of research expenditure to GNP is over 2% among advanced countries, with Japan leading the race (at 2.96%). The ratio in Korea, one of the NIEs, is 2.17%. This shows Malaysia ranks quite low (Figure I.2.1).

The research expenditure per researcher is RM337,000 in Malaysia, 1/2 of that of Japan (RM664,000)and ranks lowest among advanced countries, or about 1/3 that of France (RM1,060,000) which ranks highest (Figure I.2.2).



Source: 1992 National Survey of Research & Development (Dec. 1994 , MASTIC, MOSTE)

Figure I.2.1 R & D Expenditure per GNP (%)

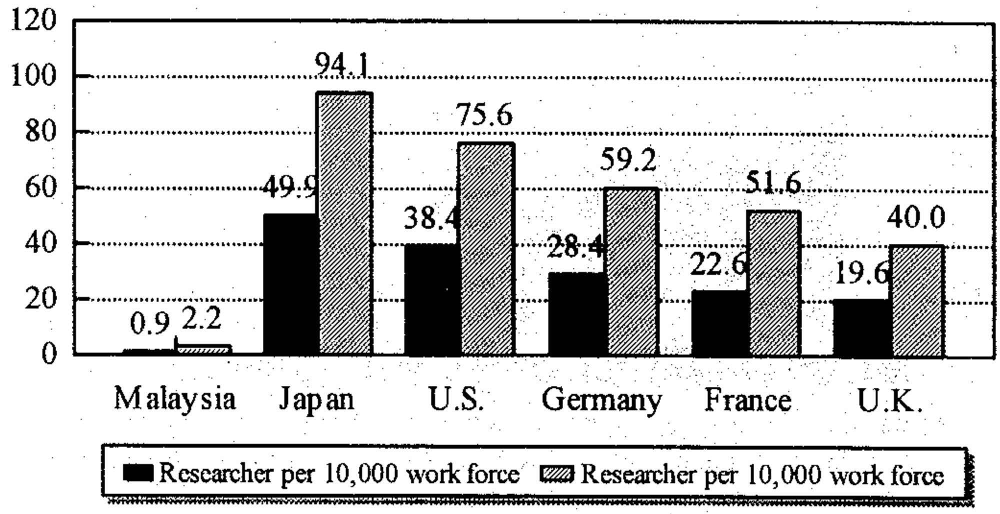


Source: 1992 National Survey of Research & Development (Dec. 1994 , MASTIC, MOSTE)

Figure I.2.2 R & D Expenditure per Researcher (RM '000)

Human resources for R & D

The number of researchers that support R & D activities in Malaysia is 1,633.1 persons (converted in full-time engagement in 1992). This represents only 0.9 persons per 10,000 population, or 2.2 persons per 10,000 work force. The number only represents 5% of the number of researchers in the U.K which ranks lowest among advanced countries (Figure I.2.3).



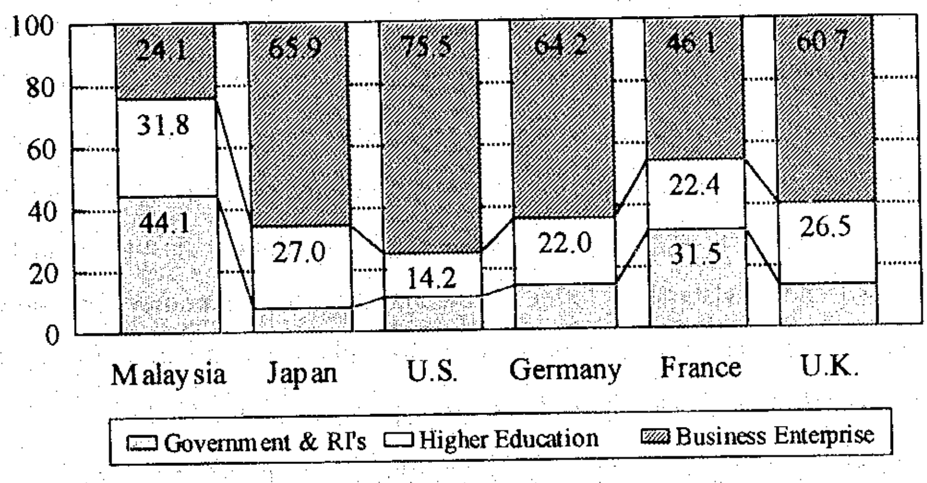
Source: 1992 National Survey of Research & Development (Dec. 1994, MASTIC, MOSTE)

Figure I.2.3 Researcher per Population and Work Force

Research organizations

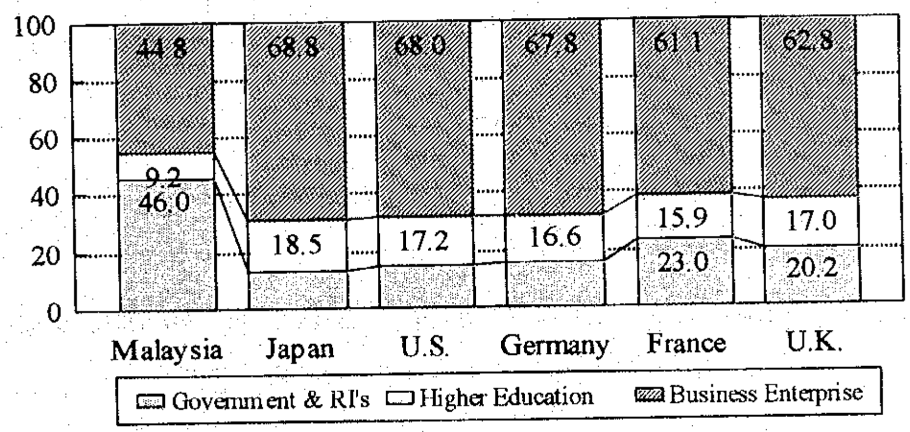
In the breakdown of researchers in Malaysia by organization, the ratio is high especially among governmental research organizations, and low among companies and other private organizations (Figure I.2.4). By contrast, the ratio is high among private enterprises (over 60%) and low among governmental research organizations (10%) in the advanced countries, with the exception of France which has a relatively large number of national enterprises as a result of a prolonged socialist administration.

In the breakdown of research expenditure in Malaysia by organization, the ratio is high among governmental research organizations and low among private enterprises, revealing a sharp contrast from advanced countries (Figure I.2.5). The ratio is extremely low (9%) among higher education institutes compared to the number of researchers there (32%). The ratio of research expenditure tends to fall far below that of the number of researchers because higher education institutes are considered to serve dual purposes as a place of both research and education. However, such a sharp contrast between research expenditure (9%) and the number of researchers (32%) in Malaysia is seen nowhere among advanced countries.



Source: 1992 National Survey of Research & Development (Dec. 1994 , MASTIC, MOSTE)

Figure I.2.4 Researcher by Sector (%)



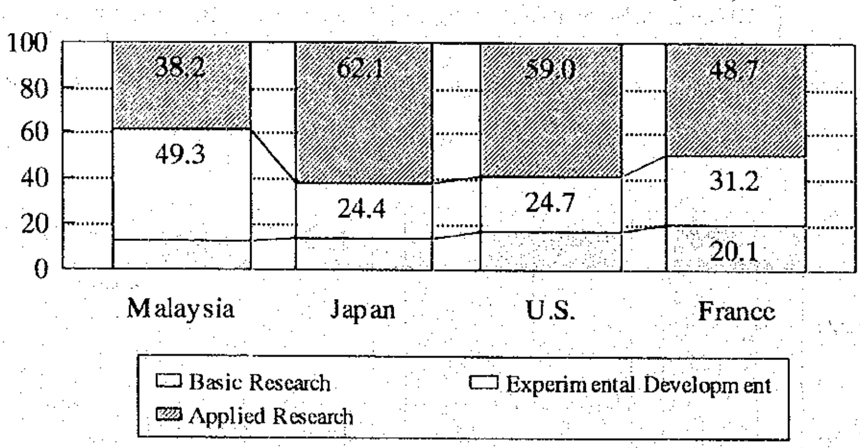
Source: 1992 National Survey of Research & Development (Dec. 1994 , MASTIC, MOSTE)

Figure I.2.5 R & D Expenditure by sector

<u>Research areas by nature</u>

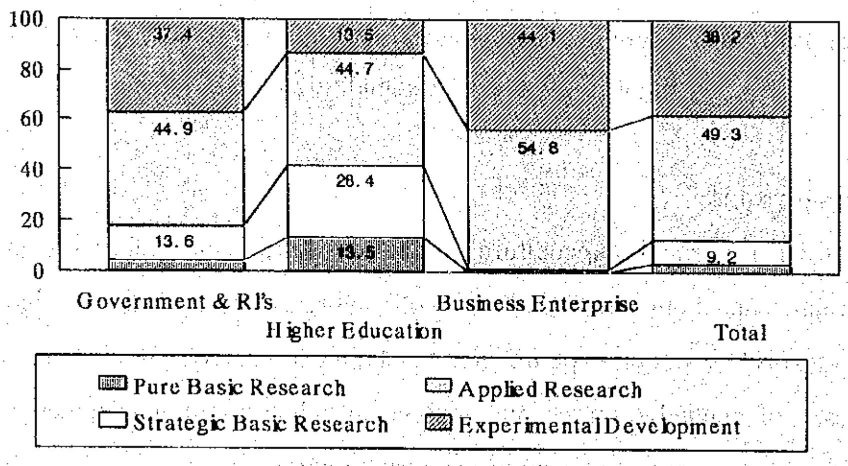
In the breakdown of research expenditure by nature, the ratio of applied research is high in Malaysia. It represents about one half (49.3%) of total research expenditure (Figure I.2.6). By contrast, the ratio is low among experimental development research (38.2%). These researches fall downstream of applied research and involve introduction of new material, equipment, products, systems, processes, etc., or improve existing ones.

In general, private enterprises in the advanced countries are active in experimental development research projects leading directly to product development. Universities and other higher education institutes in those countries place greater importance on basic and applied research while their governmental research organizations are equally engaged in both. In Malaysia, the ratio of basic research is high among higher education institutes compared to private enterprises or governmental research organizations (Figure I.2.7). Governmental research organizations fall somewhat between higher education institutes and private enterprises. This trend in Malaysia is found also among advanced countries. One significantly unique aspect of Malaysia is that private enterprises give less attention to experimental development research (less than a half) and more to applied research (60%).



Source: 1992 National Survey of Research & Development (Dec. 1994 , MASTIC, MOSTE)

Figure I.2.6 Field of R & D Expenditure by Country



Source: 1992 National Survey of Research & Development (Dec. 1994 , MASTIC, MOSTE)

Figure I.2.7 Field of R & D Expenditure by Sector

Research areas

In the breakdown of research expenditure and the number of researchers by area of research, higher ratios in both categories are found among applied science and technologies, engineering sciences, and agricultural sciences (Tables I.2.1-2).

In the breakdown of research expenditure and the number of researchers by research organizations, governmental research organizations rank high in both categories in agricultural sciences, followed by applied science and technologies. Higher education institutes rank high in research expenditure in agricultural sciences and applied science and technologies. The number of researchers ranks notably high in chemical sciences and medical and health sciences only next to agricultural sciences and followed by applied science and technologies and biological sciences. Engineering sciences rank higher than 60% of research expenditure by private enterprises, far higher than that of agricultural sciences by governmental research organizations (approximately 43%). The number of researchers is high in such areas as engineering sciences and applied sciences.

In the breakdown of research expenditure per researcher, the ratio is high in engineering sciences in all aspects. Among governmental research organizations, the ratio is high in biological sciences and applied science and technology. The ratio is high in applied science and technologies and earth sciences among higher education institutes. It is high in engineering sciences among private enterprises.

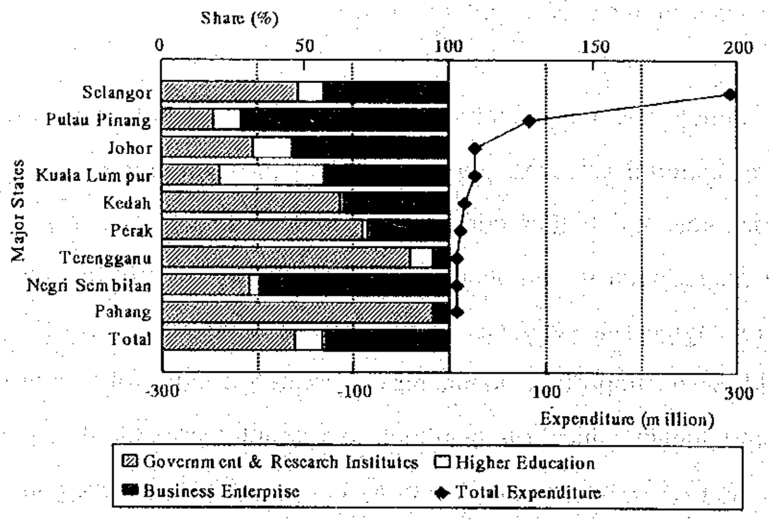
In view of the above, we may conclude that more funds are directed towards research in similar areas (agricultural sciences, applied science and technologies) among governmental research organizations and higher education institutes. By contrast, private enterprises are spending more for research in engineering sciences. It may be safe to suppose that financial concentration in engineering sciences among private enterprises reflects industrial needs. Then, it would seem important to increase research funds for governmental research organizations and higher education institutes to promote research in engineering sciences (currently 3.1% and 7.2%, respectively) in order to meet industrial needs on a national scale.

Research activities by locality

Most governmental research organizations and universities are located in KL and vicinities. The only research center outside the Malay peninsula is the Malaysia Cocoa Bureau located in Sarawak. The country s industry is heavily concentrated in and near KL, Penang, and Johor. Figure I.2.8 shows the ratio of research expenditure and research organizations in major states in the Malay peninsula. The states with high concentration of research organizations, universities and industry also have high ratios in research expenditure. This applies to the state of Selangor more than in other states.

In the breakdown of research expenditure by state and research organ, the states of Penang and Negri Sembilan rank high (over 50%) in the ratio of research expenditure by private enterprises. The states of Pahang and Teregganu rank high (over 85%) in the ratio of research expenditure by governmental research organizations. The ratio of research expenditure by higher education institutes is lower than 10% in states other than KL.

The ratio of research expenditure by research organ demonstrates a significant state-to-state variation in Malaysia. It is high among governmental research organizations and private enterprises. Research expenditure also shows a heavy concentration in Kuala Lumpur and vicinities.



Source: 1992 National Survey of Research & Development (Dec. 1994 , MASTIC, MOSTE)

Figure I.2.8 R & D Expenditure by State

Table I.2.1 R & D expenditure by field of research (F0R)

	Field of Research	Expenditure(RM)				Expenditure(%)			
		Govt & RI's*	Higher Educa.	Business Entr.	Total	Govt & RI's*	Higher Educa.	Business Entr.	Total
F01	Mathematical Sciences	1,522,164	488,553	80,000	2,090,717	0.6	1.0	0.0	0.4
F02	Physical Sciences	1,022,082	2,071,205	219,800	3,313,087	0.4	4.1	0.1	0.6
F03	Chemical Sciences	5,332,698	6,322,737	7,849,950	19,505,385	2.1	12.5	3.2	3.5
F04	Earth Sciences	2,131,553	2,267,430	397,550	4,796,533	0.8	4.5	0.2	0.9
F05	Information, Computer, Communications Technologies	2,878,683	2,843,219	30,166,650	35,888,552	1.1	5.6	12.2	6.5
F06	Applied Science and Technologies	70,395,412	8,392,741	21,330,050	100,118,203	27.8	16.6	8.7	18.2
F07	Engineering Sciences	7,890,908	3,642,541	161,575,550	173,108,999	3.1	7.2	65.6	31.4
F08	Biological Sciences	43,492,983	6,960,585	35,900	50,489,468	17.1	13.7	0.0	9.2
F09	Agricultural Sciences	108,060,953	10,148,721	24,356,450	142,566,124	42.6	20.0	9.9	25.9
F10	Medical and Health Sciences	4,158,631	5,102,956	-	9,261,587	1.6	10.1	0.0	1.7
F11	Social Sciences	6,655,785	2,090,356	-	8,746,142	2.6	4.1	0.0	1.6
F12	Humanities	101,041	354,109	323,100	778,251	0.0	0.7	0.1	0.1
	Total	253,642,893	50,685,154	246,335,000	550,663,047	100.0	100.0	100.0	100.0

* Breakdown of expenditure figures are estimated from the formula on page 18 of report. Total figure differs slightly(>1%) from reported total figure
Source : 1992 National Survey of Research & Development (Dec 1994 MASTEC, MOSTE)

Table I.2.2 R & D expenditure by field of research (F0R) per researcher(FTE)

	Field of Research	Expenditure per reseacher(RM)				Reseacher(FTE)			
		Govt & RI's*	Higher Educa.	Business Entr.	Total	Govt & RI's*	Higher Educa.	Business Entr.	Total
F01	Mathematical Sciences	801,139	67,855	160,000	217,783	1.9	7.2	0.5	9.6
F02	Physical Sciences	129,377	118,355	56,359	113,075	7.9	17.5	3.9	29.3
F03	Chemical Sciences	209,949	90,067	254,869	154,315	25.4	70.2	30.8	126.4
F04	Earth Sciences	222,037	132,598	662,583	175,697	9.6	17.1	0.6	27.3
F05	Information, Computer, Communications Technologies	28,990	84,872	725,160	205,783	99.3	33.5	41.6	174.4
F06	Applied Science and Technologies	506,078	136,025	205,294	328,580	139.1	61.7	103.9	304.7
F07	Engineering Sciences	154,119	105,888	1,072,879	732,892	51.2	34.4	150.6	236.2
F08	Biological Sciences	694,776	117,577	359,000	414,188	62.6	59.2	0.1	121.9
F09	Agricultural Sciences	463,383	110,673	406,619	370,494	233.2	91.7	59.9	384.8
F10	Medical and Health Sciences	83,173	74,279	-	77,698	50.0	68.7	0.5	119.2
F11	Social Sciences	171,984	40,907	-	97,396	38.7	51.1	0.0	89.8
F12	Humanities	67,361	51,320	269,250	81,068	1.5	6.9	1.2	9.6
	Total	352,086	97,622	625,851	337,168	720.4	519.2	393.6	1633.2

* Breakdown of expenditure figures are estimated from the formula on page 18 of report. Total figure differs slightly(>1%) from reported total figure
Source : 1992 National Survey of Research & Development (Dec 1994 MASTEC, MOSTE)

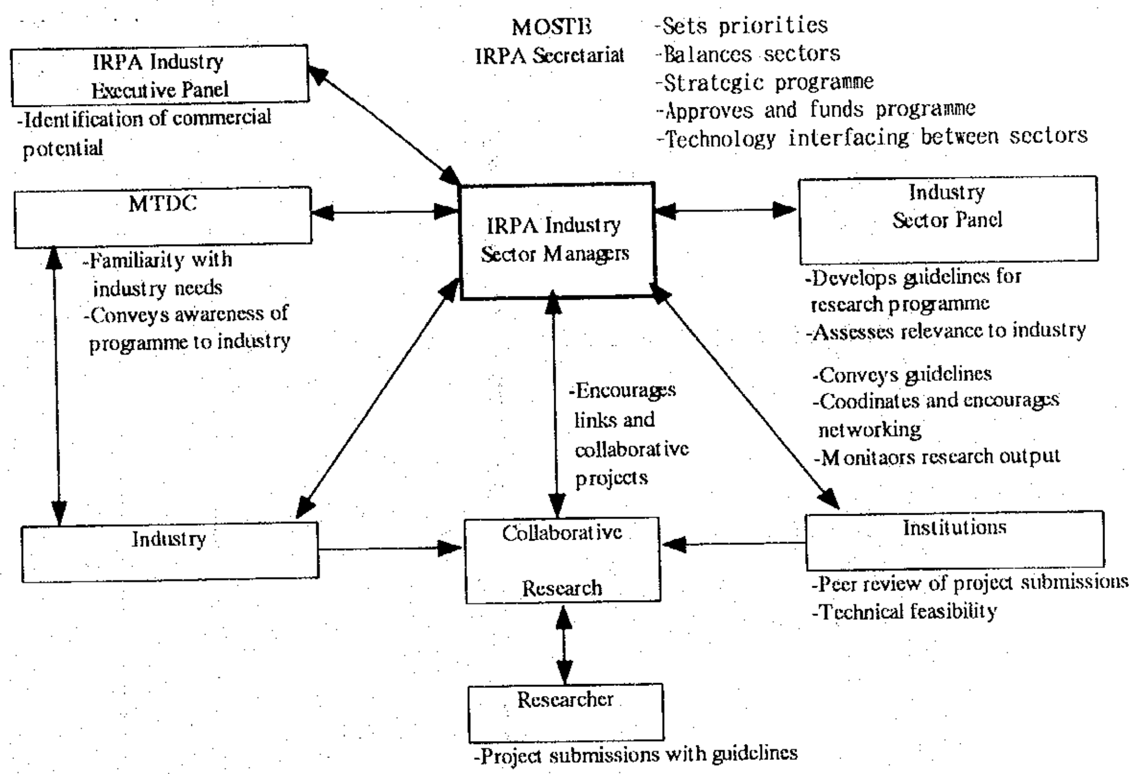
(2) Present activities by major research organizations and universities

Activities by area of research

In the breakdown of allocation of the IRPA (The Intensification of Research in Priority Areas) Program (Figure I.2.9) by area of research and organization, the largest is the Malaysian Agricultural Research and Development Institute (MARDI). MARDI receives twice the amount granted to the second largest allocation, Malaysian Agricultural University (UPM) (Figure I.2.10). The fact that two largest allocations of the IRPA Program are agricultural institutes indicates a priority on research in agriculture (Figure I.2.11). The funds granted to research of an industrial nature are about one-half of the funds allocated to research of an agricultural nature. The total amount of IRPA funds granted to industrial research projects in Malaysia are about the same as the IRPA funds allocated to MARDI alone for its agricultural research.

Among the allocation of funds for industrial research projects, the largest is the Standards and Industrial Research Institute of Malaysia (SIRIM), followed by Malaysian Institute for Nuclear Technology Research (MINT) and Malaysian Institute for Public Work (IKRAM). Among them, SIRIM is the only institute engaged in manufacturing (MINT is dedicated to atomic power and IKRAM to construction and transportation research projects). A research organ closely related to manufacturing is the Malaysian Institute of Microelectronics Systems (MIMOS). But the amount of IRPA funds allocated to MIMOS is less than those granted to MARDI for its industrial research.

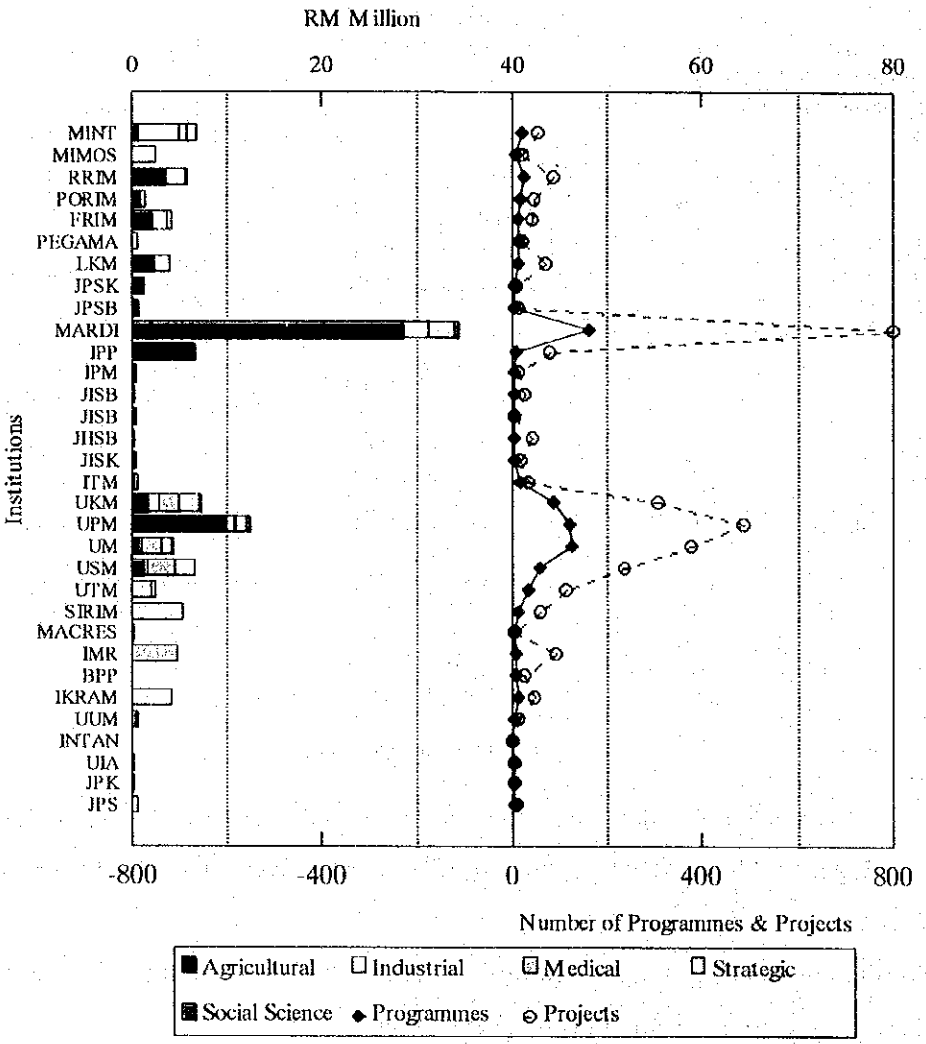
IRPA funds granted to universities reflect their academic specialization. Largest funds are granted to UPM for agricultural projects, to University of Malaya (UM) and University of Science Malaysia (USM) for medical projects, and to University of Technology Malaysia (UTM) for industrial projects. The National University of Malaysia (UKM) receives approximately the same amount of funds in all areas of research.



Source: 1993 Annual Report of the National Council for Science Research and Development (MPKSN)

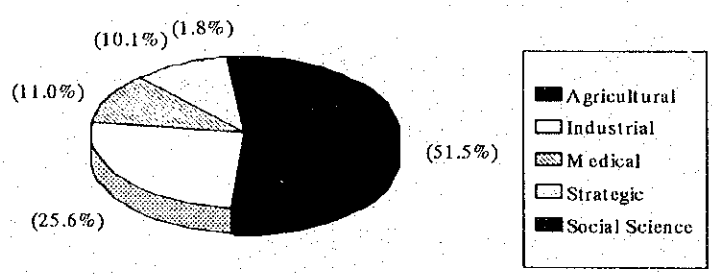
Figure I.2.9 Proposed Expansion of IRPA for Greater Industry Focus

In terms of the number of programs and projects under the IRPA Program, MARDI and UPM rank highest as they do in the amounts of IRPA grants.



Source: 1993 Annual Report of the National Council for Science Research and Development (MPKSN)

Figure I.2.10 Allocation, Nos. of Approved Programmes and Projects under IRPA



Source: 1993 Annual Report of the National Council for Science Research and Development (MPKSN)

Figure I.2.11 Allocation of IRPA

Table I.2.3 Summary of Major R & D Organizations and Universities

Name		Address	Est. year	Nos. of Researchers	Field of R&D activities	IRPA(RM)
SIRIM	MOSTE	Shah Alam	1975	29	Advanced Materials Technology, Advanced Manufacturing Technology, Product And Machine Development, Chemical Technology, Biotechnology, Environment Technology, Energy Technology, Metrology	35,558,000
MIMOS	MOSTE	Kuala Lumpur	1985	126	Semiconductor Technology, Computer Systems, Telecommunications, Information Technology and Product Development	9,000,000
RRIM	MOA	Kuala Lumpur	1925	53	Rubber(Breeding,Biotechnology and Disease Management), Mechanization and Farming Methods, Techno-economic Studies, Latex/Timber Production")	29,730,000
FRIM	MOA	Kuala Lumpur	1918	109	Management Of Natural And Non-Timber Forest, Plantation Species And Forest Biodiversity, Forestry In Urban Environments, Policy Reseach On Forestry, Processing And Production Of Timber And Fibre-Based Products, Natural Products And Alternative Energy	22,880,000
MARDI	MOA	Kuala Lumpur	1969	42	Food Technology, Agricultural Engineering, Techno-Economic And Social Studies	152,000,000
PORIM	MOA	Bangi	1979	53	Oil Palm(Agronomy, Plant Breeding, Pest And Disease Management, Biotechnology), Farm Mechanisation, Waste Management, Processing And Manufacturing Technologies, Product Development Including Food And Oleochemicals, Studies On Properties And Nutritional Values Of Oil Palm	9,885,000
UKM	MOE	Bangi	1970	54	Advanced Materials, Information Technology, Digital Image Processing, Microelectronics, Advanced Manufacturing Technology, Chemical Sciences, Energy, Biodiversity, Environmental Management And Technology, Natural Products, Geological Sciences, Transport Systems, Biotechnology, Food Technology, Health Problems, Associated With Demographic Changes, Health Problems Associated With Lifestyles, New Technologies In Health Care, Epidemiological Database, Occupational And Environmental Health, Vector-Borne And Other Communicable Diseases, Development Issues And Indicators And Social Value Reforms	38,303,022
UM	MOE	Kuala Lumpur	1949	97	Information Technology, Telecommunications, Electronics, Manufacturing Technology, Materials Science And Technology, Construction Technology, Laser And Precision Optics, Energy, Environmental Management, Fine Chemicals, Genetics And Biotechnology, Natural Products, Animal Production, Communicable And Non-Communicable Diseases, Toxin Studies Emergency Medicine, Environmental Health, Tissue And Organ Transplants	44,312,750
UPM	MOE	Serdang		189	Plantation Crops, Food Crops, Lifestock, Fisheries, Forestry, Post-Harvest And Food Technology, Agroindustrial Processing, Instrumentation And Production Machineries, Biotechnology, Natural Products, Biodiversity, Environmental Management, Telecommunications, Electronics, Information Technology, Robotics, Advanced Materiales And Construction Technology	68,764,870
USM	MOE	Georgetown	1969	110	Information Technology And Telecommunications, Electronics, Computer Science, Materials Science, Manufacturing Technology, Physico-Chemical Studies, Energy, Biotechnology, Natural Products, Biodiversity, Environmental Sciences, Fisheries, Health Problems Associated With Demographic Changes, New Technologies In Health Care, Study Of Psycho-Social Disorders, Study Of Socio-Economic Issues Relating To Industrialisation, Consumerism And Historical-Cultural Studies	49,243,120
UTM	MOE	Johor Bahru	1973	57	Chemicals And Pharmaceuticals, Petroleum, Energy, Civil Engineering, Marine/Naval Engineering, Electrical/Electronics Engineering Including Telecommunications And Information Technology, Remote Sensing And Material Technology, Manufacturing Technology, Environmental Management And Technology Including Coastal Engineering, Aeronautical Engineering And Technology Management	17,350,000

Note : MOE (Ministry of Education)
MOA (Ministry of Agriculture)

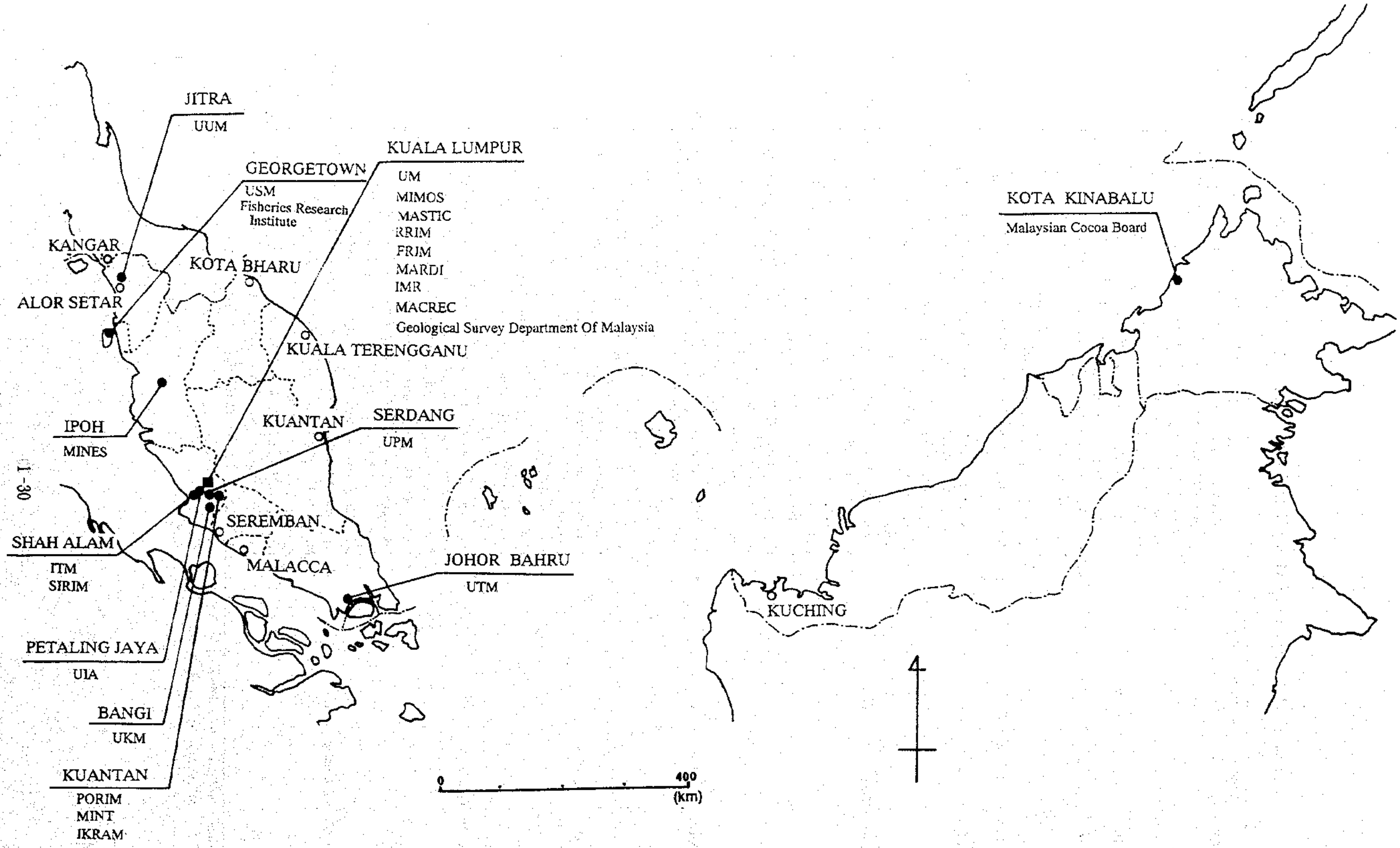


Figure I.2.12 Distribution of Government Research Organizations

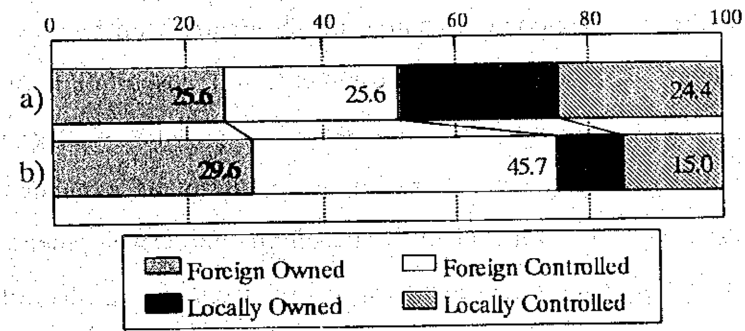
(Research Institutions and Universities Research)

Science and technology development by private enterprises

In the breakdown of research expenditure among private enterprises of varying capital structure (four types, all representing generally same structural ratios), the largest research expenditure is found among foreign controlled joint ventures followed by foreign owned companies (wholly owned by foreign companies) (Figure I.2.13). Although this is a result of sampling survey, it appears the foreign owned or controlled companies are more keen about research and development than locally owned or controlled companies.

By industrial classification, the ratio of research expenditure is very high (more than twice their ratio in samples of industry) among companies specialized in electronics although the sample size is small. The ratio is low among those engaged in chemical and food industries compared to their ratio in samples of industry (Figure I.2.14).

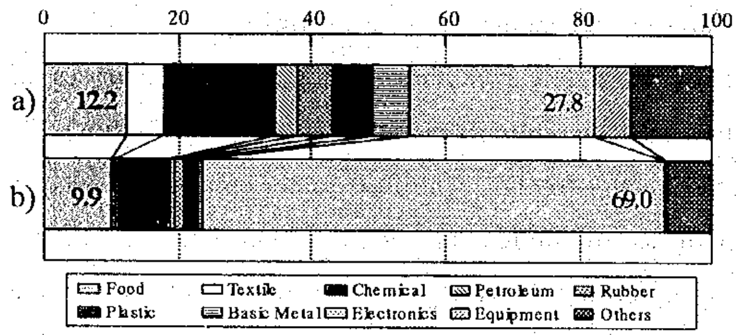
The above results indicate that foreign owned or controlled companies engaged in electronics tend to spend more for research. Local Malaysian companies are spending much less. Therefore, the country should adopt a policy to increase research expenditure by local companies to reduce the effects of foreign firms in Malaysia.



Note : a) Samples of Industry by Capital Structure
b) R&D Expenditure by Capital Structure

Source: 1993 Annual Report of the National Council for Science Research and Development (MPKSN)

Figure I.2.13 Business enterprise R & D expenditure by type of ownership(%)



Note : a) Samples of Industry by Industrial Classification
b) R&D Expenditure by Industrial Classification

Source: 1993 Annual Report of the National Council for Science Research and Development (MPKSN)

Figure I.2.14 Business enterprise R & D expenditure by industrial classification(%)

I.2.2 Science and Technology Development

(1) Present Situation of Science and Technology Development Policy

The Ministry of Science, Technology and Environment (MOSTE) plays a central role in the execution of measures related to science and technology. In addition, the Cabinet Committee on Science and Technology, chaired by the Prime Minister, has been formed by the Ministers of Science, Technology and Environment, of Transportation, of Finance, and of Human Resources. This council s role is to formulate policies, strategies and programs aimed at science and technology development, and to sound out and evaluate their progress.

In 1955, the National Council for Scientific Research and Development (MPKSN) was organized to formulate policies regarding science and technology. Its role also includes deciding areas of priority, adjusting, executing and evaluating activities related to science and technology, making plans to raise the level of recognition of the importance of science and technology in both public and private sectors, monitoring the compliance of action plans related to industrial and technical development projects and those approved by the government, and submitting advice to the Cabinet Committee on Science and Technology chaired by the Prime Minister, MOSTE, etc. The MPKSN is organized by people representing industrial, academic and government sectors. It has two permanent committees, five working groups, and two panels.

The second Outline Perspective Plan (OPP2) urges the need, in the industrial area, to raise the level of domestic industries and technologies as well as international competitiveness of the country to support the development and growth of its industry and agriculture. To accomplish such a goal, the economic plan presents the importance to promote technical revolution and application of technologies in both public and private sectors, thereby encouraging technical development and promotion of science and technology that enables such development.

In relation to the promotion of technical development and of science and technology, the economic plan does not put priority on basic research such as new discoveries or the construction of new theories. Rather, it emphasizes research in the most downstream areas such as research in applied technologies, including product development using new technologies or new designs. Such an emphasis is justifiable in the data in Figure I.2.6.

In other words, Malaysian policies for the promotion of science and technology center on the improvement of development and research in applied technologies rather than on basic research.

The sixth Malaysian plan, evolving from OPP2, calls for the continuation of R & D activities to maintain high economic growth and build an industrialized society based on science and technology by the year 2020. This would require introducing the latest and most advanced technologies in areas where technology and information are most needed and fully utilizing those areas for practical purposes. There are five such areas: new materials, automated manufacturing technologies, bio-technologies, microelectronics, and information technologies. These areas are chosen under the IRPA (The Intensification of Research in Priority Areas) Program that was established, in 1988, prior to the sixth Malaysian plan.

A total of RM588 million has been allocated in the sixth Malaysian plan and under the IRPA among organizations engaged in agricultural, industrial, medical, and strategic areas and in social sciences. The fund is being used to finance 726 research programs by 29 research organizations and universities.

An industrial technology development action plan was proposed in 1990 to supplement the industrial master plan (IMP). This plan calls for the reinforcement of research and development capabilities as a method to improve the competitiveness of the manufacturing industry that supports the country's economic growth. It also introduces five factors that are hampering progress in those R & D activities along with ways to overcome them.

Structural Weakness

- -Poor S&T Infrastructure
- -A Law Level of Technology Application in Industry, with Inadequate Appreciation of the Key Role of Technology
- -Lack of Awareness and Focus with Regard to the Critical Generic Technologies of the Future
- -Insufficient Attention to Developing Human Resources of the Required Quantity and Quality to Support Industrial Technology
- -Society is Generally Apathetic and Indifferent to Science and Technology Development

↓

Strategic Thrust

- -Provide Leadership to Strengthen the Institutional and Support Infrastructure for Rapid and Realistic Industrial Technology Development
- -Ensure Widespread Diffusion and Application of Technology, Leading to Enhanced Market-driven R&D to Adapt and Improve Technologies
- -Build Competence for Specialisation in the Key Emerging Technologies
- -Strengthen Institutions and Mechanisms for Continual Development and Elevation of Technological Proficiency of the Ultimate source
- -Increase S&T Awareness and Appreciation of Society to Provide the most Conducive Climate Possible for Invention, Innovation, and Technology Advancement

The action plan further lists 42 strategic measures aimed at the enhancement of R & D capabilities while defining the respective roles to be played by the government, governmental research organizations, and private enterprises (Figure I.2.15).

The action plan lists many measures aimed, in particular, at the improvement of R & D capabilities and activities by private enterprises and through joint efforts between public and private sectors. This suggests a shift in R & D leadership from governmental R & D organizations and higher education institutes to private enterprises. Therefore, the action plan

Providing Leadership to strengthen the institutional and support infrastructure for industrial Technology Development

- Establish a permanent cabinet Committee on Science and Technology, headed by the Prime Minister, to ensure committed leadership and strong policy direction.
- Strengthen the Ministry of Science, Technology and the Environment, endowing it with the full authority and resource necessary to ensure effective Science and Technology policy formulation, policy research, coordination and monitoring.
- Charge the Ministry of Science, Technology and the Environment with the responsibility of coordinating R&D programmes in Science and technology and the disbursement of funds, in keeping with national priorities.
- Form and Advisory Council on Science and Technology, with membership from the government, private sector, and research community, ensuring that at least 50 percent of its membership shall be drawn from the private sector.
- Establish an effective and vigorous national Science and Technology intelligence and information system.
- Increase private and public sector R&D investment applications-oriented, market-driven research, targetting for gross national R&D expenditure levels to reach at least 1.5 percent of GDP by 1995, and 2 percent of GDP by 2000, with at least 60 percent from the private sector.
- Act to ensure that national R&D expenditures on industrial technology are commensurate with the contribution of the industrial sector to the economy.
- Require all government R&D institutes to draw up five-year budget plans which shall be subjected to annual review by the Advisory Council on Science and Technology.
- Implement a system of contract research as a first step towards corporation of all industrial research institutes.
- Apply self-financing targets for all industrial R&D institutes: 30 percent by 1995, and 60 percent by 2000.
- Launch a Commercialisation of Technology (COT) initiative, investing resource in this endeavour that are commensurate with the central importance of indigenous technology development.

Ensuring widespread Diffusion and Application of technology, leading to enhanced market driven R&D to adapt and improve technologies

-Provide incentive to promote private sector Industry Research Consortia and the common R&D facilities.
-Elevate and institutionalise Quality and Design in Malaysian industrial culture by implementing continuous national-level awareness programmes.
-Set up regional Quality Centres for key industrial areas in collaboration with industries and State Development Agencies, as well as a national Centre for Product Design and Development.
- From a special Technical Committee to propose specific and concrete measures to enhance the capability of the critical and weak Engineering and Technical Services Sector.
- Ensure the effectiveness of the Industrial Technical Assistance Fund.
- Use public procurement policy judiciously to stimulate innovation and product development for indigenous firms
- Consolidate procurement linkages.
- Enhance industrial R&D incentives through appropriate fiscal measures.
- Clarify, publicise and improve access to the system of R&D incentives.
- Critically examine the 67 product group Action Profiles in the nine key industry sectors, with a view to implementation.

Building Competence for Specialisation in Key Emerging Technologies

- Designate: Automated Manufacturing Technology, Advanced Materials Technology, Electronics Technology, Biotechnology, and Information Technology.
- Prioritise research programmes in the new and emerging technologies to ensure focus in areas which can yield the highest economic pay-offs.
- Institute special measure to encourage the formation and development of New Technology-Based firms(NTBFs), including enabling grants and other incentives.
- Set up National Focal Points for each of the new and emerging technologies.
- Ensure exposure to international developments in the new technologies, and exploitation of foreign research expertise where necessary.

Strengthening Institutions and Mechanisms to for continual development and elevation of the technical proficiency of the human resource base

- Establish a Skills Development Fund to be jointly managed by the private sector and government--raised through the collection of a 1 percent cess on the payroll of manufacturing establishments --to finance industry training programmes.
- Enhance and modernise the existing system of certification of technical personnel and classification of skills.
- Expand adult and continuing education programmes, particularly in technical subjects, to upgrade the skills base in specific areas.
- Strengthen the effectiveness of mechanisms to allow industry to contribute to course design and curriculum review in institutions of higher learning and industrial training institutes.
- Ensure that Malaysian graduates from overseas universities are trained in fields and acquire skills that are fully relevant to the nation's needs.
- Enhance and institutionalise linkages for industrial training between industry and institutions of higher learning and industrial training institutes.
- Enhance the role of tertiary of institutions in advanced technology research and innovation.
- Ensure an effective role for institutions of higher learning in all proposed technology parks and innovation centres.

Elevating S&T awareness and appreciation to provide the most conducive climate possible for Invention, Innovation, and Technological Advancement

- Inculcate Science and Technology awareness and appreciation in all levels of government through a wide range of measures, including courses at INTAN and IAB.
- Elevate S&T awareness and appreciation by inculcating S&T culture in the education system.
- Utlise mass media to heighten public awareness and appreciation of S&T.
- Expand the scope and coverage of the Science and Technology Week programme and other S&T promotional adtivities; and create a Science Centre of international standard.
- Encourage and increase the role of professional and science-oriented societies through incentive and support measure.
- Encourage the formation of guilds for technical sub-professionals with activities that are specifically focussed on technical issues.
- Support the proposed Yayasan Rekacipta Malaysia, and launch prestigious award schemes for excellence for special target groups and technology areas.
- Strengthen the system for management of intellectual property rights, and enhance patent advisory and other services.

Figure I. 2.15 Industrial Technology Development A National Plan of Action

contains improvement of infrastructure, incentives and other strategies that will encourage more private enterprises to initiate R & D activities. It even gives numeric targets in R & D by private enterprises that R & D expenditure will increase to 1.5% of GNP by 1995 and to 2% by 2000, at least 60% of which is to be by private enterprises.

Incentives for Promotion of R & D Activities by Private Sector

- Partial subsidy to cover research expenditure for joint research with universities or public research organizations under the Council s grants
- Funding by the Malaysian Technology Development Corporation (MTDC) for commercialization of an outcome from R & D or introducing foreign technologies into Malaysia
- Double deduction of R & D expenditure (expenditure for an approved in-house or entrusted research project, service by approved development firms and laboratories, expenditure for use of equipment, and donations to approved research organizations)
- Five-year exemption or reduction of income tax for approved R & D companies and laboratories
- Exemption of import, commodity, or sales tax for equipment and raw materials necessary for research activities
- Five-year exemption or reduction of income tax for an enterprise based on new technologies

The environments around private enterprises will thus have a stronger influence in the Cabinet Committee on Science and Technology and MPKSN where measures related to science and technology and R & D activities are legislated and promoted. This means it will be possible to promote measures that more directly cater to the needs of private enterprises. It might strengthen the linkage with training organizations, or lead to some changes in the present system that will allow modification of the curriculum at higher education institutes and/or training organizations according to the request from the industrial circle. Then, needs among private enterprises may be reflected more effectively in educational and training areas also.

In other words, private enterprises will be playing a leading role in the promotion of science and technology in Malaysia in the future.

I. 3 Present Human Resource Development and Policy

The rapid industrialization which started in the 1980's has created job opportunities, and improved income levels and standards of living in Malaysia. However, the labour supply could not catch up with the demand, with the gap between them now a big problem. Due to this gap, foreign companies which once considered Malaysia an attractive investment are now reducing their investment. The labour issue in Malaysia is deeper than the simple imbalance between supply and demand. The labour shortage is particularly acute in the technical labour force. As the technology of foreign manufacturers in Malaysia advances, demand for skilled workers increases. To increase the local content of products, skilled workers are in demand in related industries. Technologically-skilled workers are an indispensable asset to enhance the technological level of Malaysian industries. Organizations which are in charge of educating the labour force should focus on equipping workers with the necessary skills. Based on this background, we will analyze the current condition of the organizations responsible for educating the labour force. Further, we discuss what skills are in demand, and how the labour force can acquire those skills.

I.3.1 Human Resource Development Activities

(1) Higher Education

Public institutions of higher education in Malaysia consist of universities, two-year colleges, and polytechnics. There are eight universities (excluding an international university), two junior colleges, and six polytechnics (Figure I.3.1). Table I.3.1 shows major science and technology oriented departments and divisions of universities. Most such universities have electronics and electrical engineering departments in addition to departments for computers, information technology and software. In Kedah, where KHTP is located, and around Penang, there are located Malaysia Northern University (UUM) and Malaysia Science University (USM). Since USM is solely a science and technology-oriented university, a wide range of science and technology related departments are available. Meanwhile, there are not very many technology oriented departments at UUM.

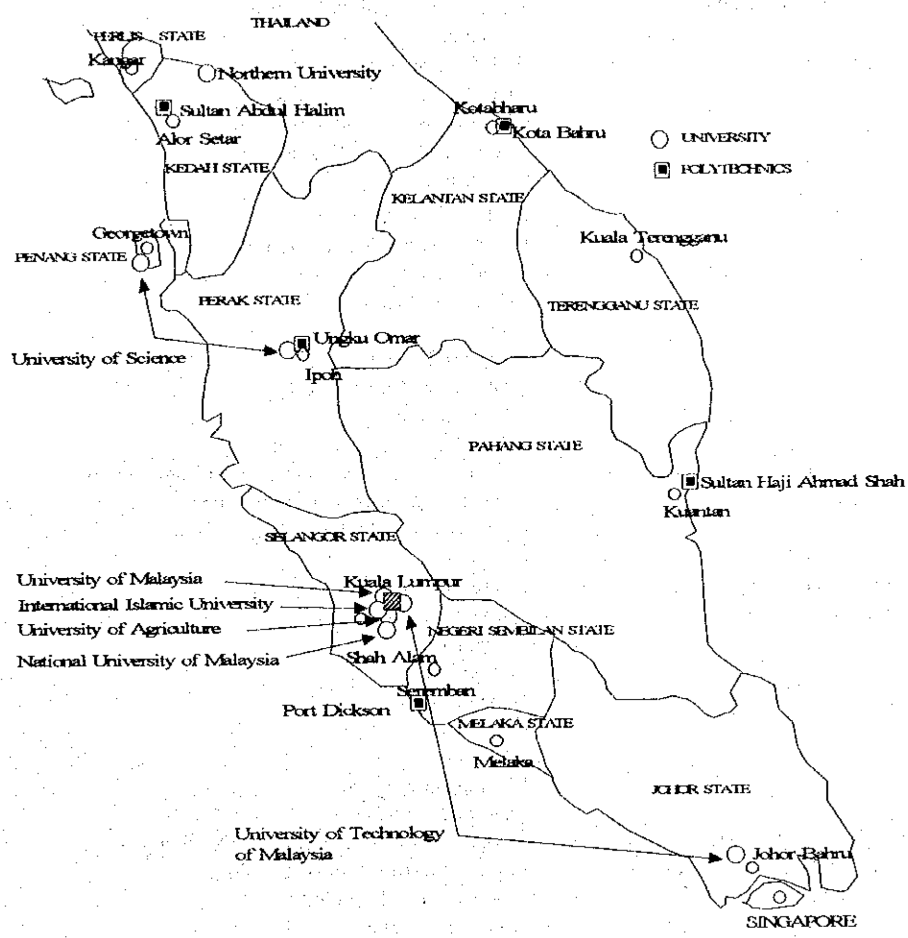


Figure I.3.1 Location of higher education organizations.

Table I.3.1 Science-technology oriented faculties in universities

Name	Faculty
Universiti Kebangsaan Malaysia (National University of Malaysia) - Bangi, Selangor	1.Physics & Applied Science 2.Medicine 3.Natural Science - Cellular & Molecular Biology - Ecology & Conservation Biology - Food & Duration Science 4.Education 5.Allied Health Science 6.Mathematics & Computer Science - Mathematics - Computer Science - Statistics - Actuarial Science 7.Science & Natural Resources 8.Engineering - Civil & Structural Engineering - Electrical, Electronics & System Engineering - Chemical & Process Engineering - Mechanical & Material Engineering
Universiti Malaysia (University of Malaysia) - Kuala Lumpur	1.Medicine 2.Science - Biology - Chemistry - Geography - Geology - Mathematics - Physics 3.Computer Science 4.Biomedical Science
Universiti Malaysia Sarawak (University of Malaysia, Sarawak) - Kuching, Sarawak	1.Cognitive Science & Human Development 2.Science in Resource Technology - Resource Biotechnology - Chemical Resource - Science & Plant Resource Management - Science & Aquatic Resource Management - Science & Animal Resource Management 3.Engineering - Civil Engineering - Electronics & Telecommunications Engineering - Computer & Information 4.Information Technology - Software Engineering - System Technology - Information System
Universiti Pertanian Malaysia (University of Agriculture, Malaysia) - Serdang, Selangor	1.Agribusiness 2.Resource Economics 3.Accountancy 4.Science with Education 5.Horticulture 6.Biotechnology 7.Biomedical Science 8.Food & Community Health 9.Science 10.Environment

	11.Veterinary Medicine 12.Forestry Science 13.Computer Science 14.Agriculture Science 15.Food Science & Technology 16.Human Development Science 17.Education - Agriculture, Home Science, Physical, Guidance & Counselling 18.Fisheries Science 19.Oceanography 20.Engineering - Civil, Mechanical/System, Electrical/Computer
Universiti Sains Malaysia (University of Science, Malaysia) - Pulau Pinang, Pulau Pinang	1.Science 2.Science with Education 3.Applied Science 4.Pharmacy 5.Medicines 6.Computer Science 7.Engineering - Electric & Electronic Engineering - Material, Mineral Resource Engineering - Civil Engineering - Mechanical Engineering - Chemical Engineering 8.Industrial Technology - Food Technology - Polymer Science - Wood, Paper & Lamination - Quality control & Instrumentation 9.Housing, Building & Planning
Universiti Teknologi Malaysia (University of Technology of Malaysia) - Johor Bahru, Johor - Kuala Lumpur	1.Building Environment 2.Science 3.Computer Science & Information System 4.Management & Human Resource Development 5.Surveying 6.Civil Engineering 7.Electrical Engineering 8.Mechanical Engineering 9.Chemistry & Natural Resource Engineering
Universiti Utara Malaysia (Northern University of Malaysia) - Jitra, Kedah	1.Business Administration 2.Information Technology
Universiti Islam Antarabangsa Malaysia (International Islamic University, Malaysia) - Petaling Jaya, Selangor	1.Human Science 2.Engineering - Computer & Information Systems Engineering - Manufacturing Systems Engineering - Mechatronics Engineering

SOURCE : Education Guide -Malaysia-

ITM (Institute Technologi MARA) and KTAR (Kolej Tunku Abdul Rahman) are two junior colleges where students can receive either certificates or diplomas. ITM, which was founded in Shah Alam in 1956, offers courses in technology, commerce, and management . KTAR, which was founded in 1969, provides two courses -- commerce and science and technology -- for a certificate and diploma.

The concept of polytech education began in 1969 to train skilled workers and middle management employees. Polytech offers two courses in three-year-full-time course and two-year-certify course. The SPVM/SPM or equivalent qualifications are necessary to enter a polytech. Currently, six polytechs offer specialization in architecture, electronics, electricity, machinery, and accounting (Table I.3.2). One polytech, Sultan Abbdul Halim Mu'adzam Shah Polytechnics, is located in Jitra city north of Alor Setar in Kedah State. Another is located in Ungku Omar, Ipoh city in Perak state. The Ipoh city polytech offers courses in electronic machinery, air conditioning, freezing technology, and management which are not taught in other organizations. Four more polytechs are scheduled to be established, one of which is planned for Penang state.

Malaysian Technology University (UTM) and Malaysian Science University (USM) are scheduled to be constructed in KHTP. The Information Technology Centre (ITC) is scheduled to be established by USM in an industrial urban zone adjacent to the site for the Techno Centre. KTPC and UTM together proposed the creation of the Higher Learning Centre in the industrial urban zone. They plan to offer degree and diploma courses in electronics, mechatronics and telecommunications (Figure I.3.2)

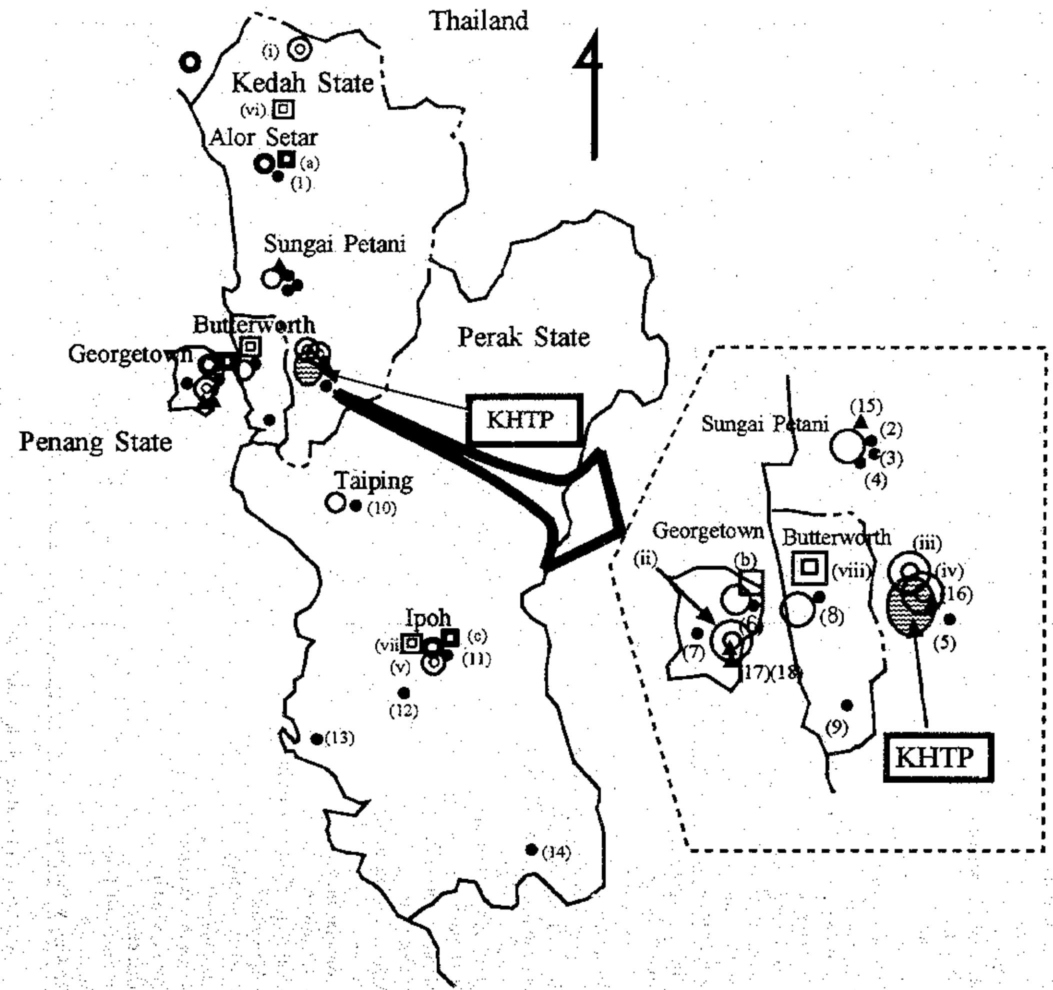
(2) Training Centres

The Ministry of Human Resources and Ministry of Youth and Sports, Ministry of Education, and Council of Trust for Indigenous People (MARA) supervise vocational education in Malaysia. To match demand for skilled workers and technicians, these organizations are responsible for training centres. The number of people to enter training centres increased by 6,700 or 30% from 1990 to 1993 and by 18,400 or 63% from 1993 to 1995 (Table I.3.3). Particularly, the number of mechanics in the engineering department is expected to increase by about 8,000. This jump is set to target the needs of companies.

Table I.3.2 Departments and divisions in Polytechnics

Name / City	Sultan Abdul Halim Mu'adzam Shah JITRA POLIMAS	Ungku Omar IPOH PUO	Sultan Haji Ahmad Shah KUANTAN POLISAS	Kota Bahru KOTA BAHRU PKB	Kuching SARAWAK PKS	Port Dickson NEGERI PPD
Certificate Courses						
Civil Engineering						
- Construction	X	X	X	X	X	X
- Public Works & Hydraulic		X		X		
- Highway				X		
Architecture	X	X	X			X
Land Survey		X	X		X	
Building Services Engineering	X					
Quantity Surveying	X					
Town & Country Planning	X					
Electrical Engineering						
- Power	X	X	X	X	X	X
- Control		X			X	
- Petroleum					X	
Electronic Engineering						
- Communication	X	X	X	X		X
- Computer		X	X	X		X
- Petroleum					X	
Mechanical Engineering						
- Petroleum					X	
- General	X	X	X	X	X	X
- Plant	X					
- Manufacturing	X	X	X	X		X
- Automotive		X	X	X	X	X
- Refrigeration & Air Conditioning		X			X	
- Agriculture				X		
Food Technology			X			
Business Studies		X				
Bookkeeping			X	X	X	
Data Processing			X			
Diploma Courses						
Civil Engineering	X	X		X		X
Land Survey		X				
Architecture			X			
Building Services Engineering	X					
Electrical Engineering						
- Power Electronic&Control						X
- Communication	X	X	X			
Electronic Engineering		X				
- Computer		X		X		
Marine Engineering		X				
Mechatronic	X	X		X		
Mechanical Engineering						
- General	X	X	X		X	X
- Manufacturing	X					X
- Automotive				X		
- Refrigeration & Air Conditioning		X				
- Agriculture				X		
Food Technology			X			
Accountancy	X	X	X	X	X	X
Secretarial Science			X			X
Business Studies		X				
Marketing	X			X	X	X
International Trade				X		
Insurance	X					
Banking & Finance		X				

SOURCE : Education Guide -Malaysia-



List of Uuniversities and Polytechs

Name/City	State
- Universities - ◎	
(i) UUM	Kedah
(ii) USM	Pulau Pinang
(iii) UTM (plan)	Kedah(KHTP)
(iv) USM(ITC plan)	Kedah(KHTP)
(v) USM	Perak
- Polytech - ▣	
(vi) Jitra	Kedah
(vii) Ipoh	Perak
(viii) Butterworth(plan)	Pulau Pinang

List of Secondary Technical Schools ■

City	State
(a) Alor Setar	Kedah
(b) Penang	Pulau Pinang
(c) Ipoh	Perak

List of Secondary Vocational Schools ●

City	State
(1) Alor Setal	Kedah
(2) Sungai Petani	Kedah
(3) Sungai Petani 1	Kedah
(4) Sungai Petani 2	Kedah
(5) Kulim	Kedah
(6) Penang	Pulau Pinang
(7) Balik Pulau	Pulau Pinang
(8) Butterworth	Pulau Pinang
(9) Nibong Tebal	Pulau Pinang
(10)Taiping	Perak
(11)Ipoh	Perak
(12)Bota	Perak
(13)Sitiawan	Perak
(14)Slim River	Perak

List of Training Centres ▲

Name	State
(15) Kismec	Kedah
(16) Kismec(plan)	Kedah
(17) PSDC	Pulau Pinang
(18) IPM	Pulau Pinang

Figure I.3.2 Higher Education Oganizations around KHTP
and future plans

Table I.3.3 Changing of Capacity in public training organization

	1990	1993	1995	Increase(%) 93/90	Increase(%) 95/93
Engineering	15,540	19,700	32,750	27	64
Mechanical	9,960	10,140	18,030	2	78
Electrical	5,390	9,300	13,020	73	40
Civil Engineering	190	260	1,320	37	408
Other	6,680	9,220	14,530	38	58
Total	22,220	28,920	47,280	30	63

Source) MID-TERM REVIEW OF THE SIXTH MALAYSIA PLAN(1991-1995)

MARA's GMI, IKTBN and Sepang in Ministry of Youth and Sports, and the Centre for Instructor and Advanced Skill Training (CIAST) are at Level 3 (advanced career training) of the National Vocational Training Standard (NVTC).

The German government-supported GMI started with 160 registered trainees in 1992 (focusing on manufacturing technology and electronics fields). GMI, which basically targets recruiting new high school graduates, is attempting to train engineers with technical skills in three years (a half-year is spent in on-the-job training at factories).

The Japanese government-supported CIAST aims at educating future instructors for public training centres, such as polytechs. The Level 3 training done at CIAST, usually modular type, lasts 1~4 weeks for individuals who are already working. Most of these programs are funded.

Ten Industrial Training Institutes (ITI) supervised by the Ministry of Human Resources, six IKBN supervised by Ministry of Youth and Sports, twelve Institute Kemahiran MARA (IKM), 69 Secondary Vocational Schools (SVS) supervised by the Ministry of Education and nine Secondary Technical School (STS) are Level 2 long-term training organizations. ITI and MARA's IKM are at a relatively higher level. SVS's curriculum is divided into two --both theory and practical classes. There are few on-the-job training programs involving production lines. Instead, they are focused on electrical assembly, automobile mechanics and service industries.

In Kedah, Penang and Perak, there are two STS (Alor Setar in Kedah, Ipoh in Perak), nine SVS and three of them in Sungai Petani. Penang Skill Development Centre (PSDC), founded in 1989, is renowned as a training centre which enjoys the joint support of the government and private sectors. The Institute of Precision Moulds was founded near PSDC by Sunny Precison (M) Sdn Bhd (SPM) and Penang Development Corporation (PDC) in 1994. This contributed to the training of people in technical areas in Penang. Inspired by the success by PSDC, efforts to create more training centres jointly supported by local business communities and the government culminated in the establishment of the Kedah Industrial Skill & Management Development Centre (KISMEC) in Sungai Petani, Kedah in October 1993 (Table I.3.4). In addition, such projects are being implemented in five states, including Johore, Melaka, Negeri Sembilan, Perak and Selangore. In Pahang and Sarawak, similar projects are planned. Such organizations can plan their curriculum based on demands from the private sector to accommodate the flexible needs of corporations and changing environment. The focus is to train people who can provide an immediate contribution to corporations. Inspired by joint educational projects, more cooperative ventures by public and private sectors are planned in various fields.

(3) Researchers

As of 1992, about 4,600 people were employed in public and private research centres and universities. Among these, 1,600 or 35% are researchers and an equal number are technicians (Figure I.3.3). Most technicians and researchers are employed by public research facilities, indicating that public research institutes play a central role in Malaysian research and development. By field, most researchers are concentrated in agriculture, chemical, medical and applied scientific technology, while few specialize in computers and information (Figure I.3.4). By organization, it is apparent that there is a large gap in the number of researchers in each field. Judging by the number of researchers, areas of importance include the promotion of joint projects with government-related research centres for R & D, the advancement of industrialization and increasing value added. Particularly, for local corporations which do not have critical technology and skills, the key to advancement is how to proceed in joint projects with government organizations. In this sense, strategic support by the government is indispensable. Meanwhile, more researchers and technicians in electronics and mechatronics, the two leading industries in Malaysia, need to be trained in anticipation of the continuation of this trend.

(4) Training Content

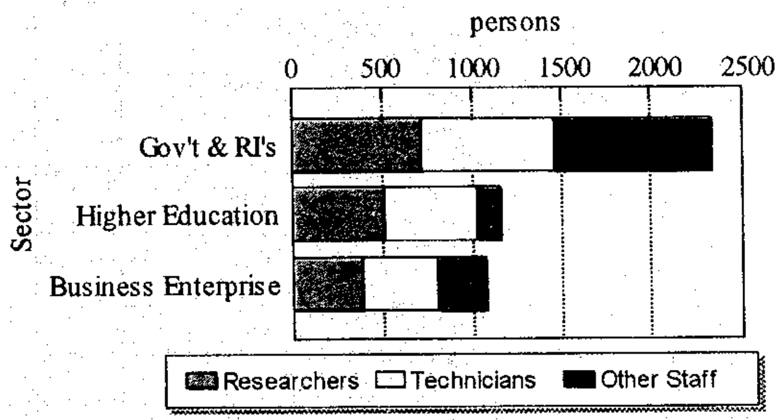
Higher education organizations provide long-term training based on curriculum. In contrast, CIAST provides training through short-term practical training and lectures. Table I.3.5-7 and Figure I.3.5 show the content of courses offered by CIAST for instructor training, the National Productivity Corporation (NPC) which targets improvements in productivity and product quality in the manufacturing sector, and the Association for Overseas Technical Scholarship (AOTS). Many courses on production management and quality control are offered. These organizations are famous for training in world standards of quality control, such as ISO9000. According to a survey based on interviews, computer software training is expanding. Since electrical machine companies are concentrated in Penang and Kedah, it is natural that demand for related training is high in this region. In the future, to secure productivity with higher value added, demand for a labour force capable of product management and quality control will increase along with demand for higher qualifications.

In Europe, standards are set for product quality as well as environmental management (IEC standard, CE mark, ISO14000 etc.). Therefore, training to obtain skills and techniques to fulfill these requirements are expected to be in demand.

Table I.3.4 Major training centres

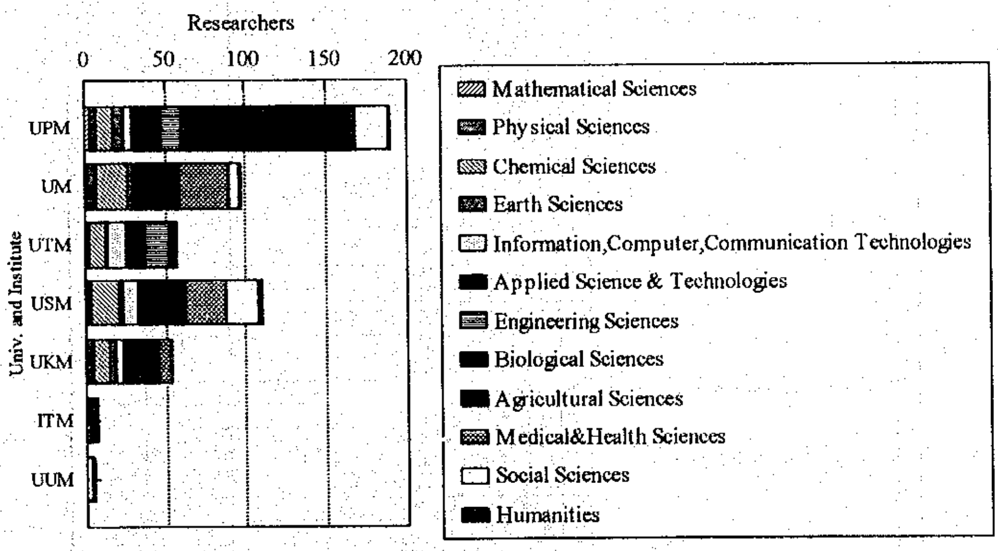
Name	Contents
CIAST	CIAST (Centre for Instructor and Advanced Skill Training) - Established in 1984 in conjunction with Japanese government as a part of ASEAN labour development project. - Goal is to train skilled workers and supervisors for both public and private sectors. - Consists of three sections 1. Instructor and Supervisory Training Department (IST): Responsible for training of supervisors and instructors 2. Advanced Skill Training Department (AST): Responsible for training in electronics/electrical engineering, precision moulding, machinery operations. 3. Vocational Training Research Department (VTRD): Responsible for overall industrial training, including leaders and supervisors, small and medium companies and information systems. - Problem of instructor shortage at CIAST caused by relatively higher salary and better reputation in the private sector. - Currently implementing F/S with supervision by private sector rather than the government
PSDC	PSDC (Penang Skill Development Centre) - Established as a non-profit technology training centre in May 1989 - Only financially independent training centre in Penang boasting highest quality. - Receives financial support from tie-up with HRDF. - Financial support from companies (31 founders, 9 formal members, 16 normal members) with more than 57,000 employees. - Program starts with technical skills courses, continuing to manufacturing and management skills courses. - 656 total courses taught to 9,820 people from the foundation (though end of May 1994) - Facilitates computer, automation, electronics, microprocessor and mechatronics labs.
IPM	IPM (Persatoan Latihan Precision Moulds Pulau Pinang Institute of Precision Moulds) - Training centre for factory workers engaged in precision moulding. - Operation began January 1995 with support from Japanese companies. - Basically offers three year course. First-year-training is focused on education for technicians. Year two stresses engineering. Year three divided into four sections - production engineering, manufacturing engineering, quality control, design.
KISMEC	KISMEC (Kedah Industrial Skill & Management Development Centre) - Founded by both private and public sectors in Kedah using PSDC as model. - Launched in October 1993 with total of three employees. - Mainly provides workers short-term and practical training. - Courses typically last 2-5 days.

	- Split between technical and non-technical training. - Technical training consists of electronics, industrial automation, logic control programs. Recently, computer application training (including CAD) added to course list. - 75 courses given to 1,350 people. - Training costs could be subsidized 75%~80% by HRDF (based on SBL scheme). - Currently, considering move to KHTP (on the university site).



Source: 1992 National Survey of Research & Development (Dec 1994 MASTIC,MOSTE)

Figure I.3.3 Researcher by sector



Source: 1992 National Survey of Research & Development (Dec 1994 MASTIC,MOSTE)

Figure I.3.4 Researcher by research field

Table I.3.5 Training at CIAST

Training Courses		Period Week(s) (Average)	No of Training
Instructor & Supervisory Department			
Instructor	Pedagogy	14	3
	Basic Training Methodology	2	10
	Post Basic Training	1	9
	Training Psychology	1	9
	Competency Based Education	1	4
	Training Media	1	3
	Effective Speech Techniques	1	6
	Skill Analysis		
	Written Instructional Materials		
	Test and Testing Method		
	Training Administration		
	Basic Instructional Techniques		
	Module Training System Design		
Supervisory	Method and Work study	2	5
	Quality Control	2	11
	ISO 9000 Quality Requirement	0.5	9
	Total Quality Management	0.5	10
	Production Planning and Control	2	9
	Maintenance Management	2	11
	Industrial Safety	1	24
	Industrial Health	0.5	12
	Leadership & Human Relation	2	6
	Industrial Psychology	1	8
	Discipline Industry	1	5
Software Development	Audio Visual Aids	2	9
	Slide Production for Training Aids	2	5
	Video Production for Training Aids	2	7
Advanced Skill Training Department			
Automotive	Petrol Engine Services	3	7
	Diesel Engine Services	2 or 4	8
	Auto Electrical/Electronics	3	5
	Performance Analysis	2	3
	Vehicle Chassis Repair	3	5
	Vehicle Body Repair	3	4
Machine Operation & Die Making	Shearing Die	2	2
	Plastic Mould	3	3
	Progressive Die	3 or 4	2
	Plastic Mould-Hot Runner Mould	3	2
	Tool & Jig	3	3
	Finishing & Fitting	2	6
	NC Machining	3	11
	NC EDM & Autocopy Milling	2	3
	Electromechanical Maintenance	2	4
Fabrication	Shielded Metal Arc Welding	2	6
	Gas Metal Arc Welding	1 or 2	4
	Gas Tungsten Arc Welding	1 or 2	5
	Combination Pipe Welding	2	5
	Oxy-acetylene Welding & Brazing	2	3
	Metal Fabrication	2 or 3	5
	Nondestructive Testing	1 or 2	8
Moulding & Casting Processes	Foundary	1 or 2	21
	Die Casting Technique	3	1
	Plastic Injection Moulding	1 or 3	12
Electrical,Electronic & Control	Contact Circuit & Electronic Control	3 or 4	14
	Electrical Motor Services	2 or 3	4
	Motor Testing & Control System	2 or 3	5
	Computer Hardware	3	2
	Distribution Panel Works	2	4
	Industrial Process Control & Instrumentation	2 or 3	7
	Electromechanical Maintenance	3	11
	Specialized Electro-Mechanical Maintenance	3	4

Source : News Letter CIAST (January 1995,July 1995)

Table I.3.6 Training at NPC

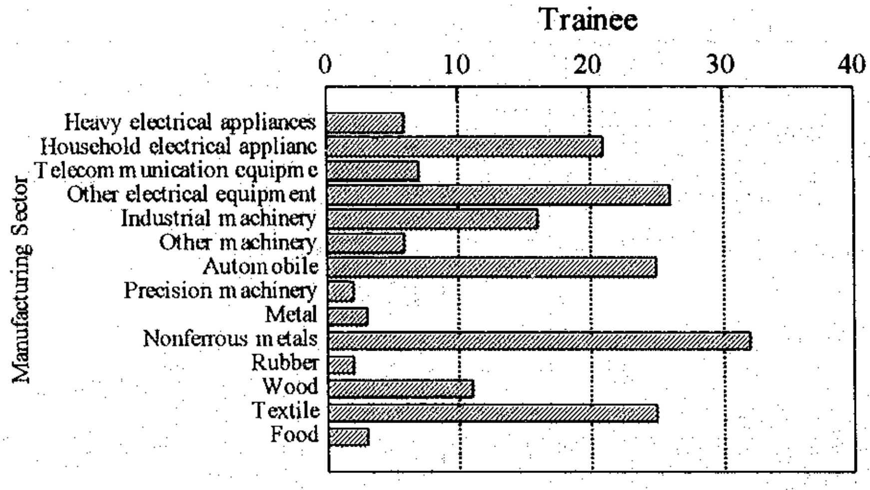
	Total No.of Courses	Total No.of Participants	Example (Training Courses)
Quality Management Programme	29	1,379	Quality Control
			Total Quality Management
Productivity Management Programme	32	496	Company Manual for Productivity Assesment
			Measuring Resource Productivity in Manufacturing
Human Resource Management	107	1,783	Training Management
			Leadership & Human Relations
			Training Methodology
Production Management Programme	19	276	Industrial Safety
			Production Planning & Control
			Computerised Maintenance Management System
Sales & Marketing Programme	9	120	
SMI & Entrepreneurship Programme	78	1,737	ISO 9000 for Small & Medium industry
			Quality Control for Leader
Special Programme	3	72	Auditing Quality System ISO 9000 Auditor
			Entrepreneur Development Training for Managers
International Programme	2	50	Management Consultancy for Small & Medium Enterprise
			Productivity Improvement Programme
Other Programmes	38	924	
Total	317	6,837	

Note :Total No. of Courses and Participants (1992)、Example of Training Courses (1995)
Source:Productivity&Quality Enhancement Programmes 1995、Laporan Tahunan 1992 Annual Report

Table I.3.7 Training at AOTS

Training Courses
1 Top Management Seminar on Japanese Business
2 Executive Programme on Corporate Management
3 Executive Seminar on Total Quality Management
4 Programme for Cross-Cultural Management
5 Training Course on Solving Human & Organizational Problems
6 Programme for Quality Management
7 Quality Control Training Course
8 Programme for Innovative Operations Management
9 Production Management Training Course
10 Practical Improvement Programme for Factories
11 Programme for Industry & Environmental Protection
12 Training Course on Science Approaches for Factory Managment in Medium Scall Industries
13 Programme for Entrepreneurs
14 Other Management Training Courses

Source : Guide to AOTS (the Association for Overseas Technical Scholarship)



Source : Guide to AOTS (the Association for Overseas Technical Scholarship)

Figure I.3.5 Trainees from Malaysia in 1993

(5) Prospective graduates from higher education

Table I.3.8 shows the enrollment in higher education and research centres administered by the Ministry of Human Resources and the Ministry of Education. Currently, about 70% of regular high school graduates pass the SPM exam of which 10% enter the technology field. About 85% of 49,400 vocational and technical high school graduates pass the SPM. According to the Ministry of Education, SVS (vocational school) is expected to be converted to SMT (industrial high school) by 1988, and the number of technical high school graduates is expected to increase. After the conversion of SVS's to SMT's, the number of students proceeding to higher education is expected to more than double, and the SPM pass rate is expected to rise by 5%. This will lead to 90,000 technical high school graduates annually by the year 2000.

The capacity of technical divisions of higher educational institutions such as universities is currently about 11,000. The current polytech expansion plan (which includes establishing new institutions in Penang) will increase capacity to 13,000 by the year 2000. However, since the number of graduates from technical high schools is expected to increase rapidly, enrollment in higher education will become more competitive (Table I.3.9). The capacity for training centres administered by the Ministry of Human Resources, the Ministry of Youth and Sports and MARA is between 10,000 and 12,000 (Table I.3.10).

As noted earlier, SVS will be converted to SPM, and the number of SPM holders will increase in the near future. The capacity of higher education and training centres will be short (Figure I.3.6). In addition, the current educational system doesn't offer appropriate education in basic technical issues essential for level 3 training. To promote industrial advancement, the level of basic education of SPM holders needs to be raised as well as increasing the number of higher educational institutions.

In Kedah, approximately 2,500 skilled workers are expected to join the work force between 1994 and 2000. However, it is not certain if all will stay and work in Kedah. Electric machinery corporations in Penang have not yet secured the labour force they need. In addition, skilled workers and engineers, rather than unskilled workers, are indispensable in the transition of Malaysia's industrial structure to a higher value-added economy. It is important to increase the number of training centres to educate the work force to the appropriate levels.

Table I.3.8 Technical high school graduates

	No of Graduates	SPM Holders	SPM Holders in Science&Technology
Regular Upper Secondary School	220,000	(×70%)154,000	(× 10%)15,400
Vocational(69) and Technical(9)	40,000	(×85%) 34,000	(×100%)34,000
Total(at present)	260,000	188,000	49,400

Table I.3.9 Capacity of universities and polytechs

School	Scale	Intake	Level
Polytech (existing)	6Schools×500	3,000	Diploma
ITM,UTM		3,000	Diploma
UTM		2,000	Degree
UM and other Univ.		3,000	Degree
Polytech (planned)	4Schools×500	2,000	Diploma
Total (by2000)		13,000	

Table I.3.10 Capacity of public training centres (long-term training)

School	Scale	Intake
ITI(MHR)	10Institutes×300-500	3,000-4,000
IKTBN(MY&S)	112(200)	200
IKBN(MY&S)	6Institutes×500	3,000
GMI(MARA)	118(150)	150
IKM(MARA)	12Institutes×200-600	3,000-4,000
Total		10,000-12,000

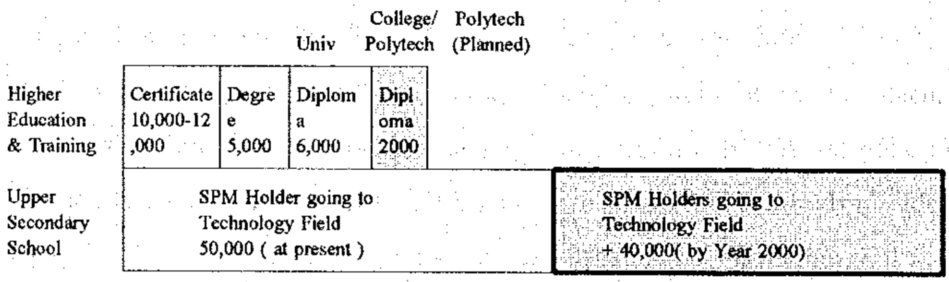


Figure I.3.6 Movement of SPM holders and facilities in higher educational institutions

Table I.3.11 Estimate of the number of skilled/semi-skilled workers in Kedah State

Institution	1980~85	1985~90	1990	1991	1992	1993	1994~2000
Vocational School	2,245	4,137	523	500	486	1,426	3,500
Technical School	3,444	2,500	255	255	264	253	1,792
Mara Vocational Institute	1,055	2,415	428	122	344	280	2,800
Mara Skill Centres	–	969	199	275	447	639	2,908
Polimas	–	1,452	438	477	683	719	4,900
Industrial Training Institute	–	–	–	–	150	230	1,400
Kedah Centre	–	–	61	150	130	158	700
Total	6,744	11,473	1,904	1,779	2,504	3,705	18,000

Source: KSDC

I.3.2 Human Resource Development Policy

Malaysia is determined to join the ranks of the industrialized countries by the year 2020. The key to achieving this goal is the education of the work force, particularly in R & D in the manufacturing sector, among engineers, technicians, and skilled workers.

The result of the survey based on company interviews points out the major obstacle to further industrial development is the training of the work force, particularly skilled workers and technicians. Increased demand for such training was triggered by the rapid industrialization accelerated by foreign investment. In addition, the rise in product quality and technological level enhanced the demand for a higher quality work force. Because of these elements, the government implemented a policy of sending more competent workers to corporations. Here, we would like to analyze the policy itself and its problems.

(1) National Action Plan by the MOSTE

The action plan administered by the Ministry of Science, Technology and Environment announced in February 1990 lists the following new segments of industrial technological development. These sectors are repeatedly stressed in the sixth 5-year-plan. Education of the work force in these sectors is important.

- Engineering for Automated manufacturing technology (AMT), Information technology, control technology and software (e.g., CAD/CAM, CNC, Industrial Robot, flexible manufacturing system, expert system, etc.)
- High level research in material sciences (plastics, metals and ceramics)
- Biotechnology (molecular biology, genetic engineering) applying to agriculture, medicine, food and energy industries
- Electrical engineering, particularly micro-electronics and digital technology
- Information technology, particularly (micro)computers and networks

(2) Review of the sixth 5-year-plan and estimate in 1994/1995

1) Labour demand

As the industrial structure changes, the employment structure is also changing. Labour demand in the manufacturing sector in 1990 was only 19.9%, which is expected to surpass 25% in 1995. Labour demand in 1995 has already surpassed expected demand in 2000 by the second long term plan (OPP2) at 23.9% (Table I.3.12). The annual growth rate in the manufacturing sector has reached 9.8%, well above initial expectations of 5.7%. (The growth in manufacturing sector greatly contributes to the overall economic growth and increases in labour demand.)

Amid changes in the industrial structure, the demand for factory workers increases by the largest margin. The demand for technicians and specialists who require long term training is expected to increase by 320,000 by the year 2000. Among these 320,000, 153,000 are in engineering-related fields, which is divided into 30,100 engineers and 122,900 engineering assistants. However, the capabilities of the current public educational and training institutions cannot accommodate all of them. A shortage of 9,100 engineers and 17,930 engineering assistants is expected. This estimate doesn't include those members of the work force who are educated overseas. Looking at the specialties, the largest shortage is expected to be in electronics and electrical engineering with 17,800, or 63.5% of total amount. Supply programme excludes personnel educated and trained overseas.

Table I.3.12 Labour demand and targets

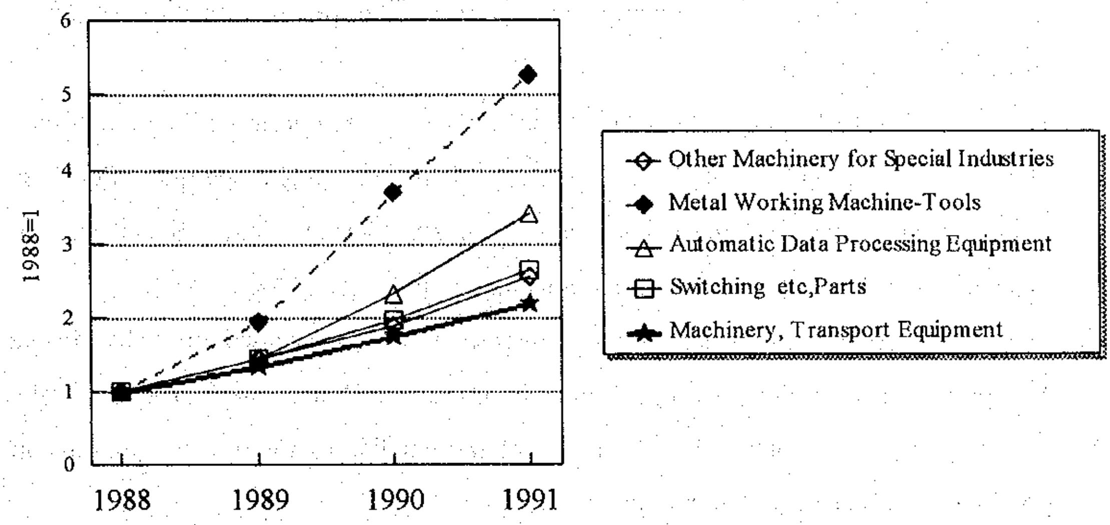
('000) (%)

	1990	1995	2000	Difference(2000-1995)
Manufacturing	1,330.0	2,012.0	2,143.9	131.9
Share(%)	19.9	25.6	23.9	-1.7

Source: MID-TERM REVIEW OF THE SIXTH MALAYSIA PLAN(1991-1995)
THE SECOND OUTLINE PERSPECTIVE PLAN (1991-2000)

2) New technology and labour saving technology

New facilities and machinery are generally installed when an economic structure of low value added shifts to one with increasing technological orientation and higher value added. Malaysia is not an exception as CNC, CAD/CAM, robots are installed (imported). Figure I.3.7 shows the import index calculated with 1988 as the base year. The growth of imports of these machines is progressing much more quickly than regular machinery, transportation machinery total imports.



Source : Yearbook of International Trade Statistics (United Nations)

Figure I.3.7 Machinery Imports

3) Establishment of Human Resource Development Fund (HRDF)

To provide private sector incentives to train employees, the government established the Double Tax Deduction Incentive Scheme. In addition, the Human Resource Development Fund was founded in 1993. Manufacturing companies with more than 50 employees can be reimbursed for training costs by setting aside 1.0% of workers' salaries into HRDF. Currently, HRDF can be used in PSDC and KISMEC.

4) Strengthening the system and educational organizations

To provide more flexibility to training systems, National Occupational Skills Standards were established and their curriculum was reviewed. For example, by adding computer and English classes, trainees can familiarize themselves with computer skills. This leads to more students who are capable of using computer control systems at work.
The German Malaysian Institute was founded to accommodate increased demand in high tech industries and high skilled labour. Furthermore, for public training centres to be able to react more flexibly, the government is considering the privatization of ITI and corporatization of CIAST.
The success of the Penang Skill Development Centre (PSDC) promoted the establishment of more training centres jointly managed by private and public sectors. Seven such training centres were established in Johore, Kedah, Melaka, Negeri Semblian, Perak, Penang, and Selangore. Two more are planned in Pahang and Sarawak.
In addition, the Japan-Malaysia Technical Institute (JMTI) is planned jointly by Japan and Malaysia. There, training of industrial technologists (including the first level 4 training in Malaysia) is scheduled. KHTP is one of the candidates for the site (among other possibilities is Seberang Prai in Penang).

Table I.3.13 Training organizations by career

		L1	L2	L3	L4	L5	Certificate	Degree	Diploma
Pre-employment Training	College/University							X	X
	Polytech						X	X	
	ITI		X						
	IKM		X						
	SVS	X	X						
	GMI			X					
Advanced Training	IKBN	X	X						
	IKTBN		X	X					
	CIAST		X	X					
	NPC		X	X					
	KISMEC		X	X					
	PSDC		X	X					
	JMTI (plan)				X				

Note : L1:Operator, L2:Skilled Worker, L3:Industrial Technician,
L4:Industrial Technologist, L5:Industrial Engineer

Furthermore, to increase the number of experienced instructors, it is important to train more talented workers and hire retirees. Expanding the capacity of the training division of CIAST is planned.

(3) Points of policy for human resource development

The Industrial Master Plan (IMP) in Malaysia points out the following as part of its Human Resource Development Policy. Many strategies focus on training more science and technology-oriented workers to match expanding demand in these areas, particularly among engineers and technicians. Realizing automation and using more labour-saving machines, investment in facilities is encouraged. The effect on unskilled workers who are replaced by this automation is large. The use of female workers is promoted as unskilled labour force. The human resource development policy is focused on expanding the supply of engineers, technicians and unskilled workers along with maintaining the current level of workers.

To achieve such a goal, the development of training programs jointly designed with the private sector is most important. For example, engineers receive more practical training in applied research fields in addition to enhancement of basic skills. Technicians also get more practical training in corporations. Unskilled workers learn the most basic knowledge of the production process.

To accommodate female workers and more unskilled workers, production facilities, as well as the production and management system, need to be adopted. Automation and facilitation of more machines will lead to a more efficient production system in both an unskilled and skilled work environment, and further reduce the number of unskilled workers. Currently, most higher education is concentrated in the KL area. This accelerates the concentration of the population to urban areas such as KL. It is important to establish training centres in local cities to disperse the population.

Table I.3.14 Human Resource Development by IMP

Items	Contents
Expansion of supply of trained science and technology-oriented workers	- Establishment of educational systems according to demand - Expansion of workers with diploma or equivalent education in science and technology fields - Private sector provides regular review of engineering and technological curriculum provided by polytechs and universities. -Invite foreign trained specialists with high salary and proper visa. -Promotion of skill development in corporations -Strengthening English education in order to learn skills from overseas -Establishment of skill development centres
Promotion of automation	-Industrial automation will promote more efficient production processes and produce products with higher value added. This reduces labour shortages and enhances competitiveness.
Finding undeveloped labour force	-Proper environment is necessary for female workers to join work force. (Provide work that can be done at home and install flexible time work schedules)
Promotion of better communications	-Establishing systematic information programs about labour market

I.3.3 Major points and directions of human resource development

Based on our analysis of government policy, we summarize the direction and major points of the human resource development field (Figure I.3.8).

- Supply expansion of technologically skilled work force and establishment of training system.
- Shift to more labour efficient production system
- Proper allocation of human resource development function

(1) Supply expansion of technologically skilled work force and establishment of training system.

Strengthening training centres for science and technology- oriented work force

With the rapid industrialization and increase in the wage level, the industrial structure in Malaysia has shifted to manufacturing products with higher value added and greater technology. This has caused a serious labour shortage. The government, in reaction, has tried to strengthen the polytech; however, its effort has failed to catch up with demand. Strengthening training centres will be important.

Foreign workers

One remedy to the labour shortage is to invite more foreign engineers. Singapore, which is also suffering from a serious labour shortage, is considering inviting more foreign skilled workers from neighboring countries with the incentive of offering citizenship. Malaysia is considering a similar strategy. However, we were told in our interviews that securing a work visa is difficult in this country. It is indispensable to ease immigration restrictions to invite particularly trained instructors, who are in serious short supply. Industries in the world are increasingly standardized (ISO9000, ISO14000). Malaysia, as an export-driven economy, will have to adopt such a standardization. Foreign workers who are familiar with standardization are important.

Promoting new educational system

In Malaysia, the value of graduation certificates is very high. Once working in a company, it is very difficult to be promoted from factory line worker to technician. By contrast, once university graduates join companies as engineers, they are reluctant to go to factories to get their hands dirty. We often heard of such division of labour in the course of our interviews. This is part of the reason for the shortage in engineers and technicians. To change the current situation, a system of promotion for engineers (to some level below managers) and for factories workers (to technicians) needs to be established through the creation of opportunities and a training system which promotes based on ability. A system which avoids creating managers with no factory experience may be one promising solution.

Training system for establishing highly specialized companies

In Japan, there are many specialized companies which manufacture test parts and products when the products and production system itself are developed. These companies are capable of supporting themselves with R & D and have very high skill levels. Although such companies do not exist in Malaysia, they are essential to the advancement of industry and add value to products. Such companies are usually small scale, but have very unique qualifications. Training to eventually create companies with such specialized skills should be provided in Malaysia.

(2) Shift to more labour efficient production system

Labour saving production system

The labour shortage is reported in all industrialized regions, all segments of industries, and at the engineering and management levels. To increase the supply of labour is a simple solution; however, it is physically impossible in Malaysia (there cannot be more workers than the country's population unless foreign workers are admitted).

One remedy is to install a labour-saving production system. This system allows manufacturers to maximize the level of production and add the most value with the minimum labour force. Minimization of the labour force applies mainly to unskilled and skilled workers, not to engineers who are indispensable to R & D. Tasks which can be accomplished by skilled workers and are less related to R & D will be automated and performed by unskilled workers. In addition to such downsizing, the number of unskilled workers should be reduced.

Training work force to establish labour saving production system

In addition to automation, installing more machines, computerization, and more systems management training, a production system which promotes downsizing (from skilled workers to unskilled workers and then to female workers) is needed. Training programs which educate R & D staff and labour saving systems need to be promoted. Proceeding with downsizing of production system means that the time has arrived for new type of high-tech companies to emerge. The time when only high-tech manufacturers are called high-tech companies is ending.

(3) Proper allocation of human resource development function

Because most training centres and educational institutions are concentrated in the KL area, many trainees from local cities tend to remain in the KL area after training. This is creating a large gap in labour supply between urban areas and local cities. Because of this, it is extremely difficult to secure higher skilled workers in local cities. To rectify this situation, more high-tech companies should move to local cities as well as establish training and educational facilities there.

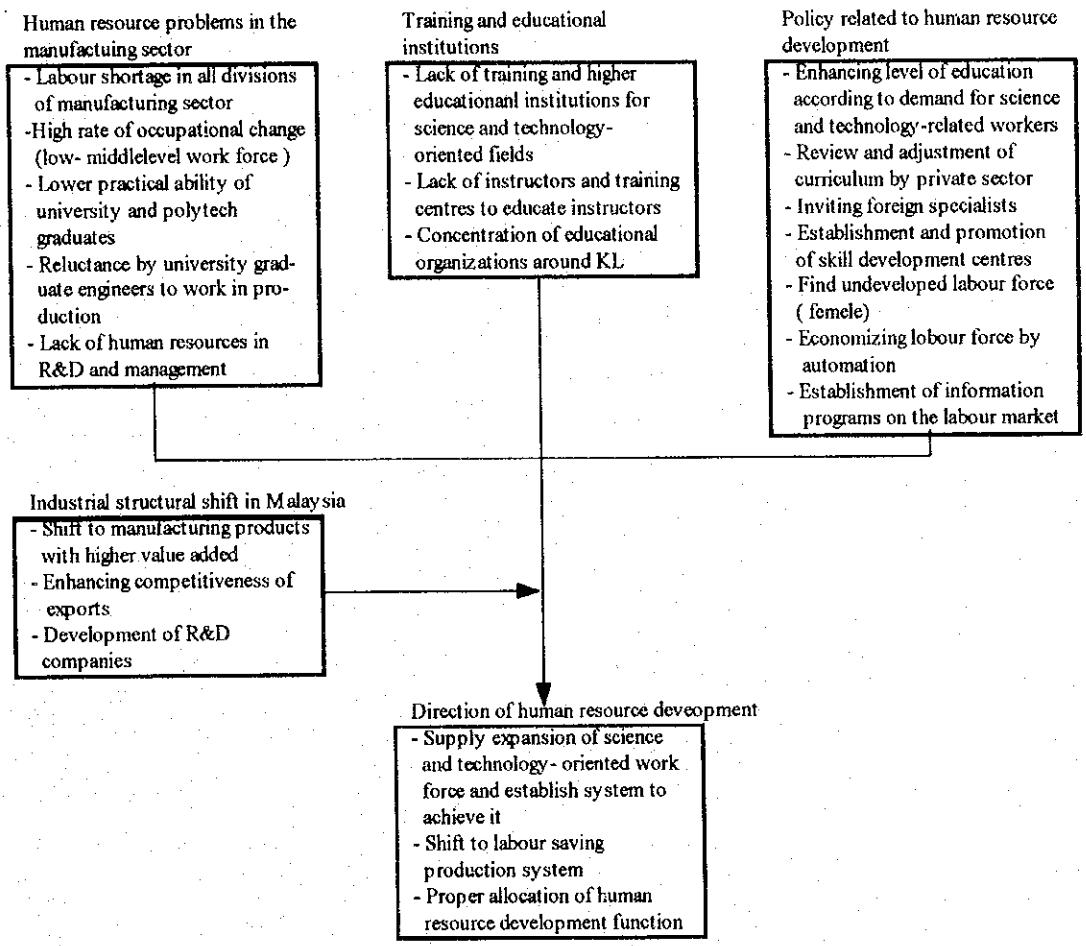


Figure I.3.8 Direction of human resource development

CHAPTER II

REVIEW OF EXISTING PLAN

II REVIEW OF EXISTING PLAN

II.1 Objectives of KHTP Development

KHTP is the first joint federal and state government project for Malaysia. It passed 5 years since planning began. Five years ago, in all states more than 100 I/E already were developed by State Development Corporations (SDCs). This means that the know-how of the I/E development existed in the SDCs. In that situation, the reasons why KHTP was a joint project between federal and state governments should be considered. Detail discussion of the background of the ages were done in Chapter I, so here, to clarify the objectives of the development background related to the KHTP will be briefly summarize in below(refer to Chapter I).

The late 80's, it has been termed the period of third boom for foreign investment. This situation is the result of the synergistic effect of international circumstances following the Plaza Accord in '85 (because of high yen, Japanese investment rushed overseas) and strengthening the open-door policy for foreign companies in Malaysia. There are many investigations why Japanese companies chose Malaysia as target country to invest, therefore the detail of that is not considered here. But, roughly speaking, the reasons are 1) political stability 2) ease of communication, 3) well-improved infrastructure, and 4) relatively low wages. At present, for example, the mainland China is one of the biggest recipient countries of foreign investment. China, at that time, attracted attention as the rest of largest frontier of investment, however, foreign investment boom to her was not come yet. Furthermore, Indonesia with cheap and huge labour force, reflecting the stance for the foreign investment of Government, did not establish the Investment Promotion law. Therefore foreign investment in Indonesia was slight. Thanks to these circumstances, foreign investors rushed into Malaysia during the period of late '80s. On the other hand, several issues were revealed.

First, most foreign companies promoted set-up assembly and labour intensive factories in Malaysia. As the 18 million population in Malaysia, the supply of labour is strictly limited. Investment concentrated to the certain area where the infrastructure improved. The result of these led the serious problem for labour shortage in region.

Second, the supply capability of parts and components by the domestic supporting industries were not sufficient and could not keep up with demand created by rapid industrialization and by the advancement of foreign assembly firms. The process formation in industries, namely import of materials, parts, and component → assemble → export of products, was fixed. This formation made the Malaysian industrial structure become sensitized to the exchange rate. Furthermore, assembly factories are often stand-alone; therefore, the technical and technological relationships with local companies are weak. Because of the weakness of the above and the industrial structure, if production conditions, and hourly wage in Malaysia is changed, foreign assemblers can easily move to other countries with better conditions.

Third, rapid industrialization brought an incremental burden on the environment. Thanks to industrialization in Malaysia excluding heavy chemical industries, serious pollution has not occurred. However the treatment of industrial waste, especially solid waste, has been a critical issue.

In 1990, there existed a plan to construct a final dumping area for industrial waste, construction of it, however, has not commerced yet. Guidance by DOE (Department of Environment) is that solid waste shall be kept within the factory lot until now. Hi-tech industries, particularity the electronics industry, use organic solvents and various heavy metals in the process; therefore, those wastes possibly exhaust namely toxic waste treatment Issues.

To overcome these difficulties, the government aggressively tackled and carried out various programs. Guidance adopted by the government were nurturing / introducing so called "hi-tech industry." The government faced problems. First, the definition of hi-tech; second, method of nurturing and location condition of hi-tech industries; third, the toxic waste mentioned above. These discussions narrowed to two options, one is the science park characterized by incubation, the other is "Hi-tech Park" in which hi-tech industries were introduced as extensions of ordinary industrial estates.

Technology Park Malaysia (TPM), already in planning stage at that time, tend to the former, and KHTP tend to the latter. It is possible to understand that KHTP was the extenuation of ordinarily industrial estate, but only the target industries focused on the hi-tech industries. KHTP was a pilot project to achieve the technology-oriented industrial structure as the Malaysia industrial development directional.

Above background, the initial objectives of the KHTP development were as followings.

-To establish the growth centre through the integration of the hi-tech industries and R & D functions.

-To propose the new development method characterized as the harmonious development with industries, academy, amusement, and habitation.

-To propose the development to minimize damage to the surrounding natural environment.

During 1990-1995, Malaysia made a great slide in terms of economic growth of 8% through the invitation of foreign investment in industrial estate, never the less, Malaysia faced the problems such as labour shortage, increment of wage, competition with neighbor countries which adopted more outward-looking industrial policies.
In the development method, namely foreign-investment-oriented-industrial-estate development, technology transfer to the local companies and industrialization in region should remain behind. During this five years, Malaysian government made effort to solve these problems though the following means, TPM project, SMIs development measures (ITAF, soft loan, etc.), nurturing-oriented industries (Supporting venture company by MTDC), strengthening of R & D activities. KHTP project implemented in the last five years, completion of industrial zone and introduction of R & D facilities ruches SIRIM and MIMOS and some hi-tech industries. The said objectives is evaluated as useful at present. The existing KHTP plan lacked the viewpoint of globalization and information improvement; nevertheless, the dramatically change of globalization and networking started at that time. The concept of Techno Centre studied here shall include above important matters.

II.2 Present Status of KHTP Project

II.2.1 Present Status of Construction of KHTP

KHTP having total land area of 1,448 ha comprises six zones as shown below;
Industrial Zone, Urban Zone, R & D Zone are located in the north of KHTP. These zones are connected via an interchange to East-West Highway (under construction), and there is a large buffer area between KHTP and the Highway which offered future extension area. Thus, the location allows both traffic access and development potential.

Table II.2.1 Land use of KHTP

	Land Area(ha)
Total	1,448
High-Tech Industrial Zone	405
Urban Zone	113
Housing Zone	470
Amenity Zone	248
R & D Zone	157
Institutional Zone	55

(1) First Phase Construction

Currently the first portion of the High-Tech Industrial Zone (H.I. Zone) has been completed, approximately 250 ha, which accounts for about 60% of the H.I Zone. Major on-going construction projects are the trunk road (running through the center of KHTP from north to south), the elevated water supply reservoir, and two units of semi-detached buildings for temporary office for tenant companies. The trunk road is expected to be completed by June, 1996, which connected with the East-West Highway via an interchange and will enable access to KHTP at the main north entrance.
Another construction project underway is the Golf Course. Other notable facilities completed in KHTP are the Hospital and its staff residential quarters (southern area in KHTP), the Main Power Substation, the Water Transmission Pipe Line from the river and the Toxic Waste Depot. The other facilities which are to be completed by the time tenant factories

start their operation, i.e. the end of 1996 are the Water Treatment Plant, Sewage Disposal Plant, Telecommunication Center on top of the KHTP's Business Center.

(2) Outline of Phase I

First phase area is constituted of the following land use:

- Factory Lots
- R & D Zone
- Business Centre, Information Technology Centre, Software Park
- Utilities (Power Substation, Water Treatment Plant, Toxic Waste Dump, Sewage Disposal Plant, Gas Supply Station)
- Green and Flood Retention Ponds

The R & D Zone is placed in the center of the High-Tech Industrial Zone, on a relatively higher ground, with a backdrop of preserved green forest, commanding a good view of the area. In this area two government agencies are going to set up their branches as given below:

Table II.2.2 Outline Plan of SIRIM and MIMOS in KHTP

Agencies	Lots Area(ha)	Expected Activities
SIRIM	5	Advanced Material Research
MIMOS	2	Micro-electronics Research

These agencies will construct facilities on their own, expected to be ready in the latter half of 1996.

The Business Centre, High-Tech Core and IT centre forms a cluster of facilities located along the trunk road, covering a total of approximately 23 ha. The site is located opposite to the current

"Urban Zone" designated in the Land Use Map. They are expected to act as forums for business exchanges.

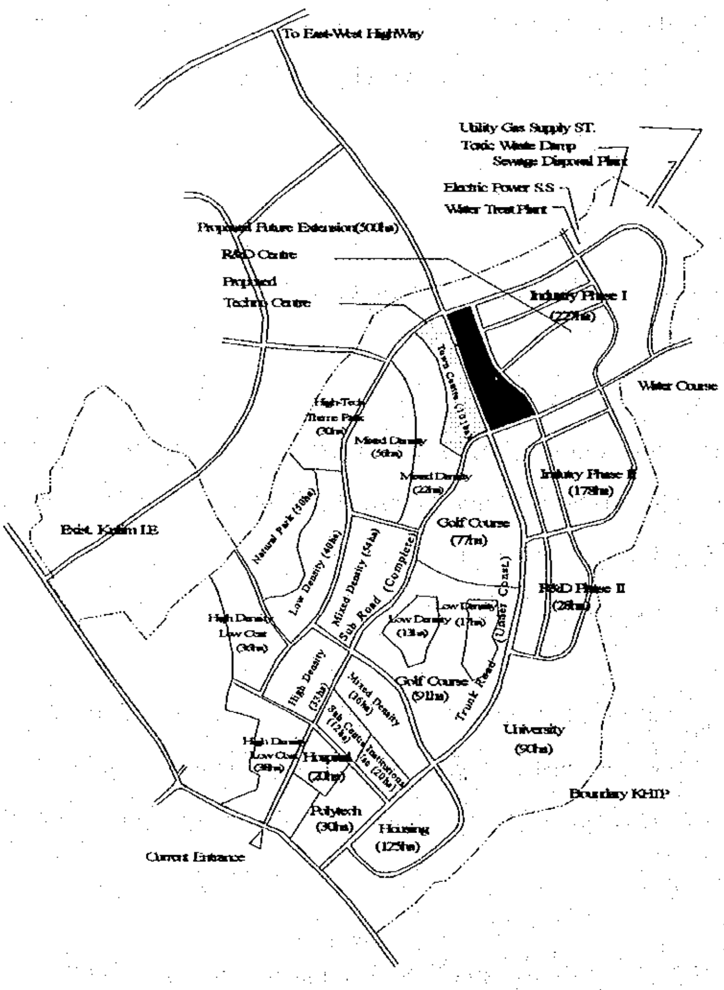


Figure II.2.1 Development Plan of KHTP

Within the Business Centre KTPC plans to set up its main office. The office will act as a so-called "One-Stop Service Centre" in addition to the administration and operation & maintenance services for the common utilities and infrastructures. The place may accommodate other services as exhibition, security and social services.

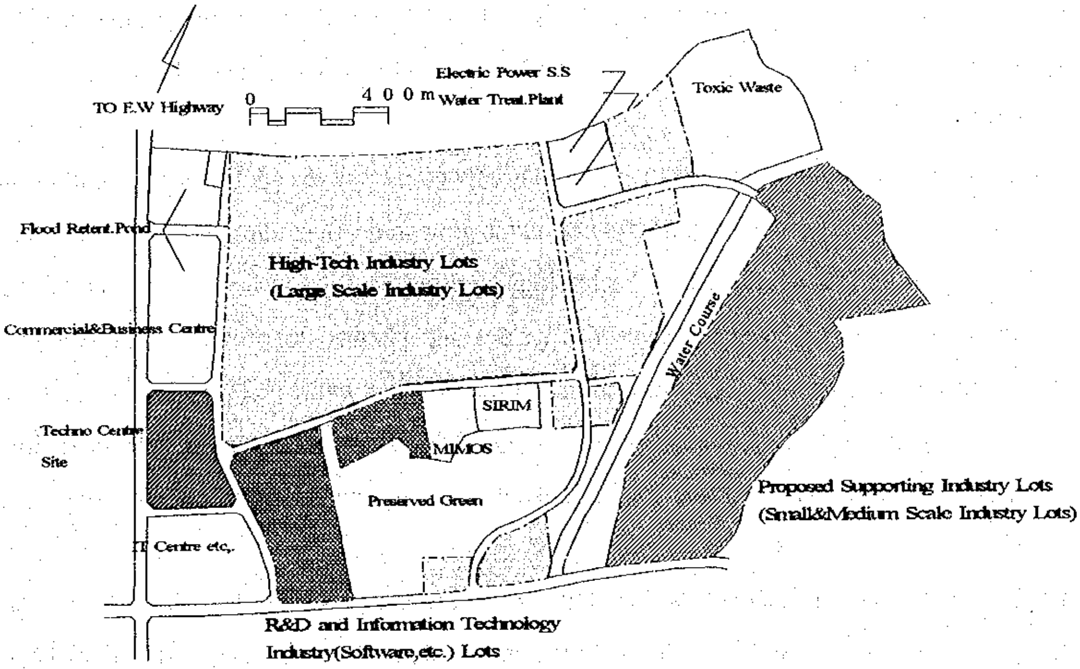


Figure II.2.2 Layout Plan of Phase I (Industrial Zone)

The Hi-Tech Core with a total area of 6.8 ha is planned to include proposed Techno Centre. Here, a land use plan by KSDC, is shown below:

Table II.2.3 Land Use Plan in Hi-Tech Core

Items	Area (ha)
Techno Centre (M)	1.799
Plaza	1.125
Training Centre 1	1.321
Training Centre 2	1.129
Car Park	0.677
(Sub Total)	6.051
TNB	0.154
Food Court	0.545
Total	6.750

The lot allocated to the Techno Centre (M)*) has an area of about 1.8 ha, in a rectangular shape on flat and level ground. It faces the trunk road on the west and surrounded by compound road on two other sides.

Since there is a large gap between the levels of the trunk road and of the ground for the Techno Centre, the access (entrance) to the lot inevitably has to be made from one of the sub-road.

There seems to be some room for modification, concerning the lot allotment and plotting in the Hi-Tech Core site as current plan has not under-gone in depth studies yet. The Software Park is where the ITC (Information Technology Centre) is going to be located. The ITC is supported by USM (University Sains Malaysia) and planned to provide comprehensive information dissemination and distribution service to the entire KHTP and engage in information technology development research. The ITC is surrounded by a number of lots where software development firms will be located, making it an information technology core of KHTP.

The basic architectural design of the ITC has been approved by KHTP. It is shaped in a solid hexagon with 3-stories, and has a total floor area of about 3,000m2. The currently planned access from the main north entrance passes through aqua-park, the Business Centre, Hi-Tech Core and Software Park one after another, while having glimpse of the buildings in R & D Zone over a hill green forest in the backdrop.

KHTP is currently developing an overall landscaping concept specially concerning the skyline configuration, greenery preservation etc. to make KHTP truly park-like, which will come out as a guideline some time in late 1995.**)

*) The terminology of "Techno Centre" here is different from one defined by the Study Team later. Techno Centre in the Master Plan carried out by KSDC in 1992 was considered as the Building. Hereinafter the terminology of Techno Centre by Master Plan are called as Techno Centre (M).

**)Draft planning guidelines was proposed by Jurong Environmental Engineering PTE.LTE in December 1994.

II.2.2 Investment Promotion

(1) Criteria for High-Tech Industries

The KHTP is defined as a high-tech industrial estate in its Master Plan. In the factory lots, high-tech industries are planned to be located while in the R & D lots, research laboratories from both public and private sector are to be located. However, the word "high-tech" is not clearly defined. When the investment promotion for the KHTP begins, the criteria to determine acceptability of the applicant as a high-tech organization become crucial. In the previous JICA study, the report attempts to define high-tech in terms of technology intensity based on that adopted by the Office of Technology Assessment. MIDA further carried the work and created a short list of high-tech industries and criteria to receive the incentives.

The target industries in the short list created by MIDA cover a wide range of industries starting from electronics and bio-engineering to new materials. The list also includes the strategic industries of Malaysia. The list has flexibility in its comprehesiveness.

The criteria for the incentives by MIDA adds two more conditions to the short list. First, the local R & D expenditure has to exceed 1% of the gross sales on an annual basis. Second, the employees with scientific and engineering degrees must exceed 7% of the total employment. These criteria are simple, operational and free from arbitrary interpretation. However, the ratio in the criteria could lead to some intended distortion in local activities by the investor.

Even those firms in the category of low-tech industries sometimes have a high proportion of R & D activities. The criteria has a danger of discourage such R & D activities. Another danger is that the KHTP may exclude itself from world-wide production network of multinational corporations which tend to conduct R & D in home countries.

(2) Promotion Organization

The KHTP is a joint-venture between the federal and local government. Thus KTPC and MIDA collaborate in the investment promotion. In practice, the committee that the KTPC and MIDA are to establish jointly is responsible for investment promotion.
The current organizational structure is depicted in Fig II.2.4. which suggests that it has the autonomous authority in the management of the entire KHTP with an area of 1448 hectares. The KTPC is responsible for the construction, and sales of the industrial estate, and co-responsible with the joint-venture partners for the development and sales of the housing and amenity facilities. The KTPC is expected to participate in a venture

capital with MTDC and Information Technology Centre. There are no official documents regarding the roles of the KTPC in the establishment of the Techno-Centre or Business Centre.

(3) Current Status of Investment in Factory Lots

Currently, with two companies are admitted to the industrial zone and negotiation is underway with 9 companies. The majority of companies are related the manufacturing of silicon wafer. Over 90% of the these firms are foreign companies.
In parallel with the major high-tech factories, supporting industries will be encouraged to move into the smaller lots in the vicinity of large factories.

Table II.2.4 List of admission or under negotiation Companies

Product	Country
1) Wafer Fab	Taiwan
2) CAD/CAM Software	Australia
3) Wafer Fab	USA
4) Wafer Fab	Taiwan/Germany
5) R & D	UK
6) Wafer Production equipment	USA
7) Hard Disc Drive	USA
8) Wafer Fab	Taiwan
9) R & D	Malaysia
10) Electronics	Germany
11) Ceramic Capacitor	Singapore/USA

II.2.3 Management

The previous JICA study and Master Plan both offer proposals for the organization for the construction, and management of the KHTP. The previous JICA study suggests three alternatives and recommends the following plan as shown in Fig II.2.3.

KSDC carried out the plan in organizational building. First, KSDC established a 100% owned subsidiary, KTPC. The KTPC is the organization solely responsible for the development of the industrial estate. In addition, the KTPC has formed joint-ventures with the private sector to develop housing, golf course and other amenity facilities.

In April, 1995 the Kulim Authority was established as an one-stop centre for the KHTP proposed in the previous JICA study.

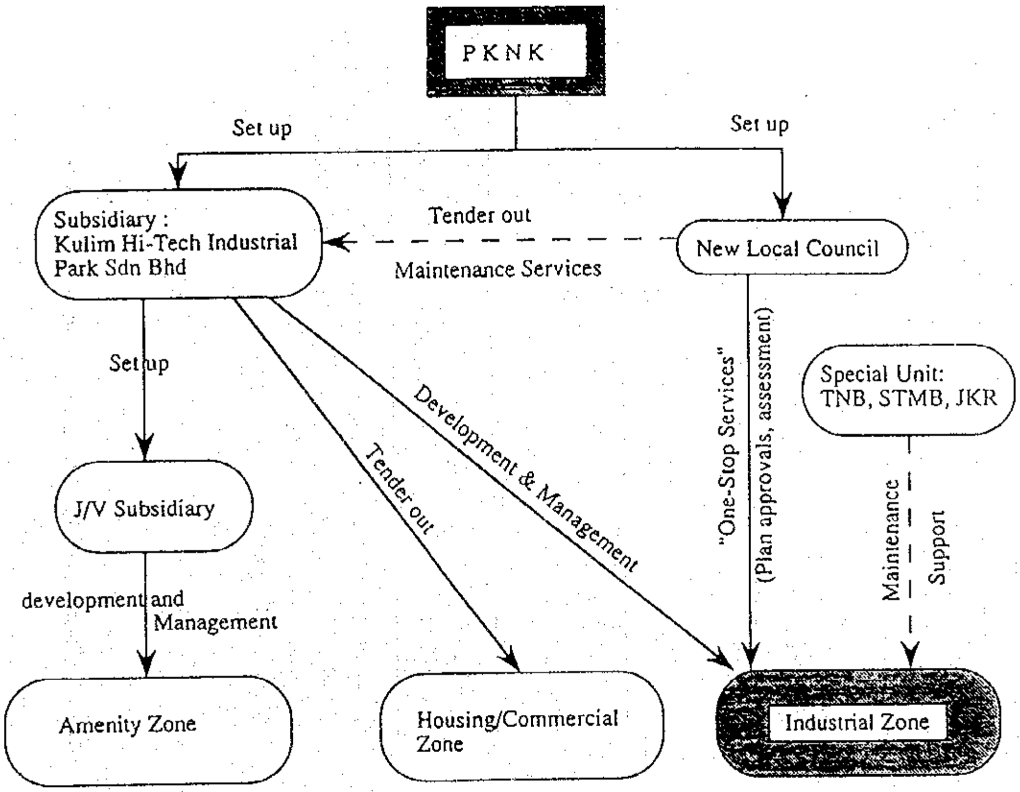


Figure II.2.3 Proposed KHTP Management Organizations in 1992

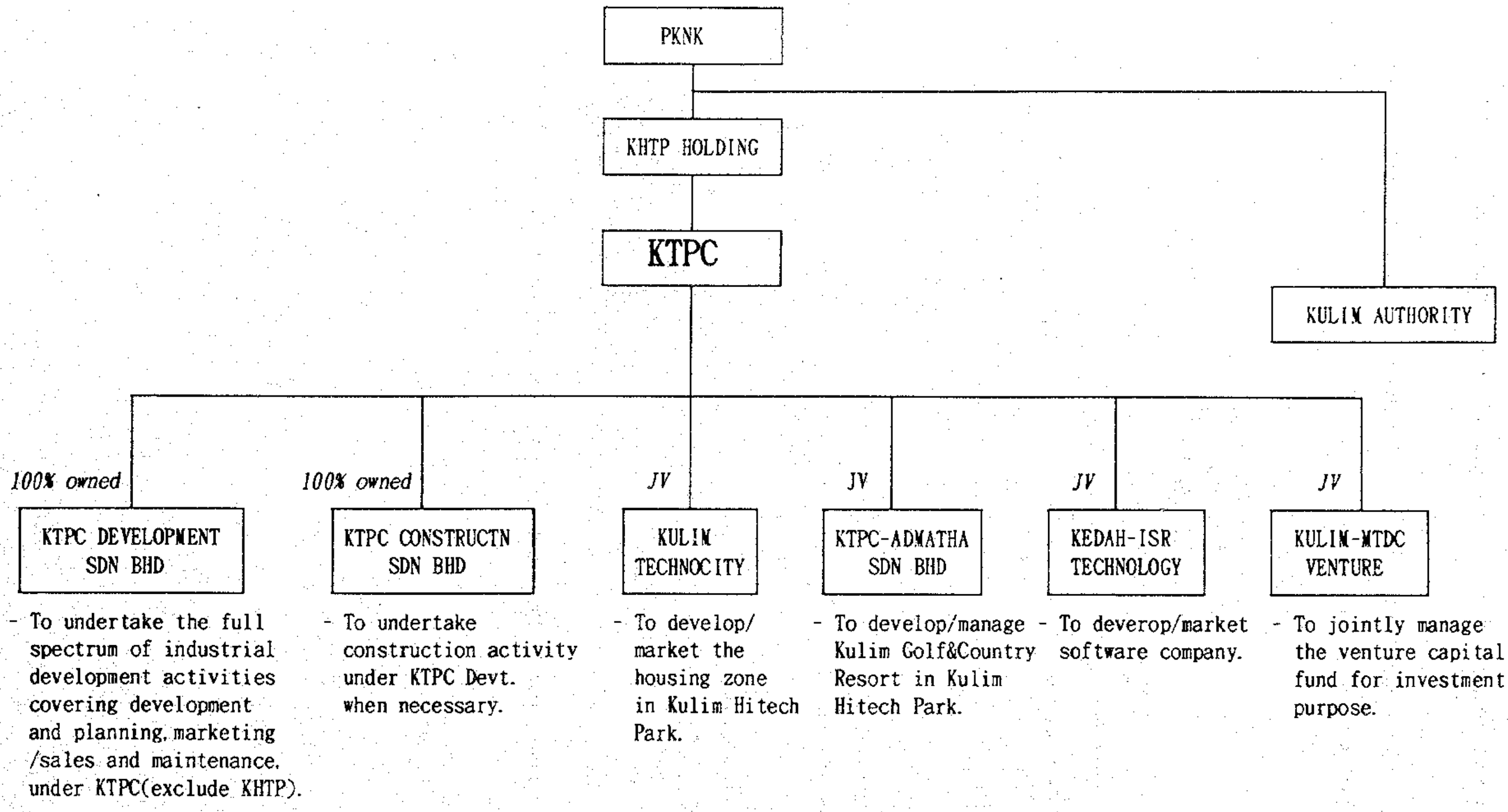


Figure II.2.4 Existing organization system for development promotion of KHTP