NATIONAL SURVEY
of Research and Development

2008 : Summary

MOSTI

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Foreword

The 2008 Report on the National Survey of Research & Development was based on the survey carried out in 2006, which was the seventh survey of Research & Development (R&D) activities conducted in Malaysia. The National Survey of R&D is done once every two years and the analysis of the survey results provides an insight into the developments of R&D activities undertaken by the public and private sectors in Malaysia. Hence, this 2008 Report is the main source currently available to provide comprehensive information on the status of R&D activities in the country. It also includes data spanning 10 years so as to serve as a means to measure R&D growth in Malaysia.

The survey received good cooperation from all sectors involved, and we hope it will be even better in future. We certainly will not spare any efforts to enhance the usefulness of the survey, as it has always been our objective to make it an informative tool for policy makers to develop strategies and directions for R&D in Malaysia.

Acknowledgements

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We also wish to thank the Technical Committee for their contribution. Their assistance, advice and suggestions were invaluable in carrying out the survey and completing the report. Our appreciation, too, goes to all researchers for their comments and suggestions on improving the R&D online for the next R&D survey.

Last but not the least, we would like to thank consulting firm IIUM Consultancies Sdn. Bhd. and the team of consultants, led by Assoc. Prof. Dr. Ratnawati Mohd Asraf, for carrying out the 2006 National Survey of R&D and for compiling and analyzing the data as well as writing the 2008 Report in collaboration with MASTIC.

With everyone's co-operation, MASTIC will endeavor to enhance the R&D Survey further and take it to a higher level.

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INTRODUCTION

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The ongoing process of globalization means that there is a growing interdependence of locations and economic units across countries and regions. This has led to the international division of labor or international specialization based on a country comparative advantage. However, the globalization process has "trapped" many developing countries into having a narrow international specialization, and on becoming dependent on cheap, labor intensive, low value added products. The United Nations Conference on Trade and Development (UNCTAD) Report, for example, showed that even though the developing countries' share of world trade has increased, their share in the world manufacturing value added is decreasing, meaning that they are producing low value added products. Yet, in order to enter the club of industrial countries, the developing countries need to be able to produce capital intensive, high value added products competitively; products that the developing countries do not have the comparative advantage. The ability to produce those products competitively means that the developing country is in the process of closing the technology gap with industrial countries, improving their comparative advantage.

In order to free themselves from the "trap" of globalization, and in order to close the technology gap, developing countries will need to be innovative as innovations will help in changing the comparative advantage. Innovations will also help in bridging the technology gap with industrial countries. However, innovations require heavy investment in education and research and development (R&D) activities. Ironically, even though technological change and innovations are acknowledged almost universally as one of the determinants of globalization, it is also technological change and innovations which will free a developing country from the trap of globalization. Knowledge creation and innovation as a result of R&D activities can move a country from the "user" of capital intensive, high technology, and high value added products to the "creator" of such products.

Therefore to foster sustainable economic development, Malaysia needs to have a critical mass of research scientists and engineers (RSE) involved in R&D activities. The RSEs will help in achieving the "absorptive capacity" needed to adopt the existing technology and finally, improve upon the technology. It should be stressed that adopting existing technology is not without cost. The development of the absorptive capacity requires a huge investment in education whether it be in science and technology, or the arts and humanities.

Technology is also advancing faster than ever before. Developing countries that fail to build capabilities enabling them to participate in the evolving global networks of knowledge creation risk falling further behind in terms of competitiveness as well as economic and social development. While international technology transfers due to foreign direct investment (FDI) may bring important knowledge to an economy that alone is not enough. Actions from both the domestic enterprises and the government are essential to build technological capabilities in the country.

Malaysia's emphasis on the importance of R&D and innovations in the process of economic and social development can be witnessed in the formulation of the Knowledge-Based (K-Based) Economy Master Plan. In the K-based economy model, a high proportion of the GDP is expected to be derived from knowledge-based and knowledge-enabling industries such as high and medium technology industries. K-based economies are also characterized by high investment in R&D, good technology related capacity and skills, and strength in innovation.

There are several reasons cited by the K-based economy Master Plan as to why Malaysia should undertake the development of a K-based economy. Firstly, Malaysia's global competitiveness has seen some erosion as foreign competition increased, necessitating new sources of growth. Secondly, the process of globalization and liberalization has forced Malaysia to prospect for new products and services that will be competitive in the global market. There is also a need to seek higher value-added, partly to offset higher costs, and also the need to move into more profitable and wealth-generating stages of production. Consequently, the production of high value-added products will enhance Malaysia's total factor productivity.

The concern about establishing a knowledge-based economy is not Malaysia's alone. According to the UNESCO Science Report 2005, what is foremost in the minds of governments, enterprises, research bodies, and universities, is how to develop a knowledge-

based economy; an economy based on the production, utilization and distribution of knowledge, which are the primary factors in the growth and wealth creation of the economy.

The realization of a knowledge-based economy requires a high commitment to R&D. R&D activities will increase the stock of knowledge, including knowledge of man, culture, and society, and to use this stock of knowledge to devise new applications. R&D is also crucial in improving production processes, in raising the quality of outputs, and in cutting costs through the introduction of new methods. It is through R&D that Malaysia will be able to promote and support the production of high-quality, up-to-date, and relevant output, which will allow us to be and remain competitive.

To improve the level of R&D, and hence innovations and technological development, the government has set aside, under the 9th Malaysian plan, research funding in the amount 1.5% of Malaysia's GDP. The government also aims to have 50 researchers for every 10,000 labor force. And by 2020, the Malaysian Higher Education Strategic Plan is aiming for 100 RSE per 10,000 labor force, the average for EU in 2003.

To achieve the targeted goals Malaysia needs to be able to measure and assess its R&D activities in an accurate and timely manner. Information on the various R&D activities must be gathered and comprehensively analyzed. It is for this reason that MASTIC has been conducting surveys of R&D activities in Malaysia since 1992, the first year in which the survey was conducted.

This report, the 8th Report on the National Survey of R&D in Malaysia, presents the results of the survey on R&D in Malaysia for the calendar year 2006. It was carried out in both the public and the private sectors. The main objectives of the 2006 National Survey of Research and Development are to:

- assess the trends and developments in R&D in Malaysia, in the public (institutions of higher learning, and government research institutes) and the private (business) sector.
- assess the challenges faced by the above institutions in conducting R&D activities
- compare where Malaysia stands internationally with regard to R&D
- propose recommendations for the continued development of R&D in Malaysia
- guide the government in making policy decisions with regard to R&D

The definitions and methods used in this survey were based on the internationally agreed upon guidelines as put forth by the Organization for Economic Co-operation and Development (OECD) member countries, otherwise known as the Frascati Manual. In the following chapters, we present the methodology of the survey, the key R&D terms and definitions, the government's mechanism for promoting R&D, and the trends and developments in R&D in Malaysia. The report concludes with a summary of the main findings, the implications of the findings, and recommendations for policy.

EXECUTIVE SUMMARY

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Overview of R&D in Malaysia

Malaysia's gross expenditure on R&D (GERD) in 1996 was RM549.2 million. Since then, it has been rising steadily. It surpassed the RM 2 billion mark in 2004, and continued to rise in 2006, with an expenditure of RM3.6 billion. The increase in R&D spending is evident not only in nominal terms, as measured by GERD, but also in real terms as indicated by the GERD per capita and the GERD/GDP ratio.

- In relation to type of cost, current expenditure has shown an upward trend since 1996. The following figures display the growing trend:
  - 1996 (RM329.1 million)
  - 2002 (RM1.4 billion)
  - 2004 (RM2.2 billion)
  - 2006 (RM3.3 billion)
- As regard capital expenditure, there was a marked decline in capital expenditure in 2006, a decrease of RM298.2 million (or 46%), against the 2004 statistics.
- For the last 10 years, the emphasis has been on Applied Research, followed by Experimental Research, and Basic Research. This trend continued in 2006:
  - Applied Research (45.1%)
  - Experimental Development Research (43.6%)
  - Basic Research (11.3%)
- The five major FOR for 2006 were:
  - Applied Sciences & Technologies (34.7%),
  - Engineering Sciences (32.2%),
  - Material Sciences (10.0%),
  - Information Computer & Communication Technology (5.7%), and
  - Agricultural Sciences (4.6%).
- The five major SEO categories for 2006 were:
  - Manufacturing (62.9%),
  - Natural Sciences, Technologies & Engineering (7.9%),
  - Transport (5.9%),
  - Plant Production and Plant Primary Products (4.1%), and
  - Energy Resources (4.1%).
- The main source of funds for R&D, as in the previous years, came from the internal funds. Flow of funds from the government largely concentrated on the IHLs and the GRIs.
- The highest headcount for R&D personnel involved in R&D since 1996 was 30,983 (2004). This number dropped to 24,588 (by 20.6%) in 2006.
- The total FTE of researchers in 2004 was 12,669.5. In line with the drop in headcount, this figure dropped, in 2006, to 9,694.3. Nonetheless, the drop in total FTE is much less than that for the headcount.
- The total number of women R&D personnel decreased from 10,544 in 2004 to 9,127 in 2006. The proportion of female R&D personnel in the GRIs and the IHLs, similar to the private sector, showed an increase.
- In 2006, outsourcing expenditure of R&D activities was RM201.1 million. The private sector, given its considerable share in the total R&D expenditure, dominated the outsourcing activities (84% of the RM201.1 million). It is important to note that the percentage of R&D outsourced within Malaysia increased substantially from 2004.

R&D in the Government Research Institutes (GRI)

- The total expenditure for the GRIs showed a significant decline, from RM296.9 million in 2004 to RM189.5 million in 2006. This is a 36.2% decrease in R&D spending.
- The main type of research conducted was:
  - Applied research (58.2%),
  - Basic research (23.5%), and
  - Experimental Development research (18.2%).

The focus on Applied and Basic Research is characteristic of the public sector, which sees the development of new knowledge as being fundamental to a nation's advancement in science and technology.

- The top 5 expenditure by FOR were:
  - Agricultural Sciences (31.5%),
  - Forestry Sciences (9.3%),
  - Sciences (7.7%),
  - Engineering Sciences (7.6%), and
  - Biotechnology (7.0%).
- The top 5 expenditure by SEO were:
  - Natural Sciences, Technology & Engineering (23.9%),
  - Plant Production & Plant Primary Products (22.8%),
  - Manufacturing (10.3%),
  - Animal Production & Animal Primary Products (8.2%), and
  - Environmental Management & Other Aspects (7.2%).
- 47.0% (RM89.1 million) of the source of funds for R&D activities came from the institution's own funds. Government funds contributed RM65.0 million (34.3%) of the total R&D expenditure.
- The total headcount for research personnel fell from 7,437 in 2004 to 4,556 in 2006. This trend is not seen with technicians and support staff.
- Researchers made up the majority of R&D personnel (59.5%), and their FTE accounted for 45.5% of the total FTE. The total FTE for researchers fell from 4,021.3 in 2004 to 2,350.1 in 2006.
- 42.0% of the researchers in the GRIs were female; a growing trend since 2000 (29.9%).
- The amount of GRI outsourced R&D expenditure grew from RM6.3 million in 2004 to RM27.2 million in 2006.
- The main internal limiting factors in R&D activities cited were 'limited time due to class/administrative work', 'lack of skilled personnel', 'limited financial resources', 'lack of infrastructure', and 'poor reward system'.
- The main external limiting factors in R&D activities were due to 'increased capital cost', 'lack of R&D expertise', 'lack of ancillary services to support R&D', 'insufficient government funds', and 'difficulty in finding private sector collaboration'.

R&D in the Institution of Higher Learning (IHL)

- The total R&D expenditure for IHLs dropped substantially by 29.7% from RM513.3 million in 2004 to RM360.8 million in 2006.
- The amount spent on each type of research was:
  - Applied research (RM179.9 million)
  - Basic research (RM133.7 million)
  - Experimental Development research (RM47.2 million)
- The top five expenditure by FOR were:
  - Medical and Health Sciences (12.9%)
  - Engineering Sciences (12.8%)
  - Applied Sciences & Technology (10.2%)
  - Social Sciences (9.1%), and
  - Chemical Sciences (8.0%).
- The top five expenditure by SEO were:
  - Natural Sciences, Technology and Engineering (46.7%)
  - Manufacturing (8.5%)
  - Health (7.4%)
  - Social Sciences & Humanities (4.5%)
  - Education & Training (4.3%)
- The two main sources of funds for the IHLs came from Own Funds (66.3%) and Federal Government Funds (31.1%).

- There is a continuous growth in the number of research personnel from 1996 to 2006, with researchers making up the largest percentage (93.4%).

- The total FTE for researchers, technicians, and support staff in 2006 was 5,438.0 compared to 7,738.1 in 2004, a drop of 29.7%.

- The proportion of female to male R&D's personnel increased to 40.1% in 2006 from 39.0% (2004).

- As regard to expenditure of outsourced R&D, the amount spent dropped for both 'within' and 'outside' Malaysia.

- The top five main internal limiting factors in the R&D activities were 'limited time due to classes or administrative work', 'limited financial resources', 'lack of infrastructure for R&D', 'delayed fund management', and 'lack of skilled personnel'.

- The top five main external limiting factors were 'increasing capital costs', 'insufficient government funds', 'difficulty in finding private sector collaboration', 'lack of R&D personnel with requisite expertise', and 'lack of ancillary service to support R&D'.

R&D in the Private Sector

- There is an uptrend in Malaysia's GERD since 1996, surpassing the RM2 billion mark in 2004, and reaching slightly more than RM3 billion this year. This increase of RM1.0 billion is the highest recorded across the years surveyed.

- Although there is an increase in R&D expenditure, the headcount for R&D personnel has shown a substantial drop by 19.6% from 2004.

- There was a drop of 8.1% in private sector R&D Personnel FTE from 2004 to 2006. The drop in FTE is especially substantial as regard researchers, from 4,104.3 in 2004 to 3,529.3 in 2006. The drop in FTE is expected given the drop in the total headcount in R&D for the year 2006.

- In terms of the involvement of female researchers in R&D, the overall trend shows an increase, despite dips in 2000 and 2006. This rising trend is also seen in terms of the proportion of female researchers against male researchers in R&D activities.

- Manufacturing of rubber and plastic products, manufacturing of motor vehicles, trailers & semi trailers and extraction of crude oil & natural gas and service activities were the top 3 industry in 2006.

- The major type of ownership in the private sector was still foreign ownership. There is, however, a shift in R&D spending in relation to Malaysian-owned and Malaysian-controlled companies. In 2006, Malaysian-owned companies showed more R&D spending than Malaysian-controlled companies.

    - The top expenditure by FOR for 2006 were;
    - Applied Sciences & Technologies (39.5%),
    - Engineering Sciences (36.0%),
    - Material Sciences (10.5%),
    - Information, Computer & Communication Technology (5.5%), and
    - Agricultural Sciences (3.0%).

- The top expenditure by SEO were;
    - Manufacturing (72.5%),
    - Transport (6.8%),
    - Energy Resources (4.6%),
    - Plant Production and Plant Primary Products (3.3%), and
    - Natural Sciences, Technologies and Engineering (2.4%)

- In terms of type of research, Experimental Development Research led the way, followed by Applied Research. Experimental Development Research and Applied Research accounted for 92.5% of the total R&D expenditure. Basic Research only made up 7.5% of the total R&D expenditure.

- In terms of the total amount of outsourced R&D expenditure, there was a considerable increase from 2004. In terms of location of outsourcing, the 2006 statistics indicate that companies are not outsourcing R&D outside Malaysia as much as they did in 2004. There was a drop in percentage of outsourced R&D

outside Malaysia, from 89.4% in 2004 to 53.3% in 2006.

- With respect to internal factors limiting R&D in the private sector in Malaysia, the top 5 factors mentioned were 'lack of skilled R&D personnel', 'limited financial resources', 'lack of Infrastructure for R&D', 'lack of market research', and 'lack of proven analytical techniques'.

- The top 5 external factors limiting R&D in the private sector were 'shortage of R&D personnel with requisite expertise', 'increasing capital costs', 'lack of ancillary services to support R&D', 'increasing labour costs', and 'insufficient government incentives'.

International Comparisons

- Malaysia's GERD of RM3.6 billion placed it 37th in the world. The amount was small compared to the developed and the East Asian NIEs.

- Malaysia's GERD/GDP ratio of 0.64 placed it 44th in the world. The ratio is small compared to the developed and the East Asian NIEs, but it was better than the South and South East Asian countries and many OIC member countries. Israel's GERD/GDP of 4.71 was the highest in the world.

- Malaysia's GERD per capita of RM137.1 also placed it 41st in the world. The ratio is also small compared to the developed and the East Asian NIEs, but it was better than the South and South East Asian countries and many OIC member countries. Sweden's GERD per capita of RM5,785 was the highest in the world.

- The private expenditure on R&D as a percentage of GDP for Malaysia was 0.54. The percentage is small compared to the developed and the East Asian NIEs, but it is better than the South and South East Asian countries and many OIC member countries. The highest percentage was charted by Israel at 3.58.

- In 2006, Malaysia's researcher headcount per 10,000 labour force was 17.9. It is quite a long way to go before Malaysia achieves the 9th Malaysia Plan target of having 50 researchers per 10,000 labour force. This places us in the same group with South Africa (20.7) and Chile (19.3). For the other ASEAN countries, Singapore has the highest concentration of researchers at 87.4; the number of researchers for Thailand, Indonesia and Philippines was 12.7, 10.7 and 2.4 per 10,000 labour force respectively. Iceland has the highest concentration of researchers, at 328.4 researchers per 10,000 labour force.

- The FTE for Malaysian researchers was 9,694; this was smaller than the East Asia NIEs. Singapore researchers' FTE were 23,789 and South Korea's was 179,812.

- The number of female researchers in Malaysia (7,162) was comparable to that of Singapore (7,346) and Pakistan (7,261). However, this number does not take into account the size of the population.

KEY R&D TERMS AND DEFINITIONS

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DEFINITION OF R&D

Research and development (R&D) comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge and the use of this stock of knowledge to devise new applications.

CATEGORIES OF R&D ACTIVITIES

R&D can be systematically categorized into the following categories:

Basic Research

Basic Research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view.

Applied Research

Applied Research is undertaken either to determine possible uses for the findings of basic research or to determine new methods or ways of achieving specific and predetermined objectives. It involves considering the available knowledge and its extension in order to solve particular problems. The results of applied research are intended primarily to be valid for a single or limited number of products, operations, methods or systems. Applied research gives operational form to ideas.

Experimental Research

Experimental Research is systematic work, drawing on knowledge gained from research and practical experience that is directed to producing new materials, products and devices; to installing new processes, systems and services; or to improving substantially those already produced or installed.

HUMAN RESOURCES STRUCTURE IN R&D

All persons directly employed on R&D and those providing direct services. It includes persons who are mainly or partially engaged in R&D.

Researchers

Researchers are professionals engaged in the conception or creation of new knowledge, products, processes, methods, systems and in the management of the projects concerned. Postgraduate students at the PhD level engaged in R&D are considered as researchers.

Technicians

Technicians and equivalent staff are persons whose main tasks require technical knowledge and experience in one or more fields of engineering, physical and life sciences (technicians) or social science and humanities (equivalent staff). They participate in R&D by performing scientific and technical tasks involving the application of concepts and operational methods, normally under the supervision of researchers.

Support Staff

Other supporting staff include skilled and unskilled craftsmen, secretarial and clerical staff who support R&D projects or who are directly associated with such projects. Also included in this category are managers and administrators dealing mainly in financial and personnel matters and general administration, in so far as their activities are a direct service to R&D.

HEADCOUNT

Headcount refers to the total number of people involved in R&D. Each person involved in R&D (regardless of qualification, gender or nationality and whether the person is a researcher, technician or support staff) is considered as a single headcount. For example, headcount of R&D team consisting of 2 researchers, 3 technicians, and 5 support staff has a headcount of 10.

FULL-TIME EQUIVALENT (FTE)

This is the true measure of the number of people actually involved in R&D. FTE is based on the actual proportion of times a researcher, technician or support staff spends on R&D during the surveyed year. A person (whether

researcher, technician or support staff) involved in R&D does not necessarily devote all of his or her time on R&D activities but also spends a portion on non-R&D work such as administration and teaching.

Hence, a researcher who spent 70% of his or her time on R&D and 30% on non-R&D activities for a given year would have an FTE of 0.70 but the headcount would equate to 1. If 2 researchers spent 50% of their time on R&D for a given year, then the FTE of each researcher is 0.50 and the sum of the two researchers' FTE is 1.0 but the headcount, however would equate to 2.

R&D EXPENDITURE

Gross Expenditure on Research and Development (GERD)

This is the total expenditure on R&D activities done within a country's boundary during a given period, usually a year. Expenditure is categorized into current and capital expenditure.

Current Expenditure

This comprises the total labour and operating cost described as follows:

- **Labour Cost**
  The sum of the total emoluments received by each person involved in R&D multiplied by their individual FTE. Thus labour cost is the proportion of the emoluments received related to R&D but excludes the proportion not related to R&D.

- **Operating Cost**
  Operating cost include non-capital purchases of materials, supplies and equipment to support R&D performed by the organization. Administrative and other overhead expenditures are included and prorated if necessary. Expenditures on indirect services as well as rents and fees associated with R&D are included.

Capital Expenditure

Annual expenditure on fixed assets used in R&D reported over the full period of the R&D activity, and which includes the following:

- **Land and Building Cost**
  Comprises expenditure on land and building for R&D purposes and includes fixed assets purchased or constructed, including improvements and modifications.

- **Machinery and Equipment Cost**
  Expenditure on major instruments used in R&D including, where applicable, the cost of built-in software.

RESEARCH INTENSITY

Gross Domestic Product (GDP)

The total market value of all goods and services produced in a country within a year and used as a measurement of a country's economic performance. It is the sum investments, consumer and government spending, and net exports. Thus a country's rising GDP indicates economic growth while declining GDP indicate economic decline.

Research Intensity (GERD / GDP ratio)

This is the ratio of a country's gross expenditure on R&D (GERD) to the country's GDP. Thus the higher the research intensity, or GERD/GDP ratio of a country, the greater the national emphasis or expenditure on R&D in relation to its economy.

FIELD OF RESEARCH (FOR)

These are the R&D activities classified according to their scientific and academic disciplines. There are a total of 20 FOR category classifications used in the 2006 R&D Survey, which consist of several sub groups.

SOCIO-ECONOMIC OBJECTIVES (SEO)

These are the R&D activities classified according to their purpose or fields that benefit from the research activity. There are a total of 26 SEO category classifications used in the 2006 R&D Survey.

OUTSOURCING OF R&D ACTIVITIES

Outsourcing of R&D refers to R&D activities from the GRIs, IHLs or private companies not done internally within the organization but outsourced or contracted to other GRIs, IHLs or private companies. R&D may be outsourced within the country (internal outsourcing) or outside of the country (external outsourcing).

Payment for such outsourced R&D may be in the form of grants, contracts, commissions or donations. The monetary value or expenditure for outsourcing R&D is not included in the survey as part of an organization's R&D expenditure.

FACTORS LIMITING R&D

Internal Factors Limiting R&D

These are the factors within an organization limiting or prohibiting developments in an organization's R&D activities. Examples of internal factors limiting R&D include limited financial resources and lack of skilled R&D personnel within the organization.

External Factors Limiting R&D

These are factors from outside an organization limiting or prohibiting developments in an organization's R&D activities. Examples of external limiting factors include increasing costs of capital goods and shortage of R&D personnel with the requisite expertise.

Table 1 : Key Indicators of R&D Activities in Malaysia

Notes :		
Total labour force 2006 (mil) = 10.628		
Total population 2006 (mil) = 26.64		
GDP 2006 (RM mil) = 572,555 (Based on current price)		
Total labour force 2004 (mil) = 10.856		
Total population 2004 (mil) = 25.62		
GDP 2004 (RM mil) = 449,609 (Based on current price)		
Organizations Surveyed With R&D	**2006**	**2004**
Government Agencies and Research Institutions (GRI)	45 agencies or institutes	43 agencies or institutes
Institutions of Higher Learning (IHL)	28 institutes	24 institutes
Privates sector	204 companies	230 companies
Total	277 organizations	297 organizations
R&D Projects Surveyed		
Government Agencies and Research Institutions (GRI)	1,008 Projects	1,318 Projects
Institutions of Higher Learning (IHL)	5,577 Projects	4,870 Projects
Private sector	3,412 Projects	3,723 Projects
Total	9,997 Projects	9,911 Projects
Total R&D Expenditure		
Gross Expenditure on R&D (GERD)	RM 3,646.7 million	RM 2,843.8 million
GERD/GDP Ratio	**0.64%**	**0.63%**
Current Expenditure	RM 3,297.7 million	RM 2,196.6 million
Labour Cost	RM 635.8 million	RM 947.2 million
Operating Cost	RM 2,661.9 million	RM 1,249.4 million
Capital Expenditure	RM 349.0 million	RM 647.2 million
Headcount and FTE		
Total Human Resources in R&D	**2006**	**2004**
Total Headcount of R&D Personnel	24,588	30,983
Total Headcount of Researchers	19,021	23,092
Total FTE of R&D Personnel	13,415.90	17,886.55
Total FTE of Researchers	9,694.23	12,669.49
FTE per R&D Personnel	0.55	0.58
FTE per Researcher	0.51	0.55
Total Number of Degree Holders (PhDs, Masters, Bachelors)	17,486	20,967
Number of Researchers per 10,000 Labor Force	17.90	21.3
R&D Expenditure per R&D Personnel	RM 148,315.02	RM 91,782.60
Other Indicators		
Three Main Field Of Research (FOR)	**1. Applied Sciences & Technology** RM 1,265.0 million	**1. Engineering Sciences** RM 1,006.5 million
	2. Engineering Sciences RM 1,175.4 million	**2. ICT** RM 764.6 million
	3. Material Sciences RM 364.9 million	**3. Applied Sciences & Technologies** RM 260.9 million

Three Main Socio-Economic Objectives (SEO)	**1. Manufacturing** RM 2,294.7 million	**1. Manufacturing** RM 1,441.2 million
	2. NSTE RM 289.2 million	**2. Information & Communication Services** RM 297.4 million
	3. Transport RM 214.0 million	**3. NSTE** RM 241.1 million
R&D IN GOVERNMENT AGENCIES & RESEARCH INSTITUTIONS (GRI)		
R&D Expenditure in GRI		
Total Expenditure	RM 189.5 million	RM 296.9 million
Current Expenditure	RM 132.0 million	RM 196.3 million
Labour Cost	RM 72.2 million	RM 101.1 million
Operating Cost	RM 59.8 million	RM 95.2 million
Capital Expenditure	RM 57.5 million	RM 100.6 million
Human Resources in R&D		
Headcount of R&D Personnel	4,556	7,437
Headcount of Researchers	2,709	4,347
Headcount of Technicians & Support Staff	1,847	3,090
FTE of R&D Personnel	2,350.09	4,021.31
FTE of Researcher	1,068.21	2,130.81
FTE per R&D Personnel	0.52	0.54
FTE per Researcher	0.39	0.49
Other Indicators		
Largest R&D Activity by Field of Research (FOR)	1. Agricultural Sciences	1. Agriculture Sciences
	2. Forestry Sciences	2. Engineering Sciences
	3. Material Sciences	3. Information, Computer & Communication Technology (ICT)
Largest R&D Activity by Socio - Economic Objective (SEO)	1. Natural Sciences, Technologies & Engineering	1. Plant Productions & Plant Primary Products
	2. Plant Production & Plant Primary Products	2. Natural Science Technology & Engineering
	3. Manufacturing	3. Environmental Management & Other Aspects
R&D IN INSTITUTIONS OF HIGHER LEARNING (IHL)		
	2006	**2004**
R&D Expenditure		
Total Expenditure	RM 360.8 million	RM 513.3 million
Current Expenditure	RM 305.4 million	RM 401.2 million
Labour Cost	RM 216.2 million	RM 267.6 million
Operating Cost	RM 89.2 million	RM 133.6 million
Capital Expenditure	RM 55.4 million	RM 112.2 million
Human Resources in R&D		
Headcount of R&D Personnel	13,007	14,809
Headcount of Researchers	12,152	12,805

Headcount of Technicians & Support Staff	855	2,004
FTE of R&D Personnel	5,438.02	7,738.04
FTE of Researchers	5,096.75	6,434.38
FTE per R&D Personnel	0.42	0.52
FTE per Researcher	0.42	0.5
Other Indicators		
Largest R&D Activity by Field of Research (FOR)	1. Medical & Health Sciences	1. Engineering Sciences
	2. Engineering Sciences	2. Applied Sciences & Technologies
	3. Applied Sciences & Technologies	3. Biological Sciences
Largest R&D Activity by Socio-Economic Objective (SEO)	1. Natural Sciences, Technologies & Engineering	1. Natural Sciences, Technology & Engineering
	2. Manufacturing	2. Manufacturing
	3. Health	3. Plant Production & Plant Primary Products
R&D IN THE PRIVATE SECTOR		
	2006	**2004**
R&D Expenditure		
Total Expenditure	RM 3,096.4 million	RM 2,033.6 million
Current Expenditure	RM 2,860.3 million	RM 1,599.1 million
Labour Cost	RM 347.4 million	RM 578.5 million
Operating Cost	RM 2,512.9 million	RM 1,020.6 million
Capital Expenditure	RM 236.1 million	RM 434.5 million
Human Resources in R&D		
Headcount of R&D Personnel	7,025	8,737
Headcount of Researchers	4,160	5,940
Headcount of Technicians & Support Staff	2,865	2,797
FTE of R&D Personnel	5,627.79	6,127.20
FTE of Researchers	3,529.27	4,104.30
FTE per R&D Personnel	0.80	0.7
FTE per Researcher	0.85	0.69
Other Indicators		
Largest R&D Activity by Field of Research (FOR)	1. Applied Science & Technologies	1. Engineering Sciences
	2. Engineering Sciences	2. Information, Computer & Communication Technology (ICT)
	3. Material Sciences	3. Applied Science & Technologies
Largest R&D Activity by Socio-Economic Objectives (SEO)	1. Manufacturing	1. Manufacturing
	2. Transport	2. Information & Communication Services
	3. Energy Resources	3. Energy Resources

OBJECTIVES AND RESEARCH METHODOLOGY

OBJECTIVES AND RESEARCH METHODOLOGY

The methodology used in this survey was based on the internationally agreed upon guidelines as put forth by the Organization for Economic Co-operation and Development (OECD) member countries, otherwise known as the Frascati Manual.

OBJECTIVES OF THE 2006 NATIONAL R&D SURVEY

The main objectives of the 2006 National Survey of Research and Development were to:

- assess the trends and developments in R&D in Malaysia, specifically among the GRI, IHL and the private sector;
- assess the challenges faced by the above institutions in conducting R&D activities;
- compare where Malaysia stands internationally with regard to R&D;
- propose recommendations for the continued development of R&D in Malaysia; and
- guide the government in making policy decisions with regard to R&D.

RESEARCH METHODOLOGY

The data were obtained via questionnaires prepared by MASTIC, based on the Frascati Manual recommendations. Two sets of questionnaires were developed for the survey, one for the public sector, which comprised the government research institutes (GRIs) and institutes of higher learning (IHLs), and the other for the private sector, which includes businesses and public listed companies.

For the public sector, the survey was conducted online to provide a more efficient means of getting back the survey forms from the respondents. Letters were sent to each researcher or project leader known to have conducted R&D or who are likely to have conducted R&D requesting them to submit the surveys through the R&D Online published in the MASTIC website. Project leaders were provided with a user ID and password to enable them to have access to the online survey forms. A project coordinator was appointed from each organization to assist MASTIC in ensuring the participation of the project leaders in this survey.

For the private sector, survey forms were mailed to 2,500 companies that were known to conduct, or that were very likely to have conducted, R&D activities. This list of companies was obtained after having reviewed a master list of 3,187 probable R&D performing companies provided by various government agencies.

PARTICIPATION OF THE PUBLIC SECTOR

In an attempt to achieve the highest response rate possible for the public sector, letters were sent to all research project leaders or researchers from all the Institutes of Higher Learning and Government Research Institutes impressing upon them the importance of their participation in the survey, and the contribution that they would be making by doing so. As in most surveys, this did not immediately result in the response rate that we had targeted, and hence, several follow-up measures, including visits, were made to various institutions to assist researchers and project leaders in filling in online the survey forms. For the researchers who were not able to attend these help sessions, help was provided through telephone.

This strategy resulted in our obtaining a response rate of 88.7% for the government research institutes, and 85.6% for institutes of higher learning. In all, survey forms were obtained from a total number of 1,008 GRI projects and 5,577 IHL projects (See Table 2).

Table 2: Number Of Projects Surveyed, Responded and Response Rate 2006

Sector	No. Of Projects Surveyed	No. Of Projects Responded	Response Rate
GRI	1,136	1,008	88.7
IHL	6,517	5,577	85.6

PARTICIPATION OF THE PRIVATE SECTOR

As was the case with the public sector, special emphasis was placed on getting the participation of the 2,500 companies in the survey. This was done by impressing upon them the contribution that their companies would be making to the reported national GERD, and subsequently, to the country's competitiveness rating by doing so. Visits were also made to these companies to assist them in filling in the survey forms.

From the 2,500 questionnaires that were mailed out, a total of 1,800 companies returned their survey forms. 1,596 companies stated that they had not conducted any R&D activity in the 2006 fiscal year while 204 companies said that they had. Hence, the results of the survey are based on the responses from the 204 companies.

ACCURACY AND RELIABILITY OF DATA

In the conduct of surveys, the accuracy of the data is an issue that has always been of prime concern. Hence, the following steps were undertaken to ensure the accuracy and reliability of the data:

1. Checking each item in the Private Sector Survey Form for complete and accurate responses. This was done manually by the researchers and cross checked by another group of researchers.

2. For the Public sector, the data (responses) were complied and checked for accuracy through the database, MySQL, and rechecked manually.

3. After thorough checking and counterchecking, each of the dataset (private and public) was transferred into the SPSS program for analysis.

4. Both sets of data (private & public) were then merged together into one main dataset file for analysis, thus having several datasets such as that for the IHL and GRI (Public) and Private, and finally, the Overall Dataset.

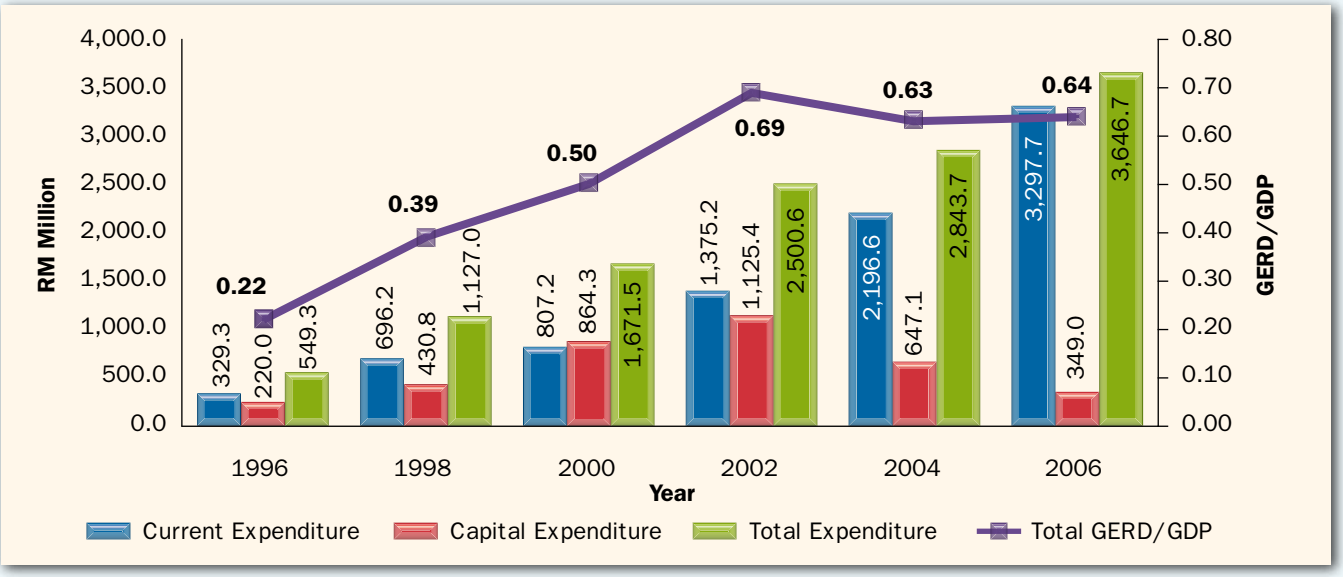
5. Initial checks and preliminary counter checks were done to make sure that the variables and fields are complete and accurate in all datasets. A pre-analysis was conducted to confirm the authenticity and accuracy of each individual set of data and overall data through simple descriptive statistics.

6. Finally, to ensure reliability and accuracy, the analyses of data and creation of output data in the form of summary statistics, tables, and charts were done by two independent groups of researchers.

OVERVIEW OF R&D IN MALAYSIA

GROSS EXPENDITURE ON R&D (GERD)

Figure 1 : R&D by Expenditure

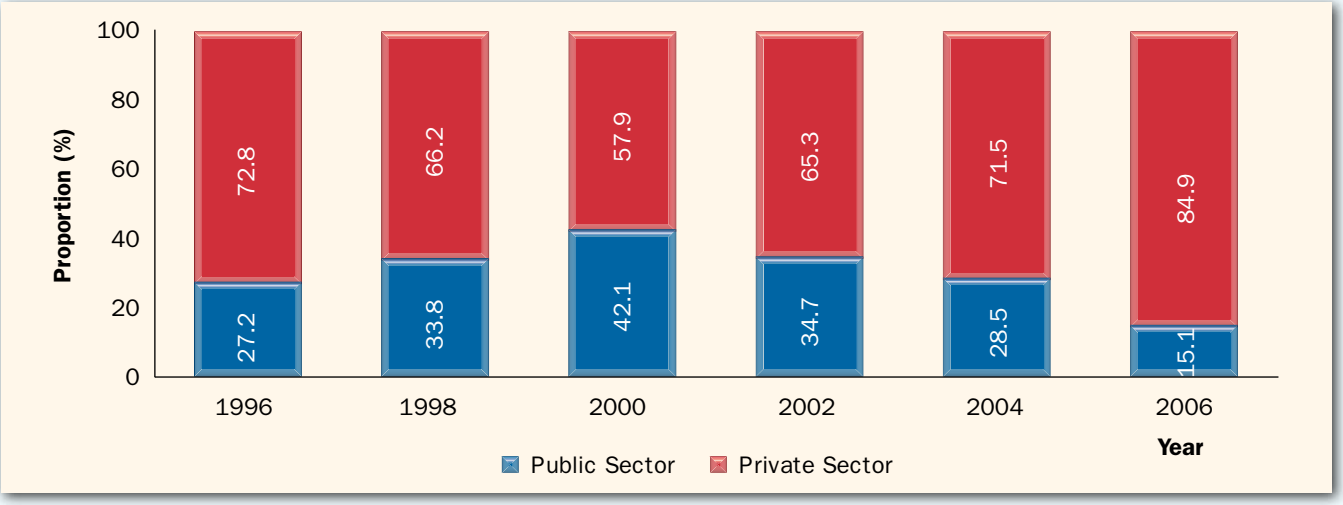


The gross expenditure on R&D activities (GERD) in 2006 totaled RM3.6 billion, which was 0.64% of the GDP. The GERD/GDP ratio reached a maximum of 0.69 in 2002. However, it dropped to 0.63 in 2004 (Figure 1).

In both the nominal and real terms, the GERD showed a positive trend. The total expenditure in 1996 was RM549.3 million; nominally it increased by about 6.6 times in the 10 year period from 1996 to 2006. In real terms the expenditure increased by about 4.7 times in the same time period (The GERD is deflated by the GDP deflator base year 1987: Source-WDI).

Expenditure by Sector

Figure 2 : R&D Expenditure by Sector



The public sector accounted for 15.1% of the GERD and the private sector accounted for 84.9%. From the public sector, the GRIs and IHLs accounted for 5.2% and 9.9% of the total expenditure respectively. The private sector remains the major contributor to the GERD during the 10 year period, accounting for more than three quarters of the expenditure (See Figure 2).

Total current expenditure in 2006 was RM3.3 billion, accounting for 90.4% of the nation's GERD. Of this, the GRIs contributed RM132.0 million (4.0%), the IHLs RM305.4 million (9.3%), and the private sector RM2,860.3 million (86.7%) (Table 3).

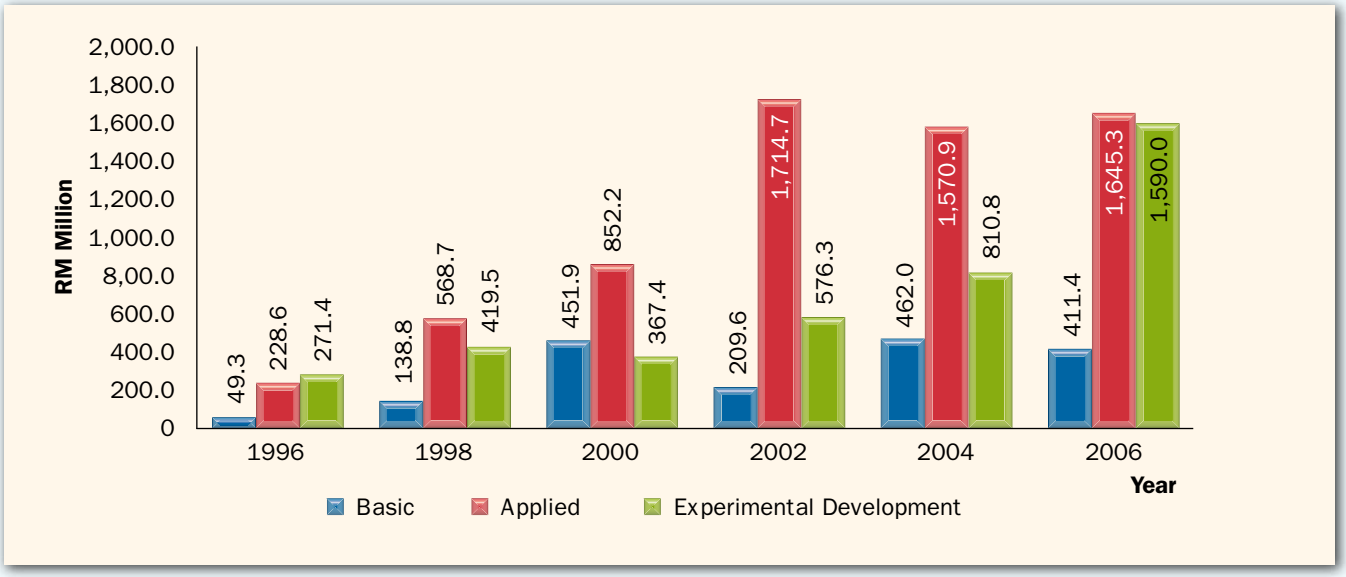
Total capital expenditure in 2006 was RM349.0 million, which accounted for 9.6% of GERD. The GRIs contributed RM57.5 million (16.5 %), the IHLs RM55.4 million (15.9%) and the private sector RM236.1 million (67.7%) (Table 3).

Table 3 : Expenditure by Sector and Type of Cost (2004-2006)

Institutions	Type of Cost	2006 (RM Million)	2004 (RM Million)
GRI	Current	132.0	196.3
	Capital	57.5	100.6
	Total	189.5	296.9
IHL	Current	305.4	401.2
	Capital	55.4	112.2
	Total	360.8	513.3
PRIVATE	Current	2,860.3	1,599.1
	Capital	236.1	434.5
	Total	3,096.4	2,033.6

Expenditure by Type of Research

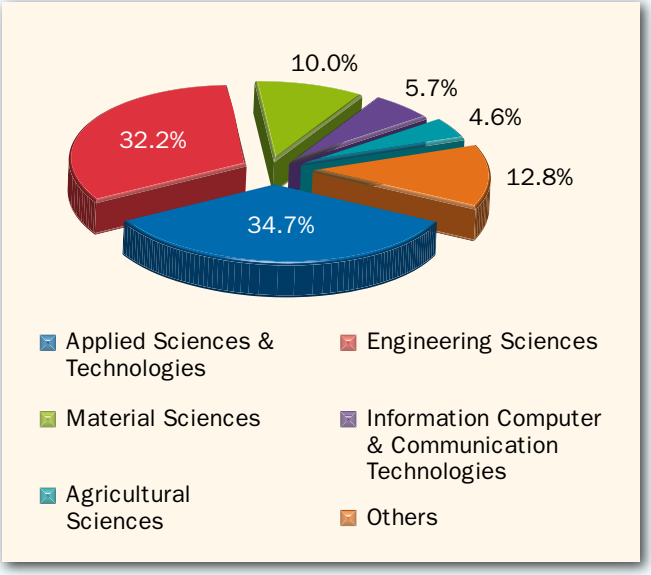
Figure 3 : Expenditure by Type of Research



There are three types of R&D activities: (i) basic research, (ii) applied research and (iii) experimental development research. The amount spent on each of these areas in 2006, respectively, was RM411.4 million (11.3%), RM1.6 billion (45.1%) and RM1.6 billion (43.6%). For the 10 year period, the emphasis has been on applied research, followed by experimental and basic research. Applied research accounted for about half of the GERD for the 10 year period (Figure 3).

Expenditure by FOR

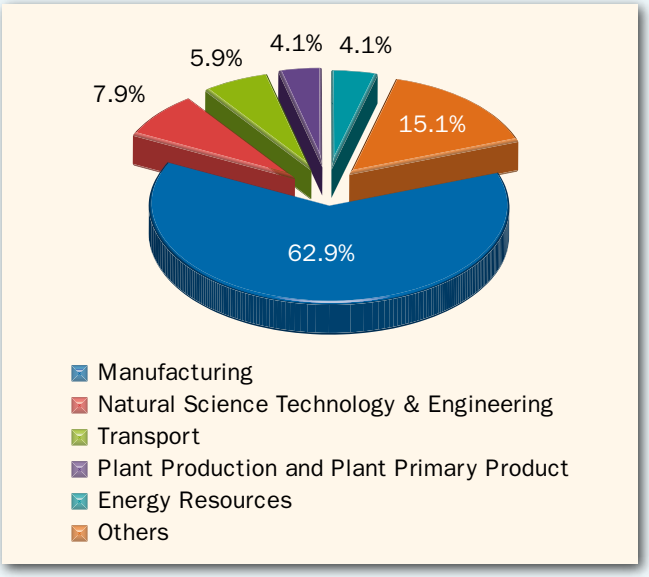
Figure 4 : Proportion of Expenditure by 5 Major FOR



The top 5 FOR by expenditure in 2006 were (Figure 4):

i. Applied Sciences and Technologies (34.7%)
ii. Engineering Sciences (32.2%)
iii. Material Sciences (10.0%)
iv. Information, Computer and Communication Technology (5.7%)
v. Agricultural Sciences (4.6%)

Figure 5 : Proportion of Expenditure by SEO in 2006

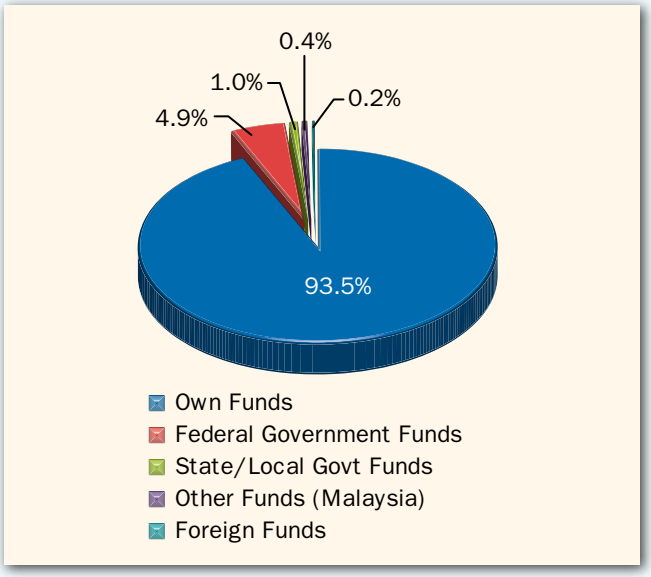


The top 5 SEO by expenditure in 2006 were (Figure 5):

i. Manufacturing (62.9%)
ii. Natural Sciences, Technologies & Engineering (7.9%)
iii. Transport (5.9%)
iv. Plant Production and Plant Primary Products (4.1%)
v. Energy Resources (4.1%)

SOURCES OF FUNDS IN 2006

Figure 6 : Sources of Funds in 2006



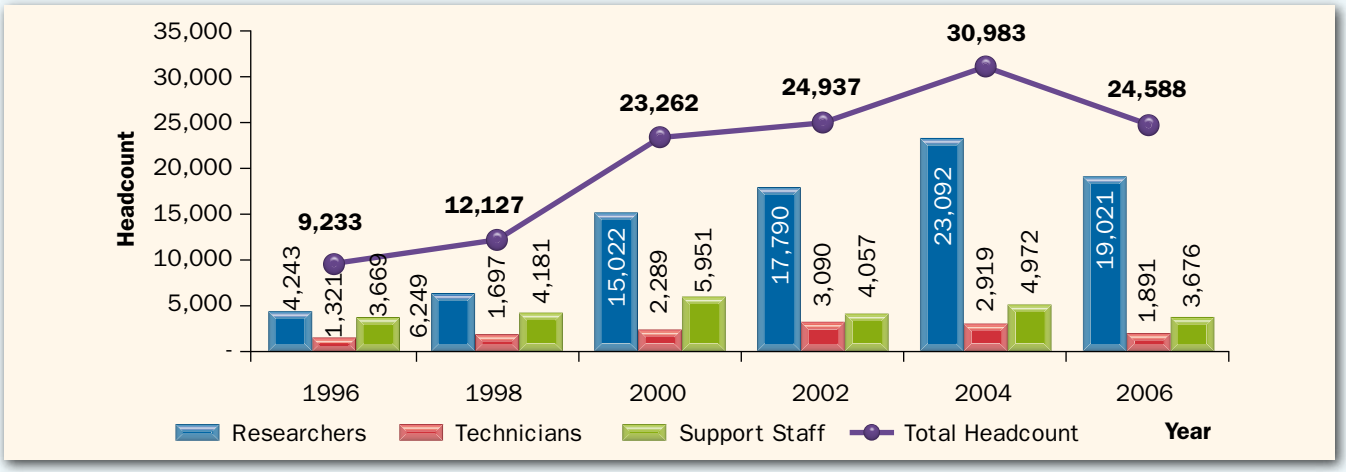
The majority of the funding for the R&D activities came from the institutions' or the companies' own funds. This accounts for 93.5% of the total R&D expenditure (Figure 6). For the GRIs, 47% of the funding for R&D came from their own funds, 34.3% from federal government funds, 14.1% from state or local government funds, 2.4% from foreign funds and 2.2% from other funds (See Table 4). For the IHLs, 66.3% of the R&D funding came from their own funds while 31.0% came from federal government funds. Unlike the public sector, almost all (99.5%) of the funding for R&D activities by the private sector came from the companies' own funds.

Table 4: Percentage of Sources of Funds by Sector 2006

Sectors	Own Funds (%)	Federal Govt. Funds (%)	State/Local Govt. Funds (%)	Other Funds (M'sia) (%)	Foreign Funds (%)
GRI	47.0	34.3	14.1	2.2	2.4
IHL	66.3	31.0	0.5	1.4	0.7
PRIVATE	99.5	0.0	0.3	0.2	0.0

HUMAN RESOURCE DEVELOPMENT

Figure 7: National R&D Personnel Headcount



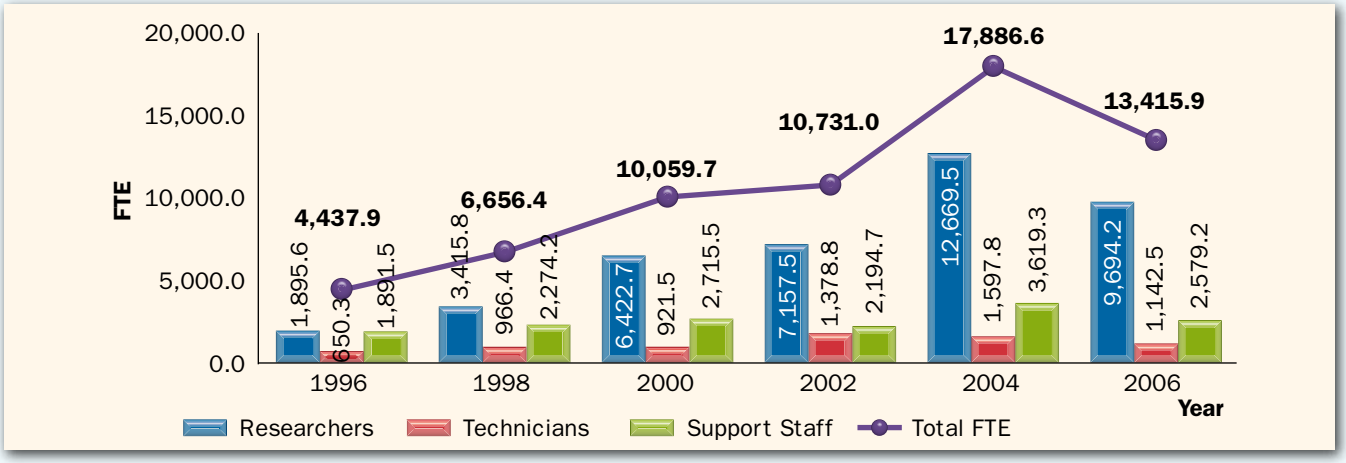
By Headcount

There were 24,588 personnel in 2006, compared to 9,233 R&D personnel in 1996. The maximum number of personnel involved in R&D was in 2004, where 30,983 personnel were involved (Figure 7). In 1996, there were 4,243 researchers and in 2006 there were 19,021 researchers. The highest number of researchers was recorded in 2004, where 23,092 researchers were involved; it decreased to 19,021 in 2006. The number of technicians and support staff has remained relatively stable over the years.

By FTE

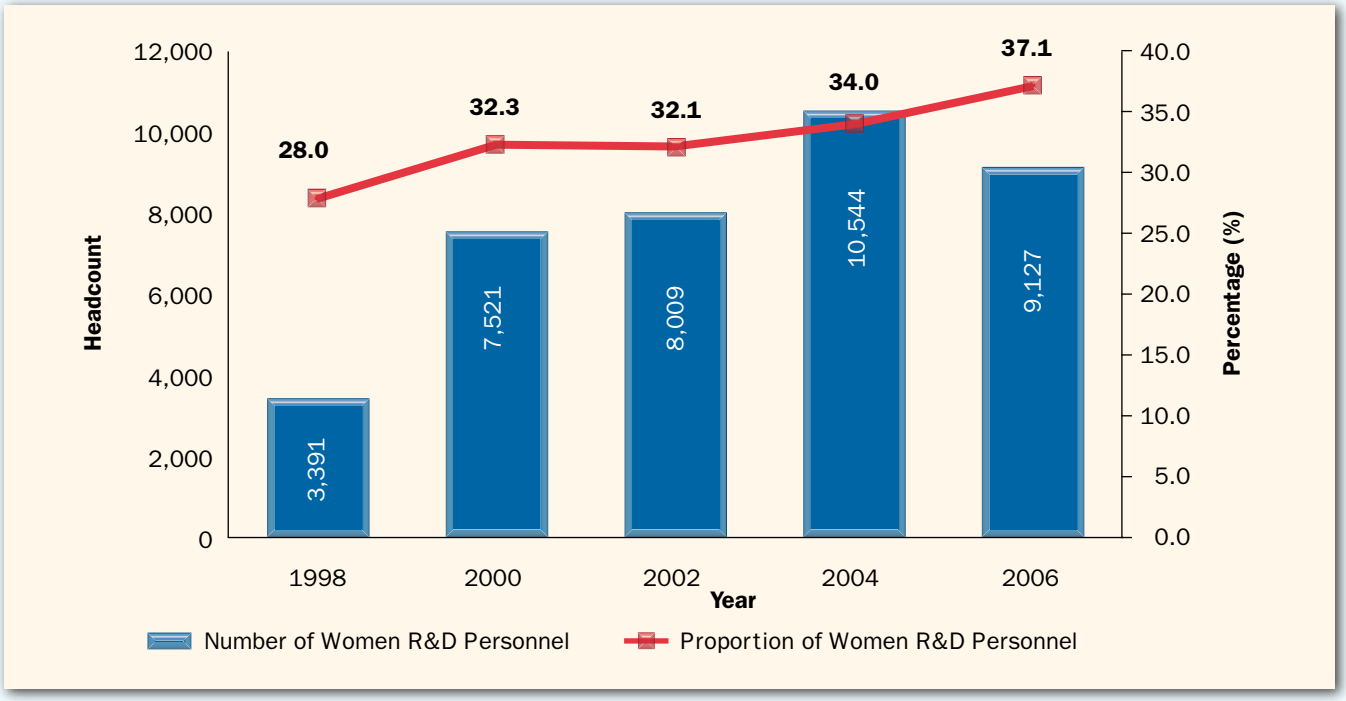
The FTE in 2006 was 13,415.9, it decreased from a high of 17,886.6 in 2004. For the period 1996 to 2004, the FTE has been steadily increasing from a low of 4,437.9 in 1996 (Figure 8).

Figure 8 : National FTE



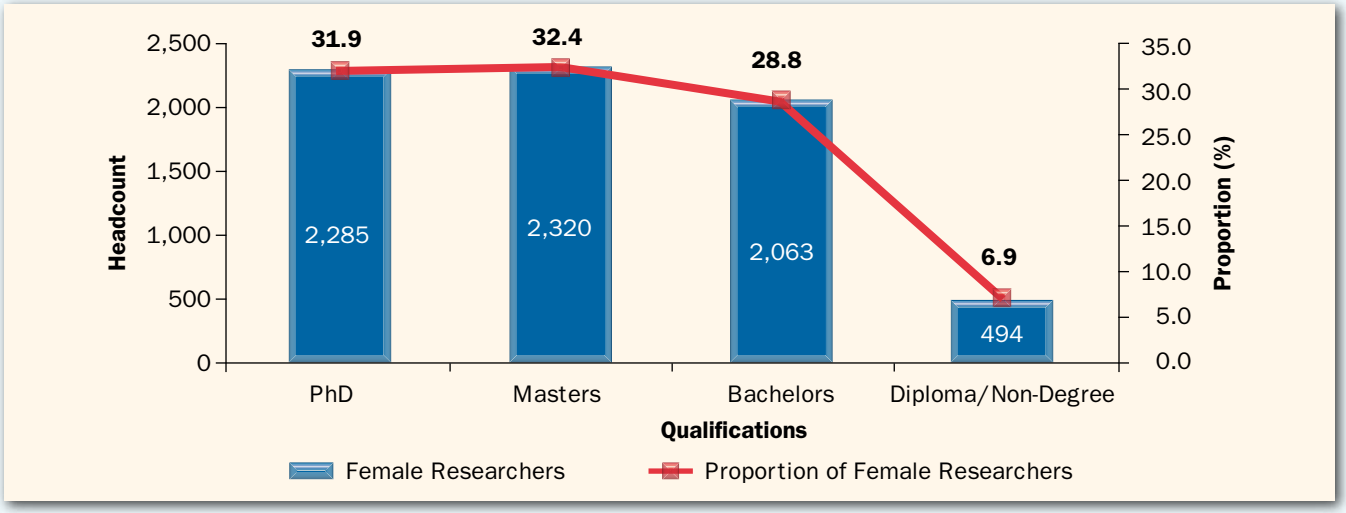
Female Participation in R&D

Figure 9: Female R&D Personnel



The total number of female R&D personnel in 2006 was 9,127 charting a decrease of 1,417 from 10,544 in 2004. In terms of proportion to males, female participation in R&D activities increased from 34.0% in 2004, to 37.1% in 2006 (Figure 9).

Figure 10 : Number of Female Researchers by Qualifications (2006)



In 2006, there were 2,285 (31.9%) female researchers who were doctorate holders, 2,320 (32.4%) with a Masters degree, and 2,063 (28.8%) with a Bachelors degree. There were 494 (6.9%) non-degree holders (Figure 10).

OUTSOURCED R&D

Table 5: Total Outsourced R&D 2002-2006

Year	Within Malaysia		Outside Malaysia		Total
	RM	%	RM	%	
2002	75,935,108	24.8	230,043,440	75.2	305,978,548
2004	12,999,438	39.4	19,958,936	60.6	32,958,374
2006	107,370,822	53.4	93,750,494	46.6	201,121,316

A total of RM201.1 million of expenditure on R&D activities was outsourced in 2006. Out of which, RM107.4 million (53.4%) was outsourced within Malaysia and RM93.7 million (46.6%) was outsourced outside of Malaysia (Table 5).

Table 6: Outsourced R&D by Institutions

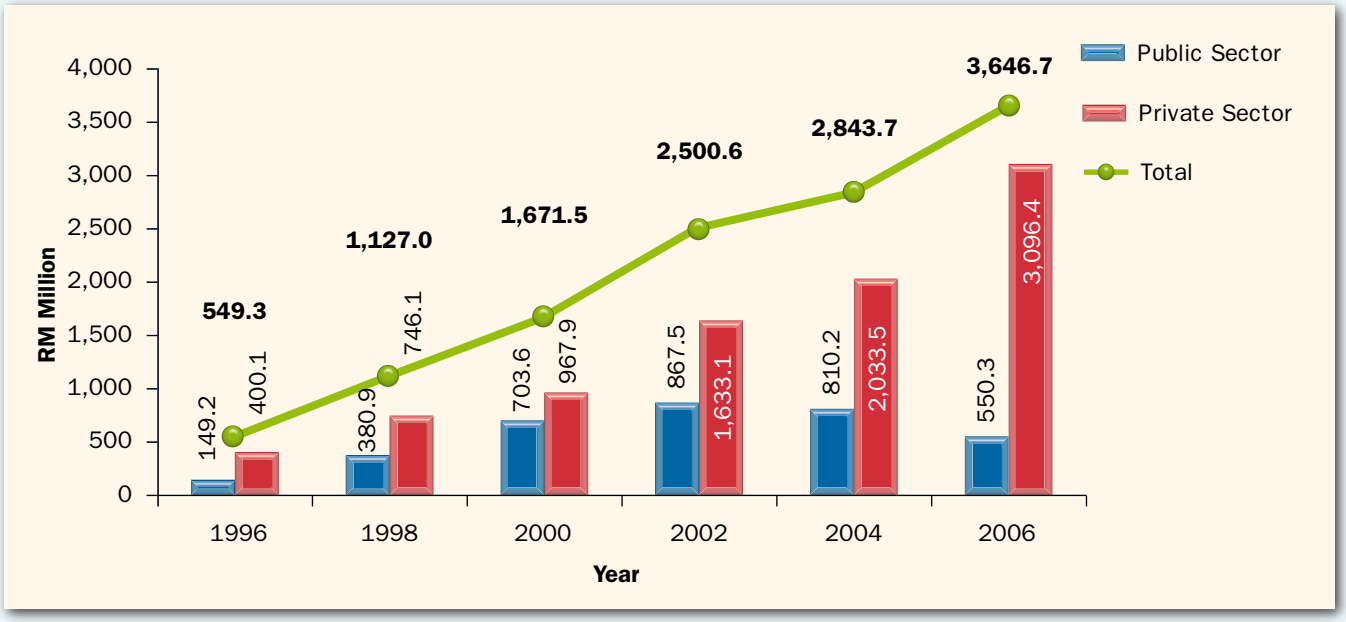
Institution	Within Malaysia	Outside Malaysia	Total
GRI	RM 27.2 mill	RM 0.9 mill	RM 28.1 mill
IHL	RM 1.3 mill	RM 2.8 mill	RM 4.1 mill
Private Sector	RM 78.9 mill	RM 90.0 mill	RM 168.9 mill
Total	RM 107.4 mill	RM 93.8 mill	RM 201.1 mill

The GRIs outsourced RM28.1 million of its expenditure on R&D activities, where RM27.2 million was outsourced within Malaysia and RM0.9 million was outsourced outside of Malaysia. The IHLs outsourced a much smaller amount of its R&D activities, RM4.1 million, of which RM1.3 million was within Malaysia and RM2.8 million outside of Malaysia.

The private sector outsourced RM168.9 million of its R&D, of which RM78.9 million was within Malaysia and RM90.0 million was outside Malaysia (Table 6).

COMPARISON BETWEEN THE PUBLIC AND PRIVATE SECTORS

Figure 11: Gross Expenditure on R&D

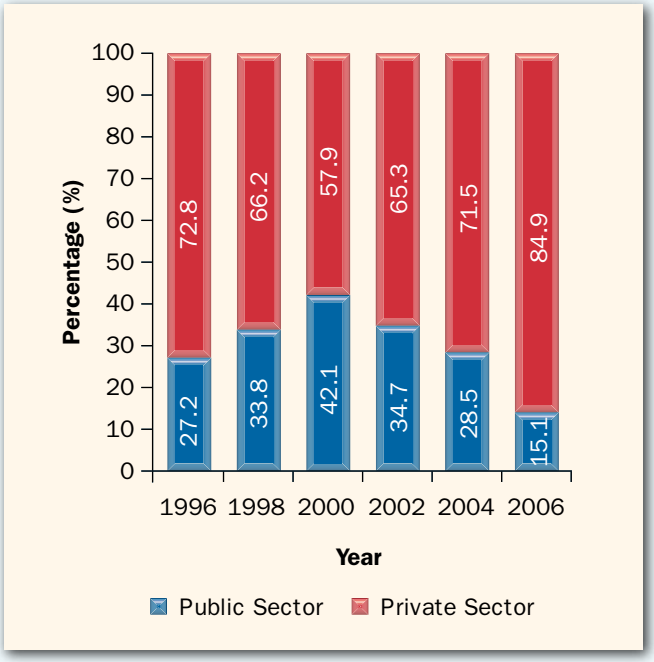


GROSS EXPENDITURE ON RESEARCH AND DEVELOPMENT

In nominal terms, the national R&D expenditure increased steadily from 1996 to 2006. The main contributing factor for this was the increase in research expenditure in the private sector. In 2006, research expenditure in the private sector increased, from 2004, by RM1,062.9 million (Figure 11). It should also be noted that since 1996, the private sector has occupied the lion's share of the national GERD (See Figure 12).

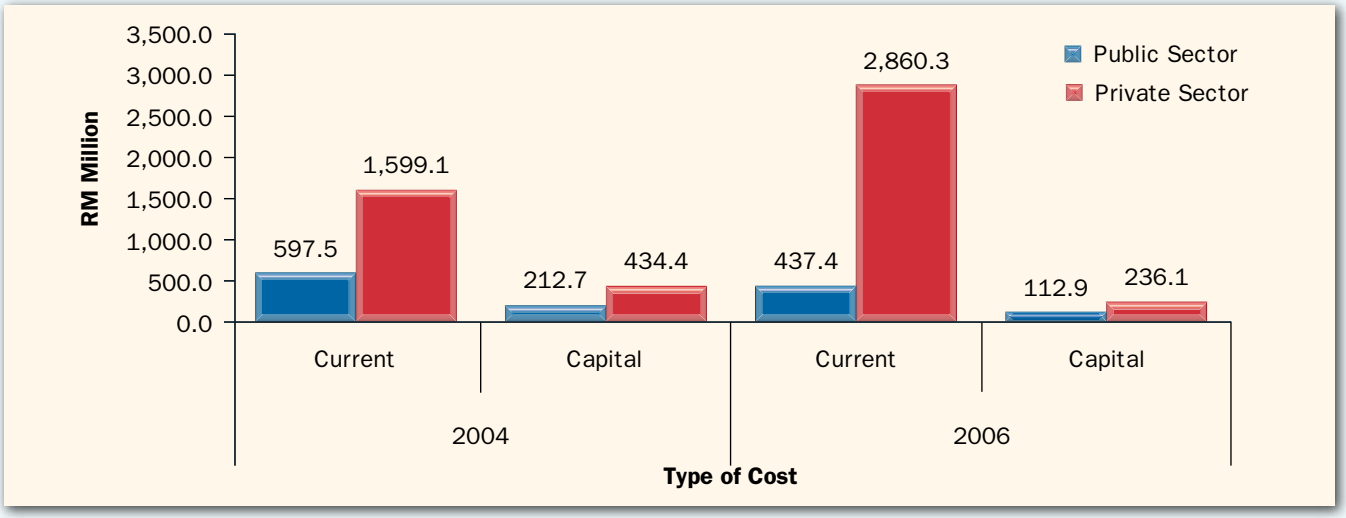
The same pattern can be seen in the GERD for the public sector, which increased, in nominal terms, from RM149.2 million in 1996 to RM867.5 million in 2002. However, the GERD for the public sector dropped from RM867.5 million in 2002 to RM810.2 million in 2004, and to RM550.3 million in 2006 (Figure 11).

Figure 12: Proportion of R&D Expenditure



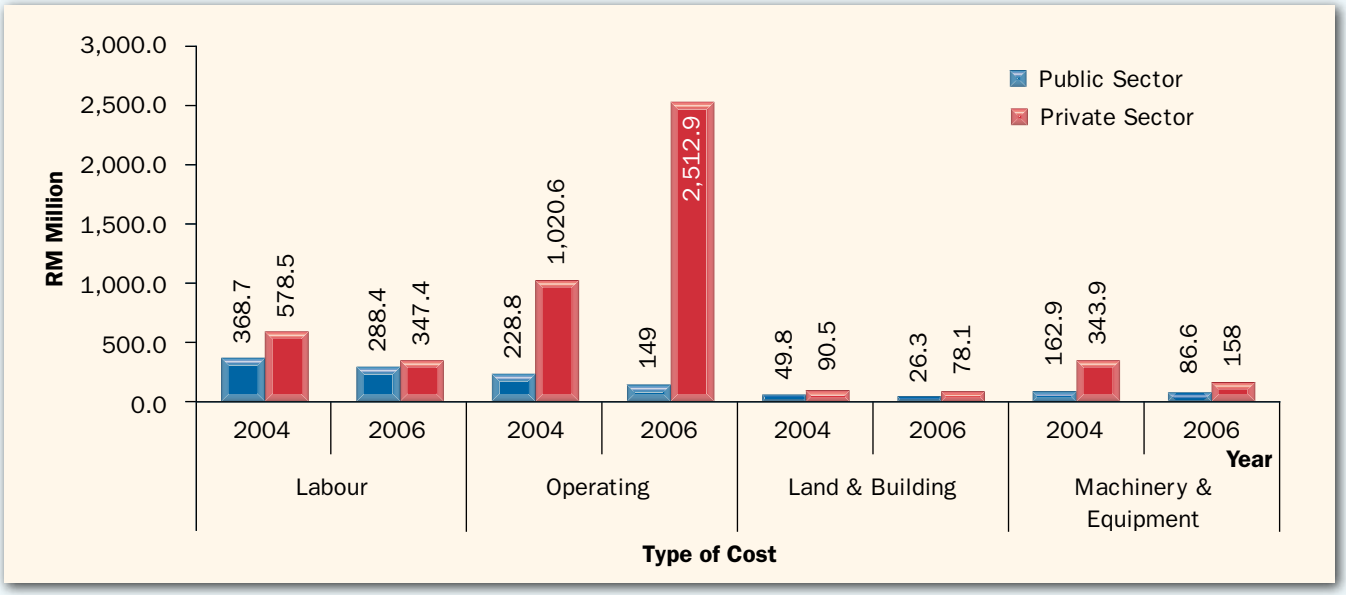
Expenditure by Type of Cost

Figure 13 : R&D Expenditure by Type of Cost



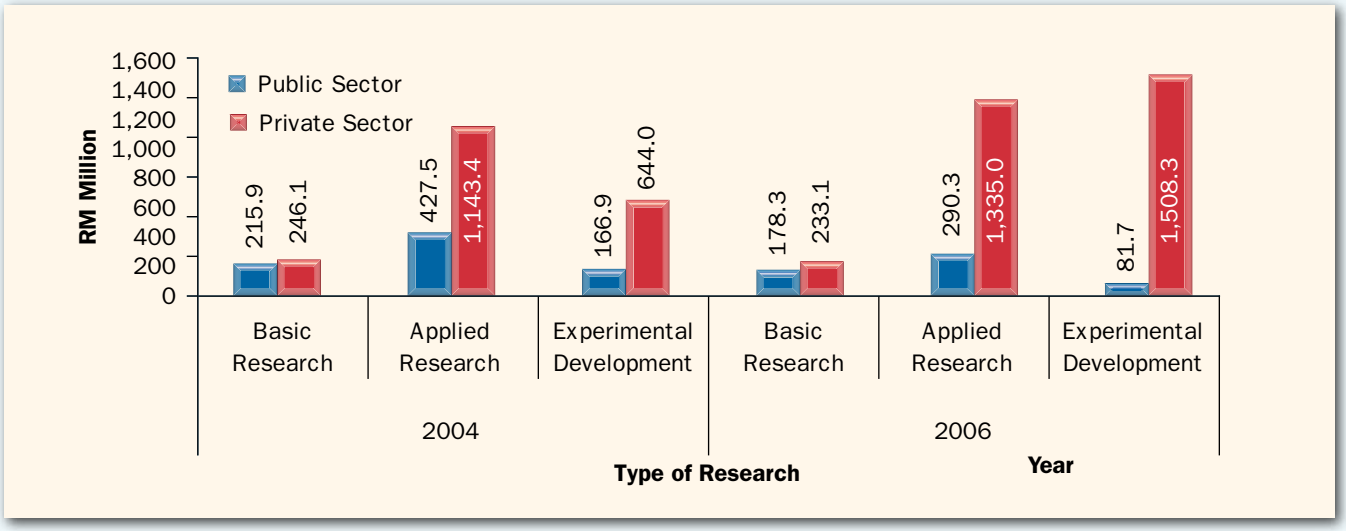
In 2006, the private sector spent RM2.9 billion on current expenditure (an increase of RM1.3 billion, in nominal terms, from 2004) and RM236.1 million on capital expenditure, while the public sector spent RM437.4 million on current expenditure and RM112.9 on capital expenditure. In the public sector, there is a decrease in both current and capital expenditure (Figure 13) when compared to 2004.

Figure 14 : R&D Expenditure by Type of Cost



In 2006, the private sector spent RM347.4 million on labour cost, RM2.5 billion on operating cost, RM78.1 million on land and building cost and RM158 million on machinery and equipment cost while the public sector spent RM288.4 million on labour cost, RM149 million on operating cost, RM26.3 million on land and building cost, and RM86.6 million on machinery and equipment cost (See Figure 14). The increase in national R&D expenditure can be attributed to the increase, in nominal terms, in operating cost in the private sector, from RM1.0 billion in 2004 to RM2.5 billion in 2006.

Figure 15 : R&D Expenditure by Type of Research



Expenditure by Type of Research

In 2006, the private sector spent RM1.5 billion on experimental development research, an increase, in nominal terms, of RM864.3 million from 2004; RM1.3 billion on applied research, an increase of RM211.6 million from 2004, and RM233.1 million on basic research. In the public sector, expenditure decreased, in nominal terms, in basic, applied, and experimental research when compared to 2004. In 2006, the public sector spent the most on applied research (RM290.3 million), followed by basic research (RM178.3 million), and experimental research (RM81.7 million (See Figure 15).

Expenditure by FOR and SEO

Table 7: Top 5 Field of Research (FOR)

PUBLIC			PRIVATE		
FOR	GERD (RM Mil)	%	FOR	GERD (RM Mil)	%
Agricultural Sciences	73.1	13.3	Applied Sciences & Technologies	1,221.8	39.5
Engineering Sciences	60.7	11.0	Engineering Sciences	1,114.7	36.0
Medical & Health Sciences	58.0	10.5	Material Sciences	325.5	10.5
Applied Sciences & Technologies	43.2	7.9	Information, Computer & Communication Technology	171.2	5.5
Material Sciences	39.5	7.2	Agricultural Sciences	94.5	3.1
Other	275.8	50.1	Other	168.7	5.4

R&D expenditure in the private sector, according to FOR, is heavily concentrated on Applied Sciences and Technologies, Engineering Sciences, and Material Sciences, while in the Public Sector, the highest amount of R&D expenditure are in the FOR areas of Agricultural Sciences, Engineering Sciences, and Medical and Health Sciences (See Table 7). According to SEO, the private sector dominates in the areas of manufacturing, transport, and energy resources, while the public sector dominates in the fields of Natural Sciences, Technologies and Engineering, Manufacturing, and Plant Production and Plant Primary Products (See Table 8).

Table 8: Top 5 Socio-economic Objectives (SEO)

PUBLIC			PRIVATE		
SEO	GERD (RM Mil)	%	SEO	GERD (RM Mil)	%
Natural Sciences, Technologies & Engineering	213.8	38.9	Manufacturing	2,244.6	72.5
Manufacturing	50.1	9.1	Transport	210.4	6.8
Plant Production & Plant Primary Products	49.7	9.0	Energy Resources	142.5	4.6
Health	35.1	6.4	Plant Production & Plant Primary Products	101.2	3.3
Environmental Management & Other Aspects	27.4	5.2	Natural Sciences, Technologies & Engineering	75.4	2.4
Other	172.9	31.4	Other	322.3	10.4

SOURCES OF FUNDS

In 2006, both the public and private sectors relied primarily on their own funds. In the private sector, RM3,081.1 million, or 95.5%, came from their own funds, RM8.7 million (0.3%) from state or local funds, and RM6.5 (0.2%) million from other funds (See Figures 16 and 18). In the public sector, RM328.4 million (59.7%) came from their own funds, RM7.1 million from foreign funds (1.3%), RM177.0 million (32.2%) from federal government funds, RM28.6 million (5.2%) from state or local funds, and RM9.2 million (1.7%) from other funds (See Figures 16 and 17).

Figure 16 : Sources of Funds

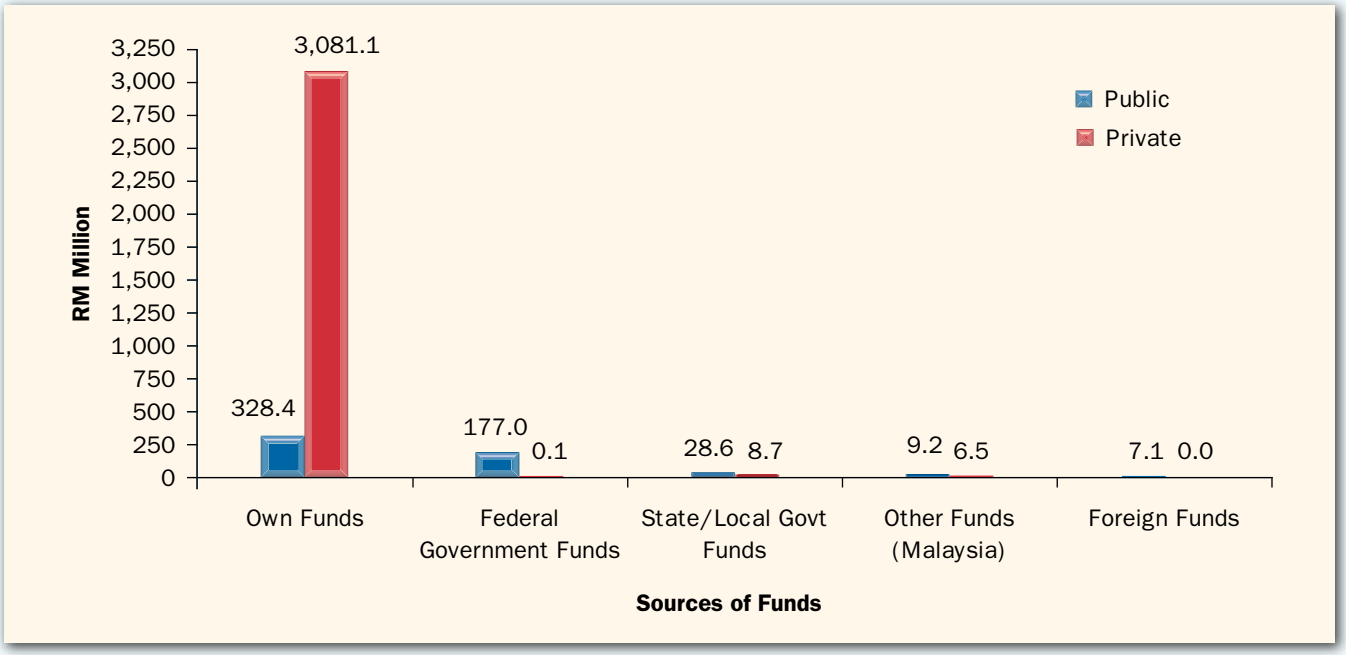


Figure 17 : Sources of Funds in the Public Sector

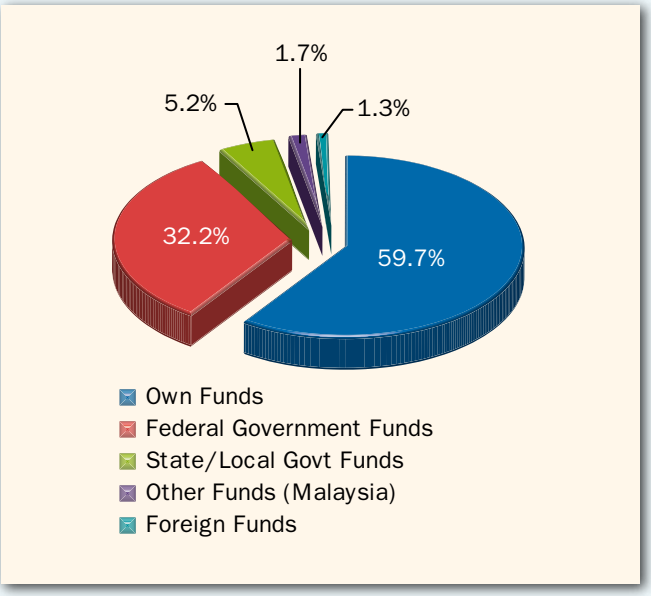
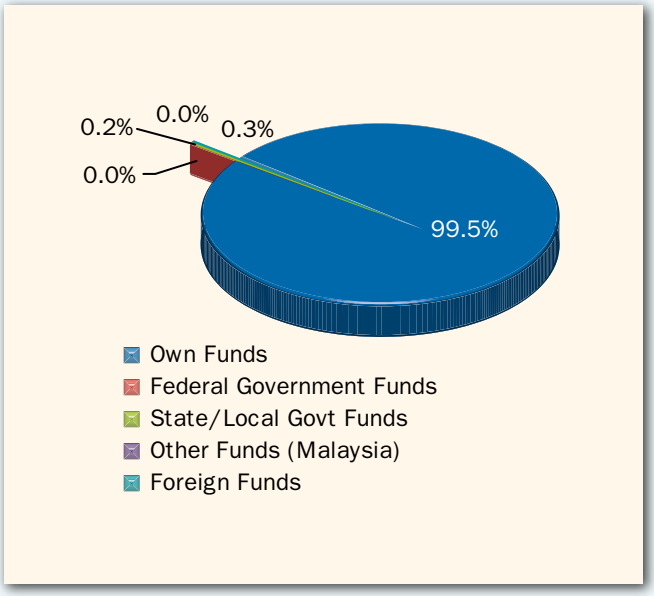
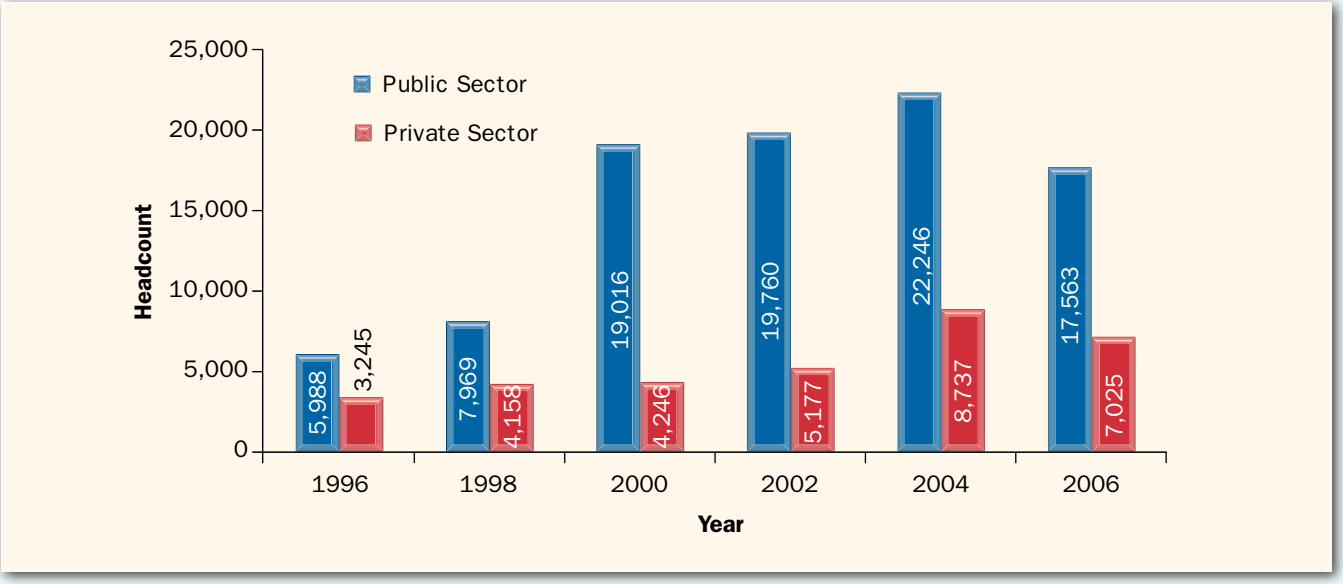


Figure 18 : Sources of Funds in the Private Sector



HUMAN RESOURCE DEVELOPMENT

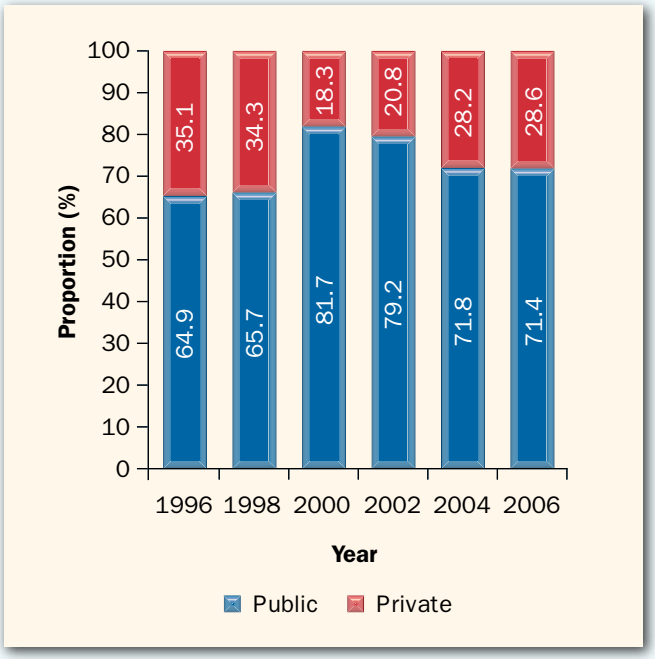
Figure 19 : Headcount of R&D Personnel



By Headcount

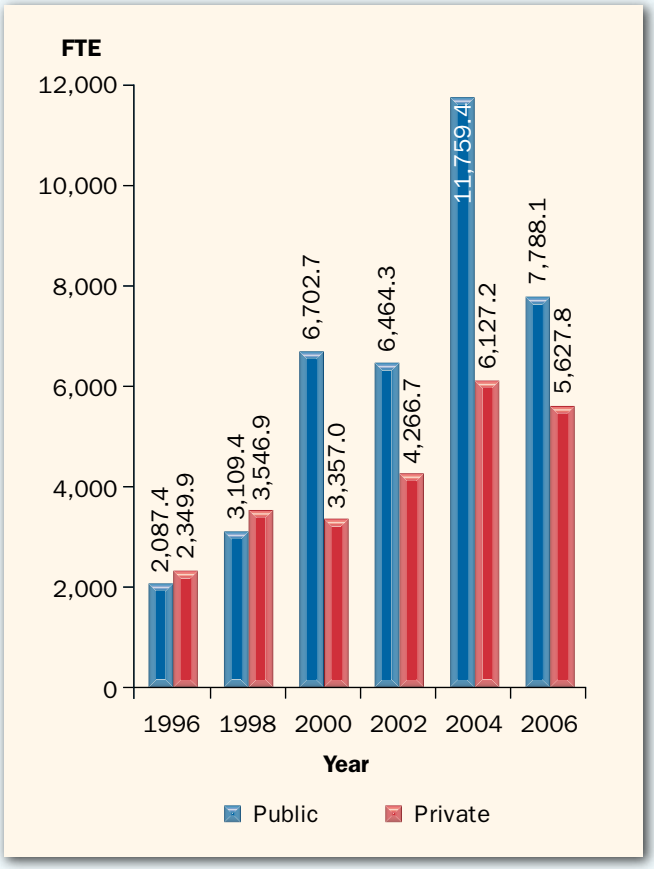
The headcount of R&D personnel in the public sector decreased from 22,246 in 2004 to 17,563 in 2006, while in the private sector, it decreased from 8,737 in 2004 to 7,025 in 2006 (See Figure 19). In terms of proportion, the majority of R&D personnel were from the public sector, amounting to more than 70% of the total, from 2002 to 2006 (See Figure 20).

Figure 20 : Proportion of R&D Personnel Headcount



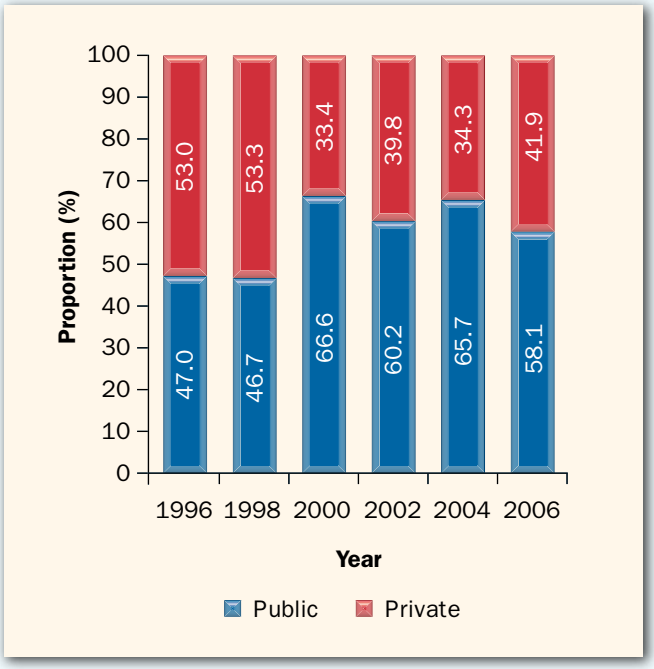
By FTE

Figure 21 : FTE of R&D Personnel



In 2006, the FTE of R&D personnel in the public sector decreased from 11,759.4 in 2004 to 7,788.1 in 2006, while for the private sector, it decreased from 6,127.2 in 2004 to 5,627.8 in 2006 (Figure 21). In terms of proportion, the public sector accounts for 58.1% of the FTE of R&D personnel in 2006, and more than 60% of the FTE from 2000 to 2004 (Figure 22).

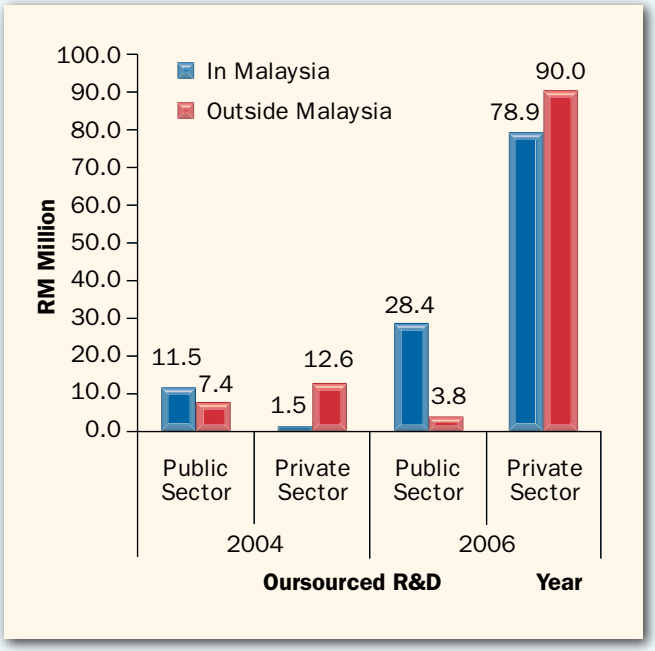
Figure 22 : Proportion of R&D Personnel FTE



OUTSOURCED R&D

In 2006, outsourced R&D increased for both the public and private sectors. For the public sector, outsourced R&D within Malaysia increased, in nominal terms, from RM11.5 million in 2004 to RM28.4 million in 2006, while research that was outsourced outside of Malaysia decreased from RM7.4 million in 2004 to RM3.8 million in 2006. In the private sector, outsourced R&D within Malaysia increased, in nominal terms, from RM1.5 million in 2004 to RM78.9 million in 2006, while R&D outsourced outside Malaysia increased from RM12.6 million in 2004 to RM90.0 million in 2006.

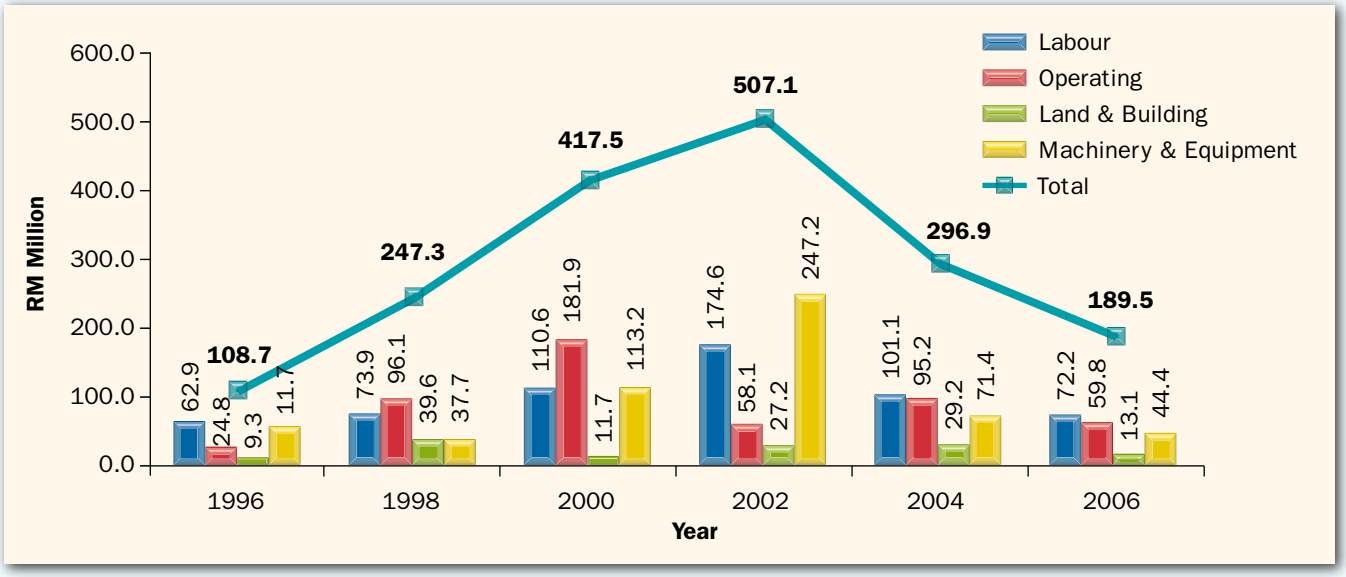
Figure 23: Outsourced R&D 2004 and 2006



R&D IN GOVERNMENT AGENCIES AND RESEARCH INSTITUTIONS (GRI)

R&D EXPENDITURE

Figure 24 : Expenditure by Type of Cost



In 2006, the total expenditure for the GRIs showed a significant decline, from RM296.9 million in 2004 to RM189.5 million, marking, in nominal terms, a 36.2% decrease.

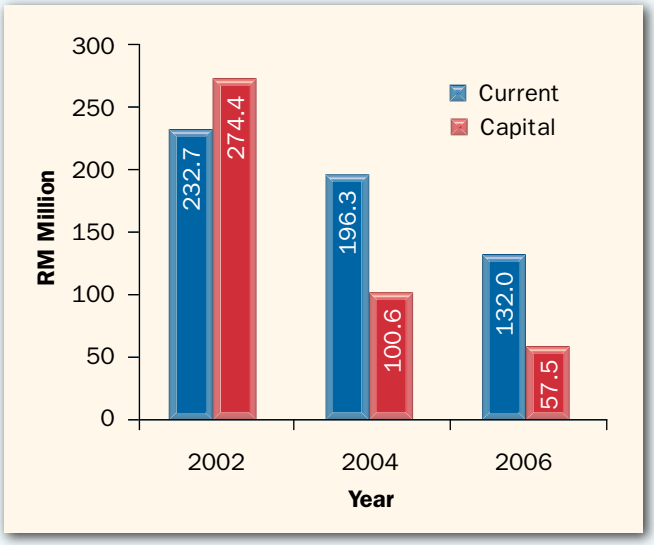
Expenditure by Type of Cost

Expenditure on labour similarly dropped from RM101.1 million in 2004 to RM72.2 million in 2006 (Figure 24). The operating expenditure for 2006 was RM59.8 million (Figure 7.1) a drop of RM35.4 million from 2004 (RM95.2 million).

Land and building expenditure showed another further decrease, from RM29.2 million in 2004 to RM13.1 million in 2006. This reflects a 55.1 % decrease, in nominal terms, in the R&D expenditure. There was also a drop in R&D expenditure on machinery & equipment. From RM71.4 million in 2004, R&D expenditure dropped, in nominal terms, to RM44.4 million in 2006.

GERD by Current and Capital Cost

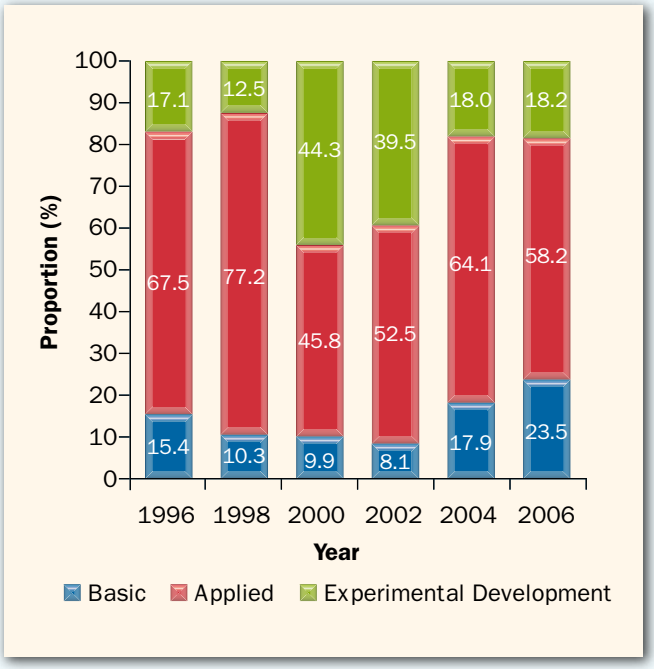
Figure 25 : R&D Expenditure by Current and Capital Cost



In 2006 the GRIs spent RM132.0 million on current expenditure and RM57.5 million on capital expenditure. In nominal terms, there was a decrease in the current expenditure from RM232.7 million in 2002 to RM196.3 million in 2004 to RM132.0 million in 2006. In terms of capital expenditure, there is also a decrease, in nominal terms, of 42.8%; from RM100.6 million in 2004 to RM57.5 million in 2006.

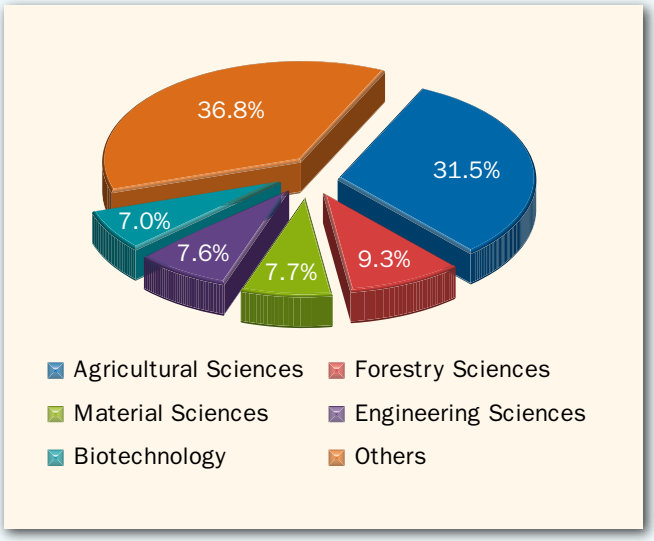
R&D Expenditure by Type of Research

Figure 26 : Proportion of R&D Expenditure by Type of Research



In terms of proportion, the amount spent on Basic Research in 2006 was 23.5%, Applied Research, 58.2%, while Experimental Development Research 18.2% (Figure 26).

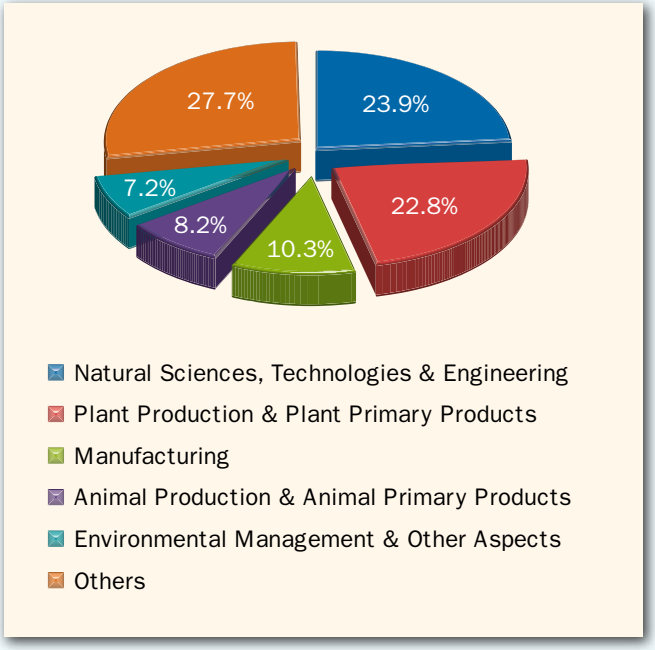
Figure 27 : Proportion of Expenditure by 5 Major FOR



In 2006, as in 2004, Agricultural Sciences dominates the top national R&D expenditure (See Table 1) by FOR (a shift from 3rd place in 2002) followed by Forestry Sciences (9.3%), Material Sciences (7.7%), Engineering Sciences (7.6%) and Biotechnology (7.0%) (See Figure 27).

Expenditure by SEO

Figure 28 : Proportion of Expenditure by 5 Major SEO in 2006



In 2006, the top 5 expenditure according to SEO were: Natural Sciences, Technology & Engineering (23.9%), Plant Production and Plant Primary Products (22.8%), Manufacturing (10.3%), Animal Production & Animal Primary Products (8.2%), and Environmental Management & Other Aspects (7.2%).

SOURCES OF FUNDS

Figure 29 : GRI Sources of Funds 2006

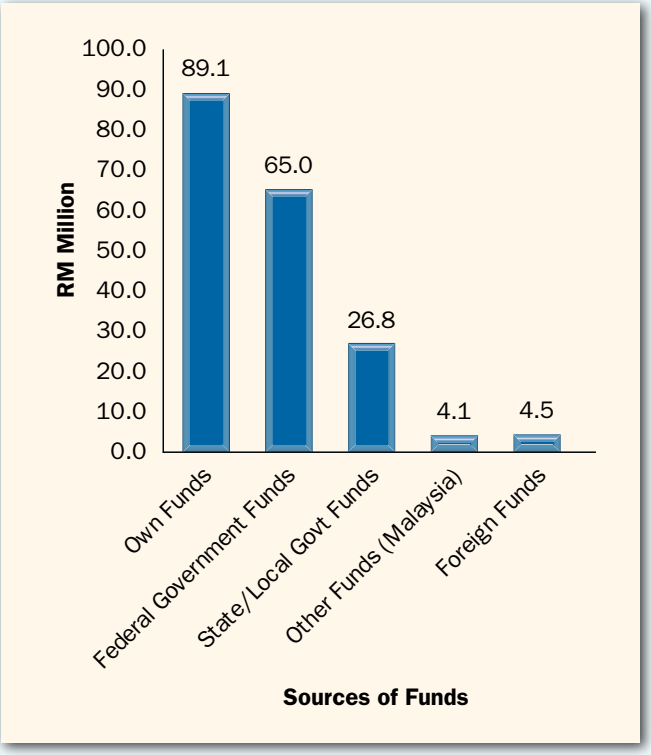
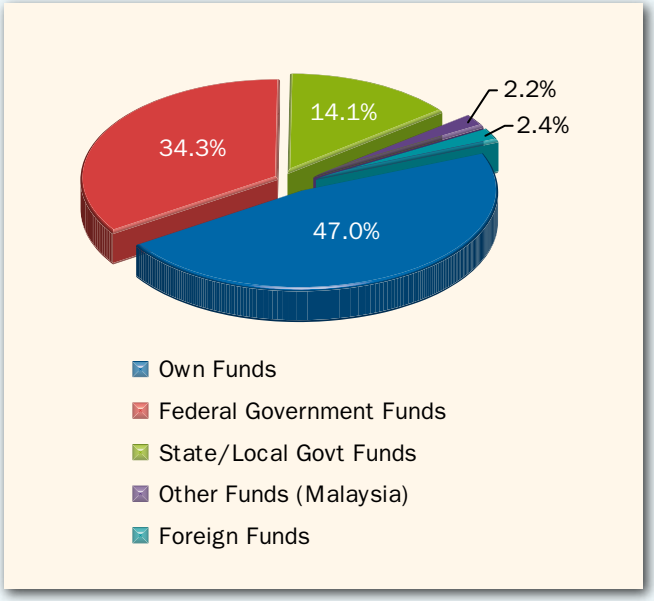


Figure 30 : Proportion for GRI Sources of Funds 2006

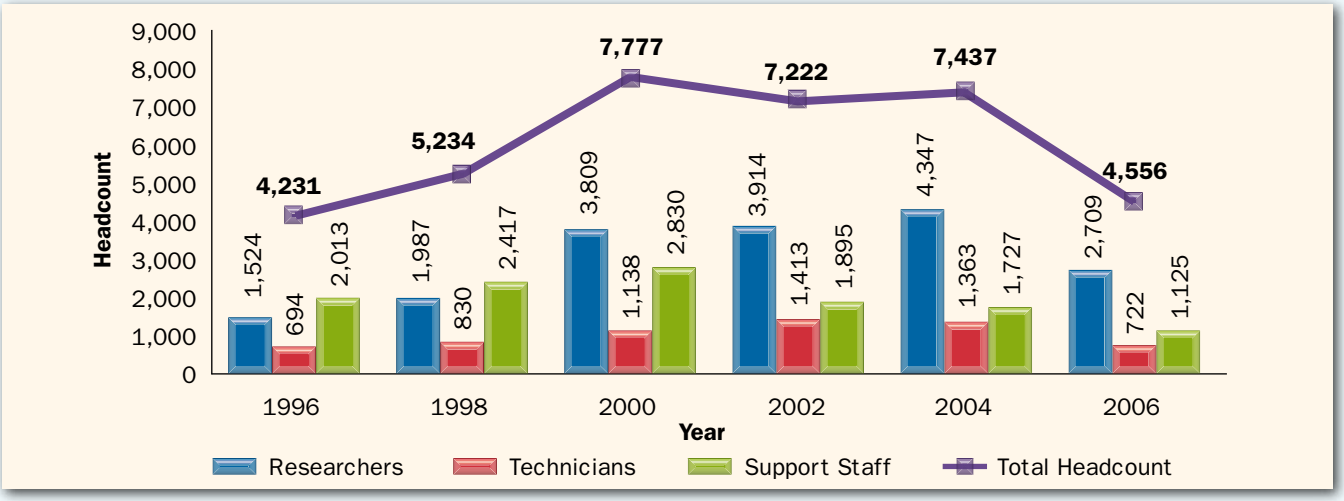


In 2006, 47.0% (RM89.1 million) of the funds received by the GRIs came from their own funds. Federal Government Funds fall second with RM65.0 million (34.3%), followed by the State/Local Government Funds, totaling RM26.8 million (14.1%) (Figures 29 and 30).

HUMAN RESOURCE DEVELOPMENT

By Headcount

Figure 31 : GRI Total Headcount

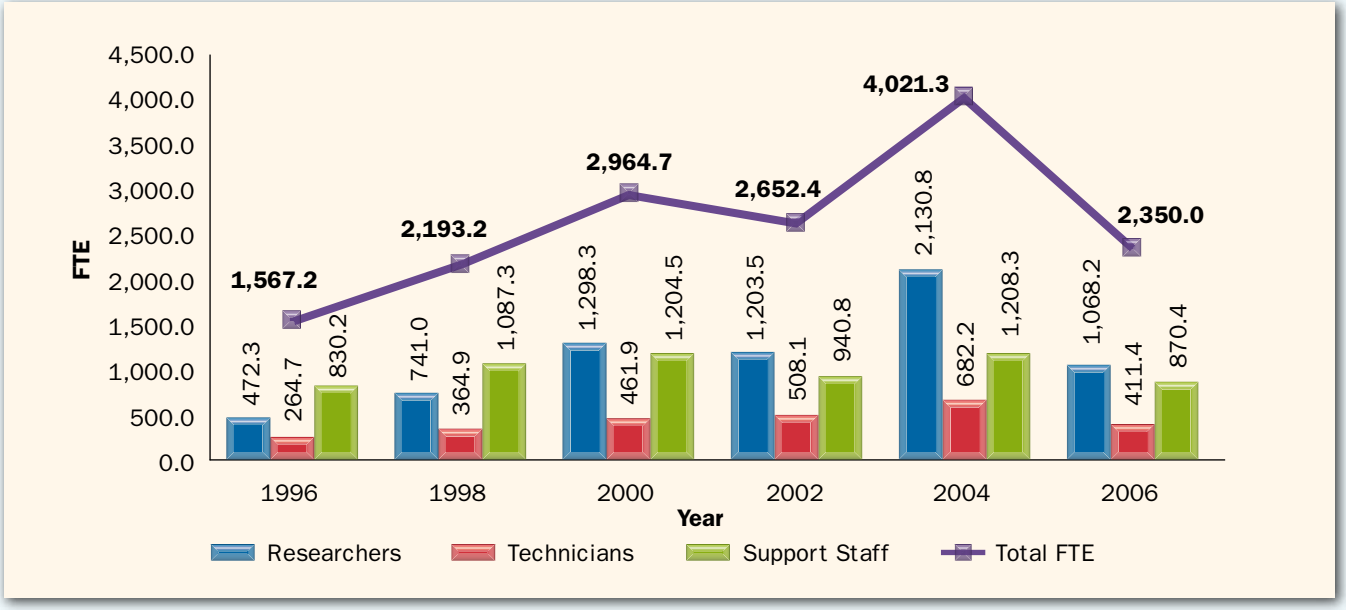


From 2002 to 2004, the number of researchers increased while the number of technicians and support staff decreased. In 2006, however, the headcount for research personnel fell from 7,437 in 2004 to 4,556 (Figure 31).

Researchers made up the bulk of the personnel (59.5%) followed by technicians (15.8%) and supporting staff (24.7%).

By FTE

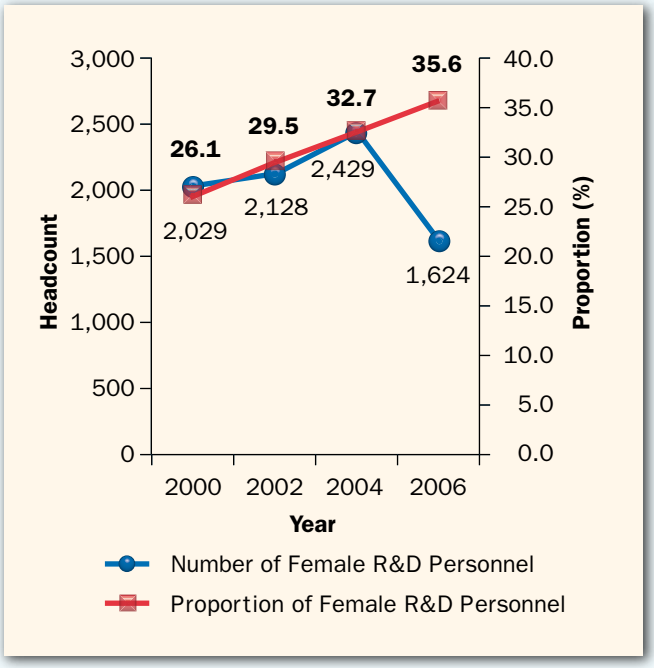
Figure 32 : FTE by Personnel Category 1996-2006



In 2006, the FTE of R&D personnel dropped from 4,021.3 in 2004 to 2,350.1 (Figure 32). In terms of proportion, researchers accounted for 45.5% of the total FTE, followed by support staff (37.0%) and technicians (17.5%). Since 2000, researchers have accounted for the bulk of the FTE.

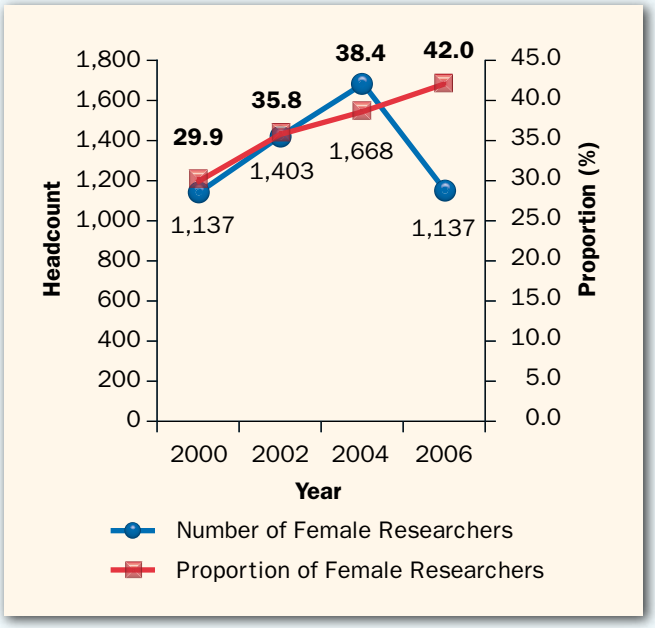
Female Participation in R&D

Figure 33 : Female R&D Personnel in the GRIs



From 2000 to 2004, there was an increase in the number of female R&D personnel in the GRIs. However, in 2006, the number of female R&D personnel dropped to 1,624 (See Figure 33). A similar trend is also seen in the total number of female researchers. From a total of 1,137 in 2000, this figure rose to 1,403 in 2002, and later to 1,668 in 2004. However, in 2006, the number dropped to 1,137 (Figure 34). In terms of proportion, however, 42.0% of the researchers were female.

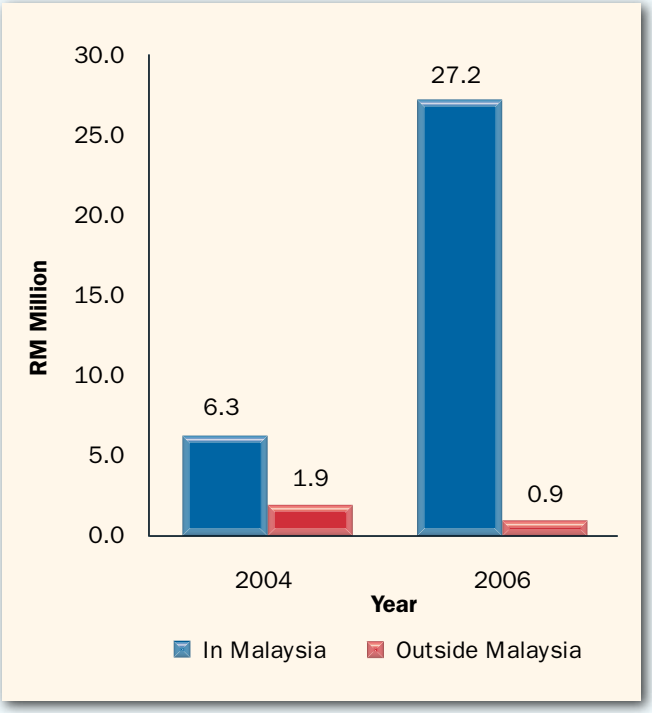
Figure 34 : Female R&D Researchers in the GRIs



OUTSOURCED R&D

In 2006, a total of RM27.2 million (96.8%) was outsourced in Malaysia while RM0.9 million was outsourced outside Malaysia (See Figure 35).

Figure 35 : Outsourced R&D



FACTORS LIMITING R&D ACTIVITIES

Internal Factors Limiting R&D

The respondents of the survey were asked to identify the internal factors limiting their institution's activity. Their responses, in order of priority, are as follows:

1. limited time due to class/administrative work
2. lack of skilled personnel
3. limited financial resources
4. lack of infrastructure in R&D
5. poor reward system

External Factors Limiting R&D

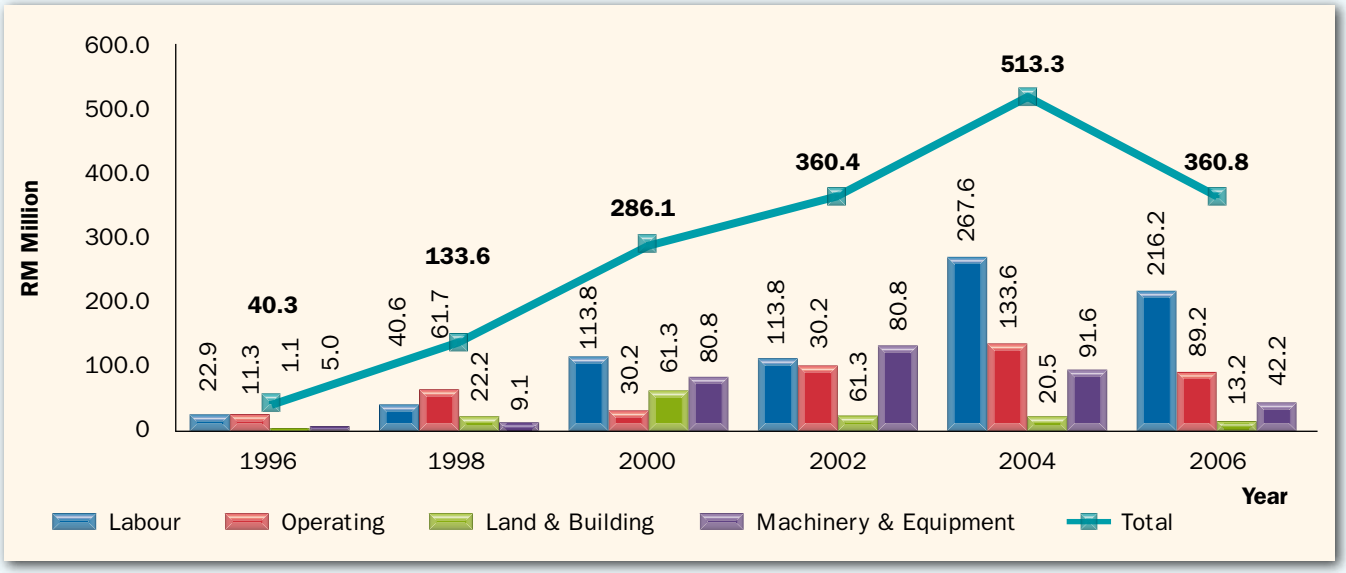
The 5 main external factors that limiting R&D activities for the GRIs in 2006 are:

1. increased capital cost
2. lack of R&D expertise
3. lack of ancillary services to support R&D
4. insufficient government funds, and,
5. difficulty in finding private sector collaboration

R&D IN INSTITUTIONS OF HIGHER LEARNING (IHL)

R&D EXPENDITURE

Figure 36 : Expenditure by Type of Cost

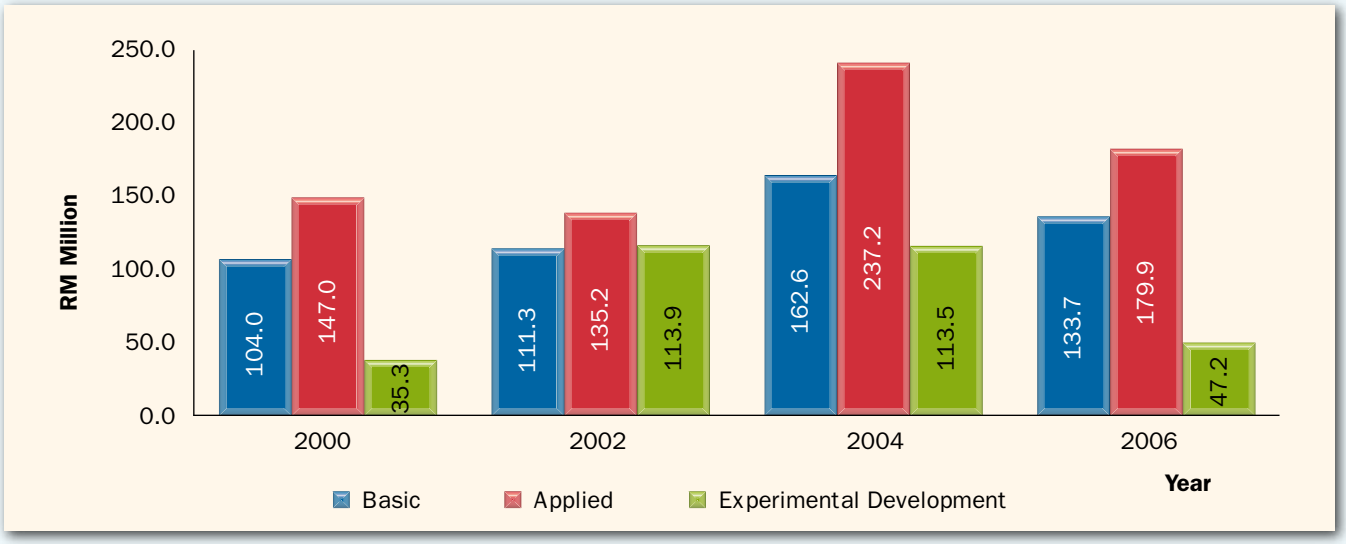


In nominal terms, there has been a steady increase in the total R&D expenditure by the IHLs since 1996, totaling RM513.3 million in 2004.

However, the total expenditure in 2006 dropped by 29.7% to RM360.8 million. This is reflected in the substantial decreases in Labour, Operating, Land & Building, and Machinery & Equipment (Figure 36).

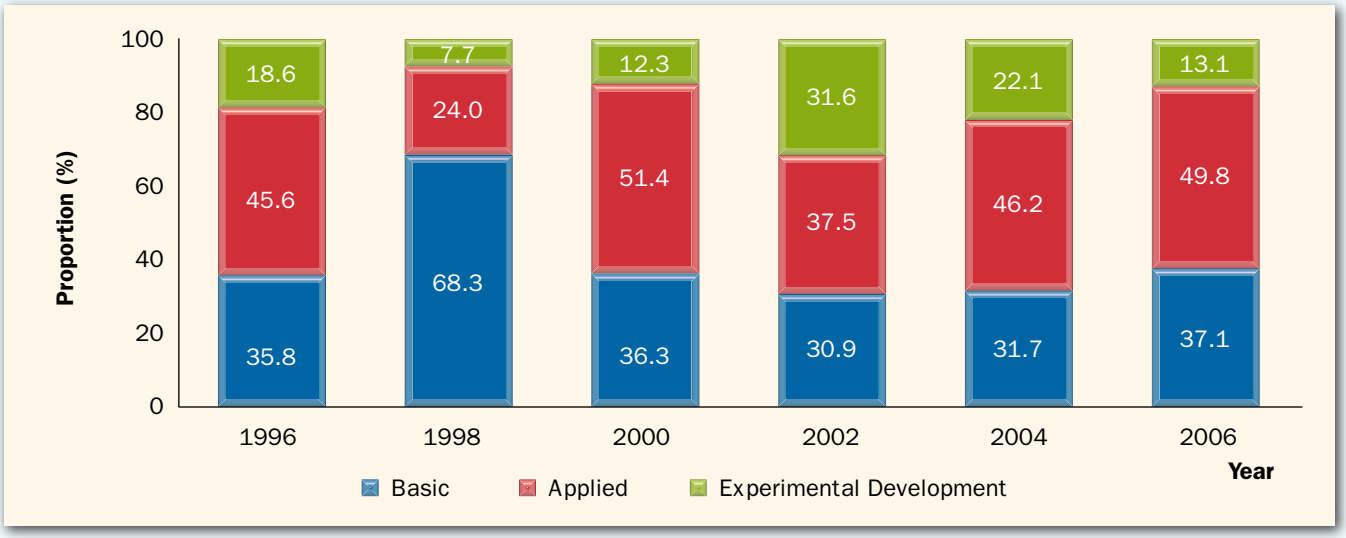
Expenditure by Type of Research

Figure 37 : Expenditure by Type of Research



In 2006, the most was spent on Applied Research (RM179.9 million). This was followed by Basic Research (RM133.7 million) and Experimental Development Research (RM47.2 million) (See Figure 37). The same pattern can be seen in 2000, 2002 and 2004.

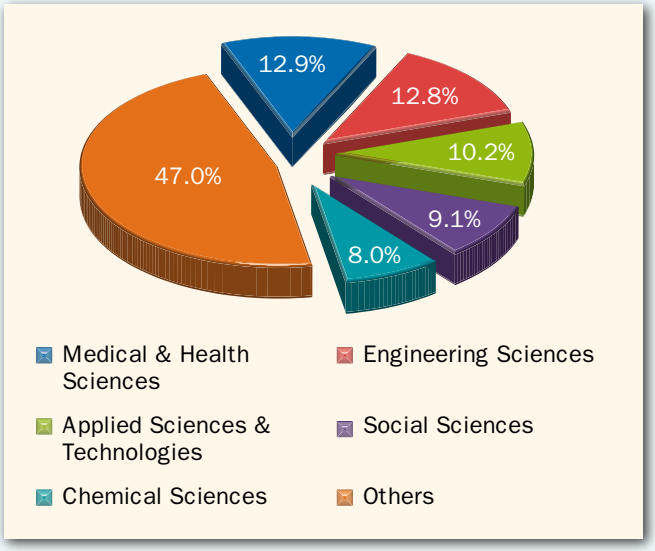
Figure 38 : Proportion of Expenditure by Type of Research



In terms of proportion, the amount spent on Basic Research was 37.1%, Applied Research (49.8%), while Experimental Development Research (13.1%). As shown in Figure 38, the proportion of expenditure in basic and applied areas has increased since 2002.

Expenditure by FOR

Figure 39 : Expenditure by FOR

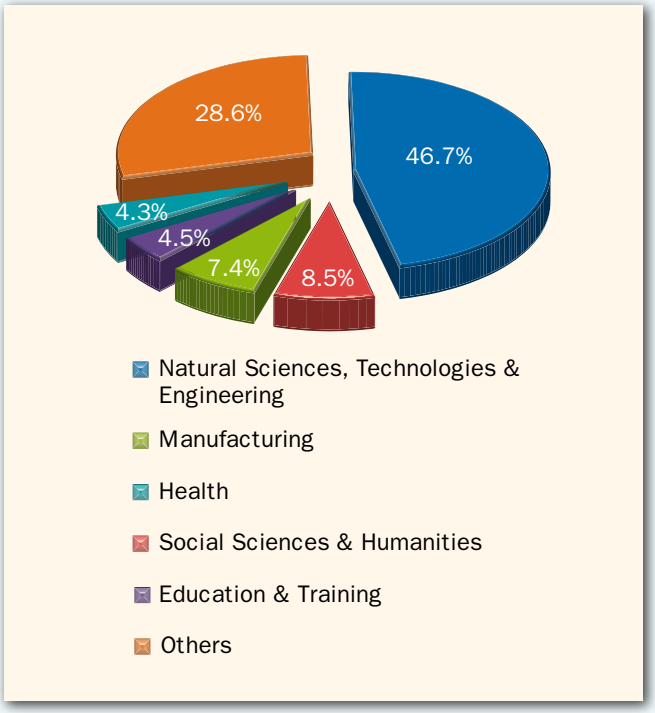


The top five FOR expenditure for 2006 were (See Figure 39):

1. Medical and Health Sciences (12.9%)
2. Engineering Sciences (12.8%),
3. Applied Sciences & Technology (10.2%)
4. Social Sciences (9.1%)
5. Chemical Sciences (8.0%)

Expenditure by SEO

Figure 40 : Expenditure by SEO

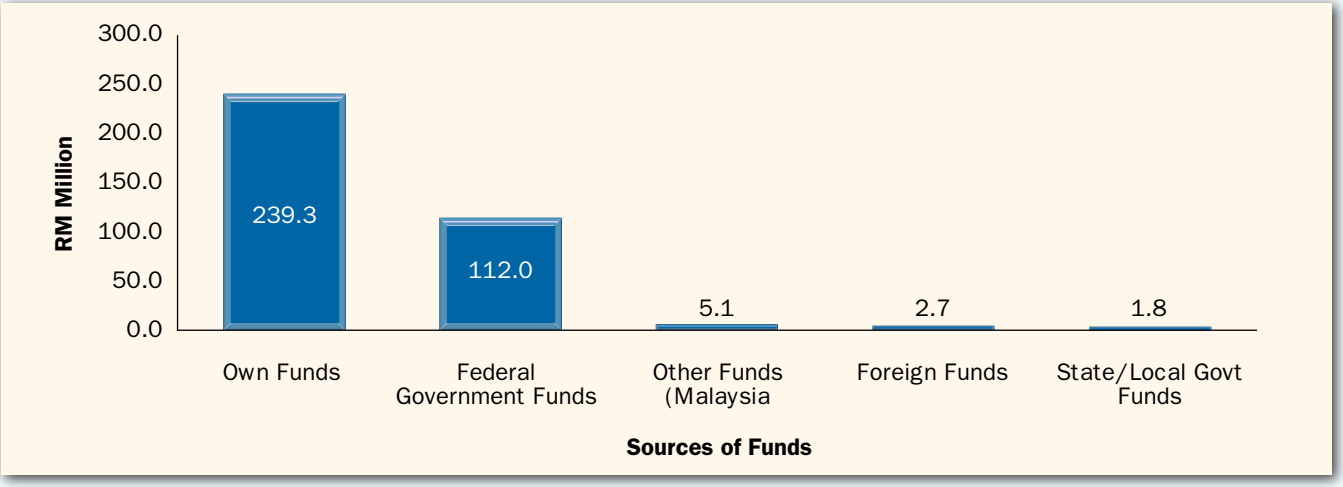


The top five expenditure by SEO in 2006 were (See Figure 40):

1. Natural Sciences, Technology & Engineering (46.7%)
2. Manufacturing (8.5%)
3. Health (7.4%)
4. Social Sciences & Humanities (4.5%)
5. Education & Training (4.3%)

SOURCES OF FUNDS

Figure 41 : Sources of Funds in 2006

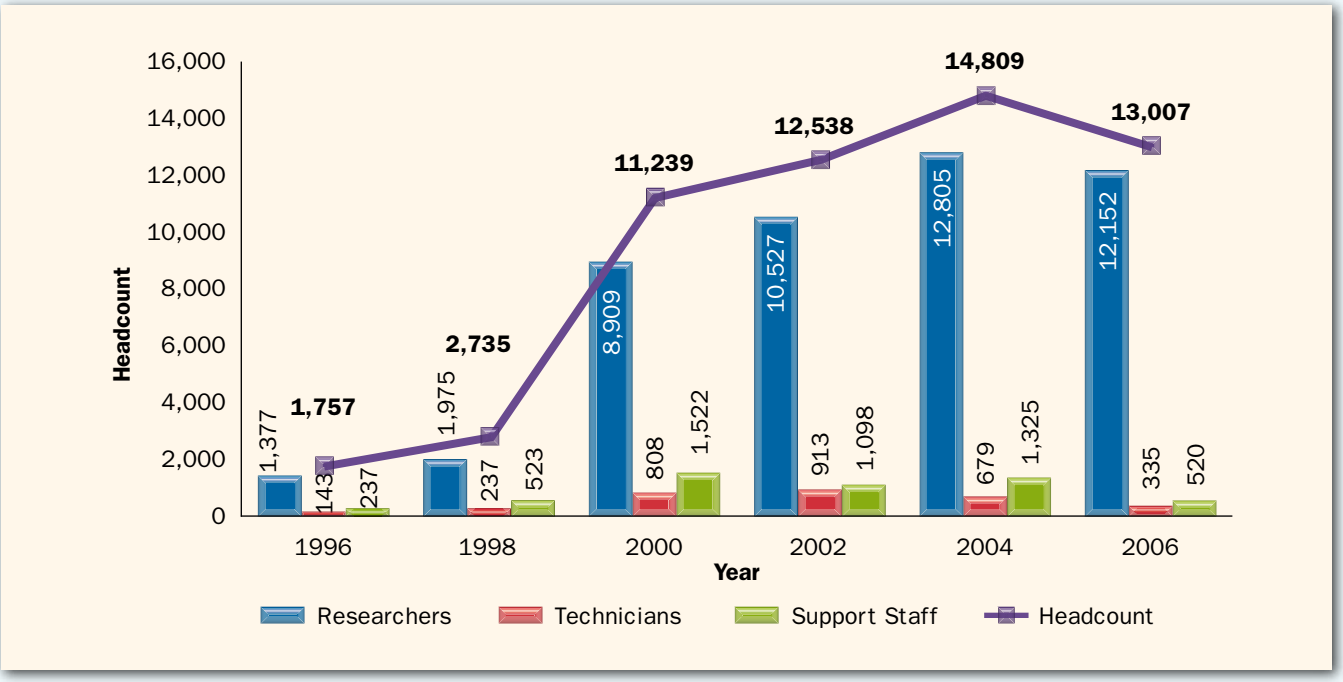


In 2006, the IHLs relied heavily on their own funds as their main source of R&D funds, amounting to RM239.3 million (66.3%). Federal Government Funds fall second, with RM112.0 million (31.1%). Other sources of funds were Other Funds in Malaysia (RM5.1 million), Foreign Funds (RM2.7 million) and State/local Government Funds (RM1.8 million) (See Figure 41).

HUMAN RESOURCE DEVELOPMENT

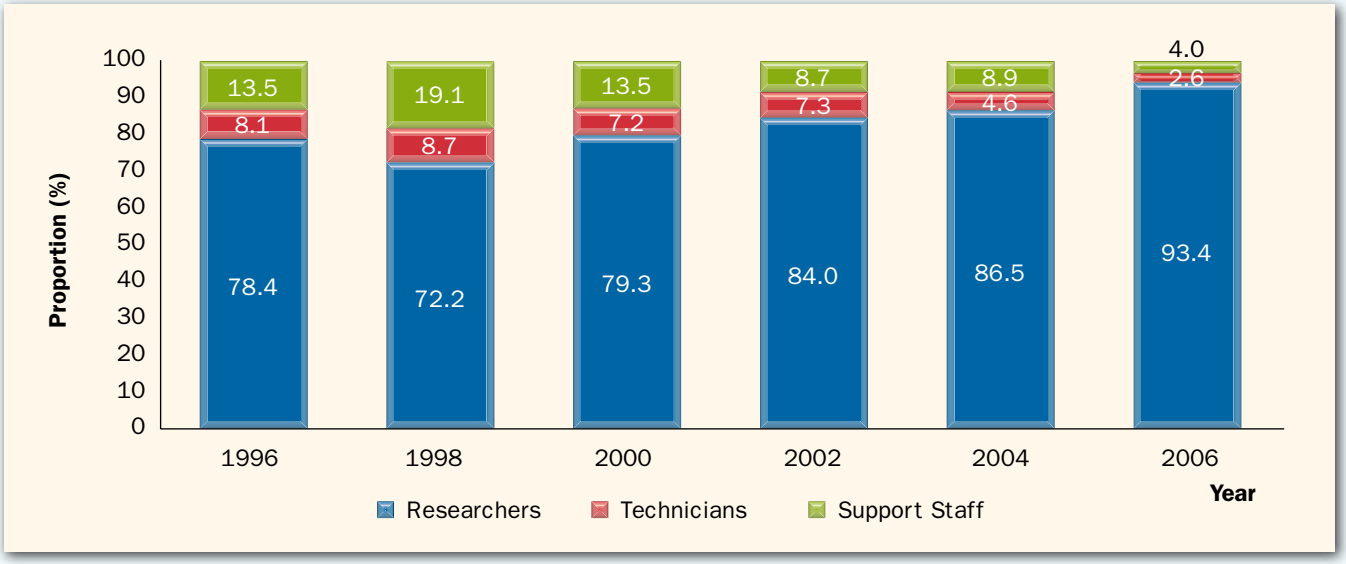
By Headcount

Figure 42 : Research Personnel Headcount



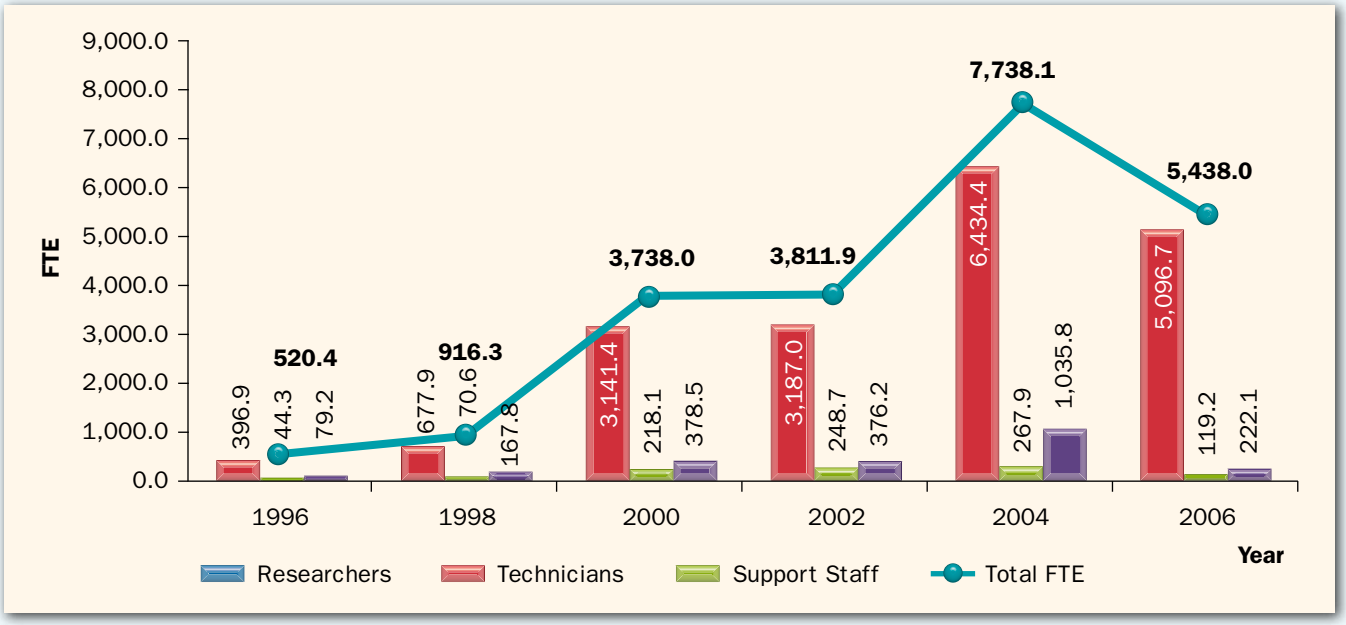
In 2006 (Figure 43), there were 13,007 researchers, technicians and supporting staff involved in the R&D activities in the IHLs. This 2006 figure shows a drop of 12.2% from a figure of 14,809 in 2004. In 2006, 93.4% of the total headcount comprised of researchers. The fact that researchers make up the bulk of R&D personnel has been a salient feature of Malaysian R&D since 1996 (See Figure 43).

Figure 43 : Proportion of Research Personnel Headcount



By FTE

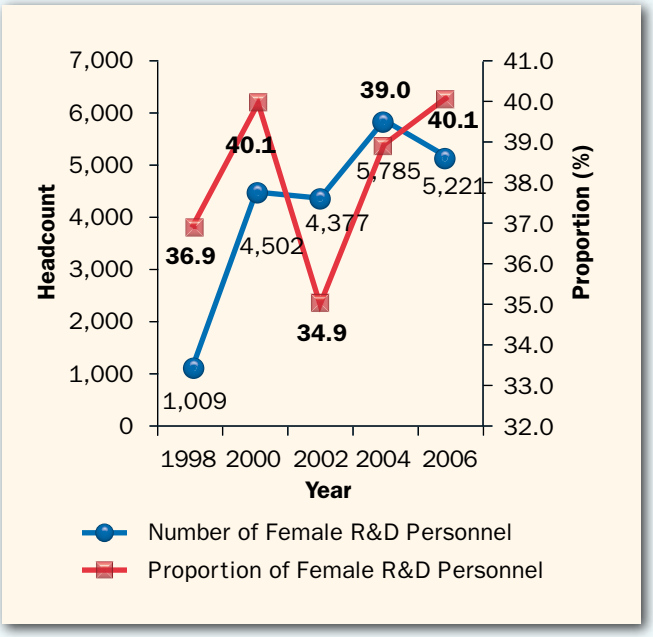
Figure 44 : R&D Personnel FTE



The total FTE for researchers, technicians and support staff in 2006 was 5,438.0, which is a drop of 29.7% from the total FTE 7,738.1 in 2004 (Figure 44). Since 2000, there has been a steady increase in the FTE for researchers (Figure 44). In 2004 the FTE peaked at 6,434.4 before it fell by 1,337.6 to 5,096.7 in 2006. In 2006 and in the other years, technicians had the lowest FTE. In 2006, the FTE of support staff was 222.1.

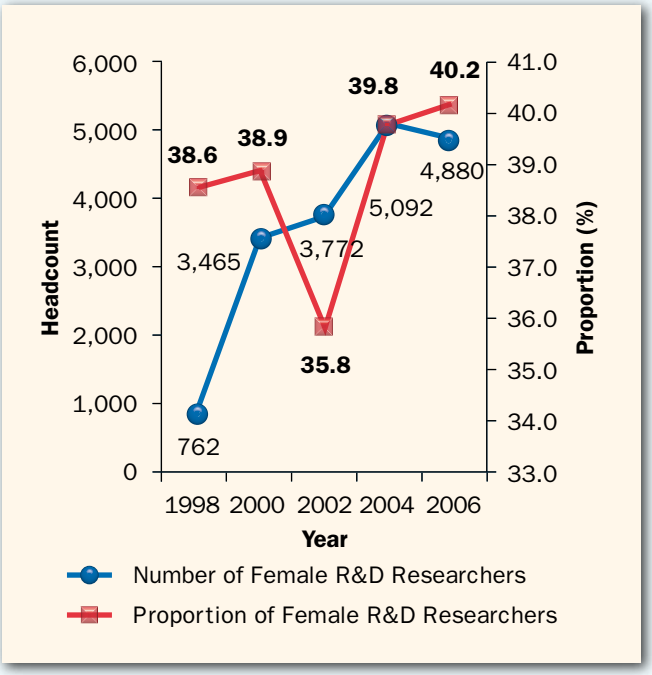
Female Participation in R&D

Figure 45: Female R&D Personnel in the IHLs



The number of women R&D personnel in 2006 dropped to 5,221, but the proportion of female to male personnel increased to 40.1% (Figure 45).

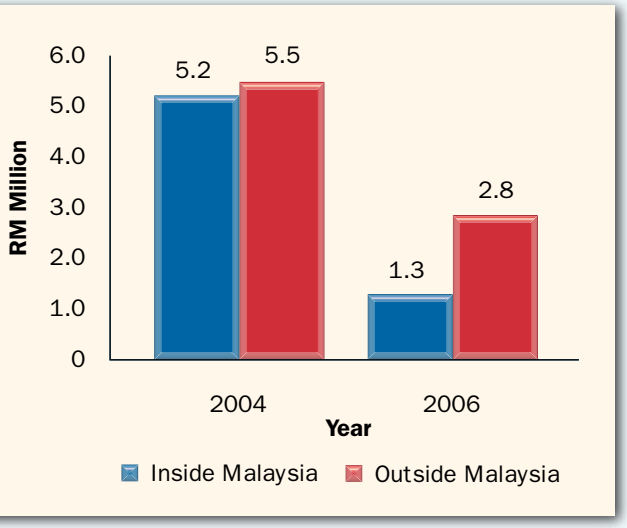
Figure 46 : Female Researchers in the IHLs



As shown in Figure 46, the proportion of female researchers in the IHLs increased to a new high of 40.2% in 2006 albeit a small drop in the number by 212 researchers.

OUTSOURCED R&D

Figure 47 : Outsourced R&D 2006



In 2006, the amount of outsourced R&D both within and outside of Malaysia dropped. From the RM5.5 million that was outsourced outside of Malaysia in 2004, the amount dropped to RM2.8 million in 2006. Similarly, the R&D that was outsourced within Malaysia dropped from RM5.2 million to RM1.3 million (Figure 47).

FACTORS LIMITING R&D ACTIVITIES

Internal Factors Limiting R&D

As shown in Figure 8.14, the top five internal factors limiting R&D activities in the IHLs were reported to be the following:

1. limited time due to classes or administrative work,
2. limited financial resources,
3. lack of infrastructure for R&D
4. delayed fund management, and,
5. lack of skilled personnel.

External Factors Limiting R&D

The top five external factors limiting R&D activities in the IHLs:

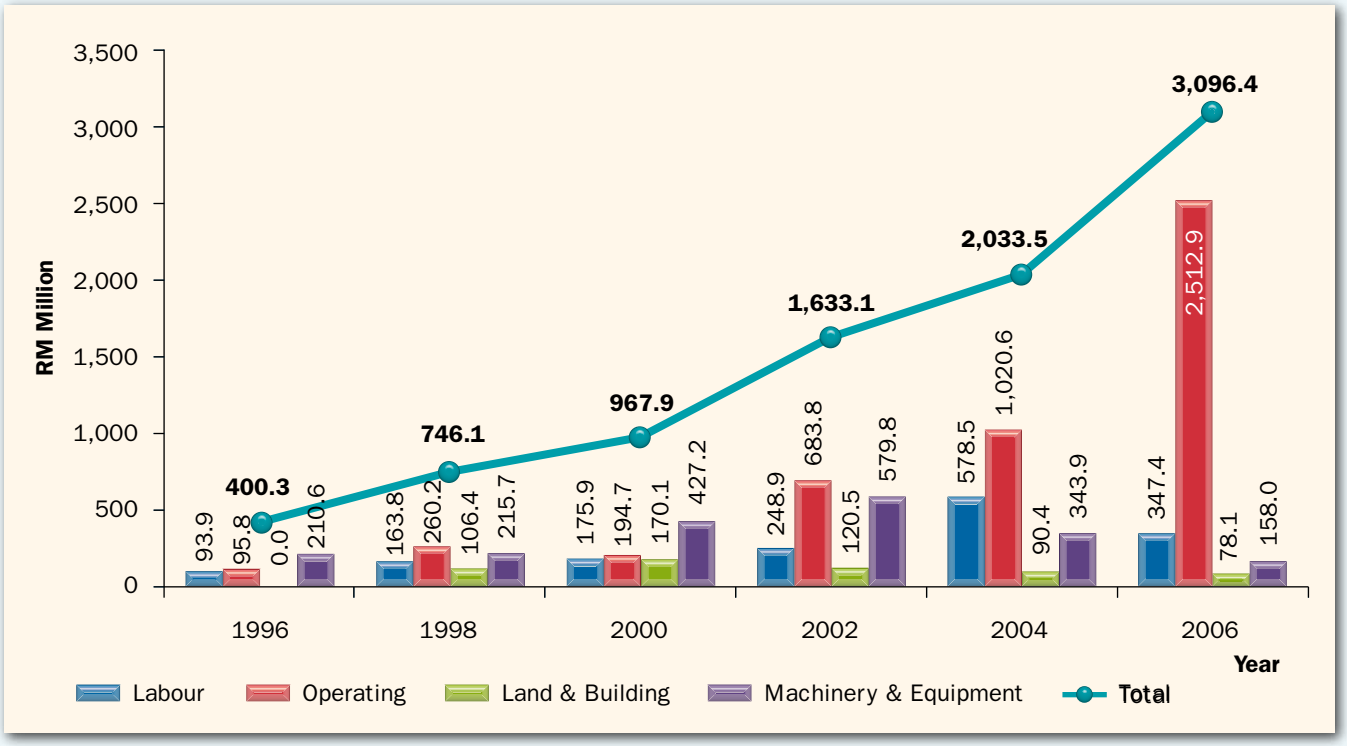
1. increasing capital costs
2. insufficient government funds
3. difficulty in finding private sector collaboration
4. lack of R&D personnel with requisite expertise
5. lack of ancillary service to support R&D

R&D IN PRIVATE SECTOR

R&D EXPENDITURE

Expenditure by Type of Cost

Figure 48 : R&D Expenditure by Type of Cost



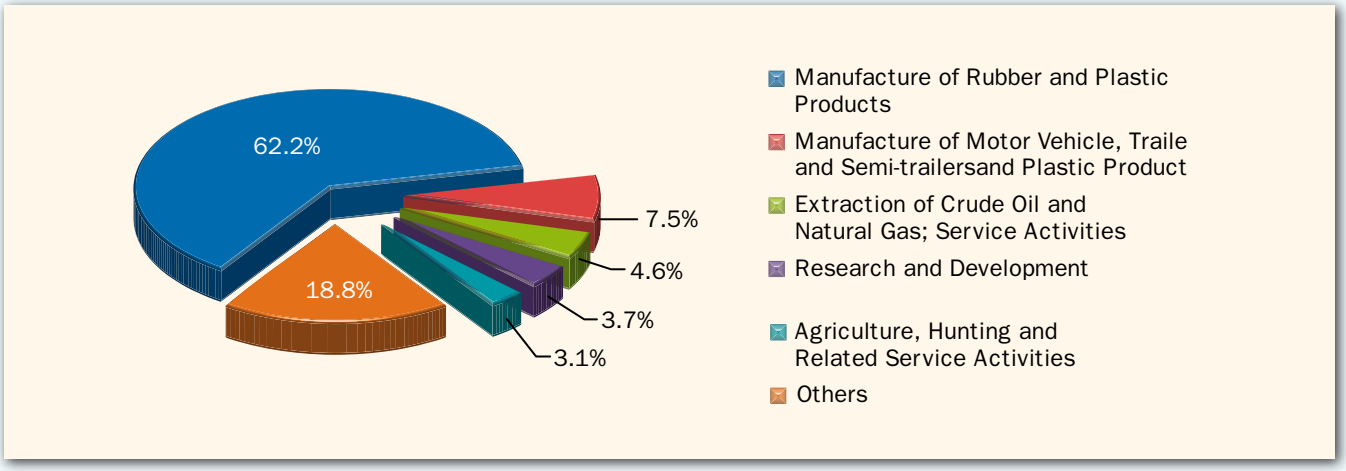
In nominal terms, the total R&D expenditure for the private sector has seen a steady increase from 1996 to 2006. This increase is steepest from 2004 (RM2.0 million) to 2006 (RM3.1 billion), where the R&D expenditure went up by more than half the amount spent in 2004 (See Figure 48).

In terms of type of cost, operating cost chartered the highest amount of R&D expenditure across the years surveyed. This is followed by labour cost. The amount spent on land and building has remained somewhat constant over the years. Machinery and equipment cost exhibited a gradual increase from 1996 but showed a decline in 2006.

For the year 2006, the highest R&D expenditure (in nominal terms) was for operating cost (RM2.5 billion). This accounted for about 81.2% of the total R&D expenditure. Labour cost, on the other hand, constituted only about 11.2% of the total R&D spending, which amounted to RM347.4 million. Current expenditure (operating & labour costs) for 2006, therefore, constituted 92.4% of the total R&D expenditure in the private sector (RM2.9 billion). Less than 8% (RM236.1 million) was spent on capital expenditure (land, building, machinery and equipment).

Expenditure by Industry

Figure 49 : R&D Expenditure by Major Industries 2006



The industry that recorded the largest amount of R&D spending for 2006 was the rubber and plastic products manufacturing industry. This industry accounted for 62.2% (RM1.9 billion) of the private R&D expenditure. The manufacturing of motor vehicles, trailers & semi-trailers industry was a remote second, with a spending of RM233.5 million, contributing only 7.5% of the total R&D expenditure. Extraction of crude oil & natural gas and service activities was the third largest industry, constituting 4.6% (RM143.7 million) of the total R&D expenditure for the private sector (See Figure 49). Overall, it is evident that the focus in R&D spending is still within the manufacturing industry.

Expenditure by Company Revenue

For 2006, the largest R&D expenditure came from companies from the middle bracket (RM10-RM100 million), with an expenditure of RM2.1 billion, accounting for 69.4% of the total expenditure in the private sector. Companies with a revenue of above RM100 million, on the other hand, only contributed 20.9% of the total R&D expenditure (RM647.2 million). The lowest amount of R&D expenditure came from the lowest bracket, companies with revenue of below RM10 million (See Table 9 and Figure 50).

Figure 50 : Proportion of Expenditure by Company Revenue (2002 - 2006)

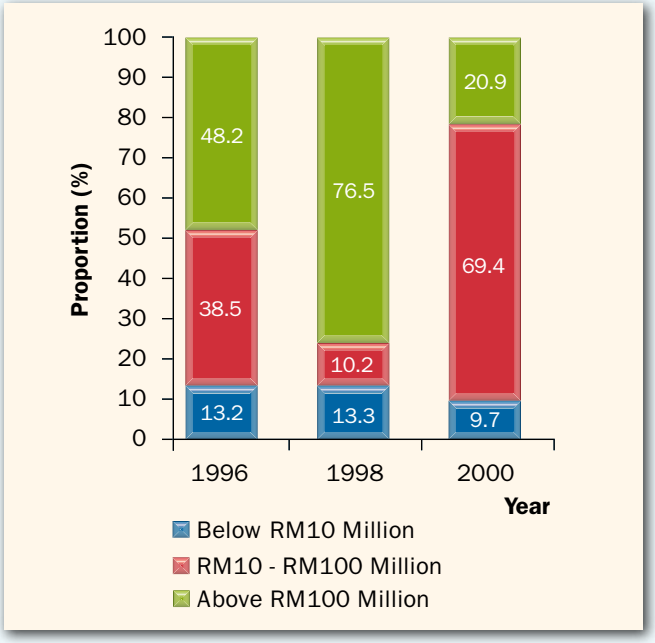
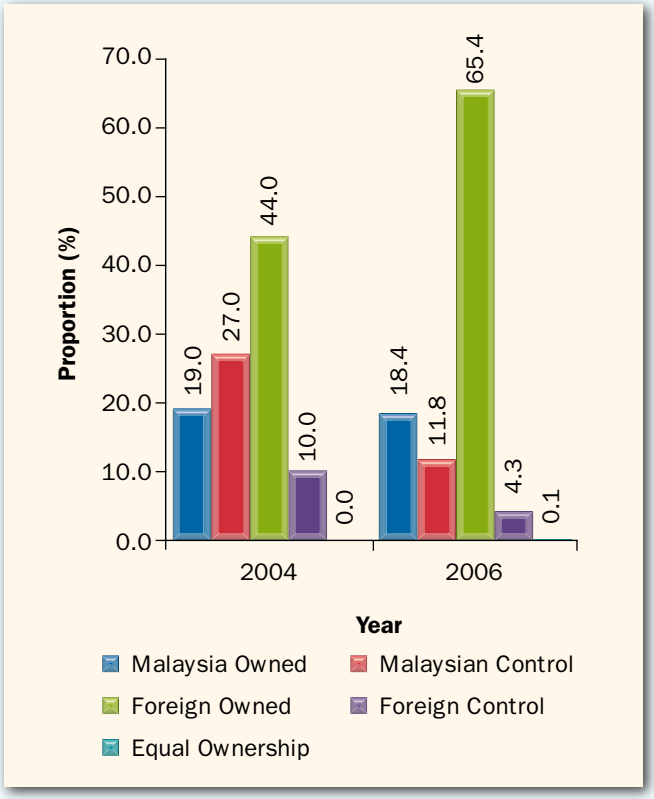


Table 9 : R&D Expenditure by Category of Company Revenue 2006

Category of Company Revenue	(RM Million)	(%)
Below RM10 Million	301.6	9.7
RM10 - RM100 Million	2,147.6	69.4
Above RM100 million	647.2	20.9
Total	3,096.4	100.0

Expenditure by Ownership

Figure 51 : Proportion of GERD by Ownership of Companies (2004 and 2006)



Similar to 2004, the largest amount of R&D expenditure was with foreign owned companies. However, there is a shift in the amount spent by Malaysian-owned and Malaysian-controlled companies. In 2004, Malaysian-controlled companies charted a higher R&D spending compared to Malaysian-owned companies. This pattern is reversed in 2006, where Malaysian-owned companies recorded a higher R&D spending. The proportion of R&D expenditure for foreign controlled companies indicated a decrease from 10% in 2004 to 4.3% in 2006. (See Figure 51).

Expenditure by Type of Research

Figure 52 : GERD by Type of Research (2004 and 2006)

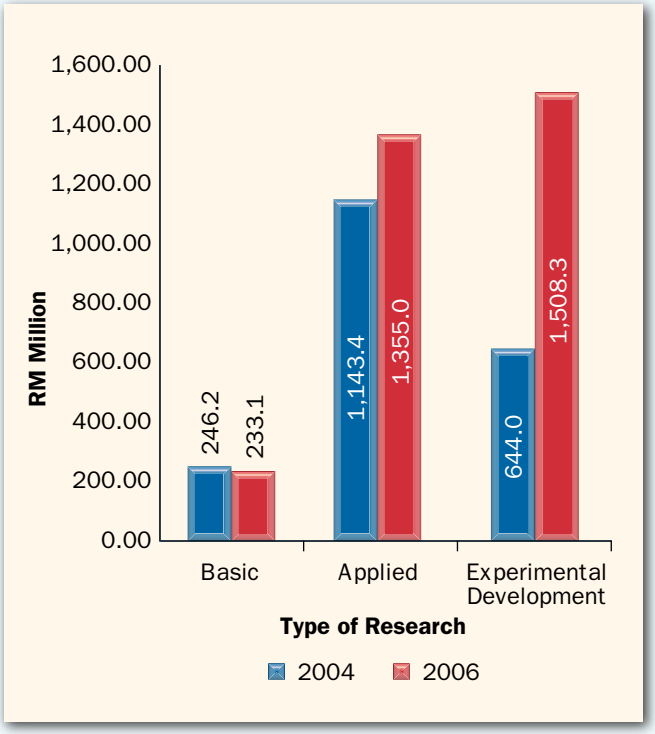
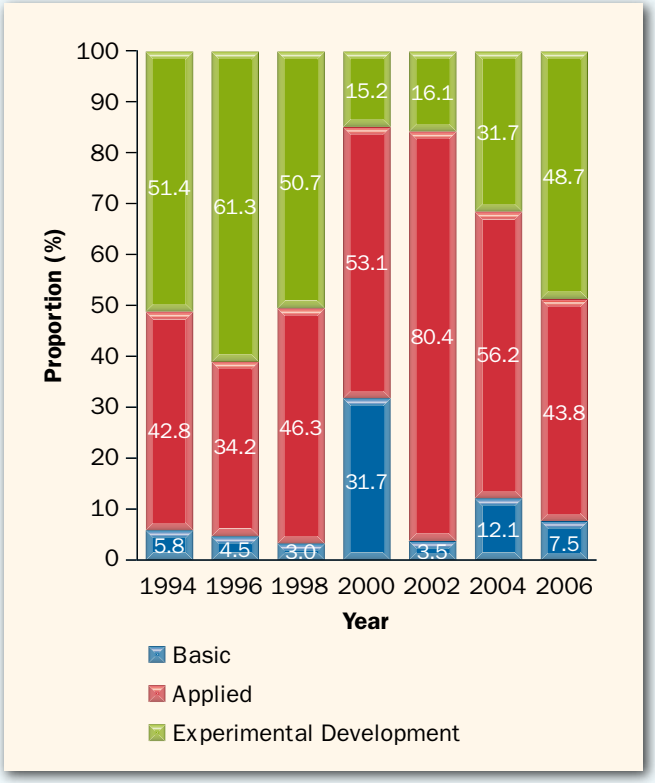


Figure 53 : Proportion of GERD by Type of Research (1996 to 2006)

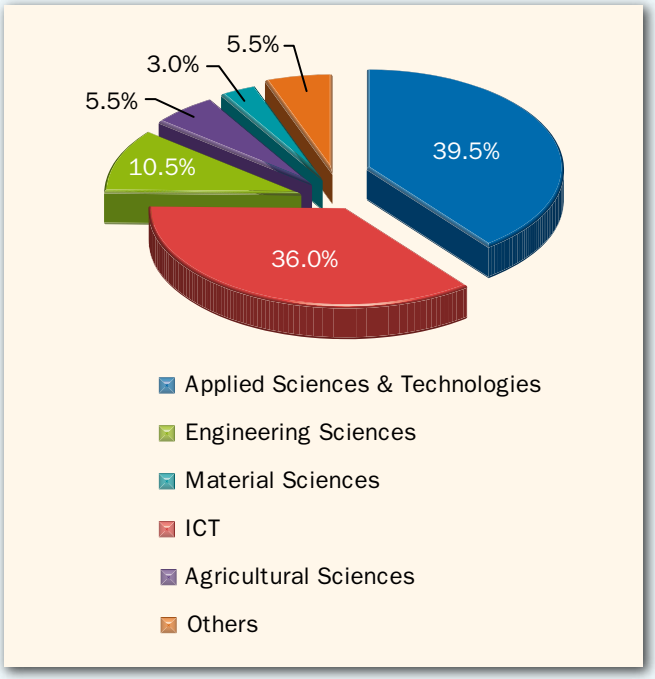


The main type of research conducted by the private sector was experimental developmental research (48.7%) followed by applied research (43.8%). The amount spent on basic research was minimal, at 7.5%. The proportion of expenditure by type of research appears to be consistent across the years surveyed, where focus is given to both applied and experimental development research. Basic research, with the exception of the years 2000 and 2004, remained below 10% of the total R&D expenditure in the private sector (See Figure 52). In terms of Ringgit spent, RM233.1 million was spent on basic research, RM1.4 billion on applied research, and RM1.5 billion on experimental development research.

Comparisons of R&D expenditure across the years surveyed show that basic research accounts for a very small proportion of R&D expenditure (See Figure 53). More money is spent on R&D in applied research and in experimental developmental research. This trend in R&D expenditure in the private sector is reflective of the focus on commercialization via the development of new processes and commercialization of products that are market driven.

Expenditure by FOR

Figure 54 : Proportion of Expenditure by Major FOR in 2006

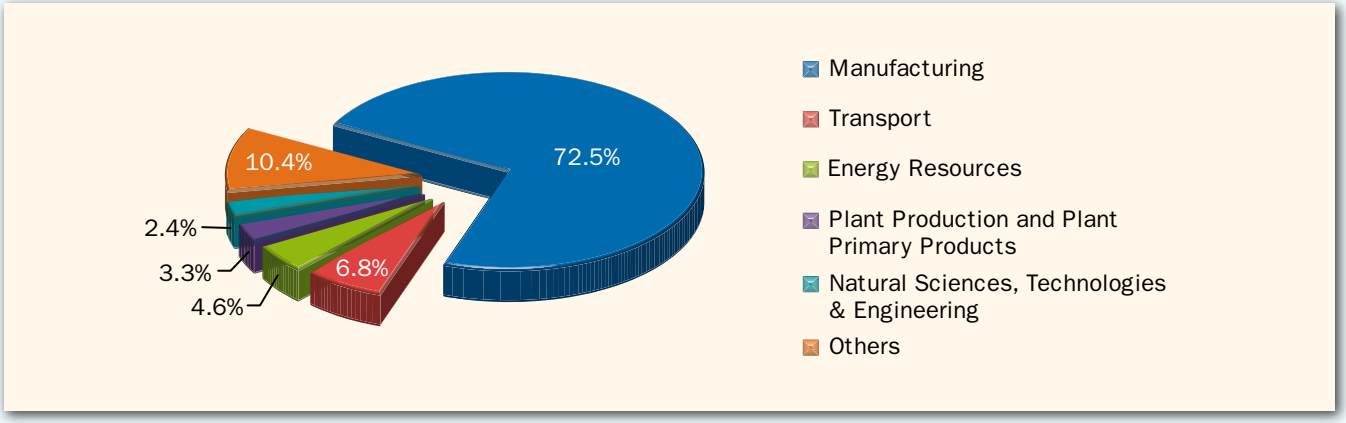


The top 3 FOR for 2006 were:

1. Applied Sciences & Technologies (39.5%),
2. Engineering Sciences (36.0%), and
3. Material Sciences (10.5%)

Expenditure by SEO

Figure 55 : Proportion of Expenditure by Major SEO in 2006



In 2006, the top 3 SEO were:

- Manufacturing (72.5%)
- Transport (6.8%)
- Energy resources (4.6%)

SOURCES OF FUNDS

Table 10 : Sources of Funds for Private Sector

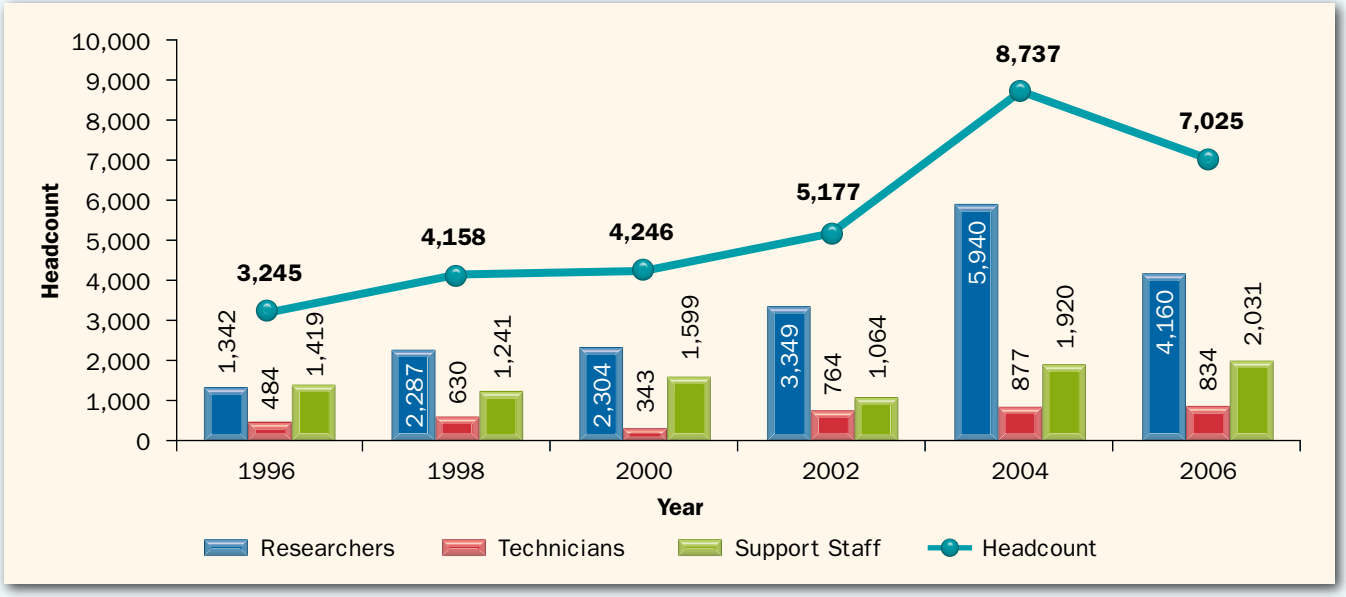
SOURCES OF FUNDS	RM (MILLION)	PERCENTAGE (%)
Own Funds	3,081.1	99.5
State/Local Government Funds	8.7	0.3
Other Federal Government Funds	0.1	0.0
Other Funds (Malaysia)	6.5	0.2
Foreign Funds	0.0	0.0

As with previous years, R&D funding in the private sector largely comes from internal funds. In 2006, this made up 99.5% (RM3,081.1 million) of the total R&D expenditure. This percentage is slightly higher than that of the previous year (98.7% in 2004). Other sources of R&D funds for 2006 include state/local government funds (RM8.7 million), which accounts for 0.3% of R&D expenditure, and 'Other funds' within Malaysia (RM6.5 million) constituting 0.2% of R&D funds. In summary, only less than 0.3% of the funds used by the private sector come from the Malaysian government and state/local governments (See Table 10).

HUMAN RESOURCE DEVELOPMENT

R&D Personnel by Headcount

Figure 56 : Headcount of R&D Personnel



From 1996 to 2002, there has been a gradual increase in the total headcount of personnel involved in R&D. There was a dramatic increase in 2004, where the total headcount went up from 5,177 in 2002 to 8,737 in 2004, an increase of 68.8% over 2002 (See Figure 56). This number, however, dropped considerably to 7,025 in 2006, a decrease of 19.6% from the previous year. Nonetheless, in terms of category of research personnel, this trend is seen only with regard to researchers, and not technicians and support staff. The number of researchers dropped from 5,940 in 2004 to 4,160 in 2006, a reduction of about 30% from the previous year.

R&D Personnel by FTE

Figure 57 : FTE by R&D Personnel (1996 – 2006)

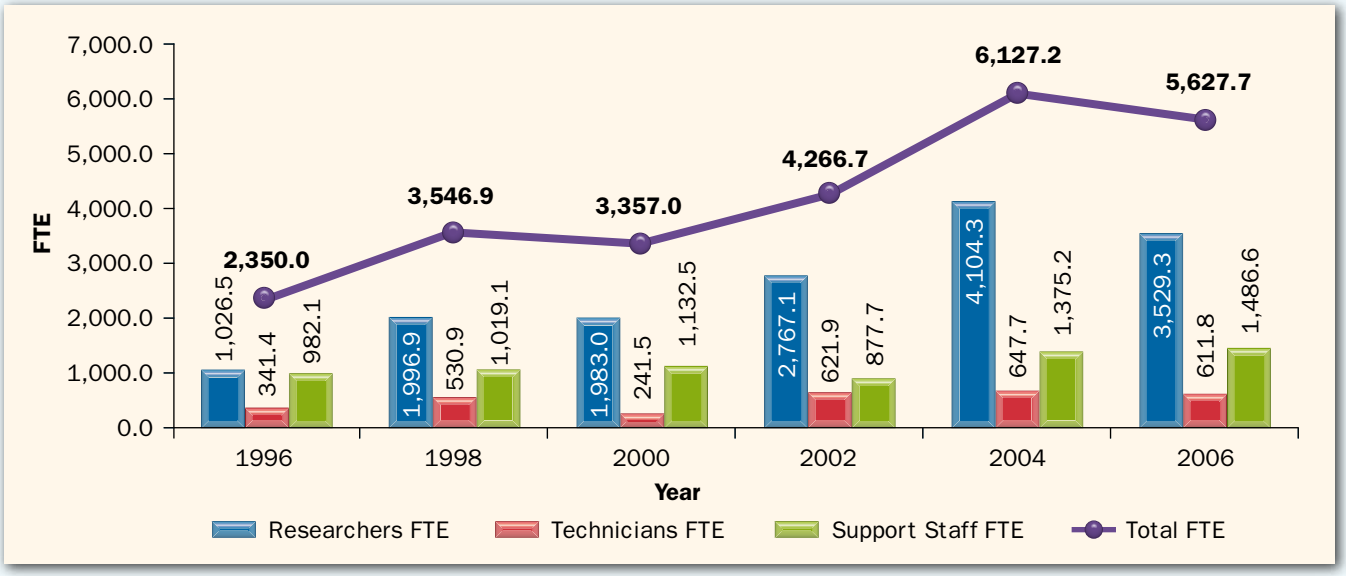


Figure 57 indicates that overall, there is an increasing trend in the FTE for R&D personnel from 1996 to 2004. Total FTE for R&D personnel, however, dropped in 2006. The drop in FTE is especially substantial as regard researchers, from 4,104.3 in 2004 to 3,529.3 in 2006. The drop in FTE is expected given the drop in the total headcount in R&D for the year 2006.

The number of female R&D personnel fluctuated across the years surveyed; nonetheless, the general trend indicates that female involvement in R&D is on the incline (See Figure 58).

The number of female R&D personnel increased from 1,504 in 2002 to 2,330 in 2004 but dropped to 2,282 in 2006. In terms of the proportion of female R&D personnel relative to the number of male personnel, there was an increase from 2004 (26.7%) to 2006 (32.5%). Despite the dips in 2000 and 2006, a similar rising trend is seen in the proportion of female R&D personnel (See Figure 58).

Figure 58: Headcount and Proportion of Female R&D Personnel

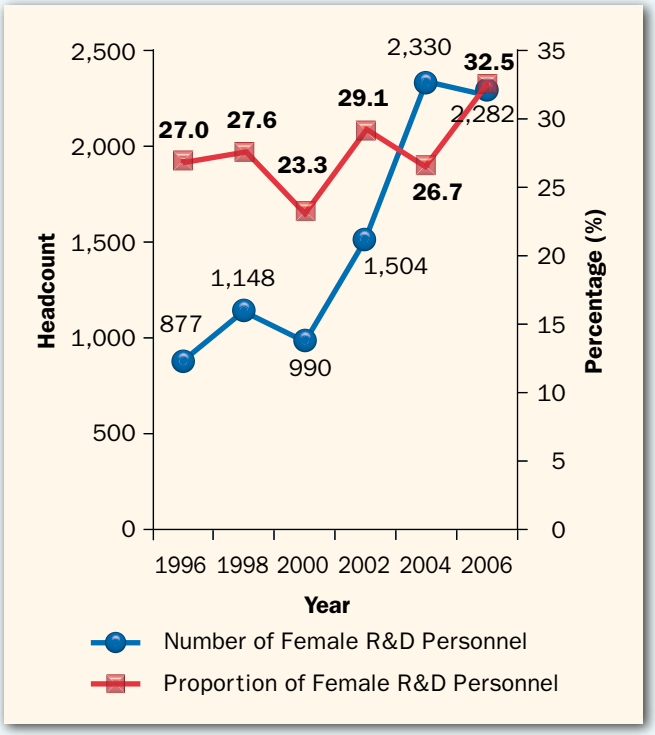
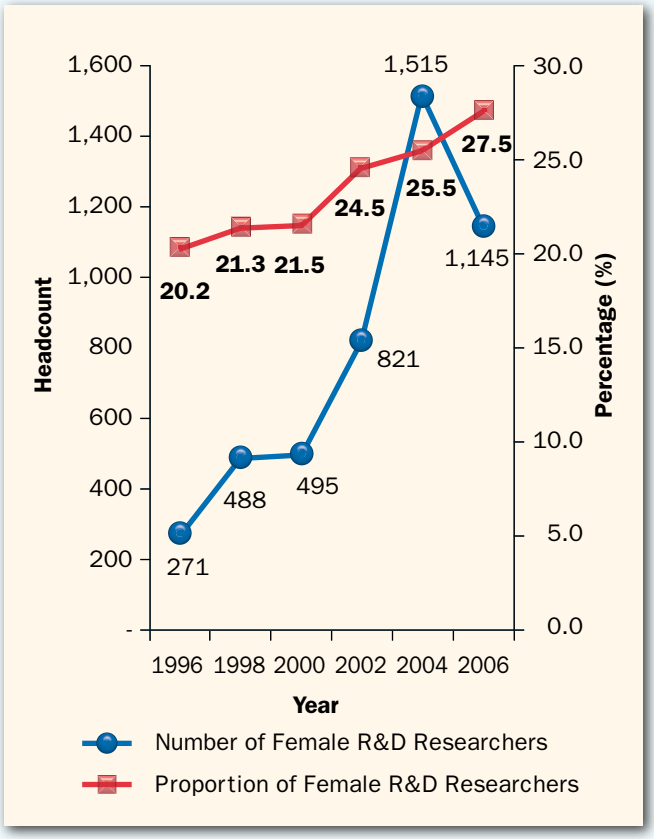


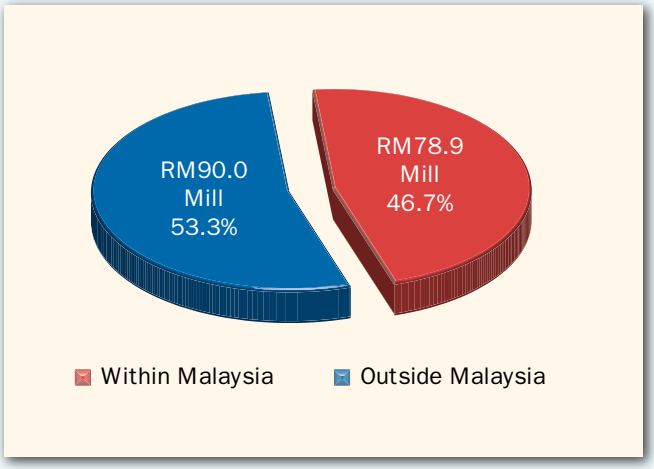
Figure 59: Female Researchers in the Private Sector



This trend is also seen with female researchers. The increase is highest between 2002 and 2004, where the number of female researchers almost doubled. Although there is a drop in the number of female researchers in 2006, the proportion of female researchers to male continues to go up. The percentage of female R&D researchers increased from 25.5% in 2004 to 37.9% in 2006, the highest ever recorded (See Figure 59).

OUTSOURCED R&D

Figure 60: Outsourced R&D by Location



The amount of R&D outsourced by the private sector in 2006 was RM168.9 million (See Figure 60). This figure is a dramatic increase to the previous year, which charted an amount of only RM14.1 million (See Table 11). Of the amount spent in 2004, RM1.5 million (10.6%) was outsourced in Malaysia while RM12.6 million (89.4%) outside Malaysia. This pattern of R&D outsourcing is not seen in 2006. For 2006 fiscal year, RM78.9 million (46.7%) was outsourced in Malaysia while RM90.0 million (53.3%) outside Malaysia (Table 11).

Table 11: Comparison of Outsourced R&D by Location (2004 and 2006)

Location	2004		2006	
	Expenditure (RM Mill)	Percentage (%)	Expenditure (RM Mill)	Percentage (%)
Within Malaysia	1.5	10.6	78.9	46.7
Outside Malaysia	12.6	89.4	90.0	53.3
Total	**14.1**	**100.0**	**168.9**	**100.0**

FACTORS LIMITING R&D ACTIVITIES

Internal Factors Limiting R&D

The following are the top 5 internal factors that were reported as inhibiting R&D in the private sector (See Figure 60):

- Lack of skilled R&D personnel
- Limited financial resources
- Lack of Infrastructure for R&D
- Lack of proven analytical techniques
- Lack of market research

External Factors Limiting R&D

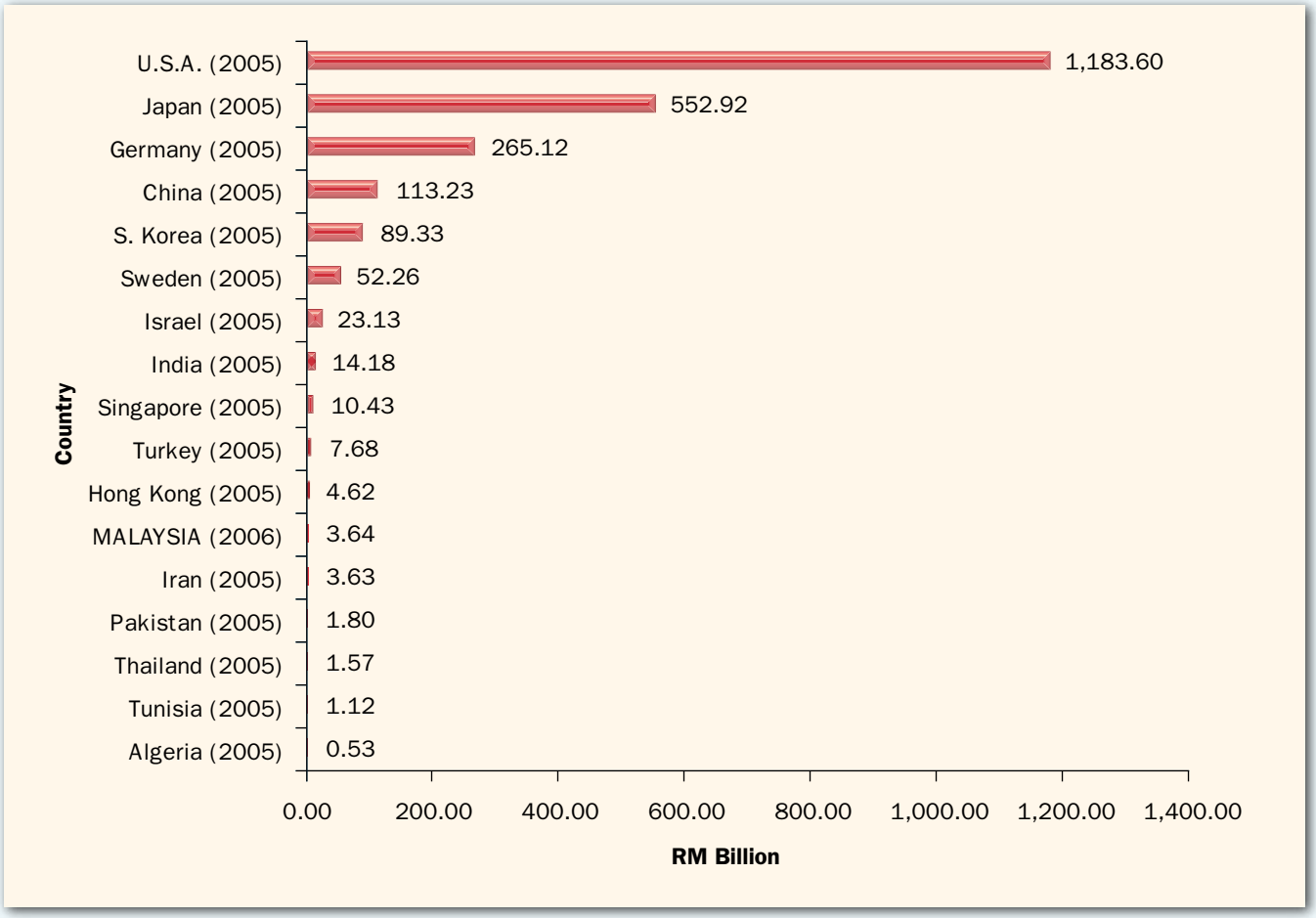
The top 5 limiting external factors that were reported as affecting R&D in the private sector are as follows (See Figure 61):

1. Shortage of R&D personnel with requisite expertise
2. Increasing capital costs
3. Lack of ancillary services to support R&D
4. Increasing labour costs
5. Insufficient government incentives

INTERNATIONAL COMPARISON OF R&D

GROSS EXPENDITURE ON R&D (GERD)

Figure 61: International Gross R&D Expenditure (GERD)



Source: IMD World Competitiveness Yearbook 2007 and World Development Indicators.

Malaysia's GERD of RM3.6 billion placed it 37th in the world ranking. The first place is held by the U.S.A., with a GERD of RM1.2 trillion, followed by Japan (RM552.9 billion), Germany (RM265.1 billion), U.K (RM207.69 billion) and France (RM171.2 billion). China is trailing not too far behind France, with a GERD of (RM113.2 billion).

The GERD of the East Asian Newly Industrialising Economies (NIE) was also larger than Malaysia's: South Korea's GERD, ranked 7th in the world, was RM89.3 billion, Singapore's GERD, ranked 26th, was RM10.4 billion, and Hong Kong's, ranked 34th, was RM4.6 billion.

Malaysia's GERD of RM3.6 billion places her with Hungary, Ukraine, and the Iran, whose GERD were RM3.9 billion, RM3.8 billion, and RM3.6 billion respectively. Thailand, our closest neighbour, was at the 45th place, with GERD of RM1.6 billion.

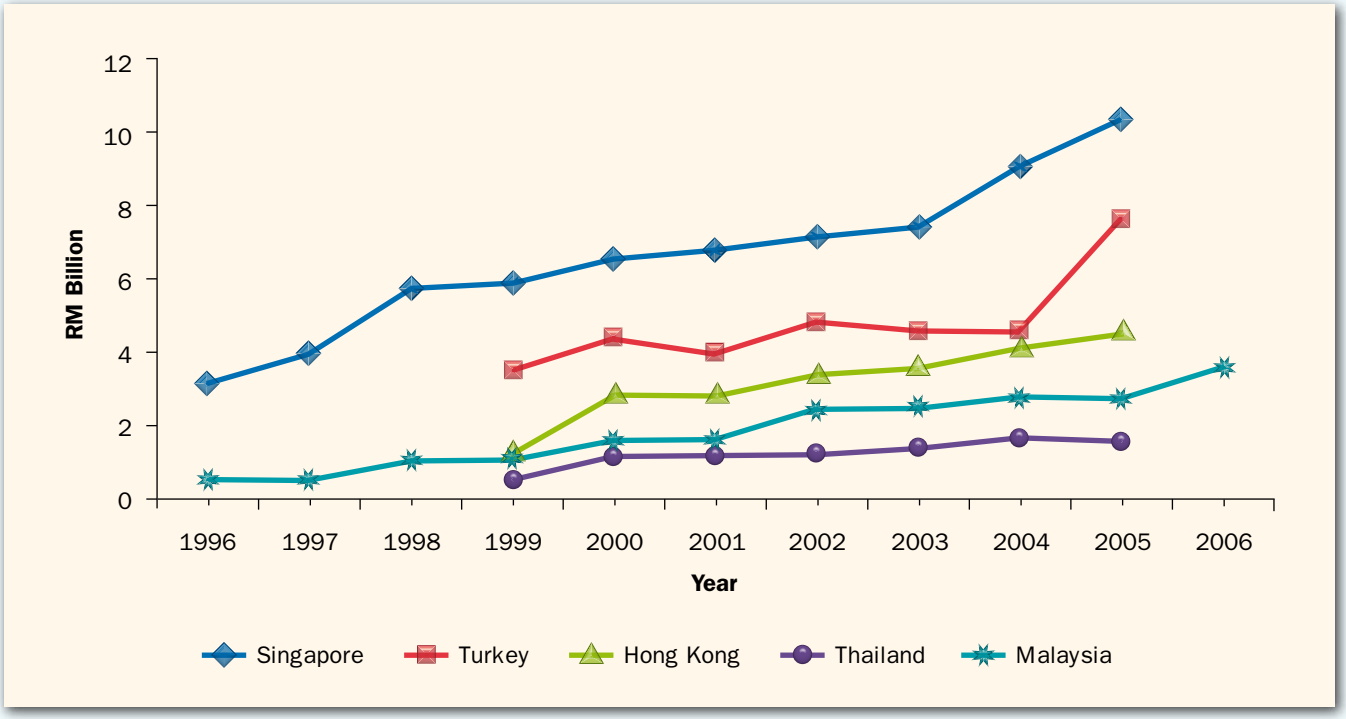
For the OIC member countries, Turkey's GERD was RM7.7 billion, Iran's GERD was RM3.6 billion and Pakistan was RM1.8 billion. They were ranked 28th, 38th, 44th respectively (Figure 61 and Table 12).

Table 12 : Gross Expenditure on R&D (billion of Ringgit)

Rank	Country	GERD RM Billion	Rank	Country	GERD RM Billion	Rank	Country	GERD RM Billion
1	U.S.A.	1,183.60	**18**	Austria	27.21	**35**	Hungary	3.94
2	Japan	552.92	**19**	Finland	25.75	**36**	Ukraine	3.81
3	Germany	265.12	**20**	Belgium	25.54	**37**	MALAYSIA	3.64
4	U.K.	207.69	**21**	Denmark	23.99	**38**	Iran	3.63
5	France	171.22	**22**	Israel	23.13	**39**	New Zealand	3.50
6	China	113.23	**23**	Norway	16.95	**40**	Argentina	3.20
7	South Korea	89.33	**24**	India	14.18	**40**	Chile	3.06
8	Canada	84.98	**25**	Mexico	10.51	**42**	Luxembourg	2.15
9	Italy	71.76	**26**	Singapore	10.43	**43**	Slovenia	1.92
10	Sweden	52.26	**27**	Ireland	9.50	**44**	Pakistan	1.80
11	Spain	47.51	**28**	Turkey	7.68	**45**	Thailand	1.57
12	Australia	43.95	**29**	South Africa	7.15	**46**	Croatia	1.47
13	Netherlands	41.04	**30**	Czech Rep.	6.67	**47**	Iceland	1.39
14	Switzerland	39.91	**31**	Poland	6.53	**48**	Tunisia	1.12
15	Taiwan	33.08	**32**	Portugal	5.59	**49**	Romania	1.11
16	Russia	30.90	**33**	Greece	5.23	**50**	Venezuela	0.92
17	Brazil	27.80	**34**	Hong Kong	4.62			

Source: IMD World Competitiveness Yearbook 2007 and World Development Indicators.

Figure 62 : Trends in GERD (Selected Countries)



Note : The GERDs were deflated using Malaysia's CPI. Malaysia's GERD for 1996, 1998, 2000, 2002 and 2004 was based on the GERD for 1997, 1999, 2001, 2003 & 2005. Hong Kong's GERD for 2001 was based on the 2000's expenditure.

Source : IMD World Competitiveness Yearbook 2007 and World Development Indicators.

Figure 62 presents the trends in GERD for Singapore, Turkey, Hong Kong, Thailand and Malaysia. These countries are selected as they are economically interdependent and their GERD were comparable with Malaysia, unlike the GERD for Taiwan and South Korea, which was about 30 times greater than Malaysia's GERD.

The GERD for all five countries has been increasing. Even though relative to Singapore and Turkey, Malaysia's GERD was small, Malaysia's GERD has been increasing at the fastest rate among the five countries. From 1996 to 2006, Malaysia's GERD increased by 334%, while Singapore's GERD increased by 165% and Thailand's GERD increased by 211%.

RESEARCH INTENSITY

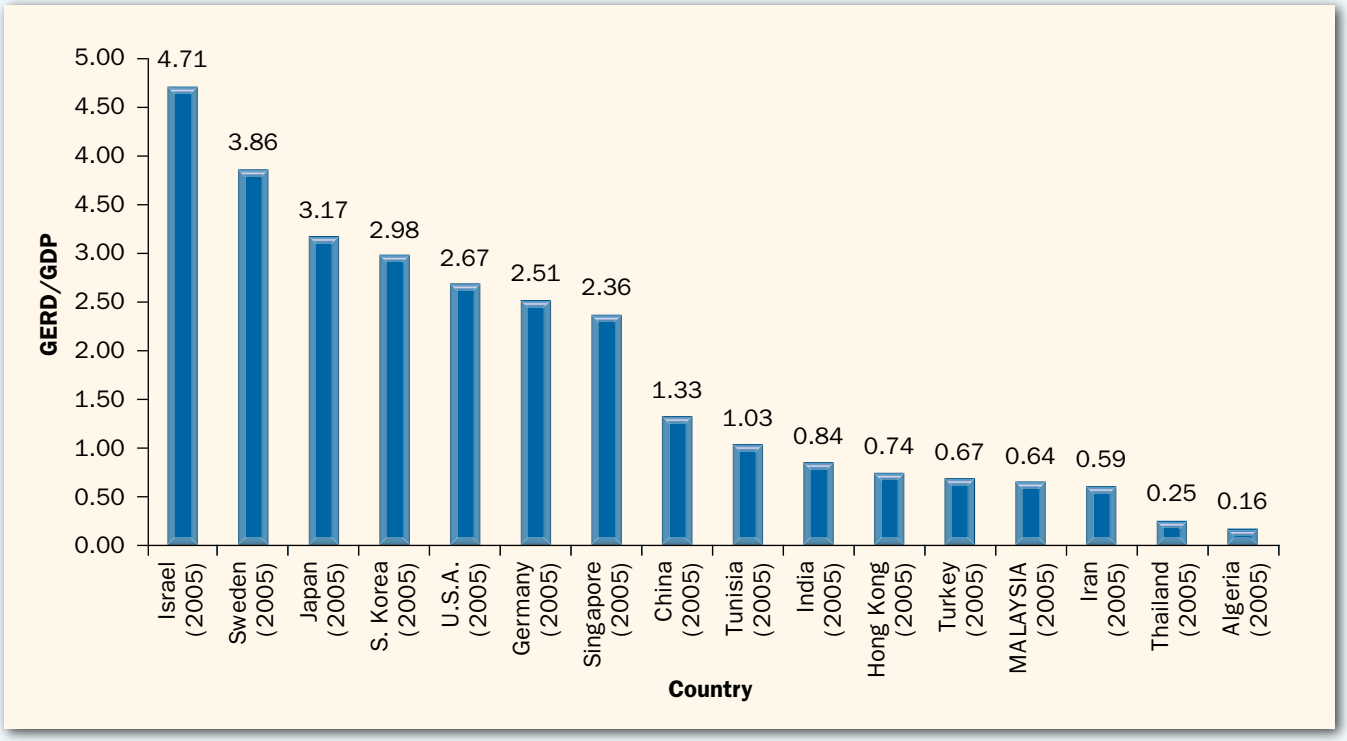
GERD/GDP RATIO

Malaysia GERD/GDP of 0.64 was at the 44th place in the world ranking. The highest GERD/GDP ratio was charted by Israel, with a GERD/GDP of 4.71. Other countries that charted relatively high GERD/GDP ratios were Sweden (3.86), Finland (3.48), Japan (3.17), and South Korea (2.98). The USA was in 8th place with a GERD/GDP ratio of 2.67 (See Figure 63 and Table 13).

Other developed countries with GERD/GDP ratios of above 2 include Switzerland, Iceland, Germany, Denmark, Singapore, Austria, France and Canada. South Korea and Singapore, two NIEs, had GERD/GDP ratios higher than some developed countries. Hong Kong, also an East Asian NIE, however, had a low GERD/GDP ratio of 0.74.

Among the OIC member countries Turkey was at the 43rd place with a ratio of 0.67, Iran at 45th place with a ratio of 0.59, and Pakistan at 56th place with a ratio of 0.43. This places Malaysia, with the exception of Turkey, higher than these OIC countries. However, Malaysia is very far behind Singapore, its closest neighbour.

Figure 63 : International GERD/GDP



Source : IMD World Competitiveness Yearbook 2007 and World Development Indicators.

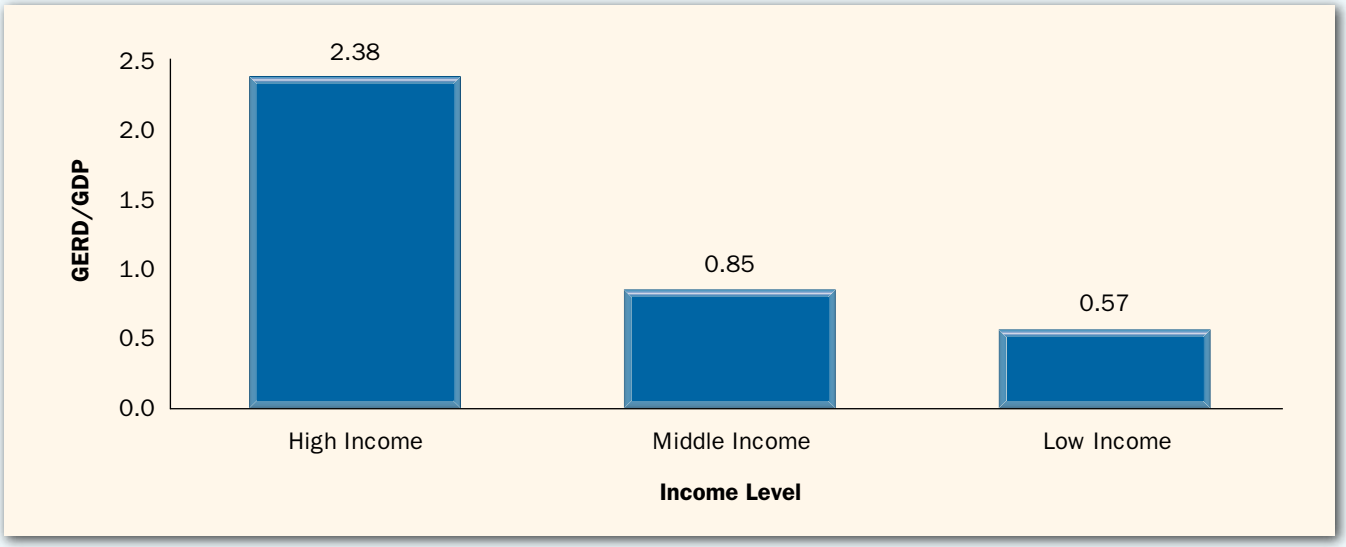
Table 13 : GERD/GDP Ratio

Rank	Country	GERD /GDP	Rank	Country	GERD /GDP	Rank	Country	GERD /GDP
1	Israel	4.71	**18**	Australia	1.82	**35**	India	0.84
2	Sweden	3.86	**19**	Netherlands	1.78	**36**	Brazil	0.83
3	Finland	3.48	**20**	Luxembourg	1.56	**37**	Portugal	0.80
4	Japan	3.17	**21**	Slovenia	1.49	**38**	South Africa	0.78
5	South Korea	2.98	**22**	Norway	1.48	**39**	Lithuania	0.76
6	Switzerland	2.93	**23**	Czech Rep.	1.42	**40**	Jordan	0.74
7	Iceland	2.83	**24**	China	1.33	**41**	Hong Kong	0.74
8	U.S.A.	2.67	**25**	Ireland	1.25	**42**	Chile	0.68
9	U.K.	2.55	**26**	Ukraine	1.17	**43**	Turkey	0.67
10	Taiwan	2.52	**27**	New Zealand	1.15	**44**	MALAYSIA	0.64
11	Germany	2.51	**28**	Spain	1.12	**45**	Iran	0.59
12	Denmark	2.44	**29**	Italy	1.10	**46**	Poland	0.57
13	Austria	2.36	**30**	Russia	1.07	**47**	Slovak Rep.	0.51
14	Singapore	2.36	**31**	Tunisia	1.03	**48**	Greece	0.49
15	France	2.13	**32**	Croatia	1.00	**49**	Bulgaria	0.49
16	Canada	1.98	**33**	Hungary	0.94	**50**	Argentina	0.46
17	Belgium	1.82	**34**	Estonia	0.94			

Source : IMD World Competitiveness Yearbook 2007 and World Development Indicators.

Figure 64 shows the GERD/GDP ratio for countries grouped by the level of income. The average GERD/GDP ratio for high income countries was 2.38, the ratio for the middle income countries was 0.85, and for the low income countries the ratio was 0.57. This means that Malaysia's GERD/GDP ratio of 0.64 was lower than the middle income countries but closer to the low income countries.

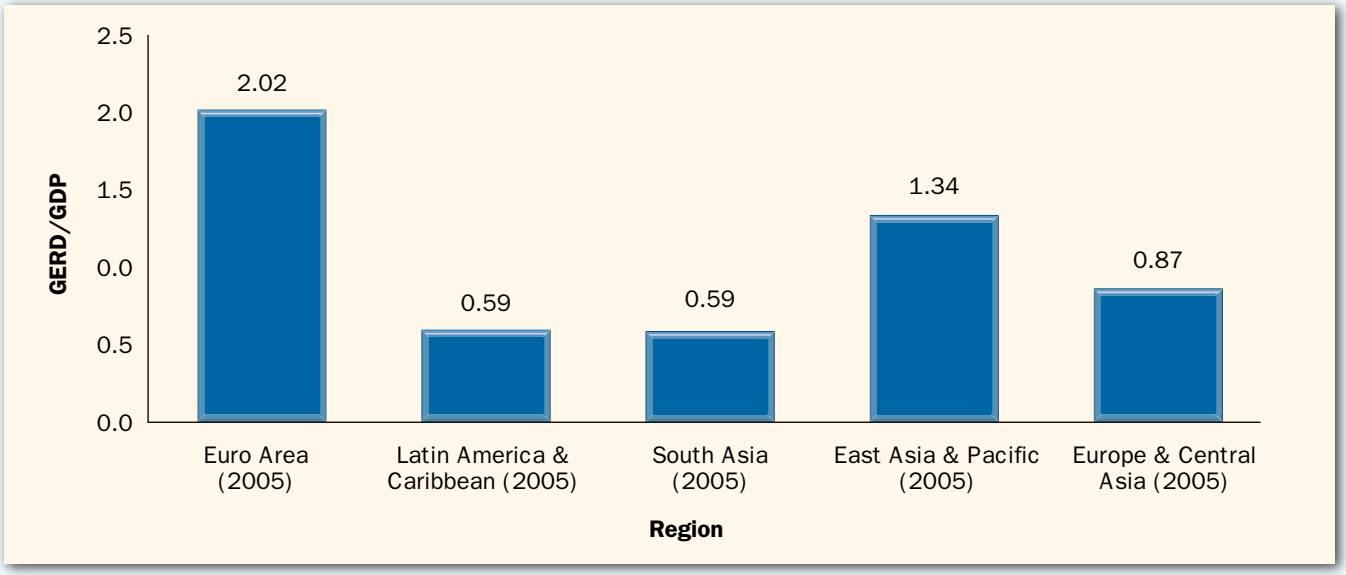
Figure 64 : GERD/GDP by Level of Income



Source : World Bank, World Development Indicators (WDI).

Figure 65 shows the GERD/GDP ratio grouped by region. In the Euro region, which covers most of the developed countries, the GERD/GDP ratio was 2.02, the highest among the region. The East Asia & Pacific region, the GERD/GDP ratio was 1.34. This means that Malaysia's GERD/GDP ratio of 0.64 is far below the average for the region, closer to the South Asia region.

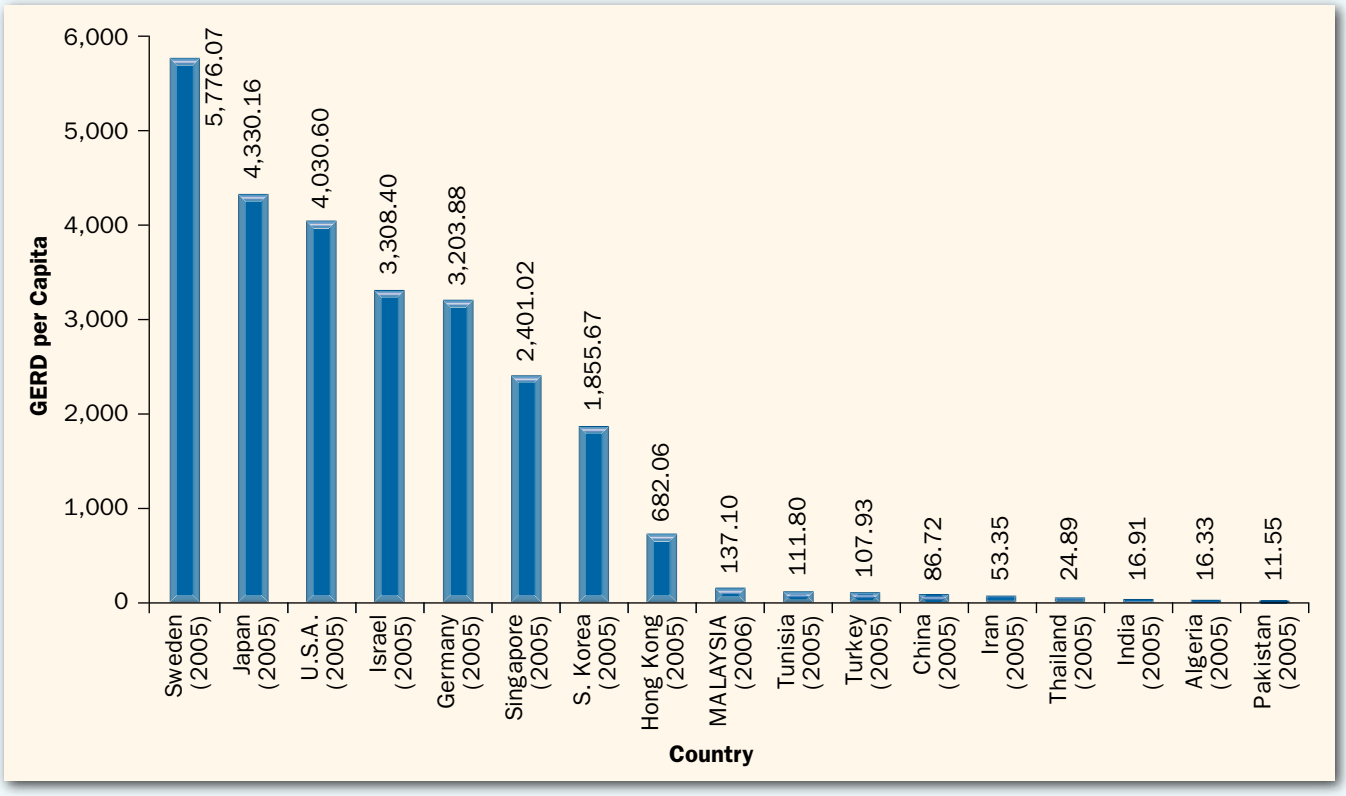
Figure 65 : GERD/GDP by Region



Source: World Development Indicators (WDI).

GERD Per Capita

Figure 66 : GERD per Capita



Source: IMD World Competitiveness Yearbook 2007 and World Development Indicators.

Sweden had the highest GERD per capita, totaled at RM5,776 per person. Among the East Asian NIEs, Singapore was ranked 18th in the world with a per capita GERD of RM2,401, South Korea, 21st; with a per capita GERD of RM1,855, and Hong Kong, 27th; with per capita GERD of RM682.

Thailand was ranked 64th in the world with a per capita GERD of RM25.0. Malaysia's GERD per capita in the amount of RM137.1 was ranked 41st in the world. This puts her quite ahead of Thailand but very far behind Singapore.

With regard to the OIC countries, Turkey was ranked 43rd with a per capita GERD of RM107.9, lower than Malaysia's. Another OIC country that has a GERD per capita lower than Malaysia's was Tunisia, which ranked 42nd; with per capita GERD of RM111.8 (Figure 66 and Table 14).

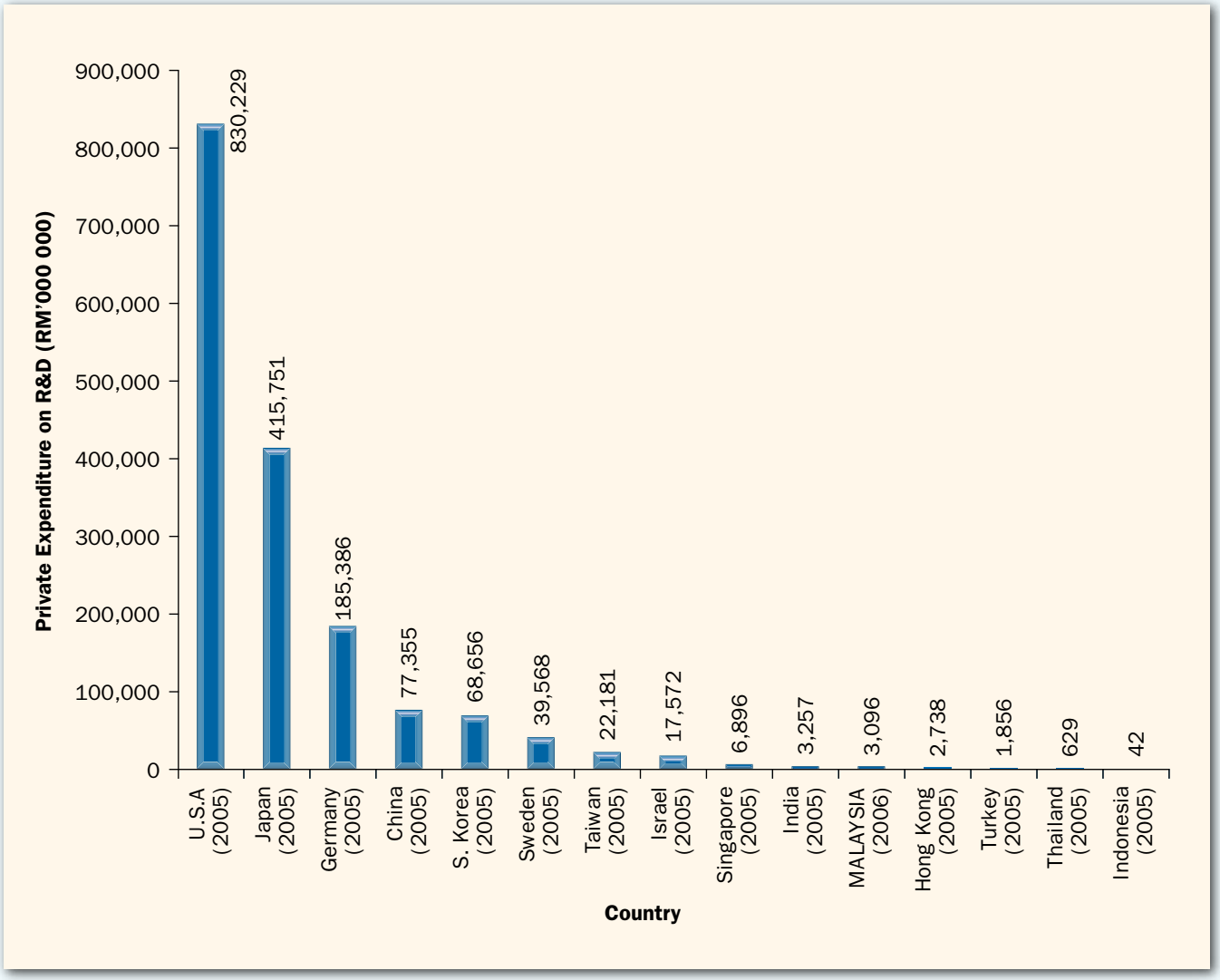
Table 14 : GERD per Capita

Rank	Country	GERD /Capita (RM)	Rank	Country	GERD /Capita (RM)	Rank	Country	GERD /Capita (RM)
1	Sweden	5,776.07	**18**	Singapore	2,401.02	**35**	Russian Fed	216.12
2	Switzerland	5,400.77	**19**	Ireland	2,300.66	**36**	Chile	187.84
3	Finland	4,908.83	**20**	Australia	2,187.80	**37**	Poland	171.18
4	Iceland	4,762.27	**21**	South Korea	1,855.67	**38**	Slovak Rep.	170.04
5	Luxembourg	4,735.38	**22**	Taiwan	1,452.73	**39**	South Africa	152.62
6	Denmark	4,426.73	**23**	Italy	1,246.71	**40**	Brazil	149.97
7	Japan	4,330.16	**24**	Spain	1,077.05	**41**	MALAYSIA	137.10
8	U.S.A.	4,030.60	**25**	Slovenia	962.30	**42**	Tunisia	111.80
9	Norway	3,679.16	**26**	New Zealand	872.55	**43**	Turkey	107.93
10	U.K.	3,471.25	**27**	Hong Kong	682.06	**44**	Mexico	100.74
11	Israel	3,308.40	**28**	Czech Rep.	654.03	**45**	China	86.72
12	Austria	3,304.99	**29**	Portugal	529.06	**46**	Argentina	82.94
13	Germany	3,203.88	**30**	Greece	472.25	**47**	Ukraine	81.04
14	France	2,820.63	**31**	Hungary	391.21	**48**	Bulgaria	64.76
15	Canada	2,634.30	**32**	Estonia	363.56	**49**	Jordan	51.13
16	Netherlands	2,524.10	**33**	Croatia	331.37	**50**	Romania	35.98
17	Belgium	2,429.42	**34**	Lithuania	224.57			

Source : IMD World Competitiveness Yearbook 2007 and World Development Indicators.

PRIVATE SECTOR R&D EXPENDITURE

Figure 67 : PRIVATE SECTOR R&D EXPENDITURE



Source: IMD World Competitiveness Yearbook 2007

The USA's private sector expenditure was the highest, at RM0.83 trillion. For the East Asian NIEs, South Korea chartered the largest amount of private sector R&D expenditure, amounting to RM68.6 billion, followed by Taiwan (RM22.2 billion), and Hong Kong (RM2.7 billion).

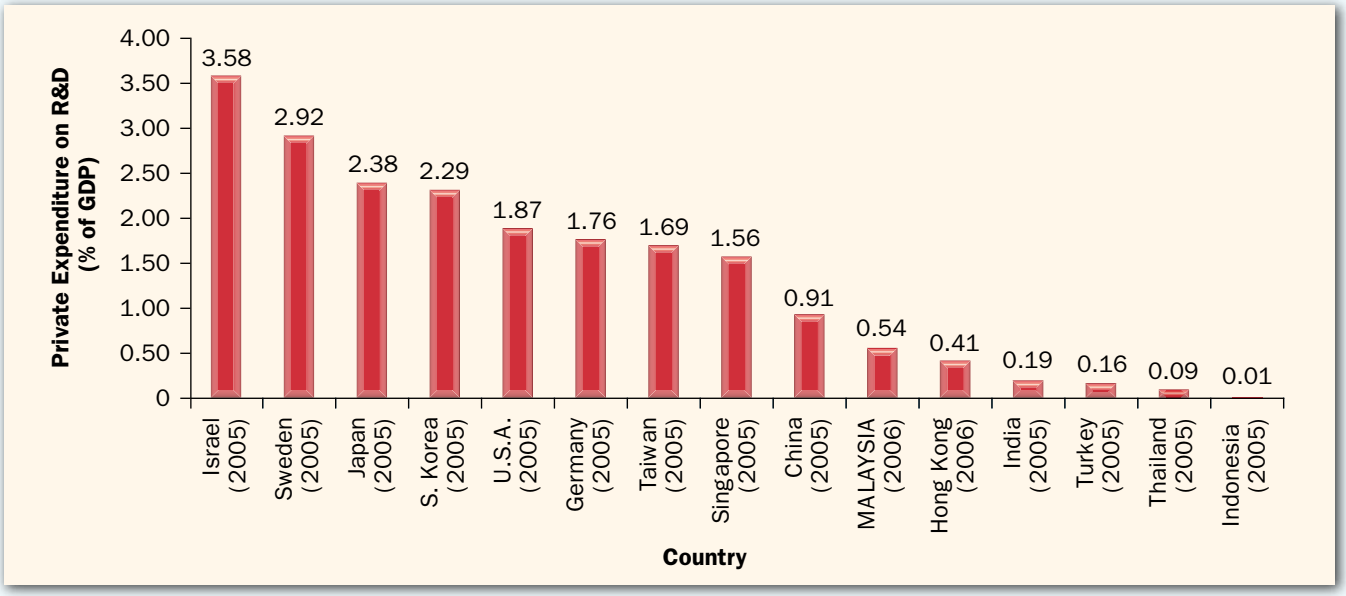
Malaysia's private expenditure on R&D totaled RM3.1 billion. This figure is higher than the amount for Hong Kong but less than half the amount spent by Singapore (RM6.8 million). It is however, substantially more than what was spent by Thailand (RM628.7 million) and Indonesia (RM41.7 million) (Figure 67 and Table 15).

Table 15 : Private Sector R&D Expenditure

Rank	Country Name	Private Expenditure on R&D (RM '000 000)	Rank	Country Name	Private Expenditure on R&D (RM '000 000)
1	U.S.A.	830,228.96	**26**	Czech Republic	4,302.14
2	Japan	415,750.71	**27**	Mexico	3,631.82
3	Germany	185,385.71	**28**	India	3,256.90
4	France	106,053.72	**29**	MALAYSIA	3,096.00
5	United Kingdom	88,894.40	**30**	Hong Kong	2,738.07
6	China	77,355.13	**31**	Ukraine	2,548.71
7	Korea, Rep.	68,656.18	**32**	Poland	2,071.54
8	Canada	45,831.38	**33**	Portugal	2,026.09
9	Sweden	39,567.53	**34**	Luxembourg	1,859.46
10	Italy	36,723.43	**35**	Turkey	1,855.67
11	Switzerland	29,433.28	**36**	Hungary	1,704.19
12	Spain	25,831.75	**37**	Greece	1,533.77
13	Netherlands	24,218.45	**38**	Slovenia	1,174.00
14	Australia	23,536.77	**39**	Argentina	1,030.09
15	Taiwan	22,181.00	**40**	Iceland	787.72
16	Russian Federation	21,007.00	**41**	Thailand	628.66
17	Austria	18,435.56	**42**	Chile	609.72
18	Finland	18,238.63	**43**	Romania	609.72
19	Israel	17,572.11	**44**	Croatia	605.93
20	Belgium	17,428.20	**45**	Slovak Republic	454.45
21	Denmark	16,382.96	**46**	Estonia	219.65
22	Brazil	10,115.32	**47**	Lithuania	155.27
23	Norway	9,153.40	**48**	Bulgaria	109.83
24	Singapore	6,896.29	**49**	Indonesia	41.66
25	Ireland	6,210.83			

Source : IMD World Competitiveness Yearbook 2007

Figure 68 : Private Sector R&D Expenditure as Percentage of GDP



Source : IMD World Competitiveness Yearbook 2007

As a percentage of GDP, Israel's private sector expenditure, at 3.58%, was the highest. Among the East Asian NIEs, South Korean private sector expenditure was at 2.29% of its GDP, Taiwan at 1.69%, Singapore at 1.56%, and Hong Kong 0.41%. The percentage of Malaysia's private sector R&D expenditure was 0.54%, Thailand's 0.09%, Indonesia's 0.01%, and India's 0.19% (Figure 10.7 and Table 10.5). This puts Malaysia quite a way behind Singapore, but ahead of Thailand, Indonesia, India, and even Hong Kong, which is an East Asian NIE. (See Figure 68 and Table 16)

Table 16 : Private Sector R&D Expenditure as Percentage of GDP

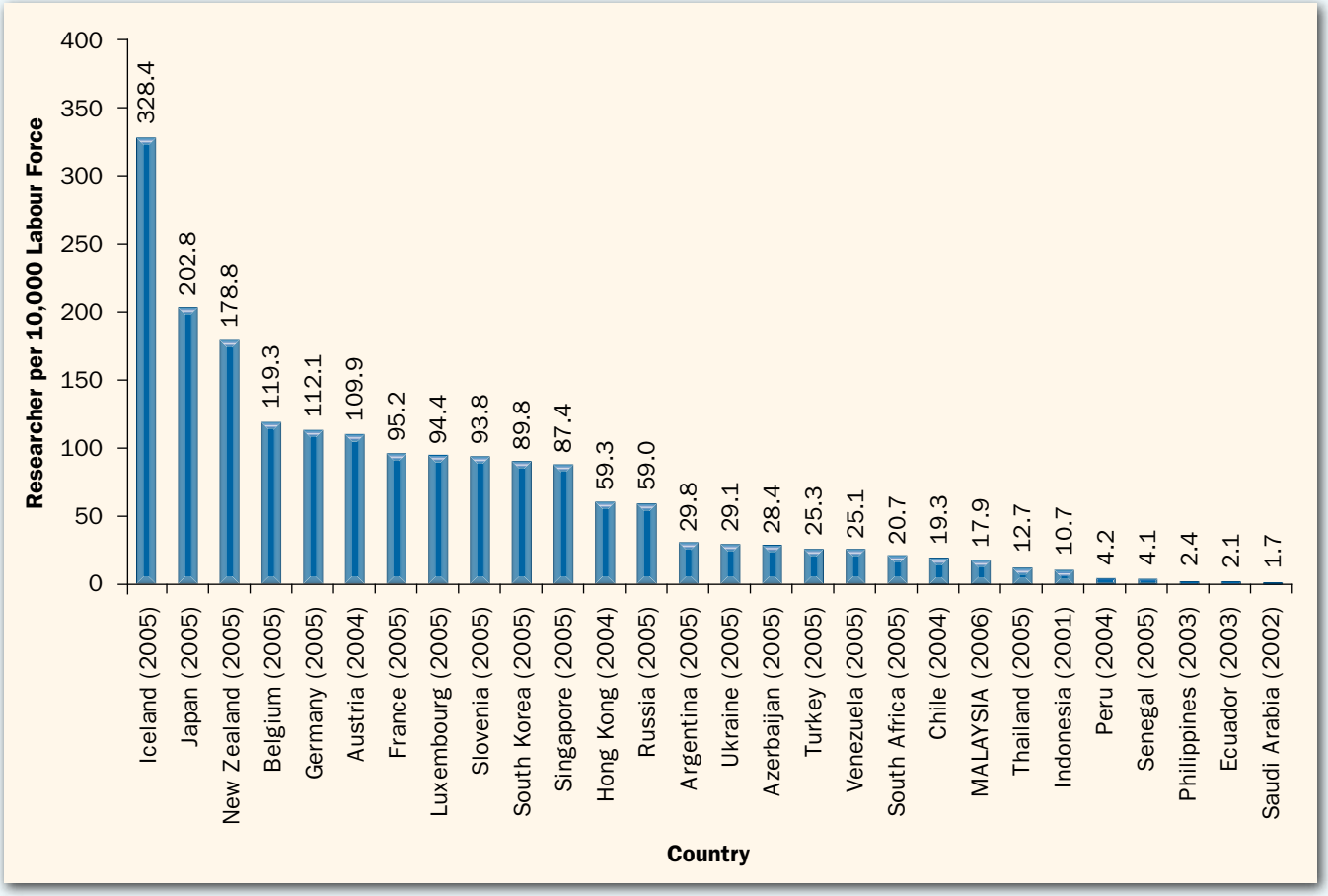
Rank	Country Name	Private Expenditure on R&D (% of GDP)	Rank	Country Name	Private Expenditure on R&D (% of GDP)
1	Israel	3.58	**26**	Ukraine	0.78
2	Sweden	2.92	**27**	Russian Federation	0.73
3	Finland	2.47	**28**	Spain	0.61
4	Japan	2.38	**29**	Italy	0.55
5	South Korea	2.29	**30**	MALAYSIA	0.54
6	Switzerland	2.16	**31**	Estonia	0.42
7	U.S.A.	1.87	**32**	Croatia	0.41
8	Germany	1.76	**33**	Hong Kong	0.41
9	Taiwan	1.69	**34**	Hungary	0.41
10	Denmark	1.67	**35**	Brazil	0.30
11	Austria	1.60	**36**	Portugal	0.29
12	Iceland	1.59	**37**	Slovak Rep	0.25
13	Singapore	1.56	**38**	Romania	0.21
14	Luxembourg	1.34	**39**	India	0.19
15	France	1.32	**40**	Poland	0.18
16	Belgium	1.24	**41**	Turkey	0.16
17	U.K.	1.09	**42**	Argentina	0.15
18	Canada	1.07	**43**	Lithuania	0.15
19	Netherlands	1.02	**44**	Mexico	0.15
20	Australia	0.97	**45**	Chile	0.14
21	Czech Republic	0.92	**46**	Greece	0.14
22	China	0.91	**47**	Bulgaria	0.12
23	Slovenia	0.91	**48**	Thailand	0.09
24	Ireland	0.82	**49**	Indonesia	0.01
25	Norway	0.80			

Source : IMD World Competitiveness Yearbook 2007

HUMAN RESOURCE DEVELOPMENT

Headcount of Researchers

Figure 69 : Researchers per 10,000 Labour Force



Source : UNESCO Institute for Statistics (www.uis.unesco.org) and Labour force from World Development Indicators

Figure 69 shows the number of researchers per 10,000 labour force for selected countries and Table 17 tabulates the number of researcher. In 2006, Malaysia's researcher headcount per 10,000 labour force was 17.9. It is quite a long way to go before Malaysia achieves the 9th Malaysia Plan target of having 50 researchers per 10,000 labour force. This places us in the same group with South Africa (20.7) and Chile (19.3). For the other ASEAN countries, Singapore has the highest concentration of researchers at 87.4; the number of researchers for Thailand, Indonesia and Philippines was 12.7, 10.7 and 2.4 per 10,000 labour force respectively. Iceland has the highest concentration of researchers, at 328.4 researchers per 10,000 labour force.

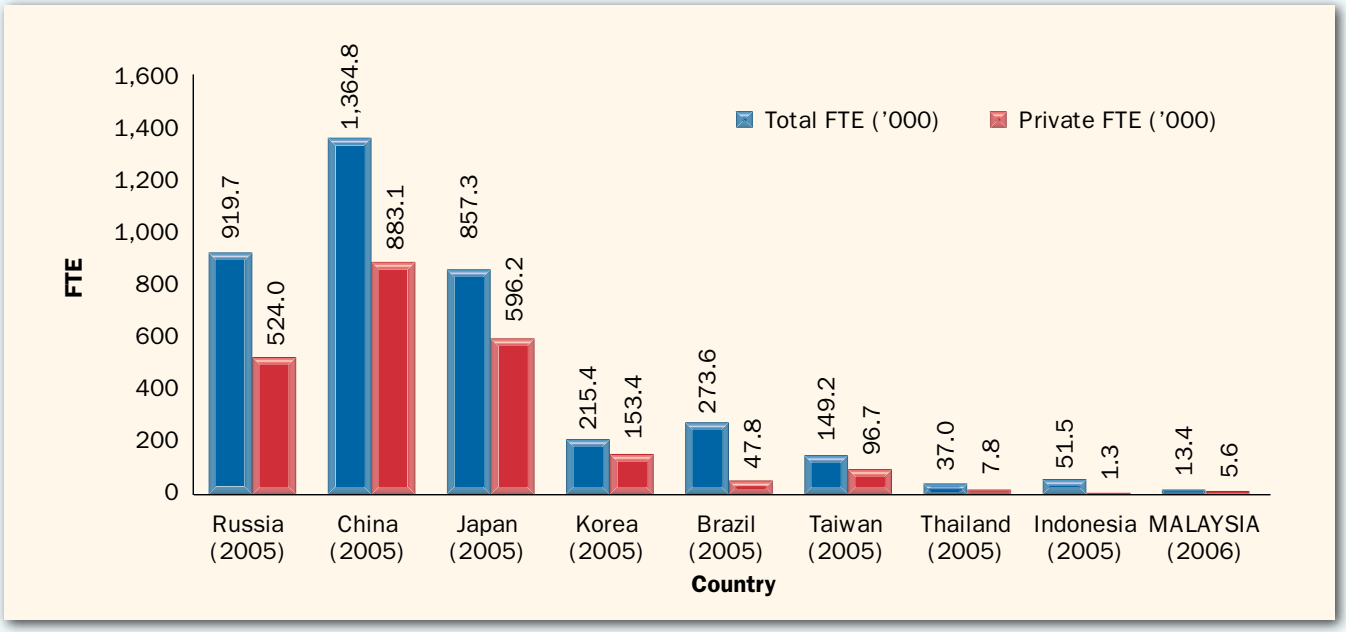
Table 17: Researchers per 10,000 Labour Force

Rank	Country	Researcher per 10,000 Labour	Rank	Country	Researcher per 10,000 Labour	Rank	Country	Researcher per 10,000 Labour
1	Iceland	328.4	**18**	South Korea	89.8	**35**	Cyprus	36.6
2	Finland	217.2	**19**	Singapore	87.4	**36**	Bulgaria	34.2
3	Norway	213.2	**20**	Lithuania	74.6	**37**	Argentina	29.8
4	Japan	202.8	**21**	Czech Rep.	70.3	**38**	Ukraine	29.1
5	Denmark	192.0	**22**	Tunisia	67.3	**39**	Azerbaijan	28.4
6	New Zealand	178.8	**23**	Netherlands	65.8	**40**	Macao	28.0
7	Sweden	161.2	**24**	Slovakia	63.4	**41**	Romania	26.7
8	Switzerland*	148.6	**25**	Croatia*	61.1	**42**	Turkey	25.3
9	Belgium	119.3	**26**	Hong Kong*	59.3	**43**	Venezuela	25.1
10	Germany	112.1	**27**	Russian	59.0	**44**	South Africa	20.7
11	Austria*	109.9	**28**	Jordan*	58.1	**45**	Chile*	19.3
12	Spain	99.3	**29**	Latvia	57.9	**46**	Botswana	19.2
13	Portugal	96.1	**30**	Hungary	52.3	**47**	MALAYSIA	17.9
14	Estonia	96.0	**31**	Italy	49.0	**48**	Brazil*	17.8
15	France	95.2	**32**	Poland	48.4	**49**	Morocco	17.4
16	Luxembourg	94.4	**33**	Belarus	43.5	**50**	Thailand	12.7
17	Slovenia	93.8	**34**	Georgia	36.6			

*Note : Data used are for calendar year 2005 except for * where data for 2004 are used. Data for Malaysia is for 2006.*
Source : UNESCO Institute for Statistics (www.uis.unesco.org) and Labour force from World Development Indicators

FTE of R&D Personnel and FTE of R&D Personnel in Private Sector

Figure 70: FTE of R&D Personnel and FTE of R&D Personnel in Private Sector

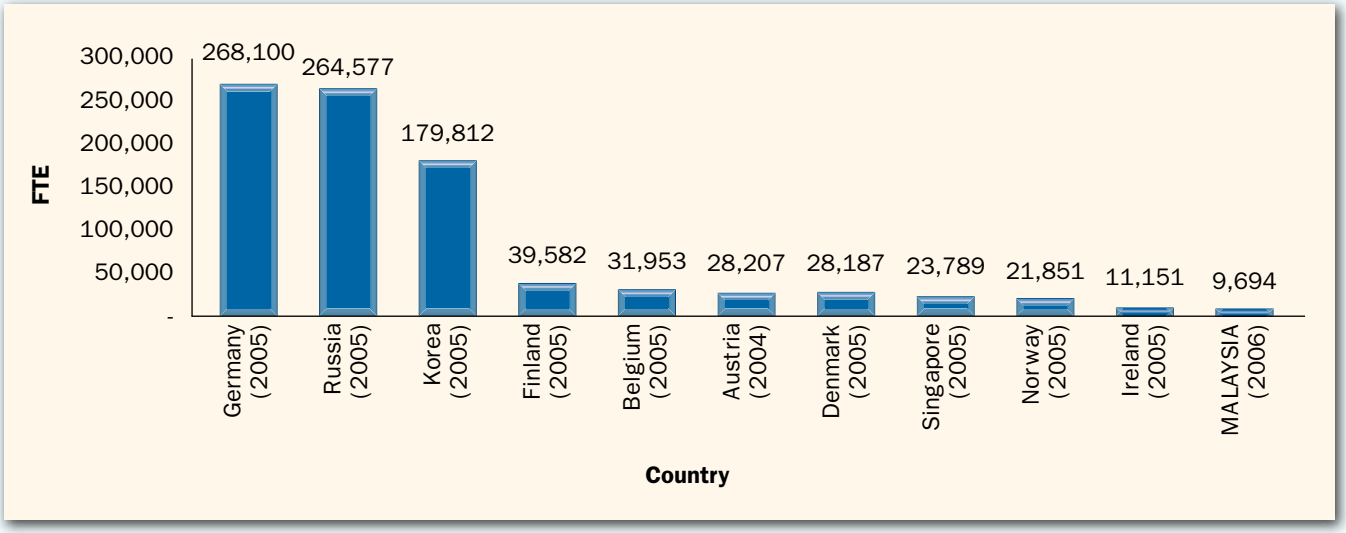


Source : IMD World Competitiveness Yearbook 2007

Figure 70 plots the total and private sector FTE for a selected group of countries. The FTE for Malaysia's private sector was 5,627.8, 42% of the total national FTE. This percentage was much higher than Indonesia, where only 3% of the FTE was from the private sector. For Thailand, 21% of the FTE was from the private sector. The private sector FTE for Japan, Korea, Taiwan, Russia and China was around 60% to 70%.

FTE of Researchers

Figure 71 : FTE of Researchers for Selected Countries

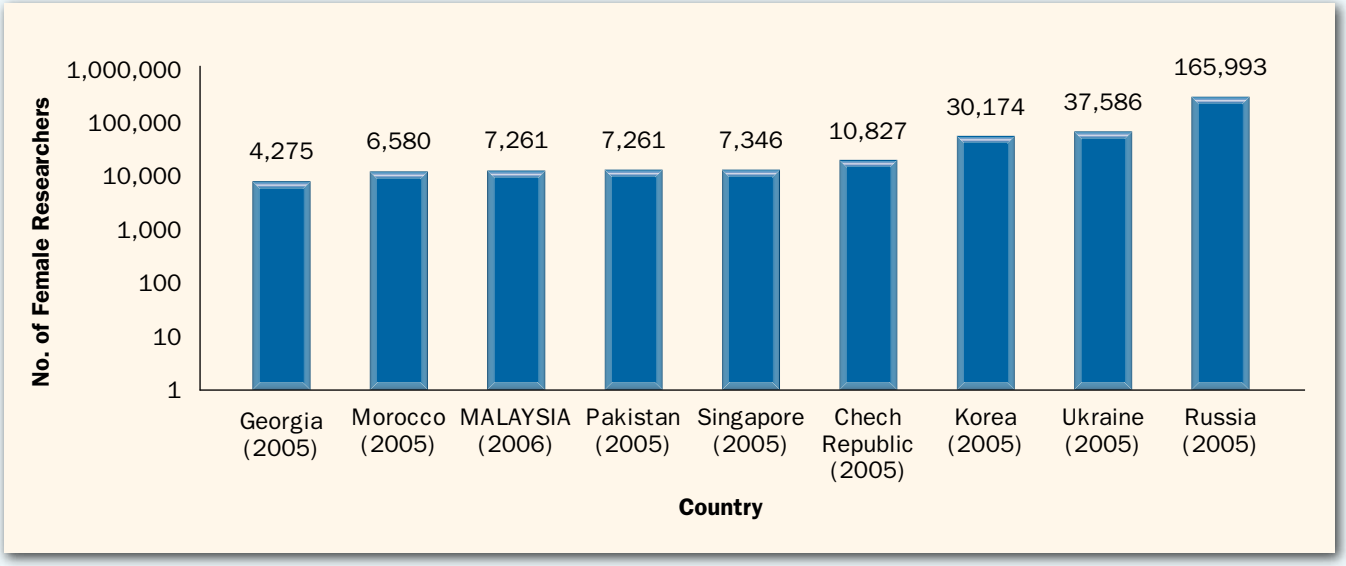


Source : UNESCO, Statistics on Research and Development

The FTE for Malaysian researchers was 9,694; this figure was much smaller than Germany with an FTE of 268,100, and the East Asian NIEs. Singapore researchers' FTE was 23,789, and South Korea's was 179,812 (Figure 71).

Female Researchers in R&D

Figure 72 : Female Researchers in Selected Countries



Source : UNESCO, Statistics on Research and Development 2006

In 2006 the number of female researchers in Malaysia was 7,261; it is comparable to that of Singapore (7,346), and Pakistan, with 7,261 female researchers (Figure 72).

CONCLUSION

CONCLUSION

In 2006, Malaysia's total expenditure on R&D activities (GERD) totaled RM3.6 billion, while her GDP was RM572.5 billion. This resulted in a GERD/GDP ratio of 0.64.

Involvement of Personnel in R&D

There were 9,233 personnel involved with R&D activities in 1996, and there were 24,588 personnel in 2006. In 2004, there were 30,983 personnel involved with R&D activities, the highest for the 10 year period.

In 1996 there were 4,243 researchers, and in 2006 there were 19,021 researchers. Similar to the number of R&D personnel, the maximum number of researchers was counted in 2004, where 23,092 researchers were involved.

The total number of female R&D personnel in 2006 was 7,990, charting a decrease of 2,554 from 10,544 female R&D personnel in 2004. In terms of proportion, female participation in R&D activities decreased from 34.0% in 2004, to 32.5% in 2006.

In terms of FTE, there was a decrease from 17,896.0 in 2004 to 13,415.9 in 2006.

Major Research

The amount spent on basic research in 2006 was RM411.4 million. RM1.6 billion was spent on applied research and RM1.6 billion on experimental research. For the 10 year period, the emphasis has been on applied research, followed by experimental and basic research. Applied research accounted for about half of the GERD for the 10 year period.

The main FOR by expenditure in 2006 was Applied Sciences and Technologies (RM1.3 billion), Engineering Sciences (RM1.2 billion), and Material Sciences (RM364.9 billion) while the main SEO was Manufacturing (RM2.3 billion), followed by Natural Sciences and Technologies Engineering (RM289.3 million), and Transport (RM214.0 million).

Public Sector R&D

Total R&D expenditure by the GRIs dropped from RM296.9 million in 2004 to RM189.5 million in 2006. while total R&D expenditure in the IHLs dropped from RM513.3 million in 2004 to RM360.8 million in 2006.

In terms of headcount, for research personnel in the GRIs fell from 7,437 in 2004 to 4,556. For the IHLs the number of research personnel dropped from 14,809 in 2004 to 13,007 in 2006.

The GRIs spent 58.2% of its expenditure on Applied Research, followed by Basic Research 23.5%, and Experimental Development Research 18.2%, while the IHLs concentrated on Applied Research (49.8%), followed by Basic Research (37.1%), and Experimental Development Research (13.1%).

The GRIs' top three R&D expenditure by FOR were in the fields of Agricultural Science, Forestry Sciences and Material Sciences, while for the IHLs, their main FOR were Medical & Health Sciences, Engineering Sciences, and Applied Sciences & Technologies.

The top three SEO for the GRIs were Natural Sciences, Technologies & Engineering, Plant Production and Plant Primary Products and Manufacturing, while for the IHLs, the top three SEO were Natural Sciences & Technologies, Manufacturing and Health.

Private Sector R&D

The GERD for private sector surpassed the RM2 billion mark in 2004, reaching slightly more than RM3 billion in 2006. This increase of RM1.0 billion is the highest recorded across the years surveyed.

There was a dramatic increase in the number of R&D personnel in 2004, where the total headcount went up from 5,177 in 2002 to 8,737 in 2004, an increase of 68.8% over 2002. This number, however, dropped considerably to 7,025 in 2006, a decline of 19.6%. The number of researchers also dropped, from 5,940 in 2004 to 4,160 in 2006, a reduction of about 30%.

In terms of type of research, Experimental Development Research (48.7%) led the way, followed by Applied Research (43.8%), and Basic Research (7.5%).

The major industry is in manufacturing of rubber and plastic products, followed by the manufacturing of motor vehicles, trailers & semi trailers. Though the focus of R&D in the private sector in Malaysia is still in manufacturing, there is a more concentrated effort in energy resources. For 2006, extraction of crude oil and natural gas is the third major industry.

The private sector's top FOR in 2006 were Applied Sciences & Technology followed by Engineering Sciences, while the top SEO was Manufacturing, followed by Transport.

Malaysia's R&D Activities (2004-2006)

The GERD of RM3.6 billion in 2006 was a significant increase compared to the GERD in 2004, which was RM2.8 billion. However, other measures for R&D activities did not show a similar increase. The GERD/GDP ratio of 0.64 was only 0.02% higher than the research intensity in 2004, while the GERD for the public sector decreased from RM810.2 million in 2004 to RM550.3 million in 2006. Furthermore, the involvements of personnel in R&D (researchers, technicians and support staff) and their FTE have decreased for both the public and the private sectors.

The increase in the GERD was due to the significant increase (RM 1.1 billion) in the private sector GERD. However, as the other measures for R&D activities did not follow the increase in GERD, this means that Malaysia's overall R&D activities have not improved for the period 2004 to 2006.

The marginal increase in GERD/GDP ratio indicates that our increase in economic growth did not bring about a commensurate increase in research intensity. In addition, the decrease in GERD, R&D personnel, and FTE, especially for the public sector, may be due to the delay in the release of funds for R&D activities in 2006. Although many projects were approved for 2006, the approved funds were not disbursed until 2007. Thus, main research activities only started in 2007, affecting both the GERD and the researcher headcount and FTE for the public sector.

Malaysia's Trend in R&D (1996-2006)

Even though R&D activities decreased from 2004-2006, for the 10 year period of 1996 to 2006, R&D activities in Malaysia have shown a significant positive trend. In nominal terms, the GERD increased 6.5 times, and in real terms it increased 4.7 times. Furthermore, the GERD over GDP ratio for the ten year period has been growing faster than the growth of the real GDP; The real GDP increased by about 50%, and the GERD over GDP ratio increased by about 190%; from 0.22 in 1996 to 0.64 in 2006.

This upward trend is also evident for the number of R&D personnel, researcher FTE, and FTE per researcher. These trends mean that Malaysia is making steady progress in its R&D activities.

However, even though Malaysia's R&D activities for the 10 year period have shown a positive trend, they are still relatively small compared to many developed countries and the East Asian NIEs. This places Malaysia in the same group as the lower middle income countries, similar to its GDP per capita. However, Malaysia spent more on R&D activities compared to the South and South East Asian countries, and the OIC member countries.

The Challenges Ahead

The process of globalisation has forced Malaysia to be heavily involved in R&D activities. The formulation of the Knowledge-Based Economy Master Plan showed that the Malaysian government has the political will to ensure that R&D is a large part of the national agenda. The challenge for the country is how to move towards the requirements needed to be successful in the knowledge-based economy.

The Malaysian government has supported R&D in the form of tax incentives, funds, and grants for both the public and private sectors. The government has set aside an amount equal to 1.5% of Malaysia's GDP for research funding under the 9th Malaysia Plan. However,

financial support alone is not sufficient, as one of the main obstacles cited by the survey respondents was the insufficient number of innovative and creative R&D personnel.

Under the 9th Malaysia Plan, the government has set a goal of having 50 researchers for every 10,000 labour force by 2010. Further, by 2020, the Malaysian Higher Education Strategic Plan is aiming towards 100 research scientists and engineers (RSE) per 10,000 labour force, the average for the EU in 2003. Nevertheless, in 2006 Malaysia's RSE per 10,000 labor force was 17.9, compared to 87.4 RSE per 10,000 labour force in Singapore. The United Nations Conference on Trade and Development's (UNCTAD) World Investment Report 2005 ranked Malaysia 60th in its Innovation Capability Index ranking.

These figures mean that Malaysia is still far from being competitive in the global K-economy. In order to succeed, Malaysia will need to increase its investment in the knowledge infrastructure. This will help in generating, acquiring and utilizing knowledge to produce high value added goods and services, and to be competitive in the global market.

The knowledge infrastructure will require an education system that is able to produce a critical mass of qualified and skilled workers, whether it be in science and technology or arts and humanities that are innovative, creative, and enterprising. This workforce will be working independently or employed by innovative firms in generating and exploiting knowledge at the frontiers, as well as new technologies demanded by the market.

New knowledge may be produced locally, due to local R&D activities, or from abroad, due to foreign direct investment (FDI). There is a need for a system that will efficiently transfer the new knowledge and technology to local industries and businesses, whether or not the new knowledge is from local R&D activities or from abroad.

The new knowledge and technology need to be protected justly, so that the gains from knowledge creation can be appropriately distributed. Thus the intellectual property system must provide an effective and just protection of intellectual property.

The workforce and a critical mass of innovative firms and entrepreneurs need to be supported by a financial system that is willing to promote and invest in high risk and consequently high return ventures, without which R&D activities will not have sufficient funds to operate.

The challenge for Malaysia lies in ensuring that both the human and financial capital can support the new economy. The education system, whether it is at the primary, secondary or tertiary level needs to be able to nurture an innovative, creative, and enterprising culture. The financial system will need to be strong enough to sustain any losses from unsuccessful ventures. And the legal system will need to be strong enough for intellectual property to be effectively and justly protected.

LIST OF ACRONYMS AND ABBREVIATIONS

LIST OF ACRONYMS AND ABBREVIATIONS

FOR : Field of Research

FTE : Full-time Equivalence

GDP : Gross Domestic Product

GERD : Gross Expenditure on R&D

GRI : Government Research Institute

ICS : Information and Communication Services

ICT : Information, Computer and Communication Technology

IHL : Institutes of Higher Learning

NIE : Newly Industrialising Economies

NSTE : Natural Sciences, Technologies and Engineering

OECD : Organization for Economic Co-operation and Development

R&D : Research and Development

RM-9 : Rancangan Malaysia ke-9 (9th Malaysian Plan)

S&T : Science and Technology

SEO : Socio-economic Objective