NATIONAL SURVEY of RESEARCH & DEVELOPMENT

2004 Report

MALAYSIAN SCIENCE AND TECHNOLOGY INFORMATION CENTRE (MASTIC)
Ministry of Science, Technology and Innovation, Malaysia

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FOREWORD

The 2004 Report on the National Survey of Research & Development was based on the survey carried out in 2002, which was the sixth 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 2004 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.

Collection of valuable data and information under the 2002 National Survey of Research & Development took six months to complete. This exercise saw the co-operation of government agencies and research institutions (GRI), institutions of higher learning (IHL) and private sector companies involved in R&D.

Since 1992, gathering of data was done through the use of traditional hardcopy survey forms, however in 2002 MASTIC introduced for the first time another option for respondents from GRI and IHL to submit their reply. The option came in the form of R&D Online, which is published in the MASTIC's website. R&D Online is an innovative and simplified way of answering the survey questions as it reduces the manual aspects of the survey. It is encouraging to note that 75% of the researchers in the public sector preferred to use R&D Online.

The survey received good co-operation 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.

MASTIC

ACKNOWLEDGEMENT

MASTIC wishes to extend our appreciation to all individuals and organisations whose involvement and commitment have contributed towards the successful completion of the 2004 Report on the National Survey of Research & Development as well as the planning and conducting the 2002 National Survey of R&D. We would like in particular to thank the Secretary-General of the Ministry of Science, Technology and Innovation for extending invaluable guidance and support, as well as the heads of various public and private sector organisations including their researchers, project coordinators and officials for their relentless efforts in ensuring the success of the survey.

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 least, we would like to thank consulting firm Spire Research Sdn Bhd for carrying out the 2002 National Survey of R&D, compiling and analysing the data as well as developing the 2004 Report in collaboration with MASTIC.

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

CONTENTS

EXECUTIVE SUMMARY

OVERVIEW OF R&D IN MALAYSIA

Malaysia's Gross Expenditure on Research and Development (GERD) has been on an upward trend since 1996: from RM549.2 million then to RM2,500.6 million in 2002.

- Current and capital expenditure increased from 1996 to reach RM1,375.2 million and RM1,125.4 million respectively in 2002.
- In 2002, R&D shifted in emphasis:

	% of GERD
Higher on applied research	68.6
Less on basic research	8.4
Relatively unchanged in experimental research	23.0

- The three major expenditure by Field of Research (FOR) were the same in 2000 and 2002, namely:
  - Engineering Sciences
  - Information, Computer and Communication Technologies
  - Applied Sciences and Technologies

  They constituted 76.1% of the GERD in 2002.
- The three major expenditure by Socio-Economic Objective (SEO) were also the same in 2000 and 2002. They were:
  - Manufacturing
  - Information and Communication Services
  - Natural Sciences, Technologies and Engineering

  They constituted 76.5% of GERD in 2002.
- R&D expenditure in the public and private sectors both increased for the period 2000 to 2002. However, R&D expenditure in the public sector decreased from 42.1% to 34.7% of the GERD while the private sector increased from 57.9% to 65.3% during the period.
- Malaysia's GERD as a proportion of the Gross Domestic Product (GDP) i.e. GERD/GDP ratio has been on an uptrend since 1996 and reached 0.69% in 2002.

The national headcount increased from 23,262 in 2000 to 24,937 in 2002. The number of researchers per 10,000 labour force was 15.6 in 2000 and rose to 18.0 in 2002. The national Full-Time Equivalent (FTE) also increased from 1996 to reach 10,059.7 in 2000 and 10,730.95 in 2002. The average FTE per R&D personnel was 0.43 in 2000 and remained at the same level in 2002.

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

R&D expenditure in the GRI sector increased from RM417.5 million in 2000 to RM507.1 million in 2002.

- Expenditure on labour in GRI increased from RM110.6 million in 2000 to RM174.6 million in 2002. However, operating expenditure in the same period declined from RM181.9 million to RM58.1 million.
- Expenditure on land and building increased from RM11.7 million in 2000 to RM27.2 million in 2002. Expenditure on machinery and equipment also increased from RM113.2 million to RM247.2 million in the same period.

There was greater involvement in GRI in applied research in 2002 compared to 2000 but the opposite occurred for basic and experimental researches.

Three major expenditure by FOR in 2002 were:
- Information, Computer and Communications Technologies
- Economics, Business and Management
- Agricultural Sciences

Three major expenditure by SEO in the same year were:
- Information and Communication Services
- Social Development and Community Services
- Plant Production and Primary Products

Internal funds were the main source of funds for GRI to conduct their R&D activities in 2002. They accounted for 78.0% of the GRI funds for R&D. Funds sourced externally including federal government funds accounted for the remaining 22.0%.

Headcount in GRI decreased from 7,777 in 2000 to 7,222 in 2002 while FTE also declined from 2,964.7 to 2,652.4 respectively. Subsequently, average FTE per R&D personnel decreased from 0.38 to 0.37.

R&D AMONG INSTITUTIONS OF HIGHER LEARNING (IHL)

R&D expenditure in the IHL sector increased from RM286.1 million in 2000 to RM360.4 million in 2002.

- From 2000 to 2002, expenditure on labour in IHL declined from RM113.8 million to RM109.2 million respectively. However, operating expenditure tripled from RM30.2 million to RM100.6 million respectively for the same period.
- Expenditure on land and building declined by two-thirds from RM61.3 million in 2000 to RM20.5 million in 2002. However, expenditure on machinery and equipment increased from RM80.8 million to RM130.1 million for the same period.

Expenditure on basic and applied researches declined while expenditure on experimental research increased from 2000 to 2002.

In 2002, the three major expenditure by FOR were:
- Environmental Sciences
- Applied Sciences and Technologies
- Engineering Sciences

The three major expenditure by SEO in the same year were:
- Manufacturing
- Natural Sciences, Technologies and Engineering
- Commercial Services

A substantial proportion of IHL's R&D funds in 2002 was externally sourced.

Sources of Funds	**%**
Intensification of Research in Priority Areas (IRPA) Fund	59.1
Other external sources	6.8
Universities' own internal funds	34.1

Headcount in IHL increased from 11,239 in 2000 to 12,538 in 2002 and FTE also increased from 3,738.0 to 3,811.9. However, the average FTE per R&D personnel decreased from 0.33 to 0.30 for the same period.

R&D IN THE PRIVATE SECTOR

In the private sector, R&D expenditure increased from RM967.9 million in 2000 to RM1,633.1 million in 2002.

- Expenditure on labour increased from RM175.9 million in 2000 to RM248.9 million in 2002 while operating expenditure for the same period increased from RM194.7 million to RM683.8 million.
- Expenditure on land and building declined from RM170.1 million in 2000 to RM120.5 million in 2002 but expenditure on machinery and equipment for the same period increased from RM427.2 million to RM579.8 million.

From 2000 to 2002, expenditure on basic research in the private sector declined but expenditure on applied and experimental researches increased.

The three major expenditure by FOR in the private sector in both 2000 and 2002 were:

- Engineering Sciences
- Information, Computer and Communication Technologies
- Applied Sciences and Technologies

The three major expenditure by SEO too were the same in both years and these were:

- Manufacturing
- Information and Communication Services
- Natural Sciences, Technologies and Engineering

Funds from the government were not prominent in financing R&D in the private sector. Instead, much of the funds for R&D were internally sourced.

Headcount in the private sector increased from 4,246 in 2000 to 5,177 in 2002. Subsequently, FTE increased from 3,357.0 to 4,266.7 and average FTE per R&D personnel increased from 0.79 to 0.82 during the period.

INTERNATIONAL COMPARISON

Though Malaysia's GERD exceeded RM2 billion and reached RM2.51 billion in 2002, it was relatively less compared to Mexico, Singapore, Turkey, Poland, Ireland, South Africa, Portugal and Greece. Malaysia's GERD in 2002 was within the level reached by the Czech Republic and Indonesia in 2001. However, Malaysia's GERD in 2002 surpassed the GERD of Hungary and Thailand in 2001.

The Asia-Pacific countries of Korea, Taiwan and Singapore surpassed Malaysia's research intensity three to four times. These countries also have a GDP per capita two to four times more than that of Malaysia.

KEY FACTS OF R&D ACTIVITIES IN MALAYSIA

	2002 R&D Survey
Organisations Surveyed with R&D	
Government Agencies and Research Institutions (GRI)	39 agencies or institutes
Institutions of Higher Learning (IHL)	17 institutes
Private sector	198 companies
Total	254 organisations
R&D Projects Surveyed	
Government Agencies and Research Institutions (GRI)	1,119 projects
Institutions of Higher Learning (IHL)	3,537 projects
Private sector	1,716 projects
Total	6,372 projects
Total R&D Expenditure	
Gross Expenditure on R&D (GERD)	RM 2,500.6 million
GERD/GDP Ratio	0.69 %
Current Expenditure	RM 1,375.2 million
Labour Cost	RM 532.7 million
Operating Cost	RM 842.5 million
Capital Expenditure	RM 1,125.4 million
Three main FOR	
1. Engineering Sciences	RM 977.9 million
2. Information, Computer and Communication Technologies	RM 610.1 million
3. Applied Sciences and Technologies	RM 313.9 million
Three main SEO	
1. Manufacturing	RM 1,063.0 million
2. Information and Communication Services	RM 644.7 million
3. Natural Sciences, Technologies and Engineering	RM 205.2 million
Total Human Resources in R&D	
Total Headcount of R&D Personnel	24,937
Total Headcount of Researchers	17,790
Total FTE of R&D Personnel	10,730.95
Total FTE of Researchers	7,157.54
FTE per R&D Personnel	0.43
FTE per Researcher	0.40
Total Number of Degree Holders (PhDs, Masters, Bachelors)	16,553
Number of Researchers per 10,000 Labour Force	18.0
R&D Expenditure R&D Personnel	RM 100,277.7
R&D IN GOVERNMENT AGENCIES & RESEARCH INSTITUTIONS (GRI)	
R&D Expenditure in GRI	
Total Expenditure	RM 507.1 million
Current Expenditure	RM 232.7 million
Labour Cost	RM 174.6 million
Operating Cost	RM 58.1 million
Capital Expenditure	RM 274.4 million
Human Resources in R&D	
Headcount of R&D Personnel	7,222
Headcount of Researchers	3,914
Headcount of Support Staff	3,308
FTE of R&D Personnel	2,652.40
FTE of Researcher	1,203.49
FTE per R&D Personnel	0.37
FTE per Researcher	0.31
Other Indicators	
Largest R&D Activity by Field of Research (FOR)	Information, Computer and Communications Technologies
Largest R&D Activity by Socio-Economic Objective (SEO)	Information and Communication Services

	2002 R&D Survey
R&D IN INSTITUTIONS OF HIGHER LEARNING (IHL)	
R&D Expenditure	
Total Expenditure	*RM 360.4 million*
Current Expenditure	*RM 209.8 million*
Labour Cost	*RM 109.2 million*
Operating Cost	*RM 100.6 million*
Capital Expenditure	*RM 150.7 million*
Human Resources in R&D	
Headcount of R&D Personnel	*12,538*
Headcount of Researchers	*10,527*
Headcount of Support Staff	*2,011*
FTE of R&D Personnel	*3,811.89*
FTE of Researchers	*3,186.95*
FTE per R&D Personnel	*0.30*
FTE per Researcher	*0.30*
Other Indicators	
Largest R&D Activity by Field of Research (FOR)	*Environmental Sciences*
Largest R&D Activity by Socio-Economic Objective (SEO)	*Manufacturing*
R&D IN THE PRIVATE SECTOR	
R&D Expenditure	
Total Expenditure	*RM 1,633.1 million*
Current Expenditure	*RM 932.7 million*
Labour Cost	*RM 248.9 million*
Operating Cost	*RM 683.8 million*
Capital Expenditure	*RM 700.3 million*
Human Resources in R&D	
Headcount of R&D Personnel	*5,177*
Headcount of Researchers	*3,349*
Headcount of Support Staff	*1,828*
FTE of R&D Personnel	*4,266.70*
FTE of Researchers	*2,767.10*
FTE per R&D Personnel	*0.82*
FTE per Researcher	*0.83*
Other Indicators	
Largest Industry Group Involved in R&D	*Motor Vehicles, Trailers and Semi-Trailers*
Largest R&D Activity by Field of Research (FOR)	*Engineering Sciences*
Largest R&D Activity by Socio-Economic Objectives (SEO)	*Manufacturing*

Notes:
Total labour force 2002 ('000) = 9886.2
Total population 2002 (million) = 24.53
GDP 2002 (RM million) = 361,624

OBJECTIVES OF THE 2002 NATIONAL R&D SURVEY

The key objectives are:

- To assess trends and developments in R&D between GRI, IHL and private sector organisations in Malaysia
- To assess challenges faced by GRI, IHL and private sector organisations in Malaysia in their R&D endeavour
- To make comparative analysis of Malaysia's international position in R&D against other developing countries

RESEARCH METHODOLOGY USED IN THE 2002 NATIONAL R&D SURVEY

The methodology adopted included a review of the previous 2000 National R&D Survey questionnaires sent to GRI, IHL and private companies. Hardcopy survey forms were initially delivered to the Project Co-ordinators appointed by their respective GRI and IHL before being redistributed to the researchers. In the 2002 R&D Survey, researchers were given the option to reply either through the traditional hardcopy survey form or respond via an online version known as R&D Online published in MASTIC's website. However, only hardcopy survey forms were made available to private companies.

In the public sector, survey forms were directed to and filled by individual researchers who accounted for their own R&D activities in 2002. In the private sector, a single survey form was sent to each company to account for the total R&D activities conducted by the company in 2002.

Distribution of survey forms and collection of completed forms took six months. Quality control (QC) checks were conducted on each hardcopy and online survey form submitted to ensure accuracy of the data. Face-to-face interviews were conducted with selected researchers in GRI and IHL, and relevant officials in private companies to complement the survey.

Sector	No. of Org. Surveyed	No. of Org. Responded	No. of Org. with R&D
GRI	41	39	37
IHL	18	17	17
Private	2,312	461	198
Total	2,371	517	254

Sector	No. of Res. Surveyed	No. of Res. Responded	Response Rate
GRI	1,435	1,119	78.0%
IHL	4,790	3,537	73.8%

Extracted data from the 2002 R&D Survey; statistical data from previous R&D survey reports; feedbacks from interviews; and published sources analysed to develop findings and trends on R&D in Malaysia are published in this report.

Key terms used in this report are based on the *Proposed Standard Practice for Surveys of Research and Experimental Development (published in 2002)* commonly known as *The Frascati Manual*. *The Frascati Manual*, developed by the Organisation for Economic Co-operation and Development (OECD), is internationally recognised and accepted as the international standard for discussion and analysis on matters related to R&D.

MAJOR GOVERNMENT MECHANISMS PROMOTING R&D IN MALAYSIA

Major Government Agencies Promoting R&D

Malaysian Technology Development Corporation (MTDC). MTDC provides financial and professional assistance in commercialisation of R&D findings as well as facilitates technology transfer into the country from overseas. The MTDC grant scheme covers several funding schemes.

Malaysian Industry Government Group for High Technology (MiGHT). MiGHT was formed in 1993 and is a joint government and private sector initiative. Its role is to identify new business opportunities to exploit prospects in research and technology.

Major Areas Identified with Focus on R&D

Multimedia Super Corridor (MSC). The MSC is an area measuring 15km by 40km and has within it the Kuala Lumpur City Centre (KLCC), Putrajaya, Cyberjaya and the Kuala Lumpur International Airport (KLIA). The MSC spearheads development of information and communication technology in the country and managed by The Multimedia Development Corporation (MDC).

Technology Park Malaysia (TPM). TPM was established in 1988 to provide world-class infrastructure and facilities for knowledge-based industries. Its aim is to facilitate private sector participation in R&D in the country right up to the commercialisation of the R&D findings. Additionally, it is intended to increase R&D collaboration between public and private sector organisations.

BioValley Malaysia. BioValley Malaysia was officially launched in May 2003 following the government initial announcement of its BioValley initiative in 2001. It is located within the MSC and will be developed across 2,000 hectares south of Cyberjaya. The BioValley Development Corporation (BDC) manages BioValley Malaysia while the Biotechnology Development Directorate provides assistance in commercialisation of R&D findings in biotechnology.

Major Government Grants and Funds

Intensification of Research in Priority Areas (IRPA). IRPA was established to promote R&D in the public sector through grants managed by the Ministry of Science, Technology and Innovation. Private sector organisations are also eligible provided R&D activities are conducted with the involvement of public sector organisations.

Industry Research and Development Grant Scheme (IGS). The IGS Scheme was established in 1997. It is also managed by the Ministry of Science, Technology and Innovation. The aim of the scheme is to increase R&D activities in the private sector and collaboration between the private and public sectors. Malaysian and Malaysian-majority owned companies are eligible to apply for the scheme and are required to work with local GRI or IHL.

Multimedia Super Corridor Research and Development Grant Scheme (MGS). The MDC implements this scheme. MGS is targeted at Malaysian and joint-venture companies, which are at least 30% Malaysian-owned and having MSC status, and primarily targeted at R&D projects involved in multimedia applications.

Demonstrator Application Grant Scheme (DAGS). This scheme was established in 1998 and managed by MIMOS Bhd (formerly known as the Malaysian Institute for Microelectronic Systems). The scheme encourages R&D in information technology (IT) and multimedia

based applications. It is targeted at short-term R&D projects of less than 12 months. Locally registered companies with at least 30% Malaysian ownership are eligible for the scheme.

Human Resource Development Scheme (HRDS). The HRDS was set up to enhance human resources development in R&D. The HRDS is an umbrella programme with several schemes under it including the Science and Technology Human Resource Development Fund (S&T HRDF), National Science Fellowship (NSF) and Postgraduate and Postdoctoral Programmes (PPP).

Industrial Technical Assistance Fund (ITAF). ITAF was set up in 1990 and its aim is to provide financial assistance to enhance technology development among small and medium scale industries (SMI) in the country.

Investment and Capital Tax Allowance

Pioneer Status. The government accords this status to qualified contract R&D companies providing R&D services in Malaysia to companies other than its related company. Pioneer Status offers 100% tax exemption of statutory income for 5 years, or Investment Tax Allowance of 100% on qualifying capital expenditure within 10 years which can be offset against 70% of the statutory income for the year under assessment.

Investment Tax Allowance. The government also offers qualified R&D companies that provide R&D services in Malaysia to its related company or any other company an Investment Tax Allowance of 100% on the qualifying capital expenditure incurred within 10 years. This allowance can be offset against 70% of its statutory income under the year of assessment. If the R&D company opts not to avail itself to the allowance, then its related company can apply for double tax deduction for payments made to the R&D company.

Double Tax Deduction. A company can also apply for double tax deduction on its revenue for non-capital expenditure for research undertaken by research institutes approved by the Ministry of Finance.

PRIVATE SECTOR MECHANISM PROMOTING R&D

Promoting R&D through Internally Generated Funds

Many private sector organisations involved in R&D fix a proportion of their revenue to fund their R&D activities. Large multinational companies operating in Malaysia also source their R&D funds within the company's group located outside Malaysia. However, Malaysian companies often source funds for their R&D activities from within the country.

Private Sector Vehicles Promoting R&D

Venture capital companies are examples of organisations in the private sector promoting R&D by investing in technology companies with strong growth potential but having limited funds to grow their business and commercialise the outcome of their R&D efforts. Malaysian Venture Capital and OSK Technology Ventures are examples of such venture capital companies which derive gain from their investments through growth in the invested company's business or through listing on MESDAQ of Bursa Malaysia.

Private sector organisations such as Malaysian Debt Ventures promote R&D by providing loans to technology companies with strong growth potential. These debt venture companies take higher risks than banks, since loans are geared towards the business potential rather than the company's assets.

Technology companies can also secure funds from the public through initial public offering (IPO) for listing on MESDAQ of Bursa Malaysia. MESDAQ allows technology companies with strong growth potential to seek these funds to finance their R&D activities.

GROSS EXPENDITURE ON R&D (GERD)

Malaysia's GERD has been on an upward trend since 1996 (Figure 1). GERD passed the RM1 billion mark when it reached RM1,127.0 million in 1998 and increased further to reach RM1,671.5 million in 2000. GERD then passed the RM2 billion mark in 2002 when it reached RM 2,500.6 million.

- Current expenditure (consisting of labour and operating costs) increased from RM807.2 million in 2000 to RM1,375.2 million in 2002.
- Capital expenditure (consisting of expenditure on land, building, vehicles, machinery and equipment) increased from RM864.3 million in 2000 to RM1,125.4 million in 2002.
- Malaysia's GERD as a proportion of GDP has been on an uptrend since 1996. The GERD/GDP ratio increased from 0.22% in 1996 to 0.39% in 1998. GERD/GDP ratio increased further to 0.50% in 2000 before reaching 0.69% in 2002.

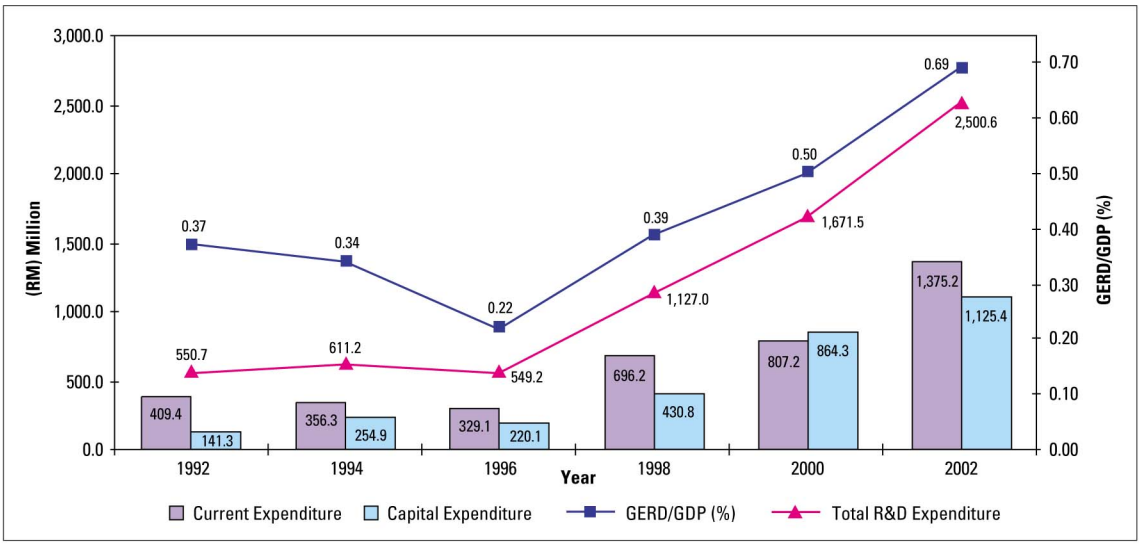


Figure 1: R&D Expenditure

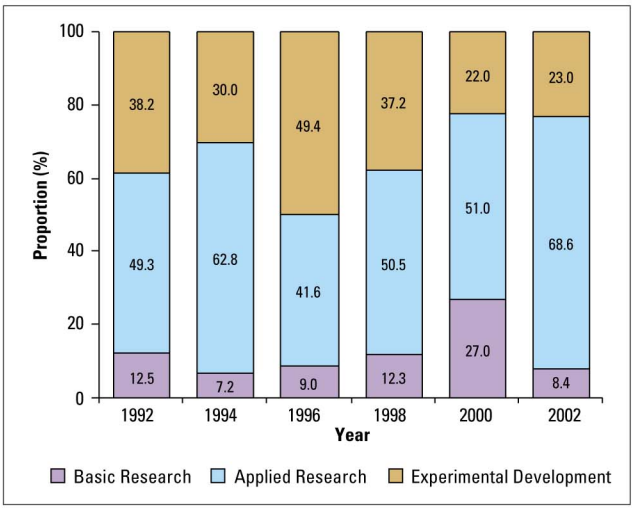


Figure 2: Proportion of Expenditure by Type of Research

Expenditure by Type of Research

Overall, the country's R&D activities focussed on applied research followed by experimental research (Figure 2). The emphasis on applied research in 2002 was more prominent in the private sector, which emphasised less on basic research. Similarly, GRI showed more emphasis towards applied research and IHL towards experimental research than basic research.

Expenditure by FOR

The three major R&D activities by FOR in 2002 accounting for nearly three-quarters of Malaysia's GERD were:

- Engineering Sciences (RM977.9 million)
- Information, Computer & Communication Technologies (RM610.1 million)
- Applied Sciences & Technologies (RM313.9 million)

The combined expenditure in these three major FOR increased from RM1,211.5 million in 2000 to RM1,901.9 million in 2002. Thus, their proportion of GERD increased from 72.5% in 2000 to 76.1% in 2002 (Figure 3).

Expenditure by SEO

The three major R&D activities by SEO in 2002 were:

- Manufacturing (RM1,063.0 million)
- Information & Communication Services (RM644.7 million)
- Natural Sciences, Technologies & Engineering (RM205.2 million)

The combined expenditure of these three R&D activities increased from RM1,164.1 million in 2000 to RM1,912.9 million in 2002. Together, they accounted for 69.6% of the GERD in 2000, which increased to 76.5% in 2002 (Figure 4).

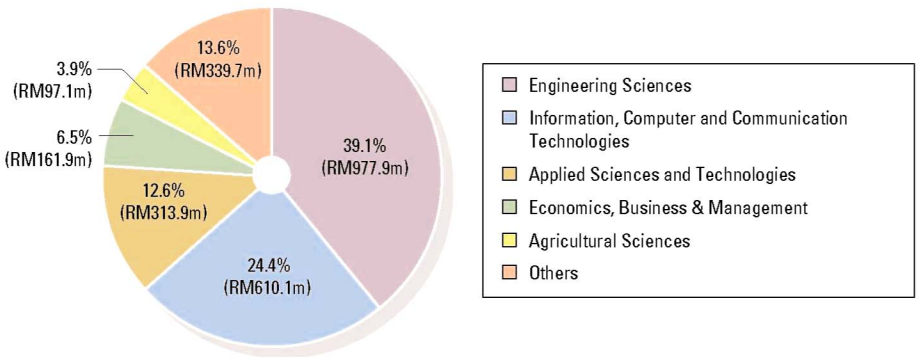


Figure 3: Proportion of Expenditure by FOR in 2002

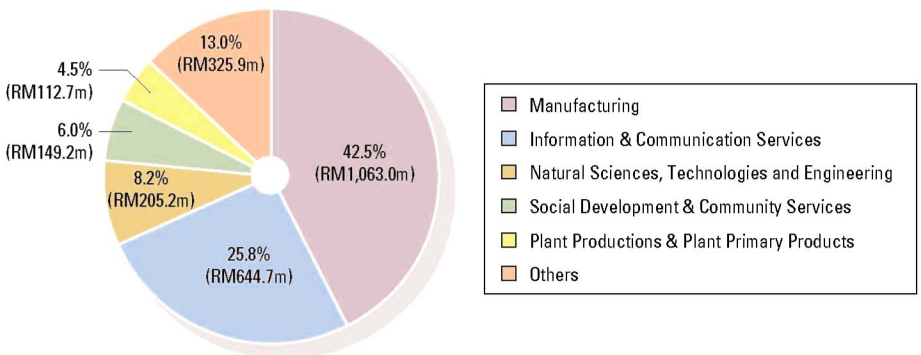


Figure 4: Proportion of Expenditure by SEO in 2002

SOURCES OF FUNDS

Funds sourced within the organisation accounted for most of the R&D funds in 2002 (Figure 5). The private sector, throughout the years, relies primarily on internal funds for its R&D activities accounting for the majority of the total R&D funds sourced internally. The private sector spent RM1,633.1 million on R&D in 2002 and sourced 75.8% of its R&D funds internally. GRI spent RM507.1 million on R&D in 2002, and also relied significantly on internal funds accounting for 78.0% of its R&D expenditure. However, IHL are more dependent on external funds accounting for 65.9% of their R&D funds in 2002.

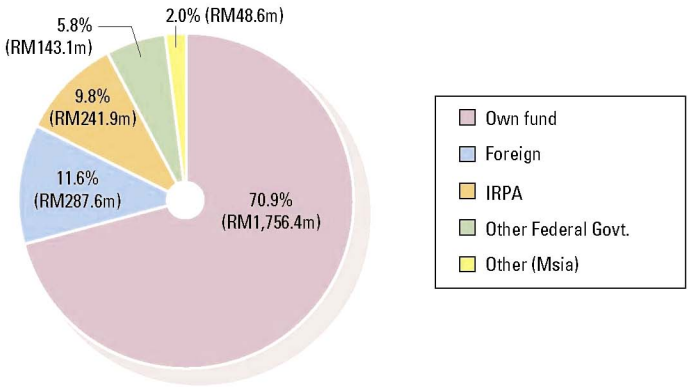


Figure 5: Proportion of Sources of R&D Funds in 2002

HUMAN RESOURCES DEVELOPMENT

By Headcount

The headcount of R&D personnel including researchers, technicians and support staff reached 24,937 in 2002 (Figure 6). From 2000 to 2002, the number of:

- Researchers increased from 15,022 to 17,790
- Technicians increased from 2,289 to 3,090
- Support staff declined from 5,951 to 4,057

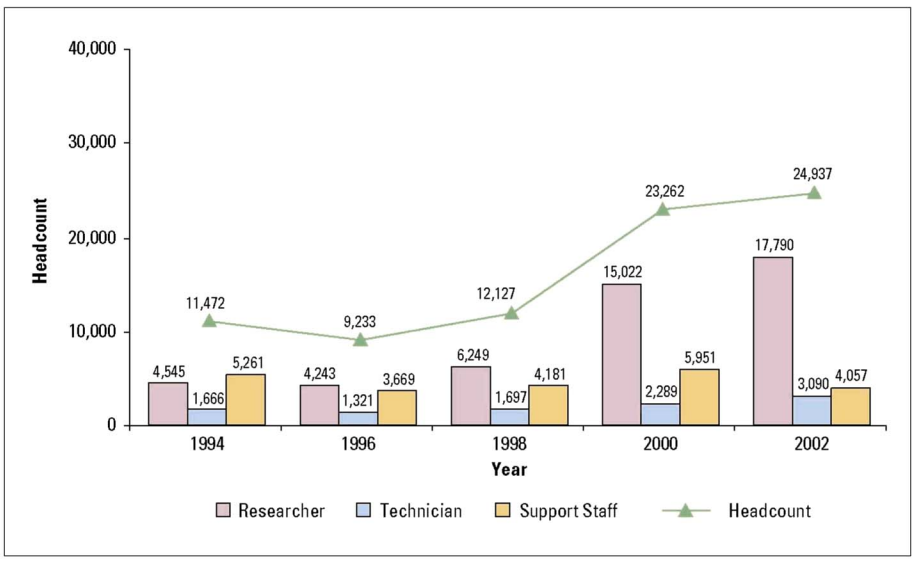


Figure 6: National Headcount of R&D Personnel

By FTE

Similar to the national headcount, the national FTE of R&D personnel increased by 6.7% from 10,059.7 in 2000 to 10,731.0 in 2002 (Figure 7). Between 2000 and 2002, the national FTE among:

- Researchers increased from 6,422.7 to 7,157.5
- Technicians increased from 921.5 to 1,378.8
- Support staff declined from 2,715.5 to 2,194.7

However, the average FTE per R&D personnel in the public sector declined from 2000 to 2002. During the period, the average FTE per R&D personnel in:

- GRI declined from 0.38 to 0.37
- IHL declined from 0.33 to 0.30

Only the private sector recorded a notable increase from 0.79 in 2000 to 0.82 in 2002.

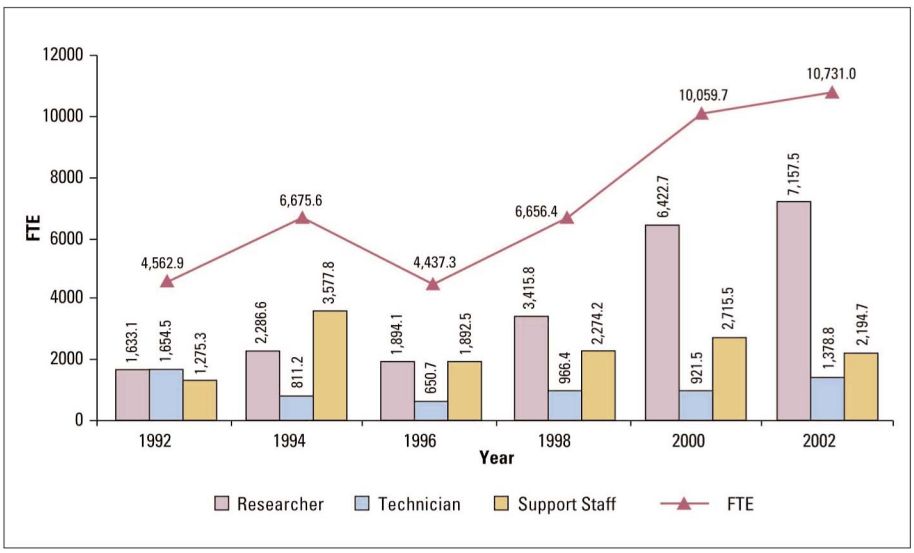


Figure 7: National FTE of R&D Personnel

Participation of Women in R&D

The total number of women R&D personnel increased by 6.5% from 7,521 in 2000 to 8,009 in 2002 (Figure 8) but their proportion remained relatively unchanged. The total number of women researchers involved in R&D in both the public and private sectors also increased by 17.6% from 5,097 in 2000 to 5,996 in 2002. However, women researchers continue to account for only one-third of the total researchers in the country.

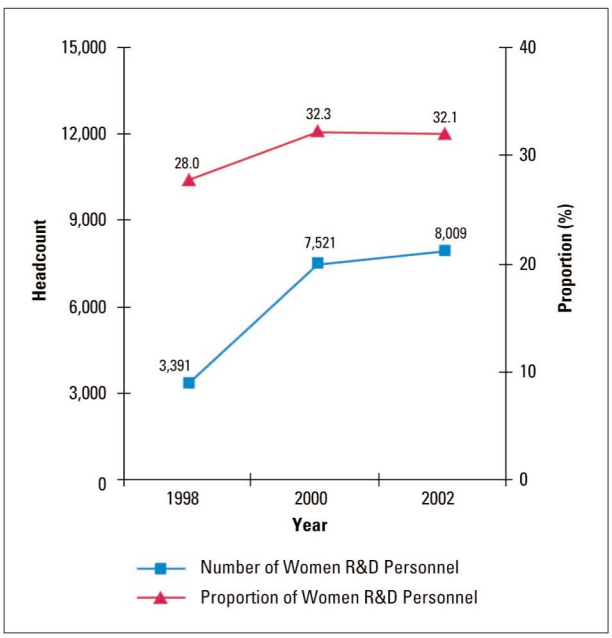


Figure 8: Women R&D Personnel

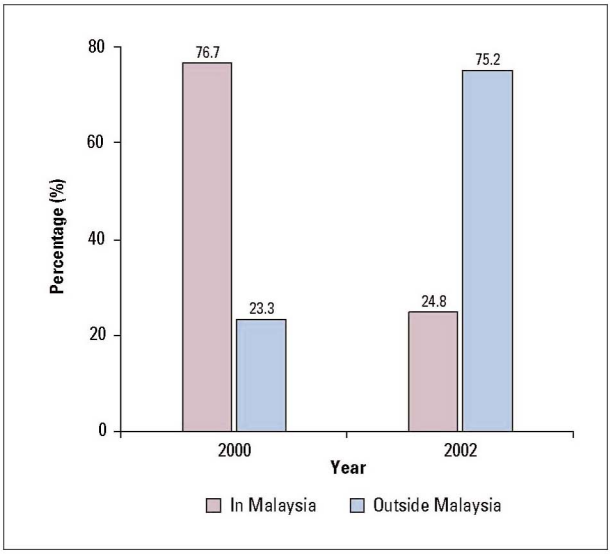


Figure 9: Proportion of Outsourced R&D

OUTSOURCED R&D

From 2000 to 2002, total outsourcing of R&D declined by 46.2% from RM569.1 million to RM306.0 million respectively. The major cause was a decline in outsourcing of R&D by Malaysia Centre for Remote Sensing (MACRES) – a GRI, from RM410.0 million in 2000 to only RM0.28 million in 2002.

Most of the R&D outsourced in 2000 was done locally. The reverse occurred in 2002 when the majority of the funds were outsourced to foreign countries (Figure 9). A probable reason for outsourcing R&D overseas was the lack of technical expertise or facilities in Malaysia to conduct the particular R&D activity.

Comparison Between The Public And Private Sectors

GROSS EXPENDITURE ON R&D

R&D expenditure in the private sector has always outpaced the expenditure in the public sector since 1996. However, the proportion of the total R&D expenditure in the public sector has increased from 27.1% in 1996 to 33.8% in 1998 and further to 42.1% in 2000 but it decreased to 34.7% in 2002. This decrease was attributed to a strong increase in expenditure in the private sector from RM967.9 million in 2000 to RM1,633.1 million in 2002 (Figure 10).

Expenditure by Type of Cost

Public sector expenditure on labour was higher than that spent in the private sector in 2000 and also in 2002 (Figure 11). In 2000, the private sector operating expenditure was lower than that of the public sector but this reversed in 2002 when it increased nearly four-fold.

Private sector expenditure on land and building has generally been higher than that of the public sector since the first survey. The private sector also recorded higher spending on machinery and equipment since 1996.

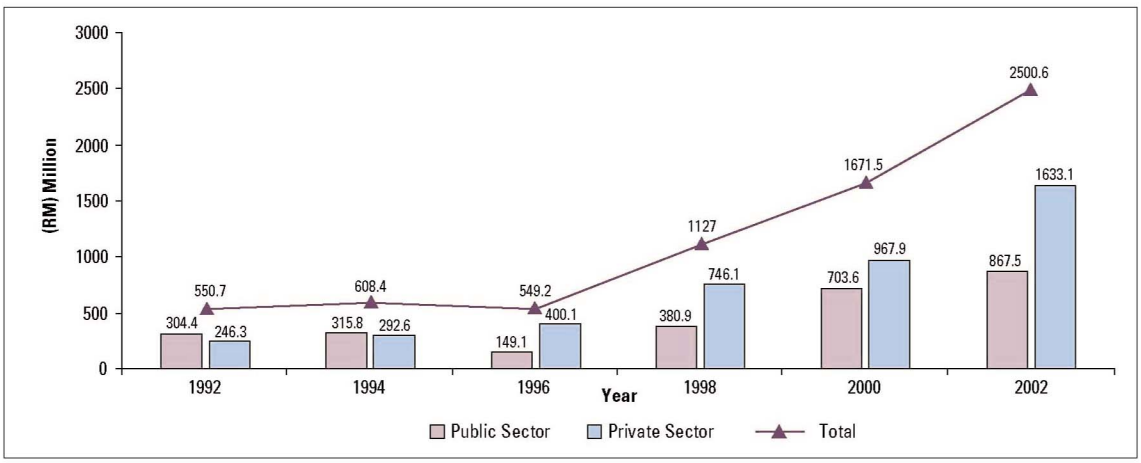


Figure 10: Gross Expenditure on R&D between Public and Private Sector

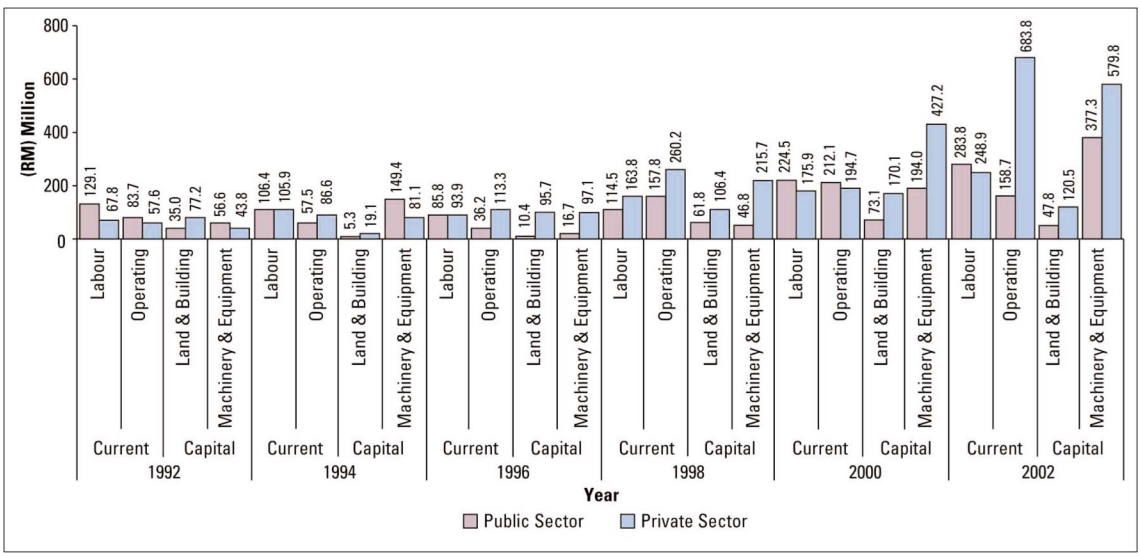


Figure 11: R&D Expenditure by Type of Cost Between Public and Private Sector

Expenditure by Type of Research

The public sector generally spends more on basic research than the private sector in each year surveyed except 2000 (Figure 12). On the other hand, the private sector has been spending more on applied research than the public sector since 1996. In 2000 and 2002, public sector expenditure on experimental research increased and it spent more on this area than the private sector.

Expenditure by FOR

The three major FOR by expenditure were the same for the public and private sectors in 2000 and 2002, however, the private sector spent comparatively more in this category than the public sector (Figure 13). In other categories, namely Agricultural Sciences and Biological Sciences, the public sector spent more than the private sector in 2000 and 2002.

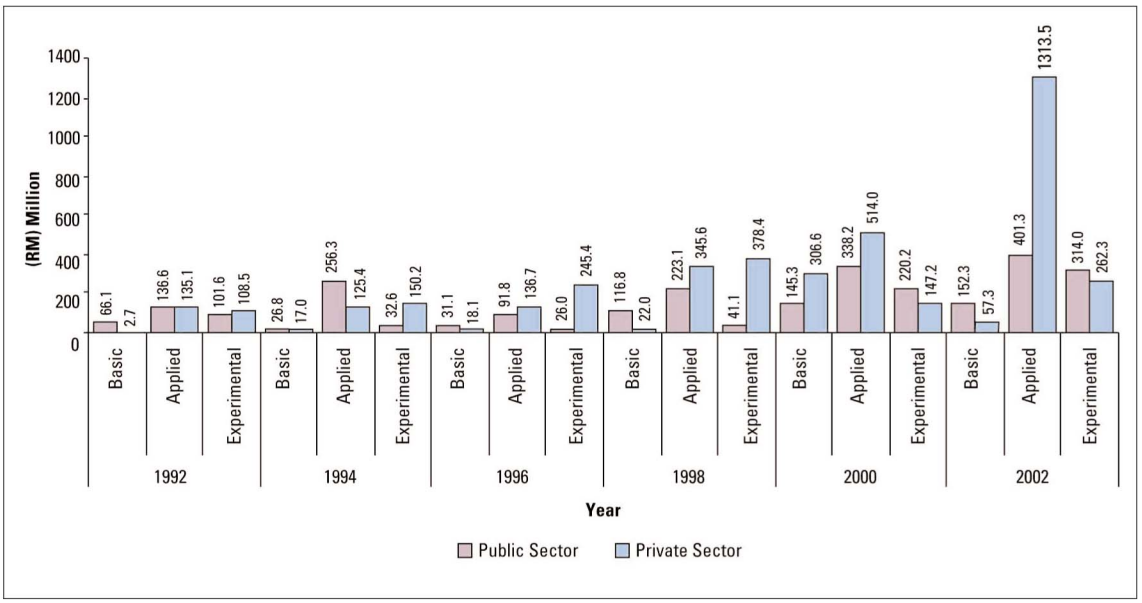


Figure 12: R&D Expenditure between Public & Private Sector by Type of Research

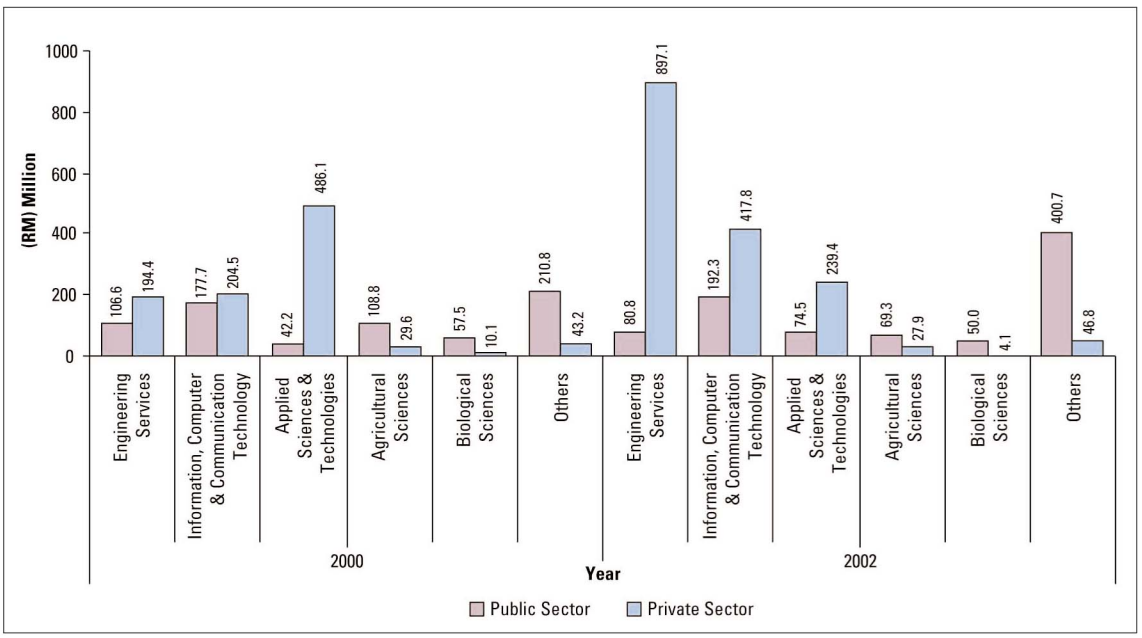


Figure 13: 5 Major R&D Expenditure between Public & Private Sector by FOR

Expenditure by SEO

The three major SEO by expenditure were also the same for both the public and private sectors in 2000 and 2002 (Figure 14). The private sector spent more on Manufacturing and Information and Communication Services. However, the public sector spent more on Natural Sciences, Technologies and Engineering in 2000 but incurred nearly the same expenditure as the private sector in this category in 2002. In other categories, namely Plant Production and Plant Primary Products and Environmental Aspects of Development, the public sector spent more than the private sector.

SOURCES OF FUNDS

Most of the funds for R&D in 2002 were from the organisations' internally generated funds (Figure 15). External funds for R&D from the federal government (including IRPA) amounted to RM385.0 million in 2002. The main recipients of these federal government funds were public sector organisations, especially IHL. The private sector including multinational companies received nearly all of the external funds from overseas.

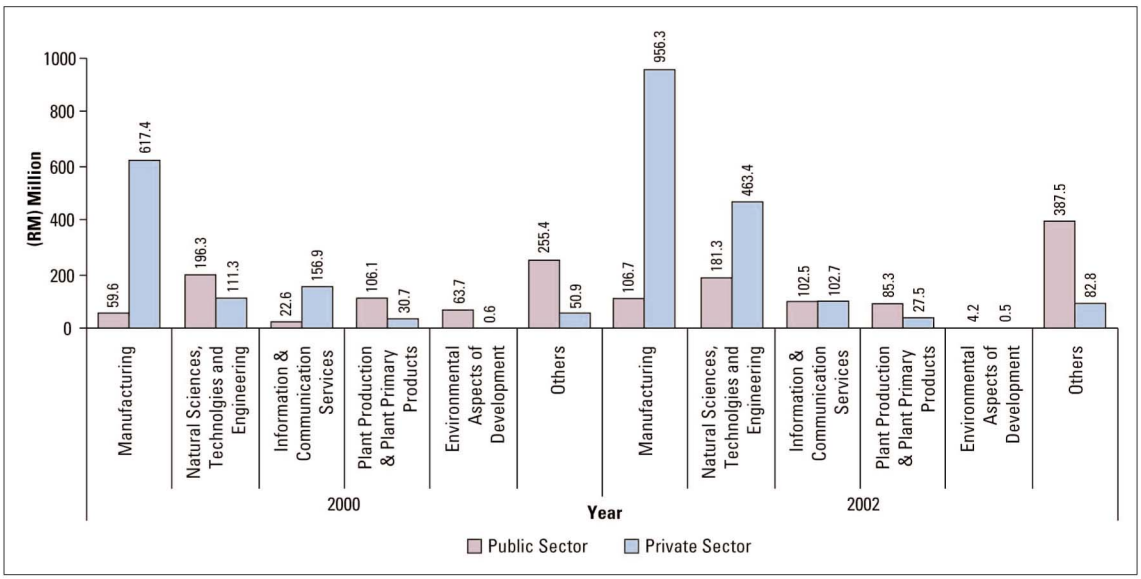


Figure 14: R&D Expenditure between Public & Private Sector by SEO

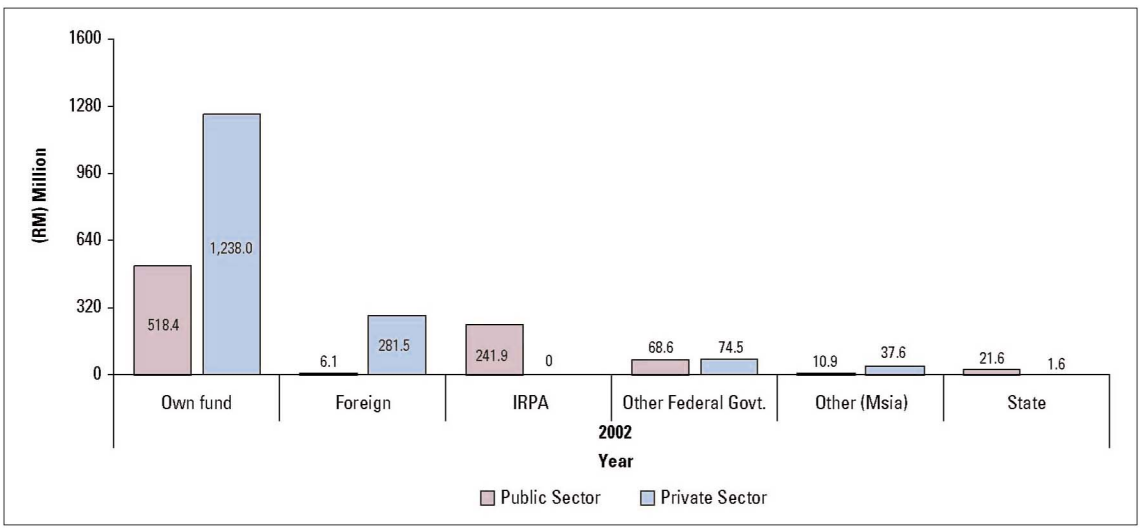


Figure 15: Sources of R&D Funds between Public & Private Sector

HUMAN RESOURCES DEVELOPMENT

By Headcount

The public sector accounted for nearly two-thirds of the R&D headcount from 1994 to 1998. In 2000 and 2002, this proportion increased further with the public sector accounting for 19,016 or 81.7% of the total headcount in 2000 and 19,760 or 79.2% in 2002 (Figure 16). Graduate and postgraduate students conducting research with researchers in IHL also contributed to the headcount in the public sector.

By FTE

FTE in the public sector was higher compared to the private sector in 2000 and 2002. However, FTE in the public sector declined moderately by 3.6% from 6,702.7 in 2000 to 6,464.3 in 2002. FTE in the private sector grew by 27.1% from 3,357.0 in 2000 to 4,266.7 in 2002 attributed to the increase in headcount in the private sector (Figure 17).

By proportion, the public sector accounted for nearly two-thirds of the total FTE in 2000 and 2002. The public sector accounted for 66.6% of the total FTE in 2000 but the proportion decreased to 60.2% in 2002. The proportion of the FTE contributed by the private sector increased from 33.4% in 2000 to 39.8% in 2002.

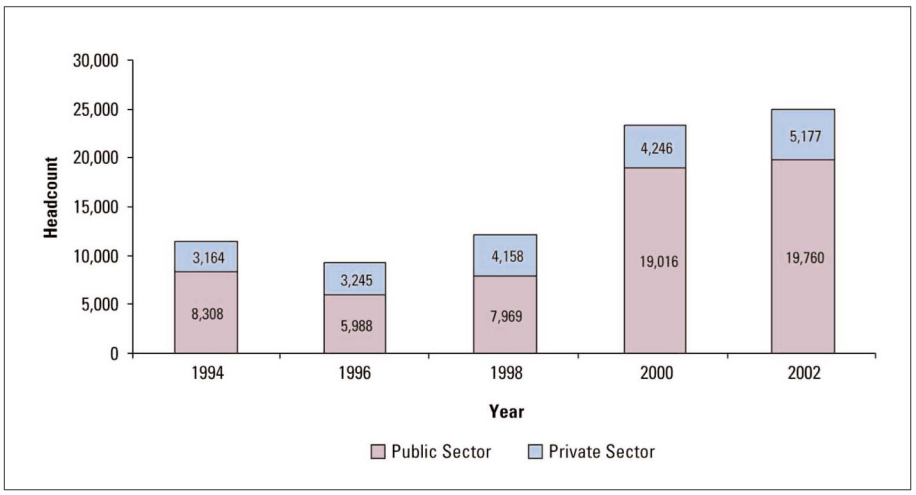


Figure 16: Comparison Between Public and Private Sector by Headcount

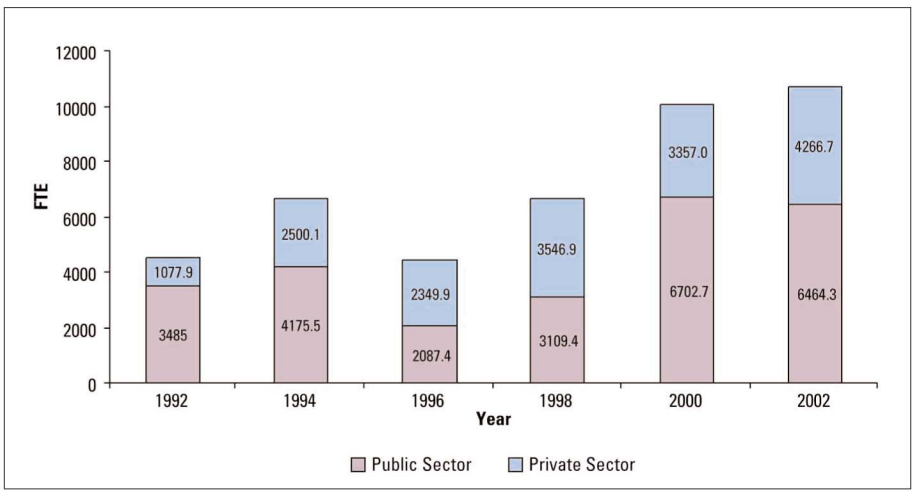


Figure 17: Comparison Between Public and Private Sector by FTE

OUTSOURCED R&D

The public sector tends to outsource R&D within Malaysia. Outsourcing was most prominent in 2000 when the public sector outsourced RM425.0 million within Malaysia while only RM120.7 million was outsourced overseas (Figure 18). MACRES outsourced the most, amounting to nearly RM410.0 million.

On the other hand, the private sector has always outsourced a larger amount outside Malaysia compared to within Malaysia. Outsourcing to other countries by the private sector in 2002 was mainly by foreign multinational companies operating in Malaysia.

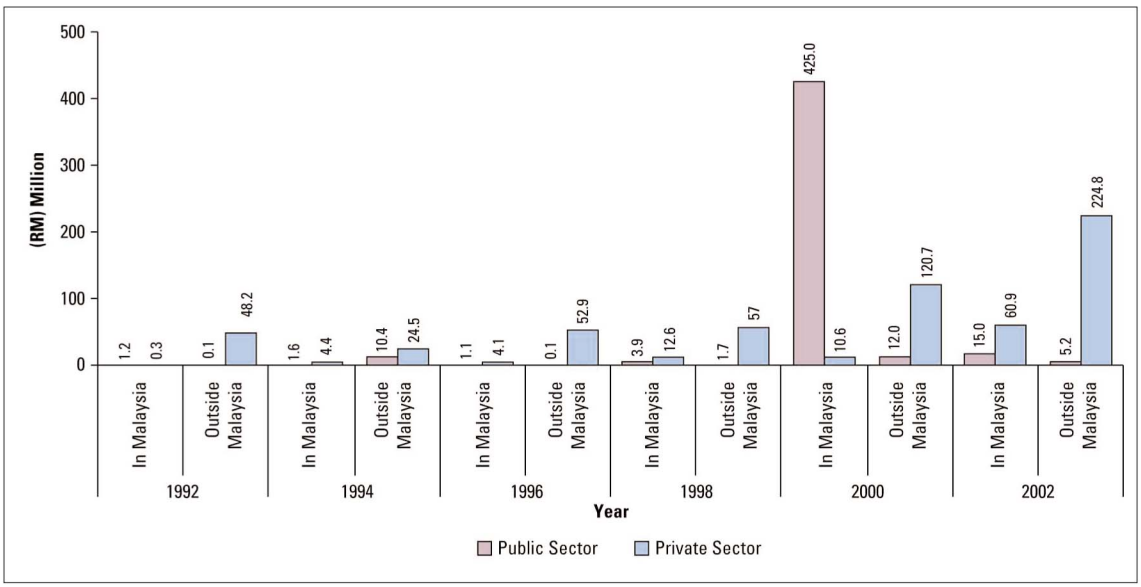


Figure 18: Outsourced R&D

R&D EXPENDITURE

Expenditure on R&D in GRI has been increasing since 1996. It reached RM507.1 million in 2002 (Figure 19). From 2000 to 2002 expenditure on:

- Labour increased from RM110.6 million to RM174.6 million
- Operating expenses declined from RM181.9 million to RM58.1 million
- Land and building increased from RM11.7 million to RM27.2 million
- Machinery and equipment increased from RM113.2 million to RM247.2 million

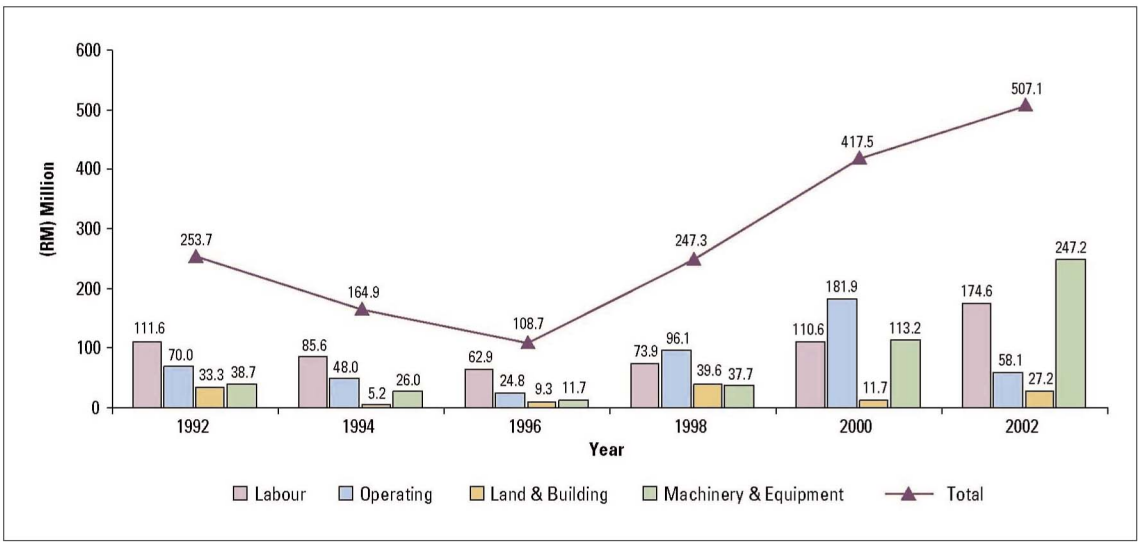


Figure 19: Expenditure by Type of Cost

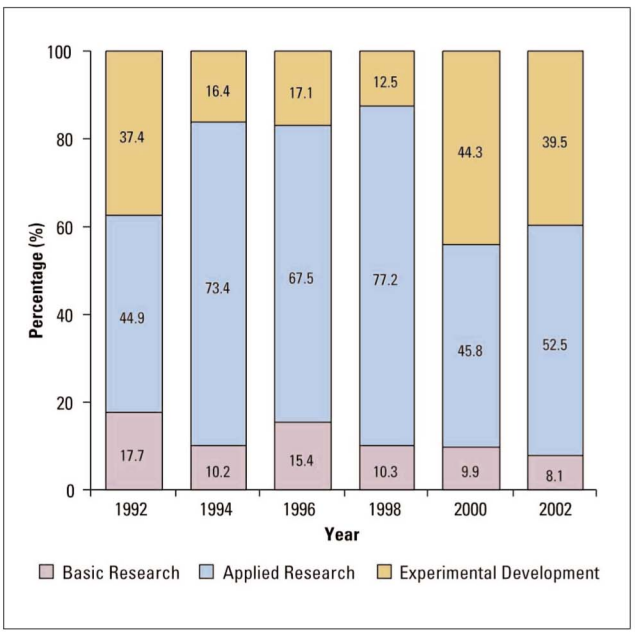


Figure 20: Proportion of Expenditure by Type of Research

Expenditure by Type of Research

Expenditure on basic research changed little at RM41.3 million and RM41.0 million accounting for 9.9% and 8.1% of the GRI expenditure on R&D in 2000 and 2002, respectively (Figure 20). However, there was greater involvement in applied research in GRI with increased expenditure from RM191.2 million or 45.8% to RM266.1 million or 52.5% from 2000 to 2002. Experimental research also increased but by a lesser extent from RM184.9 million or 44.3% to RM200.1 million or 39.5% in 2000 and 2002, respectively.

Expenditure by FOR

Three research activities by FOR accounted for nearly three-quarters of the GRI R&D expenditure in 2000 and 2002. They were:

- Information, Computer and Communications Technologies (RM172.3 million)
- Economics, Business and Management (RM144.0 million)
- Agriculture Sciences (RM49.4 million)

They accounted as major expenditure in 2002 (Figure 21). Information, Computer and Communications Technologies and Agriculture Sciences were also among the three major expenditure in 2000.

Expenditure by SEO

Three-quarters of the total GRI expenditure by SEO were from three research activities in 2002, namely:

- Information and Communication Services (RM170.2 million)
- Social Development and Community Services (RM144.8 million)
- Plant Production and Primary Products (RM70.9million)

However, only Plant Production and Primary Products (RM70.9million in 2002) were among the three major research activities in both 2000 and 2002 (Figure 22).

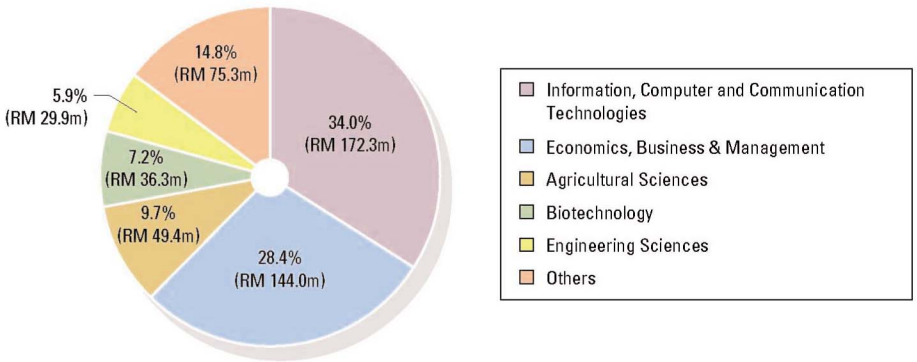


Figure 21: Proportion of Expenditure by 5 Major FOR in 2002

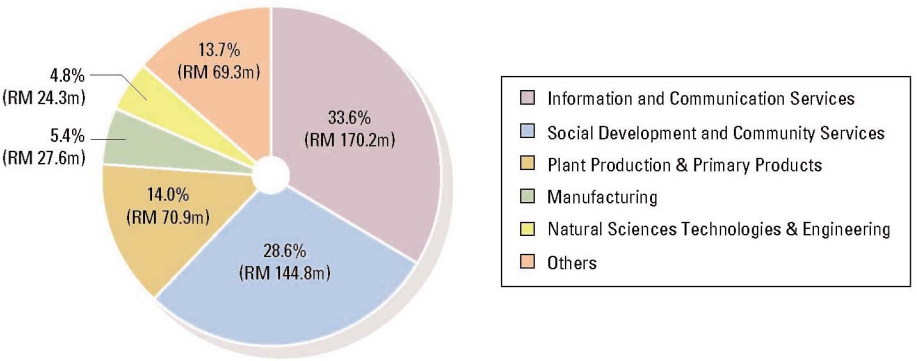


Figure 22: Proportion of Expenditure by 5 Major SEO in 2002

SOURCES OF FUNDS

Internal funds were the main source of R&D funds for GRI. In 2002, internal funds accounted for RM395.6 million or 78.0% of total GRI funds for R&D (Figure 23). The majority of these internal funds were from allocations under the Eighth Malaysia Plan (8MP). Since they are categorised as development budget, they are reported as internal funds as in previous R&D surveys. Funds sourced externally accounted for the remaining 22.0% of the funds for R&D in GRI.

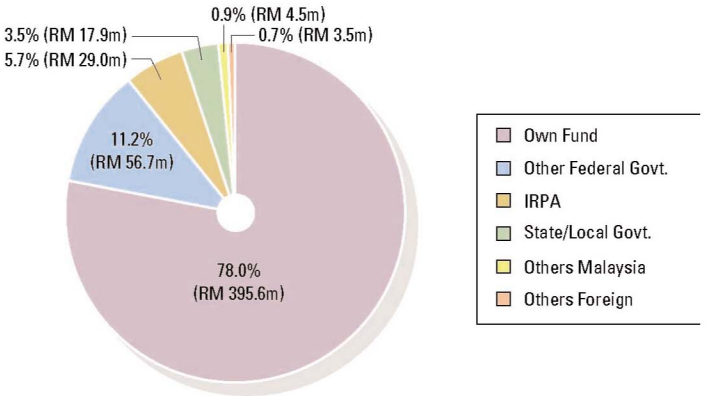


Figure 23: Proportion of Sources of R&D Funds in 2002

HUMAN RESOURCES DEVELOPMENT

By Headcount

The headcount or number of R&D personnel working in GRI declined from 7,777 in 2000 to 7,222 in 2002 (Figure 24). From 2000 to 2002, the headcount of:

- Researchers increased by just 2.8% from 3,809 to 3,914
- Technicians increased by 24.2% from 1,138 to 1,413
- Support staff declined from 2,830 to 1,895

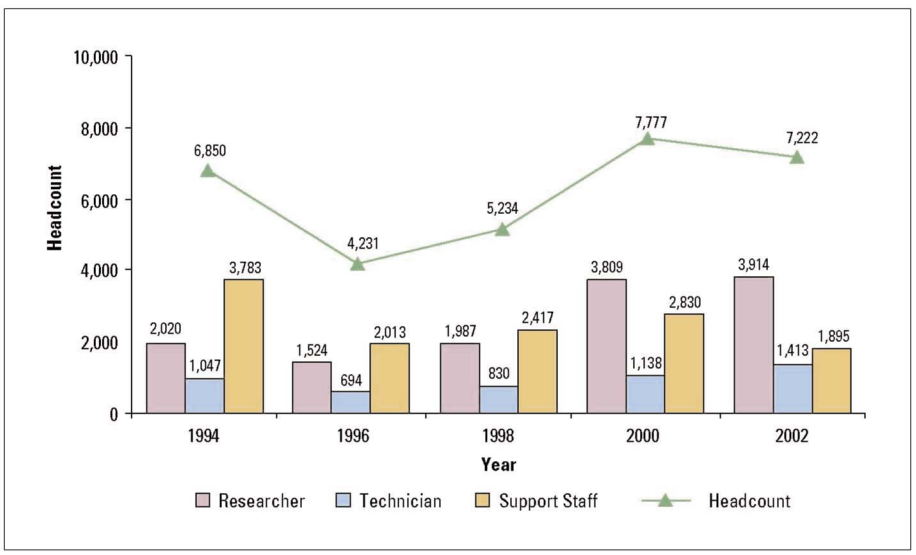


Figure 24: Headcount of R&D Personnel in GRI

By FTE

FTE declined from 2,964.7 in 2000 to 2,652.4 in 2002 (Figure 25). Over the period, FTE of:

- Researchers declined from 1,298.3 to 1,203.5 although there was an increase in headcount
- Technicians increased from 461.9 to 508.1
- Support staff declined from 1,204.5 to 940.8

Participation of Women in GRI

The total number of women involved in R&D in GRI increased by 4.9% from 2,029 in 2000 to 2,128 in 2002 (Figure 26). Similarly, the number and proportion of women researchers also increased from 1,137 (29.9%) to 1,403 (35.8%) in 2000 and 2002, respectively.

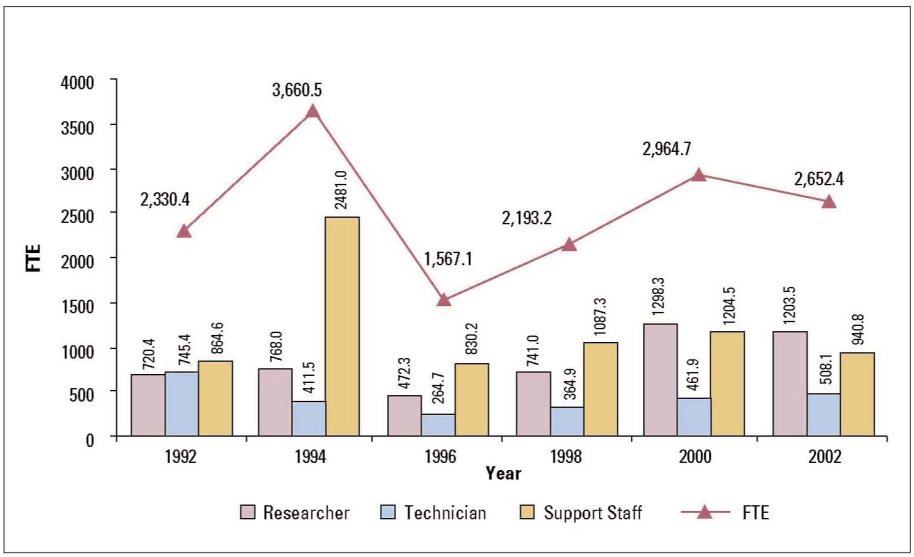


Figure 25: FTE of R&D Personnel in GRI

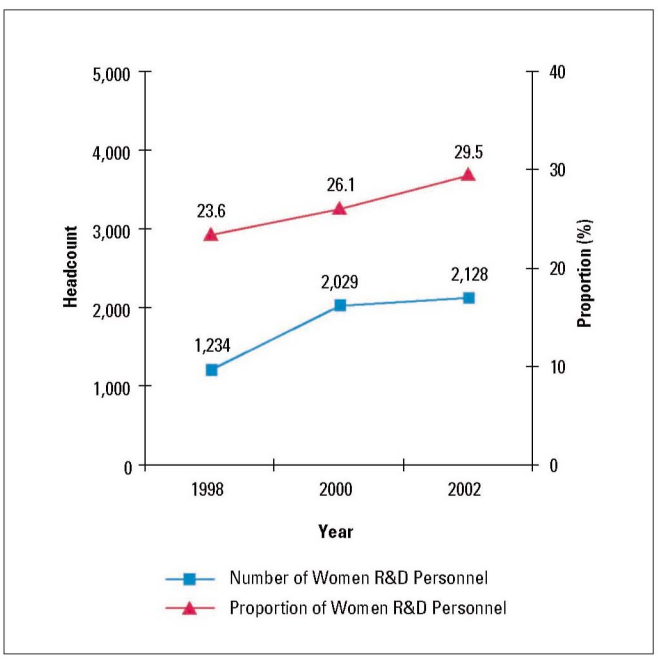


Figure 26: Women R&D Personnel in GRI

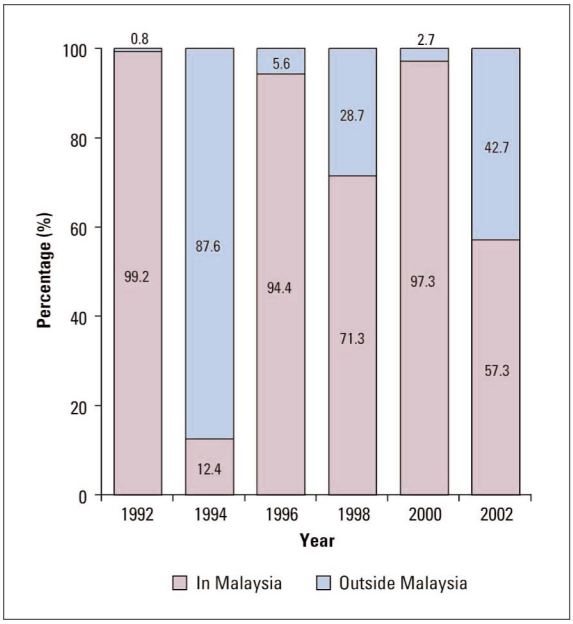


Figure 27: Proportion of Outsouced R&D for GRI

OUTSOURCED R&D

Outsourcing of R&D by GRI declined from RM433.0 million in 2000 to RM11.6 million in 2002. In 2000, MACRES alone had outsourced RM410.0 million mainly in the form of grants and donations to local universities. Other GRI accounted for the remaining RM23.0 million outsourced in 2000.

More than half of outsourced R&D was outsourced within Malaysia in 2002 at 57.3% compared to 42.7% outsourced outside Malaysia. Outsourcing within Malaysia accounted for most of the outsourced R&D since 1992 except in 1994 when it accounted for 12.4% with the remainder outsourced outside the country (Figure 27).

FACTORS LIMITING R&D ACTIVITIES

Internal Factors Limiting R&D

While management issues were the main factors limiting R&D in 2000, issues related to resources were the main limiting factors in 2002. The five most common issues in 2002 were:

- Lack of skilled R&D personnel
- Limited financial resources
- Lack of infrastructure such as space and equipment for R&D
- Inadequate market research
- Lack of R&D management know-how

External Factors Limiting R&D

Major external issues limiting R&D in 2000 and 2002 were the same. These external issues included:

- Shortage of R&D personnel with the requisite expertise in specific areas of research
- Increasing cost of capital including equipment and upgrading of facilities
- Overall shortage R&D personnel including researchers, technicians and support staff
- Perceived lack of government incentives to encourage developments in R&D
- Increasing labour costs restricting recruitment of new R&D personnel.

R&D In Institutions of Higher Learning (IHL)

R&D EXPENDITURE

Expenditure on R&D in IHL has also increased since 1996 and reached RM360.4 million in 2002 (Figure 28). From 2000 to 2002, expenditure on:

- Labour declined from RM113.8 million to RM109.2 million
- Operating expenses increased by nearly three-fold from RM30.2 to RM100.6 million
- Land and building declined from RM61.3 million to RM20.5 million
- Machinery and equipment increased from RM80.8 million to RM130.1 million

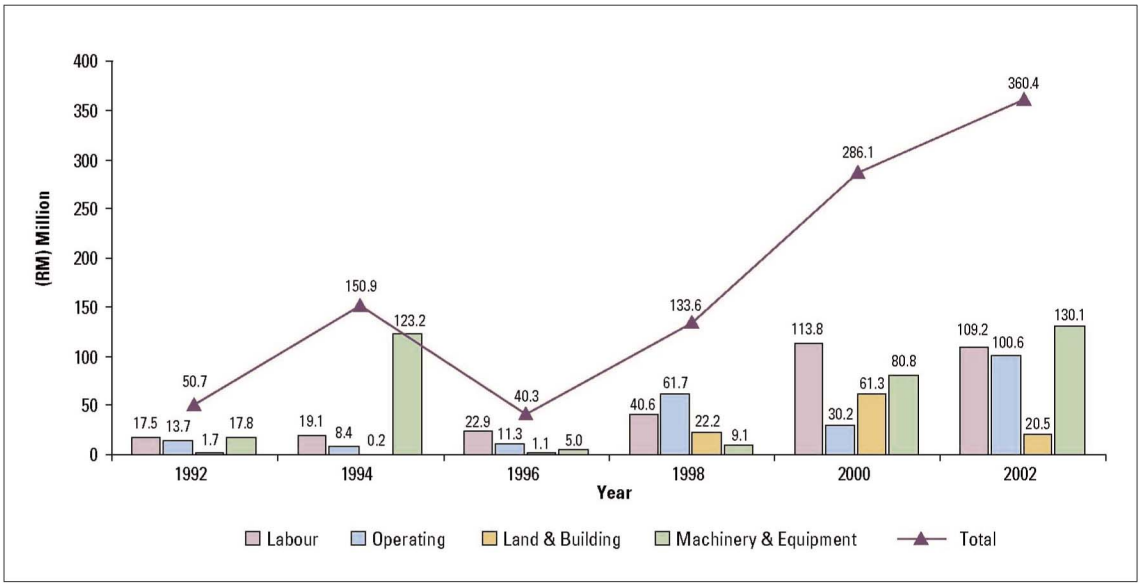


Figure 28: Expenditure by Type of Cost

Expenditure by Type of Research

Expenditure on basic research increased from RM104.0 million or 36.3% of total GRI expenditure in 2000 to RM111.3 million or 30.9% in 2002 but applied research declined from RM147.0 million or 51.4% to RM135.2 million or 37.5% during the same period. However, there was greater emphasis on experimental research with expenditure increasing from RM35.3 million or 12.3% in 2000 to RM113.9 million or 31.6% in 2002 (Figure 29).

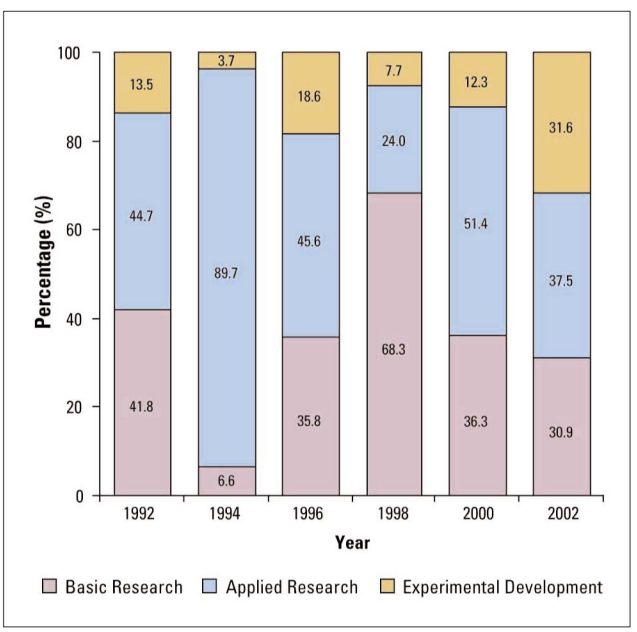


Figure 29: Proportion of Expenditure by Type of Research

Expenditure by FOR

In 2002, the three major research activities by FOR accounting for half or 48.4% of the total IHL RD expenditure (Figure 30) were:

- Environmental Sciences (RM62.3 million)
- Applied Sciences and Technologies (RM61.2 million)
- Engineering Sciences (RM50.9 million)

Expenditure by SEO

In 2002, the three major R&D activities by SEO accounting for 61.0% of the total R&D expenditure among IHL (Figure 31) were:

- Manufacturing (RM79.1 million)
- Natural Sciences, Technologies and Engineering (RM78.1 million)
- Commercial Services (M62.3 million)

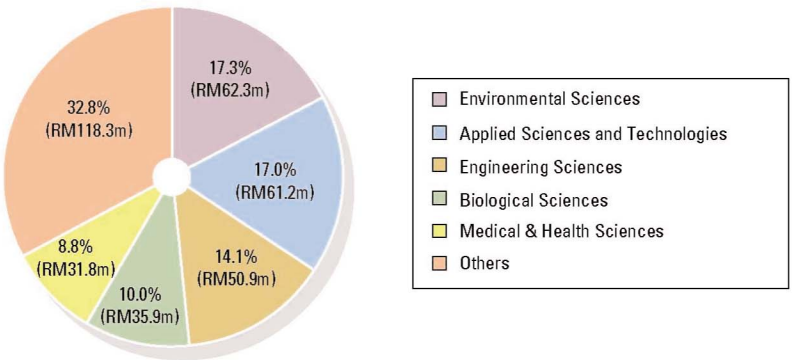


Figure 30: Proportion of Expenditure by 5 Major FOR in 2002

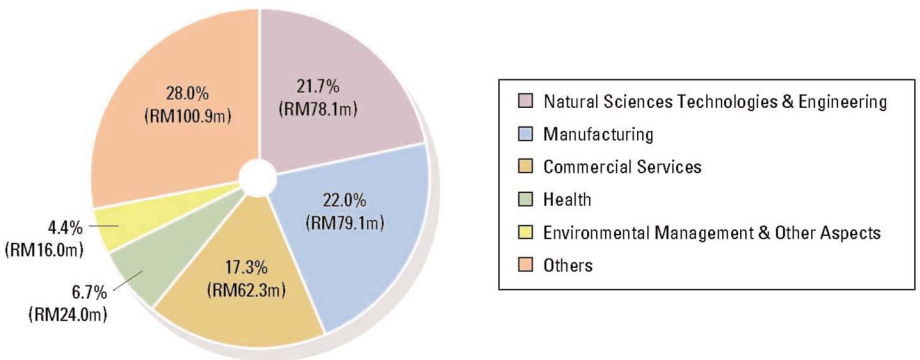


Figure 31: Proportion of Expenditure by 5 Major SEO in 2002

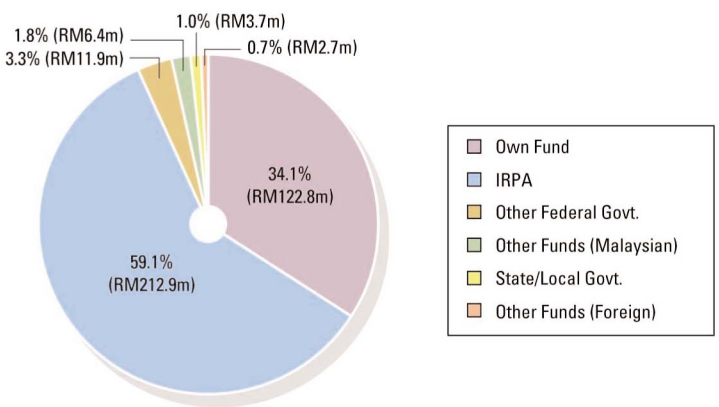


Figure 32: Proportion of Sources of R&D Funds in 2002

SOURCES OF FUNDS

A substantial proportion of the funds for R&D in IHL are sourced from external funds. In 2002, funds sourced from IRPA (under the Federal Government) totalled RM212.9 million while other Federal Government funds (other than IRPA) amounted to RM11.9 million. Funds sourced from the IHL's own internal funds amounted to RM122.8 million accounting for 34.1% of the total R&D funds (Figure 32).

HUMAN RESOURCES DEVELOPMENT

By Headcount

The headcount increased by 11.6% from 11,239 in 2000 to reach 12,538 by 2002 (Figure 33). Over the period the number of

- Researchers increased by 18.2% from 8,909 to 10,527
- Technicians increased by 13.0% from 808 to 913
- Support staff decreased significantly by 27.9%, from 1,522 to 1,098

Figure 34 shows the proportion of headcount for IHL. The percentage of researchers remains higher than the other professions.

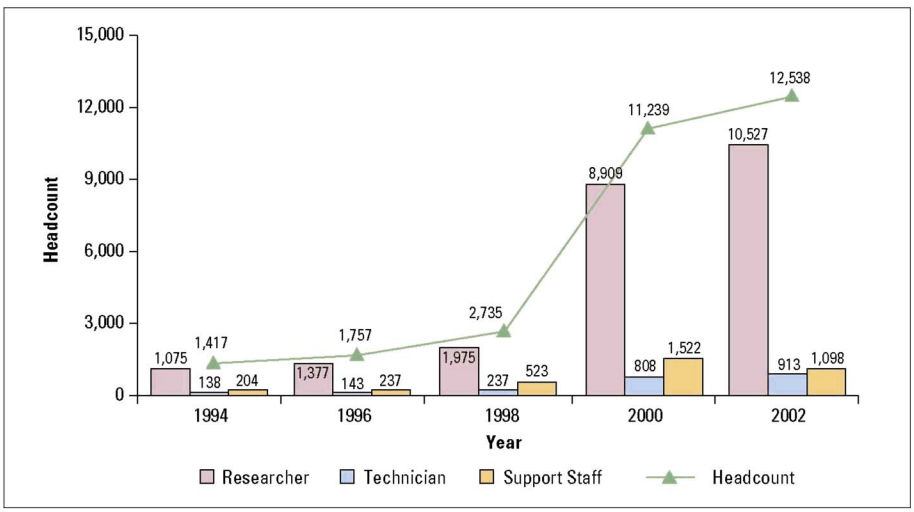


Figure 33: Headcount of R&D Personnel in IHL

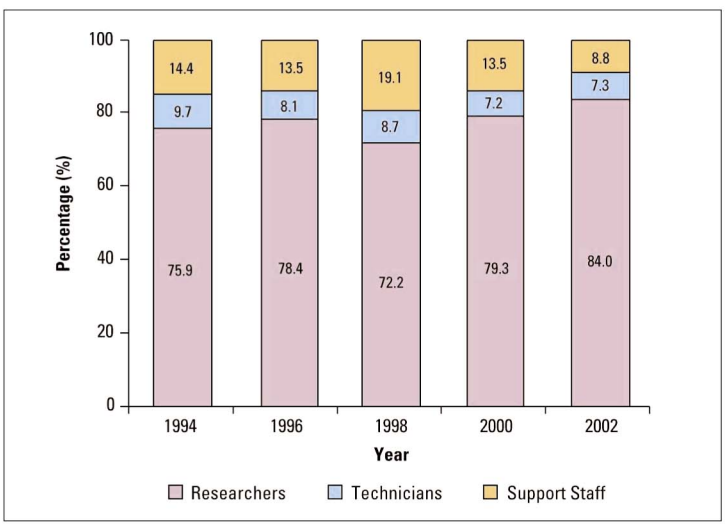


Figure 34: Proportion of Headcount of R&D Personnel in IHL

By FTE

FTE increased moderately from 3,738.0 in 2000 to 3,811.9 in 2002 (Figure 35). During the period, FTE of:

- Researchers increased by just 1.4% from 3,141.4 to 3,187.0
- Technicians increased by 14.1% from 218.1 to 248.7
- Support staff fell from 378.5 to 376.2

Participation of Women in IHL

The headcount of women R&D personnel (including researchers, technicians and support staff) in IHL declined by 2.8% from 4,502 in 2000 to 4,377 in 2002 (Figure 36). Though the total headcount of women researchers involved in IHL increased by 8.9% from 3,465 in 2000 to 3,772 in 2002, their proportion of the total R&D personnel in IHL declined from 40.1% to 34.9% in the same period.

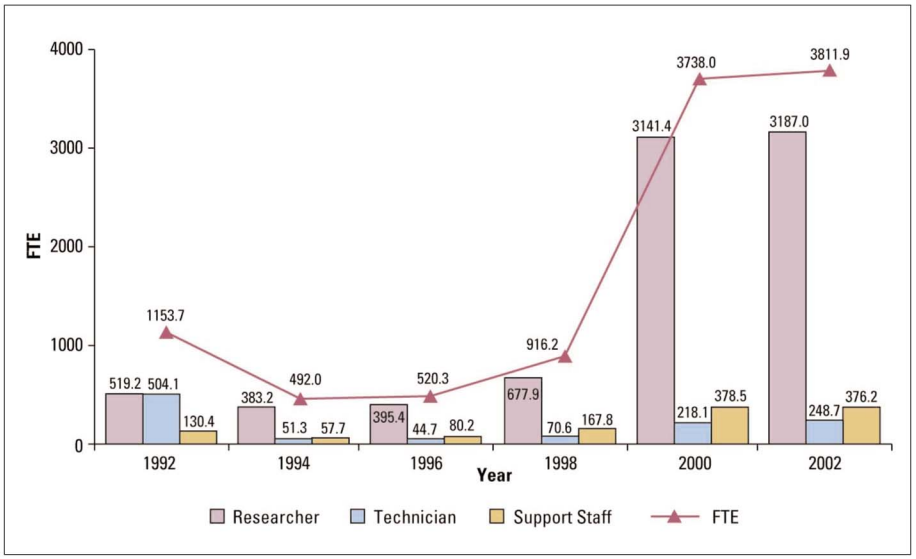


Figure 35: FTE of R&D Personnel in IHL

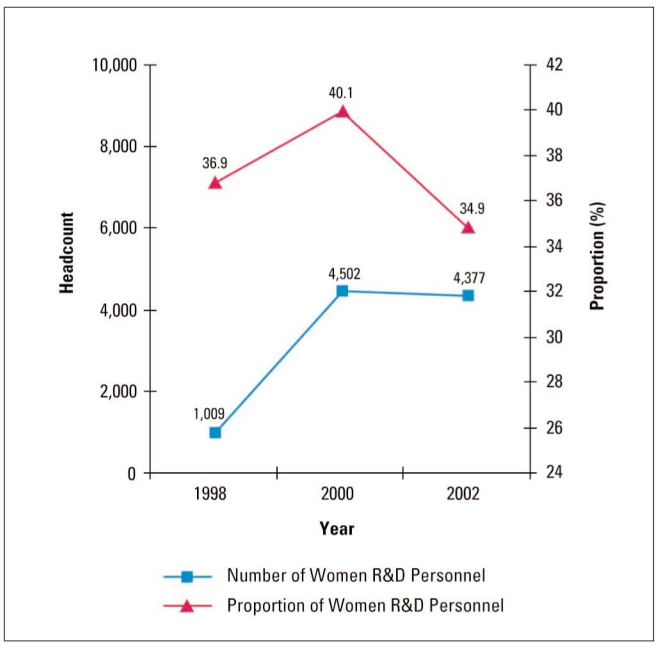


Figure 36: Women R&D Personnel in IHL

OUTSOURCED R&D

Outsourcing of R&D doubled from RM4.2 million or 94.0% in 2000 to RM8.8 million or 96.5% in 2002. The major reason cited for outsourcing was the need for funding projects conducted in collaboration with other organisations, such as other IHL.

Nearly all of outsourced R&D was outsourced within Malaysia in 2002 at 96.5% compared to 3.5% outsourced outside Malaysia. Outsourcing within Malaysia also accounted for most of the outsourced R&D since 1998 and remained similar in 2000 and 2002 (Figure 37).

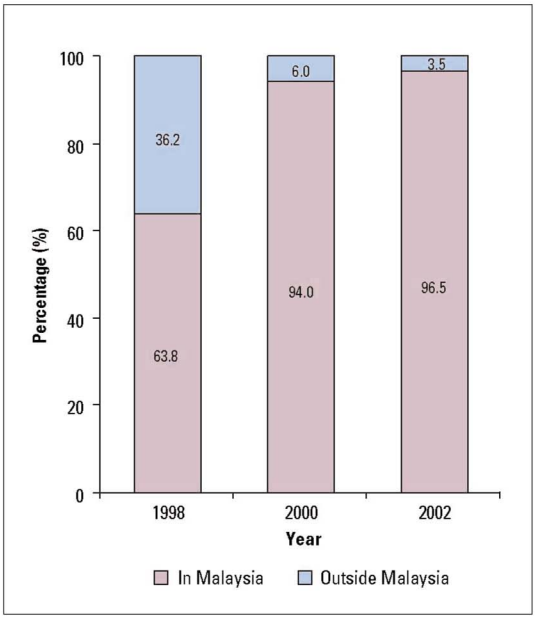


Figure 37: Proportion of Outsourced R&D for IHL

FACTORS LIMITING R&D ACTIVITIES

Internal Factors Limiting R&D

Similar to GRI, the five major factors limiting R&D in 2002 were related to resources. These were:

- Lack of skilled R&D personnel
- Lack of infrastructure for R&D, such as space and equipment
- Limited financial resources
- Management delays in making decisions
- Inadequate market research

External Factors Limiting R&D

The five major external factors limiting R&D remained similar in both 2000 and 2002. These were:

- Shortage of R&D personnel with requisite expertise
- Shortage of other personnel in R&D such as technicians and support staff
- Increase in capital cost especially machinery and equipment
- Lack of government incentives to researchers to encourage further research
- Lack of physical infrastructure such as facilities and equipment to support R&D.

R&D EXPENDITURE

Total R&D expenditure recorded by the private sector has increased since the beginning of the survey in 1992 and crossed the RM1 billion mark to reach RM1,633.1 million in 2002 (Figure 38). From 2000 to 2002, expenditure on:

- Labour increased from RM175.9 million to RM248.9 million
- Operating expenses rose from RM194.7 million to reach RM683.8 million
- Land and building recorded a decline from RM170.1 million to RM120.5 million
- Machinery and equipment increased from RM427.2 million to RM579.8 million

Expenditure by Industry

Expenditure on R&D leading to the manufacture of Motor Vehicles, Trailers and Semi-Trailers; Electrical Machinery and Related Apparatus; and Radio, Television, Communications Equipment and Related Apparatus featured prominently in both 2000 and 2002 (Figure 39). The combined R&D expenditure in these activities reached RM1,232.4 million or 75.4% of private sector expenditure in 2002.

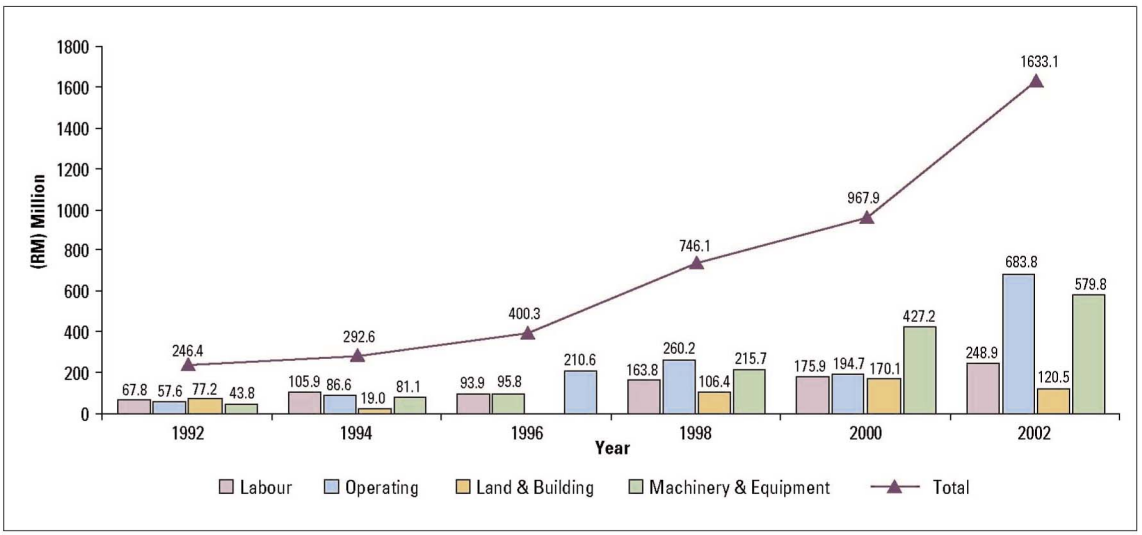


Figure 38: R&D Expenditure for the Private Sector

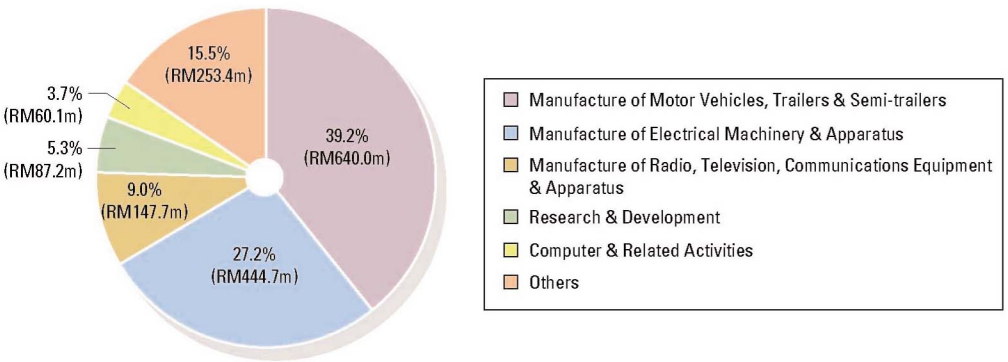


Figure 39: Proportion of R&D Expenditure by 5 Major Industries in the Private Sector in 2002

Expenditure by Company Revenue

From 2000 to 2002, there has been a general increase in R&D expenditure among companies earning smaller revenues compared to companies earning larger revenues (Figure 40). During the period, R&D expenditure of companies with annual revenues:

- Of less than RM10 million increased eight-fold from RM27.2 million or 2.8% of total private sector expenditure to RM215.9 million or 13.2%
- Between RM10 million and RM100 million increased five-fold from RM124.9 million or 12.9% to RM629.4 million or 38.5%
- Earning more than RM100 million annually declined from RM815.9 million or 84.3% to RM787.7 million or 48.3%

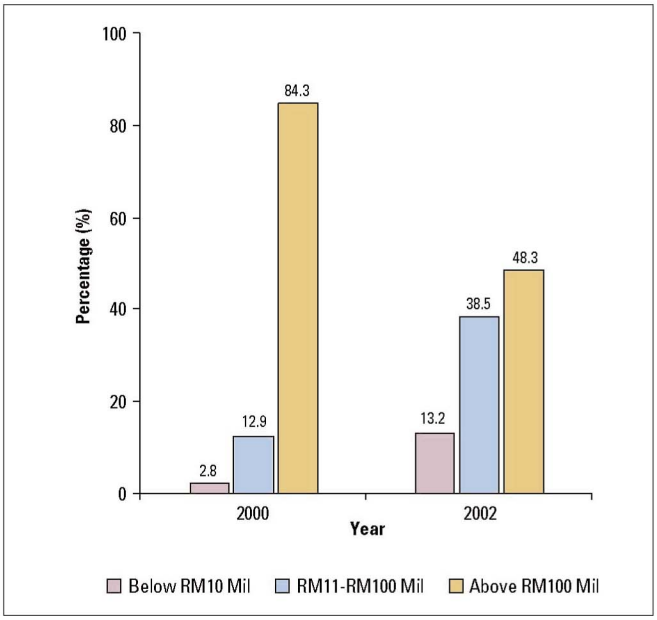


Figure 40: Proportion of Expenditure by Company Revenue in the Private Sector

Expenditure by Ownership

R&D expenditure among Malaysian-owned companies increased from RM144.3 million in 2000 to RM240.2 million in 2002. However, as a proportion of total private sector expenditure, this remained almost unchanged at 14.9% and 14.7% respectively (Figure 41). From 2000 to 2002, R&D expenditure:

- Among Malaysian-controlled companies increased four-fold from RM185.8 million or 19.2% to RM701.5 million or 43.0%
- Among foreign-controlled companies doubled from RM371.4 million or 38.4% to RM632.9 million or 38.8%
- Foreign-controlled companies declined from RM266.2 million or 27.5% to RM58.2 million or 3.6%

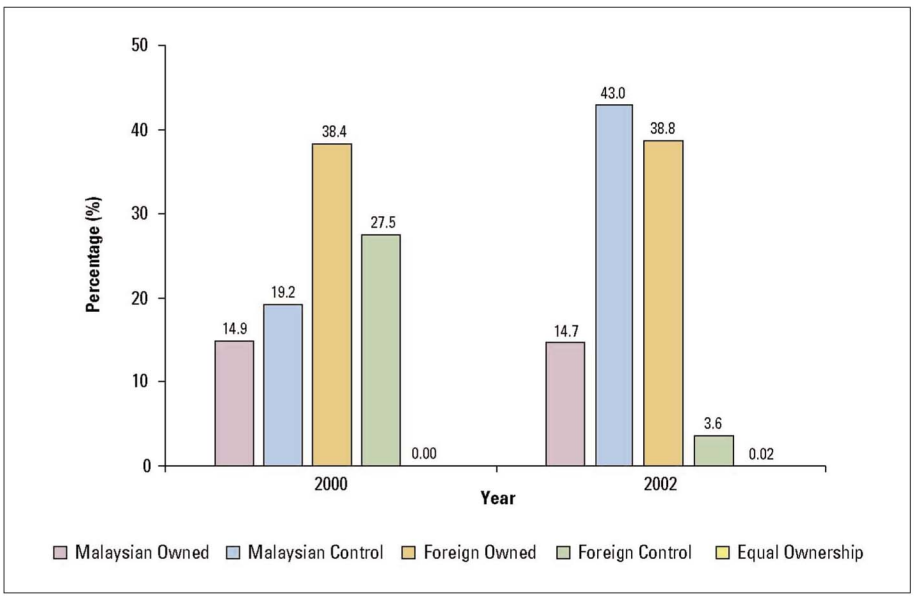


Figure 41: Proportion of R&D Expenditure by Ownership in the Private Sector

Expenditure by Type of Research

In 2002, expenditure on basic research was RM57.3 million or 3.5% of total private sector expenditure. Applied research and experimental research were the main R&D activities conducted by private companies in Malaysia recording RM 1,313.5 million or 80.4% and RM262.3 million or 16.1% respectively in 2002. Expenditure on applied and experimental research in the private sector is geared towards commercialisation of R&D through development of new products and processes (Figure 42).

Expenditure by FOR

In 2002, the three leading FOR conducted were:

- Engineering Sciences (RM897.1 million)
- Information, Computer and Communication Technologies (RM417.8 million)
- Applied Sciences and Technologies (RM239.4 million)

Together, these three FOR accounted for 95.2% of the total private sector R&D expenditure for the year (Figure 43). The next FOR in terms of expenditure were Agricultural Sciences and Chemical Sciences.

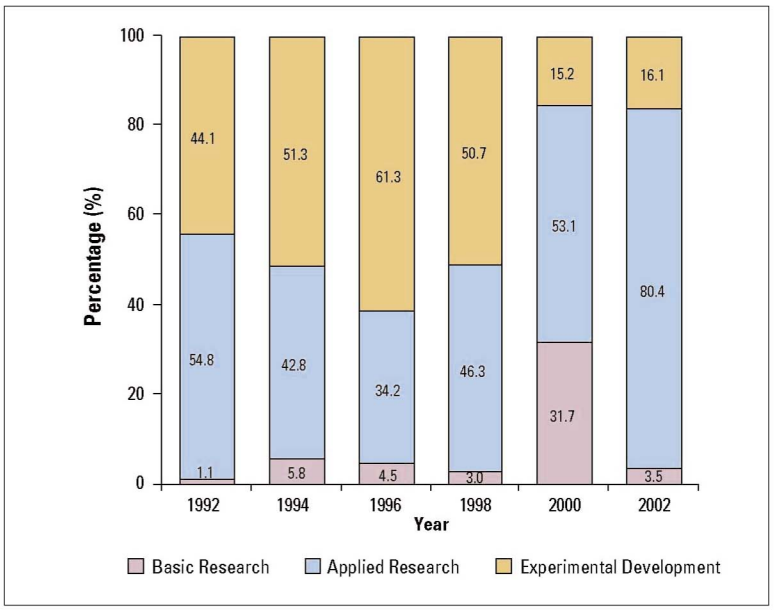


Figure 42: Proportion of R&D Expenditure by Type of Research in the Private Sector

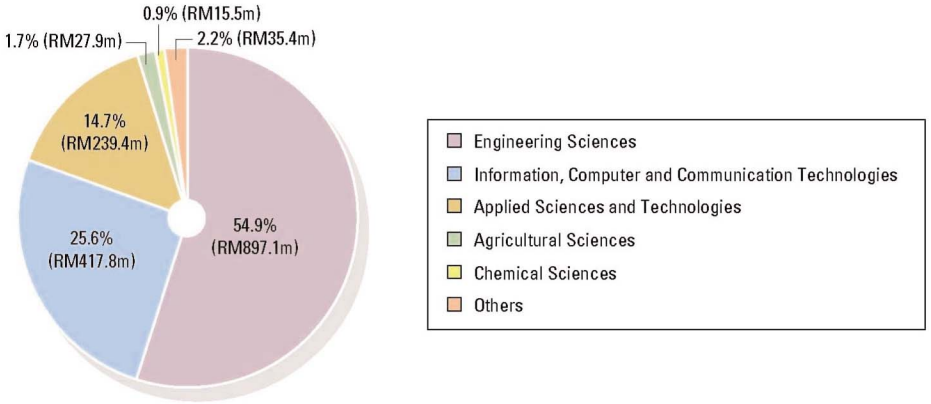


Figure 43: Proportion of R&D Expenditure by 5 Major FOR in the Private Sector in 2002

Expenditure by SEO

The three leading R&D activities by SEO in 2002 were:

- Manufacturing (RM956.3 million)
- Information and Communication Services (RM463.4 million)
- Natural Sciences, Technologies and Engineering (RM 102.7 million)

Together, they accounted for 93.3% of the private sector R&D expenditure for the year (Figure 44).

SOURCES OF FUNDS

Funds from the government (federal, state or local) are not prominent in financing R&D activities in the private sector. Instead, much of the funds for R&D in the private sector are sourced internally (RM1,238.0 million) from within the company (Figure 45).

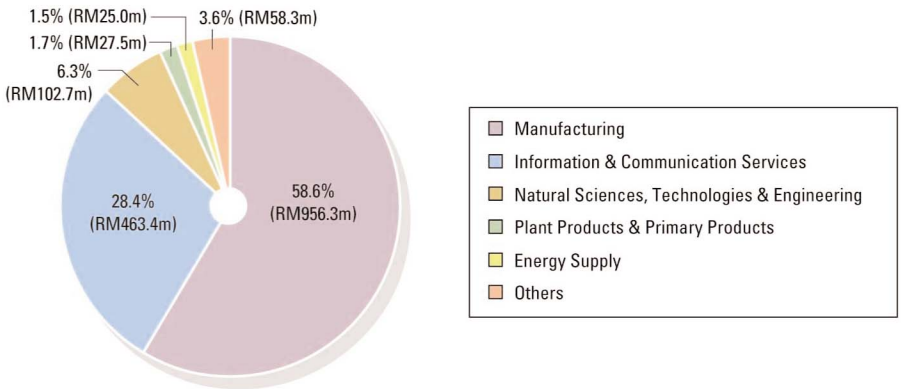


Figure 44: Proportion of R&D Expenditure by 5 Major SEO in the Private Sector in 2002

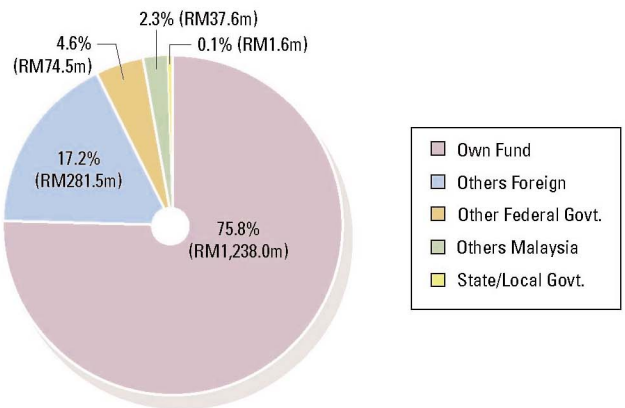


Figure 45: Proportion of Sources of R&D Funds in the Private Sector in 2002

HUMAN RESOURCES DEVELOPMENT

By Headcount

The headcount of R&D personnel in the private sector has been increasing since 1994. It reached 5,177 in 2002 (Figure 46). From 2000 to 2002, the number of:

- Researchers in the private sector increased nearly half from 2,304 to 3,349
- Technicians increased two-fold from 343 to 764
- Support staff recorded a decrease from 1,599 to 1,064

By FTE

The overall increase in headcount from 1994 to 2002 was matched by a near parallel increase in FTE reaching 4,266.7 in 2002 (Figure 47). From 2000 to 2002, FTE of:

- Researchers increased by 35.0% from 1,983.0 to 2,767.1
- Technicians more than doubled from 241.5 to 621.9
- Support staff decreased by 22.5% from 1,132.5 to 877.7

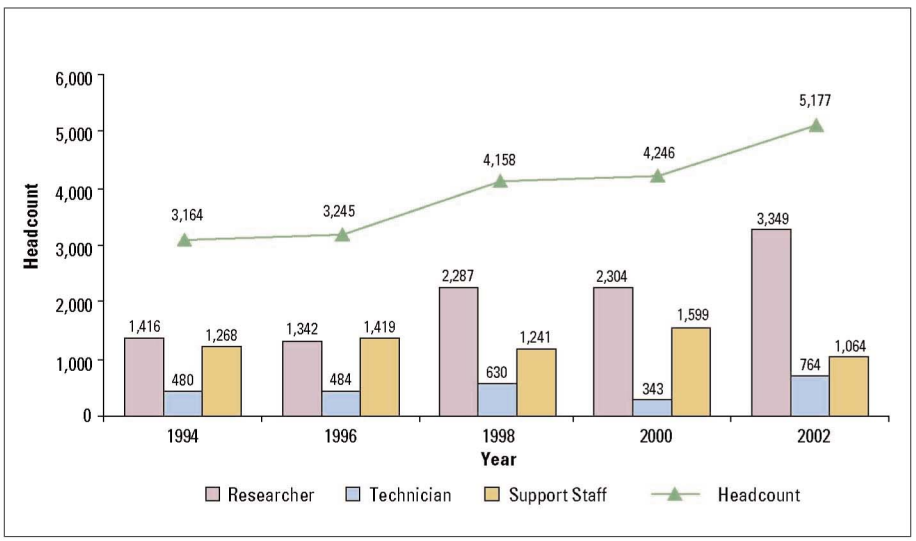


Figure 46: Headcount of R&D Personnel in the Private Sector

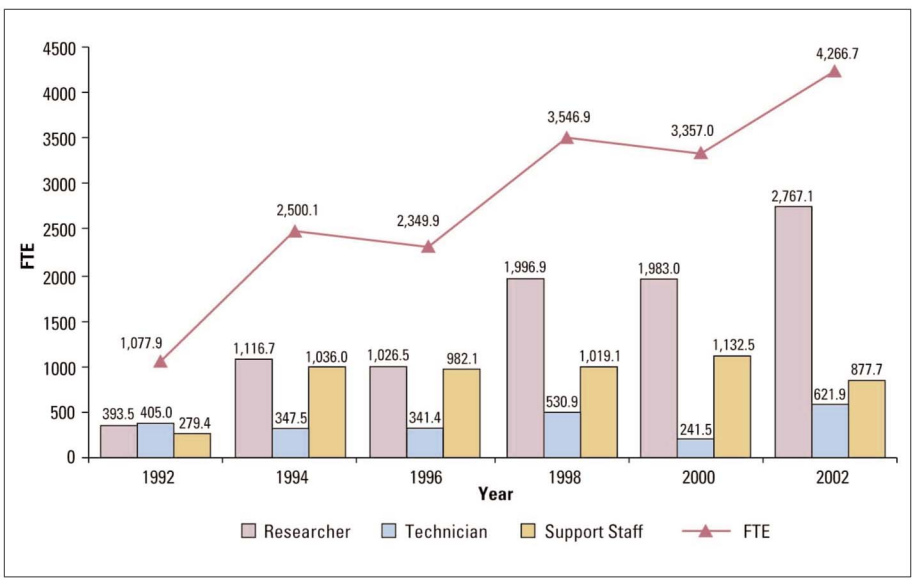


Figure 47: FTE of R&D Personnel in the Private Sector

Participation of Women in the Private Sector

The total headcount of women R&D personnel in the private sector increased by 51.9% from 990 in 2000 to 1,504 in 2002. Their proportion among R&D personnel in the private sector also increased during the same period (Figure 48). Additionally, the number of women researchers involved in the private sector also increased from 495 in 2000 to 821 in 2002.

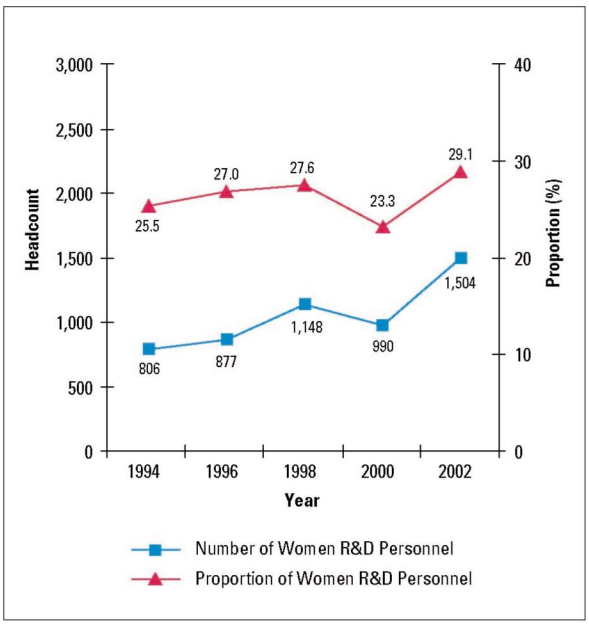


Figure 48: Women R&D Personnel in the Private Sector

OUTSOURCED R&D

The amount of R&D outsourced by the private sector increased from RM131.9 million in 2000 to RM285.6 million in 2002.

78.7% of outsourced R&D was outsourced outside Malaysia as compared to 21.3% outsourced within the country by the private sector in 2002. This trend has been reflected since 1992, which had 99.4% of outsourced R&D outsourced outside Malaysia (Figure 49).

Major reasons cited for outsourcing were:

- Specific technologies and capabilities to conduct research were not available within the company
- It is more cost-effective to outsource the R&D work

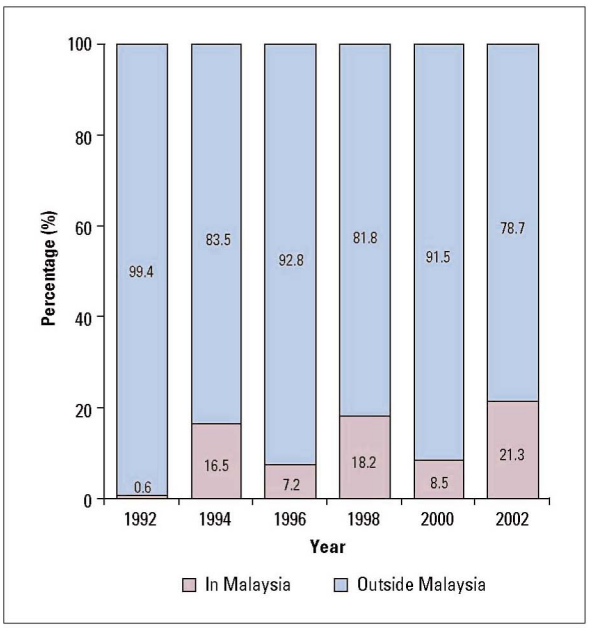


Figure 49: Proportion of Outsourced R&D for the Private Sector

FACTORS LIMITING R&D ACTIVITIES

Internal Factors Limiting R&D

The five major internal factors limiting R&D in the private sector in 2000 and 2002 were mainly issues related to resources. These were:

- Limited financial resources
- Lack of skilled R&D personnel
- Inadequate market research
- Lack of facilities and equipment
- Lack of proven analytical technique

External Factors Limiting R&D

The five major external factors limiting R&D in 2000 were also similar to those cited in 2002. These were:

- Shortage of researchers with requisite expertise
- Increasing capital cost
- Insufficient government incentives
- Increasing labour cost
- Issues related to intellectual property rights.

R&D EXPENDITURE

Gross Expenditure on R&D (GERD)

The advanced economies of the United States and Japan lead the world in R&D expenditure. The United States spent over RM1.0 trillion on R&D in 2002, which was 12 times larger than Malaysia's own GDP during the same period. Japan follows the United States, spending RM486.1 billion in 2002.

Other countries outside the United States and Japan, with relatively large R&D expenditure are China, Korea and Italy.

Though Malaysia's GERD passed the RM2 billion mark to reach RM2.51 billion in 2002, it was still less compared to those incurred by Mexico, Singapore, Turkey, Poland, Ireland, South Africa, Portugal and Greece. However, Malaysia surpassed the GERD of the Philippines and Thailand and was comparable to Hungary (Figure 50).

GERD/GDP Ratio

A country's research intensity or GERD/GDP ratio relates a country's expenditure on R&D to its economic performance. Thus, the higher the GERD/GDP ratio, the greater the proportion of the country's GDP is spent on R&D.

The Asia-Pacific countries of Korea, Taiwan and Singapore surpass Malaysia's research intensity by three to four times while their GDP per capita are two to four times that of Malaysia. Malaysia's research intensity in 2002 was comparable to Greece and Turkey and surpassed Chile, Mexico, Argentina and Thailand (Figure 51).

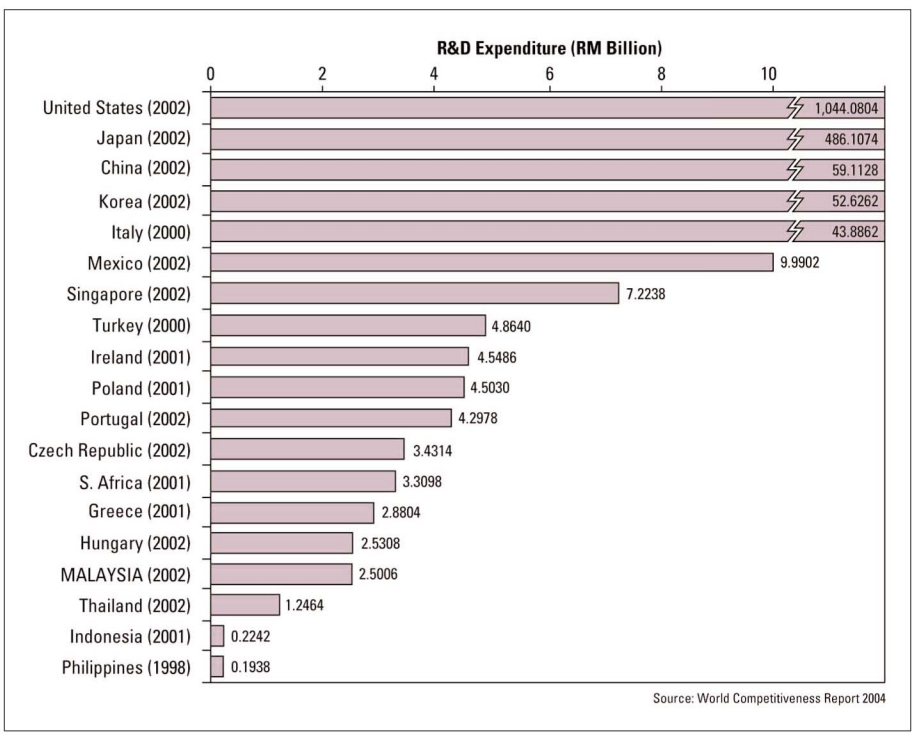


Figure 50: GERD by Country

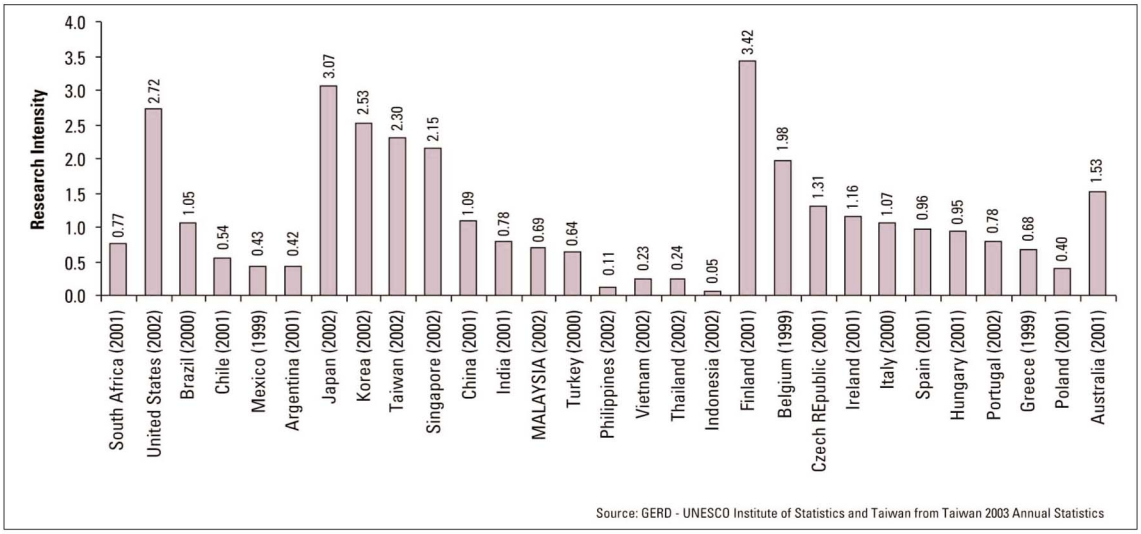


Figure 51: Research Intensity by Selected Countries

SOURCES OF FUNDS IN R&D

Local funds from the private sector play a major role in funding R&D activities in Japan, the United States, Finland, and even Korea and Ireland, and they account for about two-thirds of the individual country's R&D expenditure. These countries were also among countries with higher research intensities (Figure 52).

About half of the funds used to finance R&D projects in Malaysia in 2002 were from the private sector and this was comparable to Spain and the Czech Republic. There is greater contribution from the private sector to fund R&D activities in Malaysia compared to Chile, Mexico, Argentina and Poland. Interestingly, Malaysia's research intensity is higher than these countries.

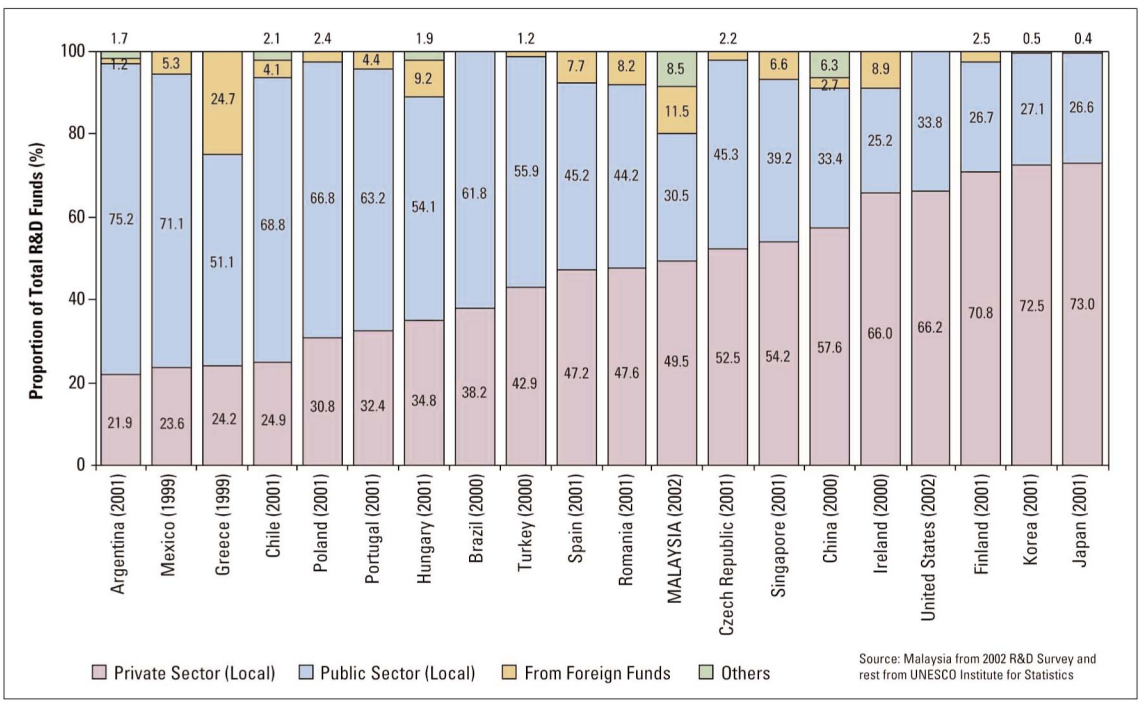


Figure 52: Sources of Funds for R&D

HUMAN RESOURCES DEVELOPMENT

FTE of Researchers

Finland has one of the highest FTE by labour force with an FTE of 15.45 per 1,000 labour force. Japan, Taiwan, Singapore and Korea follow suit and these countries also have a relatively high FTE per 1,000 labour force (Figure 53). These countries lead over many countries in Asia-Pacific, Europe, Central and Latin America in their FTE by labour force. Malaysia's FTE of 0.72 per 1,000 labour force ranks among one of the lowest and is surpassed by the emerging economies of South Africa, China, the Czech Republic and Argentina.

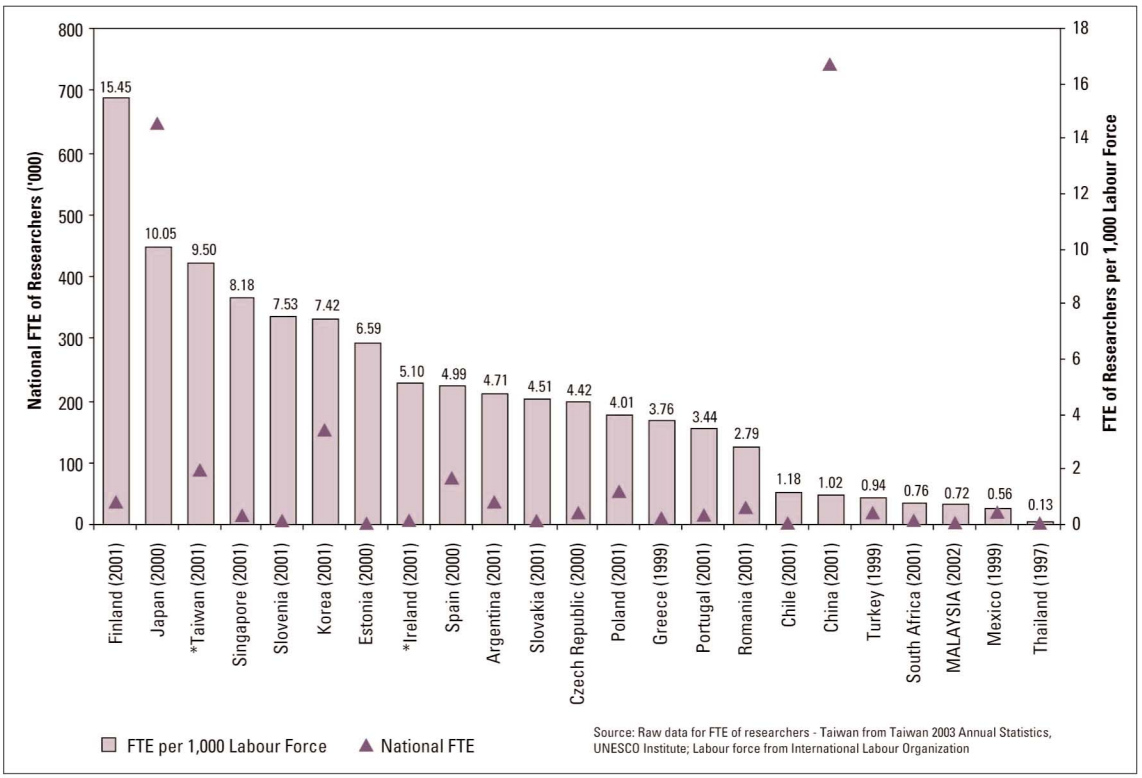


Figure 53: FTE of Researchers

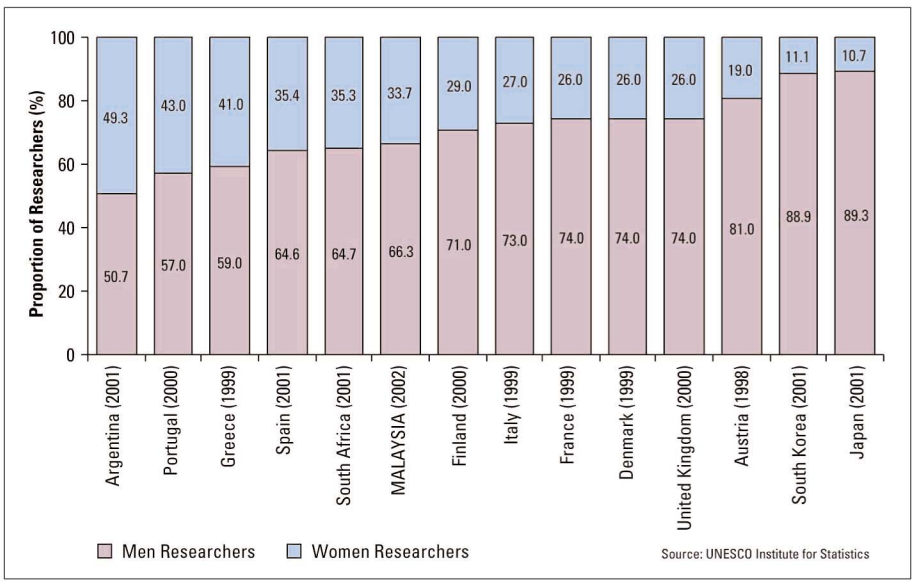


Figure 54: Proportion between Men and Women Researchers by FTE

Women Researchers in R&D

Women researchers account for one-third of the total FTE in Malaysia. This proportion is higher than the advance economies of Japan, Austria, United Kingdom, Denmark, France and even South Korea. Malaysia's proportion of women researchers by FTE compares closely to South Africa and Spain while Argentina, Portugal and Greece have a higher proportion of women researchers than Malaysia (Figure 54).

PRIVATE SECTOR IN NATIONAL R&D

Private Sector Expenditure on R&D

Malaysia's private sector expenditure of RM1.6 billion on R&D in 2002 was comparable to Turkey, Poland and South Africa. However, Malaysia's R&D expenditure by the private sector on a per capita basis at RM67 in 2002 was less than Hungary at RM87 (Figure 55). Malaysia's private sector expenditure on R&D per capita exceeded Poland, South Africa, Brazil, Mexico, Turkey and China.

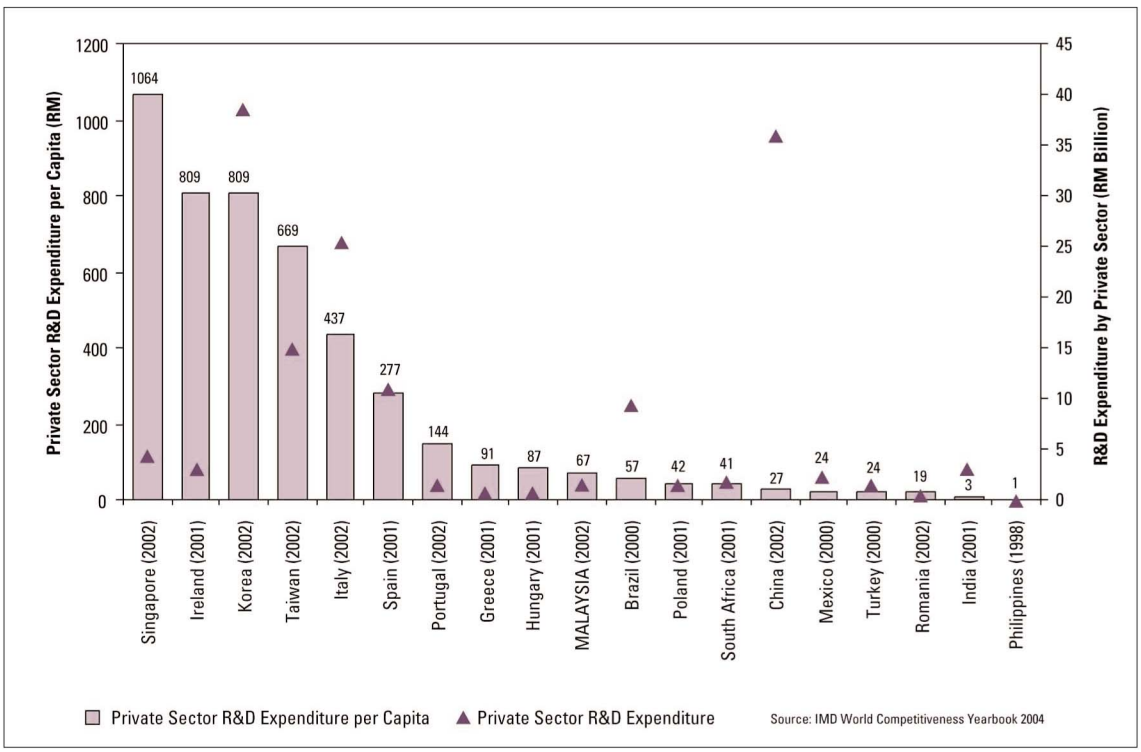


Figure 55: Private Sector R&D Expenditure per Country and Per Capita

PERSPECTIVE

Malaysia's R&D Trend

In 2000, Malaysia's R&D expenditure increased to RM1.7 billion and passed the RM2 billion mark when it reached RM2.5 billion in 2002. In addition, Malaysia's research intensity increased from 0.50 in 2000 to 0.69 in 2002. This indicates Malaysia's expenditure on R&D has increased at a faster pace than Malaysia's economy during the period.

Public Sector Involvement

The public sector has placed greater emphasis on applied research. Expenditure on applied research from the public sector increased from RM26.0 million in 1996 to RM220.2 million in 2000 and it increased further to RM314.1 million in 2002. Expenditure on applied research was mainly incurred by the IHL as they place greater emphasis on commercialising their R&D efforts.

Private Sector Involvement

The private sector's role in R&D has become more prominent since 1998. R&D expenditure increased from RM967.9 million in 2000 and passed the RM1 billion mark to reach RM1.6 billion in 2002, accounting for 65.3% of Malaysia's total R&D expenditure. This is in line with the government's objective of increasing private sector involvement in Malaysia's R&D activities. In the 2002 R&D Survey, it is encouraging to note that companies earning smaller revenues were spending more on R&D compared to the expenditure in 2000.

THE WAY FORWARD

Professor Michael Porter of Harvard Business School mentions in his book *The Competitive Advantage of Nations* that a country undergoes three stages of competitive development in its economy:

- The first stage is an economy dependent on low cost of inputs
- The second stage is an investment driven economy achieving efficiency through heavy investments
- The third stage is an innovation driven economy developing unique values

Thus, R&D plays an important role in an economy driven by innovation.

Malaysia has already entered and passed the first and second stages of its economic development. Malaysia's increasing expenditure on R&D since 1998 is an indication that the country is beginning to enter the third stage of its economic development.

Malaysia's Technology Map

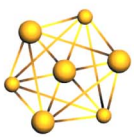
Malaysia's *Knowledge Based Economy Master Plan* by the Ministry of Finance has identified technologies recommended for development. These include:

- Biotechnology and life sciences
- Microelectronics
- Advanced materials
- Technologies for human senses
- Internet technologies
- Fuzzy logic technologies
- Environment and energy related technologies

R&D plays a crucial part in the development of these technologies and transforming Malaysia into an innovative driven economy. Thus, the government has undertaken various measures to spearhead Malaysia's R&D initiatives into various fields of technologies.

ABBREVIATIONS

8MP	Eight Malaysia Plan
BDC	BioValley Development Corporation
DAGS	Demonstrator Application Grant Scheme
FOR	Field of Research
FTE	Full-time Equivalent
GDP	Gross Domestic Product
GERD	Gross Expenditure on Research and Development
GRI	Government Agencies and Research Institutions
HRDS	Human Resource Development Scheme
IGS	Industry Research and Development Grant Scheme
IHL	Institutions of Higher Learning
IPO	Initial Public Offering
IRPA	Intensification of Research in Priority Areas
IT	Information Technology
ITAF	Industrial Technical Assistance Fund
KLCC	Kuala Lumpur City Centre
KLIA	Kuala Lumpur International Airport
MACRES	Malaysian Centre for Remote Sensing
MASTIC	Malaysian Science and Technology Information Centre
MDC	Multimedia Development Corporation
MGS	Multimedia Super Corridor Research and Development Grant Scheme
MiGHT	Malaysian Industry Government Group for High Technology
MSC	Multimedia Super Corridor
MTDC	Malaysian Technology Development Corporation
NSF	National Science Fellowship
OECD	Organisation for Economic Co-operation and Development
PPP	Postgraduate and Postdoctoral Programmes
QC	Quality Control
R&D	Research and Development
S&T HRDF	Science and Technology Human Resource Development Fund
SEO	Socio-Economic Objective
SMI	Small and Medium Scale Industries
TPM	Technology Park Malaysia



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