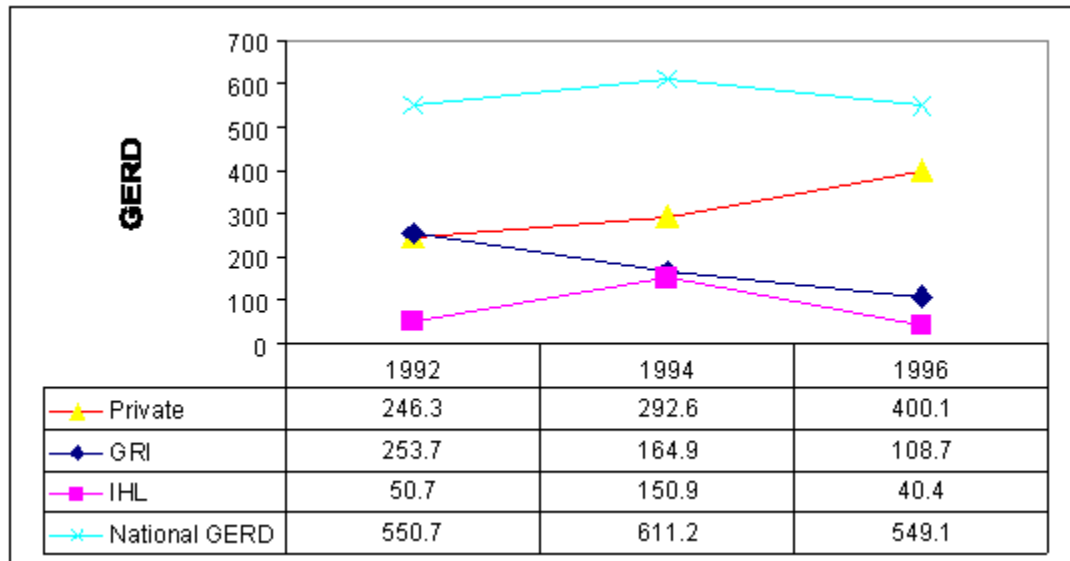


Chapter 4 - OVERVIEW OF NATIONAL RESEARCH AND DEVELOPMENT

4.1 Profile of National R&D Activities

In 1996, National Gross Expenditure on R&D (GERD) declined by 10.1% from RM 611.2 million in 1994 to RM549.1 million [see Fig. 4.1].



(Source : Table 4.1)
Fig. 4.1 : The National GERD and Total Expenditures on R&D by Sectors

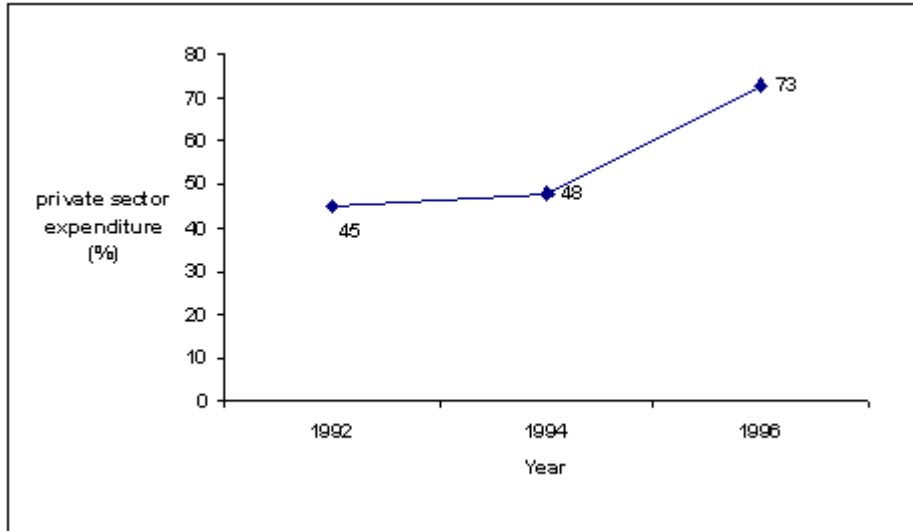
Despite a significant growth in Gross Domestic Product (GDP) from RM185,692 million in 1994 to RM246,825 million in 1996, the GERD/GDP ratio decreased by 35.3% from 0.34 in 1994 to 0.22 in 1996. This might be attributed to the fairly significant reductions in IHLs (73%) and GRIs (34%) R&D expenditures [see Table 4.1].

The decline in the GERD/GDP ratio may also be associated with some other factors; the R&D expenditures in 1996 were much affected by the stringent policy on purchasing of equipments (by the GRI and IHLs) which reduced the capital cost significantly [see Table 4.3]. It should be noted that the year 1996 was the first year of implementation of the Seventh Malaysia Plan which to a certain extent affected the R&D expenditure for that period. It is expected the major portion of the R&D expenditure be utilised towards the end of the plan. Also, with the rapid growth (up 33% from 1994) of the GDP in 1996 it is to be expected that the ratio would be reduced from the figure reported in 1994.

4.2 R&D Spending by Sector

There was much improvement in private sector involvement in R&D activities. The number of private companies carrying out R&D activities increased from 140 in 1994 to 158 in 1996. The private sector contributed 73% of the total GERD in

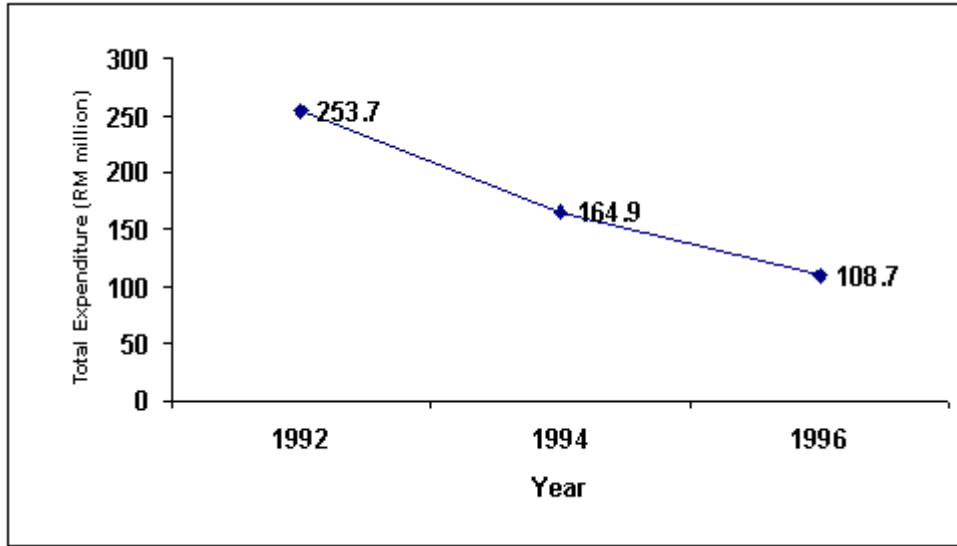
1996 and continued to lead the growth in R&D expenditure with the highest spending being registered in service industries. In this case, research, technical and consultancy services for PETRONAS alone contributed 95.6% of the total expenditure of RM 119.3 million for the industries. R&D spending by the private sector grew by RM 107.5 million to reach RM400.1 million in 1996. This accounts for 73% of the total GERD, an increase from 42% recorded in 1994. The average spending per company also increased from RM2.09 million to RM 2.53 million, registering an increase of 21%.



(Source : Table 4.1)
 Fig. 4.2 : % Contribution to GERD by Private Sector

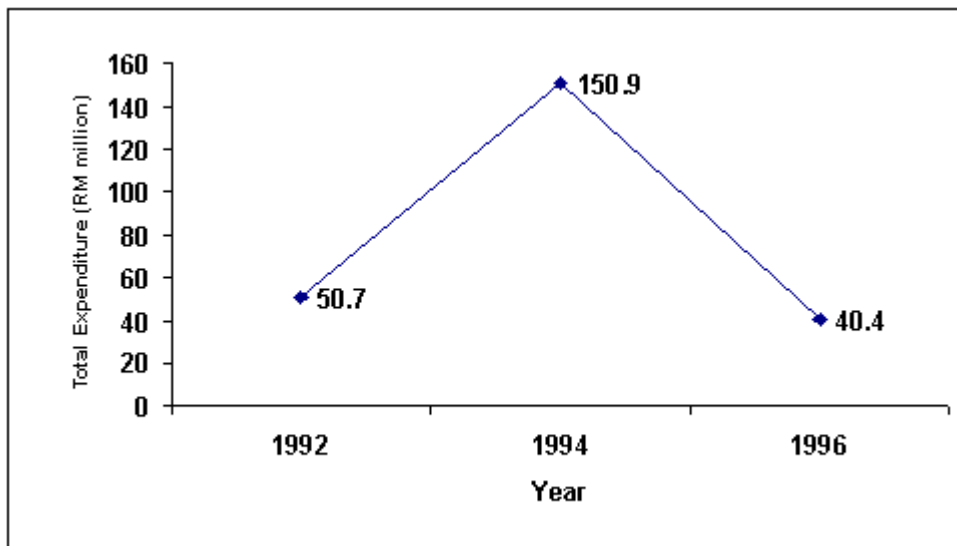
R&D spending by the GRIs, which contributed 19.8% of the total GERD, registered a decline by 34 %, from RM164.9 million in 1994 to RM108.7 million in 1996. This was mainly attributed to the fall in the number of GRIs carrying out R&D, from 37 in 1994 to only 28 in 1996. About 57% of the R&D expenditure in 1996 were due to labour cost.

R&D spending by the IHLs (comprising nine universities) showed a sharp decline, i.e., by 73%, from RM150.9 million in 1994 to only RM40.4 million in 1996. This is rather surprising in view of the fact that the number of researchers (headcount) has increased from 1075 in 1994 to 1377 in 1996. However, further investigations revealed that the purchase of machinery and equipment in Energy Industry in 1994 accounted for RM120.1 million (out of RM125.5 million), i.e., almost 80% of the total expenditure. In absolute terms (i.e., by disregarding the cost for purchasing of machinery and in equipment in 1994 and no purchasing of such equipment in 1996) the R&D spending by IHLs was slightly higher in 1996 compared to that of 1994.



(Source : Table
Fig. 4.3 : R&D Total Expenditure by GRI (1992-1996)

4.1)

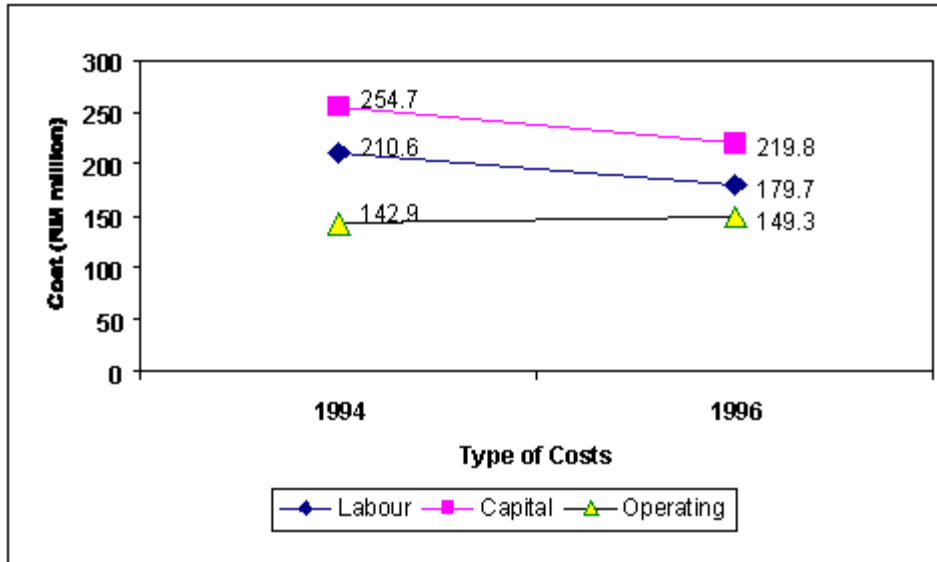


(Source : Table
Figure 4.4 : R&D Total Expenditure by IHLs (1992-1996)

4.1)

4.3 R&D Spending by Type of Cost

R&D spending by type of cost declined for two types of cost, i.e., labour (by 14.7%) and capital (by 13.7%) but registered a slight increase in operating cost (by 4.5%) [see Fig. 4.5].



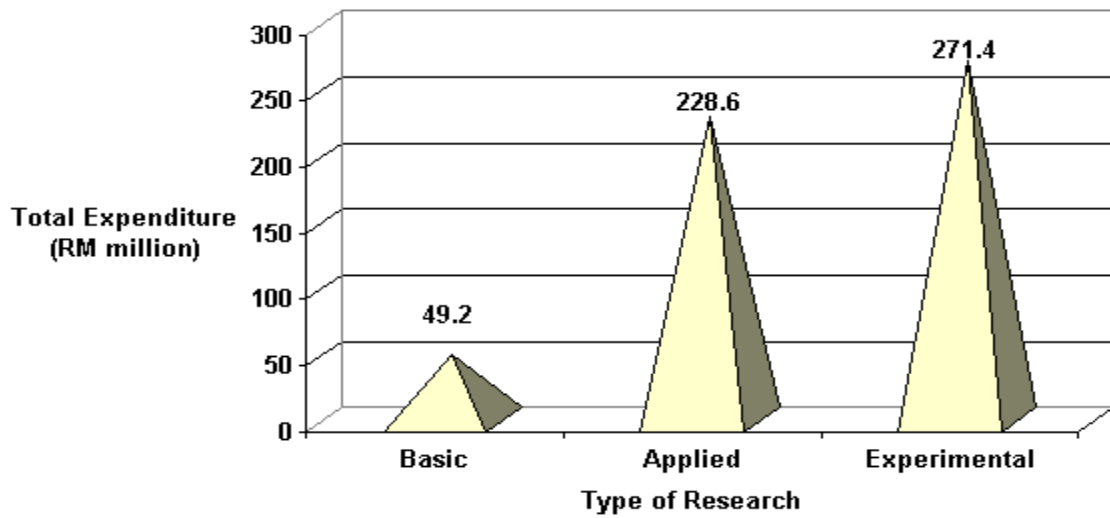
(Source : Table 4.3)
 Fig. 4.5 : R&D spending by Type of Cost

4.4 R&D Spending by Type of Research

Research is often motivated by the quest for fundamental knowledge; often it also contributes to strategic projects and/or national goals. Basic research is the domain of Institutes of Higher Learning (IHL) and is seen as an investment in the future.

In 1996, Basic Research constituted about 9% of the total GERD, amounting to RM49.2 million. A total of RM14.4 million, or 29.3% of the Malaysia's basic research came from the IHLs. The government provided the majority of the fund (mostly through IRPA grants). The private sectors spent RM18.3 million on Basic Research.

R&D spending for Basic research grew by 11.3% and Experimental Development by 47.9% but showed a substantial drop for Applied Research (40.4%). Experimental Development continues to constitute the largest share of total R&D expenditure, at 49.4%. This is followed by Applied Research (41.6%) and Basic Research (9%) [see Fig. 4.6].



(Source : R&D Spending by Type of Research : Table 4.2)

4.5 Manpower for R&D

The following diagram [see Fig. 4.7] provides a breakdown of the total R&D Manpower.

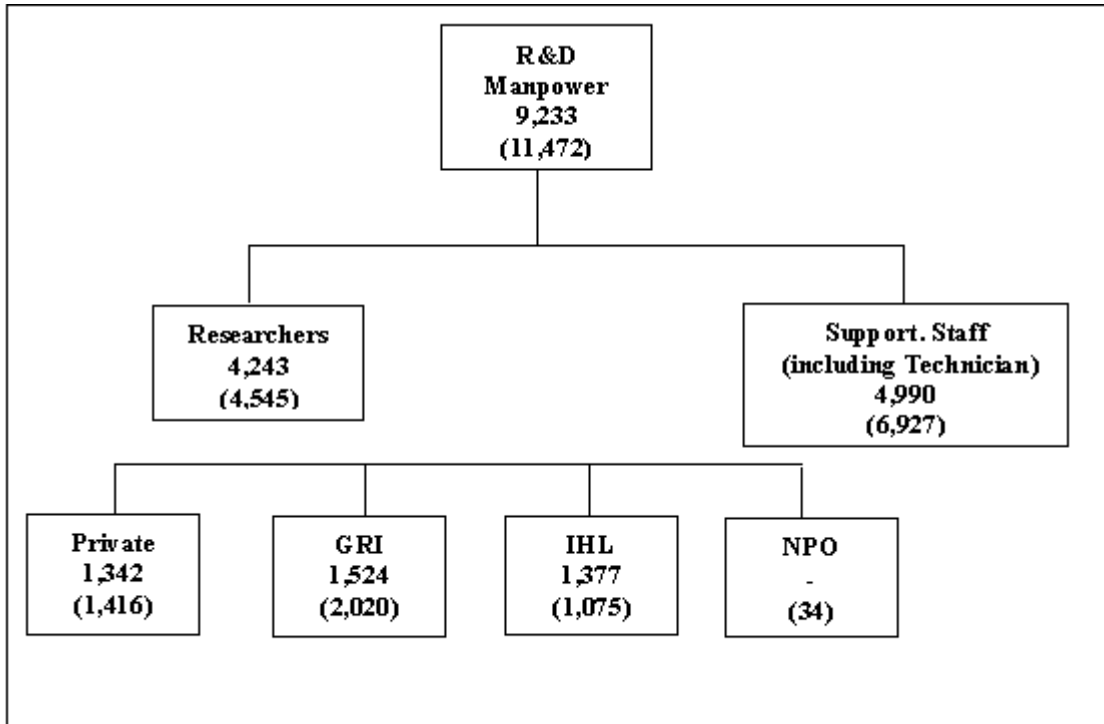


Fig. 4.7 : The Breakdown of Manpower for R&D

A total of 9,233 R&D personnel (Headcount) were engaged in R&D activities in 1996, representing a reduction of 19.5% in the number of research personnel over 1994. Researchers constitute the largest share, accounting for 46% (4243) of the total number of R&D personnel.

In terms of FTE, a total of 4,436.92 research personnel were utilised by all the three sectors [see Fig. 4.8]. This registered a decline by 33.5%, from 6,675.6 in 1994 to 4,436.92 in 1996. This is attributed to the drop in FTE levels in two of the sectors with the highest drop in the GRI (38.6%) and Private (8.1%) while the IHL recorded a slightly increase of 3.2%.

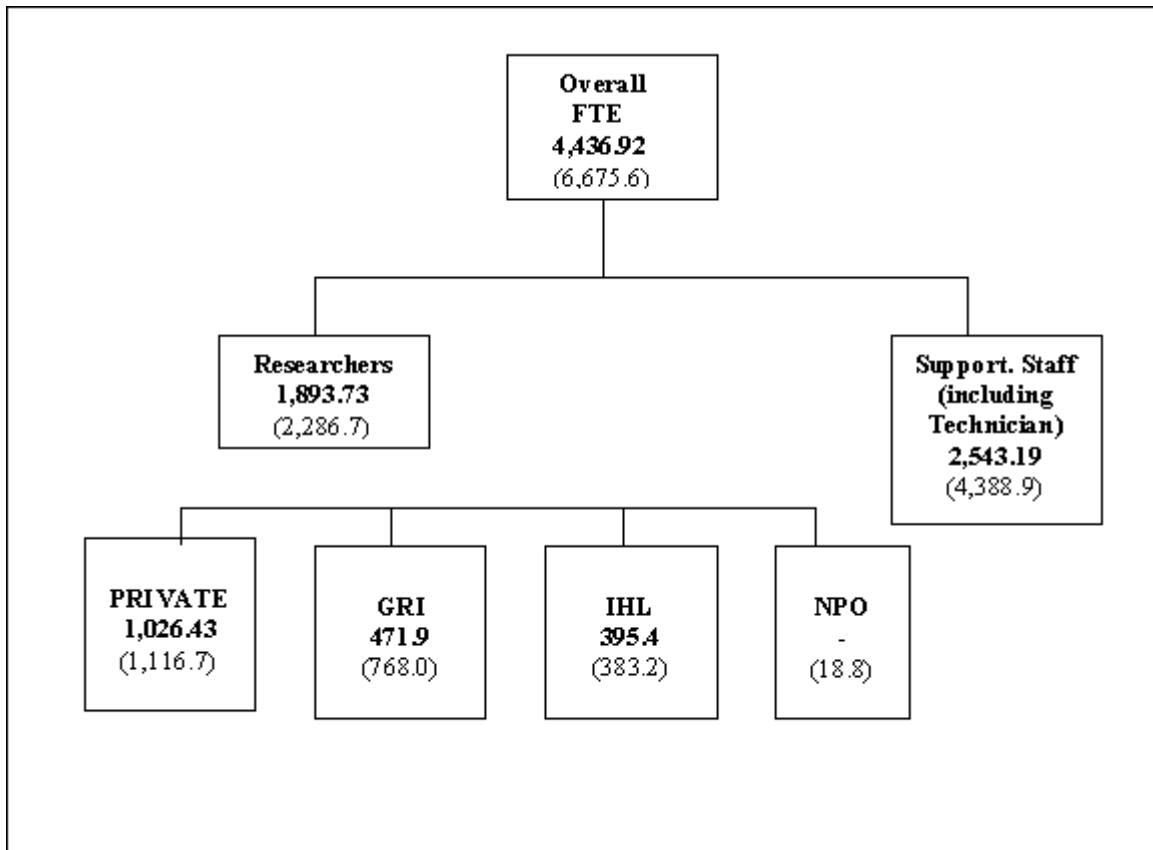


Fig. 4.8 : The Breakdown of FTE

4.6 The Factors Limiting R&D Activities

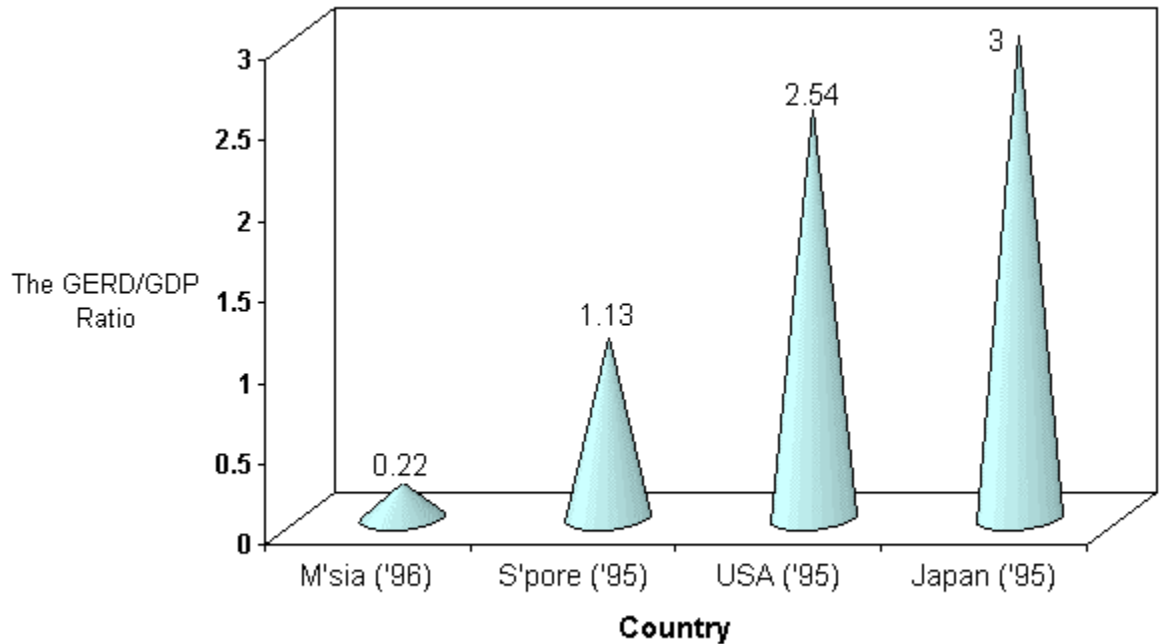
'Lack of new product/R&D strategy' and 'Shortage of R&D personnel with requisite expertise' were identified as the major factors that limited R&D activities in the private sector. The incentives provided by the government have not been able to attract more private companies to undertake R&D activities. The survey revealed that this was due to unclear procedures for application for R&D incentives and the narrow scope of eligibility for the incentives. In contrast, 'Delays in making decisions' and 'Increasing capital cost' were identified as the factors that limited R&D activities in the GRIs and the IHLs [see Table 4.4].

4.7 International Comparisons

4.7.1 The GERD/GDP Ratio

Malaysia's total expenditures for R&D were RM549.1 million in 1996 or 0.22% of the Gross Domestic Product (GDP). Japan remained the leading nation by posting a ratio of 3.0% in 1995. It is closely followed by the United States, whose

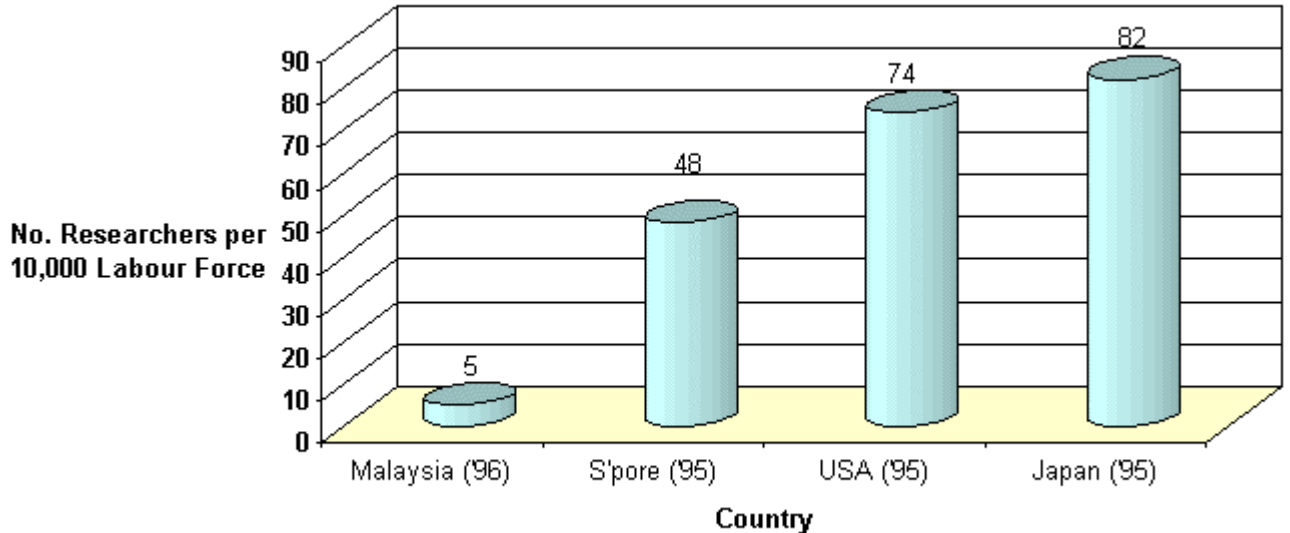
GERD/GDP ratio was 2.54 %. In the ASEAN region, Singapore registered a GERD/GDP ratio of 1.13% [see Fig. 4.9].



(Source : Table 4.5)
Fig. 4.9 : The GERD / GDP Ratio by Countries

4.7.2 The Manpower for R&D

Malaysia had only 5 researchers engaged in R&D per 10,000 labour force in 1996 compared to Singapore was 48 in 1995. In 1993, the ratio of researchers per 10,000 labour force was 82 in Japan and 74 in the United States [see Fig. 4.10 and Table 4.5].



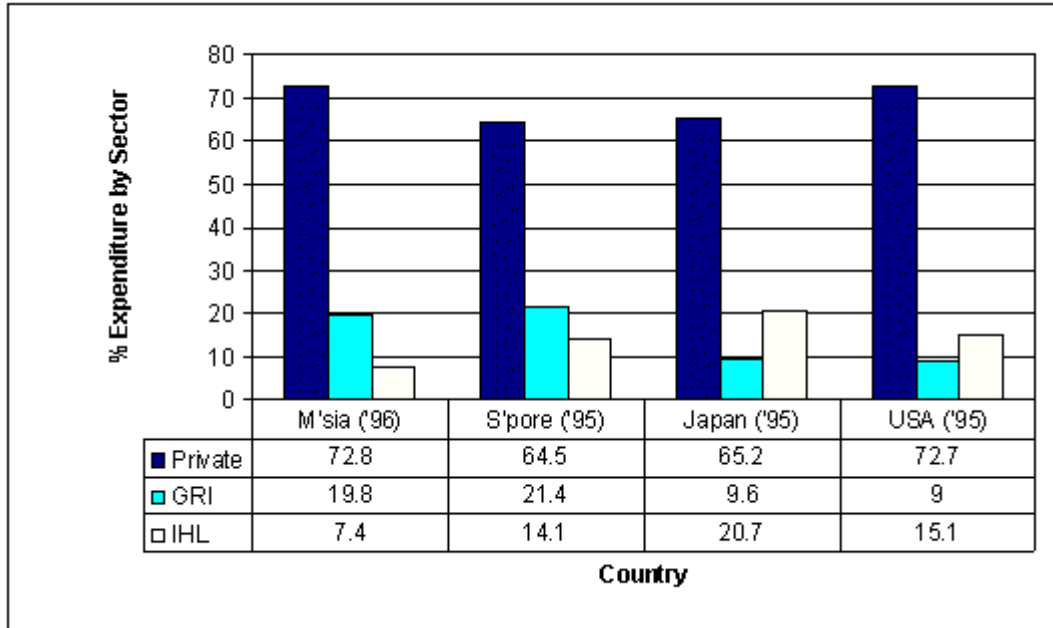
(Source : Table 4.5)
 Fig. 4.10 : The Number of Researchers per 10,000 Labour Force by selected Countries

4.7.3 Type of Research by Sectors

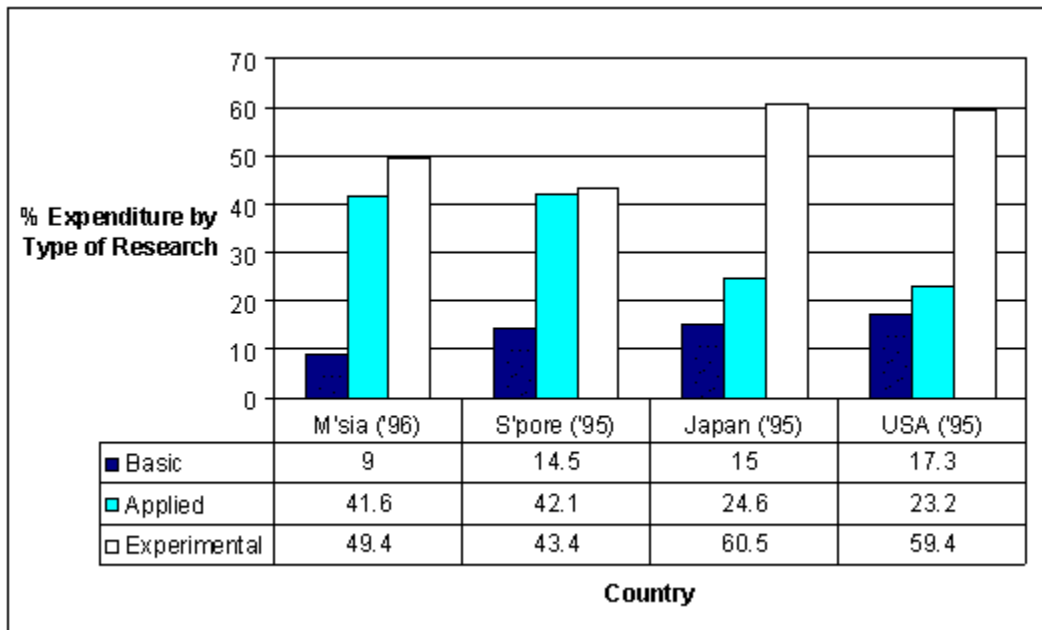
Private sector continues to provide the largest share of the total Malaysian effort in R&D. The funding represents 73% of the total expenditure. This figure exceeds the contributions to R&D by private sectors in the United States (72.7%), Japan (65.2%), and Singapore (64.5%) [see Fig. 4.11].

In the United States there is a widespread consensus on the importance of basic research. National expenditures in this area have increased to 17.3% in 1995. Other countries registered smaller contributions to this area; Malaysia (9%), Japan (12.2%) and Singapore (14.5%).

The co-operation between private sectors and Universities and Government Research Institutes through R&D activities in Malaysia is hardly visible. In 1996, only 0.4% of the expenditures of RM400.1 million was contracted out to Universities and Government Research Institutes [see Table 4.1]. In the United States private sectors' support to IHLs has grown rapidly, i.e., from 4% to 7% of the total expenditures during the period from 1980 to 1995. While the United States and Japan directed the majority (59.4% and 58.1%, respectively) of the R&D expenditure to Experimental Development, Malaysia and Singapore focused more on Applied Research [see Fig. 4.12].



(Source : Table 4.5)
 Fig. 4.11 : Sectors' Contributions to R&D by Countries



(Source : Table 4.5)
 Fig. 4.12 : Contributions to Type of Research by Countries