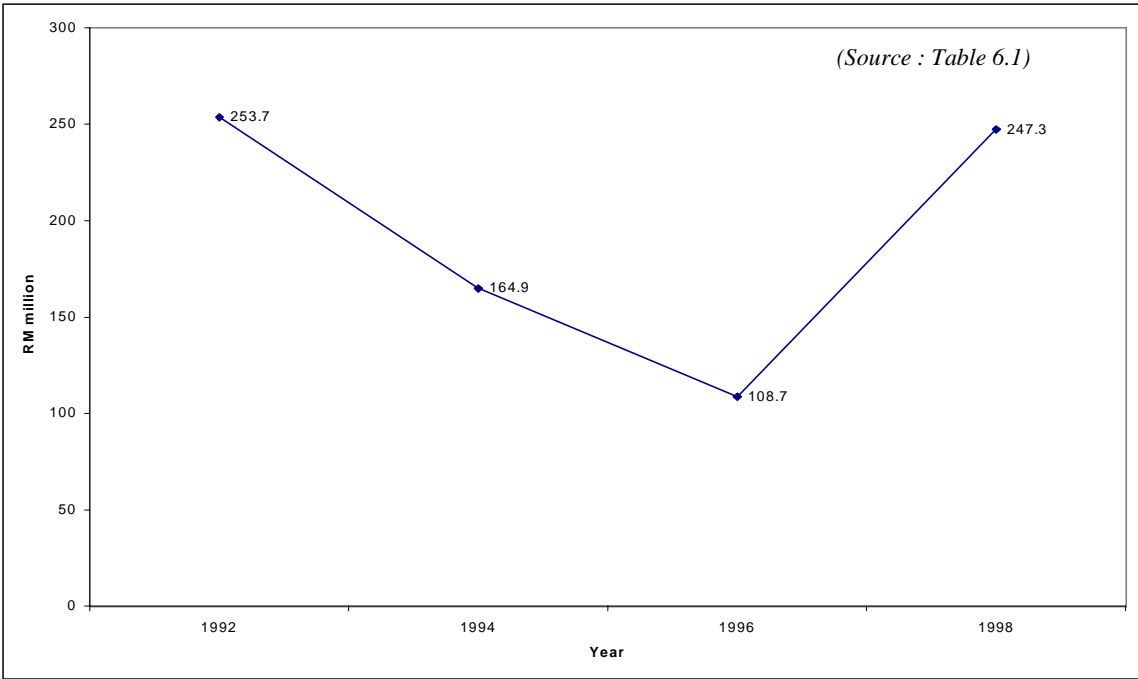


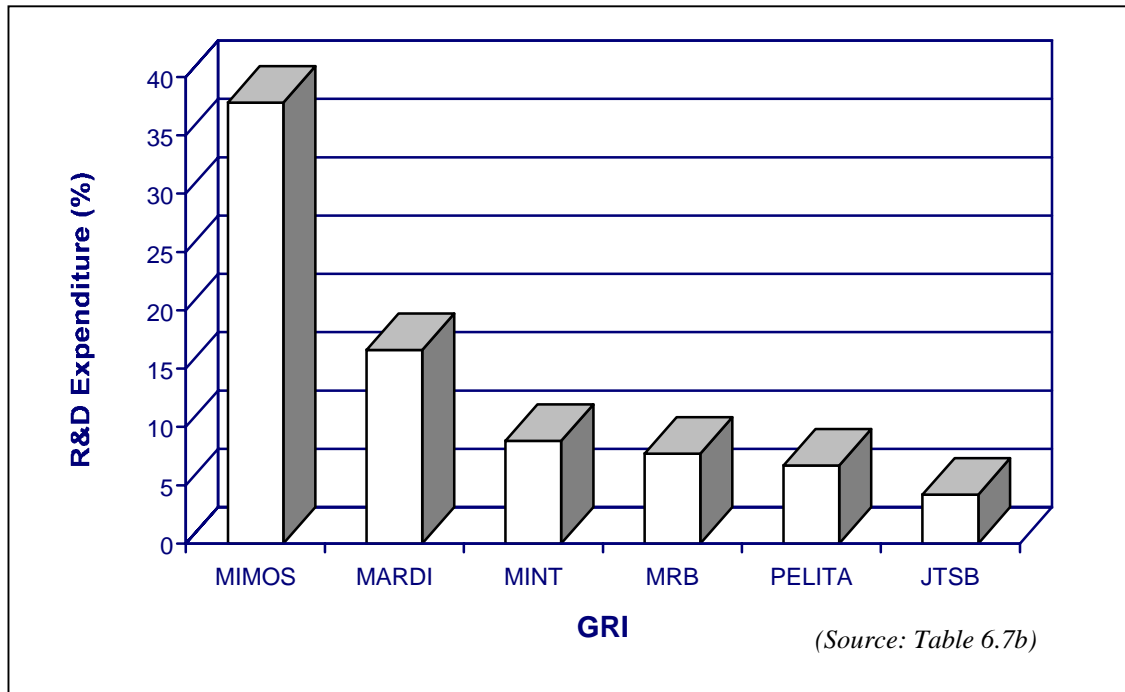
**6.1 Expenditure on R&D**

In 1998 there were 33 government research institutions (GRI) carrying out R&D activities [see Table 6.1]. The total expenditure on R&D by the GRI in 1998 was RM 247.3 million, reflecting a sudden upturn after a steady decline over the period 1992-96. [See Fig. 6.1]. The breakdown of the total expenditure of R&D activities by the GRI are the operating, capital and labour costs. Operating costs spent by the GRI constituted 38.1% of the total expenditure, labour and capital cost which accounted for 29.3% and 30.7%, respectively, of the total expenditure on R&D activities in 1998 [Table 6.1].



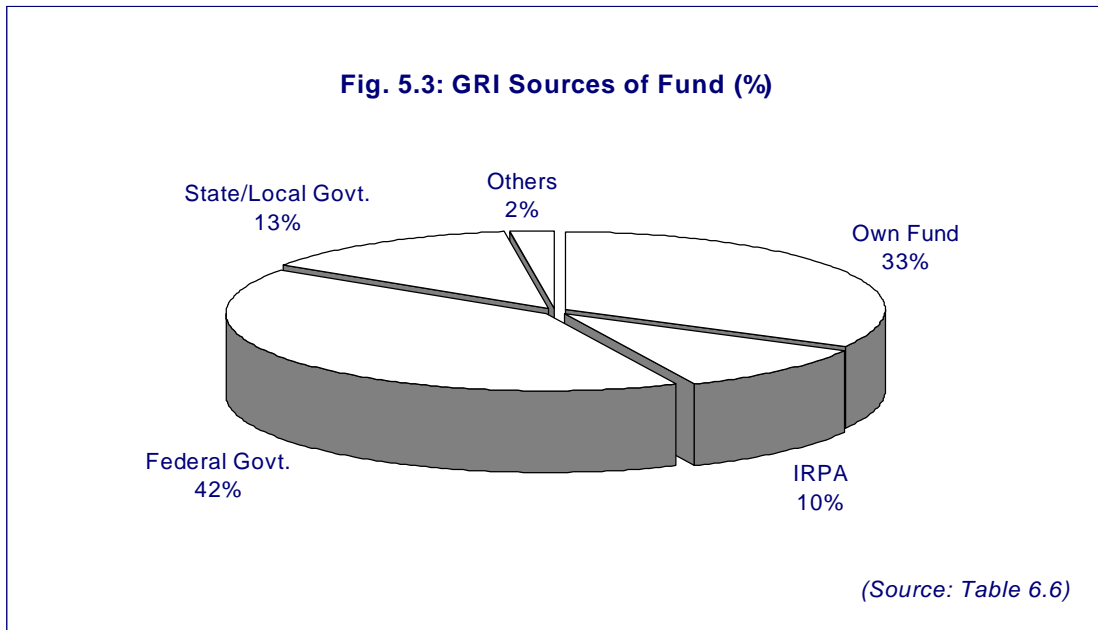
**Fig. 6.1 The GRI total R&D Expenditure (1992-1998)**

The most notable organisation that spent a fairly large amount (about 37.8% of the total GRI expenditure) on R&D activities was MIMOS [see Fig. 6.2]. The substantial increase in R&D expenditure by MIMOS (from only RM4 million in 1996 to RM93.5 million in 1998) reflected a greater alignment with the government’s emphasis on IT industry.



**Fig. 6.2 : The R&D Expenditure by selected GRI**

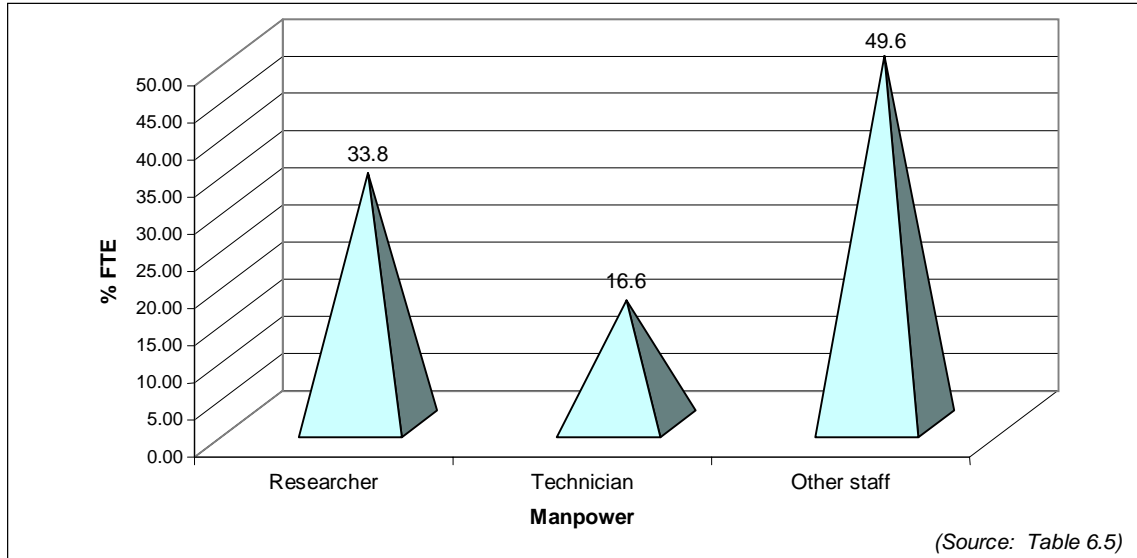
Another government agency that spent a large amount on R&D was MARDI which accounted for 16.6% of the total expenditure. However, MARDI’s total expenditure on R&D in 1998 was below the level registered in 1996, down 19.6% over the 2-year period. In terms of R&D funds, about 40.9% of MARDI’s total R&D expenditure was acquired from the Federal Government and 33% from its own funds [see Fig. 6.3].



**Fig. 6.3 : Sources of Fund (%)**

## 6.2 Manpower for R&D

There were 580 research groups reported employing R&D personnel in 1998. The total research effort (FTE) in 1998 was 2,193.18 involving a total number of 5,234 research personnel. There was an increase of 24% in the number of research personnel compared to 1996. The breakdown of the total (headcount) research personnel comprises the number of researchers, technicians and other supporting staffs. Of the total number of research personnel employed by the GRI, there were 1939 researchers, 828 technicians and 2,417 other supporting staffs. [see Fig. 6.4].

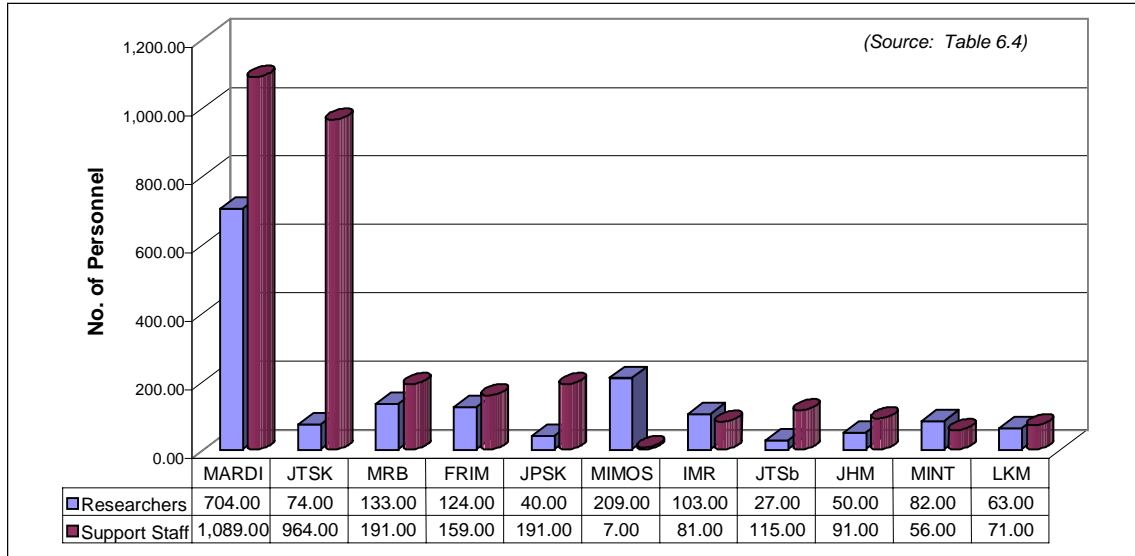


**Fig. 6.4 : percentage of breakdown of FTE among R&D personnel**

MARDI maintained its position as the agency with the largest number of research personnel (inclusive of foreigners) for 1998 with 1,793 research personnel, and this is followed by JTSK (1,038), MRB (324), and other agencies which employed below 300 research personnel such as FRIM, JPSK, MIMOS, IMR, JTSB, JHM, MINT and LKM. Fig. 6.5 illustrates the number of researchers and support staffs for all the agencies.

Most of the agencies have higher ratio of support staff to researchers. The government agency with the least number of researchers was LKM where the ratio of support staff to researchers was 1.17 : 1. On the contrary, the leading agency with the largest number of research personnel was MARDI with the ratio of support staff to researchers of 1.5: 1 [see Fig. 6.5].

Of the total (headcount) research personnel in the GRI 35.5% of them held at least first-degree qualifications. The Ph.D. holders constituted 10.2% of the total number of research personnel of which 35.9% of them (including foreigners) were from MARDI, followed by 15.2% from MRB and 10.3% from FRIM [Table 6.22].

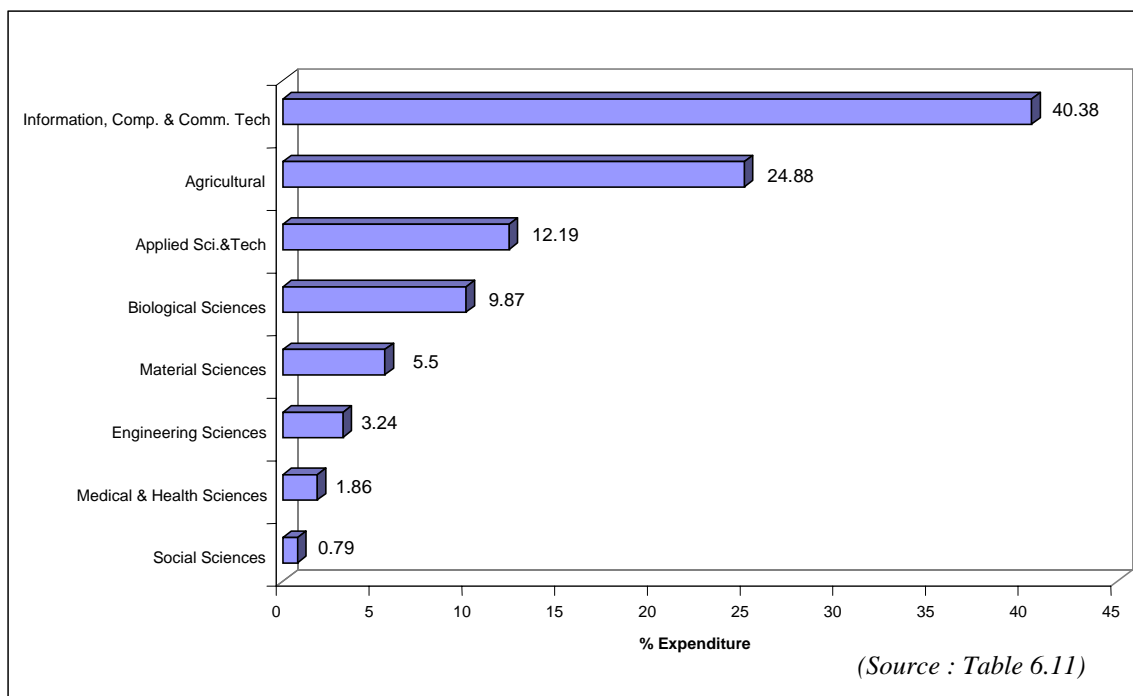


**Fig 6.5 : The number (headcount) of researchers and supporting staff for selected GRI**

### 6.3 R&D Field of Research (FOR) Priorities

In terms of the expenditures on the R&D activities based on field of research (FOR), most of the research areas covered by GRI were concentrated in Info. Computer and Communication Technology (40.4 %) followed by Agricultural Sciences (24.9 %) and Applied Sciences (12.2 %). [see Fig. 6.6]. In 1996 the leading field of research (FOR) was Agriculture.

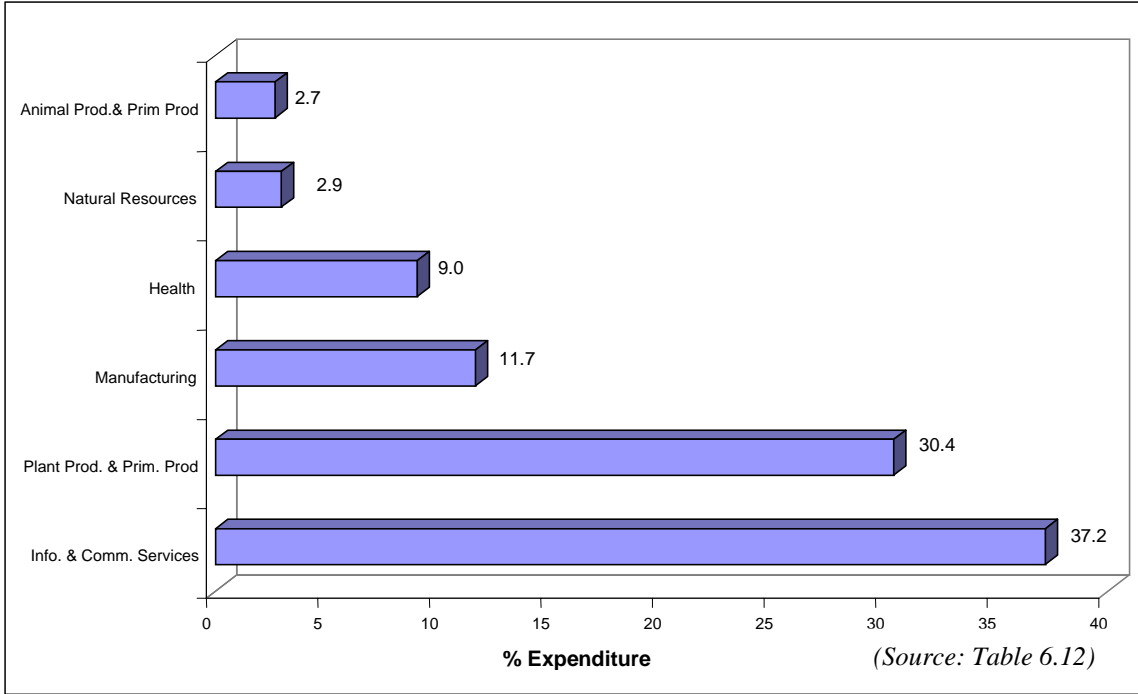
There was a drastic increase of the total expenditure by the GRI in Information, Computer and Communication Technology from less than RM5 million in 1996 to almost RM100 million in 1998 [Table 6.15]. It might have been due to the government pronouncements of the importance of this sector. The field of Agricultural Sciences also continued to grow steadily as its share of the total spending went up by 6.4% over the period 1996-98.



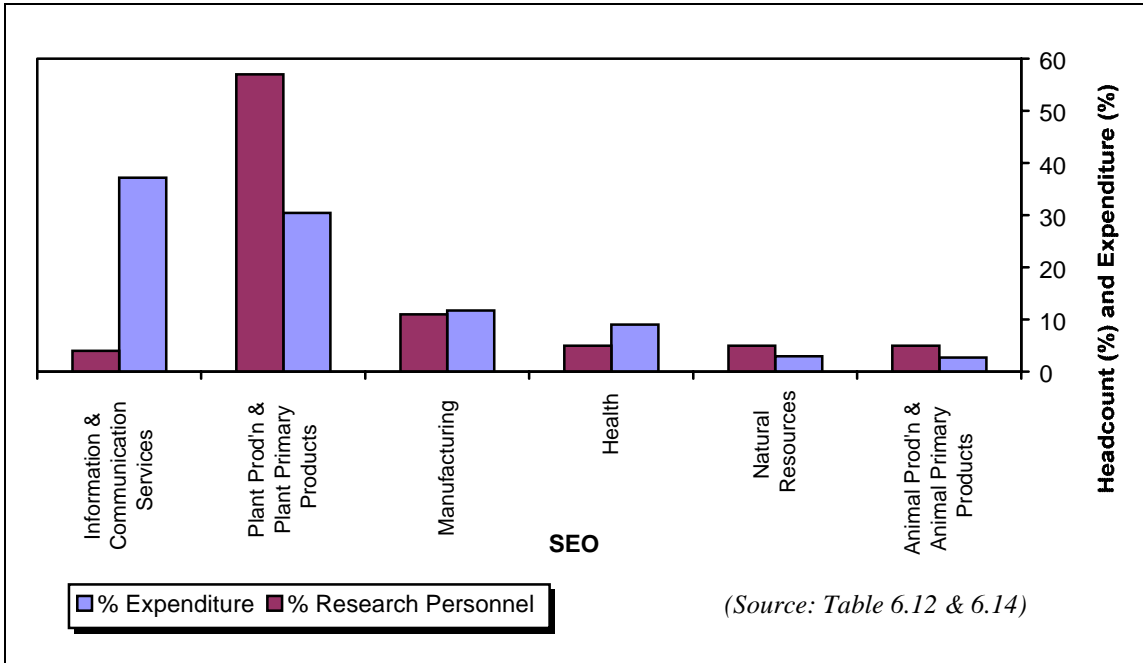
**Fig : 6.6 : Percentage Expenditure for selected Field of Research (FOR)**

#### **6.4 Socio-Economic Objectives (SEO) of R&D**

The SEO of R&D activities in 1998 was concentrated in Information and Communication Services where this area contributed about 37.2% of the total expenditure. [see Fig. 6.7]. Plant Production and Plant Primary Products emerged as the second SEO that contributed 30.4% of total expenditure. It also experienced a substantial growth of 48.1% in the expenditure compared to 1996. Both of the SEO accounted for about 67.6% of the total R&D GRI expenditure. Other sectors like Manufacturing contributed about 11.7% of the expenditure, followed by Health (9.4%) and Natural Resources (2.9%).



**Fig. 6.7 : Percentage of Expenditure for selected SEO**



**Fig 6.8 : Percentage of Research Personnel (Headcount) for selected SEO**

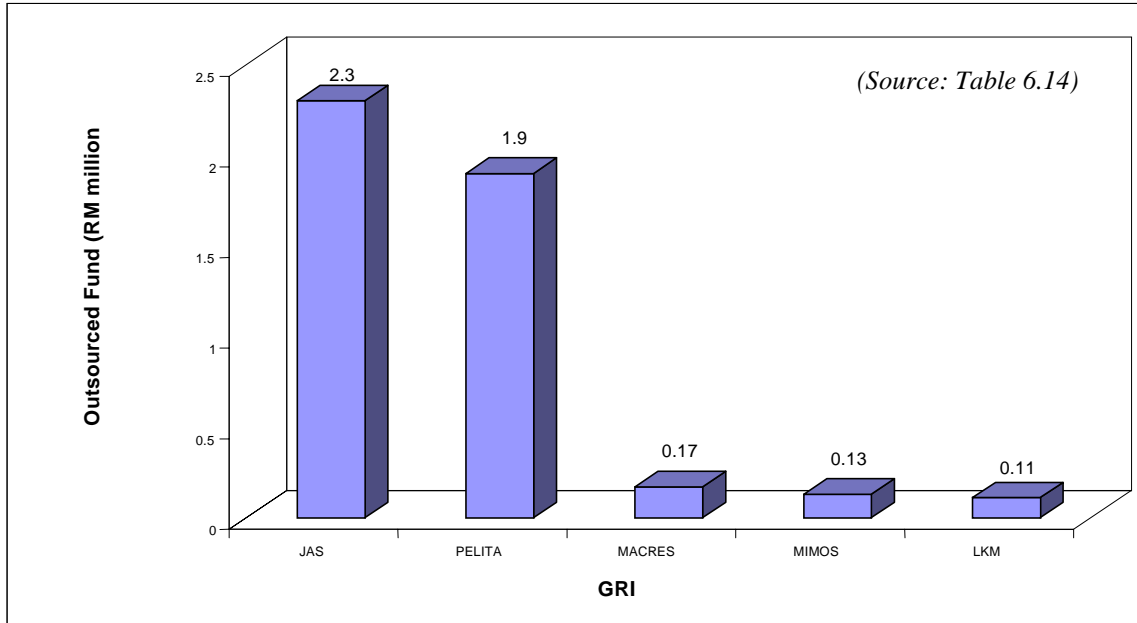
Fig. 6.8 illustrates the comparison of the percentage of research personnel (headcount) with that of R&D expenditure for some selected SEO. While there is no shortage of R&D funding in the area of Information and Communication Services one problem that clearly needs serious attention is the lack of manpower for R&D. Other areas, particularly, the area of Plant Production and Primary Products do not have serious problem in both R&D funding and manpower.

### **6.5 R&D Labour Cost**

On average, the cost per research personnel in the GRI was RM14, 123.72, a slight decrease of 5% compared to 1996. [see Table 6.2]. The agencies with the highest cost per research personnel were MACRES with RM 47,527.8, followed by MIMOS (RM 38,001) and JTSB (RM 33,063). For MACRES and MIMOS, they represent R&D organisations associated with research fields that are known to require high costs.

### **6.6 R&D Outsourcing**

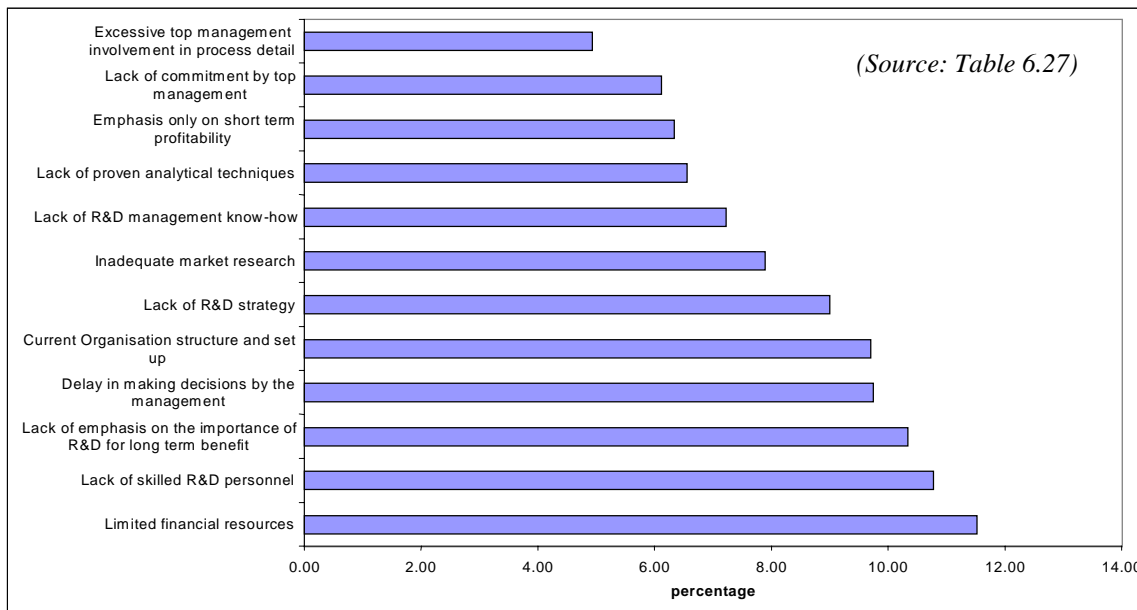
The amount of funds contracted out by the GRI to other organisations has increased considerably, from only RM1.1 million in 1996 to RM4.85 million in 1998 [see Table 6.14]. Of the ten government agencies and research institutes that contracted out their funds, JAS and PELITA were the major contributors, amounting to RM2.3 million and RM1.9 million, respectively. While JAS outsource all its outsource funds to local universities PELITA allocated about 66% of its outsource funds to foreign companies and another 34% to local universities. Five other agencies contracted out their funds amounting to less than RM 0.13 million to other institutions [see Fig. 6.9].



**Fig 6.9 : Amount of Funds Contracted by the GRI**

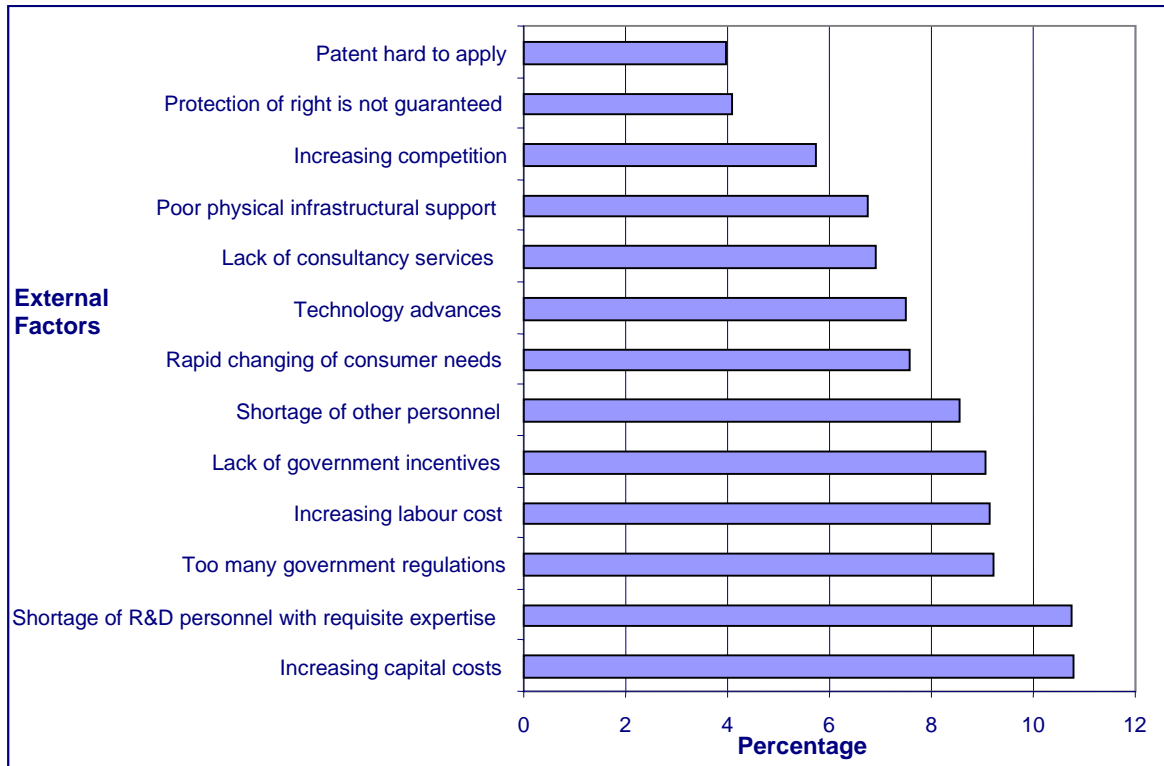
### 6.7 Factors Limiting R&D Activities

Among the major internal limiting factors identified as limiting the R&D activities were ‘Limited financial resources’, ‘Lack of skilled research personnel’ and ‘Lack of emphasis on the importance of R&D for long term benefit’. This is illustrated in Fig 6.10 below.



**Fig 6.10 : Internal Factors Limiting R&D Activities of the GRI**

Three major external factors that were recognised as the ones that limit the R&D activities were ‘Increasing capital costs’, ‘Shortage of R&D personnel with requisite expertise’ and ‘Too many government regulations’. These factors are displayed in Fig 6.11 below.



**Fig 6.11 : External Factors Limiting R&D Activities of the GRI**