CHAPTER V

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RESEARCH AND DEVELOPMENT IN INDUSTRIAL SECTOR

Research and Development (R&D) is an essential facet of any industrial activity especially, in the wake of growing global competition. Financial and human resources represent the principal inputs to R&D and can be used as indicators of the commitment of industry to innovation. It is a well known fact that the research and development in industries is essential for generating know-how necessary for production of quality products, promoting efficiency, promoting exports and technological self-reliance needed in the country as well as absorption, adaptation and upgradation of imported know-how. Research and Development in Industrial Sector is also essential for solving day-to-day production problems and for exploring the potential for future industrial expansion. The Government of India has been encouraging industrial units to take up R&D activities by paying special attention for promotion and support to R&D.

A scheme for granting recognition to in-house R&D units in industrial sector and private and public funded R&D laboratories was initiated by the Department of Science and Technology (DST) in 1973. This activity is being dealt by the Department of Scientific and Industrial Research (DSIR) since 1984. One of the objectives of this scheme is to provide liberalized import facilities to recognized R&D units for purchase of equipment, components, raw materials, etc., necessary for carrying out R&D work in order to update the technology and effecting improvements in the manufacturing process, introducing new products, processes, developing import substitutes. These incentives have encouraged industry to establish their in-house R&D centres (or units).

Industries in India comprise public sector industries (both central and state) and private sector industries. The private sector industries include in-house R&D units and Scientific and Industrial Research Organisations (SIRO) recognized by DSIR. The scope and coverage of data on R&D expenditure and human resources for Private Sector has been enlarged this time by including multi-national companies and companies not covered by the Department of Scientific and Industrial Research (DSIR) under its recognition scheme. Public sector together with private sector is called as industrial sector for convenience.

For 2005-06 survey, 2152 industrial R&D units were contacted through mail card enquiry. This comprised of 1056 DSIR recognised in-house R&D

Table 5.1

RESPONSE PROFILE OF INDUSTRIAL SECTOR

R&D Units	Private Sector			Public Sector	Industrial Sector
	In-house R&D Units	SIRO	Total Private Sector R&D Units		
Surveyed	1575	428	2003	159	2152
Responded	1108	290	1398	112	1510
Estimated*	185	60	245	-	245
'NIL' R&D	95	5	100	20	120
Not Responded	177	73	250	27	277

Note: 1. *projected for total R&D expenditure only
2. Industrial Sector = Private Sector + Public Sector

units of Private Sector, 424 companies performing R&D activities & registered with Ministry of Company Law Affairs, 95 Multi-national Companies, 428 Scientific and Industrial Research Organisations (SIRO non commercial) and 159 in-house R&D units of the Public/ Joint Sector. Requisite information for the survey in the Questionnaires specially designed for this sector has been received from 909 DSIR recognised companies, 180 R&D units not covered by DSIR recognition scheme, 19 Multi-national Companies, 290 SIRO units and 112 Public/Joint Sector R&D units and the R&D expenditure for 185 R&D units of Private Sector and 60 SIRO units have been estimated to arrive at the total Private Sector R&D expenditure of 1643 R&D units. It may be mentioned here that 100 R&D units in Private Sector and 20 units in Public/ Joint Sector reported 'NIL' R&D activities. Detailed analysis of data in respect of R&D expenditure and human resources is based on the actual data received from 1510 in-house R&D units of Industrial Sector. Table 5.1 gives the response profile of Industrial Sector.

Table 5.2 gives the investment on R&D and number of in-house R&D units for public sector, private sector and industrial sector as a whole for four years duration.

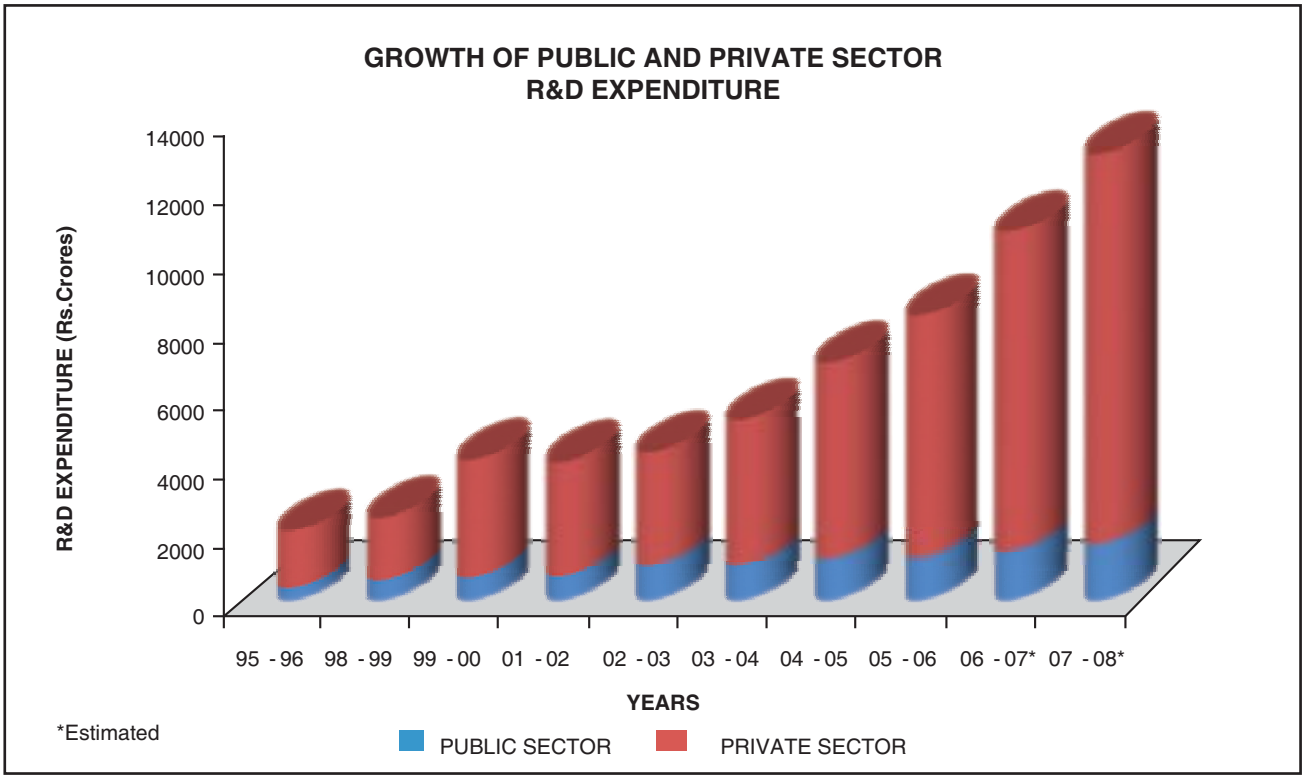
Investment on R&D activities by 1755 Industrial Sector R&D units attained a level of Rs. 8748.47 Crores at current prices for the year 2005-06. For the Private and Public Sector industries separately, the R&D expenditure was Rs. 7444.21 Crores and Rs. 1304.26 Crores respectively. Industrial Sector R&D expenditure constitutes 30.4% of the national R&D expenditure of Rs. 28776.65 Crores in the year 2005-06. For Private and Public Sector separately the share was 25.9% and 4.5% respectively. The Industrial Sector investment on R&D for the year 2005-06 worked out to be 0.27% of the Gross National Product (GNP) at current prices. The R&D expenditure as percentage of Sales Turnover (STO) for Industrial Sector worked out to be 0.55% for the year 2005-06. Industrial R&D expenditure increased from Rs. 4576.37 Crores in 2002-03 to Rs. 5562.30 Crores in 2003-04 to Rs. 7296.84 Crores in 2004-05 and further to Rs. 8748.47 Crores in 2005-06 representing an increase of 21.5%, 31.2%, and 19.9% respectively. Based on the past trend, the projected R&D expenditure for the year 2006-07 and 2007-08 were of the order of Rs. 10617.29 Crores and Rs. 12893.23 Crores respectively. It may be seen from Table 5.2 that investment on R&D by Private Sector industries has more than doubled from Rs. 3498.30 Crores in 2002-03 to Rs. 7444.21 Crores in 2005-06 and the same is expected to reach the level of Rs. 11192.86 Crores in 2007-08. It may also be mentioned here that the share of Private Sector investment in total national investment on R&D has increased from 19.3% in 2002-03 to 25.9% in 2005-06, whereas the share of Public Sector industries in national investment has decreased from 6.0% to 4.5% during this period.

It may be seen from Table 5.2 that 85.1% of the total Industrial Sector investment on R&D was by 93.6% of Private Sector in-house R&D units whereas rest 14.9% was invested by 6.4% of Public/Joint Sector R&D units during 2005-06. It may be interesting to note that though the number of R&D units for public and private sectors were kept constant for the duration of four years, the share of public sector R&D investment has decreased from 23.6% in 2002-03 to 14.9% in 2005-06. It may not be out of place to mention here that the Private Sector R&D expenditure during this period has increased at the faster pace than Public Sector R&D expenditure.

Table 5.2

R&D EXPENDITURE BY INDUSTRIAL SECTOR

Sector	Period	Public Sector	Private Sector	Industrial Sector
No. of R&D Units		112	1643	1755
R&D Expenditure	2002-03	1078.07	3498.30	4576.37
(Rs. Crores)	2003-04	1091.03	4471.27	5562.30
	2004-05	1257.88	6038.96	7296.84
	2005-06	1304.26	7444.21	8748.47



It may also be seen from Table 5.2 that per unit R&D expenditure for Private and Public Sector were quite variant which were Rs. 4.5 Crores and Rs. 11.6 Crores respectively during 2005-06. The variation between the two set of figures may be attributed to the big size of the companies in public sector and their need for complex and sophisticated technology calling for higher investment on R&D whereas private sector R&D units were heterogeneous in size which even included small scale industries and voluntary organizations operating on non-commercial basis spending very little on R&D.

It is known that industries are profit oriented and the investment by industries is to a large extent conditioned by the financial benefits accruing to them by way of increase in production, sales, reduction in the cost of production etc. The investment on advertisement also aims at increasing sales. Therefore, the information on R&D expenditure as percentage of sales turnover, advertising expenditure as percentage of sales turnover and expenditure on purchase of new plant and equipment and its percentage share in sales turnover were compiled to assess the relative importance given by the industries to R&D, advertising and purchase of new plant and equipment. The R&D expenditure as percentage of sales turnover for Industrial Sector worked out to be 0.55% for the year 2005-06 while for the Private and Public Sector separately, the figures were 0.66% and 0.30% respectively. It may be seen that this ratio was quite less than the advertising expenditure as percentage of sales turnover ratio for Private, Public and Industrial Sector. The investment on purchase of new plant and machinery as percentage of sales turnover was 2.93% for Industrial Sector during 2005-06. For the Private and Public Sector separately the figures were 4.03% and 2.42% respectively during 2005-06. It appears from the data and analysis that industry as a whole has higher priority for investment on advertising and purchase of new plant and equipment compared to R&D. It may be mentioned here that the R&D expenditure as percentage of sales turn over for a number of developed countries of the world varies between 3.0% and 4.0%.

The total R&D expenditure of Industrial Sector, Private Sector (excluding non-commercial 350 SIRO units) and Public Sector were apportioned into 41 industrial groups on the basis of the products manufactured by them. Out of 41 industrial groups identified, 13 leading industry groups arranged in

Table 5.3

INDUSTRIAL R&D EXPENDITURE CLASSIFIED BY LEADING INDUSTRY GROUPS DURING 2005-06

Sl. No.	Industry Group	Public Sector		Private Sector		Industrial Sector	
		R&D Units	R&D Exp. (Rs. Crores)	R&D Units	R&D Exp. (Rs. Crores)	R&D Units	R&D Exp. (Rs. Crores)
1	Drugs & Pharmaceuticals	5	2.02	156	2826.86	161	2828.89
2	Transportation	4	68.95	60	1047.20	64	1116.15
3	Defence Industries	9	506.01	7	15.67	16	521.68
4	Electricals & Electronics	12	54.38	132	375.40	144	429.78
5	Chemicals (other than fertilizers)	15	28.21	161	300.87	176	329.07
6	Fuels	14	316.10	9	10.85	23	326.95
7	Information Technology	1	11.81	20	306.63	21	318.44
8	Bio-Technology	1	1.20	70	277.74	71	278.94
9	Metallurgical Industries	11	89.02	50	142.87	61	231.89
10	Industrial Machinery	2	99.88	29	39.70	31	139.58
11	Telecommunications	2	39.63	30	98.67	32	138.30
12	Soaps, Cosmetics and Toilet Preparations	1	0.14	10	137.22	11	137.36
13	Miscellaneous Mechanical Engineering Industries	0		55	137.31	55	137.31
14	Others	35	86.91	319	551.42	354	638.33
	Total	**112**	**1304.26**	**1108**	**6268.41**	**1220**	**7572.67**

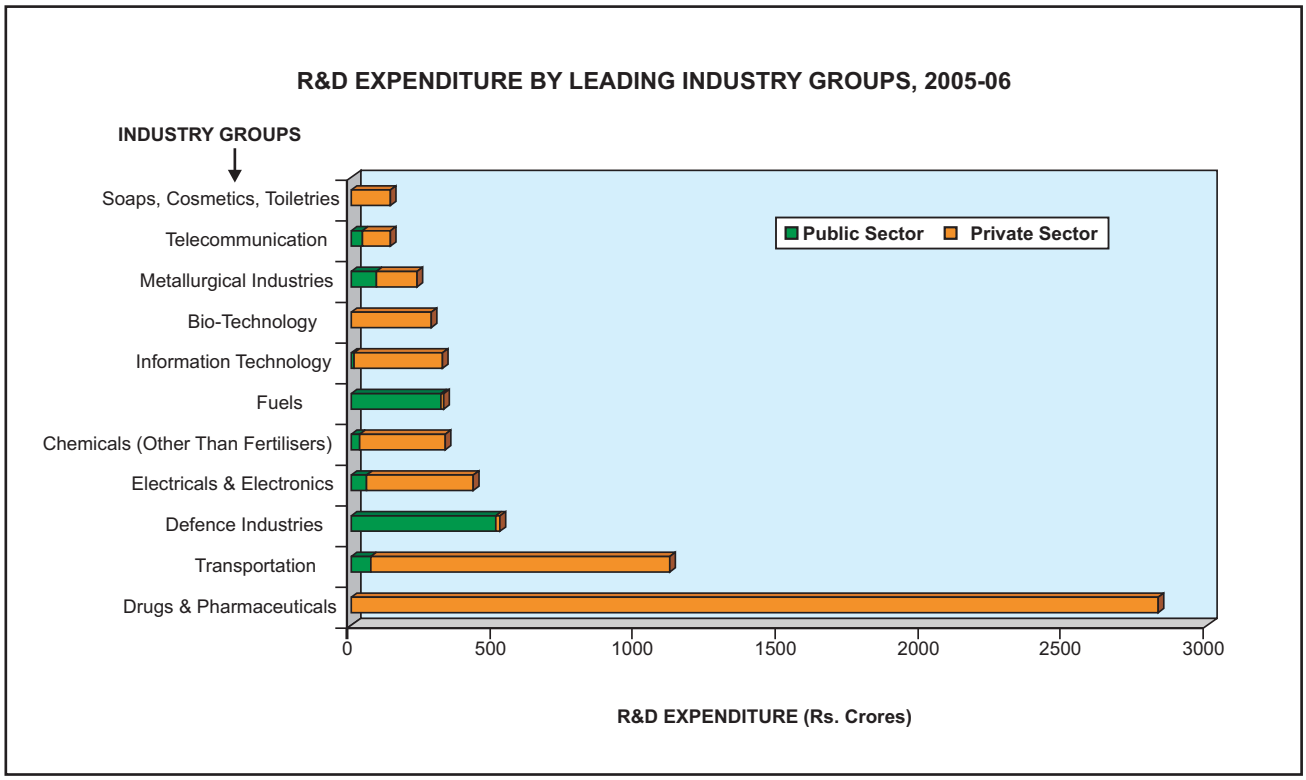


Table 5.4

PER UNIT INDUSTRIAL R&D EXPENDITURE CLASSIFIED BY SECTOR AND BY INDUSTRY GROUP, 2005-06

Industry Group	Per Unit R&D expenditure (Rs. Crores)		
	Public Sector	Private Sector	Industrial Sector
Defence Industries	56.22	2.24	32.6
Drugs and Pharmaceuticals	0.40	18.12	17.57
Transportation	17.24	17.45	17.44
Information Technology	11.81	15.33	15.16
Fuels	22.58	1.21	14.22
Soaps, Cosmetics and Toilet Preparations	0.14	13.72	12.49
Industrial Machinery	49.94	1.37	4.50
Telecommunications	19.82	3.29	4.32
Bio-Technology	1.20	3.97	3.93
Metallurgical Industries	8.09	2.86	3.80
Electricals and Electronics	4.53	2.84	2.98
Miscellaneous Industries	–	2.50	2.50
Chemicals (other than Fertilizers)	1.88	1.87	1.87
Others	2.48	1.73	1.8
Total	**11.65**	**5.66**	**6.21**

descending order of their expenditure spent 91.6% of total Industrial Sector R&D expenditure in 2005-06. Table 5.3 gives information on the number of R&D units and total R&D expenditure in each industry group separately for public, private and industrial sector during 2005-06.

It may be seen from Table 5.3 that Drugs & Pharmaceuticals group with 161 units occupy the first place in terms of R&D expenditure with Rs. 2828.89 Crores (37.4%). This was followed by Transportation and Defence Industries with 14.7% and 6.9% respectively during 2005-06. In the same manner if one looks at the Public/Private Sector industries data separately, the trend changes. In Public Sector, Defence Industries alone accounted for 38.8% followed by Fuels Industry groups with 24.2%. In case of Private Sector, the R&D expenditure of Drugs & Pharmaceuticals group was the highest accounting for 45.1% followed by Transportation with 16.7%. At the same time, Chemicals (Other than Fertilizers) remained the largest 14.4% as far as the number of units was concerned, followed by Drugs and Pharmaceuticals 13.2% in the Industrial Sector as a whole. It may be safely concluded from the above discussion that R&D expenditure in industry was concentrated in some industry groups only.

The heterogeneity in the size of R&D expenditure for different industry groups between Private and Public Sector in-house R&D units was quite significant. Table 5.4 may be seen for details. According to the data given in Table 5.4 per unit R&D expenditure for Industrial Sector as a whole was maximum for Defence Industries, i.e. Rs. 32.60 Crores and majority of these industries were under Public Sector. Similarly, the per unit R&D expenditure for the industry group Drugs and Pharmaceuticals was Rs. 17.57 Crores next to Defence Industries followed by the group Transportation with Rs. 17.44 Crores. When the per unit R&D expenditure of Public Sector was separately looked into, Defence Industries ranked first followed by Industrial Machinery, Fuels, Telecommunication and Transportation Industries. Among the Private Sector industry groups, this was maximum for Drugs and Pharmaceuticals Rs. 18.12 Crores succeeded by Transportation, Information Technology and Soaps, Cosmetics and Toilet Preparations. The per unit R&D expenditure of Public and Private Sector, when all units taken, was Rs. 11.65 Crores and Rs. 5.66 Crores respectively. This may be mainly due to the existence of a large number of R&D units of small scale industrial category and also Private Sector R&D units are heterogeneous in size in terms of R&D resources input. It may be interesting

to note from this table that variation in size of R&D investment was quite high between different industry groups. It may also be observed heterogeneity in the size of R&D expenditure for different industry groups between public and private sector was also quite significant.

The quantum of manpower employed in R&D units is another major indicator of country's R&D effort. As on 1st April, 2005, 87,249 full time equivalent personnel were employed in 1510 units of Industrial Sector in-house R&D units including 290 SIRO units which worked out to be 22.3% of total personnel employed in all the R&D establishments in the country. Out of the total manpower, employed in industrial R&D units 72605 were employed in 1398 Private Sector industries and rest 14,644 were employed in 112 Public/Joint Sector industries. In terms of percentage this works out to be 83.2% and 16.8% in Private and Public Sector respectively.

The personnel employed in the in-house R&D units of Industrial Sector were either engaged in research and development work (called R&D personnel) or were extending technical support for research and development (called auxiliary personnel) or were providing administrative support (called the administrative personnel) for research activities. It may be safely assumed that R&D personnel and auxiliary personnel were mostly S&T qualified. Information in this context may be seen from Table 5.5 which gives the number of personnel by type of work for Public, Private and Industrial Sector separately. It may be indicated here that the classification of all personnel into the three categories is not easy for many R&D units and therefore, this data may be considered only as order of magnitude.

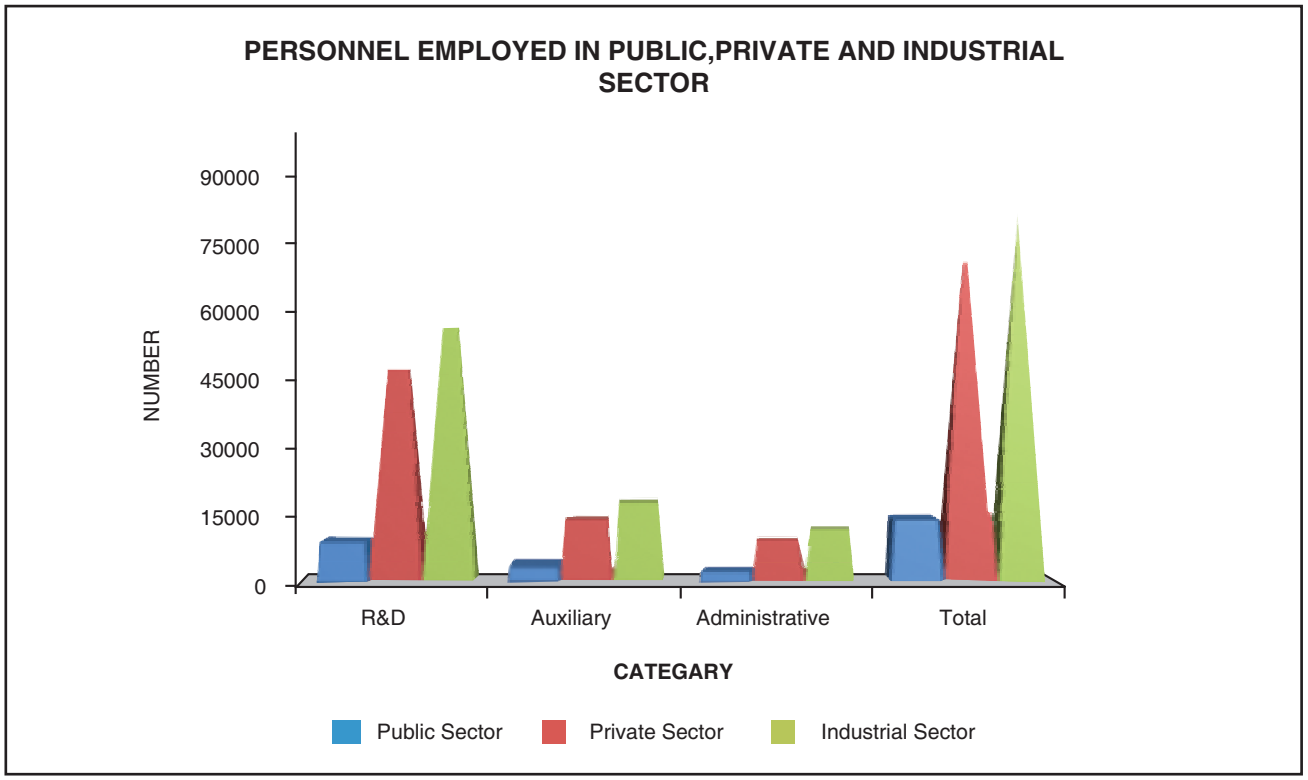
Table 5.5

CLASSIFICATION OF PERSONNEL BY TYPE OF WORK AS ON 01.04.2005

(Number)

Category	Public Sector	Private Sector	Industrial Sector
Number of R&D Units	112	1398	1510
R&D	9281	48079	57360
Auxiliary	3787	14180	17967
Administrative	1576	10346	11922
Total	**14644**	**72605**	**87249**

It may be seen from Table 5.5 that for every 100 personnel employed in Industrial Sector R&D units, 65.7 were engaged in research and development,



20.6 extended technical support for performing the R&D work and 13.7 provided administrative support. In Private Sector including SIRO, out of every 100 personnel, 66.2 were engaged in research and development 19.6 provided technical support and 14.2 provided administrative support and for Public Sector employment, the share of these categories was 63.4, 25.9 and 10.7 respectively.

As on 1st April, 2005, the total number of R&D personnel employed in 1510 Industrial Sector R&D units were 57,360 which work out to be 37% of total R&D personnel at national level. For Private Sector this figure was 48,079 and for Public Sector it was 9281. About 13,166 female personnel were employed in Industrial Sector R&D establishments in the country. Out of this, 56.5% (7437) were employed in Industrial Sector R&D work (Ref. Table - 16) given at the end.

Table 5.6 provides information on the total number of R&D personnel employed in Public, Private and Industrial Sector by field of science (or by discipline).

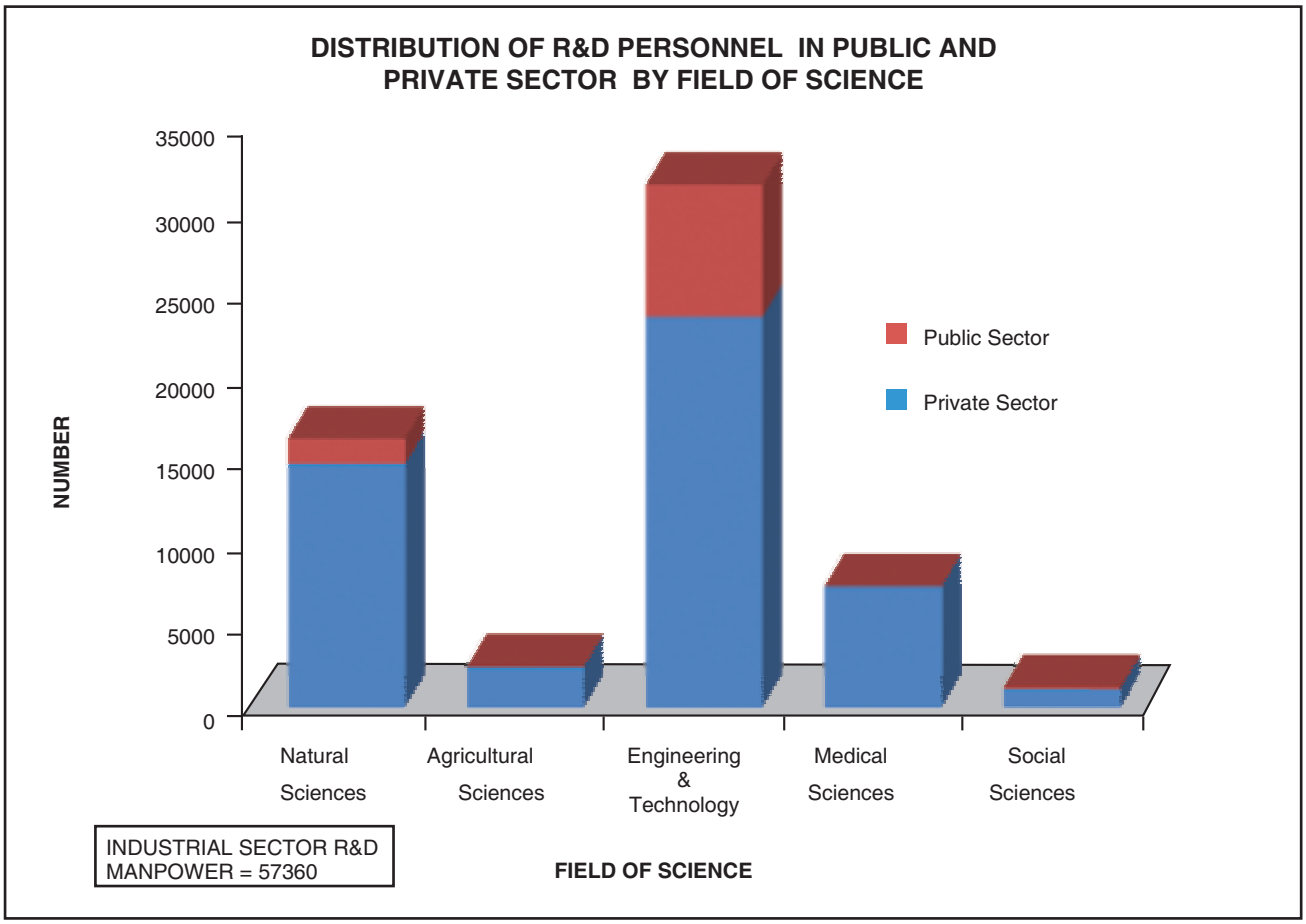
Table 5.6

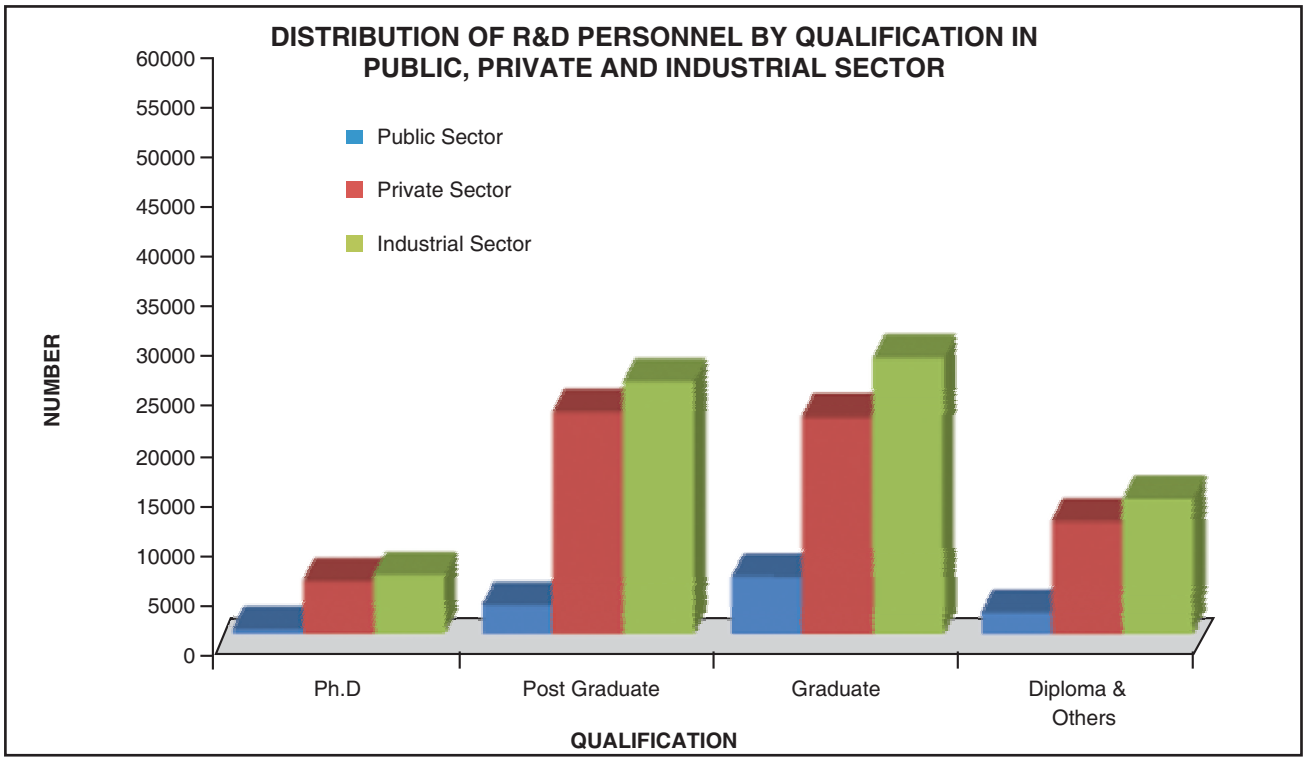
DISTRIBUTION OF R&D PERSONNEL IN THE INDUSTRIAL SECTOR BY FIELD OF SCIENCE

(Number)

Field of Science	Public Sector	Private Sector	Industrial Sector
Natural Sciences	1431	14349	15780
Agricultural Sciences	26	2470	2496
Engineering & Technology	7731	22881	30612
Medical Sciences	6	7188	7194
Social Sciences	87	1191	1278
Total	**9281**	**48079**	**57360**

Classification by discipline was available for all R&D personnel employed in Industrial Sector (57,360). It may be seen from Table 5.6 that R&D personnel with Engineering & Technology background dominate over all other fields of sciences in Industrial Sector as a whole as well as in Public & Private Sector separately. They accounted for 53.4%, 83.3% and 47.6% respectively. Next to this comes Natural Sciences which accounted for 27.5%, 15.4% and





29.8% respectively. It may be appropriate to conclude from the above analysis that R&D in Industrial Sector was more stressed towards applied sciences.

Table 5.7 provides information on the number of R&D personnel by level of qualifications for Public, Private and Industrial Sector.

Table 5.7

QUALIFICTION MIX OF R&D PERSONNEL IN THE INDUSTRIAL SECTOR

(Number)

Sector	Qualification				
	Ph.D	Post Graduate	Graduate	Diploma & Others	Total
Public Sector	492	2381	4606	1802	9281
Private Sector	4280	17594	17234	8971	48079
Industrial Sector	4772	19975	21840	10773	57360

The information for level of qualifications was available for all 57,360 R&D personnel employed by the industries. Out of this 8.3% were Doctorates, 34.8% were Post-Graduates, 38.1% were Graduates and 18.8% were having Diploma or Other qualifications in the combined disciplines of Natural, Agricultural, Medical, Engineering and Social Sciences. The proportion of Ph.Ds and Post-Graduates were more in the Private Sector when compared to Public Sector.

The relevant table giving information on female R&D personnel by qualifications and by field of science is given at the end (Table - 18) and this may be referred while going through this paragraph. As on 1st April, 2005, the total number of female R&D personnel employed in 1510 Industrial Sector R&D units was 7437 which works out to be 13.0% of total R&D personnel in Industrial Sector. For Private Sector this figure was 6506 and for Public Sector it was 931. Analysis of data by field of science and level of qualifications shows that 83.7% of female R&D personnel employed in the Public Sector industries were from the Engineering & Technology discipline whereas, Private Sector employed more female R&D personnel (37.7%) with Natural Science background when compared to other fields. In case of Industrial Sector as a whole, employment of female R&D personnel with Engineering & Technology background dominates other fields of science. The proportion of female Ph.Ds and Post-Graduates in total Industrial Sector employment was higher in case of Private Sector when compared to Public Sector. More than

one half (50.6%) of total female R&D personnel employed in Industrial Sector were having Post-Graduate or above qualifications.

The relevant tables in respect of gross emoluments of R&D personnel for Public, Private and Industrial Sector is given at Table - 19 at the end and this may be referred. There is no well defined salary structure available for Private Sector industries and so it is difficult to compare salaries of Public and Private Sector industries. In order to make it comparable, the industries were approached to provide information on annual gross emoluments. Some of interesting points emerging out of the analysis are given in the ensuing paragraph.

About 49.1% of the total R&D personnel employed in Public Sector had received annual gross emoluments between Rs. 2.00 Lakhs to 2.99 Lakhs. Only 17.9% of total R&D personnel in Public Sector were paid annual gross emoluments less than Rs. 2.00 Lakhs, whereas, in case of Private Sector it was 33.5%. About 19.8% and 15.3% of R&D personnel in Public and Private Sector had received annual gross emoluments more than Rs. 5.00 Lakhs.

To sum up, the salient features are as under:-

- Industrial Sector investment on R&D at current prices during 2005-06 attained a level of Rs. 8748.47 Crores. Out of this, 14.9% was spent by Public Sector and 85.1% was spent by Private Sector.
- Industrial Sector accounted for 30.4% of national R&D expenditure during 2005-06.
- Industry spent 0.27% of Gross National Product (GNP) on R&D in 2005-06.
- The R&D expenditure as percentage of Sales Turnover (STO) for Industrial Sector was 0.55% for the year 2005-06 while for Private and Public Sector separately the figures were 0.66% and 0.30% respectively.
- Per unit R&D expenditure for Private and Public Sector industries was Rs. 4.50 Crores and Rs. 11.60 Crores respectively during 2005-06.
- Drugs and Pharmaceuticals industry group topped the R&D expenditure followed by Transportation, Defence industries during 2005-06.
- As on 1st April, 2005, 87,249 personnel were employed in 1510 Industrial Sector R&D units out of which 57,360 were engaged directly on R&D activities. This was 37.0% of total R&D manpower employed in all the R&D establishments in the country.
- Out of the total R&D personnel in Industrial Sector, 16.2% were employed in Public Sector and 83.8% were employed in Private Sector.
- Of every 100 personnel employed in Industrial Sector, 65.7 were primarily engaged in R&D, 20.6 extended technical support and 13.7 provided administrative support.
- 53.4% of Industrial Sector R&D personnel were from Engineering and Technology discipline.
- 43.1% of Industrial Sector R&D personnel had Post-Graduate or above qualifications.
- About 19.8% and 15.3% of R&D personnel employed in Public and Private Sector had received Rs. 5.00 Lakhs or more as annual gross emoluments.