

## CHAPTER V

## 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 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 up-gradation of imported know-how. 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 centers (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. Public sector together with private sector is called as industrial sector for convenience. For 2000-01 survey, 1435 industrial R&D units were approached through mail card enquiry. This comprised of 1030 in-house R&D units of the private sector, 248 SIRO units (non-commercial) and 157 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 962 private sector in-house R&D units, 212 SIRO units and 152 public/joint sector R&D units and the R&D expenditure for the rest of the 63 in-house R&D units of private sector and 36 SIRO units have been projected to arrive at the total private sector R&D expenditure of 1273 R&D units. It may be mentioned that 5 in-house R&D units in the private sector reported no R&D activities. In order to enlarge the coverage of the survey, information in respect of 529 industries not recognized by DSIR but performing R&D activities was taken from the Central Monitoring of Indian Economy (CMIE) database. The primary source of this database is the Ministry of Company and Law Affairs. Detailed analysis of data in respect of R&D expenditure by industry groups is based on the actual data received from 1326 recognised in-house R&D units of industrial sector and 529 industries of CMIE database.

**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 Units		2000-01	2002-03	2000-01	2002-03
	2000-01	2002-03	2000-01	2002-03	2000-01	2002-03				
Surveyed	1030	1030	248	248	1278	1278	157	157	1435	1435
Responded	962	948	212	248	1174	1196	152	93	1326	1289
From CMIE Database@	529	529	0	0	529	529	0	0	529	529
<b>Total Response (A)</b>	<b>1491</b>	<b>1477</b>	<b>212</b>	<b>248</b>	<b>1703</b>	<b>1725</b>	<b>152</b>	<b>93</b>	<b>1855</b>	<b>1818</b>
Non-response* (B)	63	77	36	0	99	77	0	0	99	77
<b>Grand Total (A+B)</b>	<b>1554</b>	<b>1554</b>	<b>248</b>	<b>248</b>	<b>1802</b>	<b>1802</b>	<b>152</b>	<b>93</b>	<b>1954</b>	<b>1895</b>

**Note :** 1. \*projected for total R&D expenditure only  
 2. Industrial Sector = Private Sector + Public Sector  
 3. @ Data for 529 industries was taken from Central Monitoring of Indian Economy (CMIE) database.

For the first time, a single page questionnaire was designed for 2002-03 survey to reduce the time lag in getting the response. Through this survey, information was collected only on one input parameter i.e. R&D expenditure. Information received in response to this has also been included in the analysis. Table 5.1 may be seen for the profile of response from industry for both surveys.

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 five years duration.

Industrial sector investment on R&D activities attained a level of Rs.4457.19 crores at current prices for the year 2002-03. The private sector includes data collected through sample studies on Small Scale Industries of Madhya Pradesh and Karnataka and 529 industries doing R&D with paid up capital of more than Rs.50 lakhs and above (not recognized by DSIR) compiled from CMIE database. Industrial sector R&D expenditure constitutes 24.8% of the national R&D expenditure of Rs.18000.16 crores in the year 2002-03. The industrial sector investment on R&D for the year 2002-03 worked out to be 0.20% of the Gross National Product (GNP) at current prices. The R&D expenditure as percentage of sales turnover for industrial sector worked out to be 0.47% for the year 2002-03. Industrial R&D expenditure increased from Rs.3314.92 crores in 1998-99 to Rs.3415.46 crores in 1999-2000 to Rs.3766.21 crores in 2000-01 to Rs.4060.06 crores in 2001-02 and further to Rs.4457.19 crores in 2002-03 representing an increase of 3.0%, 10.3%, 7.8% and 9.8% respectively. Based on the past trend, the projected R&D expenditure for the year 2003-04 and 2004-05 were of the order of Rs.3955.14 crores and Rs.4287.84 crores respectively.

During the year 2002-03, 18.1% of the total industrial sector investment was by 93 public/joint sector industries and rest 81.9% was by 1554 private sector in-house R&D units and 248 SIRO units. On the same basis, the share worked out to be 22.4% for public sector and 77.6% for private sector during the year 2000-01.

It may be seen from Table 5.2 that 77.6% of the total industrial sector investment on R&D was by 92.2% of private sector in-house R&D units whereas rest 22.4% was invested by 7.8% of public/joint sector R&D units during 2000-01. 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 three years (main survey period), the share of public sector R&D investment has marginally increased during this period.

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.2.0 crores and Rs.8.7 crores respectively during 2002-03. 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.

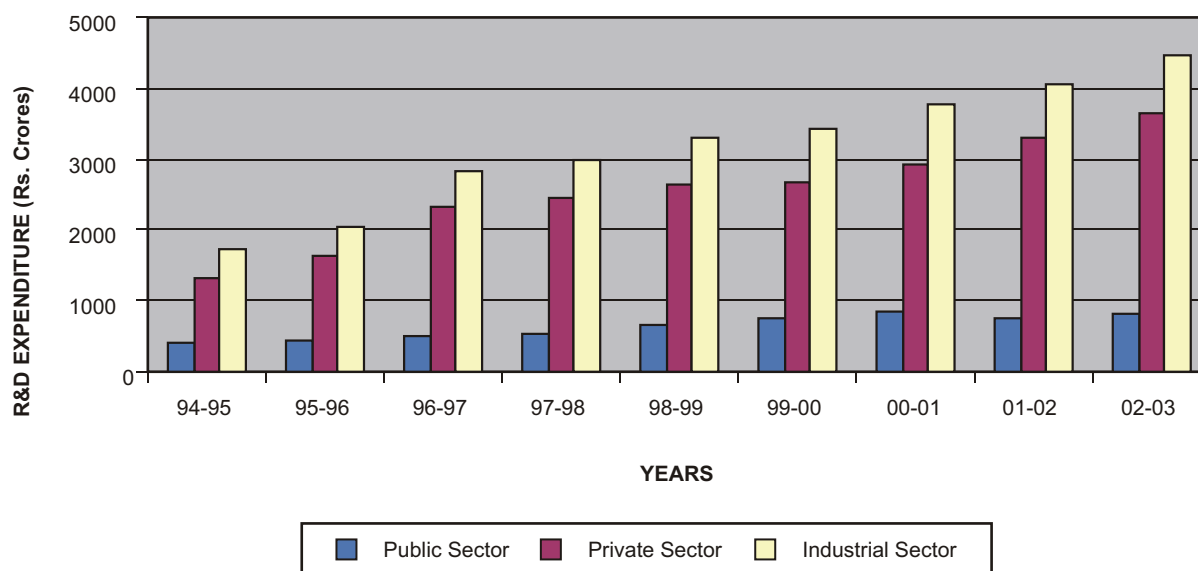
It is known that industries are profit oriented and the investment by industries is to a large extent conditioned by the financial benefits accruing to them by way of increase in production, sales, reduction in the cost of production etc. The investment on advertisement also aims at increasing sales. Therefore, the information on R&D expenditure as percentage of sales turnover, advertising expenditure as percentage of sales turnover

**Table 5.2**

**R&D EXPENDITURE BY INDUSTRIAL SECTOR**

Sector	Period	Public Sector	Private Sector	Industrial Sector
<b>Main Survey (2000-01)</b>				
No. of R&D Units		152	1802	1954
R&D Expenditure	1998-99	673.87	2641.05	3314.92
(Rs. Crores)	1999-00	757.63	2657.83	3415.46
	2000-01	842.89	2923.32	3766.21
<b>Quick Survey (2002-03)</b>				
No. of R&D Units		93	1802	1895
R&D Expenditure	2001-02	767.37	3292.69	4060.06
(Rs. Crores)	2002-03	808.94	3648.25	4457.19

### GROWTH OF INDUSTRIAL SECTOR R&D EXPENDITURE



and expenditure on purchase of new plant and equipment and its percentage share in sales turnover were compiled in the main survey to assess the relative importance given by the industries to R&D, advertising and purchase of new plant and equipment. The advertising expenditure as percentage of sales turnover for industrial sector worked out to be 0.35% for the year 2000-01 while for the private and public sector separately, the figures were 0.60% and 0.04% respectively. It may be seen that this ratio was quite less than the R&D 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 5.44% for industrial sector during 2000-01. For the private and public sectors separately the figures were 4.11% and 7.14% respectively during 2000-01. It appears from the data and analysis that industry as a whole has higher priority for investment on R&D as compared to advertising, but less priority than the purchase of new plant and equipment. Investment on R&D as percentage of sales turnover for industrial sector as a whole works out to be 0.47% for the year 2002-03, while for private and public sector the figures were 0.59% and 0.26% respectively. It may not be out of place to mention here that this ratio for a number of developed countries of the world varies between 3% to 4%.

The total R&D expenditure of industrial sector, private sector (excluding non-commercial 248 SIRO units) and public sectors were apportioned into 41 industrial groups on the basis of the products

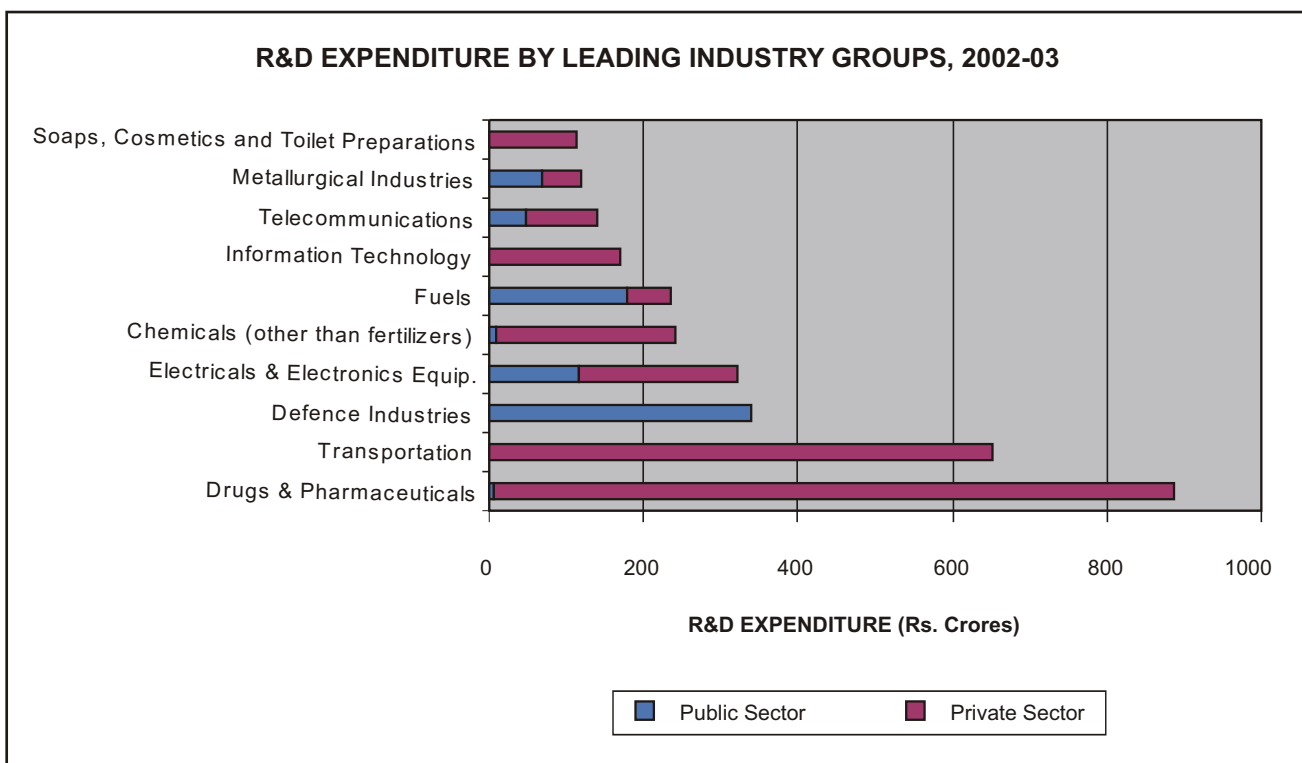
manufactured by them. Out of 41 industrial groups identified, 10 leading industry groups arranged in descending order of their expenditure spent 83.1% of total industrial sector R&D expenditure in 2002-03. Table 5.3 gives information on the number of R&D units and total R&D expenditure in each industry group separately for public, private and industrial sector during 2002-03.

It may be seen from Table 5.3 that Drugs & Pharmaceuticals group with 159 units occupy the first place in terms of R&D expenditure with Rs.885.82 crores (22.9%). This is followed by Transportation with 16.8% and Defence Industries with 8.8% as share in industrial R&D expenditure. 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 41.9% followed by Fuels and Electricals & Electronic Equipment Industry groups with 22.1% and 14.2% respectively (Ref. Table 11). In case of private sector, the R&D expenditure of Drugs & Pharmaceuticals group was the highest accounting for 28.7% followed by Transportation and Chemicals (other than fertilizers) with 21.3% and 7.6% respectively. At the same time, Chemicals (Other than Fertilizers) remained the largest (13.9%) as far as the number of units was concerned, followed by Electrical and Electronics Equipment (12.6%) 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.

**Table 5.3**

**INDUSTRIAL R&D EXPENDITURE CLASSIFIED BY LEADING INDUSTRY GROUPS DURING 2002-03**

S. No.	Industry Group	Public Sector		Private Sector		Industrial Sector	
		No. of Units	R&D Expenditure (Rs. Crores)	No. of Units	R&D Expenditure (Rs. Crores)	No. of Units	R&D Expenditure (Rs. Crores)
1.	Drugs & Pharmaceuticals	6	4.71	153	881.11	159	885.82
2.	Transportation	1	0.48	94	652.04	95	652.52
3.	Defence Industries	5	338.99	5	1.40	10	340.39
4.	Electricals & Electronics Equipments	9	114.86	189	207.15	198	322.01
5.	Chemicals (other than fertilizers)	8	9.28	211	232.13	219	241.41
6.	Fuels	7	178.97	12	54.86	19	233.83
7.	Information Technology	0	0	49	170.93	49	170.93
8.	Telecommunications	5	48.91	41	90.81	46	139.72
9.	Metallurgical Industries	10	69.41	60	48.49	70	117.90
10.	Soaps, cosmetics and Toilet Preparations	1	0.10	9	114.29	10	114.39
11.	Others	41	43.24	654	611.72	695	654.96
	<b>Total</b>	<b>93</b>	<b>808.95</b>	<b>1477</b>	<b>3064.93</b>	<b>1570</b>	<b>3873.88</b>



**Table 5.4****PER UNIT INDUSTRIAL R&D EXPENDITURE CLASSIFIED  
BY SECTOR AND BY INDUSTRY GROUP, 2002-03**

Industry Group	Per Unit R&D expenditure (Rs. Crores)		
	Public Sector	Private Sector	Industrial Sector
Defence Industries	67.80	0.28	34.04
Fuels	25.57	4.57	12.31
Soaps, Cosmetics and Toilet Preparations	0.10	12.70	11.44
Transportation	0.48	6.94	6.87
Drug & Pharmaceuticals	0.79	5.76	5.57
Agricultural Machinery	0.95	4.89	4.17
Information Technology	0.00	3.49	3.49
Telecommunications	9.78	2.21	3.04
Metallurgical Industries	6.94	0.81	1.68
Electrical & Electronic Equipments	12.76	1.10	1.63
Overall	8.70	2.08	2.47

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 some details.

According to the data from Table 5.4 per unit R&D expenditure for industrial sector as a whole was maximum for Defence Industries, i.e. Rs.34.04 crores and five out of ten of these industries were under public sector. Similarly the industry group fuels was Rs.12.31 crores next to Defence Industries followed by the group soaps, cosmetics and toilet preparations with Rs.11.44 crores.

When the per unit R&D expenditure of public sector was separately looked into, Defence Industries ranked first followed by Fuels, Electricals and Electronic equipments and Telecommunication Industries (Ref. Table 11). Among the private sector industry groups, this was maximum for Soaps, Cosmetics and Toilet Preparations (Rs.12.70 crores) succeeded by Transportation, Drugs and Pharmaceuticals, Agricultural Machinery and Fuels. The per unit R&D expenditure of public and private sector, when all units taken, was Rs.8.70 crores and Rs.2.08 crores respectively. This may be mainly due to the existence of a large number of R&D units of small scale industrial category in Electrical and Electronics Equipment, Drugs and Pharmaceuticals, Chemicals (other than Fertilizers), as 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 1<sup>st</sup> April, 2000, 53,408 full time equivalent personnel were employed in 1326 units of industrial sector in-house R&D units including 212 SIRO units which worked out to be 18.0% of total personnel employed in all the R&D establishments in the country. Out of the total manpower, employed in industrial R&D units 39,734 were employed in 1174 private sector industries and rest 13,674 were employed in 152 public/joint sector industries. In terms of percentage this works out to be 74.4% and 25.6% 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 1.4.2000**

Category	(Number)		
	Public Sector	Private Sector	Industrial Sector
R&D	8767	25957	34724
Auxiliary	2580	7303	9883
Administrative	2327	6474	8801
Total	13674	39734	53408

It may be seen from Table 5.5 that for every 100 personnel employed in industrial sector R&D units, 65 were engaged in research and development, 18.5 extended technical support for performing the R&D work and 16.5 provided administrative support. In private sector, out of every hundred personnel, 65.3 were engaged in research and development, 18.4 provided technical support and 16.3 provided administrative support and for public sector employment, the share of these categories was 64.1, 18.9 and 17 respectively.

As on 1<sup>st</sup> April, 2000, the total number of R&D personnel employed in 1326 industrial sector R&D units was 34,724 which works out to be 37% of total R&D personnel at national level. For private sector this figure was 25,957 and for a public sector it was 8,767. About 6,595 female personnel were employed in industrial sector R&D establishment in the country. Out of this, 55% (3629) were employed in industrial sector R&D work.

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

- Industrial Sector investment on R&D attained a level of Rs.4457.19 crores at current prices during 2002-03 and out of this, 18.1% was invested by public sector and 81.9% was by private sector.
- Industrial sector accounted for 24.8% of total investment on research and development in the country during 2002-03.
- Industry spent 0.20% of Gross National Product on R&D during 2002-03.
- Industrial sector devoted 0.47% of their sales turnover on R&D during 2002-03. For private and public sector separately, these figures were 0.59% and 0.26% respectively.
- Per unit R&D expenditure for private and public sector industries was Rs.2.0 crores and Rs.8.7 crores respectively during 2002-03.
- Drugs & Pharmaceuticals industry group was the highest in R&D expenditure followed by Transportation, Defence industries in total Industrial sector during 2002-03.
- As on 1<sup>st</sup> April, 2000, 53,408 personnel were employed in 1326 industrial sector R&D units out of which 34,724 were engaged directly on R&D activities. This was 18% 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 25.6% were employed in public sector and 74.4% were employed in private sector.
- For every 1000 R&D personnel in Industrial sector 104.5 were female employees.
- Of every 100 personnel employed in industrial sector, 65 were primarily engaged in R&D, 18.5 extended technical support and 16.5 provided administrative support.