

## **CHAPTER - XIII**

# **TECHNICAL MANPOWER AND R&D**



**TABLE 13.1**  
**ESTIMATED WORLD R&D EXPENDITURE**

Region	R & D Expenditure (US \$ Billion)			R & D Expenditure as % of GDP		
	1990-91	1996-97	1999-2000	1990-91	1996-97	1999-2000
World	409.8 (100%)	549.7 (100%)	755.1 (100%)	1.8	1.6	1.7
Developed	367.9 (89.8%)	460.4 (83.4%)	596.7 (79%)	2.3	2.2	2.3
Developing	41.9 (10.2%)	89.3(16.2%)	158.4 (21%)	0.7	0.6	0.9

*Source: Department of Science & Technology*

**TABLE 13.2**  
**R&D EXPENDITURE AND ITS SHARE IN WORLD TOTAL BY CONTINENTS**

Continent	Expenditure on R & D in billion US dollars and % share in brackets		
	1990-91	1996-97	1999-2000
Africa	5.2(1.3)	4.3(0.8)	5.8(0.8)
Noeth America	156.4(38.2)	209.0(38.0)	281.0(37.2)
Latin America &Caribbean	11.3(2.8)	16.8(3.1)	21.3(2.8)
Asia	94.2(23.0)	154.8(28.2)	235.6(31.2)
Europe	138.8(33.9)	157.7(28.7)	202.9(26.9)
Oceania	3.9(1.0)	7.2(1.3)	8.5(1.1)
<b>World (Total)</b>	<b>409.8(100)</b>	<b>549.7(100)</b>	<b>755.1(100)</b>

*Source: Department of Science & Technology*

**TABLE 13.3**  
**R&D EXPENDITURE PER CAPITA AND AS PERCENTAGE OF GDP FOR**  
**SELECTED COUNTRIES 2000-02**

SI	Country	Per Capita R & D expenditure in US\$	Per Capita GDP in US \$	R & D Expenditure as % of GDP
1	Argentina	11.03	2835	0.39
2	Australia	281.07	20471	1.55
3	Austria	564.59	25508	2.21
4	Brazil	22.55	2600	1.04
5	Canada	459.63	23043	2.00
6	Czech Republic	90.26	6951	1.30
7	Denmark	869.68	34586	2.51
8	Egypt, Arab Republic	2.20	1361	0.19
9	France	552.08	24259	2.27
10	Germany	613.94	24196	2.64
11	China	12.15	989	1.23
12	Hungary	66.49	6584	1.01
13	India*	3.53	486	0.80
14	Israel	755.91	14813	5.11
15	Italy	220.76	20419	1.11
16	Japan	976.58	31444	3.11
17	Korea Republic	288.50	9931	2.91
18	Pakistan	1.13	407	0.27
19	Russian Federation	29.91	2406	1.24
20	Singapore	475.52	21742	2.20
21	Spain	165.52	15929	1.04
22	Sri Lanka*	1.74	872	0.20
23	Sweden	1104.20	26701	4.27
24	United Kingdom	436.40	26547	1.88
25	United States	962.15	36052	2.67
26	Venezuela, RB	14.48	3774	0.38
Note : 1		* : 1996		

Source: Department of Science & Technology

**TABLE 13.4**  
**SCIENTISTS, ENGINEERS AND TECHNICIANS FOR SELECTED COUNTRIES**

Sl. No.	Name of Country	SET per thousand Population		SET in R & D per thousand population	
1	Argentina	34.84	(1991	0.81	-1995
2	Australia	53.59	-1986	4.16	-1996
3	Austria	21.57	-1981	2.44	-1993
4	Brazil	11.23	(1981)*	0.23	-1995
5	Canada	180.66	-1986	2.7	(1995)*
6	China	8.36	-1988	0.46	(1996)*
7	Cuba	14.36	(1981)*	2.73	-1995
8	Czech Republic	...		1.2	(1997)*
9	Denmark	97.78	-1991	3.26	(1998)*
10	Egypt	...		0.8	-1991
11	Germany	85.12	-1989	2.83	(1995)*
12	France	...		2.66	(1996)*
13	Guyana	1.28	(1982)*	0.35	-1982
14	Hungary	49.94	-1990	1.1	(1997)*
15	India	7.05	-1998	0.1	-1998
16	Indonesia	3.5	(1991)*	0.18	(1988)*
17	Israel	82.54	-1984	5.86	-1984
18	Italy	83.34	-1981	1.32	(1995)*
19	Japan	112.77	-1987	7.14	(1996)*
20	Republic of Korea	53.13	(1981)@	2.19	(1996)*
21	Nigeria	1.41	-1980	0.09	-1987
22	Pakistan	4.08	-1990	0.09	-1997
23	Philippines	36.65	(1980)*	0.18	-1992
24	Singapore	26.58	-1980	2.62	-1995
25	Spain	44.9	-1990	1.31	(1996)*
26	Sweden	113.63	-1992	3.83	(1995)*
27	U.K.	89.53	-1991	2.45	(1996)*
28	U.S.A	21.15	(1988)*	3.68	(1993)*
29	Russian Federation	139.16	-1989	4.2	-1997
30	Venezuela	107.82	-1991	0.24	-1992

Note : 1 @ Provisional Data  
2 \*Excludes Technicians  
3 SET : Scientists Engineers & Technicians  
4 Figures in parentheses represent the year for which data available  
5 ... Not Available.

Source: Department of Science & Technology

**TABLE 13.5**  
**ESTIMATED STOCK OF S&T PERSONNEL**

		<i>(Thousands)</i>					
Sl.No.	Category	Stock of S&T Personnel at the beginning of the year					
		1991	1996	1998	1999	2000	2001
1	Engineering Degree Holders	519.6	753.3	859.1	913.7	969.5	1024.4
2	Engineering Diploma Holders	859.3	1173.1	1312.3	1379.5	1546.0	1531.7
3	Medical Graduate*	310.3	358.4	380.4	391.7	403.4	415.9
4	Agricultural Graduates	168.4	202.3	216.5	223.8	231.2	238.6
5	Veterinary Graduates	34.4	40.2	42.7	44.0	45.3	46.7
6	Science Graduates	2430.3	3154.8	3479.3	3655.4	3837.7	4024.9
9	Science Post Graduates	482.0	626.1	695.5	730.6	767.1	805.0
<b>Total</b>		<b>4804.3</b>	<b>6308.2</b>	<b>6985.8</b>	<b>7338.7</b>	<b>7800.2</b>	<b>8087.2</b>
Note: *Includes Dental Surgeons							

Source: Department of Science & Technology

**TABLE 13.6**  
**NATIONAL EXPENDITURE ON RESEARCH AND DEVELOPMENT**  
**(At Current and Constant Prices)**

<i>(Rs. Crore)</i>		
Year	National Research & Development Expenditure	
	Current Price	Constant Price (Base : 1993-94)
1980-81	760.52	2342.16
1981-82	940.73	2629.71
1982-83	1206.03	3117.54
1983-84	1381.10	3278.64
1984-85	1781.55	3938.63
1985-86	2068.78	4216.14
1986-87	2435.40	4686.81
1987-88	2853.07	5020.23
1988-89	3347.26	5434.51
1989-90	3725.74	5585.80
1990-91	3974.17	5397.24
1991-92	4512.81	5386.79
1992-93	5004.60	5494.78
1993-94	6073.02	6073.02
1994-95	6622.44	6042.53
1995-96	7483.88	6263.44
1996-97	8913.61	6949.70
1997-98	10611.34	7750.76
1998-99	12473.17	8436.26
1999-00	14397.60	9375.10
2000-01	16198.80	10196.28
2001-02	17038.15	10372.09
2002-03	18000.16	10522.57
2003-04*	19726.99	11198.93

Note: 1. For working out Research and Development Expenditure at Constant Prices  
2. \*: Estimated

Source: Department of Science & Technology

**TABLE 13.7**  
**EXPENDITURE ON RESEARCH & DEVELOPMENT BY MAJOR SCIENTIFIC AGENCIES**  
**UNDER CENTRAL GOVERNMENT**

Agency/Year	Research and Development Expenditure										(Rs Lakhs)
	1970-71	1980-81	1990-91	1995-96	1998-99	1999-00	2000-01	2001-02	2002-03		
Council of Scientific & Industrial Research	2155.7	6900.0	24918.8	41170.0	69844.8	78088.2	86412.0	89226.0	95125.0		
Defence Research & Development Organisation	1755.4	7970.0	68100.0	139540.0	229198.0	282353.0	335932.0	317275.0	307949.0		
Department of Atomic Energy	2871.6	7347.8	27554.0	48664.0	84120.0	92604.2	100551.5	111560.4	123467.0		
Department of Biotechnology	-	-	4136.7	7382.7	9288.5	10239.8	12057.9	14103.8	16780.4		
Ministry of Information & Tech	-	540.6	3303.0	3637.9	6357.8	6417.9	5107.0	12919.0	10109.0		
Ministry of Non-Conventional Energy Sources*	-	400.4	1602.0	697.6	915.0	1021.0	1227.0	1995.0	1239.0		
Department of ocean Development	-	-	2780.4	4564.0	8466.7	8398.5	8422.6	11868.4	13960.0		
Department of Science & Technology	84.2	4063.7	11982.5	22367.5	26290.2	27885.1	31146.3	37051.0	50952.0		
Department of Space	-	5601.6	38622.2	91788.1	140170.3	167738.6	190540.0	190097.4	216543.0		
Indian Council of Agricultural Research	1837.0	9744.7	27625.1	43236.9	79961.1	109901.5	116173.6	137212.5	137100.0		
Indian Council of Medical Research	217.6	900.1	4454.0	5060.7	9536.0	11753.0	14912.0	16697.0	15750.0		
Ministry of Environment & Forests	-	374.0	16209.3	24459.5	28848.0	27498.7	27286.0	31086.9	26522.6		
<b>Total</b>	<b>8921.5</b>	<b>43842.8</b>	<b>231287.0</b>	<b>432568.9</b>	<b>692996.3</b>	<b>823899.3</b>	<b>929767.9</b>	<b>971092.4</b>	<b>1015497.0</b>		
Note : 1) Not including Public Research & Development Expenditure 2. - NIL 3. * Data for 1995-96 onwards is only for Plan Expenditure											
Source: Department of Science & Technology											

**TABLE 13.8**  
**NATIONAL EXPENDITURE ON RESEARCH AND DEVELOPMENT BY SECTOR**

Sector	Research and Development Expenditure									
	1970-71	1980-81	1990-91	2000-01	2001-02	2002-03	2003-04*	2004-05*	(Rs. Crore)	
Central Sector	112.5	580.5	3058.3	11050.2	11536.3	12073.0	13199.0	14443.4		
State Sector	12.6	59.3	365.9	1574.3	1494.3	1528.4	1682.2	1851.6		
Private Sector	14.6	120.7	550.0	2923.3	3292.7	3648.3	3955.1	4287.8		
Higher Education Sector	N.A	N.A	N.A	650.9	714.8	750.5	890.6	1056.8		
<b>Total</b>	<b>139.6</b>	<b>760.5</b>	<b>3974.2</b>	<b>16198.8</b>	<b>17038.2</b>	<b>18000.2</b>	<b>19727.0</b>	<b>21639.6</b>		

Note: 1. \* Estimated  
2. The number of R & D units in the private sector varies from year to year as per the DSIR recognition.  
3. Private sector industries data for the year 1998-99 onwards comprised of R & D units/firms recognised by DSIR & registered with M/o Company Law Affairs.  
4. Data refers to 1802 in-house R & D units of Private Sector Industries which include 248 SIRO units, projects data for 63 in-house R & D units and 529 industries of Central Monitoring of Indian Economy (CMIE) database.  
5. Data for the 2003-04 and 2004-05 has been estimated by applying the rate of growth for the period 1998-99 to 2002-03 sector-wise.  
6. Higher Education Sector Includes Data from 106 universities and 27 PG colleges having R & D but excludes R & D expenditure of 21 State Agricultural Universities  
7. State Sector includes R & D expenditure of state Agricultural Universities and other state departments/organisations.  
8. Data for Private sector for the year 1996-97 onwards include R & D expenditure of Small Scale Industry (SSI).  
9. N.A : Not available.  
10. R&D : Research & Development.  
11. Central Sector = Central Govt. + Public Sector.

Source: Department of Science & Technology

**TABLE 13.9**  
**EXPENDITURE ON RESEARCH AND DEVELOPMENT BY OBJECTIVES**

Sl. Objective No.	(Rs. lakh)															
	Central Government			State Government			Public Sector			Private Sector			Total		No.	
	2000-01	2001-02	2002-03	2000-01	2001-02	2002-03	2000-01	2001-02	2002-03	2000-01	2001-02	2002-03	2000-01	2001-02		2002-03
1	Exploration and Assessment of Earths, Seas, Atmosphere	24774.6	26137.8	27339.5	493.2	468.2	478.8	10930.8	11281.1	11892.3	93.6	105.4	116.8	36292.2	37992.5	39827.3
2	Space	190540.0	190097.4	216543.0	0.0	0.0	0.0	0.0	0.0	0.0	437.4	492.6	545.8	190977.4	190590.0	217088.6
3	Development of Agriculture, Forestry and Fishing	135005.8	142434.4	148982.6	146367.0	138930.1	142096.7	2675.9	2761.7	2911.3	19802.8	22305.0	24713.5	303851.5	306431.1	318704.0
4	Promotion of Industrial Development	68244.5	71999.6	75309.6	1621.1	1538.8	1573.8	27098.8	27967.2	29482.3	89618.9	100942.5	111842.7	186583.2	202448.0	218208.4
5	Production Conservation & Distribution of Energy	83571.1	88169.6	92223.0	1046.2	993.0	1015.7	2707.1	2793.8	2945.2	9860.7	11106.6	12306.0	97185.1	103063.1	108489.8
6	Development of Transport and Communication	16459.7	17365.4	18163.8	536.9	509.6	521.2	7450.1	7688.9	8105.4	54811.9	61737.5	68404.2	79258.7	87301.5	95194.7
7	Development of Health Services	39548.1	41724.2	43642.4	3364.9	3193.9	3266.7	951.3	981.8	1035.0	85924.0	96780.8	107231.6	129788.3	142680.7	155175.7
8	Social Development & other Socio-Economic Services	4606.9	4860.4	5083.8	1014.7	963.2	985.1	24.5	25.3	26.6	7058.4	7950.2	8808.7	12704.4	13799.0	14904.3
9	Protection of Environment	28688.7	30267.3	31658.8	159.2	151.1	154.5	149.4	154.2	162.5	842.4	948.9	1051.3	29839.7	31521.4	33027.2
10	General Advancement of Knowledge	128065.9	185985.4	201029.3	246.7	234.1	239.5	2717.5	2804.6	2956.5	3715.5	4185.0	4636.9	134745.5	193209.1	208862.2
11	Other aims	28795.9	30380.3	31777.0	2582.3	2451.1	2507.0	347.6	358.8	378.2	16365.2	18433.0	20423.5	48091.0	51623.2	55085.7
12	Defence	335932.0	317275.0	307949.0	0.0	0.0	0.0	27686.2	18687.4	19699.7	2095.0	2359.7	2614.6	365713.2	338322.1	330263.3
13	Urban and Rural Planning	1591.5	1679.1	1756.3	0.0	0.0	0.0	1550.2	1232.3	1299.0	1706.3	1921.8	2129.4	4848.0	4833.2	5184.7
<b>TOTAL</b>		<b>1085824.6</b>	<b>1148376.0</b>	<b>1201458.0</b>	<b>157432.2</b>	<b>149433.0</b>	<b>152839.0</b>	<b>84289.4</b>	<b>76737.0</b>	<b>80894.0</b>	<b>292332.0</b>	<b>329269.0</b>	<b>364825.0</b>	<b>1619878.2</b>	<b>1703815.0</b>	<b>1800016.0</b>

Note: Central Sector includes Higher Education.

Source: Department of Science & Technology

**TABLE 13.10**  
**EXPENDITURE ON RESEARCH & DEVELOPMENT BY CENTRAL**  
**MINISTRIES/DEPARTMENTS**

		(Rs. Lakh)				
Sl.No.	Ministry / Department	Research & Development Expenditure				
		1998-99	1999-00	2000-01	2001-02	2002-03
1	Agriculture & cooperation	2140.7	2415.4	3767.8	4521.3	5508.5
2	Animal Husbandry & Dairying	2101.2	1435.9	1546.8	1569.4	1592.4
3	Chemicals & Petrochemicals	771.3	956.5	994.1	519.8	629.6
4	Civil Aviation	208.0	357.0	367.8	444.8	537.9
5	Coal	823.8	833.1	901.4	1189.3	1144.1
6	Commerce	3436.6	3273.5	3604.8	3662.7	3721.6
7	Culture	2953.9	2966.9	3064.5	3102.2	3140.5
8	Defence	73.3	79.9	87.6	92.9	98.6
9	Defence Production & Supplies	19919.6	25387.2	29185.9	32883.9	39553.8
10	Education	4714.0	5025.4	5028.4	5137.8	5249.6
11	Fertilizers	2001.5	1887.4	1916.8	1892.4	1654.4
12	Food & Public Distribution	136.2	119.2	133.5	132.6	131.7
13	Food Processing Industries	683.8	742.0	740.3	552.3	757.2
14	Health & Family Welfare	8515.9	8789.2	10334.2	11020.7	11756.3
15	Heavy Industry	7040.7	6921.1	8190.2	9929.1	9344.7
16	Home	644.0	660.4	771.5	819.3	870.2
17	Industrial Policy & Promotion	3142.4	3376.3	4114.7	4307.7	4509.8
18	Information & Broadcasting	487.4	475.0	440.3	442.7	445.3
19	Labour	815.4	866.2	896.9	925.8	955.7
20	Mines	19422.7	20099.9	22041.5	21904.2	21205.4
21	Petroleum & Natural Gas	17004.1	18160.3	18805.2	19315.0	19448.9
22	Posts	19.4	9.0	9.0	9.0	310.0
23	Power	1981.1	1726.8	2123.7	2234.1	2164.1
24	Railways	5479.3	5839.9	6255.0	6123.8	6260.5
25	Rural Development	332.2	361.9	348.5	552.7	698.0
26	Small Scale Agro Industries	1553.2	1560.9	1244.0	1158.4	1080.1
27	Steel	5454.2	5476.8	6288.3	6101.0	6524.7
28	Consumer Affairs	403.1	410.4	394.7	462.4	541.7
29	Road Transport & Highways	587.8	617.1	577.2	309.1	282.9
30	Statistics & Programme Implementation	3715.5	3880.0	4030.0	4197.2	4371.2
31	Telecommunications	13744.0	14563.0	15774.8	14228.7	13160.1
32	Textiles	5981.9	6144.1	7302.7	7804.7	8341.7
33	Urban Development	845.6	1057.8	1189.8	1229.0	1269.6
34	Water Resources	3011.2	3063.7	3156.7	3206.7	3257.5
35	Welfare	1140.4	1779.5	1813.5	2119.4	2477.3
36	Public Sector under Major Scientific Agencies	3236.3	3777.3	3726.7	4102.6	4205.1
37	Joint Sector including State undertakings	3698.2	3631.9	4085.7	4335.7	4601.1
<b>Total</b>		<b>148219.6</b>	<b>158727.7</b>	<b>175254.3</b>	<b>182540.5</b>	<b>191801.4</b>

Source: Department of Science & Technology