

EXECUTIVE SUMMARY

National Science and Technology Management Information System (NSTMIS), a Division of Department of Science & Technology (DST), Ministry of Science & Technology, Government of India, entrusted National Foundation of Indian Engineers (NAFEN) to undertake the following study:

Study on Status of Foreign Participation in R&D Activities of Selected Organisations & Centres in India

The main highlights of the study are as follows :

- This study intends to explore the characteristics of R&D activities of select international Manufacturing Segment organisations, Institutional Segments & centres operating in India in identified sectors, other than those covered under the R&D statistics data base of Government of India.
- The study also intends to explore the latest scenario and to quantify input/output R&D resources in terms of Manpower, Finance, Infrastructure, Patents, Licensing, Technology Transfer, Know-how of Products/Systems/Processes/Software Programmes.
- 95 premier international organisations in the manufacturing segment, 2 organisations from institutional segment and 4 centres were surveyed.
- Period of review was selected as 1999-2002.
- Eight major sectors were selected for review viz. Agriculture, Automobile, Bio-Technology, Chemical, Information Technology (IT), Non Conventional Energy Sources (NCES), Pharmaceutical & Power.

The Analysis

Based on the data received, the position on various parameters has emerged as follows. The Analysis is in 5 Chapters:-

Chapter I	-	Introduction
Chapter II	-	Methodology of the Study
Chapter III	-	R&D Analysis for Manufacturing Segment
Chapter IV	-	R&D Analysis for Institutional Segment
Chapter V	-	R&D Analysis for Centres

A. Analysis for Manufacturing Segment :

- **RESPONSE** [Page No. 4 Table 3.01]*
Out of 95 identified organisations, 73 organisations responded resulting in an overall response of 77%. The maximum response of 91% was received from Bio-tech sector followed by Pharma sector with 89%, while the lowest response of 50% was received from Power sector.
- **ZONE-WISE RESPONSE OF R&D ORGANISATIONS SURVEYED** [Page No. 5 Table 3.02]
Maximum 82% organisations responded from Northern India followed by 76% from Southern India.
- **WORLDWIDE LOCATION OF FOREIGN COLLABORATING ORGANISATIONS** [Page No. 6 Table 3.04]
Maximum 47% Foreign Collaborating Organisations are located in Europe followed by 44% in USA.
- **YEAR OF ESTABLISHMENT** [Page No. 7 Table 3.05]
33% of R&D organisations were established in India before 1990 & 67% after 1990.
- **YEAR OF COMMENCEMENT OF R&D ACTIVITIES** [Page No. 7 Table 3.06]
19% of organisations commenced their R&D activities in India before 1990 & 81% after 1990. However maximum 33% organisations started their R&D activities during the period 1999-2001.
- **CATEGORIES OF R&D ORGANISATIONS** [Page No. 8 Table 3.07]
Maximum 62% R&D organisations are subsidiaries of a foreign company followed by 32% as joint ventures.
- **TOTAL GROSS TURNOVER (GTO) (RUPEES MILLION)** [Page No. 9 Table 3.08]
Total Gross Turnover for all the sectors taken together during the year 2001-2002 has increased approx. by 10% as compared with 2000-2001.
- **TOTAL EXPENDITURE ON ADVERTISEMENT AND NEW PLANT & MACHINERY FOR THE WHOLE ORGANISATION** [Page No. 10 Table 3.09]
Automobile sector has made maximum expenditure on advertisement (Rs. 547 million) during the year 2000-2001 followed by Pharma sector (Rs. 279 million).

* *Figures in [] brackets refer to the page numbers & table numbers of the report, for details.*

- **TOTAL EXPENDITURE ON ADVERTISEMENT AND NEW PLANT & MACHINERY FOR R&D ACTIVITIES** [Page No. 11 Table 3.10]

Expenditure on new plant and machinery for R&D activities as a percentage of expenditure on new plant & machinery for the whole organisation is highest in I.T. sector i.e. 64% in the year 2001-2002 followed by Chemical sector 44%. Expenditure on advertisement for R&D activities as a percentage of expenditure for advertisement on the whole organisation is also highest in I.T. sector 42% in the year 2001-2002 followed by NCES sector 37%.

It is seen from the above that I.T. sector is spending highest both for new plant & machinery and advertisement for R&D activities during the year 2001-2002.

- **LINKAGES** [Page No. 12 Table 3.11]

On an overall basis, organisations covered in the study have maximum Indian linkages with 66 private organisations followed by 61 R&D laboratories.

Foreign linkages are maximum with 65 R&D Laboratories followed by 62 with private organisations.

- **RESOURCES ALLOCATION BY TYPE OF RESEARCH**

[Page No. 13 Table 3.12]

On an average basis, maximum time & resources 73% & 72% respectively are devoted by NCES sector followed by 51% & 52% respectively by Automobile sector on Experimental Development.

On the Applied Research parameter, maximum time & resources 56% & 57% respectively devoted in Agriculture sector, followed by 55% & 54% in Pharma sector.

- **R&D EXPENDITURE BY SOURCES OF FUNDS** [Page No. 14 Table 3.13]
(Total R&D Expenditure Rs. 7934 million during 2001-2002)

R&D expenditure in Rs. million has increased from 2325 in the year 1999-2000 to 7934 in the year 2001-2002 i.e. an increase of 241%. Maximum total R&D expenditure was made in I.T. sector amounting to Rs. 5938 million followed by Rs. 566 million in Pharma sector during the year 2001-2002. There have been substantial rise in R&D expenditure for I.T. sector over the years (more than 5 times in three years).

- **R&D EXPENDITURE AS A %AGE OF GROSS TURNOVER (GTO)**

[Page No. 15 Table 3.14]

R & D expenditure as a %age of GTO was highest 5% in IT sector followed by Chemical sector 2.5% during the year 2001-2002.

- **MAN POWER** [Page No. 16 Table 3.15]

Total Man power employed in the eight sectors covered in the study is 55094 as on 1st April 2002, out of which 15.5% are exclusively working for R&D activities.

- **PERSONNEL ENGAGED IN R&D ACTIVITIES** [Page No. 17 Table 3.17]

For R&D activities alone, maximum 1930 Indian male are employed in I.T. sector followed by 892 in Pharma sector. Similarly maximum 962 Indian female are employed in I.T. sector followed by 490 in Automobile sector.

On an overall basis, for all the sectors taken together in R&D activities, 67% are male employees and 33% are female.

- **ACADEMIC BACKGROUND** **[Page No. 18 Table 3.18]**
Maximum Ph.D's & PG's 440 & 577 employed by I.T. sector followed by 126 & 195 in Automobile sector. Maximum Graduate's 814 employed by I.T. sector followed by 344 by Pharma sector.
- **GROSS TURNOVER (GTO) PER EMPLOYEE (RS. MILLION/EMPLOYEE)** **[Page No. 20 Table 3.20]**
Maximum productivity in I.T. sector followed by Automobile sector. However, it may not be proper to compare the productivity of one sector with another sector due to various reasons like capital employed, nature of manpower employed, working conditions prevailing in an organisation and other infrastructural differences.
- **GROSS TURNOVER (GTO) PER R&D EMPLOYEE (RS. MILLION / EMPLOYEE)** **[Page No. 20 Table 3.21]**
GTO in Rs. million / R&D employee highest in Automobile sector followed by Power sector.
- **R&D EXPENDITURE PER R&D EMPLOYEE (RS. MILLION/EMPLOYEE)** **[Page No. 20 Table 3.22]**
R&D expenditure / R&D employee highest in I.T. sector followed by Bio-Tech sector.
- **PATENTS** **[Page No. 21 Table 3.23]**
Maximum Indian patents 40 awarded in I.T. sector followed by 14 in Pharma sector during the year 2001-2002. Maximum foreign Patents 2 awarded in Bio-Tech sector in the year 2001-2002.

Maximum patents 201 developed by I.T. sector followed by 78 by Pharma sector during the period of study.
- **R&D EXPENDITURE PER PATENT** **[Page No. 22 Table 3.25]**
R&D expenditure in Rs. million / patent ranges from 11 to 61 in the year 2001-2002.
- **R&D OUTPUT** **[Page No. 23 Table 3.26]**
In three years, 250 products and 49 processes have been developed, maximum 113 products developed in I.T. sector.
- **PUBLICATIONS** **[Page No. 24 Table 3.27]**
In three years, 177 papers have been published in Journals, 388 Technical reports published and 12 papers published in conferences/seminars/symposia etc. Maximum 37% papers were published in Journals in Pharma sector, followed by 25% in Power sector. Maximum 58% papers published in conferences / seminars / symposia in Pharma sector followed by 25% in Bio-tech sector. Maximum 31% technical reports were published in I.T. sector followed by 21% in Pharma sector.

In many cases, organisations may avoid publishing their papers due to their organizational policies.

- **R&D EXPENDITURE PER PUBLICATION** [Page No. 25 Table 3.28]
R&D expenditure in Rs. million / publication was highest in I.T. sector. Sector-wise, it ranges from 2.6 to 114 during the year 2001-2002.
 - **SKILL UPGRADATION** [Page No. 26 Table 3.29]
In three years, 4583 R&D personnel deputed for conferences and 4901 deputed for training. Maximum R&D personnel deputed for conferences/seminars/symposia 1922 by I.T. sector followed by 959 by Pharma sector. Similarly maximum 2678 R&D personnel deputed for training by I.T. sector followed by 667 in Pharma sector during the period of study.
 - **MAJOR USE OF R&D OUTPUT** [Page No. 27 Table 3.30]
(Multi choice answers)
On sector-wise analysis, it is observed that maximum 17 organisations have identified '*Further R&D*' in I.T. sector followed by 14 in Pharma sector as the major use of R&D output. Similarly 17 organisations in Pharma sector followed by 16 in I.T. sector have identified '*Commercial & Marketing*' as the second major use of R&D output. Out of 73 responding organisations, 66 organisations have stated '*Further R&D*' and 64 have stated '*Commercial and Marketing*' as the major use of R&D output.
In some of the above areas, further in depth studies are required to probe developments in these types of areas.
 - **SOURCES OF INNOVATION** [Page No. 28 Table 3.31]
(Multi choice answers)
Out of 73 respondent organisations 72 have identified '*In-House R&D*' as the crucial source of innovation followed by 47 identifying '*Customers*' as the next crucial source of innovation.
- B. Analysis for Institutional Segment :**
- **RESPONSE** [Page No. 29 Table 4.01]
Response from institutional segment was 100%. Both the institutions commenced their R&D activities before 1990.
 - **ZONE-WISE RESPONSE OF R&D ORGANISATIONS SURVEYED** [Page No. 29 Table 4.01]
The response from institutions was 100%.
 - **WORLDWIDE LOCATION OF FOREIGN COLLABORATING ORGANISATIONS** [Page No. 29 Table 4.01]
Both institutions have FCO's located in Europe (Italy).
 - **YEAR OF ESTABLISHMENT** [Page No. 29 Table 4.01]
Both the institutions were established in India before 1990.

- **YEAR OF COMMENCEMENT OF R&D ACTIVITIES** [Page No. 29 Table 4.01]
Both the institutions commenced R&D activities in India before 1990.
- **CATEGORIES OF R&D ORGANISATIONS** [Page No. 29 Table 4.01]
ICRISAT is International Research Institute while ICGEB is International Research Centre.
- **TOTAL GROSS TURNOVER (GTO) (RUPEES MILLION)** [Page No. 30 Table 4.02]
It is observed that in Total GTO, ICGEB recorded upward trend and ICRISAT downward.
- **EXPENDITURE ON ADVERTISEMENT AND NEW PLANT & MACHINERY** [Page No. 30 Table 4.03]
ICRISAT made maximum expenditure of Rs. 106 million on new plant & machinery during the year 2000-2001.
- **LINKAGES** [Page No. 31 Table 4.04]
ICRISAT & ICGEB both have linkages with Indian & Foreign Government, Private Organisations, Universities & R&D Laboratories. In addition ICRISAT also have linkages with Non Government Organisations.
- **RESOURCES ALLOCATION BY TYPE OF RESEARCH** [Page No. 31 Table 4.05]
Maximum time & resources 60% and 60% respectively are devoted by ICRISAT on Experimental Development and ICGEB maximum time & resources 50% & 52% on basic research.
- **TOTAL R&D EXPENDITURE BY SOURCES OF FUNDS** [Page No. 32 Table 4.06]
ICRISAT has maximum foreign funding and ICGEBN maximum Indian funding. It is observed that in R&D Expenditure, ICGEB recorded upward trend and ICRISAT downward.
- **R&D EXPENDITURE AS A %AGE OF GROSS TURNOVER (GTO)** [Page No. 32 Table 4.07]
R & D expenditure as a %age of GTO witnessed downward trend from 99% to 75% during the period of study.
- **MAN POWER** [Page No. 33 Table 4.08]
Total Manpower employed by both the institutions is 729, out of which 18% are employed in R&D activities.
- **PERSONNEL ENGAGED IN R&D ACTIVITIES** [Page No. 33 Table 4.10]
Out of total 132 employees engaged in R&D activities alone, 23% are female employees.

- **ACADEMIC BACKGROUND** [Page No. 34 Table 4.11]
ICGEB employs maximum Ph.D's 50.
- **GROSS TURNOVER (GTO) PER EMPLOYEE (RS. MILLION/EMPLOYEE)** [Page No. 35 Table 4.13]
ICGEB has maximum GTO / employee (2).
- **GROSS TURNOVER (GTO) PER R&D EMPLOYEE (RS. MILLION/EMPLOYEE)** [Page No. 35 Table 4.14]
ICRISAT has maximum GTO / R&D employee (27)
- **R&D EXPENDITURE PER R&D EMPLOYEE (RS. MILLION/EMPLOYEE)** [Page No. 35 Table 4.15]
ICRISAT has maximum R&D expenditure / R&D employee
- **PATENTS** [Page No. 36 Table 4.16]
ICGEB developed maximum patents 32, whereas ICRISAT developed no patent during the period of study.
- **R&D EXPENDITURE PER PATENT** [Page No. 36 Table 4.17]
ICGEB has spent maximum R&D expenditure in Rs. million / patent (13).
- **R&D OUTPUT** [Page No. 36 Table 4.18]
Total 3 products and 3 processes developed by ICRISAT and 6 processes developed by ICGEB. However, ICGEB developed no products during the period of study.
- **PUBLICATIONS** [Page No. 37 Table 4.19]
700 papers published in journals by ICGEB followed by 449 by ICRISAT.
No technical report published by ICGEB. ICRISAT generated 131 technical reports, ICGEB published maximum 1000 papers in conferences/seminars/symposia followed by 324 by ICRISAT during the period of study.
- **R&D EXPENDITURE PER PUBLICATION** [Page No. 37 Table 4.20]
Maximum R&D expenditure in Rs. million / publication was (4.70) by ICRISAT during the year 1999-2000.
- **SKILL UPGRADATION** [Page No. 38 Table 4.21]
ICGEB deputed 500 R&D personnel for training followed by 254 by ICRISAT. ICGEB also deputed 200 R&D personnel for conferences / seminars / symposia while ICRISAT deputed none during the period of study.
- **MAJOR USE OF R&D OUTPUT** [Page No. 39 Table 4.22]
(Multi choice answers)
"Technology Upgradation" has been found to be the major use of R&D output by both institutions.

- **SOURCES OF INNOVATION** [Page No. 39 Table 4.23]
(Multi choice answers)

Both institutions have identified '*In-House R&D*' & '*Customer*' as the crucial source of innovation.

C. Analysis for Centres :

- **MAIN FIELDS OF OPERATIONS** [Page No. 40 Table 5.02]

Both centres support R&D in Bio-tech., Information Technology (IT) and Non Conventional Energy Sources (NCES) sectors. In addition, IDRC supports R&D in Agriculture and IFCPAR supports R&D in Chemical, Pharmaceutical sectors as well.

- **GROSS FUNDS PROVIDED FOR R&D ACTIVITES (RUPEES MILLION)**
[Page No. 41 Table 5.03]

IFCPAR has reported maximum gross funds provided for R&D activites, followed by IDRC during the period of study. the gross funds provided by IDRC to institutes and NGO's whereas IFCPAR provided all the gross funds only to institutes during the period of study. Funding from IDRC had downward trend from 1999-2000 to 2000-2001 and in 2001-2002 they maintained the 2000-2001 level. IFCPAR maintained same level during the period of study.

- **LINKAGES** [Page No. 41 Table 5.04]

Both centres have linkages with Foreign Government.

IDRC has linkages with Indian NGOs whereas IFCPAR has linkages with Indian Government, Indian & Foreign Universities, R&D Laboratories and other Industries as well.

- **UTILIZATION OF FOREIGN FUNDS (R&D OUTPUT)**
[Page No. 48 Table 5.08]

Over a period of three years, 18 Indian patents and 18 Foreign patents have been applied by IFCPAR, whereas no patent applied by IDRC. No Indian or Foreign patent has been reported as awarded by any centre.

8 products and 3 processes have been developed by IDRC, whereas no product/process has been developed by IFCPAR over a period of 3 years.

No import substitute/design prototype have been reported as developed by any centre.

Total 285 papers published in journals by both the centres and 130 papers published in conferences/seminars/symposia by IFCPAR over a period of 3 years.

130 R&D personnel have been deputed for conferences/seminars/symposia by IFCPAR during the period of study. No personnel deputed for training by any centre.

Major Highlights at a Glance :

Position on various major parameters for the three segments covered in the study emerges as follows :-

(Year 2001-2002)

Sr. No.	Item	Segments		
		Manufacturing	Institutional	Centres
1.	Total Gross Turnover (Rs. Million)	328957	1441	N.A.
2.	Total R&D Expenditure (Rs. Million)	7933.94	1079.38	N.A.
3.	Total Manpower (Nos.)	55094	729	N.A.
	Male	40094	610	
	Female	15000	119	
4.	Total Manpower for R&D Activities (Nos.)	8537	132	N.A.
	Male	5728	101	N.A.
	Female	2809	31	N.A.
5.	Patents (Nos.)	199	5	36
(a)	Indian	195	5	N.A.
	Awarded	90		N.A.
	Applied	105	5	18
(b)	Foreign	4		N.A.
	Awarded	3		N.A.
	Applied	1		18
6.	Publications (Nos.)	227	1140	146
	Papers published in journals	74	468	106
	Technical Reports published	149	49	0
	Papers published in conferences / seminars / symposia etc.	4	623	40
7.	Skill Upgradation (Nos.)	3755	364	40
	R&D Personnel deputed for conferences / seminars / symposia etc.	1752	278	40
	R&D personnel deputed for Training programmes	2003	86	0
8.	Gross Turnover / *Employees (Rs. Million)	5.97	1.98	N.A.
9.	Gross Turnover / R&D Employees (Rs. Million)	38.53	10.92	N.A.
10.	R&D Expenditure / R&D Employees (Rs. Million)	0.93	8.18	N.A.
11.	R&D Expenditure / Patent (Rs. Million)	11.39-61.21	12.75	N.A.
12.	R&D Expenditure / Publication (Rs. Million)	2.59-114.18	2.83	N.A.

* Includes total employees working in an organisation