

## Executive Summary

The institutions under the Central Socio- economic Ministries/ Departments have a well-developed multi- dimensional Scientific and Technical (S&T) infrastructure spread across the country and fairly large number of R&D personnel. Another important sub-set

of S&T activities is the Research and Development ( R&D) which employs a large proportion of highly qualified persons in creative work and thus acts as a prime mover of in- house S&T development under the jurisdiction of the Socio- economic Ministries/ Departments.

The Techno Economic Services (TES) undertook this study on the behest of Department of Science & Technology to fabricate a systematic DATABASE on the scientific manpower engaged in R&D activities in the institutions under study. Through an appropriately framed DATABASE, it is easier to answer various questions relating to:

- Utilization pattern of R&D personnel
- Professional and innovative skills available ,
- Problems of qualitative mismatch in specific discipline(s) ,
- Quality of motivation etc.

The DATABASE can also help to solve the problems of existing anomalies through proper planning of future intake of S&T manpower.

The data analyzed and processed in the report are based on the extensive fieldwork conducted by TES. This covered 117 institutions and 2,455 R&D personnel of category B responded. The response rate to this massive data seeking exercise through three sets of questionnaires viz. Listing Sheets, Questionnaire for Scientists of category B and above, Institutional Questionnaire is summarized below:

	Listing Sheets	Scientist Schedules	Institutional Schedules
1. Response received from Institutions	92	117	92
2. Percentage of Institutions covered	61.33	74.11	61.33
3. Response received from R&D personnel	3025	2455	
4. Percentage of total scientists listed		81.15	

Because of the commendable response, the data received through the Institutional Questionnaire and Scientist schedule constitute the core of the database. The data available from the filled- in listing sheets have been used as a cross- check.

## **Demographic Profile:**

The demographic profile of scientists employed in the institution has a bearing on the inherent characteristics of the institution. The variations, therefore, also co-exist along with the commonalities of aims and objectives of the institution. On the basis of response received through the Institutional Questionnaires, the over all profile that emerges as under:

1. The female scientists formed about 14 per cent of population of scientists of category B and above. However, in respect of some of the institutions under the Ministry of Health and Family Welfare the percentage of female scientists was as high as 37 per cent.
2. The proportion of the female auxiliary and technical staff was higher i.e. 17.8 per cent and in certain institutions, their presence was about one- third of the total personnel of this category.
3. Age distribution of R&D personnel shows that majority of them (84 per cent) belonged to age segments falling within broader range of 33 to 56 years whereas only 16 per cent were in the age segments falling within the age range of 24 to 33 years.
4. Above 17.6 per cent of the total scientists were above 53 years of age and were likely to retire in the next five years. On an annual basis the institution needed about 100 new scientists per year to compensate for the retiring scientists.
5. Interestingly there were 75 scientists out of 2455 responding scientists (including 10 female scientists) who were involved in R&D activities even after the age of super- annuation (58 years). These were mostly the scientists engaged in research institutions under the Central Ministry of Health and Family welfare.
6. Since the essential and desirable qualifications for male and female candidates remain the same, the female scientists with higher qualifications compatible with high standard of research work in Central Institutions, also found direct entry to category B jobs along with their male counterparts. Out of 2455 responding scientists, 1135 (46.2%) got direct recruitment to grade B and above. There are the scientists who were considered academically highly qualified at the time of recruitment.

7. In a scientific pursuit, qualification has over riding influence and priority. Female scientists had an edge over the male counterpart in respect of having acquired higher qualification:

	Male Scientists	Female Scientists
M.Phil.	20.8%	26.86%
Ph.D./D.Sc.	7.32%	10.75%

8. But both the sexes had similarity in respect of minimum entry Qualifications i.e.:

	B.A B.Sc.
Male Scientists	20.14%
Female Scientists	20.95%

9. The area-wise configuration of responding scientists was as under:

Area of Specialization	Number	Per cent
Natural Sciences	641	26
Engineering & Technology	731	30
Medical Sciences	788	32
Agricultural Sciences	96	04
Social Sciences & Humanities	199	08

10. Medical sciences (inclusive of Indian System of Medicines & Homeopathy) dominate the scientific manpower followed by Engineering & Technology.
11. The salary profile does not present a comfortable picture. Ninety five per cent of male scientific manpower is concentrated up to grade 5 while only 5 per cent of the scientists are placed in the grades 6 and above. While in the case of female scientists, the corresponding figure is 87 per cent. There is a negative co-relation between pay scale and number of scientists as expected. As the pay scale rises, the number of scientists on the scale decreases. Also it is observed that the number of female scientists was nil in the higher pay scale. A large number of female scientists in some institutions as high as 95 per cent remained at the lower and middle rungs of pay scales.

Generally, despite having high academic background as many as 63 per cent of the scientists continued to be placed in the initial two grades.

12. In the institutions under the ambit of the Socio- economic Ministries it was observed that the scientists were engaged in research areas primarily linked with areas of qualification. This may probably be assigned to recruitment of scientific manpower in limited number and for the specific research by the institution in areas of R&D activities of specific application. The R&D personnel are invariably attached to the R&D cell of their respective institutions. This explains the overwhelming percentage (97.3 ) of the manpower to have been gainfully employed in their areas of qualification/ specialization:

### **Employment Profile:**

Seventy per cent of scientists had no involvement in basic research while maximum involvement of the scientists (78.45 per cent) was in the applied research This implies that the research of applied nature had the maximum acceptance and operation. The next in preference (practiced by 61.2 per cent) was the experimental research followed by the other research activities (accounting for 56 per cent of involvement of scientists)

It is also discernible that 81.50 of the scientists were involved in non-research activities in some way or the other; the average duration of involvement during the year, of course, varied within a wide range.

Involvement in different types of research – basic, applied and experimental- depends upon the attitude of scientists, their qualification and inherent attributes of sustainable interest and efforts. On the basis of the response received from the filled- in scientists questionnaires, the weighted average time spent in various categories of research conducted in the institutions under study were as under:

Type of research activities	Weighted average of time spent in various research activities ( % )
Basic Research	5
Applied Research	55
Experimental Research	25
Other activities	15

Since applied research provides the output of immediate application, 55 per cent of the time of the scientists was dedicated to applied research. Besides 15 per cent of their time was spent on 'Other activities' essentially related to research. Near the top level, the job content largely comprised functions of a managerial nature involving planning, supervision, control etc. This may lead to an important question whether a person would cease to be an R&D scientist as he approached higher levels. These issues deserve consideration and need to be addressed.

## **Revenue & Expenditure:**

70.25 per cent of the funds came as a grant from the controlling ministries/ departments while 16.12 per cent of the funds were generated internally by the institutions and 4.2 per cent were made available by other ministries/ departments. Thus more than 90 per cent of the funds needed were available by the central government sources. The funds available from the private initiative were dismal 0.25 per cent.

Non-research activities usually encompass S&T management, planning and co-ordination, services like information and documentation, quality assurance/control involving testing, analysis of research output, testing etc. besides administration-cum-management.

It is desired that one-third of the annual expenditure on R&D on an average is dedicated to capital expenditure. The survey also comes out that average share of over all non-recurring expenses was 29.4 percent. The recurring expenses accounted for 70.6 percent of the total expenses.

This left an over all saving of Rs.2,050 lakhs between revenue and expenditure, which was about 4 per cent. Of course, the deficit between the revenue and expenditure in certain institutions was even more than 50 per cent thus leaving the institutions in the syndrome of resource crunch.

## **Research Projects Handled:**

As expected, the number of research projects awarded by the Government accounted for more than 50 per cent of the projects sanctioned and if the projects undertaken at the behest of all the three government agencies viz. Govt., public sector and self-sponsored by the institutions are taken into consideration, their contribution rises to 68.73 per cent. The number of projects financed by the industry exceeded 40 per cent: out of which 26 per cent was the share of private sector.

## **Research output:**

The development of new product/ new process/ new design and their subsequent commercialization is a real test of research-related competence of an institution and relevance of its output.

Thanks to the liberalization of economy in 1991, import substitution engages the lowest priority of research pursuits of an institution (0.3 percent). A very low level of involvement in this sub-segment of research activity amply manifests this. Otherwise once import substitution was the prime area of concern of R&D activities.

The assignments completed constituted about 65 per cent of total jobs assigned to the institutions while projects in progress accounted for 15.5 per cent and assignments transferred constituted the balance 17.5 per cent.

The research assignments related with the development of new products, new process and consultancy services formed the core of scientific base of the institutions. These

three combined together alone accounted for 63.5 per cent of total assignments. Modifications accounted for 14.2 percent of assignments.

### **Research Output Scientist- wise (in the institutions surveyed):**

The research output expected from the scientist at his/her level is governed by a number of factors such as:

- individual scientist's interest and drive ,
- incentives available to him/her from the senior scientists .
- credit and rewards given to him/her for the output ,
- the research atmosphere prevailing in the institution that the scientist is attached with ,
- the proportion of time the scientist is called upon to dedicate to activities other than research.

Left to himself/ herself, the scientist would wish to do his/her best unless restricted by the constraints and limitations discussed in Chapter 9. The difficulties identified at the level of scientists impinge on his/her productivity the most.

#### **Research output by R&D Personnel of Category B and above (Average of the year 1995-96 and 1996-97)**

Output	Output per scientist reporting the specified output ( in number)
Product/ process developed	1.9 ( 0.3)
Patents obtained	1.9 (0.019)
Patent applied for	1.75 (0.029)
Awards/merits earned	1.25 (0.094)
Articles published in Indian journals	3.8 (0.74)
Articles published in foreign journals	3.23 (0.55)
Books published	1.56 (0. 14)

Note: the data are derived from the filled- in scientist questionnaires from 2455 scientists of category B and above. The figures in parentheses represent the average of overall response. These are the average figures irrespective of gender.

### **Details of R&D Activities by the Institutions at National Level:**

The seminars and training together engaged nearly two- thirds of the events that took place and 73.75 per cent of the participants were also attracted towards seminars and training.

The expenditure incurred as mentioned above was also commensurate with importance and relevance of events. The per cent share of expenditure on seminars and training was 72.6 per cent -- logically at par with the percentage of the participants.

## **Constraints Influencing R&D Activities of Institutions:**

Ninty-two institutions expressed their opinion about the constraints impinging on research activities. These constraints are - inadequate funds, late receipt of funds, less R&D staff, less supporting staff, poor quality of R&D staff etc. On an average, more than 60 percent of responding units expressed that these constraints did not have any effect on the outcome of research output.

The existence of vacant post does interfere with the output efficiency of a research institution. The most conspicuous presence of vacant posts as revealed through the survey work was in the institutions under the perview of Department of Health, Department of Indian System of Medicine and Homeopathy, Department of Industrial Policy and Promotion, Ministry of Information and Broadcasting, Ministry of Home Affairs etc.

The vacant posts do exists in other institutions as well but these are usually limited to below 2 percent level of the total posts.

## **Work Culture, Job Satisfaction, Problems and Prospects:**

The satisfactory work culture provides the much needed fillip to R&D output and maintains an atmosphere of mutual cooperation. The work culture is defined by a set of parameters such as area of work, present project, work atmosphere, support from the lower staff and encouragement from the seniors. The levels of satisfaction derived from all the four constituents of work culture add upto the composite work culture. This hovered within a range of 80 to 90 percent during the field work.

The job satisfaction was found to be between 82 to 87.5 percent depending upon the grade of the scientist. The highest job satisfaction was reported at grade 8.

## **Suggestions of Scientists:**

Only 1117 scientists i.e.,45.5 percent of the response came forward with suggestions for betterment of research output at the level of scientists and ultimately the productivity of the institution. Their suggestions may be grouped into nine broad catagories and the number of suggestions ranged between 141 to 559 for each of the category. The suggestions are multiple in nature.