CHAPTER 2

DEFENCE SCIENTISTS IN INDIA: THEIR GENESIS, STATUS AND WORKING ENVIRONMENT

India's defence policy aims at promoting and sustaining durable peace in the subcontinent through negotiation with and cooperation among various countries in the region and, at the same time, equipping the defence forces adequately as a safeguard against aggression.

The Supreme Command of the Armed Forces is vested in the President of India. The responsibility for national defence, however, rests with the Cabinet. The Defence Minister is responsible to the Parliament for all matters concerning defence. The administrative and operational control of the Armed Forces is exercised by the Ministry of Defence and the three Services Headquarters. The Ministry of Defence acts as the central agency for ensuring coordinated development of the three Services, for conveying the Government's decisions on policy matters to the three Services Headquarters for implementation and for obtaining financial sanctions for defence expenditure from the Parliament.

The Ministry of Defence comprises three departments: (a) Department of Defence, (b) Department of Defence Production & Supplies, and (c) Department of Defence Research & Development. The functions of these departments are as follows:

(i) Department of Defence, headed by the Defence Secretary, deals with the three Services and interservices organisations.

(ii) Department of Defence Production & Supplies, headed by Secretary, deals with matters pertaining to defence production, indigenisation of imported equipment and spares, planning and control over the
departmental production units and defence public sector undertakings.

(iii) Department of Defence Research & Development, headed by a Secretary who is also the Scientific Adviser to the Defence Minister, is engaged in rendering advice on scientific aspects of military equipment and logistics and formulating research, design and development plans for equipment used by the services.

1. MINISTRY OF DEFENCE

1.1 Department of Defence

1.1.1 Army

The Indian Army maintains effective vigil on Indian borders. It also provides assistance to civil administration in the maintenance of law and order. At the Army Headquarters in New Delhi, the Chief of the Army Staff is assisted by Vice-Chief of the Army Staff and five Principal Staff Officers. The Army is organised into five Commands: Southern, Eastern, Western, Central and Northern. Each Command is under a General Officer Commanding-in-Chief, who holds the rank of Lieutenant General.

1.1.2 Navy

The Indian Navy is responsible for the safety of our coastline and island territories both in the East and West extending over 7600 km. It is also responsible for safeguarding the increasing maritime assets and interests. The Chief of the Naval Staff at Naval Headquarters, New Delhi, exercises control over the Indian Navy through a chain of three Commands: Western, Eastern and Southern, each under a Flag Officer Commanding-in-Chief, having their Headquarters at Bombay, Visakhapatnam and Cochin, respectively. At Naval Headquarters, the Chief of the Naval staff is assisted by five Principal Staff Officers.
1.1.3 Coast Guard

The Coast Guard was constituted as an Armed Force of the Union of India on 19 August 1978, under the Coast Guard Act to protect the maritime and other national interests in the maritime zone of India, which covers the sea area of approximately 28 lakh sq. km. This Service is under the administrative control of the Ministry of Defence with its Headquarters located at New Delhi. The national maritime zones, being the area of responsibility of the Service, have been divided into three regions: Western, Eastern and the Andaman and Nicobar. The Director General, Coast Guard exercises command and control through three Regional Commanders in Bombay, Madras and Port Blair.

1.1.4 Air Force

The main role of the Indian Air Force (IAF) is to keep the Indian skies inviolate and be prepared to strike at the enemy whenever called upon to do so. In addition, it is given responsibilities like air-maintenance of distant outposts of the Army and Border Security Force. IAF also assists the civil administration when called upon to do so, for example, in times of natural calamities such as earthquakes, floods, etc. The Indian Air Force is organised on both functional and geographical basis. There are five Operational Commands: Western Air Command, South Western Air Command, Central Air Command, Eastern Air Command, and Southern Air Command. The Maintenance Command and the Training Command are the two Functional Commands.

1.2 Department of Defence Production and Supplies

A substantial part of the defence stores needed by the Services is now being developed and produced in India. The Department of Defence Production and Supplies organises, directs and coordinates production of material and equipment required by Armed Forces. It carries out its responsibility through the Directorate of Technical Development and Production, Ordnance Factories, Inspection, Standard-
disation and the 10 public sector undertakings.

1.3 Department of Defence Research and Development

In this technological era, the defence of a country is dependent not only on the size of its Armed Forces, but also on modern weapons and equipment. As the focus of all scientific and technological aspects of national security, the mandate of the Department of Defence R&D is to enable the nation to become self-reliant in weapons, weapon systems and equipment through research and development in wide ranging areas of modern technology.

The Department of Defence Research and Development serves as the focal point for all scientific and technological aspects of national security. The Department operates with the nucleus of a multi-disciplinary team of scientists, engineers and administrators in its secretariat. The mandate of the Department is accomplished through a network of 42 labs/estts administered by Defence Research and Development organisation (DRDO), listed in Table 2.1.

The R&D projects of DRDO emerge from expressed, anticipated and futuristic needs in respect of weapons systems, equipment and materials for defence preparedness. While all areas from underwater to high altitude are covered under the research conducted by DRDO in its efforts to provide S&T support to the Armed Forces, the activities of DRDO also bring benefits to the civil community in several ways.

The Department operates through a complex network of inter-dependent laboratories and establishments located nationwide, and manned by over 30,000 personnel. The profile of defence R&D programmes ranges from relatively simple product improvement projects to complex programmes for the development of sophisticated systems. There has been a steady increase in the number of projects as also in that of major projects of high value undertaken.

The near-term projects of the Department emerge from clearly visible needs in respect of weapons systems, equipment and materials required to maintain the state of defence preparedness. Long-term R&D policies and programmes are derived from a clear iterative analysis of the Threat-Tactics-Technology spectrum and a close
dynamic interaction with the Services for synchronisation with their long-term objectives. The Department, in close collaboration with the three Services, has, for the first time, drawn up a 15-year perspective plan covering technological areas of interest to Defence.

### TABLE 2.1.
**DRDO LABS/ESTTS IN INDIA**

<table>
<thead>
<tr>
<th>Subject area</th>
<th>Name of the Labs/Estts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aeronautics</td>
<td>Aerial Delivery Research and Development Establishment (ADRDE), Agra</td>
</tr>
<tr>
<td></td>
<td>Aeronautical Development Establishment (ADE), Bangalore</td>
</tr>
<tr>
<td></td>
<td>Centre for Aeronautical System Studies and Analysis (CASSA), Bangalore</td>
</tr>
<tr>
<td></td>
<td>Gas Turbine Research Establishment (GTRE), Bangalore</td>
</tr>
<tr>
<td>Armament</td>
<td>Armament Research and Development Establishment (ARDE), Pune</td>
</tr>
<tr>
<td></td>
<td>Explosives Research and Development Laboratory (ERDL), Pune</td>
</tr>
<tr>
<td></td>
<td>Proof and Experimental Establishment (PEE), Balasore</td>
</tr>
<tr>
<td></td>
<td>Terminal Ballistics Research Laboratory (TBRL), Chandigarh</td>
</tr>
<tr>
<td></td>
<td>Defence Research and Development Laboratory (DRDL), Hyderabad</td>
</tr>
<tr>
<td>Defence Electronics</td>
<td>Defence Electronics Application Laboratory (DEAL), Dehradun</td>
</tr>
<tr>
<td></td>
<td>Defence Electronics Research Laboratory (DLRL), Hyderabad</td>
</tr>
</tbody>
</table>
Field Research

- Defence Laboratory (DL), Jodhpur
- Snow and Avalanche Study Establishment (SASE), Manali
- Defence Research Laboratory (DRL), Tezpur
- Field Research Laboratory (FRL), Leh
- Defence Institute of Fire Research (DIFR), Delhi

Information/Management

- Defence Institute of Work Study (DIWS), Mussorie
- Institute of Armament Technology (IAT), Pune
- Defence Scientific Information and Documentation Centre (DESIDOC), Delhi

Materials

- Defence Metallurgical Research Laboratory (DMRL), Hyderabad
- Defence Materials and Stores R&D Establishment (DMSRDE), Kanpur
- Solidstate Physics Laboratory (SSPL), Delhi
- Defence Research and Development Unit (DRDU), Calcutta
- Defence Science Centre (DSC), Delhi

Medical/Food Sciences

- Defence Bio-Engineering and Electro-Medical Laboratory (DEBEL), Bangalore
- Institute of Nuclear Medicine and Allied Sciences (INMAS), Delhi
- Defence Food Research Laboratory (DFRL), Mysore
- Defence Institute of Psychological Research (DIPR), Delhi
- Defence Research and Development Establishment (DRDE), Gwalior
- Defence Institute of Physiology and Allied Sciences (DIPAS), Delhi
Defence Agricultural Research Laboratory (DARL), Almora
Naval Chemical and Metallurgical Laboratory (NCML), Bombay
Naval Physical and Oceanographic Laboratory (NPOL), Cochin
Naval Science and Technological Laboratory (NSTL), Vizag
Institute of System Studies and Analysis (ISSA), Delhi
Scientific Analysis Group (SAG), Delhi
Combat Vehicles Research and Development Establishment (CVRDE), Avadi
Vehicles Research and Development Establishment (VRDE), Ahmednagar
Research and Development Establishment (Engineers), R&DE (E), Pune

1.3.1 Growth of DRDO and Change in its Complexion

In the DRDO, the focal point of its information system had been the libraries of the respective laboratories and establishments situated all over the country. Not due to lack of funds but the inability to cope with the sudden expansion of activities in the laboratories, induction of a large number of scientific and supervisory staff, rapid increase in the number of scientific and technological specialisations, spurt in the number of R&D projects, geographic proliferation of work centres within a laboratory and many other reasons. Fig 2.1 presents the growth history during 1960-85, and the projected growth up to 1990, of the DRDO in terms of scientific manpower, budget and major projects. It is seen that considerable expansion in activities of the Organisation occurred in the period 1975-85, and still a higher rate of growth is projected in the next five years.
Fig. 2.1: DRDO Growth: Trend & Forecast
Fig. 2.2: Three Dimensions of Change in which Information Scientist must Function
Not only have the laboratory activities increased in scope and size by two orders of magnitude since 1960, but from mid-seventies, another important trend set in, namely growth in interdisciplinary scientific and technological research. Today, not less than 20 of DRDO laboratories are working jointly among themselves and with industries to help develop major systems like tanks, guided missiles, combat aircraft, radar, sonar, etc. In addition, work has been taken up on many critical state-of-art technologies which need a multi-disciplinary approach, like optoelectronics, lasers, semiconductor devices, ram-rocket engines, etc. It seems a miracle that the second, and now the third, generation of DRDO scientists are able to function in an environment where information is available generally on an informal, personal basis, while the need is obvious for a well-coordinated, impersonal and positive flow of scientific, technical and managerial information to cater for a vastly different context than the one in which libs/TICs of DRDO Labs/Ests in India started to function in the '60s and '70s with DESIDOC as the central coordinating organisation. Under this system, individual libs/TICs were catering to the information needs of the scientists of the local laboratories. This system is inadequate for the present-day and future needs. R&D work in the current era of high technology calls for a far more efficient, effective and comprehensive information network. Our information scientists will have to adapt themselves very rapidly to the changing needs for information. They have to become partners in specific projects, in specific disciplines, and in corporate management. They have to bid goodbye to their traditional ways, and become fully conversant with the new technology which facilitates information dissemination at electronic speed. This is an issue of vital concern to DRDO as a whole (Gopalaswamy, 1986). As discussed earlier, information management, which is essentially the information scientists' job, must be concerned with the management of change, and not just the management of information. Change in the DRDO has three major dimensions, as illustrated in Fig. 2.2.

(i) Change in the age of organisation, viz., laboratories, the HQrs, and the Department resulting in change in the size of its projects, budget, manpower, specialisations, facilities, and management systems.

(ii) Change in the age of the individuals: scientists, engineers, technicians, S&T managers, administrators, all of whom need information to work efficiently.
(iii) Change in the existing state of S&T: its evolution as a single discipline and then transformation into multi-disciplinary fields.

It is essential for librarians and information managers not only to be fully conscious of the changes taking place in individual settings but also to be able to feel the rate of change intuitively.

2. PLANNING FOR DEFENCE

Systematic Planning for Defence was introduced in India during the 1960s and the first Defence Plan was prepared for the period 1964-69. The emphasis of the 1985-90 Defence Plan is on modernisation in keeping with the prevailing security environment, induction of latest technology weapon systems in the region and overall strategic considerations. The Plan lays emphasis on providing the Defence Services with weapon systems of increased mobility, fire power and accuracy, improved surveillance techniques, night observation, fighting capability and better communications.

3. DEFENCE EXPENDITURE

Viewed in the context of India's size and the security environment, the outlay on Defence as percentage of the total Central Government expenditure or Gross National Product (GNP) continues to be one of the lowest among the neighbouring countries. Fig 2.3 illustrates the Budget allocation for the year 1986-87; 1987-88 and 1988-89 among the three Services and the Departments of Defence Production and Supplies and Defence Research and Development.

The approved annual budget (1988-89) of Defence R&D is Rs 670 crore, which is approximately 5.15% of the total defence budget. A comparative account of defence budget versus DRDO budget from 1961-62 to 1988-89 is given in Fig 2.4. The R&D in DRDO has led to the production of defence items worth Rs. 1385 crore.
Fig. 2.3: Budget Allocation between Defence Services and Departments of Defence Production and Supplies and Research and Development.
Fig. 2.4: GROWTH : DEFENCE BUDGET Vs DRDO BUDGET

DEFENCE TO THE SCALE
DRDO NATIONAL

THOUSAND OF CRORES

YEAR

61-62
66-67
71-72
76-77
81-82
86-87

131
909
1525
2563
4652
10194

3
12
21
49
96
420
4. DEFENCE SCIENCE

Science applied to defence is generally known as defence science. Defence science has grown to embrace an ever-widening area. It differs only in respect of its limited clientele and restricted accessibility. There is also difference in the working environment. Most of the research work in defence is conducted under the veil of secrecy. In certain key areas, the information is not allowed to come out of the concerned department. Defence science is somewhat different from other sciences even in the age of information explosion.

5. DEFENCE SCIENTISTS

5.1 Genesis of Defence Scientists

In India, the defence science sector comprises the research labs/estts under DRDO, the public sector undertakings in the Ministry of Defence, the production units and some other subordinate institutions under the Ministry. In some developed countries, it has been extended to the private sector also.

The modern trend of dependence on science for fighting wars gave rise to a class of scientists and technologists who can be termed as defence scientists. Their duty is to make the defence system successful by solving the scientific and technological problems faced by the Armed Forces. Apart from solving the problems, defence scientists also keep watch over global developments in the field of defence science and bring them to the notice of the policy-makers. All these operations require a powerful information system capable of storing relevant information and disseminating it in proper form as per the requirements of the defence scientists.

5.2 Categories of Defence Scientists

Defence scientists can be broadly grouped into the following three categories, keeping in view their functional roles (Bandyopadhyay et al, 1986):

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(i) **Working Scientists**: Scientists working in the laboratories and establishments belong to this category. They carry out the work required for the projects allotted to them. They are the workhorses in defence R&D. Numerically, they outnumber all other categories.

(ii) **Evaluating Authority**: This category of scientists are working in technical directorates at the DRDO Headquarters. They provide necessary guidance and review the progress of the sanctioned projects. They are responsible for transferring the successful project work to production units.

(iii) **Top Managers**: Policy planners and decision-makers constitute this category. They coordinate the research work in the light of national and international developments.

### TABLE 2.2

**PAY SCALES OF DRDO SCIENTISTS**

<table>
<thead>
<tr>
<th>Post</th>
<th>Salary per month (in Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientist G</td>
<td>5900-7300</td>
</tr>
<tr>
<td>Scientist F</td>
<td>5100-6300</td>
</tr>
<tr>
<td>Scientist E</td>
<td>4500-5700</td>
</tr>
<tr>
<td>Scientist D</td>
<td>3700-5000</td>
</tr>
<tr>
<td>Scientist C</td>
<td>3000-4500</td>
</tr>
<tr>
<td>Scientist B</td>
<td>2200-4000</td>
</tr>
<tr>
<td>Junior Scientific Officer</td>
<td>2000-3500</td>
</tr>
</tbody>
</table>

5.3 **Working Environment and Service Conditions of Scientists**

In India, the defence scientists are inducted into the service either through departmental promotions or through fresh recruitment, by the in-house Recruitment and Assessment Centre (RAC). The minimum qualifications required are post-graduation in any subject related to defence. The defence scientists have the status of Class I Gazetted Officer and they enjoy time bound promotion facility. They
are highly paid and highly respected in the community. The present pay scales of
defence scientists in India are given in Table 2.2.

6. INFORMATION REQUIREMENTS

The information requirements of defence scientists depend mainly on the role they play. Working scientists require information/data about the projects allotted to them. Scientists working at DRDO Headquarters require information on broader aspects of the project. They also require information about similar type of work conducted elsewhere in the country or abroad. Top managers also require project-oriented information in brief along with information about the present and future needs of the Armed Forces in the light of national technological capability and international developments.

7. PHASES OF PROJECTS

All defence scientists need information on projects, but in different forms. DRDO has a large number of laboratories engaged in S&T research for end products required for the Armed Forces. Defence scientists are engaged in these labs/estts on various research projects. These projects are either user sponsored or suggested by the scientists from the laboratory group. Distinct steps of a complex project may be described as follows (Souder, 1978):

(i) Preliminary Project Formulation: In this phase, broad objectives are translated into preliminary practical alternatives. The end result of this exercise is a recommendation that feasibility studies be undertaken on one or more of the alternatives. At this stage, they need review articles and state-of-the-art reports about the project. Any information about similar type of work conducted elsewhere is helpful to the scientists.

(ii) Feasibility Study and Report: At this stage, a little detailed information is needed. If there are several methods of achieving the end, then all the alternatives have to be studied and the basis of selecting the proposed one is be given. Exhaustive information is necessary for better reporting.
(iii) **Detailed Project Report:** The report contains, in brief, details about (a) the general description analysing the environment to which the project belongs, (b) project description giving analysis of alternatives and detailed description of the accepted one, (c) technological aspects covering technology/process to be used and availability of know-how, (d) financial aspect stating the estimated cost, including foreign exchange, (e) manpower requirement, and (f) system plan. Detailed and extensive information covering all aspects of the project report is necessary at this stage.

(iv) **Progress of Project Work:** After sanction of the project, work is carried out as per Probable Date of Completion (PDC). The progress is reported periodically. At this stage, the scientists require specific information and data about the project.

(v) **Final Stage:** After completion of the project work, the research product, equipment/store developed, undergoes user trials. After successful trials, the design characteristics are finalized and this information is sent for use in relation to production. Relatively less information is required at the final stage in comparison to the earlier stages. The scientists rather generate certain amount of data at all these stages. These are to be compared with similar data available from elsewhere. The information supplied has to be very specific and correct.

From the above, the following general observations can be made in respect of the information requirements of defence scientists:

(i) More information is required at the operational/working stage than at the planning stage.

(ii) The higher the hierarchical level, the greater is the requirement of information about national and international developments.

(iii) Some information may be required during several or all steps of the management cycle.

(iv) Information has a time dimension. It becomes outdated rapidly and new information is required to take the place of the old one.

(v) There is a precise need for better, rather than more, information.

Scientific and technological information holds the key to successful research work. The right type of information should be made available as and when required. But in practice, there is always a gap between the available and the needed information.
Indian defence is primarily concerned about guarding the nation's borders. The present study is concentrated on Department of Defence R&D, especially DRDO, which is the backbone of the nation's defence. Presently there are 42 DRDO labs/estts in India and many more are being planned to be established in the very near future. Defence scientists working at various DRDO labs/estts in India have excellent serving conditions and working environment. Information is necessary for all the categories of defence scientists during various phases of a project. It is seen that because of lack of prompt information many defence projects are delayed. The study of DRDO, its scientists and its labs/TICs is essential to understand the information needs, awareness level, habits and problems of defence scientists in India.