

## Chapter 5

### Analysis of Physical & Information Sciences Group Laboratories

#### 5.0 List of laboratories under the Physical and Information Sciences Group:

1. National Physical Laboratory, New Delhi
2. National Institute for Science, Technology And Development Studies, New Delhi
3. National Institute of Science Communication And Information Resources, New Delhi
4. National Institute Oceanography, Goa
5. National Geophysical Research Institute, Hyderabad
6. Central Scientific Instruments Organization, Chandigarh
7. Central Electronic & Electrical Engineering Research Institute, Pilani

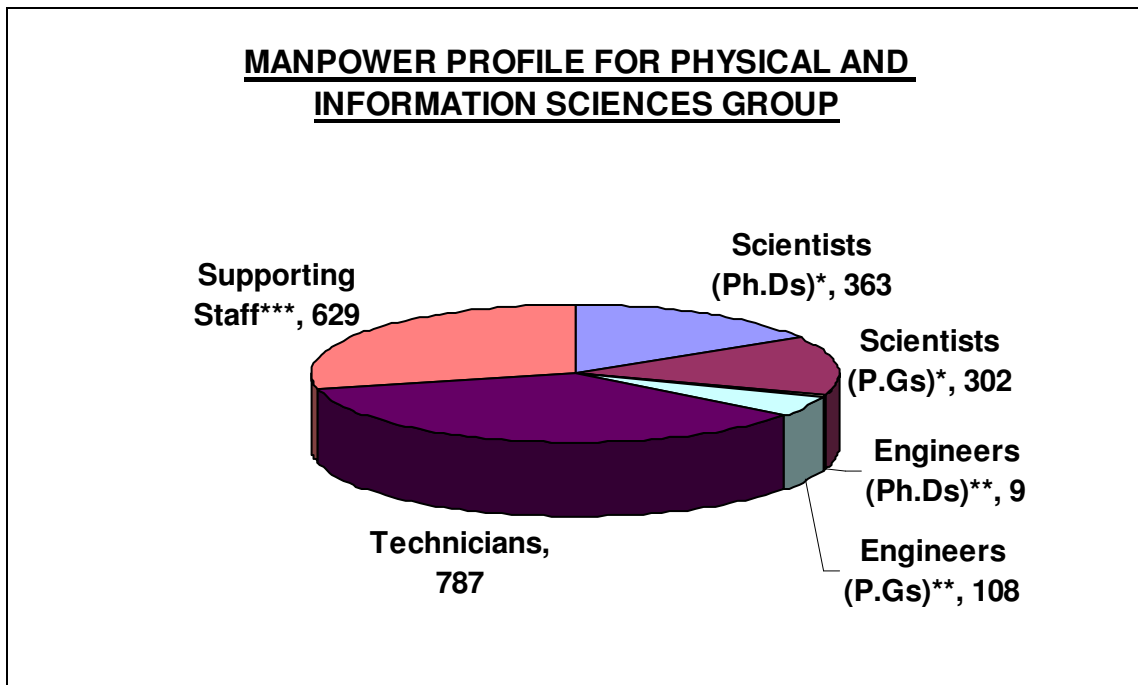
## 5.1 Overall Analysis of Physical and Information Sciences Group

The seven institutes categorized in the physical and information sciences group cover varied areas of research like information sciences, physical and geophysical, oceanography, instrumentation, science publishing and communication and science policy studies.

### 5.1.1 Manpower Profile

The figure 5-1 below represents the manpower profile in terms of scientists, engineers, technicians and supporting staff of the physical and information sciences group as a whole (data as received from the individual Institutes):

**Figure 5-1**



\*The figure for the number of scientists with qualifications as Ph. D. or P.G. does not include that of NIO.

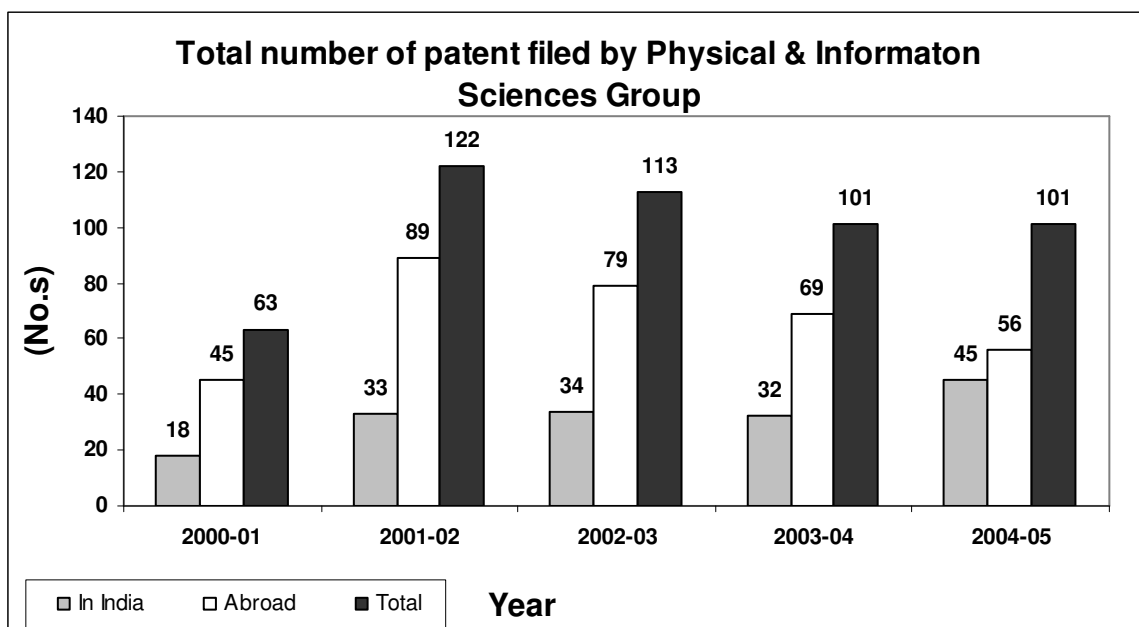
\*\*The figure for the number of Engineers with qualifications as Ph. D. or P.G. includes only those for NPL and CSIO.

\*\*\*The figure for the number of Supporting Staff does not include NPL.

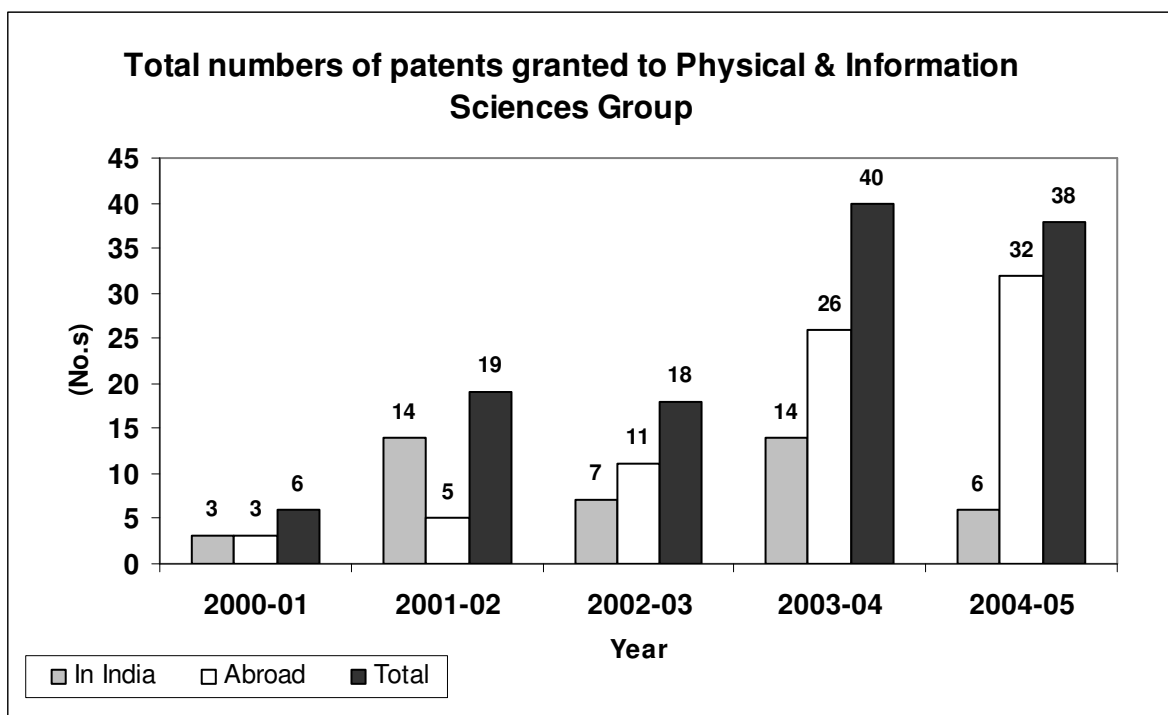
### 5.1.2 Patents

The following figure 5-2 & 5-3 represents the total number of Patents applied for and the number of patents granted to, for the Physical and Information Sciences Group as a whole for 2000-01 to 2004-05

**Figure 5-2**



**Figure 5-3**



The laboratories wise details of the patents filed in India and abroad are given below in table 5-1

**Table 5-1**

**Patents filed by Physical & Information sciences group of laboratories in India and abroad**

Year → Labs ↓	2000-01		2001-02		2002-03		2003-04		2004-05		Total	
	I	A	I	A	I	A	I	A	I	A	I	A
CEERI	2	-	3	-	-	-	-	-	-	-	5	-
CSIO	-	4	-	12	1	15	6	19	11	10	18	60
CSH	10	6	19	23	18	11	13	14	14	15	74	69
NGRI	-	-	-	5	1	5	-	-	2	-	3	10
NIO	1	27	2	29	9	36	9	34	14	21	35	147
NPL	5	8	9	20	5	12	4	2	4	10	27	52

I – India

A – Abroad

Source: CSIR

The laboratory wise details of the patents granted in India and abroad are given below in table 5-2

**Table 5-2**

**Patents granted to Physical & Information sciences group of laboratories in India and abroad**

Year → Labs ↓	2000-01		2001-02		2002-03		2003-04		2004-05		Total	
	I	A	I	A	I	A	I	A	I	A	I	A
CEERI	1	-	7	1	2	-	2	-	-	-	12	1
CSIO	-	-	1	-	2	-	-	2	-	4	3	6
CSH	-	-	1	1	-	2	8	6	1	7	10	16
NGRI	-	-	-	-	-	-	-	1	-	2	-	3
NIO	-	-	1	-	1	4	-	12	3	13	5	29
NPL	2	3	4	3	2	5	4	5	2	6	14	22

I – India

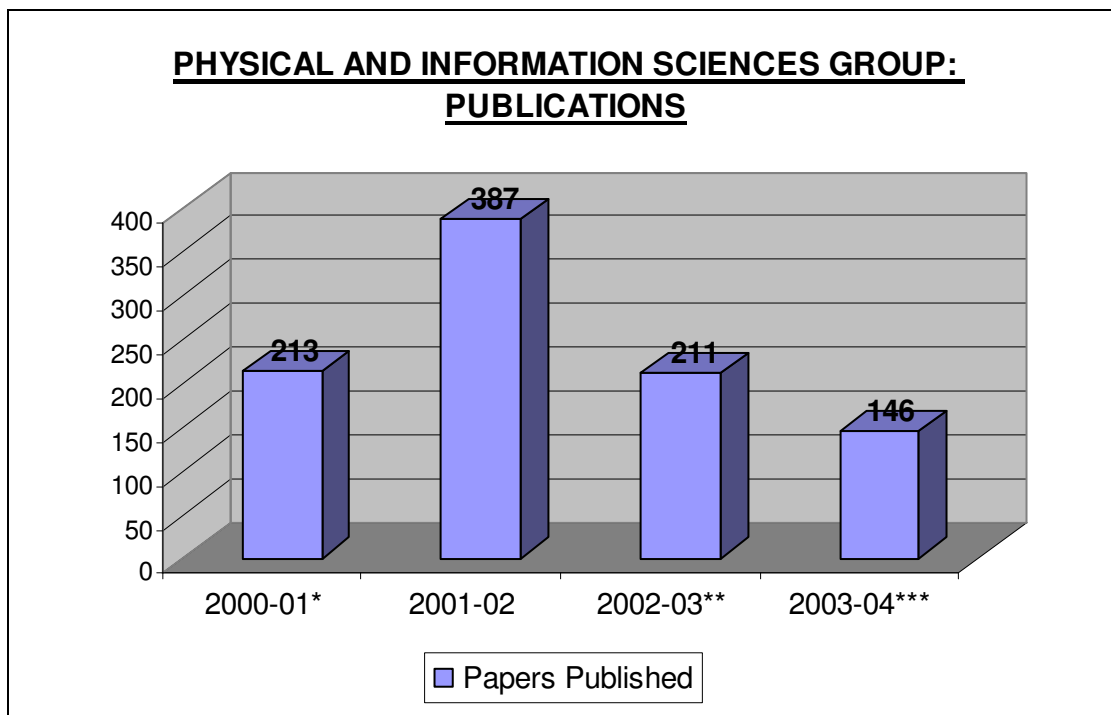
A – Abroad

Source: CSIR

### 5.1.3 Papers

The following figure 5-4 represents the total number of publications, for the physical and information sciences group as a whole during the period 2000-01 to 2003-04 (data not received from NPL and CMRI):

**Figure 5-4**



\* The figure for the number of papers published in 2000 - 01 includes only those for CSIO, NISTADS and NGRI.

\*\* The figure for number of papers published in 2002 – 03 does not include those for NGRI.

\*\*\* The figure for the number of papers published in 2003 - 04 includes only those for NISCAIR and NIO.

5.1.4 Areas of Core Competencies and Exportable R&D Services of the Physical & Information Sciences Group Laboratories are given in table 5-3

**Table 5-3**

<b>PHYSICAL AND INFORMATION SCIENCES</b>			
<b>S. No.</b>	<b>Name of laboratory</b>	<b>Area of Core Competency</b>	<b>Exportable R&amp;D Services</b>
1.	<b>National Physical Laboratory, New Delhi</b>	1. Measurement standards	1. International calibration services  2. Training Services in the area of calibration
		2. Materials science	
		3. Materials characterization	
		4. Radio & atmospheric science	
		5. Superconductivity & cryogenics	
2.	<b>National Institute for Science, Technology and Developmental Studies</b>	1. Globalization and development policy studies	1. Scientometrics studies 2. Knowledge management studies 3. Geographical information system (GIS) studies 4. Technological change and Innovation studies 5. Rural development studies
		2. Focus on ecology and economic development studies	
		3. Innovation & knowledge society studies	
		4. Technology & integrated assistance to rural artisans studies	
		5. Science-technology-education valuation studies	
		6. History & philosophy of science / public awareness of science studies	

3.	<b>National Institute of Science Communication and Information Resources</b>	1.Science writing and science editing 2.Database creation, and management, patent search, and traditional knowledge protection system 3.Graphic art and designing 4. Training library professionals	1. Science writing and science editing 2. Database creation and management, patent search, and traditional knowledge protection system 3. Training to library and information professionals 4.Science writing and science editing
4.	<b>National Institute of Oceanography</b>	1. Biogeochemistry and ecosystems of marine environments 2. Drugs and chemicals from the sea 3. Instrumentation and engineering for oceanographic research 4. Marine archaeology	1. Oceanographic surveys 2. Training of scientific manpower in different fields of ocean sciences 3. Consultancy / sponsored projects in the area of oceanography
5.	<b>National Geophysical Research Institute</b>	1. Hydrocarbon exploration 2. Mineral exploration and engineering geophysics 3. Groundwater exploration, assessment and management 4. Earthquake hazard assessment 5. Lithospheric studies 6. Geo – environment studies 7. Geophysical instrumentation	1. Seismic reflection / refraction surveys for mineral exploration (hydrocarbon) 2. High resolution seismic surveys for coal explorations 3. Acromagnetic studies for mineral exploration (diamonds) 4. Groundwater management and recharge studies 5. Magneto –telluric studies for geothermal resources and mineral exploration 6. Integrated geophysical surveys for oil and minerals



6.	<b>Central Scientific Instruments Organization</b>	<ol style="list-style-type: none"> <li>1. Agri – electronic instrumentation</li> <li>2. Environmental monitoring instrumentation</li> <li>3. Instrumentation for energy management</li> <li>4. Instrumentation for geo-science and disaster mitigation</li> <li>5. Instrumentation for strategic and defense application</li> <li>6. Medical Instrumentation</li> <li>7. Optics and opto-electronics</li> <li>8. MEMS sensors for diverse applications</li> <li>9. Biomolecular electronics and nanotechnology</li> </ol>	<ol style="list-style-type: none"> <li>1. Research, design and development of scientific &amp; industrial instruments, components and system</li> <li>2. Service &amp; maintenance of instruments / components</li> <li>3. Human resource development in the area of instrumentation</li> <li>4. Technical assistance to industry in the area of Instrumentation</li> </ol>
7.	<b>Central Electronic &amp; Electrical Engineering Research Institute</b>	<ol style="list-style-type: none"> <li>1. Silicon based semiconductor devices and processes</li> <li>2. III-V Compound Semiconductor based devices and Processes</li> <li>3. Very large scale Integrated circuit designs</li> </ol>	<ol style="list-style-type: none"> <li>1. Consultancy services for device design &amp; prototype development of silicon based semiconductor devices, VLSI, MEMS, micro sensors, hybrid microcircuits, electron tubes and related technologies.</li> <li>2. Consultancy services for device design &amp; prototype development services and customized services in process control instrumentation, speech technology, power electronic systems</li> <li>3. Mask making services for VLSI</li> </ol>

		4. MEMS and micro sensors	4. Advanced courses in the area of VLSI design, silicon devices, MEMS, compound semiconductor Devices, industrial process control instrumentation, power electronics and electron tubes and related technologies
		5. Hybrid Micro-circuits	
		6. Speech technology	
		7. Power electronic systems	
		8. Electron tubes	

## **5.2 Analysis of Individual laboratories under the Physical & Information sciences group**

### **5.2.1 National Physical Laboratory, New Delhi**

The National Physical Laboratory, New Delhi is one of the earliest national laboratories set up under the Council of Scientific & Industrial Research. Late Shri Jawaharlal Nehru laid the foundation stone of NPL on the 4th January 1947. The main building of the laboratory was formally opened by Late Deputy Prime Minister, Sardar Vallabhbhai Patel on the 21st January 1950. The objective of NPL is to strengthen and advance physics-based R & D for the overall development of science & technology in the country.

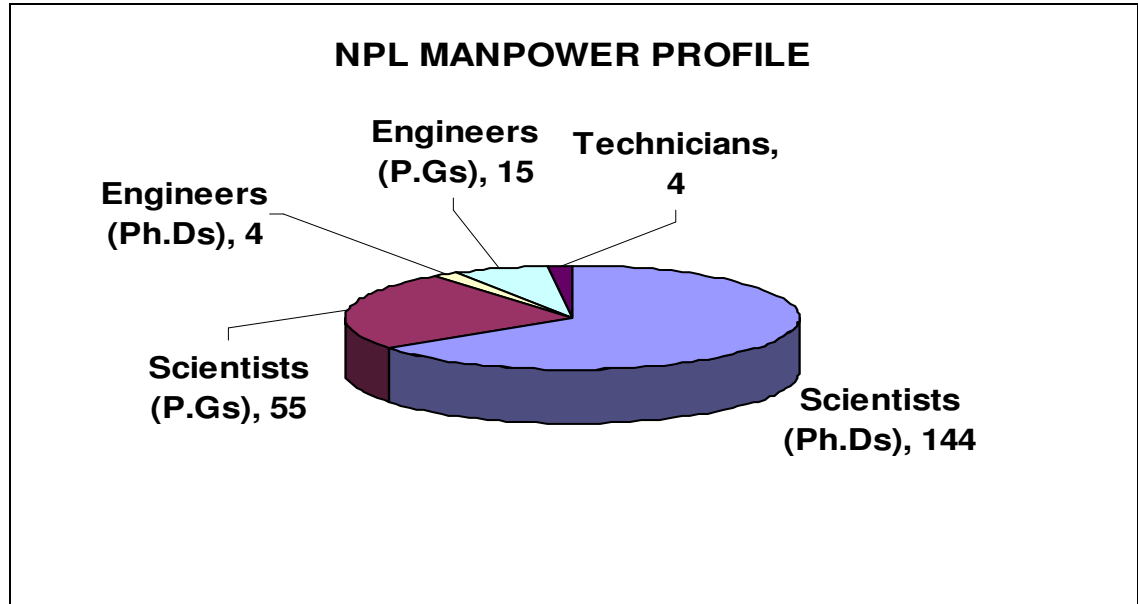
The charter of the organization is to establish, maintain and improve continuously by research, for the benefit of the nation, national standards of measurements and to realize the units based on international system to identify and conduct after due consideration, research in areas of physics which are most appropriate to the needs of the nation and for advancement of field, to assist industries, national and other agencies in their developmental tasks by precision measurements, calibration, development of devices, processes, and other allied problems related to physics and to keep itself informed and study critically the status of physics.

National Physical Laboratory has the responsibility of realizing the units of physical measurements based on the international system (S.I. units) under the subordinate legislations of weights & measures act 1956 (reissued in 1988 under the 1976 act). NPL also has the statutory obligation to establish, maintain & update the national standards of measurement & calibration facilities for different parameters. The Seven SI base units are metre, kilogramme, second, kelvin, ampere candela, mole (mol) and the SI supplementary units are radian (rad) & steradian (sr). The other derived units for measurement of force, pressure, vacuum, luminous flux, sound pressure, ultrasonic power & pressure and the units for electrical and electronic parameters viz., dc voltage; resistance; current and power; ac voltage; current and power; low frequency voltage; impedance and power; high frequency voltage; power; impedance; attenuation and noise; microwave power; frequency. impedance; attenuation and noise are also maintained.

### 5.2.1.1 Manpower Profile

The following figure 5-5 depicts the manpower profile of NPL:

**Figure 5-5**



### 5.2.1.2 Areas of Core Competency

The areas of core competency as identified by NPL are:

1. Measurement standards
2. Materials science
3. Materials characterization
4. Radio & atmospheric science
5. Superconductivity & cryogenics

### 5.2.1.3 Patents

The following table 5-4 represents the total number of Patents applied for and the number of patents granted to NPL from the year 2000-01 to 2004-05

**Table 5-4**

Patents filed by & granted to NPL during 2000-01 to 2004-05

Year	Patents Filed		Patents Granted	
	In India	Abroad	In India	Abroad
<b>2000-01</b>	5	8	2	3
<b>2001-02</b>	9	20	4	3
<b>2002-03</b>	5	12	2	5
<b>2003-04</b>	4	2	4	5
<b>2004-05</b>	4	10	2	6
<b>Total</b>	<b>27</b>	<b>52</b>	<b>14</b>	<b>22</b>

### 5.2.1.4 Potential Exportable R&D Services

The following have been identified by NPL to be their potential exportable R&D services:

1. International calibration services
2. Training services in the area of calibration

### 5.2.1.5 Target Markets

The following target markets have been identified for the above R&D services:

1. SAARC
2. Asia Pacific region
3. Eastern europe

### 5.2.1.6 Constraints & Suggestions

*NPL highlighted the lack of market information as the constraint that they faced in the export of R&D services. It was suggested that a professional agency to undertake business development and for international marketing can help to overcome these constraints for enhancing exports of R&D Services.*

## 5.2.2 National Institute for Science, Technology and Development Studies

National institute of science, technology and development studies (NISTADS), New Delhi is devoted to study of various aspects of interaction among science, society and state. Currently, the faculty comprises 45 members (including the Director) out of which 14 are women. This faculty is drawn from a variety of academic disciplines: 35 have a degree in science or engineering while the remaining 10 are from social sciences. This intellectual diversity (as Dr. Raghunath Mashelkar, Director-General, CSIR puts it) is the mainstay of the institute. Research students enrolled in the Institute obtain Ph.D. degree from different universities. NISTADS has a vibrant visiting scholars programme, under which researchers from India and abroad are encouraged to spend time at the Institute.

The roots of NISTADS go back to August 1973 when CSIR set up at its headquarters a Centre for the Study of Science, Technology and Development. On 30 September 1980, the Governing Body of the CSIR approved that the Centre “should function as an autonomous Centre with a separate budget”. Its objectives “would continue to be the same”, but it “will be autonomous, headed by a scientist of the rank of a Director of a national laboratory, with its own infrastructure”.

The research activity of the institute can be grouped under the following broad programmes:

**GDP:** Globalization and development policy

**FEED:** Focus on ecology and economic development

**INKS:** Innovation & knowledge society

**TIARA:** Technology & integrated assistance to rural artisans

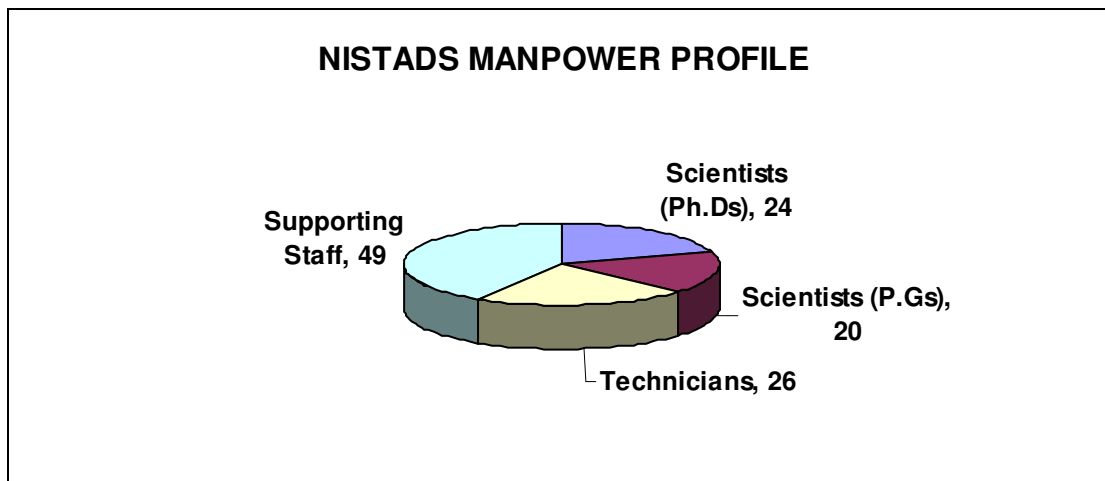
**STEVS:** Science-technology-education valuation studies

**HPS:** History & philosophy of science / public awareness of science

### 5.2.2.1 Manpower Profile

The following figure 5-6 details out the manpower profile of NISTADS:

**Figure 5-6**



### 5.2.2.2 Areas of Core competence

The following table 5-5 indicates the areas of core competencies of NISTADS and available manpower for each:

**Table 5-5**

S.No.	Area of Core Competence	Manpower
1.	<b>GDP:</b> Globalization and development Policy	5
2.	<b>FEED:</b> Focus on ecology and economic development	4
3.	<b>INKS:</b> Innovation & knowledge society	11
4.	<b>TIARA:</b> Technology & integrated assistance to rural artisans	6
5.	<b>STEVS:</b> Science-technology-education valuation studies	10
6.	<b>HPS:</b> History & philosophy of science / Public awareness of science	4

### 5.2.2.3 Major R&D Facilities

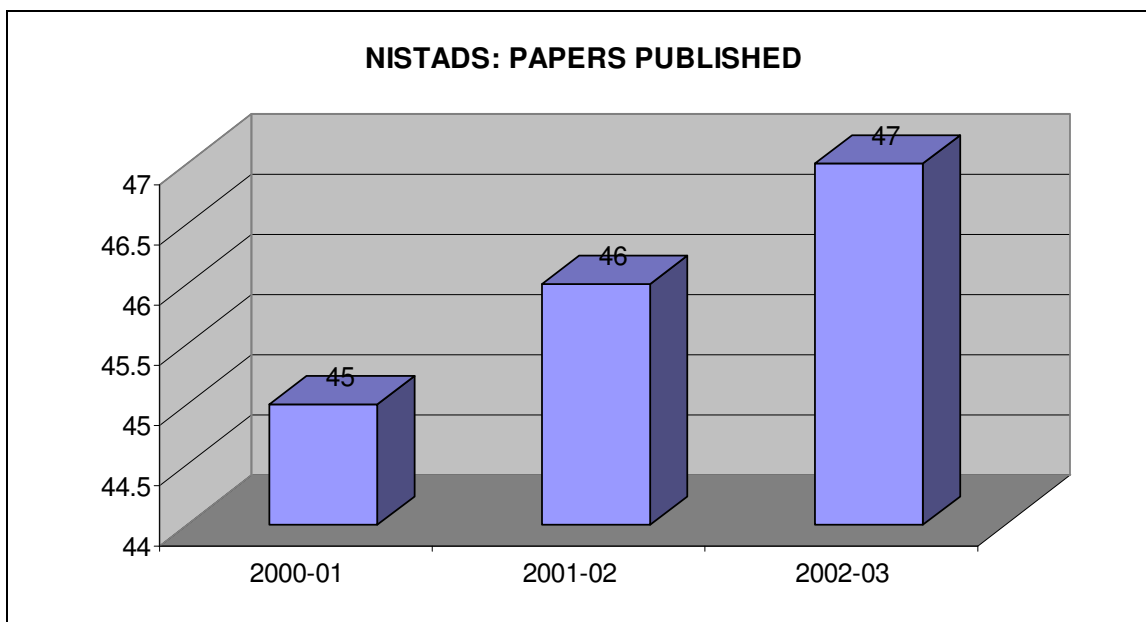
The following R&D facilities support the areas of core competency:

1. Excellent library in the area of science, technology and society studies
2. Excellent desktop computer facilities to all scientists with local area network.
3. Excellent conference hall facilities to hold national and international conferences / symposia and discussion meetings.
4. Excellent academic secretariat for support services for R&D work.

#### 5.2.2.4 Papers

Following figure 5-7 depicts the papers published by NISTADS during 2000-01 to 2002-03

**Figure 5-7**



The following table 5-6 lists the papers published by NISTADS during 2000-03 classified according to the various areas of core competence:

**Table 5-6**

S.No.	Area of Competence	Papers Published
1.	GDP: Globalization and development Policy	10
2.	FEED: Focus on ecology and economic development	4
3.	INKS: Innovation & knowledge society	56
4.	TIARA: Technology & integrated assistance to rural artisans	7
5.	STEVs: Science-technology-education valuation studies	21
6.	HPS: History & philosophy of science / Public awareness of science	8

(For details about the publications of NISTADS, refer to the website [www.nistads.res.in](http://www.nistads.res.in))



### 5.2.2.5 Potential Exportable R&D Services

The following areas have been identified as the potential R&D services that can be offered to clients abroad by NISTADS:

1. Scientometrics
2. Knowledge management
3. Geographical information system (GIS)
4. Technological change and innovation
5. Rural development studies

The following table 5-7 gives the number of publications brought out in the year 2002-03 to 2003-04 in which the R&D services can be offered to clients abroad

**Table 5-7**

<b>Areas of R&amp;D services</b>	<b>Publications in 2002-03</b>	<b>Publications in 2003-04</b>
Scientometrics	11	17
Technological change and Innovation	28	16
Knowledge Management	8	4
Geographical Information System (GIS)	6	23
Rural development studies	7	4

### 5.2.2.6 Target Markets

The following potential target markets / regions have been identified by NISTADS for their exportable R&D services:

1. European Union (especially Eastern Europe)
2. Asian region
3. Middle east
4. African region

### 5.2.2.7 Constraints & Suggestions

*NISTADS highlighted the lack of market Information and bureaucratic bottlenecks as the constraints that they faced in the export of R&D Services. It was suggested that to overcome these constraints for enhancing exports of R&D services, bureaucratic procedures must be simplified which includes national and international regulations. On the part of CSIR, specific market information may be acquired through surveys.*

### **5.2.3 National Institute of Science Communication And Information Resources**

National Institute of Science Communication and Information Resources (NISCAIR) came into existence on 30 September 2002 with the merger of National Institute of Science Communication (NISCOM) and Indian National Scientific Documentation Centre (INSDOC). Both NISCOM and INSDOC, the two premier institutes of the Council of Scientific and Industrial Research (CSIR), were devoted to dissemination and documentation of S&T information.

NISCOM had been in existence for the last six decades (first as two Publication Units of CSIR, which were merged to form the Publications Division, which was later renamed as Publications & Information Directorate and in 1996, as NISCOM). Over the years, NISCOM diversified its activities, and through a host of its information products, comprising research and popular science journals, encyclopaedic publications, monographs, books, and information services, it had been reaching out to researchers, students, entrepreneurs, industrialists, agriculturists, policy planners and also the common man.

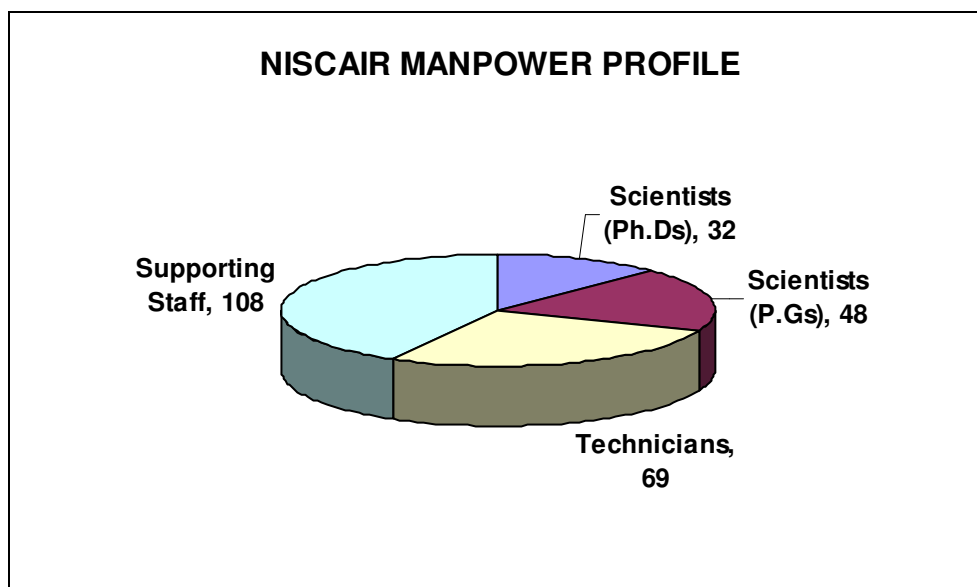
INSDOC came into being in 1952 and was engaged in providing S&T information and documentation services through myriad activities such as abstracting and indexing, design and development of databases, translation, library automation, providing access to international information sources, human resource development, consultancy services in setting up modern library-cum-information centres. INSDOC was also host to the National Science Library and the SAARC Documentation Centre.

Now, with the formation of NISCAIR, all the above multi-faceted activities have been amalgamated, making NISCAIR, an institute capable of serving the society using modern IT infrastructure in a more effective manner and taking up new ventures in the field of science communication, dissemination and S&T information management systems and services. Broadly the core activity of NISCAIR will be to collect / store, publish and disseminate S&T information through a mix of traditional and modern means, which will benefit different segments of society.

### 5.2.3.1 Manpower Profile

The following figure 5-8 details out the manpower profile of NISCAIR:

**Figure 5-8**



### 5.2.3.2 Core Competence

The following table 5-8 indicates the areas of core competencies of NISCAIR and manpower available for each:

**Table 5-8**

S.No.	Area of Competence	Manpower
1.	Science writing and science editing	80
2.	Database creation and management, patent search, and traditional knowledge protection system	11
3.	Identification of crude drugs	3
4.	Graphic art and designing	6
5.	Printing and production facility	34+10
6.	Training library professionals	5+20

### 5.2.3.3 Major R&D Facilities

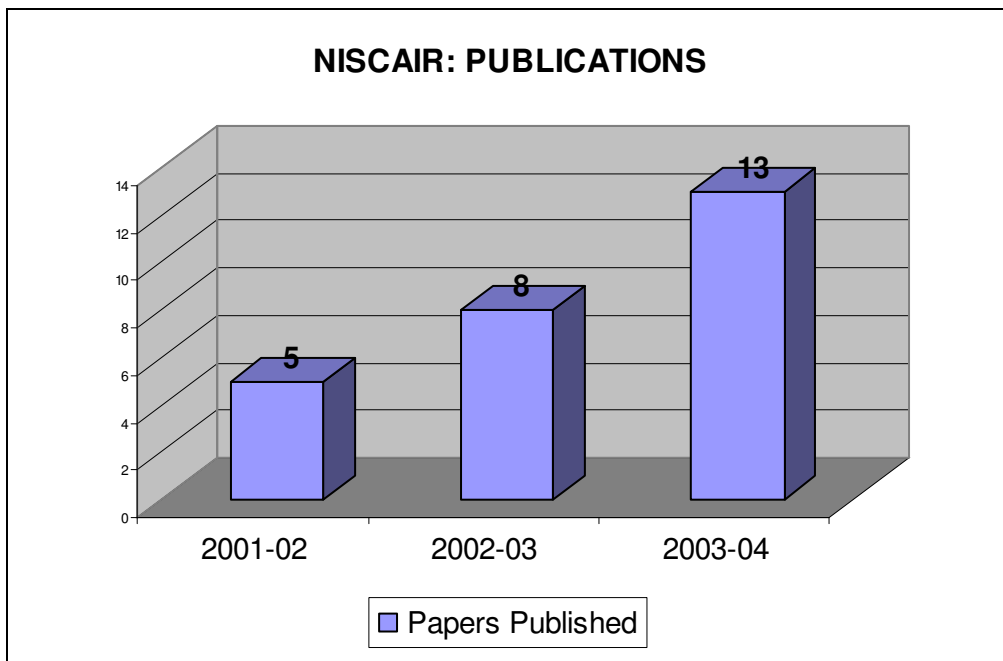
The following R&D facilities support the areas of core competency:

1. IT facilities to create and manage databases on traditional knowledge
2. Science writing and editing
3. Designing and printing of S&T literature
4. Herbarium and facilities to identify crude drugs

#### 5.2.3.4 Papers

The following figure 5-9 lists papers published by NISCAIR during 2001-02 to 2003-04

**Figure 5-9**



(For details about the publications of NISCAIR, refer to the website [www.niscair.res.in](http://www.niscair.res.in))

#### 5.2.3.5 Potential Exportable R&D Services

NISCAIR has identified the following R&D services as having potential for export:

1. Science writing and science editing
2. Database creation and management, patent search, and traditional knowledge protection system
3. Identification of crude drugs
4. Training to library and information professionals

NISCAIR has identified training, consultancy services, IPR services and surveys and studies as their areas of interest, as is indicated from the exportable R&D services listed above.

#### 5.2.3.6 Target Markets

The following target markets have been identified for the export of the above R&D services:

1. Government departments interested in protecting their traditional knowledge
2. Industries / departments interested in analysis and identification of crude drugs
3. Library professional
4. Departments interested in publishing their S&T data

#### 5.2.3.7 Constraints & suggestions

*NISCAIR highlighted the lack of market information as the constraint that they faced in the export of R&D Services.*

#### **5.2.4 National Institute Oceanography, Goa**

The National Institute of Oceanography (NIO) Goa was established on January 1, 1966 following the International Indian Ocean Expedition (IIOE) in 1960s. NIO has grown today into a large oceanographic laboratory with focus on oceanography of the waters around India. While the headquarters of the institute is at Dona Paula, Goa, its regional centres are located at Kochi, Mumbai and Visakhapatnam.

NIO's real strength lies in trained manpower developed during last four decades for basic ocean research. Over 150 individuals and groups from the institute have studied the special features that the north Indian basin offers and have made handsome contributions to knowledge regarding the ocean. Over 400 technical and supporting staff backs up the research workers. Besides, the institute gives an opportunity for the young, freshly graduated students to work as project trainees on various projects.

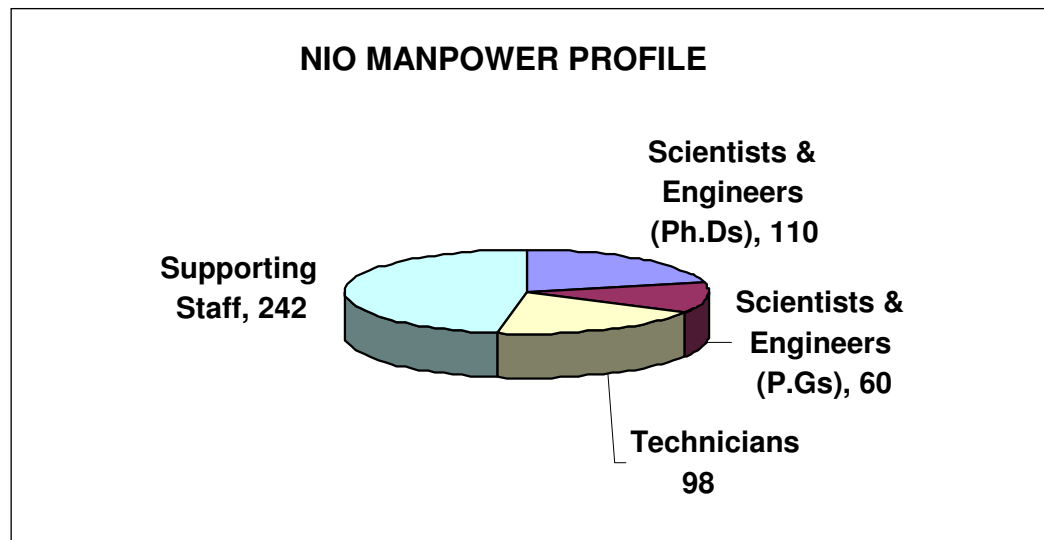
The core areas of study are ocean processes, coastal studies, resource survey, identification and conservation, and ocean engineering. In all, 21 institute projects focus on these research areas. The institute conducts surveys and provides advisory, consultancy services to its sponsors for specific tasks assigned thus making its infrastructure immediately useful to the nation.

In addition to the research laboratories spread in various divisions of the institute, a data centre, rich library, a powerful network connected to the world grid using high speed communication lines, computing facility for data analysis, etc., make the working conditions of the institute very favorable.

#### 5.2.4.1 Manpower Profile

The following figure 5-10 details out the manpower profile of NIO:

**Figure 5-10**



#### 5.2.4.2 Areas of Competence

NIO has identified the following as the areas of core competency Oceans and climate

1. Biogeochemistry and ecosystems
2. Non living resources
3. Pollution and environmental impact
4. Drugs and chemicals from the sea
5. Instrumentation and engineering
6. Marine archaeology

#### 5.2.4.3 Major R&D Facilities

The major R&D facilities that support the above mentioned areas of competency are:

1. Fully equipped research labs for oceanographic research
2. State-of-the-art library / online information facilities
3. Coastal research vessel for offshore surveys
4. Trained manpower for any offshore and coastal studies

#### 5.2.4.4 Patents

Following table 5-9 depicts the patents filed for and granted to NIO during 2000-01 to 2004-05

**Table 5-9**

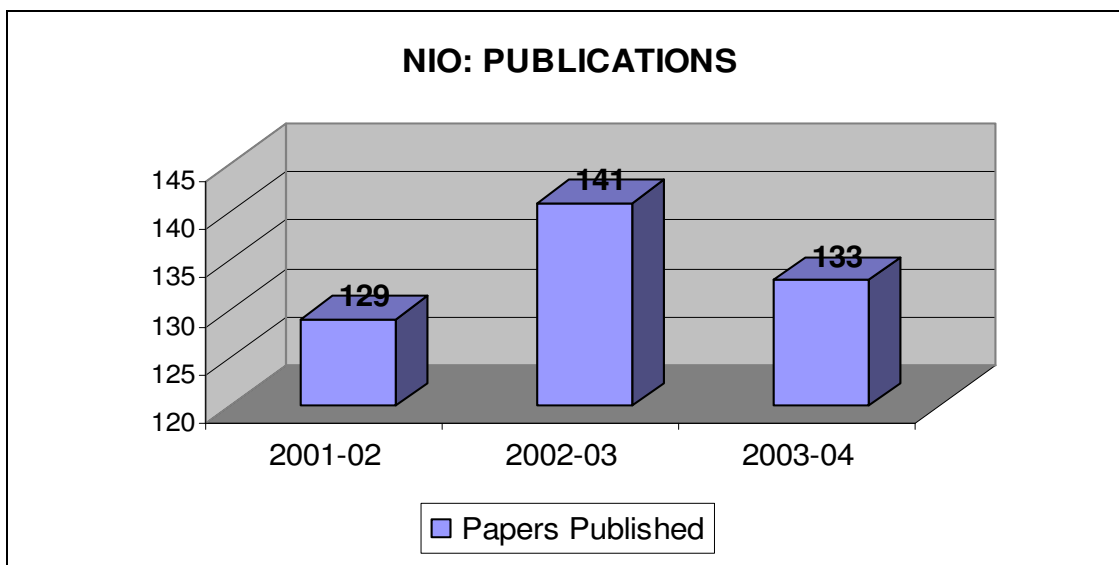
Patents filed by & granted to NIO during 2000-01 to 2004-05

Year	Patents Filed		Patents Granted	
	In India	Abroad	In India	Abroad
<b>2000-01</b>	1	27	Nil	Nil
<b>2001-02</b>	2	29	1	Nil
<b>2002-03</b>	9	36	1	4
<b>2003-04</b>	9	34	Nil	12
<b>2004-05</b>	14	21	3	13
<b>Total</b>	<b>35</b>	<b>147</b>	<b>5</b>	<b>29</b>

#### 5.2.4.5 Papers

Following figure 5-11 depicts the papers published by NIO during 2001-02 to 2003-04

**Figure 5-11**



(For details about the publications of NIO, refer to the website [www.nio.org](http://www.nio.org))



#### 5.2.4.6 Potential Exportable R&D Services

NIO has identified the following as their potential exportable R&D services:

##### **1. Oceanographic surveys**

NIO has in the past undertaken oceanographic surveys to explore the living and non-living resources in the Exclusive Economic Zones (EEZs) of different countries, such as Seychelles, Mauritius, Myanmar and the Caribbean islands. Similar surveys can be undertaken as consultancy services for development of offshore resources and technical support in the EEZs of different countries, as follows:

- i. Surveys for living resources
- ii. Exploration of coastal and offshore mineral and fuel resources
- iii. Aquaculture
- iv. Industrial surveys
- v. Environmental impact assessment
- vi. Development of offshore structures
- vii. Coastal zone regulation
- viii. Marine archaeology
- ix. Data and information management

##### **2. Training of scientific manpower in different fields of ocean sciences**

NIO has been receiving students from foreign countries for research and training in different fields of oceanography, such as:

1. Marine corrosion
2. Primary productivity
3. Bioactivity
4. Ecobiology
5. Management of coastal low lands
6. Sediment geochemistry
7. Offshore mineral explorations
8. Hydrography
9. Phyto, zooplankton and nutrient, heavy and trace metal analysis
10. Living and non living marine resources

11. Physical oceanographic processes and climates
12. Marine corrosion and biofouling
13. Drugs from the sea
14. Environmental Impact assessment and pollution control
15. Coastal zone management
16. Exploraion of underwater heritage

The students are received from different countries like France, Yemen, Germany, Vietnam, Malaysia, Bangladesh, Myanmar, Sri Lanka, Kenya, Ghana and other African countries.

### **3. Consultancy / sponsored Projects in the area of oceanography**

NIO has proven capability to offer sponsored / consultancy services in different fields.

NIO has identified training, consultancy services, surveys and studies and contract research as their areas of interest, as is indicated from the exportable R&D services listed above.

#### **5.2.4.7 Target Markets**

The potential target markets identified by NIO for providing the above services are:

1. Industries
2. Government agencies
3. Ports and harbours
4. Academicians and students

#### **5.2.4.8 Constraints & Suggestions**

NIO highlighted the lack of market information, bureaucratic bottlenecks and national regulations as the constraints that they faced in the export of R&D Services. It was suggested that the following can help to overcome these constraints for enhancing exports of R&D Services:

- *Scientific delegations to potential countries / clients for business promotion.*
- *Setting up information centers on CSIR capabilities through Indian High commissions / consulates.*
- *Developing scientific programs of oceanographic interest with participation of Indian Ocean countries.*

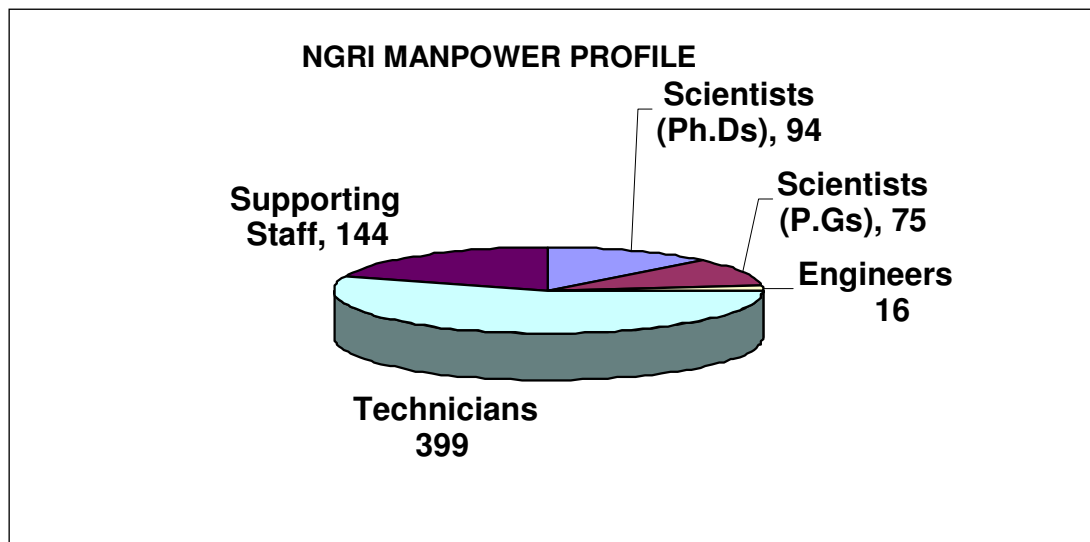
### 5.2.5 National Geophysical Research Institute, Hyderabad

The National Geophysical Research Institute (NGRI) was established under CSIR in 1961 in Hyderabad with the mission to be the premier geoscientific organisation in India. Over the last three and a half decades, it has established an enviable reputation with its excellent research programmes and developments in earth sciences that have provided the benefit of scientific and technological prowess for the well being of the people of the country.

The charter of the institute is to carry out basic and applied research in the frontier areas of solid earth geophysics, to acquire new information about the earth's interior by electrical, magnetic, thermal and gravitational fields, to study the history of the lithosphere and crustal evolution in space and time integrated geological, geochemical, geophysical and geochronological studies, to device new methods, techniques and instruments for the exploration of minerals and ground water resources by geophysical methods, to understand the processes involved in earthquakes and related phenomena, and to understand the earth's interior and its physical properties.

The following figure 5-12 details out the manpower profile of NGRI:

**Figure 5-12**



### 5.2.5.1 Manpower & Core Competencies

The following table 5-10 lists out the areas of core competency of NGRI and available manpower in each:

**Table 5-10**

<b>S.No.</b>	<b>Area of Competence</b>	<b>Manpower</b>
1.	Hydrocarbon exploration	116
2.	Mineral exploration and engg. geophysics	55
3.	Groundwater exploration, assessment and management	42
4.	Earthquake hazard assessment	40
5.	Lithospheric studies	80
6.	Geo – environment studies	7
7.	Geophysical instrumentaion	14

### 5.2.5.2 Major R&D Facilities

The major R&D facilities that support the above mentioned areas of competency are:

1. Mineral physics laboratory with high pressure diamond anvil cell (DAC), ultra high resolution (0.02/cm) double monochrometer and micro-Raman spectrometer.
2. High pressure laboratory consisting of Keithly electrometer, strain measuring sensors universal testing machine (100 tons) and Bridgeman-Birch high pressure apparatus.
3. In-situ stress measurement facility consisting of hydraulic equipment.
4. Rock magnetism laboratory consisting of astatic magnetometer, digital spinner magnetometer, alternating magnetic field and thermal demagnetizers, high field and low field hysteresis and susceptibility meter.
5. Geochemical laboratory consisting of fully automated x-ray fluorescence spectrometer (XRF), atomic absorption spectrometer, inductively coupled plasma mass spectrometer (ICPMS), electron probe micro analyzer (EPMA).
6. Geochronology laboratory for rock age determination by the Sm-Nd isotope methods and apparatus for Pb-Pb dating of rocks.
7. MT, EM, Deep resistivity and IP model laboratories
8. Helium emanometry, heatflow and radiometry laboratory
9. Tritium and carbon dating laboratory for ground water.
10. TL / OSL dating lab

11. Surface geochemical prespecting for hydrocarbon lab

12. State-of-the-art computing facilities at each lab

#### 5.2.5.3 Patents

Following table 5-11 depicts the patents filed for and granted to NGRI during 2000-01 to 2004-05

**Table 5-11**

Patents filed by & granted to NGRI during 2000-01 to 2004-05

Year	Patents Filed		Patents Granted	
	In India	Abroad	In India	Abroad
<b>2000-01</b>	Nil	Nil	Nil	Nil
<b>2001-02</b>	Nil	5	Nil	Nil
<b>2002-03</b>	1	5	Nil	Nil
<b>2003-04</b>	Nil	Nil	Nil	1
<b>2004-05</b>	2	Nil	Nil	2
<b>Total</b>	<b>3</b>	<b>10</b>	<b>Nil</b>	<b>3</b>

#### 5.2.5.4 Papers

The following table 5-12 lists out the number of Publication brought out by NGRI during 2001-03, classified according to the areas of competency:

**Table 5-12**

S.No.	Area of Competence	Papers published
1.	Hydrocarbon exploration	22
2.	Mineral exploration and engg. geophysics	56
3.	Groundwater exploration, assessment and management	81
4.	Earthquake hazard assessment	54
5.	Lithospheric studies	86
6.	Geo – environment studies	27
7.	Geophysical instrumentaion	15

(For details about the publications of NGRI, refer to the website [www.ngri.org](http://www.ngri.org) )

#### 5.2.5.5 Potential Exportable R&D Services

NGRI has identified the following as their potential exportable R&D services:

1. Seismic reflection / refraction surveys for mineral exploration (hydrocarbon)
2. High resolution seismic surveys for coal explorations
3. Aero-magnetic studies for mineral exploration (diamonds)
4. Groundwater management and recharge studies
5. Magneto –telluric studies for geothermal resources and mineral exploration
6. Integrated geophysical surveys for oil and minerals

#### 5.2.5.6 Target Markets

The following target markets have been identified for the above mentioned potential exportable R&D services of NGRI:

1. West asian countries
2. Gulf countries: groundwater and seismic surveys / consultancy
3. Far east countries: seismic surveys for oil exploration
4. African countries: mineral exploration for gold and precious minerals like diamonds

#### 5.2.5.7 Constraints & Suggestions

NGRI highlighted the lack of market information (in terms of the specific needs of a country in terms of projects being undertaken in the core competence of NGRI and the assessment of the requirements of a country), lack of specialized manpower in R&D marketing (in terms of support of professional marketing staff to assist scientist engaged in R&D services) and stiff international competition as the constraints that they faced in the export of R&D Services.

It was suggested that the following can help to overcome these constraints for enhancing exports of R&D Services:

- *Exposure of the Scientists looking after the affairs of Contract Research to the International Markets through their participation in International Business Meets and conferences etc. Professional marketing professionals should support them. Separate funding should be provided for such activities, like their travel, stay, and other expenses.*
- *More autonomy to the competent authority within the CSIR guidelines to negotiate international projects on competitive financial terms.*

### **5.2.6 Central Scientific Instruments Organization, Chandigarh**

Central Scientific Instruments Organization (CSIO) is a premier national laboratory dedicated to research, design and development of scientific and industrial instruments. It is a multi-disciplinary and multi-dimensional apex industrial research & development organization in the country.

Established in October 1959, CSIO was chartered to stimulate the growth of indigenous instrument industry in the country through development of contemporary technologies and other scientific & technological assistance.

Initially located at New Delhi, CSIO moved to Chandigarh in 1962. CSIO is a multi-disciplinary organization having well equipped laboratories manned by highly qualified and well trained staff with infrastructural facilities in the areas of microelectronics, optics, applied physics, electronics, mechanical engineering, etc. Large number of instruments ranging from simple to highly sophisticated ones, have been designed and developed by the institute and their know-how have been passed on to the industry for commercial exploitation. Having contributed substantially towards the growth of the scientific instruments industry in the country, CSIO enjoys high degree of credibility among the users of the instruments as well as the instrument industry.

CSIO campus (spread over an area of approximately 120 acres) comprises of office buildings, R&D laboratories, Indo-Swiss Training Centre and a housing complex. An austere four-storey building and the accompanying workshops were inaugurated in December 1967. Another four-storey block was added in 1976 for housing R&D divisions, library, etc. during mid-eighties, the laboratory buildings and infrastructural facilities were modernized in order to gear the institute towards taking up development projects in challenging and emerging areas of technology. A separate administrative block was inaugurated in September 1994.

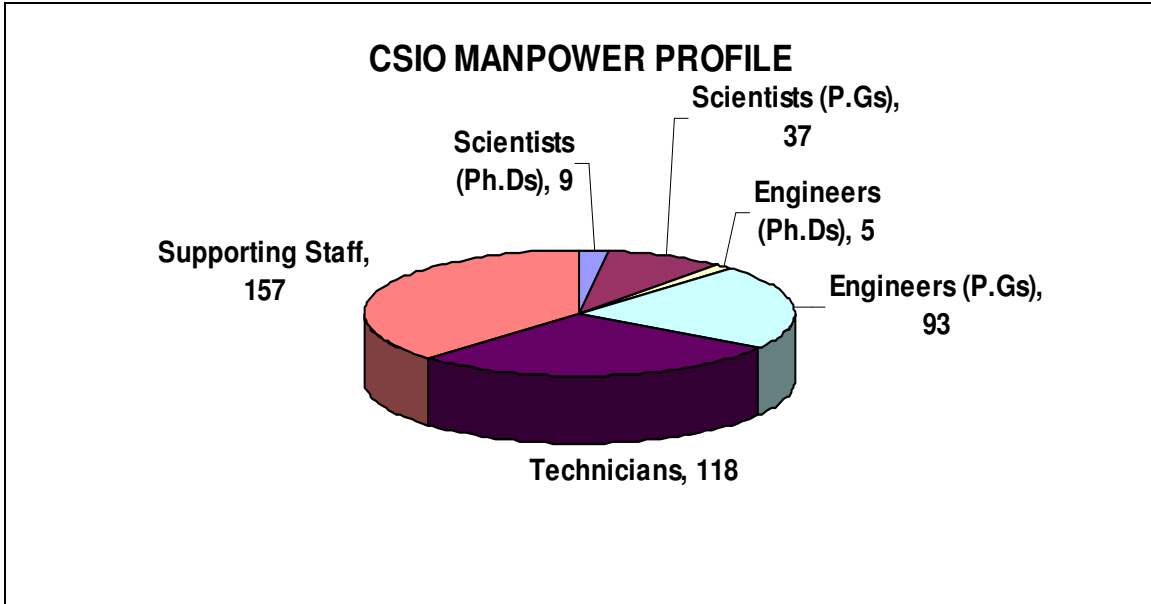
Central Scientific Instruments Organization (CSIO) is a premier national laboratory dedicated to research, design and development of scientific and industrial instruments of a diverse variety. The lab has state-of-art infrastructural facilities in optics, electronics and mechanical engineering.



### 5.2.6.1 Manpower Profile

The following figure 5-13 details out the manpower profile of CSIO:

**Figure 5-13**



### 5.2.6.2 Areas of Core Competency

The following table 5-13 indicates the areas of core competency of CSIO and available manpower for each:

**Table 5-13**

S.No.	Area of Core Competence	Manpower
1.	Agri – electronic instrumentation	11
2.	Environmental monitoring instrumentation	6
3.	Instrumentation for energy management	25
4.	Instrumentation for geo-science and disaster mitigation	20
5.	Instrumentation for strategic and defense application	45
6.	Analytical instrumentation	18
7.	Medical instrumentation	29
8.	Optics and opto-electronics	31
9.	MEMS sensors for diverse applications	33
10.	Biomolecular electronics and nanotechnology	05
11.	Services (S&M, manpower training, etc.)	133

### 5.2.6.3 Major Facilities

The following R&D facilities support the areas of core competency:

1. Inductively coupled plasma atomic emission spectrometer (ICP-AES)
2. Growth and characterization facility for III-V compound semiconductors e.g. GaAs
3. Characterization by scanning tunneling microscope / atomic force microscope
4. Liquid nitrogen plant
5. Microprocessor controlled thin film coating plant
6. High precision optical component fabrication
7. Well equipped hologram recording and processing facility
8. Optical fibre characterization and measurement benches
9. Aspheric generation and polishing machine with accessories
10. CNC universal 3-D measuring machine
11. CAD design tools for PCB layout and simulation
12. FPGA and ASIC design capabilities
13. METLAB facility for signal processing, mechanical Simulation, mathematical modeling, thermal mapping
14. Femto range IV-CV measurement system
15. Optical tweezer and micro dissection system

### 5.2.6.4 Patents

Following table 5-14 depicts the patents filed and granted to CSIO during 2000-01 to 2004-05

**Table 5-14**

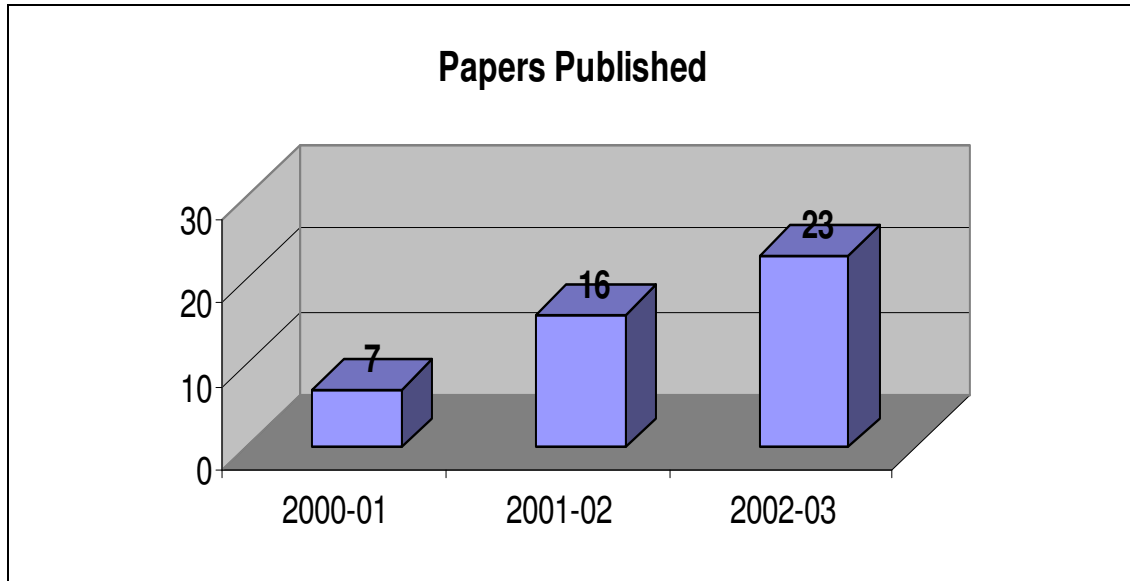
Patents filed by & granted to CSIO during 2000-01 to 2004-05

Year	Patents Filed		Patents Granted	
	In India	Abroad	In India	Abroad
<b>2000-01</b>	Nil	4	Nil	Nil
<b>2001-02</b>	Nil	12	1	Nil
<b>2002-03</b>	1	15	2	Nil
<b>2003-04</b>	6	19	Nil	2
<b>2004-05</b>	11	10	Nil	4
<b>Total</b>	<b>18</b>	<b>60</b>	<b>3</b>	<b>6</b>

### 5.2.6.5 Papers

Following figure 5-14 depicts the papers published by CSIO during 2000-01 to 2002-03

**Figure 5-14**



(For details about the publications of CSIO, refer to the website [www.csio.org](http://www.csio.org) )

### 5.2.6.6 Potential Exportable R&D Areas

With its multi-disciplinary expertise, the organization can cater to the needs of international clients abroad in the following major R&D areas:

- Research, design and development of scientific & industrial instruments, components and systems
- Service, maintenance, testing and calibration of instruments / components
- Human resource development in the area of instrumentation
- Technical assistance to industry

## **1. Research, design and development of scientific & industrial instruments, components and system**

In following areas, R&D services, for the development of instruments and instruments systems in form of technological know-how & consultancy services can be offered to the clients abroad:

- a) Instrumentation for strategic and defence applications
- b) Optics & opto-electronics (including coherent Optics)
- c) Geo-scientific instrumentation
- d) Medical instrumentation
- e) Analytical instrumentation
- f) Agri-electronic instrumentation
- g) Energy management, condition monitoring & quality control
- h) Environmental monitoring instrumentation
- i) Micro-electro mechanical systems (MEMS) and sensors for diverse applications
- j) Biomolecular electronics and nanotechnology

## **2. a Service & maintenance of instruments / components**

Apart from R&D Services, CSIO offers S&T services in the repair & maintenance of scientific equipments. This specialized service is rendered through three Service & Maintenance (S&M) Centres located in different regions of the country-one each at Delhi, Jaipur and Chennai, besides S&M Division at CSIO, Chandigarh. The S&M centres contribute towards saving of large amount of money by providing adequate service facilities which otherwise would have been spent for buying new equipments. At present, the beneficiaries of repair & maintenance services include hospitals and medical institutes, industry, educational institutions, R&D laboratories / institutes, etc of India.

These Centres not only put back to use defective instruments but also contribute towards saving of a large amount of foreign exchange which otherwise would have to be been spent to import the substitutes. Repair of some of the instruments

involves development work for redesigning the circuits with components available indigenously and for incorporating modifications in the instruments with a view to improving their performance. Besides revitalizing the defective equipments of industry, R&D, medical and educational institutions, annual contract Servicing facilities are also provided.

The services offered by these Centres are broad based taking an intergrated view of user's requirements and aim at offering a range of services e.g.

- Repair & Maintenance of instruments ensuring minimum down time to the extent possible;
- Contract Servicing wherein repair & maintenance responsibility w.r.t. instrumentation shall be that of the S&M Centres;
- Offer services for establishing medical instrumentation labs including advice on procurement of appropriate type of instruments;
- Undertake installation and commissioning jobs;
- Provide test and calibration facilities;
- Undertake design & development work necessitating circuit modifications in respect of costly instruments where spares are either too costly or are not available.

CSIO has also undertaken a programme on repair & maintenance of instruments in S&T Institutes of Myanmar under POC. Already several instruments worth Rs. 10 million have been repaired by CSIO's experts at Myanmar in Phase-I. Phase-II envisages training of Myanmar personnel on repair & maintenance aspects, besides establishing Service & Maintenance outfits in Myanmar. This has been one of the biggest success stories of CSIO.

Possibility of providing these services to other countries can also be explored.

### **b. Test & calibration services for instruments:**

Quality assurance by production agencies depends upon the test & Calibration equipments being used by the Industry. The authenticity of the results depends upon the calibration of these instruments from time to time. The facilities are provided by this organization for the calibration of the instruments / components for following parameters:

- Electrical / electronic instruments
- Electromechanical
- Thermal
- Geo-scientific instruments calibration
- Medical instruments calibration

Such services can also be extended to the foreign clients as well.

### **3. Human Resource Development in the area of instrumentation**

CSIO & its S & M Centres have also been conducting training programmes, both for the users as well as for service & maintenance personnel on operation, handling and preventive maintenance as well as on technical intricacies involving maintenance. Some of the important training programmes presently being organized are:

- Management Development Programme on Operation, Repair and Maintenance of Bio-Medical Equipments for third world countries
- Management Development Programme on Operation, Repair and Maintenance of Analytical Equipments for third world countries

The Ministry of External Affairs, Government of India, sponsors both these programmes. On behalf of UNICEF, CSIO has also been organizing training on basic health equipments for cold chain officers.

#### **4. Technical assistance to industry**

The organization has a team of highly skilled workers in the area of mechanical, optical & electronic fabrication. Expertise gained by them in the above areas is being utilized by the industries & Govt. agencies in India from time to time. Highly specialized assistance is being rendered by CSIO in the following areas:

- Critical job fabrications
- Technical consultancy
- Upgradation of existing facilities & creation of new facilities
- Enhancement of knowledgebase of industries by seminars, industry-R & D meets
- Creating awareness of potential technological advancements thus promoting their business.

This service of technical assistance could also be extended to industry abroad.

CSIO has identified testing and calibration services, training, consultancy services and contract research as its areas of interest, as is indicated from the exportable R&D services listed above.

#### 5.2.6.7 Target Markets

Further CSIO has identified the following target markets keeping the above exportable R&D services in mind with special emphasis to the third world countries:

1. Strategic industries
2. Universities
3. R&D institutions
4. Ophthalmic / Optic industries
5. Optical workshops – aspheric surphase generation, lens grinding, graticule fabrication, thin films deposition
6. Optical system designing / optical component designing
7. Meteorological departments
8. Nuclear power stations
9. Natural disaster and mitigation departments
10. Hydrological research institutes
11. Remote sensing agencies
12. Medical instruments industries
13. Health catering industries
14. Medical research institutes
15. Beverage industries
16. Quality control departments
17. Process monitoring industries
18. Procurement agencies / storage houses
19. Food processing industries
20. Agricultural universities
21. Heat treatment plant / power houses
22. Locomotive & heavy engineering industries
23. Automobile industries
24. Pollution control boards
25. Chemical industries / foundries
26. Effluent treatment plants
27. Ceramics



28. Material industries

29. Biomolecular research institutes

#### 5.2.6.8 Constraints & Suggestions

CSIO highlighted the lack of market information and lack of resources as the constraints that they faced in the export of R&D services.

In terms of lack of market information, the following are noted:

- Lack of proper mechanism to understand the requirements of the other countries
- Absence of appropriate channels for exchange of information pertaining to the development and availability of technology in the areas concerned
- Scientific instruments is a secondary / tertiary sector
- Available technology not competitive with the state-of-art
- Faster obsolescence rate

The following Market Information needs to be gathered:

- Total size of the market
- Present status of technological development in the third world countries
- Entrepreneurial culture of the target markets
- Legislative and administrative government practices in these countries
- Funding of R&D in these countries

The proposed market information could be generated through various sources such as the embassies of third world countries in India, interaction with the scientists from these countries and direct market analysis.

In terms of lack of resources, the following are noted:

- This is an inherent weakness of the developing country, where the lack of resources in terms of ready availability of components of desired specs and the quality infrastructure places hurdles in competing the international players of the same area.

It was suggested that the following can help to overcome these constraints for enhancing exports of R&D Services:

- *Generation of database for instrument / technological needs of different countries*
- *Publication of compendium of technologies available, expertise, core strengths and client base*
- *Identification of potential users*
- *Establishment of state linkages with them*
- *Seeking assistance from Indian Missions abroad for this purpose*
- *Requesting Science Attaches in Indian Embassies to build on-line database for assessment of requirements*
- *Rapid and need based upgradation of technology*
- *Collaborations with organizations having similar / updated knowledge base*

### 5.2.7 Central Electronic Engineering Research Institute, Pilani

Central Electronics Engineering Research Institute (CEERI), Pilani, a constituent laboratory of Council of Scientific and Industrial Research (CSIR), New Delhi, was established in 1953, for advanced research and development (R&D) in the field of electronics. Since its inception, it has been working for the growth of electronics in the country and has established the required infrastructure and well experienced manpower for undertaking R&D in three major areas of electronics systems, microwave tubes and semiconductor devices.

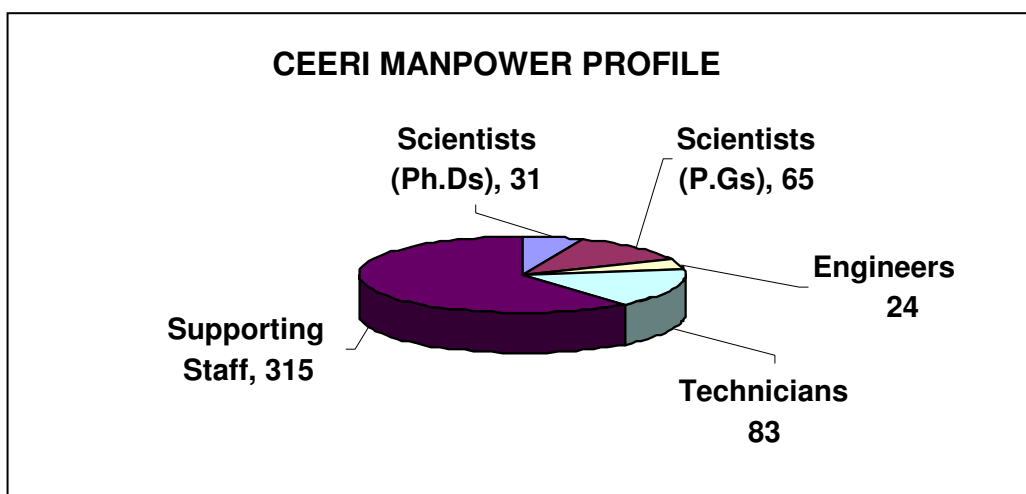
The institute is currently carrying out research and development in the following areas:

1. MEMS and microsensors
2. Electron tubes
3. Photonic components
4. Electronics for society, environment and industry

#### 5.2.7.1 Manpower Profile

The following figure 5-14 depicts the manpower profile of CEERI

**Figure 5-14**



### 5.2.7.2 Areas of Competency

The following table 5-15 depicts the areas of core competency of CEERI and available manpower for each:

**Table 5-15**

<b>S.No.</b>	<b>Area of Competence</b>	<b>Manpower</b>
1.	Silicon based semiconductor devices and processes	15
2.	III-V compound semiconductor based devices and processes	10
3.	Very large scale integrated circuit designs	10
4.	MEMS and microsensors	15
5.	Hybrid micro-circuits	5
6.	Process control Instrumentation (Agro-based)	15
7.	Speech technology	8
8.	Power electronic systems	5
9.	Electron tubes	17

### 5.2.7.3 Major R&D Facilities

The following R&D facilities support the above areas of competency:

1. Silicon based semiconductor device and IC fabrication facility (2" and 3" wafers)
2. MEMS based sensor fabrication facility (3" and 6" wafers)
3. Compound semiconductor based high power MESFET, Laser diode (980 nm) and MMICs device fabrication facility
4. Hybrid micro-circuit fabrication facility
5. Semiconductor device / material characterization facility: SEM, STM/AFM, CV, KPC Kelvin probe etc.
6. VLSI design facility (front end design, simulation, synthesis and back end design)
7. Electron tube design facility (Magnetron, Klystron, TWT and Thyratrons)
8. Electron tube fabrication facility (Magnetron, Klystron, TWTs and Thyratrons)
9. Electron tube testing and characterization facility

#### 5.2.7.4 Patents

The following table 5-16 gives the details of the number of patents filed by and granted to CEERI during 2000-01 to 2004-05

**Table 5-16**

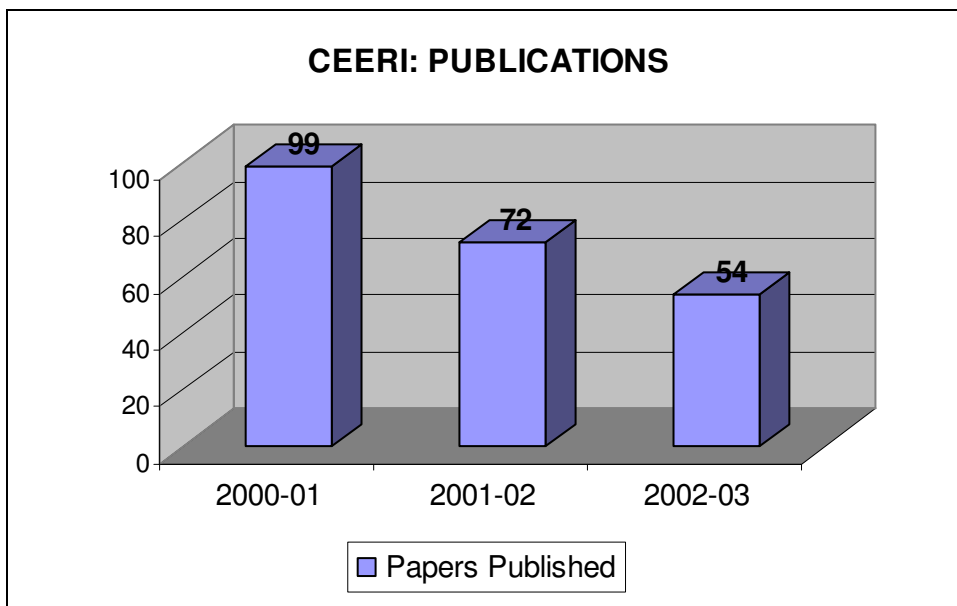
Patents filed by & granted to CEERI during 2000-01 to 2004-05

Year	Patents Filed		Patents Granted	
	In India	Abroad	In India	Abroad
<b>2000-01</b>	2	Nil	1	Nil
<b>2001-02</b>	3	Nil	7	1
<b>2002-03</b>	Nil	Nil	2	Nil
<b>2003-04</b>	Nil	Nil	2	Nil
<b>2004-05</b>	Nil	Nil	Nil	Nil
<b>Total</b>	<b>5</b>	<b>Nil</b>	<b>12</b>	<b>1</b>

#### 5.2.7.5 Papers

The following figure 5-15 gives the details of the number of papers published by CEERI during 2000-01 to 2002-03

**Figure 5-15**



(For details about the publications of CEERI, refer to the website [www.ceeri.res.in](http://www.ceeri.res.in))

#### 5.2.7.6 Potential Exportable R&D Services

CEERI has identified the following as their potential exportable R&D services:

#### **I. Consultancy services / for device design & prototype development and customized services in the following areas:**

1. Silicon based semiconductor devices and processes
2. III-V compound semiconductor based devices and processes
3. Very large scale integrated circuit designs
4. MEMS and microsensors
5. Hybrid micro-circuits
6. Electron tubes and related technologies

#### **II. Consultancy services for device design & prototype development and customized services in the following areas:**

1. Process control instrumentation (Agro – based)
2. Speech technology
3. Power electronic systems

#### **III. Mask making services**

#### **IV. Advanced courses in the area of VLSI design, silicon devices, MEMS, compound semiconductor devices, industrial process control instrumentation, power electronics and electron tubes and related technologies**

CEERI has identified training, consultancy services and contract research as their areas of interest, as is indicated from the exportable R&D services listed above.

#### 5.2.7.7 Target Markets

The following target markets have been identified for the above services:

European Union markets

#### 5.2.7.8 Constraints & Suggestions

CEERI highlighted the lack of market information as the constraint that they faced in the export of R&D Services. It was suggested that the following can help to overcome these constraints for enhancing exports of R&D services:

- *Active market exploration: Better market feedback should be made available.*
- *There should be a periodic advertisement of the services available.*
- *Indian missions in the target countries should be involved in the marketing effort.*
- *Specific budget should be earmarked for scientists to travel for business development activities*
- *Enhancing collaborative programs / projects with target countries.*