

Chapter 6

Analysis of Chemical Sciences Group Laboratories

6.0 List of laboratories under the Engineering Sciences Group

1. National Environmental Engineering Research Institute, Nagpur
2. National Metallurgy Laboratory, Jamshedpur
3. Regional Research Laboratory, Tiruvananthapuram
4. Regional Research Laboratory, Bhubaneshwar
5. Regional Research Laboratory, Bhopal
6. National Aeronautical Laboratory, Bangalore
7. Structural Engineering Research Centre, Chennai
8. Central Road Research Institute, New Delhi
9. Central Mechanical Engineering Research Institute, Durgapur
10. Central Building Research Institute, Roorkee
11. Central Fuel Research Institute, Dhanbad
12. Central Glass and Ceramic Research Institute, Kolkatta
13. Central Mining Research Institute, Dhanbad

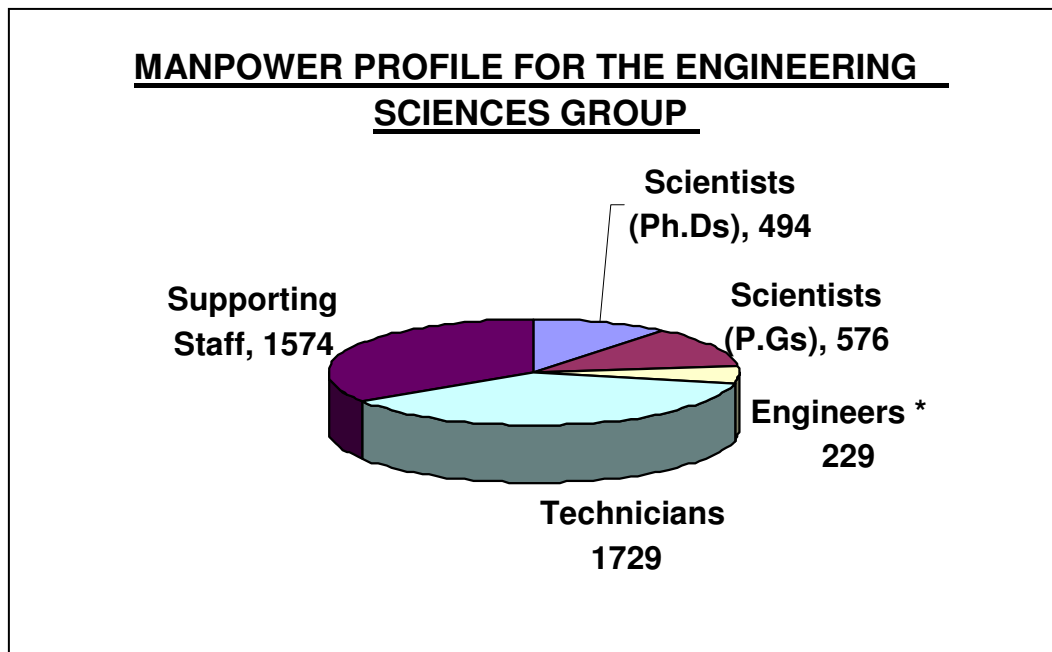
6.1 Overall Analysis of Engineering Sciences Group

The thirteen institutes categorized in the engineering sciences group cover varied areas of research like environmental engineering, mechanical engineering, chemical engineering, fuels, mining, glass and ceramics technology, building technology, aerospace etc.

6.1.1 Manpower Profile

The figure 6-1 below represents the manpower profile in terms of scientists, engineers, technicians and supporting staff of the engineering sciences Group as a whole (data as received from all the individual Institutes):

Figure 6-1

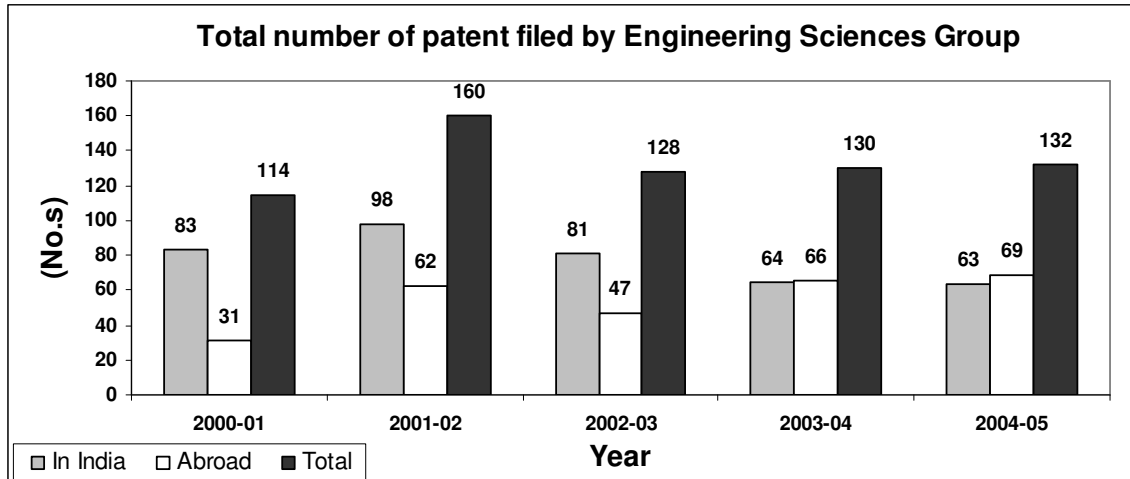


* The figure for the number of engineers does not include those for CMERI, CBRI, NML, NAL, RRL Bhopal and RRL Bhuvaneshwar.

6.1.2 Patents

The following figure 6-2 represent the total number of patents applied for (both Indian & foreign) by the engineering sciences group as a whole for the period 2000-01 to 2004-05

Figure 6-2

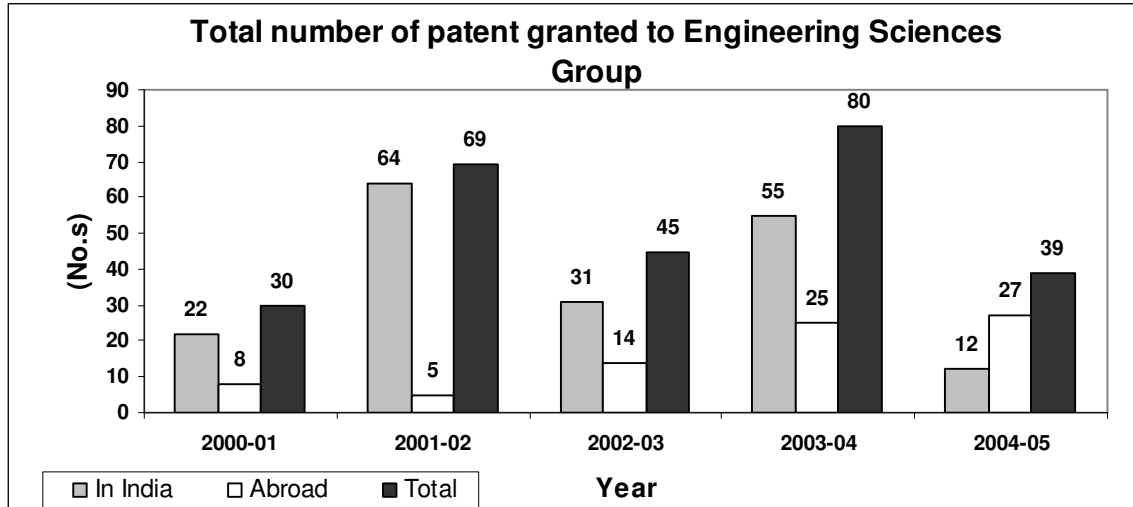


The number of Indian patents applied for by the engineering sciences group as a whole increased by 18 % from the year 2000-01 to 2001-02 but decreased by 17.3 % in the very next year i.e. from 2001-02 to 2002-03 and again decreased by 21% in the year 2003-04. However in the next two years the number of Indian patents applied for have remained practically the same (64 in the year 2003-04 and 63 in the year 2004-05).

The foreign patents applied increased by 100% from the year 2000-01 to 2001-02 but decreased by 24.2% in the year 2002-03. However there is an increase of 40.4% in the year 2003-04 and further increased by 9% in the year 2004-05.

The figure 6-3 indicates the number of patents granted to engineering sciences group as a whole during the period 2000-01 to 2004-05

Figure 6-3



The laboratories wise details of the patents filed in India and abroad are given below in table 6-1

Table 6-1

Patents filed by Engineering 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
CBRI	4	-	2	-	2	-	-	14	-	27	8	41
CFRI	7	4	8	10	8	10	2	18	4	6	29	48
CGCRI	25	3	30	8	21	6	14	9	12	9	102	35
CMERI	5	-	2	-	5	1	4	-	1	4	17	5
CMRI	6	-	6	-	3	-	9	-	18	-	42	-
CRRI	-	-	-	-	-	-	2	-	1	-	3	-
MERADO(P)	-	-	-	-	-	-	-	-	-	-	-	-
NAL	6	1	3	-	10	3	4	1	1	1	24	6
NEERI	-	-	4	1	2	2	1	2	2	1	9	6
NML	7	-	10	20	7	14	12	2	7	11	43	47
RRL(B)	10	-	17	3	11	2	9	2	5	2	52	9
RRL(BP)	1	-	7	-	2	-	-	-	3	1	13	1
RRL(T)	12	23	6	20	8	9	7	18	9	7	42	77
SERC(M)	-	-	3	-	2	-	-	-	-	-	5	-

I – India

A – Abroad

Source: CSIR

The above table shows that CGCRI has applied for the maximum number of patents during the period 2000-01 to 2004-05 numbering 137 including 102 Indian and 35 foreign patents. RRL(T) comes next with 119 patents applied for including 42 Indian and 77 foreign. The minimum number of patents have been applied for by CRRI numbering 3 only and that too in India.

The laboratories wise details of the patents granted to India and abroad are given below in table 6-2

Table 6-2

Patents granted to Engineering 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
CBRI	2	-	1	-	2	-	1	6	1	-	7	6
CFRI	1	-	4	-	1	2	3	4	1	4	10	10
CGCRI	2	1	5	3	3	1	6	3	1	3	17	11
CMERI	2	-	1	-	-	-	2	-	-	-	5	-
CMRI	-	1	8	-	3	1	15	1	-	-	26	3
CRRI	-	-	-	-	-	-	1	-	1	-	2	-
MERADO(P)	-	-	1	-	-	-	-	-	-	-	1	-
NAL	-	-	2	-	2	2	1	-	1	1	6	3
NEERI	-	4	1	-	7	-	9	-	1	-	18	4
NML	7	-	23	-	3	-	6	2	3	5	42	7
RRL(B)	2	-	11	-	5	1	5	-	1	1	24	2
RRL(BP)	3	-	2	-	1	-	1	-	1	-	8	-
RRL(T)	3	2	5	2	3	7	3	9	2	13	16	33
SERC(M)	-	-	-	-	-	-	1	-	-	-	1	-
SERC(G)	-	-	-	-	-	-	1	-	-	-	1	-

I – India

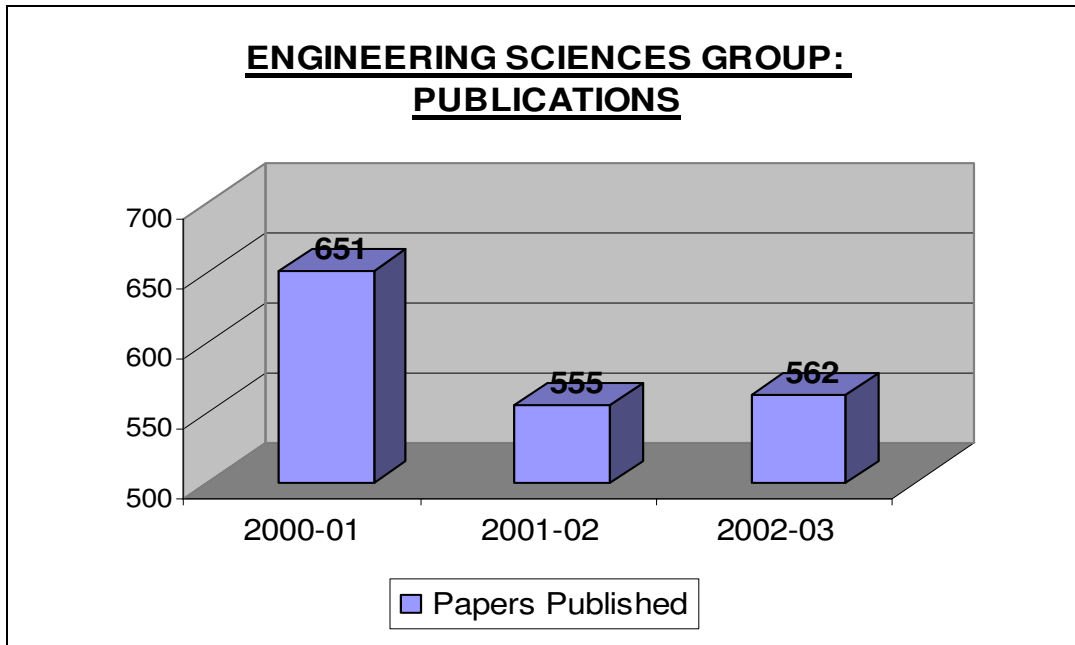
A – Abroad

Source: CSIR

6.1.3 Papers

The following figure 6-4 represents the total number of papers published, for the engineering sciences group as a whole for 2000-01 to 2002-03 (data not included from NEERI, RRL Trivandrum and RRL Bhopal):

Figure 6-4



As can be seen from the above chart, the total number of papers published by the engineering sciences group as a whole dropped significantly from 2000-01 to 2001-02 by 15%. However, a slight improvement of 1.2% was seen subsequently in 2002-03.

6.1.4 Areas of Core Competencies and Exportable R&D Services of the Engineering Sciences Group Laboratories are given in table 6-3

Table 6-3

ENGINEERING SCIENCES			
S. No.	Name of laboratory	Area of Core Competency	Exportable R&D Services
1.	National Environmental Engineering Research Institute	1. Environmental impact assessment 2. Environmental system design 3. Environmental audit & risk 4. Wastewater management	1. Environmental impact assessment 2. Wastewater treatment
2.	National Metallurgy Laboratory	1. Mineral processing and engineering 2. Ferrous and non-ferrous Metal Extraction 3. Material characterization and evaluation 4. Metal casting and forming 5. Refractories and Advanced ceramics 6. Corrosion protection of metals / materials 7. Process modeling and simulation 8. SRM and hall marking	1. Analysis and testing of metallography structure 2. Heat Treatment and hardness Tests 3. Chemical analysis of metal, mineral and alloys 4. Corrosion tests 5. Physical tests 6. Magnetic material testing 7. Mechanical tests 8. Tensile tests 9. Compression tests 10. Torsion tests 11. Transverse tests 12. Bend tests 13. Ductility tests 14. Wear tests 15. Creep tests 16. Refractories test 17. Iron ores and coal samples 18. Testing of bentonite

			<p>19. Testing of molding sands</p> <p>20. Evaluation of dextrine or other cellustic material as foundry biner</p> <p>21. Know how for laboratory scale mineral processing plants</p> <p>22. Pilot plant scale investigation of metallurgical process</p> <p>23. Material testing and characterization</p>
3.	Regional Research Laboratory, Tiruvananthapuram	<p>1. Agrotechnology</p> <p>2. Environmental engineering</p> <p>3. Building materials</p>	<p>1. Fresh spice processing and oil seeds processing- turn key packages</p> <p>2. High Tech building and ceramic materials</p> <p>3. Odour control and sanitation devices for effluents</p>
4.	Regional Research Laboratory, Bhubaneshwar	<p>1. Minerals processing and engineering</p> <p>2. Extractive metallurgy</p> <p>3. Energy and environment management</p> <p>4. Bioresources management</p>	<p>1. Process development to beneficiate low grade ores and minerals for their effective utilization</p> <p>2. Process development to recover values from waste and byproducts from mineral and metallurgical industries</p> <p>3. Expert evaluation / consultancy of the existing process / plants</p> <p>4. Improving the performance of existing mineral beneficiation plants</p> <p>5. Development of process know how for extractive metallurgy, smelting of ore (ferrous and non-ferrous)</p>

5.	Regional Research Laboratory, Bhopal	<ol style="list-style-type: none"> 1. Metal matrix composites 2. Agrotechnology 3. Building materials 	<ol style="list-style-type: none"> 1. Synthesis of aluminium particles composites using certification processes 2. Characterization of composite material in terms of particle distribution and interface investigation 3. Wear of composite material and ascertain the mechanism of material removal 4. Wear of composite material and ascertain the mechanism of material removal 5. Development of prototype component using aluminium composite 6. Appropriate surface modification techniques that can be applied on agricultural and mining components based on its present material and nature of exposure during service 7. Optimization of surface modification techniques / parameters 8. Metallurgical characterization of metallic components
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			<p>9. Development and performance evaluation of industrial wastes based wood substitute products, coating materials, bricks and blocks and natural fiber based composites</p> <p>10. Bulk utilization of fly ash in converting wasteland into agriculturally productive land</p>
6.	National Aeronautical Laboratory	<ol style="list-style-type: none"> 1. Aerospace vehicle aerodynamics 2. Design and fabrication of complex wind tunnel models using advance composites 3. Wind tunnel testing of aerospace vehicles 4. Ground vibration testing of full airframe structures 5. Testing of aerospace structures in the acoustic test facility 6. Software for computational fluid dynamics (on sequential and parallel computing machines) 7. Evaluation and characterization of materials for fatigue and fracture 	<ol style="list-style-type: none"> 1. Aerospace vehicle aerodynamics 2. Design and fabrication of complex wind tunnel models using advanced composites 3. Wind tunnel testing of aerospace vehicles 4. Ground vibration testing of full airframe structures 5. Testing of aerospace structures in the acoustic test facility 6. Software for computational fluid dynamics (on sequential and parallel computing machines) 7. Evaluation of materials for fatigue and fracture

		<p>8. Evaluation of structural integrity of airframe and other structural components</p> <p>9. Testing and optimization of compressor and turbine blade profiles using cascade tunnel</p> <p>10. Design and development of composite materials and structures including smart materials</p> <p>11. Failures analysis and accident investigation</p> <p>12. FOQA avionics software</p> <p>13. Control law</p>	<p>8. Evaluation of structural integrity of airframe and other structural components</p> <p>9. Testing and optimization of compressor and turbine blade profiles using cascade tunnel</p> <p>10. Design and development of composite materials and structures</p> <p>11. Failure analysis and accident investigation</p>
7.	Structural Engineering Research Center	<p>1. Wind engineering, Field experimentation and structural dynamics</p>	<p>1. Design and development including software development and laboratory based and field experiments / testing including prototype testing as contract research for:</p> <ul style="list-style-type: none"> i. Improvement to structural design of steel / concrete structures with special reference to natural hazards such as wind, earthquake and such disaster prevention and to withstand the effects and vagaries of nature. ii. Guidelines and improvement / strengthening codal provisions with regard to steel structures with reference to transmission line towers, wind mill turbines

		<p>2. Fatigue and fracture, Experimental Mechanics and Shock and vibration</p>	<p>2. Product development as contract research for:</p> <ul style="list-style-type: none"> i. New materials (cement based) improvements to existing materials and improved use of the available materials for enhanced durability. ii. Supplementary cementitious materials, viz fly ash, ground granulated blast furnace slag, silica fume; iii. Concrete compositions viz ferro cement, fibre reinforced concrete iv. Application of cement based new materials supplementary cementitious materials and concrete compositions for repair / retrofitting of disturbed concrete structures v. Fibre reinforced plastic for special applications.
		<p>3. Steel structures, transmission line towers and other steel skeletal structures</p>	<p>3. Process development as contract research for:</p> <ul style="list-style-type: none"> i. Prefabricated construction materials and new form of construction and prefabricated elements and structures, self compacting / consolidating concrete etc. ii. Conditional assessment / life extension of structures

		<p>4. Computer aided analysis and design of structures and software development</p> <p>5. Concrete composites and materials and reinforced concrete structures</p> <p>6. Construction engineering and prestressed concrete structures</p>	
8.	Central Road Research Institute	1. Pavement engineering and materials	<p>58. Training in the areas of</p> <ul style="list-style-type: none"> i. Highway design model (HDM) of the World Bank for economic & financial evaluation of highway projects. ii. Design, quality control and preparation of detailed project reports for highways iii. Sub-soil investigation and design of substructures. iv. Zonation of landslides and corrective measures. v. Traffic engineering and management for the city engineers and traffic managers including traffic police. vi. Transportation planning including the methods of travel demand estimation, analysis of transport systems characteristics and capabilities. vii. Environmental impact assessment (EIA) of highway projects. viii. Feasibility study of highway projects. ix. Road safety Audit (RSA) procedures to field engineers.

		<p>2. Geotechnical engineering</p> <p>3. Bridge and instrument engineering</p>	<p>59. Testing and evaluation of:</p> <ul style="list-style-type: none"> i. Highway materials, pavements etc. including airfield pavements. ii. Traffic signs and road marking materials iii. Elasto-meric bearing iv. Coding on steel bearing <p>60. Consultancy services for:</p> <ul style="list-style-type: none"> i. Preparation of transportation plans for urban and regional context ii. Preparation of traffic systems management plans iii. Conduct of road safety audit iv. Preparation of Road Safety management (RSM) plans v. Preparation of detailed techno-economic feasibility study reports related to road transportation vi. Preparation of Detailed Project Reports (DPR) for road research and transportation vii. Application of geo-synthesics and ground improvement techniques viii. Long term performance monitoring of bridges ix. Aerodynamic studies of towers and bridges
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		<p>4. Traffic and Transportation</p> <p>5. Engineering including Safety and Environment</p> <p>6. Road Planning and Management</p>	<p>x. Preparation of Environmental Impact Assessment (EIA) reports for highways and road transportation</p> <p>xi. Sub-soil investigation and design of foundations</p> <p>xii. Landslide investigations and corrections</p> <p>xiii. Development of pavement management systems</p> <p>xiv. Bridge ratings and evaluation</p> <p>61. IPR Services in the areas of road research: Guidance in protecting the IPR and commercialization of IP</p> <p>62. Technology transfer in</p> <ul style="list-style-type: none"> i. Transportation planning ii. Land slide corrections iii. Techniques of conducting traffic studies <p>63. Turn key projects in</p> <ul style="list-style-type: none"> i. Transportation planning and development ii. Highway design and development iii. Preparation of DPR and its implementation for highways and road transportation <p>64. Contract R&D for:</p> <ul style="list-style-type: none"> i. Traffic engineering and management ii. Pavement design and management iii. Bridge design and management iv. Instrumentation of highways and bridges v. Investigations of land slides and corrections
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9.	Central Mechanical Engineering Research Institute	<ol style="list-style-type: none"> 1. Robotics & mechatronics 2. Heat power engineering 3. Advance manufacturing technology 4. Rapid prototyping & tooling 5. Farm machinery & post harvest technology 6. Life enhancement studies 	<ol style="list-style-type: none"> 1. Post harvest technology for drying of grain 2. Residual life assessment studies of mechanical systems 3. Industrial component development 4. Computer aided design analysis
10.	Central Buildings Research Institute	<ol style="list-style-type: none"> 1. Shelter planning 2. New material 	<ol style="list-style-type: none"> 1. Advisory consultancy for: <ol style="list-style-type: none"> i. Housing and planning ii. Urban and rural buildings iii. Educational and health care buildings, iv. Building materials and constructional technologies for rural and hilly areas; v. Sustainable development of hilly towns vi. Space norms and design guidelines for buildings in hilly areas vii. Building physics – illumination, thermal comfort, ventilation, acoustics, driving rain studies etc. 2. Testing and evaluations services for: <ol style="list-style-type: none"> i. Organic building material ii. Cement lime and clay products iii. Pollution mitigation in brick and lime industries, waste recycling iv. Development of environment friendly termite control pesticides v. Structural and building components out of new / waste material vi. Fire retardant materials.

		<p>3. Structure and foundation</p> <p>4. Disaster mitigation</p> <p>5. Process development</p>	<p>71. Structural analysis and design</p> <ul style="list-style-type: none"> i. Construction technology, ii. Rehabilitation of distress structures iii. Concrete technology iv. Geo technological engineering – pile foundation v. Strengthening of weak soils for foundation and other foundation related problems vi. Landslide mitigation vii. Slope stability viii. Rock mechanics. <p>72. Sponsored studies for:</p> <ul style="list-style-type: none"> i. Building dynamics ii. Earthquake mitigation – earthquake resistant construction iii. Retrofitting and rehabilitation of earthquake damaged buildings iv. Studies on strong motion seismic instrumentation v. Pre and post disaster management with reference to cyclones vi. Landslides vii. Fire hazards viii. Fire resistance systems ix. Fire spreading modeling and simulations.
11.	Central Fuel Research Institute	1. Resource quality assessment	<p>1. Resource quality assessment of coal and its characterization</p> <p>2. Surveys of energy (coal) resources</p>

		2. Coal preparation	<p>3. Full scale washability studies of coal and interpretation of results including sampling of coarse and fine coals standardization of auto sampler for quality monitoring of washed product</p> <p>4. Lab/ bench/ pilot scale investigations by various techniques on the beneficiation of coarse, small and fine coals</p> <p>5. Process know-how for the beneficiation of coking and non-coking coals</p> <p>6. Performance evaluation and technical audit of washeries.</p>
		3. Coal carbonization	<p>7. Testing and characterisation</p> <p>8. process know how for</p> <ol style="list-style-type: none"> a. Briquetting b. Active carbon c. High temperature carbonisation
		4. Power Coal	<p>9. Chemicals & Liquid Fuels</p> <ol style="list-style-type: none"> i. Recovery of chemicals from Coal tar and other by-products of carbonization & further synthesis to value added chemicals. ii. Production of alternative fuels through Fischer-Tropsch Synthesis. iii. Catalysts for coal to liquid processes
		5. Environment Management	10. Coal Liquification and Gasification

			<ul style="list-style-type: none"> i. Process Development ii. Clean Coal Technology iii. Gasification
		6. Coal Liquification and Gasification	
		7. Chemical Liquid Fuels	
12.	Central Glass and Ceramic Research Institute	1. Optical communication Fibre	1. Contract Research / Sponsored projects in the areas of glass and ceramics
		2. Glass science and technology	2. Characterization of materials in the areas of glass and ceramics
		3. Sol-Gel Science and technology	3. Training and development in the areas of glass and ceramics
		4. Oxide and Bio-ceramics	4. Strategic materials supply in the areas of glass and ceramics
		5. Ceramic membrane	5. Technology transfer in the areas of glass and ceramics
		6. Electro-ceramics	
		7. Non-oxide ceramics	
13.	Central Mining Research Institute	1. Mine technology	1. Contract R&D in the area of mining
		2. Mine safety	2. Consultancy services concerning any mining activity
		3. Mine Engineering	3. Testing of equipments for approval in Mining Industry and Ariel Ropeway (NDT)
		4. Mine Environment	4. Service to industry concerning any mining activity

6.2 Analysis of individual laboratories under the Engineering sciences group

6.2.1 National Environmental Engineering Research Institute

The institute was established in the year 1958, as Central Public Health Engineering Research Institute (CPHERI). The Institute was renamed in 1974 as National Environmental Engineering Research Institute (NEERI)

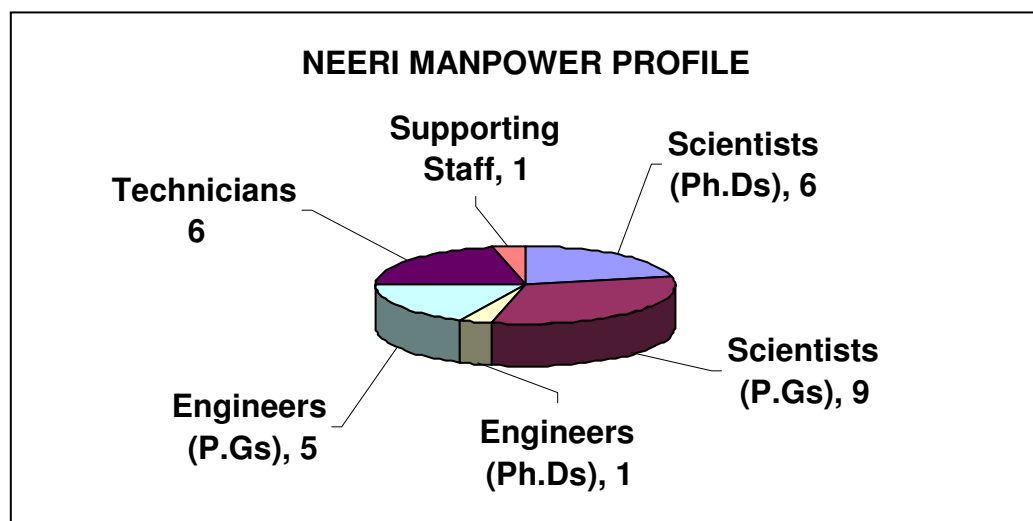
The main campus at Nagpur is spread over 108 acres where the laboratory buildings and demonstration plants are located. Green stretches of land are liberally scattered over the campus and nearly 40 percent of the land is under forest cover.

Discernible positive movement towards the overall aspirational goal of sustainable development warrants pursuance of an effective R &D program in environmental science and technology to enable solutions to backlog and future environmental problems emanating from development imperatives in various socio-economic sectors. Accordingly, the Institute, while fulfilling its commitment towards the societal missions, has made significant contributions in identified thrust areas of R & D, viz. environmental monitoring, environmental biotechnology, hazardous waste management, environmental systems design, modeling & optimization, environmental impact & risk assessment and audit and environmental policy analysis.

6.2.1.1 Manpower Profile

The following figure 6-5 depicts the manpower profile of NEERI:

Figure 6-5



6.2.1.2 Areas of Core Competency

The following have been identified by NEERI as their areas of core competency:

1. Environmental Impact Assessment
2. Environmental System Design
3. Environmental Audit & Risk
4. Wastewater Management

The following table 6-4 depicts the available manpower in each one of these areas of core competency:

Table 6-4

S.No.	Area of Competence	Manpower
1.	Environmental impact assessment	16
2.	Environmental system design	3
3.	Environmental audit & risk	4
4.	Wastewater management	6

6.2.1.3 Major R&D Facilities

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

1. Laboratory for chemical and biological analysis of water, wastewater and soil samples
2. Softwares for modeling required in EIA studies

6.2.1.4 Patents

The following table 6-5 gives the details of the number of patents filed by and granted to NEERI during 2000-01 to 2004-05 and 2003:

Table 6-5

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

Year	Patents Filed		Patents Granted	
	In India	Abroad	In India	Abroad
2000-01	Nil	Nil	Nil	4
2001-02	4	1	1	Nil
2002-03	2	2	7	Nil
2003-04	1	2	9	Nil
2004-05	2	1	1	Nil
Total	9	6	18	4

6.2.1.5 Potential Exportable R&D Services

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

1. Environmental impact assessment studies.

testing and design for

6.2.1.6 Target Markets

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

1. South Asian countries

6.2.2 National Metallurgy Laboratory

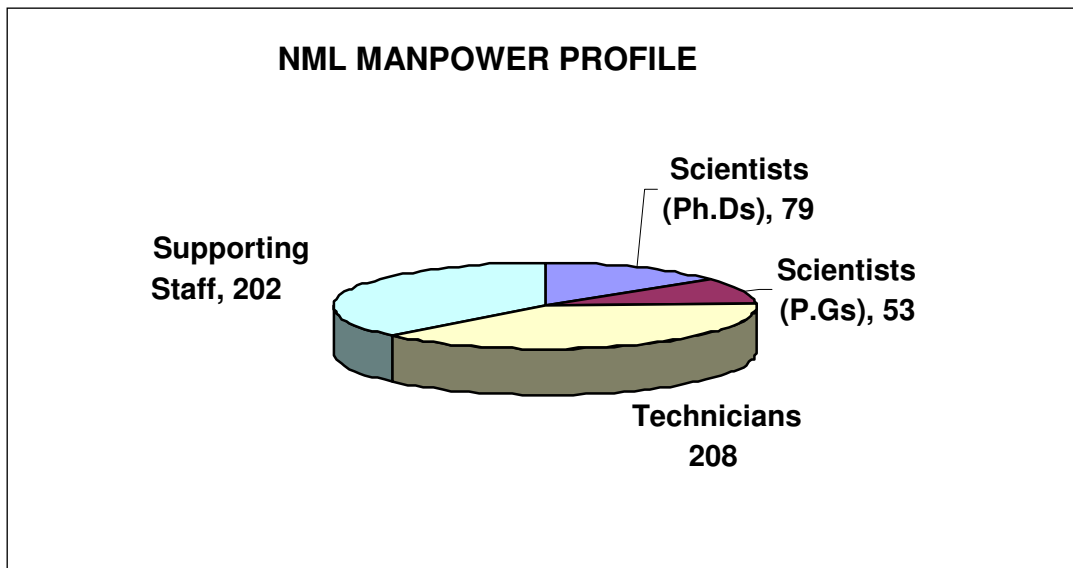
The National Metallurgical Laboratory, was formally inaugurated and dedicated to the nation on the 26th of November, 1950 by Pandit Jawaharlal Nehru . The laboratory has set the pace for the rapid growth through the establishment of a number of pilot plants and facilities and initiating research programmes which were in line with the Five Years Plans of the young Republic of India. NML has one Centre at Chennai and one field station at Ahmedabad.

The Objective of NML is “to innovate, develop, transfer and standardise and provide specialised services such as Research and Development, Technology Transfer, consultancy and standards and quality to support the scientific and industrial growth and success in the areas of Metals, Minerals and Advanced Materials, by putting our experienced team of scientists and engineers and wealth of state-of-the art technology and facilities to work. “

6.2.2.1 Manpower Profile

The following figure 6-6 depicts the manpower profile of NML:

Figure 6-6



6.2.2.2 Core Competency

The following have been identified by NML as their areas of core competency:

1. Mineral processing and engineering
2. Ferrous and non-ferrous metal extraction
3. Material characterisation and evaluation
4. Metal casting and forming
5. Refractories and advanced ceramics
6. Corrosion protection of metals / materials
7. Process modeling and simulation
8. SRM and Hall marking

The following table 6-6 depicts the available manpower in each one of these areas of core competency:

Table 6-6

S. No.	Area of Competence	Manpower
1.	Mineral processing and engineering	16
2.	Ferrous and non-ferrous metal extraction	17
3.	Material characterisation and evaluation	28
4.	Metal casting and forming	11
5.	Refractories and advanced ceramics	9
6.	Corrosion protection of metals / materials	13
7.	Process modeling and simulation	8
8.	SRM and hall marking	10

6.2.2.3 Major R&D Facilities

Table 6-7 gives the R&D facilities that support the above areas of competency:

Table 6-7

1.	Computational facility for blast furnace (CFBF)
2.	Precision and analytical mass comparator for NML's calibration centre.
3.	Laser flash thermal constant measuring unit
4.	Impact echo system (hand held)
5.	Reciprocating water bath

6.	Assay shaft encoder grating POS
7.	Labo Tex-the texture analysis software for Windows
8.	Hindhivac sputtering unit
9.	Cement testing equipment
10.	Primavera Project Planner
11.	Silicon Transfer Facility
12.	Wear & Friction Monitor
13.	Humidity cabinet
14.	Graphics Workstation
15.	PID Controller
16.	Non-destructive evaluation facility for infrastructure asset management
17.	Digital electronic balance
18.	Data acquisition switch unit
19.	Temperature controlled incubator
20.	Abrasion Tester
21.	Dry Abrasion Tester
22.	Analytical balance
23.	Zero Head Space Extractor
24.	Curing tank
25.	Autoclave
26.	Horizontal Tubular Furnace
27.	Glove box
28.	Planetary Ball Mill
29.	Plasma Enhanced CVD Unit
30.	Nag Fortran Library
31.	Bottom mounted CCD camera for Philips CM 200 TEM
32.	UV –VIS spectrophotometer, computer & printer
33.	PC – based Ultrasonic Flaw detector USLT-2000, probes & cables
34.	Up gradation of kevelex delta-EDS system
35.	Single disc polishing machine
36.	Oscillation stage for Seifert XRD 3003 PTS
37.	Biological Microscope
38.	Solid liquid analyzer ICP.OES Spectrometer & computer & printer

39.	Proof ring system
40.	Part No. PSR 4005 Laser & Laser power supply package
41.	Thermal imaging system
42.	Ultrasonic Flaw Detector USM23LF
43.	Hybrid cell for arsenic
44.	Lab Vibrating Cup Mill
45.	Data acquisition card
46.	Micro hardness tester
47.	Atomic Force Microscope(AFM)
48.	Twin Disc Polishing Machine
49.	Laser Particle Size Analyser
50.	Multi-channel Isothermal Heat Conduction Calorimeter
51.	Metallurgical microscope, image Analyser
52.	Bipolar Operational Power Amplifier
53.	Electronic Balance, cap: 400g
54.	Density Determination Kit for solids
55.	Density Determination Kit for liquid
56.	Multi channel Isothermal Heat Conduction Calorimeter
57.	Software –MS Visual Studio Net Enterprise 2003 (Latest)
58.	Softwares: Exceed Multiplatform version 8.0, MPF NT 95,98,2000/xp, Exceed 3D 32 Bit from ver 8.0, Exceed On Demand ver 4.0
59.	HP x W8000 workstation
60.	High Speed Refrigerated Research Centrifuge
61.	Magnetic Strirrer with Hot Plate
62.	Softwares: Matlab Base Module, Matlab Compiler
63.	Neural Network Toolbox
64.	Partial Differential Toolbox
65.	Data Acquisition Toolbox
66.	Signal Processing Toolbox
67.	Image Processing Toolbox
68.	Water Distillation Plant-SS
69.	Hot Air Oven with air circulation system
70.	Tektronix Digital Phosphor Oscilloscope

71.	Communication Module
72.	Heating Bath Circulator
73.	Water Bath Shaker
74.	Custom Built SHS Reaction Chamber
75.	Digital pH Meter with combined Electrodes
76.	Electronic Precision Balance Cap: 2200g
77.	Image Analyzer System
78.	Meiji ML-7100 Metallurgical Microscope
79.	Twin Disc Polishing Machine
80.	Perpetual license of PHOENICS-3.5 on five PCs Digital Fortran Compiler
81.	X-Ray Radiography System
82.	Laboratory Multi talented hot plate with integrated stirrer and temp. control
83.	Autoclave for Digestion in Acidic Medium
84.	3D Particle Image Velocimetry (PIV) System
85.	Environmental Control System with air-cooled condenser and Humidifier
86.	Windows (95/98) GUI based Data logger
87.	AIM -374 Length Comparator
88.	Image Analyser-Image Analysis
89.	System CLEMEX IMPAK (15-021) with CIR software
90.	Table top, Heavy duty, Automatic abrasive cut off machine
91.	Electroheat Horizontal Tubular Furnace
92.	Salt Spray Chamber
93.	Electro chemical STM including components
94.	APLAB SCR Pre-regulated Bench Power supply
95.	Top loading single pan Electronic Balance, cap : 300gms
96.	Laboratory Water Purification System
97.	JULABO Refrigerated and Heating Circulator
98.	Radiation Pyrometer & accessories
99.	Cassette type Heater for Condenser
100.	Image (Micrograph) Recording up gradation for JEOL Scanning Electron Microscope
101.	Grinding Set Hardmetal Tungsten Carbide, useful volume 50 ml
102.	Rotary Evaporator with vacuum pump

6.2.2.4 Patents

The following table 6-8 gives the details of the number of patents filed by and granted to NML during 2000-01 to 2004-05

Table 6-8

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

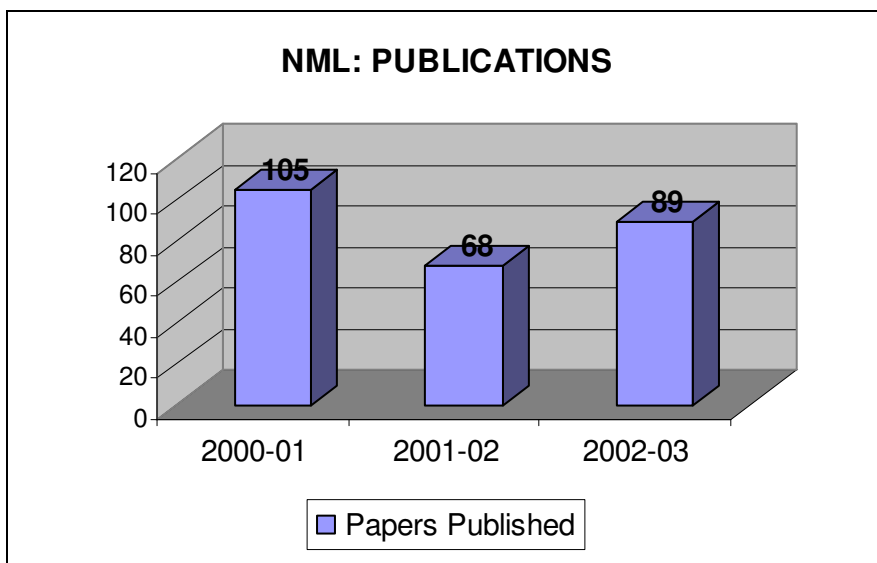
Year	Patents Filed		Patents Granted	
	In India	Abroad	In India	Abroad
2000-01	7	Nil	7	Nil
2001-02	10	20	23	Nil
2002-03	7	14	3	Nil
2003-04	12	2	6	2
2004-05	7	11	3	5
Total	43	47	42	7

As can be seen from the above chart, the number of patents filed in India dropped considerably in 2002-03, however, the number of patents filed abroad increased considerably in the same period.

2.2.2.5 Papers

The following figure 6-7 gives the details of the number of papers published by NML during 2000-01 to 2002-03

Figure 6-7



(For details about the publications of NML, refer to the website www.nmlindia.org)

6.2.2.6 Potential Exportable R&D Services

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

1. Analysis and testing of metallography structure
2. Heat treatment and hardness tests
3. Chemical analysis
4. Corrosion Tests
5. Physical tests
6. Magnetic material testing
7. Mechanical tests
8. tensile tests
9. Compression tests
10. Torsion tests
11. Transverse tests
12. Bend tests
13. Ductility tests
14. Wear tests
15. Creep tests
16. Refractories test
17. Iron ores and coal samples
18. Testing of bentonite
19. Testing of molding sands
20. Evaluation of dextrine or other cellustic material as foundry biner
21. Know how for laboratory scale mineral processing plants
22. Pilot plant scale investigation of metallurgical processes
23. Material testing and characterization

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

6.2.2.7 Target Markets

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

1. Japan
2. US
3. European countries
4. Bulgaria
5. Egypt
6. Singapore
7. Saudi Arabia
8. Russia
9. Malaysia
10. Australia
11. Kazakhstan
12. Taiwan
13. China

6.2.2.8 Constraints & Suggestions

NML highlighted lack of market information, bureaucratic bottlenecks, inferior quality of services as compared to competitors, international regulations, national regulations and lack of resources as the constraints that they faced in the export of R&D Services.

It was suggested that to overcome the constraints in enhancing the exports of R&D services, *there is a need to review not only these constraints but to bring out some guidelines / regulations so that a niche market for R&D services is created internationally because the information about the R&D services are not only poorly projected internationally, they need to be brought to the notice of all the consumer industries / business houses / R&D institutions within the country. It is therefore inevitable that a complete package especially for enhancing exports of R&D services is developed which can not only take care of the above constraints but also related impending constraints which are likely to affect the marketing and export of R&D services both nationally and internationally.*

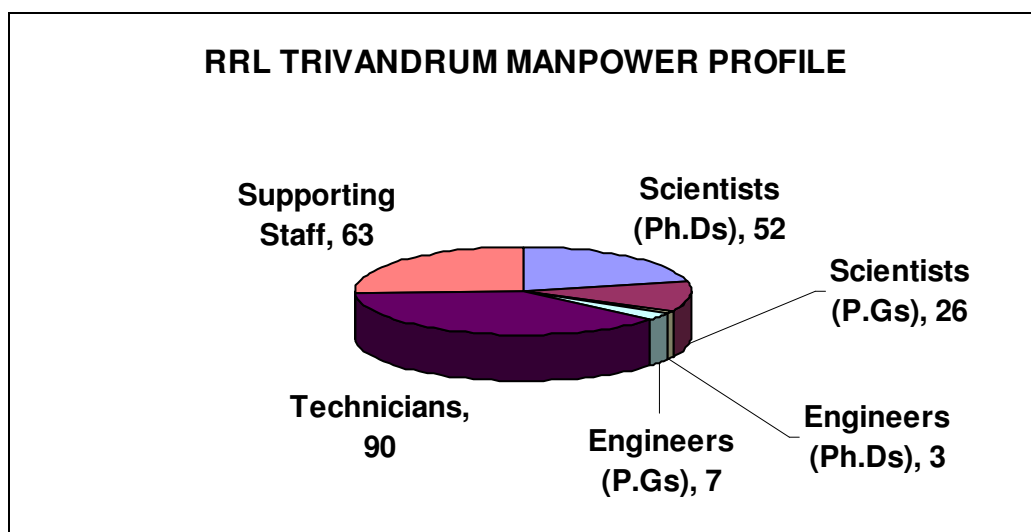
6.2.3 Regional Research Laboratory, Tiruvananthapuram

RRL, Tiruvananthapuram is the leading lab of CSIR devoted to multidisciplinary R&D work for the optimum utilization of regional/national resources. The institute carries out research in agroprocessing & natural products, chemical sciences, biotechnology, environmental science & waste water technology, materials science & technology and mineral processing. The institute also provides consultancy services to industries for upgradation of technology, skills and productivity and human resource development in S & T in collaboration with universities and allied research institutions

6.2.3.1 Manpower Profile

The following figure 6-8 depicts the manpower profile of RRL Tiruvananthapuram:

Figure 6-8



6.2.3.2 Areas of Core Competency

The following have been identified by RRL TRIVANDRUM as their areas of core competency:

1. Agro processing
2. Environmental engineering
3. Building materials

The following table 6-9 depicts the available manpower in each one of these areas of core competency:

Table 6-9

S.No.	Area of Competence	Manpower
1.	Agro processing	18
2.	Environmental engineering	9
3.	Building materials	7

6.2.3.3 Major R&D Facilities

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

1. Simultaneous DT/TGA System
2. Surface area analyzer
3. Thermo mechanical analyzer
4. Image analyzer
5. Micro hardness test
6. Impedance spectrometer
7. DPX300 FTNMR spectrometer
8. ACF300 FTNMR spectrometer
9. IMS600 High resolution mass spectrometer
10. FTIR- UV VIS spectrometer
11. High performance liquid chromatograph
12. CHNS analyzer
13. Polarimeter
14. Spray drier
15. Super critical extraction unit
16. Solvent extraction unit
17. Membrane separator
18. Phase equilibria analyzer
19. GAMMA ray analyzer
20. GC – MSD

21. Spectrofluorimeter
22. Flash photolysis system
23. Electrochemical analyzer
24. Optical polarizing Microscope
25. INSTRON dynamic mechanical testing
26. JEOL scanning electron microscope
27. Integrated clay processing facility
28. Collins ceramic extruder
29. Foundry sand testing facility
30. Water quality monitoring facility

6.2.3.4 Patents

The following table 6-10 gives the details of the number of patents filed by and granted to RRL Tiruvananthapuram during 2000 and 2003:

Table 6-10

Patents filed by & granted to RRL(T) during 2000-01 to 2004-05

Year	Patents Filed		Patents Granted	
	In India	Abroad	In India	Abroad
2000-01	12	23	3	2
2001-02	6	20	5	2
2002-03	8	9	3	7
2003-04	7	18	3	9
2004-05	9	7	2	13
Total	42	77	16	33

6.2.3.5 Papers

The following table 6-11 gives the details of the number of papers published by RRL Tiruvananthapuram in different areas of work during 2000-01 to 2002-03

Table 6-11

S.No.	Areas of work	Papers
1.	Agro processing	8
2.	Organic Chemistry and natural products	24
3.	Photochemistry	13
4.	Polymers	20
5.	Clay and minerals	5
6.	Inorganic and analytical chemistry	9
7.	Structural ceramics	5
	Total	84

(For details about the publications of RRL Tiruvananthapuram, refer to the website <http://w3rrlt.csir.res.in>)

6.2.3.6 Potential Exportable R&D Services

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

1. Fresh spice processing and oil seeds processing- turn key packages
2. High tech building and ceramic materials
3. Odour control and sanitation devices for effulents

6.2.3.7 Target Markets

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

1. Fresh spices: S E Asia, Australia
2. Oil Seeds: S. America, Africa
3. Building ceramics: Europe
4. Effluent control: Other developing countries in Asia and Latin America

6.2.3.8 Constraints & Suggestions

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

It was suggested that to overcome the constraints in enhancing the exports of R&D services, the following should be undertaken:

- *Strategic alliances*
- *Link up with organizations and agencies*
- *Marketing contracts and business development visits*

6.2.4 Regional Research Laboratory, Bhubaneswar

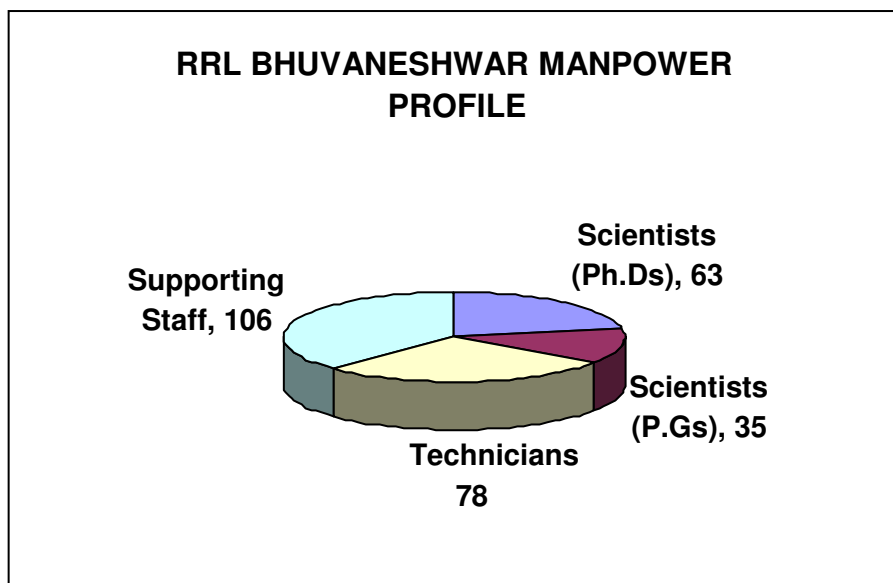
Regional Research Laboratory, Bhubaneswar (Orissa), set up in 1964 is a premier establishment of Council of Scientific & Industrial Research. The Laboratory specializes in providing R&D support base for process and product development with special emphasis on conservation and sustainable utilization of natural resources. Over the years, the institution has created scientific capabilities in wide spectrum of areas. Today it has a number of technology oriented multidisciplinary programmes, ranging from mining to mineral processing, metal extraction to material characterization, process engineering to pollution control, marine & forest products utilization to medicinal & aromatic plants cultivation, by products utilization to bio-leaching, to mention a few.

The laboratory undertakes externally funded projects and offers know-how, feasibility reports, analysis and testing facilities, consultancy and technical information services and human resource development in its various R&D Divisions.

6.2.4.1 Manpower Profile

The following figure 6-9 depicts the manpower profile of RRL Bhubaneswar:

Figure 6-9



6.2.4.2 Areas of Core Competency

The following have been identified by RRL Bhuvaneshwar as their areas of core competency:

1. Minerals processing and engineering
2. Extractive metallurgy
3. Energy and environment management
4. Bioresources management

The following table 6-12 depicts the available manpower in each one of these areas of core competency:

Table 6-12

S.No.	Area of Competence	Manpower
1.	Minerals processing and engineering	40
2.	Extractive metallurgy	23
3.	Energy and environment management	23
3.	Bioresources management	12

6.2.4.3 Major R&D Facilities

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

1. Scanning electron microscope with WDS and EDS attachments
2. XRD and XRF equipments
3. Atomic absorption spectrophotometer
4. Ion chromatograph for trace analysis of both anions and cations
5. Electron probe micro analyzer
6. Viscometer
7. 400 MHz NMR

6.2.4.4 Patents

The following table 6-13 gives the details of the number of patents filed by and granted to RRL(B) during 2000-01 to 2004-05

Table 6-13

Patents filed by & granted to RRL(B) during 2000-01 to 2004-05

Year	Patents Filed		Patents Granted	
	In India	Abroad	In India	Abroad
2000-01	10	Nil	2	Nil
2001-02	17	3	11	Nil
2002-03	11	2	5	1
2003-04	9	2	5	Nil
2004-05	5	2	1	1
Total	52	9	24	2

6.2.4.5 Potential Exportable R&D Services

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

1. Process development to beneficiate low grade ores and minerals for their effective utilization
2. Process development to recover values from waste and byproducts from mineral and metallurgical industries
3. Expert evaluation / consultancy of the existing process / plants
4. Improving the performance of existing mineral beneficiation plants
5. Development of process know how for extractive metallurgy, smelting of ore (ferrous and non-ferrous)

6.2.4.6 Target Markets

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

1. Australia
2. South Africa
3. Kazakhstan
4. Germany
5. Brazil
6. Bangladesh
7. Vietnam
8. Laos

RRL Bhubaneswar highlighted lack of market information, international regulations, existing administrative procedures and rules and lack of resources as the constraints that they faced in the export of R&D services.

6.2.4.7 Constraints & Suggestions

It was suggested that to overcome the constraints in enhancing the exports of R&D services, a strong mechanism of dissemination of information on R&D services being provide by the lab.for the target countries needs to be evolved.

6.2.5 Regional Research Laboratory Bhopal

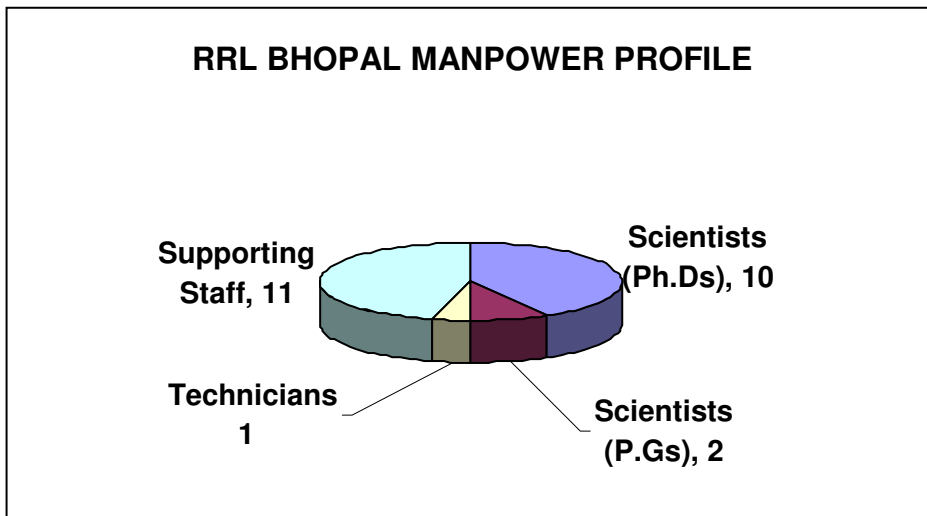
RRL Bhopal, a constituent laboratory of CSIR, was established in 1981. RRL Bhopal endeavors to attain excellence and world-class stature in design and development of materials and processes related to engineering materials, alternate building materials, minerals and environment management. The laboratory aims to be a vital source of S&T for societal missions in water and rural technologies.

Of late, RRL, Bhopal has carried out applied and basic research projects in mission mode in newer areas, viz, sisal fibre technologies, waste utilization, metal matrix composites, and developed design capabilities in the areas of material characterization, process / equipment design and CAE-CAD-CAM integration and resources modeling in environment, disaster, water management

6.2.5.1 Manpower Profile

The following figure 6-10 depicts the manpower profile of RRL Bhopal:

Figure 6-10



6.2.5.2 Areas of Core Competence

The following have been identified by RRL Bhopal as their areas of core competency:

1. Metal matrix Composites
2. Agrotechnology
3. Building materials

The following table 6-14 depicts the available manpower in each one of these areas of core competency:

Table 6-14

S.No.	Area of Competence	Manpower
1.	Metal matrix composites	13
2.	Agrotechnology	20
3.	Building materials	12

6.2.5.3 Patents

The following table 6-15 gives the details of the number of patents filed by and granted to RRL(BP) during 2000-01 to 2004-05

Table 6-15

Patents filed by & granted to RRL(BP) during 2000-01 to 2004-05

Year	Patents Filed		Patents Granted	
	In India	Abroad	In India	Abroad
2000-01	1	Nil	3	Nil
2001-02	7	Nil	2	Nil
2002-03	2	Nil	1	Nil
2003-04	Nil	Nil	1	Nil
2004-05	3	1	1	Nil
Total	13	1	8	Nil

6.2.5.4 Potential Exportable R&D Service

RRL Bhopal has identified the following as its potential exportable R&D services:

1. Synthesis of aluminium particles composites using certification processes
2. Characterization of composite material in terms of particle distribution and interface investigation
3. Wear of composite material and ascertain the mechanism of material removal
4. Development of prototype component using aluminium composite
5. Appropriate surface modification techniques that can be applied on agricultural and mining components based on its present material and nature of exposure during service
6. Optimization of surface modification techniques / parameters
7. Metallurgical characterization of metallic components
8. Development and performance evaluation of industrial wastes based wood substitute products, coating materials, bricks and blocks and natural fiber based composites
9. Bulk utilization of fly ash in converting wasteland into agriculturally productive land

6.2.5.5 Target Markets

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

1. Metal matrix composites: Australia, Europe, Canada, U.S.A.
 - a. Automobile sectors
 - b. Mineral processing industries
 - c. Defense sector
2. Agrotechnology:
 - a. Developing countries
 - b. Under developed countries
 - c. Countries where agriculture is major source of economy
 - d. SAARC countries
3. Building materials:
 - d. Malaysia, China,

- e. U.S.A., Canada, Brazil
- f. Moscow,
- g. Germany, Netherland, Italy
- h. Australia,
- i. South Africa

6.2.5.6 Constraints & Suggestions

RRL Bhopal highlighted lack of market information, not having tried this earlier and lack of resources as the constraints that it faced in the export of R&D services.

It was suggested that to overcome the constraints in enhancing the exports of R&D services, the following should be undertaken:

- Exposure to requirements in foreign countries for improved agricultural and mining components of the nature undertaken by the group
- Collective programmes for mutual interaction
- Preliminary feasibility studies on application of available expertise to agricultural components used in foreign countries
- Confidence generation among the international agencies on use of alternative construction materials through dissemination of information, exhibition, demonstration, interaction, awareness programmes / exchange programmes
- Well equipped infrastructure is required for full scale demonstration to translate lab scale study results for confidence building and commercialization

6.2.6 National Aerospace Laboratories, Bangalore

National Aerospace Laboratories (NAL), is India's pre-eminent civil R&D establishment in aeronautics and allied disciplines. NAL was set up at Delhi in 1959 and moved to Bangalore in 1960. NAL's primary objective, as articulated in its new Vision Statement, is the "development of aerospace technologies with a strong science content and with a view to their practical application to the design and construction of flight vehicles". NAL is also required "to use its aerospace technology base for general industrial applications".

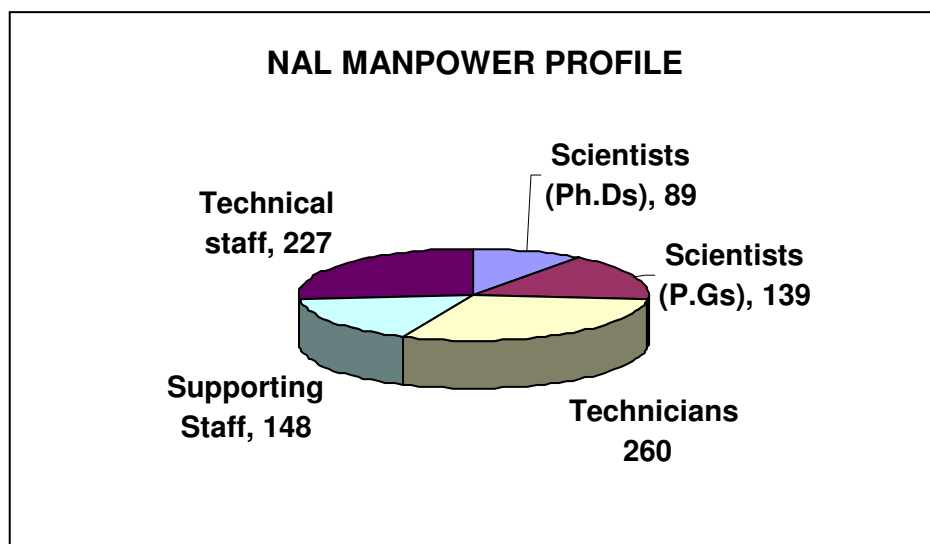
NAL's core competence spans practically the whole aerospace spectrum. Over the years, NAL has made very significant contributions to all Indian aerospace programmes. During the last decade, NAL has spearheaded the effort to design and develop HANSA and SARAS aircraft for the civil sector.

NAL's real strength lies in its vast reservoir of expertise and facilities created over the years. With this imposing infrastructure, NAL has been very successful in obtaining a large number of R&D contracts for testing and subsystem development for various national programmes as well as industries all over India and abroad.

6.2.6.1 Manpower Profile

The following figure 6-11 depicts the manpower profile of NAL:

Figure 6-11



6.2.6.2 Areas of Core Competency

The following have been identified by NAL as their areas of core competency:

1. Aerospace vehicle aerodynamics
2. Design and fabrication of complex wind tunnel models using advance composites
3. Wind tunnel testing of aerospace vehicles
4. Ground vibration testing of full airframe structures
5. Testing of aerospace structures in the acoustic test facility
6. Software for computational fluid dynamics (on sequential and parallel computing machines)
7. Evaluation and characterization of materials for fatigue and fracture
8. Evaluation of structural integrity of airframe and other structural components
9. Testing and optimization of compressor and turbine blade profiles using cascade tunnel
10. Design and development of composite materials and structures including smart materials
11. Failures analysis and accident investigation
12. FOQA avionics software
13. Control law

6.2.6.3 Major R&D Facilities

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

1. Wind tunnels
2. Acoustic test facility
3. Full scale fatigue testing facility
4. Composite material development
5. Autoclave
6. High pressure laboratory
7. Surface engineering lab
8. Facility for failure analysis
9. Advanced computational facility
10. Turbomachinery and combustion research facility

- 11. Material characterization
- 12. Airport Instrumentation
- 13. Ceramics for special applications

6.2.6.4 Patents

The following table 6-16 gives the details of the number of patents filed by and granted to NAL during 2000-01 to 2004-05

Table 6-16

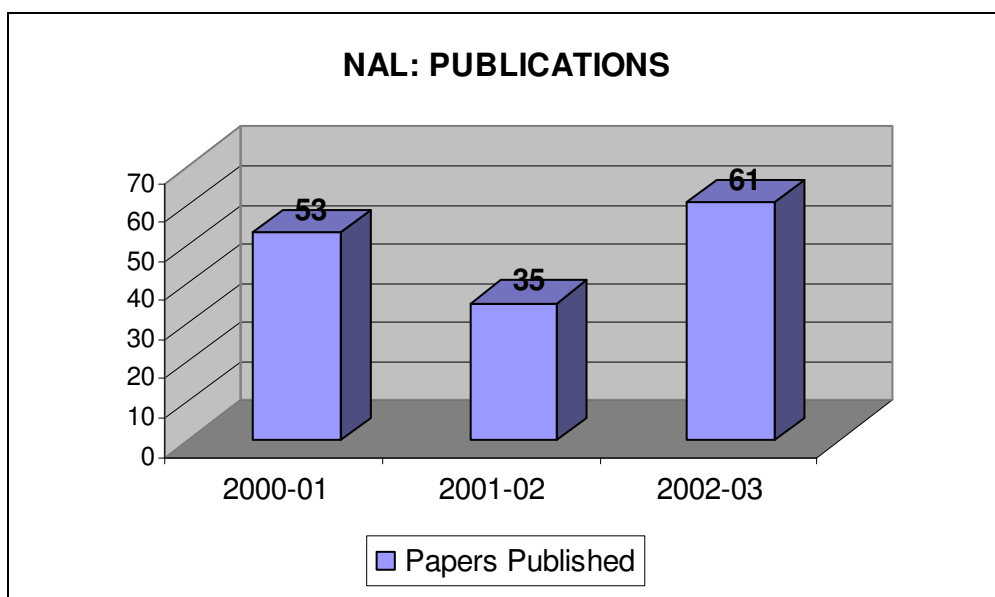
Patents filed by & granted to NAL during 2000-01 to 2004-05

Year	Patents Filed		Patents Granted	
	In India	Abroad	In India	Abroad
2000-01	6	1	Nil	Nil
2001-02	3	Nil	2	Nil
2002-03	10	3	2	2
2003-04	4	1	1	Nil
2004-05	1	1	1	1
Total	24	6	6	3

6.2.6.5 Papers

The following figure 6-12 gives the details of the number of papers published by NAL during 2000-01 to 2002-03

Figure 6-12



(For details about the publications of NAL, refer to the website www.nal.res.in)

6.2.6.6 Potential Exportable R&D Services

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

1. Aerospace vehicle aerodynamics
2. Design and fabrication of complex wind tunnel models using advanced composites
3. Wind tunnel testing of aerospace vehicles
4. Ground vibration testing of full airframe structures
5. Testing of aerospace structures in the acoustic test facility
6. Software for computational fluid dynamics (on sequential and parallel computing machines)
7. Evaluation of materials for fatigue and fracture
8. Evaluation of structural integrity of airframe and other structural components
9. Testing and optimization of compressor and turbine blade profiles using cascade tunnel
10. Design and development of composite materials and structures
11. Failure analysis and accident investigation

6.2.6.7 Target Markets

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

1. Design, testing, certification agencies / groups: Europe, U.S., China
2. Flying clubs, hobby pilots and small application: Asia-oceanic and Europe
3. SARAS Aircraft- future feeder airlines. Executive aircraft applications and special applications: most parts of the world

6.2.6.8 Constraints & Suggestions

NAL highlighted national regulations, international regulations, lack of resources, airworthiness certification requirement for all flight vehicles, after sales support which is critical to aircraft, import policies of Govt. of India and sensitivity due to strategic aspects as the constraints that they faced in the export of R&D Services.

It was suggested that to overcome the constraints in enhancing the exports of R&D services, the following should be undertaken:

- *Bilateral agreements at government level*
- *Networking (will be expensive to begin with but only long term solution)*
- *Changes in duty structures of aircrafts / spares*
- *Restriction to non sensitive area*

6.2.7 Structural Engineering Research Centre

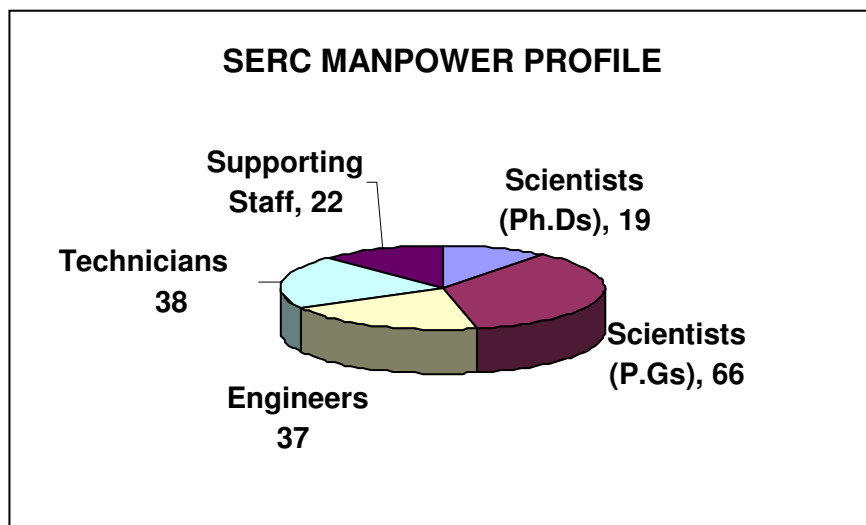
Structural Engineering Research Centre (SERC), Chennai, has built-up excellent facilities and expertise for the analysis, design and testing of structures and structural components. Services of SERC are being extensively used by the Central and State Governments and public and private sector undertakings. Scientists of SERC serve on many national and international committees and the Center is recognised at the national and international levels as a leading research institution in the field of structural engineering. SERC has recently been certified as ISO:9001 quality institution.

SERC acts as a clearing house for the latest available knowledge and develops know-how on design and construction of all types of structures. It undertakes application-oriented research in all aspects structural engineering- both design and construction, including rehabilitation of structures. It provides design consultancy services, including proof checking, to organisations in the public and private sectors in developing a variety of structural designs. SERC also organises specialised courses on structural engineering for the benefit of practising engineers to familiarise them with the latest developments in analysis, design and construction.

6.2.7.1 Manpower Profile

The following figure 6-13 depicts the manpower profile of SERC:

Figure 6-13



6.2.7.2 Areas of Core Competency

The following have been identified by SERC as their areas of core competency:

1. Wind engineering, field experimentation and structural dynamics
2. Fatigue and fracture, experimental mechanics and shock and vibration
3. Steel structures, transmission line towers and other steel skeletal structures
4. Computer aided analysis and design of structures and software development
5. Concrete composites and materials and reinforced concrete structures
6. Construction engineering and prestressed concrete structures

The following table 6-17 depicts the available manpower in each one of these areas of core competency:

Table 6-17

S.No.	Area of Competence	Manpower
1.	Wind engineering, field experimentation and structural Dynamics	17
2.	Fatigue and fracture, experimental mechanics and shock and vibration	18
3.	Steel structures, transmission line towers and other steel skeletal structures	15
4.	Computer aided analysis and design of structures and software development	20
5.	Concrete composites and materials and reinforced Concrete structures	10
6.	Construction engineering and prestressed concrete structures	14

The following table 6-18 gives the various areas of expertise that the Centre has under its various competencies:

Table 6-18

Department	Area of expertise
Wind engineering and full scale field experimentation	<ul style="list-style-type: none"> ▪ Field investigations on dynamic response of structures under wind loading ▪ Wind tunnel testing of models of buildings and structures ▪ Expert system for damage assessment and vulnerability analysis ▪ Development of improved methodologies and guidelines/codes for safe and economical designs of buildings and structures subjected to extreme winds ▪ Cyclone resistant design of buildings and structures
Fatigue testing	<ul style="list-style-type: none"> ▪ R&D in fatigue and fracture mechanics ▪ Assessment of fatigue behavior of steel and concrete structures and structural components ▪ Field assessment and analytical studies for remaining life estimation of fatigue affected structures ▪ Analysis and design of offshore platforms
Steel structures	<ul style="list-style-type: none"> ▪ Development of minimum weight designs of power transmission line and microwave communication towers ▪ Development of optimal design of industrial structures including space grid roofs, employing hot rolled as well as cold formed and hollow steel sections
Structural dynamics	<ul style="list-style-type: none"> ▪ Dynamic analysis and testing of complex structures, structural components and machine foundations ▪ Seismic qualification of industrial components ▪ Blast resistant design of structures ▪ Safety assessment and vibration isolation
Experiential mechanics	<ul style="list-style-type: none"> ▪ Photo Elasticity ▪ Speckle interferometry ▪ Moire fringes ▪ Strain measurement

Department	Areas of expertise
CAD and software development	<ul style="list-style-type: none"> ▪ Artificial intelligence (A) and expert systems; object-oriented programming ▪ Parallel processing: error estimation and adaptive refinement or finite element analysis of structures ▪ Fuzzy sets and neural networking: nonlinear dynamic response analysis ▪ Stochastic finite element analysis: risk and reliability based design
Reinforced and prestressed concrete structures and concrete composites	<ul style="list-style-type: none"> ▪ Structural analysis and design (including proof checking of design) of RC structures especially large shell roofs, chimneys, natural draught cooling towers, containers, etc ▪ Inelastic/non-linear analysis of RC plate and shell structures subjected to static and dynamic loadings taking into account material and geometric nonlinearities ▪ Development of software packages for analysis and design of RC beams, columns, slabs, flat slabs, continuous footing, strip footing, intze water tanks and industrial roof system ▪ Computer-aided design of prestressed concrete bridge action ▪ Application of genetic algorithms for optimal design of continuous span prestressed concrete bridge girders ▪ Risk analysis and reliability based design of RC structural elements ▪ Design, development and testing of new concrete composites, building materials, concrete chemicals/repair materials, building blocks from laterite soils and industrial wastes, SERC products ▪ High Performance Concrete (HPC) technology using supplementary cementitious material (SCM) such as fly ash, ground granulated blast furnace slag and silica fume, including high performance cementitious grouts

Department	Area of expertise
Construction engineering	<ul style="list-style-type: none"> ▪ Development of suitable methodology for condition assessment and monitoring of corrosion-affected RC and prestressed concrete structures and evaluation of their strength and residual life ▪ Cost effective construction techniques for residential and institutional buildings and industrial buildings ▪ Ferrocement products (Water tanks, service core units, trusses, rafters, roof/cladding)

6.2.7.3 Major R&D Facilities

The following table 6-19 gives R&D facilities that support the above areas of competency:

Table 6-19

Department	Major equipment and facilities
Wind engineering and full scale field experimentation	<ul style="list-style-type: none"> ▪ Atmospheric boundary layer wind tunnel including: wind speed range-0.5 m/s to 55 m/s; test section -18 m x1.8 m; high speed pressure scanning system; three directional traversing mechanism; CTA anemometry; precision turn table; piezo-electric type accelerometers; high speed data recorder with related accessories. ▪ Mobile field instrumentation laboratory ▪ Equipments for full scale field experimentation ▪ Three directional anemometers and direction sensors; on line data acquisition system; three directional accelerometers; pressure transducers
Fatigue testing	<ul style="list-style-type: none"> ▪ Computer-controlled closed loop servo controlled electro hydraulic actuator system with actuators of capacities = 500 kN and 1000kN ▪ Fatigue rated, computer controlled universal testing machine of capacity = 500kN ▪ Loading frames for static and dynamic testing up to = 1000 kN; portable data acquisition systems for measuring strain, monitoring crack growth by ACPD, ACFM, etc.

Department	Major equipment and facilities
Steel structures	<ul style="list-style-type: none"> ▪ Tower Testing and Research Station: Load capability; transverse-1000 t, Longitudinal – 540 t, vertical 500 t ▪ Equipment: servo-controlled long travel actuators, simultaneous loading travel actuators, simultaneous loading facility, equipment for response measurements.
Structural dynamics	<ul style="list-style-type: none"> ▪ A unidirectional shaking table (2.5 m x 2.5 m) coupled with servo-controlled electro-hydraulic actuator (100 kN capacity) ▪ A one-directional slip table (0.9 m x 0.9 m) coupled with an electro-dynamic shaker (5 kN capacity) ▪ Vibration exciters/shakers of mechanical and electro dynamic type; vibration sensors and analysers
Experiential mechanics	<ul style="list-style-type: none"> ▪ Diffused light , lens and reflection polariscopes Laser holography, image processing system for on-line fringe analysis ▪ Facilities for real time monitoring, such as vibrating wire strain gauges, fibre optic sensors, coating techniques ▪ Photoelastic oven: dataloggers
CAD and software development	<ul style="list-style-type: none"> ▪ CAD and software ▪ Computational facilities include: <ol style="list-style-type: none"> 1. Pentium based PCs 2. High and low end Workstations (SUN, HP, Silicon graphics, Compaq, etc) 3. Parallel processing facility with cluster of workstations 4. A Strong Local Area Network <p>The campus-wide local area network is based on the state –of the art high-speed fibre optic backbone. The backbone connects over 120 nodes spread over the campus offering 100 mbps speed and good bandwidth. The nodes not only connect all the work places of the scientists and laboratories but also connect the infrastructural places and the entire administrative and maintenance sections. The campus-wide network is linked to SCPC-DAMA based V-SAT that provides Internet connectivity presently at 64 kbps with voice facility.</p>

	<ul style="list-style-type: none"> ▪ Commercial Structural Engineering Software/programs ANSYS, COSMOS,NISA. II ALGOR, STAAD III, AUTOCAD, besides Visual Studio, FOXPRO, SQL, Oracle, etc. RDBMS packages are available.
Reinforced and prestressed concrete structures and concrete composites	<ul style="list-style-type: none"> ▪ A box type heavy duty floor with anchorage provisions at 1.0 m x 0.50 m 0.50 m grid ▪ A hydraulic power plant and associated actuators for conducting monotonic, cyclic and fatigue load tests ▪ Sensors for displacement measurements ▪ 400 KN and 1000 k N capacity universal testing machines ▪ GECOR corrosion testing equipment; mercury intrusion porosity meter and other porosity measuring devices ▪ Temperature and humidity controlled hamber (walk in type) for testing of concretes under controlled environmental conditions ▪ Equipments for concrete/mortar testing of mechanical and durability related properties ▪ Concrete cutting saw
Construction engineering	<ul style="list-style-type: none"> ▪ Concrete core drilling equipment ▪ Equipment for non-destructive testing such as ultrasonic pulse velocity measuring system, impact hammer and cover meter ▪ Equipment for conducting corrosion survey

6.2.7.4 Patents

The following table 6-20 gives the details of the number of patents filed by and granted to SERC(M) during 2000-01 to 2004-05

Table 6-20

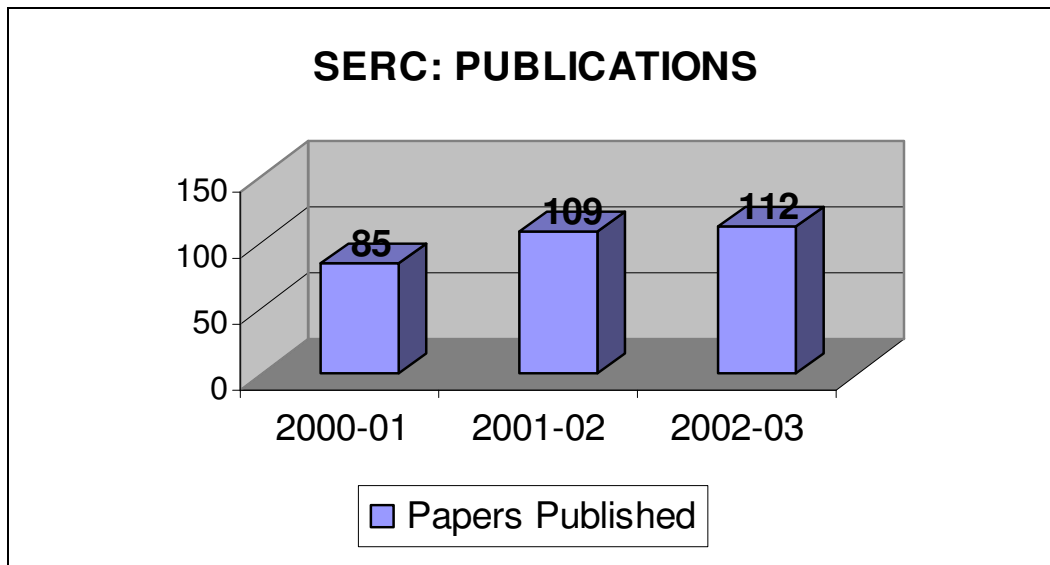
Patents filed by & granted to SERC(M) during 2000-01 to 2004-05

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

6.2.7.5 Papers

The following figure 6-14 gives the details of the number of papers published by SERC during 2000-01 to 2002-03

Figure 6-14



(For details about the publications of SERC, refer to the website www.sercm.org)

6.2.7.6 Potential exportable R&D Services

SERC has identified the following as its potential exportable R&D services:

1. Design and development including software development and laboratory based and field experiments / testing including prototype testing as contract research for:
 - i. Improvement to structural design of steel / concrete structures with special reference to natural hazards such as wind, earthquake and such disaster prevention and to withstand the effects and vagaries of nature.
 - ii. Guidelines and improvement / strengthening codal provisions with regard to steel structures with reference to transmission line towers, wind mill turbines
2. Product development as contract research for:
 - i. New materials (cement based) improvements to existing materials and improved use of the available materials for enhanced durability.
 - ii. Supplementary cementitious materials, viz fly ash, ground granulated blast furnace slag, silica fume;
 - iii. Concrete compositions viz ferro cement, fibre reinforced concrete
 - iv. Application of cement based new materials supplementary cementitious materials and concrete compositions for repair / retrofitting of disturbed concrete structures
 - v. Fibre reinforced plastic for special applications.
4. Process development as contract research for:
 - i. Prefabricated construction materials and new form of construction and prefabricated elements and structures, self compacting / consolidating concrete etc.
 - ii. Conditional assessment / life extension of structures

6.2.7.7 Target Markets

The following target markets have been identified for the above services: SAARC countries like Malaysia, Singapore, Philippines, Thailand, Vietnam, Korea and countries of Middle East.

6.2.7.8 Constraints & Suggestions

SERC highlighted lack of market information as the constraint that it faced in the export of R&D Services.

It was suggested that to overcome the constraints in enhancing the exports of R&D services, the following should be undertaken:

- 1. Identifying broadly the clients / firms mainly involved in construction / fabrication / turnkey contractors*
- 2. The nature, scope, value and the possible R&D content in the overall contract which will form part of our area of core competency.*
- 3. Other agencies involved in similar R&D services / other agencies from advanced countries rendering such services, which can be competitively handled by us. This will help to penetrate the overseas / target market with vital market information initially.*
- 4. Possible collaboration with major companies / government agencies and promoters in contracts that is relevant to us.*

This above information can be generated or acquired through:

- 1. By setting up representative offices in select identified target markets / countries by CSIR or a group of identified labs under CSIR.*
- 2. A consortium approach from India in the target country for market penetration as well as collection of relevant information.*
- 3. Formation of business development teams in every laboratory with an export thrust that can undertake at least two visits every year.*
- 4. Participation in conferences / seminars and also identification of joint programmes of mutual relevance for the target customers / markets / CSIR / Laboratories.*
- 5. Finally, CSIR must set up dedicated fund export of R&D services and also give lot of freedom (administrative / otherwise) without hassles to laboratories in undertaking foreign trips on such export promotion missions.*

6.2.8 Central Road Research Institute

The Central Road Research Institute (CRRI) was established in the year 1948 with the mission to deliver high quality and globally acceptable research as well as consultancy services to the profession in the major areas of road and road transportation technology. It has always been striving for quality and has successfully implemented ISO quality management system. As an ISO certified institution, CRRI endeavors to develop a quality culture in R&D activities by adopting a well disciplined approach for improvement in customer satisfaction. Strength of 250 highly qualified, experienced and dedicated scientists and technologist to deliver quality research in the above areas.

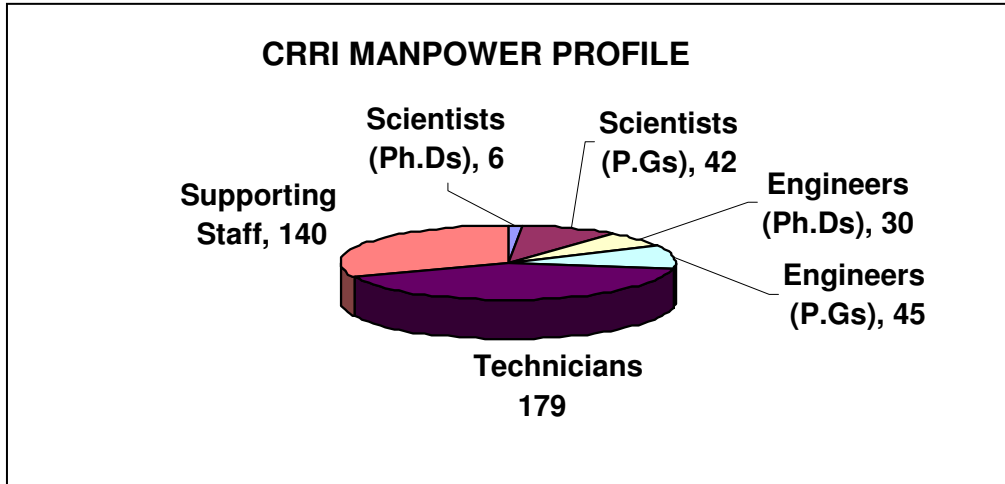
On the basis of extensive field trials with the help of vast variety of infrastructural facilities including test tracks, various new techniques have been developed and formulated codes of practice, guidelines and standard specifications for Bureau of Indian Standards and Indian Roads Congress in the areas of road materials, structural and geometric design of roads, road construction and maintenance management, traffic engineering including safety and environment, bridges and geotechnical engineering etc. Many of the techniques developed / patented by CRRI have already been taken up by industry for commercial applications.

Some of the current activities of CRRI include Systematic Network Planning of Rural Roads, Road User Cost Study (RUCS) phase II, Fly-ash project, Disaster Mitigation, Development of Road Network in the new city of Dwaraka, Establishment of Technology Transfer Centre for PIARC. The Institute is successfully undergoing the process of uncovering the research skills in today's competitive world market. CRRI has been identified as the principal technical agency to provide technical support to Ministry of Rural Development, Govt of India in the implementation of Pradhan Mantri Gram Sadak Yojana (PMGSY).

6.2.8.1 Manpower Profile

The following figure 6-15 depicts the manpower profile of CRRI:

Figure 6-15



6.2.8.2 Areas of core Competency

The following have been identified by CRRI as their areas of core competency:

1. Pavement engineering and materials
2. Geotechnical engineering
3. Bridge and instrument engineering
4. Traffic and transportation engineering including safety and environment
5. Road planning and management
6. Estate services
7. Human resources and project planning

The following table 6-21 depicts the available manpower in each one of these areas of core competency:

Table 6-21

S.No.	Area of Competence	Manpower
1.	Pavement engineering and materials	63
2.	Geotechnical engineering	33
3.	Bridge and instrument engineering	40
4.	Traffic and transportation engineering including safety and environment	45
5.	Road planning and management	20
6.	Estate services	50
7.	Human resources and project planning	36

6.2.8.3 Major R&D Facilities

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

- Fatigue testing of bridges
- Load test
- Corrosion studies
- Non destructive testing facilities
- Quality assurance facilities
- Vibration / frequency test
- Elastomeric bearing test
- Pre-stressing
- Axle-mounted road roughness measuring system
- Vertical profile meter
- Nuclear surface density / moisture gauge
- CBR impact tester for field CBR
- Pavement deflection gauge
- Bitumen content estimation in bituminous mixes
- Road distress measuring system
- Machinery and equipment for subsoil investigation, collection of undisturbed and disturbed samples
- In-situ testing like dynamic cone penetration apparatus, vane shear test, SPT, etc.
- Instrumentation for field monitoring like piezometers, settlement gauges, bore hole extensometers, inclinometers, etc – installation and monitoring
- Soil testing laboratory for carrying out tests like index properties, compaction, shear strength, CBR,

- permeability, consolidation, field density, etc
- Large box shear test for gravels
 - Triaxial shear and consolidation apparatus (GDS computerized)
 - Cyclic triaxial test apparatus
 - Geotextile testing laboratory
 - Equipment for investigation, surveying and mapping of land slides like total station, digital camera, GPS, plane table survey, Brunton compass, geological hammer etc.
 - Software package for various geotechnical application like high embankment design, settlement analysis, reinforced earth wall design, design of stone columns, etc
- Walk-in environment chamber
 - Portable wheel weigh pads
 - Weigh-in-motion (WIM)
 - Dipstick
 - Nuclear density and moisture meter
 - Soil impact tester
 - Dynamic cone penetrometer
 - Falling weight deflectometer (FWD)
 - Mu-meter
 - British portable skid tester (BPT)
 - Fifth wheel bump integrator
 - Unevenness indicator
 - Heavy weight deflectometer (HWD)
 - Material testing system (MTS)
 - Portable deflection measurement Equipment (Load man)
 - Test bed facility for characterisation

6.2.8.4 Patents

The following table 6-22 gives the details of the number of patents filed by and granted to CRRI during 2000-01 to 2004-05

Table 6-22

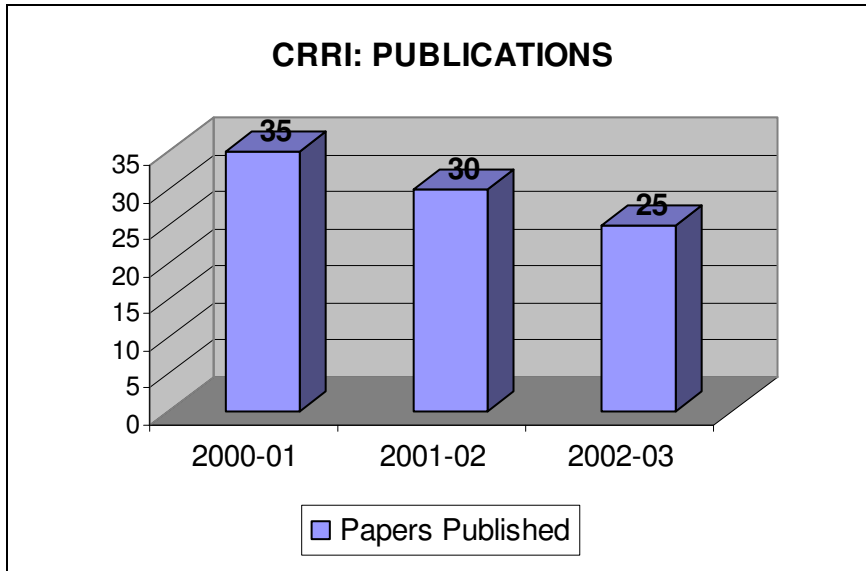
Patents filed by & granted to CRRI during 2000-01 to 2004-05

Year	Patents Filed		Patents Granted	
	In India	Abroad	In India	Abroad
2000-01	Nil	Nil	Nil	Nil
2001-02	Nil	Nil	Nil	Nil
2002-03	Nil	Nil	1	Nil
2003-04	2	Nil	1	Nil
2004-05	1	Nil	Nil	Nil
Total	3	Nil	2	Nil

6.2.8.5 Papers

The following figure 6-16 gives the details of the number of papers published by CRRI during 2000-01 to 2002-03

Figure 6-16



(For details about the publications of CRRI, refer to the website www.crridom.org)

6.2.8.6 Potential Exportable R&D Services

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

1. Training in the areas of road research
 - a. Training in the application of Highway Design Model (HDM) of the World Bank for economic and financial evaluation of highway projects.
 - b. Training in the design, quality control and preparation of detailed project reports for highways (existing as well as new)
 - c. Training in sub-soil investigation and design of substructures.
 - d. Training in zonation of landslides and corrective measures.
 - e. Training in the area of traffic Engineering and Management for the city engineers and traffic managers including Traffic police.
 - f. Training in the field of Transportation Planning which includes the methods of travel demand estimation, analysis of transport systems characteristics and capabilities.

- g. Training in conducting the Environmental impact assessment (EIA) of highway projects.
 - h. Training in conducting feasibility study of highway projects.
 - i. Training in Road safety Audit (RSA) procedures to field engineers.
2. Testing and Evaluation in the areas of road research
 - a. Testing and evaluation of highway materials
 - b. Testing of traffic signs and road marking materials
 - c. Testing of elasto-meric bearing
 - d. Testing and evaluation of coding on steel bearing
 3. Consultancy services in the areas of road research
 - a. Preparation of transportation plans for urban and regional context
 - b. Preparation of traffic systems management plans
 - c. Conduct of Road Safety Audit
 - d. Preparation of Road Safety Management (RSM) plans
 - e. Preparation of detailed techno-economic feasibility study reports
 - f. Preparation of Detailed Project Reports (DPR)
 - g. Application of geo-synthesics and ground improvement techniques
 - h. Testing and evaluation of the highway and airfield pavements
 - i. Long term performance monitoring of bridges
 - j. Aerodynamic studies of towers and bridges
 - k. Preparation of Environmental Impact Assessment (EIA) reports
 - l. Sub-soil investigation and design of foundations
 - m. Landslide investigations and corrections
 - n. Development of pavement management systems
 - o. Bridge ratings and evaluation
 4. IPR Services in the areas of road research
 - a. Guidance in protecting the IPR and commercialization of IP
 5. Technology transfer in the areas of road research
 - a. Transportation planning
 - b. Land slide corrections
 - c. Techniques of conducting traffic studies
 6. Turn key projects in the areas of road research

- a. Transportation planning and development
 - b. Highway design and development
 - c. Preparation of DPR and its implementation
7. Contract R&D in the following areas:
- i. Traffic Engineering and Management
 - ii. Pavement design and Management
 - iii. Bridge design and Management
 - iv. Instrumentation of highways and bridges
 - v. Investigations of land slides and corrections

6.2.8.7 Target Markets

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

1. SAARC countries

CRRI highlighted lack of market information, bureaucratic bottlenecks and lack of resources as the constraints that they faced in the export of R&D Services.

6.2.8.8 Constraints & Suggestions

It was suggested that to overcome the constraints in enhancing the exports of R&D services, the following should be initiated:

- *More liberal funding with specific budget head for business development*
- *The lab should be allowed to approve the visit of scientists in such cases*
- *All these must be seen as investment for long term gain.*

6.2.9 Central Mechanical Engineering Research Institute

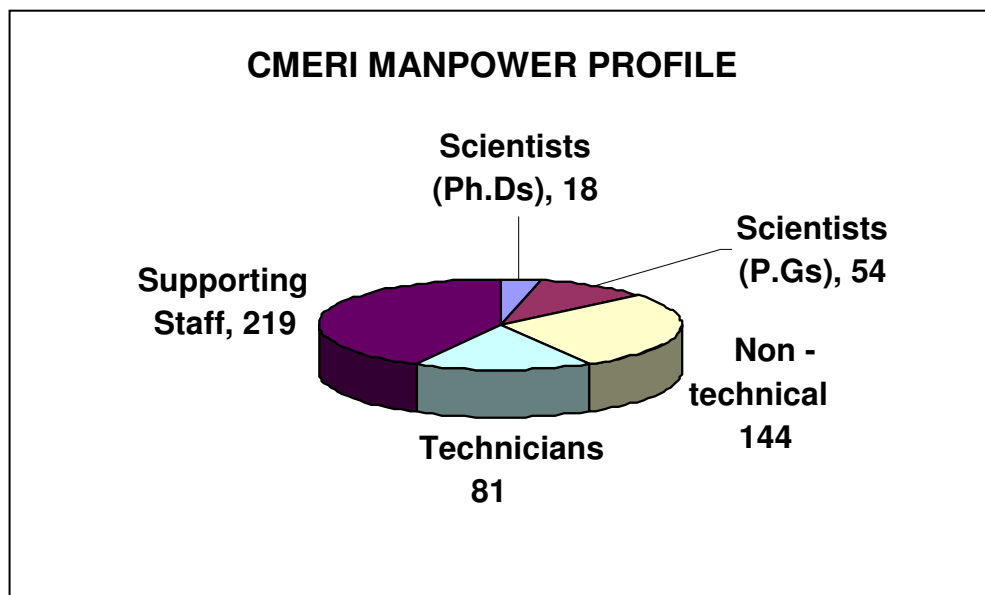
Established in 1958, the Central Mechanical Engineering Research Institute (CMERI), Durgapur is a premier R&D establishment in mechanical and allied engineering under the aegis of CSIR . Being the only national level research institute in this field, the CMERI's mandate is to serve industry, to develop mechanical engineering technology so that India's dependence on foreign technology is minimized in strategic and economic sector. Besides, the institute is facilitating innovations and inventions for establishing the claims of Indian talent in International field to enable India compete globally. In the new millennium, CMERI is poised to expand its horizon of research activities so as to steer the country forward in cutting edge and sunrise fields.

CMERI provides complete know-how packages and technological solutions, offering the convenience of single point sourcing of technology and services for developing winning products. The spectrum includes new generation / platform product, incremental improvements in products, productivity improvement and cost reduction and quality control and standardization of products.

6.2.9.1 Manpower Profile

The following figure 6-17 depicts the manpower profile of CMERI:

Figure 6-17



6.2.9.2 Areas of Core Competency

The following table 6-23 depicts the areas of core competency of CMERI and available manpower for each :

Table 6-23

S.No.	Area of Competence	Manpower
1.	Robotics & mechatronics	22
2.	Heat power engineering	54
3.	Advance manufacturing technology	139
4.	Rapid prototyping & tooling	27
5.	Farm machinery & post harvest technology	49
6.	Life enhancement studies	32

6.2.9.3 Major R&D Facilities

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

1. Design engineering
 - i. Computer aided design (CAD / CAM)
 - ii. Solid modeling
 - iii. Design analysis
2. Rapid prototyping and manufacturing
 - i. Layered object manufacturing: LOM (Helisys) and stereolithography
 - ii. Development of physical model of prototypes for automobile components, medical implants, consumer durables etc.
 - iii. Development of rapid tooling using rapid prototyping, vaccum casting and TAFE Process
3. Manufacturing technology
 - i. CNC machine tools environment
 - ii. CAM manufacturing including CAM machining and grinding, customized heat treatment, JIG Boring and EDM wirecut
 - iii. Fluidized bed heat treatment
4. Foundry and precision casting
 - i. Computerized methoding for molding and casting

- ii. Sand molding facilities
- iii. Shell molding facilities
- iv. Investment casting facilities
- v. Spin casting facilities
- vi. Induction furnace 200kg/50kg
- vii. Rotary furnace for non-ferrous

5. Services

- i. Residual life assessment (RLA)
 - Power plant equipment
 - Chemical process plant
 - Industrial machines
- ii. Calibration, testing and quality assurance
 - Calibration – metrology, thermal, electrical, chemical instruments
 - Mechanical testing
 - NDT and vibration and noise analysis
 - Metallurgical and mechanical property evaluation of materials and components
 - Lubricants and pressure testing

6.2.9.4 Patents

The following table 6-24 gives the details of the number of patents filed by and granted to CMERI during 2000-01 to 2004-05

Table 6-24

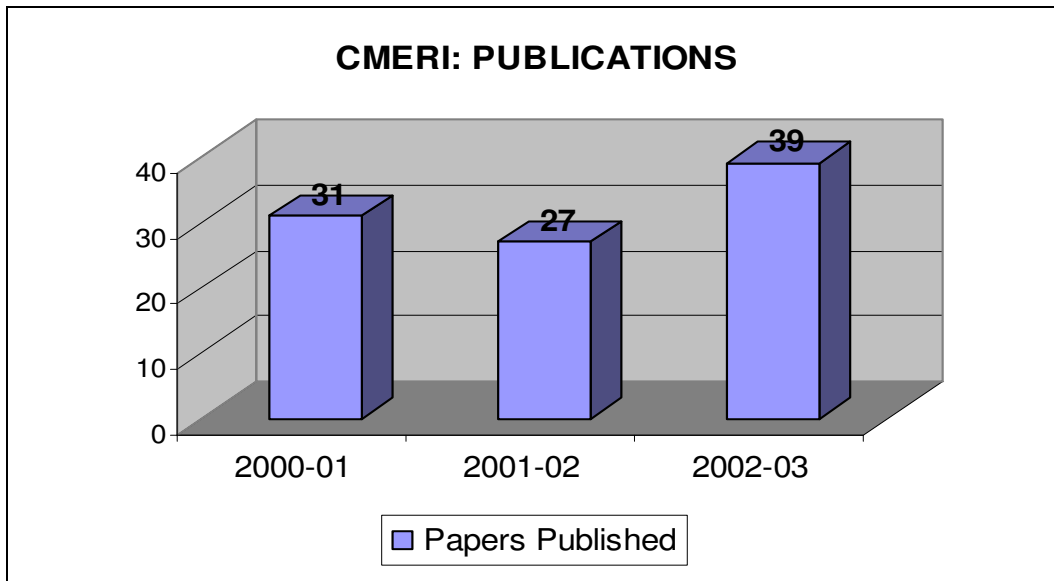
Patents filed by & granted to CMERI during 2000-01 to 2004-05

Year	Patents Filed		Patents Granted	
	In India	Abroad	In India	Abroad
2000-01	5	Nil	2	Nil
2001-02	2	Nil	1	Nil
2002-03	5	1	Nil	Nil
2003-04	4	Nil	2	Nil
2004-05	1	4	Nil	Nil
Total	17	5	5	Nil

6.2.9.5 Papers

The following figure 6-18 gives the details of the number of papers published by CMERI during 2000-01 to 2002-03

Figure 6-18



(For details about the publications of CMERI, refer to the website www.cmeri.org)

6.2.9.6 Potential Exportable R&D Services

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

1. Post harvest technology for drying of grain
2. Residual life assessment studies of mechanical system
3. Industrial component development
4. Computer aided design analysis

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

6.2.9.7 Target Markets

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

1. Southeast Asian countries
2. West Asian countries
3. Latin American countries
4. African countries

6.2.9.8 Constraints & Suggestions

CMERI highlighted lack of market information for specific services, and lack of its exposure of its R&D services in the regions / countries specified as the constraints that they faced in the export of R&D services.

6.2.10 Central Building Research Institute Roorkee

The Central Building Research Institute, Roorkee, India, has been vested with the responsibility of generating, cultivating and promoting building science and technology in the service of the country.

Since its inception in 1947, the institute has been assisting the building construction and building material industries in finding timely, appropriate and economical solutions to the problems of materials, rural and urban housing, energy conservation, efficiency, fire hazards, structural and foundation problems and disaster mitigation.

The objectives of the institute are to carry out applied and basic research in all areas of building science to solve problems confronting the country in the areas of shelter planning, building materials, structures and foundations and disaster mitigation including fire engineering; to develop new technologies for the promotion of building materials and systems; to disseminate the results of research far and wide for the good of community and to transfer the developed technologies to the industry for further commercialization.

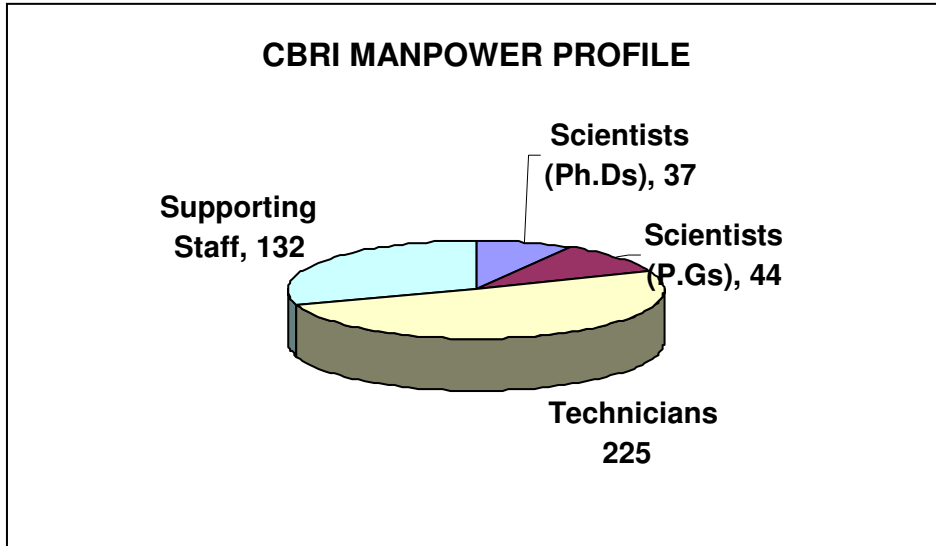
The mission of the institute is to carry out R&D on all aspects of building and housing and assist the building industry in solving problems of planning, designing, foundations, materials and construction including disaster mitigation in all kinds of buildings with a view to achieve economy, comfort, functional efficiency, speed, productivity in construction, environment preservation and energy conservation.

The focus and vision of CBRI is to work as world class knowledge base for providing solutions to almost all area of building / habitat planning and construction including building materials, construction technology, fire engineering, disaster mitigation and construction.

6.2.10.1 Manpower Profile

The following figure 6-19 depicts the manpower profile of CBRI:

Figure 6-19



6.2.10.2 Areas of Core Competency

The following table 6-25 depicts the areas of core competency of CBRI and the available manpower for each:

Table 6-25

S.No.	Area of Competence	Manpower
1.	Shelter planning	28
2.	New material	30
3.	Structure and foundation	43
4.	Disaster mitigation	22
5.	Process development	23

6.2.10.3 Patents

The following table 6-26 gives the details of the number of patents filed by and granted to CBRI during 2000-01 to 2004-05

Table 6-26

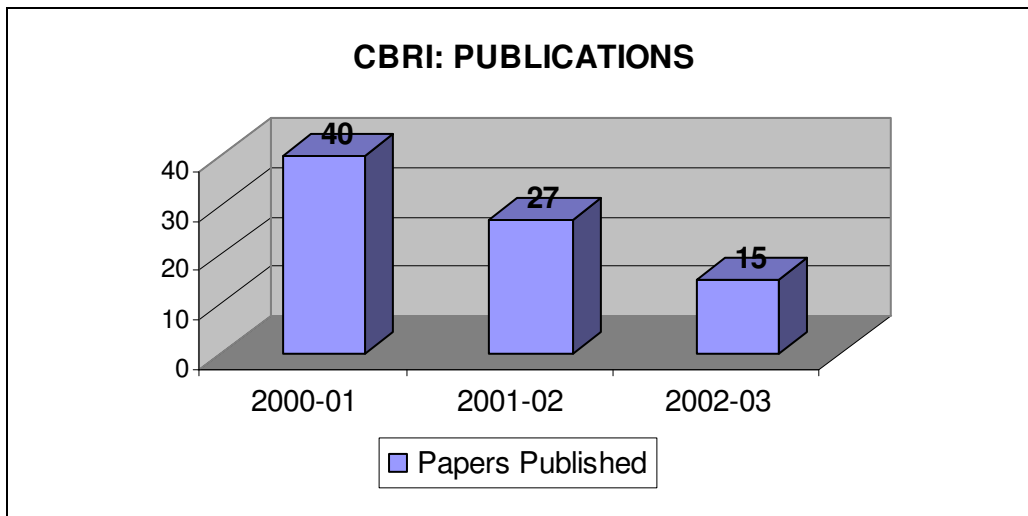
Patents filed by & granted to CBRI during 2000-01 to 2004-05

Year	Patents Filed		Patents Granted	
	In India	Abroad	In India	Abroad
2000-01	4	Nil	2	Nil
2001-02	2	Nil	1	Nil
2002-03	2	Nil	2	Nil
2003-04	Nil	14	1	6
2004-05	Nil	27	1	Nil
Total	8	41	7	6

6.2.10.4 Papers

The following figure 6-20 gives the details of the number of papers published by CBRI during 2000-01 to 2002-03

Figure 6-20



(For details about the publications of CBRI, refer to the website www.cbri.org)

6.2.10.5 Potential Exportable R&D Services

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

1. Advisory consultancy for:

- i. Housing and planning
- ii. Urban and rural buildings
- iii. Educational and health care buildings,
- iv. Building materials and constructional technologies for rural and hilly areas;
- v. Sustainable development of hilly towns
- vi. Space norms and design guidelines for buildings in hilly areas
- vii. Building physics – illumination, thermal comfort, ventilation, acoustics, driving rain studies etc.

2. Testing and evaluations services for:

- i. Organic building material
- ii. Cement lime and clay products
- iii. Pollution mitigation in brick and lime industries, waste recycling
- iv. Development of environment friendly termite control pesticides
- v. Structural and building components out of new / waste material

73. Structural analysis and design

- i. Construction technology,
- ii. Rehabilitation of distress structures
- iii. Concrete technology
- iv. Geo technological engineering – pile foundation
- v. Strengthening of weak soils for foundation and other foundation related problems
- vi. Landslide mitigation
- vii. Slope stability
- viii. Rock mechanics.

5. Sponsored studies for:

- i. Building dynamics

- ii. Earthquake mitigation – earthquake resistant construction
- iii. Retrofitting and rehabilitation of earthquake damaged buildings
- iv. Studies on strong motion seismic instrumentation
- v. Pre and post disaster management with reference to cyclones
- vi. Landslides
- vii. Fire hazards
- viii. Fire resistance systems
- ix. Fire spreading modeling and simulations.

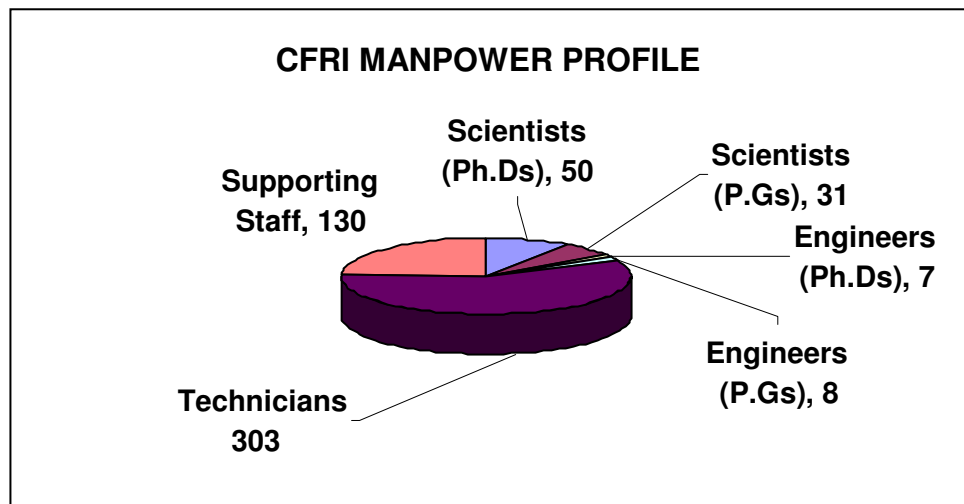
6.2.11 Central Fuel Research Institute, Dhanbad

Central Fuel Research Institute, Dhanbad under the Council of Scientific & Industrial Research(CSIR), is a premier research organization of international repute devoted to R&D work - both fundamental and applied on Indian fuel resources, especially coal and lignite. Accredited with ISO 9001 certification, the first in the CSIR chain of laboratories, the institute, since its inception in 1946 has made significant contributions to the industrial growth of the nation through concerted research efforts towards the utilization of coal. Engaged in R&D on coal for more than five decades, CFRI has developed itself as the largest repository of knowledge base of coal science and technology in the country. CFRI with its long-standing achievement and impressive built-in-capability can play a significant role in providing R&D support to the nation to manage its energy needs and utilize the primary resource in a more efficient and eco-friendly manner.

6.2.11.1 Manpower Profile

The following figure 6-21 depicts the manpower profile of CFRI:

Figure 6-21



6.2.11.2 Areas of Core Competency

The following table 6-27 depicts the areas of core competency of CFRI and the available manpower for each:

Table 6-27

S.No.	Area of Competence	Manpower
1.	Resource quality assessment	87
2.	Coal preparation	18
3.	Coal carbonization	10
4.	Power coal	18
5.	Environment management	8
6.	Coal liquification and gasification	16
7.	Chemical liquid fuels	14

6.2.11.3 Major R&D Facilities

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

1. Fine coal treatment pilot plant
2. Drop tube furnace
3. X-Ray fluorescence spectrometer
4. X-Ray diffraction unit
5. Fluorescent microscope
6. Heating microscope
7. carbolic electric oven
8. Quantasorb surface analyzer
9. Porosimeter
10. TGA / DTA unit
11. Auto Calorimeter
12. Atomic absorption spectrometer
13. CHN analyzer
14. Particle analyzer
15. Sulphur analyzer
16. Proximate analyzer

6.2.11.4 Patents

The following table 6-28 gives the details of the number of patents filed by and granted to CFRI during 2000-01 to 2004-05

Table 6-28

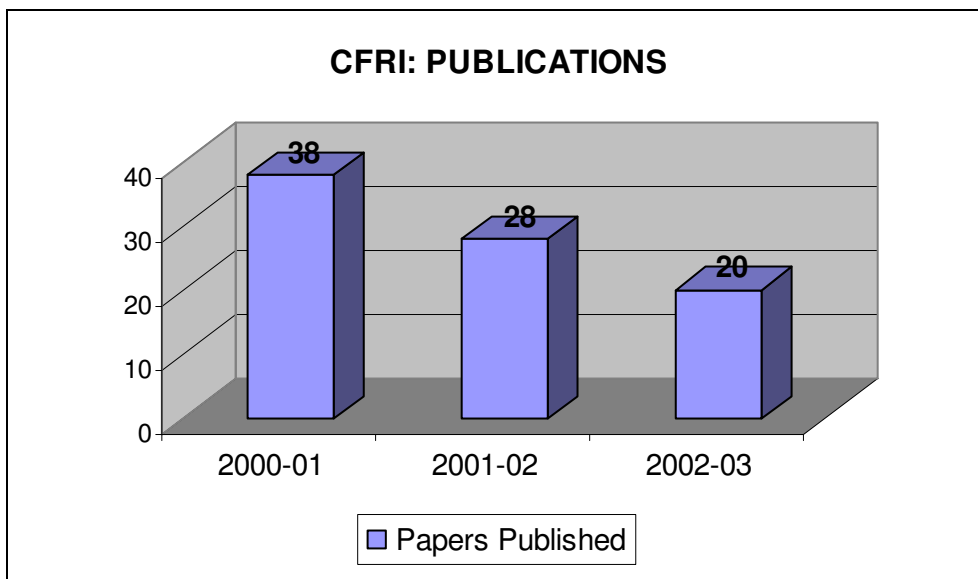
Patents filed by & granted to CFRI during 2000-01 to 2004-05

Year	Patents Filed		Patents Granted	
	In India	Abroad	In India	Abroad
2000-01	7	4	1	Nil
2001-02	8	10	4	Nil
2002-03	8	10	1	2
2003-04	2	18	3	4
2004-05	4	6	1	4
Total	29	48	10	10

6.2.11.5 Papers

The following figure 6-22 gives the details of the number of papers published by CFRI during 2000-01 to 2002-03

Figure 6-22



(For details about the publications of CFRI, refer to the website www.cfriindia.com)

6.2.11.6 Potential Exportable R&D Services

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

1. Resource quality assessment of coal and its characterization
2. Surveys of energy (coal) resources
3. Full scale washability studies of coal and interpretation of results including sampling of coarse and fine coals standardization of auto sampler for quality monitoring of washed product
4. Lab/ bench/ pilot scale investigations by various techniques on the beneficiation of coarse, small and fine coals
5. Process know-how for the beneficiation of coking and non-coking coals
6. Performance evaluation and technical audit of washeries.
7. Testing and characterisation
8. Process know how for
 - i. Briquetting
 - ii. Active carbon
 - iii. High temperature carbonization

10. Chemicals & Liquid Fuels
 - i. Recovery of chemicals from Coal tar and other by-products of carbonization & further synthesis to value added chemicals.
 - ii. Production of alternative fuels through Fischer-Tropsch Synthesis.
 - iii. Catalysts for coal to liquid fuel process

10. Coal Liquification and Gasification
 - i. Process Development
 - ii. Clean Coal Technology
 - iii. Gasification

6.2.12 Central Glass and Ceramic Research Institute Kolkata

Central Glass and Ceramic Research Institute (CGCRI) Kolkata is one of the first four laboratories set up under the Council of Scientific & Industrial Research. Even though it started functioning in a limited way in 1944, the institute was formally inaugurated on August 26, 1950.

At the initial stages, most of the work was directed towards identifying suitable mineral resources within the country and their suitability for specific product development. The quality control aspects in glass and ceramic received due attention and so was the work on glass forming machines and glass-lined equipment. Development of various types of optical glasses brought CGCRI into limelight in the international arena.

A special assignment given to the institute by the Planning Commission was to work out the process technology for production of optical glass with a view to making the country independent of imports in respect of this material. The institute's pilot plant with an annual capacity of 10 tonnes went into production in 1961. Several varieties of optical glass representing the principal requirements of the consumers are still being produced, in this plant. Besides the development of optical glass, the work on introduction of modern techniques in glass and ceramic, basic studies on generation of colour in glasses, evaluation of different minerals of the country such as clay and mica for their suitability in specific uses, development of high temperature combustion boats are some of the important activities of the institute.

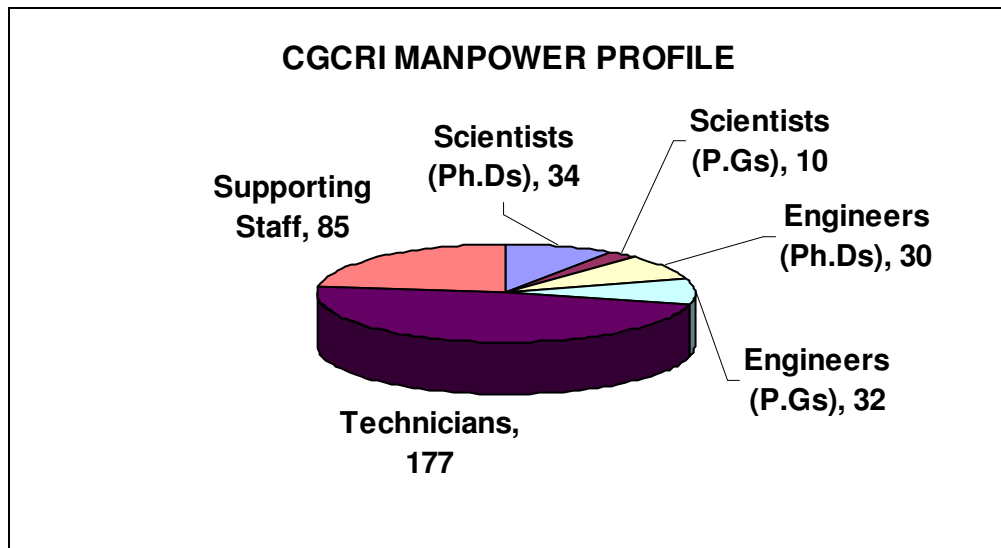
The seventies witnessed the initiation of the development of laser glass, infra-red transmitting filters, synthetic quartz single crystal, high temperature protective enamels, high alumina ceramic seals, spacers and research work on foam glass, glass bonded mica, steel plant refractories were added keeping in mind the need of Indian industries. All these carry the testimony of CGCRI's 'aggressive' research in an endeavour to be a leader in glass and ceramic research.

In the eighties and nineties, CGCRI started work in a number of fields, some of which were in nascent stages in even abroad. Work in the field of optical fibre for telecommunications, sol-gel processing of glass and ceramic materials, production of glass fibre based composites and application of ceramic materials in electronics were initiated. Some of these activities have placed CGCRI in the global map in their respective areas. In the frontier fields on which CGCRI started work were in demand by the Indian industries as well as the three strategic sectors viz. atomic energy, defence and space which have been facing sanctions of different kinds from the developed countries.

6.2.12.1 Manpower Profile

The following figure 6-23 depicts the manpower profile of CGCRI:

Figure 6-23



6.2.12.2 Areas of core competency

The following table 6-29 depicts the areas of core competency of CGCRI and the available manpower for each:

Table 6-29

S.No.	Area of Competence	Manpower
1.	Optical communication Fibre	14
2.	Glass science and technology	51
3.	Sol-Gel science and technology	7
4.	Oxide and bio-ceramics	21
5.	Ceramic membrane	10
6.	Electro-ceramics	16
7.	Non-oxide ceramics	16

6.2.12.3 Major R&D Facilities

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

1. Optical communication fibre drawing tower (speed 200m / min fibre perform 28 mm)
2. Scanning electron microscope
3. Tape casting m/c
4. Chemical analysis and characterization for glass and ceramic
5. High temperature furnace up to 2000 °C
6. Controlled atmosphere furnace
7. High temper viscosity measurement for glass
8. Temperature calibration

6.2.12.4 Patents

The following table 6-30 gives the details of the number of patents filed by and granted to CGCRI during 2000-01 to 2004-05

Table 6-30

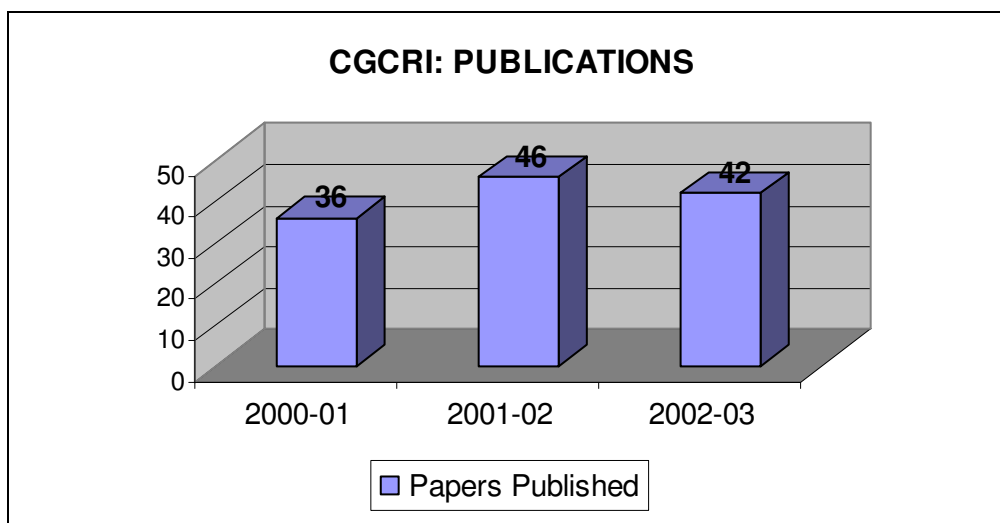
Patents filed by & granted to CGCRI during 2000-01 to 2004-05

Year	Patents Filed		Patents Granted	
	In India	Abroad	In India	Abroad
2000-01	25	3	2	1
2001-02	30	8	5	3
2002-03	21	6	3	1
2003-04	14	9	6	3
2004-05	12	9	1	3
Total	102	35	17	11

6.2.12.5 Papers

The following figure 6-24 gives the details of the number of papers published by CGCRI during 2000-01 to 2002-03

Figure 6-24



(For details about the publications of CGCRI, refer to the website www.cgcri.res.in)

6.2.12.6 Potential Exportable R&D Services

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

1. Contract research / sponsored projects in the areas of glass and ceramics
2. Testing and characterization of materials in the areas of glass and ceramics
3. Training and development in the areas of glass and ceramics
4. Specialty materials development in the areas of glass and ceramics
5. Technology transfer in the areas of glass and ceramics

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

6.2.12.7 Target Markets

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

1. South east asia
2. Africa
3. Middle east countries

6.2.12.8 Constraints & Suggestions

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

6.2.13 Central Mining Research Institute, Dhanbad

Central Mining Research Institute (CMRI), Dhanbad was established on May 10, 1956 for carrying out research & development work in the field of mining and cognate subject to make mining safe, productive, environment friendly and economical as well as reduce health hazards to miners and environmental pollution due to mining and associated industrial activities. The primary mission of the institute is to provide scientific and technical input to mineral and mining industry with a view to optimize mining technology for better safety economy, conservation and environmental management. Since inception of the institute about 49 years ago the activities of CMRI has gone sea change due to adoption of open market policy and globalization by the Government of India as well as due to change of total mining scenario with the added dimensions for safety in mines, placer mining, environmental management and eco-friendly mining operations, computer application and higher productivity in mines, and use of advance mining technology for both large and small scale mines.

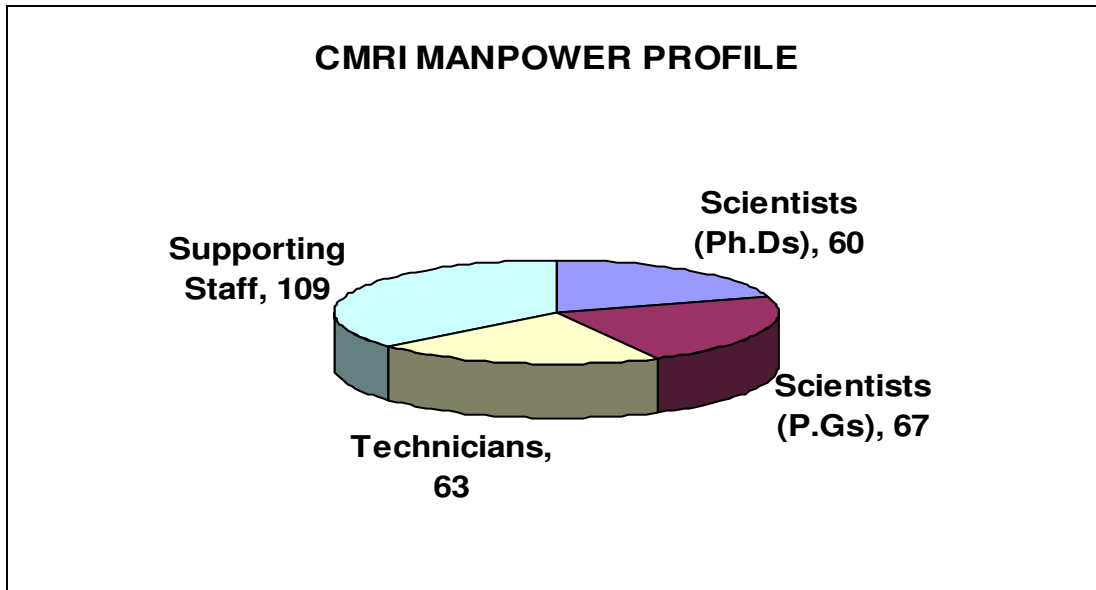
Apart from mining and allied fields, the institute has diversified and extended its activities in the areas of development of underground space technology and technology for the construction of caverns, hydel projects, dams and tunnel. This institute is gaining continuous momentum in its research portfolio because of its increasing demand of these associated activities.

The mission of the institute is to provide scientific and technological inputs to mineral sector for optimization of mining technologies for better safety, economy, conservation and environmental management.

6.2.13.1 Manpower Profile

The following figure 6-25 details out the manpower profile of CMRI:

Figure 6-25



6.2.13.2 Areas of Core Competency

CMRI has recognized the following as areas of their core competency, with the available manpower in all these areas put together being around 127:

1. Mine technology
2. Mine safety
3. Mine engineering
4. Mine environment

6.2.13.3 Major R&D Facilities

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

1. Geo-mechanics and mining methods
2. Safety in mines
3. Environment management
4. Design of mining equipment and machinery
5. Facilities for testing and evaluation of mining equipments, explosives and personal protective equipment.

6.2.13.4 Patents

The following table 6-31 depicts the patents filed for and granted to CMRI during 2000 - 01 to 2004-05

Table 6-31

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

Year	Patents Filed		Patents Granted	
	In India	Abroad	In India	Abroad
2000-01	6	Nil	Nil	1
2001-02	6	Nil	8	Nil
2002-03	3	Nil	3	1
2003-04	9	Nil	15	1
2004-05	18	Nil	Nil	Nil
Total	42	Nil	26	3

6.2.13.5 Potential Exportable R&D Services

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

1. Contract R&D in the area of mining
2. Consultancy services concerning any mining activity
3. Testing of equipments for approval in mining industry and ariel ropeway (NDT)
4. Training service to industry concerning any mining activity

6.2.13.6 Target Markets

CMRI has identified the following as their target markets for the above R&D services:

1. Mining and allied industries in SAARC countries, middle – eastern countries and china
2. Hydel power projects, construction companies
3. Tunnel, metro railway projects
4. Underground construction for defense purpose