# RESEARCH AND DEVELOPMENT IN INDUSTRY : AN OVERVIEW

**NOVEMBER 2007**

सत्यमेव जयते

**DEPARTMENT OF SCIENTIFIC & INDUSTRIAL RESEARCH**
**MINISTRY OF SCIENCE AND TECHNOLOGY**
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# Contents

## RESEARCH AND DEVELOPMENT IN INDUSTRY : AN OVERVIEW

### PREAMBLE

The economies of the present day world are driven by scientific research and technology. In our country, the adoption, in 1958, of the Resolution on Science Policy had provided a much needed thrust in this direction and had led to the creation of a strong S&T infrastructure in the country. It involved setting up of a chain of National Laboratories - under the aegis of several central organisations, such as, the Council of Scientific & Industrial Research (CSIR), Indian Council of Agricultural Research (ICAR), Indian Council of Medical Research (ICMR), Defence Research and Development Organisation (DRDO), Department of Atomic Energy (DAE), Department of Space (DoS), Department of Electronics (DoE) etc., as well as, many other specialised R&D centres, universities, IITs, and various academic institutions, to continuously provide expertise, technically trained manpower and technological support to the industry. During the formative years Indian industry had to perforce depend on imported technologies, and, the S&T infrastructure facilitated rapid assimilation and indigenisation of such technologies. Many additional policy measures have also been enunciated, from time to time, to meet



the changing industrial and technological requirements of the country. The Science & Technology Policy 2003, seeking to achieve synergy between industry and scientific research, envisages the creation of "Technology Transfer Organisations" as associate organisations of universities and national laboratories to facilitate transfer of know-how generated. It further seeks to encourage the transfer, to industry, of know-how generated by scientists and technologists, through flexible mechanisms for financial returns. The Policy further seeks to encourage, through innovative mechanisms, investments by industry in education/research and R&D, either in-house or through outsourcing.

### 2. RESOURCES DEVOTED TO SCIENTIFIC AND TECHNOLOGICAL ACTIVITIES:

The Department of Science and Technology (DST) has been undertaking biennial national surveys on a regular basis since 1973-74 on resources devoted to scientific and technological activities as per UNESCO guidelines.

As per the directory of R&D institutions 2006 ( August) published by the Ministry of Science and Technology, there are about 3960 R&D institutions classified as follows: -

**Table-I**

| | | |
|---|---|---|
| i | Central Government R&D institutions | 707 |
| ii | Public sector ( includes only in house R&D units of Central Public Sector undertaking) | 115 |
| iii | State Government Institutions | 834 |
| iv | Universities, deemed universities and Institutions of national importance | 284 |
| v | Private sector includes in-house R&D units of Private Sector industry and Scientific & Industrial Research Organisations (SIROs) recognized by DSIR | 2020 |
| | **Total** | **3960** |

As per the Research and Development Statistics published by the Ministry of Science & Technology in September - 2006, the national investment on R&D activities during 2002-03 was Rs. 18000.16 crores, sectorwise percentage is given below :

**Table II**

| **R&D Investments by** | **%** |
|---|---|
| Central Government | 62.6 |
| State Governments | 8.5 |
| Public Sector Industry | 4.5 |
| Private Sector Industry | 20.3 |
| Higher Education Sector | 4.1 |
| **Total** | **100** |

R&D expenditure was 0.80% of the GNP in 2002-03.



Industry spent 0.47% of their sales turnover on R&D in 2002-03. For private and public sector separately, these figures were 0.59% and 0.26% respectively.

During the year 2002-03, 84.1% of the R&D expenditure incurred by Central Government sources came from 12 major scientific agencies DRDO, DOS, ICAR, DAE, DSIR, CSIR, MOEn, DST, DBT, ICMR, DOD, MICT , MNEs and rest came from other central ministries departments/ public sector industries.

The activities of most of the institutions set up by the central government are available on Government of India directory of official website (http://goidirectory.gov.in/) and on National Portal of Government of India website (http://www.India.gov.in)

As on 1st April 2000 nearly 2.96 lakh personnel were employed in R&D establishments in the country, including in-house R&D units of public and private sector industries. 31.7% were performing R&D activities, 30.4% were performing auxiliary activities and rest 37.9% were providing administrative and non-technical support.

In the year 2003-04, 2469 patents were granted out of which 1078 patents were granted to Indians. The maximum number of patents filed by Indians were from the State of Maharashtra with a percentage share of 28.6 %.

## 3. INTERNATIONAL COMPARISON

For the year 2000-02, Per capita GDP in US$, Per capita R&D expenditure in US$, R&D expenditure as % of GDP and Number of Researchers per million population (1996-2002) for selected countries is tabulated below:-

| Name of the Country | Per Capita R&D Expenditure (in US$) | Per Capita GDP (in US$) | R&D Expenditure as % GDP | No. of Researchers per million population |
|---|---|---|---|---|
| Israel | 755.91 | 14813 | **5.11** | - |
| Sweden | 1104.20 | 26701 | **4.27** | 5171 |
| Japan | 976.58 | 31444 | **3.11** | 5085 |
| Republic of Korea | 288.50 | 9931 | **2.91** | 2979 |
| USA | 962.15 | 36052 | **2.67** | 4526 |
| Germany | 613.94 | 24196 | **2.64** | 3222 |
| France | 552.08 | 24259 | **2.27** | 3134 |
| Canada | 459.63 | 23043 | **2.00** | 3487 |
| UK | 436.40 | 26547 | **1.88** | 2691 |
| Australia | 281.07 | 20471 | **1.55** | 3446 |
| China | 12.15 | 989 | **1.23** | 633 |
| Brazil | 22.55 | 2600 | **1.04** | 324 |
| India | 3.53 | 486 | **0.80** | 110 |
| Pakistan | 1.13 | 407 | **0.27** | 88 |

* Source: Research and Development Statistics 2004-05 published by Department of Science & Technology, September 2006.

## 4. FISCAL INCENTIVES AND SUPPORT MEASURES

There are number of fiscal incentives and other support measures aimed at promoting R&D in industry and also at encouraging the utilisation of



locally available R&D options for industrial development. These include the following:

**Fiscal Incentives:-**

### A. Incentives based on direct taxes

- 100% write off of revenue expenditure on R&D; **(Section 35(1)(i) of Income-tax Act)**.
- 100% write off of capital expenditure on R&D in the year the expenditure is incurred; **(Sec.35(1)(iv) of Income Tax Act)**.
- Weighted tax deduction @125% for sponsored research programmes in approved national laboratories, Universities and IITs, available to the sponsor. **(Section 35(2AA) of the I.T. Act)**.
- Weighted tax deduction @125% **(raised to 150% by the Finance Act 2000)** on R&D expenditure to companies engaged in the business of bio-technology or in the business of manufacture or production of drugs, pharmaceuticals, electronic equipment, computers, telecommunication equipment and chemicals and manufacture of aircraft's & helicopters, automobiles including automobile components in Government approved in-house R&D centres. Expenditure on scientific research in relation to drugs and pharmaceuticals, includes expenditure

incurred on clinical drug trials, obtaining approvals from any regulatory authority under any Central, State or Provincial Act and filing an application for a patent under the Patents Act, 1970 **(39 of 1970)**. **(Section 35(2AB) of the Income Tax Act)**.

- Income-tax exemption @125% to donations made to approved non-commercial Scientific and Industrial Research Organisations **(Section 35(1)(ii) and 35(1)(iii) of the Income Tax Act)**.

- Accelerated depreciation allowance for investment on plant and machinery, made on the basis of indigenous technology **(Rule 5(2) of Income Tax Rules, 1962)**.

**B. Incentives based on indirect taxes**

i) Customs duty exemption to public funded R&D institutions and privately funded scientific and industrial research organisations, both for capital equipment and consumables needed for R&D. **(Notification No.51/96-Customs, dated 23 July 1996)**.

ii) Excise duty exemption to public funded R&D institutions and privately funded scientific and industrial research organisations, both for



capital equipment and consumables needed for R&D. **(Notification No.10/97-Central Excise, dated 1March 1997)**.

iii) Excise duty waiver for 3 years on goods designed and developed by a wholly owned Indian company and patented in any two countries out of: India, USA, Japan and any one country of European Union **(Notification No.15/96-CE dated July 23, 1996, amended vide Notification No.13/99-CE dated 28 February, 1999)**.

iv) Exemption from customs duty on imports made for R&D projects funded by Government in industry. **(Notification No.50/96-Customs dated 23 July 1996)**.

v) Pharmaceutical reference standards allowed to be imported duty free **{notification No. 26/2003-Customs dated 1 March 2003 (entry substituted at S.No 138 of the table in the said notification)}**.

vi) Goods specified in List-28 (comprising of analytical and specialty equipment) for use in pharmaceutical and biotechnology sector allowed to be imported duty free **{notification No. 26/2003-Customs dated 1 March 2003**

**(entry substituted at S.No. 248 of the table in the said notification)}** provided :

(a) The goods are imported for research and development purposes by an importer registered with DSIR for installation in the R&D wing of the importer within six months of the date of importation on submission of a certificate from the jurisdictional assistant commissioner of central excise or the Deputy commissioner of central excise to the assistant commissioner of customs or Deputy commissioner of customs at the port of importation. The goods imported should not be transferred or sold for a period of seven years from the date of installation.

(b) The goods are imported for use in the manufacture of commodities and the total value of goods imported does not exceed 25% of the FOB value of exports made during the preceding financial year and installation in the factory of the importer within six months of the date of importation on submission of a certificate from the jurisdictional assistant commissioner of central excise



or the Deputy commissioner of central excise to the assistant commissioner of customs or Deputy commissioner of customs at the port of importation. The goods imported should not be transferred or sold for a period of seven years from the date of installation.

**C. Other incentive**

Exemption from Price Control of Drugs (Prices Control) Order for drugs, which have been developed indigenously or produced through a process, developed through indigenous R&D, subject to DSIR certification of the technology.

**Support measures for promoting R&D in industry**

- Support in the form of grants for industrial R&D projects through Technology Development and Innovation Programme (TDIP) under TPDU scheme of DSIR.

- Support to industry for R&D through sector specific programmes of scientific and economic ministries/departments, such as, DST, DBT, DOD, Ministry of Information and Communication Technology, MNEs and Ministry of Agro and Food Processing.

- Associations of industry with the national R&D programmes in area of atomic energy space and Defence research.

- Promotion of technology transfer from national laboratories and nationally funded R&D programmes to industry through public sector organisations like NRDC and Antrix.

## 5. RESEARCH AND DEVELOPMENT BY INDUSTRY (IN-HOUSE)

The Technology Policy Statement of Government of India announced in January 1983 had referred to the In-house R&D units of industries and had stated that "In-house R&D units in Industry provide a desirable and essential interface between efforts within the national laboratories and the educational sector as well as production in industry. Appropriate incentives will be given to the setting up of R&D units in industry and for industry including those on a co-operative basis. Enterprises will be encouraged to set up R&D units of appropriate size to permit the accomplishment of major technological tasks". In line with this, there are several Governmental measures aimed at encouraging research and development by industry and also at establishing workable linkages between the national laboratory system, educational institutions and the industry. In addition, there are also fiscal incentives and support measures which encourage



and make it financially attractive for private, joint and public sector industrial units to establish their own In-house R&D units.

### 5.1 In-house R&D Units recognition scheme of DSIR

A scheme for granting recognition to In-house research and development units in industry has been in existence since 1973. Department of Science and Technology, Government of India, New Delhi, was granting such recognitions till 1985 after which these activities got transferred to the Department of Scientific & Industrial Research. One of the objectives of this scheme, when it was launched, was to provide liberal import facilities to recognised In-house R&D units under Open General License (OGL). This has now been absorbed in the liberalised trade policies announced by the Government in 1991. Recognising the need to establish their own R&D units and taking advantage of the incentives and support measures available, a number of industrial units have set up their own in-house R&D units to meet the technical and technological needs of their production centres.

The number of In-house R&D units recognized has increased steadily from about 100 in 1973 to about 275 in 1975; around 700 by 1980; around 925 by 1985 and to around 1257 as of now.

Majority of In-house R&D units are located in and around major cities. The reason for such large numbers around these major cities is due to the fact that several of the industrial units are also located around these cities.

A revised and updated "Directory of Recognized In-house R&D Units" is published by DSIR every year during the last quarter of the year.

### 5.2 R&D Expenditure

The expenditure incurred by In-house R&D units in industry has steadily increased. During 1980-81 it was of the order of Rs. 300 crores. In 1985-86, it was of the order of Rs. 500 crores. It is estimated that the present R&D expenditure of 1230 recognized R&D units is of the order of Rs. 5900 crores. The share of public and joint sector is about 20% and the private sector about 80%. 148 in-house R&D units spend over Rs. 5 crores each on R&D, 299 in-house R&D units spent between Rs. 1 crore to Rs. 5 crores each per annum on R&D. Over 600 in-house R&D units spend more than 1% of their sales turnover on R&D.

### 5.3 R&D Manpower

There has been a steady increase in R&D manpower employed by In-house R&D units over the years. By



1975 - 76, about 12,000 R&D personnel were employed by recognised In-house R&D units and by 1981-82, the figure was over 30,000. The present estimated manpower employed by about 1230 In-house R&D units is around 65,000, out of which around 20,000 R&D personnel are employed in public sector In-house R&D units and around 45,000 R&D personnel are employed in the private sector In-house R&D units. Of the total 65,000 R&D personnel, around 3500 are Ph.D's, 25,000 Post Graduates, 21,000 Graduates and the rest are technicians and support staff

## 6. NON-COMMERCIAL RESEARCH ORGANISATIONS ENGAGED IN SCIENTIFIC RESEARCH

### 6.1 Scientific & Industrial Research Organisations recognised by DSIR

To promote the growth of research and development activities in industry and non-commercial organisations, various measures have been evolved. Some of the provisions in the Income Tax Act have been designed to encourage research and development. Department of Scientific and Industrial Research has a scheme for granting recognition to non-commercial, voluntary Scientific and Industrial Research Organisations (SIROs). The SIROs recognised by DSIR

are eligible for Customs & Excise duty exemption on capital equipment, spares and consumables required for scientific research subject to ceiling as per the procedures of notifications 51/96-Customs dated 23 July 1996 and 10/97-Central Excise dated 1 March 1997.

At present there are 570 Scientific and Industrial Research Organisations recognised by DSIR, which are engaged in scientific research in the areas of agricultural, medical, natural and applied sciences and social sciences. A sector-wise break-up of the SIROs is as under:

| | | |
|---|---|---|
| Agricultural Sciences | : | 38 |
| Medical Sciences | : | 200 |
| Natural and Applied Sciences | : | 198 |
| Social Sciences | : | 108 |
| Universities/Colleges | : | 26 |

Revised and updated Directories of Recognized Scientific and Industrial Research Organizations are brought out every year during November. DSIR has also published Profiles on Scientific and Industrial Research Organizations during 1988, 1989, 1991, 1993 and 1997. These Profiles enable a proper



appreciation of the good work done by the SIROs, indicating therein the contributions they make in the overall scientific and/or industrial research activities in the country.

### 6.2 Public Funded Research Institutions

Public funded research institutions, universities, IITs, IISc Bangalore, regional engineering colleges, medical research institutions (other than hospitals) and regional cancer centres (Cancer Institutes) registered with DSIR are eligible for Customs & Excise duty exemption on capital equipment, spares and consumables required for scientific research subject to as per notifications 51/96-Customs dated 23 July 1996 and 10/97-Central Excise dated 1 March 1997. At present there are 559 institutions registered with DSIR.

### 6.3 Co-operative Research Associations

The Government have encouraged setting up of co-operative research associations in selected sectors with active involvement of the industry such as textiles, (ATIRA-Ahmedabad, BITRA-Bombay, SITRA-Coimbatore, WRA- Thana and so on); building materials (NCBM-New Delhi); tea (TRA-Toklai); jute (IJIRA-Calcutta); rubber (IRMRA- Thane); automobiles (ARAI-Pune); electricals (ERDA- Vadodara). These co-

operative research associations are financed jointly by the Government and the members comprising of concerned industry. The experience with such co-operative research associations seems to indicate that these have not grown adequately. Further encouragement appears to be needed to enable the co-operative research concept to flourish to the advantage of the industry.

### 6.4 Joint Industry - Institution Centers

Such centers of R&D set up by industry in academic institutions have now made a beginning in India. Examples are centres set up by firms like IBM, Monsanto etc. in institutions like IIT (Delhi) & IISc., Bangalore.

## 7. PROMOTIONAL PROGRAMMES OF THE GOVERNMENT FOR R&D

### 7.1 Technology Development and Demonstration Programme (TDDP)

The Department of Scientific and Industrial Research (DSIR) under its Plan scheme "Technology Promotion Development and Utilisation" (TPDU) is promoting industry's efforts in technology development and demonstration of indigenous technologies and absorption of imported technologies.

The department provides, on a selective basis, partial



financial support in the form of grants-in-aid to research, development, design and engineering projects undertaken or sponsored by industry for technology development and demonstration, absorption and upgradation of imported technology. Bulk of the project cost has to be made by the industry. Project activities supported by the DSIR include prototype development and pilot plant work, both in-house by industry or jointly with research organization, tests and evaluation of products flowing from such R&D, user trials etc. The projects are undertaken solely by industry or could be jointly with national laboratories and academic institutions of repute. During last 10-15 years, the department has supported over 150 projects of industrial units, both in public and private sectors involving the government share of about Rs. 600-700 millions in the total project cost of Rs. 4000 million. These projects cover products and processes in various important industries such as metallurgy, electrical, electronics, instrumentation, mechanical engineering, earth moving & industrial machinery, chemicals, explosives, drugs & pharmaceuticals and food processing. Distinctive feature of TDDP funding is that it addresses innovation in SMEs. Environmental consideration is prime in all projects supported under the programme.

Since inception of the scheme, 108 projects have so far been completed and over 35 technologies developed

under the scheme have been commercialized or under commercialization.

### 7.2 Technopreneur Promotion Programme (TePP)

The Ministry of Science & Technology has launched a novel programme entitled "Technopreneur Promotion Programme" on 15th August 1998 to tap the vast innovative potential of the citizens of India. Department of Scientific & Industrial Research (DSIR) and Department of Science & Technology (DST) jointly operate the programme. TePP has been playing a catalytic role in promoting individual innovators particularly 'Grassroot Innovators' to become technology-based entrepreneurs (technopreneurs). Indian citizens viz. farmers, students, housewives, scientists, engineers, doctors, technicians etc. having an original idea/invention/know-how can apply under this programme for financial support to translate/convert them into working models, prototypes/processes. Since, its inception in the year of 1998, about 161 project proposals of individual innovators/inventors have been considered for support under the programme.

Some of the innovative products developed under the programme are Robot for Fire Fighting, Solar Water Heater, Energy Efficient Oil Expeller Machine,



Motorcycle Driven Plough, Coconut Harvester, Anti-fungal principles of Alseodaphane species, Digital camera for fundus photography, solar water harvestors, Intrauterine distending system etc.

### 7.3 New Millenium Indian Technology Leadership Initiatives (NMITLI)

The NMITLI is the largest R&D scheme to boost public-private partnership effort in the country. NMITLI looks beyond today's technology and seeks to build, capture and retain for India, a leadership position by synergizing the best competencies of publicly funded R&D institutions, academia and private industry. The Government finances plays a catalytic role. It is based on the premise of consciously and deliberately identifying, selecting and supporting potential winners. NMITLI has carved out a unique niche in the innovation space and enjoys an unprecedented brand image. In the six years of its existence the programme has evolved 42 R&D projects covering diverse areas and involving 287 partners (222 in the public sector and 65 in the private sector) with an estimated outlay of Rs. 300 Crores.

NMITLI seeks to catalyse innovation-centered scientific and technological developments as a vehicle to attain for Indian industry a global leadership position, in selected niche areas in a true 'Team India' spirit, by synergizing the best competencies of publicly

funded R&D institutions, academia and private industry.

NMITLI employs innovative mechanism to render support. It is not a reactive scheme, but a proactive scheme, in the sense that instead of funding any project from private or Government undertakings based on their requests, it invites various institutions in Government as well as private sector to play a role in the development of a particular components of technological field selected for development. The distinctive features of NMITLI include: proactive effort; widespread national level consultation to solicit ideas; stringent screening and technology filtering; technology and patent mapping; high quality professional inputs for projectization; desegregation of technology into "viable components"; selection of best/most competent group/industry for each technology packet; invitation to the "best" to partner in the project; support to all partners; tight monitoring; and foreclosure if objectives are not met. The programme was initiated during 2000-01.

### 7.4 Technology Development Board (TDB)

In 1996, for the purposes of the development and application of indigenous technology in a dynamic economic environment, the Government of India enabled the placing of the proceeds of an existent cess



on the import of technology into a fund called the "Fund for Technology Development and Application". To administer the fund, the Government constituted Technology Development Board (TDB) on 1st September 1996. The Technology Development Board invests in equity capital (50%) or gives soft loan @5%interest (50%) to industrial concerns and other agencies, as applicable attempting development and commercial applications of indigenous technology or adapting imported technology to wider domestic applications. Industrial concerns and other agencies, research and development laboratories, and universities and other academic institutions are eligible for receiving financial assistance from TDB in the form of grants, loans or equity. TDB has, been, providing financial support to all fields of S&T i.e. agriculture, chemicals, electronics, medical and health etc., for development and commercialisation of new technological products. The Board has so far disbursed Rs. 6630 million towards 141 projects. During the year 2006-07, total of 14 projects have been supported. 4 projects supported in earlier years have gained considerable commercial successes and national visibility. It includes human health care products and electronic engineering advanced technology products.

### 7.5 Technology Parks

The concept of technology parks in specialised areas

has been there for quite some time now. This involves interaction of groups of academic and research institutions, group of industries and financial institutions. They work in harmony to evolve new technologies starting from the inventions in the academic or research inventions. This concept has made a beginning in India. Software Technology Parks promoted by Ministry of Information and Communication Technology have provided a strong impetus to IT industry in India.

### 7.6 Programmes by TIFAC

Technology Information, Forecasting and Assessment Council (TIFAC) under the Department of Science & Technology (DST) under the broad umbrella of Technology Vision 2020, TIFAC has launched a mission called **REACH** (Relevance and Excellence in Achieving new heights in educational institutions). This mission has been shaped on the concept of creation of multiple centres of excellence in specific areas, involving industry and R&D organisations as partners.

This programme calls for enriching engineering institutions to impart high quality education in specific areas having high relevance to industry and society. The mission calls for establishing about 80-100 centres of excellence within engineering institutions



and will lead to producing high caliber teaching environment and to create a research environment in the academic institutions leading to quality technology.

TIFAC, under **Sugar Production Technology Mission** aimed at providing technology up-gradation of selected sugar factories through implementation of proven modern technologies and assessment and evaluation of selected bench level technologies and their adoption on commercial scale; trial of new technologies which have not yet been proven on commercial scale in sugar industry through horizontal technology transfer, technology adaptation and scale up of bench level/emerging technologies.

**The Advanced Composites Mission** of TIFAC aims at indigenous development of composite products and focus to enhance the utilization and application of composites in various sectors - process equipment, railways, automobiles, construction, marine operations, bio-medical devises and sports goods.

**Fly Ash Mission** operational under TIFAC since 1994 supports projects towards confidence building in fly ash disposal/utilization technology.

Druing 2006-07, TIFAC mounted a new security technology initiative for promoting coordinated research and development of new tools and techniques

for Homeland Security. Advanced composites and Coregroup on Automotive R&D (CAR) projects added new dimensions.

### 7.7 Pharmaceutical Research & Development Support Fund (PRDSF) programme

In the Pharmaceutical sector, recognizing the profound influence of R&D on the prospects and opportunities for the growth of the Indian Drug Industry, Department of Science & Technology initiated a separate programme, Drugs & Pharmaceutical Research Programme during 1994-95 for promoting collaborative R&D in drugs and pharmaceuticals sector. The objectives of the programme are: to synergise the strengths of publicly funded R&D institutions and Indian Pharmaceutical Industry; to create an enabling infrastructure, mechanisms and linkages so as to facilitate new drug development; and to stimulate skill development of human resources in R&D for drugs and pharmaceuticals; and to enhance the nation's self-reliance in drugs and pharmaceuticals sector especially in areas critical to national health requirement.

Recently the allocation to this fund has been increased. DST under the PRDSF now has a provision to fund Rs. 1500 million in the current financial year of which Rs. 800 million is loan and Rs. 700 million is in grants-in-



aid. A soft loan of Rs. 90 million has been distributed to 5 pharmaceutical companies in the year 2004-05. During the year 2006-07 22 agreements have been signed, 2 patents have been filed and 15 projects have been recommended for funding.

### 7.8 Instrumentation Development Programme

Department of Science & Technology has been promoting the area of instrumentation through this program with the objective of strengthening indigenous capability for research, design and development of instruments in the country leading to their indigenous development and production, continuous updating of the technology. National Instrument Development Board (NIDB) was constituted for capacity building & development of instruments in the country. The thrust areas identified by the National Instrument Development Board (NIDB) are Analytical Instrumentation, Sensors and allied instrumentation, Medical Instrumentation and Healthcare Systems and Industrial Instrumentation.

### 7.9 Small Business Innovation Research Initiative (SBIRI)

The commercialization of new technologies and high-tech projects in various bio-tech industries need to be

accelerated to meet future challenges and realize full potential of bio-technology. The SBIRI is the new scheme launched by the Department of Bio-technology to boost public-private partnership efforts in the country. The distinctive feature of SBIRI is that its support to high risk, pre-proof of concept research and late stage development in small & medium scale companies led by innovators with science background which is unique in nature to support private industries and to get them involved in development of such products and processes which have high societal relevance. It will be expanded further in the form of soft loan upto Rs. 10 Crores for projects which have established the proof of concept and have ability to get venture capital funding. The scheme is new and the annual provision under this programme is Rs. 200 million.

The Department of Bio-Technology has supported a number of programmes on tissue culture, aquaculture, hybrid seeds, vaccine development, bio-fertilizers and bio-pesticides. Task forces of experts have been set up to identify research areas, generate projects and monitor the same. Some of these are on crop biotechnology, plant tissue culture, human genetics, food biotechnology, sericulture etc. DBT has also set up Biotech Consortium Ltd., for promoting, transfer and commercialization of Biotechnologies.



## 7.10 Other Promotional Programmes

A number of R&D projects have been initiated for technology development by the Ministry of Information Technology (MIT), through Technology Development Council (TDC), the National Radar Council (NRC), the National Microelectronics Council (NMC) and Electronic Materials Development Council (EMDC). The ministry is also implementing a R&D support program entitled FRIEND (Funding R&D in Electronics to Industry).

Department of Atomic Energy has been engaged in design and development of various systems for the nuclear power programme and for promoting peaceful applications of atomic energy, as well as, generating technologies in related high tech areas. They have established horizontal linkages with industry in the area of power generation equipment. They have diffused the use of radio isotopes in industry, medicine and agriculture. Over 60,000 consignment of different radio- pharmaceutical and radio-immunoassay kits were supplied for use in nuclear medicine enabling 7,50,000 patient investigations.

A number of spin-off technologies, which are not directly related to the nuclear energy programme, are transferred to many private and public sector companies for commercial exploitation. These are in

the field of electronics, nuclear and radiation instruments, super conductivity, robotics, computers, lasers, electron beam welding, high vacuum and plasma systems, chemical and metallurgical processes, bio-sciences, nuclear medicine, etc. In addition, consultancy services are provided to a large number of public sector companies for research, development and know-how generation in hi-tech areas.

Department of Space has used the development contract system effectively in the National Space Programme. Over 200 technologies have been transferred to the industry during the period 1983-97.

The Indian Space Programme has a strong interaction with the academic institutions in the country through its Sponsored Research Programmes (RESPOND). Nearly 300 research projects at 80 institutions, including universities, IITs, national laboratories, regional engineering colleges and public sector industries have been supported, so far, under the RESPOND programme. To cater to the increasing demand for space products and services from various space agencies, Department of Space has set up a commercial venture, "Antrix Corporation Ltd.," which would look after commercial aspects of technology transfer. This company would also handle consultancy services in India and export of space products and services.



The environmental research programme operated by the Ministry of Environment & Forests aims at developing strategies, technologies and methodologies by way of better facilities and infrastructure to facilitate research and training of man power for undertaking environmental research. The programme particularly aims at attempting solutions to the practical problems of resource management and provide necessary inputs for development and formulation of action plans for conservation of natural resources and restoration of degraded echo-systems and environment protection.

Research projects are funded in multi-disciplinary aspects of environmental protection, conservation and management at various universities, research and development institutions and reputed non-governmental organizations. These are supported under the main schemes of Man and Biosphere (MAB) Programme; Environmental Research Programme (ERP); Action-Oriented Research Programme for Eastern & Western Ghats; and Climate Change.

The Ministry of New & Renewable Energy is supporting R&D in Rural energy; Solar Energy; Energy from the Urban & Industrial Wastes; Power Generation- Wind, Biomass, Small Hydro; New Technologies- Chemical Sources, Hydrogen, Fuel Cell, Ocean & Geothermal Energy; materials, devices,

products and applications in various solar cell manufacturing technologies. The R&D support is open to industry directly as well as in association with any academic institutions/research organizations. Such proposals are supported on merit after appraisal by a research committee. The Ministry is supporting industry-linked projects, which have clear objectives and are goal-oriented projects. The Ministry has identified crystalline silicon solar cell/module technology as one of the areas where industry linked R&D will be supported. They have a programme on "Non-conventional Energy Technology Commercialization Fund (NETCOF)."

The Science and Technology programme of the Department of Mines was initiated in 1978, essentially to encourage R&D in the mineral and non-ferrous metal sectors. The programme covers areas of geology, exploration, mining and environment, beneficiation, metallurgy, ground control and rock mechanics and bioleaching. The project are approved and monitored by the Scientific Advisory Group under the chairmanship of Secretary (Mines). So far they have completed 135 projects.

The Ministry of Steel has also instituted a committee to look after the R&D needs in the steel sector. Government of India has decided to set aside certain



funds from the interest proceeds of the Steel Development Fund loans advanced to the main producers which would be used for financing R&D proposals received from the iron and steel sector for technology upgradation, pollution control, reduction in energy consumption etc.

Thus it may be seen that the Government has extended a whole hearted multiprong support to R&D in industry through the above Fiscal incentives and support measures.

## 8. AWARDS

### 8.1 DSIR National Awards for outstanding R&D achievements and commercialization of public funded R&D results

In order to provide recognition to the efforts of industry towards innovative research and competitive research and competitive technology development, DSIR instituted "National Awards for Outstanding in-house R&D achievements in industry" in 1987. These awards aim to recognise the efforts of industry not only in developing their own technologies, but also the efforts in absorbing/upscaling the technology developed by other research institutions or the efforts involving indigenisation of imported technologies. The awards are in the form of silver shields and are presented to award winning companies at the inaugural session of

the "Annual National Conference on In-house R&D in Industry" organized by DSIR. During the twenty year period 1988-2006, DSIR has presented 162 such awards in a wide range of sectors/ areas covering chemical and allied industries, drugs and pharmaceutical industries, biotech industries, electrical and electronics industries, mechanical industries, processing industries, agro industries, new materials, energy conservation, pollution control and environmental protection, technology absorption and for successful commercialisation of achievements of public funded R&D and R&D in non-commercial research institutions/organisations.

The Department of Scientific & Industrial Research, Ministry of Science & Technology, announced the winners of the National Awards for Outstanding In-house R&D Achievements (2007), in various sectors/areas of industry are:-

* *Chemical and Allied Industries*
  **Laila Impex, Vijayawada (A.P)**
* *Agro & Food Processing Industries*
  **Pest Control (India) Pvt. Ltd, Bangalore**

* *Pollution Control & Environmental Protection*
  **United Phosphorous Ltd, Vapi ( Gujarat)**

* *Mechanical Engineering Industries*
  **Minda Industries Ltd, Gurgaon**



* *Electrical Industries*
  **Crompton Greaves Ltd, Mumbai**

* *Electronics / Opto Electronics Industries*
  **Ananth Technologies Ltd, Hyderabad**

* *Computer Software*
  **Sasken Communication Technologies Ltd, Bangalore**

* *Technology Absorption of Imported Technologies*
  **Reliance Industries Ltd, Surat**

* *Successful Commercialization of Technologies acquired from others*
  **Tata Steel Ltd, Jamshedpur**

## 8.2 National Awards for successful commercialisation of indigenous technology

With a view to provide synergic partnership between industry and R&D, the Technology Development Board (TDB), has instituted two national awards for successful commercialisation of indigenous technology. The national awards are:

i) Cash award of Rs. 10 lakhs to be shared equally between the industrial concern that has successfully commercialized an indigenous

technology, and the developer/ provider of such technology. In-house R&D units of industry can also be the developer/ provider of the technology.

ii) Cash award of Rs. 2 lakhs to a SSI unit that has successfully commercialized a product based on indigenous technology.

These awards are given on Technology Day, which is celebrated every year on 11th May.

## 9. IMPORTANT ACHIEVEMENTS OF IN-HOUSE R&D UNITS

Sector wise achievements claimed by award winning R&D units are as follows:

### 9.1. AGRO AND FOOD PROCESSING INDUSTRIES

**Pest Control (India) Pvt Ltd, Bangalore**

The company has claimed to have successfully developed and promoted technology & products for environment friendly management of tissue borers of sugarcane using indigenously synthesized sex pheromones and patented water trap.

The technology to manage sugarcane borers could not be adopted due to the absence of indigenous



commercial pheromone synthesis facilities and a simple, cheap and portable water trap. The company established for the first time the commercial facility for pheromone synthesis and also developed protocols for pheromone synthesis for four sugarcane borers and designed & developed insect trapping device and made them commercially available. They have succeeded in scaling up production capacity from about 1 Kg of technical pheromone concentrate (in the year 2000) to the current level of 60 Kg per annum. The company was granted patent for portable water trap by patent on Feb 5, 2007.

The portable water trap developed under the project was also found to be effective in trapping other insect pests including brinjal shoot and fruit borer, diamond back moth of cabbage, etc. PCI has also started exporting some of the pheromone lures and the patented portable water trap.

### 9.2 CHEMICAL AND ALLIED INDUSTRIES

**Laila Impex, Vijayawada (AP)**

The company has claimed to have invented **5**-Loxin, a noval anti-inflammatory & anti- arthritic product. The product is a unique and synergetic composition of boswellic acids which is several times more potent than the traditional boswellia serrata extract. The product

has notched exports of over 8 million US$ and is key ingredient in "Osteo Bi-flex triple shield," the best selling joint care supplement in US for the year 2006-07.

The efficacy has been demonstrated in genetic level, cellular level, animal model and human clinical trials. Indian and Australian patents have been obtained. US and European patents are under process.

The company has exported the product valued at over 8 million US$ and it has a potential of over 100 million US$ per annum of exports from India. This is a significant achievement for Indian Herbal & Natural product industry in receiving world-wide recognition for a well researched product. 5-Loxin is the key ingredient in "Osteo Bi-flex triple shield", the best selling joint care supplement in US for the year 2006-07.

## 9.3 COMPUTER SOFTWARE

### Sasken Communication Technologies Ltd., Bangalore

The company has claimed to have conceptualised, designed and developed an optimized Multimedia Subsystem (wireless embedded software for mobile phones).



The Multimedia Subsystem has made a difference to the society by making multimedia communication accessible to a larger customer base on affordable handsets. The software helps people not only in satisfying the basic need of personal communication, but also adds multidimensional uses such as entertainment and spontaneous capture of images and video. This has the potential to be the pivotal technology for driving further adoption of the mobile handset, thus increasing the overall connectivity, which is paramount in countries with low teledensity such as India.

The Multimedia Subsystem IP ships on 45+ models and over 48 million phones across networks in Australia, China, Europe, Hong Kong, Japan and Taiwan earning development and maintenance license fees as well royalties for Sasken. The highlights are Sasken's IP was present in over 4% of the phones shipped in 2005; over 7% of phones shipped in 2006 across the world; 8 million phones in Japanese market carry Sasken multimedia software; over 45 models and over 48 million phones shipped with Sasken's wireless protocol stack and multimedia solutions to date

## 9.4 ELECTRICAL INDUSTRIES

### Crompton Greaves Ltd., Mumbai

The company claimed to have developed energy

efficient electronically controlled new generation brushless DC motors (Voyager railway carriage fan). Developed brushless DC railway carriage fans which are electronically controlled.34900 units have been produced so far. Value: Rs. 903 lakhs. 5 Patents and 2 design registrations filed.

The company claimed to have developed energy efficient electronically controlled new generation brushless DC motors ("Zephyr" telecom shelter fan).Developed brushless DC motor telecom shelter fans which are electronically controlled. Higher efficiency compared to conventional fans. Maintenance free due to the absence of brushes. Highly reliable with an estimated life of 2 years on continuous run basis compared to 1 year in case of conventional fans.9300 units produced so far. Value: Rs. 240 lakhs.

The company claimed to have developed brushless DC motor ceiling fans which are being electronically controlled. Power consumption is 50% less than the conventional fans. Higher efficiency, maintenance free due to the absence of brushes. Very compact having half the size & weight compared to conventional fans, eco-friendly due to the absence of carbon brushes. Highly reliable with an estimated life of 2 years on continuous run basis compared to 1 year in case of conventional fans.500 units have been produced on trial basis.



This Technology Programme is one of the 5 Technology Mission Programmes run by the CG Global R&D Centre, each focussing on development of energy efficient products and process technologies.

## 9.5 ELECTRONICS / OPTO ELECTRONICS INDUSTRIES

**Ananth Technologies Ltd, Hyderabad**

The company has claimed to have developed a 12-channel rotary telemetry system for monitoring the strain and temperatures from the blades of a rotating turbine. This system uses "non-contact" technology for power and data transfer. It has many advantages compared to conventional slip ring system.
This is a state-of-the-art technology and has the advanced features such as Non-contact power transfer using inductive coupling; High speed PCM digital telemetry upto 3 MBPS; Unique PWM technology for transferring control information from the stationary part to the rotating part; Fully software controlled advanced signal conditioners; Remote non-contact programmability in-situ on the rotors. Advanced digital modulation techniques; Advanced packaging technology to withstand the accelerations encountered during high speed rotations. 3 patents have been filed with respect to the 12-channel rotary telemetry

system, for Programmable signal conditioner; High bit rate RF receiver; Low power RF transmitter.

This product is applied for testing the gas turbines of Kaveri engine developed by GTRE/DRDO for Light Combat Aircraft (LCA) leading to a huge saving for the defence. The telemetry system has undergone rigorous qualification tests such as 3-axis vibration, thermal, spin test etc. Since it is a non-contact technology, the system can be operated for longer duration without any wear and tear which is a severe limitation in the conventional slip ring system. Two sets of the product/system valued at Rs. 5 crores have been produced and sold to DRDO so far.

## 9.6 MECHANICAL ENGINEERING INDUSTRIES

**Minda Industries Ltd., Gurgaon**

The company has claimed to have designed and developed "Intelligent illuminated non contact handle bar switch for motor cycle" with novel features such as non contact mechanism, illumination in handle bar switch, self cancellation blinkers and body control unit for motorcycle.

The newly designed control system include domain such as elector-magnetism, optics, and electronics and the system has been packaged in ergonomically



styled switch consoles. The whole product is covered by 2 patents each on non contact switching and self cancellation of blinkers respectively and 2 design registrations for left hand switch and right hand switch consoles by the company.

The product is already commercialized and mounted over Bajaj Pulsar 150cc, 180cc, 200cc Motorcycles. 400,000 units are running successfully on Indian roads since last 9-12 months. It has generated new business worth over Rs.50 crores. This new feature product has received an overwhelming response from the Two-wheeler users & manufacturers across the country.

## 9.7 POLLUTION CONTROL & ENVIRONMENTAL PROTECTION

**United Phosphorus Ltd., Gujarat**

The company has claimed to have developed and manufactured Gas Monitoring devices for fumigation industry, Flammable gas detection devices for industrial & domestic segments, Breath Alcohol Analyzer for Traffic police, railways, hospital and Gas Sensors.

The Gas monitoring devices developed by the company has taken into account for requirements of the

fumigation industry. As many as 6 varieties of gas monitoring devices are brought out namely methyl bromide gas monitor in the range of 0-200 mg/L, Funisence which can measure both MBr or $SO_2F_2$ and $PH_3$ on the same instrument , methyl bromide leak detector in the range of 0 -200 ppm , microprocessor based potable phosphine monitor etc.

The other products developed are flammable gas detection device for detecting leakage of LPG & CNG in industry or large scale hotels, the breath alcohol analyzers required for police departments, hospitals, railways, workers in factories who suspect to have consumed alcohol and the electrochemical sensors for monitoring gases like CO, $SO_2$, $H_2S$, NO, $PH_3$.

The handy BA Analyzer was able to fetch sales worth Rs. 11.54 Lakhs just after its introduction in the police department (Mumbai Police, Gujarat Police, Karnataka state transport etc). UPL is planning to promote these products to all the police department across the country in future.

## 9.8 SUCCESSFUL COMMERCIALISATION OF TECHNOLOGIES ACQUIRED FROM OTHERS.

**Tata Steel Ltd., Mumbai**

The company has claimed to have developed a process



to reduce the hexavalent chromium to trace levels (less then 0.01 ppm) in chromite concentrates by using an organic reductant known as Myrobalam in collaboration with Central Leather Research Institute, Chennai. Chromium presence in hexavalent state Chromium (VI), in any industrial operation is environmental unfriendly.

The Myrobalam which is obtained by grinding a naturally occurring forests plant nut known as Kasafal in Hindi (Botanical Name: Terminalia Chebula). It is basically a fruit of Indian tree Terminalia Chebula which contains around 40-60% tannin. For the First time, the Myrobalam is successfully used for reduction of hexavalent chromium in chromite concentrates to trace levels (i.e. less than 0.01 ppm, much below the permissible limit of 0.05 ppm).

This technology is implemented at chrome ore beneficiation plant, Sukinda, Tata Steel and successfully operationalized in November 2006. It has impacted the entire chrome ore business at Tata Steel, with cost savings of Rs 1.8 crores per annum compared to conventional technologies for hexavalent chromium treatment of chromite concentrates.

## 9.9 TECHNOLOGY ABSORPTION ( OF IMPORTED TECHNOLOGIES)

**Reliance Industries Ltd., Surat**

The Company claimed to have developed solid Catalyst external donor system for polypropylene technology based on current generation supported titanium catalyst system which enables polymer production without removal of catalyst residues due to higher productivity; polymer with desired molecular weight distribution; polymer with controlled degree of stereo-regularity without requiring removal of undesirable polymeric fractions. The catalyst developed comprises of supported catalyst external donor technology (RELCAT 10X and RELD1000). The solid catalyst technology (RELCAT 10 X) developed has resulted in saving of Rs. 130 crores on 100 ton of equivalent imported catalyst required for one million tons polypropylene production (Hazira and Jamnagar complex). Development of RELD 1000 has resulted in additional cost avoidance of Rs. 2.8 crores during 2006-07 in the production of 250 KT Raffia grade of PP. Collaborating organizations were NCL, Pune; Polymer Institute, Czech Republic and Gujrat Organics Ltd., Ankleshwar.



This is done for the first time in Reliance-Hazira among the other 10 licensees (Canada, Brazil, China, South Korea, Nigeria, Venezuela, Italy, Uzbekistan and GAIL India) operating globally. This project has a potential to export, the technology of cyclohexane recovery to other licensees.