# Sectoral Innovation Council on Industrial R&D – White Paper

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### White Paper

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A. Office Order

No. DSIR/TPDU/SInC/2011-12
Government of India
Ministry of Science and Technology
Department of Scientific and Industrial Research

4th January, 2012

ORDER

The National Innovation Council (NInC) seeks to create an eco-system to boost innovation performance in the country and evolve a strategy for fostering innovations at the National, State and Sectoral levels by focusing on five key parameters, viz. Platform, Inclusion, Eco-system, Drivers and Discourse. NInC has called upon Ministries / Departments to set up Sectoral Innovation Councils to drive innovative strategies in key sectors and prepare a Roadmap for the Decade of Innovations in the respective sector.

2. Department of Scientific and Industrial Research (DSIR) has decided to set up a Sectoral Innovation Council (SInC) on “Industrial R&D” with the following mandate:

Mandate

- Enabling India to emerge as global industrial research and innovation hub;
- Creating an enabling environment for nurturing the innovative potential at the National level; and
- Promoting development and utilization of new innovations and channelizing benefits of innovations to the people.

3. The Constitution of the Sectoral Innovation Council on Industrial R&D will be as follows:

Chairman:
- Dr. Arun Firodia, Chairman, Kinetic Engineering Ltd., Pune

Members:
- Prof. Dewang Khakhar, Director, Indian Institute of Technology, Mumbai
- Dr. Vivek Ranade, Scientist “H”, National Chemical Laboratory, Pune
- Mr. Santosh Kumar Mishra, Chief Scientist, Institute of Minerals and Materials Technology (IMMT), Bhubaneswar
- Shri H K Mittal, Adviser & Head (NEB), Department of Science & Technology
- Representative from Department of Biotechnology
- Dr. M.P. Wakdikar, Scientist ‘G’, Ministry of Earth Sciences
- Representative from Department of Information Technology
- Shri V.V.R.Sastry, Executive Director, C-DOT (Deptt. of Telecom)
- Dr. Bibek Bandyopadhyay, Adviser, Ministry of New and Renewable Energy
- Shri Anjan, Das, Executive Director, Confederation of Indian Industry
- Shri OP Bhutani, Director (Engg, R&D), Bharat Heavy Electricals Ltd.
Special Invitees:

xiii. Suitable experts / consultants may be invited as special invitees

Secretariat:

xiv. Shri Ashwani Gupta, Scientist ‘G’, DSIR — Member Secretary

xv. Shri S.K. Sharma, Head (Business Development)
Consultancy Development Centre

4. The council will assist the department in preparing a white paper outlining the innovation road map and thereafter, monitor implementation of the innovation road map. The Terms of Reference of the Innovation Council on Industrial R&D will be as under:

- Prepare a road map for making India an innovation hub;
- Prepare a strategy on promoting and supporting frugal innovations;
- Prepare a strategy for enhancing industry’s share in national R&D expenditure;
- Evolve a strategy so that India’s share in PCT filing is competitive with respect to China and Korea;
- Evolve a policy framework for promoting knowledge based enterprises;
- Evolve a strategy for setting up of MSME Cluster Innovation Centres;
- Suggest measures on process innovations relating to recognition of industrial R&D units, Scientific and Industrial Research Organizations (SIROs) and funding of R&D projects;

5. The expenditure involved in connection with the Council shall be met out of the budgeted outlay for the Plan Scheme of DSIR.

6. This issues with the approval of Secretary, DSIR.

(ASHWANI GUPTA)
SCIENTIST ‘G’

To,

1. Member Secretary, National Innovation Council, Office of the Adviser to Prime Minister on Public Information Infrastructure and Innovations, Planning Commission, Yojana Bhavan, Sansad Marg, New Delhi.
2. Chairman and All Members of the Sectoral Innovation Council
3. Office of the Secretary, DSIR, New Delhi
4. Shri V.K. Gupta, Sr. Adviser and Director, TKDL, New Delhi
5. Dr. K. Jayakumar, Joint Secretary, DSIR, New Delhi

(ASHWANI GUPTA)
SCIENTIST ‘G’
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## B. Road Map for Sectoral Innovation Council on Industrial R&D

### Mandate

- Enabling India to emerge as global industrial research and innovation hub;
- Creating an enabling environment for nurturing the innovative potential at the National level; and
- Promoting development and utilization of new innovations and channelizing benefits of innovations to the people.

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<tr>
<th>SNo</th>
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<th>Strategies &amp; Measures towards TOR</th>
<th>Targets for 2020</th>
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| 1.  | Prepare a road map for making India an innovation hub. | (i) **Science & engineering leadership**<sup>(1)</sup>  
  - Leverage knowledge & core strengths  
  - Transform old and create new connected institutions  
  - Establish hubs of scientific excellence  
  - Attract the best minds  
  - Mentor young researchers  
  - Benchmark internationally  
  - Network and source globally  
  
  (ii) **Nurturing talent in trans-disciplinary areas**<sup>(1)</sup>  
  - Grooming young minds (thru The Academy of Scientific and Innovative Research (AcSIR))  
  - Emphasis on research based education | (i) **Strive for global scientific impact**<sup>(1)</sup>  
  - Create five new research domains.  
  - International network with R&D Institution’s campuses in other nations of Africa and Asia.  
  - One exceptional publication of global impact every month. |
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2. **Prepare a strategy on promoting and supporting frugal innovations.**

   - **Mobile Exhibition of Innovations** \((^{(2)}\): To capture and disseminate frugal innovations, e.g. the database of more than 100,000 ideas maintained by the National Innovation Foundation, a mobile exhibition depicting these innovations may be taken around the country to create awareness among people and attract some entrepreneurs among the audience to take up commercial development of innovations of interest to them as well as dealers who will sell and service these products.

   - Generating more output from less resources for more people \((^{(2)}\).

   - **Innovative technology solutions** \((^{(1)}\)

   - To propagate technologies having applications for the common man and rural masses and to target that one million people benefit from CSIR 800 projects (aimed at bottom of the pyramid i.e. 800 million people in India) per year \((^{(1)}\).

   - Thrust on trans-disciplinary science and

- **disciplinary leadership** \((^{(1)}\)

- 1200 Ph.D. students and 2000 post graduates every year.

- Creation of 12 Innovation Complexes.
### Engineering

- More science in engineering & more engineering in science
- Fluid networked organization structure
- Identify & implement select mission mode projects
- Professional project management
- Create publicly owned and professionally managed facilities
- Run the last mile alongside industry with enthusiasm and energy

#### (iv) Open innovation and crowd sourcing (1)

- Create and harness open source platforms
- Connect with students across the country
- Distributed co-creation of technologies
- Produce public good on the web
- Involve stakeholders including NGOs & social entrepreneurs

---

#### 3. Prepare a strategy for enhancing industry’s share in national R&D expenditure.

| Quantum jump in R & D Expenditure by industry is to be planned. For this purpose following steps are suggested (2):
| (i) Govt. to give 50% Grant to recognized R&D Units (to support capital as well as revenue expenditure, including for setting up in-house R&D units).
| Increase industry’s R&D expenditure from present level of Rs. 33,934 cr. to Rs. 176,744 cr. by the end of 12th five year plan (2). |
(ii) To promote insurance companies for R&D investments. This will ensure that companies do not hesitate to earmark funds for R&D. It was suggested that to lessen the burden of premium on private companies, Government may share the premium appropriately (say 50%)

(iii) To provide support to the extent of 50% for VC funding as well as Seed and Angel funding into R&D intensive and high-tech areas of national priority as R&D spending.

A rating system for R&D establishments should be implemented. This will enable Govt. VC funds and Insurance Companies to freely give support to deserving institutions to ensure commercial success of products emerging out of it.

(iv) Support to Indigenous R & D by way of promoting consortium approach for projects of national importance.

4. **Evolve a strategy so that India’s share in PCT filing is competitive with respect to China and Korea.**

   **To focus on filing in production sector rather than services sector** (2): India contributes more in service sector as compared to the production sector, therefore it lags behind in filing PCT applications. Other factors that may account for growth in filings include multiple filings for the same

   - Continue to maintain CSIR’s position as possessing the largest patent portfolio in the Country (1).
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<td>5.</td>
<td>Evolve a policy framework for promoting knowledge based enterprises.</td>
<td>invention, patenting in new technological areas and generating new inventions.</td>
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<td>(i) Government to support Venture Capital Institutions (Government to refinance VCs through a fund) (2)</td>
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<td>(ii) “Idea To Production” time to be minimized (to set up co-operative research centres and readymade factory sheds) (2)</td>
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<td>(iii) Convert Know-how into “Products” and market them (evolve special incentives for technology transfer and commercialization organizations - like CSIR-Tech) (2)</td>
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<td>(iv) Government to bear 50% of academician's deputation cost to industry (2)</td>
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<td>(v) Evolve insurance facility for acceptance of products based on indigenous R&amp;D to promote product Commercialization (2)</td>
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<td>(vi) Technology Transfer to be made Mandatory in FDI deals in select sectors (2)</td>
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<td>(vii) Public Procurement plays a key role in promotion of R&amp;D and innovative technologies. Therefore, Government needs to be the anchor</td>
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<td>- Transfer 10 major cutting edge technologies a year for development/commercialization (1).</td>
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<td>- Facilitate 50 spin-off companies from R&amp;D institutions (1).</td>
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| 6. | Evolve a strategy for setting up of MSME Cluster Innovation Centres. | (i) Establish Sectoral Centres of Excellence (to upgrade industrial clusters in Moradabad, Rajkot, Ambala etc.) (2)  
(ii) Practical innovative projects to form part of engineering course (2).  
(iii) Enable innovations in Micro, Small and Medium Enterprises (MSMEs) by being their knowledge partner and mentor (1) | Catalyse inclusive innovation to benefit over 250,000 MSMEs (1) |

(viii) For major R&D investors and maha-ratna and nava-ratna PSUs, pre-qualification requirements for introducing new line of products and systems may be relaxed. For equipment procurement, the mandatory requirement of acceptance of L1 bid in the tendering process may also be relaxed. Also, procedure for engagement of highly competent national and international experts for projects of national importance may be simplified (2).

(ix) Facilitate start-up/spin-off companies using knowledge as equity (1).
| 7. | Suggest measures on process innovations relating to recognition of industrial R&D units, Scientific and Industrial Research Organizations (SIROs) and funding of R&D projects. | Evolve a standard recognition criterion and nurture other organizations/agencies who can act as attached offices of DSIR for grant of recognitions \(^{(2)}\). | To increase the number of in-house R&D Centres of industry from around 1600 to 4000 \(^{(2)}\). |

1. **Ref: CSIR@80: Vision & Strategy 2022**

2. **Ref: Recommendations by Sectoral Innovation Council Chaired by Shri Arun Firodia, Chairman, Kinetic Engineering**
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C. Summary of Recommendations by the 
Sectoral Innovation Council on Industrial R&D

1. **QUANTUM JUMP IN R & D EXPENDITURE:**

    Indian investments into the R&D sector have never exceeded 1% of GDP. On the other hand, many developed and emerging economies invest about 2% of GDP. Government’s intention is to raise R&D expenditure to 2% of GDP, 1% each from Public and Industry sector, at the end of the Twelfth Five Year Plan. According to the Approach Paper for the Twelfth Plan, the projected GDP in 2016-17 will be Rs 17,674,428 crore. Two percent of this amounts to Rs.3,53,488 crore. Thus Rs.1,76,744 crore each would have to be spent by Public and Private sector.

2. **NEED TO SET-UP 100 WORLD CLASS RESEARCH INSTITUTES AND UNIVERSITIES:**

    In order to absorb such vast expenditure, there is a need to have 100 world class Research Institutions. Land should be made available by the Government and Private / Public entities should be encouraged to establish a number of new Research Institutions and Universities in alliance with reputed Universities and Research Laboratories in the USA, Europe, Japan etc. Approval process for establishment of such collaborative Institutions should be simplified to speed up establishment of such institutions.

    The status of existing scientific institutions may also be examined and upgraded. They should be asked to take up specific research targets for development of technologies having wide spread applications in industry.

3. **EXPATS TO BE INDUCED TO RETURN TO INDIA:**

    Reputed Indian expatriates who have earned a name for themselves in global S&T space should be induced to return to India to guide existing or new Research Institutes. These highly qualified and competent expatriates should be scouted by High Powered Committee empowered to offer facilities to them across the table. The
facilities offered should take care of their and their family’s basic needs, especially their children’s education.

4. **ESTABLISH SECTORAL CENTRES OF EXCELLENCE:**

   There is a need to establish sectoral Centres of Excellence close to the industry clusters which have potential to become leading players in global supply chains. For example, Centres of Excellence could be established in Ambala for the scientific instruments and optics, in Rajkot for diesel engines, in Pune for auto-components, in Moradabad for Brassware etc.

   Government should assist local Chambers of Commerce to set up Testing Facilities in order to ensure conformity and compliance of International standards by products of the local manufacturers. Local Universities should be assisted to establish courses and labs in areas required by the Centres of Excellence. Also Government should bear 50% of travel expenses for entrepreneurs in these centres to visit exhibitions and take part in seminars worldwide.

5. **GOVERNMENT TO SUPPORT VENTURE CAPITAL INSTITUTIONS:**

   The private sector needs to assume a greater role in promoting Innovation in the country. The budding innovators should be catalyzed through venture capital institutions, who would ensure critical assessment of the funding required by the budding innovator. Government may co-invest along with the venture capital institutions to the extent of 50% and also refinance the Venture Capitalists through a Fund. This support should be extended in key priority areas where the country wishes to be a leader in the world.

   It may be noted here that, in a small way, the Technology Development Board (TDB) under DST provides soft loan @ 5% for commercialization of technologies and products. It also provides equity support to companies through venture capital funds.

6. **“IDEA TO PRODUCTION” TIME TO BE MINIMIZED:**
The budding innovators should be enabled to productionize their ideas at the earliest so that their enthusiasm is not killed in the time consuming start-up procedure which takes nearly two years. For this purpose, the Government should set up readymade factory sheds which can be rented to the innovators for a limited period. In this connection, it may be worthwhile to note that Cooperation Research Centres (CRCs) have been promoted in Australia as engines of innovation. These have at least one Australian university and one private sector participant. National Science Foundation (NSF) has also sponsored Engineering Research Centres (ERCs) in the US which have industry – university partnership with NSF acting as a catalyst. These research centres are equipped with all the facilities required for transforming an innovative idea into a model / prototype followed by up-scaling to pilot plant level and thereafter, commercialization. India may study these centres and adopt them suitably.

7. **GOVT TO GIVE 50% GRANT TO IN HOUSE R & D UNITS:**

In order to incentivise private companies in R&D, Government should give a grant to the extent of 50% of Capital as well as Revenue expenditure incurred in their recognized in-house R & D Unit. Such R&D units may have conditions that these are distinct from production units and the capital equipment in the R&D unit may not be used for production at least for 5 years after its deployment. The R&D programmes of the unit may be closely monitored by the Government in a manner, as desirable. The government should consider supporting all categories of industries, viz. large, medium and small, uniformly.

This support may be designed on the lines of infrastructural support provided to public funded S&T institutions under the FIST scheme of DST.

8. **CONVERT KNOW-HOW INTO “PRODUCTS” AND MARKET THEM:**

Many R & D Institutes develop “Products” which do not reach the market place. Agencies which act as a bridge between R & D Institutes and Market Place should be encouraged to be set up. These agencies will conduct market research, conduct
field trials of the products, develop know-how, apply for patents, obtain IPR, arrange angel funding and venture capital funding, and license them to Private Companies and subsequently, earn Know-how fee and royalties when the “product” is marketed.

A minimum of 50% of knowhow fee and royalties should be passed on to the R & D Institutes and balance may be retained by the Agency. Income of Agency should be tax-free. This will not only help in improving the competitiveness of our industries but will also benefit our consumers by supply of innovative products.

9. **GOVT TO BEAR 50% OF ACADEMICIAN'S DEPUTATION COST:**

In order to forge stronger linkages between academia and industry, there is a need to facilitate greater mobility of university faculty and industry professionals between universities / institutions and industry. Government should bear 50% of deputation cost of an academician to Industry.

It may be made mandatory for the faculty of technical educational institutions to acquire a minimum two years of industrial exposure before they are given the position of full Professors.

Also, Scholarships may be instituted for industry employees to pursue Ph.Ds. Just as Institution of Engineers offers A.M.I.E., which is recognized to be on par with B.E., they should also be allowed to offer a degrees which would be treated as equivalent to Ph.D.

10. **INNOVATION PROJECT TO FORM PART OF ENGINEERING COURSE:**

There is a need to assign simple but practical innovative projects to the engineering students as a part of their B.Tech./B.E. degree program. The teaching institutions should be equipped with innovation labs, which may be set-up using government funding, e.g. under the FIST (Funding for Infrastructure in S&T) scheme of DST.
11. **SUPPORT TO INDIGENOUS R & D:**

In order to encourage indigenous R&D in areas of national importance, a consortium approach should be adopted with active participation of all the stakeholders. Special considerations should be made available to the stakeholders in such projects of national importance. Some of the usual norms for procurement, vendor selection, audit etc. may be relaxed in case of such a consortium.

12. **PRODUCT COMMERCIALIZATION:**

Many Indian Companies insist that their intending suppliers must have a “Proven Track Record” while offering their products. This raises a question, how will the products based on indigenous R&D get a market? There is therefore a need to consider risk mitigation measures to facilitate acceptance of such products based on indigenous R&D. Insurance Companies should be encouraged to offer an insurance cover to the users/suppliers and 50% of the premium charged by the insurance companies should be subsidized by the Government.

Here again, it may be noted here that, in a small way, the Technology Development Board (TDB) under DST provides soft loan @ 5% for commercialization of technologies and products.

13. **TECHNOLOGY TRANSFER TO BE MADE MANDATORY:**

In order to enhance the technology depth of our industry, technology transfer should be made mandatory in approvals for foreign direct investment into the country.

14. **MOBILE EXHIBITION OF INNOVATIONS:**

To capture and disseminate frugal innovations, e.g. the database of more than 100,000 ideas maintained by the National Innovation Foundation, it is
recommended that a mobile exhibition depicting these innovations may be taken around the country to create awareness among people and attract some entrepreneurs among the audience to take up commercial development of innovations of interest to them. In the next phase, the agency which is engaged in dissemination of innovations must identify the dealers, suppliers and vendors to convert the innovations into marketable products.

15. **FACILITIES FOR PROFESSIONALS TO IMPLEMENT “PURA”:**

Providing Urban Amenities in Rural Areas (PURAs), as proposed by former President of India is extremely important to ensure inclusive growth. The need is to engage professionals belonging to rural areas in contributing towards the development of the areas from where they come from. “PURA” centres should also have facilities for professionals who will provide after sales service for the development projects of PURA.
1. Global R&D Scenario

1.1 Growth in R&D spending has resumed following recession-induced cuts in advanced economies, while growth in emerging nations continues unabated. Total global spending on R&D is anticipated to increase 3.6%, to almost $1.2 trillion (Table-1). With Asia’s stake continuing to increase, the geographic distribution of this investment will continue a shift begun more than five years ago. The U.S., however, still dominates absolute spending at a level well above its share of global GDP (Table-2).

U.S. research and development is so large compared to R&D performed in the rest of the world that its individual components are mostly larger in funding and structure than the entire spending of most other countries. R&D spending by the U.S. Dept. of Defense, for example, is larger in absolute spending than all countries except China and Japan and nearly 20% larger than that of Germany. Only China, Japan and Germany have R&D infrastructures at a scale comparable to the U.S. However, globalization of R&D is slowly altering the dominance that the U.S. has maintained for the past 40 years. The economies of China, Korea, India, Russia and Brazil, and their investments in R&D, are expanding at rates substantially higher than that of the U.S., Japan, and Germany. Table-3 gives the forecast of gross domestic expenditure on R&D for different countries. As a result, emerging economies are starting to challenge the technological and discovery capabilities of the historic R&D leaders. Globalization of R&D can be illustrated by multinational corporations, which are decentralizing their R&D organizations across advanced and emerging economies. This strategy optimizes the balance of cost and capability access (and often access to natural resources as well), and also provides synergy with commercial development of a wider range of local markets.

However, as wages in China and India keep rising, that will eventually reduce their cost advantages in the performance of R&D among other areas of international competition. The growing strength of the emerging nations and their high-tech organizations has also created a reverse flow of R&D investments from the emerging nations to the advanced nations. India’s pharmaceutical companies also have made
substantial acquisitions of European generic drug companies to gain market share of this growing industry. China’s Huawei Technologies, for example, has made substantial investments outside of China to become a global telecom leader.

| Table-1 |
|------------------|------------------|------------------|------------------|------------------|------------------|
| **Global R&D Spending Forecast** | **2009 GERD PPP Billions, U.S.$** | **2009 R&D as % of GDP** | **2010 GERD PPP Billions, U.S.$** | **2010 R&D as % of GDP** | **2011 GERD PPP Billions, U.S.$** | **2011 R&D as % of GDP** |
| Americas | 433.2 | 2.2% | 446.7 | 2.2% | 458.0 | 2.2% |
| U.S. | 383.6 | 2.7% | 395.8 | 2.7% | 405.3 | 2.7% |
| Asia | 372.5 | 1.9% | 400.4 | 1.9% | 421.1 | 1.8% |
| Japan | 139.6 | 3.4% | 142.0 | 3.3% | 144.1 | 3.3% |
| China | 123.7 | 1.4% | 141.4 | 1.4% | 153.7 | 1.4% |
| India | 28.1 | 0.8% | 33.3 | 0.9% | 36.1 | 0.9% |
| Europe | 267.0 | 1.7% | 268.6 | 1.6% | 276.6 | 1.7% |
| Rest of World | 34.2 | 1.2% | 34.8 | 1.2% | 36.3 | 1.2% |
| Total | 1,107.0 | 1.9% | 1,150.6 | 1.9% | 1,192.0 | 1.9% |

PPP, Purchasing Power Parity

Source: Battelle, R&D Magazine

| Table-2 |
|------------------|------------------|------------------|------------------|------------------|
| **Share of Total Global R&D Spending** | | 2009 | 2010 | 2011 |
| Americas | 39.1% | 38.8% | 38.4% |
| U.S. | 34.7% | 34.4% | 34.0% |
| Asia | 33.6% | 34.8% | 35.3% |
| Japan | 12.6% | 12.3% | 12.1% |
| China | 11.2% | 12.3% | 12.9% |
| India | 2.5% | 2.9% | 3.0% |
| Europe | 24.1% | 23.3% | 23.2% |
| Rest of World | 3.1% | 3.0% | 3.0% |

Source: Battelle, R&D Magazine
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<td>1</td>
<td>United States</td>
<td>383.6</td>
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<td>2.8%</td>
<td>2.3%</td>
<td>14,963</td>
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<tr>
<td>3</td>
<td>Japan</td>
<td>139.6</td>
<td>3.4%</td>
<td>142.0</td>
<td>3.3%</td>
<td>1.5%</td>
<td>4,339</td>
<td>144.1</td>
</tr>
<tr>
<td>4</td>
<td>Germany</td>
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<td>68.2</td>
<td>2.4%</td>
<td>2.0%</td>
<td>2,957</td>
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</tr>
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<td>5</td>
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<td>42.9</td>
<td>3.0%</td>
<td>4.5%</td>
<td>1,512</td>
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<td>6</td>
<td>France</td>
<td>41.1</td>
<td>2.0%</td>
<td>41.5</td>
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<td>1.6%</td>
<td>2,176</td>
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<td>7</td>
<td>United Kingdom</td>
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<td>1.7%</td>
<td>37.6</td>
<td>1.7%</td>
<td>2.0%</td>
<td>2,218</td>
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<tr>
<td>8</td>
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<td>33.3</td>
<td>0.9%</td>
<td>8.4%</td>
<td>4,193</td>
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<td>9</td>
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<td>1.8%</td>
<td>23.7</td>
<td>1.8%</td>
<td>2.7%</td>
<td>1,357</td>
<td>24.3</td>
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<tr>
<td>10</td>
<td>Russia</td>
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<td>1.0%</td>
<td>22.1</td>
<td>1.0%</td>
<td>4.3%</td>
<td>2,288</td>
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</tr>
<tr>
<td>11</td>
<td>Brazil</td>
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<td>0.9%</td>
<td>18.6</td>
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<td>4.1%</td>
<td>2,253</td>
<td>19.4</td>
</tr>
<tr>
<td>12</td>
<td>Italy</td>
<td>18.7</td>
<td>1.1%</td>
<td>18.7</td>
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<td>1.0%</td>
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<td>2.4%</td>
<td>18.2</td>
<td>2.3%</td>
<td>4.4%</td>
<td>839</td>
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</tr>
<tr>
<td>14</td>
<td>Spain</td>
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<td>1.3%</td>
<td>17.2</td>
<td>1.3%</td>
<td>0.7%</td>
<td>1,366</td>
<td>17.2</td>
</tr>
<tr>
<td>15</td>
<td>Australia</td>
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<td>1.8%</td>
<td>3.5%</td>
<td>907</td>
<td>15.9</td>
</tr>
<tr>
<td>16</td>
<td>Sweden</td>
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<td>3.4%</td>
<td>11.6</td>
<td>3.3%</td>
<td>2.6%</td>
<td>366</td>
<td>11.9</td>
</tr>
<tr>
<td>17</td>
<td>Netherlands</td>
<td>10.5</td>
<td>1.6%</td>
<td>10.6</td>
<td>1.6%</td>
<td>1.7%</td>
<td>681</td>
<td>10.8</td>
</tr>
<tr>
<td>18</td>
<td>Israel</td>
<td>8.8</td>
<td>4.3%</td>
<td>9.1</td>
<td>4.2%</td>
<td>3.8%</td>
<td>223</td>
<td>9.4</td>
</tr>
<tr>
<td>19</td>
<td>Austria</td>
<td>8.2</td>
<td>2.5%</td>
<td>8.2</td>
<td>2.5%</td>
<td>1.6%</td>
<td>339</td>
<td>8.3</td>
</tr>
<tr>
<td>20</td>
<td>Switzerland</td>
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<td>2.3%</td>
<td>7.4</td>
<td>2.3%</td>
<td>1.7%</td>
<td>327</td>
<td>7.5</td>
</tr>
<tr>
<td>21</td>
<td>Belgium</td>
<td>6.8</td>
<td>1.7%</td>
<td>6.8</td>
<td>1.7%</td>
<td>1.7%</td>
<td>402</td>
<td>6.9</td>
</tr>
<tr>
<td>22</td>
<td>Turkey</td>
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<td>0.7%</td>
<td>6.7</td>
<td>0.7%</td>
<td>3.6%</td>
<td>983</td>
<td>6.9</td>
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<tr>
<td>23</td>
<td>Poland</td>
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<td>0.5%</td>
<td>3.6</td>
<td>0.9%</td>
<td>3.7%</td>
<td>738</td>
<td>6.9</td>
</tr>
<tr>
<td>24</td>
<td>Mexico</td>
<td>5.8</td>
<td>0.4%</td>
<td>6.0</td>
<td>0.4%</td>
<td>3.9%</td>
<td>1,599</td>
<td>6.4</td>
</tr>
<tr>
<td>25</td>
<td>Finland</td>
<td>6.1</td>
<td>3.2%</td>
<td>6.1</td>
<td>3.1%</td>
<td>2.0%</td>
<td>200</td>
<td>6.3</td>
</tr>
<tr>
<td>26</td>
<td>Singapore</td>
<td>5.7</td>
<td>2.4%</td>
<td>6.0</td>
<td>2.2%</td>
<td>4.5%</td>
<td>287</td>
<td>6.3</td>
</tr>
<tr>
<td>27</td>
<td>Denmark</td>
<td>4.9</td>
<td>2.4%</td>
<td>4.9</td>
<td>2.4%</td>
<td>2.3%</td>
<td>213</td>
<td>5.1</td>
</tr>
<tr>
<td>28</td>
<td>Norway</td>
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<td>1.6%</td>
<td>4.1</td>
<td>1.6%</td>
<td>1.8%</td>
<td>263</td>
<td>4.2</td>
</tr>
<tr>
<td>29</td>
<td>Czech Republic</td>
<td>3.7</td>
<td>1.4%</td>
<td>3.7</td>
<td>1.4%</td>
<td>2.2%</td>
<td>273</td>
<td>3.8</td>
</tr>
<tr>
<td>30</td>
<td>South Africa</td>
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<td>0.7%</td>
<td>3.6</td>
<td>0.7%</td>
<td>3.5%</td>
<td>526</td>
<td>3.7</td>
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<tr>
<td>31</td>
<td>Portugal</td>
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<td>1.2%</td>
<td>2.8</td>
<td>1.2%</td>
<td>0.0%</td>
<td>239</td>
<td>2.8</td>
</tr>
<tr>
<td>32</td>
<td>Argentina</td>
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<td>0.4%</td>
<td>2.6</td>
<td>0.4%</td>
<td>4.0%</td>
<td>641</td>
<td>2.7</td>
</tr>
<tr>
<td>33</td>
<td>Ireland</td>
<td>2.6</td>
<td>1.4%</td>
<td>2.6</td>
<td>1.4%</td>
<td>2.3%</td>
<td>191</td>
<td>2.6</td>
</tr>
<tr>
<td>34</td>
<td>Greece</td>
<td>1.8</td>
<td>0.5%</td>
<td>1.8</td>
<td>0.6%</td>
<td>-2.6%</td>
<td>318</td>
<td>1.7</td>
</tr>
<tr>
<td>35</td>
<td>Hungary</td>
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<td>0.9%</td>
<td>1.7</td>
<td>0.9%</td>
<td>2.0%</td>
<td>201</td>
<td>1.7</td>
</tr>
<tr>
<td>36</td>
<td>New Zealand</td>
<td>1.3</td>
<td>1.2%</td>
<td>1.4</td>
<td>1.2%</td>
<td>3.2%</td>
<td>123</td>
<td>1.4</td>
</tr>
<tr>
<td>37</td>
<td>Romania</td>
<td>1.3</td>
<td>0.5%</td>
<td>1.3</td>
<td>0.5%</td>
<td>1.5%</td>
<td>269</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>Country</td>
<td>2008</td>
<td>2009</td>
<td>2010</td>
<td>2011</td>
<td>2012</td>
<td>2013</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>--------------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>Slovenia</td>
<td>0.8</td>
<td>1.3%</td>
<td>0.8</td>
<td>1.4%</td>
<td>2.4%</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>Slovak Republic</td>
<td>0.5</td>
<td>0.4%</td>
<td>0.5</td>
<td>0.4%</td>
<td>4.3%</td>
<td>129</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>Iceland</td>
<td>0.3</td>
<td>2.3%</td>
<td>0.3</td>
<td>2.3%</td>
<td>3.0%</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>

Source: International Monetary Fund, R&D Magazine, Battelle

1.2 In a Global Researcher Survey, as conducted by Battelle, the 378 respondents ranged from CEOs to laboratory analysts, and are located in 38 different countries. Of course, given the nature of the survey, slightly more than half (53%) came from the U.S. The results, however, include respondents from the UK, Japan, India, Russia and China. The respondents are involved in R&D activities across a range of technologies and from a wide variety of organizations. The largest share of the respondents, 38%, comes from the broadly defined life sciences technology domain. The second largest share comes from the energy generation and technology domain, accounting for 12% of the global respondents. The third largest share, from a broadly defined advanced materials (including chemicals) domain, represents 10% of the respondents. The remaining 40% come from a number of segments spanning electronics, IT, transportation, agriculture/food production and environmental technologies. The group as a whole has a fairly optimistic view of research in the future, with only 20% expecting decreases in their industrial R&D funds in 2011 and just 23% expecting decreases in their government R&D funding.

The researchers were asked about their most critical R&D challenges as researchers, not their specific scientific and technical challenges (Table-4). The results provide some unique insights into the global research community. While it may not be surprising, there is significant unanimity among the research community both here and abroad in the issues they face; however, no single issue is an overarching concern in the entire global research community. Overall issues of importance are very similar, but there are some interesting differences worth mentioning. The most critical challenge across the board was dealing with budget limitations, but U.S. researchers expressed this issue as being a critical challenge at a higher rate than their non-U.S. counterparts. A similar result also is found in the overall availability of development time. The ongoing concern in the U.S. regarding the outsourcing of R&D activities also is reflected in the findings, with a larger share of U.S. researchers concerned about the challenges involving outsourcing.
Interestingly, a slightly higher share of non-U.S. researchers felt that both intellectual property issues and skilled worker shortages are going to be critical challenges for them in 2011. Finally, though a much lower concern overall, U.S. researchers reported legal issues will be a critical challenge for them in 2011 at twice the rate of non-U.S. researchers.

Table-4

<table>
<thead>
<tr>
<th>Area</th>
<th>U.S. Researchers</th>
<th>Non-U.S. Researchers</th>
<th>All Researchers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited Budget</td>
<td>41%</td>
<td>33%</td>
<td>37%</td>
</tr>
<tr>
<td>Development Time</td>
<td>37%</td>
<td>30%</td>
<td>34%</td>
</tr>
<tr>
<td>Competition</td>
<td>35%</td>
<td>31%</td>
<td>33%</td>
</tr>
<tr>
<td>Collaboration</td>
<td>31%</td>
<td>33%</td>
<td>32%</td>
</tr>
<tr>
<td>Cost-Savings Requirements</td>
<td>30%</td>
<td>28%</td>
<td>29%</td>
</tr>
<tr>
<td>Intellectual Property</td>
<td>22%</td>
<td>24%</td>
<td>22%</td>
</tr>
<tr>
<td>Skilled Worker Shortages</td>
<td>16%</td>
<td>19%</td>
<td>17%</td>
</tr>
<tr>
<td>Technology Solutions</td>
<td>17%</td>
<td>18%</td>
<td>17%</td>
</tr>
<tr>
<td>Globalization</td>
<td>15%</td>
<td>14%</td>
<td>15%</td>
</tr>
<tr>
<td>Outsourcing</td>
<td>17%</td>
<td>10%</td>
<td>13%</td>
</tr>
<tr>
<td>Product Prioritization</td>
<td>13%</td>
<td>15%</td>
<td>13%</td>
</tr>
<tr>
<td>Product Qualification</td>
<td>9%</td>
<td>11%</td>
<td>10%</td>
</tr>
<tr>
<td>Legal Issues</td>
<td>12%</td>
<td>6%</td>
<td>9%</td>
</tr>
<tr>
<td>Cost of Instrumentation</td>
<td>6%</td>
<td>9%</td>
<td>7%</td>
</tr>
<tr>
<td>Product Safety</td>
<td>6%</td>
<td>8%</td>
<td>7%</td>
</tr>
<tr>
<td>Energy Use</td>
<td>6%</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Inflation Costs</td>
<td>2%</td>
<td>5%</td>
<td>3%</td>
</tr>
</tbody>
</table>

Source: R&D Magazine, Battelle

The respondents were also asked whether certain global issues or concerns had any direct bearing on their future R&D efforts (Table-5). In this area there were marked differences between U.S. and non-U.S. researchers. Three areas, Healthcare for the Aging, Demand for Renewable/Sustainable Energy and Global Population Growth, made the top five for both respondent groups. U.S. researchers, perhaps reflecting both a market orientation and a significant biomedical representation in the respondent set, elevated both Growth in Consumerism in Emerging Markets and the Threat of Global Pandemics into their top five. Non-U.S. respondents, perhaps reflecting a larger environmental industry presence among them, included Climate Change/Global Warming and Environmental Clean-up and Remediation among their top five.
### Table-5

**Key Global Issues of Importance Impacting Future R&D Efforts**

<table>
<thead>
<tr>
<th>U.S.</th>
<th>Non-U.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthcare for the Aging</td>
<td>Demand for Renewable/Sustainable Energy</td>
</tr>
<tr>
<td>Demand for Renewable/Sustainable Energy</td>
<td>Global Population Growth</td>
</tr>
<tr>
<td>Global Population Growth</td>
<td>Climate Change/Global Warming</td>
</tr>
<tr>
<td>Growth in Consumerism in Emerging Markets</td>
<td>Healthcare for the Aging</td>
</tr>
<tr>
<td>Threat of Global Pandemics</td>
<td>Environmental Clean-up/Remediation</td>
</tr>
</tbody>
</table>

*Source: R&D Magazine, Battelle*

Finally, the global researcher community was asked to provide its insights into what countries were doing leading edge R&D work (across all performers) by asking them to select their top three leading countries in each of nine technology areas (Table-6). The overall top five is fairly consistent regardless of whether the respondents were U.S. or non-U.S. researchers. One unique point worth noting is that non-U.S. researchers often included as their “third” best country, examples that often were not mentioned by U.S. researchers.

### Table-6

**Global Researcher Views of Leading Countries in R&D by Technology Area**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>USA</td>
<td>USA</td>
<td>USA</td>
<td>USA</td>
<td>USA</td>
<td>USA</td>
<td>USA</td>
<td>USA</td>
</tr>
<tr>
<td>China</td>
<td>USA</td>
<td>Japan</td>
<td>Germany</td>
<td>Japan</td>
<td>India</td>
<td>USA</td>
<td>Japan</td>
<td>USA</td>
</tr>
<tr>
<td>India</td>
<td>Germany</td>
<td>Japan</td>
<td>Germany</td>
<td>Russia</td>
<td>Japan</td>
<td>India</td>
<td>USA</td>
<td>USA</td>
</tr>
<tr>
<td>Brazil</td>
<td>Japan</td>
<td>China</td>
<td>Israel</td>
<td>South Korea</td>
<td>Japan</td>
<td>China</td>
<td>China</td>
<td>Germany</td>
</tr>
<tr>
<td>Japan</td>
<td>China</td>
<td>UK</td>
<td>UK</td>
<td>Germany</td>
<td>Germany</td>
<td>South Korea</td>
<td>France</td>
<td></td>
</tr>
</tbody>
</table>

*Source: R&D Magazine, Battelle*

### 2.0 Vision for India to attain Global Leadership in S&T

#### 2.1 India’s economy is projected to grow between 7% and 9% annually over the next five years, well ahead of the projections for most countries. India is becoming
very active in collaborating and doing business with established R&D leaders. India’s record for R&D investments has not always been robust. While setting goals for the past several years to increase its R&D to GDP ratio to more than 1%, its actual performance has seen a stable ratio over the past several years at 0.9%. Of this spending, 0.61% is attributable to government R&D investments, which have been increasing over the past several years. Industrial investments in Indian R&D have risen 10% over the same period. India’s technology strength is dominated by its service sector; 60% of its “knowledge-intensive production” comes from this area, according to the Indian Central Statistics Organisation. India has acquired a significant amount of technological knowledge through its industrial acquisitions. For example, the Corus takeover by Tata Steel has brought with it more than 80 patents and 1,000 researchers, thus giving Tata immediate access to the technological capacity of the acquired firms. India’s exports are dominated by low-tech products; less than 20% of the value of its exports are classified as high-tech. However, India is still the world’s largest exporter of information technology products. India also has a strong pharmaceutical sector, with more than $20 billion in annual revenues, ranking it third behind only the U.S. and Japan, with a 10% share of the world market. There are more than 5,000 pharmaceutical firms in India, employing about 340,000 people. The pharmaceutical industry is also one of the most innovative industries in India in terms of R&D spending and the number of patents granted in both India and abroad. India accounts for about 25% of the world’s generic drug production and has 25% of the drug master files with the U.S. Food and Drug Administration. India also has the highest number of FDA approved production facilities of any country in the world.

2.2 Robust growth of Indian economy points to the distinct possibility of the country emerging as a major global economic power by 2025. In the global knowledge economy, leadership in science, technology and innovation would become crucial. To this end, Scientific Advisory Committee (SAC) to PM has presented a National Vision for Science to enable global leadership. 2.

Objectives of R&D in the country:

- R&D needs to be carried out for development of:
- technologies focusing on future needs of the country;
- technologies involving usage of improved materials (light weight, improved life);
- technologies aimed at optimum utilization of natural resources;
- technologies for improving internal processes/systems, (e.g.) cost effectiveness, low emission, etc.;
- technologies promoting urbanization entailing mass transportation; and
- technologies supporting grid connected renewable energy power plants.

- In order to position the products to be close to customer requirement, R&D needs to be directed towards improved design performance, better ergonomics, cost efficiency, energy efficiency, enlarging the product life cycle etc.

- In order to encourage indigenous technology development, Government may consider FDI only with mandatory condition of transfer of technology to India;

- There is a need for accessing IPR registered by foreign companies for Indian companies at reasonable cost;

- Indian testing and research laboratories to be accredited to International standards by suitable agencies for Indian R&D to be globally accepted.

Some of the recommended strategic interventions are:

i. Carefully plan an increase in the density and volume of manpower in the Research and Development sector by about 60% from current levels during the Twelfth Plan period

ii. Identify a dozen India-centric Grand Science Technology and Innovation challenges with potential for global impact and sets of dedicated groups to pursue them without structural confinements or tight resource limitations.
iii. Identify 100-200 research groups to create a number of centres around individual and teams of scientists with proven track record of performance. Make long term investments in them through flexible grants for reprioritization among investments into revenue expenditures for making global impact.

iv. Energise the university system with special funding and procedural flexibility. Mandate all PSUs and companies to spend a specified share of their profit for funding research in universities and elite institutions with a provision for matching funding support by the government. (This could be part of the proposed CSR spending likely to be specified in the new Companies Act).

v. Provide Research and Development grants to performing universities and centres of excellence with flexibility for enhancing international research collaboration. A dedicated funding provision could be set aside for such global collaboration in identified priority areas.

vi. Establishment of non-homogenous clusters for co-locating various players of the innovation ecosystem, so as to promote work across – and at the intersection of – disciplinary boundaries.

vii. Challenge prizes and awards of major grants for research in selected areas (e.g., energy, environment, health, agriculture, water and sanitation) after connecting research competencies and resources.

viii. Launch a scheme of 1000 doctoral and post-doctoral overseas fellowships for training of young scientists in chosen centres abroad in selected areas of national priorities.

ix. Networking Indian Institute of Science, Indian Institutes of Science Education and Research, and National institutes of Technology with other institutions and colleges for enrolling researchers from academic institutions into research and development.

x. Establish more inter university and inter institutional centres.

xi. Establish a flexible and focused meeting of minds to foster public private partnerships with a changed mind-set: moving from a grant-centric approach, to creating of enabling research synergies.

xii. Set up good schemes for summer training of youth, sabbaticals for career scientists, and for mentoring future and youthful leaders in science.
3.0 Current Status of Indian Industry's Investment in R&D

3.1 As per R&D Statistics 2007-08 published by Department of Science & Technology, National Investment on R&D activities attained a level of Rs. 28776.65 crore in 2005-06 which was 0.89% of Gross Domestic Product (GDP). Sectorwise percentage share of various stakeholders were: Central Government (57.5%); state government (7.7%); higher education (4.4%); public sector industries (4.5%); and private sector industries (25.9%). The National Investment on R&D is estimated to be Rs. 32941.64 crore in 2006-07 and Rs. 37777.90 crore in 2007-08.

3.2 Investment on R&D activities by 1755 Industrial Sector R&D units attained a level of Rs. 8748.47 Crores at current prices for the year 2005-06. For the Private and Public Sector industries separately, the R&D expenditure was Rs. 7444.21 Crores and Rs. 1304.26 Crores respectively. Industrial Sector R&D expenditure constitutes 30.4% of the national R&D expenditure of Rs. 28776.65 Crores in the year 2005-06. For Private and Public Sector separately the share was 25.9% and 4.5% respectively. The Industrial Sector investment on R&D for the year 2005-06 worked out to be 0.27% of the Gross National Product (GNP) at current prices. Industrial R&D expenditure increased from Rs. 4576.37 Crores in 2002-03 to Rs. 5562.30 Crores in 2003-04 to Rs. 7296.84 Crores in 2004-05 and further to Rs. 8748.47 Crores in 2005-06 representing an increase of 21.5%, 31.2%, and 19.9% respectively. Based on the past trend, the projected R&D expenditure for the year 2006-07 and 2007-08 are of the order of Rs. 10617.29 Crores and Rs. 12893.23 Crores respectively. It may be seen that investment on R&D by Private Sector industries has more than doubled from Rs. 3498.30 Crores in 2002-03 to Rs. 7444.21 Crores in 2005-06 as a result of 28.6% compounded annual growth rate. It may also be mentioned here that the share of Private Sector investment in total national investment on R&D has increased from 19.3% in 2002-03 to 25.9% in 2005-06, whereas the share of Public Sector industries in national investment has decreased from 6.0% to 4.5% during this period. It may not be out of place to mention here that the Private Sector R&D expenditure during this period has increased at the faster pace than Public Sector R&D expenditure.
3.3 The R&D expenditure as percentage of sales turnover for Industrial Sector worked out to be 0.55% for the year 2005-06 while for the Private and Public Sector separately, the figures were 0.66% and 0.30% respectively. It may be mentioned here that the R&D expenditure as percentage of sales turn over for a number of developed countries of the world varies between 3.0% and 4.0%.

3.4 The total R&D expenditure of Industrial Sector, Private Sector (excluding non-commercial 350 SIRO units) and Public Sector were apportioned into 41 industrial groups on the basis of the products manufactured by them. Out of 41 industrial groups identified, 13 leading industry groups arranged in descending order of their expenditure spent 91.6% of total Industrial Sector R&D expenditure in 2005-06. It may be seen that Drugs & Pharmaceuticals group with 161 units occupy the first place in terms of R&D expenditure with Rs. 2828.89 Crores (37.4%). This was followed by Transportation and Defence Industries with 14.7% and 6.9% respectively during 2005-06. In the same manner if one looks at the Public/Private Sector industries data separately, the trend changes. In Public Sector, Defence Industries alone accounted for 38.8% followed by Fuels Industry groups with 24.2%. In case of Private Sector, the R&D expenditure of Drugs & Pharmaceuticals group was the highest accounting for 45.1% followed by Transportation with 16.7%. Other sectors in which private sector R&D investments took place were electrical & electronics, chemicals, IT, bio-technology, metallurgical and telecom. It may be safely concluded from the above discussion that R&D expenditure in industry was concentrated in some industry groups only.

3.5 The heterogeneity in the size of R&D expenditure for different industry groups between Private and Public Sector in-house R&D units was quite significant. According to the available data, per unit R&D expenditure for Industrial Sector as a whole was maximum for Defence Industries, i.e. Rs. 32.60 Crores and majority of these industries were under Public Sector. Similarly, the per unit R&D expenditure for the industry group Drugs and Pharmaceuticals was Rs. 17.57 Crores next to Defence Industries followed by the group Transportation with Rs. 17.44 Crores. When the per unit R&D expenditure of Public Sector was separately looked into, Defence Industries ranked first followed by Industrial Machinery, Fuels, Telecommunication and Transportation Industries. Among the Private Sector
industry groups, this was maximum for Drugs and Pharmaceuticals Rs. 18.12 Crores succeeded by Transportation, Information Technology and Soaps, Cosmetics and Toilet Preparations. The per unit R&D expenditure of Public and Private Sector, when all units taken, was Rs. 11.65 Crores and Rs. 5.66 Crores respectively. This may be mainly due to the existence of a large number of R&D units of small scale industrial category and also Private Sector R&D units are heterogeneous in size in terms of R&D resources input. It may be interesting to note from this table that variation in size of R&D investment was quite high between different industry groups. It may also be observed heterogeneity in the size of R&D expenditure for different industry groups between public and private sector was also quite significant.

**R&D in India**

![Fig 1](image)

**Fig. 1**

**NATIONAL R&D EXPENDITURE AND ITS PERCENTAGE TO GNP**

<table>
<thead>
<tr>
<th>YEAR</th>
<th>R&amp;D EXP (Rs. Crores)</th>
<th>GNP%</th>
</tr>
</thead>
<tbody>
<tr>
<td>90-91</td>
<td>5000</td>
<td>0.05</td>
</tr>
<tr>
<td>95-96</td>
<td>7000</td>
<td>0.07</td>
</tr>
<tr>
<td>98-99</td>
<td>10000</td>
<td>0.10</td>
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<tr>
<td>03-01</td>
<td>15000</td>
<td>0.16</td>
</tr>
<tr>
<td>02-03</td>
<td>20000</td>
<td>0.21</td>
</tr>
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<td>03-04</td>
<td>25000</td>
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<td>04-05</td>
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</tr>
<tr>
<td>06-07</td>
<td>40000</td>
<td>0.63</td>
</tr>
<tr>
<td>07-08</td>
<td>45000</td>
<td>0.65</td>
</tr>
</tbody>
</table>
Fig. 2
GERD (%) by Public Sector & Private Sector

Fig. 3
SECTOR-WISE GROWTH OF R&D EXPENDITURE
Fig. 4

R&D EXPENDITURE BY LEADING INDUSTRY GROUPS, 2005-06

INDUSTRY GROUPS
- Soaps, Cosmetics, Toiletries
- Telecommunications
- Metallurgical Industries
- Bio-Technology
- Information Technology
- Fertilisers
- Chemicals (Other Than Fertilisers)
- Electricals & Electronics
- Defence Industries
- Transportation
- Drugs & Pharmaceuticals

R&D EXPENDITURE (Rs. Crores)

[Graph showing R&D expenditure by leading industry groups, 2005-06, with data points for public and private sectors.]
4. Schemes in various government departments to promote industry’s investment in R&D

4.1 Department of Scientific & Industrial Research:

Department of Scientific & Industrial Research operates an “Industrial R&D Promotion Programme” wherein it is responsible for:

- Recognition / Registration of in-house R&D units established by corporate industries, Scientific & Industrial Research Organisations (SIROs) established by industry, individuals etc. and Public Funded Research Institutions;

- Implementation of Fiscal incentives for scientific research announced by Ministry of Finance from time to time.

Sector-wise Break-Up of In-house R&D Units of industry recognized by DSIR

<table>
<thead>
<tr>
<th>Sector</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical and Electronics industries</td>
<td>422</td>
</tr>
<tr>
<td>Mechanical Engineering industries</td>
<td>278</td>
</tr>
<tr>
<td>Processing industries (Metallurgical, Refractories, Paper, Cement, Ceramics, Leather and others)</td>
<td>212</td>
</tr>
<tr>
<td>Agro including Biotechnology and food processing industries and others</td>
<td>162</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1745</strong></td>
</tr>
</tbody>
</table>

Out of the above units, 341 units spend between Rs.1 crore and Rs.5 crore on R&D and 196 units spend more than Rs.5 crore on R&D.

Major fiscal incentives to promote industrial R&D:

- Weighted tax deduction @200% on in-house R&D expenditure to companies engaged in the business of bio-technology or in the business of manufacture or production of any article or thing not being an article or
thing specified in the list of the eleventh schedule. *(Section 35(2AB) of the Income Tax Act).*

*R&D Investments by industries, certified by DSIR have increased from around Rs. 1500 crore in 2005-06 to around Rs. 3000 crore in 2010-11.*

- Weighted tax deduction @200% for sponsored research programmes in approved national laboratories, Universities and IITs, available to the sponsor. *(Section 35(2AA) of the I.T. Act).*

- Income-tax exemption @175% 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).*

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

- Central Excise duty exemption to R&D institutions and scientific & industrial research organisations, both for capital equipment and consumables needed for R&D. *(Notification No. 10/97-Central Excise, dated 1st March 1997).*

- Central 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).*
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).*

(i) **Technology Development and Demonstration Programme (TDDP):**

The objective of the scheme, which was operated till the end of 11th five year plan was development and demonstration of innovative need-based technologies for making industry competitive. The technology development projects aimed at development of a new product or a process (including development of process equipment) with attractive market potential in any sector leading to industrially useful applications. The partial financial support by DSIR primarily covered prototype development, cost of pilot plant, cost of process equipment development, test and evaluation of products, user trials etc. Bulk of the financial support to the projects had to be from industry’s resources.

Company were required to pay lump sum royalties in five annual instalments amounting to 1.3 times the value of grant received, upon successful commercialisation, i.e. after start of commercial sale/commercial production of the product developed with TDDP support.

During the 11th Five Year Plan, support has been provided to 75 projects of industries for innovative technology development and demonstration in sectors such as drugs and pharmaceuticals, chemical, biotechnology, IT, metallurgy, automotive components, mechanical and electrical engineering, etc. involving a project cost of around Rs.520 crores and DSIR commitment to support around Rs.200 crores. Total royalty payments received from around 60 successfully commercialized projects out of over 200 projects so far is around Rs. 15 Crores. Out of the 75 projects supported in 11th Plan, another 40 projects are expected to be successfully commercialized in the next three years, raising the cumulative royalty collection to an estimated value of Rs. 50 crore. Completed projects are estimated to have resulted in production of Rs.750 Cr (approx) and Excise & Sales Tax/VAT revenue generation of
approx. Rs.100 Crores, besides generation of employment and contemporary products.

In the 12th five year plan, this scheme has been subsumed in the new scheme – PACE (Patent Acquisition and Collaborative Research and Technology Development) wherein, besides support to industries collaborative projects of industry and R&D/academic institutions also shall be supported for technology development and demonstration including patent acquisition cost. Further, repayment amount by industry shall be 1.1 times the DSIR grant.

(ii) Council of Scientific & Industrial Research

New Millennium Indian Technology Leadership Initiative:

The New Millennium Indian Technology Leadership Initiative (NMITLI) seeks to build, capture and retain for India a leadership position by synergising the best competencies of publicly funded R&D institutions, academia and private industry. NMITLI has so far evolved more than 60 largely networked projects in diverse areas viz. Agriculture & Plant Biotechnology, General Biotechnology, Bioinformatics, Drugs & Pharmaceuticals, Chemicals, Materials, Information and Communication Technology and Energy. These projects involve around 100 industry partners & 300 R&D groups from different institutions. Approximately 1800 researchers are engaged in these projects.

4.2 Department of Science & Technology:

(i) Drugs & Pharmaceutical Research

Recognising the profound influence of R&D on the prospects and opportunities for the growth of the Indian Drug Industry, Department of Science and Technology (DST), Government of India mounted the programme on drug development during 1994-95 for promoting collaborative R&D in drugs and pharmaceuticals sector.
Under the programme many industries – institutional alliances have been funded. Besides, a number of state-of-the-art infrastructure facilities for pharmaceutical R&D have been created in premier institutions.

During January 2004, Government of India established **Drug Development Promotion Board (DDPB)** under the administrative control of DST for supporting R&D projects jointly proposed by industry and academic institutions/ laboratories and to extend soft loan for R&D to drug industry. Soft loans have been extended to pharma industry for R&D.

**(ii) Technology Development Board (TDB)**

The Government of India constituted the Technology Development Board (TDB) in September 1996 as a statutory body under the Department of Science and Technology, as per the provisions of the Technology Development Board Act, 1995.

The mandate of the TDB is to provide financial assistance to the industrial concerns and other agencies attempting development and commercial application of indigenous technology or adapting imported technology for wider domestic application. The financial assistance from TDB is available in the form of loan or equity and/or in exceptional cases, grant.

As on 31\(^{st}\) March 2011, TDB has signed a total of 248 agreements (since its inception in 1996) with a total project cost of Rs.3524.12 crore involving TDB’s commitment of Rs.1092.22 crore against which TDB has disbursed Rs.954.64 crore from the grants provided by the government and through internal accruals.

As pro-active role, TDB has also supported six Venture Capital funds with a commitment / participation of Rs.175.00 crores leveraging total funds aggregating to Rs.1203.00 crores from other investors. In addition, TDB has
provided grant assistance of Rs.1.00 crore each to 24 incubators under the Seed Support Scheme.

(iii) Technology Information, Forecasting & Assessment Council (TIFAC)

(a) Collaborative Automotive Research (CAR) Programme

The programme was implemented during the years 2003 to 2010. During the period 2005-2010, the programme funded 10 projects, based on the ‘CAR Technology Roadmap’ prepared earlier by TIFAC. The projects resulted in the following five prototype systems developed and demonstrated:

- Engine Management System for Petrol Powered Small Vehicles.
- Vehicle Tracking and control Systems using GPS/GSM technologies.
- Acoustic Diagnostics for 2 wheeler engine assembly line
- Low Cost Flexible Automation using Robotic Arms
- Wi-Fi Based Vehicle Tracking

The first two have already been commercialized, signifying private sector investments. Others have good commercialization potential.

The projects also resulted in developing three novel manufacturing technologies listed below and results of which were shared with industry in the first two projects:

1. Development of Tailor Welded Blank and Hydroforming Technology for Automotive Weight Reduction
2. Process Development in Semisolid Forming and Squeeze Casting of Aluminium Alloy Components for Automobiles
3. Development of Automobile Components through Electromagnetic Forming (EMF) Process

(b) Bioprocess & Bioproducts Programme
The programme was launched in 2007 with the aim to address critical technology needs for biotransformation & enzymatic processes towards development of active pharmaceutical ingredients, nutraceuticals, phytochemicals, value-added bio-products, bio-energy & bio-fuels. Under the scheme 10 technology development/demonstration projects have been supported and 5 have been completed.

(c) TIFAC-SIDBI Revolving Fund

This new programme named was launched by TIFAC on November 1, 2010, as a joint TIFAC-SIDBI Technology Innovation initiative. Under the scheme, TIFAC set up a Revolving Fund with Small Industries Development Bank of India (SIDBI) to fund industries particularly MSMEs for scaling up/commercialization of innovative technologies pertaining to novel/innovative product or process to prove the techno-economic viabilities of commercially unproven technologies. This would encourage and promote innovation capabilities and bring high-risk technology innovations to the market in emerging technology areas for opening up new business opportunities. This Program gives TIFAC the opportunity to assess innovative technologies. Two projects are now in the implementation phase. Two other projects have now been recommended for funding after technical appraisal.

4.3 Department of Biotechnology

(i) Small Business Innovation Research Initiative (SBIRI)

The Department of Biotechnology (DBT) invites proposals from Indian Companies under the SBIRI Scheme for support of early stage, pre proof-of-concept research & development of research leads towards commercialization in all fields of biotechnology.

The key objectives are:
• to provide support for early stage, pre-proof-of-concept research in biotechnology by industry,
• to support late stage development and commercialisation of new indigenous technologies particularly those related to societal needs in the healthcare, food and nutrition, agriculture and other sectors,
• to nurture and mentor innovative and emerging technologies / entrepreneurs, to assist new enterprises to forge appropriate linkages with academia and government.

Since its launching in September 2005, the department has sanctioned over 100 projects of which around 50% of the projects have been completed and significant achievements have been noted.

(ii) Biotechnology Industry Partnership Programme (BIPP)

The BIPP scheme was approved by the Cabinet in November 2008 for implementation during the 11th plan with an allocation of Rs. 350 crores for the plan period. The present scheme on Biotechnology Industry Partnership Programme (BIPP) is a government partnership with Industries for public support on a cost sharing basis. More than 70 projects have been supported.

(iii) Bio-incubators

The Department has been supporting Biotech Parks and Incubators under BIRAP also support for Bio-incubators is being extended. A call was announced to establish New Generation Biotechnology Incubators in the Biopharma, Bio-agriculture, Industrial Biotechnology, Bio-energy and other areas of Life sciences. Support has been provided for 5 Incubators.

4.4 Ministry of Steel

Investment in R&D in Indian Steel Sector, including the private sector is quite low and currently vary in the range of 0.15 to 0.25% of the sales turnover. Having
noted the very low investment in R&D and large scope for R&D in the sector, the Cabinet Committee of Economic Affairs (CCEA) in 1997-98 decided that investment upto Rs. 150 Crore per annum may be made from the interest proceeds of Steel development Fund (SDF) on R&D in the steel sector. Under this scheme 68 R&D projects have been approved since 1998 till 2011 with total project cost of Rs. 544 with SDF assistance of Rs. 263 crore. So far 35 projects have been completed and the results of some of them have been found positive and already implemented in the Industry in improvement in productivity, reduction in energy consumption and pollution etc. The private industries that have been involved in these projects include MECON, Usha Ispat Ltd., Modern Steel Ltd., TISCO, Ispat Metallics, Kalyani Carpenter Special Steels, Facor Alloys and Electrotherm and their own investment in the projects have been to the tune of Rs. 40 crore.

R&D with Govt. Budgetary support during 11\textsuperscript{th} Plan:

The Government has allocated Rs.118 crore with SDF assistance, for promotion of R&D in Iron & Steel Sector during the 11\textsuperscript{th} Five Year Plan. As per the approval of the Expenditure Finance Committee (EFC) the three broad areas to be pursued under this scheme are:

- Development of innovative/ path breaking technologies for utilization of iron ore fines and non-coking coal.
- Beneficiation of raw materials like iron ore, coal etc. and agglomeration.
- Improvement in quality of steel produced through the induction furnace.

Eight R&D projects have so far been approved within the aforesaid 3 broad areas with a total cost of Rs.144 crores involving Plan Fund of Rs.96.23 crores (approx). Actual work in these projects started w.e.f. 2010-11. The funding for these projects have gone to public funded R&D institutions, viz. NML, IMMT, RDCIS, and IIT Kharagpur.

Major projects covered under the scheme include exclusive R&D initiatives to upgrade Indian low grade iron (including BHQ/BHJ) and Indian coking/non-coking coal. Presently, these projects are at the preliminary stage of work but when
completed, and if results are successful; these may go a long way in making available high quality inputs from lean ore/coal for the iron/steel industry.

Other initiatives of Ministry of Steel

Notwithstanding the above initiatives of the Government, actual investment on R&D by the steel companies has remained low and Government needs to take some innovative measures to promote R&D in the steel sector. Ministry of Steel has recently published a “A Roadmap for Research & Development and Technology for Indian Iron & Steel Industry”, identifying thereby certain key R&D programmes of national importance and strategies. The roadmap also impress upon the need for increasing R&D investment to 1% of turnover by the end of 12th Five Year Plan and 2% of turnover by end of 13th Five Year Plan by the Indian steel companies.

4.5 Ministry of New and Renewable Energy (MNRE)

Research, Design and Technology Development

The Ministry has identified thrust areas in which R&D efforts are required. Ministry considers R&D proposals which are directly related to the activities/programmes of the Ministry and hold promise for commercialization in near future. The thrust areas mainly covers programmes, such as, Rural Energy; Solar Energy; Energy from Urban & Industrial Wastes; Power Generation-Wind, Biomass, Small Hydro; New Technologies- Chemical Sources (fuel cells), Hydrogen, Ocean & Geothermal Energy; etc.

Industry Involvement in R&D

- R&D projects may be taken up by Universities, research institutions, R&D laboratories and industry, individually or as a consortium.
- A profit making industry registered with Department of Scientific & Industrial Research for in-house R&D may submit an R&D project in the prescribed form, to the Ministry for support. The industry is
expected to share 50% of the cost of the project and Ministry supports to the extent of remaining 50%.

- A consortium of industry, academic institutions, research laboratory and R&D institution etc., may be formed to undertake a R&D project. Clear role and tasks of each member of the consortium will have to be clearly defined. Consortium members will also be required to share at least 50% of the cost of the project. MNRE funds will be released to the implementing institution in the consortium selected by consortium members. Implementing institution will be responsible for the entire expenditure and for other terms and conditions of the project.

- An industry may join hands with the Ministry to entrust an R&D project to an R&D institution/research laboratory or an academic institution. Funds in this case will be released to the concerned implementing institution which will also be responsible for the entire expenditure and other terms and conditions MNRE support up to 50% of the cost of the project will be available.

- Financial assistance for RD&D projects that involve partnership with industry should normally be restricted to 50% of the project cost. However, any proposal from Universities, Government research institutions etc. Ministry may provide upto 100% funding, depending on project priority.

- In all the above three models, industry/institution contributing 50/50% of the cost will have the right on commercialization of the technical know-how.

4.6 Department of Information Technology

(a) Multiplier Grant Scheme (MGS)

Multiplier Grants Scheme (MGS) encourages collaborative R&D between industry and academics/ R&D institutions for development of products and packages and bridge the gap between R&D and commercialization.
Aim:

The aim of the scheme is to encourage industry to collaborate with premier Academic and Government R&D institutions (hereafter also called institute) for development of products/packages.

Description

i. In this scheme, if an industry supports innovation at institute(s) and commits its resources [say x], the Government would commit a Grant of \([n \times x]\) to the Institutes, where ‘n’ is the multiplication factor. The multiplication factor ‘n’ may vary up to a maximum of 2, and would be recommended by a committee of experts on a case-to-case basis.

ii. The contribution of industry and grant-in-aid from DIT will be given to academic / R&D institution(s) only. The industry contribution should be remitted to the institution in cash (cheque/DD/RTGS etc.) so that the same could be duly certified by the academic/R&D institution(s) for the purpose of release of grant-in-aid from DIT in an apportionate manner as per the recommendation of the Working Group. The Government grants would cover specific items of expenditure under the project, namely equipment, consumables, manpower, Travel & Training, contingencies, and overheads if any; The overheads admissible in the project will be limited to 15% of the total of the project.

iii. The contribution of industry and grant-in-aid from DIT will be given to academic/R&D institution(s) only.

iv. The company must retain the know-how in India and could do further R&D to create products and IPR in India.

(b) Technological Incubation and Development of Entrepreneurs (TIDE) Scheme

Department of Information Technology’s (DIT) Technological Incubation and Development of Entrepreneurs (TIDE) scheme was launched in the year 2008. The Scheme has multipronged approach in the area of Electronics, ICT
and Management. Some of the broad objectives of the scheme include the following:

- Setting up and strengthening Technology Incubation Centres in institutions of higher learning;
- Nurturing Technology Entrepreneurship Development for commercial exploitation of technologies developed by them;
- Promoting product oriented research and development;
- Encourage development of indigenous products and packages; and
- Bridging the gap between R&D and commercialisation.

At present the scheme is being implemented at 15 TIDE centers. Eventually the scheme proposes to support 27 TIDE centers and 2 virtual incubation centres over a period of 4 years. Recognizing the importance of Technology Incubation, many institutions of higher learning have already taken initiatives to nurture this activity. Steps include policy measures, creating appropriate frameworks, infrastructure support, entrepreneurial- training and IPR facilitation. The incubation centers provide a host of services to new enterprises and facilitate networking. The centre networks with Angel Investors and Venture Capitalists(VCs) who provide mentoring and financial support to the startups. The centre also enables the tenant companies to gradually mature over a period of 2-3 years and then shift to a commercial place for transacting actual business. The faculty is keenly involved in startup activity thus ensuring interaction between education and industry and alignment of education with the market requirements. DIT provides financial and policy support for strengthening technology incubation activity with the promise that this would in the long run result in indigenous development of products and packages in Electronics as well as IT sectors.

5.0 Targets proposed by the Government

5.1 National Targets for S&T Sector for the Twelfth Plan are:
i. Global Share of Publications : >5%
ii. Global Ranking in SCI publications : better than sixth
iii. Global Ranking in Number PCTs : better than tenth
iv. FTEs in R&D personnel : 2,50,000
v. PhDs outputs in whole Science sector : 12,500 per year
vi. Public: Private Sharing of investments : 50:50
vii. Gender parity in EMR funding(PI ratios) : better than 60:40
viii. The relative global rank in patent portfolio : better than ninth
ix. Commercialization of patents : better than 5% levels
x. Share of high technology content in exports: better than 20%
xii. Global Ranking in innovation index : better than 25th
xiii. Establishment of Section 25 companies : In select sectors

5.2 **Targets for R&D:** Indian investments into the R&D sector have never exceeded 1% of GDP. On the other hand, many developed and emerging economies invest about 1.5 to 2% of GDP. Although promises have been made that India would invest about 2% of GDP into R&D, actual investments have not kept pace with the desired levels. This is partially because the size of the R&D base and absorption capacity is not commensurate with the requirements. With the Government’s intention to raise R&D expenditure to 2% of GDP, 1% each from Public and Industry sector, at the end of the Twelfth Five Year Plan, the allocation to Six Science Departments also has to be raised during the Twelfth Plan. According to the Approach Paper for the Twelfth Plan, the projected GDP in 2016-17 will be Rs 17,674,428 crore. Two percent of this amounts to Rs.3,53,488 crore. Thus Rs.1,76,744 crore each would have to be spent by Public and Private sector. Table 7 below provides the Scenario where 2% of GDP is spent on R&D with 50% share each from Public and Corporate Sector Spending. Based on these projections/calculations, five year scenario of Plan provisions for the Six Science/Agencies has been arrived at. With this proposed allocation, the % share of S&T Plan outlay for six Departments with respect to Central Plan outlay will have to be increased to 5.54% from the current level of 4.6%.
Table 7

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<tbody>
<tr>
<td>Projected GDP -Rs. in crore</td>
<td>8980860</td>
<td>10283085</td>
<td>11774132</td>
<td>13481381</td>
<td>15436181</td>
<td>17674428</td>
</tr>
<tr>
<td>R&amp;D expenditure as % of GDP</td>
<td>0.9</td>
<td>1.06</td>
<td>1.24</td>
<td>1.45</td>
<td>1.7</td>
<td>2</td>
</tr>
<tr>
<td>R&amp;D Investment</td>
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<td>145999</td>
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<td>Central Plan outlay (prop)</td>
<td>335521</td>
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<tr>
<td>S&amp;T Plan outlay of Six Deptts</td>
<td>15334</td>
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<td>28740</td>
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<td>S&amp;T Plan as % of Central Plan</td>
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<td>4.94</td>
<td>5.26</td>
<td>5.63</td>
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* Estimated

5.3 Targets for scientific publications and density of scientists:

Although there are some incremental improvements with respect to volume of scientific publications from India, the national science and technology sector aims to significantly enhance its global ranking from the current 9th to 6th by the end of Twelfth Plan. At current per capita outputs of scientific publications from Indian R&D personnel, 62,500 scientific publications in the year 2017, would require 2,50,000 Full Time Equivalent in R&D and PhD outputs of 12,500 in science and engineering by the end of Twelfth Plan. This calls for increase in the volume of FTEs of R&D personnel by nearly 60% within five years. India could target a share of about 5% of scientific publications by 2017. Expansion of volume of FTEs would require a
combination of twin strategies of both recruitment of new R&D personnel and enrolling of latent potentials in academic and university sector through special schemes. Since excellence can not be created in short spans of time, preferred strategy for building excellence targets is to invest into people with proven track records. The Indian share of publications in top 1% of impact making publications as of 2006 is 0.54%. A target for Indian share of top 1% publications by 2017 is 1.5%. For this, creation of 150 centres around performing individuals and teams of performing individuals is proposed. This investment is to be based on transparent methodologies for selection of individuals based on the record of performance over the past five years. Parameters like h-index and citation analysis would become necessary tools. Careful applications of such tools are necessary.

5.4 Targets for increase the volume of patents and Intellectual Properties:

Currently there are incremental increases in the number of patents filed by Indians for work in India as well as PTC applications of Indians and Indian entities. The share of 16-20% of Indian work in patents filed in India does not auger well for the country. Overseas entities are filing large number of patents in India at the present time. Corresponding share of China for patents filed by Chinese for work done in China is higher than 80%. While conservatism of Indian R&D professionals may be responsible for lower number of patents being filed by Indians for work in India, there is a need to alter the social behaviour of Indian researchers with respect to filing patents. Doubling the number of patents filed by Indians for work done in India would seem practical target for the Twelfth Plan period.
Private sector prioritizes their investment into intellectual properties which bear potentials for commercialization in preference to scientific publications; engagement of private sector into R&D seems the most preferred option. This may require a policy environment to alter the behaviour of private sector and increase their investment into R&D. New policy changes for investing patents from the public funded research as sweat equity as a general practice could be considered. Such instruments may be already available for agencies like CSIR. A more general policy may be explored. Commercialization of the 5-6% of patent portfolio available with most public funded bodies may seem a realistic national target.

5.5 Attraction of Indian Diaspora for R&D in India

Other Asian economies have adopted several aggressive tools and mechanisms to attract their Diaspora for R&D positions. India may need to develop and position new schemes to provide Start up research grants to returning Diaspora for undertaking research in at least public funded institutions. An active reverse brain drain policy to attract the scientist and engineers back home and designing an attractive repatriation package to incentivize overseas scientist and engineers to government labs can be a mechanism to build local capabilities for technology development. Under the prevailing circumstances in R&D institutions in the country, a lag phase of 2.5-4 years is observed for gaining measurable R&D outputs from
new inductees into R&D positions. There is a need to shorten the lag phase in R&D centres through several local actions and initiatives. One of the enabling schemes, especially for researchers returning to India after training and active research in established centres is a scheme for providing a start-up grant of Rs 50 lakhs for a period of three years under Extra Mural Research funding systems delivered through the institutions hiring such personnel.

5.6 Technology Innovation Centres (TIC) in Frontier Areas:

There is a need to drive the development of highly innovative technologies in frontier areas which can provide global leadership to India. The Centres equipped with state of the art facilities, source the requisite manpower nationally or internationally at competitive salaries. These centres are different from the present research institutions, in the sense that they are subject specific and pool together all the resources, including IPs for developing commercially viable technologies in the frontiers of science.

6. Role of various stakeholders in R&D

6.1 Indian corporate sector’s engagement into R&D:

Indian corporate companies are acquiring large companies abroad. Through this model, such companies gain access to technologies as well as market share. Establishment of in-house R&D units and ensuring a supply chain of technologies leading to innovation and technology led manufacturing are essential investments for large corporate companies. Currently, large enterprises are expected to allocate a certain percentage (2%) of their profit for Corporate Social Responsibility. Large Indian companies must be urged to consider support to R&D in public funded institutions as a part of corporate social responsibility.

R&D activities by MNCs such as GE, Motorola, Texas Instruments, CISCO, DuPont, Honda etc. have created enclaves for world class technological development and have helped the creation of a pool of highly skilled scientists and technologists through setting up their R&D centres in India. Large Indian companies may be
encouraged to establish similar centres. Many of them are now global companies with large interests worldwide in metals, engineering, energy, medicine, etc. and they have the organizational and financial capacity to recruit top class S&T personnel from across the world.

Transition during the Twelfth Plan is in providing a policy environment for large companies in India to invest into a) in house R&D, b) R&D in public funded institutions and Corporate Social Responsibility and c) commitments up to 2% of sales turnover into R&D.

6.2 **R&D in public funded institutions:**

Suitable budget related incentive schemes for academic and research institutions could be designed for attracting private sector funds into R&D in public funded institutions. Currently fiscal tax incentives are offered to industry for supporting research in public funded institutions. R&D incentive plan grants could be offered to public funded institutions if they attracted private sector funds for R&D and earned out of royalty incomes from commercialization of technologies. A scheme which offers 400% of royalty incomes earned as plan grant for academic and research institutions could be considered.

6.3 **Role of Public Sector for Research in Strategic Sectors:**

The innovative component of several technologies that have been developed by the three strategic Departments of Atomic Energy, Space and Defence Research and Development, for their own respective needs, could trigger unique mechanisms for encouraging innovation and ensuring the right impact on social, industrial and strategic sectors in the Twelfth Plan. Examples of successful spin offs such as automatic weather stations, fleet monitoring equipment and telemedicine systems developed by ISRO; the instrumented pipeline inspection gauges, food processing/irradiation technologies developed by DAE and biomedical instruments, diagnostic kits and bio toilets for water scarce areas developed by DRDO are but a few examples of the enormous potential that exist for further technology transfers to industrial and service sectors. In order to facilitate this, special directorates have
been set up at the headquarters of the three Departments essentially to serve as a clearing house of the relevant information on technologies and also to coordinate, share and exchange information leading to new strategies on the deployment of these technologies. Linkage with the industry associations is another dimension which would need additional thrust in the Twelfth Plan.

It must also be recognised that many of India’s urgent high-tech needs some of them strategic would not be addressed by industry on commercial consideration alone. Here industrial production should be started in industry, with support of R&D from universities and national laboratories with Government financial support but with strategic control to prevent take over by foreign entities. Public sector has to play important role in this.

6.4 **Role of MSME Sector:**

MSMEs due to their size and low profitability are not in a position to undertake R&D activities at a globally competitive level. It would be necessary for the State to support these companies through R&D to position competitively in the global market place. It is felt that a cluster based R&D access system is well suited to them.

National Innovation Council has also suggested a similar approach. But the efforts need to be expanded on a much larger scale. Some recommendations are:

i. To facilitate and fund technology imports through hard currency for specified Export oriented sectors;

ii. To assist development including reverse engineering of equipments / machinery to move away from exclusive dependence on imports;

iii. To encourage and promote Foreign Direct Investment flows into SME sector for technological up gradation and modernization;

iv. To promote partnership between government, universities, R&D institutions and private sector industry, particularly SME sector to develop innovations;

v. To facilitate development of Technology parks to promote new start-ups;

vi. To supported SMEs to develop their own Brands for product marketing rather remain as simple intermediaries supplier through technological up gradation;
Accordingly it is suggested:

- to establish **R&D and Innovation Support Centres** equipped with most modern facilities at select locations to cater to a group of MSMEs, preferably in Public-Private (75:25) partnership mode. These centres will carry out application oriented R&D activities in specified S&T areas that are relevant to the cluster. A suitable model needs to be evolved to operationalize these centres with participation of the industries from the cluster.

- Since the SME sector, due to their low R&D intensity, are unable to compete with established industries in drawing the benefits of the government promoted R&D schemes, a special scheme exclusively focusing on the SME sector may be mounted covering some of the above aspects. This initiative could be catalysed by the office of Principal Scientific Adviser to GoI and at an appropriate time will be transferred to an appropriate agency.

As a strategy, the country needs to encourage its industry to aggressively undertake such technology acquisition. Government may create a Global Technology Acquisition Fund with an initial contribution of US $ 1 billion. Indian firms can source the funds for acquisition of IP/ Knowledge / technology intensive foreign venture/start-up firms. The support could be through equity or a loan.

6.5 **Forging and Nurturing Industry – Academic Linkages:**

The level of industry – University / academia / R&D institutions linkages in India needs to be enhanced. The ‘synergy projects’ of the office of Principal Scientific Adviser to Government of India (PSA) encourages Industry – Academic linkages. Other possibilities are:

- Office of PSA has proposed a R&D programme to encourage ‘**Directed Basic Research**’. This programme supports industry – Academia / research institution linkage projects in all fields that aims to expand the knowledge of the industrial processes, Understand know-why, improvements in industrial processes and generally address the applied research concerns of the industry. The proposals
will come from industry, but the research will be carried out at R&D institutions or academic institutions / universities. The required funding will be shared between the government and industry in a ratio of 70:30. The programme may need a sum of about Rs. 30 crore in the first year, which eventually may grow to Rs. 100 crore per year in Twelfth FYP. PSA office could manage the programme for the first three years to set the implementation model and then transfer the programme to an S&T department of the Government.

- Office of PSA has proposed sponsored research wherein for every rupee invested by the industry on R&D, at least Rs 0.3 to be made available as a special incentive to be drawn from a ‘Technology Innovation Fund’, to be set up by Government, for sponsoring projects at public or private funded R&D and academic institutions as well as universities.

6.6 Public-Private-Partnership – Replicating model of CRC:

If one examines the history of innovation in Japan and more recently in Korea and China, one notices the role of strong intervention of public investment in key areas of knowledge and technology development in partnership with private industries to leap frog the innovation chain. Even the more advanced nations like USA, Germany and Australia have an elaborate system for leveraging public investment in research and development with industrial partnership in order to achieve national innovation goals. In USA, the National Science Foundation (NSF) operates two schemes to bring industry-academia-and research organizations together on a single platform and provides support for a specific period to achieve clearly articulated objectives. These platforms where collaborative innovation takes shape are known as NSF supported “Engineering Research Centres (ERCs)” and “Industry-University Cooperative Research Centres (I/UCRCs)”. In Australia, where the system of R&D infrastructure and governance is similar to India, there is a thriving programme operated by the Department of Industry, Innovation and Education, known as the “Cooperative Research Centre (CRC)” scheme, where Australian government invests with matching contributions from industry. Annexure-I may be seen for details. The Germans have Fraunhofer Society Institutions (FhG) that get government support for privately driven research programmes. The principle
of dovetailing public investment in innovation with private/industry or market and end-user driven objectives under the active oversight of government is well accepted and have delivered successful results.

In India we have various government funded programmes in laboratories, and universities for running collaborative projects. But these programmes have less flexibility in bringing together other researchers or developers from outside organizations into the collaborative fold under one umbrella. Thus the extent and success of these collaborative projects in accelerating industrial innovation are not very encouraging barring few exceptions here and there. Therefore we need to create a mechanism where under an independent entity, technology generators typically from university or research laboratory and end-users from industry can be brought together to meet the common needs of knowledge development and innovative deployment of results in a win-win situation. This independent entity or special purpose vehicle may be supported partially from public exchequer for a limited period to clearly achieve the articulated goals falling within national priorities.

The model of CRC varies slightly in features across various counties where it has been implemented. Most countries like China, Korea, Japan, Germany, USA, UK have made similar schemes operational. An expert group consisting of representatives from research organizations, academia and industry associations may go into the details of PPP cooperative research centre schemes operational in different countries to distil the most suitable features and adapt the same for India keeping in view our national needs and priorities.

6.7 **Synergistic efforts of all stakeholders in National Missions:**

PAN India mission mode projects addressing national needs and priorities should be launched, through extensive participation of stakeholders, in the areas of Health, Water, Energy, food and environment security with the objective to achieve the goals and targets in a defined time frame.

Major research concerns for Agriculture sector relate to water management, soil degradation and fatigue; genetic erosion, increasing biotic and abiotic pressures;
inefficient energy management; inadequate markets and unfavourable trade, increasing knowledge lag; management and protection of farm produce and harvest and post harvest losses. Furthering R&D efforts in precision agriculture using space technology inputs for detailed assessment of biotic and abiotic stresses, creation of spectral library for various crops and soils and application of microwave remote sensing and polarimetry for soil moisture, crop identification etc. is essential. Resource Conservation Technologies for improving input use efficiency and choice and responsible use of biotechnology tools and realistic assessment of their potential in crop and livestock improvement are essentially needed for new generation designer crop plants; bio fortification of staple food crops, pre breeding for resistance/ tolerance to various stresses; microbial genomics in search of new genes; and research solutions for secondary agriculture. There is also a need to review the present state of agriculture education with the aim at improving and sustaining quality of higher agriculture education for addressing emerging challenges for livelihood security and sustainable development. It is also necessary to re-examine the architecture of agricultural extension services in the country.

7.0 **Industrial R&D related recommendations in the National Manufacturing Policy:**

The Government has announced the National Manufacturing Policy (salient features given in Annexure – II).

7.1 One of the objectives of the National Manufacturing Policy (NMP) is to: “Increase domestic value addition and technological depth in manufacturing”.

The National Manufacturing Policy suggests:

- Financial and institutional mechanisms for technology development, including green technologies;
- Partnerships between industries and government laboratories;
• Incentives, in the form of tax concessions and government subsidies, for indigenous development of technology;

7.2 Planning Commission’s Industry Steering Committee for 12th Five Year Plan, has defined depth as –

“Depth can be defined as capability & expertise in all aspects of a product value chain, from R&D and product design to manufacture of components and final products to installation and servicing, where appropriate”.

In order to increase "depth" in manufacturing, with focus on the level of domestic value addition, following mechanisms have been proposed:

(a) Promoting indigenous technological development

• Improving partnership between Industry and Government labs and academia;

• Inducing foreign technology transfers by promoting JVs with foreign companies and undertaking risk funding for promoting JVs

• Promoting products having larger share of value addition in India, viz.

"Made for India" products >40% local value
"Made in India" products with local IP

There is a need to nominate a nodal department for co-ordinating indigenous technology development efforts by various agencies.

(b) Trade and Fiscal Measures

• Elimination of anomalies in tax structure
• Tax incentives for R&D
• Setting up one nodal agency (Directorate of Science & Technology)
• Address the inverted duty structure - making Indian manufacturing preferable to import
• Import of second hand equipments be discouraged
• Tax credit instead of tax deduction
• Use of R&D cess to fund further R&D in select sectors

DSIR has been implementing fiscal incentives for R&D and may be strengthened to continue to act as a nodal department for these measures.

(c) Standardization, Certification & Accreditation

• Measures to build capacity for writing standards, certification & accreditation

An appropriate agency, possibly BIS could be entrusted with this responsibility.

7.3 The National Manufacturing Policy proposes: “development of advanced indigenous technologies by Indian companies as well as access to foreign technologies”.

In order to promote acquisition and development of appropriate technology in the country, the National Manufacturing Policy proposes to establish a Technology Acquisition and Development Fund (TADF) for acquisition of appropriate technologies including environment friendly technologies; creation of a patent pool; and development of domestic manufacturing of equipments used for controlling pollution and reducing energy consumption. The TADF will function as an autonomous patent pool and licensing agency. It will purchase Intellectual Property (IP) rights from patent holders. Any company that wants to use the IP to produce or develop products can seek a license from the pool against the payment of royalties. The TADF would reserve the right to license more than one company for a particular patent.
The Fund will also have the option to approach the Government for issue of a Compulsory License for the technology which is not being provided by the patent holder at reasonable rates or is not being worked in India to meet the domestic demand in a satisfactory manner. Such compulsory licenses will be issued only within the provisions of TRIPS. Reasonable royalty will be paid to the patent holder.

An appropriate nodal department having in-depth experience of dealing with industries may be nominated to handle TADF.

7.4 In order to achieve the goal of National Manufacturing Policy, the policy proposes that:

- Innovation will be encouraged for augmenting productivity, quality, and growth of enterprises;

- Incentives be provided for SMEs.

One initiative in this direction is the NInC – CSIR MoU, under which it is proposed to set-up 150 Cluster Innovation Centres (CICs).

8.0 Model R&D Innovation Council:

One of the models for consideration is Zinnov R&D Innovation Council as given below:

Zinnov is a private managing consulting company with offices in India and USA. The R&D Innovation Council was launched on August 7th, 2008.

Zinnov through its profound experience in the industry and several engagements with Indian R&D center stalwarts, realized the need of a product offering that would help India centers improve productivity, drive innovation and optimize operations.
The “R&D Innovation Council” aims to bring senior managers from R&D centers together to brainstorm on the top challenges and exchange best practices around peculiar issues confronting them. Through this council, a member company can gain a variety of services that would help them benefit in their everyday decision making. Services are tailored to address issues around operations cost management, productivity, innovation, talent sourcing, vendor partnerships, organization structuring and peer networking.

Benefits of membership:

As a member of the council, companies will have access to various case studies, best practice research and tools necessary to optimize and improve performance of their India development center. A very R&D focused research, our expert analysis and interaction with peers in the numerous events hosted by us, will allow members to adopt and leverage some practices to march ahead.

R&D Council - Mode of operations:

• Operational Framework: Strategic & operational guidelines to council members
• Best Practices Council: Forum for interaction with MNC R&D companies; focus on solutions
• R&D Conference: Sharing, Learning & getting inspired
• Productivity Analysis: Drivers-HR, Infrastructure; Metrics-Quality, Management & Sustenance
• Innovation Analysis: Drivers-Talent, Incentives, Outreach Programs; Metrics-Patents, New Ideas, Products
• Operating Cost Analysis: Benchmarking current costs with industry standards and forecasting cost escalations
• Talent Pool Analysis: Installed talent base quality-Forecast
• Service Provider Ratings: Select most appropriate vendors
9. Concluding Remarks

This Council looked at global R&D scenario vis-à-vis India’s current industrial R&D status and its future goals and targets. The Council examined the roles that have to be played by the government, academia, R&D institutions, industry, angel investors, venture capitalists, financial institutions and other concerned agencies to enable industry reach a R&D expenditure that is 1% of country’s GDP by 2017. Having realized that R&D investment is critical for industry’s survival and future growth, innovative mechanisms for facilitating R&D by industry need to be implemented as well as innovative ways need to be found for improving the efficiency and predictive-ness of industrial R&D.

It was recognized that the recommendations of this Council will be applicable to other sectoral innovation councils and will cut across horizontally among a number of vertical innovation councils proposed for other sectors, viz. telecommunications, steel, heavy industries, MSME, road transport & highways, chemicals & fertilizers, petroleum & natural gas, railways, power and drinking water & sanitation.

The road map for this Council outlines the strategies and measures for addressing the seven terms of reference of the Council as well as defines the targets for 2020, the terminal year of the decade of innovation. These strategies and targets have been aligned with Council of Scientific and Industrial Research’s CSIR@80: Vision & Strategy for 2022 which talks about science & engineering leadership, nurturing talent in trans-disciplinary areas, innovative technology solutions, open innovation and crowd sourcing, transferring cutting-edge technologies for commercialization and maintaining strong patent portfolio.
Key Features of Cooperative Research Centre Scheme in Australia

The Cooperative Research Centres (CRCs) Program was established in 1990 in Australia (Ref: CRC Programme Guidelines 2012, www.crc.gov.au). A CRC is an independent registered entity which can be non-profit, for profit or a hybrid model of profit and non-profit company. Its objective is to deliver significant economic, environmental and social benefits to Australia by supporting end-user driven research partnerships between publicly funded researchers and end-users to address clearly articulated, major challenges that require medium to long-term collaborative efforts. The scope of activities of a CRC includes:

- Medium to long-term end-user driven collaborative research;
- An end-user-focused education and training program at least including, but not limited to, a PhD program that complements the research programs and that builds engagement, innovation and/or research and development (R&D) capacity within end-users;
- Research and education engagement, particularly co-investment arrangements;
- Small or medium enterprise (SME) strategies that build their innovation and/or R&D capacity; and
- Utilisation activities to deploy research outputs and encourage take up by end-users;

The CRC Program is a significant component of the national innovation system in Australia supporting medium to long-term collaboration between the producers and end-users of research. Through the CRC Program the Government of Australia provides funding to build critical mass in research ventures between end-users and researchers to tackle clearly-articulated, major challenges for the end-users. The Government support may be for a period of ten years extendable in exceptional cases by another five years.
CRCs can be viewed as “virtual” organizations, typically with a small headquaters in one location and often geographically dispersed nodes with people working in the laboratories.

The CRC Program seeks to stimulate a broader education and training experience for postsecondary students, particularly research students, to enhance their employment prospects, providing them with the skills needed to utilise research outputs and produce innovative end-user centric solutions. The CRCs are producing more work-place oriented post-graduates and making a major contribution towards building Australia’s scientific, engineering and technological skills.

At any time a CRC must have among its essential participants at least one Australian end-user (either from the private, public or community sector); and at least one higher education institution or a research institute affiliated with a university. CRCs may secure additional participants. Participants (including essential participants) are not required to commit resources for the full funding period. However, flexibility in participant commitment must be balanced against the stability of the collaboration, the provision of matched funding and the ability of the CRC to undertake its activities to achieve the proposed outputs and impacts/benefits.

All participants in a CRC must contribute resources to the CRC. The total of these resources, including cash and in-kind, tied and untied, must at least match the amount of funding sought from the CRC Program over the funding period. Access to large capital items provided as non-staff in-kind contributions must be valued proportionally to the usage by the CRC and based on the running costs and depreciation of the capital item.

Universities and publicly funded research agencies, such as the CSIRO, are not required to contribute cash resources. Cash and in-kind resources are treated equally for determining the ‘matching’ contributions against the CRC grant.

Determination of the proportion of contributions from participants and subsequently their proportion of return from any income or access to IP is a matter
for the CRC participants and, in this respect, they are not bound by the information provided in the application or in the agreement with the Government.

Participants exercise discretion about the approaches to management of intellectual property that best suit the needs of industry and research participants in their sector, within the parameters set by the CRC Program Guidelines. During the establishment phase these approaches are written into the agreements, and it is important to have a shared understanding of the breadth of intellectual property and their relationship to utilisation. Key issues for intellectual property management include:

- background intellectual property where use is made available to the CRC for any conditions of use
- links to the planned structure of the CRC
- ownership, control and benefits flowing from intellectual property utilisation
- utilisation rights for participants in the CRC and for third parties
- intellectual property register
- intellectual property management arrangements, particularly to support utilisation
- intellectual property protection

CRCs can have minimum requirements for participant contributions that are greater than an individual SME can meet. In this circumstance, a CRC can establish a new structure to engage with SMEs as a club or a consortium. An industry association can also become a member of the CRC. It becomes the conduit through which the transfer of research problems and outputs between the CRC and SMEs is undertaken. As part of a CRC’s commercialisation and utilisation activities, a company may be created or spun-off from a CRC to commercialise new intellectual property. If this commercialisation process is successful and creates a revenue stream, the spun-off SME company may see value in itself becoming a CRC participant.
At the end of the support period the CRC has a choice to go on its own, or wind up and follow an exit plan or re-invent itself as a new CRC for another set of objectives.

A 2006 study found that the CRC Programme is delivering strong net economic benefits for Australia. In particular, as a result of research, training, commercialisation and utilisation activities of CRCs, Australia’s Gross Domestic Product (GDP) has been increased by almost $2.7 billion since the Programme began. The return to GDP for each dollar invested in the Programme is $2.16. Three main channels through which the CRC Programme delivers benefits for Australia are:

- application of CRC generated knowledge and intellectual property
- access to international knowledge networks
- enhanced skill formation, particularly through the development of highly skilled and industry ready postgraduates.

In June 2007, the CRC association of Australia brought out an analysis of the impact carried out by Deloitte-Insight Economics which echoed similar findings.
Annexure - II

National Manufacturing Policy (Salient Features)

1. Government of India has brought out the National Manufacturing Policy with the following six objectives:

(i) Increase manufacturing sector growth to 12-14% over the medium term to make it the engine of growth for the economy. The 2 to 4 % differential over the medium term growth rate of the overall economy will enable manufacturing to contribute at least 25% of the National GDP by 2022.

(ii) Increase the rate of job creation in manufacturing to create 100 million additional jobs by 2022.

(iii) Creation of appropriate skill sets among the rural migrant and urban poor to make growth inclusive.

(iv) Increase domestic value addition and technological depth in manufacturing.

(v) Enhance global competitiveness of Indian manufacturing through appropriate policy support.

(vi) Ensure sustainability of growth, particularly with regard to the environment including energy efficiency, optimal utilization of natural resources and restoration of damaged/ degraded eco-systems.

2. In order to achieve these goals:

(i) Foreign investments and technologies will be welcomed while leveraging the country’s expanding market for manufactured goods to induce the building of more manufacturing capabilities and technologies within the country;

(ii) Competitiveness of enterprises in the country will be the guiding principle in the design and implementation of policies and programmes;

(iii) Compliance burden on industry arising out of procedural and regulatory formalities will be reduced through rationalization of business regulations.

(iv) Innovation will be encouraged for augmenting productivity, quality, and growth of enterprises; and

(v) Effective consultative mechanism with all stakeholders will be instituted to ensure mid-course corrections.
3. The relatively low level of value-addition in the products manufactured in the country, and the growing imports of capital equipment – the building blocks of a country’s manufacturing competitiveness also needs to be addressed urgently. Acquiring depth in manufacturing is crucial from the stand point of long-term competitiveness in strategic areas of economy such as defence and telecommunication. It is important to have a strong indigenous value chain addition element from the stand point of national security. Finally, the growth of the manufacturing sector has to be made sustainable, particularly ensuring environmental sustainability through green technologies, energy efficiency, and optimal utilization of natural resources and restoration of damaged / degraded ecosystems.

4. The following industry verticals will be given special attention:

(i) Employment intensive industries:

Adequate support will be given to promote and strengthen employment intensive industries to ensure job creation. Special attention will be given in respect of textiles and garments; leather and footwear; gems and jewellery; and food processing industries.

(ii) Capital Goods:

A robust economic growth would necessitate a strong demand for capital goods. Such growth would create a strong and continuing demand for capital goods. The capital goods industry, which is the mother industry for manufacturing has not grown at the desired pace. A special focus will be given to machine tools; heavy electrical equipments; heavy transport, earth moving and mining equipments. Time bound programmes will be initiated for building strong capacities with R&D facilities and also to encourage growth and development of these capacities in the private sector while strategically strengthening the public sector to complement the private initiatives where essential.
(iii) **Industries with strategic significance:**

A strategic requirement of the country would warrant the launch of programmes to build national capabilities to make India a major force in sectors like aerospace; shipping; IT hardware and electronics; telecommunication equipment; defence equipment; and solar energy. Mission mode projects will be conceptualised in each of these sectors, recognizing the fact that a mission on solar energy has already been launched under the National Action Plan on Climate Change.

(iv) **Industries where India enjoys a competitive advantage:**

India's large domestic market coupled with a strong engineering base has created indigenous expertise and cost effective manufacturing in automobiles; pharmaceuticals; and medical equipment. The concerned ministries will be formulating special programmes to consolidate strong industry base to retain the global leadership position.

(v) **Small and Medium Enterprises:**

The SME sector contributes about 45% to the manufacturing output, 40% of the total exports, and offers employment opportunities both for self-employment and jobs, across diverse geographies. A healthy rate of growth shall be ensured for the overall growth of the manufacturing sector as also the national economy by policy interventions in areas like manufacturing management, including accelerated adoption of Information technology; skill development; access to capital; marketing; procedural simplification and governance reform. The National Manufacturing Competitiveness Programme, being implemented by M/o MSME will be strengthened, and the recommendations of Task Force on MSME for creation of a separate fund with SIDBI, strengthening of NSIC, modification of lending norms and inclusion of lending to MSMEs under ‘priority sector’ lending will be given due regard in taking appropriate measures.

(vi) **Public Sector Enterprises:**
Public Sector Undertakings, especially those in Defence and Energy sectors, continue to play a major role in the growth of manufacturing as well as of the national economy. A suitable policy framework will be formulated in this regard to make PSUs competitive while ensuring functional autonomy.

5. By leveraging the strength of our large market, policies and measures will be taken to ensure access for Indian companies to foreign technologies as well as development of advanced indigenous technologies. These would include:

i. Incentives, in the form of tax concessions and government subsidies, for indigenous development of technology;

ii. Partnerships between industries and government laboratories;

iii. Preferential purchases by government agencies of indigenously developed products and technologies;

iv. Judicious development of an Intellectual Property regime to enable more collaborative innovation, as well as more indigenous innovation and improved access to environmentally friendly technologies. India will be very cautious about further expansions beyond the present TRIPS regime which could have implications on development and ownership of technologies within the country and

v. Joint ventures between foreign companies and Indian partners.

6. The National Manufacturing Policy will leverage the existing incentives / schemes of the Government of India and also introduce new mechanisms to promote green technologies. This will necessitate specification of clear definitions/eligibility criteria for what can be categorised as Clean and Green. The system for defining and implementing Greener and Cleaner Technology shall be devised which would address the following issues:

- Objective criteria will be prescribed by a Committee called the Green Manufacturing Committee (GMAC) comprising representatives from the concerned Ministries/Departments of the Central Government and relevant sectoral experts from outside government. The criteria will be consistent with the
objective of the national action plan on climate change and the strategy for
inclusive sustainable development.

- The criteria will be reviewed by the Committee annually as technology is dynamic
  and evolving constantly.

7. In order to promote acquisition and development of appropriate technology in
the country, the following measures are proposed:

(i) **Technology Acquisition and Development Fund (TADF)**

A Technology Acquisition and Development Fund will be established for
acquisition of appropriate technologies including environment friendly technologies;
creation of a patent pool; and development of domestic manufacturing of equipments
used for controlling pollution and reducing energy consumption. TADF will address
these concerns across a broadbased set of industries / sectors and it will be decided
upfront for each sector as to how many units with a specific technology in the
particular sector will be supported

SMEs will be given access to the patent pool and/or part reimbursement of
technology acquisition costs up to a maximum of Rs. 20 lakhs for the purpose of
acquiring appropriate technologies patented up to a maximum of 5 years generally,
prior to the date of submission of the project.

a. Equipment and/or technologies used to produce energy from the sun, wind,
geothermal and other renewable resources; clean coal technology; creation and
management of carbon sinks.
b. Equipment used in energy-conservation technologies (including energy
   conserving lighting technologies and smart grid technologies).
c. Equipment used to refine or blend renewable fuels.
d. Fuel Cells, Micro-turbines or energy-storage systems for use with electric or
   hybrid-electric motor vehicles.

These incentives shall consist of:
Five percent interest reimbursement of the nominal interest charged by lending agency;

Ten percent capital subsidy.

Operation, Monitoring and Review of the Fund will be done by the Green Manufacturing Committee.

(ii) Compulsory licensing:

On occasion, a company may be unable to access the latest patented green technology, which can substantially reduce its carbon footprint, because of its inability to obtain a voluntary license from the patent holder. This could arise for two reasons. First, the cost of obtaining such voluntary license could be a barrier for the company. Second, the patent holder could be unwilling to part with the license, or it is not available at reasonable rates or it is not being worked in India.

To address the first issue, the Technology Acquisition and Development Fund will also function as an autonomous patent pool and licensing agency. It will purchase Intellectual Property (IP) rights to inventions from patent holders. Any company that wants to use the IP to produce or develop products can seek a license from the pool against the payment of royalties. This company may then produce the product for use in specified geographical areas subject to meeting agreed quality standards. The TADF would reserve the right to license more than one company for a particular patent.

To address the second issue, the Fund will have the option to approach the Government for issue of a Compulsory License for the technology which is not being provided by the patent holder at reasonable rates or is not being worked in India to meet the domestic demand in a satisfactory manner. Such compulsory licenses will be issued only within the provisions of TRIPS. Reasonable royalty will be paid to the patent holder.
(iii) **Improvements in the standardization, certification & conformity assessment system in India:**

- Setting up a framework for standards development
- Promoting conformity assessment and accreditation system in country
- Measures to build capacity for
  - Writing standards
  - Certification
  - Accreditation
- Decentralization of setting up of standards

8. **Special Focus Sectors:**

   While the proposals in this policy paper are sector neutral, it is proposed to identify special focus sectors where India can be cost competitive and which would generate maximum employment. These sectors would need sector specific policy interventions. Some of these sector specific policy interventions are already in place. Their efficacy would need to be examined and wherever necessary additional measures would need to be introduced. The priority sectors as identified in the Planning Commission and NMCC papers are:-

a) Employment intensive industries like textiles and garments; leather and footwear; gems and jewellery; and food processing.

b) Capital goods like machine tools; heavy electronic equipment; heavy transport, earth moving and mining equipment; high technology equipment like telecom, power, ICT and electronic hardware.

c) Strategic industries like aerospace; shipping; IT and electronic hardware; renewable energy; solar, wind etc; defence equipment.

d) Industries where India enjoys a comparative advantage like automotive; pharmaceuticals.

   UNIDO has identified textiles; chemicals; basic metals; machinery and equipment and electrical machinery, as sectors in which India leads among developing countries.
A set of areas were identified by BHEL where development activities should be focused. These include: High Temperature Materials, Processes for containment/conversion of CO2, containment of pollutants like NOx, SOx generated during combustion of coal, Coal Gassification, Generation and storage of Hydrogen in large scale, absorption, storage and conversion of Solar Thermal Energy, Semiconductor Physics for higher efficiency photovoltaic cells for conversion of solar energy, photosynthesis/biochemical processes for effective utilization of Solar Energy, Photosynthesis/biochemical processes for effective utilization of Solar Energy and nano Technology.

This is an illustrative list of sectors which could be amended from time to time in keeping with the evolving economic situation. Ministries/Departments dealing with these sectors would need to come out with specific policy interventions to ensure that Indian industry is cost competitive viz-a-viz the other major players in those fields.
Minutes of the First Meeting of the Sectoral Innovation Council on “Industrial R&D” held at New Delhi on 30th January, 2012

Following were present:

1. Dr. Arun Firodia, Chairman, Kinetic Engineering … Chairman
2. Dr. Vivek Ranade, Scientist “H”, National Chemical Laboratory, Pune
3. Dr. Santosh Kumar Mishra, Chief Scientist, Institute of Minerals and Materials Technology (IMMT), Bhubaneswar
4. Dr. M.P. Wakdikar, Scientist “G”/Adviser, Ministry of Earth Sciences, New Delhi
5. Dr. G.V. Ramaraju, Sr. Director, Department of Information Technology, New Delhi
6. Shri V.V.R. Sastry, Executive Director, C-DOT, New Delhi
7. Dr. Bibek Bandyopadhyay, Adviser, Ministry of New and Renewable Energy, New Delhi
8. Shri Mallikarjun Javali, Confederation of Indian Industry, New Delhi
9. Smt. Seema Gupta, CII, New Delhi
10. Shri K. Srikanthan, Addl. General Manager, BHEL, New Delhi
11. Shri Ashwani Gupta, Scientist ‘G’, DSIR … Member Secretary
12. Shri S.K.Sharma, Head (BD), Consultancy Development Centre

Brief of discussions held and action points that emerged:

1. Shri Ashwani Gupta presented a background of the meeting. Points highlighted included National Innovation Council’s guidelines to setup Sectoral Innovation Council by Ministries / Departments, target to raise the industrial R&D expenditure to about Rs.120,000 crore by the end of the 12th Five Year Plan, mandate and terms of reference of Sectoral Innovation Council on Industrial R&D. Establishment of R&D Council by Zinnov Management Consulting and its operational framework to promote industrial R&D in the council members was also presented. It was stated that based on the inputs of this meeting, a draft of the white paper on “Sectoral Innovation Council on Industrial R&D” shall be prepared which shall be circulated to members for discussion in the second meeting. It was also stated that the Council will help DSIR, not only in preparation of the white paper but also in implementation of recommendations of the white paper.

2. The Council members enquired about the distinctive scope and role of “Sectoral Innovation Council on Industrial R&D” when sectoral innovation councils have been setup by number of other departments in their respective sectors. It was clarified that this council on “Industrial R&D” cuts across various sectors and shall suggest measures that will improve the efficiency and outcome of R&D being carried out by industries in various sectors. This council shall touch upon the policy guidelines that govern industrial research in the country and shall also suggest focus areas and priority sectors where R&D needs be carried out in the country. Further, this council could also suggest the R&D priorities for developing “Made in India” products where IP is Indian or “Made for India” products where IP is foreign but involve sufficient value addition and other measures that may evolve during discussions.
3. The Chairman Dr. Arun Firodia made following remarks:

- Translation of R&D into commercial products and services in the market is one of the main concerns. Looking at the low rate of R&D commercialization from government funded R&D institutions and laboratories, the private sector must assume a leading role in this regard to enable India to go up the innovation ladder.

- Promotion of venture capital institutions is the way forward for achieving faster commercialization of R&D results. Since venture capitalists are in the business of making investments in new ventures in anticipation of returns, they usually have the capability to critically evaluate the viability of the R&D project. Such proposals, involving calculated risks and adequately vetted by venture capitalists can then be considered for financing by the government. Government may even think of refinancing the banks for promoting R&D projects as done in case of NABARD.

- There is a need to evolve ways and means to attract Indian Expatriates Abroad who could be offered key position in premier R&D institutions, laboratories and industry. A study of the policies of China and Korea who have been successful in this endeavour will provide useful insights.

- There is a great need to enhance the engineering skills of our work force through appropriate training so that they are able to convert the innovations into real products for use by the society. The engineering colleges may offer specialized courses on innovation.

- Establishment of world class private universities by corporate houses must be encouraged which are at par or even better than the existing national institutes viz. IITs and IIMs.

- There is a need to obtain a feedback on why innovation is not resulting into products on ground. It was stated that there is need to setup Centres of Excellence in clusters which offer high growth potential e.g. the auto cluster. Artificial rain making was suggested as one of the focus areas where R&D may be directed.

- It was suggested that R&D in India may be focused towards providing urban amenities in rural areas (PURAs), taking forward the concept articulated by the former President of India, Dr.A.P.J. Abdul Kalam.

- It was mentioned that all concerned stakeholders i.e. concerned Ministries and other organizations may be involved or their inputs may be obtained to avoid conflicts and discrepancies, if any with regard to approach being followed in their organizations.

4. Dr. Bibek Bandyopadhyay mentioned about the various schemes of the Government of India that fund R&D by industry. It was felt that these schemes need to be synergized and the industries which are really in need of support should get the
benefit of the schemes. Adequate awareness about the schemes and creation of mechanisms to identify the rightful beneficiaries was emphasized.

5. Shri V.V.R. Sastry stated that R&D is just one aspect of innovation and there is a need to also look at promoting business process innovation in industries. He also expressed the need for newer fiscal incentives to promote R&D.

6. Dr. Rama Raju stressed upon the need to facilitate greater mobility of university faculty and industry professionals between universities / institutions and industry.

7. Dr. Ranade talked about improving the affectivity of government funding for R&D. He stressed upon linking government funding to angel investors, private equity funds and banks. It was stated that proper fund management in incubation centres can give raise to promising enterprises who can then, come out with innovative products for use by society.

8. Shri Srikanthan mentioned that to facilitate R&D in specialized areas by public sector undertakings, mechanisms need to be established (with conditions, if necessary) that would exempt the PSUs from following the usual tendering process and scrutiny by audit and vigilance.

9. Dr. Mishra gave example of Cooperation Research Centres (CRCs) promoted in Australia as engines of innovation. These have at least one Australian university and one private sector participant. He also talked about National Science Foundation (NSF) sponsored Engineering Research Centres (ERCs) in the US which have industry – university partnership with NSF acting as a catalyst. These research centres are equipped with all the facilities required for transforming an innovative idea into a model / prototype followed by upscaling to pilot plant level and thereafter, commercialization. India may study these centres and adopt them suitably.

10. Mr. Mallikarjun talked about enhancing the supply of Ph.Ds to facilitate R&D by Industry and also increasing technology depth in industry to attain the targets set by National Manufacturing Policy.

The members were requested to send brief write-ups so as to evolve the draft white paper.

Meeting ended with vote of thanks to the Chair.
Annexure IV

Department of Scientific and Industrial Research

Minutes of the Second Meeting of the Sectoral Innovation Council on
“Industrial R&D” held at New Delhi on 28th February, 2012

Following were present:

1. Dr. Arun Firodia, Chairman, Kinetic Engineering - Chairman
2. Shri T.K. Sarkar, Group Coordinator, Department of Information Technology, New Delhi
3. Dr. G.V. Ramaraju, Sr. Director, Department of Information Technology, New Delhi
4. Dr. Bibek Bandyopadhyay, Adviser, Ministry of New and Renewable Energy, New Delhi
5. Dr. S. Lomash, GM (Incharge, CEPD), BHEL, New Delhi
6. Shri K. Srikanthan, Addl. General Manager, BHEL, New Delhi
7. Shri Ashwani Gupta, Scientist ‘G’, DSIR … Member Secretary
8. Shri S.K. Sharma, Head (BD), Consultancy Development Centre

Brief of discussions held and action points that emerged:

1. Minutes of the first meeting held on 30th January 2012 were reviewed. Member from BHEL requested revision in point pertaining to BHEL (point no. 8 of the minutes). It was suggested that the minutes should reflect the need to incorporate some risk mitigation measures to facilitate acceptance of newly developed products by the customers. It was mentioned that to support commercialization of indigenously developed products, an acceptable mechanism or an enabling provision is required for risk mitigation.

   It was suggested that in order to absorb the R&D output of institutions / industries, some kind of insurance facility, may be for a limited period may be made available to enable them to establish their products in the market. The premium of the insurance companies could be subsidized by the government.
It may be noted here that the Technology Development Board (TDB) under DST provides soft loan @ 5% for commercialization of technologies and products. It also provides equity support to companies through venture capital funds.

2. As regards the mandate of this innovation council on industrial R&D, it was stated that the recommendations of this council will be applicable to other sectoral innovation councils and therefore, this council may be treated as cutting across horizontally among a number of vertical innovation councils proposed for other sectors.

3. The chairman re-iterated the set of recommendations made in the draft white paper, e.g. the need to set up 100 world class research institutes, expats to be induced within the country, establishing sectoral centres of excellence, support to venture capital institutions, deputation of academicians to industry, introducing practical innovation projects as part of engineering curriculum, mobile exhibitions on innovations and 50% grants to industry for capital as well as revenue expenditure in their in-house R&D units.

4. As regards 50% grants to industry, it may be noted that this support may be on the lines of infrastructural support provided to public funded S&T institutions under the FIST scheme of DST. However, there will be a need to clearly define the terms and conditions and an approved criteria for disbursal of grants.

4. On the point of deputation of academicians to industry, it was recommended that it may be made mandatory for the faculty of technical educational institutions to acquire a minimum two years of industrial exposure before they are given the position of full professors.

5. On the point of the need to set up 100 world class research institutes, it was added that while this is done, the status of existing scientific institutions may also be examined and their outputs assessed. It was suggested that specific research targets for development of technologies having wide spread applications in industry may be defined, which the major existing scientific institutions may take up.
6. On the point regarding government’s support to venture capital institutions, it was suggested that support may be extended in key priority areas where the country wishes to be a leader in the world.

7. It was suggested that for undertaking R&D of national importance, a collaborative and consortium approach may be adopted with active participation of all the stakeholders possessing the required capabilities in the area of proposed research. For such nationally important projects, special considerations may be available to the stakeholders and some of the usual norms for procurement, vendor selection, audit etc. may be relaxed.

8. It was suggested that in order to enhance the technology depth of our industry, technology transfer may be made mandatory in approvals for foreign direct investment into the country.

9. Testing laboratories in the country need to be upgraded and accredited in order to address the conformity and compliance requirements that various manufacturers face before launching their products in the market.

10. It was felt that facilities may be created in the country so that new IPR generated by Indian institutions / agencies / individuals is absorbed within the country for further development of technologies and products. This will not only help in improving the competitiveness of our industries but will also benefit our consumers accessing innovative products.

The members were requested to provide brief write-ups for inclusion in the white paper, in line with the mandate and terms of reference of the council.

The meeting ended with thanks to the Chair.
Department of Scientific and Industrial Research

Minutes of the Third Meeting of the Sectoral Innovation Council on “Industrial R&D” held at New Delhi on 3rd September, 2012

The above meeting was held to develop a road map for the Sectoral Innovation Council on Industrial R&D. A list of participants is given at Appendix. Brief of discussions held and action points that emerged are as follows:

1. A brief presentation was made covering: the mandate and TOR of the council; review of: the minutes of 2nd meeting held on 28/02/2012 and recommendations made by SInC Chairman, BHEL member and the DST-CII joint committee on stimulating private sector investments into R&D; other suggested innovations; and the way forward.

2. It was suggested that recommendations of this council on Industrial R&D may be forwarded to the Chairmen of other Sectoral Innovation Councils and a common meeting of all Sectoral Innovation Councils (possibly called by NInC) may be organized so as to arrive at synergy.

3. It was agreed that Public Procurement plays a key role in promotion of R&D and innovative technologies. Therefore, Government needs to be the anchor customer for promoting Industrial R&D and bringing innovative products and services into the market.

4. It was suggested that a rating system for R&D establishments may be implemented.

5. It was recommended that for major R&D investors and maha-ratna and navaratna PSUs, pre-qualification requirements for introducing new line of products and systems may be relaxed. For equipment procurement, the mandatory requirement of acceptance of L1 bid in the tendering process may
also be relaxed. Also, procedure for engagement of highly competent national and international experts for projects of national importance may be simplified.

6. It was discussed that it is desirable to work out provisions for writing off government loans/grants for private sector R&D failures. In order to avoid audit observations in such cases, it was suggested to promote insurance companies for R&D investments so that companies do not hesitate to earmark funds for R&D. It was suggested that to lessen the burden of premium on private companies, Government may share the premium appropriately. A mechanism for this could be that the Government places a lump-sum fund in fixed deposit in bank and the interest on this fund may be utilized for sharing the insurance premium with private industry.

7. It was agreed to evolve a method to take into account VC funding as well as seed and angel funding into R&D intensive and high-tech areas of national priority as R&D spending.

8. It was agreed that Government may promote Innovations in SMEs through subcontracting relationships with Trans-National Corporations (TNCs) by enhancing the linkages between TNCs and SME clusters.

9. It was suggested that SInC on Industrial R&D may focus on CSIR’s road map for industrial research in priority areas.

10. It was also agreed that this council may promote innovations in industrial R&D that cross cut across a number of industries, e.g. promoting energy efficiency in industries, waste minimization i.e. reduction of waste generation at source and recycling of wastes and adoption of green productivity methodology of cleaner production.

The meeting ended with thanks to the Chair.
Appendix

Third Meeting of the Sectoral Innovation Council on “Industrial R&D” held at New Delhi on 3rd September, 2012

Following were present:

1. Dr. Arun Firodia, Chairman, Kinetic Engineering … Chairman
2. Dr. Santosh Kumar Mishra, Chief Scientist, CSIR-IMMT
3. Dr. Debashis Dutta, Group Coordinator, DeITY, New Delhi
4. Dr. R.C. Mehrade, Scientist “G”, DeITY
5. Shri J.C. Sharma, GM (Engg. and R&D), BHEL, New Delhi
6. Shri V.V.R. Sastry, Executive Director, C-DOT, New Delhi
7. Mr. Anjan Das, Executive Director, CII, New Delhi
8. Shri S.K. Sharma, Head (BD), Consultancy Development Centre, New Delhi
9. Dr. S.K. Deshpande, Scientist “G”, DSIR
10. Shri G.M. Bagai, Scientist “F”, DSIR
11. Shri Ashwani Gupta, Scientist ‘G’, DSIR … Member Secretary
Annexure – VI

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