



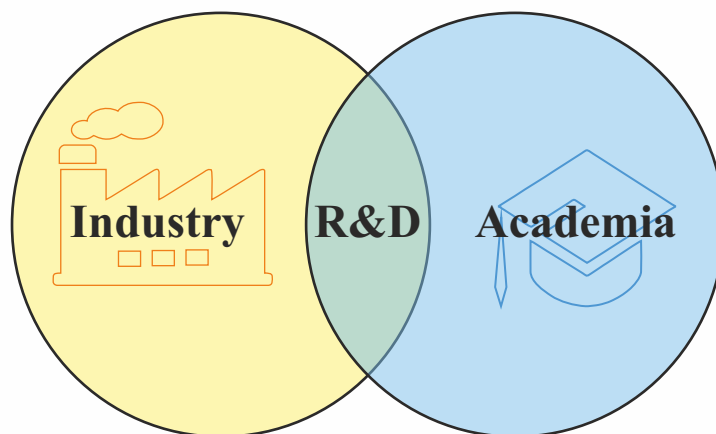
सत्यमेव जयते

Department of Science and Technology  
Ministry of Science and Technology  
Government of India



*Booklet-2017*

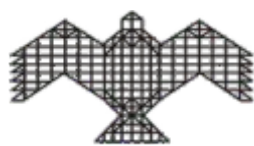
**DST-Centre for Policy Research  
at  
Panjab University, Chandigarh**



<http://cpr.puchd.ac.in>

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10.	<b>Dr Amod Kumar</b>	Chief Scientist, CSIR-CSIO, Chandigarh
11.	<b>Prof. Rupinder Tewari</b>	Coordinator, DST-CPR, PU, Chandigarh



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### **MESSAGE**

Knowledge economy with large demands on well being and security of the citizens and the nation coupled with aspirations of growing India mandates a productive, dynamic and creative interface between academia, research and industry. Universities and industries for long, have been operating in separate silos except for limited success of working together for the purpose. Strategic sectors of atomic energy, space and defence are exceptions. These two entities are endeavouring to come closer to each other for realizing synergies. The strong economies of the world have realized the importance of a robust and dynamic bridge between the academia and industry. Many novel innovations (technologies, products and processes) in these countries are the result of close and worthy collaborations between the academia and industry on a sustained basis in a framework of mutual respect and understanding.

Moreover, industry is working on products and processes where India has an ambition to research, innovate and lead, thus collaborations with universities and research institutes (in and outside the country) are emerging as robust strategies. The awareness has resulted in enhanced engagements. At best, these are beginnings only, though, exceptions do exist where robust and sustained collaborations have produced substantial results. IITs, ICT-Mumbai, IISc-Bangalore and a few other Higher Education Institutes are good examples of growing robust Industry-Academia synergy especially, in the domain of R&D which has resulted in increasing the IPRs, products and generation of resources for the academic institutes. For India to be counted amongst the stable growing large economies of the world, it is imperative that Industry-Academia synergy is enhanced amongst universities, national research laboratories and industries.

The broad mandate of DST sponsored 'Centre for Policy Research' (CPR) at Panjab University, Chandigarh is to make recommendations for the promotion of collaboration, based on success stories in the Indian ecosystem. I have been experiencing the activities of CPR at Panjab University since its inception. After a few initial experiments for finding approaches, this Centre is shaping up expeditiously and in a competent manner. Prof. Rupinder Tewari has consistently endeavoured to understand the Industry-Academia R&D ecosystem of public and private sectors in India. The suggestions and recommendations put forward by the centre will be of great interest to the collaborators, policy makers, organizations and agencies involved in Science & Technology programmes of the country.

I wish success to the 'Centre for Policy Research' at Panjab University in the pursuit for strengthening Industry-Academia research paradigm for changing and growing India. The success in this domain shall enhance competence of India and contribute to well being of our economy, citizens and the nation.

Dr Baldev Raj  
Director, National Institute of Advanced Studies, IISc, Bangalore  
Chairperson, Policy Research Cell, DST, New Delhi

**PANJAB UNIVERSITY  
CHANDIGARH, INDIA 160 014**



**Professor Arun K. Grover**  
*Vice Chancellor*



### **MESSAGE**

I am pleased to know that Department of Science & Technology (DST), Government of India, New Delhi has set up a 'Centre for Policy Research' (CPR) at Panjab University (PU), Chandigarh, with the mandate to prepare guidelines for strengthening Industry-Academia (I-A) collaborations under Public Private Partnership (PPP) mode.

Industry-Academia collaborations have become the subject of great interest to the academicians, industry leaders and policy makers, as it is now acknowledged that scientific innovations will be the key driver of the economy of the nations. In developed countries, there is healthy symbiotic relationship between R&D of public and private sectors and is contributing greatly to the kitty of knowledge economy of the nations.

Recently, Asian countries like China, South Korea, Singapore and Taiwan have become economically strong nations. The success of these countries is attributed to their modified policies in the areas of Higher Education and Science & Technology, especially I-A interactions. India has the potential to emulate these countries. It can even surpass them. All that is needed is the change in the mind set of academia and industrial sector. Both have to hand hold each other. The conversion of academic knowledge into a commercial success is the need of the hour.

I am sure, DST-CPR at PU, Chandigarh will come up with recommendations which will become the basis of strong and robust I-A policy to be laid down by the Government. I wish all the success to DST-CPR in their endeavours.

**(Arun K. Grover)**

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Panjab University  
Chandigarh.



सत्यमेव जयते  
Department of  
Science & Technology  
Government of India

**Prof. Rupinder Tewari**  
Coordinator

DST-Centre for Policy Research  
Panjab University, Chandigarh.



## ***PREFACE***

In the 21<sup>st</sup> century, Industry-Academia collaborations have become the subject of great interest to the academicians, industry leaders and policy makers, as it is now acknowledged that scientific innovations will be the key driver of the economy of a nation. In developed countries, there is a healthy symbiotic relationship between R&D of the public and the private sectors and is contributing greatly to the knowledge economy of the nation.

Unfortunately, in India, the Industry-Academia R&D has not reached the desired levels, despite the fact that our nation has more than 800 universities & autonomous institutes, over 500 R&D units established by scores of ministries of GoI and nearly 3000 R&D set ups in the private sector including 1800 DSIR accredited private research laboratories. Time has come to bring them on a single platform so that they collectively work together and contribute towards the economic and societal progress of the nation.

In addition, the latest STI Policy-2013 has laid special emphasis on bridging the gap between Industry and Academia. Various schemes have been floated by many ministries of GoI, especially Ministry of Science and Technology to enhance the R&D status of public and private sectors. In 2014, DST (GoI, New Delhi) established DST-Centre for Policy Research at Panjab University, Chandigarh with the mandate to study the Industry-Academia R&D ecosystem of India and make recommendations (to DST, GoI) for strengthening this ecosystem. The scientists of the Centre have been engaged in this study and submitted nine reports to DST. In addition, a book entitled “Industry Academia R&D Ecosystem in India.....an evidence based study” has been published by the Centre, which has been highly acclaimed by the government bodies and the policy makers.

In the next phase, our Centre wishes to interact with all the stakeholders (government, industry, academia and policy makers) to specifically make recommendations for a) Enhancing public-private partnership in R&D, b) Incentivization of private sector in the domain of innovative research, c) Identifying areas of policy gaps in IPR, and d) Reforms in the R&D of Higher Education Institutes.

Prof. Rupinder Tewari  
Coordinator,  
DST-Centre for Policy Research,  
Panjab University, Chandigarh.

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## **DST – Centre for Policy Research at PU, Chd.**

### **Vision**

*Strengthening Industry-Academia R&D Ecosystem in the Public Sector as well as the Private Sector of India.*

### **Objectives**

- *Development of a New Country Specific Model for Promotion of Public Private Partnership (PPP) for R&D.*
- *Identify Areas of Policy Gaps for Stimulation of Private Sector Investment in R&D and Suggest Changes in Policy Environment.*
- *Adopt Evidence-based Approaches for Identifying and Promoting Areas for Generation of Intellectual Properties.*
- *Reforms in Higher Education for Strengthening Industry-Academia Interactions in India.*

## Book Authored by the Scientists of DST-CPR, PU, Chd.



The book was released by **Dr R Chidambaram** (Principal Scientific Advisor to GoI) on Jan. 4, 2017 during 104<sup>th</sup> Indian Science Congress held in Tirupati (*Please see back cover*)

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## Visit of a Nobel Laureate, Prof. Roger D Kornberg, at DST-CPR at PU, Chd.

(April 27, 2017)



*Left to Right: Ms Mamta Bhardwaj, Dr Radhika Trikha, Dr Ajit Singh, Prof. Roger D Kornberg, Prof. Rupinder Tewari, Dr Mansimran Khokhar and Mr Ashok Gupta*



*Prof. R Tewari presenting the book to Prof. Roger D Kornberg*



*Prof. Roger D Kornberg interacting with scientific staff of DST-CPR at PU, Chd.*

Prof. Roger D Kornberg (Stanford University, USA) was awarded Nobel Prize in 2006 for his fundamental research on the molecular basis of Eukaryotic Transcription. Prof. Kornberg has served as Chairman/Director of a number of companies. He is a firm believer that innovative R&D requires deep knowledge of fundamental science/research.

# Launch of Industry-Academia CRIKC\* Web Portal

(Developed by DST-CPR, PU, Chd.)

by  
**Hon. Shri V. P. Singh Badnore,**  
Governor, State of Punjab & U.T. Administrator  
(July 7, 2017)



**Weblink:** <http://iacrikc.dstcpr.in>



*Dr Radhika Trikha, scientist at DST-CPR at PU, Chd. presenting Industry-Academia web portal. Hon. Shri V. P. Singh Badnore (Governor State of Punjab and U.T. Administrator) and Dr Dinesh Dua (Head-CII, Higher Education, Northern Region) sitting on the dais*

**Times of India Dated: 10-07-2017**  
**R&D experts  
just a click away**

Chandigarh: Are you from the industry sector in Chandigarh and want to seek scientific expertise for research and development? Rupinder Tewari, a Panjab University professor, along with his team of young scientists at DST Centre for Policy Research at Panjab University has developed a website linking industry with the academia of the Chandigarh Region Innovation and Knowledge Cluster (CRIKC) institutions, including Panjab University, PEC University of Technology and IIT Ropar. At a single click of a mouse, one can get the right contact of experts in the Chandigarh region institutions.

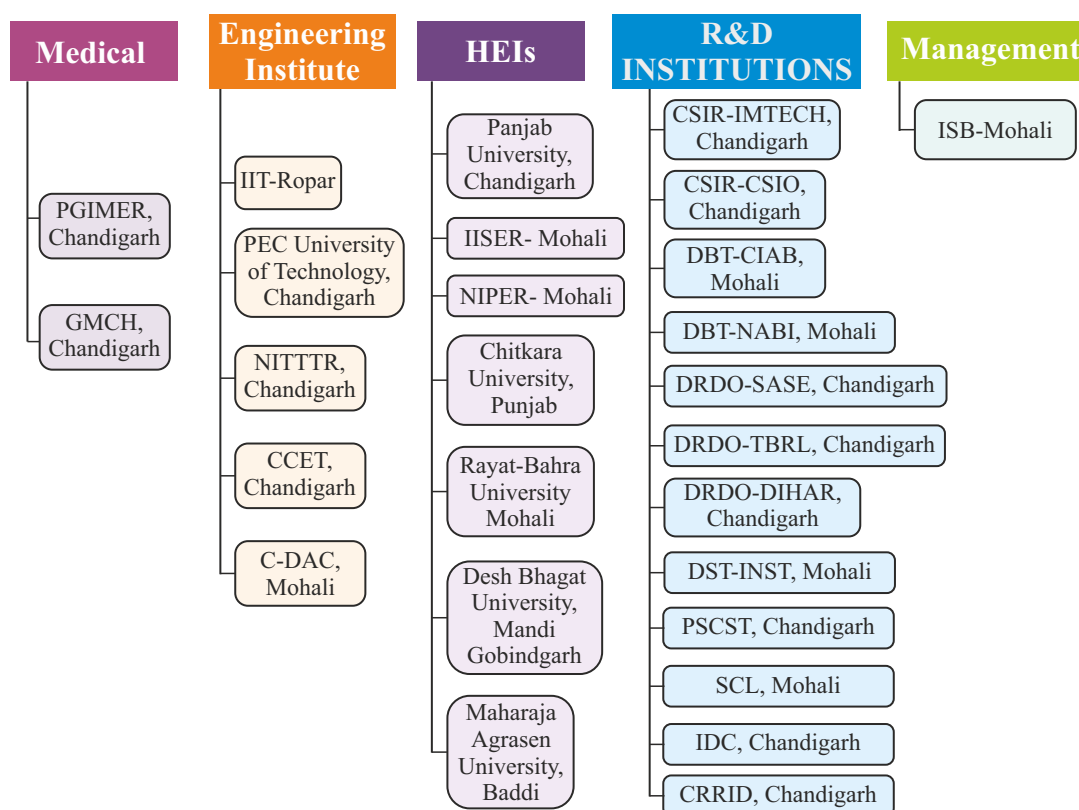
"The industry was finding very difficult to contact right kind of scientific experts for solving its research and development (R&D) and other academia-related problems. This web portal has been developed specifically to address this issue of the private sector: With the introduction of this portal, industry is only one click away from CRIKC institutes comprising universities (public and private) and national R&D organizations located in and around the Tricity region," said Tewari.

Besides displaying the scientific expertise, the portal also has information on the research facilities, centres of excellence, patents (filed & granted), and technologies (available and transferred to industries) of CRIKC institutes. Moreover, the portal contains a dedicated tab for industry-academia (I-A) query, which can be used by young researchers, scientists and industry personnel for addressing their industry-academia related problems. The web portal was launched by UT administrator V P Singh Badnore at the CII head office, Chandigarh.

\*CRIKC-Chandigarh Region Innovation and Knowledge Cluster

## Chandigarh Region Innovation and Knowledge Cluster (CRIKC)

CRIKC, a registered society, is a conglomerate of 27 academic and research institutes located in and around Chandigarh. The mandate of CRIKC is to promote academic excellence among the CRIKC member institutes and act as a single window for the private sector to provide solutions to their problems related to R&D and management. The member institutes of CRIKC are mentioned below and detailed information can be accessed at <http://crikc.puchd.ac.in/>.



### Need for I-A Web Portal:

One of the reasons for below par Industry-Academia interactions is the limited/lack of access to academic facilities and information (Scientific expertise, Patents, Technologies, etc.) by the industries. To fill this gap, DST-Centre for Policy Research at Panjab University, Chandigarh, has created a single window web portal displaying the scientific expertise, patents, technologies, major research facilities, etc. of the academic institutions situated in and around Chandigarh region. The portal also has 'I-A Query' menu tab where industry personnel can upload their problems, to be addressed by the academia. The web portal can be accessed at <http://iacrikc.dstcpr.in>



**MEMORANDUM OF UNDERSTANDING  
BETWEEN  
CHANDIGARH REGION INNOVATION AND KNOWLEDGE CLUSTER (CRIKC)  
AND  
CONFEDERATION OF INDIAN INDUSTRY (CII) NORTHERN REGION  
(July 7, 2017)**



*MoU was signed by Prof. Arun K. Grover (President, CRIKC & Vice Chancellor, PU, Chd.) and Mr Babu Khan (Regional Director CII Northern Region) in the august presence of Hon. Governor Shri V. P. Singh Badnore.*

**DST- CPR, PU, Chd. has been instrumental in the signing of MoU between CRIKC and CII (Northern Region)**

WHEREAS it has been the concern of the Government of India, academicians and industry to enhance global competitiveness of Indian technologies and products, and to accelerate the flow of the research findings of Indian institutes from lab to land, it is increasingly realized that this requires increasing science and technology based collaborations between academia and industry.

IN PURSUANCE OF THE ABOVE SAID CONCERN, the parties agree to the following;

1. Create CRIKC-CII (NR) "Industry-Academia (I-A) Board" to prepare a road map and devise governance model to promote partnership programmes between the research and educational institutes in Chandigarh region and industries represented by CII-NR.
2. Unless otherwise specifically agreed to in writing by the Parties for implementing the Scope of Services, each Party will bear the respective costs of carrying out the obligations under this MEMORANDUM.
3. The I-A Board shall endeavor to undertake the following activities in form of several individual projects:
  - a) Creation of 'Industry-Academia Interfaces' encompassing different branches of industries. Each Interface will have equal number of representatives from academia and industry.
  - b) Submit collaborative Research-Projects to public and private funding agencies.
  - c) To assist in identifying industry-experts who could be engaged for teaching & research programmes of academic and R&D institutes as per their rules/regulations.
  - d) Set up of Industry sponsored Chairs, Scholarships, Fellowships, laboratories at institutes in Chandigarh region.
  - e) Organize Industry-Academia Collaborative Workshops/Seminars/ Conferences /Showcasing and Networking Meets, Design competitions etc. to evolve new ideas and support the best for addressing industrial challenges and setting up Start Up, Entrepreneurship and Skill development programmes.
  - f) Conduct academic courses for industry- personnel for enhancing their technical and management skills.
  - g) Conduct Industry-oriented short term Skill-Development programmes for the students.
  - h) Facilitate placement of students in industries.
  - I) Seek grants from public and private sectors for the creation of dedicated facilities, such as I-A Cells, Patent Cells, Technology –Transfer Cells, Science museum, Centre for Excellence, etc.
  - j) Seek grants from various funding agencies for carrying out studies/collection of data/holding meets/conferences/seminars for making recommendations to Government of India for laying down policies related to Higher Education, Science & Technology and Industries.

## Medical Device Innovation Cluster Meet at CSIR- CSIO, Chandigarh (November 12, 2016)



### Dignitaries on the dais

*Left to Right: Dr J. K. Arora (Exec. Director, PSCST, Chd.); Dr Dinesh Dua (Head-CII, Higher Education, Northern Region); Prof. Arun K. Grover (Vice Chancellor, PU, Chd.); Dr R. K. Sinha (Director, CSIR-CSIO, Chd.); Dr Anita Aggarwal (Scientist E, DST, New Delhi) and Prof. G. D. Puri (Head, Deptt. Anaesthesia, PGIMER, Chd.).*



*Welcome address being delivered by Dr R. K. Sinha (Director CSIR-CSIO, Chd.)*



*Dr P. J. Singh (MD, Tynor Orthotics Pvt. Ltd., Chd.) delivering a talk on the importance of industry-academia collaborations*

DST-CPR, PU, Chd. conceptualized and initiated the creation of **Medical Device Innovation Cluster (MDIC)** for the promotion of innovative research in the area of medical devices by bringing industries (medical devices) and scientists of Chandigarh region on a single platform. The list of Industry-Academia research collaborations between CRIKC member institutes and the local industry in the domain of medical devices is mentioned on next page.

## Research Collaborations (Medical Devices) between CRIKC and Industries

### A. PGIMER, Chd.

1. Industrial Partner: Clarity Medical Pvt. Ltd.  
Projects:
  - CLADS (Closed loop Anaesthesia Drug Delivery System)
  - CLAPS (Closed loop Automated Blood Pressure Control System)
  - IV-ALERT (Infusion Volume Alarm Alert System)
  - Volumetric Index for Detecting Hypovolemia
  - Pulse Pressure Contour Analysis
  - Volumetric Capnography
2. Industrial Partner: Advance Tech India Pvt. Ltd., Zirakpur  
Project: Cricoid Pressure Sensor Device

### B. PU, Chd.

1. Academic Partner : PGIMER, Chandigarh; Industrial Partner: Esteem Industries, Baddi  
Project: Development of Artificial Breathing Capability Device for Patients Suffering from Breathing Problems.
2. Industrial Partner: Esteem Industries, Baddi  
Project: Development of 5-axis Milling Machine for Dental Implants
3. Industrial Partner: Tynor Orthotics Pvt. Ltd., Mohali  
Project: Development of Cool-cap to Reduce Chemotherapy Induced Alopecia

### C. CSIR-IMTECH, Chd.

1. Academic Partner : Panjab University, Chandigarh; Industrial Partner: Venus Remedies, Baddi (HP)  
Project: Rapid Detection of Gram-negative Bacteraemia using Novel Nano-Bioprobes

### D. CSIR-CSIO, Chd.

1. Industrial Partner: M/S Walnut Medical Ambala  
Project: a.) Artificial Electronic Knee Joint. b.) Virtual Intelligent Techniques for Rehabilitation of Persons with Motor Disability
2. Industrial Partner: M/S Pentagon Rugged System, Hyderabad  
Project: a.) Technology Solutions for Exoskeleton Device. b.) Control Module for Touch based Finger Gesture Controlled Intelligent Patient Vehicle
3. Industrial Partner: M/s Medicaid System, Chandigarh  
Project: Postural Stability Assessment System
4. Industrial Partner: M/s LM Health Care Solutions, Chandigarh  
Project: Myo-Meter
5. Industrial Partner: M/s AllengersGlobal Healthcare Pvt. Ltd., Chandigarh  
Project: Indigenous Development of Laser Lithotripsy System for Medical Application
6. Industrial Partner: M/s Auxien Medical Pvt. Ltd., Sonapat  
Project: MoU for Joint research work for Development of Indigenous Orthopedic Implants
7. Industrial Partner: M/S Tynor Orthotics Pvt. Ltd., Mohali  
Project: MoU for Industrial Collaboration

### E. IIT-Ropar

1. Industrial Partners: Advance Tech India Pvt. Ltd., Zirakpur  
Project: Affordable, Preventive and Assistive Technology for Health Care

### F. PEC University of Technology, Chd.

1. Industrial Partners: Tynor Orthotics Pvt. Ltd., Mohali  
Project: Design and Development of Orthopaedic Cane Handle
2. Industrial Partners: Allengers Medical Systems Ltd., Chd .

### G. INST, Mohali

1. Industrial Partners: Advance Tech India Pvt. Ltd., Zirakpur

## Activity 1: Industry-Academia Programmes/Schemes of Public and Private Sectors

S. No.	Sector and Respective Agencies	Industry-Academia Programmes
<b>I. Public Sector</b>		
1.	<b>Department of Science and Technology (DST);</b> www.dst.gov.in	<ul style="list-style-type: none"> <li>➤ Technology Development Board (TDB)</li> <li>➤ Technology Systems Development Programmes (TSDP)</li> <li>➤ National Science and Technology Entrepreneurship Development Board (NSTEDB)</li> <li>➤ Schemes for Funding Industry Relevant R&amp;D (Under SERB)</li> <li>➤ Drugs and Pharmaceutical Research Programme</li> <li>➤ Start-Up Research Grant (Young Scientists)</li> <li>➤ International S&amp;T Co-operation: setting up of Indo-French Centre for Promotion of Advanced Research (IFCPAR / CEFIPRA), Indo-US Science &amp; Technology Forum (IUSSTF) and Indo-German Science &amp; Technology Centre (IGSTC)</li> <li>➤ Nano Applications and Technology Advisory Group (NATAG)</li> <li>➤ National Initiative for Developing and Harnessing Innovations (NIDHI)</li> <li>➤ Instrumentation Development Programme</li> <li>➤ Policy Research Centres (PRC)</li> </ul>
2.	<b>Technology Information, Forecasting and Assessment Council (TIFAC);</b> www.tifac.org.in	<ul style="list-style-type: none"> <li>➤ Advanced Composites Programme</li> <li>➤ Revolving Technology Innovation Fund [under TIFAC-Small Industries Development of Bank of India (SIDBI) Programme]</li> <li>➤ Technology Refinement and Marketing Programme (TREMAPP)</li> <li>➤ Home Grown Technology (HGT) Programme</li> <li>➤ Bioprocess and Bioproducts Programme</li> <li>➤ Collaborated Automobile R&amp;D Core-Group</li> </ul>
3.	<b>Global Innovation and Technology Alliance (GITA);</b> www.gita.org.in	<ul style="list-style-type: none"> <li>➤ Bilateral programmes               <ul style="list-style-type: none"> <li>· Technology Acquisition and Development Fund</li> <li>· India UK Collaborative Industrial Research Development Programme</li> </ul> </li> </ul>

		<ul style="list-style-type: none"> <li>➤ Multilateral programmes <ul style="list-style-type: none"> <li>· The Enterprise Europe Network (EEN)</li> <li>· Innovation Driven Initiative for the Development and Integration of Indian and European Research (INNO INDIGO)</li> </ul> </li> </ul>
4.	<b>Department of Scientific and Industrial Research (DSIR);</b> <a href="http://www.dsir.gov.in">www.dsir.gov.in</a>	<ul style="list-style-type: none"> <li>➤ Building Industrial R&amp;D and Common Research Facilities (BIRD-crf)</li> <li>➤ Patent Acquisition and Collaborative Research and Technology Development (PACE)</li> <li>➤ Promoting Innovations in Individuals, Start-ups and MSMEs (PRISM)</li> <li>➤ Access to Knowledge for Technology Development and Dissemination (A2K+)</li> <li>➤ Technology Development and Demonstration Program (TDDP)</li> <li>➤ Technopreneur Promotion Programme (TePP)</li> <li>➤ Technology Development and Utilization Programme for Women (TDUPW)</li> <li>➤ Technology Management Programme (TMP)</li> <li>➤ Encouraging Development and Commercialization of Inventions and Innovations: A new impetus</li> <li>➤ Consultancy Promotion Programme (CPP)</li> <li>➤ International Technology Transfer Programme (ITTP)</li> </ul>
5.	<b>National Research Development Cooperation (NRDC);</b> <a href="http://www.nrdcindia.com">www.nrdcindia.com</a>	<ul style="list-style-type: none"> <li>➤ Innovation Portal/ Technology Portal</li> <li>➤ Knowledge Management system for Technology Promotion</li> <li>➤ Entrepreneurship Development Programme</li> <li>➤ Patent Search Facility</li> </ul>
6.	<b>Council of Scientific and Industrial Research (CSIR);</b> <a href="http://www.csirhrdg.res.in">www.csirhrdg.res.in</a>	<ul style="list-style-type: none"> <li>➤ New Millennium Indian Technology Leadership Initiative (NMITLI)</li> <li>➤ Entrepreneurship Support Programme</li> <li>➤ Knowledgebase of 642 technologies which can be readily taken up for commercialization</li> <li>➤ Innovation Fund</li> <li>➤ CSIR-Industry Sponsored Research Fellowship Scheme</li> </ul>
7.	<b>Biotechnology Industry Research Assistance Council (BIRAC);</b> <a href="http://www.birac.nic.in">www.birac.nic.in</a>	<ul style="list-style-type: none"> <li>➤ Small Business Innovation Research Initiative (SBIRI)</li> <li>➤ Biotechnology Industry Partnership Programme (BIPP)</li> <li>➤ Contract Research and Service (CRS) Scheme</li> <li>➤ Biotechnology Ignition Grant (BIG) Scheme</li> </ul>



		<ul style="list-style-type: none"> <li>➤ University Innovation Cluster (UIC)</li> <li>➤ BIRAC Regional Innovation Centre (BRIC) at IKP Knowledge Park</li> <li>➤ Bio-Incubator Support</li> <li>➤ BIRAC-Society for Research and Initiatives for Sustainable Technologies and Institutions (SRISTI)</li> <li>➤ BIRAC AcE Fund-Accelerating Entrepreneurs</li> </ul>
8.	<b>Indian Council of Agricultural Research (ICAR);</b> www.icar.org.in	<ul style="list-style-type: none"> <li>➤ Competitive Grant Scheme under National Agricultural Technology Project (NATP)</li> <li>➤ MoU between ICAR and ABLE for Knowledge Partnership (2013)</li> </ul>
9.	<b>Indian Council of Medical Research (ICMR);</b> www.icmr.nic.in	<ul style="list-style-type: none"> <li>➤ Health Systems Research Cell</li> <li>➤ Intellectual Property Rights (IPR) Unit</li> </ul>
10.	<b>Defense Research and Development Organization (DRDO);</b> www.drdo.gov.in	<ul style="list-style-type: none"> <li>➤ The DRDO-FICCI Accelerated Technology Assessment and Commercialization (ATAC) Programme</li> <li>➤ Extramural Research (ER) Scheme</li> <li>➤ Grant-in aid Scheme</li> </ul>
11.	<b>Department of Industrial Policy and Promotion (DIPP);</b> www.dipp.gov.in	<ul style="list-style-type: none"> <li>➤ Industrial Corridor Projects</li> <li>➤ Rajiv Gandhi National Institute of Intellectual Property Management (RGNIPM)</li> <li>➤ Project Based Support to Autonomous Institutions</li> <li>➤ Invest India</li> <li>➤ Atal Innovation Mission (AIM) with Self-Employment and Talent Utilization (SETU) Programme</li> <li>➤ Modified Industrial Infrastructure Upgradation Scheme (MIUS)</li> </ul>
12.	<b>Department of Atomic Energy (DAE);</b> www.dae.nic.in	<ul style="list-style-type: none"> <li>➤ Nuclear Fuel Complex (NFC)</li> <li>➤ Heavy Water Board (HWB)</li> <li>➤ Board of Radiation and Isotope Technology (BRIT)</li> <li>➤ BARC Entrepreneur's Corner-Technology Transfer and Consultancy &amp; Scientific Services</li> <li>➤ Patents and Technology Transfer Cell at Indira Gandhi Centre for Atomic Research (IGCAR)</li> </ul>

13.	<b>Ministry of Electronics and Information Technology (MeitY);</b> www.deity.gov.in	<ul style="list-style-type: none"> <li>➤ Multiplier Grant Scheme</li> <li>➤ Visvesvaraya Ph.D. Scheme for Electronics and IT</li> <li>➤ Funding and Support to Industry and Academic Institutions through GITA</li> <li>➤ Scheme of Financial Assistance for Setting Up of Electronics and ICT Academies</li> <li>➤ Scheme for Financial Assistance to Select States/UTs for Skill Development in Electronics System Design and Manufacturing (ESDM) Sector</li> <li>➤ Incubators for Electronics</li> <li>➤ National Portal of India</li> </ul>
14.	<b>Ministry of Environment, Forests and Climate Change (MoEF&amp;CC);</b> www.envfor.nic.in	<ul style="list-style-type: none"> <li>➤ Creation of Indian Plywood Industries Research and Training Institute (IPIRTI), Bengaluru</li> <li>➤ National Natural Resources Management System (NNRMS) Programme</li> </ul>
15.	<b>Indian Space Research Organization (ISRO);</b> www.isro.gov.in	<ul style="list-style-type: none"> <li>➤ Sponsored Research (RESPOND)</li> <li>➤ Antrix Corporation Limited</li> <li>➤ ISRO Technology Transfer Group</li> <li>➤ Space Application Centre (SAC) Industry Portal and Industry Interface</li> </ul>

### B. Educational Sector

16.	<b>Ministry of Human Resource Development (MHRD);</b> www.mhrd.gov.in	<ul style="list-style-type: none"> <li>➤ Council for Industry Higher Education Cooperation (CIHEC)</li> <li>➤ Research Parks</li> <li>➤ Technical Education Quality Improvement Programme (TEQIP)</li> <li>➤ IMPRINT India</li> <li>➤ Global Initiative for Academic Network (GIAN)</li> <li>➤ Kaushal Kendras</li> <li>➤ Rashtriya Ucchta Aavishkar Abhiyaan (RUSA)</li> </ul>
17.	<b>University Grants Commission (UGC);</b> www.ugc.ac.in	<ul style="list-style-type: none"> <li>➤ Council for Industry Higher Education Cooperation (CIHEC)</li> <li>➤ University-Industry Inter Linkage (UIL) Centres</li> <li>➤ Global Initiative for Academic Network (GIAN)</li> <li>➤ Kaushal Kendras</li> </ul>

<b>18.</b>	<b>All India Council for Technical Education (AICTE);</b> www.aicte-india.org	<ul style="list-style-type: none"> <li>➤ Industry Institute Partnership Cell (IIPC)</li> <li>➤ Research Park</li> <li>➤ Innovation Promotion Scheme (IPS)</li> <li>➤ AICTE – Indian National Academy of Engineering (INAE) Distinguished Visiting Professorship (DVP)</li> <li>➤ AICTE-CII Survey of Industry-Linked Technical Institutes 2016</li> <li>➤ Global Initiative for Academic Network (GIAN)</li> <li>➤ Pradhan Mantri Kaushal Vikas Yojana (PMKVY)</li> </ul>
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### C. International Agency

<b>19.</b>	<b>United Nations Industrial Development Organization in India (UNIDO-India);</b> www.unido.org	<ul style="list-style-type: none"> <li>➤ India-Combining Businesses</li> <li>➤ India-Gears of growth [UNIDO-ACMA Automotive Component Supplier Development Programme]</li> <li>➤ CSR South East Asia</li> <li>➤ India-Climate-friendly refrigerators</li> <li>➤ UNIDO Centre for South-South Industrial Cooperation (UCSSIC)</li> </ul>
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## II. Private Sector

### A. Industry Associations

<b>20.</b>	<b>Federation of Indian Chambers of Commerce and Industry (FICCI);</b> www.ficci.com	<ul style="list-style-type: none"> <li>➤ National Knowledge Functional Hub</li> <li>➤ FICCI Ladies Organization (FLO)</li> <li>➤ I-A-Research/Government Interface (IARGI)</li> <li>➤ DRDO - FICCIATAC programme</li> <li>➤ Invest India</li> </ul>
<b>21.</b>	<b>Confederation of Indian Industry (CII);</b> www.cii.in	<ul style="list-style-type: none"> <li>➤ Recommendation of CII National Committee on Higher Education on New Education Policy</li> <li>➤ Quality Enhancement in Engineering Education (QEEE)-CII Industry Bridge Programme</li> <li>➤ AICTE-CII Survey of Industry-Linked Technical Institutes 2016</li> <li>➤ Global Innovation &amp; Technology Alliance (GITA)</li> <li>➤ Prime Minister's Fellowship Scheme for Doctoral Research</li> </ul>
<b>22.</b>	<b>National Associations of Software and Services Companies (NASSCOM);</b> www.nasscom.in	<ul style="list-style-type: none"> <li>➤ The India Innovation Fund</li> <li>➤ Setting up of Centre for Excellence in Internet of Things (CoEIoT), Bengaluru</li> </ul>

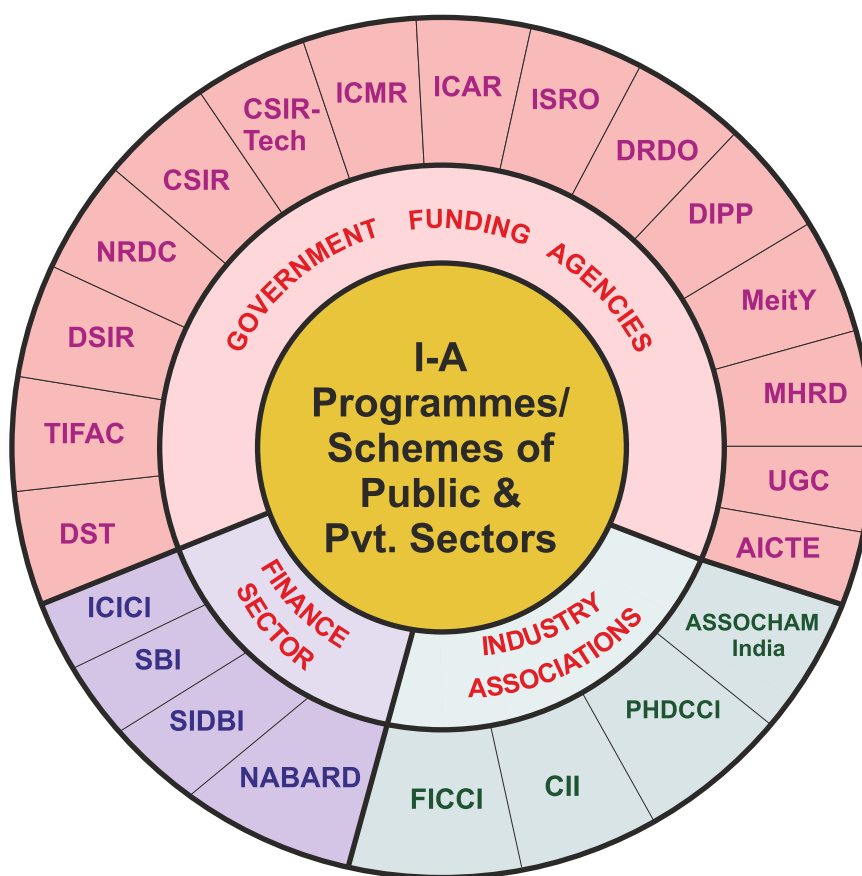
### III. Banking Sector

#### A. Industry Associations

23.	<b>Small Industries Development Bank of India (SIDBI);</b> www.sidbi.com	<ul style="list-style-type: none"> <li>➤ Creation of SIDBI Innovation and Incubation Centre (SIIC) at IIT Kanpur</li> <li>➤ Financing Schemes for Sustainable Development Including Energy Efficiency and Cleaner Production of MSMEs</li> <li>➤ TIFAC-SIDBI Revolving Fund for Technology (SRIJAN Scheme)</li> <li>➤ Technology and Quality Upgradation Support to Micro, Small and Medium Enterprises (TEQUP)</li> <li>➤ Scheme for Food Processing Industries</li> <li>➤ Technology Upgradation Fund Scheme for The Textile Industries (TUFS)</li> <li>➤ Integrated Development of Leather Sector Scheme (IDLSS)</li> </ul>
24.	<b>Industrial Credit and Investment Corporation of India (ICICI);</b> www.icicibank.com	<ul style="list-style-type: none"> <li>➤ Creation of Sponsored Research and Development Board (SPREAD)</li> <li>➤ Social Initiatives Group (SIG)</li> <li>➤ Creation of ICICI Knowledge Park (IKP)</li> <li>➤ Entrepreneurship Development Institute of India (EDI)</li> <li>➤ Technology Finance Group (TFG)</li> </ul>
25.	<b>National Bank for Agriculture and Rural Development (NABARD);</b> www.nabard.org	<ul style="list-style-type: none"> <li>➤ Corpus fund of ₹ 50 crores for R&amp;D</li> </ul>
26.	<b>Other Banks</b>	<ul style="list-style-type: none"> <li>➤ <b>SBI:</b> Setting up of Entrepreneurship Development Institute of India (EDI)</li> <li>➤ <b>Industrial Development Bank of India:</b> Technology financing scheme for commercialization of indigenous technology and start-ups related to indigenous technologies</li> <li>➤ <b>IFCI:</b> Scheme for credit enhancement facility for budding entrepreneurs especially for lower strata of society</li> <li>➤ <b>PNB:</b> PNB Mahila Udyam Nidhi Scheme, PNB MAHILA Samridhi Yojna, PNB Mahila Sashakitaran Abhiyan and PNB Kalyani card scheme</li> <li>➤ <b>OBC:</b> Oriented Mahila Vikas Yojana women entrepreneurs</li> <li>➤ <b>Syndicate Bank:</b> setting up of Syndicate Bank Entrepreneurship Research and Training Centre at IIT-Kanpur (SBERTC-IITK)</li> </ul>

## RECOMMENDATION

**Establishment of an Apex Body-National Industry-Academia Centre (NIAC):** In India, large number of I-A programmes/schemes/activities are being carried out by the public and private organizations which can be placed in three categories, a) Government Funding Agencies, b) Industries/Industry Associations, and c) Finance Sector as depicted below.



Although, many I-A related R&D programmes/schemes/activities are being carried out in India through agencies/institutions listed in the above figure, there is no common platform where all the information pertaining to I-A ecosystem in India is available. It will be prudent to have a centralized place e.g. NIAC (National Industry-Academia Centre), wherein all the information pertaining to I-A ecosystem in India is available and accessible to all. The collated I-A information will help in avoiding overlaps as well as identifying gaps in the I-A programmes. NIAC may liaison with international I-A bodies and learn from their experiences to strengthen I-A ecosystem of India.

## **First Advisory Committee Meet**

*(November 14, 2015 at ICSSR Complex, Panjab University, Chandigarh)*



*Dr Girish Sahni (DG, CSIR) talking about translational research*



*Dr V. M. Katoch (Fmr DG, ICMR) and Prof. G. D. Yadav (Vice Chancellor, ICT-Mumbai)*

## **Session on “Industry Institute Interface and University Innovation Clusters”**

*(January 23, 2015, Golden Jubilee Hall, Panjab University, Chandigarh)*



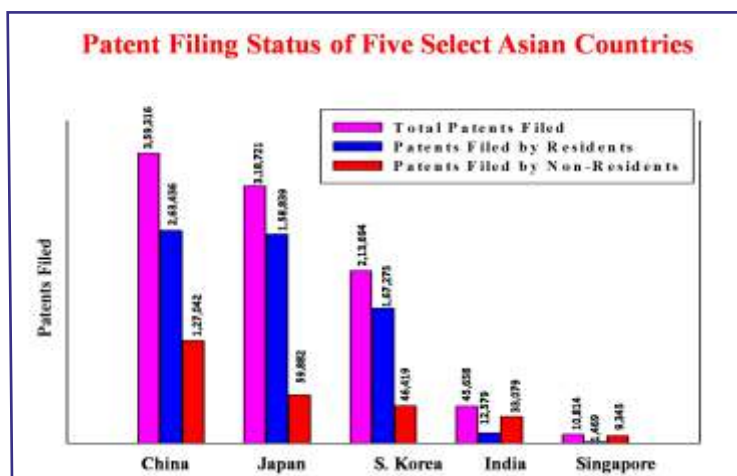
*Dr Anil Wali (MD, FITT, IIT-Delhi), sharing his views on Industry-Institute interface*



*Prof. Arun K. Grover (Vice Chancellor, PU, Chd.) amongst the audience during panel discussion*

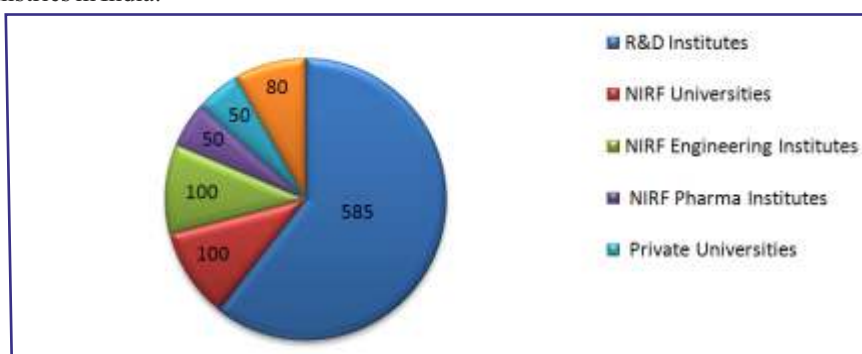
## Activity 2: Mapping of HEIs & R&D Organizations for Patents and Research Publications

In this era of knowledge and innovation, Intellectual Property (IP) occupies a prominent position as global indicator for ranking of world economies. India's dream of becoming a strong and developed nation cannot be fulfilled unless India improves its ranking in the domain of IP.



**Source:** World Intellectual Property Indicators, 2016 by World Intellectual Property Organization (WIPO)

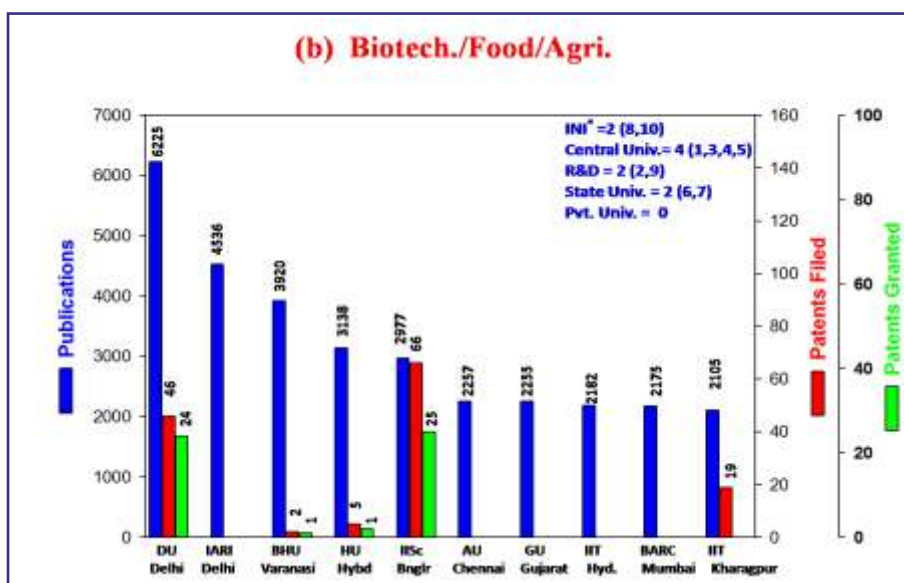
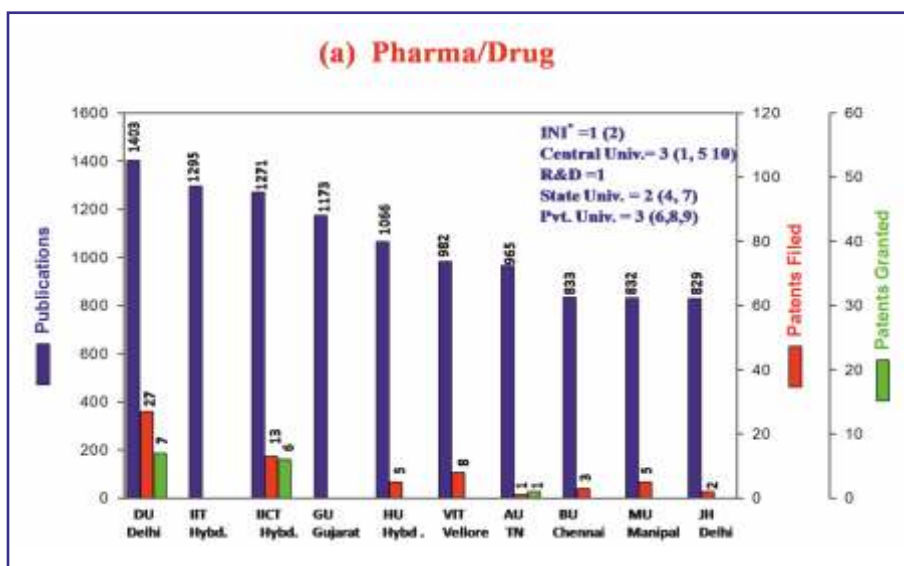
In order to achieve this, it is imperative that, we understand the ecosystem of IPR, especially patents, existing in India. Keeping this in mind, DST-Centre for Policy Research at Panjab University, Chandigarh undertook a responsibility to analyse the research publications and patents profile of Indian HEIs and R&D units. For this study, we have collected requisite data of 914 institutions comprising of IITs, NITs, AIIMS, public & private universities, pharma & engineering institutes and research laboratories existing under various ministries in India.



Indian scientists and researchers publish large number of research papers, but they fail in converting their research into patent, thus reducing chances of commercial exploitation of their innovative idea. After the analysis, Centre has figured out institutes which have good profile for both research publications and patents. These institutions can act as role models for other counterparts and can guide them on the factors hampering in converting their research into commercial products/processes.

## Publications and Patents of Top 10 Institutes (HEIs & R&D Units) in the Field of

(Based on Publications, Period: 2010 -16)

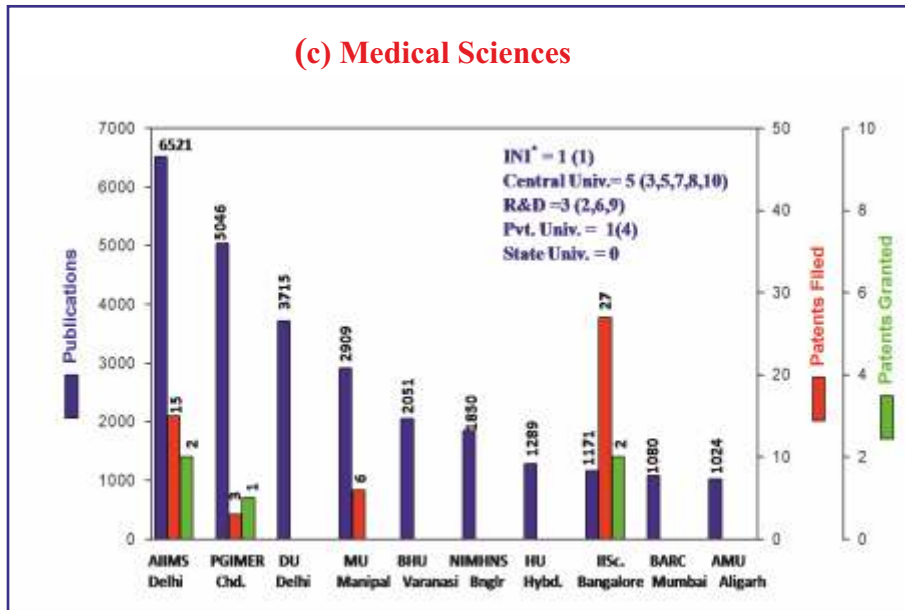


Sources: Publications: SCOPUS owned by ELSEVIER, Patents: Talwar & Talwar Consultants, Mohali

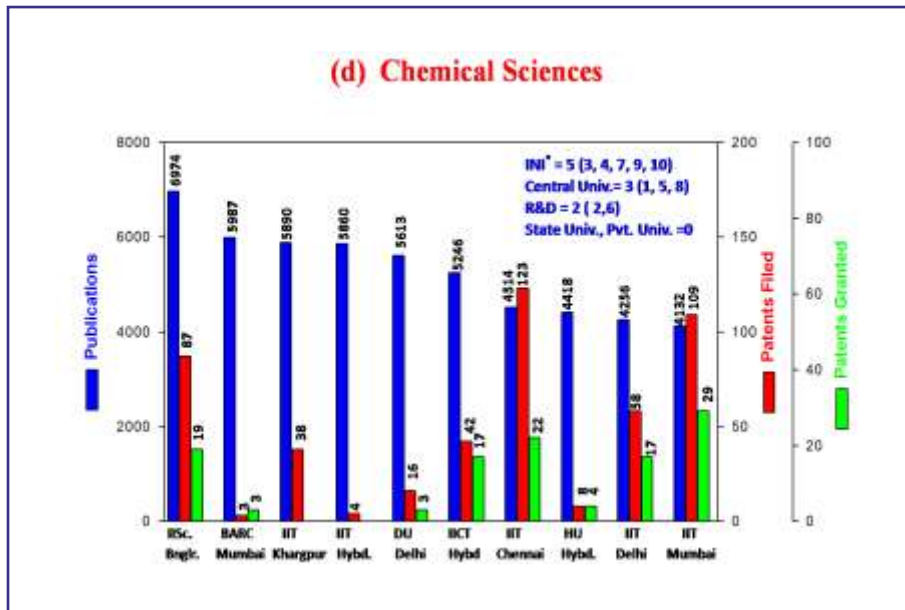
\* INI (Institutions of National Importance) 1 (2) → Rankings  
 ↓  
 No. of Institutions



### (c) Medical Sciences



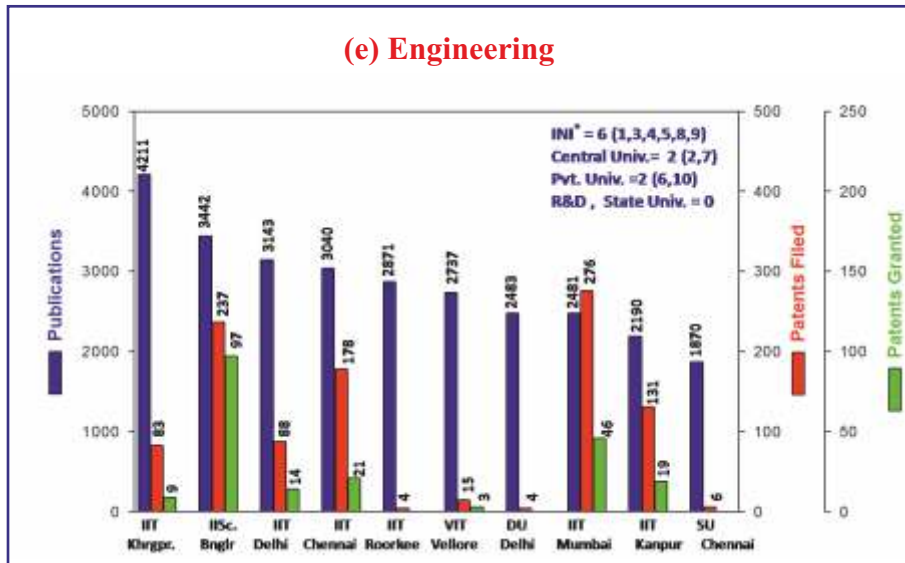
### (d) Chemical Sciences



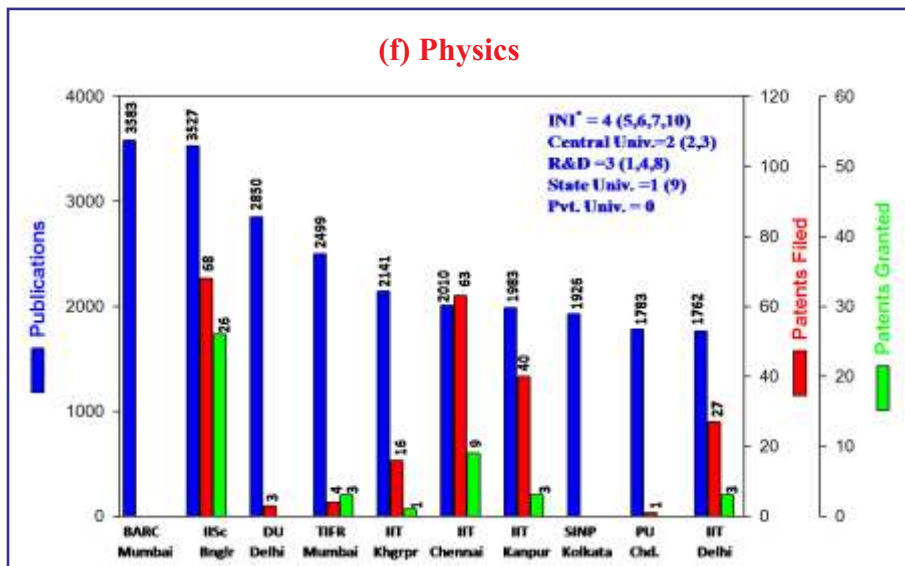
Sources: Publications: SCOPUS owned by ELSEVIER, Patents: Talwar & Talwar Consultants, Mohali

\* INI (Institutions of National Importance) 1 (1) → Rankings  
 ↓  
 No. of Institutions

**(e) Engineering**



**(f) Physics**



Sources: Publications: SCOPUS owned by ELSEVIER, Patents: Talwar & Talwar Consultants, Mohali

\* INI (Institutions of National Importance) 6 (1,3,4,5,8,9) → Rankings

↓  
No. of Institutions

## Advisory Committee (IPR) Meet

(July 15, 2017, CIL Seminar Hall, PU, Chd.)

DST-CPR at PU, Chd. has constituted an “Advisory Committee” (please see box) to guide the centre in undertaking the studies for strengthening IP regime of India.

### Advisory Committee (IPR)

**Dr K. S. Kardam,**  
Sr. Joint Controller of Patents & Designs  
Patent Office, New Delhi

**Dr Rajesh Dixit**  
Deputy Controller of Patents & Designs  
Patent Office, New Delhi

**Dr H. Purushotham**  
CMD, NRDC, New Delhi

**Shri Avinash Kumar**  
Addl. Director (IPR), DRDO (HQ)  
Ministry of Defence, GoI, New Delhi

**Mr Yashawant Dev Panwar**  
Scientist- E , TIFAC, New Delhi

**Mr Siddhant Chouksey**  
Asstt. Manager , CIPAM, New Delhi

**Mr Jitin Talwar,** Attorney, Patent Agent  
& Founder, TT Consultants, Mohali



*“Advisory Committee” members on dais.*

*Left to Right: Mr Yashawant Dev Panwar, Shri Avinash Kumar, Dr H. Purushotham, Dr K. S. Kardam, Dr Rajesh Dixit and special invitees - Dr (Mrs) Manu Chaudhary (JMD, Venus Remedies, Panchkula) and Mr Gurharminder Singh [In Charge (PIC & IPFC), PSCST, Chd.]*



*Participants of the Meet*

## **Industry-Academia Workshop on “Intellectual Property Rights (IPRs) and Regulatory Perspective for Pharma & Biotech Sectors”**

*(February 22 - 23, 2017, Golden Jubilee Hall, PU, Chd.)*

**Pharmaceutical Export Promotion Council of India, Hyderabad (Pharmexcil)** is the authorized agency of the Government of India for promotion of pharmaceutical exports from India. DST-CPR at PU, Chd. in association with Pharmexcil organized this workshop. The glimpses of the Meet are presented below.



*Left to Right: Prof. R. Tewari, Dr Dinesh Dua (Vice Chairman, Pharmexcil & CEO, Nectar Lifesciences, Chd.), Shri Bodh Raj Sikri (Co-Chairman, Federation of Pharma Entrepreneurs), Prof. Arun K. Grover (Vice Chancellor, PU, Chd.), Mr A. K. Pradhan (Dy. DCGI, Central Drugs Standard Control Organization, North Zone), Shri Navneet Marwaha (State Drugs Controller-cum-Drugs Licensing Authority, HP) and Dr Abhay Sinha (Regional Director, Pharmexcil)*



*Welcome address by Prof. Arun K. Grover, Vice Chancellor, PU, Chd.*



*Curtain Raiser address by Dr Dinesh Dua (Vice Chairman, Pharmexcil & CEO, Nectar Lifesciences, Chd.)*

## **Industry-Academia Round Table Meet** [April 6, 2016 at Institute of Chemical Technology (ICT), Mumbai]



*Dr Baldev Raj (Director, National Institute of Advanced Studies, Bangalore & Chairperson, Policy Research Cell, DST, New Delhi) addressing the audience*



*Dignitaries on the dais.*



*Dr Ajit Sapre, Group President, Research and Technology, Reliance Industries Ltd., Mumbai*



*Deliberation on Industry – Academia Interactions in the fields of Chemical, Food & Pharma*

DST-Centre for Policy Research at Panjab University, Chandigarh organized a one day Roundtable Meet on “Industry-Academia (I-A) interactions” in the areas of Pharma, Food and Chemical on April 6, 2016 at ICT-Mumbai. The Roundtable Meet was chaired by Dr Baldev Raj and Prof G D Yadav presided over the Meet.

### **Industry Representatives**

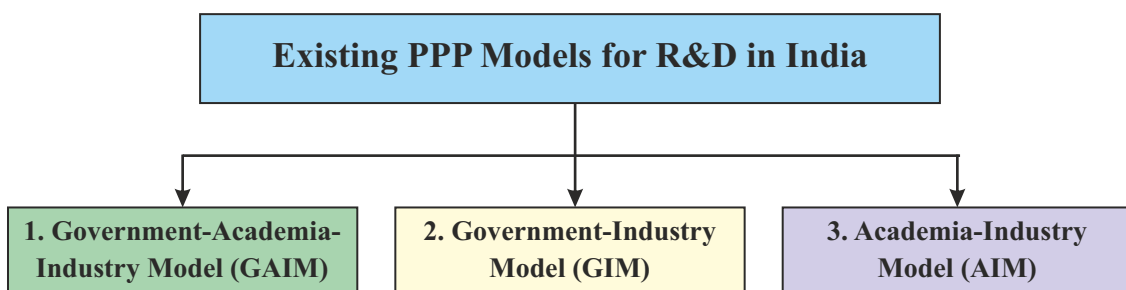
Pharma	Food	Chemical
Dr Milind Joshi, JB Chemicals & Pharmaceuticals Ltd., Mumbai	Mr Karupasamy Parasuraman, Aditya Birla Science & Technology Company Pvt. Ltd., Mumbai	Dr Ajit Sapre, Group President, Research & Technology, Reliance Industries Ltd., Mumbai
Mr Nitin Deshmukh, CEO-Kotak Private Equity, Mumbai	Mr Sanjaya Mariwala, Omni Active Health Technologies, Mumbai	Dr Sangita Srivastava, Godavari Bio-refineries Ltd., Mumbai
Mr Santosh Nandan, Managing Director, Ambernath Organics Pvt. Ltd., Mumbai	Dr Sudhir Tamne, Vice President, Innovation and Food Safety, Burger King, Mumbai	Mr Soni, Sun Pharma/Ramdev Chemicals Pvt Ltd., Mumbai
Dr Anil Pareek, President- Medical Affairs & Clinical Research, IPCA Laboratories Ltd., Mumbai	Dr Prabodh Halde, Marico India Pvt. Ltd., Mumbai	
Mr Gaurav Pathak, Glenmark Pharmaceuticals Ltd., Nashik		
Ms Maharukh Rustomjee, Founder, Rubicon Pvt. Ltd., Mumbai		

## Activity 3: Public Private Partnership (PPP) Models in R&D

PPP mode has become a phenomenon all around the world, including India, in the fields of infrastructure, transportation and urbanization as it provides not only essential capital (which a public sector alone cannot afford) but also professional competence in the work culture (focused approach, better management of finances and time bound projects). In addition, developed nations like, USA, U.K., Germany, Singapore and S. Korea have also built successful models of PPP for R&D. One of the most successful models of PPP (R&D) is termed as 'Triple Helix Model' in which government-academia-industry come together for strengthening nation's innovation ecosystem. A table comprising of successful schemes floated by various countries is mentioned later in this chapter.

Realizing the huge benefits (commercial and societal) accruing from industry (private sector)-academia (public sector) strategic partnerships in the domain of R&D, the Science, Technology and Innovation (STI)-2013 Policy of India has emphasized the need for promotion of R&D programmes via PPP mode. In India, PPP in R&D is in its infancy. Technically, there are a few examples of PPP (R&D) such as Global Innovation and Technology Alliance (GITA) and Centres of Excellence for Internet of Things (CoEIOT). But, there are many other instances wherein public (government and/or academia) and private (industry) sectors have collaborated in the pursuit of scientific excellence, but are not bound by tight regulations.

For convenience sake, the R&D programmes/activities functioning under PPP (R&D) mode have been put under three models i.e. Government-Academia-Industry Model (GAIM); Govt.-Industry Model (GIM) and Academia-Industry Model (AIM), as mentioned below:





## Examples of Government-Industry Model (GIM)



GLOBAL  
INNOVATION &  
TECHNOLOGY  
ALLIANCE

<https://www.gita.org.in>

### Government-Industry Supported Institutes/Organizations



Automotive Research Association of India

<https://www.araiindia.com/>



<http://ipirti.gov.in/>

### Government Supported Incubators for Industrial Research



(A Unit Of Shriram Scientific & Industrial Research Foundation)

<http://www.shriraminstitute.org>



<http://www.ikpknowledgepark.>



<http://www.venturecenter.co.in/>



<http://www.ccamp.res.in/>



## Examples of Academia-Industry Model (AIM)

### Industrial Laboratory Set Ups

- ❖ Tata Infotech Laboratory, Intel Microelectronics Laboratory, Wadhvani Electronics Laboratory and Cummins Engine Research Laboratory at IIT-Bombay
- ❖ E- Merck Laboratory and Chemistry Laboratory and Nihchal Israni Microbiological Laboratory at Bombay College of Pharmacy (BCP), Mumbai

### Industry Supported I-A Cells



(<http://pidiip-fitt-iitd.in/>)

### Industry Funded Fellowship Schemes

In IITs: Google India Fellowship, Aditya Birla Fellowship, TCS Research Scholarship, Singapore Technologies Engineering Scholarship, Infosys Fellowship, Intel India Fellowship and Nissan Scholarship

### Industry Chairs

- TATA Chair, Praj Industries Chair, Forbes Marshall Chair and Bajaj Group Chair at IIT-Bombay
- USV Chair at IIT-Kanpur
- ABB Chair, Microsoft Chair, Henry Ford Chair, Bharti Airtel Chair and Reliance Chair at IIT-Delhi

### IBM Software Centres of Excellence (CoE)

#### IBM Software CoEs at-

- Varadhaman Engineering College, Hyderabad
- Manipal Institute of Technology, Manipal
- D Y Patil College of Engineering & Technology, Pune
- Banasthali Vidyapeeth, Vanasthali
- Don Bosco Institute of Technology, Bengaluru
- Punjab Agricultural University, Ludhiana

## Successful Programmes/Schemes of PPP in R&D Existing in Various Countries

Country	Examples of Programs/Schemes
<b>USA</b>	➤ <b>Industry/University Cooperative Research (I/UCRC) Program</b> ( <a href="https://www.nsf.gov/eng/iip/iucrc/home.jsp">https://www.nsf.gov/eng/iip/iucrc/home.jsp</a> )
	➤ <b>Grant Opportunities for Academic Liaison with Industry (GOALI)</b> ( <a href="https://www.nsf.gov/eng/iip/goali.jsp">https://www.nsf.gov/eng/iip/goali.jsp</a> )
	➤ <b>Partnerships for Innovation: Accelerating Innovation Research-Technology Translation (PFI: AIR-TT)</b> ( <a href="https://www.nsf.gov/eng/iip/pfi/air-tt.jsp">https://www.nsf.gov/eng/iip/pfi/air-tt.jsp</a> )
	➤ <b>Engineering Research Center (ERC) Program</b> ( <a href="https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5502">https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5502</a> )
<b>U.K.</b>	➤ <b>Catapult Centers</b> ( <a href="https://catapult.org.uk/">https://catapult.org.uk/</a> )
	➤ <b>Collaborative Grant for R&amp;D Program (CR&amp;D)</b>
	➤ <b>Knowledge Transfer Partnerships</b> ( <a href="http://ktp.innovateuk.org/">http://ktp.innovateuk.org/</a> )
	➤ <b>Higher Education Innovation Fund (Third Stream)</b> ( <a href="http://dera.ioe.ac.uk/5902/1/rd03_06.pdf">http://dera.ioe.ac.uk/5902/1/rd03_06.pdf</a> )
	➤ <b>Industrial Partnership Awards (IPA)</b> ( <a href="http://www.bbsrc.ac.uk/innovation/collaboration/industrial-partnership-awards/">http://www.bbsrc.ac.uk/innovation/collaboration/industrial-partnership-awards/</a> )
	➤ <b>Stand-alone LINK</b> ( <a href="http://www.bbsrc.ac.uk/innovation/collaboration/stand-alone-link/">http://www.bbsrc.ac.uk/innovation/collaboration/stand-alone-link/</a> )
<b>Germany</b>	➤ <b>Research Campus - Public Private Partnership for Innovation</b> ( <a href="https://www.bmbf.de/en/research-campus-public-private-partnership-for-innovation-3418.html">https://www.bmbf.de/en/research-campus-public-private-partnership-for-innovation-3418.html</a> )
	➤ <b>VIP + Program</b> ( <a href="https://www.bmbf.de/de/vip-technologische-und-gesellschaftliche-innovationspotenziale-erschliessen-563.html">https://www.bmbf.de/de/vip-technologische-und-gesellschaftliche-innovationspotenziale-erschliessen-563.html</a> )
	➤ <b>Central Innovation Programs for SMEs (ZIM) Program</b> ( <a href="https://www.zim-bmwi.de/zim-overview">https://www.zim-bmwi.de/zim-overview</a> )
	➤ <b>Start-ups from Science (EXIST)</b> ( <a href="http://www.exist.de/EN/Home/home_node.html">http://www.exist.de/EN/Home/home_node.html</a> )
<b>European Union</b>	➤ <b>Horizon 2020 - EU Research and Innovation Programme (2014 to 2020)</b>
	➤ <b>Example of an Initiative - Joint Technology Initiatives (JTIs)</b> ( <a href="https://ec.europa.eu/programmes/horizon2020/en/area/partnerships-industry-and-member-states">https://ec.europa.eu/programmes/horizon2020/en/area/partnerships-industry-and-member-states</a> )

<b>Australia</b>	➤ <b>Co-operative Research Center (CRC) Program</b> ( <a href="https://www.business.gov.au/assistance/cooperative-research-centres-programme">https://www.business.gov.au/assistance/cooperative-research-centres-programme</a> )
	➤ <b>ARC Linkage Grants</b> ( <a href="http://www.arc.gov.au/linkage-projects">http://www.arc.gov.au/linkage-projects</a> )
	➤ <b>Rural Research and Development Corporations</b> ( <a href="http://www.ruralrdc.com.au/rural-research-development-corporations/">http://www.ruralrdc.com.au/rural-research-development-corporations/</a> )
<b>China</b>	➤ <b>Torch Program</b> ( <a href="http://www.chinatorch.gov.cn/english/xhtml/Program.html">http://www.chinatorch.gov.cn/english/xhtml/Program.html</a> )
	➤ <b>Blue Flame Program</b>
<b>Japan</b>	➤ <b>Adaptable and Seamless Technology Transfer Program through Target Driven R&amp;D (A-STEP)</b> ( <a href="https://www.jst.go.jp/tt/EN/univ-ip/a-step.html">https://www.jst.go.jp/tt/EN/univ-ip/a-step.html</a> )
	➤ <b>START (Program for Creating Start-ups from Advanced Research and Technology)</b> ( <a href="http://www.jst.go.jp/start/en/">http://www.jst.go.jp/start/en/</a> )
<b>Singapore</b>	➤ <b>Corporate Laboratory@ University Scheme</b> ( <a href="https://www.nrf.gov.sg/programmes/corporate-laboratory@university-scheme">https://www.nrf.gov.sg/programmes/corporate-laboratory@university-scheme</a> )
	➤ <b>Technology Consortia</b> ( <a href="https://www.nrf.gov.sg/programmes/test-bedding-and-demonstration-of-innovative-research">https://www.nrf.gov.sg/programmes/test-bedding-and-demonstration-of-innovative-research</a> )
	➤ <b>Test-Bedding and Demonstration of Innovative Research Funding Initiative</b> ( <a href="https://www.nrf.gov.sg/programmes/test-bedding-and-demonstration-of-innovative-research">https://www.nrf.gov.sg/programmes/test-bedding-and-demonstration-of-innovative-research</a> )
<b>Israel</b>	➤ <b>Kamin Program</b> ( <a href="http://www.matimop.org.il/KAMIN.html">http://www.matimop.org.il/KAMIN.html</a> )
	➤ <b>Magneton Program</b> ( <a href="http://www.matimop.org.il/MAGNETON.html">http://www.matimop.org.il/MAGNETON.html</a> )
	➤ <b>MAGNET Consortiums</b> ( <a href="http://www.matimop.org.il/MAGNET_Consortiums.html">http://www.matimop.org.il/MAGNET_Consortiums.html</a> )
	➤ <b>NOFAR Incentive Program</b> ( <a href="http://www.matimop.org.il/NOFAR.html">http://www.matimop.org.il/NOFAR.html</a> )

**Programmes floated by funding agencies (public sector) in support of PPP in R&D in India**

<b>BIRAC</b>	SBIRI, BIPP, CRS, PACE, Bio-Incubator
<b>DSIR</b>	PRISM, TDDP, TMP, CPP, PACE, BIRD-crf
<b>CSIR</b>	NMITLI, Corpus Fund
<b>DST</b>	TDB, Prime Minister's Fellowship Scheme for Doctoral Research, International S&T, GITA, NIDHI, NSTEDB
<b>MeitY</b>	Multiplier Grant Scheme, Incubators, ICT-Academies
<b>DIPP</b>	Invest India, AIM, MIUS
<b>MHRD</b>	IMPRINT India, CIHEC, Research Parks, GIAN

## RECOMMENDATIONS

- **BIRAC, an autonomous *not for profit* Section 8 company, has been a successful model of PPP (R&D) in the fields of Pharma and Biotechnology. It is suggested that the ministries of GoI dealing with Science, Technology and Innovations may set up *Industry Research Assistance Councils (IRAC)* on the lines of BIRAC (<http://www.birac.nic.in/>).**
- **To promote industry specific R&D, government may establish *Research Institutes* in collaboration with industry associations. One highly successful example is Automotive Research Association of India (ARAI), Pune, which is now a self-sustaining institute (<https://www.araiindia.com/>).**
- **Setting up of *Centers of Excellence (CoEs)* in public institutions of higher education and R&D organizations via PPP mode. Many successful examples of CoEs exist in IITs, IISc- Bangalore etc.**
- **Setting up of theme based *Research Universities* under PPP mode. The government may provide land to the private sector (individual industry/industry association) for building and operating these universities. To start with, government may initiate a dialogue with industries having annual R&D expenditure worth ₹ 1000 crores or more e.g. TATA Motors, Reliance Industries Ltd., Mahindra & Mahindra and Sunpharma Ltd.**
- **Strengthening the management of Incubators. Government of India has set up hundreds of 'Incubators' in HEIs, R&D Labs and Science/Technology Parks. Unfortunately, barring a few, majority of the Incubators are functioning below par, primarily due to the absence of/limitation of the professional expertise required to run the Incubator. In addition, Incubators have been unable to provide needful guidance (access to angel investors, venture capitalists, banking sector, marketing strategies etc.). It is recommended that a critical review of the functioning of the existing Incubators be carried out.**
- **One of the sore points faced by the industries is the difficulty accessing scientific expertise, technologies, patents, instrumentation facilities and Centers of Excellence existing in the vicinity of the industrial units. Similarly, academia finds it hard to interact with the industries for the lack of information. It is suggested that state specific or region specific web portals of the academia as well as industries be created. One such portal, which has gained appreciation from the industry and academia, is the Industry-Academia CRIKC Web Portal (<http://iacrikc.dstcpr.in>).**
- **It is strongly recommended that government should come out with lucrative incentives for the private sector to engage with public institutions for carrying out collaborative R&D programs.**

## **Industry-Academia Round Table Meet** *(April 28, 2016, ICSSR Complex, Panjab University, Chandigarh)*



### **Release of DST-CPR Brochure**

*Left to Right: Prof. R. Tewari (Coordinator, DST-CPR at PU, Chd); Prof. Arun K. Grover (Vice Chancellor, PU, Chd.); Dr Girish Sahni (DG, CSIR); Prof. S. K. Das (Director, IIT-Ropar) and Prof. A. K. Puri (DG, ITS, Ghaziabad)*



*Dr Neeraj Sharma (Head, Policy Research Cell, DST, New Delhi) addressing the audience*



*Dr S. S. Marwaha (Fmr. Director, PBTI, Mohali) sharing his views on I-A partnerships*

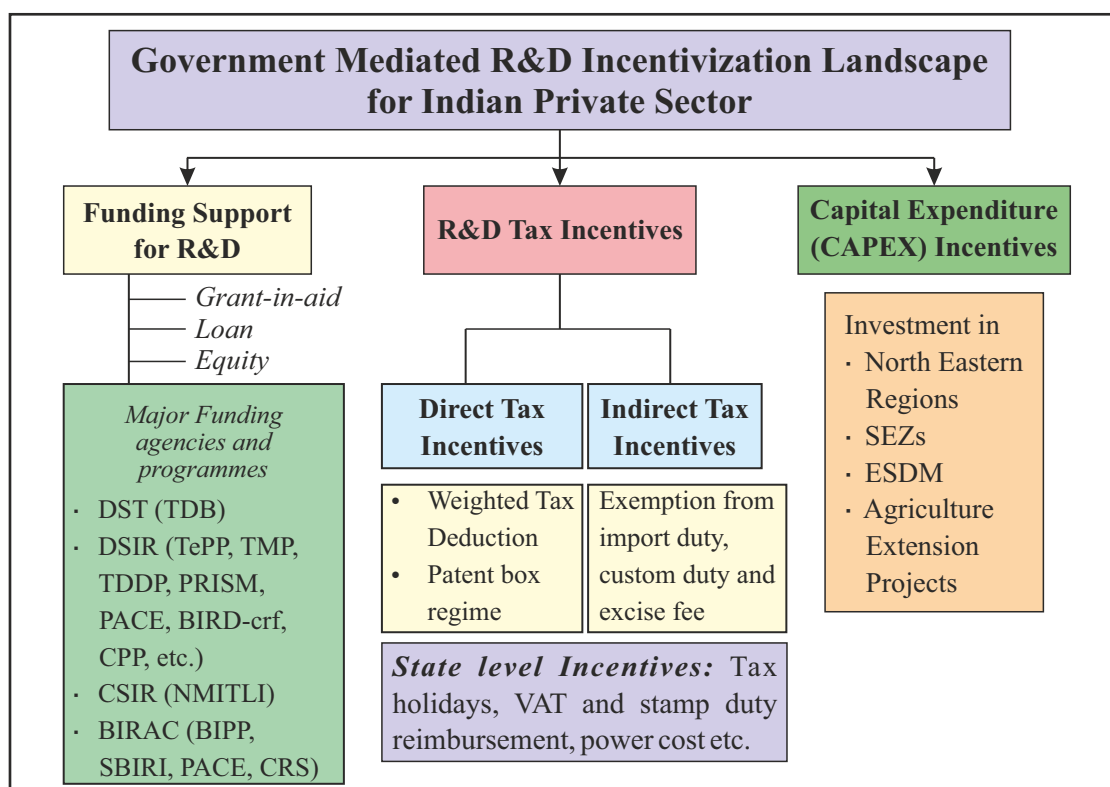


*Audience participating in the Technical Session of the Meet*

**Three Parallel Sessions were held in the fields of Food, Pharma & Agriculture**

## Activity 4: Stimulation of Private Sector Investments in R&D

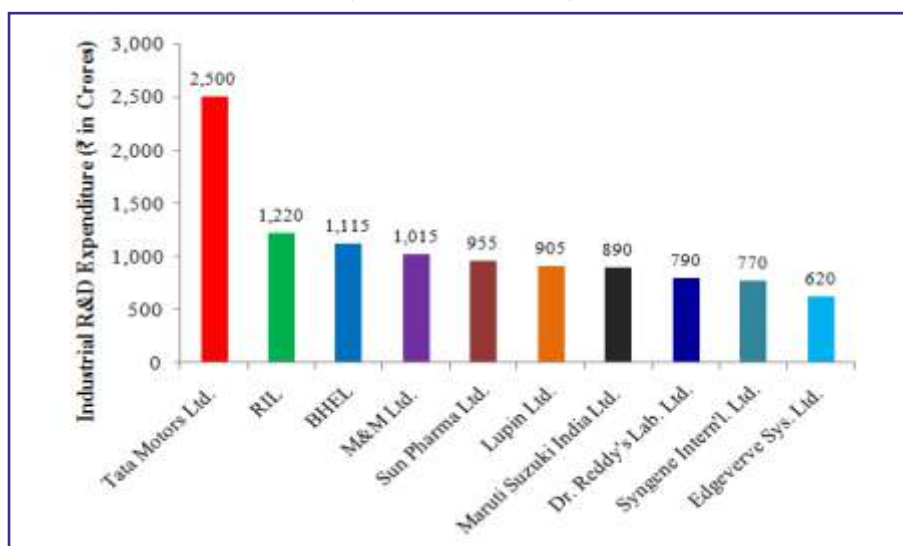
As we move into the 21<sup>st</sup> century, the importance of knowledge-based industries is being realized. Currently, the global investments in R&D sector are around 2.066 trillion (USD in purchasing power parity) and the major chunk of investment comes from the private sector. In developed as well as emerging economies of the world (USA, U.K., Germany, France, Singapore, S.Korea, China, etc.) public: private investments into R&D are in the ratio of 1:2. However, in India, almost 1/3<sup>rd</sup> of R&D investments are contributed by the private sector and rest comes from the public sector. Hence, to stimulate private sector investments in R&D, our Centre has initiated a study on comparing R&D incentivization of private sectors of select countries as listed in the text.



*DST-Department of Science and Technology, TDB-Technology Development Board, DSIR-Department of Scientific and Industrial Research, TePP-Technopreneur Promotion Programme, TMP-Technology Management Programme, TDDP-Technology Development and Demonstration Program, PRISM-Promoting Innovations in Individuals, Start-ups and MSMEs, BIRD-crf-Building Industrial R&D and Common Research Facilities, CPP-Consultancy Promotion Programme, CSIR-Council of Scientific and Industrial Research, NMITLI-New Millennium Indian Technology Leadership Initiative, BIRAC-Biotechnology Industry Research Assistance Council, BIPP-Biotechnology Industry Partnership Programme, SBIRI-Small Business Innovation Research Initiative, PACE-Promoting Academic Research Conversion to Enterprise, CRS-Contract Research Scheme, SEZs: Special Economic Zones, ESDM-Electronics System Design & Manufacturing*

## Top Ten Private Sector Investors in R&D in India

(Period: 2016-17)



*Source: DSIR Annual Report 2016-17 RIL: Reliance Industries Ltd., BHEL: Bharat Heavy Electricals Ltd., (founded by GoI), M&M Ltd., Mahindra & Mahindra Ltd.*

## Major Government Mediated R&D Incentivizations Availed Globally

Countries	Tax Credits	Tax Deductions	Patent Box Regime	Financial Support	Risk Coverage	IP Jurisdiction (Location Specific)
USA	✓	✓	✗	✓	✗	✗
UK	✓	✓	✓	✓	✓	✓
China	✗	✓	✓	✓	✓	✗
Japan	✓	✗	✓	✓	✓	✗
S. Korea	✓	✗	✓	✓	✓	✗
Singapore	✗	✓	✓	✓	✓	✗
France	✓	✗	✓	✓	✓	✗
Israel	✓ (Reduction in corporate tax rate)		✗	✓	✓	✗
India	✗	✓	✓ (2017 onwards)	✓ (Limited support)	✗	✗

*Source: 2017 Survey of Global Investment and Innovation Incentives-Deloitte; Worldwide R&D Incentives Reference Guide 2017-EY; Global R&D Incentives Group-pwc; Compendium of R&D Tax Incentive Schemes: OECD countries and selected economies, 2016-OECD*

## Major Tax Incentives Availed by the Private Sector in Select Countries

Country	Direct Tax Incentive	Indirect Tax Incentive	Patent Related Tax Incentives
USA	<p><b>1. Research tax credits</b></p> <ul style="list-style-type: none"> <li>➤ Incremental specific (computed on an increment of qualified research spending exceeding a base amount)</li> <li>➤ Non-refundable</li> <li>➤ Unused credits can be carried forward for 20 years and carried back for 1 year</li> <li>➤ Three types:                             <ul style="list-style-type: none"> <li>a. <b>Traditional research credit: 20%</b> <i>(Credit on incremental Spending with Limitations)</i></li> <li>b. <b>Alternative research credit: 14%</b> <i>(Credit on incremental Spending without Limitations)</i></li> <li>c. <b>Targeted research credit: 20%-basic research; 20%-Energy Research Consortium &amp; 50%-clinical research for orphan drugs</b></li> </ul> </li> </ul>	No	No
China	<p><b>1. Super deduction</b></p> <ul style="list-style-type: none"> <li>➤ Non-refundable</li> <li>➤ 50% the Deduction on volume</li> <li>➤ Can be carried forward for 5 years (in case of losses)</li> </ul> <p><b>2. Reduced tax rates for High-New Technology Enterprise (HNTE)-15% reduced</b></p> <p><b>3. Reduced tax rates for Technology Advanced Service Enterprises (TASE)-15% reduced</b></p> <p><b>4. Preferential Tax Incentives (10% tax credit) for using energy saving technologies</b></p>	VAT/Custom duty incentives	Annual income from qualified technology transfers is exempted from enterprise corporate tax.
S.Korea	<p><b>1. Tax credit</b></p> <ul style="list-style-type: none"> <li>➤ Non-refundable</li> <li>➤ Unused R&amp;D credits may be carried forward for the following five years.</li> <li>➤ A tax credit for SMEs: 50% on incremental and 25% on volume.</li> <li>➤ A tax credit for medium sized companies:</li> </ul>	No	SMEs: 50% tax exemption on IP transfer and 25% of lending

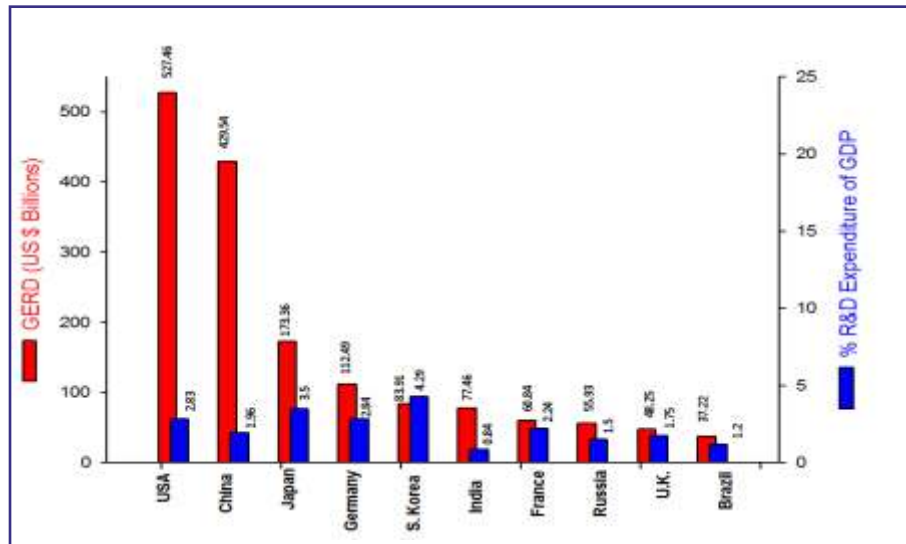


	<p>40% on incremental and 8% on volume.</p> <ul style="list-style-type: none"> <li>➤ A tax credit for large sized companies: 30% on incremental and 3% on volume.</li> </ul> <p><b>2. 30% Additional R&amp;D tax incentives on qualified expenditure related to new growth engine industry</b></p> <p><b>3. Investment tax credit for R&amp;D equipment (1% for large companies; 3% for medium-sized companies and 6% for SMEs)</b></p> <p><b>4. Additional tax credit for investing in facilities for energy-saving (1% for large companies; 3% for medium-sized companies and 6% for SMEs)</b></p>		<p>SMEs acquire a patent (7% exemption on the amount paid to acquire the patent)</p> <p>SMEs lend a qualified patent (25% of the related income)</p>
<b>U.K.</b>	<p><b>1. Volume-based super deductions (230% deduction)</b></p> <ul style="list-style-type: none"> <li>➤ Super deduction scheme is available for SME (fewer than 500 employees and either gross revenue not exceeding EUR 100M or gross assets not exceeding EUR 86M)</li> <li>➤ Refundable</li> <li>➤ Carried forward for indefinite period</li> </ul> <p><b>2. Research and Development Expenditure Credit (RDEC) Scheme: Volume-based tax credits (11%)</b></p> <ul style="list-style-type: none"> <li>➤ Tax credits are available for large companies</li> <li>➤ Higher tax credit of 49% available for companies working in petroleum oil extraction (these companies also have higher corporate tax rates on their respective profits in comparison to other countries)</li> <li>➤ Non-refundable</li> <li>➤ Carried forward for indefinite period</li> </ul> <p><b>3. Cash credits for SMEs in loss positions, up to 33.35% of qualifying expenditure</b></p>	No	10% rate of corporation tax to profits generated from patents

<b>India</b>	<ol style="list-style-type: none"> <li><b>1. Super deduction for in-house R&amp;D expenditure</b> <ul style="list-style-type: none"> <li>➤ Non-refundable</li> <li>➤ If the taxpayer is in a loss situation, unused benefits may be carried forward for the following eight years, but cannot be carried back</li> <li>➤ The R&amp;D facility must be approved by the Department of Scientific and Industrial Research (DSIR) for a company to qualify for the super deduction</li> <li>➤ 150% super deduction for carrying out R&amp;D activities in the in-house center</li> </ul> </li> <li><b>2. 150% super deduction for specified payments made to certain scientific research associations, approved universities, colleges, or other institutions</b></li> <li><b>3. 100% super deduction for specified payments made to a scientific research company/research association/university/college/other institution for the purpose of scientific and statistical research</b></li> <li><b>4. 100% tax exemption for the first five years, starting from the year manufacturing commences, followed by a 50% tax exemption for the following five years on export profits earned from a new undertaking set up in a Special Economic Zones</b></li> </ol>	<p>Customs duty exemption on goods imported for R&amp;D</p> <p>Duty-free import for biotech and pharma units</p> <p>Central excise duty waiver for 3 years</p> <p>Reimbursement of countervailing duties (CVD) and excise duties on capital equipment under M-SIPS</p>	<p>10% tax rate on royalty income from the patent.</p>
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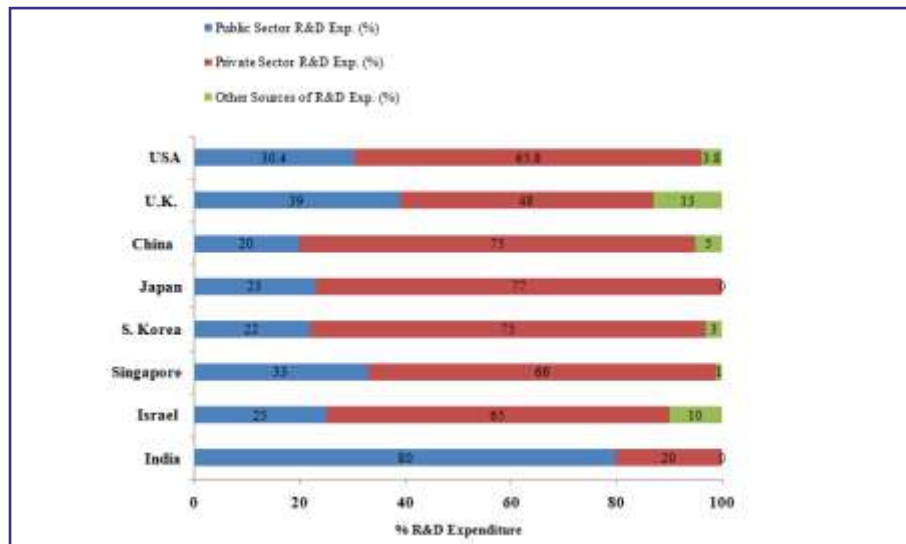
*Source: 2017 Survey of Global Investment and Innovation Incentives-Deloitte; Worldwide R&D Incentives Reference Guide 2017-EY; Global R&D Incentives Group PWC; Compendium of R&D Tax Incentive Schemes: OECD countries and selected economies, 2016-OECD*

## Top Ten R&D Investing Countries



Source: *Global R&D Forecast 2017*,  
[http://digital.rdmag.com/researchanddevelopment/2017\\_global\\_r\\_d\\_funding\\_forecast?pg=1#pg1](http://digital.rdmag.com/researchanddevelopment/2017_global_r_d_funding_forecast?pg=1#pg1)

## Pattern of R&D Funding in Leading Countries



Source: *Global R&D Forecast 2017*; Patil A and Biswas S, 2014; <http://ec.europa.eu/eurostat/statistics>

## **Recommendations for Stimulating Private Sector Investments in R&D in India**

- In comparison to other countries, in India a few R&D investments are qualified for R&D incentivization. Expenditure incurred on following items is not considered:
  - Land and building (for R&D)
  - Cost of using R&D infrastructure of public institutions
  - Funds provided by industry to research scholars
  - Cost of development for R&D
  - Cost of IP purchased as sub components of final R&D output
  - Cost of patent filing/maintenance investments by venture capitalists in technology ventures
- Creation of 'Special Fund' for global partnership in R&D by Public and Private sectors
- Write off loan, in case of genuineness of the failure of the R&D by Private sector
- To encourage R&D by small businesses, government may provide financial guarantee, as is the case in Germany
- Distribution of tax incentives in accordance to the scale of industry as practised in developed economies such as S.Korea, where tax credit of 50% for SMEs, 40% for medium sized companies and 30% for large sized companies is implemented.
- A right mix of loan, equity and grant-in-aid according to the stage of technology development and risk factor involved in Private sector R&D should be introduced.
- A part of Corporate Social Responsibility (CSR) fund may be considered for carrying out research in collaborative mode.
- In accordance to the Indian government, a fixed percentage of commercial products, developed through private sector R&D has set to be purchased by government, but this is not practiced widely, therefore needs reforms in implementation.
- Securing of loans against IP of the companies
- Special R&D expansion programmes of tax incentivization, as applied in Singapore can be introduced for Indian companies who wish to expand their R&D business.
- Creation of simplified rules and guidelines for the process of approval and accreditation of tax incentives to R&D companies on lines of Japan should be promoted in India.
- Added tax relaxation should be provided to industries carrying out res. projects in PPP mode
- Mandatory disclosure of R&D investments by Private sector in their 'Balance Sheets' and 'Annual Reports'.
- Under each ministry heads, expert committees to monitor and maintain R&D incentivization of Private sector should be constituted.

**Popularization of Research Fellowship Schemes of Govt. of India**  
(March 24, 2015, CIL Auditorium, Panjab University, Chandigarh)



*Dr P. J. Singh (Tynor Orthotics Pvt. Ltd.)  
enlightening the audience*



*Ms Shalini Sharma (CII, New Delhi)  
delivering a talk*

**Expectation of Industrial Sector from Universities**  
(February 18, 2014, CIL Auditorium, Panjab University, Chandigarh)



*Dr Neeraj Sharma (Head, Policy Research Cell,  
DST, New Delhi)*



*Felicitation of Dr. (Mrs.) Manu Chaudhary (MD,  
Venus Remedies Ltd., Panchukula) by Prof. Arun K  
Grover (Vice Chancellor, PU, Chd.)*

**Bridging the Industry- Academia (I-A) Gap in the IT Sector**  
(December 18, 2014, ICSSR Complex, Panjab University, Chandigarh)

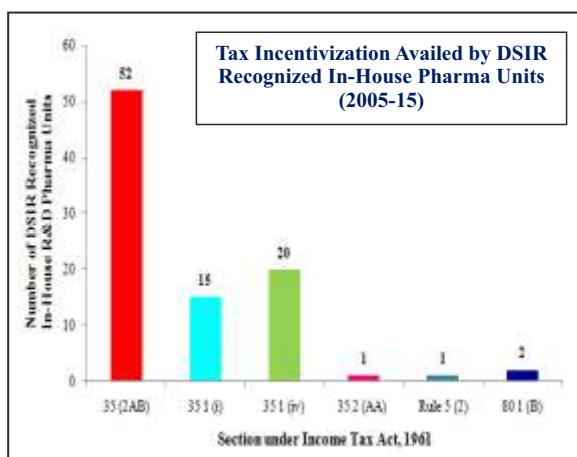


*Mr David Lelliot (British High Commissioner, Chd.) and Mr Ajay Davessar (VP & Global  
Head Corporate Communications, HCL Technologies, Noida, UP) delivering a talk*

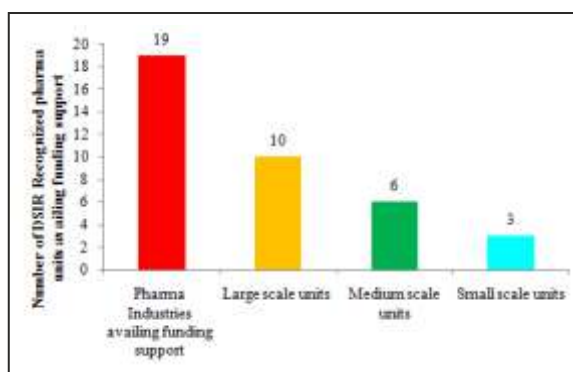
## Activity 5: Case Study: Impact of Government Incentivization on R&D Output of DSIR Recognized In-House R&D Units in Pharma Sector

The Centre is in the process of compiling data on the impact of government sponsored incentivization on Private Sector's R&D. Initially, we have undertaken a case study using pharma sector as a model. This study is being carried out with active participation of DSIR, GoI.

- **Total Number of Pharmaceutical Industries in India (2017):~850**
- **Number of Pharmaceutical Industries recognized by DSIR: ~330**
- **Number of Pharmaceutical Industries Considered in Study : 110**  
(With >10 years of existence; in order to evaluate impact of govt. mediated R&D incentivization on R&D output of these industries)
- **Government Mediated R&D Incentives Availed by Pharmaceutical Industries Considered in the study:**
  - **Tax Incentives: Availed by 64 units out of 110 units**
  - **Government Funding Support: Availed by 19 Units out of 110 units**



Section	R&D Incentivization
35 (2AB)	Tax deduction (150%) on expenditure of a industry on performing In-House R&D
35 1 (i)	Tax deduction (150%) on sum paid as a salary component for research work
35 1 (iv)	Tax deduction (150%) on capital expenditure incurred (e.g. pilot plant, biosafety facilities etc.)
35 2 (AA)	Tax deduction (125%) on amount paid to national res. lab./university/institute for carrying out research work
Rule 5 (2)	Tax deduction (150%) for amount used in developing plant and machinery to be used for scientific research
80 1 (B)	Tax deduction on profits and gains from industrial research



Funding Support can be availed in form of **Loan** (a sum of money that is provided by the government agency for R&D purpose which needs to be returned to an industry with added interest in specified time frame); **Grant** (a sum of money given by the government to the industry for the specific purpose without the need to return it back to the grant provider); **Equity** (a sum of money provided by the government to the company for the specific purpose of which in return government holds a portion of the share of the same company in accordance to the investment) and **Subsidy** (a sum of money is provided by the government to the company to maintain the price fluctuation of the specific products).

**Invited Lecture**  
by  
**Prof. H. P. Khincha**

*[Founder and Chief Executive of Society for Innovation and  
Development (SID) at IISc Bangalore]*

on

***“Innovation and Entrepreneurship in India”***  
*(August 2, 2016, ICSSR Complex, Panjab University, Chandigarh)*



*Audience listening to the talk delivered by Prof.  
H.P. Khincha*



*Prof. H.P. Khincha*



*Light moments shared between Prof. R. Tewari  
(Coordinator, DST-CPR at PU, Chd.) and Prof.  
H.P. Khincha*



*Prof. H.P. Khincha being felicitated with  
memento by Prof. Arun K. Grover (Vice  
Chancellor, PU, Chd.) and Prof. Manoj Arora  
(Director, PEC, Chd.)*

## Activity 6: Reforms in Higher Education for Strengthening Industry-Academia Interactions

With the onset of the knowledge economy, the role of the higher education system is gradually being seen as a driver of economic growth and sustainability, in addition to imparting quality education to young minds. This new functionality of higher education sector necessitates greater emphasis on translational research leading to generation and commercialization of patents/technologies to the industrial sector, thereby necessitating closer Industry-Academia linkages. In order to realise these expectations, it has become imperative to urgently reform our higher education system, as mentioned below, under various sub-heads.

### Higher Education Reforms in R&D

#### 1. Infrastructure

#### 2. Faculty Development

#### 3. Central Level and State Level Policies

#### 4. Reformation of Existing Universities

#### 5. Research Focus

#### 6. Funding Access for Students

### 1. Infrastructure

- **Setting up theme based Research/Innovation universities under PPP mode:** In order to be at par with global R&D institutions, it is essential to have at least 100 world class autonomous research/innovation institutions, which can be established at a typical investment of ₹ 500-600 crores per institution and spread over all states of India which might be covered in a span of 8-10 years. National Universities can be established by the government or by a private sponsoring body by setting up a society, charitable trust or Section 25 Company or under PPP mode. Industries having R&D investment of over ₹ 1000 crores (TATA, RIL, Mahindra and Mahindra, etc.) may be invited for establishing theme based institutions.
- **Consolidating and improving the capacity and quality of the existing institutions:** The concept of Meta University aimed at collaborative and multi disciplinary learning that redefines knowledge creation and knowledge sharing in the twenty first century, should be explored. The strategy of converting universities into



Research Universities, on the pattern of China (e.g. Peking University, Tsinghua University, University of Science and Technology of China, etc.) may be adopted in India.

- **Inter University Centres:** The few inter university centres that have been set up have proved the concept to be a successful and viable one. Such centres need to be multiplied in different fields to enable a wider cross section of university researchers access advanced research facilities and equipment which are otherwise not available in university environments.
- **Creation of 'Industrial Zones' in Universities:** In universities engaged in applied-research, Govt. may set up 'Industrial Zones' which cater to entrepreneurship programmes, business management programmes, space for incubators/start-up companies. This facility may be created under PPP mode.
- **Research-Building Funds:** In India, the funding agencies provide grants for R&D projects and refurbishing of laboratories. However, there is no provision of funds for the construction of dedicated buildings for housing R&D facilities like Entrepreneurship Centre, Incubation Centres, Centres of Excellence, I-A Cell, IPR Cell, Technology Transfer Cell, Laboratory Animal Facility, Bio-Safety Level-III facility, Test- Beds, Workshops and so on. To give impetus to applied research it is suggested that MHRD along with UGC and AICTE should earmark dedicated funds for the construction of buildings for R&D related activities. The presence of such facilities will definitely encourage university scientists to orient their research towards translational R&D.
- **Establishment of Translational Research Centre (TRC):** The study carried out by our Centre suggests that HEIs excelling in translational research have strong IPR and Tech Transfer set ups. In order to promote the spirit of patenting in the universities, it is felt that each university should have a TRC having a vibrant Patent Cell managed by a professional/s competent enough to assist/guide young researchers and teaching-faculty in patent search/filing and technology transfer. Each TRC should lay down robust policies of IPR and Tech Transfer. Industries are reluctant to forge R&D collaborations if these policies are not in place.
- **Setting up of Business & Marketing Entities in Universities:** Generally, the administrative ecosystem of the universities is not conducive for smooth functioning of patenting and Tech Transfer processes. Red tapism and ambiguous rules/regulations hampers the scientists to tread this path. To promote the culture of patenting and Tech. development/transfer, it is recommended that universities be permitted and encouraged to establish a legally distinct non-profit entity such as Society, Trust, Foundation or Section 25 Company to exploit market its knowledge base, products, databases etc. *Evidence:* Foundation for Innovation in Technology Transfer (FITT) in IIT-Delhi is an autonomous body, set up by Govt. of India, and is

dedicated for promoting Industry-Academia interactions and converting academic knowledge of IIT-D into commercial products. FITT is financially self sufficient, well connected with private sector and has a hefty bank balance (around ₹ 30 crores). During last one decade it has licensed ~33 technologies and incubated > 46 Start ups.

- **Setting up of IPR Academies:** It is suggested that in each state, one university is adopted for the setting up of IPR Academy, which runs dedicated IPR programmes/workshops for researchers and scientists throughout the year. The main objective of the IPR Academy will be to generate at least two resource persons for each university. The IPR Academy will act as mentor for the universities associated with it. The IPR Academies may be financed by Department of Industrial Policy & Promotion (DIPP)/ Cell for IPR Promotion and Management (CIPAM) for its administration and for running IPR programmes.
- **Creation of 'Industry Academia Web Portal':** Though, Indian academic sector is engaged in applied research of industrial relevance, but the private sector finds it difficult to access the expertise and facilities existing in the academic institutes. It is suggested that 'Web Portals' catering to the expectations of industry from academia be created at university level, state level and national level, displaying the following parameters existing in universities: a) Scientific expertise (field wise), b) Centres of Excellence, c) Infrastructure facilities such as sophisticated instruments, test beds, animal facility, library, workshops, fermentation facility etc., d) Patents (filed/granted), Technologies (transferred, available & under process), e) IPR and Tech Transfer policies of the institute, f) Entrepreneurship and Incubator programmes of institute. The institutes may use CRIKC I-A web portal as a template. The information collected from all the institutes should be collated to construct a 'National I-A Web Portal'. The responsibility of maintaining and updating the 'National I-A Web Portal' may be delegated to MHRD or DST or DIPP.

## 2. Faculty Development

- **Faculty Fellowships for Indian Academics:** Academicians should be encouraged to be stakeholders/partners of the entrepreneurial and incubation ecosystems in universities by offering “Faculty Entrepreneurial Fellowships”.
- **Employing retired employees from corporations:** Retired employees from reputed corporates with relevant experience may be encouraged to undertake a second-career in teaching in higher education institutions, after completion of a short training/orientation course.
- **Industrial training for academic leaders:** Industry could help train the academic leaders like Vice Chancellors, finance officers, administrators, principals and heads of departments on leadership skills.
- Introduction of Crash-Courses on IPR, Entrepreneurship and Business Management for science faculty.

- **Mobility of R&D Professionals** of public sector to private sector and *vice versa*, with full pay and job protection should be encouraged. Provisions of sabbatical leave for the faculty members engaged in applied research to spend time in industry to understand industrial environment should be introduced.
- Incentives should be given to academicians/scientists having industry tie ups for pursuing collaborative I-A R&D. Similarly, industries having research tie ups with universities or R&D institutes should be incentivized.

### 3. Central Level and State Level Policies

- **Dedicated R&D Funds for State Universities by the Funding Agencies:** If India has to progress in the domains of scientific research, patents and technologies, the R&D ecosystem of state universities needs to be improved. These universities need to be empowered with R&D infrastructure and Translational Research Ecosystem. It is strongly recommended that central government, through its funding agencies, creates a special R&D fund for State governed universities. State universities, having potential of good R&D, should be mentored by an experienced faculty member of central universities/autonomous institutes. To begin with, top ten percent of the universities showing promising research, as evidenced from their research publications, patents and technology transfers, may be provided special funding for R&D.
- **Special Fund under Maintenance Grant:** The funding agencies are quite liberal in granting money for creating R&D facilities including purchase of equipments. However, it is difficult to maintain the equipments after the warranty period is over. Almost each institute is facing this problem. It is suggested that funding agencies should create a separate fund under Maintenance Grant, to be utilized by a scientist/institute.
- **Creation of Talent Retention Grant:** A fresh Ph.D pass out finds it difficult to get absorbed immediately once his/her Ph.D *viva voce* has been conducted. It might take a year, may be more, before he/she gets a job or post doctoral fellowship. In order to utilize the services of these highly talented scholars, it is recommended that funding agencies may initiate 'Talent Retention Grant' (TRG), under which a fresh Ph.D pass out can continue working in the laboratory for at least an year. This time period can be utilized by the candidate (or his/her Ph.D guide) to continue working on interesting leads found during Ph.D research work or channelize his/her innovative research into generation of patent/technology. A candidate may apply for TRG, six months prior to the submission of Ph.D thesis, so that he/she gets the grant immediately after the Ph.D *viva voce* has been conducted.
- **Creation of UGC-IP Fund:** Public sector R&D funding agencies like CSIR, DRDO,

ICAR etc. take care of the charges involved in patents (filing and maintenance) generated by their scientists. Unfortunately, UGC has no such provision. It is the discretion of the university to set aside funds for patenting. In reality, universities are not in a position to create IP Fund due to financial constraints, thereby creating a bottle neck in stimulating IP ecosystem in the universities. It is suggested that UGC-IP Fund be created as is prevalent in CSIR/DRDO/ICAR.

- **I-A Activities as an Important Criterion in National Assessment and Accreditation Council (NAAC) Evaluation of Universities:** NAAC, an autonomous body of UGC, is an organization that assesses and accredits institutions of higher education. One of the NAAC evaluation criteria is 'Consultancy' by the faculty of the university/college. By replacing 'Consultancy' category with 'I-A Activities' category (consultancy, industry sponsored activities such as, R&D projects, industry chairs, centre of excellence and I-A fares/symposia/workshops) and allotting more weightage for the same, the universities will be bound to promote I-A activities.
- **Linking of Universities, R&D Laboratories and Industries:** Our nation has a mammoth strength of public funded R&D laboratories (over 500), > 1800 DSIR certified private R&D labs. and hundreds of HEIs (institutes of national importance + NAAC 'A' accredited universities) excelling in research. However, each sector has its own strengths and limitations. Universities are rich in intelligentsia and man power, but have limited availability of sophisticated instruments and knowledge of R&D problems of the private sector i.e. industries. Public funded R&D labs have ample sophisticated instruments but are limited in manpower and understanding of R&D bottle necks of the industries. Private sector is well aware of the needs of the society that can be addressed by developing innovative products but have limited R&D manpower and research facilities. The limitations of each sector can be overcome by developing meaningful linkages among them and the net result would be improvement in the area of applied research resulting in increased number of patents, products and technologies. Government would be the biggest beneficiary of these alliances, as it does not have to spend even a single additional penny, but the quantum of research publications, patents, technologies will increase.

#### 4. Reformation of Existing Universities

- **Appointment of R&D Oriented Vice Chancellors:** Universities having a track record of excellent scientific research should be headed by a reputed scientist. It has been observed that, if a Vice Chancellor of a university is from arts/languages/social-sciences/law/music background, he/she may find difficult to understand the importance of scientific research/fervour and thus may not be promoting scientific research to a level it should be. Hence, it is recommended that science-oriented universities may be headed by a reputed scientist having good administrative skills.

- **Alignment of Science Syllabi:** A serious re-look is needed on the academic syllabi of science subjects. Syllabi should be in tune with the requirements of the industries. Dedicated courses on entrepreneurship development, IPRs and business management programmes should be introduced.
- **Reforms in Promotion Criteria for Teaching Faculty:** A Promotion criterion for universities faculty is heavily tilted towards research publications. Due weightage to scientists working on industry related projects should be given. For the promotions of Asstt. Professor to Assoc. Professor and then to full Professor, a condition for having successfully completed at least one industry activity i.e. consultation, tenure (period: at least 6 months) in industry, technology transfer, patent, member/expert in governing body of industry/industry association etc. should be mandated.

## 5. Research Focus

- **The Indian Corporate R&D Fund** should be set up with a corpus of ₹ 5,000 crores on the lines of National Science Foundation in the United States of America. This should be funded by the central government and the corporate operating in India. Such a fund operating with a transparent and merit based funding mechanism can act as a huge fillip for R&D in all Indian universities and higher education institutions.
- To recognize the local priorities, local enterprise partnerships between Small and Medium Enterprises (SMEs) and universities should be promoted. Through these partnerships, the SMEs can leverage the facilities of the universities in the region.
- A flexible Public Private Partnership (PPP) developmental framework should be defined to build local synergies and to leverage existing resources/capabilities to their full potential
- Two percent of the budgeted allocation of each Ministry/Department should be exclusively earmarked for research, as it will reap a lot of benefits and go a long way in creating an enabling climate of research.
- Transparent centrally implementable **Performance Related Incentive Scheme (PRIS)** based on past and proven track record in research, should be put in place to enable grant based investments in such performers. For R&D leading to technology development and knowledge services, the criteria would, however, be institution specific. Centrally instituted incentives to public-funded R&D centres for outcomes leading to public and strategic goods could be introduced.
- Industry should be involved from the very beginning of the university research projects having industrial implications. Using this approach, the project will be more focussed and shorten the time for commercialization of the technology developed.

## 6. Funding Access for Students

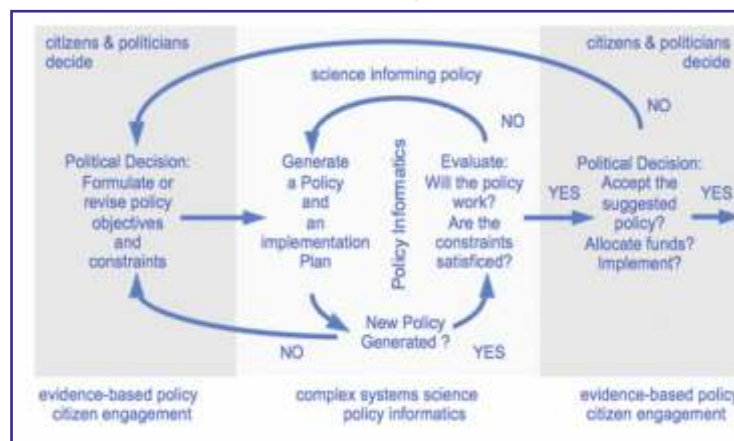
- **Industry-Academia Scholarship/Fellowship Schemes:** DST (GoI) has introduced 'PM's Fellowship Scheme for Doctoral Research' It is recommended that in order to stimulate I-A collaborative R&D, higher education bodies i.e. UGC and AICTE should initiate similar schemes for Ph.D and Post-Doctorate research work
- A scholarship to be named “**The Indian Corporate Higher Education Scholarship**” should be set up with a corpus of ₹1,000 crores contributed by the top corporates of the country. This should be run by an eminent independent board. This scheme should be encouraged by the government by providing full matching grants as well as providing tax exemption of up to 300% for all contributions.

## Policy Informatics (PI) for Enhancing R&D and I-A Interactions

The emerging area of Policy informatics dwells on developing theories and research concerning complexity theory, decision-making, visual representation of quantitative and qualitative data, collective intelligence, behavioural economics and persuasive technologies (Helbig *et al.*, 2012). Policy informatics utilizes modern computational approaches to mine data from multiple sources, process vast amount of data and develop models to analyze networks of interacting elements and forces. Data visualisation tools are also used in policy informatics to expand our ability to display and disseminate complex information. Such tools bring ample opportunities and challenges for developing new theories on complex and dynamic social systems and new approaches that might be suitable for analysing the effect of policies on these complex systems (Johnson and Kim, 2011).

Policy Informatics can be defined as "the transdisciplinary study of how computation and communication technology leverages information to better understand and address complex public policy and administration problems and realise innovations in governance processes and institutions" (Center for Policy Informatics, Arizona State University). Policy informatics also encompasses exploration of the implications of new analytical tools and data sources for conducting policy relevant research. This approach strengthens the linkages among policy practitioners who share an interest in policy formulation, implementation, and evaluation (Kamensky, 2012). Various Policy Informatics projects are presently being utilized in various domains such as tracking epidemics (e.g. **CIMPLEX**, <https://www.cimplex-project.eu/>) forecasting and monitoring financial crisis (e.g. **FOC**, <http://www.focproject.eu>) map technology and capability ecosystems of countries and industrial sectors (e.g. **G.R.O.W.T.H.C.O.M.**, <http://global-systems-science.eu/gss/content/growthcom>) water demand and supply (e.g. **WaterSim**, <https://sustainability.asu.edu/dcdc/watersim/>) and so on.

### The Role of Policy Informatics



*Source: Future Learn, Global System Science, 2017*

## PI and its Utility

Policy makers and policy analysts face a constant influx of:

- Vast information
- Conflicting values and
- Political pressures

Thus making it increasingly difficult to choose between policy options that may or may not work.

In policy areas the lingering questions are:

- What are the policy options?
- Will these policies have the desired outcomes?
- Can unintended consequences be avoided?

Therefore, there is a need to devise tools for:

- Navigating complex information effectively
- Identifying patterns of policy consequences
- Building Narratives/Justifications
- Ensuring transparency of influences

The emerging area of PI brings together:

- Traditional sciences,
- Social sciences,
- Mathematics,
- Information & Communication Technologies.
- ❖ PI find ways of combining different kinds of data sets to create Simulations of the impact of policies.
- ❖ This robust and systematic approach gives a clear-cut range of policy consequences.

### Plan of Study

- Mapping Pharma research (Publications, Patents and Tech - transfer) being carried out in HEIs & R&D Units of India. Period of study: 2000 onwards.
- Develop Policy Informatics models for exploring policy options/ interventions for enhancing R&D (Pharma) of HEIs & R&D Units

### References:




- Helbig, N., Nakashima, M. and Dawes, S., (2012), Understanding the Value and Limits of Government Information in Policy Informatics: A Preliminary Exploration. In Proceedings of the 13th Annual International Conference on Digital Government Research. College Park, MD. ACM Digital Library.
- Johnson, E. and Kim, Y. (2011). Introduction to the Special Issue on Policy Informatics, The Innovation Journal: The Public Sector Innovation Journal.
- Centre for Policy Informatics, Arizona State University.
- Kamensky, J. (2012). Policy Informatics is Bridging the Gap Between Researchers and Politicians, Government Executive.



## Additional Information

### a) Reports Prepared by DST-CPR at PU, Chd.

#### Period: 2015-16

 DST-Centre for Policy Research at PU, Chd. (DST/PRC/CPR-03/2013) <b>REPORT-1</b> (May, 2015-Aug., 2016) <i>Industry-Academia Programmes/Schemes of Public and Private Sectors</i>	 DST-Centre for Policy Research at PU, Chd. (DST/PRC/CPR-03/2013) <b>REPORT-2</b> (May, 2015-Aug., 2016) <i>Existing Models of R&amp;D under Public Private Partnerships (PPP) Mode</i>	 DST-Centre for Policy Research at PU, Chd. (DST/PRC/CPR-03/2013) <b>REPORT-3</b> (May, 2015-Aug., 2016) <i>Patents Ecosystem of India Based on WIPO and IPO Indicators</i>
 DST-Centre for Policy Research at PU, Chd. (DST/PRC/CPR-03/2013) <b>REPORT-4</b> (May, 2015-Aug., 2016) <i>Case Studies on Feedback from Select Scientists Engaged in Industry-Academia Research Projects</i>	 DST-Centre for Policy Research at PU, Chd. (DST/PRC/CPR-03/2013) <b>REPORT-5</b> (May, 2015-Aug., 2016) <i>Industry-Academia R&amp;D Regimes in Indian Institutes of Technology (IITs)</i>	 DST-Centre for Policy Research at PU, Chd. (DST/PRC/CPR-03/2013) <b>REPORT-6</b> (May, 2015-Aug., 2016) <i>Industry-Academia Related Questionnaire Survey Report of IITs</i>

#### Period: 2014-15

 DST-Centre for Policy Research at PU, Chd. (DST/PRC/CPR-03/2013) <b>REPORT-7</b> (May, 2014-Aug., 2015) <i>Comparative Study of Asian Economies: Lessons for India</i>	 DST-Centre for Policy Research at PU, Chd. (DST/PRC/CPR-03/2013) <b>REPORT-8</b> (May, 2014-Aug., 2015) <i>Reforms Needed in Higher Education Sector for Promotion of Industry- Academia Interactions</i>	 DST-Centre for Policy Research at PU, Chd. (DST/PRC/CPR-03/2013) <b>REPORT-9</b> (May, 2014-Aug., 2015) <i>Foundation for Innovation and Technology Transfer (FITT): A Case Study on I-A Interface in India</i>
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## b) Science and Technology Indicators of First Generation IITs

IP Attributes	IIT Kharagpur	IIT Bombay	IIT Madras	IIT Delhi	IIT Kanpur	IIT Guwahati
<i>Publications (2015-16)*</i>	2889	2614	2581	1938	2410	1511
<i>Patents (2010-16)**</i>						
<i>Filed</i>	171	441	376	252	208	23
<i>Granted</i>	10	100	48	44	56	0
<i>Technology available</i>	214	409	358	6	50	05
<i>Technology Licensed (till date)</i>	24	>140	60	60	15	06
<i>Revenue generated from tech transfers (Crores ; upto 2015)</i>	186.80	209	461	2.38	135.83	1
<i>Incubating Companies</i>	172	71	95	52	44	13
<i>Start-ups (till date)</i>	104	>26	89	26	16	10
<i>Industrial Collaborations (MoUs; 2010-15)</i>	72	225	~176	124	8	09
<i>Corporate Clients</i>	~400	~400	227	~124	48	50
<i>Sponsored projects (Crores ; 2010-15)</i>	577.45 (2011-2016)	1149.95	491.11	401.23	328 (2010-14)	220.53
<i>Revenue generated Consultancies (Crores ; 2010-15)</i>	69.75 (2011-2016)	143.5	251.11	52.25	138 (2010-14)	16.37

**Source:** \*Scopus, \*\* Talwar & Talwar Consultants, Mohali  
 IIT Bombay, R&D highlights 2016, Annual Reports (IIT-K) 2010-2015;  
 Annual Reports (IIT-M) 2010-2015, Annual Reports (IIT Bombay) 2010-2015,  
 Questionnaire filled by IITs for DST-CPR at PU, Chd., <http://www.iitk.ac.in/>,  
<http://www.iitr.ac.in/>, <http://www.iitb.ac.in/>, <https://www.IIT-M.ac.in/>,  
<http://www.iitd.ac.in/>, <http://www.iitkgp.ac.in/>, <http://www.iitg.ac.in/>,  
 External Peer Review committee Report (IIT Delhi -2015), External Peer  
 Review committee Report (IIT Kharagpur -2015).

## c) Global Rankings of Select Asian Countries in S&T Indicators

(Period: 2016-17)

S.No.	Indicators	Global Rankings					
		Singapore	Japan	Taiwan	S. Korea	China	India
1.	* <b>Publications<sup>a</sup></b>	31 (16.98)	6 (14.96)	21 (11.97)	12 (11.75)	2 (0.93)	5 (8.32)
2.	** <b>H-Index<sup>b</sup></b>	25 (33.93)	6 (71.78)	n/a	19 (41.78)	14 (49.91)	21 (37.10)
3.	** <b>Intellectual Property Rights<sup>c</sup></b>	4 (8.797)	14 (8.226)	24 (7.67)	46 (5.676)	59 (5.424)	41 (5.882)
4.	** <b>University-Industry Collaboration in R&amp;D<sup>d</sup></b>	7 (5.5)	18 (4.8)	17 (4.8)	29 (4.4)	30 (4.3)	24 (4.5)
5.	** <b>Capacity for Innovation<sup>d</sup></b>	20 (5.2)	21 (5.1)	24 (5.1)	30 (4.8)	45 (4.4)	39 (4.6)
6.	** <b>Availability of Scientists &amp; Engineers<sup>d</sup></b>	9 (5.2)	3 (5.5)	28 (4.7)	39 (4.4)	30 (4.7)	36 (4.6)
7.	** <b>Quality of Scientific Research Institutions<sup>d</sup></b>	10 (5.8)	13 (5.7)	26 (5.0)	34 (4.6)	40 (4.5)	36 (4.6)
8.	** <b>Country Capacity to Retain Talent<sup>d</sup></b>	6 (5.5)	38 (4.1)	39 (4.1)	29 (4.4)	33 (4.2)	32 (4.3)
9.	** <b>Country Capacity to Attract Talent<sup>d</sup></b>	4 (6.0)	77 (3.2)	62 (3.5)	49 (3.7)	23 (4.4)	22 (4.4)
10.	** <b>Availability of Latest Technologies<sup>d</sup></b>	14 (6.1)	12 (6.2)	29 (5.6)	30 (5.6)	81 (4.5)	78 (4.5)

**Source**

*a - SJR — SCImago Journal & Country Rank (<http://www.scimagojr.com/countryrank.php?year=2016>)*

*b - The Global Innovation Index (<https://www.globalinnovationindex.org/gii-2017-report#>)*

*c - IPRI Report 2017 (<https://internationalpropertyrightsindex.org/countries>)*

*d - The Global Competitiveness Report-2016-17*

*n/a - WIPO does not consider Taiwan as individual country so data for H-Index is not available for it*

*\*Citations per document in parenthesis*

*\*\*Actual scores in parenthesis*

## d) Glimpse of Industry-Academia Portals Existing in India

S. No.	Website/Portal	Developing Agency
1.	<b>CSIR Technology Portal</b> <a href="http://techindiacsir.anusandhan.net/online/Control.do?_main=488t3s">http://techindiacsir.anusandhan.net/online/Control.do?_main=488t3s</a>	CSIR, DSIR, GoI
2.	<b>Techpedia</b> <a href="http://techpedia.sristi.org/">http://techpedia.sristi.org/</a>	SRISTI (Non-Government Organization)
3.	<b>Innovation Portal</b> <a href="http://fccollc.com/nrdclive/index.php">http://fccollc.com/nrdclive/index.php</a>	NRDC, DSIR, GoI
4.	<b>Indian Scientists in Major Scientific Agencies (2008)</b> <a href="http://indianscientist.in/">http://indianscientist.in/</a>	NSTMIS (DST)
5.	<b>Database of Experts in Life Sciences in India</b> <a href="http://nstmis-dst.org/lifesciencedatabase/Intro.asp">http://nstmis-dst.org/lifesciencedatabase/Intro.asp</a>	NSTMIS (DST)
6.	<b>Global Technology Base- APCTT</b> <a href="http://apctt.org/technology-offer">http://apctt.org/technology-offer</a>	Asian and Pacific Centre for Transfer of Technology (APCTT), DSIR, GoI
7.	<b>Ideapoke</b> <a href="https://www.ideapoke.com/">https://www.ideapoke.com/</a>	Ideapoke Technologies Pvt Ltd.
8.	<b>Database of Experts in Mathematical Sciences in India</b> <a href="http://www.nstmis-dst.org/ExpertDatabase.aspx">http://www.nstmis-dst.org/ExpertDatabase.aspx</a>	NSTMIS (DST)
9.	<b>TIME IS (Technology Innovation Management &amp; Entrepreneurship Information System)</b> <a href="http://www.techno-preneur.net">http://www.techno-preneur.net</a>	DST, GoI and FICCI
10.	<b>CRIKC Industry – Academia Web Portal</b> <a href="http://iacrikc.dstcpr.in/">http://iacrikc.dstcpr.in/</a>	DST – CPR, PU. Chd.

## **e) Top 10 Indian Applicants for Patents from Scientific and R&D Organizations**

(Period: 2015-16)

<b>S. No.</b>	<b>Name of Scientific and R&amp;D Organization</b>	<b>Public/Private</b>	<b>Applications Filed</b>
<b>1.</b>	<b>CSIR, New Delhi</b>	<b>Public</b>	<b>323</b>
<b>2.</b>	<b>Samsung R&amp;D Institute India-Bangalore Private Ltd.</b>	<b>Private</b>	<b>271</b>
<b>3.</b>	<b>DRDO, New Delhi</b>	<b>Public</b>	<b>85</b>
<b>4.</b>	<b>ICAR, New Delhi</b>	<b>Public</b>	<b>63</b>
<b>5.</b>	<b>Hetero Research Foundation, Hyderabad</b>	<b>Private</b>	<b>40</b>
<b>6.</b>	<b>GHR Labs and Research Centre, Nagpur</b>	<b>Private</b>	<b>33</b>
<b>7.</b>	<b>ISRO, Bengaluru</b>	<b>Public</b>	<b>25</b>
<b>8.</b>	<b>Sandip Institute of Technology and Research Centre, Nasik</b>	<b>Private</b>	<b>21</b>
<b>9.</b>	<b>C-DAC, Pune</b>	<b>Public</b>	<b>20</b>
<b>10.</b>	<b>Sun Pharma Advanced Research Company Ltd., Mumbai</b>	<b>Private</b>	<b>19</b>

*Sources: IPO Annual Report, 2015-16*

## f) Top 10 Indian Applicants for Patents from Institutes and Universities

(Period: 2015-16)

S. No.	Name of Scientific and R&D Organization	Public/Private	Applications Filed
1.	IITs (Collective)	Public	391
2.	Amity University, Noida	Private	99
3.	Bharath University, Coimbatore	Public	65
4.	IISc., Bangalore	Public	46
5.	Chitkara University, Patiala	Private	46
6.	Saveetha School of Engineering, Chennai	Private	33
7.	GHR College of Engineering/GHR Labs and Research Centre, Nagpur	Private	33
8.	Shoolini University of Biotechnology and Management Sciences, Solan (HP)	Private	22
9.	Janardan Rai Nagar Rajasthan Vidyapeeth University, Rajasthan	Public	22
10.	Veltech Dr. RR & Dr. SR Technical University, Chennai	Private	20

*Sources: IPO Annual Report, 2015-16*

## **Team, DST-Centre for Policy Research at PU, Chd.**

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**Ms. Kanwal Puneet Kaur**  
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**Mr. Rohan**  
*Secretarial Staff / Data Entry Operator*



सत्यमेव जयते  
Department of  
Science & Technology  
Government of India

DST-Centre for Policy Research  
at  
Panjab University, Chandigarh



Panjab University  
Chandigarh.

A Book on

**Industry-Academia R&D Ecosystem in India**  
*.....an evidence based study*

released by Dr R Chidambaram (*Principal Scientific Advisor to GoI*) on  
Jan. 4, 2017 during 104<sup>th</sup> Indian Science Congress held in Tirupati



*Left to Right: Dr Akhilesh Mishra (Scientist D, DST, New Delhi); Dr Anita Aggarwal (Scientist E, DST, New Delhi); Prof. Rupinder Tewari (Coordinator, DST-CPR at PU, Chd.), Dr Neeraj Sharma (Head, PRC, DST, NewDelhi), Dr G Satheesh Reddy (Scientific Advisor to Defence Minister); Dr Ashutosh Sharma (Secretary, DST, NewDelhi); Dr R Chidambaram (Principal Scientific Advisor to GoI) and Dr V K Saraswat (Member Science, NITI Aayog)*

***e-Book: <http://cpr.puchd.ac.in/>***