DST- Centre for Policy Research
at
Panjab University,Chandigarh

Sanctioned by the Department of Science and Technology (DST),
(DST/PRC/CPR-03/2013, Dated 09/01/2014)

Annual Report

(Revised)

Period

(i) January, 2014 - March, 2014
(ii) April, 2014 – March, 2015

Coordinators:

Prof. Rupinder Tewari
Prof. Manmohan Gupta

DST-CPR
at
Panjab University, Chandigarh.

Email: dstprc2014@pu.ac.in

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OBJECTIVES

DST, New Delhi sanctioned Centre for Policy Research at Panjab University, Chandigarh in December 2013. The major objectives of this Center are:

- Development of a new country specific model for promotion of 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.

ACTIVITIES

- Period: 3 months (January, 2014- March, 2014)
- Period: 1 year (April, 2014 - March, 2015)

Period: 3 months (January, 2014- March, 2014)

- A one-day meet on "**Expectation of Industrial Sector from Universities"** was held on 18th February 2014 at Panjab University, Chandigarh. Experts from various industries interacted with the students and faculty. The minutes of the outcome of this meet and the key recommendations are enclosed as Annexure I.

- The process of recruitment of staff for the Centre was initiated.

- The process of procuring a dedicated space for the Centre for Policy Research was initiated.

Period: 1 year (April, 2014 - March, 2015)

- The first objective was to identify Institutes of Higher Education and Research in the country, which have established 'Cell' working towards the said goal. A comprehensive list of the above-mentioned institutes was prepared and correspondence with them initiated (Annexure II-VI). The institutes have been categorized as Universities, Research laboratories, Management institutes, Technical Institutes and Govt. & Private bodies. We have contacted roughly 300 sources through email.

- Appropriate and dedicated space (approx. 3500 sqft) was allocated to DST-CPR at the PU campus. It will comprise of separate (a) Offices for Coordinators and Officials hired under this project, (b) Seminar cum Conference room (c) Common room and (d) Library.

- The process of calling for quotations for various items sanctioned under this project was initiated.

- Director, Computer Center was requested to create a website of the DST- Centre for Policy Research at PU and link the same to the University website. The URL of the website is http://cpr.puchd.ac.in

- Communication was initiated with two Universities of UK i.e. the University of Cambridge and University of Nottingham to assist us in our endeavours in Industry-Academia interactions. These universities have well established Cells for industry-academia linkages. Prof. R. Tewari, Coordinator, DST-CPR visited these universities (23^{rd}-28^{th} June, 2014) as a part of the delegation comprising of the Scientists from Chandigarh region.

- Detailed and extensive studies were initiated on analyzing the existing models of public-private partnerships and the policies that govern the PPP working of developed and developing countries. The framework and norms governing the expenditure on R&D in India by the Govt. and Public Sector were also studied to identify the status of the same. Comparison of the said status of India with Korea and China was made. (Annexure VII and VIII)

- Setting up of infrastructure and establishing a dedicated work area with appropriate resources.

- Questionnaires for the Academia(Annexure IX) and Industry (Annexure X)were prepared to analyze the extent of collaborations that exist amongst their Institute/ Organization and respective counterparts.

- A case study on Foundation for Innovation and Technology Transfer (FITT), New Delhi was initiated in the month of Sept, 2014 and has been completed (Annexure XI).

- A Round Table Meet on **"Bridging the Industry- Academia Gap in the IT Sector"** was organised and held in the month of December, 2014. The minutes and the key recommendations of the meet have been enclosed as Annexure XII.

- The Officers of the Centre attended an Interaction -cum- Reviewmeeting with all the Coordinators of 5 Centres on January 17th2015 during the workshop at BBAU, Lucknow.

- A session on "Industry Institute Interface and University Innovation Clusters" was organized by the Centre in the MICROCON 2015 (22-24th January, 2015).

- A case study to analyze the industrial collaboration of core research institutes has been conceptualized and initiated on CSIR-Institute of Microbial Technology (IMTECH).

- Discussions with the Confederation of Indian Industry (CII), Chandigarh have been were set in motion in the first week of February, 2015.

- DST - CPR at PU organized a workshop for **Popularization of Research Fellowship Schemes of Govt. of India**on Tuesday, March 24th 2015. The Minutes of the Meet have been attached as Annexure XIII.

- Preliminary evidence based study forpromising areas of Intellectual Property (IP) generation in Punjab and Chandigarh was been initiated (Annexure XIV).

Annexure I

Minutes of the meeting of a One day meet conducted on

"Expectation of Industrial Sector from Universities"

The seminar was held on 18th February 2014, Tuesday at 10:00 am in the Seminar room, CIL Building, Panjab University, Chandigarh.

Key speakers present:

1. Prof. Arun K. Grover, Vice Chancellor, Panjab University, Chandigarh.
2. Mr. Anil Arora, Director (EPD), Abbot Healthcare Pvt. Ltd., Mumbai.
3. Dr. (Mrs.) Manu Chaudhary, Managing Director, Venus Remedies Ltd., Panchkula, Hrayana.
4. Dr. Anil Wali, Managing Director, Foundation for Innovation and Technology Transfer (FITT), Indian Institutes of Technology (IIT), New Delhi.
5. Mr. Rajneesh, Biotechnology Industry Research Assistance Council (BIRAC), Department of Biotechnology (DBT), New Delhi.
6. Dr. Neeraj Sharma (Head, Policy Research), Department of Science & Technology (DST) (GoI), New Delhi.
7. Dr. Purusottam Bhatacharjee, Head (Quality), Frezenius-Kabi Oncology Ltd, Gurgaon.

Other dignitaries present:

1. Prof. RupinderTewari, Dean (Science), Panjab University, Chandigarh.
2. Prof. Lalit Bansal, Dean (Research), Panjab University, Chandigarh.
3. Dr. Ganesh Kumraj, MD, Biobriodge Healthcare Solutions, Chandigarh.
4. Faculty members of other teaching departments.

The speakers addressed the audience on the following key points.

1. Prof. Arun K. Grover, Vice Chancellor Panjab University.
   He emphasized on the need for Industry driven research and at keeping the Universities at par with the technological advances. He also discussed the requirement of the faculty to keep them updated with the latest developments in the industrial sector.

2. Mr. Anil Arora, Director (EPD), Abbot Healthcare Pvt. Ltd., Mumbai
   - The University curriculum projects should be done in collaboration with the Industries.
   - The theoretical and practical knowledge of the students is not advanced enough thus creating a technological gap.
   - Syllabi of the University needs up gradation
   - The faculty and students should be well conversant with contemporary techniques and instruments used in the Industries.

3. Dr. (Mrs.) Manu Chaudhary, MD, Venus Remedies Ltd., Panchkula

   " Industry Needs and Academic Challenges"

   a) Expectations of the Industry from students
      - Practical domain knowledge
      - Versatility
      - Good regulatory understanding
      - Systematic approach

   b) Gaps in practical approach, shortage of Infrastructure in the affiliated Institutes and the lack of updation with the latest in the Industry were emphasized to be the reasons for unmet expectations of the Industry.

   c) Challenges faced by the Industry and the academia
      - Development of soft skills of the students
      - Retraining the faculty
      - Optional courses for development of business etiquette, leadership, personality development
      - Drafting research guidelines.

   d) Benefits of Academic/Industry partnership
      - Creation of Industry ready students
      - Multi specialty working with complementary capability and skill set

4. Dr. Anil Wali, MD, FITT, IIT, New Delhi.

   "Innovation and Technology transfer- academic perspective"

      - Collaboration with Industry

- Research mobilization: Knowledge transfer and research partnership between Industries and research Institutes/Universities
- Need driven research i.e. Research should be done according to the need of the Industries
- Understanding the importance of Intellectual Properties (IP's): Universities should have a strong hold on the policies and aspects of Intellectual Property
- Models of Institutional setups should be followed- eg. Business incubators, Science and technology parks

5. Mr. Rajneesh, BIRAC, DBT, New Delhi
   "Fostering Innovation and Public Private Partnership"
   - A formal introduction to BIRAC: BIRAC aims to nurture Industry research and development, 30% budget spent on public private partnership (PPP).
   - It strategizes for promoting small and medium enterprises to ensure global competitiveness and hence enable commercialization.
   - Programs for early and late stage innovation research: BIG, SBIRI, BIPP, CRS.
   - Programs for product innovation and commercialization: BIRAC-DBT-BMGF, SPARSH, RAPID.
   - They have a provision of IP management, technology transfer and market analysis.
   - University Innovation Clusters (UIC) have been set up which is a BIRAC-NInC initiative.

6. Dr. Neeraj Sharma (Head, Policy Research), DST (GOI), New Delhi
   "Industry Academia Collaboration"
   - Science Technology and Innovation Policy 2013.
   - Emphasis on attracting private sector investments into R&D
   - Challenges that need to be addressed: Lack of harmonious relations between the Industry and academia, lack of technology oriented education system.
   - Establishment of DST Policy Research Centre at Panjab University. It aims at understanding present collaborations and policy patterns.

- It has come up for ensuring active involvement of private sector with the academia.

7. Dr. Purusottam Bhatacharjee, Head (Quality), Frezenius-Kabi Oncology Ltd, Gurgaon "Expectations of the Industrial sector from the Universities"
    - Space creation for Industry in syllabi.
    - Industry looks for solutions from databanks or expertise of the Institutes.

Key Recommendations of the Meet

- The university curriculum projects should be done in collaboration with the Industries.
- There is a need for the faculty and students to be well conversant with the contemporary techniques and instruments used in the Industries.
- Emphasis on the need for better infrastructure and updation with the latest techniques in the teaching Institutes which would lead to stun the gaps in the practical approach of the students.
- Significant attention was also paid to the development of soft skills, business etiquette, leadership *etc.* in the students.
- Stress was laid on "Need driven Research" i.e. Research should be performed according to the need of the Industries.
- The Universities and Academic Institutes need to have a strong understanding and hold on aspects of Intellectual Property.
- Repeated emphasis was laid on attracting and stimulating private sector investment into Research & Development (R&D).
- Lack of harmonious relations between the Industry and academia and the lack of technology oriented education system was reviewed.
- It was held forth that the Industry should look for solutions from the databanks or expertise of the Institutes.

Annexure II

S.No.	UNIVERSITIES
ANDHRA PRADESH	
1	Acharya N G Ranga Agricultural University, Hyderabad-500 030.
2	Adikavi Nannaya University, Jaya Krishnapuram, Rajahmundry - 533 105, Andhra Pradesh.
3	Andhra University, Visakhapatnam-530 003
4	Acharya Nagarjuna University, Nagarjuna Nagar, Guntur-522 510
5	Dravidian University, Kuppam-517 425.
6	Dr B R Ambedkar Open University, Jubilee Hills, Hyderabad-500 033
7	Dr. NTR University of Health Sciences, Vijayawada-520 008
8	Jawaharlal Nehru Technological University, Hyderabad-500 072.
9	Kakatiya University, Warangal-506 009.
10	Krishna University, Machhlipattanam.
11	Mahatma Gandhi University, Panagal, Nalgonda - 500 803, Andhra Pradesh (Former name of the University was Nalgonda University)
12	Osmania University, Hyderabad-500 007.
13	Palamuru University, Ayyappa Complex, Opp. Police Head Quarters, Mahabubnagar - 509 001 Andhra Pradesh.
14	Potti Sreeramulu Telugu University, Hyderabad-500 004.
15	Rayalaseema University, Kurnool
16	Satavahana University Jyothi Nagar, Karim Nagar - 500 001. (Andhra Pradesh)
17	Sri Krishnadevaraya University, Anantapur-515 003.
18	Sri Venkateswara University, Tirupati-517 507.
19	Telangana University, Nizamabad - 503 002
20	Vikram Simhapuri University, Nellore
Central Universities	
21	University of Hyderabad
Deemed Universities	
22	Gandhi Institute of Technology and Management (GITAM) Gandhi Nagar Campus, Rushikonda, Visakhapatnam-530 045 A.P.
23	International Institute of Information Technology Survey No. 25, Gachibowli, Ranga Reddy District, Hyderabad-500 032 Andhra Pradesh
24	Sri Sathya Sai Institute of Higher Learning Prasanthinilayam-515 134, District-Ananthpur A.P.
25	Vignan's Foundation of Science, Technology & Research Vallmudi, Guntur Distt A.P.
26	ICFAI Foundation for Higher Education Hyderabad A.P.

ARUNACHAL PRADESH	
	Central University
27	Rajiv Gandhi University, Rono Hills, P.O. Doimukh, Itanagar, Arunachal Pradesh - 791 112
	Deemed University
28	North Eastern Regional Institute of Science & Technology Nirjuli, Itanagar, Dist - Papum Pare- 791 109 Arunachal Pradesh
ASSAM	
	State Universities
29	Assam Agricultural University, Jorhat- 785 013
30	Tezpur University (Tezpur)
31	Gauhati University, Guwahati- 781 014
32	Dibrugarh University, Dibrugarh-78 004
33	Assam University
	Private Universities
34	Assam Doon Bosco University Azara, Guwahati
BIHAR	
	State Universities
35	B.R Ambedkar Bihar University, Muzaffarpur-842 001
36	Veer Kunwar Singh University, Arrah- 802 301
37	T.M. Bhagalpur University, Bhagalpur- 812 007
38	Rajendra Agricultural University, Samastipur- 848 125
39	Patna University, Patna-800 005
40	Magadh University, Bodh Gaya.-824 234
41	Lalit Narayan Mithila University, Darbhanga- 846008
42	Jai Prakash University, Chhapra - 8410301.
43	B N Mandal University, Madhepura -852 113
	Central Universities
44	Central University of Bihar, BIT Campus, P.O. - B.V. College, Patna - 800 014
	Deemed Universities
45	Nava Nalanda Mahavihara Nalanda - 803 111 (Bihar)
CHATTISGARH	
	State Universities
46	Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G).
47	Pt. Ravishankar Shukla University, Raipur-492 010
48	Pt. Sundarlal Sharma (Open) University, Bilaspur, Chhatisgarh
49	Sarguja University, Ambikapur

50	Bastar Vishwavidyalaya, jagdalpur, Distt. - Bastar.
	Central Universities
51	Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhatisgarh, - 495 009
	Private Universities
52	Maharishi University of Management and Technology, post: Mangla, Bilaspur- 495001
53	MATS University Arang Kharora Raipur
54	Dr. C.V. Raman University Kargi Road, Kota Bilaspur
	DELHI
	State Universities
55	Bharat Ratna Dr. B.R. Ambedkar University, IIT Campus Plot No. 13, Sector - 9, Dwarka, New Delhi - 110 075.
56	Delhi Technological University, Shahbad Daultapur, Bawana Road, Delhi (State University)
57	Guru Gobind Singh Indraprastha Vishwavidyalaya, Kashmere Gate, Delhi- 110 006
58	Indraprastha Institute of Information Technology, Dwarka, New Delhi
	Central Universities
59	Jamia Millia Islamia, Jamia Nagar, New Delhi - 110 025
60	University of Delhi, Delhi - 110 007
61	Jawahar Lal Nehru University, New Mehrauli Road, New Delhi - 110 067
	Deemed Universities
62	Indian Agricultural Research Institute Pusa Institute, Pusa-110 012 New Delhi
63	TERI School of Advanced Studies Darbari Seth Block, Habitat Place, Lodhi Road
64	Jamia Hamdard Hamdard Nagar-110 062 New Delhi
65	Institute of Liver and Biliary Sciences (ILBS) D1,Vasant Kunj, New Delhi - 110070
	GOA
66	Goa University
	GUJARAT
	State Universities
67	Sardar Patel University, Vallabh Vidyanagar-388 120
68	Anand Agricultural Univerisity, Anand Bhavnagar University, Bhavnagar- 364 002
69	Centre for Environmental Planning and Technology University, University Road, Narvrangpura Ahemdabad-380 009 (Gujarat)
70	Dharmsinh Desai University, College Road, Nadiad-387 001 (Gujarat). (converted from Deemed University to State University)
71	Dr. Babasaheb Ambedkar Open University, Ahmedabad - 380 003
72	Gujarat Agricultural University, Sardar Krushinagar, Banaskantha-385 506
73	Gujarat University, Ahmedabad- 380 009

75	Gujarat Technological University, JACPC Building, L.D.College of Engineering Campus, Navrangpura, Ahmedabad, Gujarat.
76	Hemchandracharya North Gujarat University, P.B. No. 21, University Road, Patan-384 265
77	Krantiguru Shyamji Krishna Verma Kachchh University, CS-60, Jubilee Ground, Bhuj-Kachchh-370 001
78	Maharaja Sayajirao University of Baroda, Vadodara-390 002
79	South Gujarat University, Surat-395 007
80	Saurashtra University, Rajkot- 360 005
Central Universities	
81	Central University of Gujarat, Plot No. 95/1, Sector-2A, Gandhinagar - 382 007
Deemed Universities	
82	Gujarat Vidyapith PO Navjivan, Ashram Road, Ahmedabad-380 014 Gujarat
Private Universities	
83	Ahmedabad University Navrangpura, Ahmedabad-380009 Gujarat
84	Charotar University of Science & Technology Changa-388421 Distt. Anand
85	Dhirubhai Ambani Institute of Information & Communication Technology Gandhinagar-382 007
86	Nirma University of Science & Technology Sarkhej, Gandhinagar
87	Ganpat University Ganpat Vidyanagar Gandhinagar
88	Kadi Sarva Vishwavidyalaya Sarva Vidyalaya Campus Gandhinagar
89	Pandit Deendayal Petroleum University Gandhinagar-382 009
HARYANA	
State Universities	
90	Chaudhary Devi Lal University, Sirsa
91	Choudhary Charan Singh Haryana Agricultural University, Hisar-125 004
92	Deen Bandhu Chhotu Ram University of Science & Technology, Murthal, Haryana
93	Guru Jambeshwar University of Science and Technology, Hisar,- 125 001
94	Kurukshetra University, Kurukshetra- 136 119
95	Maharshi Dayanand University, Rohtak- 124 001
Central Universities.	
96	Central University of Haryana
Deemed Universities	
97	National Brain Research Centre
98	National Dairy Research Institute Karnal-132 001 Haryana
99	Manav Rachna International University Faridabad Haryana
Private Universities	
100	O.P. Jindal Global University, Sonepat
101	ITM University Gurgaon, Haryana

102	AMITY University, Haryana
103	Maharishi Markandeshwar University Mullana, Ambala Haryana
HIMACHAL PRADESH	
State Universities	
104	Dr. Y.S.Parmar University of Horticulture & Forestry, Nauni, Solan - 173 230
105	Himachal Pradesh University, Shimla-171 005
106	Himachal Pradesh Agriculture University, Palampur-176 062.
Central Universities	
107	Central University of Himachal Pradesh, PO Box No.21, Dharamashala, Dist-Kangra, Himachal Pradesh-176215
Private Universities	
108	Chitkara University HIMUDA Education Hub Solan-174 103
109	Jaypee University of Information Technology Distt. Solan-174 103
110	Eternal University Baru Sahib Distt. Sirmour
111	Shoolini University Solan Himachal Pradesh
112	Indus International University V.P.O. Bathu, Tehsil Haroli, Distt. Una, Himachal Pradesh-174301
113	Arni University Kathgarh, Tehsil Indore Distt Kangra (H.P.)
114	Manav Bharti University Solan Himachal Pradesh
115	Baddi University of Energing Science & Technology Makhnimajra,
JAMMU & KASHMIR	
State Universities	
116	Baba Ghulam Shah Badshah University, Rajouri Camp Office, Bye- Pass Road, Opp. Channi Himmat, Jammu
117	Jammu University, Jammu Tawi-180 006
118	Kashmir University, Srinagar-190 006
119	Sher-e-Kashmir University of Agricultural Science & Technology, Srinagar-191 121.
120	Shri Mata Vaishno Devi University, Camp Office: 27 A/D, Gandhinagar, Jammu-180 004.
Central Universities	
121	Central University of Kashmir, Qureshi Manzil, 50-Naseemabad, Saderbal, Srinagar - 190 006
122	Central University of Jammu
JHARKHAND	
State Universities	
123	Birsa Agricultural University, Ranchi-834 006
124	Vinoba Bhave University, Hazaribagh- 825 301.
125	Nilamber-Pitamber University, Madininagar, Palamu - 822 101.

126	Kolhan University, Chaibasa, West Singhbhum
127	Ranchi University, Ranchi-834 001
Central Universities.	
128	Central University of Jharkhand, Brambe, Ranchi, 601, Maru Tower, Kanke Road, Ranchi, Jharkhand - 834 008
Deemed Universities	
129	Birla Institute Of Technology Mesra, Ranchi-835 215 Jharkhand
130	Indian School of Mines Dhanbad-826 004 Jharkhand
KARNATAKA	
State Universities	
131	Bangalore University, Bangalore-560 056
132	Davangere University, Shivagangothri, Davangere - 577 002 Karnataka.(State University)
133	Gulbarga University, Gulbarga-585 106
135	Karnatak University, Dharwad-580 003
136	Kuvempu University, Shankaraghatta- 577 451
137	Mangalore University, Mangalore-574 199
138	Mysore University, Mysore-570 005
139	Tumkur University, 1st Floor, Dr. B.R. Ambedkar Bhavan, M.G. Road, Tumkur- 572 101.
140	University of Agricultural Sciences, Bangalore-560 065
141	University of Agricultural Sciences, Dharwad -580 005
142	Visveswaraiah Technological University, Belgaum-590 010
Central Universities	
143	Central University of Karnataka, 2nd Floor, Karya Saudha, Gulbarga University, Gulbarga - 585 106
Deemed Universities	
144	B.L.D.E. University Bijapur Karnataka
145	Indian Institute of Science Bangalore-560 012 Karnataka
146	International Institute of Information Technology 26/c, Opp. Infosys (Gate - 1), Electronic City, Hosur Road, Bangalore-560 100 Karnataka
147	Jagadguru Sri Shivarathreeswara University Jagadguru Dr. Sri Shivarathri Rajendra Circle, Ramanuja Road, Mysore-570 004 Karnataka
148	Jawaharlal Nehru Centre for Advanced Scientific Research Bangalore-560 064 Karnataka
149	NITTE University Mangalore 575 003 Karnataka
150	Appajappa Agrahara, Chamarajpet, Bangalore-560 018 Karnataka
151	Yenepoya University Mangalore Karnataka

	Christ Universitys Hosur Road, Bangalore-560 029 Karnataka
152	Jain University V.V. Puram, Bangalore Karnataka
KERALA	
State Universities	
153	Calicut University, Trichy Palary, Malapuram District, Kozhikode-673 635
154	Cochin University of Science & Technology, Kochi-682 022
155	Kannur University, Kannur-670 562
156	Kerala Agricultural University, Thrissur- 680 656
157	Kerala University, Thiruvananthapuram - 695 034
158	Mahatma Gandhi University, Kottayam - 686 560
Central Universities	
159	Central University of Kerala
Deemed Universities	
160	Kerala Kalamandalam Vallathol Nagar, Cheruthuruthy - 679 531, via Thrissur Kerala
MADHYA PRADESH	
State Universities	
161	Awadesh Pratap Singh University, Rewa- 486 003
162	Barkatullah University, Bhopal-462 026
163	Devi Ahilya Vishwavidyalaya, Indore.-452 001
164	Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur-482 004
165	Jiwaji University, Gwalior-474011
166	M.G. Gramodaya Vishwavidyalaya, Chitrakoot-485 331, District Satna
167	Maharishi Mahesh Yogi Vedic Vishwavidyalaya, Jabalpur-482 001
168	M.P.Bhoj (open) University, Bhopal-462 016.
169	Rajiv Gandhi Prodoyogiki Vishwavidyalaya, Bhopal-462 036
170	Rani Durgavati Vishwavidyalaya, Jabalpur-482 001.
171	Vikram University, Ujjain-456 010
Central Universities	
172	Dr. Harisingh Gour Vishwavidyalaya, Sagar, Madhya Pradesh-470 003
Deemed Universities	
173	Indian Institute of Information Technology and Management Gola Ka Mandir, Gwalior-474 005 M.P
174	Pandit Dwarka Prasad Mishra Indian Institute of Information Technology, Design & Manufacturing (PDPM-IIITDM) IT Bhawan, Government Engineering College, Jabalpur Madhya Pradesh.

Private Universities	
175	Jaypee University of Engineering & Technology AB Road, Raghogarh, Distt, Guna, M.P.
MAHARASHTRA	
State Universities	
176	Dr. Babasaheb Ambedkar Marathwada University, Aurangabad-431 004.
177	Dr. Babasaheb Ambedkar Technological University, Lonere-402 103
178	Marathwada Agricultural University, Parbhani-431 402.
179	Mumbai University, Mumbai-400 032
180	Nagpur University (Nagpur).
181	North Maharashtra University, Jalgaon- 425 001
182	Pune University, Pune-411 007.
183	Sant Gadge Baba Amravati University, Amravati-444 602.
184	Shivaji University, Kolhapur-416 004.
185	Solapur University, Solapur, Solapur Pune Road, Kegaon, Solapur-413 255.
186	Yashwant Rao Chavan Maharashtra Open University, Nashik-422 222
187	The Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur-440 001 (M.S).
188	Swami Ramanand Teerth Marathwada University, Nanded-431 606.
Deemed Universities	
189	Institute of Chemical Technology Matunga, Mumbai Maharashtra
190	Tata Institute of Social Sciences VN Purav Marg, Deonar, Mumbai-400 088 Maharashtra
191	Tata Institute of Fundamental Research Homi Bhabha Road, Mumbai-400 005 Maharashtra
192	SYMBIOSIS - International University, Senapati Bapat Road, Pune-411 004 Maharashtra
193	Padmashree Dr. D.Y. Patl Vidyapeeth Vidya Nagar, Sector 7, Nerul, Navi Mumbai-400 706 Maharashtra
194	Homi Bhabha National Institute Regd. Office: Knowledge Management Group, Bhabha Atomic Research Centre, Central Complex, Mumbai-400 085 Maharashtra
195	Dr. D.Y. Patil Vidyapeeth Sant Tukaram Nagar, Pimpri, Pune-411 018 Maharashtra
196	D.Y. Patil Educational Society Line Bazar, Kasaba, Bavada, Kolhapur-416 006 (Maharashtra)
197	Bharati Vidyapeeth Bharati Vidyapeeth Bhawan, Lal Bahadur Shastri Marg, Pune-411 030 Maharashtra
MANIPUR	
Central University	
198	Central Agricultural University (Imphal)
199	Manipur University (Imphal)

MEGHALAYA	
Central University	
200	North Eastern Hill University, NEHU Campus, Shillong, Meghalaya - 793 022
Private University	
201	University of Science & Technology Meghalaya
MIZORAM	
Central University	
202	Mizoram University, Post Box No. 190, Aizwal, Mizoram - 796 009
NAGALAND	
Central University	
203	Nagaland University, Campus Kohima, Headquarter Lumani, Nagaland - 797 001
ORISSA	
State Universities	
204	Berhampur University, Berhampur-760 007.
205	Biju Patnaik University of Technology, Rourkela
206	North Orissa University, Baripada, District Mayurbhanj-757 003, Bhubaneswar
207	Utkal University, Bhubaneswar-751 004.
208	Utkal University of Culture, Bhubaneswar-751 009.
209	Shri Jagannath Sanskrit Vishwavidyalaya, Puri-752 003.
210	Veer Surendra Sai University of Technology, P.O. Burla Engineering College, Distt. Sambalpur Orissa. (State University)
211	Sambalpur University, Sambalpur-768 019.
212	Ravenshaw University, Cuttak - 753 003.
213	Orissa University of Agriculture & Technology, Bhubaneswar-751 003.
Central University	
214	Central University of Orissa, Sabara, Srikhetra, Coats Building, Koraput - 764 020
Deemed Universities	
215	Kalinga Insitute of Industrial Technology (KIIT) Patia, Khurda, Bhubaneshwar, Orissa
PUNJAB	
State Universities	
216	Guru Nanak Dev University, Amritsar-143 005
217	Punjab Agricultural University, Ludhiana- 141 004
218	Punjab Technical University, Jalandhar- 144 011
219	Punjab University, Chandigarh-160 014.
220	Punjabi University, Patiala-147 002

Central Universities	
221	Central University of Punjab, D-13, Civil Station, Bathinda-151 001
Deemed Universities	
222	Sant Longowal Institute of Engineering and Technology (SLIET), District Sangrur Punjab
223	Thapar Institute of Engineering & Technology Thapar Technology Campus, Bhadson Road, Patiala-147 004 Punjab
Private Universities	
224	Lovely Professional University Jalandhar, Ludhiana Distt. Kappurthala
RAJASTHAN	
State Universities	
225	Maharana Pratap University of Agriculture & Technology, Udaipur-313 001
226	Maharshi Dayanand Saraswati University, Ajmer-305 009.
227	Rajasthan Agricultural University, Bikaner-334 006.
228	Rajasthan University, Jaipur-302 004
229	Rajasthan Technical University, Akelgarh, Rawat Bhata Road, Kota
230	Rajasthan Vidyapeeth (Udipur)
231	University of Bikaner, 23, Civil Lines, Bikaner
232	University of Kota, Kota (Rajasthan)
Central University	
233	Central University of Rajasthan, 16, Nav Durga Colony, Opp. Hotel Clarks Amer Near Fortis Hospital , Malviya Nagar, J.L.N. Marg, Jaipur-302 017
Deemed Universities	
234	Mody Institute of Technology & Science Lakshmangarh-33211, District Sikar Rajasthan
235	I.I.S. University Gurukul Marg, Mansarovar Jaipur, (Rajasthan)
236	LNM Institute of Information Technology Gram-Rupa ki Nagal, Post-Sumel, Via Kanota, Dist.-Jaipur-303 012 (Rajasthan)
237	Janardan Rai Nagar Rajasthan Vidyapeeth Udaipur-331 401 Rajasthan
238	Jain Vishva Bharati Institute Box No. 6, Ladnun, Nagaur -341 306 Rajasthan
239	Banasthali Vidyapith Banasthali-304 022 Rajasthan
240	Birla Institute of Technology & Science Pilani
Private Universities	
241	Amity University Kant Kalwar, Jaipur-303 002
242	Bhagwant University Sikar Road, Ajmer-305 001
243	Jagannath University Vill. Rampura Teshil-Chaksu, Jaipur
244	Jaipur National University Jagatpura, Jaipur

245	Jodhpur National University Narnadi, Jhanwar Road, Jodhpur
246	Mahatma Jyoti Rao Phoole University RIICO Ind Area, Tala Mod NH-I, Achrol, Jaipur
247	Mewar University Chittorgarh
248	NIMS University Shobha Nagar, Jaipur-303 001
249	Sri Padmapat Singhania University Bhatewar, Udiapur-313 601
250	Singhania University Pacheribari, Jhunjhunu
251	Suresh Gyan Vihar University Mahal Jagatpura, Jaipur
252	Shridhar University Pilani Chirawa Road, Pilani Rajasthan-333031
SIKKIM	
Central University	
253	Sikkim University, 6th Mile, Samdur, P.O. Tadong, Gangtok, Sikkim-737 102
Private Universities	
254	Sikkim Manipal University of Health Medical & Technological Science Gangtok
255	Vinayaka Missions Sikkim University Middle Tadong, PO Daragaorn Tadong-237 102
TAMIL NADU	
State Universities	
256	Alagappa University, Alagappa Nagar, Karaikudi-630 003.
257	Anna University, Guindy, Chennai-600 025.
258	Annamalai University, Annamalainagar- 608 002
259	Bharathiar University, Coimbatore-641 046.
260	Bharathidasan University, Tiruchirappalli - 620 024.
261	Madras University, Chennai-600 005.
262	Madurai Kamraj University, Madurai-625 021
263	Periyar University, Salem-636 011.
264	Tamil University, Thanjavur-613 005.
265	Tamilnadu Agricultural University, Combatore-641 003.
266	Thiruvalluvar University, Fort,Vellore- 632 004.
Central Universities	
267	Central university of Tamil Nadu, C/O. Collectorate Annexe, Tiruvarur - TN-610 001
268	Indian Maritime University, Chennai - 600 119
Deemed Universities	
270	Periyar Maniammai Institute of Science & Technology (PMIST) Priyar Nagar, Vallam, Thanjavur -613 403 Tamil Nadu
271	Ponnaiyah Ramajayam Institute of Science & Technology (PRIST) Yagappa Chavadi, Thanjavur-614 904 Tamilnadu

272	S.R.M Institute of Science and Technology, Veerasamy Street, West Mambalam, Chennai, Tamilnadu
273	Sathyabama Institute of Science and Technology Jappiaar Nagar, Old Mamallpuram Road, Chennai-600119 (T.N)
274	Shanmugha Arts, Science, Technology & Research Academy (SASTRA) Tirumalai Samudram, Thanjavur-613 402 Tamilnadu
275	Sri Chandrasekharendra Saraswathi Vishwa Mahavidyalaya Sri Jayendra Saraswathi Street, Enathur, Kancheepuram-631 561 Tamilnadu.
276	Vel's Institute of Science, Technology & Advanced Studies (VISTAS) Pallavaram, Chennai Tamilnadu
277	Vellore Institute of Technology Vellore-632 014 (Tamilnadu)
278	Vinayaka Mission - Research Foundation, NH 47, Ariyanoor, Salem Tamilnadu.
279	Hindustan Institute of Technology and Science (HITS) Padur, Kelamballam, Kancheepuram District. (Tamilnadu)
280	Kalasalingam Academy of Research and Higher Education Anand Nagar, Krishnankoil, Virudhunagar-626 190 , via Srivilliputhrur Tamilnadu
281	Karunya Institute of Technology and Sciences Karunya Nagar, Coimbatore-641 114 (Tamil Nadu).
282	M.G.R. Educational and Research Institute Periyar EVR Salai (NH 4 Highway), Maduravoyal, Chennai-600 095 Tamilnadu.
283	Vel Tech Rangrajan Dr. Sagunthala R&D Institute of Science & Technology Chennai Tamilnadu.
284	B.S. Abdul Rahman Institute of Science & Technology Vandalur, Kanchipuram Distt., Chennai Tamilnadu.
UTTARANCHAL	
State Universities	
285	University Of Roorkee
286	Doon University, Campus Office, 388/2, Indira Nagar Dehradun.
287	G.B. Pant University of Agriculture and Technology, Pantnagar-263 145.
288	Kumaun University, Nainital-263 001.
289	Uttaranchal Sanskrit University, Hardwar-249 401 (Uttranchal)
290	Uttrakhand Technical University, A-12, Saraswati Vihar, Lover Aghoewala, Post-Dhalanwala, Dehradun, Uttrakhand
Central Universities	
291	Hemwati Nandan Bahuguna Garhwal University, Srinagar, Garhwal - 246 174

Deemed Universities	
292	Gurukul Kangri Vishwavidyalaya Haridwar-249 404 Uttrakhand.
293	HIHT University Swami Rama Nagar, Jolly Grant, P.O. Doiwala, Dehradun Uttrakhand
294	Graphic Era University Dehradun Uttrakhand
Private Universities	
295	Himgiri Nabh Vishwavidyalaya (University in the Sky) Dehradun
296	University of Petroleum and Energy Studies Dehradun-248007
UTTAR PRADESH	
State Universities	
297	Bundelkhand University, Jhansi-284 128.
298	Chandra Shekhar Azad University of Agriculture & Technology, Kanpur-208 002
299	Chhatrapati Sahuji Maharaj Kanpur University, Kanpur-208 024.
300	Chaudhary Charan Singh University, Meerut-250 005.
301	Deen Dayal Upadhyay Gorakhpur University, Gorakhpur-273 009.
301	Dr Ram Manohar Lohia Awadh University, Faizabad-224 001.
303	Dr. B.R. Ambedkar University, Agra-282 004.
304	Gautam Buddha University, Greater Noida, District-Gautam Budh Nagar, Uttar Pradesh - 201 308
305	Lucknow University, Lucknow-226 007.
306	M.J.P. Rohilkhand University, Bareilly-243 006.
307	Narendra Deo University of Agriculture & Technology, Faizabad-224 229.
308	Sardar Vallabh Bhai Patel University of Agriculture & Technology, Meerut-250 110 (U.P)
309	Uttar Pradesh Technical University, Sitapur Road, Lucknow226 021
310	Veer Bahadur Singh Purvanchal University, Jaunpur-222 002
Central Universities	
311	Aligarh Muslim University, Aligarh, U.P.-202 002
312	Babasaheb Bhimrao Ambedkar University, Vidya Vihar, Rae Bareily Road, Lucknow, U.P. - 226 025
313	Banaras Hindu University, Varanasi, U.P. 221 005
314	University of Allahabad, Allahabad, U.P.-211 002
315	Deemed Universities
316	Sam Higginbottom Institute of Agriculture, Technology & Sciences (Formerly Allahabad Agricultural Institute) Rewa Road, Allahabad - 211007 Uttar Pradesh
317	Dayalbagh Educational Institute Dayalbagh, Agra-282 005 Uttar Pradesh
318	Indian Institute of Information Technology Devghat, Jhalwa, Allahabad-211 012 Uttar

	Pradesh.
319	Jaypee Institute of Information Technology A-10, Sector-62, Noida-201 307 Uttar Pradesh.
320	Shobhit Institute of Engineering & Technology Dulhera Marg, Roorkee Road, Meerut-250 010 Uttar Pradesh.
321	Central Institute of Higher Tibetan Studies Sarnath, Varanasi-221 007 Uttar Pradesh
Private Universities	
322	Amity University Uttar Pradesh Gautam Budh Nagar
323	Teerthanker Mahaveer University Moradabad
324	Sharda University Gautam Budh Nagar Greater Noida (UP
325	Swami Vivekanand Subharti University Delhi-Haridwar Bye Pass Road Meerut
WEST BENGAL	
State Universities	
326	Aliah University, Kolkata, West Bengal
327	Burdwan University, Rajbati, Burdwan- 713 104
328	Calcutta University, Kolkata-700 073
329	Gaur Banga University, Rabindra Avenue, Malda College Campus, P.O. & Dist- Malda - 732 101
330	Jadavpur University (Calcutta)
331	Kalyani University, Kalyani-741 235
332	North Bengal University, Raja Ram Mohanpur, Darjeeling-734 430.
333	The Bengal Engineering & Science University, Shibpur, Howrah-711 103. (converted from Deemed University to State University)
334	The West Bengal University of Health Sciences, DD-36, Secotor-1, Salt Lake, Kolkata-700 064
335	Vidya Sagar University, Midnapore-721 102.
336	West Bengal University of Technology, BF-142, Salt Lake, Kolkata-700091
337	West Bengal State University, Barasat Govt. College, Annexe Building, 10, KNC Road, Kolkata- 700 124.
Central Universities	
338	Visva Bharati, Shantiniketan, West Bengal - 731 235

Annexure III

S.No.	List of CSIR Laboratories and other Research Institutes
	CSIR Laboratories
1	Central Building Research Institute (CBRI), Roorkee
2	Central Drug Research Institute (CDRI), Lucknow
3	Central Electrochemical Research (CECRI), Karaikudi
4	Central Electronics Engineering Research Institute (CEERI) Pilani, Rajasthan
5	Central Food Technological Research Institute (CFTRI), Mysore
6	Central Fuel Research Institute (CFRI), Dhanbad
7	Central Glass and Ceramic Research Institute (CGCRI), Calcutta
8	Central Institute of Medicinal & Aromatic Plants (CIMAP), Lucknow
9	Central Leather Research Institute (CLRI), Madras
10	Central Mechanical Engineering Research Institute (CMERI), Durgapur
11	Central Institute of Mining& Fuel Research (CIMFR), Dhanbad
12	Central Road Research Institute (CRRI), New Delhi
13	Central Salt & Marine Chemicals Research Institute (CSMCRI)
14	Central Scientific Instruments Organisation (CSIO), Chandigarh
15	Centre For Biochemical Technology (CBT), Delhi
16	Centre for Cellular and Molecular Biology (CCMB), Hyderabad
17	Indian Institute of Chemical Biology (IICB), Calcutta
18	Indian Institute of Chemical Technology (IICT), Hyderabad
19	Indian Institute of Petroleum (IIP), Dehradun
20	Industrial Toxicology Research Centre (ITRC), Lucknow
21	Institute of Genomics and Integrative Biology (IGIB), New Delhi
22	Institute of Himalayan BioresourceTechnolonogy (IHBT), Palampur
23	Institute of Microbial Technology (IMTECH), Chandigarh
24	National Aerospace Laboratories (NAL), Bangalore
25	National Botanical Research Institute (NBRI), Lucknow
26	National Chemical Laboratory (NCL), Pune
27	National Environmental Engineering Research Institute (NEERI), Nagpur
28	National Geophysical Research Institute (NGRI), Hyderabad
29	National Institute of Oceanography (NIO), Goa

30	National Institute of Science Communication & Information Resources (NISCAIR), New Delhi
31	National Institute of Science Technology and Development Studies (NISTADS), New Delhi
32	National Metallurgical Laboratory (NML), Jamshedpur
33	National Physical Laboratory (NPL), New Delhi
34	Advanced Materials and Processes Research Institute, Bhopal
35	National East Institute of Science and Technology, Jorhat
36	National Institute for Interdisciplinary Science and Technology, Triuvananthapuram
37	Institute of Minerals and Materials Technology, Bhubaneshwar
38	Structural Engineering Research Centre (SERC-C), Chennai
39	Structural Engineering Research Centre (SERC-G), Ghaziabad
Research Laboratories	
40	International Centre for Genetic Engineering and Biotechnology (ICGEB), New Delhi
41	Tata Institute Fundamental Research (TIFR), Mumbai
42	The National Centre for Biological Sciences (NCBS), Bengaluru
43	Bhabha Atomic Research Centre (BARC), Mumbai
44	Indian Institute of Science (IISc), Bengaluru
45	National Institute of Pharmaceutical Education and Research (NIPER), Mohali
46	National Institute of Pharmaceutical Education and Research (NIPER), Hyderabad
47	Indian Institute of Science Education and Research (IISER), Mohali
48	Indian Institute of Science Education and Research (IISER), Pune
49	Indian Institute of Science Education and Research (IISER), Kolkata
50	Indian Institute of Science Education and Research (IISER), Bhopal
51	Indian Institute of Science Education and Research (IISER), Bhubaneswar
52	Institute of Nanoscience and Technology, Mohali
53	National Agri-Food Biotechnology, Mohali
54	Bose Institute, Kolkata
55	National Institute of Immunology, New Delhi
56	Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore
57	Birbal Sahni Institute of Palaeobotany
58	Rajiv Gandhi Centre for Biotechnology, Triuvananthapuram

Annexure IV

List of Management Institutes

1	Indian Institute of Management, Kolkata
2	Indian Institute of Management, Ahemdabad
3	Indian Institute of Management, Lucknow
4	Indian Institute of Management, Rohtak
5	Indian Institute of Management, Bangalore
6	Indian Institute of Management, Kozhikode
7	Indian Institute of Management, Indore
8	Indian Institute of Management, Kashipur
9	Indian Institute of Management, Udaipur
10	Indian Institute of Management, Trichy
11	Indian Institute of Management, Raipur
12	Indian Institute of Management, Ranchi
13	Indian Institute of Management, Shillong
14	Indian School of Business, Hyderabad
15	Indian School of Business, Mohali
16	S.P. Jain Institute of Management and Research (SPJIMR), Mumbai
17	XLRI Xavier Institute of Management, Jamshedpur
18	Indian Institute of Foreign Trade (IIFT), New Delhi
19	FORE School of Management, New Delhi
20	Symbiosis Institute of Management Studies (SIMS), Pune
21	Birla Institute of Management Technology (BIMTECH), Noida
22	Narsee Monjee Institute of Management Studies (NMIMS), Bengaluru
23	Narsee Monjee Institute of Management Studies (NMIMS), Hyderabad

Annexure V

TECHNICAL INSTITUTES

1.	Indian Institute of Technology, Bhubaneswar
2.	Indian Institute of Technology, Bombay
3.	Indian Institute of Technology, Delhi
4.	Indian Institute of Technology, Gandhinagar
5.	Indian Institute of Technology, Guwahati
6.	Indian Institute of Technology, Hyderabad
7.	Indian Institute of Technology, Indore
8.	Indian Institute of Technology, Jodhpur
9.	Indian Institute of Technology,Kanpur
10.	Indian Institute of Technology,Kharagpur
11.	Indian Institute of Technology,Madras
12.	Indian Institute of Technology,Mandi
13.	Indian Institute of Technology,Patna
14.	Indian Institute of Technology,Roorkee
15.	Indian Institute of Technology,Ropar
16.	National Institute of Technology, Kurukshetra
17.	National Institute of Technology, Calicut
18.	National Institute of Technology,Delhi
19.	National Institute of Technology,Agartala
20.	National Institute of Technology,Durgapur
21.	National Institute of Technology,Goa
22.	National Institute of Technology,Puducherry
23.	National Institute of Technology, Bhopal
24.	Malaviya National Institute of Technology, Jaipur
25.	Motilal Nehru National Institute of Technology
26.	National Institute of Technology, Manipur
27.	National Institute of Technology, Meghalaya
28.	National Institute of Technology, Mizoram
29.	National Institute of Technology, Nagaland

30.	Dr. B. R. Ambedkar National Institute of Technology, Jalandhar
31.	National Institute of Technology, Jamshedpur
32.	Visvesvaraya National Institute of Technology
33.	National Institute of Technology, Patna
34.	National Institute of Technology, Raipur
35.	National Institute of Technology, Rourkela
36.	National Institute of Technology, Sikkim
37.	National Institute of Technology, Silchar
38.	National Institute of Technology, Srinagar
39.	S V National Institute of Technology, Surat
40.	National Institute of Technology, Karnataka
41.	National Institute of Technology, Tiruchirappalli
42.	National Institute of Technology, Uttarakhand
43.	National Institute of Technology, Warangal
44.	National Institute of Technology, Arunachal
45.	National Institute of Technology, Hamirpur

Annexure VI

List of Govt. And Private Bodies

1.	UGC (University Grants Commission), New Delhi
2.	DBT (Department of Biotechnology), New Delhi
3.	BIRAC (Biotechnology Industry Research Assistance Council), New Delhi
4.	TDB (Technology Development Board)
5.	CII (Confederation of Indian Industry)
6.	ICMR (Indian Council of Medical Research), New Delhi
7.	PHD Chamber of Commerce and Industry, New Delhi
8.	NInC (National Innovation Council), New Delhi
9.	FICCI (Federation of Indian Chambers of Commerce and Industry)
10.	Indian Vaccine Corporation Ltd.
11.	Bharat Immunological & Biological Corporation
12.	TICEL Bitoech Park, Chennai
13.	MITCON Biotech Park, Pune
14.	International biotech park, Pune
15.	Inspira Infrastructure BiotechPark, Aurangabad
16.	Agri Biotechnology Park, Jalna
17.	Shapoorji Pallonji Biotech Park, Hyderabad
18.	ICICI Knowledge Park, Hyderabad
19.	Agri-Science Park, Hyderabad
20.	Bangalore Helix, Bangalore
21.	Biotech Park, Lucknow
22.	Kinfra Biotech Park, Thiruvananthapuram
23.	Golden Jubilee Biotech Park for Women Society, Kanchipuram
24.	Savli Biotech Park, Vadodra
25.	Gujarat Akruti Biotech Park, Vadodra
26.	Guwahati Biotech Park (GBP), Guwahati
27.	BioProcessing Unit (BPU), Mohali

Annexure VII

Comparative Study on the Korean and Indian Science and Technology System

As we move into the 21st century the importance of knowledge-based industries is being realized, them being the most critical for sustainable growth of the nations. To actualize the aspirations of continual and inclusive development countries like India, China and Korea have developed National Science & Technology strategies as a part of long- term economic development plan. The strategies instituted for Science, Technology and Innovation articulate the Government's vision in regard to the contribution of STI for the country's social and economic development, thereby playing a major role in policy making. The design of these strategies additionally serves in a firm policy making by:

- Determining the government's focus areas such as reforms in the funding, university research, evaluation systems *etc*.
- Setting priority regions/ areas for public investments.
- Engaging the stakeholders in effective policy development and implementation.
- Providing a roadmap for parameters to be used in policy making.
- Providing targets/ guideposts to meet goals (for stakeholders).

Amongst the setting of increasing knowledge intensities, S&T capabilities and the steep growth rates of countries that were once behind our nation lies a crucial theme for India, whether it can adopt from the experiences of countries like China and Korea.

Korea is regarded as one of the most successful Asian countries and the world's most R&D intensive country with a Gross Domestic Expenditure on R&D (GERD) of 4.36% of Gross Domestic Product (GDP) in the year 2013 (Table 1), even though the GDP of Korea was less than that of India in the same year [1, 2, 3]. This can mainly be attributed to the emphasis laid by Korea on their STI system, investment of large funds and well timed implementation of scientific programs. Like Korea, India is a developing country and is desirous of making reforms in STI systems for growth and development. Table 1 also lists the publications of the two countries compared with USA, showing that India leads in publications, amongst the two, which infers the spread of S&T in our country. The percentage of Export of Goods and Services, of the GDP is an evidence of the market position of India globally, and the same is low for India as compared to Korea. The employment rate of Korea (74.7) is also higher than that of India (64.1), India (5.5) also lags behind Korea (6.4) in the Intellectual Property Rights Index (IPRI). IPRI is

an index based on factors reflecting the level of legal and political environment (LP), physical property rights (PPR) and Intellectual property rights (IPR). A comparison of ranking of Korea and India based on parameters namely Basic Requirements, Efficiency Enhancers and Innovation and Sophistication factors from the global competitiveness report also clearly indicates that India needs to work a lot more before it reaches the pedestal that Korea has [1, 2, 3, 4, 5].

The details are listed in the following two tables:

Table 1: Comparison of key indicators of development of a few countries

Indicators		**Korea**	**India**	**USA**
GDP (million US$) 2013		1221.8	1870.7	16,799.7
% GDP spent on R&D		4.15%	0.87%	2.81%
Publications (2013)		71,072	1,06,029	5,63,292
Export of Goods and Services (% GDP in 2009)		47.5	19.8	13.6
Employment rate (Population: 25-54 yrs in 2012)		74.7	64.1	75.7
IPR Index		6.4	5.5	7.6
Rank in Global Competitiveness Index (Ranking out of 144 countries)	Basic Requirements*	20	92	33
	Efficiency Enhancers **	25	61	1
	Innovation and sophistication factors	22	52	5

Sources: OECD (2015), Scopus, Global competitiveness Index, International property Rights Index 2013

***Basic Requirements**: Institutions, Infrastructure, Macroeconomic environment, Health and Primary Education.*

*** **Efficiency Enhancers**: Higher Education and Training, Goods marketing efficiency, Labor market efficiency, Financial market development, Technological readiness, Market size.*

Table 2: Comparison of Important Global Competitiveness Index rankings

S. No.	Global Competitiveness Index (GCI)	Korea	India	USA
1.	Overall GCI ranking	26	**71**	3
2.	Property Rights	64	**73**	25
3.	Intellectual Property Protection	**68**	65	20
4.	Burden of Government Regulation	96	59	**82**
5.	Efficiency of Legal framework in setting disputes	**82**	57	23
6.	Transparency Of Govt. in policymaking	**133**	64	44
7.	Secondary education enrolment, gross %	48	**106**	59
8.	Tertiary education enrolment, gross %	2	**87**	3
9.	Availability of research and training services	36	**64**	8
10.	Availability of latest technologies	30	**110**	2
11.	Capacity for Innovation	24	**48**	2
12.	Quality of Scientific Research Institutions	27	**52**	2
13.	Company spending on R&D	20	**30**	4
14.	University – Industry collaboration in R&D	26	**50**	2
15.	PCT patents, applications/ million population	8	**61**	11

Source: The Global Competitiveness Report 2014-2015 (World Economic Forum)

The ranking displayed is from a study involving 144 countries.

While analysing the Korean System it is observed that amongst the key strategies devised for growth of S&T was a strong governmental intervention and targeted approach. The S&T policy designing and implementation was also intense, coupled with the economic policies of the country [6, 7].

The salient points of the Korean System that can be adapted according to the Indian scenario have been summarized as follows:

a) **Targeted Approach -**

Korea: The Korean policies were drawn out with a clear vision of a target of achieving excellence within a stipulated time period at a global level. By the early 1980's the government had understood& acknowledged the transition in the S&T settings and therefore launched the National R&D Program. Various policy initiatives were taken with a focus on promoting and facilitating private sector R&D activities. A bank specializing in technology financing, the Korea Technology Development Corporation, was also created in the early 1980's, along with the establishment of programs to facilitate commercialization of technology (Industrial Development Fund, 1986; S&T Promotion Fund, 1991; Information & Telecommunication Technology Fund, 1993) [8]. The establishment of the National Science & Technology Council (NSTC), the highest decision making body for S&T policy, in 1999 was a landmark in the history of Korea's S&T policy. The government played a highly interventionist role by targeting national R&D projects (50% of all expenditure is incurred by Govt., if performed by a private firm), exports (enhanced technological competence for global markets), and high growth industries [7, 8].

India: Impressive advancements have been observed in India when development has been directed in sectors like defence, atomic energy and space. Unlike Korea the industries of our country fall short of performance at a global level therefore it would be prudent to reform the industrial policies to be in blend with the economic policy of the nation.

Suggestions: Coupling of the S&T policy together with the economic policies of the country is the first key point to be adapted. Composing a targeted vision for industrial sector i.e. concentrating on sectors with manufacturing strengths, will also lead to sustainable growth.

b) Policy Designing and Implementation -

Korea: In Korea the entire policy making process is under a single central authority and is therefore subject to continuous monitoring. The power withheld with the principal authority jurisdiction makes policy enforcement uncomplicated. NSTC, the control tower, as a part of the Korean Govt. body, which is chaired by the Presidenthas the power and responsibilities of national STI policies of Korea. The Republic of Korea is characterized by the presence of strongly formulated and govt. driven STI priority processes. S&T Framework Law (2001) sets the policy fields together with other S&T laws [9, 10].

The Government in Korea has also given extreme importance on effective implementation of STI policies and has made Acts such as for Technology Commercialization (Technology Transfer Promotion Act, 2000). This Act stimulates the academic and public research institutes to have technology transfer offices (TLOs) [10, 11]. There are approximately 40 individual acts for commercialization of Technology related to development of technology, support for commercialization, information promotion *etc.*

India: In India the policy designing and implementation is a fragmented process i.e. the policies of various sectors are made by their concerned ministries and the policies of research and education emanate from their respective parent bodies. This is a reason for lack of co-ordination amongst them viz-a-viz designing and enforcement. Therefore we need to develop a system to consolidate all the policies together for better & strong implementation [6].

Suggestions: GoI needs to form a centralized authoritative body which has control over the nations STI policy and can direct various ministries to achieve targets leading to the holistic growth of the nation.Alongwith, there is an urgent need to strengthen synchronization amongst various sectors viz-a-viz planning and enforcement. The process of policy making should be progressive and monitored continuously.

c) Increased Research and Development Investments -

Korea: Korea has successfully transformed itself into one of the most dynamic economies of the world. The first step along this path was to adapt to a 'target centric' approach. The Korean approach was to target specific Industries for export (technologies

in line with the developed countries) and for this the Korean Govt. also supplemented them with R&D investments. They aimed to speed up the industrialisation process in a few targeted sectors and create a global niche for themselves. Well timed implementation of national R&D programmes (with favourable investments) was another factor that worked in favour of Korea. All the programmes were rigorously evaluated and funding was directly linked to outputs. Korea clearly distinguished between 'performers' and 'non performers' and finances were used to discriminate them [7, 8, 12]. Analysis and measurement of the socio-economic contributions made by the R&D programmes was given due importance.

India: Even though India leads Korea in terms of publications but it is far behind Korea in a rather crucial factor: R&D expenditure as a percentage of GDP. While in Korea the industry dominates R&D with approximately 70% share, the government stands to be the major investor in R&D in India with only $1/4^{th}$ being the private sector's share. Despite persistent policy manifestations our country has not been able to cross the 1% mark of GERD and with govt. sector being the major investor in R&D it becomes all the more important to follow the principal of targeted approach. Many sectors in India have immense potential for growth such as pharmaceuticals, IT, automotives, biotechnology, textiles etc.

Suggestions: Primarily, India like Korea should target areas where it possesses manufacturing strengths and use the Korean policy of discrimination between performers and non-performers. Continual assessment of national R&D programs and withdrawal of funding in the absence of stipulated output(s) are the two main steps to be taken. Finances should only go to sectors that work towards innovation and present manufacturing strengths.

d) Human resource development -

Korea: The Korean govt. and the industries have been able to increase R&D intensity at such rapid pace due to the pool of highly educated and skilled manpower. The process of continuous up gradation of education system is the key point in human resource generation in Korea. The govt. first identified the areas which will lead to nations development globally, then reinforced basic S&T education and finally cultivate S&T experts to guide and promote future activities. They also made most of the S&T

manpower available to them by initiating exchange programs amongst business and education. The universities and research institutes are encouraged to compete for research funding and this has lead to 5 Korean universities being in top 200 universities in the world[6, 13, 14].

In 2006, the govt. came up with 'Basic Plan for Promoting S&T Human Resources', which focussed on promoting world class research oriented universities, promotion of efficient utilization of HRST via Industry- Academia- research programs, improving HRSTs research environment, promoting life education system for HRST *etc*.

India: India has to its credit an abundant pool of human resource owing to its demography but there is scarcity of trained and skilled manpower. Reforms in the education system, particularly in the higher education are the need of the hour. It is imperative that we work towards cultivating experts in the frontier areas of S&T and encouraging them to work for the nation rather than abroad. Even though repatriation of foreign trained Indians has begun it hasn't been able to fulfil the skill shortage in India. There is a huge gap in the requirement and availability of Ph.D's in the engineering and IT sector [14, 15].

Suggestions: The curriculum needs to be updated and revised according to the Technological/ Industry modules. Up gradation and modernization of the university programs is crucial for our nation.

e) Reorganising the Infrastructure -

Korea: Korea created Government Research & Development Institutes (GRIs) to overcome its technological incompetence. GRI's proved to be the most powerful tool for both technological developments and human resource training in the early stages of industrialization. These provide the technical support, help find solutions for the practical problems that arose from the Industries and helped them build technological capacities. Parallel to facilitating GRI's the Korean govt. also initiated programmes to encourage linkages between the industry, academia and GRI's. With due course of time and with the advent of industrialization, it was realized that the focus of the innovation system needed a shift from being GRI – centric to industry – centric. It was observed that as industrialization advanced the GRI's lead to duplication in research therefore R&D responsibility was handed over to the industry and the GRI's were refocused for

development of knowledge base and basic technologies [7, 10, 11]. TheGRIs now play a major role in fostering and bolstering SMEs. It can be observed that a regular revamping in the focus area and goals of GRIs was deemed necessary to fit into national S&T environment.

Korea has also taken serious steps towards technology transfer and commercialization as is evident from the establishment of Korea Technology Transfer Center (KTTC) in 2002 [10]. The enactment of the Technology Transfer Promotion Act, 2000 encouraged the transfer and commercialization of R&D under govt. funding. Constant evaluation and reforms of such structures is mandatory as they tend to become inefficient and bureaucratic over a period of time.

India: The process of restructuring the goals of major research institutes and universities can be feasibly adapted to the Indian system. This would ensure enough skill and technical support to the firms coming up and would also spur them to invest in R&D. But it then also becomes obligatory to constantly assess, amend and refocus them according to the socio-economic needs of the nation. The govt. research institutes in India have outstanding facilities and infrastructure which unfortunately is not available to the academicia or the industries.

Suggestions: A national policy should be enforced that allows pooling of resources and facilities. Periodic and timely evaluation of the Institutes working on national R&D programs should be carried out.

f) Environment for Innovation -

Korea: The creation of an ecosystem characterized by clusters, S&T parks, Knowledge Parks are key factors for promoting Innovation in Korea. The existence of Regional Research Centres, which specialize in technologies dominating that regions industry and are located within easy access of universities have created co-operation between universities and SMEs. The form of business conglomerate: '*Chaebol'* has also played an important role in Innovation in Korea. These Chaebols are under a highly centralized structure and are under the ownership of the founding family [6, 7, 8]. As the decision making is highly centralized the response time to the opportunities is prompt.

India: The past decade has seen the growth of Knowledge and Technology Parks in India as well, which is promising. But there is a lack of support and promotion of innovation for*eg*. the local governments do not efficiently implement the schemes and

make available the resources provided by the centre. It is to be noted that the Software Technology Parks that have come up recently, have done extremely well in exports and now the time has come to strengthen / engage the firms residing in these parks to intensify their R&D via govt. support on the research.

Suggestions: The form of business conglomerates can also be adopted by the Indian industries with Govt. support. The larger firms can club with smaller firms for R&D projects, which will allow pooling of resources for major investment projects, reduction of transactions costs, sharing of risks etc.

Identifying areas of policy gaps for stimulation of private sector investment in R&D

The role of Science and Technology in promoting economic growth and welfare improvement is well established, for both developed and developing countries. India also yearns to emerge as a top knowledge power globally in the area of Science and Technology. Even though the public investments in our country meet the global benchmark of 0.7% GDP, our nation lags behind majorly in the investments by the private sector for R&D.

To study the framework of Science and Technology funding in India and comparing it with other developing economies like Korea, a background study of the S&T policy of the two countries was made.

- Understanding the reforms and incentives offered by Government of India (GoI) for supporting and stimulating the investment by the private sector in Research & Development. The reforms made in the policy framework of India have helped in creating an environment conducive for large investments. The Government procedures are being constantly simplified and the paper work has also been minimized. These reforms in the policy by the GoI are aimed towards significant and accelerated economic growth [16, 17].

A few exemplary reforms made and schemes introduced by the Government:

- Industrial licensing requirements, except for certain sectors, have been eliminated.
- The procedure for obtaining govt. approvals has been streamlined and quickened.
- The 'In-house R&D Centres Recognition Scheme' of the GoI, focuses on granting recognition to in-house R&D units in industries.

- Scheme by DSIR to give recognition to Scientific & Industrial Organisations (SIROs) and thus enabling them to be eligible for exemption various duties such as customs and excise for capital equipment, spares and consumables required for scientific research.
- Fiscal incentives for investment into R&D by the private sector have been announced by GoI.

GoI provides immense support to the R&D environment by way of incentives. These incentives are classified as Direct and Indirect Incentives. A few of the incentives offered have been listed in the table 3 below [16, 17, 18, 19, 20]:

Table 3 Direct and Indirect Incentives offered by GoI

Direct Incentives	Indirect Incentives
• Includes Grants and Credits by various Govt. agencies	• Customs duty exemption to in-house R&D units
• 100% write off of the revenue expenditure on R&D, capital expenditure on R&D in the year the expenditure is incurred.	• Exemption from the customs duty on the products imported for R&D projects that have been funded by GoI.
• 125% super deduction on any sum paid to the companies recognised by the prescribed authority for R&D	• Exemption of Central excise duty for in-house R&D units of the corporate sector
• A deduction of R&D personnel salary and materials consumed within 3 years preceding the initiation of the business.	• Weighted tax deduction - 200% on expenditure incurred on approved in-house R&D facilities, for sponsored research projects in national laboratories.
• Tax holiday on profits earned by export (for units set up in Special Economic Zones, SZEs)	• Depreciation allowance for investment on plant and machinery.

Along with the various fiscal benefits provided by the GoI, the state governments also offer incentives such as

a) VAT & CST incentives for new Units with Fixed Capital Investment
b) Electricity Duty Incentive
c) Property Tax Incentive

The GoI also administers marked assistance to industrial units that perform research in collaboration with public R&D units by means of soft loans, setting up of facilities, grant-in-aid

for clinical trials *etc.* GoI has also focused on the establishment of major national R&D facilities for encouraging the involvement of private sector investment in R&D through Public-Private Partnership mode.

Even though there is provision for the private sector to avail funds from the public sector but the protocol for approval and sanction in India is laborious and complex. A few countries like USA, UK, Japan, and Korea have circumvented the requirement of approvals.

- To understand the gaps that are hampering increased private sector investment in R&D, we aimed to study the policy framework of a few countries, **Republic of Korea** being one of them [5, 6, 7, 13, 14].

  The foremost point of observation is that all the reforms and changes in policy environment (support measures and incentive system) were initiated in the early 1970's. Under the provision of Industrial Technology Development Promotion law, private firms establishing research centres were extended various tax privileges such as tariff deduction on R&D equipment and subsidies. Small firms that cannot set up individual research centre have been encouraged to build research unions with other firms.

Incentives and Support for Private sector (Industrial) R&D

Tax Incentives:
• Tax deduction is extended to private firms that reserve funds for technology development (R&D facilities, manpower *etc.*) • Tax deduction upto 15% of the total expenditure on training and in-house technical college is applicable for private firms. • Tax deductions of upto 10% of the investment for R&D facilities and a depreciation rate of 90% per year.
Financial Support:
• If a private firm is involved in national R&D project, the Korean Govt. provides upto 50% of all the expenditure. • The percentage financial support is higher in case an individual or a small firm tries to commercialize new technology
Support by Banks:
• The Banks provide long term, low-interest loans for R&D to the private sector.

• A bank specializing in technology financing, the Korea Technology Development Corporation, was also created in the early 1980's, alongwith the establishment of programs to facilitate commercialization of technology.
Support by Venture Capitalists:
• Venture capital investment for supporting private sector R&D takes the form of Equity investments, debenture purchases *etc.*
Encouragement of private R&D:
• Strengthen the mid- and long-term R&D capabilities of companies (e.g., research collaborations among the triple helix i.e. GRIs, universities and the industry) • Provide quick responses to industrial needs (e.g., tax credit, job support, public procurement)

Other measures that have been taken by the Korean Govt. for supporting innovation and encouraging R&D for sustainable growth are:

Develop high-quality human resources:
• High investment in education and continuous upgradation of the programs • Desirable graduate education (according to national needs) • Post-doctoral researchers • Star scientists and scholars
Strengthen S&T policy governance
• Establish a central National autonomous coordinating body • Set up R&D budget review and coordinating sub-committee • Set up Knowledge Diffusion sub- committee
Increase efficiency of R&D
• Conduct creative and transformative research • Allow/ make provision for R&D failure, if sincere • Promote cooperation among triple helix (GRI, university and industry)

The R&D system of Korea has successfully transformed, responding to the changes in socio-economic conditions and demands during the rapid growth of country's economy and provided appropriate technologies for industrial development.

- **Key Factors enabling the rapid growth of R&D and Innovation in Korea that can be strived to be adapted to the Indian system:**

  - The export drive of the Govt. of Korea forced the domestic industries into the international competition and to survive it was imperative to keep up with the technological advancements and therefore these domestic industries had to invest heavily in R&D.
  - The *Chaebol* (a form of business conglomerate) played an important role too. The industrial policy of the Govt. which favoured large firms gave rise to a unique business organization. The decision making process under such an organization is highly central and therefore results in quicker responses to emerging technologies.
  - The increased investment of Korean industries in R&D is also a in direct relation with the availability of highly-educated/ talented manpower. Korea invested heavily in education and development of human resources at a very early stage.
  - Though the Indian govt. also provides large number of tax and fiscal incentives but it is to be noted that the Korean govt. apart from making available tax credits, grants *etc.* also complemented by providing support programs such as technology transfer, information, procurement, technical consultancy, thus encouraging increased collaborations between the Academia and Industry.

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Annexure VIII

Comparative study: Chinese and Indian S&T systems

It is a well known fact that a country's scientific and technological capabilities play a key role in its economic progress. Thus the policies in developing economies are designed to strengthen the educational and academic infrastructure which in turn will reinforce their R&D competence. India and China share some important similarities in the fact that both countries are rapidly developing economies and are emerging as modern countries with the potential of attaining global leadership. They also share similarity in market size, investment risk and market entry barriers [1].

In spite of the above mentioned similarities China has recently forged much ahead of India both in terms of S&T achievements and overall economic growth. The pace and scale of their growth is indeed spectacular. In this study we intent to investigate the policy framework which triggered the rise of Chinese S&T and to suggest suitable changes in the Indian S&T policies.

The founding vision of Chinese Science and Technological development was aligned towards achieving **Technological Self Reliance** leading to **Indigenous Innovation** and **Scientific and Technological World Leadership [2, 3]**. Some characteristics of the model may be described as follows:

a) Centrally planned R&D initiatives followed by efficient national mobilization of Human and Material resources to support their implementation
b) Integrate and harmonize rather than fragment social, political and economic goals in decision making regarding Scientific and technological development. This policy was largely
c) It related Science to agricultural and industrial production through a complex series of linkages between industry and agriculture, urban and rural development, and manual and mental labour.
d) It prioritized resource allocations to defense sector Science and Technology

One of the major reasons could be the emphasis laid by China on modifying STI systems by re-drafting the scientific policies keeping in view their economic implications, investing huge funds into STI system and vigorously implementing the scientific programmes. The key drivers were/are (i) a strong governmental intervention (ii) targeted approach and (iii) designing S&T policies in sync with economic policy [4].

A study of the S&T policy framework of China will give us a deeper understanding of the reason behind the spectacular rise of Chinese scientific and economic achievements. The GDP of China is around five times that of India and the percent GDP spending on R&D is also relatively higher at 1.98% as compared to India's 0.87%. Based on the quantum of spending in R&D it can be safely inferred that China gives due importance to the development of S&T competence. The number of publications emerging from China is also 4 times of that of India. The percentage contribution of Export of Goods and services in the annual GDP reflects the market orientation towards capturing global markets and in this important indicator too India lags far behind China. The employment rate in China (85.8%) is also much higher than the Indian Employment rate (64.1%) in the same age group (25 to 54 years). As far as Intellectual Property Rights Index (IPRI) is concerned, China and India are at the same level (5.5). This index is based on 10 factors reflecting the level of legal and political environment (LP), physical property rights (PPR) and Intellectual property rights (IPR) [5]. A comparison of China and India based on three important parameters namely Basic Requirements, Efficiency Enhancers and Innovation and Sophistication factors from the global competitiveness report [6] also clearly indicate that China over the years have concentrated their efforts on the development of these basic growth structures and due to this reason they have forged ahead of India. The details are listed in the following two tables (4 & 5):

Table 4: Comparison of China and India based on key indicators of development.

Indicators		China	India	USA
GDP (million US$) 2013		9181.4	1870.7	16,799.7
% GDP spent on R&D		1.98%	0.87%	2.81%
Publications (2013)		4,25,677	1,06,029	5,63,292
Export of Goods and Services (% GDP in 2009)		26.7	19.8	13.6
Employment rate (in population aged 25-54 yrs in 2012)		85.8	64.1	75.7
IPR Index		5.5	5.5	7.6
Rank in Global Competitiveness Index (Ranking out of 144	Basic Requirements*	28	92	33
	Efficiency enhancers**	30	61	1

countries)	Innovation and Sophistication factors	33	52	5

Sources: OECD (2015),Scopus, Global competitiveness Index, International Property Rights Index Report 2013

***Basic Requirements:** Institutions, Infrastructure, Macroeconomic environment, Health and Primary Education.*
*** **Efficiency Enhancers:** Higher Education and Training, Goods marketing efficiency*,
Labor market *efficiency, Financial market development, Technological readiness, Market size*

Table 5:Comparison of Important Global Competitiveness Index rankings

S. No.	Global Competitiveness Index (GCI)	China	India	USA
1.	**Overall GCI ranking**	28	71	3
2.	**Property Rights**	50	73	25
3.	**Intellectual Property protection**	53	65	20
4.	**Burden of Government regulation**	19	59	82
5.	**Efficiency of Legal framework in settling disputes**	49	57	23
6.	**Transparency of Government policymaking**	33	64	44
7.	**Secondary education enrolment, gross %**	72	106	59
8.	**Tertiary education enrolment, gross %**	85	87	3
9.	**Availability of research and training services**	58	64	8
10.	**Availability of latest technologies**	97	110	2
11.	**Capacity for Innovation**	40	48	2
12.	**Quality of Scientific research institutions**	39	52	4
13.	**Company spending on R&D**	23	30	4
14.	**University-Industry collaboration in R&D**	32	50	2
15.	**PCT patents, applications/million population**	34	61	11

After studying the above points we have selected some salient points of the Chinese System that can be adapted according to the Indian scenario as follows:

- ***Policy Designing and Implementation:***

China: A central theme in designing of Chinese S&T policy is its integration with social, political and economic goals [3]. This planning tradition places S&T as an important driver of Social and Economic achievements. Starting from early 1980's China adopted a policy of orienting S&T activities to serve economic development [2]. National funding programs for research that were formulated in the 1980s as part of Science and Technology plans were designed to shuttle financial resources to scientific projects critical to economic and military needs in alignment with the five year national economic plans. Apart from drafting and publishing S&T policies China also enacts corresponding legal instruments to ensure the effective implementation of the policies. As for example the following laws can be cited- "The Law for Promoting Commercialization of Science and Technology", "Technology Contract Law", "The Law for Agricultural Technology Diffusion" and "The Patent Law" [1].

India: In the Indian system policy design and implementation is fragmented as policies for different sectors (eg Defence, Agriculture, Education, Science & Technology, Industry etc.) are drafted by the concerned ministries and there is no centralized agency to consolidate the various policies into a focused national activity [4].

Suggestions: Measures to enhance co-ordination amongst the various sectors/ministries that are related to S&T policy making and implementation will help in synergizing the system. It is high time Govt. of India set up Integrated Policy Making Body and prioritize strengthening and implementing STI Policy, taking into consideration the needs of the country.

- ***Integrated & Targeted Approach:***

China: STI policies were targeted for achieving self reliance leading to *IndigenousInnovation and Scientific and Technological World Leadership*. The Chinese research planning was initiated in the early 1950s in cooperation with the then Soviet Union and was further elaborated during 1956 with the introduction of the 12th Year Plan for Scientific and Technological Development [2]. All these efforts were characterized with a top- down model with State directed Science and Technological programs to achieve developments in strategically important areas.

India: The policy making and implementation is disintegrated as mentioned earlier. The diffusion of S&T into important sectors like *agriculture, manufacturing, education, research and service* are minimal thereby weakening the link between S&T and Economic growth.

Suggestions: GoI should also form a Central Policy Body which can act as a bridge to all the different agencies or Govt. organs to link the various planning and implementation process. It is further added that the STI policy should be in blend with the economic policy of the nation to achieve sustainable growth, poverty alleviation and global competitiveness.

- ***Human Resource Development***:

China: Itconsiders human resource as an integral component of economic and social development. The training and educational level and employees' professional capacity are being greatly enhanced due to the *application of human capital theory, public administration and talents evaluation skills*, drawn from the policies of developed countries [2]. Apart from strengthening the basic education, secondary education and technical education, China regularly trains its Scientific and Technical manpower in overseas labs and institutions through its greatly expanded international cooperation in S&T.

India: Barring IITs, a few universities and research institutions, majority of the higher education and research institutes are not in tune with the expectations of the (i) Industry and (ii) needs of the Indian society. Due to this factors India is not able to convert its huge demographic resources into engines for economic and social growth.

Suggestions: Our education system needs to be upgraded to meet these expectations and urgently take measures to enhance employability by upgrading the skill level of the masses. Even though repatriation of foreign skilled Indians has begun, it hasn't been able to fulfil the skill shortage in India. Hence it is imperative for India to reform the University/Research programmes.

- ***Reorganizing the Infrastructure***:

China: Chinese S&T policy has undergone a series of reforms over the past fifteen years. The R&D in industrial enterprises accounts for about 70 percent of all national R&D expenditure [7]. Aclose cooperation between private firms and universities/ institutes is also encouraged in order to stimulate the pace of innovation with the central belief that true innovation will only come from linking forefront research and academic institutes with the industrial sector that can

commercialize and profit from scientific and technological findings [2].As a consequence of such interactions Chinese universities have also established a strong commercial identity, having many spin off companies and active contract research projects with national and International companies [1].

India: Policies for the reorganization of Academic and Scientific Institutes have been drafted and efforts to form clusters and umbrella bodies have been initiated, however on the implementation front much is to be desired. Secondly the Govt. funded research institutes have excellent infrastructure which is not easily accessible to other nearby universities and industries.

Suggestions: A national policy is needed to promote the collaborative activities among institutes by pooling of resources/infrastructure amongst education/research institutes as well as with private sector.

- ***Environment for Innovation & Entrepreneurship:***

China: Chinese policy supports 'Entrepreneurship Development' through the establishment of Science and High-Technology Park models which encourages local and foreign investments and allows universities to nurture native companies through information networks and entrepreneurship training [1, 2, 8, 9]. As a result some of China's most innovative firms are smaller startups characterized by vigorous high technology entrepreneurship partnered with public funded research institutions [1].

India: India has started giving due importance to innovation and entrepreneurship**.** The past decade has seen the growth of Knowledge and Technology parks in India, which is quite promising. Incubation Centres are coming up in select universities and research institutes for the promotion of innovations. The government has set up a dedicated *'Ministry of Skill and Entrepreneurship'* to provide better manpower to Industry and encourage young minds to set up their own startup companies so that they become job providers, instead of job seekers.

Suggestions: The establishment of Incubation Centres needs to be intensified and strengthened across the country. Proper mechanisms need to be put in place to monitor the implementation of various S&T schemes of the central government as local governments.

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Department of Science & Technology
Govt. of India

Annexure IX

DST-Centre for Policy Research

at

PANJAB UNIVERSITY, CHANDIGARH-160 014 (INDIA)

(Estt. Under the Panjab University Act VII 1947 enacted by the Govt. of India)

SURVEY ON INDUSTRY-ACADEMIA LINKAGES (For Academia)

The information sought pertains to your Institute only. This survey consists of 17 objective type questions. For questions 2-9, pl. fill up the columns 'Yes/No/Other'. For questions 12-17, please underline / tick / bold the option(s) mentioned in the question.

The filled up Questionnaire can either be emailed at dstprc2014@pu.ac.in or a hard copy may be sent to ***Prof. Rupinder Tewari,*** *Co-ordinator DST – Centre for Policy Research, Deptt. of SAIF/CIL, CIL Building, Panjab University, Sector-14,Chandigarh-160014.*

(i) Name of the Institute:

(ii) Complete address:

1.	**Interaction of the Institute with the Industries**				
	Life Sciences (Please specify the field)	**Engineering Sciences (Please specify the field)**	**Business Management**	**Legal Studies**	**Other(s)**
Industrial training					
Campus recruitments					
Research collaborations					
Members of the governing body					

		Yes	No	Other
2.	Does the Institute have a dedicated "Industry - Academia Cell" or its equivalent?			
3.	Is the Institute aware of the Industry oriented Govt. funded programs like DSIR, TDB, BIRAC, PM's Fellowship Programme for Doctoral Research?			
4.	Does any Industry have a set up (research facility / laboratory) in the Institute?			
5.	Is there any Industry sponsored research fellowship in the Institute?			
6.	Do the students of the Institute visit industrial facilities on a regular basis?			
7.	Are there any incentives for faculty members / researchers who have obtained patents/ transferred technology?			
8.	Does the Institute provide leave to the faculty to take an assignment in the Industry?			
9.	Does the Institute offer special courses/ modules for regular employees of the Industry?			
10.	Does the Industry use infrastructure resources like instruments, library, legal services, any other (pl. mention) of the Institute?			
11.	Does the Institute have an IPR Cell/ Entrepreneurship Cell/ Placement Cell/ Technology transfer Cell/ any other (pl. mention)?			
12.	Does the Institute engage Industry personals for teaching programmes? If yes, are they engaged as: (a) Invited speakers for a few lecture, (b) Guest faculty, (c) Adjunct faculty			
13.	Please fill in the appropriate details relevant to the Institute (last five years): (a) Number of Patents (i) Granted..... (ii) Filed..... (b) Number of Technology transfers (i) Commercialized.....(ii) Under process..... (c) Number of MoU with the Industries (i) Signed..... (ii) Under process.....			
14.	Does the Institute hold workshops/ conferences/ seminars in association with the Industry (pl. mention)?			

15.	Factors hampering the growth of Industry-Academia linkages in the Institute are : (a) Lack of common area of interest (b) Lack of co-operation from the Industry (c) Intellectual property rights (IPR) issues (d) Not much weight-age given by Institute to develop industrial linkages (e) Lack of incentives for Industry- driven research
16.	Lack of sensitization of Intellectual Property Rights (IPR) in the Institute is because of: (a) Compulsion of publication (as a part of doctoral programs) hampers going in for patents. (b) Tedious protocols of IPR (c) Lack of IPR related guidance and awareness (d) Lack of a dedicated IPR cell in the Institute
17.	The barriers preventing the successful technology transfers from the Institute to Industry are: (a) Inadequate legal support services (b) Inadequate technical facilities (c) Any other
18.	Please pen down any other suggestions you wish to share:

Signature/ Seal: Dated:

Name, Designation and Complete address:

For correspondence /query: *Ms. Mansimran Khokhar, Email: dstprc2014@pu.ac.in, Ph.No: 0172- 2534660*

Department of Science & Technology
Govt. of India

Annexure X

DST-Centre for Policy Research

at

PANJAB UNIVERSITY, CHANDIGARH-160 014 (INDIA)

(Estt. Under the Panjab University Act VII 1947 enacted by the Govt. of India)

SURVEY ON INDUSTRY-ACADEMIA LINKAGES (For Industry)

The information sought pertains to your organization only. The survey consists of 12 objective type questions. For questions 1-9 (h), pl. fill up the columns 'Yes/No/Other'. For questions 9(i)-12, please underline / tick / bold the option/s mentioned in the question.

The filled up Questionnaire can either be emailed at dstprc2014@pu.ac.in or a hard copy may be sent to ***Prof. Rupinder Tewari,*** *Co-ordinator DST – Centre for Policy Research, Deptt. of SAIF/CIL, CIL Building, Panjab University, Sector-14,Chandigarh-160014.*

i. Name of the organization:

ii. Complete address:

S. No.	Questions	Yes	No	Other
1	Does your organization have any "Industry - Academia Cell" or its equivalent?			
2	Has your organization adopted any technology from any academic Institute?			
3	Does the governing body of your organization have any representation from academia? Please specify at what level.			
4	Does your organization have any 'Policy for Higher Education' for the employees?			
5	Is your organization aware of industry oriented government initiatives like TDB, DSIR, PM Fellowship for Doctoral Research, etc.?			
6	Does your organization have a set up (research facility / laboratory) in any educational / research Institute's campus?			
7	Has your organization been granted / filed any patent/s in collaboration with an academic Institute? If yes, please mention the number of patent/s (a) Filed…… (b) Granted……..			

S. No.	Questions	Yes	No	Other
8	Does your organization have MoU/s with educational Institutes : If yes, please mention the number of MoU/s (a) Signed…… (b) In Process……..			
9	Does your organization have any collaboration with the academic Institute/s? If 'Yes', please answer the following			
	(a) Campus recruitment of students			
	(b) Engage University – faculty as consultants			
	(c) Visits to the industry by the students			
	(d) Collaborative Research & Development			
	(e) Involvement in the design of academic curriculum			
	(g) Access of University scholars to industry infrastructure			
	(h) Research fellowship support to students / research scholars			
	(i) Joint supervisor of: (i) Dissertation (ii) Thesis (iii) Project of the Students			
	(j) Offer training programmes for: (i) Students (ii) Faculty (iii) Technicians			
	(k) Hold joint: (i) Workshops (ii) Conferences (iii) Seminars (iv) Lectures (v) Examinations			
	(l) Utilisation of University / Institute resources like instruments, library, legal, others (pl. mention)			
10	Are Industry personnel/s of your organization engaged with educational Institutes? If yes, please mention the type of engagement : (i) Invited speakers for a few lectures (ii) Guest faculty (iii) Adjunct faculty (iv) Other (pl. mention)			

11	In India, lack of Industry-Academia linkages can be attributed to: (i) Lack of common area of interest (ii) Intellectual property rights (IPR) issues (iii) Lack of co-operation from the academic Institutes (iv) Low weight-age given to develop academic linkages (v) Lack of incentives to the scientists for Industry-driven research	
12	Is your organization availing any benefit (financial or others) from the government for any Industry - Academia collaborations? Please mention.	
13	Any other suggestion from your side	

Signature: Dated:

Seal:

Name / Designation / Complete Address:

For correspondence / query:- *Mr. Ajit Singh, Email: dstprc2014@pu.ac.in , ajitnao@pu.ac.in Phone no: 0172-2534660*

Annexure XI

How an Industry-Academia Interface Gave a New Dimension to Innovation in India:

A Case Study of FITT

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ABSTRACT

A developing economy like India has the competence and talent to become an innovation driven system. However, in order to successfully capitalize its potential, there is an urgent need to ameliorate the current systems of the nation. The most effective way of enhancing the innovation ecosystem is by introducing methods to bridge the industry-academia gap at the higher education level. However, even with huge array of possibilities that exist in India, there are not too many successful models that effectively aim to bridge this gap. Among the few that have flourished, one of the oldest and most prevalent is the Foundation for Innovation and Technology Transfer (FITT) at IIT, Delhi. This case study attempts to analyze the modalities on which this foundation was conceptualized, its functioning, the programs initiated, and how this can serve as an effective model at a national level.

INTRODUCTION

In the wake of ever increasing industrialization and teeming graduates with every passing year, the need for better synergy between the industry and academia has become imperative. Unfortunately, until recently, the importance and consideration given to industry-academia interactions was lukewarm. The lack of a parallel movement path amongst the industry and

academia has lead to a significant skill gap in the country. This is one of the main reasons of severe unemployment issue despite the private sector claims of greater opportunities in the job market. With the industry's claims of students not being 'industry ready' and academia's claims of lack of cooperation / interest from the private sector, we have seen unending discussions and debates in an attempt to reach a conclusion. However, not much has been achieved so far.

Only in the recent past there have been noticeable efforts by government bodies and private organizations to bridge the gap. In an effort to act as a mediator, the Government of India has introduced some remarkable schemes (Biotech Ignition Grant - BIG, Biotechnology Industry Partnership Programme – BIPP, Bio-incubators Support Scheme – BISS, Small Business Innovation Research Initiative – SBIRI, Technology Incubation and Development of Entrepreneurs – TIDE, equipment financing schemes, Science and Technology parks, Incubation centres, etc.) to add commercial value to academic knowledge. One committee that offered a helping hand was the N.R. Narayan Murthy Committee, as a result of which the government has now set up a Council for Industry and Higher Education Collaboration (CIHEC) and introduced the establishment of a Ministry of Skill Development and Entrepreneurship (Report of N.R. Narayana Murthy Committee, 2012) in order to address the challenges faced in the said areas. After all, it's never too late to take a step in the right direction and that seems to have begun. For a developing economy like India, it is extremely important to remain competitive in order to keep pace with increasing globalization. The only way this can be achieved is if the Government, Industry and Academia work in unison.

A recent study conducted at our centre (DST-CPR at P.U Chandigarh), showed that majority educational institutes have now set up 'Industry-Institute Interaction Cells' or their equivalents. The sudden introduction of government schemes and institutes waking up to the

urgency of the requirement of such cells is indeed reassuring. But one institute that demonstrated their earliest efforts to bridge this gap was IIT, Delhi. It came up with one of the most successful initiatives in this area, by way of establishment of FITT (Foundation for Innovation and Technology Transfer), which has been in existence for more than two decades now. When established, FITT was ahead of its time as no publicly funded academic institution had created such a structure in India. This case study attempts to analyze the situation that led to the inception of such a foundation, its mode of functioning, some programs initiated, successes and failures, and probably how this model can and should be modulated at a national level.

HISTORY: THE INCEPTION OF FITT

It goes without saying that, in India, the IITs have been the foremost in imparting higher education and engaging in substantial R&D activities. However, one concern that needed attention was the limitation in technology transfer from institutes to industry. The ratio of the amount of research done to that of the commercialisation of the developed technology was indeed a sorry figure. As a result of this the IIT Review Committee, in 1986, recommended the formation of an industrial foundation which would function as a commercial corporate body with its own budget and plan for marketing its research and consultancy activity. It was proposed that this body would function independently, both financially and administratively so that there would be no compromise in the primary goals and objectives of the institute (Sengupta et. al., 2009).

It was at the recommendation of this proposal that the Government of India identified IIT Delhi to be the first for the foundation of an Industry-Academia interphase. A concept paper for the same was submitted in 1991 and a Memorandum of Association was drafted in 1992 (MoA,

1992). The foundation, named as Foundation for Innovation and Technology Transfer (FITT), was finally registered in 1993. The Government on India granted Rs 16.2 million as corpus fund, to IIT Delhi for this purpose. In 1995, FITT was recognised as a Scientific and Research Organisation (SIRO) by the Ministry of Science and Technology (Government of India) (Annual Report, 1994-95). FITT adopted an industrial culture and ethos in its functioning while using the expertise and infrastructure of the institute.

The first **Mission Statement** of FITT was formulated as 'To be an effective interface with the industry to foster, promote, and sustain commercialization of S&T in the institute for mutual benefit'.

The broad term **Objectives** of FITT were to add commercial value to academic knowledge and to market the intellectual and infrastructural capital of IIT Delhi for national development (as mentioned in its annual report). In order to achieve the main goal, the defined objectives included:

- To proactively market the intellectual ware of IIT Delhi to industry.
- To offer a flexible mechanism and a single window service (to the industry clients) for making use of the expertise and infrastructure of the institute and capabilities/technologies developed at the institute.
- To provide (to the faculty) an effective interface with industry, a congenial platform and a facilitative environment for collaborative work assignments.
- To augment IIT Delhi's resource generation efforts.

FITT was established with the principle purpose of providing single window services to the industry with complete professionalism, to functioning as a marketing arm for the institute

developed technologies (Sengupta et. al., 2009). This implied that FITT had two target clients: Industry and Academia. That left the foundation with the task of dealing with two sides of the same coin! This definitely called for a strong strategical approach, which we can now see, was successfully devised.

The broad work structure of the organization comprised of:

- Marketing and Business Development
- Formulation of proposals
- Drafting contracts and agreements
- Financial management
- Logistics support for pre and post project development
- Assistance to faculty and staff on IPR matters and Technology Transfer
- Assistance on Legal issues
- To draw the expertise and facilities of IIT and supplement it with that of other IITs, R&D institutes, etc., in order to formulate industry friendly projects

The broad spectrum of activities of the organization also include development of product and process technology specially requested for by the industry, to a commercially viable level; providing tech support to small scale industry and entrepreneurs; prototype and pilot development leading to commercialization of products and processes initiated by the students/researchers of the institute; undertake cooperative R&D programs jointly with industry; training industry personnel and students to become technical experts on specific products/processes (Sengupta et. al., 2009).

ORGANISATIONAL STRUCTURE AND MODE OF FUNCTION:

Being an autonomous body, the biggest challenge in the face of FITT was to survive as an organization. Hence it was decided that to be financially independent the net profit shall be added back to the Foundation Corpus Fund. FITT, thereon, adopted a corporate and industrial work ethic, thereby functioning independently by keeping a minimum number of its own fixed assets, both in terms of building and equipment. A minimum full time core staff was appointed, comprising mainly of people who had a broad-base experience and adaptability towards a wide variety of projects.

Keeping in mind the nature of the foundation, the organizational structure was conceived with minimum investment in infrastructure and personnel. The management was vested with the Managing Director of the organization, guided by a Governing Council and a Research Council. The Governing Council had representation from the industries, industry associations and nominees of the IITD senate; the research council constituted members from the faculty and industry representatives, with the aim to review the projects involving IITD faculty and facilities and hence monitoring the progress of the said projects. The strategies adopted for the functioning of FITT, to fulfill its various functions were as follows:

- Among the many functions and objectives of FITT, Marketing and Business Development was and still is one of the most important aspects of FITT. It is the only way of advertising the expertise available at IIT, giving a glimpse of the technologies developed and thereby generating the required revenue (Fig. 1). This aim was achieved by conducting Industry Academia summits; active participation in industry exhibitions at national and international level; publication of a quarterly bulletin regular dissemination of information about IIT Delhi and FITT through features and articles in newspapers and

magazines and occasional promotional advertisements; corporate membership scheme for the industry; establishment of relationships with associations like FICCI, ASSOCHAM, CII and so on.

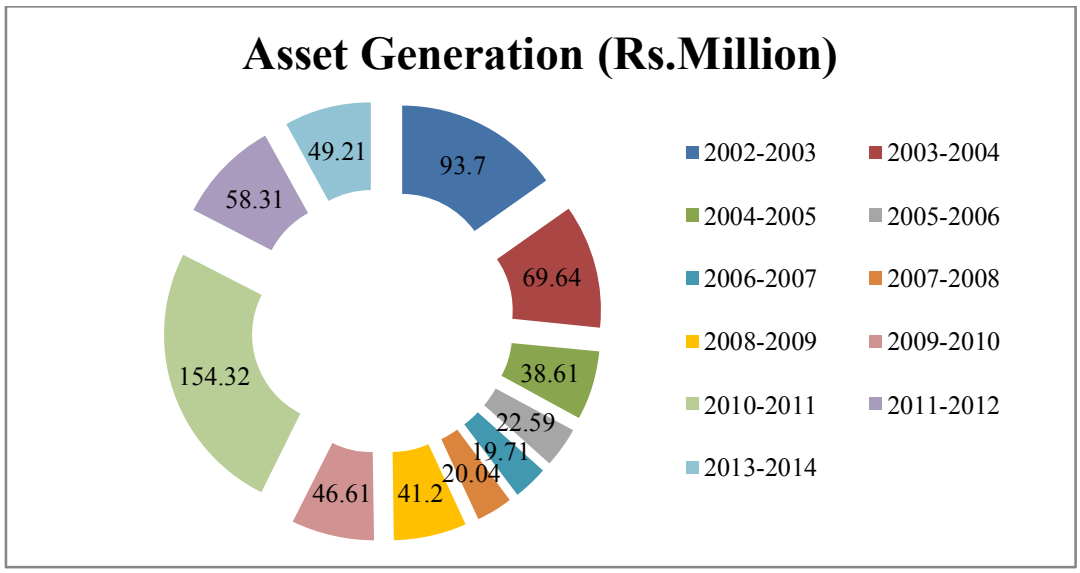

Fig. 1: Asset Generation as a result of Technology transfer projects and R&D projects.

- Project management, the next most important role of the foundation, was what led to the development of stronger industry-academia linkages and the required revenue to survive independently. This mainly involved technology transfer to the industry, initiation of joint research programs, problem solving consultancy assignments from the industry, training programs and human resource development events. FITT has contracted projects worth Rs. 169.88 million by technology development/transfer in the financial year 2013-14 (Fig. 2). Prior to the advent of FITT, hardly ten technology transfers worth less than Rs 1 million had happened in 30 years at IIT Delhi.

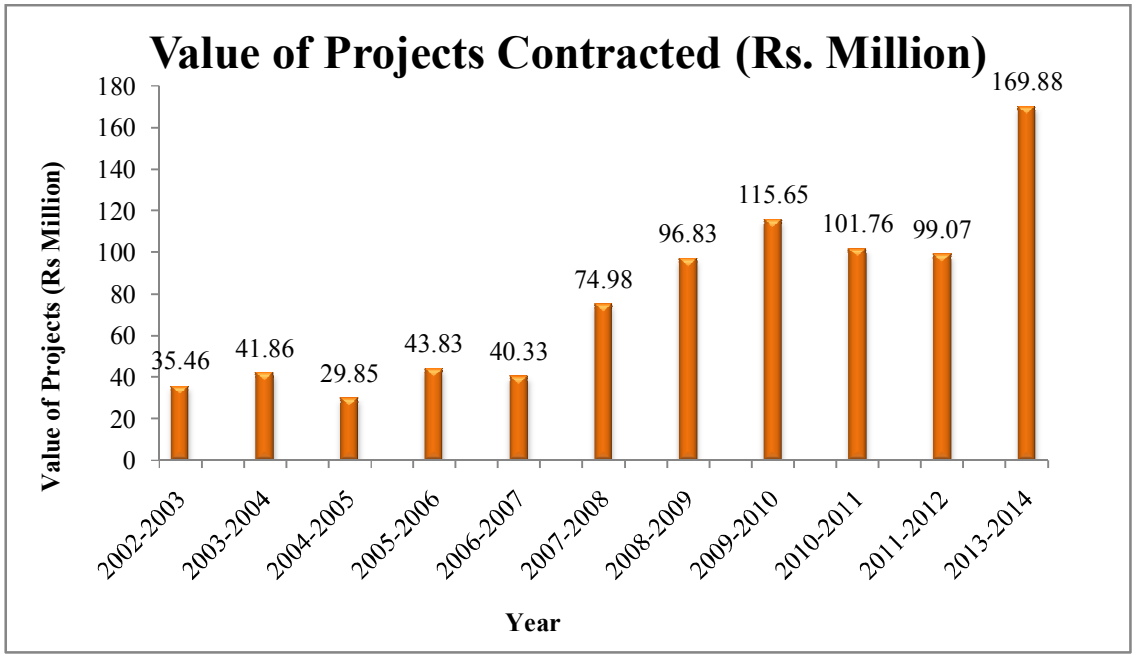

Fig. 2: Values of projects contracted/other activities undertaken at FITT in the past decade.

- The role and function of FITT was incomplete without the vital function of facilitation and value addition to the academic community for effective interaction with the industry. The most important aspect of this function was IPR management of the institute's academic community. Before FITT had taken up the responsibility of promoting the IPR interests of the institute, the rate of filing for IPRs was very low. A number of campaigns were initiated at FITT for promoting IPR filing for novel inventions / technologies / research outputs amongst the academic community. Complete assistance for filing of applications was provided by FITT by way of evaluation of proposals for patents and other IPR applications for the final submission to Indian Patent Office and other competent authorities. The decisions pertaining to the application of technologies are taken by the IPR standing committee constituted of the Dean (IRD) and MD (FITT), the Associate Dean (IRD), and the FITT Executive Consultant (IPR & ToT) as permanent

members and up to three external IPR experts and three internal faculty members as temporary members.

In the year 2013-14, 20 technologies have been approved by the IPR standing committee of FITT for application to national authorities, and two IP licenses have been executed for Tech Transfer from academia to industry. In the past two decades, more than 200 patent applications have been filed as opposed to the less than 15 patent applications filed from IIT Delhi between 1963 and 1995 i.e. before the inception of FITT (Fig. 3). Another major task accomplished by FITT was to identify the wealth output of the research done at the institute. A comprehensive list of the technologies developed and being developed was made and uploaded on the FITT website (http://www.fitt-iitd.org), circulated amongst industry associations and government agencies so as to provide visibility of the R&D being done at the Institute. This made it extremely easy for the industry to search for any technologies of their interest and contact the person in question hence boosting the institute's technology commercialization.

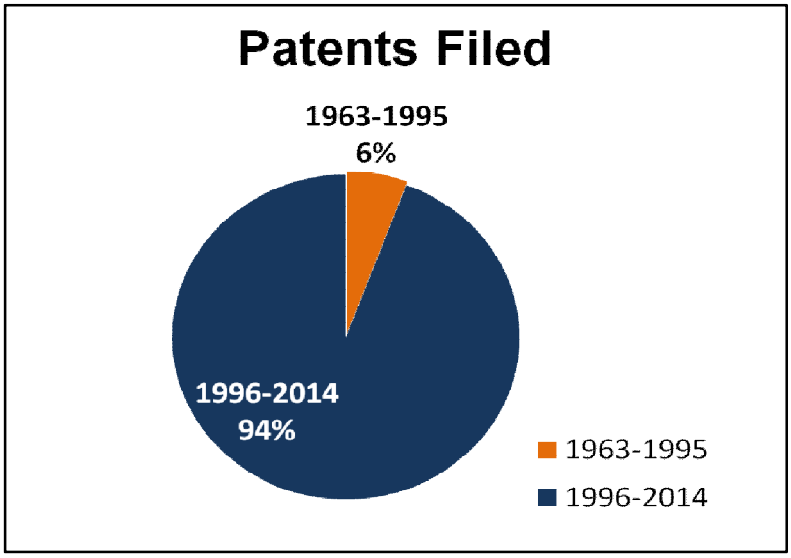

Fig. 3: Number of patents filed before (1963-1995) and after (1996-2014) and after the inception of FITT.

PROGRAMS INITIATED: RESPONSES AND OUTCOMES

Since the inception of FITT, a large number of programs and initiatives were introduced in an effort to catapult the industry academia linkages to the next level. Where some of the programs have been a huge success, for example the Technology Business Incubation Unit (TBIU), there have been some failures too. This, however, is a part and parcel of the process and has helped FITT to evolve as a model for other such organizations. The programs initiated by FITT can broadly be categorized as the following:

- Incubation Centres
- Knowledge Augmentation Courses
- Corporate Partnership
- Research/Technology Development Projects
- Awards and MoU's
- Government Schemes

A. Incubation Centres

In an endeavor to promote entrepreneurship, the foundation initiated the task of setting up incubators/ science parks, on campus, thereby providing easy access to students. These incubators were set up with the aim of providing the entrepreneur with basic infrastructural facilities without the hassle of paper-work. These include TBIU, Bio-incubator facility, science parks and the bio-accelerator program.

- *TBIU*

TBIU or the Technology Business Incubation Unit was initiated in 2000 and has been one of the most important and successful initiatives of FITT (Bhattacharya, 2005). The TBIU started as a Technology Institution program, as a part of the ICICI/World Bank Funded Technology Institution Programme (TIP) at IIT Delhi. The concept of TBIU (Sengupta et. al., 2009) was taken from foreign organisations such as the Austin Technology Incubator of the University of Texas, Austin, USA (one of the largest incubator organisations in USA); Mountjoy Research Centre of the Universities of Durham, UK; Campus Ventures Ltd., Manchester, UK; Technology House, Salford, UK; and UMIST (UMIST Venture Ltd).

The TBIU program at IIT Delhi is aimed at promoting entrepreneurship among students, faculty and scientists and creating successful technology business enterprises of the future. Under this scheme, the start-ups / technology entrepreneurs under the TBIU umbrella are a provided with initial seed money and space for converting his or her new ideas/concepts/ service of a product into a commercially viable business in technological association with members of the faculty and students of IIT Delhi. They are provided with the necessary infrastructure and space for a certain amount of time, usually not more than 2 years, during which they are given access to technical consultation as well. This model has proven to be extremely helpful for the conversion of nascent technological ideas into commercial entities. In return, minimal space utilisation charges and equity share of the company rests with FITT. The positive impact of this scheme has been huge as is exemplified by the many successful start-up businesses which have gone on to

develop as well as bring their products to the market. Eventually, the technology firm matures to the point where it can graduate from the incubator and continue its growth as a viable enterprise.

The day to day administration of the TBIU's, lies with FITT. However, the management of TBIU rests with the TBIU board and a standing/screening committee, comprising of senior faculty scientists and industry experts, who screen and evaluate the incubation proposals for innovators / start-ups admission to the TBIU.

KritiKal Solutions India (Pvt.) Ltd:

The first faculty-student led business incubation unit, KritiKal Solutions India(Pvt.) Ltd. (http://www.kritikalsolutions.com), was founded in 2002. The company started functioning as a full scale commercial venture by the year 2005 (Annual Report, 2005-06) and now holds office in Noida, (U.P). It is a 50 employee company with record annual turnovers of around Rs.10 million. The three years of incubation support provided by TBIU under the faculty guidance of Prof. B. N. Jain, has led to the development of a company which now stands tall with significant presence in India and US as of this date. The main focus of the company is Embedded System Design and Real Time Computer Vision and Imaging Solutions. The students who started/co-founded the company under the TBIU umbrella proudly claim that the technical association and guidance of the professors at IIT, Delhi has helped them immensely in bridging the gap between academic research and commercially successful technology products.

Gramvaani

Another successful spin-off from TBIU is *Gramvaani (http://www.gramvaani.org),* based at IIT, Delhi. It is a social technology based company which provides information and community technology based solutions. This company is led by an IITD faculty member, Dr. Aaditeshwar Seth, works in collaboration with the institute and encourages interning/trainee students to work on real-life problems and situations. The company is now a 35 employee strong group and has recorded turnovers of Rs 10-15 million per annum.

The TBIU clearly represents a proactive approach towards a strategic partnership among the entrepreneur, the institute and the external world. A list of resident companies in the year 2014 is as follows (Annual Report, 2013-2014):

a. *Novo-Informatics*: Develop biological software for pharmaceutical & biotechnology companies using smart computational algorithm as well as serving clients in area of target modeling & drug discovery.
b. *Silver Knight Technologies*: For advanced anti-theft bags.
c. *PLANiN Innovation and Consultancy Pvt. Ltd.*: A basket of innovative products with proprietary technologies - first product - a cooling system/fan.
d. *Innovator Lab Consultants India Pvt Ltd*: Mechanical heart valve fixation system: An improved design for superior cardiac performance.
e. *Wrig Nano- Systems Pvt. Ltd.*: Advanced Blood Haemoglobin Testing POCT (Point Of Care Testing).

f. *EkamEco Solutions Pvt. Ltd*: Ecological solutions in the field of sanitation, water conservation, nutrient recovery and sustainable habitat.

g. *Credext Technologies Pvt. Ltd.*: A device for enabling a user to access his / her desktop at remote location.

h. *Kentellus Welding & Manufacturing Pvt. Ltd*: New Technology for manufacturing welding electrodes.

i. *Carbon Neutral Technologies Pvt. Ltd*: An alternate manufacturing process for isoprene-a key industrial input at an economical cost.

j. *Inkilab Technologies Pvt. Ltd.*: Diagnostics technologies integrated with process design and decision making in manufacturing processes.

The above mentioned list of start-up companies is just a glimpse of what TBIU has done in order to promote entrepreneurship via the industry-academia interface. In the past two decades, there have been innumerable start-ups that have graduated from TBIU into successful, self-sufficient, profit generating companies.

- *Biotech Incubator Facility*

The Department of Biotechnology, GoI, has recommended supporting the establishment of a Biotech Incubator Facility at FITT, IITD. A sanction of Rs. 87 million has been proposed for the incubator, for a period of three years. This facility, like other incubators will support start-ups and provide incubation facilities for research and development work at minimal charges so as to promote innovation. This is another step

taken by the government, with FITT in play for promoting market based research and innovation.

- *Science and Technology Parks*

The most recent endeavour of FITT is to set up science and technology parks as a way of promoting the institute's intellectual capital and providing a platform for better research and development. These parks have been conceptualised in a way such that they will have all facilities for start-ups as well as well established firms. These facilities include legal, banking, research & development, consultancy, networking spaces and so on. In lieu of this concept, the Haryana government has allocated a space of 50 acres land for extension of IIT Delhi's research campus and the setting up of a Science and Technology Park, a faculty development centre and a "high performance" computing centre.

- *Bio- Accelerator Programme*

FITT in association with NII and BIORx Venture Advisors (BIORx) organised the Bio-accelerator programme which laid emphasis on "accelerating innovation to marketplace". This is indeed one aspect of research which is now gaining pace and this program provides the impetus to focus in innovation on the basis of market demands. It is a joint initiative to strengthen the Indian bio-economy by designing Master Class on Bio-entrepreneurship for students of various courses.

B. Corporate Partnership

The organization also came up with the corporate partnership program, for public and private sector industries, ministries and organizations and industry associations and

financial institutes, and offers the advantage of concessional services to its members. FITT has a large number of big corporations as their corporate member, and with the numbers increasing every year; this clearly seems to be beneficial for the corporate. The corporate members receive, among other benefits, advance notifications of all patent applications/ technologies marketed by FITT, customized research presentations and seminars, newsletters and select information dissemination. Most importantly, however, members develop an advantageous working relationship with FITT that allows them to gain access to IITD research, as well as a variety of local businesses and services. Some corporate members that are a part of this are: Indian Grameen services, L'Oreal India Pvt. Ltd., Cube Software Pvt. Ltd., Reliance Industries Ltd., National Thermal Power Corporation, Bharat Heavy Electricals Ltd, Munjal Showa Ltd., JCB India, Canon India, LG Electronics India, Danfoss Industries, Carborundum Universal, Tata Chemicals, Jubilant Organosys Ltd., Fresenius Kabi Oncology Ltd., National Research and Development Corporation, Samsung Research Institute – Delhi, Dabur Research Foundation, etc.

C. Knowledge Augmentation Courses

Higher education is a continuing process and there is no limit to enhancement of one's qualifications. In order to facilitate this increasing demand and give a platform for working professionals, the foundation in association with the institute, introduced several professional programs which have clearly been a success. These include knowledge augmentation & skill enhancement courses.

- *Professional Candidate Registration*

For encouraging professionals to enhance their qualification, a number of programs have been initiated so as to give the professionals a chance to study while they work. Suitably qualified candidates are encouraged to undertake a single course module that they deem relevant to their work structure. The course involves registration of the candidate for one semester (as per the course chosen) and is certified at the end of the program. The year 2012-2013 has seen a participation of 85 candidates, clearly demonstrating the success and demand of this program. This program is confined to the Delhi-NCR region as of now due to accessibility issues although a few selected courses are covered under the on-site delivery program by a two way audio-video link.

- *Knowledge augmentation and skill enhancement courses*

Various add-on courses for professionals and students have been initiated with the aim of honing the students to be job ready. This also includes professional development HRD programs such as conferences or short workshops for knowledge updating of the latest happenings in various fields.

D. Research/Technology Development Projects

The faculty at IITD in collaboration with students and/or companies take up several research projects which eventually lead to the development of technologies that are consequently transferred or commercialised with the help of FITT. One of the most successful of such projects has been the development of the 'Smart Cane for the Visually Impaired' which was developed as an enhancement to white cane and overcomes its

limitations by detecting knee above and hanging obstacles. This unique device was developed under the guidance of Prof. M. Balakrishnan (CSE) and Prof. P.V.M. Rao (Mech Engg.), done in collaboration with Phoenix Medical Systems, Chennai (Industrial partner) and Saksham Trust, Delhi (NGO working for the visually impaired). Some other successful technologies that have been developed and commercialised are FruWash and Ennatura.

E. Awards and MoU's

- *Launch of ICICI-Trinity Program*

The program launched by ICICI, for budding entrepreneurs, is an initiative of the bank to promote innovation and entrepreneurship amongst the youth community in India. The ICICI Trinity programme comprises of 3 stages – Ideate, Prototype and Be an Entrepreneur. This program has been launched in several top institutes across the country, with IITD being one of them. The program's second edition was launched in the year 2012-2013.

- *POSOCO Power System Award (PPSA)-2014*

The Power System Operation Corporation, a wholly owned subsidiary of Power Grid Corporation of India Ltd., launched these awards, in the form of cash prizes, to recognise the outstanding contribution made in the field of power systems and its related fields. The collaboration with FITT encompasses the IITs and NITs in order to motivate individuals and encourage further research activities in the area of power system.

- *MoU with the American Society for Quality*

An MoU was signed with ASQ, with the main agenda of advancement of new knowledge and practices for the benefit of IIT Delhi community in engineering and management sciences as well as to benefit executives working in the industries and Government through continuing education.

ASQ is a global knowledge network that links the best ideas, tools, and experts together, and offers globally accepted individual certification in programs such as six sigma, TQM, process management, etc. This MoU however, until now has not led to any major advantages and does not come across as one of the successful initiatives of FITT.

- *Frost & Sullivan's Technology Partnership Program*

Under this program, IIT Delhi had subscribed to the program wherein it had access to the Frost & Sullivan's portal thereby getting useful market, technology and econometric information along with the latest updates on technology trends across a broad range of industry sectors. However, this program has not been continued due to lack of a positive outcome in the short time since its inception.

F. Government Schemes

The foundation is actively involved in the facilitation of all technology based government schemes. It also provides for background checks on government technology development projects. Some of the prominent government schemes that are facilitated by FITT are:

- *N-WISE*

The National Information System for Science and Technology (NISSAT–DSIR) Window to Information Services to Entrepreneurs was initiated in 2001-2002.

- *Technopreneur Promotion Program (TePP) by DSIR*

FITT is a partner in this program initiated by DSIR, wherein financial support of up to Rs 1.5 / 4.5 million is provided by DSIR and technical support & mentoring for the development of an idea or a project is provided by FITT.

- *Entrepreneurial and Managerial Development of SMEs through Incubators, MSME:*

This scheme was started for the promotion of knowledge/technology based innovative ventures, in all fields of science and technology, through a financial support of upto Rs. 0.63 million.

- *PRISM (Promoting Innovation in Individuals, Start-ups and MSMEs):*

The main aim of this program is to provide support to the proof of concept/prototype/models up to Rs. 0.2 million and Fabrication of Working Model/Process know-how/Testing & Trial/ Patenting/Technology Transfer up to Rs. 2.0/5.0 million. This program promotes the development of technologies that are needed in the market and the transfer of IP of such developed technologies, which is where a major gap lies, mainly due to the lack of funds by start-up firms. The push provided by this program encourages the development and transfer of a useful technology for which could otherwise be shelved only due to lack of resources.

- *DIT-TIDE*

The Department of Information Technology has introduced Technology Incubation and Development of Entrepreneurs (TIDE) for providing seed support in the broad area of IT development. FITT has offered support and partnered for promoting this scheme which provides incubators during early stages of the development of various It and ITES enabled firms.

- *FITT as a BIG partner*

FITT has been selected as one of the three BIG (Biotech Ignition Grant) in the novel scheme initiated by Biotechnology Industry Research Assistance Council (BIRAC). BIRAC is a one of a kind organisation, which has been set up with the sole aim of strengthening and empowering the innovation research capacities of the biotech entrepreneur by providing an enabling ecosystem. It was set up in the year 2012, as a section 25 company with the aim of functioning as an industry academia interface. The BIG scheme aims at supporting start-ups and scientist entrepreneurs from research and educational institutions for the commercialisation of technologies resulting from research. An early stage grant is provided for the development of an invention into a marketable product. This is a one of a kind scheme, which aims at establishing and validating proof of concept ideas and thereby enabling spin-offs, is now gaining pace.

CONCLUSION

It has been more than two decades since the establishment of FITT. With the enormous amount of capital invested and innumerable programs initiated (some successful, some not so successful), the glaring question as to the effectiveness of the establishment of such an organization stares at our faces. Has it actually been able to justify the notion conceived by the board of directors who decided to set it up? Has the organization made good use of the funds and the responsibilities entrusted to it by the government? It sure has. Although a definite answer to these might not be possible, since the entire organization is still progressing, and might we say by leaps and bounds!

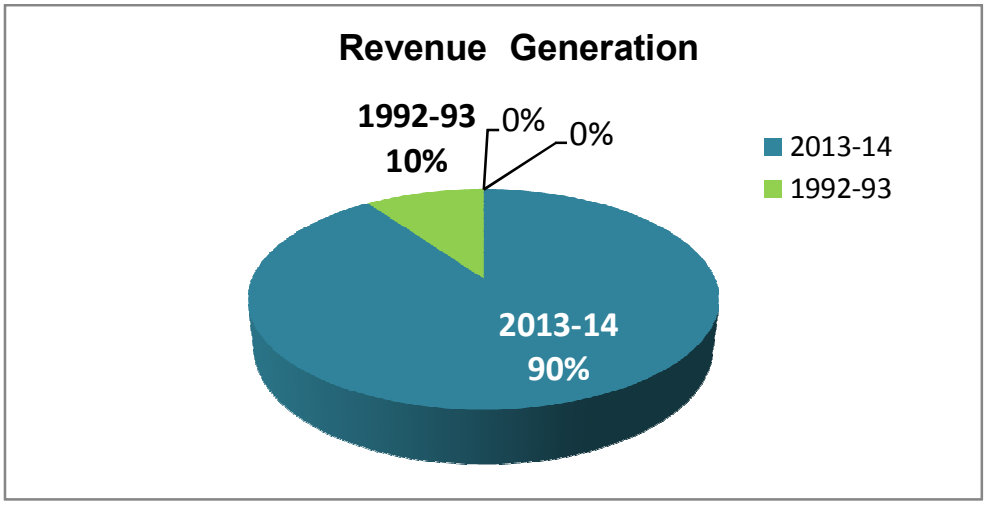

Fig. 4: Revenue Generation by IIT Delhi, before (1992-1993) and after (2013-104) the establishment of FITT.

The main aim of the creation of this organization was to cater to industry needs, bridge the looming gap between industry and academia, and facilitate generation of IP & consequent transfer and commercialization of indigenous technologies developed at the institute. Without doubt, there has been enormous growth with respect to IP generation and tech transfer (and in the process FITT becoming more than self-sufficient financially). In the past decade, FITT has generated huge revenue (Fig. 4) by technology transfer, projects initiated and royalty of the transferred technology. To exemplify, in the year 201-2014, FITT generated resources worth Rs 17.02/- million, of which Rs. 8.26/- million has been by funds transfer only (Fig. 5). This clearly shows that if executed well, there is a market for transfer of IP and the industry (who is otherwise blamed as to not being too keen on interacting with the academia) is indeed ready to put a foot forward in the direction of bridging the gap. As of date, more than 250 companies worldwide have benefited from the programs of FITT. This number speaks volumes not only about the success of the organization but also about the way in which the industry is ready to collaborate with the academia.

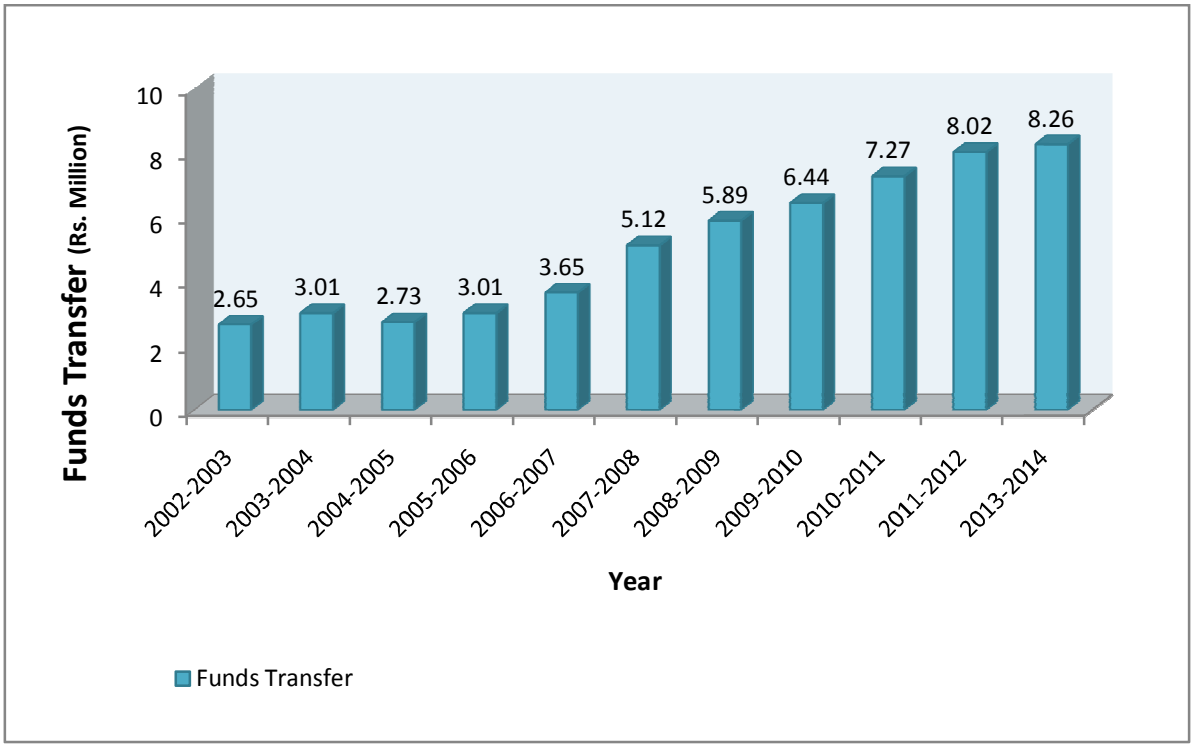

Fig. 5: Value of funds generated by technology transfer.

It is indeed sad to see that as of date less than 1% of the country's GDP is invested into research and development activities (STIP, 2013) as compared to other developing nations which invest way more. Of course, the 'IIT brand' has clearly helped in the evolution of this successful model. But one persisting question remains that why has this model not yet been developed at a national level? It is not just the figures on paper that are impressive, but the results in actual which have made us wonder at the apprehension of the government or institutes to develop on such guidelines and walk down a similar road. If at least one university / institute in each region of the country adopt this approach, we cannot even fathom the advantages it might provide, not only in financial terms, but by way of promoting the development of indigenous technology, creating entrepreneurial spirit and thereby boosting the Indian economy. The road to success of such a concept might be bumpy, but there sure is light at the end of it!

ACKNOWLEDGEMENTS:

The authors are grateful to Department of Science and Technology, Ministry of Science and Technology, Government of India, for financial support. The authors are indebted to Dr. Anil Wali (Managing Director, FITT) and Mr. P. Somarajan (Executive Consultant, Business Development, FITT) for their support and guidance throughout the case study.

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Conclusions derived from the Case Study on FITT -

(i) The inception of FITT at IIT Delhi has added commercial value to the academic knowledge and has promoted the intellectual and infrastructural facilities of IIT- Delhi.

(ii) It has invigorated the environment for Innovation by constituting *Entrepreneur Incubation Facility* and thus, encouraging entrepreneurs to commercialize their ideas.

(iii) The Center has also reduced the burden of faculty by taking charge of commercial aspects of transferring technologies developed by the students under the guidance of the faculty.

(iv) FITT provides for the Corporates by acting as the interim 'single window' for accessing IIT-D science & technology. It facilitates the commercialization of IP generated by IIT-D by regularly interacting with the Industrial sector.

(v) As evident from our study FITT has also developed Entrepreneur Incubation facility and as a result many spin off ventures has emerged which has effectively motivated job seekers to become job creators by becoming successful entrepreneurs.

Key recommendations from the Case Study on FITT:

- The creation of interfaces between Academia and Industry can provide the much needed bridge through which the Academia and Industry can interact in an organized and fruitful manner. Such activities need to be replicated in all the Research and Academic Institutions of our country.
- It is suggested that such Centers should be set up in the vicinity of selective Institutes that are doing commendable research.
- The DST- sponsored State Councils for Science & Technology should set up such centers on the pattern of FITT.

- The UGC should lay equal emphasis on the research publications as well as IPR generation. The condition for research publications for the award of Ph.D degree should be relaxed if the research work is patentable.

Annexure XII

Minutes of the meeting

Held on Thursday, December 18, 2014,

Venue: ICSSR Complex, Panjab University, Chandigarh.

Roundtable Discussion on Bridging the Industry- Academia Gap in the IT sector

A Round Table Meet to address the gap between the Industry and Academia in the IT sector was hosted by Panjab University. The Meet was jointly organized by DST- Centre for Policy Research at Panjab University and British Deputy High Commission Chandigarh.

The Meet was presided over by PU Vice-Chancellor, Prof. Arun K. Grover, British Deputy High Commissioner Chandigarh, Mr. David Lelliot OBE, Dr. Akhilesh Mishra, Sr. Scientist, DST, New Delhi, GoI. The Meet was attended by Director/ Senior Officials of Engineering Institutes situated in and around Chandigarh and representatives of the IT industry (Complete list of participants is attached at the end of the document).

The opening talk was given by Prof. Rupinder Tewari, Co-ordinator, DST- Centre for Policy Research at Panjab University. He spoke about the importance of Industry to the Academia and vice versa. He said that the point to be addressed in this Meet is that despite this fact being known to everyone why does the gap still exist. He stressed on the need for such Meets so as to understand the hitches and to then reach at concrete results. He mentioned about the existing Industry - Academia linkages which are prevalent only among a few countable institutes and industries and also suggested that the universities can act as a helping hand as the R&D in the industry is limited.

Panjab University Vice chancellor, Prof. Arun K. Grover, in his welcome address stressed on the fact that innovation is the need of the hour for which strong Industry-Academia collaboration is imperative. He repeatedly emphasized the need for in-house innovation for sustainable growth of national economy in order to compete at the international level. Laying stress on collaborations he brought up the Chandigarh Region Innovation and Knowledge Cluster (CRIKC), an academic council which is now moving ahead to collaborate with the Industry.

British Deputy High Commissioner ChandigarhMr. David Lelliot OBE while appreciating the efforts made by PU, remarked that such Meets would give them a better understanding of the issues involved and hence develop solutions taking into account the UK experience.

Dr. Akhilesh Mishra in his address to the audience brought forward the difference in the GDP spending towards R&D in developed and developing countries. He emphasized on the need to translate university research into commercial products that would generate wealth for the country. He quoted "Private sector will need to play a defining role for fostering sustainable and inclusive growth of the country." He also said that it is imperative to integrate academic R&D as intellectual inputs into the private sector for improving the standing of our nation.

The moderator Mr. D.N.V. Kumara Guru, in setting the theme of the Meet mentioned the following points:

- Taking into account the hike in the University enrolments in the past decade, there is an urgent need to communicate, interact and adapt better to overcome the disconnect that we face today.
- Curriculum needs modification according to the newer modules of the Industry.

SESSION I

The speakers of this session were

1. Mr. Ajay Davessar, VP & Global Head Corporate Communications, HCL Technologies
2. Mr. H.S. Bawa, Industrial Co-ordinator, Center for Industrial Liasion & Placement (CILP), Thapar University.

Mr. Davessar brought forward the industry perspective and talked about the sort of skills that the industry needs. In his talk, he urged the academicians to sit with the teams of the industry to jointly solve a customer agenda. The fact that the Industry today is super specializing to meet the global competitiveness adds to its existing need for researchers and manpower was also discussed by him. He invited the scientists from in and around Chandigarh to HCL, to solve problems and to add value to the industry.

Mr. Bawa threw light on the existing Industry-Academia collaborations of Thapar University and the success that has been achieved till date. He mentioned that these steps can be taken by all the Institutes to enhance their linkages with the Industrial sector. He advised that like their Institute, all Institutes should meet the Industry regularly to understand the needs and hence include a few industry specific modules to their existing curricula. He also suggested that a Feedback from the Industry is important after Campus Recruitments to know interpret and know the shortcomings. These courses and skills can then be taught by an Industry official.

Panel discussion: The following points were discussed:

- If the talent supply chain breaks the Industry will choke.
- The Industry is bound by time and hour and therefore substantial incentives (not necessarily financial) should be offered to them by the respective Academic Institute.
- The Industries should be encouraged to set up labs at the Academic Institutes.
- The industry officials should take a few classes in the online mode.
- The faculty should also go for regular training schedules and sabbaticals in the Industry.
- Incubation Centers that focus on Industry oriented research should be set up at Institutes.

SESSION II

The speakers of this session were

1. Mr. Pankaj Bharti, Senior Associate Consultant, Infosys Ltd., Chandigarh
2. Prof. B.B. Singh, Chief Scientific Advisor (Industrial and Scientific Organizations), Member of R&D Business Cell, BHU and Chairman of Innovation Committee IIT BHU.

Mr. Pankaj Bharti said that the academic system of our country is overly focused on curriculum which is obsolete in the Industry. He spoke about the changes that take place in the technological environment in the time period a student completes the term of degree. He suggested for adopting the case study approach for teaching which can be devised collaboratively by the Industry and Academia. He advocated that learnability should be the key skill in graduates.

Profr. B.B. Singh articulated that the management of knowledge is essential and conclusive results can only be achieved if both the parties recognize each other's strengths and constraints.

He emphasized on how fundamental research is the forte of Academia and that the applied Industrial research is based on the former. He stressed on the need to work for profit with purpose.

Panel discussion: The following points were discussed:

- The "White Paper on Stimulation of Investment of Private Sector into Research and Development in India" was discussed.
- Emphasis was laid on taking benefit of the incentives given by the Govt. of India (GoI).
- Stress was laid on the capability of Small and Medium-sized Enterprises (SMEs) to train and hire a large number of manpower.
- Lateral transfer of credit points for a multidisciplinary study approach and verticalization of courses (mainstream course + minor specialization course) is required.
- Introduction of Industrial Research Fellowships for students wherein the research problem will be designed synergistically by the Industry and Academia.

SESSION III

The speakers of this session were

1. Dr. Sameer Goel, Past Chairman CII Chandigarh Council and Practice Manager, Infosys, Chandigarh.
2. Dr. Sudhakar Sagi, Aston University, U.K
3. Mr. Amit Sinha, Association of Colleges (AoC), U.K
4. Mr. Pratap K. Aggarwal, M.D IDS Infotech, Chandigarh
5. Prof. R.M.K. Sinha, Jaypee University of Information Technology, Solan

Dr. Sameer Goel expressed the need for linkages within Institutes and Industries at all levels. He said that the SMEs constitute that part of the Industry which can focus on various interdisciplinary agendas hence increasing the scope for Academic collaborations. He stated that the most effective collaborations would stem from closer faculty - industry interaction. He proposed that the IT Industry as a consortium can float projects on (i) Estimation Techniques (ii)

Productivity Measurements, to a combined academic network for problem solving and thus enabling them to work together in continuity.

Dr. Sagi who is on a sabbatical working on a technology development program compared the skill gap scenario in India and U.K. In line with the trend in U.K, he suggested post placement incentives by way of regular training for sustainable and scalable growth. He voiced about the need for a board constituting of Institute and Industry professionals to make the students industry ready (program designed and funded by industries).

Mr. Amit Sinha referred to the continuous improvement in the skills ecosystem of developed countries. He advocated the development of core knowledge group consisting of officials of Industry, Govt. and Academia to revise the modules of the universities and regularly update the curriculum.

Mr. Aggarwal repeatedly stressed on the empanelment of experts both in the Boards of Industry and Academia. He also emphasized on developing process based collaborations.

Prof. R.M.K. Sinha expressed his opinions about the fact that the credit based system cannot be changed instantly and that the Industry needs to be a little more patient. On the other hand he also emphasized that it is important to develop graduates with the ability to learn and adapt to the changing ecosystem of the industry. An immediate measure that can be taken in this regard would be the joint evaluation of grades. He suggested the following points:

- Active participation in Interactive Academic Audit process
- Active participation in curriculum design
- Real life problems should be given to students.
- Adjunct faculty from Industry
- Design Challenges should be given to the Faculty by the Industry and Incentivize them (patents/ IPR/ royalty)
- Defining parameters for placing students so that the courses can be channelized.

Panel discussion: The following points were discussed:

- The most important links of the Institute are the Alumni and that they should be tapped.
- Changes should initiate at a grass root level therefore it is necessary to include the Policy makers (school level) in such discussions.
- Regular interaction of the faculty and students with Entrepreneurs (especially Alumni) should be initiated.
- Setting up of Incubation Centers at the campus of Institutes to promote Entrepreneurship.
- Interaction of the students with the Industry should start at an early stage as compared to the existing system.

The session was wrapped up with the following key recommendations and a vote of thanks was given by Prof. MM Gupta, Co-coordinator, DST- Center for Policy Research at PU Chandigarh.

Key Recommendations of the Meet

- It is imperative to have people from the Industry on the Advisory board of Academic Institutes and vice versa.
- Feedback from the Industries (after Campus recruitments) should be taken into account and the shortcomings so observed should be fulfilled by lectures delivered by Industry experts.
- The Academic curriculum needs to be supplemented with the Industry modules. The Industries should present case studies to the Institutes to be included in classroom teaching. This would enable the students to perceive and work towards a real life problem.
- A system, enabling the entrepreneurs to regularly interact with the faculty and students should be developed.
- The Alumni network should be tapped for enhancing soft skills development, entrepreneurship and job opportunities.
- Academia should perceive Small and Medium Scale Enterprises (SME's) on equal footing since they have the capacity to train and hire a large number of manpower.
- The heads of the Academic / Research Institutes should encourage the young faculty/ researchers to go on short sabbaticals in the industry.

- Industries having collaborations with the Institute such as Guest faculty/ Adjunct faculty or organize workshops *etc*. should be given first preference while hiring students.
- The Industry should be encouraged to set up research facilities on the Campus Institutes and offer research fellowships to the students.
- The private sector should look at Higher education as an investment/ Corporate Social Responsibility. They should take advantage of tax incentives that are being offered by the Government.
- A core knowledge group comprising of officials of Industry, Govt. and the Academia should be formed for devising modules for updating technological advancements and setting up of Knowledge Centers.
- The Academic sector should seek the help of CII, FICCI, ASSOCHAM*etc.*to enhance the links between Industry and Academia by facilitating joint research projects and workshops.

LIST OF PARTICIPANTS

INDUSTRY

S.No.	Name	Designation	Organisation
1.	Mr. Abhishek Puri	Deputy Director Northern Region Headquarters	CII, Chd.
2.	Mr. Ajay Davessar	VP & Global Head – Corporate Communications	HCL, Noida
3.	Ms. Anitha Shashi	Chief Training Officer	Netsmartz, Chd.
4.	Mr. Harshvir Singh	CEO	Drish Infotech Ltd., Chd
5.	Mr. Munish Jauhar	CEO/ Founder	Gray Cell Technologies Exports, Chd.
6.	Mr. Pankaj Bharti	Sr. Associate Consultant	Infosys, Chd.
7.	Mr. Partap K. Aggarwal	Managing Director	IDS Infotech Ltd., Mohali
8.	Dr. Sameer Goel	Past Chairman, CII Chandigarh Council & Practice Manager, Infosys	CII / Infosys
9.	Mr. Sameer Jain	CEO	Net Solutions, Chd.

INSTITUTES

S.No.	Name	Designation	Organisation
1.	Mr. Amit Sinha	Program Head (India)	Association of Colleges, UK – India Business Council
2.	Prof. B.B. Singh	Chief Scientific Advisor (Industrial and Scientific Organizations)	IIT-BHU, Varanasi
3.	Mr. D.N.V. Kumaara Guru	Director, External Relations	ISB, Mohali
4.	Mr. H.S. Bawa	Industrial Coordinator	Thapar University, Patiala
5.	Prof. Manoj Arora	Director	PEC University of Technology,Chd.
6.	Prof. R.M.K. Sinha	Dean, CSE & IT	Jaypee University of Information Technology, Solan
7.	Prof. Rajender Guleria	School of Management Studies	Baddi University of Emerging Sciences and Technology, Baddi
8.	Dr. Ajay Goel	Dean, International Relations	Baddi University of Emerging Sciences and Technology, Baddi
9.	Prof. Renu Vig	Director	UIET, P.U, Chd.
10.	Dr. Sudhakar Sagi	Research Associate	Aston University, U.K

Others:

1. Prof. Arun K. Grover, Vice-Chancellor, Panjab University, Chandigarh
2. Mr. David Lelliot OBE, British Deputy High Commissioner Chandigarh
3. Dr. Akhilesh Mishra, Senior Scientist , DST, New Delhi, GoI
4. Prof. Rupinder Tewari, Coordinator, DST- Centre for Policy Research at PU, Chd.
5. Prof. M.M. Gupta Co-coordinator, DST- Centre for Policy Researchat PU, Chd.
6. Mr. Charanjiv Bachhar, DHM, British Deputy High Commission Chandigarh
7. Ms. Shivani Sharma, British Deputy High Commission Chandigarh
8. Dr. Ajit Singh, DST-CPR at P.U
9. Dr. Surender Kumar, DST-CPR at P.U
10. Dr. Mansimran Khokhar, DST-CPR at P.U
11. Ms. Neha Batta, DST-CPR at P.U

Annexure XIII

Minutes of the Meet

Popularization of Research Fellowship Schemes of Govt. of India

Held on Tuesday, March 24, 2015,

Venue: Seminar Hall, CIL Building, Panjab University, Chandigarh.

Sponsored by: DST - CPR at Panjab University, Chandigarh.

Speakers for Session I (Inaugural Session):

1. Prof. Arun K. Grover, Vice Chancellor, Panjab University, Chandigarh.
2. Prof. Rakesh Tuli, Former Director, NABI, Mohali, Punjab
3. Dr. S.S. Kohli, Advisor, DST (GoI, New Delhi)
4. Dr Meenakshi Munshi, Director, DBT (GoI, New Delhi)
5. Ms. Shalini Sharma, Head Higher Education (CII, New Delhi)
6. Prof. Rupinder Tewari, Coordinator, DST-Centre for Policy Research at P.U., Chd.

Speakers for Session II (Talks by Recipients of Research Fellowship Schemes):

1. Ms. Babita Mukhija (PM Fellow), Deptt. of Plant Breeding & Genetics, Punjab Agricultural University (PAU), Ludhiana, Punjab
   Academic Mentor: Dr. Veena Khanna, Deptt. of Plant Breeding & Genetics, Punjab Agricultural University (PAU), Ludhiana, Punjab
   Industry Mentor: Mr. Sanjeev Nagpal, Director, Sampurn Agri Ventures Pvt. Ltd., Chandigarh

2. Mr. Venkatesh Vinayakarao (PM Fellow), Deptt. of Computer Science, Indraprastha Institute of Information Technology (IIIT), New Delhi

Academic Mentor: Dr. Rahul Purandare, Deptt. of Computer Science, Indraprastha Institute of Information Technology (IIIT), New Delhi

3. Dr. Jyoti Agarwal (DST-INSPIRE Faculty), Deptt. of Chemistry, Panjab University, Chandigarh
4. Dr. Nishima (DST-INSPIRE Faculty), Centre for Nanoscience & Nanotechnology, Panjab University, Chandigarh
5. Dr. Amit Tuli (Ramanujan Fellow), Sr. Scientist, CSIR-Institute of Microbial Technology (IMTECH), Chandigarh
6. Dr. K. P. Singh (Ramanujan Fellow), Indian Institute of Science Education and Research (IISER), SAS Nagar (Mohali), Punjab
7. Dr. Samer Singh (Ramalingaswami Fellow), Deptt. of Microbial Biotechnology, Panjab University, Chandigarh
8. Dr. Deepak Kumar Sharma (Ramalingaswami Fellow), Sr. Scientist, CSIR-Institute of Microbial Technology, Chandigarh

Speakers for Session III (Enhancing Industry Academia Collaborations):

1. Dr. Anil Pareek, President, Medical Affairs & Clinical Research, Ipca Laboratories Ltd., Mumbai
2. Mr. Raju Goteti, Advisor, Co-Innovation Network, Tata Consultancy Services, Mumbai
3. Mr. Dinesh Sharma, General Manager, Fresenius Kabi Oncology, Baddi, HP
4. Dr. Rajesh Sehgal, Director, PharmaInstinct, Chandigarh
5. Dr. Manoj Manuja, Principal – Education and Research, Infosys, Chandigarh
6. Mr. P.J. Singh, Managing Director, Tynor Orthotic (P) Ltd., Mohali

Session I: Inaugural Session

In the opening address, **Prof. Arun K. Grover, Vice Chancellor, Panjab University, Chandigarh,** welcomed all the senior dignitaries, the industry representatives, faculty and students. He emphasized the importance of the day, by describing it as a day that brought forth the efforts that have been made by the Govt. of India in the field of Scientific Research in the past decade or so. He remarked that with the commencement of the Research Fellowships by the GoI, Indian researchers settled abroad have an

opportunity to come back to their home country and establish their research careers. He applauded and laid stress on the relevance of the Meet as the participants from Government sector, Industry and the Academia were present at a single platform. He mentioned that the Event was held to showcase the benefits that have been reaped by the recipients of various Fellowship Programmes of the DST, GoI, New Delhi and DBT, GoI, New Delhi. He said that a few Fellowship schemes like the Prime Minister's Fellowship Scheme for Doctoral Research had not gained popularity in our region due to lack of awareness and aliveness both in the faculty and students. He further encouraged the students to take benefits of such schemes and promised to provide them a conducive environment for the same. In addition to highlighting the schemes he also spoke about the dedicated session on Industry-Academia Collaborations which was organized to know the Expectations of the Industries from the Govt. for the investment in R&D by the private sector.

Keynote Speaker, Prof. Rakesh Tuli, Former Director, NABI (DBT branch, SAS Nagar, Mohali, Pb) commented on the need for Innovation to drive the economy of the nation. He said that we need to train our minds to keep thinking innovatively if we desire sustainable growth and therefore periodic interactions with the key stakeholders are necessary. He emphasized on working in teams for obtaining better results, risk sharing and also said that the solutions for major problems are found across various disciplines. While citing the Science, Technology and Innovation Policy (STIP) 2013 he stressed on Industry driven research in the Academic Institutes.

Dr. S.S. Kohli, Scientist G/ Advisor, DST (GoI, New Delhi) spoke about the various Research Fellowship Schemes that have been started by DST and discussed that each of the Fellowships have their own objectives. He initiated by discussing PM Fellowship for Doctoral Research which is open for students of Indian origin only who have been registered and plan to work on a problem that is Industry oriented. He also mentioned the criterion that needs to be fulfilled by the Industrial partner of the PM Fellowship Scheme. While highlighting the benefits of this Fellowship he aforementioned the recognition gained by the Fellow, host Institute and the partner Industry. Along with the financial support, PM Fellowship provides the research scholar with the experience to work in two different research environments i.e. Academic and Industrial. This scheme also caters to the need of the Industry for a dedicated researcher working on a specific problem of their interest. Moving on to the Ramanujan Fellowship started by DST to commence reverse brain drain, he remarked that such Fellowships provide opportunity to the Indians settled abroad for returning to India. This Fellowship is open for researchers of all disciplines who are settled abroad and provides them with a secure time period till they get permanent positions. He also apprised the audience about other Fellowships such as JC Bose Fellowship, SERB Overseas Postdoctoral Fellowship, Jawaharlal Nehru Science Fellowship *etc*.

He remarked that all these Fellowships are for capacity building of the nation and that the modules of these are modified regularly based on the feedback.

Dr. Meenakshi Munshi, Director, DBT (GoI, New Delhi) talked about Ramalingaswami Fellowship started by DBT, which is open only in Life Sciences. This scheme also commenced for reverse brain drain is open only for researchers working abroad and wish to come back to India. She also made the gathering aware of other Fellowships like the Tata Innovation Fellowship which is for the faculty members who have a permanent position, Wellcome Trust, DBT Postdoctoral Fellowships *etc*. Dr Munshi encouraged young researchers to regularly surf DBT website for new schemes offered by this organization.

Ms. Shalini Sharma, Head - Higher Education, CII, New Delhi represented the Industrial sector and mentioned the importance of Industry backed research. The Govt. has partnered with CII to promote and implement the PM Fellowship Scheme which was launched in the Public-Private Partnership (PPP) mode. While discussing about the scheme she said that its aim was to place the student in two different kinds of research environments - Industry and Academic. Among other things the student gets recognition and a good financial support. The Industry gets a dedicated researcher who works on their project for 4 years and then can be employed. Thus highlighting the repute of the scheme she urged the faculty and students in the audience to take the benefits of such schemes.

Session II: Talks by Recipients of Research Fellowship Schemes

This session saw the recipients of various Fellowships of the Govt. showcasing their work and talking about the perks of their respective Fellowships.

1. **Ms. Babita Mukhija (PM Fellow)** gave a presentation titled "Characterization of native *Bacillusthuringiensis*isolates against *Mylabrispustulata* Thunberg inPigeonpea and optimization of bioprocess parameters". She expressed her gratitude towards the Fellowship programme as it gave her immense experience and recognition.

   The Academic Mentor of the Fellow, Dr. Veena Khanna said that as a mentor it is imperative to design a concept that would be beneficial to the Institute and is of interest to the Industry as well.

The Industry Mentor, Mr. Sanjeev Nagpal, Sampurn Agri Ventures Pvt. Ltd., remarked that the Academia has great potential to solve the problems of the Industry and interactions between the two can result in fruitful arrangements which may be relevant to the country.

2. **Mr. Venkatesh Vinayakarao (PM Fellow)**presented his work titled "Structurally heterogeneous source code examples from unstructured knowledge sources". He voiced his pleasure at being a recipient of the Fellowship programme which gave him a security for four years with attractive stipend and collaborative research work. He said that even though there are a few challenges that are faced by the Fellows such as finding an Industry expert, allowance for travel abroad *etc.* this scheme provides an ideal setting for high-end research.

   The Academic Mentor, Dr. Rahul Purandare said that this scheme gives freedom to the Fellow and setting up of milestones by the Industry continuously encourages the Fellow to perform competently.

3. **Dr. Jyoti Aggarwal (DST-Inspire Faculty)**presented her work titled "Novel cascade reactions for asymmetric synthesis of highly functionalized N-heterocycles". She said that this scheme provided with a good platform and freedom to work independently. She suggested that the contingent grant of the Fellowship should be more for the initial two years to allow purchases of equipments and instruments.

4. **Dr. Nishima (DST-Inspire Faculty)** presented her work on "Gold nanoparticle based detection of pesticides in food and water". She suggested that there should be a web portal facilitating the interaction of all the INSPIRE faculties.

5. **Dr. AmitTuli (Ramanujan Fellow)** also presented his work "Regulation of cellular trafficking of lysosomes and lysosome-related organelles". He remarked that the Fellowship has helped him realize his dream of having his own laboratory in India so that he could engage his research skills for the benefit of the country. Security of five years,

opportunity to apply for permanent positions, recognition and flexibility in spending of funds were the other perks of the Ramanujan Fellowship mentioned by him.

6. **Dr. K.P. Singh (Ramanujan Fellow)**along with presenting his work on "Unravelling unique optical and mechanical properties of the spider silk", spoke about the independence and numerous opportunities provided by the Ramanujan Fellowship. He suggested that a hike in the Instrumentation Grant would be of great help to the Fellows availing this Fellowship.

7. **Dr. Samer Singh (Ramalingaswami Fellow)** described his journey through post graduation, doctoral and post doctoral research and how this Fellowship helped him settle back in India. He suggested that Universities should have dedicated Cells for disseminating correct information to the Ramalingaswami Fellows and therefore offer clarity of rules and regulations. He presented his work titled "Combination therapy for non-small cell lung carcinoma (NSCLC): targeting cancer stem cells (CSC) and bulk tumor cell population together". Dr. Singh volunteered to create a 'web portal' for facilitating interaction between the recipients of the Ramalingaswami Fellowship.

8. **Dr. Deepak K. Sharma (Ramalingaswami Fellow)** lauded the Fellowship programme as the Host Institute where the Fellow works is under no obligation to hire the researcher. He said that the Govt. agencies are prompt to the problems of the recipients and offer solutions within short span of time. He presented his work on "Molecular mechanism underlying roles of Hsp70 chaperones in α-synuclein mediated cytotoxicity".

Session III: Enhancing Industry Academia Collaborations

This session saw the Industry Representatives deliberating on the theme "Expectations of Industries from the Government, for their Investments in R&D of Public Sector".

1. **Dr. Anil Pareek**spoke on "Leveraging Innovation: Industry Academia Collaboration A Way Forward" He said-

(i) Indian Pharma market is largely generic in nature and Drug Discovery is not a viable option for most of the Indian Pharmaceutical companies due to the high cost involved. However, there is dire need for innovative research in Pvt. as well as public sector under PPP mode.

(ii) Industry-Academia collaborations are possible and beneficial in India. Both partners will get recognition, enhanced esteem.

(iii) Collaborative research can yield better solutions at lesser cost. The Industry-Academia collaborations can enhance the funding and access to industry resources, knowledge and contacts of academic Institutes and on the other hand the Industry will gain access to researchers and novel thinkers.

(iv) He then said that the Govt. labs should approach industries to perform research that will be useful for the country and also that Govt. organizations should take up studies to back Industrial research.

2. **Mr. Raju Goteti** said –

(i) PPP mode of research is good for the nation and is being effectively followed in many developed countries. However, in India this mode has not taken off the ground, barring a few Institutes like IITs. There are apprehensions in the minds of the scientists of public funded Institutes as well Industrial functionaries, for collaborative research. The differences amongst school of thoughts of the Govt., Academia and the Industry need to be met mid way.

(ii) Government should cover the cost of genuine-failures of collaborative research.

(3) **Mr. Dinesh Sharma** said-

(i) The cost involved in the PPP research should be made part of Corporate Social Responsibility budget of the private sector.

(ii) Special concession should be provided by the Govt. for setting up Incubating Centres in Institutes

(4) **Dr. Manoj Manuja** said –

(i) Mind set of Scientists working in Universities is to publish their research findings. There is less emphasis on generating Patents and Technology Transfer.

(ii) The University Faculty is not aware of the steps involved in translating laboratory research in to commercial product. Handshaking with industry is the need of the hour, for the universities.

(5) **Dr. Rajesh Sehgal** said –

(i) To encourage PPP mode of Research, Govt. should provide special benefits (taxes, subsidies, etc.) at all stages, starting from laboratory research, scale up studies, pilot plant studies, and manufacturing the product coming out of PPP mode of research.

(6) **Mr. P.J. Singh** said –

(i) For PPP mode of research to flourish in India, all segments of Industry i.e. Small scale, Medium scale and Large scale, should be given equal importance.

Key Recommendations of the Meet

1. Over 150 people, primarily Research Scholars and young Faculty members from Panjab University, Chandigarh, and a few from Guru Nanak Dev University, Amritsar (Pb), Central University, Bhatinda (Pb), Chitkara University (Baddi, H.P), Lovely Professional university, Jallandhar (Pb), National Institute of Pharmaceutical and Education Research, NIPER- Mohali (Pb), IISER-Mohali (Pb), IMTECH (CSIR Branch) Chandigarh, PAU, Ludhiana (Pb) attended the event.

2. Senior officials from DST (GOI) New Delhi, DBT (GOI) New Delhi and Panjab University, Chandigarh highlighted various research fellowship programmes (DST INSPIRE, PM-Fellowship, Ramanujan, Ramalingaswami *etc*.). The audience appreciated the programme and representatives from various universities expressed desire to convene such programmes at their respective Institutes.

3. The Contingent grant of the Fellowships should be re-appropriated. In the first two years, more grants should be released to buy equipments and consumables. The grant for the subsequent years should be for purchase of consumables only.

4. Dr. Samer Singh would create a 'web portal' facilitating interaction amongst the Ramalingaswami Fellows, under the guidance of Dr. Meenakshi Munshi (Director, DBT, GoI, New Delhi).

5. During the Industry-Academia session, industry representatives laid emphasis on carrying out research in PPP mode and made various suggestions, as to how this can be brought about. Suggestions which stood out were

    - The investments of R&D (of Pvt. Sector) done under PPP mode, should be considered as a part of Corporate Social Responsibility (CSR).
    - The cost of genuine failures in collaborative research should be borne by the Government.
    - Government should accord rebates to the Private sector for setting up Incubators at the Academic Institutes.
    - Land space for (a) R&D and (b) translational research leading to commercialization of the technology should be available at subsidized costs.

Annexure XIV

Evidence based Study for promising areas of Intellectual Property (IP) generation in Punjab and Chandigarh.

(Data Source: Inventory of Inventors Punjab and Chandigarh, PSCST, 2014)

The Patent Information Centre (PIC) of Punjab State Council for Science and Technology has come out with an exhaustive report titled "Inventory of Inventors, Punjab and Chandigarh." In this report the IPR generation pattern in Punjab and Chandigarh for the period January 2005 to February 2012 has been illustrated.

During the period of study a total of 260 patents were published from Punjab and 168 patents from Chandigarh. Out of the application from Punjab, 45% applications were from R&D institutions, 17% from industries and 38% from individuals. In the case of Chandigarh 55% applications were from the industry, 37% by individuals and 7% applications from Institutions (mainly from PGIMER and Panjab University, Chandigarh)

When we analyzed the sector wise patent application pattern from Punjab, the highest scoring sector is in engineering, physical and Chemical Sciences Sector with 40% share, next is the pharma sector with 18% Share, medical sector accounted for 10%, biotechnology and food technology sector contributed 8% each, 6% from environmental sciences and 10% misc. applications. In the case of Chandigarh Pharma sector contributed 57%, engineering sector was second with 30% and the remaining 13% was from other sectors.

The top five public institutions in Punjab in terms of patent filling are as follows:

1) National Institute for Pharmaceutical Education and Research (NIPER), Mohali.
2) Central Institute of Post harvest Engg. & Tech. (CIPHET), Ludhiana.
3) Punjabi University, Patiala.
4) Punjab Agricultural University (PAU), Ludhiana.
5) Thapar Institute of Engineering & Technology, Patiala.

In Punjab the higher patent filing by public R&D institutes reflects the positive role of the Government in promoting IP generation.

The top five Industries which filled the maximum patents in Punjab are as follows:

1) Nectar Life Sciences Ltd., Mohali.
2) Malwa Industries Ltd., Ludhiana.
3) Punjab Tractors Ltd., Mohali.
4) Cheema Boilers Ltd., Mohali
5) Max India Ltd., Roopnagar

In the case of Chandigarh the top public institutions are:

1. Institute for Microbial Technology (IMTECH)
2. Central Scientific Instruments Organisation (CSIO)
3. Panjab University (PU)
4. Post Graduate Institute of Medical Education and Research (PGIMER)

The Top five Industries from Chandigarh region are

1. M/s Ind Swift Pvt. Ltd.
2. Spray Engineering devices
3. Parabolic drugs
4. Venus Remedies Ltd.
5. Health Biotech Pvt. Ltd

Table 1: Sector wise breakup of patents in Punjab.

Sr. No	Type of Invention	Applications /Granted
1	**Pharmaceutical Inventions**	**47/ 9**
2	**Environmental Inventions**	**16/3**

3	**Biotechnology & Biological Inventions**	**22/6**
4	**Engineering, Physical & Chemical Sciences**	**109/32**
5	**Medical Inventions**	**26/3**
6	**Food Technology**	**22/2**
7	**Miscellaneous Inventions**	**26/9**
8	**Total**	**268/64**

Table 2: Top Five Public Institutes in Punjab

Sr . No	Institutions	Applications /Granted
1	**NIPER, Mohali**	**71/17**
2	**CIPHET, Ludhiana**	**16/0**
3	**Punjabi University, Patiala**	**8/1**
4	**PAU, Ludhiana**	**8/0**
5	**Thapar Institute of Engg. & Technology**	**5/1**

Table 3: Top five Industries in Punjab

Sr . No	Industry	Applications /Granted
1	Nectar Life Sciences Ltd., Mohali	4/0
2	Malwa Industries Ltd., Ludhiana	4/2
3	Punjab Tractors Ltd., Mohali	4/3
4	Cheema Boilers Ltd., Mohali	3/1
5	Max India Ltd., Roopnagar	3/3

The lower patent filing by industries may be attributed to the fact that SME enterprises dominates the State's Industrial sector and less focus is given on R&D by SMEs.

Table 4: Sector wise breakup of patents in Chandigarh

Sr. No	Type of Invention	Applications /Granted
1	Engineering Sector	50/12
2	Pharmaceutical Inventions	95/7
3	Environmental Inventions	1/0
4	Biotechnology Inventions	11/2
5	Medical Inventions	11/1
	Total	168/22

Table 5: Top industries in Chandigarh

Sr. No	Industry	Applications /Granted
1	M/s Ind Swift Pvt. Ltd.	63/2
2	Spray Engineering device	9/0
3	Parbolic drugs	8/0
4	Venus Remedies Ltd.	4/3
5	Health Biotech Pvt. Ltd.	2/0

Table 6: Top Public Institutes in Chandigarh

Sr . No	Industry	Applications/ Granted
1	Institute of Microbial Technology (IMTECH)	66*
2	Central Scientific Instrumentation Organisation (CSIO)	62*
3	Panjab University	9/2
4	Post Graduate Institute of Medical Education and Research (PGIMER)	2/0

Some salient observation from this study:

- Request for examination had not been filled from 13% applications from Punjab and 22% from Chandigarh indicating lack of awareness of patenting procedures. Therefore there is an urgent need for creating awareness and capacity building in the region.
- There is a need to build a proper eco-system to promote innovation in the region by approaching it from an organic and evolutionary perspective. In order to bring such changes the Government needs to provide financial and other support.
- The State needs to align its goals depending on the technological competence of the area and quality of business environment.
- Since the Government cannot provide all the financial resources on its own the promotion Industrial Activity, FDI, angel investors and venture capital funding

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