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

DST-Centre for Policy Research

at

Panjab University, Chandigarh

INDUSTRY **ACADEMIA**

Aruna Ranjit Chandra Hall, Panjab University,
Sector 14, Chandigarh 160014
http://cpr.puchd.ac.in/

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1.	**Prof. Arun K Grover**	Vice Chancellor, Panjab University, Chandigarh
2.	**Dr. Arbind Prasad**	Director General, FICCI, New Delhi
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11.	**Prof. Rupinder Tewari**	Coordinator, DST-CPR, PU, Chandigarh
12.	**Prof. M M Gupta**	Co-Coordinator, DST-CPR, PU, Chandigarh

Professor A.K. Grover
Vice Chancellor

PANJAB UNIVERSITY
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Message

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

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

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

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

(Arun K. Grover)

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PREAMBLE

In the 21st century, Science, Technology and Innovations are considered to be the key drivers of the economy and development of the nations. To achieve success in these parameters, it is imperative for any nation to have a serious re-look on its Research and Development (R&D) programmes being conducted in universities, national research laboratories and private sector.

For a large nation like India, high-end R&D programmes require huge amount of funds, running into thousands of crores of rupees. However, in India, only 1/3rd of R&D investments are contributed by the private sector and rest comes from the public sector. Government of India (GoI) has substantially increased its expenditure in higher education to give a boost to applied R&D, but expects public : private sector investments into R&D at levels of 1:1 by 2017. Apart from financial constraints, lack of linkage between academia and industry is hampering the conversion of applied research of academic sector into a commercial success.

In developed countries, there is a healthy symbiotic relationship between R&D of industries and university professors and is contributing greatly to the kitty of 'knowledge economy' of the nations. It's a win-win situation for both the parties. Unfortunately, in India, Industry-Academia (I-A) interactions are limited to IITs, and a few universities/govt. sponsored national research laboratories. The number of commercially successful technologies/innovations is not very encouraging, keeping in mind that India has (a) over 700 universities churning out annually, thousands of PhDs, in the area of applied sciences and (b) nearly 300 govt. sponsored research laboratories having thousands of scientists.

In the last decade or so, GoI has taken quite a few initiatives to promote (a) I-A interactions and (b) stimulate the culture of entrepreneurship amongst young minds studying in universities. Govt. has established many Knowledge Parks, Technology Parks, Incubation Centres and Entrepreneurship and Skill Development Centres in and around universities. Setting up of Technology

Information, Forecasting and Assessment Council (TIFAC), Biotechnology Industry Research Assistance Council (BIRAC) etc. has boosted in translating basic research of laboratories into technology transfer and setting up of Start-up companies. Though all these initiatives are a positive step in stimulating scientists to address the problems of industries, but a lot more has to be done to bring I-A environment to a level existing in developed countries. Asian countries like China, South Korea, Singapore and Taiwan, which were economically poor countries like India, a few decades ago, have also marched ahead and become economically strong nations and now considered as developed countries. The success of these countries is attributed to their modified policies in the areas of Higher Education and of Science and Technology, especially I-A interactions.

India has the potential to emulate these countries. It can even surpass them. It has all the elements needed for successful implementation of I-A programmes for the benefit of economy and societal at large. For this, all that is needed is the change in the mindset of academia and industrial sector. Currently, both are living in their separate worlds. Both, academics and industrialists are pursuing different goals. Industry thinks in terms of short range goals whereas the academia has a long range perspective. Industry prefers proven solutions with a low risk, whereas academia is interested in creating new solutions with a high innovation rate. Industry seeks minimum solution to minimize their risk, whereas academia strives for a maximum solution to maximize their recognition. Industry is mainly concerned with costs. Academia could care less about costs, it is mainly interested in publishing research papers and striving for recognition from his/her peers. An academician shows interest normally in problems that are intellectually challenging. His or her areas of interest lay in technology development initiatives and methods related to process and design improvement and not in developing the final product which is ready to be taken up by the industry as it require too much time. Industry's research

project are focused and time bound, whereas, academia prefers to work on projects which are intellectually challenging and do not desire to work in a particular time frame. The source of funding of academic research is primarily govt. funding agencies which are less stringent on the accountability part. On the other hand, industry is less keen on basic research and would fund only applied research projects and that too with lots of checks and balances, which academia is not primed for. Also, industry wants industry-ready work force from the universities, but is not forthcoming in sharing resources (financial as well as expertise) with the universities. Industry desires that professors/scientists should come out of their "tunnel vision" to publish their work. They should (a) place great importance and value on closer interaction with R&D of industrial sector, (b) attend industrial conferences and (c) should not look down upon industrial newspapers and magazines.

For the transfer of academia research into technology, it is imperative that universities and private sector work hand in hand. Though after liberalization of industrial policies in 1990s, there has been marginal improvement between education system and business and corporate productivity but these linkages are more ritualistic than real. Indian industry is myopically disengaged, if not wholly divorced from Indian academia.

GoI is aware of this situation and desires to bridge the gap between Academia and Industry. It has asked DST to frame policies for better synergy between academic and private sector. DST- Centre for Policy Research at Panjab University, Chandigarh has been entrusted with the responsibility to hold meetings with the industrial sector as well as Higher Education sector and come out with recommendations/policies which will promote I-A interactions that eventually will benefit the nation at large. This Centre came into existence in Jan 2014 and since then held meetings and brain storming sessions with university professors /scientists and industry personals. The recommendations are being regularly sent to DST, New Delhi for formulation of policies.

Objectives of DST-Centres for Policy Research

Centres	Objectives
PU, Chandigarh	• Development of a new country specific model for promotion of Public Private Partnership (PPP) for R&D • Identify areas of policy gaps for stimulation of private sector investment in R&D and suggest changes in policy environment • Adopt evidence-based approaches for identifying and promoting areas for generation of intellectual properties
BBAU, Lucknow	• Study of policies and mechanisms that could facilitate delivery of Science, Technology and Innovation (STI) outputs to diverse stakeholders including innovation for social inclusion, with special reference to: Sustainable agriculture, Healthcare, Energy, Water resource management and Climate governance
EDII, Ahmedabad	• To strengthen the policy research mechanism for providing evidence based planning approaches • Understand existing and ever changing ecosystem to promote and strengthen innovation driven S&T entrepreneurship • Scan international strategies to promote S&T based entrepreneurship and adapt them to the Indian conditions • Promoting STI driven entrepreneurship with viable and scalable business model
IIT, New Delhi	• Assessing the current landscape and status of the Indian Innovation System (IIS) • Devising policies and approaches to improve performance of IIS • Devising policies to leverage innovation to meet sustainability and inclusivity challenges, especially by enhancing access to basic needs and services and promoting environmental protection
IISc, Bengaluru	• To develop qualitative and quantitative measures that can be used by scientific groups, departments, institutions and even countries to assess their scientific output and compare themselves with their peers all over the world • To study the pattern of funding received by various Indian institutions and compare them with one another as well as with their peer institutions in other countries

EVENTS ORGANISED

- One-day meet on "**Expectation of Industrial Sector from Universities**" was held on 18th Feb, 2014 at PU, Chd.
- Round Table Meet on "**Bridging the Industry- Academia (I-A) Gap in the IT Sector**" was organised on 18th Dec, 2014 at ICSSR guest house, PU, Chd.
- Session on "**Industry Institute Interface and University Innovation Clusters**" was organized by DST-CPR at PU in the MICROCON 2015 (22-24th Jan, 2015) held at PU, Chd.
- Workshop for **"Popularization of Research Fellowship Schemes of Govt. of India"** on Tuesday 24th March, 2015 at PU, Chd.
- First **Meeting of the Advisory Committee**, DST-Centre for Policy Research at Panjab University was held on November 14th, 2015 at ICSSR Guest House, PU, Chd.
- Meet on **"Enhancing Industry- Academia (I-A) interface"** was held at ICSSR Guest House, PU, Chd. on 23rd February, 2016.
- **"Industry- Academia (I-A) Round Table Meet"** was held on 6th April, 2016 at Institute of Chemical Technology (ICT)- Mumbai (Deemed University).

GLIMPSES OF OUR ACTIVITIES

Expectation of Industrial Sector from Universities

(18th Feb, 2014)

Dr. Anil Wali (MD, FITT, IIT-Delhi), Prof. Arun K Grover (Vice-Chancellor, PU, Chd) and Mr. Anil Arora [Director (EPD), Abbot Healthcare Pvt. ltd., Mumbai] enjoying the inaugural session.

Faculty and students of various departments of Panjab University Chandigarh

Felicitation of Mr. Anil Arora by honorable Prof. Arun K Grover.

Felicitation of Dr. (Mrs.) Manu Chaudhary (MD, Venus Remedies Ltd., Panchkula) by honorable Prof. Arun K Grover.

Bridging the Industry - Academia Gap in the IT Sector

(18th Dec, 2014)

Mr. David Lelliot (OBE, British Deputy High Commissioner Chandigarh) addressing the audience. Prof. Tewari (Coordinator, DST-CPR, PU, Chd); Prof. Arun K Grover (Vice-Chancellor, PU, Chd) and Dr. Akhilesh Mishra (Senior Scientist, DST, New Delhi) are on the dias.

Mr. Ajay Davessar (Vice President and Global Head Corporate Communications, HCL Technologies, Noida, UP) putting forward the industry perspective on Industry-Academia linkages.

Dignitaries on the dias: Mr. Kumara Guru (Director, External Relations, ISB, Mohali), Prof. Arun K Grover, Mr. David Lelliot and Dr. Akhilesh Mishra.

Dr. Akhilesh Mishra sharing his views on the role of government in promoting Industry-Academia collaborations in India.

Industry Institute Interface and University Innovation Clusters

(22-24th Jan, 2015)

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

Prof. Arun K Grover (Vice Chancellor, PU, Chd.) and Prof. Deepak Pental amongst the audience for panel discussion.

Mr. Amitesh Suman (ABLE, Bangalore) delivering lecture on Industry-Institute partnership.

(L to R) Panel members from Dr. P K Singh (Principal Scientist, NBRI, Lucknow), Dr. N Seetharaman (Executive Director, ABLE, New Delhi), Prof. V P Kamboj (Ex Director, CDRI, Lucknow), Prof. Deepak Pental (Vice-Chancellor, University of Delhi, Mr. Hemant Goswami (GMO Activist, Chd), Dr. Devender Sharma (Food and Trade analyst), Prof. P Guptasarma (IISER, Mohali).

Popularization of Research Fellowship Schemes of Govt. of India

(24th March, 2015)

Prof Arun K Grover (Vice-Chancellor, PU, Chd) delivering key address of inaugural session.

(L to R) Dr. Rakesh Tuli (Former Director, NABI, Mohali), Prof. Arun K Grover, Dr. S S Kohli (Advisor, DST, New Delhi); Ms. Shalini Sharma (CII, New Delhi) and Dr Meenakshi Munshi (Director, DBT, New Delhi) during inaugural session.

Dr. S S Kohli addressing the audience.

Prof. Arun K Grover addressing the gathering.

First Advisory Committee Meet

(14th Nov, 2015)

Dr. Girish Sahni (DG, CSIR) and Dr. Neeraj Sharma, (Head Policy Research Cell, DST, New Delhi)

Advisory Committee Meet in Progress

Dr. Girish Sahni and Prof. Arun K. Grover (Vice Chancellor, P.U., Chd.)

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

Prof. Arun K. Grover and Prof. Rupinder Tewari, (Coordinator, DST- CPR at PU, Chd.)

Prof. A.K Puri, (Fore School of Management, New Delhi) Dr. Amod Kumar (Chief. Scientist, CSIO, Chd.) & Mr. Ajay Davesser, (Vice President, HCL Pvt. Ltd., Noida)

CRIKC Meet on
"Enhancing Industry - Academia Interface"

(23rd Feb, 2016.)

Prof. P.S. Ahuja (Fmr. DG., CSIR) and
Prof. Arun K. Grover (VC, PU, Chd)

Dr. Anil Wali (MD, FITT, New Delhi) and
Prof. S.K. Das (Director, IIT-Ropar)

Prof. Rupinder Tewari, Coordinator, DST-CPR speaking to the audience
on Industry-Academia Interface.

Dignitaries interacting with each other

Industry - Academia Round Table Meet
at ICT - Mumbai
(6th April, 2016)

Dr. Baldev Raj,
Director, NIAS- Bangalore &
Chairman, Expert Committee,
Policy Research Cell, DST, New Delhi

Prof. G.D Yadav,
Vice Chancellor, ICT- Mumbai

Dignitaries on the dias

Deliberations on Industry - Academia Interactions

Global Rankings of Select Asian Countries based on R&D Indicators

Indicators	Global Rankings				
	Singapore	S.Korea	Taiwan	China	India
Publications[a]	32	12	17	**2**	9
H-Index[a,]*	25	18	29	**16**	20
International property rights index[b] (*global*)	**5**	38	24	53	62
Intellectual property rights[b] (*IPR*)	**16**	30	26	53	52
University- Industry collaboration in R&D[c]	**5**	26	14	32	50
Availability of scientists and engineers[c]	**11**	40	28	36	49
Quality of scientific research instituitions[c]	**12**	27	26	42	45
Company spending on R&D[c]	**11**	21	13	23	31
Availability of latest technologies[c]	**13**	31	36	95	108
Capacity for innovation[c]	**19**	24	21	49	50
High technology exports[d] (***Billion USD***)	4	5	NA	**1**	22
Gross domestic expenditure on R&D[e] (***GERD ranking PPP billion USD***) **	20	5	14	**2**	6
R&D manpower[f] ***(Researchers per million people)***	**6,438**	5,928	NA	1,020	160
FDI and technology transfer[c]	**2**	67	37	69	95
Patent applications filed[f] (***Residents***)	1143	159,978	NA	**704,936**	10,669

**H-index:* Based on the set of most cited papers and the number of citations that they have received in other publications.
***GERD on R&D:* Total intramural expenditure on R&D performed on the national territory during a given period.
a - Scopus 2014; b - IPRI Report 2015; c - GCI Report 2015-16;
d - http://knoema.com/WBWDIGDF2016Mar/world-development-indicators-wdi-february-2016 ;
e - Industrial Research Institute (R&DMagazine-2014)
https://www.iriweb.org/sites/default/files/2016GlobalR%26DFundingForecast_2.pdf;
f - World Development Indicators, 2015;

Global Rankings of top 50 World Economies based on "University-Industry Collaboration in R&D"

Global Rank	Country	Global Rank	Country
1	Finland	26	Korea Republic
2	United States	27	Lithuania
3	Switzerland	28	Hong Kong SAR
4	United Kingdom	29	France
5	Singapore	30	Indonesia
6	Belgium	31	South Africa
7	Israel	32	China
8	Qatar	33	Costa Rica
9	Netherlands	34	Estonia
10	Germany	35	Bosnia and Herzegovina
11	Sweden	36	Hungary
12	Malaysia	37	Kenya
13	Ireland	38	Saudi Arabia
14	Taiwan, China	39	Chile
15	Norway	40	Cyprus
16	Japan	41	Panama
17	New Zealand	42	Czech Republic
18	Luxembourg	43	Mexico
19	Canada	44	Slovenia
20	Denmark	45	Thailand
21	Australia	46	Montenegro
22	United Arab Emirates	47	Equador
23	Portugal	48	Honduras
24	Austria	49	Colombia
25	Iceland	**50**	**India**

***Source**: The Global Competitiveness Report 2015-16 (World Economic Forum).*

This report is based on comparative data of 140 nations.

Case Studies on Feedback from Select Scientists engaged in Industry-Academia (I-A) Collaborative Research Projects

Sr. No.	Academician	Field of Specialization	Industry counterpart
1	**Prof. Shantanu Roy** IIT-Delhi, New Delhi	Computational fluid dynamics	Thermax Pvt. Ltd., Pune
2	**Prof. R.K. Saxena** University of Delhi, New Delhi	Applied Microbiology	Tata Chemical Ltd., Pune,
3	**Prof. K. Sankaran** Anna University, Chennai	Biochemistry	TMI Systems, Bangalore
4	**Prof. O.P. Katare** Panjab University, Chandigarh	Liposomal technology and drug development	IPCA Labs Pvt. Ltd., Mumbai
5	**Prof. Dinesh Goyal** Thapar University, Patiala	Applied Microbiology	Goetze India Pvt. Ltd., Patiala
6	**Prof. V.B. Patravale** Institute of Chemical Technology (ICT), Mumbai	Pharmaceutical Sciences	Shri. Dhirajlal Kothadia Sahajanand Medical Technologies Pvt. Ltd., Surat, Gujarat
7	**Dr. Sunil Jha** IIT-Delhi, New Delhi	Automation in manufacturing process	BSES Yamuna Power Ltd., New Delhi
8	**Prof. N. Kshirsagar** Seth GS Medical College and KEM Hospital, Mumbai	Drug development	**Dr. J.N. Verma** Founder and Managing Director Lifecare Innovations Pvt. Ltd., Gurgaon

Feedback

Prof. V.B. Patravale, Institute of Chemical Technology (ICT), Mumbai	
Hindrances	Lack of infrastructure and facilities at institute end required extensive outsourcing in formative years. However the infrastructure was build up as per requirements in later years with the support of government and private industrial grants.
Suggestions	• Rules and regulations for collaborative projects/ consultancy and technology transfer should be properly defined (As this rules are properly and clearly defined at Institute of Chemical Technology, the execution of collaborative project and technology transfer was extremely swift and convenient) • Patent cell within the institute can help the researchers scan micro patents at faster pace rather than being dependent. • Patent royalty clause should be inbuilt and a specific percentage defined by the institution. • Confidentiality agreement and MoU should be critically drafted safeguarding the interest of both the sides. • Follow up mechanism for milestone payments should be automatically built in the system. No reminders from collaborators to central accounts should be necessary. • No maintenance grant comes from government/I nstitute which at times is necessary for smooth functioning of the project.
Prof. R.K. Saxena, University of Delhi, New Delhi	
Suggestions	• For applied research of national importance being carried out in public funded institutes, the industry should be involved from the very beginning of the research project. Government should give additional incentives to industries working on research projects of national importance. • Each research institute should have a dedicated Industry-Academia Centre to look after I-A linkages, IPR management, Entrepreneurship, Technology Development and Technology Transfer. • Government should encourage setting up research facilities and scale up facilities on the campus under PPP mode. • Technology developed by scientist/teacher and transferred to an industry should be given academic wait age and incentives to the scientist/teacher.

Prof. Shantanu Roy, IIT-Delhi, New Delhi	
Hindrances	Nothing in particular. Very good cooperation from industry, who very well championed the cause of incorporating high-end research into crucial parts of their technology.
Suggestions	• Major public sectors in India have a mandate for research and development, and part of that is joint development with academia. However what plagues success in many cases is that the middle-level management in such major public sectors, who have a direct knowledge of technical challenges and problems (where academia can help), have hardly any decision-making powers. Most of the R&D decisions are taken by top management, and many of the professional occupying such positions either do not have experience of R&D, or are too busy and disinterested in R&D, let alone interactions with academia. • They would be present for industry-academia programmes but since they have very little direct experience or requirement of research-based solutions, the whole effort ends up being cash sink with little positive results. There is need to have the people who are actually working on research to also be decision makers in terms of budgets, spending and setting directions for R&D. • Also many public sectors have to abide by archaic laws of using "proven and demonstrated technologies" when they are in the process of design and commercializing a plant. Since new technologies would never by demonstrated, by definition, hence the incentive to go for new technologies developed under I/A interactions is small. Thus, an eco-system in which new technologies developed indigenously is encouraged, is required. This will have obvious conflicts with risk assessment that companies will make, and this has to be addressed. • In private sectors in India, the problem is two-fold. There are several companies who "feel the need" for research based solutions, but are too small to afford major projects. They understand the challenges very well, are doing very good work on their own, but they are not part of an "eco-system" in which they can freely interact with academia. Maybe Government needs to create an environment, in terms of funding but also in terms of "access", to support such companies to interact freely with academia. • For large private sector companies in India, the challenges to develop and commercialize technology indigenously are too many. So most of them decide to "buy-out" technology from known vendors (usually themselves major multinational companies), with the incentive towards indigenous development is low. • One other aspect is that major technology vendors provide guarantees on technology, when deployed. For a private (or even public sector) company that is a major requirement. Even if we do have new technologies and patents coming out of I/A relationships within the country, usually lack of an eco-system which ensures guarantees and troubleshooting support is a deterrent for going in for new technologies. Thus, it is important that some sort of undertaking on guarantee of technologies and troubleshooting support, should be provided.

Dr. Sunil Jha, IIT-Delhi, New Delhi	
Hindrances	Problem in getting good manpower for short term projects.
Suggestions	• A dedicated team in Industry should be identified at the commencement of the project that will interact on regular basis with the Institute. • Project Investigators at Institutes should be very clear about the deliverables of the project and work with clear focus in that direction. • Institute should provide sufficient support to the PI for execution of the project in terms of space and other infrastructure. Because of space required for execution of the industrial consulting projects, institutes normally discourage projects which require space. • There should be regular meets in institutes with different sectors of industry where industry can share their problems. Institute should maintain a website where industries can post their problems and the same information should be visible to all faculty members.
Prof. Dinesh Goyal, Thapar University, (Thapar Institute of Engineering & Technology) Patiala	
Hindrances	• Industry is not willing to spend even a single penny in exploratory research. If scientist has anything which is certified and proven technology or concept then only they will come forward that too if it leads to huge profits and money making. The industrial R&D is not at all strong in our country and they do not want to invest in that. • While conducting trials at industry, there was least interest of industry people and it was only through personal contacts and our interest in doing something meaningful from academic point of view, we could attempt successfully. After completion of work reports were given to them and recommendations were explained, they never turned back to us for any further assistance. • Fruits of science reach to society with a great difficulty and sometimes the new concept and new technology die off in between. People even after realizing its potential benefits are not able to accept, propagate and commercialize. Govt. support is necessary in this regard and all different wings of central and state govt. must come together to realize and implement immediately anything that relates to environment friendly green technologies, best practices in agriculture, environment protection etc. • Indian industry has less faith in Indian scientific community. • We nurture innovations, but it is half way and do not go further, or cannot go further, or there is no mechanism whereby it can be taken further towards its successful implementation and realization by the society. Scientists, researchers leave in between because of several reasons.
Suggestions	• Industry must actively work with researchers in working out new concepts and finally cost benefits analysis so that product or process is acceptable by the industry.

	• Provide incentives to the working teams for successful implementation. • The findings generally remain in thesis/dissertation for years and we keep reinventing the wheels. More collaboration between Industry and academia is necessary. • Industry to realize that they can get enormous benefits from this in modifying their processes in a cost effective manner, using academia which is actually a center for knowledge creation. • This knowledge can be protected as well as utilized by them for greater returns. Industry-Academia and goverment to facilitate this and making aware of available technologies which can be commercialized or results of R&D are accepted by the end users. • Patenting is very slow process in India, by the time patent is awarded everything vanishes. • Fast patenting and its commercialization or adoption by the industry is very much required. Due to this reason publishing the work in Science Citation Index Impact factor journals only remains as an alternative.
Prof. O.P. Katare, Panjab University, Chandigarh	
Hindrances	• University Infrastructure: a) Lack of sufficient space and laboratory facilities b) Equipments, maintenance • Retention of technology-trained scholars: This means that to carry on the efforts to the level of translation (Scale-up etc.), it needs well-equipped persons. But, there is no provision to retain them for such industrial projects. The work undoubtedly carried out by the scholar will leave after the Ph.D. work and the final work well then be left incomplete. • Beurocratic hindrances in utilizing private funds: There are lots of objections to clear the bills, by audit department with the prevailing attitude.
Suggestions	• Centre for Industry Institute Partnership should be given complete autonomy, especially in utilizing personal funds. • University should look to address the specific or individualized challenges which may be different project to project. • The researchers should be given incentives. • To retain post-Ph.D. scholars, there should be provision to provide the support without delay. • Also, in order to attract industry, the provision of Service tax (which is getting on funding organization) be erased.
Dr. J.N. Verma, Founder and MD Lifecare Innovations Pvt. Ltd., Gurgaon	
Hindrances	• Non-availability of affordable land in and around Delhi. No start-up or entrepreneur led enterprise can afford any land. After 15 years also, we do not have land because of affordability. Make in India is reduced to only a slogan as no one in the country knows "make where in India".

- Adequate financial support. If the financial support is not complete, the innovators are forced to depend on financers. Often these financers become impediments for the fruition of the project.
- Regulatory Agencies, particularly Drugs Controller General (India) [DCGI] / Central Drugs Standard Control Organization (CDSCO) do not work in time-bound manner, have no experience in dealing with new drugs, have no motivation to support innovation, have no appreciation of eroding patent life because of delays caused by them. Unless there are punitive actions and accountability against DCGI/CDSCO officials and State Drugs Controller Indian healthcare industry cannot progress. R&D alone cannot address unmet medical needs of the country and humanity. There should be time-bound procedures for all licenses and permissions and delays should not be allowed to be caused on frivolous grounds. Non-response should also not be allowed.
- Bureaucratic Harassment: We faced serious problems with excise department as despite clearly classified as Excise free, they charged excise on our first batch of product for which we had to stop salaries. Though we won the case, but wrongly charged excise duty was never returned. On subsequent batches they stopped only when we said that we will stop manufacturing and hold a press conference making Excise Department responsible for the deaths for the want of our life-saving drug.
- Bureaucratic Harassment: Pollution Control Board harassment and delays are very common.
- Power tariff and uninterrupted power supply to ensure Good Manufacturing Practices (GMP) Manufacturing and seamless Cold Chain. Special status shall be given to healthcare industry to provide uninterrupted power and incentivized tariff.
- The Government should promise and implement "Minimum Purchase" products manufactured through the support of Government Grant if they have been tested and their safety and efficacy is established through clinical trials. Though there is an order of MSME to procure minimum 25% from MSME in govt. procurement, hospitals in the country do not follow it and in fact several Hospitals have enforced in their "Terms and Conditions for tenders and rate contracts" a prohibitive minimum turnover clause to prevent participation of start-ups in tenders.
- If a superior product has been developed and commercialized in India, inferior imports shall be banned. Our product is known world over to be most safe and most effective of all Liposomal Amphotericin B in the world, but continue to allow inferior imports of very high value drug.
- If a product has been developed and manufactured with government support in India, that product should be compulsorily purchased in all Govt. programs. This is not being followed. Government of India or the state Government never purchased even one vial of Fungisome for Kala-Azar control programs.

Suggestions	• Indian pharmaceutical industry is "Generics and Similar Centric". Because of the huge investments involved in development, clinical trials and international norms of GMP compliance, complexed by 15-20 years of development time, return on investments and reinvestable returns are not possible. To promote the drugs discovery and development, National Pharmaceutical Pricing Authority should be abolished. Similarly, Department of Pharmaceuticals has no role is either promotion of research or industry and thus should be abolished. • Because of the long durations involved in pre-clinical regulatory toxicity and phase I to phase III clinical trials, most of the IP life of 20 years is eroded and leaves no commercial viability to get returns on investment, there should be a minimum of 15 years of post-commercialization patent life. In the absence of this provision, industry is not interested to develop products in collaboration with academic institutions. • When the technology originates in the academic institution, there is pressure of publication from both students and faculty as the publications are parameter for their performance evaluation. There is little realization that the World has transitioned from "*publish or perish*" to "*publish and perish*". In such technologies industry cannot invest. Thus a system needs to evolve for granting higher credits for patents in comparison to publication. For example 1 patent filed in India should be credited as 1 publication; Patent Co-operation Treaty (PCT) filed should be equivalent to 2 publications; an Indian patent granted should be equal to 2 publications and a high value foreign patent granted should be equivalent to 2-4 publication. This is just an indication. The system should be evolved with critical evaluation of the formula. • Young scientists shall be encouraged for entrepreneurship to take up commercialization of their work and continue collaboration with their alma mater. This will also maximize translation of research into commerce. These young scientists shall be supported with a corruption free support system as part of institution's entrepreneur cell. • R&D funding to the MSMEs shall be provided as risk sharing grant such as Programme Aimed at Technological Self Reliance (PATSER). Under PATSER scheme, no money was returnable by the company in the event of failure. However, on successful commercialization, 1.3 times the grant amount was returnable over five years, starting one year after commercialization. • Masters Degree program in relevant field shall have courses on documentation of R&D data, intellectual property, regulatory affairs, entrepreneurship, and business management. • There should be Government funded Contract Research Organizations (CROs) in Institution-Industry collaboration clusters possibly linked to entrepreneurship cells of the institution. • Collaborations with Hospitals and Doctors is a unique requirement of healthcare industry. Medical Doctors in the country mostly respond with "so what do I get out of this collaboration". R&D contributions must be a part of performance appraisal of Doctors in both teaching and non-teaching hospitals. • For sanction of R&D grant to an academic, norms shall be laid down to assess applicability/ commercialization of their earlier funded work as qualifying criterion to optimize usefulness of Government's R&D spending.

Industry-Academia Programmes/Schemes of Select Agencies

1.Department of Science and Technology (DST)

www.dst.gov.in

DST was established in 1971 by Government of India following the success of 'Green Revolution' that signified innovative deployment of scientific methodologies. DST serves as a nodal agency connecting the science sector to the government verticals. The industry related programmes of DST are as follows:

S. No	Programme	Brief Outline
1	**Science & Technology Entrepreneurs Park (STEP)** http://www.nstedb.com/institutional/step-centre.htm	• To forge a close linkage between universities, academic and R&D institutions on one hand and industry on the other. • To provide R&D support to the small-scale industry mostly through interaction with research institutions. • To promote entrepreneurship among Science and Technology persons, many of whom were otherwise seeking jobs soon after their graduation.
2	**Schemes for funding industry relevant R&D (Under SERB)** http://www.serb.gov.in/home.php	Aims to utilize the expertise available in academic institutions and national laboratories to solve industry specific problems for the larger benefit of society. **Prime Minister's Fellowship scheme for Doctoral Research** initiated by SERB and Confederation of Indian Industry (CII): Aim to encourage young, talented, enthusiastic and result-oriented scholars to take up industry-relevant research.
3	**Drugs and Pharmaceutical Research Programme** http://www.dst.gov.in/drugs-pharmaceutical-research	To synergies the strengths of publicly funded R&D institutions and Indian Pharmaceutical Industry.
4	**Start-Up research Grant (Young Scientists)** http://serb.gov.in/srg.php	Two new schemes for promoting industrial research: • Early Career Research Award (ECRA) • National Post-doctoral fellowship (NPDF)

5	**National Science and Technology Entrepreneurship Development (NSTED)** http://www.nstedb.com/	• Promoting S&T entrepreneurs in a specific technology area. • Provision for hands-on training in indigenous technologies developed by R&D institutions that are available for commercial exploitation. To fulfil its objectives NSTED has started with training programmes such as: • Entrepreneurship Awareness Camp (EAC) • Entrepreneurship development programmes (EDP) • Faculty Development Programme (FDP) • Technology based EDP (TEDP) It has also promoted institutional mechanisms for entrepreneurship development by : • Innovation and Entrepreneurship Development Centre (IEDC) • S&T Entrepreneurship Development Project (STED) • S&T based Entrepreneurship Development (i-STED) • S&T Entrepreneurs Park (STEP) • Technology Business Incubator (TBI)
6	**Technology Systems Development Programmes (TSDP)** http://www.dst.gov.in/technology-systems-development-programme-tsdp	• Development and integration of technologies in identified areas. • Promote application of advanced technology for improving the performance, value addition and exportability of various products.
7	**Technology Development Board (TDB)** http://www.dst.gov.in/technology-development-board	Aims at accelerating the development and commercialisation of indigenous technology or adapting imported technology to wider domestic application. The Board provides financial assistance in the form of Equity, Soft loans, or Grants. TDB encourages industry to enter into hi-tech, hi- risk areas and is continuously motivating industry to have firmer linkages with the R&D
8	**International S&T Co-operation** http://www.dst.gov.in/international-st-cooperation	Aims to promote commercial R&D and innovation by supporting academia-industry applied R&D projects, PPP for innovation and entrepreneurship under Global Innovation and Technology Alliance (GITA) platform, facilitating technology development and tech transfer and hosting annual technology summit with partner country.

9	**Nano Applications and Technology Advisory Group (NATAG)** http://nanomission.gov.in/org_stru.htm	To encourage implementation of industry centric and application driven projects in the area of nano science and technology
10	**Instrumentation Development Programme** http://www.dst.gov.in/instrumentation-development-programme	Through this programme the concept of hub is introduced that acts as the translational platform for academics, industries, related organizations to convert laboratory level prototypes into packaged models and help in transfer of technology and knowhow to appropriate industries at a later stage for commercialization
11	**Policy Research Centres** http://cpr.puchd.ac.in/	Aims to develop and design new programmes and action plans for implementation in science, technology and innovation sector in the country. One such centre is in Panjab University with a mandate to strengthen Industry-Academia linkages in India.

2. Department of Scientific and Industrial Research (DSIR)

www.dsir.gov.in

DSIR is a part of the Ministry of Science and Technology, which was announced through a Presidential Notification, dated January 4, 1985 (74/2/1/8 Cab.) contained in the 164th Amendment of the Government of India (Allocation of Business) Rules, 1961. DSIR has a mandate to carry out the activities relating to indigenous technology promotion, development, utilization and transfer.

S. No	Programme	Brief Outline
1	**Building Industrial R&D and Common Research Facilities (BIRD-crf)** http://www.dsir.gov.in/12plan/bird-crf/bird-crf.htm	• Industry R&D Promotion Programme (IRDP) aims to recognize research laboratories to avail fiscal incentives offered by Government. It recognizes In-House R&D units (RDI); Scientific and Industrial Research Organization (SIRO) and Public funded Research Organizations (PFRI) • Common Research and Technology Development Hubs (CRTDH) encourages research and technology development activities by MSEs by collaborating with public funded laboratories.

		• Asian and Pacific Centre for Transfer of Technology (APCTT) To assist the members and associate members of United Nations Economic and Social Commission for Asia and the Pacific (UN-ESCAP) to promote the development and transfer of technologies relevant to the region
2	**Patent Acquisition and Collaborative Research and Technology Development (PACE)** http://www.dsir.gov.in/12plan/pace/pace.htm	Aims to support Indian industries to acquire patented technology at an early stage from within the country or overseas on an exclusive as well as non-exclusive basis, add value to the acquired technology for exploitation in Indian/ foreign markets.
3	**Promoting Innovations in Individuals, Start-ups and MSMEs (PRISM)** http://www.dsir.gov.in/12plan/prism/prism.htm	This scheme aims to support individual innovators which will enable to achieve the agenda of inclusive development. It would also provide support to institutions or organizations set up as autonomous organization leading to development of state-of-art new technology solutions aimed at helping MSME clusters.
4	**Access to Knowledge for Technology Development and Dissemination (A2K+)** http://www.dsir.gov.in/12plan/a2k+/a2k+s.htm	It is a scheme targeted towards developing mechanisms to disseminate science, technology and innovation related information to industries, research and academic institutions, in-house R&D units of industry, SIROs, consultants, industry associations, techno-entrepreneurs, government departments and others.
5	**Technology Development and Demonstration Program (TDDP)** http://www.dsir.gov.in/tpdup/tddp/tddp.htm	• Development and demonstration of innovative Need-based technologies for making industry competitive. • Strengthening the interface between industry, R&D establishments and academic institutions.
6	**Technopreneur Promotion Programme (TePP)** http://www.dsir.gov.in/tpdup/tepp/tepp.htm	Under this programme micro technopreneurship support from DSIR will be made available to budding entrepreneurs.
7	**Technology Development and Utilization Programme for Women (TDUPW)** http://www.dsir.gov.in/tpdup/tdupw/tdupw.htm	Under this programme adoption of new technologies developed by women will be promoted. It also promotes technological up gradation of tiny, small and medium enterprise run by women entrepreneurs.

8	**Technology Management Programme (TMP)** http://www.dsir.gov.in/tpdup/tmp/tmp.htm	Under this programme, DSIR invites proposals for creation of resource centres on technology and innovation management and to initiate activities under it. It is working in close association with industry, industry associations, research organizations, academic institutes, state level agencies and government organizations, consultancy organizations and other government departments to attain it s objective of enhancing technology management capability of the country.
9	**Encouraging Development and Commercialization of Inventions and Innovations: A new impetus** http://www.dsir.gov.in/circulars/knowledge_equity_om_25may2009.pdf	Under this impetus permitting the researchers to have an equity share in scientific enterprise/ spin offs while in professional employment with their research and academic organizations (universities, academic and research institutions) is introduced. Secondly, permitting the scientific establishment to invest knowledgebase as equity in the enterprise is undertaken. It is also encouraging the scientific establishment to set up incubation centres and facilitating mobility of researchers between industry and scientific establishments.
10	**Consultancy Promotion Programme (CPP)** http://www.dsir.gov.in/tpdup/cpp/cpp.htm	The main objective of this scheme is to strengthen and promote consultancy services in various areas including: Consultancy services for acquisition or import of technologies, requiring technological and managerial competence, export of projects, technologies and services and setting up joint ventures abroad, development and transfer of technologies from R&D institutes and strengthening linkages of R&D system with industry etc.
11	**International Technology Transfer Programme (ITTP)** http://www.dsir.gov.in/tpdup/ittp/ittp.htm	Programme is aimed at supporting activities relating to promotion of international technology transfer and trade including export of technologies, projects, services and technology intensive products with a view to enhance the reach of Indian industry.

3. National Research Development Cooperation (NRDC)

www.nrdcindia.com

NRDC was established in 1953 by the Government of India, with the primary objective to promote, develop and commercialise the technologies/ know-how/ inventions/ patents/ processes emanating from various national R&D institutions/ universities and is presently working under the administrative control of the DSIR.

During the past six decade of its existence and in pursuance of its corporate goals, NRDC has forged strong links with the scientific and industrial community in India and abroad and developed a wide network of research institutions, academia and industry and made formal arrangements with them for the commercialisation of know-how developed in their laboratories and is now recognised as a large repository of wide range of technologies spread over almost all areas of industries.

S. No	Programme	Brief Outline
1	**Innovation Portal** http://www.nrdcindia.com/english /index.php/programmes/ innovation-portal	This portal is constructed to bridge the gap between inventor, industry, manufacturers and academia and provides complete information related to the technology required by the small and medium entrepreneur
2	**Knowledge Management system for Technology Promotion** http://www.nrdcindia.com/english/ index.php/programmes/ knowledge-managment	This is platform to promote, develop and commercialize technologies assigned to NRDC. It is self propelled mechanism for systematic identification and evaluation of technologies by a team of expert for value addition to the extent possible for making complete technology package for commercialization of technologies.
3	**Entrepreneurship Development Programme** http://www.nrdcindia.com/english/ index.php/technology-management/ innovator-s-support/entrepreneurship-development-programme	It aims to initiate skill up gradation of unemployed youth, capacity building of NGOs and to promote projects of industrial importance.

4. Technology Information, Forecasting and Assessment Council (TIFAC)

http://tifac.org.in

TIFAC is an autonomous organization set up in 1988 under the DST to look ahead in technologies, assess the technology trajectories, and support technology innovation by network actions in select technology areas of national importance. In 1993, TIFAC embarked upon the major task of formulating a Technology Vision for the country in various emerging technology areas. TIFAC continues to strive for technology development of the country by leveraging technology innovation through sustained and concerted programmes in close association with academia and industry.

The industry related programmes of TIFAC are as following:

S. No	Programme	Brief Outline
1	**Advanced Composites Programme** http://tifac.org.in/index.php?option=com	To source the knowledge from various centres of excellence across the country and brought the industries closer for technology absorption, development and dissemination.
2	**Revolving Technology Innovation Fund [under TIFAC-Small Industries Development of Bank of India (SIDBI) Programme]** http://www.sidbi.com/?q=tifac-sidbi-revolving-fund-technology-innovation-srijan-scheme	Aims at facilitating development, demonstration and scaling-up (commercialization) of technology innovation projects pertaining to new product or process development to encourage and promote development of capabilities in MSMEs to innovate and to bring high-risk innovations to the market for opening up opportunities for business linked with innovations.
3	**Technology Refinement and Marketing Programme (TREMAP)** http://tifac.org.in/index.php?option=com_	Programme is supporting the country's innovation pool by pushing the innovative technologies from the prototype stage towards a viable commercial product through a network of Technology Commercialization Facilitators (TCFs).

5. Biotechnology Industry Research Assistance Council (BIRAC)

www.birac.nic.in

It is Not-for-profit Section-8, schedule B, public sector enterprise registered under Indian Companies Act 1956 in March, 2012 set up by Department of Biotechnology (DBT; http://www.dbtindia.nic.in/), Government of India. BIRAC is an I-A interface agency to reinforce emerging biotech enterprises to carry out strategic research and development activities addressing to the national needs. It has promoted innovative excellence in number of biotech firms to make then globally competitive. The industry programmes offered by BIRAC are as follows:

S. No	Programme	Brief Outline
1	**Small Business Innovation Research Initiative (SBIRI)** http://www.birac.nic.in/desc_new.php?id=75	Scheme was started to boost Public-Private-Partnership (PPP) efforts in the country. It has facilitated innovation, risk taking by small and medium companies and bringing together the private industry, public institutions and the government under one roof to promote the research and innovation in the Indian Biotech Sector.
2	**Biotechnology Industry Partnership Programme (BIPP)** http://www.birac.nic.in/desc_new.php?id=76	Government partnership with industries for support on a cost sharing basis for path-breaking research in frontier futuristic technology areas having major economic potential and making the Indian industry globally competitive.
3	**Contract Research Scheme (CRS)** http://www.birac.nic.in/desc_new.php?id=104	It aims to enable validation of academia research that has commercialisation potential and to engage the Contract Research And Manufacturing (CRAMS) industry to carry out the validation of a process or a prototype.
4	**Biotechnology Ignition Grant Scheme (BIG)** http://www.birac.nic.in/desc_new.php?id=83	Available to scientist entrepreneurs from research institutes, academia and start ups. The Applicant must be either an incubatee or have a registered company with a functional R&D laboratory to be eligible for this grant.

5	**BIRAC University Innovation Cluster: (UIC)** http://www.birac.nic.in/desc_new.php?id=95	Five University clusters as mentioned below have been identified to establish Cluster Innovation Centres: Anna University, Chennai; Panjab University, Chandigarh; Tamil Nadu Agricultural University, Coimbatore; University of Rajasthan, Jaipur; University of Agricultural Sciences, Dharwad
6	**BIRAC Regional Innovation Centre (BRIC) at IKP Knowledge Park** http://www.birac.nic.in/desc_new.php?id=94	Mapping Regional Innovation Ecosystem across Southern India and research institution situated in that region.
7	**Bio-Incubator Support** http://www.birac.nic.in/desc_new.php?id=92	Bio-incubation allows harnessing of the entrepreneurial potential of start ups by providing access to infrastructure as well as mentoring and networking platforms that the start ups could use during their fledgling days. Till now BIRAC has extended support to15 Bio incubator.
8	**BIRAC-SRISTI (Society for Research and Initiatives for Sustainable Technologies and Institutions)** http://www.birac.nic.in/desc_new.php?id=98	Promoting grass root level innovations at the university/college level among the students. It has selected 15 entrepreneurial ideas at the university level from across India which then would be nurtured for 2 years in-situ with a grant of INR 15 lakhs.
9	**BIRAC AcE Fund - Accelerating Entrepreneurs** http://www.birac.nic.in/desc_new.php?id=99	Providing equity based fund for supporting entrepreneurs

6. CSIR-TECH

http://www.csirtech.com

CSIR-Tech is a private limited company under the provisions of Companies Act 1956 and in fact only private sector company in India that deals in commercialization of IP and its related know how and emanating of technology from public funded R&D labs and various academic institutions. It was founded in 2011, as the initiative of CSIR, India and is deemed to be a subsidiary of CSIR. It was established as a for-profit private limited company to provide a truly entrepreneurial, flexible and nimble organization, capable of

functioning in a competitive environment and ensuring the best returns on investment in R&D. The ownership of CSIR-Tech lies with Entrepreneurial Development Centre of CSIR-National Chemical Laboratory (CSIR-NCL), Pune; CSIR-Scientists Welfare Trust (CSIR-SWT) and the State Bank of India.

Its major focus area is to act as catalysing role for lab-to-market journey of technology transfer and for promoting and encouraging new technology ventures like start-ups and spin-offs by means of its association with number of R&D labs. Major offerings of CSIR-Tech are as following:

S. No	Programme	Brief Outline
1	**Technology promotion**	Opportunity identification Technology transfer Technology de-risking
2	**IPR Management**	IP filing IP licensing Synthesis, aggregation and agreements
3	**Industry advisory services**	Technology scouting, R&D Partner search, market research and consulting, open innovation, technology/IP evaluation, forming industry clusters
4	**Government advisory services**	Capacity building, research, S&T development especially for strengthening industry-academia interactions under triple helix model, events etc.
5	**Incubation support**	Business planning and raising finances Market penetration

Industry-Academia Ecosystem in IITs

IITs are the flagship of Higher Education Institutes (HEIs) in India. They, not only impart world class teaching but are also in the forefront of industry oriented research. Their importance have become much more important as the 21st century has been acknowledged by the policy-pundits of the world to be the era of scientific innovations. Only those countries having strong R&D centres will have a strong economy. The country's economic development has been linked with its technological advancements and entrepreneurial development programmes.

To keep up with growing demand of highly skilled engineers by the industrial sector and also to carry out high-end industry related R&D, India has been continuously setting up IITs, since its independence in 1947.

Timeline of the creation of Indian Institute of Technology (IITs)

S. No.	Name	Year of Establishment
1	IIT Kharagpur	1956
2	IIT Bombay	1958
3	IIT Madras	1959
4	IIT Kanpur	1959
5	IIT Delhi	1961
6	IIT Guwahati	1994
7	IIT Roorkee	2001
8	IIT Bhubneshwar	2008
9	IIT Gandhinagar	2008
10	IIT Hyderabad	2008
11	IIT Patna	2008
12	IIT Ropar	2008
13	IIT Jodhpur	2008
14	IIT Indore	2009
15	IIT Mandi	2009
16	IIT-BHU	2012
17	IIT Tirupati	2015
18	IIT Palakkad	2015

Currently, there are 18 IITs (Fig.1) located in various parts of India. The mandate of each IIT is to nurture young bright minds into top class engineers, researchers and entrepreneurs. First generation IITs have made stupendous progress in these domains as reflected by their research publications, patents, technology development, entrepreneurs and start-ups. We have compiled the data of first generation IITs (Table 1). A glance at the table, clearly indicates that IITs are in the fore front of promoting industrial research and have great synergy with industries. These IITs can be the role models for other HEIs to understand their I-A ecosystem and to emulate the same in their own institutes.

Table 1: Research profile of IITs

IP Attributes	*IIT Kharagpur*	*IIT Bombay*	*IIT Madras*	*IIT Kanpur*	*IIT Delhi*
Publication (2014-15)	*2162*	*~1500*	*1194*	*1298*	*1300*
Patents (2010-15) ***Filed*** ***Granted***	*118* *12*	*569* *>61*	*239* *25*	*204* *9*	*146* *25*
Tech. available	*85*	*409*	*358*	*6*	*50*
Tech. Licensed (till date)	*24*	*>140*	*60*	*60*	*15*
Revenue generated (Cr INR; upto 2015)	*NA*	*209*	*4.61*	*2.38*	*135.83*
Incubating Companies	*84*	*71*	*95*	*52*	*44*
Start-ups (till date)	*4*	*>26*	*89*	*26*	*16*
Industrial Collaborations (MoUs; 2010-15)	*NA*	*225*	*~176*	*124*	*8*
Corporate Clients	*NA*	*~400*	*227*	*~124*	*48*
Sponsored projects (Cr INR 2010-15)	*14.26 (2010-13)*	*1149.95*	*491.11*	*401.23*	*328 (2010-14)*
Revenue generated Consultancies (Cr INR 2010-15)	*47.46 (2010-13)*	*143.5*	*251.11*	*52.25*	*138 (2010-14)*

NA: not available;
Source: IIT Bombay, R&D highlights 2016, Annual Reports (IIT Kanpur) 2010-15;
Annual Reports (IIT Madras) 2010-2015, Annual Reports (IIT Bombay) 2010-15, Questionnaire filled by IITs for DST-CPR at PU, Chd., http://www.iitk.ac.in/, http://www.iitb.ac.in/, https://www.iitm.ac.in/, http://www.iitd.ac.in/, http://www.iitkgp.ac.in/, *External Peer Review committee Report (IIT Delhi -2015), External Peer Review committee Report (IIT Kharagpur -2015).*

Apart from having industry oriented academic syllabi, IITs have started many industry related programmes for converting academic knowledge into commercial success and are mentioned in Table 2.

Table 2: Industry Related Centres/Cells/Programmes in IITs

IIT	Centres/ Cells
IIT Kharagpur	**1. Sponsored Research and Industrial consultancy (SRIC) cell** http://www.ttg-sric.iitkgp.ernet.in/sric/ • R&D cell set up in year 1982 for handling sponsored research projects and industrial consultancy assignments. • The cell is equipped with in-house banking facility and has capacity to handle more than 600 R&D projects at a single time frame. **2. Technology Transfer Group** http://www.ttgsric.iitkgp.ernet.in/ttg/research.php • It is a students' initiative under SRIC under its R&D centre. • It acts as a link between academia and industry to facilitate transfer of industry ready technologies. • It has also designed one stop portal of research activities of the institute to be considered by industries. **3. The Science and Technology Entrepreneur's Park-Technology Business Incubator (STEP-TBI)** http://www.step-iit.org/ • STEP was established in 1986 with the financial support from DST and banks (IDBI, IFCI, and ICCI). • As per the mandate designed by NSTEDB, STEP has created conducive environment for nurturing and mentoring prospective entrepreneurs. **4. Technology Incubation and Entrepreneurship Training Society (TIETS)** http://www.step-iit.org/about_tiets.html • Started in year 2006 • Seeded the efforts to create infrastructure to trigger the generation of entrepreneurship **5. Entrepreneurship Cell (E-Cell)** http://www.ecell-iitkgp.org/index.php • The activities of TIETS has led to the creation of E-Cell run by students that act as a forum to provide opportunity for students entrepreneurs to trial their idea with help of TIET and STEP. **6. Technopreuneur Promotion Programme (TePP) Outreach Innovation Centre for PRISM (TOCIC)** http://www.step-iit.org/TePP.html • Initiative of DST & DSIR started in 2014 for promoting independent prospective innovators to emerge as entrepreneurs
IIT Bombay	**1. Industrial Research and Consultancy Centre (IRCC)** http://www.ircc.iitb.ac.in • IRCC set up in year 1975, facilitates and co-ordinates all R&D activities of the institute.

	• It is involved in facilitating short term projects to solve industrial problems as a consultancy projects or industrially/ government sponsored fully fledged long term technology development project. **2. Society for Innovation and Entrepreneurship (SINE)** http://sineiitb.org/sine/home • SINE set up in 2004 is the Technology Business Incubator (TBI) which was initiated with the support of IIT Bombay alumni. It is a platform for promotion of entrepreneurship and administers business incubator that supports technology based entrepreneurship. **3. The Desai Sethi Centre for Entrepreneurship (DSCE)** http://www.iitb.ac.in/dsce/en/about • It was established in 2013 in collaboration with DS foundation. • It aims in spurring entrepreneurship in the campus by introducing various entrepreneurship academic programmes. **4. The Entrepreneurship Cell (E-Cell)** http://www.ecell.in/2015/ • It is non profit organization of students' initiative in which regular workshops, innovative games, speaker sessions, competition for aspiring entrepreneurs. Provides financial resources such as seed funding, networking and consultancy for budding student entrepreneurs.
IIT Madras	**1. The Centre for Industrial Consultancy and Sponsored Research (IC&SR)** https://www.iitm.ac.in/icsr • IC&SR was initiated in 1973 to promote industrial interactions with the institute. • It holds the responsibility for industrial collaboration in terms of sponsored research and consultancy, technology licensing and patent related issues. **2. IIT Madras (IITM) Research Park** http://respark.iitm.ac.in/about_us.php • It is an independent company promoted by IITM and its alumni registered under section 25 (now section 8 of Companies Act 2013) of companies Act 1956 and is **India's first university driven research park**. • It facilitates promotion of R&D in partnership with industry, generation of new ventures and promoting rural economic development. **3. The Cell for Technology Innovation, Development and Entrepreneurship Support (C-TIDES)**

	http://www.c-tides.iitm.ac.in/ · Started in 1998 also named as Entrepreneurship Cell is a student hub for entrepreneurship activities in IITM to encourage and support student led entrepreneurship and pre-incubation support. **4. IITM Incubation cell** http://www.incubation.iitm.ac.in/ · It is registered under Section 8 Companies Act 2013 and is recognized as TBI by NSTEDB, Government of India. · It aims to synergize and coordinate innovation and entrepreneurship and facilitating industrial interactions. **5. The Rural Technology Business Incubator (RTBI)** http://www.rtbi.in/ · Emerged in 2006 in association with World Bank's infoDev project and DST. Major focus area of RTBI is rural and social development. **6. Bio-incubator** http://www.bioincubator-iitm.in/ · It was established by BIRAC under Bio incubator Support Scheme (BISS) and aims to foster Indian biotech entrepreneurship and innovation enhancing R&D capabilities of SMEs, MSMEs and start-ups.
IIT Kanpur	**1. SDBI Innovation and Incubation Centre (SIIC)** http://www.iitk.ac.in/siic/d/about-siic • SIIC was set up in collaboration with Small Industries Development Bank of India (SIDBI) to foster innovation, research and entrepreneurial activities in technology related areas. • It was established in 2000 with the vision of transforming knowledge into wealth. **2. TePP Outreach cum Cluster Innovation Centre (TOCIC)** http://www.iitk.ac.in/siic/d/article/siic-becomes-tepp-outreach-centre • As a new initiative during 1998-99, the Ministry of Science and Technology, Govt. of India, launched a novel programme known as "Technopreneur Promotion Programme" (TePP) jointly operated by DSIR and TIFAC to tap the vast innovative potential of the citizens of India.
IIT Delhi	**1. The Industrial Research and Development (IRD)** http://ird.iitd.ac.in/content/about-ird • Through IRD, IIT Delhi has laid strong emphasis on sponsored research and industrial interactions. It has contributed to solving industrial problems relevant to the need of the country. **2. Foundation for Innovation and Technology Transfer (FITT)** http://www.fitt-iitd.org/ • FITT was established in 1992 as a registered society. It is most successful industrial interface organization. It aims to foster, promote and sustain commercialization of R&D in IIT Delhi **3. Incubation centres (TBI, Biotech incubation facility, Science and Technology Parks)** http://www.fitt-iitd.org/ • FITT has strongly linked with government funding agencies in form of establishing centres or incubation of technologies in association with NSTEDB, BIRAC etc. that provide financial support to aspiring entrepreneurs for start-ups and to undertake I-A collaborated projects.

***Note**: Data for the first generation of IITs have been presented in present draft prepared by DST-CPR at PU, Chandigarh. Data of 2nd generation of IITs has not been collected yet because most of them are in the initial stages of development.*

IMPRINT India Initiative

http://imprint-india.org

In order to attain economic prosperity and social upliftment, the emphasis of R&D needs to be directed on societal and economical challenges of the country. To address these challenges, MHRD came out with an innovative and one of its kind programme i.e. IMPRINT* India Initiative in 2015. This programme will cater to the challenges in science and engineering sector to enable, empower and embolden the nation for inclusive growth and societal development. The programme will be carried out by the scientific fraternity of sixteen IITs and IISc, Bangalore.

MHRD has identified 10 domains of societal importance, and the responsibility of accomplishing the objectives of these domains is vested upon six institutes as mentioned below.

Institute	Domains# (10)
IIT Kharagpur	• Information and Communication Technology • Health Care
IIT Bombay	• Nano-technology Hardware • Energy
IIT Kanpur	• Water Resources and River systems • Advanced Materials
IIT Madras	• Manufacturing • Security and Defense
IIT Roorkee	• Sustainable Habitat
IISc Bangalore	• Environmental Science and Climate Change

#Each domain is categorized into themes, sub-themes, target and topics for promoting research and innovation.

- IMPRINT is working with a task force to map the strengths and weaknesses in Indian education system to champion the engineering targets.
- Under IMPRINT initiative, focus is on strengthening academia and industry linkages in order to create and sustain an inclusive eco-system in science-engineering-technology-society nexus to develop novel goods and services that would be both competitive and add value to ultimately serve the nation.
- Presently, IMPRINT is in its first phase which is focussed on creating a policy document defining the scope, strategy and mandate for pursuing engineering challenges in the country.
- Second phase of IMPRINT will be focussed on developing a specific technological product or process under well developed innovation system for the need of society.

**IMPRINT-Impacting Research Innovation and Technology*

Institute of Chemical Technology (ICT), Mumbai: A Model for Industry - Academia Linkage

http://www.ictmumbai.edu.in

- *Ranked Best Institute in I-A linkages in India (AICTE-CII SURVEY; 2014)*
- *Second rank amongst Higher Educational Institutions in India by NIRF, MHRD, 2016*
- *Number four in the world in an annual ranking of chemical engineering programs* conducted by the Georgia Institute of Technology, USA, 2012

ICT was established in 1933 as the University Department of Chemical Technology (UDCT) of the University of Mumbai through active support from industries, with the noble intention of advancing India's knowledge reserves in chemical science and technology. The mission of UDCT was and still is to cater to the needs of industry i.e. providing skilled manpower to the industries and addressing the R&D needs of private sector.

Since its inception UDCT, has been in the forefront of imparting par excellance knowledge to the students and working in complete synergy with the industry (Chemical, Pharma, Biotech, Food etc.). These achievements have been due to the stalwarts who headed UDCT such as Sir M. Visvesaraya (Bharat Ratna) and Prof. M M Sharma (Padma Vibushan). Looking at the progress UDCT under the leader ship of Prof. G D Yadav (Padmashri) MHRD granted it the status of Deemed-to-be-University in 2008 .

ICT is composed of 18 Departments, 2 Research Centres and 4 Centres for Excellence and has received various grants and projects from various funding agencies and industries. ICT has been cited as a role model for industry-institute-government relationship with faculty strength of 82 of which more than 80% of faculty is associated with industry. Several first generation entrepreneurs in chemical and allied industries, numbering over 500 are the alumni of the institute. They have pioneered in setting up of many chemical industries in and around Mumbai and in Western India. Outcomes of ICT in terms of industrial research are presented below:

Attributes	Number
Publications (2010-15)	4720
Patents: Granted/ Filed (2010-15)	28/ 161
Industrial collaborators (till date)	56
Government sponsored projects (till date)	320
Industry sponsored projects (till date)	318
Revenue generated from Industry sponsored Projects (Cr INR; 2012-15)	~84.7

Industrial consultancy projects(till date)	269
Revenue generated from Consultancy Projects	~ 7 2
(Cr INR; 2012-15)	
Entrepreneurs generated (till date)	>500

Source: ICT, Mumbai NAAC self study report (2015-16)

ICT has a set of rules and guidelines for IP protection and carrying out industrial research which are summarized in Table 2.

Table 2: Rules and guidelines of ICT, Mumbai

S. No	Focus Area	Rules/ Guidelines
1	**Intellectual Property Protection**	• Institute shall file the patent on behalf of faculty • IPR Committee of the institute takes the responsibility of IP related issues • Provision of assigning IP to suitable external agency (TIFAC, NRDC etc.) for industrial work • Creation of suitable fund for carrying out IP • License fee share: 70% Institute; 30% faculty involved • If industry is involved then well defined agreements with industry, which varies in different cases (20-40%). • Royalty Share: 20% Institute; 80% faculty(If industry involved then well defined agreement with faculty involved) • Appellate committee of ICT Mumbai handles all the dispute cases and has access to jurisdiction of Mumbai High Court.
2	**Industrial Consultancy**	• Distribution of Revenue generated: 1/3rd between institute and 2/3rd by faculty • Faculty is allowed to retain the complete revenue up to Rs 1.00 lakh, beyond this 1/3rd shared with the institute • In case of sponsored projects, industry provides fellowship to researchers involved. In case of industrially sponsored projects, Industry invests 80% and institute 20%.

BIRAC: A Nodal Organization of Industry-Academia Interface in Biotech Sector

www.birac.nic.in

BIRAC (Biotechnology Industry Research Assistance Council) is a unique organisation in the Indian context. It is the nodal funding agency to nurture and catalyse the growth of the industry to global excellence. It is a Not-for-Profit Section-8, Schedule B, Public sector enterprise registered under Indian Companies Act 1956 in 2012 set up by DBT, Government of India. BIRAC is a prime example of Public-Private Partnership (PPP) where public sector has invested INR 550 Cr and INR 750 Cr has come from the private sector. Creation of BIRAC has greatly enhanced the technology development and generation of useful products in Biotech sector.

In a short span of 4 years of its existence, BIRAC has initiated various programmes and implemented government schemes (SBIRI, BIPP, CRS, BIG, UIC, BRIC, SRISTI, ACe Fund and Bio-Incubator support; details given at page number 29) to empower biotech innovative ecosystem. BIRAC has significantly contributed to reinforce emerging biotech enterprises to carry out strategic research and development activities in collaboration with academic sector and have led to the road for development of successful biotech ventures (Table 1).

Table 1: Outcome of BIRAC Programmes

Programme	Outcome
SBIRI	• 86 ongoing projects • 26 collaborative projects • Investment contribution: INR 16.77 CR (BIRAC)+ INR 16.30 CR (company) • Products developed (2014-15): 4
BIPP	• 64 ongoing projects • 20 collaborative projects • 134 agreements signed with 108 companies involving 60 start-ups and SMEs

	• Investment contribution: INR 894.23 CR (BIRAC)+ INR 345.29 CR (GOI)+ INR 548.93 CR (Private sector) • Patents (2014-15): 3 (national) • Products developed (2014-15): 2 • Prototypes developed (2014-15): 4 • Dedicated facilities (2014-15): 2
CRS	• 181 proposals have been received, having 198 Academia and 193 Industries partners. 17 have been approved for funding and 13 contracts have been signed under the CRS scheme. • 13 Proposals ongoing involving 15 academia and 13 industrial partners • Total grant: INR 13.48 CR • Projects under development: 3
CRS Entrepreneurship development	• BIRAC has supported directly and indirectly 199 start-ups/entrepreneurs

Bio-incubators at	**Resident Incubatees**
C-CAMP, Bangalore	6
Venture Centre, NCL, Pune	20
ZTM & BPD Unit, IARI, New Delhi	5
IKP Knowledge park, Hyderabad	22
KIIT, Bhubaneshwar	5
Alexandria Knowledge Park, SBTET, Hyderabad	10
BBIF, IIT Delhi	17
SIIC, IIT Kanpur	6
IIT Madras Research park	10

Chandigarh Region Innovation and Knowledge Cluster (CRIKC) Web Portal for Industry

http://crikc.puchd.ac.in

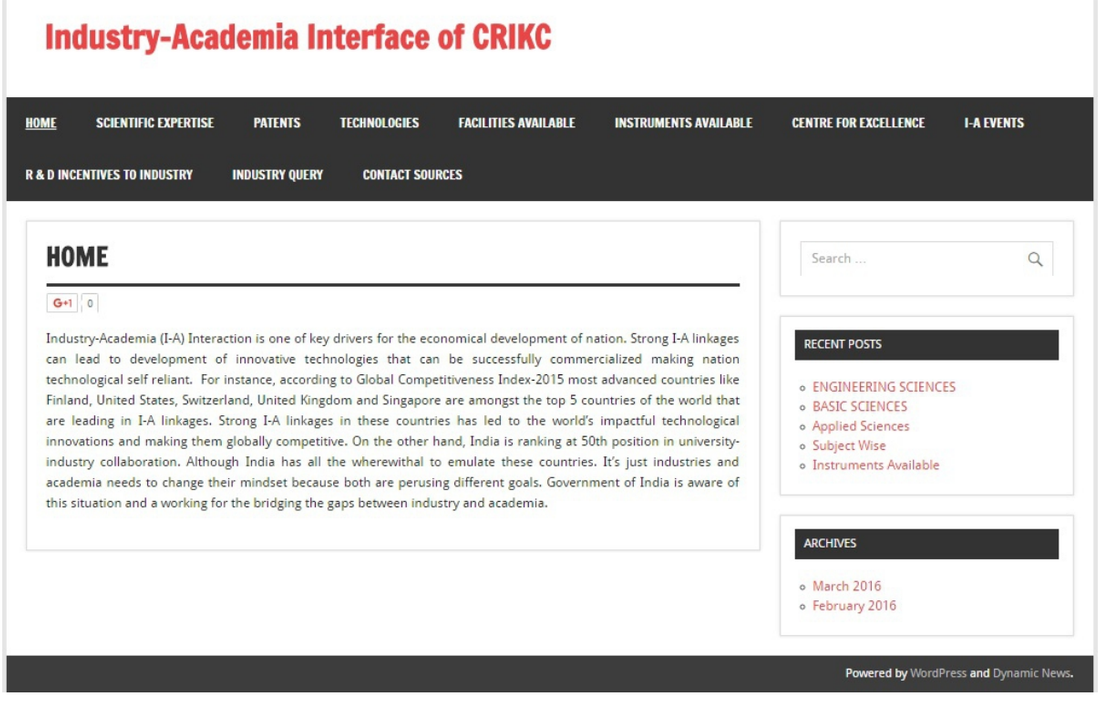
CRIKC is a conglomerate of Higher Education Institutes (HEIs) and National Research Facilities located in and around Chandigarh. Major institutes under the umbrella of CRIKC are as follows:

HEIs	• Panjab University (PU), Chandigarh • Indian Institute of Science Education and Research (IISER), Mohali • National Institute of Pharmaceutical Education and Research (NIPER), Mohali
Medical Institutes	• Post Graduate Institute of Medical Education and Research(PGIMER), Chandigarh • Government Medical College & Hospital (GMCH), Chandigarh
Engineering Institutes	• Institute of Technology (IIT), Ropar • PEC University of Technology, Chandigarh • National Institute of Technical Teachers Training & Research (NITTR), Chandigarh
CSIR Laboratories	• Institute of Microbial Technology, Chandigarh • Central Scientific Instruments Organisation, Chandigarh
DBT Laboratories	• Center of Innovative and Applied Bioprocessing (CIAB), Mohali • National Agri-Food Biotechnology Institute (NABI), Mohali
DRDO Laboratories	• Snow & Avalanche Study Estt. (SASE), Chandigarh • Defence Institute of High Altitude Research (DIHAR), Chandigarh
DST Laboratory	• Institute of Nano Science & Technology (INST), Mohali
Management Institute	• Indian School of Business (ISB), Mohali

The mandate of CRIKC is to foster and sustain close academic alliances between institutions of higher education and research in and around Chandigarh region.

CRIKC is in the process of extending its arm to the industrial belt of Chandigarh region (Chandigarh, Panchkula, Mohali and Baddi). The strengthening of Industry-Academia collaborative research is one of the important features of Science, Technology and Innovation Policy (STI) – 2013, of GoI. CRIKC – Industry handshake is one way of fulfilling the goals of STI – 2013 Policy.

Industry desires to seek collaboration with academia but is in dark about the availability of scientific expertise/ instrumentation facilities/ centres of excellence, technologies available, and patents of various institutes of Chandigarh region. To address this problem, Centre for Policy Research, has created a web portal catering to the needs of the Industry which would be put up on the website of CRIKC. The glimpse of the portal is as under:



Reforms Needed in Higher Education Sector for the Promotion of Industry- Academia Interactions

In developed countries, there is a healthy relationship between R&D of industries and universities. This successful handshake is contributing greatly to the kitty of 'knowledge economy' of the nations. It is a win-win situation for both the parties. Unfortunately, in India, Industry-Academia (I-A) interactions are limited to IITs, and a few universities /govt. sponsored national research laboratories. The number of commercially successful technologies/ innovations is not very encouraging, keeping in mind that India has (a) > 700 universities churning out thousands of Ph.Ds, in the area of applied sciences on annual basis and (b) > 300 govt. sponsored research laboratories having thousands of scientists.

Moreover, in developed nations two third of the funds for R&D of public funded institutes are contributed by the private sector, whereas in India, private sector contribution is only one third and the remaining funds are provided by the government.

It is a well accepted fact that in India, the academia and private sector are living in different worlds. Both sectors view each other through a 'tunnel vision.' But, time has come for hand-holding of each other because, in the 21st century innovations are the key factor for the survival and growth of an industry. The intelligentsia, which exists in the academic sector, has to be roped in by the industrial sector for novel innovations. Also, industry has to come forward for contributing more towards finances for R&D in public universities. For these things to happen, a change in the mindset of academia and private sector is the need of the hour.

To address the above mentioned issues, an ecosystem has to be created for stimulating I-A research programmes and increasing funding of R&D programmes of universities by the private sector so as enhance their sustainability. To achieve these goals, following suggestions are being put forward:

A) Creation of 'National Level Web Portal'

Though, Indian academic sector is engaged in applied research of industrial relevance, but the private sector finds it difficult to access the expertise and facilities existing in the academic institutes. Because of advancements in IT sector, industry has no problem in interacting with a scientist or an institute located at a distant place in India. If web portals can be designed and made accessible to Industry, this will be a big step in enhancing Industry and Academia interactions.

It is suggested that 'National Level Web Portal' be made which display following parameters existing in universities and national research laboratories:

- Availability of the type of scientific expertise
- Centres of Excellence
- Availability of infrastructure facilities, high-end Instruments, animal facility, library, workshops, fermentation facility etc.
- Latest technologies, innovative products and patents developed at the institutes
- IPR policy of the institutes
- I-A / Entrepreneurship / Meets, Symposia and Conferences
- Interactive Web Portal (for addressing the needs of the private sector)

Our Centre have created an 'I-A Web Portal' comprising of academic/research institutes located in and around Chandigarh region (for details please see page 42) and has been highly appreciated by industry and academia.

B) Creation of UGC-Tech

So far, universities were meant for imparting quality education to the students and financial assistance was provided by government agencies. However, government is showing its inability for 100% funding of the universities and asking the institutions to partially generate their own resources. A good number of universities are in a position to convert their academic intelligentsia to commercial success via generation of patents, technologies, consultancy and running industry oriented courses. Its is suggested that UGC-Tech be created on the lines of CSIR-Tech so as to provide technical and financial assistance to the scientists for converting there laboratory research to saleable products.

C) Setting up of Business & Marketing Entities in Universities

To commercialize the intellectual property of the universities, universities may be permitted to establish a legally distinct non-profit entity such as Society, Trust, Foundation or Section 25 Company to exploit/ market its knowledge base, products, databases etc. on the pattern adopted by CSIR institutions.

D) Strong and Robust IPR Policy

Industry strongly feels that universities desirous of collaborating with private sector should have a clear cut IPR Policy catering for:

- Intellectual Property (IP) Ownership Criteria
- IPR Policy Administration and Regulation of IPR Policy
- Disclosure of Intellectual Property and evaluation of Disclosed IP for Protection of Rights
- IP protection, Licensing and Technology Transfer:
- Revenue Sharing between the Institute and the inventors: between the faculty and the students

· Other pertinent issues like protection of biodiversity, dispute resolution, if any between the institute and the inventors, and the mandatory obligations for the inventors

E) Creation of Autonomous I-A Cell under section 8 in the Universities.

Each university should have an autonomous, not-for-profit I-A Cell under section 8 of The Companies Act-2013, to convert academic knowledge to commercial entities and overcome the hassles of institute's rules and regulations. Evidence: Foundation for Innovation in Technology Transfer (FITT) in IIT-Delhi. It is an autonomous body, set up by Govt. of India and is dedicated for converting academic knowledge of IIT-D into commercial products. FITT is financially self sufficient, well connected with private sector and has a hefty bank balance (around 30 crores). During last one decade it has licensed ~33 technologies and incubation of > 46 Start ups.

The autonomous I-A Cell in universities should cater for:

- Acting as a fulcrum between Academia and Industry
- Awareness of I-A related schemes of the Govt.
- Creation of University-Industry Linkage Portal
- Scouting for the R&D needs of industries
- Assist university in establishing Innovation/Incubation Centres/ Pilot scale facilities
- Establishing Finishing schools, for making students industry-employable
- Running industry-related Certificate/Diploma courses
- Creation of *Industry Chairs* in Universities by the private sector
- Organizing I-A meets

F) Reforms in Promotion Criteria for Teaching Faculty: A Promotion criterion for universities faculty is heavily tilted towards research publications. Due weightage to scientists working on industry related projects should be given. The guidelines for API score with respect to Consultancy Projects and Projects Outcomes/Outputs should be relooked as mention in table

For the promotions of Asstt. Professor to Assoc. Professor and Assoc. Professor, to full Professor, a condition for having successfully completed at least one industry activity i.e. consultation, tenure (period: at least 6 months) in industry, technology transfer, patent, member/expert in governing body of industry/industry association etc should be mandated.

S. No	APIs	Existing		Recommendations
		Particulars	Maximum Points	
1	Consultancy Projects (Clause IIICi)	Amount mobilized with minimum of Rs.10.00 lakhs	10/Rs. 10 lakhs	The lower limit of Rs. 10 lakhs should be amended to include all consultancy projects with scoring scale based on the amount involved
2	Projects Outcome / Outputs (Clause IIICiv)	Patent/Technology transfer/ Product/ Process	30/National level and 50/International level	Technology Transfer (TT) need to be given a separate category and enhanced scores in relation to Patents as TT involves more intensive R&D activities and also increased industrial interactions. The inclusion of Product/ Process under this category needs to be clarified in order to include/exclude unpatented Product or Process

G) Networking of Universities with Industries

Universities are rich in intelligentsia and young/bright man power, but have limited instrumentation facility, which hampers the univ. faculty to take up research assignments from private sector. In India, there are > 80 NAAC 'A' accredited universities, > 300 national research laboratories (CSIR, ICAR, DRDO, DST, DBT, ICMR etc.) and > 1700 DSIR certified R&D labs. in private sector. Based on the professional competence of a university, it should be made mandatory to partner with at least one national research lab. and one DSIR certified private lab. So, without spending a single penny, thousands of university scientists will have access to high end instruments and thus would be in a better position to take up industry assignments. Attachment of DSIR certified industry with university will be a starting point for effective R&D collaboration with private sector.

To enhance the research capability of DSIR certified labs industry should rope in public sector scientists belonging to professional streams (Engineering, Biotech, Microbiology,

Pharma etc) to work on industrial problems. It will be prudent if DSIR certified labs partner with one such university possessing scientific expertise complimenting the type of research being carried out in a particular DSIR certified lab.

In order to increase I-A interactions, the governing body of industry should have a senior professor/scientist on its Board of Governance and vice versa. certified private lab.

So, without spending a single penny, thousands of university scientists will have access to high end instruments and thus would be in a better position to take up industry assignments. Attachment of DSIR certified industry with university will be a starting point for effective R&D collaboration with private sector.

H) Miscellaneous

- Industry should be involved from the very beginning of the university research projects having industrial implications. Using this approach, the project will be more focussed and shorten the time for commercialization of the technology developed.
- Crash-courses on Business Management for science faculty.
- A serious re-look is needed on the academic syllabi of science subjects. Syllabi should be in tune with the requirements of the industries. Dedicated courses on entrepreneurship development, IPRs and business management programmes should be introduced.
- In universities engaged in applied-research, Govt. may set up 'Industrial Zones' which cater to entrepreneurship programmes, business management programmes, space for incubates/ start-up companies. This facility may be created under PPP mode.
- Universities should have an *Industry Web-Portal* catering to
  - Latest technologies which can be adopted by industry
  - Patents held by the universities
  - Start-up companies by university alumni
  - Innovative products generated
  - Entrepreneurship programmes
  - Availability of jobs in the public and private sectors
  - I-A meets / IPR / Entrepreneurship meets
  - Business Management programmes
- Each academic institute should have web portals of databanks for easy access by the industrial sector. Suggested databanks are as under:
  - Availability of scientific expertise in the universities
  - List of high-end instruments
  - List of infrastructure facilities like animal facility, library, workshops, fermentation facility etc.

Recommendations for Development of a new Country Specific Model for the Promotion of PPP for R&D

The proposed Country Specific Model has two components:

A) National Level Component

i) Establishment of an Apex body: *National Industry-Academia Centre (NIAC).*

ii) Establishment of *Industry Research Assistance Council (IRAC)* in Funding agencies and MHRD

iii) Setting up dedicated *I-A Institutes* under PPP mode by MHRD

iv) Partnership of NAAC 'A' accredited university with a DSIR certified industry and a National Research Laboratory

B) Institute Level Component

i) Creation of *Autonomous I-A Cells under section 8* in the universities

ii) Reforms in the *Promotion Criteria* for teaching faculty.

iii) Setting up *'R&D Centres for Industrial Excellence'* under PPP mode.

iv) I-A activities as an important criterion in NAAC evaluation of universities.

v) Incentivizing universities for I-A activities

A) National Level Component

i. **Establishment of a National Industry-Academia Centre (NIAC).** Various funding agencies (DST, DBT, ICAR, CSIR, DSIR, NRDC, TDB, TIFAC etc.), Higher Education regulatory bodies (UGC, AICTE), Industrial Association (FICCI, CII etc.) and banks are carrying out multiple I-A activities. However, there is no common place/Centre/Office, where all the information pertaining to I-A interface, is available. **In order to avoid overlaps and identify gaps in the I-A programmes of India, and also to keep abreast of global I-A practices, it is imperative that Govt. set up a dedicated body i.e. NIAC.** The Governing body of NIAC should have equal number of experts from Industry/Industry-Associations and Academia. The major responsibility of NIAC would be to assists the government in drafting as well as implementation of I-A policies.

ii. **Establishment of Industry Research Assistance Council (IRAC) in Funding agencies and MHRD.** Evidence 1: DBT has created an autonomous not-for-profit Section 8 enterprise, called BIRAC (Biotechnology Industry Research Assistance Council; www.birac.nic.in). During its three years of existence, BIRAC has initiated many Biotech-centric schemes with funds coming from public sector (550 crores) and private sector (750 crores). The Public-Private Partnership has brought out 17 products in the market, developed 11 technologies and 22 start-ups have been created. BIRAC has been instrumental in making 68 I-A collaborations and supporting 199 start ups. BIRAC has special R&D schemes for small and medium scale enterprises under PPP mode.

Funding agencies (DST, CSIR, ICMR, ICAR, DRDO, DAE, MHRD etc.) may set up BIRAC type autonomous bodies for other industrial sectors such as IT, Electronic, Aviation, Chemical, Mechanical, Civil, etc.

Setting up of dedicated Universities and/or Colleges under PPP mode by MHRD. Evidence 1: Bombay College of Pharmacy (www.bcpindia.org). Set up by Indian Pharmaceutical Association in 1957. Rated as Best Industry-Linked College for the last three years by AICTE-CII Survey. Many R&D projects are funded by Pharma industry. Pharma industries have set up Research Centres, Drug Testing Centre, Bio-Availability Centre, Clinical Excellence Academy and are involved in teaching programmes as well. Government provides the salary component, and the rest is managed from the students-fee, consultancy, R&D projects.

Evidence 2: MHRD has floated a scheme for providing financial assistance for setting up of new polytechnics and Indian Institutes of Information Technology (IIITs) under PPP mode. For example, IIIT-Pune is proposed to be set up as autonomous institution under PPP model in academic year 2016-17. The partners for setting up IIIT, Pune are central government (50% funding), state government (35% funding) and industrial segment (15% funding).

Based on these evidences it is suggested that MHRD/ICAR/ICMR may establish similar colleges/institutes for other fields (various branches of Engineering, Biotechnology, Microbiology, Bio-Engineering, Environment, Computer Science etc.) under PPP mode, The private partners could be industry or private sector education providers.

iii. **Partnership of NAAC 'A' accredited university with a DSIR certified industry and a National Research Laboratory**. Universities are rich in intelligentsia and young/bright man power, but have limited instrumentation facility, which hampers the univ. faculty to take up research assignments from private sector. In India, there are > 80 NAAC 'A' accredited universities, > 300 national research laboratories (CSIR, ICAR, DRDO, DST, DBT, ICMR etc.) and > 1700 DSIR certified R&D labs. in private sector. Based on the professional competence of a university, it should be made mandatory to partner with at least one national research lab. and one DSIR

certified private lab. So, without spending a single penny, thousands of university scientists will have access to high end instruments and thus would be in a better position to take up industry assignments. Attachment of DSIR certified industry with university will be a starting point for effective R&D collaboration with private sector.

iv. **Better monitoring of Res. Projects funded by various agencies:** By enlarge, the Project Appraisal Committees (PAC) of funding agencies comprise of scientists only, who are responsible for granting as well as evaluation of research projects. Its high time for intervention by third party. For example, for research projects of applied nature, it will be prudent if representatives of industry associations are involved. Their viewpoints on granting as well as the out come of the projects should be taken seriously.

B. Institute Level Component

i. **Creation of Autonomous I-A Cell under section 8 in the Universities.**

Each university should have an autonomous, not-for-profit I-A Cell under section 8 of The Companies Act-2013, to convert academic knowledge to commercial entities and overcome the hassles of institute's rules and regulations. Evidence: Foundation for Innovation in Technology Transfer (FITT) in IIT-Delhi. It is an autonomous body, set up by Govt. of India and is dedicated for converting academic knowledge of IIT-D into commercial products. FITT is financially self sufficient, well connected with private sector and has a hefty bank balance (around 30 crores). During last one decade it has licensed ~33 technologies and incubation of > 46 Start ups.

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- Scouting for the R&D needs of industries
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- Creation of *Industry Chairs* in Universities by the private sector
- Organizing I-A meets

ii. **Reforms in Promotion Criteria for Teaching Faculty:** A Promotion criterion for universities faculty is heavily tilted towards research publications. Due weightage to scientists working on industry related projects should be given.

For promotion of Assoc. Professor to Professor, a condition for having successfully completed at least one industry activity i.e. consultation, tenure (at least 6 months) in industry, technology transfer, patent, member/expert in governing body of industry/industry association etc.

iii. **Setting up 'R&D Centres for Industrial Excellence' under PPP mode.** MHRD and funding agencies should set aside special fund for creation of 'R&D Centres for Industrial Excellence' in the universities under PPP mode. Such Centres should come up only if the university is in long term agreement with a particular industrial sector (Pharma, IT, Electronics, Nanotechnology, Environment, Automobile, Chemical, Food, Aviation etc.).

iv. **I-A activities as an important criteria in NAAC evaluation of universities**: NAAC evaluation criteria has a dedicated category for 'Consultancy'. By replacing consultancy category with I-A activities category and allotting more weightage for the same, universities will be bound to promote I-A activities.

v. Incentivizing universities for undertaking I-A activities

vi. Mobility of R&D professionals of public sector to private sector and *vice versa,* with full pay & job protection.

vii. Creation of *Research Professor (Industry)* positions in universities by MHRD

Rcommendations for Identifing Areas of Policy Gaps for Stimulation of Private Sector Investment in R&D and Suggest Changes in Policy Environment

Incentives provided to private sector by GOI , as on Nov. 2015

A. Incentives based on direct taxes (Income-tax Act, 1961)

- 100% write off of revenue expenditure on R&D; (Section 35(1)(i) of IT Act).
- 100% write off of capital expenditure on R&D in the year the expenditure is incurred;(Section 35(1)(iv) of IT Act).
- Weighted tax deduction @175% (to the sponsor) for payments made to approved national laboratories, universities and IITs or a specified person, with a specific direction that the said sum shall be used for scientific research under a programme. (Section 35(2AA) of the IT Act).
- Weighted tax deduction @200% on expenditure (other than land & buildings) incurred on approved in-house R&D facilities of companies engaged in the business of biotechnology or in any business of manufacture or production of any article or thing, not being an article or thing specified in the list of the Eleventh Schedule. [Expenditure on scientific research in relation to drugs and pharmaceuticals, includes expenditure incurred on clinical drug trials, obtaining approvals from any regulatory authority under any Central, State or Provincial Act and filing an application for a patent under the Patents Act, 1970 (39 of 1970). (Section 35(2AB) of the IT Act.)]
- Accelerated depreciation allowance for investment on plant and machinery, made on the basis of indigenous technology (Rule 5(2) of IT Rules, 1962).

B. Incentives based on indirect taxes

1) Customs duty exemption to in-house R&D units established by corporate companies, other than a Hospital for capital equipment and consumables needed for R&D. (Notification No.24/2007-customs, dated 01 March, 2007 as amended from time to time).
2) Central excise duty exemption to in-house R&D units established by corporate companies, other than a Hospital for capital equipment and consumables needed for R&D.. (Notification No.16/2007-central excise, dated 01 March, 2007 as amended from time to time).
3) Central excise duty waiver for 3 years on goods designed and developed by a wholly owned Indian company and patented in any two countries out of: India, USA, Japan and any one country of European Union (Notification No.15/96-CE dated July 23, 1996, amended vide Notification No.13/99-CE dated 28 February, 1999).
4) Exemption from customs duty on imports made for R&D projects funded by Government in industry. (Notification No. 50/96-Customs dated 23 July 1996).
5) Goods specified in List-28 (comprising of analytical and specialty equipment) for use in pharmaceutical and biotechnology sector allowed to be imported duty free {notification No. 26/2003-Customs dated 1 March 2003 (entry substituted at S. No. 248 of the table in the said notification)} Subject to conditions mentioned in the notifications.

New incentives proposed by Centre for Policy Research:

1. It requires considerable efforts to avail the R & D incentives from the public fund. Need to streamline the process.
2. In India, R&D expenditure by private sector includes: Plant & Machinery, Materials & Consumables, Utilities & Services. Following items are not covered: Expenditure incurred on land and building (for R&D); Cost of using R&D infrastructure of public institutions, Funds provided by industry to research scholars in institutions for industrial research, Cost of development for R&D, Cost of IP purchased as sub components of final R&D output, Cost of patent filing/maintenance, Investments by Venture Capitalists in technology ventures. However, other countries, expenditure under these items fall under R&D category.
3. Write off loan, in case of genuineness of the failure of the R&D by private sector.
4. To encourage R&D by small businesses, Govt. should provide financial guarantees, as is the case in Germany.
5. Partial financial support by the government for the setting up of "**Demonstration Scale-up Level**" plants by the industries. This stage is last part of the series of steps involved prior to the commercialization of technology developed by the industries and involves high expenditures to the tune of thousands of crores of rupees.
6. A fixed percentage of commercial products, developed through R&D under PPP mode, should be purchased by the Govt.
7. Adoption of robust confidentiality agreement in public institutions for joint R&D.
8. Securing of loans against IP of the companies
9. Creation of Special Fund for global partnership in R&D by Public and Private sector.
10. Tax incentives to private sector for setting up of pilot plants and semi-commercial level plant infrastructure in public funded institutions.
11. Extend R&D incentives to companies such as beer, wine and other alcoholic drinks; confectionary, tooth pastes, steel furniture etc. These private sectors have been restricted for seeking R&D incentives.
12. The exit strategy needs to be specified at the onset of each Programme/Project.
13. A right mix of loan, equity and grant-in-aid according to the stage of technology development and risk factor involved in PPP mode.

FUTURE ACTIVITIES
(2016-17)

Preparation of Reports :

- Industry-Academia Regime in IITs established before the year 2000.
- Biotechnology Industry Research Assistance Council (BIRAC): A Public Private Partnership Agency.
- ICT, Mumbai: Leading Industry-Academia Institute (Chemical Sector).
- Status of Industry-Academia Activities of Universities and IITs.
- Programmes/Schemes for Promoting Industry-Academia Linkages in India.
- Case Studies on Feedback from Select Scientists Engaged in Industry-Academia Collaborative Research Projects.

Drafts of Policy Documents :

- Promotion of Industry-Academia Interactions in the Higher Education Institutes.
- Development of a New Country Specific Model for Promotion of Public Private Partnership (PPP) for R&D.
- Intellectual Property Status in the state of Punjab and Chandigarh.
- Stimulation of Private Sector Investment in R&D.

Creation of E-Portals :

- Industry-Academia Web Portal' of the Chandigarh Region Innovation and Knowledge Cluster (CRIKC)
- Creation of E-Portal (Industry-Academia)
- Creation of E-Publication (Industry-Academia)

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