



Draft for

UNIVERSITY–INDUSTRY (or UNIVERSITY-BUSINESS) LINKAGE PROGRAM

for

UGC, NEW DELHI

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University-Business Linkage for Enhancing R&D in India

Introduction: It is a well-acknowledged fact that in the 21st century development of nations is closely linked to their depth of Science, Technology and Innovation (STI). Developed nations score heavily in the science related indicators as measured by the latest Global Innovation Index (GII) Report published in 2018 (<https://www.globalinnovationindex.org/gii-2018-report>). By and large, the performance of developing economies in these indicators is much below expectations. Of late, serious efforts are being made by developing countries to improve their index of STI and the results have started pouring in.

Till mid-20th century, nations like India, S. Korea, Singapore, Taiwan and China were considered poor and struggling economies. However, except India all the above mentioned nations have catapulted into the category of strong economies mainly due to the dynamic and pragmatic approaches of the respective governments for strengthening their innovation ecosystem including the healthy and symbiotic relationship between public (academia) and private (industries) sectors for generating economic and societal innovations.

It is well established that developed countries have reaped immense benefits from university-industry collaborations in the field of R&D even though the goal and mission of academia and industry are wide apart. Academia pursues excellence in the domain of knowledge, whereas industries aim towards commercial gains. However, the success of both entities is dependent on each other. Industry looks up to academia for R&D solutions and universities seek industry-involvement for commercialization of research carried out in their laboratories (Fig.1).

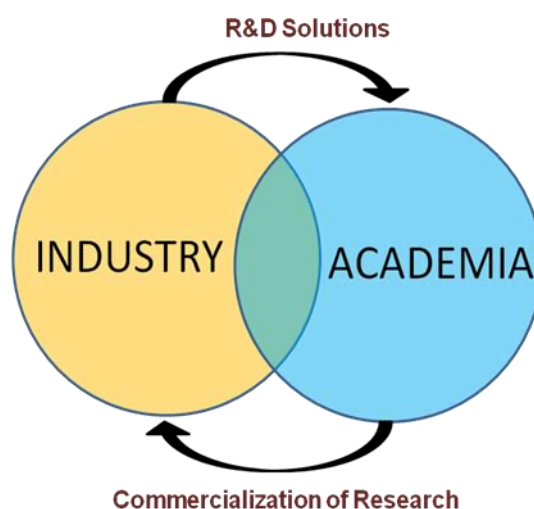


Figure 1: Aspirations of Academia and Industry from each other

As per GII-2018 Report (<https://www.globalinnovationindex.org/gii-2018-report>), developed countries such as Switzerland, USA, and Israel are the top three leaders in the parameter 'University-Industry Collaboration'. Unfortunately, India is ranked 26 despite having a vast network of HEIs (>850 universities; central universities: 48; state universities: 392; state private universities: 317; deemed to be universities: 125)(<https://www.ugc.ac.in/oldpdf/Consolidated%20list%20of%20All%20Universities.pdf>). In recent years, one of the major concerns for policy-makers in India has been to ensure the seamless transfer of wealth of scientific knowledge generated by academia to industry for commercial success.

Hence, it is imperative to strengthen University-Industry Collaborative Framework for R&D which can only be achieved through beefing up the synergistic activities between the two. The Government earnestly desires that industry and universities should work hand in hand for nation building, as is the practice in developed nations. To stimulate Industry-Academia R&D collaborations and make evidence-based recommendations to the government, DST, GoI has set up a 'Centre for Policy Research' at Panjab University, Chandigarh (<http://cpr.puchd.ac.in/>).The Centre has staff of 5 scientists working on various aspects of PPP in R&D.

In accordance with the tasks delegated to the Centre, DST-CPR at PU, Chd. has served as a forum to bring the Industry and Academia together by means of Conferences/ Seminars/ Symposiums, which have been patronized by **Dr. V.K. Saraswat** (Member NITI Aayog); **Dr. V.K. Paul** (Member, NITI Aayog); Dr. K

VijayRaghavan (Principal Scientific Advisor to GoI); **Dr. Arabinda Mitra** (Scientific Secretary, Office of the Principal Scientific Advisor to GoI); **Dr. Girish Sahni** (Ex-DG, CSIR); **Dr. Anil D. Sahasrabudhe** (Chairman, AICTE); **Dr. G.D. Yadav** (Vice Chancellor, ICT, Mumbai); **Dr. V.M. Katoch** (Fmr. DG, ICMR); **Dr. Anil Wali** (MD, FITT-IIT-Delhi); **Mr. Rajendra Mootha** (COO, IIT Madras Research Park); **Ms. Deepanwita Chattopadhyay** (Chairman & CEO, IKP Knowledge Park) and various Directors of National Research Laboratories, representatives from various Industry associations and the Industry (Reliance, Monsanto, Infosys, HCL, Mother Dairy, Panacea Biotech etc.). The outcomes of the meetings have been submitted in the form of Reports (9) to DST, GoI, New Delhi (<http://cpr.puchd.ac.in/archives/>). In addition, DST-CPR has published 2 books and two are in the pipeline (to be released in the year 2019).

Published books:

- Industry-Academia R&D Ecosystem in India
(<http://cpr.puchd.ac.in/wp-content/uploads/2017/05/Industry-Academia-RD-Ecosystem-in-India.pdf>)
- Mapping Patents and Research Publications of Higher Education Institutes and National R&D Laboratories of India
(<http://cpr.puchd.ac.in/wp-content/uploads/2016/09/Book-2-PDF-min.pdf>)



Figure 2: Books Published by DST-CPR at PU, Chandigarh.

Forthcoming Books:

- Public - Private Partnerships in R&D.....*a global perspective*
- Incentivization of Private Sector for Enhancing Investment in R&D.....*a global outlook*

In India, many government agencies, industries/industry associations and financial institutions have floated programmes/schemes for strengthening Industry-Academia co-operation for the generation and conversion of knowledge based- innovations into products/ technologies for commercial or societal gains. A snapshot of the public-private partnership in R&D programmes/schemes, compiled by DST-CPR, is presented in Annexure-1. The data presented in the table indicates that it is not only the public sector, which is funding various schemes for enhancing PPP in R&D but private sector as well as financial institutions are also contributing (financially) towards industry-academia partnerships. From the table, it is also observed that UGC has only one programme, 'University-Industry Inter-Linkage Centres (UIL Centres)', whereas other agencies/organizations have floated many schemes. It is high time UGC becomes pro-active in promoting University-Industry (Business) activities by launching new programmes/schemes.

Recommendations for UGC for Promoting

'University-Business Interactions'

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1. Setting Up of 'University-Business Council'

UGC is the most important higher education body for guiding and regulating the activities of universities and colleges in India. It started the journey of promoting industry-academia (I-A) interactions by setting up University-Industry Linkage programme. Unfortunately, it did not make any significant impact. To provide a new vigour to the endeavours of UGC to boost public-private co-operative research and innovation, it is suggested UGC sponsored University Business Council (UBC) be established which acts as an over-arching body for advising, formulating as well as implementing various I-A schemes/promotions in the universities and colleges. The Head Quarter of UBC may be located in UGC HQ in Delhi or in a university. UBC will have 3 important components: Academic Body, Executive body and Office of UBC (Figure 3).

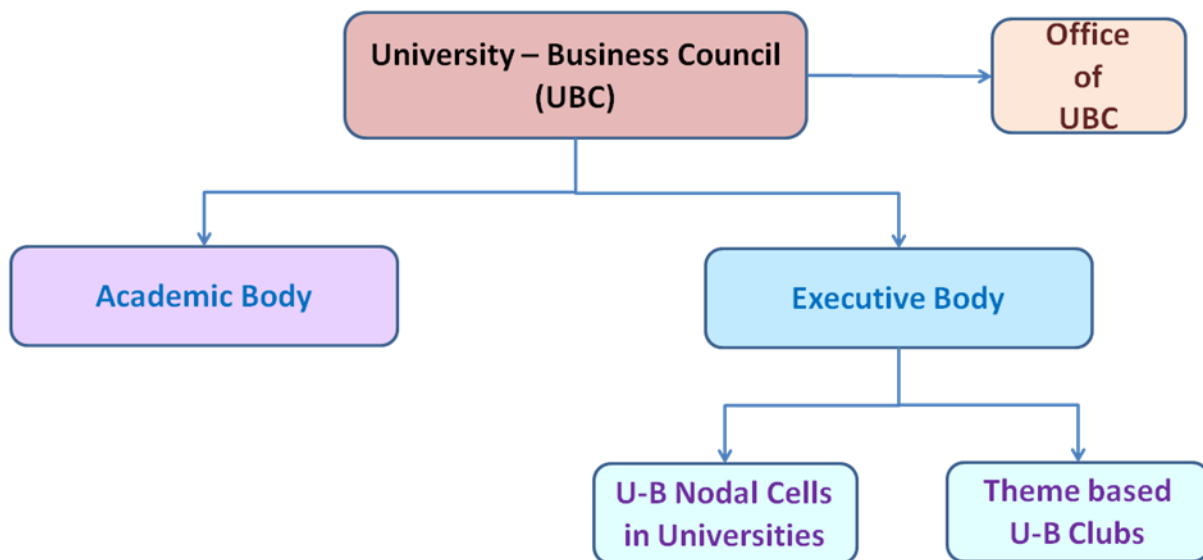


Figure 3: University-Business Council Framework

Academic Body – the most supreme body of UBC. It should comprise of 7-8 members representing three important pillars i.e. academia, industry and financial institutions such as SIDBI, NABARD, ICICI, SBI, etc. These financial institutions have floated schemes for promotion of innovation via public-private collaboration. They can also guide UGC pertaining to financial issues of I-A R&D collaborations. The Advisory Body may co-opt members from other relevant organizations such as DST, NITI Aayog, MHRD, AICTE etc. as per the need.

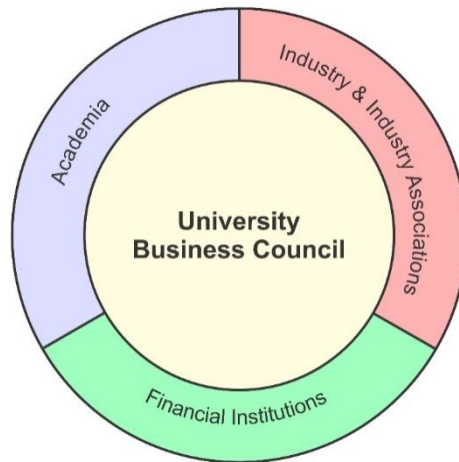


Figure 4: Three pillars of Academic Body of University-Business Council

Executive Body – For execution of the decisions undertaken by the Advisory Body, a 10-12 member Executive Body (EB) may be constituted. EB should be connected with all the universities of India. Though, it seems an improbable proposition, but it can be done by identifying one university in each State as a Nodal University, which will in turn connect with other universities of the State. Nodal Universities will act as a bridge between EB and universities/colleges located in a particular State.

Office of UBC- will act as a 'nerve centre'. Its responsibilities shall include:

- Maintenance of records/data (past, present & future) pertaining to I-A activities of UBC and other agencies and government bodies (Central and State level). This input will be crucial for formulating guidelines/activities for UGC and its affiliated universities/colleges.
- Liasioning with Central and State agencies/organization, universities, industries, industry-associations, national research laboratories, S&T divisions of foreign embassies situated in India, Research/Technology Parks and Incubators (Figure 5).
- Hosting a web portal pertaining to I-A activities, patents and technologies of universities affiliated to UGC. Such activities can be out sourced to a university/agency or carried out by UGC staff.

It will be prudent if a senior faculty member from a university, well conversant with industry-academia ecosystem, is appointed as Coordinator in the Office of UBC for a

fixed time period. This faculty member may be hired on deputation basis, as is the practice in the Office of PSA, GoI, New Delhi.

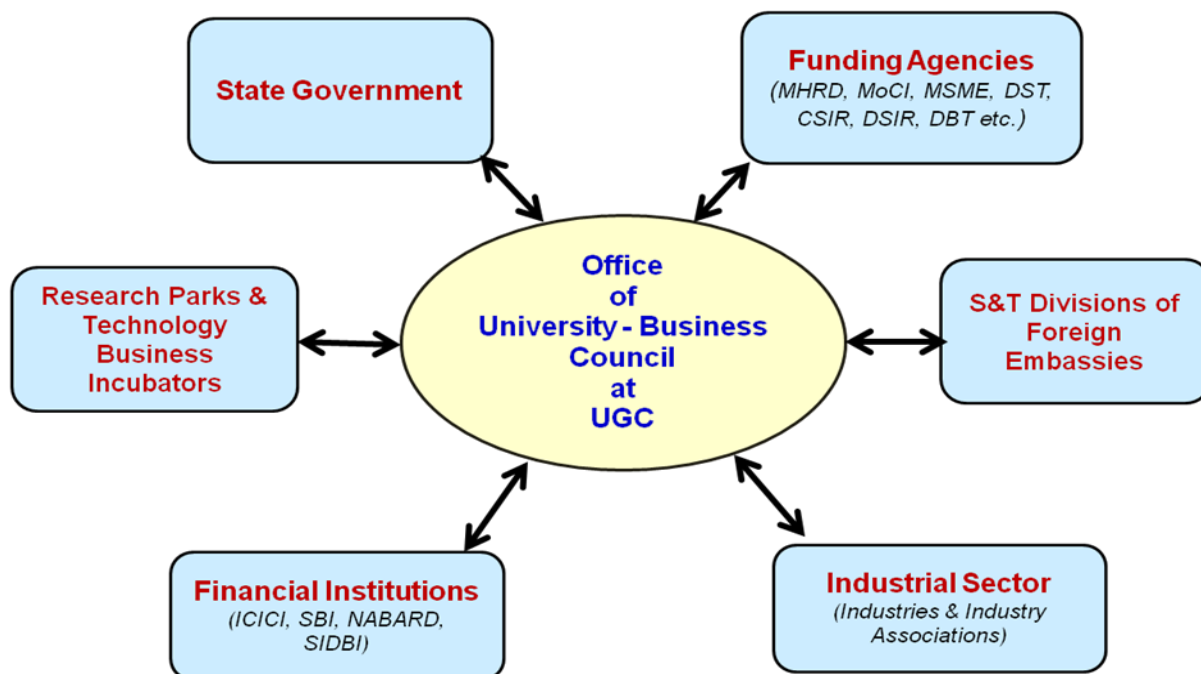


Figure 5: Networking of University-Business Council with different bodies/ agencies/ organizations

2. Creation of UGC-Tech Fund

For filing and maintenance of patents, the scientists of National Research Laboratories (CSIR DRDO, DBT, DoS, ICAR, DAE etc.) are financially supported by their respective funding agencies. Unfortunately, UGC does not provide such financial help to its scientists/researchers. There are only a handful of universities which provide partial financial assistance to their researchers/scientists. A university professor has to either shell out money from his/her own pocket or look towards TIFAC and NRDC, which have a limited amount of funds. As UGC is emphasising on stimulating ‘Translational Research’ in the universities, it is suggested that UGC may set up a dedicated budget called UGC-Tech Fund, which can be used by university/college teachers/researchers for filing and maintenance of the patents.

UGC-Tech Fund may seek inputs from the United Kingdom’s ‘Higher Education Innovation Fund’ (<http://www.hefce.ac.uk/>), designed to support knowledge transfers;

engage in networking with business; establish liaison and technology transfer offices to provide advice and to negotiate consultancy assignments, contract, collaborative research projects, and license agreements; establish spinouts; provide entrepreneurship training for science and engineering graduates; and provide work placement for students in the industry.

3. Setting up Value Creation Centres (VCCs) in the Universities

A scientist's forte is to pursue research. He/she is not fully conversant with the nuances of commercialization of technologies/products such as drafting a business proposal, prior-art search of patents, patent drafting and filing, protection from patent infringements, identifying suitable industry, assessing the legitimate value of the patent-licensing or technology to be transferred, technology-transfer protocols and much more. For taking laboratory research to market, it is imperative that universities, especially research oriented universities, should have a dedicated VCC which caters to the following tasks:

- Industry-Academia Cell
- Intellectual Property Cell,
- Technology Transfer Office
- Entrepreneurship Cell
- Business to Market Cell
- Legal Cell

VCC should be actively involved in

- developing a strong network with financial institutions, angel investors and venture capitalists for raising funds needed for successful R&D findings (of the institute)
- assisting budding entrepreneurs and Start-Ups.
- act as an interface between industry and academia
- present itself as a vibrant place by conducting seminars/conclaves/special talks by industry personnel, successful entrepreneurs, financial wizards etc.

In many IITs (primarily first generation IITs) and IISc-Bangalore, such facilities as mentioned above already exist. It is suggested that UGC may set aside funds for the

establishment of VCCs in research oriented universities, which could be identified based on the R&D related parameters of NIRF. It is advised that such centres should be autonomous and registered as a *not for profit* body under Section 8 of The Companies Act - 2013, in order to avoid the administrative red tape existing in the public funded institutes.

Recently, DST, Gol has identified a few universities for setting up of Technology Enabling Centres (TECs). These Centres will have whole-time experts for providing assistance to scientists/researchers in matters related to translational research (patenting, preparing a business proposal, acting as a bridge between academia and industry, financial guidance and so on). DST, Gol will provide all the financial assistance to TECs for first five years. Subsequently, these will have to self-support themselves. A programme on the similar lines, under the ambit of VCCs may be initiated by UGC.

4. Setting up Industry specific Web Portals

Even though a sizable number of Indian scientists (universities and R&D institutes) are conducting applied research and generating patents, the private sector finds it difficult to access this information, due to the absence of a platform where such information is displayed. Also, there is no platform which connects Indian industries to the academia for seeking solutions for their R&D related problems. Similarly, academia finds it hard to identify an industry which might be interested in the applied research being carried out in the universities or research labs. In other countries, I-A web portals have become an important tool for bringing Industry and Academia closer to each other. For example, in Japan there are many web portals (mentioned below) which act as bridge between industry and academia for working towards innovative R&D.

- **J-STORE** (JST Science Technology Research Result Database for Enterprise Development) is a free database, which provides the results of research undertaken by the public research institutions and universities, as collected by the Japan Science and Technology Agency (JST). It aims at technologically transferring research results to enterprises and encourages the commercialization of research results.

- **Portal site for I-A-G Collaboration (Japan):** The “Industry–Academia–Government Guidepost” website provides a wide range of information related to I-A-G collaborations.
- **Industry-Academia-Government Collaboration Support Database** (<http://sangakukan.jp/shiendb/>): Provides following information- R&D Support programmes of funding agencies, financial assistance programmes by Foundations and other bodies, Venture Capital and Events related to I-A-G collaboration.
- In India, similar web portal (iacrikc@puchd.ac.in) has been created in which industry relevant information (Patents, Technologies, Instruments, Scientific expertise, Centres of Excellence etc.) of nearly 30 institutes (Universities, National Research Laboratories, Medical institutes, Engineering institutes, and Management institutes) located in and around Chandigarh has been uploaded. The portal is known as Chandigarh Region Innovation and Knowledge Cluster (CRIKC) I-A web portal (<https://iacrikc.puchd.ac.in>). I-A CRIKC web portal has been appreciated by the office of Principal Scientific Advisor to GoI, NITI Aayog members and many more.



It is suggested that UGC may fund for the establishment of ‘State level I-A Web Portal’ on the lines of Chandigarh Region Innovation and Knowledge Cluster

(CRIKC) I-A web portal (<https://iacrikc.puchd.ac.in>). This responsibility may be allocated to one of the universities in the State. Creation of such I-A web portals will be a benchmark in enhancing I-A interactions. It is suggested that each university be mandated by UGC to upload information related to *Availability of scientific expertise, Patents (filed/granted), Technologies (transferred/available, under development), Scientific-infrastructure, Industry- Academia research collaborations, Consultancy projects undertaken, Technology Business Incubators and Start-ups* in a prescribed format, so that it is easier to collate the relevant information on a single UGC sponsored web portal.

5. Creation of Innovation Clusters

By and large, addressing the industries' research-problems or development of an industry-ready prototype by university researchers require multi-disciplinary approach. Usually, such multiple disciplines (of profession) are not present in a single institute. For example, developing a medical diagnostic kit requires the active participation of biologist and engineers (mechanical, electronic etc.). Therefore, creation of an academic cluster (virtual) is highly desirable. It is recommended that HEIs and national research laboratories located in close proximity should form an Innovation Cluster, which acts as a single window to solve the R&D related problems of the industries. Such academia clusters should develop contacts with local industries and also other industries located elsewhere in India and abroad. Such Clusters are quite common in other countries. UK has a N8 Cluster, also known as N8 Research Partnership. It is a collaboration of the eight research intensive Universities in the North of England: Durham, Lancaster, Leeds, Liverpool, Manchester, Newcastle, Sheffield and York. Working with universities, industry and society, N8 aims at maximizing the impact of research base by:

- promoting deeper collaboration between universities, business & society
- establishing innovative research capabilities & programmes of national and international prominence
- driving economic growth by generating income, supporting jobs and new businesses

It is further added that the idea of having knowledge cluster/hub has its genesis in the 'Narayan Murthy Report' April 2012, commissioned by Planning Commission on

'Corporate Participation in Higher Education'. This also finds echoed in the 'Knowledge Commission Report' of GOI. Further, the idea of having a knowledge cluster/hub is also inclusive of the 'Meta-University' concept, being advocated by MHRD, GOI in its RUSA document. Furthermore, 'Science, Technology and Innovation Policy (STI), 2013 ' of GOI also refers to clusters/hubs as tools for innovations. Of late such a few academia clusters have come up in India e.g. Chandigarh Region Innovation and Knowledge Cluster (CRIKC), Research and Innovation Circle of Hyderabad (RICH). The aim of these clusters/hubs is to promote excellent research (fundamental and applied). UGC may set aside funds for Cluster formation, especially in cities where large number of HEIs, National research labs and industrial hubs are located e.g. Bangalore, Chennai, Mumbai, Delhi, Pune, Dehradun, Nagpur, Mysore, Lucknow, Kanpur, Bhuvneshwar, Guwahati etc.

6. Setting up Industry – Academia Chairs

Setting up of 'Industry-Academia Chairs' in the universities aims at appointing representatives (from academia and industry) that push development of business oriented applied research at universities. Creation of I-A Chairs and appointment of such personnel as Chair Holders can enable the realization of the following objectives -

- Increased delivery of innovative applied research solutions to local companies at the community and/or regional level
- Increased participation of faculty and researchers in applied research activities
- Increased opportunities for students to gain industrial problem-solving experience
- Increased knowledge and technology transfer between universities and companies, with the objective of increasing the productivity and competitiveness of local companies, particularly Small and Medium-sized Enterprises (SMEs)

It is suggested that UGC alone or in association with other funding agencies/industries may set up at least 20 such Chairs in the universities.

7. Mandatory Linking of HEIs with Industries

Industries and academia have their own strengths and limitation in pursuing scientific research. Universities are rich in intelligentsia and manpower but lack in power of carrying out translational research. On the other hand, industries have sound knowledge of translational research work, aware of demands of futuristic innovations, but face glitch of R&D funding and availability of requisite scientific expertise. Handholding of industries and academia can overcome the limitations of each other, in the pursuits of innovations for societal as well as economical needs. Therefore, it is suggested that-

- a) Research-oriented universities be mandated to tie up with at least 5 industries, preferably medium and small scale industries for pursuing innovative research.
- b) There are nearly 2000 DSIR certified R&D units of the industries, which avail lots of benefits, in the form of direct and indirect benefits, from Gol for pursuing industry oriented research. It may be good idea if industries having DSIR certified R&D units are mandated to tie up with at least 2 universities.
- c) In India, each district of a State has District Industry Centres (DICs) which are the focal points for promoting Small and Medium Sized Enterprises (SMEs) located in a particular area and facilitating them with all the necessary services/facilities required for their development. For solving their R&D problems it is advisable that such industrial units are linked with the universities located in that State, which can offer technical and mentoring services. If the need be, both the stakeholders can jointly apply for research grant to various funding agencies for product development and improvement.

8. Linking Universities with Local PICs

It is now an accepted fact that, an overwhelming percentage of teaching faculty in the universities has little knowledge of IPR. Unless the teaching community is IPR savvy, it cannot emphasize the importance/necessity of IPR to the young students/researchers.

To promote the spirit of IPR, Technology Information Forecasting and Assessment Council (TIFAC), Gol has established 20 'Patent Information Centres' (PICs) in

various States of India for providing assistance towards patent filing by public and private sectors. Panjab University, Chandigarh is the IPR Nodal Centre of PIC for State of Punjab. PU has immensely benefitted from PIC-Punjab by collectively organizing IP seminars and workshops, assistance/guidance in Patent search/filing and many more.

In addition, Department of Industrial Policy and Promotion (DIPP), Gol has created a Cell for IPR Promotion & Management (CIPAM) for creating awareness about IPR. CIPAM has been mandated to deliver IPR-related talks/workshops all over India. In order to strengthen the IPR regime of universities, UGC may pass a directive to research oriented universities to partner with at least one PIC and CIPAM. Efforts should also be made by the universities to establish a 'Patent Nodal Centre' in the campus under the aegis of PIC.

9. Mentoring of Universities by IIT and IIM

It is a well acknowledged fact that the IITs of India rub shoulders with globally top ranked universities in the domains of generation of skilled manpower, R&D, I-A research collaborations, consultancy, start-ups and generation of crores of rupees for the institute by licencing out patents/technologies, contract research and consultancies. A study carried out by DST-Centre for Policy Research at Panjab University, Chandigarh on S&T parameters of IITs indicated that IITs are generating a significant amount of revenues running to hundreds of crores of rupees by converting their academic knowledge into commercial entities (patents/technologies/consultancies/start-ups) is mentioned in Table 1.

Table 1: Science and Technology Indicators of First Generation IITs

| IP Attributes | IIT-Kharagpur | IIT-Bombay | IIT-Madras | IIT-Kanpur | IIT-Delhi | IIT-Guwahati |
|--------------------------------|---------------|------------|------------|------------------------|-----------|--------------|
| Publications (2014-15) | 2162 | ~1500 | 1194 | 1298 ⁽²⁰¹⁴⁾ | 1300 | 1250 |
| Patents (2010-15) Filed | 231 | 569 | 239 | 204 | 146 | 37 |
| Granted | 13 | >61 | 25 | 9 | 25 | 6 |
| Technology available | 214 | 409 | 358 | 6 | 50 | 05 |

| | | | | | | |
|-----------------------------|----|------|----|----|----|----|
| Technology | 24 | >140 | 60 | 60 | 15 | 06 |
| Licensed (till date) | | | | | | |

Source: <http://cpr.puchd.ac.in/wp-content/uploads/2017/05/Industry-Academia-RD-Ecosystem-in-India.pdf>

Looking at the stupendous success of IITs, Gol has established many new such institutes all over India. Each new IIT is being mentored by an old IIT e.g. IIT-Ropar is being mentored by IIT-Roorkee.

In India, there are a handful of universities (around 50), which are regularly publishing large number of research papers in reputed journals but are poor in the domain of patents/technologies. These universities are devoid of value chain needed for converting scientific knowledge into innovative product/technology. To boost the generation of skilled manpower and translational research in such universities, it is suggested that universities having strong potential in the area of applied research be guided/mentored by the faculty of IITs. Such a venture will certainly assist the faculty and researchers of the institutes to convert their academic wealth into commercial success by means of patents, technology transfers etc.

As majority of the public funded universities are financially starved it is suggested that select universities having the potential of applied research be guided/mentored by the faculty of Management Institutions such as IIMs and ISBs.

10. Sabbatical Leave (Industry-Academia) for Faculty Members

Teaching faculties of the universities in India are not well acquainted with the industrial environment, latest technological advancements and the allied needs of the industries. They are therefore unable to imbibe the same in their academic curricula and undertake and publish research with little relevance to industries.

To overcome these concerns, it is suggested that universities should create avenues for the teachers especially working in the fields of Life Sciences, Biotechnology, Microbiology, Pharma, Nanotechnology, Agriculture, Engineering and even basic sciences (Chemistry, Physics, Botany etc.) to spend some time in the R&D units of the industries. Mobility of such teachers/scientists from universities/colleges to industries, with full pay protection along with an honorarium should be encouraged. It is suggested that UGC create a provision of 'Sabbatical Leave (I-A)' for the faculty

members with full pay protection along with an honorarium, should be encouraged. This provision will act as a strong instrument for developing and strengthening linkages between university and industry. A university professor spending one or two semesters with an industry will not only enhances personal relations between him/her and industry/industrial personnel but also makes way for the involvement of graduate students leading towards masters or doctoral degree research. The faculty visitor is immensely benefitted by means of follow on contacts, learning of novel methods and technological developments, and so on, and the industrial host benefits through being introduced to academia ecosystem. Another very important advantage of Sabbatical leave is that it brings real-life relevance to the research at the universities and is a way to periodically revise the curriculum according to the demands of the industry. Sabbatical leaves also help in exploring unmapped avenues of research, specifically those that may be indispensable for the industry.

11. Introducing I-S schemes for Students, Post-docs and Researchers

In order to prepare industry ready manpower and stimulate the concept of translational research in young minds, many governments have put in place dedicated programmes at UG, PG and PDF levels. To promote I-A R&D, Canada has introduced many schemes which are as follows:

- **Mitacs-Accelerate:** Industry oriented R&D internships for **graduate students** that foster the transfer of technology and its commercialization. 'Mitacs-Accelerate' enables Canadian companies and not-for-profit organizations to address their business needs through research partnerships with the country's top universities, professors, and graduate students. For over a decade now, the Accelerate program has offered work-integrated learning opportunities that support demand driven research projects that stimulate innovation. This program promotes cutting edge R&D, and cultivates a skilled-workforce that is innovation-literate
- **Mitacs-Elevate:** Industrial R&D management training and industrial research experience for postdoctoral fellows through classroom and on-site learning. 'Mitacs-Elevate', a **fellowship program for postdoctoral candidates**, which includes tailor-made research administration training. This training program's duration is of 2 years during which the postdocs assume and pilot a research

project. Throughout the 2 year period, the fellows are provided with empirical as well as experimental guidance and training in R&D through the means of their research collaborations (industry-academia) and the curriculum of the programme. The fellows gather skills related to articulation, delivery, management, supervision and other significant business abilities pertinent to research management careers in both industry and academia. These opportunities and prospects provide skills complementary to their specialization ensuring that the trained fellows are capable of leading large-scale projects in their future careers.

- **Mitacs-Step:** Develop business-ready skills through workshops for **graduate students and postdocs** led by industry leaders. The 'Mitacs- Step' programme provides workshops for development of professional skills. These workshops are aimed at training graduates and postdoctoral students, and endowing them with skills that prepare them for workplace. The training program is designed in accordance with the requirement of the employers. The training supplements their research experience and specialization with the tools necessary for commercial success. The workshops are conducted by experienced and leading personnel from the private sector and industry who themselves have to undergo a highly spirited selection process for being chosen to become a workshop facilitator. The facilitators are experts and are proficient in their relevant fields and also possess immense knowledge for succeeding professionally. Workshops offer prospects for hands-on, winning, and empirical education.

To give a boost to I-A interactions/collaborations similar programmes may be introduced by UGC in universities/colleges for imparting industry oriented courses and carrying out applied research.

12. Creation of Industry Supported Centres of Excellence in Universities

The CoEs existing in many institutes (IITs, universities, colleges and R&D institutions) are successful examples of pursuing R&D under PPP mode. These CoEs have been established under bipartite (government-industry/academia-industry) and tripartite (government-industry-academia) models of PPP. Most notable examples of such CoEs are Telecom Centres of Excellence (TCOEs) in IITs, IIM-

Ahmedabad and IISc-Bangalore. Creation of TCOEs under PPP mode has led to generation of mobile solutions for their respective industrial partners. The Centre of Excellence in Wireless Technology (CEWiT) in IIT-Madras and National Centre for Flexible Electronics (FlexE) in IIT-Kanpur are yet another examples of successful CoEs. The existing CoEs under PPP mode are playing a catalytic role in the industrial growth (R&D) and strengthening of industry-academia linkages.

It is suggested that UGC may set aside special funds for the creation of 'R&D Centres of Excellence' under PPP mode in HEIs. Such centres should come up only if a university/institute is in long term agreement with industry (Pharma, IT, Electronics, Nanotechnology, Environment, Automobile, Chemical, Food, Aviation, etc.) and has ample of space and infrastructure for supporting the CoE.

13. Industry-Academia Schemes

Research is the backbone of innovation in both academic as well as the industrial sector of a modern economy, making the foundation for development of new products/processes/services, which can be advanced through the means of entrepreneurial activities, transfer of knowledge and technology etc. The academia accomplishes new ideas and knowledge and the industry patronizes the translation and conversion of the wisdom and ideas into technologies for practical application. Thus, research in both these sector enhances and complements each other in a huge manner and consequently it is imperative for the two, to join forces for providing the society with the best available technology and services. While witnessing the global scenario it is evident that the collaborations and linkages between the two have not only empowered the two sectors, but has also led to advancement of technology significantly.

India is home to top quality academic institutes and pioneering industries. Therefore, supporting the engagement of the two sectors will enhance and invigorate the ecosystem tremendously.

These initiatives may be modelled on successful global programmes e.g. –

- *Industry/University Cooperative Research Centres (I/UCRC)* of USA ensure that the research undertaken in these centres at academic setting is in

alignment with the requirements of the industry. The Centre confers with the members, from industry and academia, to decide upon an agenda for research, which focuses on research opportunities and interests that are mutual. NSF provides financial support only 100,000 USD annually for 5 years. To be eligible for NSF support, the Centre has to pledge 300,000 USD from industrial partners and involvement of at least six firms. The Centre is also advocated to engage other universities, in the R&D projects, to ensure activities with a wide research base.

- *Grant Opportunities for Academic Liaison with Industry (GOALI)* of USA is another initiative that aims at promoting I-A partnerships by providing funding/fellowships and opportunities that support a blend of I-A linkages. The programmes allow for mobilization of faculty/ postdoctoral fellows/students to conduct research and gain experience in an industrial setting; industrial scientists and engineers to bring industry's perspective and integrative skills to academia; and interdisciplinary university-industry teams to undertake collaborative research projects. A few examples are mentioned below.
 - An extended (of several months duration) faculty experience in industry to foster industry-university collaboration; or at the beginning of a multiple-year university-based research project to enable hassle-free transfer of research results to industry.
 - Visit of a leading engineer, scientist, or manager from industry to a university, to catalyze collaborative research or teach and develop curricula.
 - Support for one or two semesters of work in industry by a graduate or an undergraduate student under the guidance of an academic advisor;
 - Post-doctoral support for one or two years of work in an industrial setting, under the guidance of an academic mentor in collaboration with an industrial partner
- The *Idea to Innovation (I2I)* programme (Canada) aims at accelerating the development of promising technology and promotes its transfer to companies. It finances the faculty members of the academia to help in R&D projects, which seem to have a profound potential of technology transfer. This is done through a set of phases by giving significant help in the starting stages of validating

technology and accessing market. Four types of funding are available depending on the maturity level of the technology or the level of engrossment of an investment/industrial partner.

- 'Germination Program' of Taiwan, provides a common platform for universities and industries with an aim at providing assistance for building a 'pre-development mechanism' for the advancement of results of research undertaken in institutions and universities into a high-value business model. Govt of Taiwan has set up 8 Germination Centres in the universities.
- Even though UGC can initiate programmes solely it will be prudent if program supporting partnership and association of industries with academia be started in association with MSME and DST, Gol.

14. Incentivization Schemes

Labels: France awards the label "Carnot", which is a certification given to research institutions and institutes of higher education that foster and undertakes collaborative research with industries (SMEs & large corporations). This label was introduced in 2006 and the institutes are rewarded based on their turnover from their activities for the industry.

The Government provides funding to Carnot institutes to expand their scientific and technical skills, to sharpen specialized skills needed to strengthen partnerships with private enterprises, and to provide research based services to private enterprises.

Selection Criteria for institutes to be labelled as Carnot Institutes:

- i) Name recognition of candidate institution in the research field, consistency with research policy in the region, etc.
- ii) Contribution to social issues, strategy for promoting joint research, etc.
- iii) Governance, solid organization structure
- iv) Mechanisms for improving activity quality: acquirement of ISO and other certifications, human resources development strategies, etc.
- v) Intellectual property policy: intellectual property management, utilization strategy, etc.
- vi) Social and economic partnerships, including experience partnering with SMEs
- vii) Scientific and technical capabilities

viii) Actual experience in international collaboration, quality of international partnerships, etc.

ix) Consistency with activity objectives, the Carnot Charter, etc.

The programme is highly successful as the contractual relationships between the Carnot institutes and the industry have grown from €120 million to €470 million in the ten years of programme existence. Hence, UGC may adopt this scheme and award label to universities proactive in interactions with industries i.e. involvement of industry personnel in teaching and governance, private sector investments in the institutes (i.e. scholarships, fellowships, establishing laboratories (teaching/research), Centres of Excellence), collective organization of seminars/summits/conferences/workshops, consultancy, contractual research and collaborative R&D, and so on. MHRD/UGC may set aside a fund, which can only be used by labelled-universities. The suggestive name for this label could be '**Bhatnagar-Institutes**', after the legendary Indian scientist and the founding UGC Chairman.

Incentives: cash or kind (funds to attend international conferences, less teaching load, Reforms in Promotion Criteria for Teaching Faculty

15. Theme based Research Institutes on the basis of PPP Model

At the request of chemical industry Maharashtra State government set up Institute of Chemical Technology (ICT), Mumbai (<http://ictmumbai.edu.in/>), earlier called University Department of Chemical Technology under the University of Mumbai. The pundits of science and technology consider ICT-Mumbai as an exemplary model of one industry-academia partnership. It has more than 230 industry sponsored projects worth ₹84.7 crores, generated more than 500 first generation entrepreneurs, scores of patents have been granted and over 300 are in the pipeline. The remarkable progress of ICT-Mumbai in the domains of higher education and research has catapulted ICT-Mumbai as an autonomous deemed to be university.

In 2017, Gol passed an act 'Indian Institutes of Information Technology (Public-Private Partnership) Act-2017' which allows creating of Polytechnics and Indian Institutes of Information Technology (IIITs) under MHRD, via PPP mode. For example, IIITs have been established with a capital cost of around ₹ 128 crores per

institute, with central government, state government and industrial sector contributing in the ratio 50:35:15 respectively.

For taking this initiative forward Gol or State governments may start a dialogue with Industries leading in R&D investment (over ₹ 1000 crores) such as TATA, RIL, Mahindra and Mahindra etc. A society, charitable trust or Section 25 company operating under PPP mode can undertake the responsibility of establishing HEIs. Some of the large corporates have set up private institutes of higher learning and research e.g. Dhirubhai Ambani-Institute for Information and Communication Technology at Gandhinagar, Birla Institute of Technology and Science (BITS) at Pilani, Goa, Dubai and Hyderabad, Apeejay Satya University at Gurgaon, Azim Premji University at Bengaluru, Shiv Nadar University in Noida etc. All these private institutions are doing very well in the domain of R&D. To attract more private investment in such ventures, it is suggested that the government lay down attractive norms e.g. providing land at a nominal cost, for increased participation of industries/industry associations/philanthropists.

16. Creation of TBIs, Accelerators and Science Parks in Universities

TBIs, Accelerators and Science/Technology/Research Parks are ideal platforms for generating entrepreneurship/start-ups carrying out translational research, industry-academia collaborative research, R&D by entrepreneurs/companies having limited financial resources, and scale-up studies. These places are excellent examples of private sector utilizing the infrastructure developed by the public sector. It is recommended that TBIs be set up in all universities and public funded R&D institutes, which are excelling in scientific publications and possess support mechanism for creation of TBIs and science parks in terms of land, building, instrumentation and other required infrastructural support.

17. Re-look at the Promotion Criterion of University Faculty

The promotion criterion for university-faculty is heavily tilted towards research publications. The promotion of university/college professors can easily be met by publishing a few research papers and completely ignoring Intellectual-Property (IP) component and Industry-Academia (I-A) tie-ups (R&D, consultancy, industry visits, etc.). Secondly, allocated scores for 'Research Publications' and 'Patents' is 8 and 10 respectively, even though publishing a research paper is much easier than

patenting. Also, rules are silent whether a patent score of 10 is meant for patent filed or patent granted. It is suggested that, 'patent filed' and 'research publication' may be scored at par i.e. 10, but 'patent granted' should be allocated a score of 15. In addition, if a patent is licensed out to a firm/company the score should be increased to 20.

18. Revisiting National Institutional Ranking Framework (NIRF)

In 2015, MHRD introduced NIRF for holistic evaluation and ranking of Higher Educational Institutions of India. The NIRF-2018 framework includes five basic parameters on which an institution is evaluated. Each parameter has been allocated 100 marks. One of the five parameters i.e. "Research and Professional Practice" has four sub-parameters:

- Number of Publications (35 Marks)
- Quality of Publications (35 marks)
- IPR and Patent Profile (15 Marks) *(It includes earnings from Patents)*
- Footprints of Projects, Professional Practice and Executive Development Programmes (15 marks) *(It includes earnings from Consultancy)*

The marks allocated to Publication Profile (Number and Quality) are distinctly much more than the combined marks (<35) allotted to IPR, Patent, Patent-earnings and Consultancy. The Central Government is pushing for enhanced innovations from HEIs and have introduced various schemes for stimulating innovation culture/ecosystem. It is suggested that marks allocated to the sub-parameters ('IPR and Patent Profile', and 'Footprints of Projects, Professional Practice and Executive Development Programmes') be enhanced significantly so that HEIs take this aspect seriously.

Annexure-I: Major Public Private Partnership Programmes in R&D Initiated by Various Agencies/Organizations

| S. No. | Department/Agencies | Programmes/Schemes/Initiatives |
|-------------------|---|---|
| Government | | |
| 1. | Department of Science and Technology (DST; www.dst.gov.in) | <ul style="list-style-type: none"> ➤ India Innovation Growth Programme 2.0 ➤ Technology Development Program (TDP) |
| | a) Science and Engineering Research Board (http://www.serb.gov.in) | ➤ Prime Minister's Fellowship for Doctoral Research |
| | b) National Science & Technology Entrepreneurship Development Board (NSTEDB; http://www.nstedb.com/) | ➤ National Initiative For Developing And Harnessing Innovations (NIDHI) |
| 2. | Technology Development Board (http://tdb.gov.in/) | <ul style="list-style-type: none"> ➤ Financial Assistance Programme (TDB) ➤ Seed Support Scheme & Venture Capital Fund |
| 3. | Global Innovation and Technology Alliance (GITA; www.gita.org.in) | <ul style="list-style-type: none"> ➤ Bilateral programmes ➤ Multilateral programmes ➤ Technology Acquisition Fund Programme |
| 4. | Technology Information, Forecasting and Assessment Council (TIFAC; www.tifac.org.in) | <ul style="list-style-type: none"> ➤ Advanced Composites Programme ➤ Revolving Technology Innovation Fund |
| 5. | Department of Scientific and Industrial Research (DSIR; www.dsir.gov.in) | <ul style="list-style-type: none"> ➤ Patent Acquisition and Collaborative Research and Technology Development (PACE) ➤ Promoting Innovations in Individuals, Start-ups and MSMEs (PRISM) ➤ Consultancy Promotion Programme (CPP) |
| | a) Council of Scientific and Industrial Research (CSIR; www.csirhrdg.res.in) | ➤ New Millennium Indian Technology Leadership Initiative' (NMITLI) |
| | b) National Research Development Cooperation (NRDC; www.nrdcindia.com) | ➤ Knowledge Management system for Technology Promotion |
| 6. | Biotechnology Industry Research Assistance Council (BIRAC; http://www.birac.nic.in) | <ul style="list-style-type: none"> ➤ Small Business Innovation Research Initiative (SBIRI) ➤ Biotechnology Industry Partnership Programme (BIPP) ➤ Promoting Academic Research Conversion to Enterprise (PACE) |
| 7. | Ministry of Electronics and Information Technology (MeitY; www.deity.gov.in) | <ul style="list-style-type: none"> ➤ Multiplier Grant Scheme (MGS) ➤ Modified Special Incentive Package Scheme(M-SIPS) |
| 8. | Ministry of Micro, Small & Medium Enterprises (M/o MSME; http://msme.gov.in) | ➤ A Scheme for promoting Innovation, Rural Industry & Entrepreneurship (ASPIRE) |
| 9. | Indian Council of Agricultural Research (ICAR; www.icar.org.in) | ➤ <i>National Agriculture Innovation Fund</i> |
| 10. | Department of Pharmaceuticals (http://pharmaceuticals.gov.in/) | ➤ Cluster Development Programme for Pharma Sector (CDP-PS) |
| 11. | Department of Industrial Policy and Promotion (DIPP; http://dipp.nic.in/) | ➤ Invest India |
| 12. | Defence Research and Development Organization(DRDO; https://www.drdo.gov.in/) | ➤ The DRDO-FICCI Accelerated Technology Assessment and Commercialization (ATAC) Programme |

| | | |
|-------------------------|---|--|
| 13. | Principal Scientific Advisor to the Government of India (PSA; psa.gov.in/) | ➤ Accelerating Growth of New India's Innovations (AGNIi) |
| 14. | Indian Space Research Organization (ISRO; https://www.isro.gov.in/) | ➤ Sponsored Research (RESPOND) |
| Education Sector | | |
| 15. | Ministry of Human Resource Development (MHRD); www.mhrd.gov.in | <ul style="list-style-type: none"> ➤ Institutes Innovation Council (IIC) ➤ Council for Industry Higher Education Cooperation (CIHEC) ➤ Research Parks ➤ Technical Education Quality Improvement Programme (TEQIP) ➤ IMPRINT India |
| | a) University Grants Commission (UGC; www.ugc.ac.in) | ➤ University-Industry Inter Linkage (UIL) Centres |
| | b) All India Council for Technical Education (AICTE; www.aicte-india.org) | <ul style="list-style-type: none"> ➤ Industry Institute Partnership Cell (IIPC) ➤ Innovation Promotion Scheme (IPS) ➤ AICTE-CII Survey of Industry-Linked Technical Institutes 2016 |
| Private Sector | | |
| 16. | Federation of Indian Chambers of Commerce and Industry (FICCI; www.ficci.com) | <ul style="list-style-type: none"> ➤ DRDO - FICCI initiative for Accelerated Technology Assessment and Commercialization (ATAC) ➤ National Knowledge Functional Hub ➤ DST-Lockheed Martin-TATA Trusts India Innovation Growth Programme (IIGP) |
| 17. | Confederation of Indian Industry (CII; www.cii.in) | <ul style="list-style-type: none"> ➤ AICTE-CII Survey of Industry-Linked Technical Institutes ➤ CII-BESU Innovation Centre ➤ Global Innovation & Technology Alliance (GITA) ➤ Prime Minister Fellowship Scheme for Doctorate Research |
| 18. | National Associations of Software and Services Companies (NASSCOM; www.nasscom.in) | <ul style="list-style-type: none"> ➤ Centre of Excellence for IoT and AI ➤ India Innovation Fund |
| Banking Sector | | |
| 19. | National Bank for Agriculture and Rural Development (NABARD) | <ul style="list-style-type: none"> ➤ Credit Linked Capital Subsidy Scheme ➤ Corpus fund of ₹ 50 crores for R&D |
| 20. | Syndicate Bank | ➤ Syndicate Bank Entrepreneurship Research and Training Centre at IIT-Kanpur (SBERTC-IITK). |
| 21. | Small Industries Development Bank of India (SIDBI) | <ul style="list-style-type: none"> ➤ SIDBI Innovation and Incubation Centre (SIIC) at IIT Kanpur ➤ TIFAC-SIDBI Revolving Fund for Technology (SRIJAN Scheme) |
| 22. | Industrial Credit and Investment Corporation of India (ICICI) | <ul style="list-style-type: none"> ➤ Creation of Sponsored Research and Development Board (SPREAD) ➤ ICICI Bank's Technology Finance Group (TFG) ➤ ICICI Foundation for Inclusive Growth |
| 23. | IDBI, ICICI, IFCI and SBI | ➤ Creation of Entrepreneurship Development Institute of India with the financial support from conglomerate of banks |