DST-Centre for Policy Research at PU, Chd.

(DST/PRC/CPR-03/2013)

REPORT-6

(May, 2015-Aug., 2016)

Industry-Academia Related Questionnaire

Survey Report of IITs

<u>INDEX</u>

1. Introduction

The hand holding of industry with academia has gained momentum as the evolving system of collaborations amongst the two, provides benefits to both the entities and gives them the prowess to address the challenges at the global and national level. The Industry-Academia (I-A) collaborations have carved a successful niche in the R&D ecosystem of the developed economies and are contributing greatly to the knowledge economy of the nations. However, in developing countries, including India, I-A research collaborations are in the nascent stage. India's global ranking in the parameter of 'university-industry research linkage' is not impressive even though more than 700 universities (public and private) and nearly 1700 DSIR accredited labs exist in our nation. The time has come to bring them on a single platform so that they collectively work together and contribute significantly towards economic and societal progress.

In India, Indian Institutes of Technology (IITs) have been successfully carrying out I-A activities and can act as role models for other higher educational institutes, primarily universities.

Keeping this in mind, the Centre for Policy Research at Panjab University, Chandigarh established by Department of Science and Technology (DST), New Delhi, Govt. of India (GoI) has carried out a study on the existing I-A interface in IITs.

Present study focuses on existence of I-A cells in IITs, industrial research carried out in form of sponsored research and consultancy and promotion of entrepreneurship culture. Table 1 enlists the officials who provided the information sought in the questionnaire, of their respective institutes.

This report comprises of the following sections:

2 Methodology

3 Results & Discussion

4 Conclusions

Table 1: List of Professors who Provided the Information Sought in the Questionnaire

S. No.	Institute	Name & Designation
1.	**IIT Kharagpur**	Prof. Partha P. Chakrabarti Director, IIT Kharagpur
2.	**IIT Bombay**	Prof. K.P Kaliappan Acting Dean (R&D), Office of the Dean (R&D)
3.	**IIT Madras**	Prof. Krishnan Balasubramaninan, Dean, Industrial Consultancy & Sponsored Research
4.	**IIT Kanpur**	Prof. Siddhartha Panda Associate Dean, Industrial Collaboration
5.	**IIT Delhi**	Prof. Naresh Bhatnagar, Associate Dean (R & D)
6.	**IIT Guwahati**	Prof. D. Chakraborty Dean (R&D)
7.	**IIT Roorkee**	Prof. Deepak Khare Head, Dept. of Water Resources Development & Management
8.	**IIT Bhubaneswar**	Prof. Rabindra Kumar Panda Dean (R&D)
9.	**IIT Gandhinagar**	Prof. Surya P. Mehrotra In-charge, R&D
10.	**IIT Patna**	Prof. Pushpak Bhattacharyya Director, IIT Patna
11.	**IIT Jodhpur**	Prof. V. Narayanan Coordinator (R&D)
12.	**IIT Ropar**	Dr. Harpreet Singh Assoc. Dean (Industrial Relations, International & Alumini Affairs)
13.	**IIT Indore**	Dr. Santosh Kumar Vishvakarma, Faculty In-charge, Placement
14.	**IIT Mandi**	Prof. B.D. Chaudhary Dean, Sponsored Research & Industrial Consultancy
15.	**IIT(BHU), Varanasi**	Prof. P.K. Jain Dean (R&D)

DST- Centre for Policy Research

at

PANJAB UNIVERSITY, CHANDIGARH-160 014 (INDIA)

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

Department of Science & Technology
Govt. of India

SURVEY ON INDUSTRY-ACADEMIA LINKAGES *(For Academia)*

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

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

| **(i)** | **Name of the Institute:** |
| **(ii)** | **Complete address:** |

1.	Interaction of the Institute with the Industries				
	Life Sciences (Please specify the field)	**Engineering Sciences (Please specify the field)**	**Business Management**	**Legal Studies**	**Other(s)**
Industrial training					
Campus recruitments					
Research collaborations					
Members of the governing body					
				Yes	**No**	**Other**

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

13.	Please fill in the appropriate details relevant to the Institute (last five years): (a) Number of Patents (i) Granted................ (ii) Filed................. (b) Number of Technology transfers (i) Commercialized................... (ii) Under process................. (c) Number of MoU with the Industries (i) Signed................ (ii) Under process................
14.	Does the Institute hold workshops/ conferences/ seminars in association with the Industry (pl. mention)?
15.	Factors hampering the growth of Industry-Academia linkages in the Institute are : (a) Lack of common area of interest (b) Lack of co-operation from the Industry (c) Intellectual property rights (IPR) issues (d) Not much weight-age given by Institute to develop industrial linkages (e) Lack of incentives for Industry- driven research
16.	Lack of sensitization of Intellectual Property Rights (IPR) in the Institute is because of: (a) Compulsion of publication (as a part of doctoral programs) hampers going in for patents. (b) Tedious protocols of IPR (c) Lack of IPR related guidance and awareness (d) Lack of a dedicated IPR cell in the Institute

17.	The barriers preventing the successful technology transfers from the Institute to Industry are: (a) Inadequate legal support services (b) Inadequate technical facilities (c) Any other
18.	Please pen down any other suggestions you wish to share:

Signature/ Seal: Dated:

Name, Designation and Complete address:

2. Methodology

a) **Setting:** This study was conducted at DST-Centre for Policy Research at Panjab University, India. The approval for conducting this study was obtained from DST, GoI, New Delhi, India.

b) **Study Design:** This study was based on a questionnaire, which was designed particularly for this study. The participating institutes included all the IITs established up till the year 2012 (excluding IITs at Tirupati & Palakkad).

The questionnaire contained 17 objective type questions with subparts, related to I-A interactions, start-ups, intellectual property, entrepreneurship, technology transfer, and patents. The reference year and instructions regarding filling questionnaire were mentioned on top of the questionnaire. The institutes were asked to answer these questions by either writing yes/no/other or by ticking (✓) the appropriate options.

This survey was carried out to check the status and strength of I-A interface in all IITs. By exploring the scenario of I-A interaction in IITs, we can analyse and understand the benefits of collaboration of industry and institutes and can formulate policy to promote I-A interactions in India.

c) **Data Collection:** The data was collected through a survey conducted using a questionnaire. A stipulated time period was given for filling up of the questionnaire. During analysis, the answers were represented by using numbers zero (0) and one (1). '1' is for option marked and '0' for those options that have not been marked.

d) **Statistical Analysis:** An excel sheet of all the questions was prepared and coded accordingly. For every question and its sub question, the total number of options ticked were counted and totalled following which the percentage was calculated.

e) **Graphical Representation:** Graphs were plotted/made in accordance with the percentage calculations.

3. Results & Discussion

The Questionnaire was sent to 16 IITs of which 15 responded with filled in questionnaires, corresponding to an overall response of 93.75%. Two IITs (IIT Tirupati and IIT Palakkad) were not sent the questionnaire because they were established the very same year that the survey was initiated.

Despite repeated reminders IIT Hyderabad failed to respond to the questionnaire.
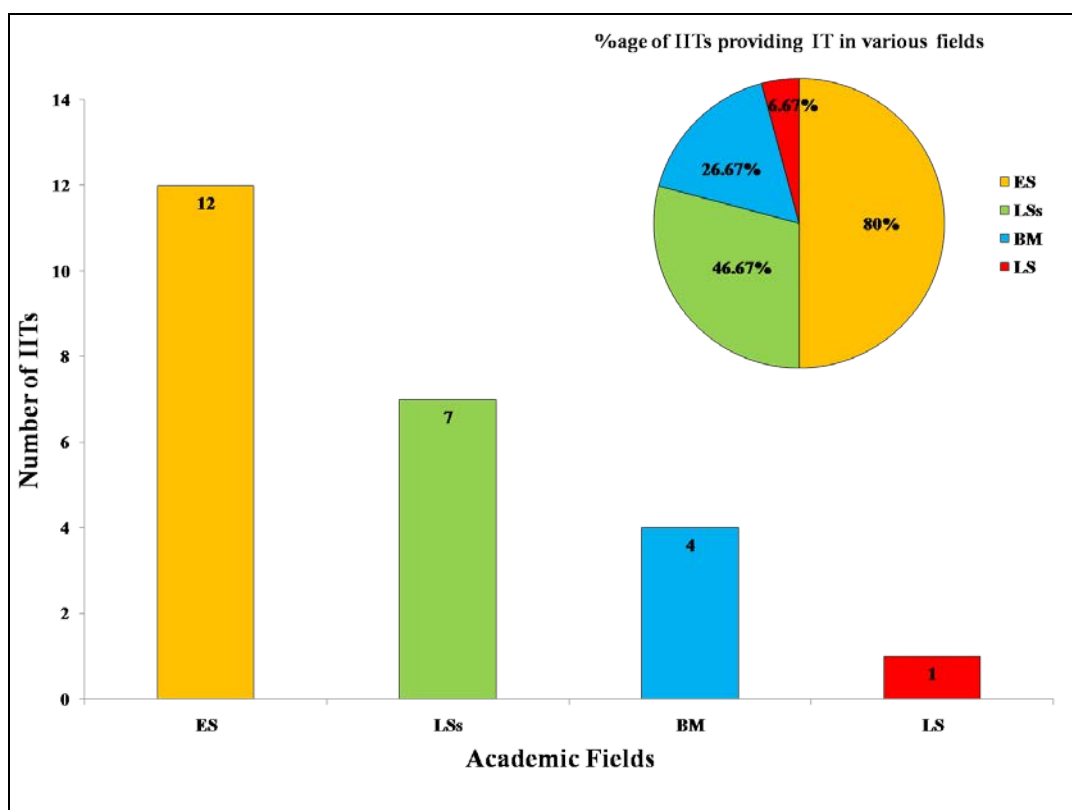
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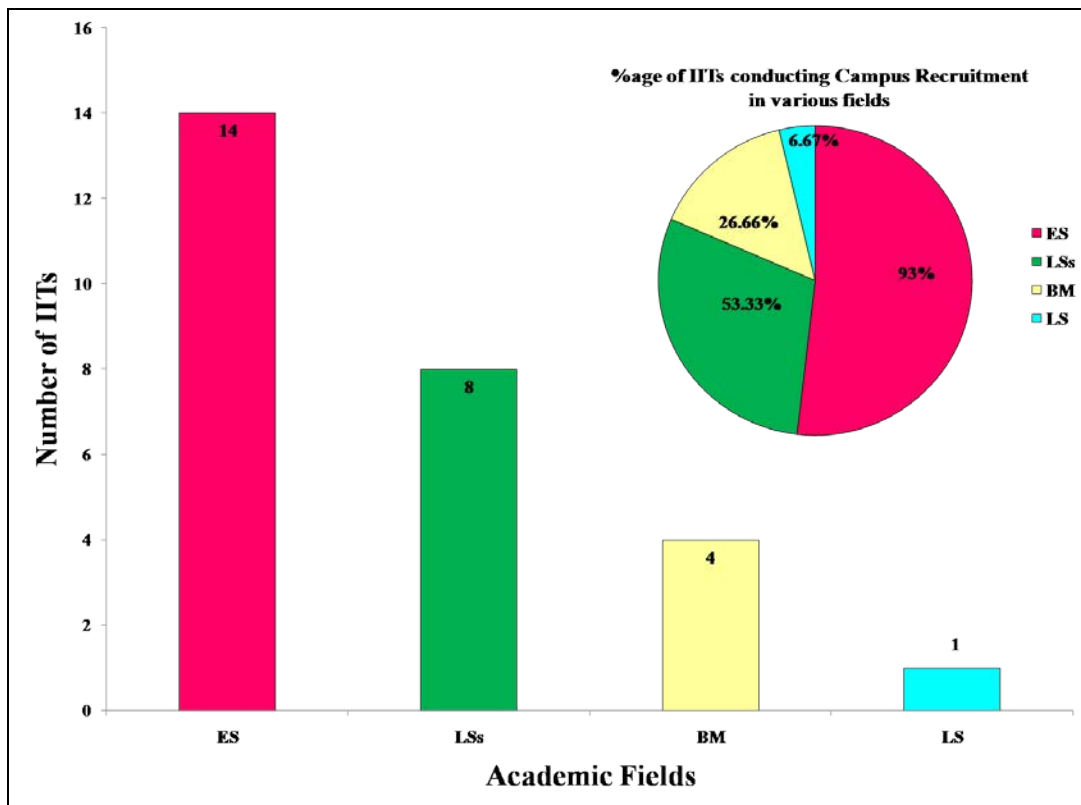
a) Industrial Training Programme

Figure 1: Number and Percentage of IITs Providing Industrial Training in Different Fields

* Abbreviations -- Life Sciences (LSs), Engineering Sciences (ES), Business Management (BM), Legal Studies (LS)

Table 2: Fields in which Industrial Training is provided by IITs

S. No.	Name	Life Sciences	Engineering Sciences	Business Management	Legal Studies
1.	**IIT Kharagpur**	✓	✓	✓	✓
2.	**IIT Bombay**	✓	✓	✓	NA
3.	**IIT Madras**	—	—	—	NA
4.	**IIT Kanpur**	✓	✓	✓	NA
5.	**IIT Delhi**	✓	✓	✓	NA
6.	**IIT Guwahati**	✓	✓	NA	NA
7.	**IIT Roorkee**	✓	✓	—	NA
8.	**IIT Bhubaneswar**	NA	✓	—	NA
9.	**IIT Gandhinagar**	—	—	—	NA
10.	**IIT Patna**	—	✓	NA	NA
11.	**IIT Jodhpur**	—	✓	NA	NA
12.	**IIT Ropar**	—	✓	NA	NA
13.	**IIT Indore**	—	—	NA	NA
14.	**IIT Mandi**	—	✓	NA	NA
15.	**IIT(BHU)**	✓	✓	NA	NA

* NA – Not Applicable

* —   – Industrial Training not provided

As depicted in the table 2 and figure 1, all IITs have 'industrial training' in their curricula which is undertaken in association with industries. Out of 15 IITs, the students of 12 IITs go for industrial training in the field of engineering sciences, which is justified by the fact that IITs are majorly institutes of higher technical education specialising in engineering. According to the information provided on the website of respective institutes, it was gathered that out of 15, 14 institutes have life science programs but industrial training is a part of the curriculum in only 7 of them. It was noted that business management is present as a course in 8 IITs and 4 participate in industrial training. A course on legal studies is present only in IIT Kharagpur, where industrial training in the said field is also undertaken (Annexure I).

b) Campus Recruitments:

Campus Recruitment is an important aspect of collaboration of the academic sector with the industries and hence can be referred as a parameter for gauging the readiness of the students for the industrial sector. Table 3 and figure 2 depict the status of the campus recruitment in different fields in the IITs. As all the IITs have expertise in engineering sciences, highest campus recruitment was observed in the same. Eight of the 14 IITs, which provide courses in life sciences, also engage in campus recruitment. In the field of business management (course provided by 8 institutes), 5 IITs are actively involved in campus recruitment. A course on legal studies is provided by IIT Kharagpur only, and they engage in campus recruitment for the same.

Figure 2: Number and Percentage of IITs Providing Campus Recruitment in Different Fields

* Abbreviations -- Life Sciences (LSs), Engineering Sciences (ES), Business Management (BM), Legal Studies (LS)

Table 3: IITs Providing Campus Recruitment in Various Fields

S. No.	Name	Life Sciences	Engineering Sciences	Business Management	Legal Studies
1.	**IIT Kharagpur**	✓	✓	✓	✓
2.	**IIT Bombay**	✓	✓	✓	NA
3.	**IIT Madras**	—	—	—	NA
4.	**IIT Kanpur**	✓	✓	✓	NA
5.	**IIT Delhi**	✓	✓	✓	NA
6.	**IIT Guwahati**	✓	✓	NA	NA
7.	**IIT Roorkee**	✓	✓	—	NA
8.	**IIT Bhubaneswar**	NA	✓	—	NA
9.	**IIT Gandhinagar**	—	✓	—	NA
10.	**IIT Patna**	—	✓	NA	NA
11.	**IIT Jodhpur**	✓	✓	NA	NA
12.	**IIT Ropar**	—	✓	NA	NA
13.	**IIT Indore**	—	✓	NA	NA
14.	**IIT Mandi**	—	✓	NA	NA
15.	**IIT(BHU)**	✓	✓	NA	NA

* NA – Not Applicable

* — – Campus Recruitment not provided

c) *Research Collaborations:*

To bring out the best in innovative research to the market, 'research collaborations' between industrial sector and academic sector are essential. As most of the IITs are majorly specialised in engineering sciences therefore maximum research collaborations have been witnessed in the said field followed by life sciences. Of the 8 institutes that provide business management courses, 5 of them are actively involved in research collaborations as well. Table 4 and figure 3 reflect the successful research collaborations of IITs in different domains.
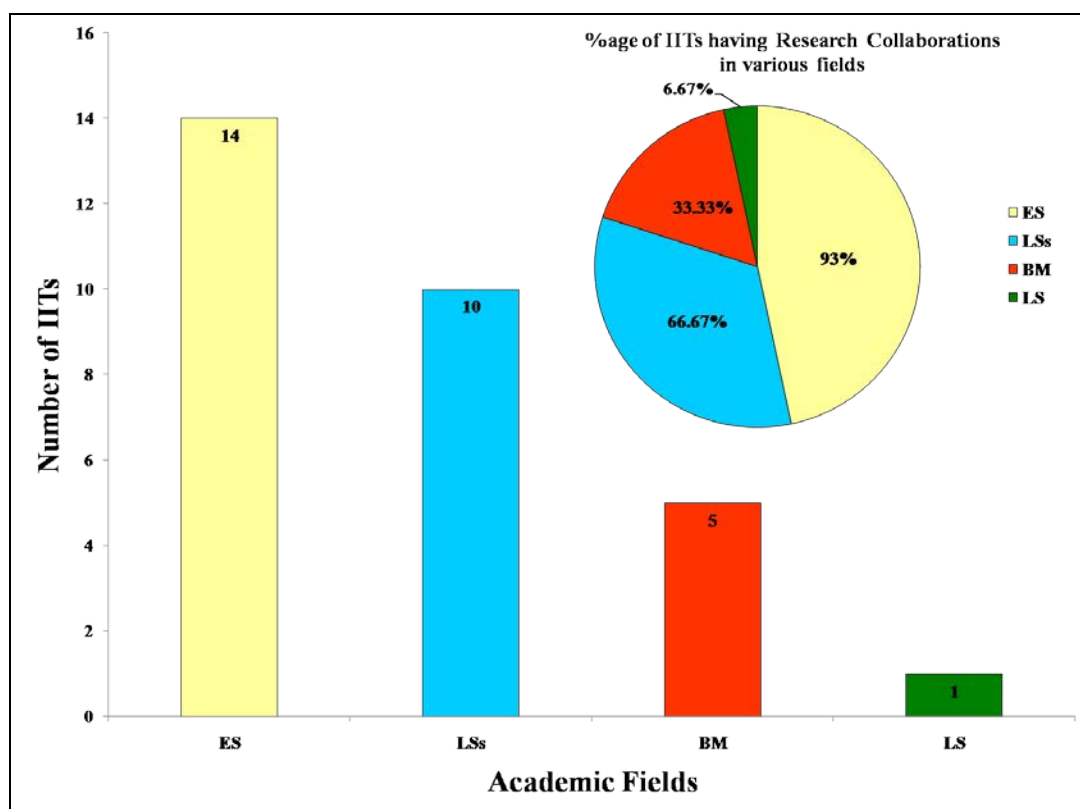
Figure 3: Number and Percentage of IITs Having Research Collaborations in Different Fields

* Abbreviations -- Life Sciences (LSs), Engineering Sciences (ES), Business Management (BM), Legal Studies (LS)

Table 4: IITs Having Research Collaborations in Various Fields

S. No.	Name	Life Sciences	Engineering Sciences	Business Management	Legal Studies
1.	**IIT Kharagpur**	✓	✓	✓	✓
2.	**IIT Bombay**	✓	✓	✓	NA
3.	**IIT Madras**	✓	✓	✓	NA
4.	**IIT Kanpur**	✓	✓	✓	NA
5.	**IIT Delhi**	✓	✓	✓	NA
6.	**IIT Guwahati**	✓	✓	NA	NA
7.	**IIT Roorkee**	✓	✓	—	NA
8.	**IIT Bhubaneswar**	NA	✓	—	NA
9.	**IIT Gandhinagar**	—	—	—	NA

S. No.	Name	Life Sciences	Engineering Sciences	Business Management	Legal Studies
10.	**IIT Patna**	—	✓	NA	NA
11.	**IIT Jodhpur**	✓	✓	NA	NA
12.	**IIT Ropar**	—	✓	NA	NA
13.	**IIT Indore**	✓	✓	NA	NA
14.	**IIT Mandi**	—	✓	NA	NA
15.	**IIT(BHU)**	✓	✓	NA	NA

* NA – Not Applicable

* — – No Research Collaborations

d) *Industry representation in the Governing Body:*

It is an understood fact that the involvement of industry personnel in designing the study and research modules of an academic institute will enhance the performance of the institute. This has been well implemented by a few IITs who have included industry representatives in the governing body of institute (Table 5).

Table 5: IITs Having Industry Representation in the Governing Body

S. No.	Name	Life Sciences	Engineering Sciences	Business Management	Legal Studies
1.	**IIT Kharagpur**	—	—	—	—
2.	**IIT Bombay**	—	✓	✓	NA
3.	**IIT Madras**	—	—	—	NA
4.	**IIT Kanpur**	—	—	—	NA
5.	**IIT Delhi**	—	✓	✓	NA
6.	**IIT Guwahati**	—	✓	NA	NA
7.	**IIT Roorkee**	✓	✓	—	NA
8.	**IIT Bhubaneswar**	NA	—	—	NA
9.	**IIT Gandhinagar**	—	—	—	NA
10.	**IIT Patna**	—	✓	NA	NA
11.	**IIT Jodhpur**	—	✓	NA	NA
12.	**IIT Ropar**	—	✓	NA	NA

				NA	NA
13.	**IIT Indore**	—	—	NA	NA
14.	**IIT Mandi**	—	—	NA	NA
15.	**IIT(BHU)**	✓	✓	NA	NA

* NA – Not Applicable

* —   – No industry representation

Question: 2 – Presence of a dedicated "Industry-Academia Cell" or its equivalent?

Apart from having industry oriented syllabi, presence of dedicated I-A Cells in IITs fosters conversion of academic knowledge into technologies. As mentioned in table 6, out of 15 IITs, 14 (93.3%) have a dedicated cell for I-A interface eg. Sponsored Research & Industrial Consultancy (SRIC) in IIT Kharagpur, Industrial Research & Consultancy Centre (IRCC) in IIT Bombay, Centre for Industrial Consultancy & Sponsored Research (IC&SR) in IIT Madras, Industrial Research & Development (IRD) & Foundation for Innovation and Technology Transfer (FITT) in IIT Delhi.

Table 6: Presence of I-A Cell or its Equivalent in IITs

S. No.	Name	Name of the Cell
1.	**IIT Kharagpur**	• Sponsored Research & Industrial Consultancy (SRIC) Cell • Science & Technology Entrepreneur's Park-Technology Business Incubator (STEP-TBI), • Technology Incubation & Entrepreneurship Training Society (TIETS) • Technopreneur Promotion Programme (TePP) Outreach cum Cluster Innovation Centre (TOCIC) • Research Park at Rajarhat
2.	**IIT Bombay**	• Industrial Research & Consultancy Centre (IRCC) • Society for Innovation and Entrepreneurship (SINE) • The Desai Sethi Centre for Entrepreneurship (DSCE) • The Entrepreneurship Cell (E-Cell)
3.	**IIT Madras**	• Industrial Consultancy and Sponsored Research (IC&SR) Centre

		• IIT Madras (IITM) Research Park
		• IITM Incubation cell
		• The Cell for Technology Innovation, Development and Entrepreneurship Support (C-TIDES)
		• The Rural Technology Business Incubator (RTBI)
		• Bio-Incubator
4.	**IIT Kanpur**	• SIDBI Innovation and Incubation Centre (SIIC)
		• TePP Outreach cum Cluster Innovation Centre (TOCIC)
5.	**IIT Delhi**	• The Industrial Research and Development (IRD)
		• Foundation for Innovation and Technology Transfer (FITT)
6.	**IIT Guwahati**	• IITG-Technology Incubation Centre (IITG-TIC)
		• The Rural Technology Action Group (RuTAG), North-East
7.	**IIT Roorkee**	• Sponsored Research and Industrial Consultancy (SRIC) Cell
		• Technology Incubation and Entrepreneurship Development Society (TIEDS)
		• Entrepreneurship Development Cell (EDC)
		• Technopreneur Promotion Programme (TePP) Outreach Centre (ToCIC).
8.	**IIT Gandhinagar**	• Incubation centre (IIC)
		• Innovation and Entrepreneurship Centre (IIEC)
		• Technology Business Incubator (DST-TBI)
9.	**IIT Patna**	• Sponsored Research and Industrial Relations Unit (SRIRU)
		• Entrepreneurship Club
10.	**IIT Jodhpur**	• Entrepreneurship cell
11.	**IIT Ropar**	• Prototype Development and Innovation Fund (Entrepreneurship Cell)
		• Intellectual Property Rights (IPR) Cell
		• Centre for Innovation and Business Incubation (CIBI)
		• Technology Business Incubator (TBI)
12.	**IIT Indore**	• Innovation and Entrepreneurship Development Centre (IEDC)

13.	**IIT(BHU)**	• Malaviya Centre for Innovation, Incubation and Entrepreneurship (MCIIE)

Question: 3 - Is the institute aware of the industry oriented Govt. funded programs like DSIR, TDB, BIRAC, PM's fellowship programme for doctoral research?

Govt. funding plays a very crucial role in science based innovations and technologies that determine the global competitiveness of the nation. All the IITs are aware of govt. funded programmes which provide financial support for research and infrastructure development.

Question: 4 – Industrial set up in the institute

Nine IITs that have an industrial set up on the campus are at Kharagpur, Bombay, Madras, Kanpur, Delhi, Guwahati, Roorkee, Gandhinagar and Patna (Table 7). It can be assumed, that one of the main reasons for the industries being attracted to these IITs is that they are well established and have acquired experience and broad base of knowledge which is of immense value to the industry. Another reason for the same can be that these IITs are situated at locations which are industry dominant. Therefore, both the entities are easily accessible to each other, to address the needs of their respective domains.

Table 7: Presence of Industrial Set Up in IITs

S. No.	Name	Name of the Set-up/ Laboratory
1.	**IIT Kharagpur**	• Vodafone Essar-IIT Centre of Excellence in Telecommunications (VEICET) • Steel Technology Centre • General Motors-IIT Kharagpur Collaborative Research Laboratory on Electronics, Controls and Software
2.	**IIT Bombay**	• Xilinx FPGA Laboratory • The Tata Infotech Laboratory • Intel Microelectronics Laboratory • Laboratory for Intelligent Internet Research

		• Tata Consultancy Services Laboratory for VLSI Design and Device Characterization
		• Texas Instruments Digital Signal Processing (TI-DSP) Laboratory
		• Wadhwani Electronics Laboratory
		• Cummins Engine Research Laboratory
		• Applied Materials Nano manufacturing Laboratory
		• Tata Teleservices-IITB Centre of Excellence in Telecommunications (TICET)
		• VLSI Design Consortium
3.	**IIT Madras**	• Autodesk, Microsoft and Intel have established Centres of Excellence and sponsored research laboratories in the campus. • Reliance IITM Telecom Centre of Excellence (RITCOE)
4.	**IIT Kanpur**	• BSNL-IITK Telecom Center of Excellence • Samtel Center for Display Technologies (SCDT)
5.	**IIT Delhi**	• Bharti School Of Telecommunication Technology And Management • Airtel IIT Delhi Centre of Excellence in Telecommunications (AICET)
6.	**IIT Guwahati**	• Society for Applied Microwave Electronic Engineering and Research-SAMEER
7.	**IIT Roorkee**	• Intel set up a Planet Labs in E&C Dept. • Cisco set up equipment for a Telephony and Security Lab • RailTel IIT Roorkee Centre of Excellence in Telecom (RICET)
8.	**IIT Gandhinagar**	• Grant from the Underwriters Laboratories Inc (UL) to develop safety initiatives at the Institute. • Ricoh Company Ltd, aided the establishment of a Centre for Design and Innovation at the Institute. • Analog Teaching Lab Setup by Cranes Software International Limited • C2000 Micro Controller Lab Setup by Cranes Software International Limited
9.	**IIT Patna**	• Elsevier Centre of Excellence for Natural Language Processing • Sushrut-eZDI Research Lab

Question: 5 –Industry sponsored research fellowship in the institute

The investment of private sector in R&D activities is a key parameter for commercialisation of technologies and for taking them from the bench to the market. It has been observed that the time for commercialising technologies is shorter in countries where private sector is actively engaged in R&D. One of the factors that reflect such engagements is 'industry sponsored research fellowships' in HEIs. As shown in table 8, industries have offered fellowships to almost all IITs (13) thereby promoting industrial research and active long term linkages of the two.

Table 8: Industry Sponsored Fellowships in IITs

S. No.	Name	Industry Partner/ Name of the Fellowship
1.	**IIT Kharagpur**	• TCS Research Scholarship Program • Google India Fellowship • Indian Oil Educational Scholarship • Aditya Birla Scholarship • Singapore Technologies Scholarship in Engineering
2.	**IIT Bombay**	• OP Jindal Engineering and Management Scholarships • TCS Research Scholarship Program • Infosys Fellowship • Intel India PhD Fellowship • Crompton Greaves Research Fellowship Programme
3.	**IIT Madras**	• Aditya Birla Scholarship • TCS Research Scholarship Program • OP Jindal Engineering and Management Scholarships • Singapore Technologies Engineering Scholarship • Nissan Scholarship
4.	**IIT Kanpur**	• Aditya Birla Scholarship • OP Jindal Engineering and Management Scholarships
5.	**IIT Delhi**	• OP Jindal Engineering and Management Scholarships
6.	**IIT Guwahati**	• ABB India Ltd.
7.	**IIT Roorkee**	• OP Jindal Engineering and Management Scholarships
8.	**IIT Bhubaneswar**	• WMG (Warwick Manufacturing Group, U.K.)
9.	**IIT Gandhinagar**	• AIMIL LTD sponsors research at the institute
10.	**IIT Patna**	• TCS Research Scholarship Program

11.	**IIT Indore**	• TCS Research Scholarship Program
12.	**IIT Mandi**	• TCS Research Scholarship Program
13.	**IIT(BHU)**	• TCS Scholarship Program • OP Jindal Engineering and Management Scholarships

Question: 6 - Do the students of the institute visit industrial facilities on a regular basis?

Industrial visits form an important part of the curricula and play an essential role in bridging the gap between classroom and the real world. Students learn about "real life" examples of application of science, engineering and business management.

Students from all the IITs involved in the study, visit industrial facilities on a regular basis to get an insight of the practicality and work ecosystem of the industries.

Question: 7 - Incentives to faculty members / researchers who have obtained patents/ transferred technology?

Providing impetus to the faculty members and researchers for generation of intellectual property (IP) (patents, technology transfer primarily) is of utmost significance to advocate research that can support economic prosperity of the nation. Eleven IITs i.e. 73% (Fig. 4) provide incentives to the faculty members and researchers to motivate them for undertaking research having societal impact.

The IITs that provide faculty with incentives are IIT Kharagpur, IIT Bombay, IIT Madras, IIT Kanpur, IIT Delhi, IIT Bhubaneswar, IIT Jodhpur, IIT Gandhinagar, IIT Indore, IIT Mandi and IIT(BHU).

IIT Guwahati, IIT Roorkee and IIT Patna do not have any provision for incentivising their faculty members/researchers who have obtained IP or commercialized technology.
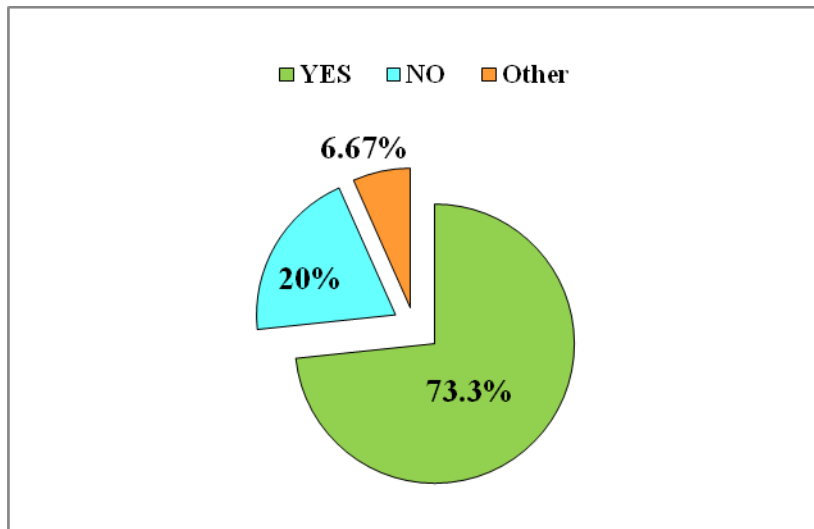
Figure 4: **Percentage of IITs Providing Incentives to Faculty/Researchers with Patents/Tech Transfers**

Question: 8 – Provision of leave to the faculty to take an assignment in the industry?

Paid leaves and sabbaticals are a way of giving time to the faculty and researchers for indulging in extra academic research collaborations. Fourteen IITs have this provision for their faculty members which gives them an opportunity to take assignments with the industry. IIT Gandhinagar does not give permission to its faculty to take any sabbatical for working with an industry.

Question: 9 - Does the institute offer special courses/ modules for regular employees of the industry?

In order to attract the industry towards the academic sector, academia can offer certain specific courses or modules for industry employees. These courses will help the industry employees to obtain certification for their professional growth. As observed in table 9 out of 15 IITs, 10 provide such special courses. For example FITT in IIT Delhi has initiated 'Professional Candidate Registration' (PCR) programme through which a number of courses in different fields are offered by the institute in accordance to suitable time slots, for commencing part time post-graduate/Ph.D. programme. There are certain online modules as well that can be taken up by industry personnel.

Table 9: IITs Offering Special Courses for Industry Personnel

S. No.	Name	Name of the Courses
1.	**IIT Kharagpur**	• Continuing Education Programme (CEP)
2.	**IIT Bombay**	• Continuing Education Programme (CEP)
3.	**IIT Madras**	• Continuing Education Programme (CEP)
4.	**IIT Kanpur**	• Continuing Education Programme (CEP)
5.	**IIT Delhi**	• Professional Candidate Registration (PCR) programme • Continuing Education Programme (CEP)
6.	**IIT Roorkee**	• Continuing Education Programme (CEP)
7.	**IIT Bhubaneswar**	• Continuing Education Programme (CEP)
8.	**IIT Gandhinagar**	• Continuing Education Programme (CEP)
9.	**IIT Ropar**	• External Registration Program (Part-time Ph.D) for industry personnel
10.	**IIT Indore**	• Continuing Education Programme (CEP)
11.	**IIT(BHU)**	• Short term courses/ training programmes

Question: 10 - Does the industry use infrastructure resources like instruments, library, legal services, any other of the institute?

A number of HEIs have a large pool of infrastructural resources and facilities that are of world class status. In order to establish effective I-A interface, both academia and industry should develop close collaboration with freedom of exchange of knowledge and resources such as instruments, library and other services. IITs are in the forefront of promoting industrial linkages. As depicted in Figure 5, 93.33% of the IITs (14) have set up a freedom of resource access for the industries that has lead to strong foundation for endowing I-A linkages. IIT Patna does not have any such provision of resource sharing.
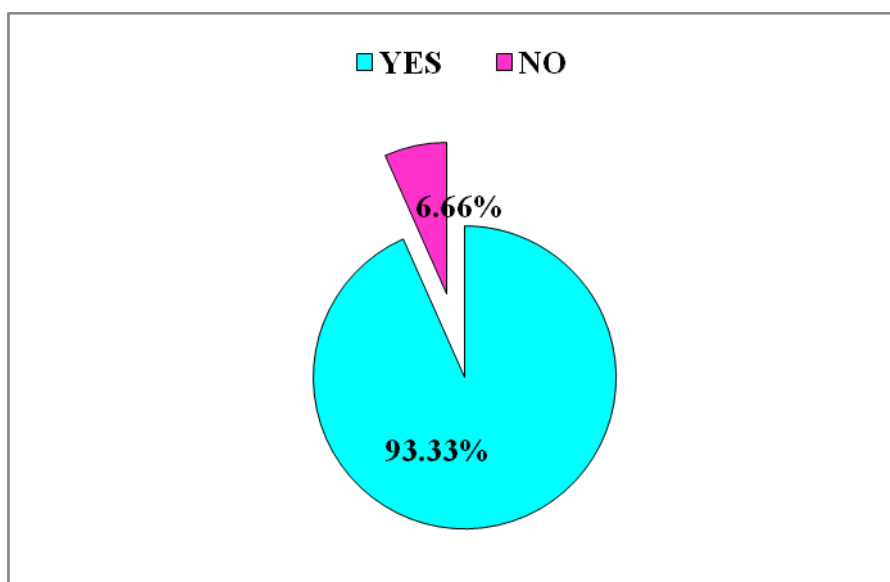
Figure 5: Percentage of IITs Sharing Infrastructure with Industries

Question: 11 - Does the institute have an IPR Cell/Entrepreneurship Cell/Placement Cell/Technology Transfer Cell/any other?

All IITs have a dedicated cell for IPR management/Entrepreneurship/Technology transfer. Presence of such cells aids in stimulating process of ideation to commercialization. These cells take responsibility for rendering all kinds of IPR assistance and inductive services like patenting and licensing. Expert mentorship for entrepreneurship and start-ups is also provided by these cells.

Question: 12 - Does the institute engage industry personals for teaching programmes? If yes, are they engaged as: (a) Invited speakers for a few lecture, (b) Guest faculty, (c) Adjunct faculty

In order to proliferate I-A linkages, not only industry oriented research should be undertaken by the academia, but they should also encourage industry participation via inviting speakers for special lectures or as a faculty (guest/adjunct), to bring forward industrial needs, practices and experiences amongst students.

Figure 6 and table 10 represent the number and percentage respectively, of IITs that engage industry personnel for different teaching programs. 14 IITs (93%), invite speakers from the industry to deliver special lectures in the field of their expertise. These kind of invited lectures are helpful for students to integrate the practical knowledge with theoretical aspects. Ten IITs

16

(67%) and eleven IITs (73%) have tied up with the industry experts to be the guest faculty and adjunct faculty at their institutes, respectively.
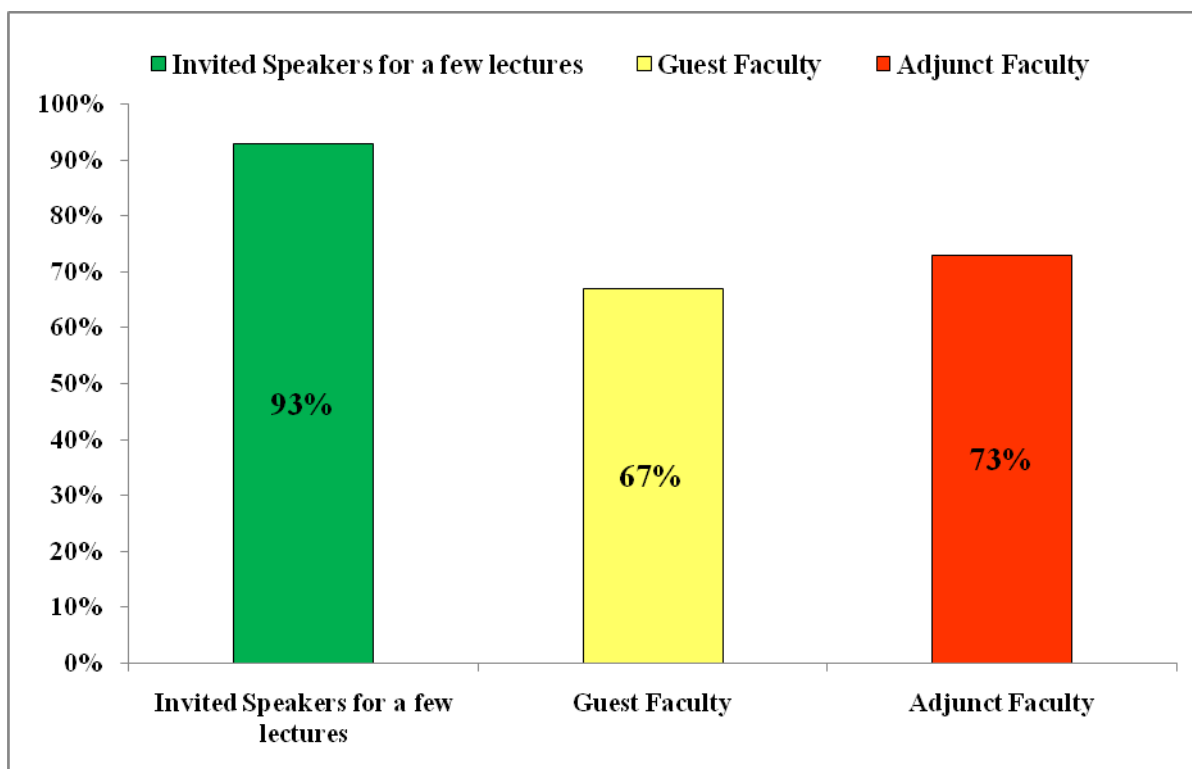

Figure 6: Percentage of IITs Engaging Industry Experts in Teaching Programme

Table 10: IITs Involving Industry Personnel in Teaching Programs

S. No.	Name	Invite Speakers for Special Lectures	Guest Faculty	Adjunct Faculty
1.	IIT Kharagpur	✓	✓	✓
2.	IIT Bombay	✓	—	✓
3.	IIT Madras	✓	✓	✓
4.	IIT Kanpur	✓	✓	✓
5.	IIT Delhi	✓	✓	✓
6.	IIT Guwahati	✓	✓	—
7.	IIT Roorkee	—	—	—
8.	IIT Bhubaneswar	✓	✓	✓
9.	IIT Gandhinagar	✓	✓	✓

17

10.	**IIT Patna**	✓	✓	✓
11.	**IIT Jodhpur**	✓	✓	✓
12.	**IIT Ropar**	✓	—	—
13.	**IIT Indore**	✓	—	✓
14.	**IIT Mandi**	✓	—	—
15.	**IIT(BHU)**	✓	✓	✓

* — – No industry personnel in teaching programmes

Question: 13 – Statistics of Patents Filed, Patents Granted, Technology Transfer, and MoUs signed with the industries, of IITs.

In today's era of knowledge economy an organization gains the trust and competence by means of its IP profile. The physical assets of an institution are of less worth and value as compared to the intangible capital (know-how, innovations, inventions etc.). IPRs are statutory rights that allow inventors to exploit their inventions for an exclusive time period. IPRs are not only devices/tools to protect ones innovation and creative ideas for generation of revenue but they are also the basis of strong alliances between different stakeholders for the benefit of society and technological development. IITs take special efforts to undertake innovative research leading to generation of IP.

Table 11 enlists the number of patents (filed and granted), technologies commercialized, technologies under process and MoUs with industries, of IITs in the last five years. Figure 7 (A & B) represents the patents filed and granted of first generation and second generation IITs respectively. Figure 8 represents the technologies commercialized and technology commercialization under process by first generation IITs. Second generation IITs are yet to open their account in the parameters of technology commercialization. Figure 9 (A & B) depicts the MoUs signed with the industries of the first and second generation IITs respectively.

IITs at Bombay, Kanpur, Madras and Delhi are performing exceptionally well in transferring technologies developed at the institute (73, 56, 17 and 15 respectively) to the market. These institutes have also generated remarkable number of IP in terms of patent (filed/granted) – IIT Bombay (439/61), IIT Kanpur (204/09), IIT Madras (311/24), IIT Delhi (146/25) and IIT Kharagpur (231/13), in the last five years (2010-15).

Amongst the second generation IITs of IIT(BHU), IIT Roorkee, IIT Ropar, IIT Bhubaneswar and IIT Patna have credited themselves with a satisfactory number of patent filings (> 10). IIT(BHU) and IIT Roorkee, have been granted 3 patents each.

Another parameter that reflects the successful I-A interface, is number of MoUs signed between industries and institutes. Maximum number of MoUs have been signed by IIT-Bombay (225) followed by IIT Madras (176), IIT Kanpur (124) and IIT Kharagpur (60). Amongst the newer IITs maximum number of MoUs have been signed by IIT Gandhinagar and IIT(BHU) (14 each) followed by IIT Jodhpur and IIT Bhubaneswar (6 each).

Table 11: Patents, Technology Transfer and MoU Details 2010 Onwards

| S. No.	Name	Patents		Technology Transfers		MoU with Industries	
		Granted	Filed	Commercialized	Under Process	Signed	Under Process
1.	IIT Kharagpur	13	231	09	02	60	10
2.	IIT Bombay	61	439	73	00	225	00
3.	IIT Madras	24	311	17	05	176	00
4.	IIT Kanpur	09	204	56	00	124	00
5.	IIT Delhi	25	146	15	01	08	03
6.	IIT Guwahati	06	61	04	01	14	00
7.	IIT Roorkee	03	22	00	00	03	00
8.	IIT Bhubaneswar	00	10	00	00	06	00
9.	IIT Gandhinagar	00	04	00	00	14	00
10.	IIT Patna	00	09	00	00	00	00
11.	IIT Jodhpur	00	05	00	00	06	01
12.	IIT Ropar	00	>10	00	00	00	02
13.	IIT Indore	00	07	00	00	02	00
14.	IIT Mandi	00	01	00	00	03	00
15.	IIT(BHU)	03	09	00	00	14	08
	Total	**144**	**1469**	**174**	**09**	**655**	**24**
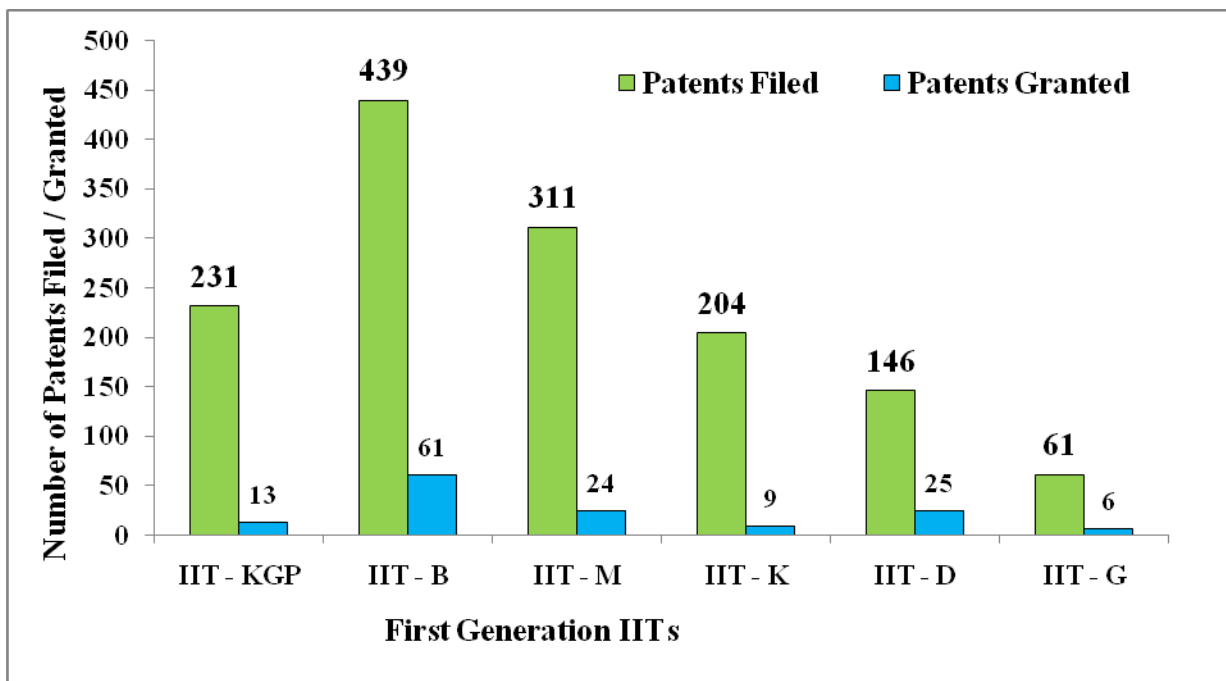
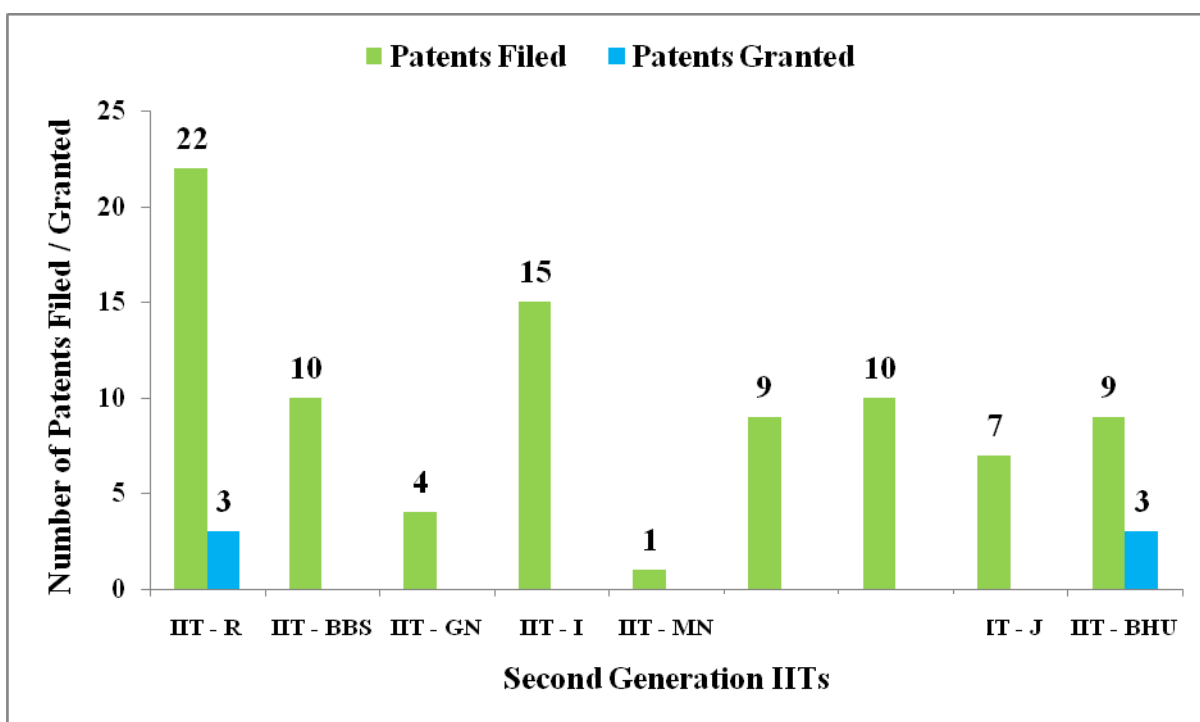**Figure 7 (A): Patents Filed/Granted of First Generation IITs**

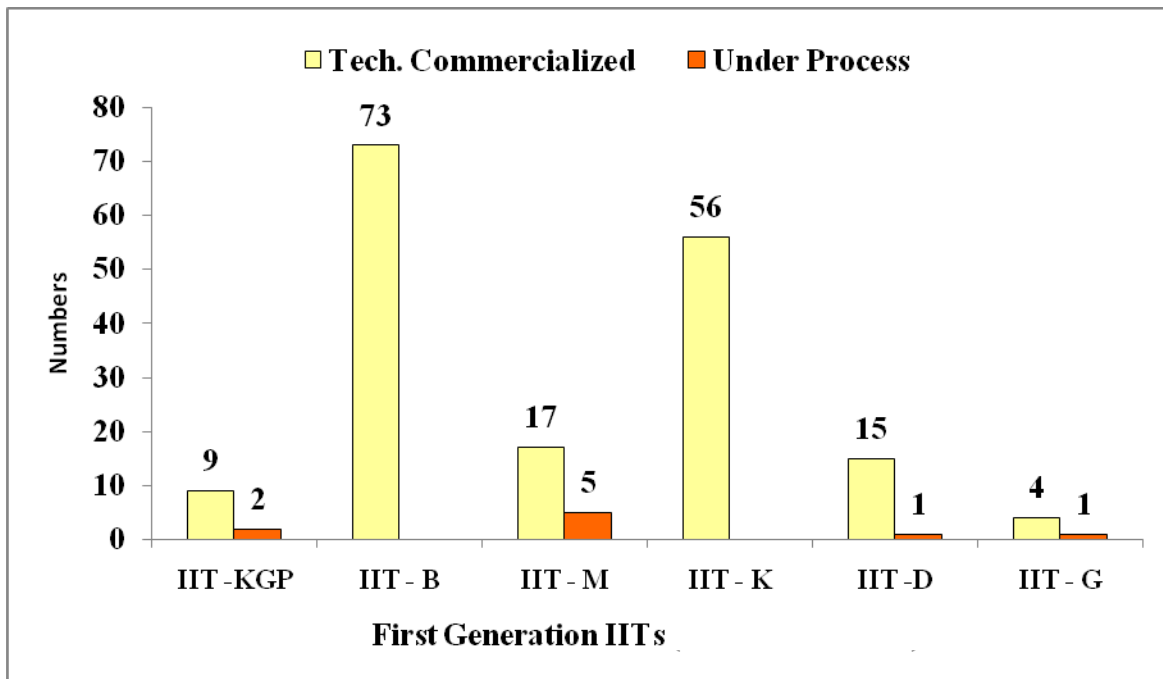**Figure 7 (B): Patents Filed/Granted of Second Generation IITs**

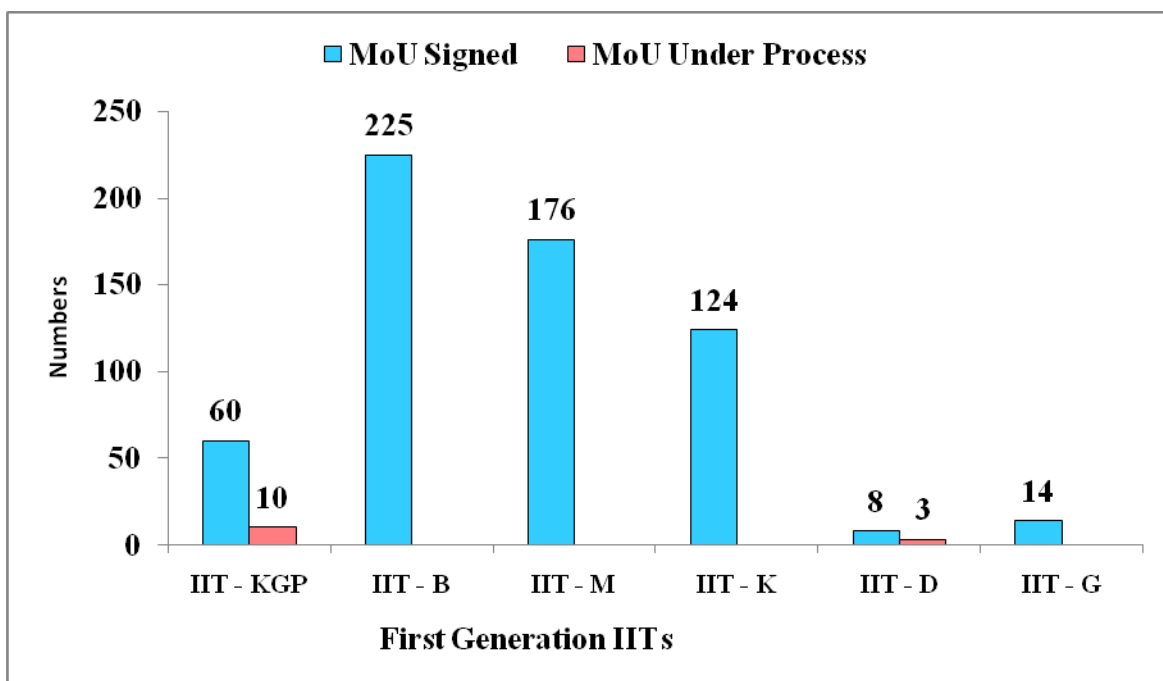**Figure 8: Technologies Commercialized/ Under Process of First Generation IITs**

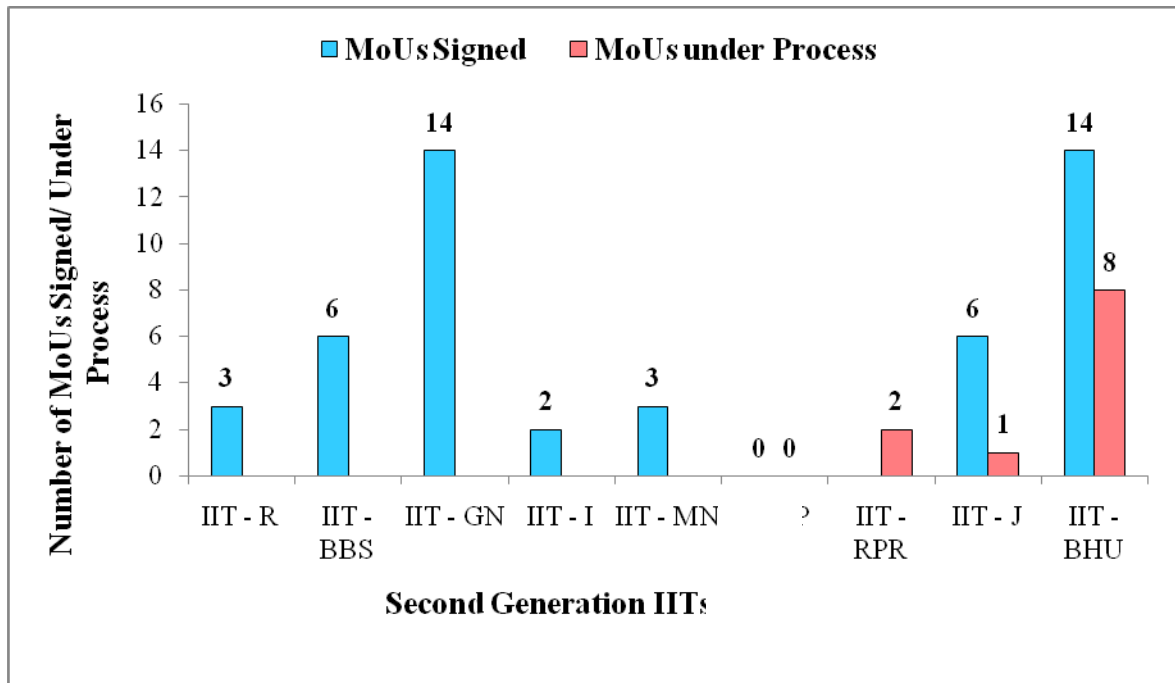**Figure 9 (A): Industry-Academia MoUs of IITs (first generation)**

Figure 9 (B): Industry-Academia MoUs of IITs (second generation)

Question: 14 –- Organisation of workshops/conferences/seminars in association with the industry?

Workshops, seminars and conferences give an opportunity to the stakeholders of I-A linkages to interact with each other at one single platform. These modes of interaction apprise the entities of the latest developments in each other's fields and the scope for collaboration. Realising the importance of such events all IITs are actively engaged in organising workshops, conferences and seminars in association with the industry. The industry benefits largely from these events by means of gathering academic expertise for problem solving and betterment of existing technologies.

Question: 15 - Factors hampering the growth of Industry-Academia linkages:

a) *Lack of common area of interest:* 7 of the 15 IITs agree on this factor (46.7%).

b) *Lack of co-operation from industry:* 6 of the 15 IITs agree on this factor (40%).

c) *Intellectual property rights issues:* 5 of the 15 IITs agree on this factor (33.3%).

d) *Not much weightage given by the institute to develop industrial linkages:* 4 of the 15 IITs agree on this factor (26.7%).

e) *Lack of incentives for industry driven research:* 5 of the 15 IITs agree on this factor (33.3%).

*f) **Others:*** 2 (new generation) of the 15 IITs have stated additional factors (13.33%)

- Being new institutes, the priority was given to setting up of laboratories and other infrastructure required for UG/PG teaching.
- Faculty members not yet ready to handle industry relations.

It is observed that most of the IITs (46%) (IIT Indore, IIT Delhi, IIT Madras, IIT Mandi, IIT Bombay, IIT Gandhinagar and IIT Patna) believe lack of common area of interest to be a major factor that hampers growth of I-A linkages, which can be explained by the lack of awareness of research areas/interests of both the organisations (Fig. 10). Therefore, measures should be taken to overcome this barrier by creation of modes such as National Web Portal.

Some of the IITs (IIT Indore, IIT Mandi, IIT Gandhinagar, IIT Kanpur, IIT Kharagpur and IIT Patna) feel that the industry does not come forward for joining hands (40%) and a few of them (IIT Indore, IIT Madras, IIT Gandhinagar, IIT Kharagpur and IIT Patna) also agree that the complications related to IPR pose as a bottleneck (33.3%). The issues of lack of confidence in each other and time constraints add to these factors. The lack of incentivisation, as discussed above (Q. 7), by the institute is also a factor that hinders I-A interactions.
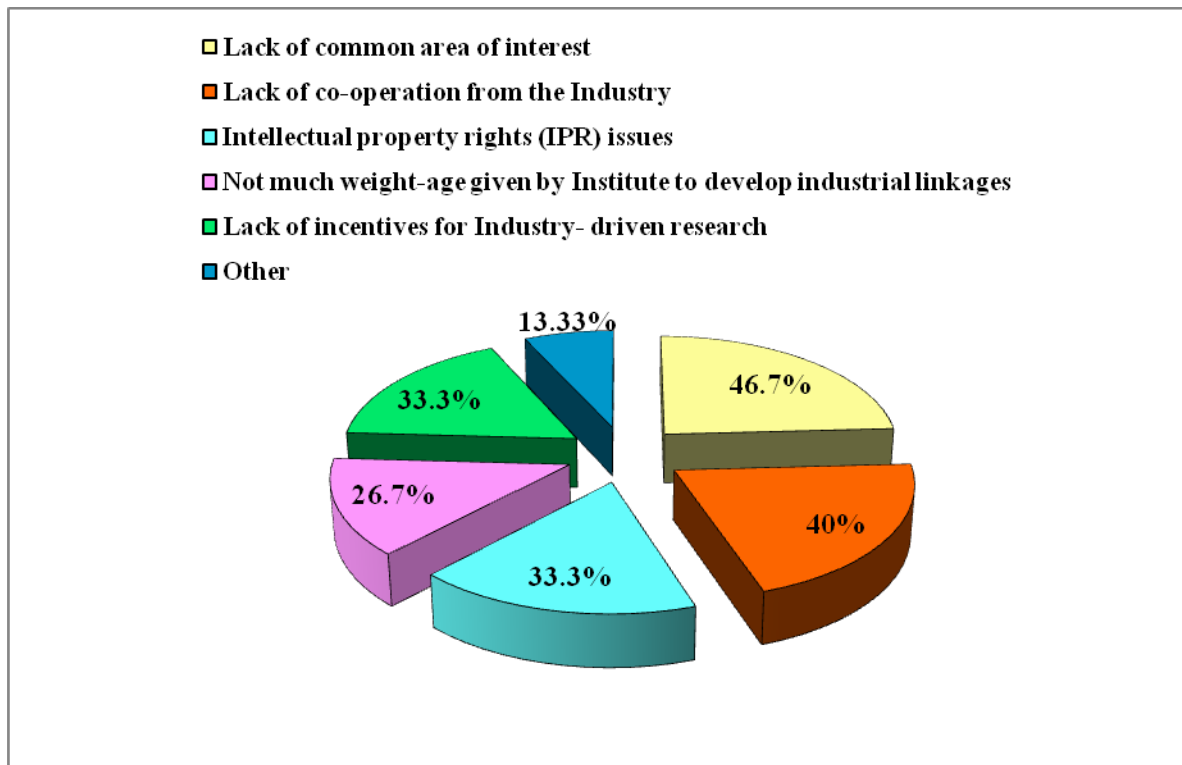

Figure 10: Factors Hampering the Growth of I-A Linkages in Institute

Question: 16 – Lack of sensitization of Intellectual Property Rights (IPR) in the institute is because of:

Figure 11 and table 12 represent the factors affecting generation of IP in IITs.
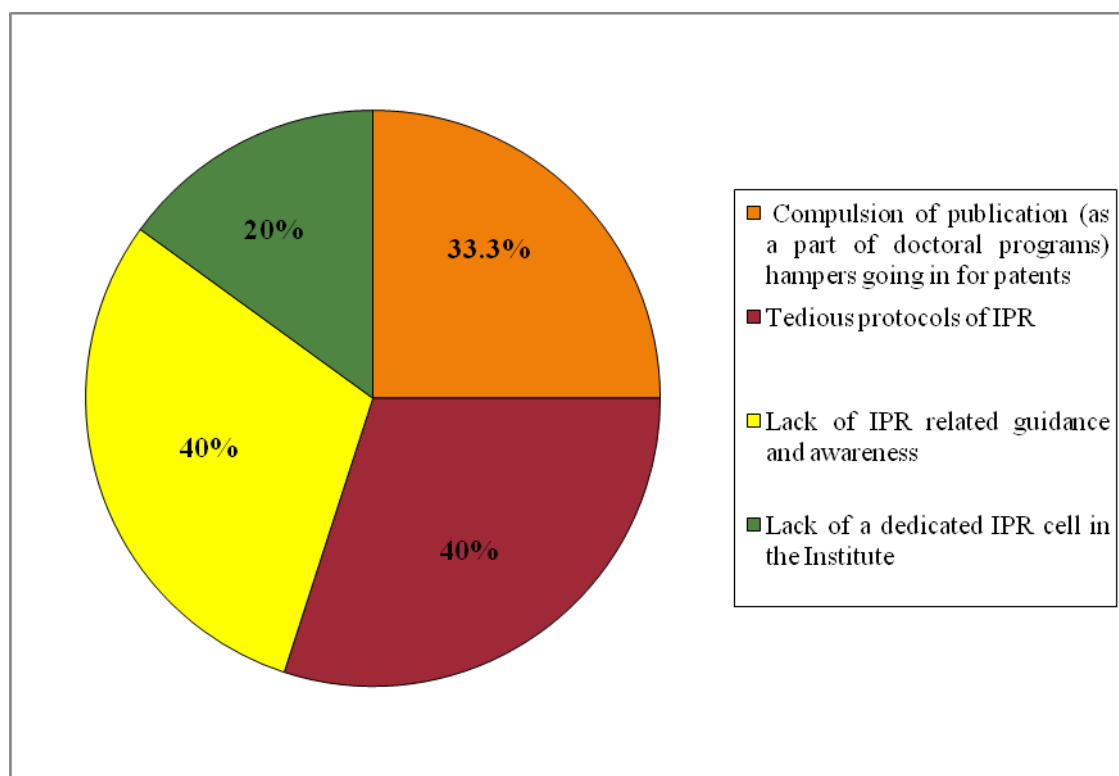

Figure 11: Factors Responsible for Lack of Sensitization of IPR in IITs

Table 12: Factors Responsible for Lack of Sensitization of IPR in the Institutes

S. No.	Factor	Percentage	Responders
a)	*Compulsion of publication (as a part of doctoral programme) hampers going in for patents*	33.3%	IIT Mandi, IIT Gandhinagar, IIT Kanpur, IIT Kharagpur and IIT Patna stated that the academic sector gives more weightage to the publications than to IP.
b)	*Tedious protocols of IPR*	40.0%	6 IITs [IIT Delhi, IIT Mandi, IIT Ropar, IIT Kharagpur, IIT Patna, IIT(BHU)] agree that filing of IP is a cumbersome process and also involves high finances and time, which is not affordable by every researcher.
c)	*Lack of IPR related guidance and*	40.0%	6 IITs (IIT Delhi, IIT Mandi, IIT

	awareness	25	Ropar, IIT Jodhpur, IIT Patna, IIT-BHU) agree upon the unavailability of appropriate guidance at the right time.
d)	*Lack of dedicated IPR Cell in the institute*	20.0%	IIT(BHU), IIT Mandi and IIT Patna.

Question: 17 - Barriers preventing the successful technology transfers from the institute to industry:

The successful conversion of academic knowledge into technologies is imperative for achieving global competitiveness in the area of science & technology. Table 13 and figure 12 highlight the barriers faced by IITs in technology transfers.

Table 13: Factors Responsible for Hindering Technology Transfer in Institutes

S. No.	Factor	Percentage	Responders
a)	*Inadequate legal support services*	26.7%	Four IITs (IIT Mandi, IIT Ropar, IIT Kharagpur and IIT Patna) feel that the lack of legal support is a hampering factor. One of the reasons may be the fact that hiring external legal services require audit permissions and high financial resources.
b)	*Inadequate technical facilities*	13.3%	Only 2 IITs [IIT(BHU) and IIT Roorkee] feel that unavailability of technical facilities hampers the testing of prototype of a new technology. The unavailability of technical facilities could be credited to lack of funds, lack of technical support and lack of maintenance.

|			7 IITs (IIT Kanpur, IIT Jodhpur, IIT Gandhinagar, IIT Bombay, IIT Mandi, IIT Madras, IIT Delhi) have stated other factors that hamper technology transfers, such as
c)	*Others*	46.67%	• Lack of govt. support and incentivisation of faculty • Technology developed is not ready for industry • Lack of training to assess the need and market for a technology • Insignificant portfolio of patents in technology domain • Insufficient engagements of faculty with the industry
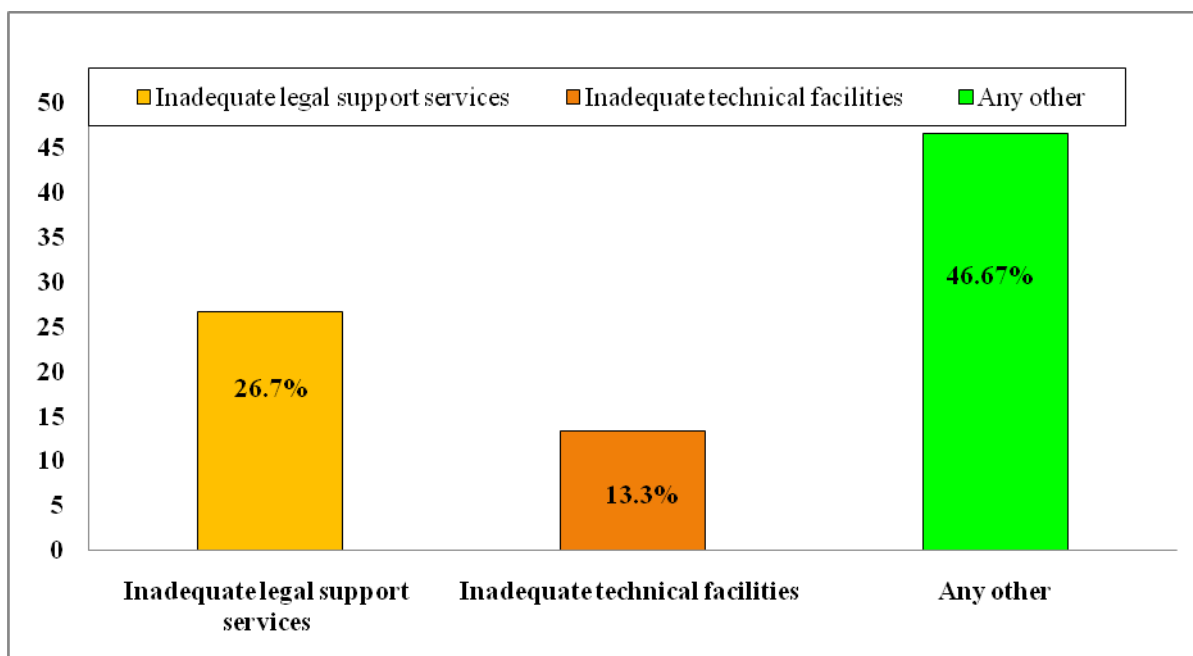
Figure 12: Barriers Preventing Successful Technology Transfer from Institute

4. Summary

The I-A Questionnaire was sent to 16 IITs. Two newly established IITs at Tirupati and Palakkad were not included in the study. IIT-Hyderabad did not respond to our questionnaire, despite repeated reminders. The salient points of the survey are:

➢ Majority of IITs have adequate presence of industrial sector in the form of members of governing/academic bodies, delivering guest lectures and holding joint workshops/seminars/conferences.

➢ Out of 15 IITs, 12 IITs provide industrial training to students in the fields of *Engineering,* 7 IITs in *Life Sciences* and 4 IITs in *Business Management*. Only IIT Kharagpur has a course in '*Legal Studies'* and imparts practical training as well.

➢ By and large all the IITs have dedicated I-A Cells, IPR Management Cells and Entrepreneurship Cells.

➢ Nine IITs have campus research centers set up by the industries. A few of them have been established under PPP mode e.g. Telecom Centers of Excellence.

➢ Majority of IITs (13) have industry sponsored '*Research Fellowships'* for the students.

➢ Eleven IITs have a provision for incentivizing faculty members/researchers who convert their innovations into patents/technologies. Three IITs namely, IIT Guwahati, IIT Patna and IIT Roorkee do not have such provision.

➢ Except IIT Gandhinagar, all IITs have a provision for sabbatical-leave for the faculty members willing to take up industrial assignments.

➢ Eleven IITs have a system of continuing education for the employees of the private sector. These IITs offer courses for the industrial sector that help employees achieve professional growth.

➢ All IITs are actively engaged in R&D. First generation IITs have excellent record in number of research publications, patents and tech transfers. In the period from 2010-2015, IIT Bombay is the frontrunner in the parameter of 'Patents Filed/Granted' (439 patents filed, 61 granted) followed by IIT Madras (311 patents filed, 24 granted). In the last five years, maximum numbers of technologies have been commercialized by IIT Bombay, followed by IIT Kanpur and IIT Madras. IIT Bombay is also at the forefront of signing MoUs with the industries (225 MoUs since 2010), followed by IIT Madras and IIT Kanpur.

➢ In the category of 'Factors hampering the growth of I-A linkages in IITs', seven IITs feel 'lack of common area of interest' and 'lack of cooperation from the industry' as the

major road blockers. Six IITs are of the view that the industry does not come forward for joining hands with academia for collaborative research. Five IITs believe 'lack of appropriate incentives for industry driven research' and 'the issue of IPR' as dampeners for effective I-A research collaborations. The issues of 'lack of confidence in each other' and 'time constraints' add to these factors.

➢ With regard to the lack of sensitization of IPR in the institute, 6 IITs feel that (a) tedious protocols of IPR and (b) lack of IPR related guidance constrain the faculty members to go in for technology oriented research work. Four IITs believe that the compulsion of publication in doctoral programmes hampers them from going in for IP protection. Seven IITs believe that (a) lack of governmental support, (b) in appropriate incentivisation to the faculty, (c) inadequate legal services, and (d) inadequate technical facilities also pose as bottlenecks for effective tech transfers and IP generation.

5. Conclusions

The industry and academia are two vital sectors for nation building, but have different goals and priorities. Earlier, both sectors were developing independent of each other. However, with changed scenario of the global economy, the hand shake of academia with industry has become an important component for the generation of innovations, for boosting the economy of the nations. Developed countries have already created bridges between academia and industry, whereas developing countries, including India, have just begun to make inroads.

In India, IITs are the flag bearers of industry-academia (I-A) relationship in the areas of academics as well as research. The governing bodies as well as academic bodies of IITs have industry personals on board. The industry visits by students is a serious business. Industry happily delivers guest lectures. Some of them have been accredited as adjunct-faculty. The creation of Industry Chairs and industry sponsored research-project/scholarships/fellowships in IITs is a reflection of the faith of industrial sector in IITs. Centres of Excellence (CoE) in IITs are a shining example of triple helix model for R&D under PPP mode, where intelligentsia in collaboration with industry works on the futuristic innovations for commercial gains or societal value. The funds for the development of infrastructure of are primarily provided by the government through funding agencies. These factors along with the presence of I-A Cell, Patent Cell, Entrepreneurship Cell has helped IITs to produce significant number of publications, patents and

technologies. In addition, IITs are helping the industrial sector by running dedicated courses for its employees, which help them in gaining promotions.

Universities and national research labs in India have intelligentsia in abundance and are also equipped with reasonable number of equipments, courtesy UGC-SAP, DST-PURSE and TEQIP programmes. Once the missing links for translational research are provided to them, industry would be happy to tie up with scientists from academia and research labs. The extension of I-A linkages to academia and research labs will take to the tally of technologies and patents to a higher pedestal, thereby improving the S&T quotient of the nation.

Though the level of I-A interactions in IITs is quite satisfactory, but there is a room for improvement. Many of IIT scientists feel lack of (a) common area of interest, (b) cooperation from the industry, (c) incentives for industry driven research and (d) IPR knowledge are some of the important factors hampering the growth of I-A collaborative R&D. The first two factors can be addressed by having regular meetings of specific industry associations with the IIT professors. For the last two factors, IITs excelling in the areas of incentivisation of faculty and IPR Cell can act as mentors for other IITs to overcome these deficits.

1. *Enhancing industrial tie ups for imparting industrial training via industry visits and involving more and more of industry representatives in teaching programme.*

2. *Initiation of industrially designed courses catering to the industrial needs and expectations.*

3. *Induction of special courses for industry personals to pursue education along with their job commitments to increase their knowledge pool.*

6. References

1. http://www.iitb.ac.in/
2. http://www.iitbbs.ac.in/
3. http://www.iitbhu.ac.in/
4. http://www.iitd.ac.in/
5. http://www.iitg.ac.in/
6. http://www.iitgn.ac.in/
7. http://www.iiti.ac.in/
8. http://www.iitj.ac.in/
9. http://www.iitk.ac.in/
10. http://www.iitkgp.ac.in/
11. http://www.iitmandi.ac.in/

12. http://www.iitp.ac.in/

13. http://www.iitr.ac.in/

14. http://www.iitrpr.ac.in/

15. https://www.iitm.ac.in/

Annexure I

Academic fields offered at different IITs

Name	Life Sciences	Engineering Sciences	Business Management	Legal Studies
IIT Kharagpur	✓	✓	✓	✓
IIT Bombay	✓	✓	✓	—
IIT Madras	✓	✓	✓	—
IIT Kanpur	✓	✓	✓	—
IIT Delhi	✓	✓	✓	—
IIT Guwahati	✓	✓	—	—
IIT Roorkee	✓	✓	✓	—
IIT Bhubaneswar	---	✓	✓	—
IIT Gandhinagar	✓	✓	✓	—
IIT Patna	✓	✓	---	—
IIT Jodhpur	✓	✓	---	—
IIT Ropar	✓	✓	—	—
IIT Indore	✓	✓	—	—
IIT Mandi	✓	✓	—	—
IIT(BHU), Varanasi	✓	✓	—	—
Total	**14**	**15**	**8**	**1**

Source: http://www.iitkgp.ac.in/, http://www.iitb.ac.in/, https://www.iitm.ac.in/, http://www.iitk.ac.in/,
http://www.iitd.ac.in/, http://www.iitg.ac.in/, http://www.iitr.ac.in/, http://www.iitbbs.ac.in/,
http://www.iitgn.ac.in/, http://www.iiti.ac.in/, http://www.iitmandi.ac.in/, http://www.iitp.ac.in/,
http://www.iitrpr.ac.in/, http://www.iitj.ac.in/, http://www.iitbhu.ac.in/