सत्यमेव जयते
Department of Science & Technology
Govt. of India

DST-Centre for Policy Research at PU, Chd.

(DST/PRC/CPR-03/2013)

<u>REPORT-4</u>

(May, 2015-Aug., 2016)

Case Studies on Feedback from Select Scientists engaged in Industry-Academia Research Projects

CONTENTS

List of Abbreviations

AICTE	All India Council for Technical Education
AIIMS	All India Institute of Medical Sciences
BARC	Bhabha Atomic Research Centre
BRNS	Board of Research in Nuclear Sciences
CDSCO	Central Drugs Standard Control Organization
CE	European Community
CII	Confederation of Indian Industry
CMC	Christian Medical College
CRO	Contract Research Organizations
CSIR	Council of Scientific & Industrial Research
DAE	Department of Atomic Energy
DBT	Department of Biotechnology
DCGI	Drug Controller General of India
DSIR	Department of Scientific and Industrial Research
DST	Department of Science and Technology
e.g.	Example
etc.	Et cetra
GLP	Good Laboratory Practices
GMP	Good Manufacturing Practices
GOI	Government of India
HEI	Higher Education Institute
I-A	Industry-Academia
IAEA	International Atomic Energy Agency
i.e.	That is
ICMR	Indian Council for Medical Research
ICT	Institute of Chemical Technology
IIT	Indian Institute of Technology
IP	Intellectual Property
IPR	Intellectual Property Right
INR	Indian Rupees
i.v.	Intra venous
JRF	Junior Research Fellows
KEM	King Edward Memorial
MHRD	Ministry of Human Resource Development
MOU	Memorandum of Understanding
MSMEs	Ministry of Small and Medium Enterprises
NAAC	National Assessment and Accreditation Council
NDDS	Novel Drug Delivery System
NRDC	The Natural Resources Defense Council
OPPI	Organization of Pharmaceutical Producers of India
PATSER	Program Aimed at Technology Self-reliance
PCT	Patent Cooperation Treaty
PGIMER	Post Graduate Institute of Medical Education and Research
PPP	Public Private Partnership
Pvt. Ltd.	Private Limited
R&D	Research and Development
S&T	Science and Technology
SGPGIMS	Sanjay Gandhi Post Graduate Institute of Medical Sciences

SOPs	Standard Operating Procedures
SMEs	Small Medium Enterprise
SRF	Senior Research Fellow
STI	Science Technology Innovation
TDB	Technology Development Board
TIFAC	Technology Information, Forecasting and Assessment Council
TU	Technical University
UGC	University Grants Commission
UNESCO	The United Nations Educational, Scientific and Cultural Organization
USA	United States of America
VASVIK	Vividhlaxci Audyogik Samshodhan Vikas Kendra

Introduction

In 21st century, innovations are the key drivers of nation's economic growth and prosperity. These innovations are the outcome of high through put research activities carried out by various research and development (R&D) components persisting in public and private sectors. World's most developed and emerging economies like USA, Korea, China, Russia etc. invests majorly into innovation development as a percentage of total R&D expenditure. R&D investments in innovations are reported to be highest in China (83%), followed by Israel (82%), the United States (63%), the Republic of Korea (62%), the Russian Federation (62%) and Japan (60%) (UNESCO Institute for Statistics, 2014). In these high income countries R&D activities are mainly undertaken by private sector and public: private investment in R&D works at 1: 2 ratio. However, in India, only 1/3rd of R&D investments are contributed by the private sector and rest comes from the public sector. Investments in R&D and its related activities lay mainly on government and higher education institutes, and private sector plays marginal role in R&D expenditure.

Since independence, four national scientific policies have been formulated. First one (in 1958) emphasized on the mass education though establishment of schools, colleges and universities, followed by setting up of National Research laboratories and IITs. The policy also addressed the country's need in science, agriculture, industry and defence. Second policy, in 1983, termed as Technology Policy Resolution laid emphasis on attaining technological competence and self-reliance. 20 years later, in 2003, Government of India issued third science policy, termed as S&T Policy, to bring science and technology together and emphasized the need for investment into R&D to address national problems. The latest science policy came out in 2013 as Science, Technology and Innovation (STI) policy. This policy aims to develop synergies between science, technology & innovation, spreading scientific temper, and enhancing skills amongst all sections of society. To attain these goals, Government has increased its funding in research projects, set up Innovation Centres and S&T Parks, and incentivizing industrial sector to invest in R&D of universities and research laboratories of public sector. Unfortunately, despite these initiatives of Government of India, large presence of scientific pool, hundreds of Government funded research laboratories, enormous deposits of natural resources, immense biodiversity, our country is still tagged as third world country. We are faring poorly in the global indicators of economic and scientific progress.

India has realized the wide gaps existing in learning, research, innovation and skills development persisting in its higher education system where corrective actions are required. Poor linkages between academic and industrial sector is one of the major road blocks for improving R&D activities in India (Progress Harmony Development Chambers, India, 2015). It is clearly highlighted that India with global rank 50 lags far behind in university-industry collaborations in comparison to the most developed economies of the world for e.g. Finland, USA and Switzerland being top 3 rankers in university-industry collaborations where I-A collaborations has generated number of innovative technologies contributing to the nation's economic growth (Global Competitiveness Report, 2015-16).

One of the reasons for lack of synergy between industrial and academic sector is attributed to quality of research, which is skewed towards basic and fundamental research, and lack of application oriented research. In addition, industry feels that maximum graduates are not industry-ready, in terms of soft skills. On the other hand, academia feels that industry is reluctant to invest in research but wants quick solutions to their problems. There is a need for effective intervention to bring both these sectors closer by understanding their needs and expectations. Keeping this in mind, Department of Science and Technology (DST), Government of India desired that our Centre should carry out 5-6 case studies on successful I-A projects to understand the I-A ecosystem existing in Indian Universities and other Higher Education Institutes (HEI) of India.

DST-CPR initiated the task by reviewing number of I-A collaborative projects carried out in different universities and other HEIs of India. Our Centre contacted scientists working in public universities, private universities, technical institutes like Institute of Chemical Technology (ICT) and Indian Institute of Technology (IIT), medical research institute such as All India Institute of Medical Sciences (AIIMS) and industry representatives to understand the mechanics and challenges involved in delivering I-A collaborative research work. Our Centre prepared a detailed I-A Proforma (Annexure 1) to be filled in by scientists having practical experience of handling I-A collaborative projects. The Proforma also sought suggestions and hindrances faced by the scientists while pursuing I-A collaborative research projects. In total 18 select scientist from all over India were requested to fill I-A proforma for I-A case study. Out of these 8 scientists filled the I-A proforma (Section A, Table 1).Four eminent scientists could not send the filled proforma, but Prof. Tewari met them personally and noted down their suggestions for improving I-A interactions.

These scientists are:

- Prof. G. D. Yadav, Vice Chancellor, ICT, Mumbai.
- Prof. A. Jhunjhunwala, Chairman, IITM's Rural Technology and Business Incubator (RTBI), IIT, Madras.
- Prof. T. Pradeep, Head, DST-Unit of Nanoscience, IIT, Madras.
- Prof. Balram Bhargava, Exec. Director, Stanford-India Biodesign, AIIMS, New Delhi.

Prof. G.D. Yadav emphasized (a) the need for incentivizing university faculty indulging in I-A activities and (b) effective short term industry-projects for under- and post-graduate students of applied sciences.

Prof. A. Jhunjhunwala suggested that government should promote entrepreneurship programme in HEI, universities, IITs, research centres. He was also of the opinion that Small Medium Enterprises (SMEs) and Ministry of Small and Medium Enterprises (MSMEs) should be encouraged by the government to indulge in R&D activities, as large companies are good at scaling up products and are not interested in serious R&D.

Prof. T. Pradeep called for upgrading research eco-system in HEIs, especially the instrumentation facilities.

Prof. Bhargava stated that India has huge potential for innovative research in the field of Bio-Medical Engineering. In short span, the collaboration of AIIMS doctors with Engineering faculty of IIT has resulted in many successful start-ups and entrepreneurs coming out of Stanford Biodesign Centre. He recommended for setting up similar Centres in research oriented hospitals like PGIMER, Chandigarh, Medical Colleges in Delhi, Lukhnow, Chandigarh etc.

Only one scientist i.e. Prof. Vijay Chaudhary (University of Delhi, New Delhi) did not provide the necessary information.

The Report has been divided into 5 sections:

Section A: List of select scientist who have carried out successful I-A collaborative research projects in India.

Section B: Brief profile details of the scientists included in present case study.

Section C: Details of I-A collaborative projects carried out by select scientists.

Section D: Feedback from scientists for strengthening I-A collaborations in India.

Section E: Recommendations of the report.

Section A

List of select academicians and industrialists who carried out I-A collaborative projects.

Table 1: Selects scientists on whom present case study is carried out

S.No	Academician	Industry counterpart
1	Prof. V.B. Patravale Institute of Chemical Technology (ICT), Mumbai	Shri. Dhirajlal Kothadia Sahajanand Medical Technologies Pvt. Ltd., Surat, Gujarat
2	Prof. O.P. Katare Panjab University, Chandigarh	IPCA Labs Pvt. Ltd., Mumbai
3	Prof. Neelima Kshirsagar Seth GS Medical College and KEM Hospital, Mumbai	Dr. J.N. Verma Founder and Managing Director Lifecare Innovations Pvt. Ltd., Gurgaon
4	Prof. Shantanu Roy IIT-Delhi, New Delhi	Thermax Pvt. Ltd., , Pune
5	Dr. Sunil Jha IIT-Delhi, New Delhi	BSES Yamuna Power Ltd., New Delhi
6	Prof. R.K. Saxena University of Delhi, New Delhi	Tata Chemical Ltd. Pune, Maharashtra
7	Prof. Dinesh Goyal Thapar University, Patiala	Goetze India Pvt. Ltd., Patiala
8	Prof. K. Sankaran Anna University, Chennai	TMI Systems, Bangalore

Section B

Brief Profile details of the scientists included in present case study

Successful I-A interface is characterized by collaborative and interactive programmes between industrial sector and academic institutions. Intensification of interdependence between academia and industry is the need of hour in order to fulfil innovation and sustenance demands of the country. There is a need of paradigm shift in the approach and attitude of industrial sector and academic sector for achieving mutual constructing objectives i.e. to promote technological innovations/ products leading to economic development of nation. Despite various Government initiatives, there is ambiguity whether I-A interaction is partial in nature or there is considerable relationship. In order to understand the extent of I-A interaction, present study was carried out.

To begin with, our centre tends to take inputs/ feedbacks from scientists working in universities both public and private university, technical institutes like IITs and Institute of Chemical Technology (ICT) and industry representative who are pursuing research in different sectors such as pharma, engineering and biotech sector. Keeping this in mind, in present study two scientists namely Prof. V.B. Patravale working in ICT, Mumbai and Prof. O.P. Katare from Panjab University, Chandigarh and one industrialist Dr. J.K. Verma co-founder of Lifecare Innovations carrying out research in field of pharma sector, whereas on other hand, 2 scientist Prof. Shantanu Roy and Prof. Sunil Jha were selected working in premier institute of national Importance IIT-Delhi carrying out research in field of engineering sciences. Other promising field in which India's present research is rapidly progressing is biotechnology. Hence, 3 scientist namely Prof R. K saxena from University of Delhi, New Delhi; Prof. Dinesh Goyal from Thapar University, Patiala; and Prof. K. Sankaran from Anna University, Chennai engaged in field of applied microbiology and biochemistry were considered for reviewing there I-A collaborative experience.

In this section we tend to present brief details of select scientists in terms of their publications, patent profile, technologies developed and transferred and awards and accreditations that they have received for their industry oriented research.

Scientist from Pharma Sector:

1. ***Prof. V. B. Patravale (Pharmaceutical Sciences)***

   Prof. V.B. Patravale is a professor in the Department of Pharmaceuticals Sciences and Technology at ICT, Mumbai, which has been rated as top industry-academia linked institute of India (AICTE CII, 2014). She is credited with 72 research publications and till date has been granted 4 national patents and has filed 16 national and 6 international patents. Prof. Patravale is actively engaged in industrial collaboration, till now she has handled 19 I-A collaborative projects, 10 technologies transferred and almost 30 industrial products have been developed by her. Moreover she has provided number of consultancy services to the industrial units such as Cadila Pharma, Sahajannand Medical Technologies, Kamani Oils, Yuva cosmetics and Charbhuja Trading and Agency. She has been accredited with various industry related awards on her name. She is the recipient of prestigious OPPI Woman Scientist Award 2015 from the organization of Pharmaceutical products of India. In the same year she received Vividhlaxci Audyogik Samshodhan Vikas Kendra (VASVIK) award from its Apex committee. In the year 2013, Smt. Chandaben Mohanbhai Patel Industrial Research Awards for Women Scientist was awarded to Prof. Patravale. She is the grant awardee for Bill and Melinda Gates Foundation for developing “Nanovaccine for Brucellosis using Green Technology”. Prof. Patravale has strongly contributed to the innovations of industry importance in field of pharma sector and has been closely associated with pharmaceutical industrial segment of India.

2. ***Prof. O.P. Katare (Liposomal technology and drug development)***

   Prof. O.P Katare is a professor in University Institute of Pharmaceutical Sciences, Panjab University, Chandigarh. He is working in field of liposome technology and developing novel drug delivery systems including nanoparticles for tropical pharmaceutical products. He is credited with 112 publications and has been granted 3 national and 4 international patents and has filed 15 patents (9 national and 6 international). He has carried out more than 10 I-A research projects, transferred 3 technologies to industrial sector and developed 3 industrial products. Prof. Katare has been acknowledged for his innovative and industry linked research by DBT by awarding him Technology National Award 2007 conferred by President of India Dr. A.P.J Abdul Kalam. He has also received prestigious OPPI Scientist Industry Awards 2011 by GlaxoSmithKline in order to honor his innovations in pharmaceutical sector. He received best patent award from Indian Association of Biomedical Scientists for the development of psorisome. On the international front, he has been a founder member and expert on the scientific board of International Phospholipd Research Centre at Heidelberg, Germany. He has been actively associated with industry oriented research and has successfully transferred his technology to industry.

3. ***Dr. J.K Verma (Drug development)***

   Dr. J.K Verma is a co-founder and managing director of Lifecare Innovations Pvt. Ltd. located in Gurgaon excelled in his research in field of drug development with focus on controlled release of pharmaceuticals viz liposomal drugs and nano drugs. He is credited with 22 research publications and has been granted with 1 national and 6 international patents and has filed 3 national and 17 international patents. He has been actively involved with academia and till date has carried out 15 I-A collaborative research work. He has commercialized 6 technologies translated from academia and has developed 8 products in total. He has been honored for his industrial research and active involvement with academic sector by the Government of India. He has received numerous awards and honor and some of them are as innovation in medical sciences and technology from Indian Council of Medical Research (ICMR, 2015); Vigyn Ratna Award (2012, 2007); National Award from Department of Scientific and Industrial Research (DSIR, 2006), Department of Biotechnology (DBT, 2004, 2006), Technology Development Board (TDB, 2008) etc. Dr. Verma is amongst those industrialists who have shown trust on academia of the country and has immensely benefitted from I-A collaborations.

Scientist from engineering sector

1. ***Prof. Shantanu Roy (Computational fluid dynamics)***

   Prof. Roy is a professor in Department of Chemical Engineering of IIT-Delhi. He is pursuing his research in field of multiphase reactors, chemical reaction engineering and modeling, and computational fluid mechanics. He is credited with more than 70 publications and has been granted 3 international patents and has filled one international patent. He has been actively involved in more than 20 I-A research projects. He provides consultancy services to various industries and is member of scientific advisory committee of Ministry of Petroleum and Natural Gas. He also services as expert of several DST-TIFAC committees for technology projection. He has been awarded with DuPont Young Faculty Award 2004 by DuPont Chemical Company, USA for pursuing industry oriented research.

2. ***Dr. Sunil Jha (automation in manufacturing process)***

   Dr. Jha is associate professor in Department of Mechanical Engineering in IIT Delhi. He is working in field of manufacturing processes, mechanatronics and automation. He is credited with 20 publications and has filled 4 national patents. He has handled 7 I-A collaborative research products and has contributed to transfer of 3 technologies and development of 4 industrial products. He is also actively involved with number of industries for providing consultancy services in domain of product designing.

Scientist from biotechnology sector

1. ***Prof. R.K. Saxena (Applied Microbiology)***

   Prof. Saxena is a professor in University of Delhi in the Department of Microbiology. His major area of research work is industrial microbiology. He has published over 175 research publications and has been granted 2 national patents and has filed 12 national and one international patent. He has handled 3 major and 1 minor I-A research projects. Till date Prof. Saxena has contributed to the development of 8 industrial products which are under industrial negotiation for commercialization. Prof. Saxena has been awarded with young Indian Next practices award (2011) by Department of Science and Technology (DST) and Indian innovation initiative (2011) by CII. Prof. Saxena is also coordinator of Innovation, Incubation and Technology Development Cell of University of Delhi and is strongly contributing to the strengthening I-A collaborations in the University.

2. ***Prof. Dinesh Goyal (Applied Microbiology)***

   Prof. Goyal is working in Department of Biotechnology at Thapar University as professor. He is working in the field of applied microbiology and biotechnology. He is credited with 80 publications and one national patent. He has been actively engaged in 4 I-A research projectsand has transferred 3 technologies to industry and has developed 5 industrial products. He is actively involved in providing consultancy services to various industries. He has also heading Science Technology Entrepreneurship Park of Thapar University to promote technology development, attracting industries and promotion of entrepreneurship culture in the University.

3. ***Prof. K. Sankaran (Biochemistry)***

   Prof. Sankaran is working as professor in Centre for Biotechnology, Anna University, Chennai. He is credited with 40 research publications and has been granted 1 international patent and has filed 9 national and 2 international patents and. He has transferred 2 technologies to the industry and has developed 2 industrial products. He has been actively involved with consultancy services to Shree Kamdhenu Electronics Pvt. Ltd. and has been associated with field validation services along with Trivitron Healthcare for uropathogenic antibiogram device. He has been involved with number of I-A collaborative projects and is delivering them successfully under required time frame and industrial requirements.

Brief profiles and achievements of academicians (7) and industrialist (1) are presented in Table 2:

Table 2: Brief profile of Select scientists who successfully delivered I-A collaborative research projects

S.No	Name	Broad Area of Research	Res. Papers	Patents		I-A projects	Tech. transfer	Industrial products developed	Consultancy and Industry related awards
				Filed	Granted				
1	Prof. V.B. Patravale	Pharmaceutical Sciences and Technology	72	22	4	19	10	30	**Consultancy**: Cadila Pharma, Sahajananad Medical Tecghnologies, Kamani Oils, Yuva cosmetics, Charbhuja trading and agency **Award**: OPPI Women Scientist Award 2015, Smt. Chandaben Mohanbhai Patel industrial Research Award for Women Scientist 2013
2	Prof. O.P. Katare	Liposome Technology and Drug Delivery	112	15	7	>10	3	3	**Award**: DBT Technology National Award 2007, OPPI Scientist Industry Award 2011, Best Patent Award by Indian Association of Biomedical Scientists (IABMS, Chennai)
3	Dr. J. N. Verma	Drug Development	22	20	7	15	6	8	**Award**: Haryana Vigyan Ratna Award 2012, Vishnu Kamal Award 2009, National award- Technology Development Board 2008, Vigyan Ratna Award 2007, Scientist of the year 2003
4	Prof. R.K. Saxena	Industrial Microbiology	175	13	2	4	-	8	**Award:** Young Indian Next Practices Award in i3 national fair 2011, Indian Innovation Initiative award 2011
5	Prof. Dinesh Goyal	Applied Microbiology and Biotechnology	80	1	1	4	3	5	-
6	Prof. K. Sankaran	Biochemistry	40	11	1	-	2	2	**Consultancy**: Shree Kamdhenu Electronics Pvt. Ltd and Trivitron Healthcare, Chennai
7	Prof. Shantanu Roy	Computational Fluid Mechanics	>70	1	3	>20	-	-	**Consultancy:** Scientific Advisory Committee of Min. Of Petroleum and Natural gas, DST-TIFAC Committee expert member **Award**: DuPont Young Faculty Award 2004
8	Dr. Sunil Jha	Manufacturing Processes, Automation	20	4	-	7	3	4	-

Section C

Details of I-A collaborative Projects carried out by Select scientists

1. Prof. V.B. Patravale, ICT, Mumbai

Title	Development of Novel Drug Eluting Coronary Stents
Duration	2006-15 (9 years)
Finances	Industry, ICT and Government financed in 3 stages of product development: INR 17,00,000 (1^{st}) + 2,69,376 (2^{nd}) + 7,21,355 (3^{rd})
Manpower	3 JRF and 1 Res. Assistant
Responsibilities	*Academia*: Concept development, product development and optimization, *in vitro* characterization, *ex vivo* studies. *Industry*: Concept development, patent filing, scale-up, preclinical and clinical studies, product approval from authorities, marketing etc. *Other Organization*: Prime Minister Fellowship Scheme (Government of India) for awarding JRF
Approach for initiating collaborative work	Industry approached Prof. Patravale for consultancy. After joining as a consultant, the work was then taken ahead as additional collaborative projects.
Stage at which Industry involved	Industry was involved at every stage of the project
IP Status	-
Institute Gain	• 25% of the project cost was received by institute as institutional share • 33% of the consultancy cost was received by institute as institutional share • Empowering image of institute in Industrial sector as promising academic collaborator
Scientist Gain	• Inventorship in the patents filed from the research work. • Financial support to conduct research • Publications • Recognition in industrial arena • Achieving scientific excellence
Industry Gain	• Research support and expertise to develop and optimize the product • Cost effective product development • Fulfillment of Social responsibility
Market Impact	• Global market entry (over 40 countries) with the superior coronary stents and 1^{st} in India to receive European Conformity (CE) mark • The regulatory authorities (India) not only approved the products but also increased the shelf life from initial 1 year to 2.5 years for SupraFLEX® in year 2015

	• More than 3.5 lakh stents implanted till date • Revenue of ~INR 50 Cr was generated in year 2013-14 • Better market opportunity for products under development
Societal Impact	Superior product with respect to biocompatibility and restenosis rate was available for patients. Cost effective treatment modality with high efficacy for patients (almost 25% cost reduction than the competitor product)
Profit Sharing	Profits not shared with collaborator/ Institute
Outcome	Currently, 4 coronary stents are being marketed in India (First to receive CE mark) and abroad under the trade names Infinnium™, Supralimus™, Supralimuscore™, Everoflex™ (More than 3.5 lakh stents have been implanted). Other stents under development: S-Link, Supraflex etc.

2. Prof. O.P. Katare

Title	Development and Scale-up of Some Novel Liposomal Products
Duration	There are different modules viz. Life long, time bound and case bound (continuing from 2004)
Finances	INR 5, 10, 000 (Industry and Panjab University)
Manpower	4 JRF
Responsibilities	*Academia*: Concept formation, hypothesis testing, generation of scientific lab-scale data and scientific evidences, varied techniques for analysis, pre-formulation, formulation development, characterization and standardization, stability issues and assessment, package development, Product technology information. *Industry*: Scale-up and tech-transfer issues, development of Standard Operating Procedures (SOPs) (Joint efforts), filling all the gaps to fulfil the regulatory requirements, funding supports for materials and outsourcing, fellowship for scholars and support for lab assistance and patent filing. *Other organization*: Funds support from agencies like UGC, AICTE, DBT and DST for infrastructure and high cost instruments.
Approach for initiating collaborative work	Industry approached only in all cases. (In case of vice versa, it was failure)
Stage at which Industry involved	Right in the beginning at the conceptual level
IP Status	University shared with innovator the royalty amount, i.e. 2% of ex-factory price which was then distributed 50:50 between the university and investigators.
Institute Gain	• Based on the achievements, the institute & the university fetched so many high-funding projects likes DST-INSPIRE, DST-Policy Research Centre, UGC-NanoSci projects (worth crores of rupees).

	• It helped University in ranking by different agencies like NAAC, THE etc. • Generating finances through Centre for Industry Institute Partnership.
Scientist Gain	• The enhancement in the employability of the scholars. They were quickly absorbed in the high growth or top performing Pharma industries like Sun, Lupin, IPCA and others. • Image or brand building at individual level and organizational levels both the investigators and university gained lots of advantages in this regard. • Financial support for procurement of materials and outsourcing that saves lots of time. • Generated I.P.R. with the support of Industries which is often ignored in the conventional lines of practice at the University level.
Industry Gain	They got novel pharmaceutical products with an edge over other products hence, the market advantages. The brand value in such cases becomes very high.
Market Impact	Products have been appreciated by the doctors and gradually catching up in the market.
Societal Impact	Helped suffering society
Profit Sharing	University shared with innovator the royalty amount, i.e. 2% of ex-factory price which was then distributed 50:50 between the university and investigators.
Outcome	Liposome and nano-tech based novel pharm. products for dermatological disorders like Psoriasis, Eczema and Fungal infection stability solutions

3. Dr. J. K. Verma

Title	Scale Up Process Development for Production of Liposomal Amphotericin B, Awareness Program and Clinical Performance Trials
Duration	16 months
Finances	Lifecare Innovations Pvt. Ltd., INR 99.76 lakhs (66.61%) DSIR under PATSER INR 50.00 lakhs (33.39%)
Manpower	-
Responsibilities	*Academia*: Development of lab scale technology (*prior to this project*). *Industry*: Innovations and developments to make the product – Liposomal Amphotericin B patient worthy and commercializable; with cold-chain compatible packing to maintain uninterrupted cold-chain from production to patients' bed-side. *Other organization* (if any, like DST/DBT etc.): DSIR funded to the industry for this project for 16 months; DBT funded academic

	institutions before this project
Approach for initiating collaborative work	In 1990s, Dr. J.N.Verma was the only known liposome technologist in Indian industry credited with discovery, development and commercialization of Asia's 1st liposomal product – a Liposome Agglutination Test for immunodiagnosis of Syphilis. Various Government agencies viz. DBT, NRDC and DSIR identified Dr.Verma and committed support for creating the company Lifecare Innovation to absorb DBT technology, carry out translational research and commercialization of life-saving drug for treatment of life-threatening fungal and leishmanial infections.
Stage at which Industry involved	Dr. J.N. Verma being a liposome technologist was in touch with Dr. B.K. Bachhawat and Dr. Neelima Kshirsagar since 1991 and was regularly interacting with their research groups. Dr. Verma played pivotal role in establishing liposome technology in the industry in India and was involved in the project at different levels before the completion of clinical trials.
IP Status	IP was assigned to the industry and the institution was paid royalty.
Institute Gain	The institutions KEM Hospital Mumbai, DBT and DSIR received Royalties and DSIR's investment as Programme aimed at Technology Self Reliance (PATSER) grant along with interest was returned by Lifecare Innovations.
Scientist Gain	Scientists were benefitted by unprecedented recognition. In addition to other honors and awards Dr. Kshirsagar was conferred with B.C. Roy Award.
Industry Gain	Dr. Verma though in the industry as founder and managing director is involved in the project as a scientist. Without Dr. Verma's pioneering initiatives as a liposome technologist, and determined pursuit in a country that was not the most conducive for technopreneurship, this project would have been buried as project report in the archives of DBT as no company wanted to invest in this project perceived to be very risky. Industry got an opportunity to establish commercial production of Novel Drug Delivery Systems (NDDS) based controlled release drugs viz. liposomal and nano-drugs. Today Lifecare Innovations has forged several collaborations both within and outside India and has become inspiring example of technology led enterprise engaged in discovery and development of novel drugs.
Market Impact	Amphotericin B due to its overwhelming toxicity particularly nephrotoxicity is referred to as *Ampho-the-terrible*. With not even single other broad-spectrum anti-fungal drug discovered, Amphotericin B despite nephrotoxicity to 2/3rd of the patients administered with the drug, Amphotericin B continued to be the only hope for invasive and

	systemic fungal infections. FUNGISOME™ – *Ampho-the-terrific* safer than any other anti-fungal drug in the world has rekindled hope that liposomes can help mitigate dose limiting toxicities. Consequent to FUNGISOME™, number of companies are now engaged in developing liposomal formulations of Amphotericin B and other drugs. New business of several hundred crores of liposomal drugs has developed in India alone. Following success of FUNGISOME™, Lifecare Innovations has developed and commercialized five lipid and liposomal formulations for treatment of fungal and leishmanial infections and psoriasis
Societal Impact	Prior to FUNGISOME™, Liposomal Amphotericin B was unaffordable by most Indians. Imported Liposomal Amphotericin B was mostly prescribed in defence hospitals. Now because of success of this project and consequent availability of FUNGISOME™, number of lives is saved every day. Two examples are cited below to highlight impact of this liposomal drug.
Profit Sharing	Institution was paid royalty
Outcome	FUNGISOME™ – the only indigenous and superior to imported Liposomal Amphotericin B (i.v.) was innovated, commercialized and made available throughout India and became preferred Liposomal Amphotericin B i.v. of most of the premier hospitals in India including – AIIMS New Delhi, PGIMER Chandigarh, Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGIMS) Lucknow, Christian Medical College (CMC) Vellore, Tata Memorial Hospital, Mumbai, Medanta - the Medicity Gurgaon, Apollo group of Hospitals, R&D and other Defense Hospitals. The daily dose cost, success rate and nephrotoxicity of FUNGISOME™ were INR 5900, whereas of the imported AmBisome were INR 60,000. Prior to FUNGISOME, only 1% of the patients needing Amphotericin B could afford its nephrosafe Liposomal formulation whereas within 3 years of FUNGISOME launch, FUNGISOME alone catered to estimated 16% of the patients needing Amphotericin B i.v. Today FUNGISOME is emerging as drug of choice in several countries. It has been launched in Latin America under the brand name AmBullet®.

4. Prod. R.K. Saxena

Title	Enzymatic Synthesis of Xylitol from Hemicellulose from Tata Chemicals Limited (TCL).
Duration	2 years
Finances	100% financial support by the industry
Manpower	2 JRF
Responsibilities	*Academia*: Sole responsibility of the academia *Industry*: Filing of the patents and subsequent commercialization

	Other organization (if any, like DST/ DBT etc.): Nil
Approach for initiating collaborative work	Industry approached
Stage at which Industry involved	Right from the beginning
IP Status	Joint patents
Institute Gain	Infrastructural support and industrial relation (university-industry interaction)
Scientist Gain	A new dimension of industrial requirement were explored and investigated
Industry Gain	Industrial processes of bio molecules required by the industry were developed.
Market Impact	Details are with the industry
Societal Impact	Industry provided jobs, based on the work carried out by us
Profit Sharing	-
Outcome	The 2 products i.e. xylitol and propanedial were developed at the pilot plant 2 students working for these projects and were awarded Ph.D. degree of the university. 13 research paper were published

5. Prof. Dinesh Goyal

Title	Utilization of waste biomass for removal of heavy metals from industrial effluents
Duration	2005-2008 (3 years)
Finances	CSIR, New Delhi: 20 lakhs
Manpower	2 JRF
Responsibilities	*Academia*: Project co-ordination & management with participating agencies and data generation Laboratory work and basic data generation *Industry*: logistic support at the Unit, sample analysis, pilot scale trial *Other organization* (if any, like DST/ DBT etc.): CSIR-Project monitoring
Approach for initiating collaborative work	Scientist approached the industry
Stage at which Industry involved	Towards the completion for pilot scale trials
IP Status	IP shared amongst the collaborators/institute/industry: Equally between TU and CSIR
Institute Gain	All deliverables were met. 2 Ph.D and 10 M.Sc were awarded, 12 publications in good journals.

Scientist Gain	One patent granted No. 244750: A process for chromium VI removal from industrial effluents by waste biomass Date of publication 24.12.2010; Journal No. 52/2010; Inventor: Ahluwalia AS and Goyal Dinesh
Industry Gain	The industry made trial and used it for environmental clearance and maintenance in removing chromium from waste water.
Market Impact	Not ascertained
Societal Impact	Not ascertained
Profit Sharing	Never estimated
Outcome	In this process bio sorbent is manufactured from microbial waste biomass, originating as waste by-product from pharmaceutical industries, such as microbial waste biomass comprising of fungus *Penicillium* sp./*Pischia* sp./ *Rhizopus* sp./ *Aspergillus* sp., used in fermentative production of antibiotics.

6. Prof. K. Sankaran

Title	Instrumentation for Long Term Monitoring of Neuromuscular and Cardiovascular Status for Diagnosis, Therapy and Rehabilitation
Duration	3 years
Finances	Total project Amount =INR 41,33,000 Source of finances: DST, New Delhi
Manpower	2 SRF
Responsibilities	*Academia*: Technology development *Industry*: Field validation and commercialization *Other organization* (if any, like DST/DBT etc.): DST for funding
Approach for initiating collaborative work	The scientist approached the industry
Stage at which Industry involved	During validation stage
IP Status	IP shared amongst the collaborators/institute/industry: 50:50
Institute Gain	The institute gets the share as stipulated by the sub-committee from the one-time technology transfer fee and royalty.
Scientist Gain	Inventor reward was given to the scientist from the one-time technology transfer fee collected from the industry and also the scientist will be given his share from the revenue generated in the form of royalty on selling of every unit.
Industry Gain	NA
Market Impact	Unknown, as the product has not hit the market yet.
Societal Impact	Unknown, as the product has not hit the market yet.
Profit Sharing	-

Outcome	Multi-channel synchronous wireless data acquisition; bladder pressure monitoring and extension for cystometrogram system. Standards compliance testing and certification of the product. The project was successfully technology transferred.

7. Prof. Shantanu Roy

Title	Flow Studies, Mixing Pattern and Modeling of Rotary Bioreactor
Duration	2 years
Finances	Industry ~ 60 lakhs; Ministry of Human Resource Development (MHRD; 25 lakhs); DST (37 lakhs); Board of Research in Nuclear Sciences (BRNS ; 20 lakhs); IIT (~ 30 lakhs).
Manpower	1 SRF, 1 project assistant
Responsibilities	*Academia*: Conduct of in-house (in IIT) experiments, experiments in industry, establishing the experimental protocol and conduct of experiments, collection and analysis of data, modelling of flow phenomena. *Industry*: Design of experimental unit, fabrication and installation. Providing logistical and manpower support for scientists from IIT and BARC. *Other organization* (if any, like DST/DBT etc.): BRNS, DAE supported part of the developmental effort in IIT in general (not specific to the current project).
Approach for initiating collaborative work	Industry approached scientist.
Stage at which Industry involved	From beginning
IP Status	IP was not shared amongst the collaborators/institute/industry. The IP was mostly in form of knowhow. The specific details of the technology were not disclosed but the use of the experimental technique in this setting, which was a novel and significant accomplishment, has been published.
Institute Gain	• Technical success • Training of students in a particular technology that has been developed in-house
Scientist Gain	This is now considered as a case study of industrial radio tracing by the International Atomic Energy Agency (IAEA), of which the PI is a technical expert.
Industry Gain	Product/technology is successfully commercialized and utilized by industry
Market Impact	It is substantial business of the “Water and Waste Solutions” division

	of Thermax. The product is sold under the commercial name "BioCask". The I-A project in question provided a crucial step in commercialization of this technology.
Societal Impact	The product/technology that has been developed is an important technology for end-to-end wastewater and sludge treatment solution. It is commercially viable and used in various urban and rural centres.
Profit Sharing	No profit sharing
Outcome	The technology for flow imaging developed at IIT Delhi was never used in the industry directly. It was a challenge to do so, and this is the first ever (anywhere in the world) successful demonstration and use of this technique in the industry. The suspected problems were fully addressed and specific recommendations were made. Some minor design changes and major operational changes were made. Good efficiency was ensured and product/technology is a success in the market.

8. Prof. Sunil Jha

Title	Solar Power Operated Water Pump
Duration	3 Months
Finances	Industry: INR 6.50 Lakhs
Manpower	Nil
Responsibilities	*Academia*: To design efficient Solar operated irrigation pumping system. *Industry*: To provide specifications of the requirement.
Approach for initiating collaborative work	Industry approached
Stage at which Industry involved	Since beginning of the project
IP Status	IP shared amongst the collaborators/institute/industry by 50-50 %.
Institute Gain	Technology knowhow
Scientist Gain	Get to know about the state of art of technologies in solar water pumping.
Industry Gain	Get commercial product developed in very short time.
Market Impact	BSES Yamuna Power Ltd. successfully commercialized and installed more than 60 such pumps in Delhi.
Societal Impact	Improved the water supply by reducing power dependency and cost.
Profit Sharing	No profit sharing with institute.
Outcome	Technology for solar water pumping for farmers, schools, hospitals etc and installation of solar pumps at respective sites

Section D: Feedback from scientists for strengthening I-A collaborations in India.

S.No	Name	Feedback	
1	Prof. V.B. Patravale	Hindrances	Lack of infrastructure and facilities at institute end required extensive outsourcing in formative years. However the infrastructure was build up as per requirements in later years with the support of government and private industrial grants.
		Suggestions	• Rules and regulations for collaborative projects/ consultancy and technology transfer should be properly defined (As this rules are properly and clearly defined at Institute of Chemical Technology, the execution of collaborative project and technology transfer was extremely swift and convenient) • Patent cell within the institute can help the researchers scan micro patents at faster pace rather than being dependent. • Patent royalty clause should be inbuilt and a specific percentage defined by the institution. • Confidentiality agreement and MoU should be critically drafted safeguarding the interest of both the sides. • Follow up mechanism for milestone payments should be automatically built in the system. No reminders from collaborators to central accounts should be necessary. • No maintenance grant comes from Government/Institute which at times is necessary for smooth functioning of the project.
2	Prof. R.K. Saxena	Hindrances	NIL
		Suggestions	• For applied research of national importance being carried out in public funded institutes, the industry should be involved from the very beginning of the research project. Government should give additional incentives to industries working on research projects of national importance. • Each research institute should have a dedicated Industry-Academia Centre to look after I-A linkages, IPR management, Entrepreneurship, Technology Development and Technology Transfer. • Government should encourage setting up research facilities and scale up facilities on the campus under PPP mode. • Technology developed by scientist/teacher and transferred to an industry should be given academic wait age and incentives to the scientist/teacher.
3	Prof. Shantanu	Hindrances	Nothing in particular. Very good cooperation from industry, who very well championed the cause of incorporating high-end research into crucial parts of their technology.

	Roy	Suggestions	• Major public sectors in India have a mandate for research and development, and part of that is joint development with academia. However what plagues success in many cases is that the middle-level management in such major public sectors, who have a direct knowledge of technical challenges and problems (where academia can help), have hardly any decision-making powers. Most of the R&D decisions are taken by top management, and many of the professional occupying such positions either do not have experience of R&D, or are too busy and disinterested in R&D, let alone interactions with academia. • They would be present for industry-academia programmes and photo-ops, but since they have very little direct experience or requirement of research-based solutions, the whole effort ends up being cash sink with little positive results. There is need to have the people who are actually working on research to also be decision makers in terms of budgets, spending and setting directions for R&D. • Also many public sectors have to abide by archaic laws of using “proven and demonstrated technologies” when they are in the process of design and commercializing a plant. Since new technologies would never by demonstrated, by definition, hence the incentive to go for new technologies developed under I/A interactions is small. Thus, an eco-system in which new technologies developed indigenously is encouraged, is required. This will have obvious conflicts with risk assessment that companies will make, and this has to be addressed. • In private sectors in India, the problem is two-fold. There are several companies who “feel the need” for research based solutions, but are too small to afford major projects. They understand the challenges very well, are doing very good work on their own, but they are not part of an “eco-system” in which they can freely interact with academia. Maybe Government needs to create an environment, in terms of funding but also in terms of “access”, to support such companies to interact freely with academia. • For large private sector companies in India, the challenges to develop and commercialize technology indigenously are too many. So most of them decide to “buy-out” technology from known vendors (usually themselves major multinational companies), with the incentive towards indigenous development is low. • One other aspect is that major technology vendors provide guarantees on technology, when deployed. For a private (or even public sector) company that is a major requirement. Even if we do have new technologies and patents coming out of I/A relationships within the country, usually lack of an eco-system which ensures guarantees and troubleshooting support is a deterrent for going in for new technologies. Thus, it is important that some sort of undertaking on guarantee of

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

		Suggestions	• Industry must actively work with researchers in working out new concepts and finally cost benefits analysis so that product or process is acceptable by the industry. • Provide incentives to the working teams for successful implementation. • The findings generally remain in thesis/dissertation for years and we keep reinventing the wheels. iv. More collaboration between Industry and academia is necessary. • Industry to realize that they can get enormous benefits from this in modifying their processes in a cost effective manner, using academia which is actually a center for knowledge creation. • This knowledge can be protected as well as utilized by them for greater returns. v. Industry-Academia and Govt., to facilitate this and making aware of available technologies which can be commercialized or results of R&D are accepted by the end users. • Patenting is very slow process in India, by the time patent is awarded everything vanishes. • Fast patenting and its commercialization or adoption by the industry is very much required. Due to this reason publishing the work in Science Citation Index Impact factor journals only remains as an alternative.
6	Prof. O.P. Katare	Hindrances	• University Infrastructure: a) Lack of sufficient space and laboratory facilities b) Equipments, maintenance • Retention of technology-trained scholars: This means that to carry on the efforts to the level of translation (Scale-up etc.), it needs well-equipped persons. But, there is no provision to retain them for such industrial projects. The work undoubtedly carried out by the scholar will leave after the Ph.D. work and the final work well then be left incomplete. • Beurocratic hindrances in utilizing private funds: There are lots of objections to clear the bills, by audit department with the prevailing attitude.
		Suggestions	• Centre for Industry Institute Partnership should be given complete autonomy, especially in utilizing personal funds. • University should look to address the specific or individualized challenges which may be different project to project. • The researchers should be given incentives. • To retain post-Ph.D. scholars, there should be provision to provide the support without delay. • Also, in order to attract industry, the provision of Service tax (which is getting on funding organization) be erased.
7	Dr. J. N.	Hindrances	• Non-availability of affordable land in and around Delhi. No start-up or entrepreneur led enterprise

	Verma		can afford any land. After 15 years also, we do not have land because of affordability. Make in India is reduced to only a slogan as no one in the country knows "make where in India". • Adequate financial support. If the financial support is not complete, the innovators are forced to depend on financers. Often these financers become impediments for the fruition of the project. • Regulatory Agencies, particularly Drugs Controller General (India) [DCGI] / Central Drugs Standard Control Organization (CDSCO) do not work in time-bound manner, have no experience in dealing with new drugs, have no motivation to support innovation, have no appreciation of eroding patent life because of delays caused by them. Unless there are punitive actions and accountability against DCGI/CDSCO officials and State Drugs Controller Indian healthcare industry cannot progress. R&D alone cannot address unmet medical needs of the country and humanity. There should be time-bound procedures for all licenses and permissions and delays should not be allowed to be caused on frivolous grounds. Non-response should also not be allowed. • Bureaucratic Harassment: we faced serious problems with excise department as despite clearly classified as Excise free, they charged excise on our first batch of product for which we had to stop salaries. Though we won the case, but wrongly charged excise duty was never returned. On subsequent batches they stopped only when we said that we will stop manufacturing and hold a press conference making Excise Department responsible for the deaths for the want of our life-saving drug. • Bureaucratic Harassment: Pollution Control Board harassment and delays are very common. • Power tariff and uninterrupted power supply to ensure Good Manufacturing Practices (GMP) Manufacturing and seamless Cold Chain. Special status shall be given to healthcare industry to provide uninterrupted power and incentivized tariff. • The Government should promise and implement "Minimum Purchase" products manufactured through the support of Government Grant if they have been tested and their safety and efficacy is established through clinical trials. Though there is an order of MSME to procure minimum 25% from MSME in govt. procurement, hospitals in the country do not follow it and in fact several Hospitals have enforced in their "Terms and Conditions for tenders and rate contracts" a prohibitive minimum turnover clause to prevent participation of start-ups in tenders. • If a superior product has been developed and commercialized in India, inferior imports shall be banned. Our product is known world over to be most safe and most effective of all Liposomal Amphotericin B in the world, but continue to allow inferior imports of very high value drug. • If a product has been developed and manufactured with government support in India, that product

			should be compulsorily purchased in all Govt. programs. This is not being followed. Government of India or the state Government never purchased even one vial of Fungisome for Kala-Azar control programs.
		Suggestions	• Indian pharmaceutical industry is “Generics and Similar Centric”. Because of the huge investments involved in development, clinical trials and international norms of GMP compliance, complexed by 15-20 years of development time, return on investments and reinvestable returns are not possible. To promote the drugs discovery and development, National Pharmaceutical Pricing Authority should be abolished. Similarly, Department of Pharmaceuticals has no role is either promotion of research or industry and thus should be abolished. • Because of the long durations involved in pre-clinical regulatory toxicity and phase I to phase III clinical trials, most of the IP life of 20 years is eroded and leaves no commercial viability to get returns on investment, there should be a minimum of 15 years of post-commercialization patent life. In the absence of this provision, industry is not interested to develop products in collaboration with academic institutions. • When the technology originates in the academic institution, there is pressure of publication from both students and faculty as the publications are parameter for their performance evaluation. There is little realization that the World has transitioned from “*publish or perish*” to “*publish and perish*”. In such technologies industry cannot invest. Thus a system needs to evolve for granting higher credits for patents in comparison to publication. For example 1 patent filed in India should be credited as 1 publication; Patent Co-operation Treaty (PCT) filed should be equivalent to 2 publications; an Indian patent granted should be equal to 2 publications and a high value foreign patent granted should be equivalent to 2-4 publication. This is just an indication. The system should be evolved with critical evaluation of the formula. • Young scientists shall be encouraged for entrepreneurship to take up commercialization of their work and continue collaboration with their alma mater. This will also maximize translation of research into commerce. These young scientists shall be supported with a corruption free support system as part of institution’s entrepreneur cell. • R&D funding to the MSMEs shall be provided as risk sharing grant such as PATSER. Under PATSER scheme, no money was returnable by the company in the event of failure. However, on successful commercialization, 1.3 times the grant amount was returnable over five years, starting one year after commercialization. • Masters Degree program in relevant field shall have courses on documentation of R&D data,

			intellectual property, regulatory affairs, entrepreneurship, and business management. • There should be Government funded Contract Research Organizations (CROs) in Institution-Industry collaboration clusters possibly linked to entrepreneurship cells of the institution. • Collaborations with Hospitals and Doctors is a unique requirement of healthcare industry. Medical Doctors in the country mostly respond with “so what do I get out of this collaboration”. R&D contributions must be a part of performance appraisal of Doctors in both teaching and non-teaching hospitals. • For sanction of R&D grant to an academic, norms shall be laid down to assess applicability/ commercialization of their earlier funded work as qualifying criterion to optimize usefulness of Government’s R&D spending.

Section E

Hindrances and Recommendations

Hindrances:

1. **Limited research infrastructural set up**: e.g. research space, facilities like GMP, Animal laboratory, Tissue culture laboratory, Scale-up facilities, Commercialization of lab. Research. Lack of maintenance grant for existing instruments.
2. **Lack of industry funding**: Lack of funding from industry for basic and applied research. Industry becomes interested only when final product/technology is ready.
3. **Lack of skilled manpower**: Getting good manpower for short term projects is very difficult.
4. **Lack of 'complete set up' for taking laboratory research to commercialization stage.** i.e. assistance needed for IPR, interaction with industry, Royalty clause, Steps involved in scale-up and Taking product to market/society.
5. **Regulatory framework**: Regulatory bodies should act fast on technologies developed under I-A collaborative mode to avoid dead lock of technologies as industry gets put off by lengthy regulatory framework. Hence, slow regulatory framework for approving the valuable product act as barrier for commercializing the technology leading to descent in I-A interface in country.
6. **Beurocratic hindrances**: For utilization of private funds, university administration and Audit Branch raise lot of objections, which sometimes are trivial in nature.
7. **Government policies**: Government policy regarding minimum purchase of superior product developed in the country is not followed properly. It discourages the industry counterparts who face the music of losses from the product developed.

Recommendations:

1. **Creation of a dedicated I-A cell**: Each university doing research should have a dedicated I-A Cell. Its responsibilities include- proper rules and regulations for collaborative research via creation of dedicated I-A cell addressing following issues. This responsibility should be taken by **dedicated I-A cell** in the academic institute to deal with all the issues pertaining to the I-A collaborations including creation of patent cell that will be in charge of patent filling and protecting IP.
    a) Framing of proper rules and regulations for collaborative I-A research e.g. IP share, Profit share, Time and finance involvement at each stage, Confidentiality agreement and MOU critically designed
    b) Assist researchers in Patent search, IPR issues, Technology development/transfer and Finding suitable industry for tie ups with scientists
    c) Holding I-A Meets on regular basis
    d) Look out for I-A programmes from funding agencies
2. **Maintenance grant**: Government should set aside special instrument maintenance grant and grants for maintaining research facilities like GLP, Tissue culture facility, Laboratory animal facility etc.

3. **Facilities under PPP mode**: Government should encourage setting up research facilities and scale up facilities on the campus under PPP mode such as creation of centre for excellence in collaboration with industrial sector to promote dedicated advanced research in particular field.
4. **I-A website**: Institute should have a I-A website mentioning the applied research, patents, technologies developed/transferred, consultancy work taken up by scientist. Website should also have a portal where Industries can post their problems and the same information should be visible to all faculty members.
5. **Dedicated Managing Body**: Top management of universities should be run by scientists having ample experience in the area of R&D.
6. **Extended patent protection**: In India time taken from filing a patent to commercialization of technology is too long. In biology related I-A project (e.g. Pre-Clinical Regulatory Toxicity and Phase I to Phase III Clinical Trials) most of the IP life of 20 years is eroded and leaves no commercial viability to get returns on investment. Rules/regulations should be amended so that there is minimum of 15 years of post-commercialization patent life. In the absence of this provision, industry is not interested to develop products in collaboration with academic institutions.
7. **Retention of expertise**: To retain post-Ph.D. research scholars, there should be a provision to the support without delay.
8. **Minimum purchase scheme**: The Government should promise and implement "Minimum Purchase" products manufactured through the support of Government grant. Though there is an order of MSME to procure minimum 25% from MSME in Government procurement, this practice is not being followed.
9. **Promotion of self-product**: If a superior product has been developed and commercialized in India, inferior imports shall be banned.
10. **Credits for patenting the research**: When the technology originates in the academic institution, there is pressure of publication from both students and faculty as the publications are parameter for their performance evaluation. There is little realization that the World has transitioned from "*publish or perish*" to "*publish and perish*". In such technologies industry cannot invest. Thus a system needs to evolve for granting higher credits for patents in comparison to publication. For e.g. 1 patent filed in India should be credited as 1 publication; PCT filed should be equivalent to 2 publications; an Indian patent granted should be equal to 2 publications and a high value foreign patent granted should be equivalent to 2-4 publication. This is just an indication. The system should be evolved with critical evaluation of the formula.
11. **Promoting entrepreneurship**: Young scientists shall be encouraged for entrepreneurship to take up commercialization of their work and continue collaboration with their alma mater. This will also maximize translation of research into commerce. These young scientists shall be supported with a corruption free support system as part of institution's entrepreneur cell.
12. **Accessibility to risk sharing grant**: R&D funding to the MSMEs shall be provided as risk sharing grant such as PATSER. Under PATSER scheme, no money was returnable by the company in the event of failure. However, on successful

commercialization, 1.3 times the grant amount was returnable over five years, starting one year after commercialization.

13. **Commencing dedicated courses**: Masters Degree program in relevant field shall have courses on Documentation of R&D data, Intellectual Property, Regulatory Affairs, Entrepreneurship, and Business Management.
14. **Creation of interlinked CROs**: There should be Government funded CROs in Institution-Industry collaboration clusters possibly linked to entrepreneurship cells of the institution.
15. **Assessment of R&D funding**: For sanction of R&D grant to academic, norms shall be laid down to assess applicability/commercialization of their earlier funded work as qualifying criterion to optimize usefulness of Government's R&D spending.

Annexure 1

I-A Proforma prepared for carrying out case study on select scientists having I-A collaborations

DST- Centre for Policy Research at Panjab University, Chandigarh

Questionnaire for Industry-Academia (I-A) Case Studies

Section A - ***(Personal Information)***

1. Name:
2. Date of Birth:
3. Present Position:
4. Complete Postal Address:
5. Mobile/Landline #:
6. Email:
7. Highest Academic Qualification:
8. Broad Area of Research:
9. Research papers (Nos. only):
10. Patents (Filed): National- ; International-

    Granted (Granted): National- ; International-
11. No. of Industry-Academia (I-A) research projects handled:
12. No. of Technologies transferred:
13. No. of Industrial product(s) developed:
14. Any other industry related activity (consultancy etc.):
15. Industry Related awards/ honours:

Section B- ***(Project Related Information)***

1. Title of I-ACollaborative Research:
2. Name and Address of Collaborative Industry:
3. Name & Address of other Collaborators (if any):
4. Genesis of the Project:
5. Duration of the Project:
6. Amount and source of finances of the project. *(Pl provide percentage of cost sharing):*
7. Manpower (*JRF/SRF/Res. Assistant/Project Assistant*) hired for the project.
8. Distribution of Responsibilities:
   - (i) Academia:
   - (ii) Industry:
   - (iii) Other organization (if any, like DST/DBT etc.):
9. Deliverables:
10. Outcome of the project:
11. Whether scientist (s) approached the industry or vice versa:
12. At what stage was industry involved in the project:
13. How was the scientist(s) benefitted by this collaborative project:
14. How was the institute (s) benefitted by this collaborative project:
15. How was the industry benefitted by this collaborative project:
16. What is the market impact of the outcome of this project:
17. What is the societal-impact of the outcome of this project:
18. Whether any incentive to the scientist(s) was provided by the institute:
19. How was the Intellectual Property (IP) shared amongst the collaborators/institute/industry:
20. How were the profits shared by the collaborators/institute/industry:

Section C -*(Feedback & Suggestions)*

1. Please list the hindrances faced during the conduct of I-A research collaboration:

2. Kindly provide suggestions that will make I-A interactions more simple and fruitful:

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