Accelerating UK - India Innovation Partnerships

Reflections from the ACTIV workshops

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Fast Tracking Innovative Global Businesses

Contents

Executive Summary

ACTIV (Accelerated Commercialisation of Technology and InnoVation) workshops, focusing on commercialisation of IP rich research, were offered in 2010 in Pune by AcceleratorIndia and its partner, the Venture Center, Pune. ACTIV workshops brought expertise and experience from Cambridge to promote and develop high-end entrepreneurship for people with a science and technology background and to create innovative, technology intensive enterprises in India.

Three ACTIV workshops, each running over 2 days, were conducted in 2010 in September, October and December and were attended by 90 people selected from over 250 applicants from premier Indian institutions. The workshops achieved a number of key outcomes, such as better understanding of the commercialisation challenges, awareness of entrepreneurial approaches to address them, exchange of tacit knowledge through faculty and participant interactions and the creation of an online network of members interested in technology commercialisation.

Feedback from the workshops showed that there is limited awareness amongst Indian science and technology personnel on emerging approaches to commercialisation in the UK. In this report, we present an overview of innovation and technology commercialisation in the UK and describe the key drivers behind its evolution: supportive government policy, premier R&D institutions, active industry and professional networks, availability of venture funding and availability of skilled manpower.

We then compare the current status in the UK with the situation in India, present traditional approaches followed in the UK for innovation and commercialisation and newer approaches such as Technology Strategy Board (TSB) Innovation competitions and Technology Innovation Centres (TICs).

The workshop feedback also highlighted the limited number of initiatives to apply the UK's commercialisation experience and expertise in the Indian context to meet commercialisation objectives locally in India and between the two countries. We offer the following recommendations to address this and achieve closer collaborations between the UK and India:

- Develop case studies specific to India that resonate with the UK models
- Share best practices and new developments in UK tech innovation, commercialisation space
- Provide formal educational and training programs supported by fellowships
- Connect UK mentors with aspiring Indian science and tech entrepreneurs

In conclusion, the UK and India can both benefit by collaborating on innovation, commercialisation and technology entrepreneurship to achieve their developmental goals and further strengthen existing collaborative research relationships. ACTIV workshops were a useful first-step, but we need a national level programme of activities targeted at scientists, technologists and entrepreneurs interested in innovation and well-integrated with on-going initiatives such as UKIERI 2.

This programme, ACTIV 2, needs to be partnership-driven to access the diverse set of skills, resources and capabilities essential for success and will need to involve partners from industry, R&D institutions and incubators, experts in innovation and business building and investors and angels. Only by doing so can we ensure that UK India collaboration efforts in innovation, commercialisation of science and technology and entrepreneurship can create corresponding impact and value.

1. Preamble

ACTIV (Accelerated Commercialisation of Technology and InnoVation) workshops, focusing on commercialisation of IP rich research, were offered by AcceleratorIndia and its partner the Venture Center, Pune in 2010. The workshops were supported by Science and Innovation Network (SIN)[1], British High Commission, Delhi, Department of Science and Technology, Council of Scientific and Industrial Research, Government of India and UK India Business Council.

ACTIV workshops[2] brought deep expertise and experience of commercialising technology and building new technology businesses from Cambridge, UK where new ventures have emerged from technologists, individual entrepreneurs who were recent graduates of the University, University of Cambridge itself, Laboratory of Molecular Biology and other research organisations.

ACTIV workshops utilised the Cambridge experience to help create technology intensive enterprises in India by promoting and developing high-end entrepreneurship for people with a science and technology background.

Three, 2-day long, ACTIV workshops were conducted in September, October and December and were attended by 90 people, shortlisted from more than 250 applicants, hailing from premier institutions including R&D labs such as the Council of Scientific and Industrial Research (CSIR) labs, the Defence Research & Development Organisation (DRDO), the Indian Institutes of Technology (IITs), the Indian Institutes of Science Education and Research (IISERs) and the National Institutes of Technology (NITs).

The workshops helped achieve a number of key outcomes, as ascertained from participant feedback:

- Developing a better understanding of the challenges in the process of commercialisation.
- Creating awareness of various entrepreneurial approaches to address the challenges.
- Exchange of tacit knowledge through faculty and participant interactions.
- Creation of an online network of participants interested in technology commercialisation.

2. Report introduction

The overall feedback for the workshops was very positive, but it also indicated that the following factors of innovation and technology commercialisation space between UK and India are relatively under-explored. These are

- Awareness of the impact of initiatives such as ACTIV in improving the level of collaboration between UK and India in technology commercialisation.
- Awareness in India regarding new and creative approaches to innovation and commercialisation as practised in the UK.
- Opportunities to apply UK's commercialisation approaches in the Indian context with relevant customisation.

This report addresses these factors by summarising the conduct, progress and impact of ACTIV workshops, by presenting a number of commercialisation approaches in the UK, to share the UK experience in this area and by offering recommendations on how closer interactions can be promoted to achieve commercialisation objectives locally in India and between the UK and India.

3. A comparison of technology entrepreneurship in the UK and in India

We have observed five key drivers of technology entrepreneurship in the UK as shown in Figure 1:

Figure 1 – Key drivers of Technology Entrepreneurship

3.1 Supportive Government policy

The UK government has developed a variety of schemes, policies and programs to promote scientific and manufacturing research, innovation and commercialisation. Some of the key areas of impact include the ownership of intellectual property rights and knowhow developed via university research, tax breaks for angel investors, government-guaranteed loans, creation of incubators and science parks to support science-based ventures during their growth phases.

Universities and researchers have been allowed to participate in the financial upside of successful ventures by promoting companies, owning equity stakes in exchange for IP & consulting, and investing in new ventures while continuing to be employed in an academic setting.

In India, various central government agencies are increasingly playing an active role, especially for early-stage funding of innovators and entrepreneurs. More importantly, the DSIR[3] notification of May 2009 and the related CSIR[4] scheme now allow Indian R&D labs and their scientists to own

equity stakes in new ventures in exchange for intellectual property, consulting, technical support, etc. However, a continuing challenge is the actual execution of these schemes and rules, given the paucity of skilled talent that can help interface between technology entrepreneurs and the government.

3.2 Premier R&D institutions

Both academic as well as corporate R&D institutions in the UK have developed robust processes to enable collaborative projects, sharing of IP rights and employee/founder incentives in the form of stock options. The existence of for-profit, listed, corporate entities such as Imperial Innovations that seek to market and commercialise university research is quite encouraging from the point of view of innovators and entrepreneurs. Universities have also created mechanisms that allow scientists and researchers to continue working in an academic setting, while contributing to technology start-ups, especially via the flow of PhD students and post-docs from academia to business.

Indian R&D institutions have recognised the importance of technology development, transfer and commercialisation[5], but few have put the necessary mechanisms in place to enable the above, primarily due to the lack of experienced people[6] in the ecosystem. Another obstacle that has been recognised but not yet fully addressed is scientists' and students' aversion to risks associated with creating, joining or collaborating with young technology ventures, given the level of uncertainty.

3.3 Active Industry/professional networks

The seamless movement of talent across academia, industry and investment circles is a key success factor in the development of technology clusters in the UK. The proliferation of industry-sponsored scholarships, events, internships and R&D projects results in scientific research that is aware of commercial needs and thus results in IP licensing and spin-outs. Moreover, the fact that equity in UK start-ups is considered an acceptable alternative to cash by professionals is a sign of a mature entrepreneurial ecosystem.

A big challenge in commercialisation of technology in Indian markets is engagement with the Indian industry. Whether they are suppliers, customers or partners, most Indian SMEs and corporations avoid technology risks; instead they prefer to license/buy scaled-up technology. This also means that real-world market insights do not flow easily from the industry to researchers, thereby limiting the commercial potential and viability of R&D projects.

3.4 Availability of Technology/venture funding

One of the biggest challenges for technology ventures is access to risk capital from inception to growth and maturity. For the earliest stages of commercialisation, the UK has a variety of grant/soft funding available for innovators and entrepreneurs. In fact, the university IP holding companies in the UK offer funding explicitly for proof-of-concept (PoC) projects – this is a stage where a new venture does not even exist and thus early-stage angel/VC investors cannot participate via equity funding. These PoC projects mature into investment-ready technologies and finally into new ventures ready for risk capital, mentoring, referrals and managerial assistance.

Early-stage funding such as PoC and seed capital remain in short supply in India, especially from the private sector. Government agencies[7] try to plug the gap, but the intangible benefits of private seed capital (e.g. experience, networks and mentoring) remain inaccessible to most Indian entrepreneurs.

3.5 Availability of Skilled Manpower

Needless to say, none of the above drivers are likely to result in a vibrant technology cluster without a critical mass of skilled manpower. In fact, the first five or ten employees are probably key in determining the eventual growth and success of a new technology venture. External human resources, in the form of business angels, technical consultants and legal and financial advisors are no less critical to the functioning of the cluster.

The relatively recent development of technology sectors in India (except chemicals and generic pharmaceuticals) implies the lack of experienced, serial entrepreneurs and advisors in the ecosystem. While metros such as Bangalore, Chennai, Hyderabad, Mumbai and Delhi are aggressively developing networks to support entrepreneurs, the emphasis remains primarily on IT and software. The flow of NRIs back to India provides hope of such networks extending to other areas such as specialty materials, biotechnology and nanotechnology.

UK Science, Technology & Innovation in a Global Context

In view of James Dyson's 2010 report[8] titled 'Ingenious Britain: Making the UK the leading high-tech exporter in Europe', we note that sharing of British expertise need not be limited to commercialisation processes and best practices. In fact, there is scope for sharing of British technological expertise by identifying market segments in India in which such British technology can be adapted and commercialised. An example is the provision of British design, engineering and high-value manufacturing expertise to Indian entrepreneurs who then convert the same into products and services for Indian customers. The value added by such STEM-D (Science, Technology, Engineering, Mathematics and Design) skills and expertise from the UK would complement the value added by tapping into the above-average economic growth in India.

Almost at the same time as the Dyson report, the Royal Society published a report[9] titled 'The Scientific Century: Securing our Future Prosperity'. It clearly emphasises the role of science education, research and innovation in the UK's long-term strategy for economic growth. Moreover, it acknowledges the fierce global competition in the race to innovate, commercialise research and build global, profitable technology enterprises.

4. Commercialisation of technology in the UK

4.1 Standard approaches to commercialisation

Commercialisation of innovative, emerging technologies developed from the research done in universities has traditionally been achieved through one of the following approaches:

- License/sell components and base technology, i.e. core components for multiple applications
- License/sell application technology, i.e. components required for specific applications
- License Technology and provide know-how and consulting services

- Create and sell products by forming a new company
- Create and sell products by forming a new company and provide consulting and know-how

Commercialisation through licensing or selling IP has traditionally been performed by technology transfer offices within the universities. Some universities have expanded the scope of activities for their technology transfer offices to include funding and creation of new businesses. To create new businesses from university research, many universities have entered into long-term agreements with external commercialisation organisations.

A summary of the commercialisation approaches followed by five UK universities is listed in Figure 2.

University	Commercialisation activity		
	Consulting	*IP Licensing*	*Spinouts/New Ventures*
Imperial[10]	In house - Imperial Innovations		
Cambridge[11]	In house - Cambridge Enterprise		
Oxford[12]	In-house - Isis Innovations		External - IP Group
Southampton[13]	In-house (Centre for Enterprise & Innovation)		External - IP Group
Edinburgh[14]	In-house (Edinburgh Research & Innovation)		External - Braveheart

Figure 2: Approaches for Commercialising University research

4.2 Current commercialisation scenario in the UK

The UK has a long tradition of excellence in research, with three institutions (Cambridge, Imperial College and Oxford) that regularly appear in the world's top ten[15]. The UK is regularly ranked in 2nd place after the US in the G8 group of countries[16] for excellence in research. This research excellence lends itself to a number of commercialisation opportunities. However, the prevalence of multiple commercialisation approaches indicates that even now, decades after the initial creation of tech transfer offices in universities, a definitive model is yet to be established.

Given the long duration of many external commercialisation agreements, between 10 and 15 years, any rapid changes in the commercialisation approaches are slow to emerge. The industry is also adopting a number of strategies towards growth such as new rounds of fund raising and consolidation in the form of mergers and co-investment agreements.

For example, Imperial Innovations has raised £140 million from the public markets in Dec 2010[17] to accelerate and increase investment in selected companies from its existing pipeline with Imperial College London and also to invest in companies founded by or based on technology from the universities of Oxford and Cambridge, and University College London, through existing collaborations that Imperial College has with the above universities.

Fusion IP, the university IP commercialisation company, has raised £3.2 million in 2009 from IP Group[18], one of the top IP commercialisation companies in the UK, in return for the right to acquire

for cash, at a valuation of £500,000, 20% of Fusion's shareholding in any new Fusion portfolio company.

In spite of such developments, the market for commercial investment in research and innovation from UK universities is identified as very limited, in particular at the early/seed stage. A BVCA[19]/NESTA report published in 2009 has termed this phenomenon as 'thin markets' where the transaction costs for a limited number of investors and entrepreneurial growth firms within the economy are high, thereby reducing the level of overall activity.

In addition, the need for strong commercial partnerships for high technology ventures in their early stage is relatively underserved in spite of long history of collaboration between industry and academia in R&D and technology development.

A number of new approaches that address the need for funding and commercial partnerships have been put in place in the UK to help create and develop new IP rich businesses and create new revenue streams within existing businesses through innovative products and services. The following sections of this report will focus on these approaches and provide the backdrop to a number of recommendations we present to scale up collaborations between the UK and India.

5. Emerging approaches to commercialisation in the UK

5.1 Technology Strategy Board

The Technology Strategy Board[20] (TSB), is an executive non-departmental public body (NDPB), established by the UK Government in 2007 and sponsored by the Department for Business, Innovation and Skills (BIS). The TSB's role is to stimulate technology-enabled innovation in the areas which offer the greatest scope for boosting UK growth and productivity.

The TSB promotes supports and invests in technology research, development and commercialisation. The TSB also advises the UK Government on how to remove barriers to innovation and accelerate the exploitation of new technologies. TSB's work is concentrated in areas where there is a clear potential business benefit, helping today's emerging technologies become the growth sectors of tomorrow to the benefit of the UK economy.

The Technology Strategy Board has identified a number of technology areas (KTAs) and application areas where its efforts will be focused. In addition, the TSB also uses other approaches to targeting its activities - particularly Innovation Platforms and Emerging technologies.

The activities of the TSB are jointly supported and funded by BIS and other government departments, the devolved administrations of the UK government, regional development agencies and research councils.

The TSB promotes innovation in many ways such as investing in programmes and projects, spreading knowledge, understanding policy, spotting opportunities and bringing people together to solve problems or make new advances as illustrated in Figure 3.

Collaborative Research and Development (CR&D)

TSB invests in projects involving business and researchers working together to deliver successful new technology-based products and services. Over 700 CR&D projects have received investment since 2004, amounting to over £1 billion (about half from the TSB and half from the businesses involved).

Knowledge Transfer Networks (KTNs)

A KTN is a national network in a specific field of technology or business application, such as Creative Industries, Electronics, Sensors and Photonics, Aerospace & Defence, Nanotechnology, which brings together people from businesses, universities, and research, finance and technology organisations in order to stimulate innovation through knowledge transfer and sharing of ideas.

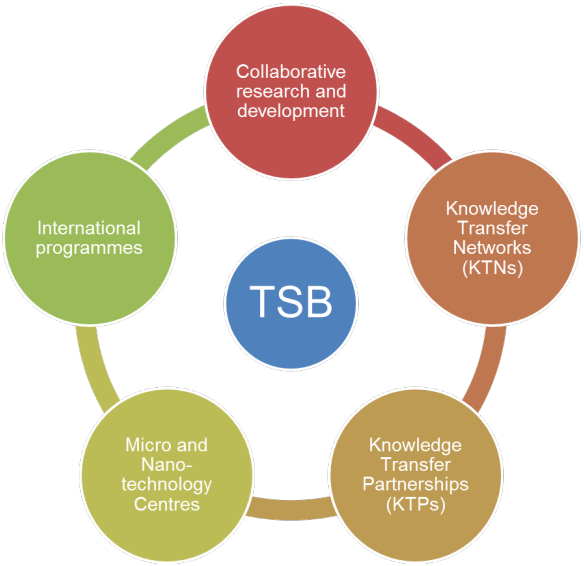

Figure 3 – TSB focus areas and activities

Knowledge Transfer Partnerships (KTPs)

A KTP is the placement of a high calibre, recently-qualified individual into a business to work on innovation projects. Increasing business interaction with the university 'knowledge base,' it provides company-based training for graduates at the same time as delivering real benefits for the business.

Micro and Nanotechnology Centres

These centres were formed to address key gaps in the existing capabilities available to the UK Micro and Nanotechnology community, by providing open access to a range of key capabilities and services at market rates.

International programmes

The Technology Strategy Board has a UK coordination role within EUREKA, a pan-European initiative for promoting collaborative business-led R&D. It is also responsible for the FP7 UK National Contact Point service, which provides advice to help UK businesses participate in the Seventh Framework Programme for Research and Technological Development. FP7 is the EU's main instrument for funding research in Europe and will run from 2007 to 2013.

5.2 Technology Innovation Centres

In October 2010 the UK government announced that over £200m will be invested in a network of elite technology and innovation centres, to be established and overseen by the Technology Strategy Board.

Centres of excellence can create a critical mass for business and research innovation in a specific area and sector by focusing on a specific technology where there is a potentially large global market and a significant UK capability.

The Technology Innovation Centres, as centres of excellence, are expected to be an important part of the UK's innovation system. They will allow businesses to access equipment and expertise that would otherwise be out of reach, as well as conducting their own in-house R&D. They will also help businesses access new funding streams and point them towards the potential of innovative, emerging technologies.

The investment towards the Technology Innovation Centres will further bridge the gap between universities and businesses, helping to commercialise the outputs of Britain's world-class research base. The centres will also complement and link with the other programmes which the Technology Strategy Board already manages, to promote collaboration between universities and business and to drive innovation and the commercialisation of new technology and ideas.

The Technology Innovation Centres initiative has been announced following last year's review "The Role of Technology and Innovation Centres in the UK" by Hermann Hauser[21] which made a robust case for long-term UK investment in such centres and provided a set of 14 recommendations for the structure, funding and governance of TICs. The underlying message of this review is the need for a "translational infrastructure" to bridge the gap between innovative laboratory research and technology commercialisation – especially one that is coordinated at a national level and in alignment with other agencies such as the TSB and Research Councils.

The potential value of such centres was also highlighted in the James Dyson review, Ingenious Britain: Making the UK the leading high tech exporter in Europe.

One of the first TICs to be announced as part of this investment is the High value manufacturing technology and innovation centre. The development plan for this centre is currently in the request for proposal status with an incredible level of response from interested organisations. A decision regarding the final awards is expected to be announced in March 2011.

Other broad areas that are considered for future Technology Innovation centres include:

- Energy and resource efficiency
- Transport systems
- Healthcare
- ICT
- Electronics, photonics and electrical systems

6. Case examples

The case examples listed below highlight the two contrasting approaches followed for commercialisation of novel technologies and taking them to market. The first example focuses on a typical university spin-out that had its origins in a proof-of-concept project that went on to become a listed company through traditional investment routes. The second example looks at a company that has been supported by the TSB to develop and commercialise novel methods of producing bio-fuels.

6.1 Novel nano-technology from university research

NanoCo[22] is a leading nanotechnology company based on research performed at the University of Manchester and Imperial College, London starting as a proof-of-concept (PoC) project. It makes and commercialises fluorescent nano-crystalline particles of semi-conductor materials that have unique chemical, electronic and optical properties, due to their small size. These semiconductor nanoparticles, known as quantum dots, have a crucial role to play in the future of electronics.

Quantum dots have applications in the fields of electronics, lighting, biomedical and clean-tech such as flatscreen TVs, biological marking, and security and PV solar cells where they are helping the development of a wide variety of next-generation products. Given their versatility, quantum dots are considered as a "platform technology" that enables novel applications across a range of industries and sectors.

Originally set-up in 2001, NanoCo received its first seed capital injection in late 2004. Having received two rounds of institutional venture capital following the university and VC seed round in 2004, NanoCo now has partnerships with major industrial firms and has also expanded into Japan. It was listed on the London Stock Exchange's AIM market in 2009, and is currently valued at circa £160M.

6.2 Using natural resources to reduce emissions[23]

A TSB-funded project to improve the method of producing a liquid fuel will help to reduce carbon emissions from transport. Biobutanol is an excellent liquid biofuel that can be used in transport and can be readily integrated into the existing fuel infrastructure. The TSB-funded project, led by Green Biologics Ltd, used the latest advances in science and process development to improve the efficiency of the fermentation process that converts sugars found in energy crops and agricultural wastes to biobutanol.

The project work focused on two aspects of the fermentation process:

- Using genetic engineering to develop superior strains of microbes that improve biobutanol yield and concentration
- Using a new system, based on an electrodialysis membrane bioreactor, to improve production efficiency

By helping to accelerate the strain development programme, the TSB's contribution resulted in improved microbes for the production of biobutanol. Out of the total project cost of £500,000, the TSB funding covered £250,000 with the rest coming from the company's own resources.

7. Recommendations

7.1 Develop case studies specific to India linking with UK models

A common approach to technology innovation & entrepreneurship in India is the emulation of successful models from the UK and US, both front-runners in this area. However, most such efforts fall short of success due to:

- A limited history of successful product development, IP creation and commercialisation based on laboratory science.
- Striking differences in the maturity of various components of the ecosystem (e.g. inventors, entrepreneurs, lawyers/accountants, consultants, early-stage investors, et al).
- An inability to understand and engage with the Indian research & development landscape, which is heavily tilted towards government funded R&D labs.

In recognition of this, a recurring theme during the ACTIV workshops was the necessity of developing and sharing detailed case studies specific to the Indian environment. These case studies must address the challenges related to product-market opportunity identification, proof-of-concept, new venture creation, early-stage funding, and the scaling up of such ventures into growth-stage enterprises. Besides engineers, science PhDs and business students, government agencies and start-up incubators can also use such case studies to better assist aspiring entrepreneurs.

Figure 4 shows a 3-layered curriculum model beginning with core entrepreneurship concepts and culminating in real-life, industry specific projects.

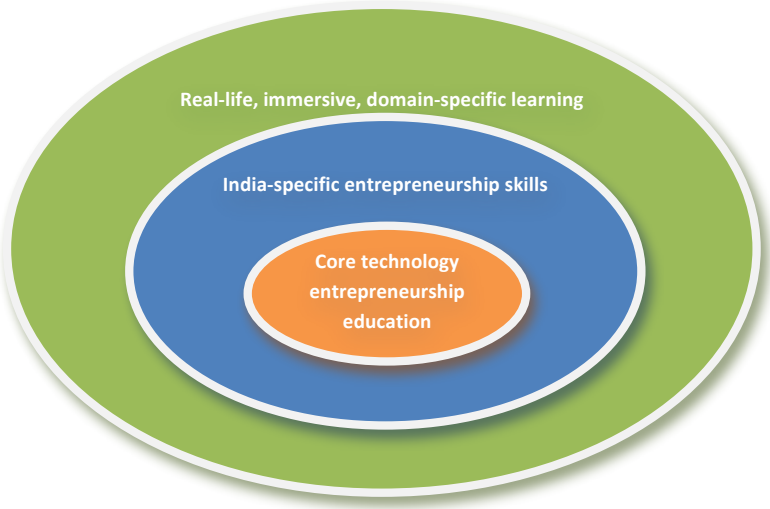

Figure 4 – Layered Curriculum Model

India-specific case studies, when developed, will need to be organised along industry verticals, functional aspects of building technology businesses such as investments and fund raising, team formation and team dynamics and commercial strategy and business models. For example, the risk faced by an Indian bio-technology start-up seeking FDA approval for its medical device is quite different than that faced by an enterprise software venture. In a similar vein, generic pharmaceutical

manufacturing has clearly shown its investment potential, yet the lack of biotechnology-driven drug discovery success stories out of India has kept investors away from seeking stakes in such ventures.

7.2 Share best practices and new developments in UK tech commercialisation space

The technology innovation and commercialisation ecosystem in UK has evolved over the past few decades. There are a number of key aspects of UK innovation and technology commercialisation that can serve as signposts as Indian initiatives in technology commercialisation continue to evolve. These are presented in Figure 5.

Driver for Technology Entrepreneurship	UK Experience	Relevance to India
Government policy	Tax/R&D regulations and Technology Innovation Centres that emphasise: • Taking science to the market • Collaboration with industry, investors	Increasing the impact of agencies such as CSIR, DSIR, DST technology by: • PoC and seed-stage funding • Training and fellowships for aspiring entrepreneurs
R&D Institutions	Independent entities (e.g. Cambridge Enterprise) that: • Bring together key resources for tech commercialisation • Enable R&D institutions to share financial rewards of venture creation	Setup, manage and refine processes for: • Engaging with incubators for technology transfer and commercialisation • Executing DSIR notifications related to venture creation
Industry/professional networks	Variety of formal and informal networks, strengthened by industry sponsorship of events, fellowships, R&D projects and new ventures	Close interaction with Indian SMEs and corporations to gain market insights and develop commercially relevant technology
Technology/venture funding	Proof-of-Concept funds, tax breaks for business angels, government guaranteed loans, etc. coupled with expert advice and high-value referrals	Scale-up existing funding schemes for technology innovators, entrepreneurs – focus on equity capital, fast decision making and mentoring
Skilled manpower	Constant flow of students and professionals between academia and industry + High-quality service providers willing to engage with young ventures	Creation of career tracks in technology commercialisation and entrepreneurship students, with funding support from industry and government

Figure 5 – UK commercialisation Best Practices and their relevance to India

7.3 Provide formal programs in Technology Commercialisation, ranging from e-learning to industry interaction

Successful commercialisation of technology requires the interplay of a variety of skills ranging from product-market insights, customer engagement and business creation to fund-raising, hiring and project management.

Traditional academic degree programs rarely cover these areas in a comprehensive fashion. What is required is an inter-disciplinary approach that brings together a variety of experts from across the whole ecosystem.

Scale vs. Scope

There is an interesting tension in entrepreneurship education – not everyone can be expected to become an entrepreneur, yet it is important that a large number of people are made aware of how

technology ventures nucleate and grow over time. Those who truly desire to build technology ventures require detailed advice and mentoring over the long-term, while the majority merely require exposure to the high-level aspects of science and technology entrepreneurship. To balance the need for detail vs. the need for (affordable) scale, we suggest a range of educational programs with increasing levels of engagement, as depicted in Figure 6.

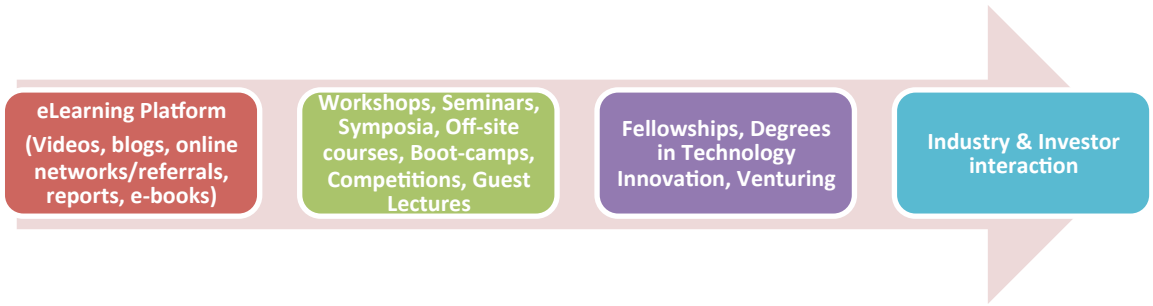

Figure 6 – From eLearning to Industry Interaction

E-Learning Platform

Given the proliferation of computing devices and improving broadband and mobile connectivity in India, and the availability of high-quality content on the Internet, we believe that the largest scale can be achieved via an e-Learning platform. Such a resource would deliver text, audio and video content into a self-directed learning process and allow participants to collaborate with each other; existing entrepreneurial education content from the Centre for Entrepreneurial Learning at Cambridge and the Centre for Entrepreneurship and Innovation at Oxford can be seamlessly integrated into the e-Learning platform. This would also serve as a networking and collaboration tool for academicians, incubators, industry and government policy-makers.

Workshops, Seminars, Competitions

The next layer of innovation and entrepreneurship education involves a broad set of inter-personal educational experiences in the form of seminars, workshops (such as ACTIV), competitions and guest lectures - scaled-up across R&D institutions and technology incubators[24] in the form of 1-day seminars. Longer duration workshops and boot-camps can be developed at a regional level with nodal agencies and partners providing local and logistical support, Indian companies sharing real-world problem statements and UK-based faculty sharing their expertise, case-studies and resources. A select group of deserving candidates can be supported for participation in intensive, entrepreneurial events in the UK such as the one-week Ignite program at Cambridge.

Fellowships & Degree Programs

The most comprehensive layer of capacity building must involve long-term engagement of budding entrepreneurs and faculty/mentors. Fellowships and degree programs of varying durations should expose students, young professionals, and potential entrepreneurs to real-life case studies of new venture creation. Enterprise fellowships, sponsored by industry partners, can be instituted technology transfer offices of R&D institutions and at technology incubators across India. These will not only mitigate the financial and career risks faced by potential entrepreneurs during technology innovation and venture creation, but also serve as prestigious career achievements.

Diploma and graduate degree programs in innovation policy & management, technology commercialisation and entrepreneurship must be cross-disciplinary efforts, modelled along:

- The MPhil in Technology Policy master's programme[25] at the University of Cambridge - Judge Business School
- Entrepreneurship Project[26], (Social) Entrepreneurship & Innovation courses and the Venturefund at the University of Oxford – Said Business School.
- The MSc in Innovation & Entrepreneurship programme[27] at Imperial College
- The Master's in Bioscience Enterprise multidisciplinary programme[28] at the University of Cambridge – Institute of Biotechnology
- The newly launched Postgraduate Diploma in Entrepreneurship[29] at the University of Cambridge - Judge Business School

Combined with a focus on industry verticals (e.g. biotechnology, specialty chemicals, scientific computing, aerospace & defence technologies, alternative/clean energy, pharmaceuticals and telecom infrastructure), such programs will be highly effective in helping convert IP & know-how into tangible social, environmental and monetary value.

Industry & Investor Interaction

Through the ACTIV workshops and a range of interactions with the Indian industry, we've realised the presence of a pool of industry professionals with deep interest in technology ventures but limited by the resources and ecosystem at their disposal. Fellowships and part-time programs as suggested above can easily accommodate such professionals, thereby allowing an opportunity for such valuable industry experience to flow into start-ups. The active involvement of large, regional technology corporations helps new technology ventures in many ways: access to infrastructure, market insights, potential early customers and even as corporate venture investors. Given their industry networks, DST-NSTEDB supported incubators across India as well as technology transfer departments of Indian R&D institutions have a central role in facilitating these interactions.

7.4 Connect UK-based mentors to aspiring Indian science and tech entrepreneurs

A CfEL, Cambridge paper[30] titled 'The effect of social capital in new venture creation: the Cambridge high-technology cluster' provides an in-depth look at how a mini-cluster of Cambridge technology entrepreneurs helped build a highly productive ecosystem. Another resource is the book[31] 'The Cambridge Phenomenon' which traces the development of the Cambridge cluster "with photographs, cameos and anecdotes". These studies highlight the importance of skilled manpower, interlocking company directorships, formation of investment-worthy reputations and an environment of trust.

A similar environment is almost non-existent in India. Unlike the IT, BPO & KPO booms, science-entrepreneurship has had limited success for a variety of reasons, ranging from risk-aversion and restrictive regulation to lack of corporate R&D investment and risk capital. While a lot of these gaps are being increasingly filled via private and government efforts, there is a clear role for UK-based experts in technology entrepreneurship and commercialisation to play in India – that of guiding young / first-generation innovators and entrepreneurs in translating science into leadership positions in entirely new industries and value chains.

Indian Mentees – UK Mentors

Building a pipeline of potential science, technology and knowledge-intensive enterprises in India can be achieved by tapping into the excellent resources from the Cambridge-Oxford-Imperial clusters. In fact, for each target audience in India, there are close parallels in the UK that could serve as mentors, as shown in Figure 6. The quality of such mentee-mentor connections is a significant determinant of success in innovation and venturing – much more so than physical infrastructure, detailed business plans and such.

India mentees	Interface	UK mentors
Undergraduate & graduate students	CUTEC, Oxford Entrepreneurs	Student-entrepreneurs
PhD students & Post-docs	CUTEC, Oxford Entrepreneurs	PhDs involved in successful technology transfers / spin-outs
Young scientists, innovators, industry professionals	Cambridge Enterprise, Imperial Innovations, Isis Innovation	Science-entrepreneurs, technology transfer/commercialisation experts
Potential / first-time entrepreneurs	Cambridge, Oxford, Imperial Business Schools	Science-entrepreneurs, angels, commercialisation experts, VCs
Senior academics, scientists & researchers	UK Research Councils, Technology Strategy Board, Technology & Innovation Centres	World-renowned academics/ scientists with a track-record of commercialisation & spin-outs
UK-India Agencies & Programs British High Commission, British Council, UK-India Business Council, UK Trade & Investment, UKIERI		

Figure 7 – UK-based mentors for India-based mentees

Role of UK-India agencies

While UK-based institutions can help support such mentoring relationships, the key drivers for such an activity would be the various UK-India agencies that already have built significant networks across the two countries. These include not only the British High Commission, the British Council, the UK-India Business Council, but also new UK-India initiatives such as UKIERI 2[32]. Additionally, the substantial resources available with DST-NSTEDB, DST-TDB[33] and DSIR can be leveraged to enable UK-based mentors to make periodic visits to India, as well as India-based entrepreneurs to participate in UK-based entrepreneurial events, workshops and training/degree programs.

Relevance to the Indian context

A fair question is whether UK-based mentors can meaningfully contribute to the success of Indian mentees, given the vast differences in India and UK with respect to regulatory environments, R&D activity, availability of early-stage risk capital & skilled manpower and risk-taking preferences.

However, there are successful models of teaching/mentoring across borders, such as:

- Business school professors from the US/UK serving as expatriate faculty in top-tier business schools in India (e.g. ISB, Hyderabad).

- Networks that connect global mentors/experts to Indian entrepreneurs (e.g. MentorSquare, The Indus Entrepreneurs, etc.)
- Innovation & commercialisation competitions and programs (e.g. DST-Intel India Innovation Pioneers, DST-Lockheed Martin India Innovation Growth Program[34])

Moreover, the increasingly global nature of R&D commercialisation and the relatively high economic growth in India are creating substantial growth opportunities in India for UK technology ventures. Experienced, UK-based mentors can thus be incentivised to co-locate in India and UK to help develop India-based ventures that leverage UK expertise but address Indian markets.

8. Conclusion

Buffeted by major changes in the global economy, UK and India are at the cusp of a radical change in their growth path. The opportunity to collaborate on new innovations can benefit both the countries and help them achieve their developmental goals and objectives. Such collaborations will serve as the bedrock to further deepen their existing relationship in collaborative research.

The ACTIV workshops have served as a useful first-step for UK India collaboration on innovation, commercialisation of science and technology and promotion of entrepreneurship. What is needed now is an expansion of scale and scope of activities, aligning and integrating them with on-going initiatives such as UKIERI 2 in order to achieve coherence and focus and to increase the impact.

A national level programme of activities, ACTIV 2, is called for to implement the recommendations suggested in this report. This programme will be partnership-driven, given the need for diverse set of resources, skills and capabilities. The partners will comprise industrial houses and major companies, R&D institutions and incubators, experts in innovation, commercialisation of science and technology and business building, investors and business angels.

Only through implementing such a programme can we ensure that the current UK India collaboration efforts in innovation, commercialisation of science and technology and entrepreneurship can create corresponding impact in commercial, economic and social value.

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