Government mediated program on intensifying industry- academia linkages for human resource development; Experiences of an innovative model from TIFAC

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Abstract

The importance of academia- industry linkages for development of an economy is well recognized. With a view to make the higher technical education relevant, by forging and catalyzing functional linkages between industry and academia, an innovative model was conceived by TIFAC in the shape of Center of Relevance & Excellence (CORE). These TIFAC-COREs were to be established in academic institutions across the country- with financial stakes of industry, academia and government and also ensuring their participation. The paper describes experiences from two TIFAC-COREs established in SASTRA University & Amrita University, both located in rural India. The achievements are redolent of intensive industry- academia interaction, bringing out the catalytic role played by TIFAC.

1. Introduction

The importance of academia- industry linkages for development of an economy today is well recognized. The developed economies appear to be characterized by strong linkages between industry and academia, the under-developed by absence of it and developing ones by 'make and break' of it. Realizing the importance of this dual helix, several initiatives have been taken world over to promote linkages between industry and academia. Some of the prominent ones catering to diverse needs of the two include Calit2 (California Institute for Telecommunications and Information Technology) in USA, Magnet & Magneton program in Israel, Fraunhoffer Society in Germany, European Framework Programs in EU, Industry Research Centers & Hsinchu Science Park in Taiwan etc. There must be scores of other such schemes all across, generally focusing on technology transfer, research and development and entrepreneurship.

In India too, several initiatives pivoted around academia and industry have been introduced; like NMITLI (New Millennium Indian Technology Leadership Initiative) & SBIRI (Small Business Innovation Research Initiative) basically for Technology Development/Pre-Commercial R&D; HGT (Home Grown Technology) & PATSER (Programme aimed at Technological Self Reliance) aimed at Technology Transfer And Upscaling (Early Stage); and Technology incubation in academic institutions (STEPs, TBIs) and TDB (Technology Development Board) with an eye on Technology Commercialization. However, none of the schemes try to comprehensively address the issue of human resource development in a sustainable manner leaving a scope for a concerted effort in this direction.

2. Industry-Academia Interaction

Most of the schemes/ program (mentioned in previous section or similar to them) see industry-academia getting together for collaborative research, technology transfer, technology commercialization etc. When seen in a wider sense, industry- academia interaction actually happens in various other manners also. Capturing them on the basis of their happening on different time- scales, authors propose a spectrum of industry- academia interaction (Figure 1) Various forms of interactions in IA can be considered to be continuous but have been shown as disjointed bands to show the overlaps. This spectrum has in it, student placement in industry at

one end which requires very little contact to a 'teaching industry' at the other end which is characterized by collocation of two entities and their unified role. Workshops/ Conferences are interactions lasting for a couple of days while training programs (industry personnel interacting with academic experts or faculty/scholars receiving in-plant training) usually are of a couple of weeks. Interactions taking place in a span of weeks to months include student projects, continuing educations programs and consultancy projects. Industry sponsored chairs in academic institutions call for commitments in mutual interest for about 3-5 years while industry sponsored R&D projects may keep them engaged for a still longer period. Collocated industry and academia allow near blurring of boundaries between the two and can be the best and most dynamic form of interaction.

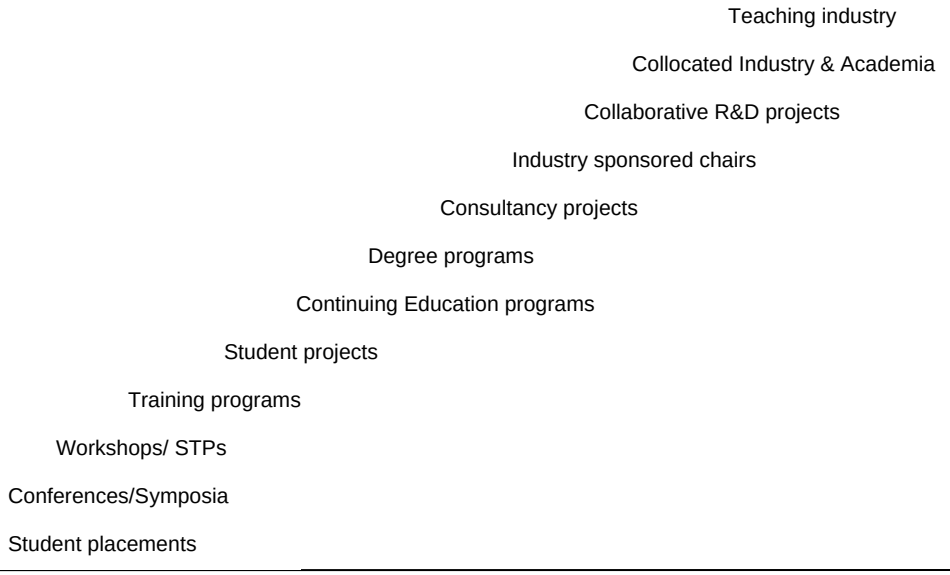

Figure 1: Spectrum of Industry-Academia Interactions, proposed by authors. As there are no sharp boundaries of each interaction and overlaps inevitable, interactions have been shown in steps. A projection of each of the interaction on time-axis would create an impression of spectrum.

One can note that vibrancy of all such interactions what though on different scales depends upon movement of personnel and also exchange of knowledge. According to Manian Ramkumar (2008), "Industry and academia partnerships can play a major role in student recruitment, retention, and workforce development from within the local economy, through positive promotion of strengths, weaknesses, and opportunities". This win-win kind of partnerships can evolve naturally in the developed world where both industry and academia have learnt to take advantage of each other, but is not so forthcoming and easy in the developing economies. It is not that nothing has happened in India on this front as Lokesh Mehra (2007) notes, "many IT companies (in India) are partnering with engineering colleges and universities. Infosys has launched a program called 'Campus Connect' to align the education being given at various engineering colleges, with the requirements of the industry. Wipro has also started a program called the Wipro Academy of Software Excellence, in association with BITS (Pilani) to prepare fresh graduates for careers in software programming and provide them with the necessary skills. Many multinationals have also established alliances with academic institutions on specific initiatives covering faculty upgradation, internships, curriculum revision workshops, research incubation *etc.* aggregating the

architects of the new global economy." However, such partnerships have not cut much ice in the non-IT areas and the (smaller) institutions located away from bigger cities.

From the proposed spectrum, one can easily make out that longer durations/ higher-order interactions are relatively difficult to come by as they require greater commitments from either side for time and money. If industry is hard-pressed for time (or autonomy), academia is hard-pressed for funds. Industry has funds while academia has time (or autonomy). This makes them natural allies, complementing each other's role but lack of will and appreciation for each other keeps them apart. It is here that the role of government becomes important to act as a buffer between them- to bring them together, catalyze the interactions, carry the two along and try to consolidate the bonding. With an eye on human resource needs of Indian industry on one side and the need of sustained relevance of technical education imparted in academic institutions on the other and realizing that this issue cannot be comprehensively addressed without bringing industry and academia together, TIFAC pitched itself to create an innovative model with triangular linkage between academia- industry- government at its distinctive feature.

2.1 TIFAC-CORE model: design & implementation

TIFAC launched Mission REACH (Relevance & Excellence in ACHieving new heights in educational institutions) in the year 2000 with an aim to strike an architectural change in the higher S&T education system of the country. The Mission objectives were to being realized by taking onboard the user industries/ agencies as financial stakeholders in aptly christened TIFAC-Centres of Relevance & Excellence (CORE). The COREs to be established in an existing academic institution are mandated to focus on realizing academic excellence in an area that interests the industry the most- not only through their financial commitments but also drawing in their technical experience.

TIFAC-CORE was basically conceived as a co-creation and co-development model, realizing that getting industry to put stakes into an ongoing activity in a smaller (academic) institution would be next to impossible. It was felt that industry might be interested in an activity in which government is also a partner, is not sub-critically funded and is also in line with its interests. Thus, a CORE was an entity created out of collaborative efforts of Industry, Academia and Government– a convergence represented and explained by Etzkowitz through the Triple Helix Model (Etzkowitz, 1994). By design, a CORE was to primarily realize academic excellence in an area that interested the industry partnering in the venture and turn out quality manpower as per the requirements of industry. CORE was also to be encouraged to take up contract research, conduct training programs for industry (and academia) and make use of facilities created to offer consultancy to industry. The intention was to make a CORE self-supporting, so that it acquired reasonable amount of financial autonomy also to operate and engage industry, with a considered view that enhanced interaction with industry will help in maintaining the quality of its academic programmes.

The proposal to establish a CORE was to come from one or more existing departments of the institution with some upgradeable infrastructure in place and faculty with experience (in the area that was to be chosen for realizing excellence in). The institution was asked to strike a dialogue with industry and get them in as partners along with government, in establishing the CORE in its campus. Industry could contribute in cash or kind, but had to necessarily commit itself in activities of CORE. No budgetary limits were prescribed leaving it to the imagination of institution and industry to conceive a CORE that was to be equipped with facilities as good as the ones in Indian Institutes of Technology (IITs). It was envisaged that the dynamism infused in this unique configuration right from the foundation level itself would generate value for each stakeholder as enunciated in Table I.

As per the design, civil infrastructure for CORE was to be provided by institution, recurring expenditures to be borne by institution and industry together and the non-recurring expenditures by industry & TIFAC (government). While day-to-day implementation of the project (under which a CORE was to be established) was the responsibility of institution, an oversight mechanism to monitor the progress and take care of the interests of stakeholders was entrusted in the hands of a monitoring committee. The committee constituted by TIFAC was to have 2-3 acclaimed domain experts from industry, academia and R&D institutions.

Table I: Value created for stakeholders in a TIFAC-CORE

Stakeholder	Value created
Industry	• Industry ready employees • Access to state-of-the-art infrastructure for its R&D needs • Testing & analytical facilities (for SMEs specially) • Training and re-skilling employees at a competitive cost • Academic perspective to its problems for smarter solutions • Better understanding of concepts of industrial engineering • Improved engineering practices • Larger network of contacts • Intangible value created through insights – difficult to make explicit • New ideas and inspiration
Institution	• State-of-the-art infrastructure available for teaching and research • Industry as partners- influencing academic pursuits • Increased visibility at national level and also among industries • Experience of engaging industries • Live industry problems to work on for students and faculty • Exposure to new ideas and new ways of doing things • See the research results finding applications • Increased opportunity for students placement • Incorporate examples from industry to make courses more relevant and theory easier to understand • Increased productivity of research • Better understanding of what other stakeholders do and create more synergy • Scholarships/ internships/ projects for students • Faculty development • Culture of interaction with industry
Government	• Advanced S&T infrastructure in smaller cities • Increased employment prospects for youth • Empowerment of small scale industries • Increased stock of highly qualified personnel trained • More vibrant S&T system (research publications, technology development, faculty development) • Identification of thrust areas • Wealth and human-resource generation

In a CORE, industries are given a much wider canvas to operate and indulge in. They are involved right from the stage of drafting syllabi to absorbing the trained students and thereby shape the CORE into a highly productive human resource centre. A CORE produces manpower near-ready for the shop-floor benefitting the industry by cutting down the cost and the time required to train a fresh graduate. Each TIFAC-CORE also offers continuing education programmes to industries for updating/ re-skilling their employees at a very competitive cost. Likewise by way of sponsored projects, the industries can gradually adopt the Centre as their

'innovation backyard' to benefit themselves. In short, the financial contribution allows them to access the entire physical assets as well as intellectual assets of the CORE. Out of the 31 centres operational so far in a wide range of highly specialized disciplines, there are several COREs that have turned out to be very successful in providing consultancy and also aiding in product/ prototype development for the industries in their region. Experiences from two such Centres are reported in the subsequent sections.

3 TIFAC-CORE, SASTRA University

With a view to experiment with the concept, 9 institutions were selected in the year 2000 to establish a TIFAC-CORE each, in their respective campuses together with industry and TIFAC (representing Government). One of them was established in Shanmugha College of Engineering, Tirumalaisamudram (a village near Thanjavur, Tamil Nadu), which is now SASTRA University. The TIFAC-CORE here focused energies and resources to realize excellence in the area of 'Advanced Computing & Information Processing' and had Electronics Corporation of India (ECIL), a Public Sector Undertaking as industry partner. The project took-off in November 2000 with funds flowing from TIFAC and SASTRA University and in due course of time saw launching of four Post-Graduate programmes, three of which were for the first time in the country- all started in consultation with industry. The CORE was equipped with high-end facilities comparable to the IITs (including a Super computer) in order to gain the confidence of industry.

In the first three years, besides the PG programme several short-term programs and small student/ research assignments were undertaken based on facilities created, with a view to showcase the TIFAC-CORE before industry and draw more of them into the venture as partners. An International Conference on Nano-Computing (ICNC) was also organized in December 2001, with this in mind. While the CORE succeeded in initiating academic and research activities and forging ties with Center for High Performance Embedded Systems (CHiPES) of NTU- Singapore, Semiconductor Complex Limited (SCL)- Chandigarh (India) and Society for Electronic Transactions & Security (SETS)- New Delhi, the major IT companies were yet to participate.

TIFAC noted that by the end of three year project, a few IT companies showed some interest in becoming partner by contributing in cash, kind or intellectually. The project was granted an extension with additional funding from TIFAC subject to a condition that 50% capital expenditure was borne by industry in the extended phase. The extended phase saw the partnership happening with likes of Microsoft, Sun Microsystems, Intel, WINDRIVER, Tata Consultancy Services besides few sponsored projects coming from government agencies and a clutch of Small and Medium Scale industry. There was committed involvement of host of other industries (including multinational companies) in several other forms, as seen from Table II.

Table II: Industry interaction under TIFAC-CORE at SASTRA University

Industry	Nature/ purpose of interaction
Analog Devices	Sponsored research, curriculum development
CISCO	Faculty training
Cypress Semiconductors	Sponsored research, student internships
ECIL	Sponsored research, M.S. (by research programme)- student training & absorption
GDA Technologies	Visiting faculty, student projects
GE	Sponsored research
Hewlett Packard	Faculty training
IBM	Faculty training
INTEL	Laboratory setup, faculty training
Larsen & Toubro	Sponsored research
Microsoft	Sponsored research, student projects

Texas Instruments	Student internships
Semiconductor Complex Ltd.	Faculty training, Student projects
Speck Systems	Sponsored research, student projects
Sun Microsystems	Laboratory setup, student training
Tata Consultancy Services (TCS)	Sponsored research, curriculum development, faculty training, guest faculty
WINDRIVER	Laboratory setup, faculty training
Xambala	Sponsored research
Student projects were also carried out at BARC, BEL, ITI, ISRO, MIT, SAMEER, SETS, Siemens, V Design, Honeywell etc. some of which are premier government establishments	

When the project was formally closed in August 2007 (marked by withdrawal of TIFAC from the project), the total project cost had nearly doubled and the financial stakes of the three partners *viz.* academia, industry and government were 56%, 13% and 31% respectively as against 54%, 0% and 46% in the beginning of the CORE project. (In the more recent COREs established by TIFAC, the industry contribution has been as high as 45%). Though the industry stakes are not substantial in this TIFAC-CORE at SASTRA University, it is worth noting that there was no previous experience of SASTRA being able to muster funds from industry on its own. Also CORE was able to generate revenue mainly from the academic programmes to meet substantial part of its running expenditures. Notable results/ outputs of the CORE besides the 4 academic programmes by 2007, include about 270 highly skilled graduates and about 25 research papers in international journals.

Looking at the scenario before and after the TIFAC intervention, it was found that TIFAC (government) intervention resulted in the following:

- Industry ready graduates in highly specialized areas of VLSI, Embedded Systems and Advanced Computing produced. No such high-end programs existed before.
- Value-addition to UG courses in Electrical, Electronics and Computer Science, due to the infrastructure created.
- A sizeable number of students (over 60%) that undertook courses at CORE had a rural background.
- TIFAC-CORE enhanced the accessibility of high-end facilities like Supercomputer, Embedded Systems Design facility, VLSI Design facility to rural students
- The faculty got opportunity to enrich and hone their competence itself due to the infrastructure and the opportunities linked with it
- TIFAC-CORE improved the visibility of the University which was evident from significant improvement in placement of students and sponsored research activities
- Visibility of TIFAC-CORE among industries increased substantially, beyond recruitment. More than 30 industries and R&D organizations, including few from overseas have been interacting with it

4. TIFAC CORE, Amrita University

In the year 2004, a TIFAC-CORE in Biomedical Technology was set up in Amrita Viswavidyapeetham (Amrita University) in Kollam (a village near Cochin in Kerala). Soon after its establishment in November 2004, the Centre began to offer B.Sc. and M.Sc. programs in Biotechnology, Bioinformatics and Microbiology. Supported by a strong faculty, the CORE was able to announce its presence in the Biotechnology/ Life Sciences arena, with 95% placement recorded for the first batch of M.Sc. (Biotechnology) and M.Sc (Bioinformatics) students in 2006. The CORE continued to exert its dominance in this aspect with students securing positions at major Pharma & Biotech companies across India and performing well at competitive exams for careers in premier research institutes. The ability of the M.Sc. students to consistently secure

project placement for their final semester lent credibility to the programs and provides a testimony to the quality training that the students received at the CORE.

The Ph.D (Biotechnology) and M.Tech (Biomedical Engineering) program initiated in 2007 at the CORE further helped in strategically positioning the CORE on the forefront of academic training to generate the skilled workforce to meet the needs of the Indian industry. The CORE has well-equipped state- of- the- art laboratories like Natural Product Chemistry lab, Radioactive Facility, Tissue Culture Facility, Biomedical Engineering Unit, Cell-biology Lab and a modern computational modeling research lab.

A very strong and substantial industry interaction right from its inception and collaborative programs with industry in the follow- through has been the hallmark of the CORE. In 2004, the Centre had two industry partners- MDS Pharma Services (USA) and Mascon Global (India). Initially the Centre had targeted to develop low-cost, automated, high quality biomedical devices and also investigate and develop novel lead molecules from natural sources with the focus on combating and managing Diabetes. In due course, with the interaction of faculty with industries and in recognition of the infrastructure and expertise of faculty, CORE ventured out to take-up an ambitious project which led to the development of an 'automated Insulin pump' designed for the precise, personalized and continuous delivery of insulin in a subcutaneous manner.

By 2006, the Centre mustered participation from three more industries including India's leading Biotech company Biocon, which extended complete support in the initial stages of the insulin pump development. The students of this Centre have benefited tremendously from the industry partners Cellworks and Mascon where a large number of graduating M.Sc. students were recruited. A number of large pharmaceutical & biotechnology companies in India including Ranbaxy, Nicholas Piramal, Intas etc. offered opportunities to the students to do their final semester project. The CORE is collaborating with VINS Bioproducts to develop new products.

During the entire project implementation period (2004-2009), there was committed involvement several industries with the center in several forms. Table III has the nature of involvement/ interaction the CORE had with various industries (Bipin Nair, 2009).

Table III: Industry interaction under TIFAC-CORE at Amrita University

Industry	Nature/ purpose of interaction
MDS	Laboratory setup
BIOCON	Product development & Consultancy
Ranbaxy	Sponsored research
Intas	Student internship
Lupin	Student internship
Nicholas Piramal	Student internship
Biogenex	Student internship
Reamatrix	Student internship
Avesthagen	Student training
Reliance	Student internship
VINS Bioproducts	Product development
Mascon	Student training and absorption
Cellworks	Sponsored research, Student training and absorption
SIDD Life Sciences	Product development

The project was formally closed in May 2009 (marked by withdrawal of TIFAC from the project). Notable output of this experiment include 500 highly skilled graduates, about 30 papers published in international journals and the insulin pump which has forced the overseas players to cut-down the cost. With cutting-edge research capabilities of faculty and the continuing inflow of research grants from Government as well as private agencies, CORE stands assured of its sustainable existence.

5. Lessons/ observations from the experiment

Coming as it does from a remote rural locations in developing India, the experience of TIFAC-COREs in SASTRA University and Amrita University indicates that it is possible through government intervention to close the gap between industry and academic institutions, if the industry is assured of manpower with right set of skills in sufficient numbers to face competition in a liberalized environment. Further, equipping the TIFAC-COREs with high-end learning facilities is found to help the local industries seeking solutions to their technical or human resource problems. With customer-centric activities promoted and in-flow of revenue actually taking place, a CORE can be less dependent on main funding agencies for their non-planned expenditures and gain autonomy. Besides CORE can serve the local interests through vocational training to the youth there and also upgrade the knowledge/ skills of those employed in the region, at a competitive cost.

By now 31 such COREs have been established by TIFAC with nearly equal investments of the three stake-holders. The course of establishment of these COREs has been waylaid with challenges in scaling-up and also implementation. Some of them are as follows:

- It is difficult to convince academic institutions about the concept itself, of co-creating and co-developing an industry-oriented enterprise (CORE) within the institution. Accepting the challenge means vigorous efforts in persuading industry, something that the faculty is not prepared for.
- Industries prefer to wait-and-watch before getting into a CORE seriously. This is possibly because the institutions are not so well known and sometimes not well established also.
- The inadequacy of faculty or its retention especially in Information Technology, Biotechnology, Pharmaceutical Sciences etc. due to high salary in industry in these sectors also impacts running of the CORE.
- Institutions having CORE have not been able to replicate and create more of CORE like enterprises with industry's support alone. It appears that attracting industry and developing vibrant linkages with them without government presence is not an easy task for smaller institutions in India.
- Smaller institutions, at best, have experience of handling small to medium scale research projects but lack in experience of handling huge investments from industry and government. The quantum of funds has been found in few cases to be comparable with the annual budgets of the institution itself.

The challenges have been overcome to some extent with better understanding of the dynamics of the linkages and increased involvement of industry. TIFAC-COREs being an altogether new entity in the academic institutions, there is no baseline data to accurately quantify the impact of government intervention. However, qualitative achievements reflecting industry- academia interaction as evident from two cases reported, offer a strong reason for a quantitative assessment which would be meaningful if done for a larger set of COREs.

6 Conclusion

The experience from TIFAC-COREs in SASTRA University, Amrita University and others setup after it, is redolent of industry's volition to (a) put its stakes if the infrastructure proposed is state-of-the-art, (b) invest where government is also a partner in the project (c) be involved in academic

activities (d) take advantage of locally available expertise and high-end facilities. The experience also suggests that industry and academia require a third agency to get them closer and create sustainable linkages. The binding factors appear to be 'funds' and 'time', brought on the table also by the government. Typical of a developing country, academic institutions here lack in funds while industry is short of time (to see if its investments are safe). In a CORE, TIFAC (government) brings in funds for the institution and time for the industry (through the oversight mechanism) and thus, reduces the diffidence between the two. Besides, the government also contributes by way of mentoring of CORE through domain experts (in its oversight apparatus) and ensuring visibility at national level. Thus, CORE model with government intervening to play the role of a 'buffer' has a dash of Triple Helix I model and that of Triple Helix II with small-scale communication overlays visible (Lydesdorff & Etzkowitz, 1998). With proper up-sizing each CORE can eventually be positioned to effectively contribute in a regional innovation system, another manifestation of Triple Helix.

TIFAC-CORE model is a unique example of Triple Helix serving the needs of quality human resource in a developing country and revitalizing higher S&T education to make it 'relevant' and also benefit the industry (specially the local SMEs). The acceptability of model among academic institutions and industry as also the appreciation received from domain experts associated with each CORE, suggests that government has an important role to forge the industry-academia linkages and also keep them vibrant.

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