Institutional settings of a triple helix: Industry - R&D institution – University cooperation for effective technology transfer – an Indian Experience

by

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INTRODUCTION

In recent years, a number of concepts have been proposed for modeling the transformation processes in university-industry-R&D relations. Industrial liaison, technology transfer, and contract office generally mediate across the three spheres. The institutional spheres of university, industry, and R&D, in addition to performing their traditional functions, each assume the roles of the others, with universities creating an industrial penumbra, or performing a quasi-governmental role as a regional or local innovation organizer. The industrial R&D laboratory can be considered as an example of the internalization of such organizational complexity.

Though the words *know how* and *know why* are often used to the point of becoming clichés, it is not easy to transform knowledge as available in public domain or that is available through contractual arrangements like operational manual, special reports etc. into actual technology commercialized. It is obvious that technology transfer cannot have one fixed rule or methodology. It will vary depending on the nature of end uses and knowledge base, the point of innovative cycle or industry cycle at which we start the efforts. For example, if one is to work on surface treatment of a material or a bio-technological process or a software approach in which very little has been done in by the leading companies or laboratories worldwide, one would also be mostly in the invention/ innovative phase. That is one will be at the cutting edge or in the frontier. In such cases, considerable R&D will have to be done even if the efforts of up scaling engineering etc. are done in concurrent engineering mode. On the contrary, if one deals with an area in which industries and technologies are mature and also where economies of scale are very large, such efforts will be to absorb technologies effectively to reach world standards of performance as well as plan for a few areas where there is an in built competitive edge. It also needs to be realized that there are many problems unique to the Indian conditions for which nobody has immediate solutions or ready technology package. In addition, we have to deal with the prevailing social situations around ourselves.

A closer interaction among government, industry and academia, forming a triple helix, is playing an increasingly important role in S&T. It is proving to be more successful than the bilateral relationships between academia and government, industry and government, academia and industry. This sort of triple helix has evolved in an historical process, in which exchanges among the actors are based on a high degree of functional differentiation and are mainly of a collaborative nature.

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TRIPLE HELIX – INDIAN SCENARIO

S&T Infrastrucutre

The adaptation of science and technology policy had evolved setting up of a chain of R&D laboratories of national importance in India. The major scientific agencies in the country include Defence Research Development Organization (DRDO) with over 50 laboratories; Department of Space (DOS) with around 8 laboratories, Indian Council of Agricultural Research (ICAR) with over 70 laboratories, Department of Atomic Energy (DAE) with around 15 laboratories, Department of Scientific & Industrial Research including Council of Scientific & Industrial Research (CSIR) with 39 laboratories, Ministry of Environment & Forests, Department of Science and Technology (DST) with around 20 scientific institutions, Department of Biotechnology (DBT) with around 6 laboratories, Indian Council of Medical Research (ICMR) with over 25 laboratories, Department of Information Technology and Ministry of Non-conventional Energy Sources (MNES). In addition to the R&D laboratories and establishments, there exists a vast network of universities, technical institutions and colleges in the country. There are around 300 universities/ deemed universities, including 11 institutions of national importance and over 15,000 colleges. The annual out-turn of S&T personnel is over 250,000. Doctorate degrees awarded annually are around 11,000 more than 50% of which are in the areas of science, engineering, technology, medicine and agriculture. The estimated stock of S&T manpower in the country is over 7.5 million. India has 7.8 scientists, engineers and technicians per 1000 population.

Industry

The Department of Scientific & Industrial Research operates a schemes wherein recognition to in-house R&D units of industry and non-commercial Scientific and Industrial Research Organizations is provided. There are over 1205 recognized in-house R&D units in all sectors of industry and over 550 recognized Scientific & Industrial Research Organizations (SIROs) as on March 2006. The break-up of these R&D and innovation centers is as under:

Sector-wise break-up of in-house R&D Units

- Chemical & Allied Industries.	500
- Electrical & Electronic Industries	280
- Mechanical Engineering Industries	185
- Processing industries	150
- Agro & Food Processing Industries and others	90

Sector-wise break-up of SIROs

- Agricultural Sciences	40
- Medial Sciences	190
- Natural and Applied Sciences	200
- Social Sciences	100
- Universities/ Colleges	20

The various R&D and innovation centers continuously provide expertise, technically qualified and trained manpower and technology support to design and develop innovative products and innovations. Presently, there are more than 3 lac R&D personnel employed in the R&D sector of industry. DSIR also administers the fiscal incentives, announced by the government from time to time to encourage R&D by industry.

Academia

The academic system in the country is quite strong and comparable to international standards. India has a huge and diverse system of higher education - 310 university level institutions including 18 Central Universities. In addition, there are Institute of Higher Learning comprising the 7 Indian Institutes of Technology, 6 Indian Institutes of Management and the prestigious Indian Institute of Science and 15 National Institutes of Technology. Also there are about 15000 colleges, imparting general and specialized education in different disciplines.

INVESTMENT ON R&D AND INNOVATION IN INDIA

The Indian Innovation System is presently going through a nascent stage, continuously adapting itself to the newer ways of conducting R&D and commercialization. The Government funding schemes and the incentives to R&D are considered essential to commercialize the results of innovations. In this era of globalization, Indian Innovation System would be keen to participate in a global innovation system, wherein an *idea is generated in one part of the world, prototype is developed in another* and it *is commercialized in yet another part of the world for global consumption.*

Industry – both the public and private, R&D Institutions and Universities are becoming more closely involved and aware of the importance of cooperation in the area of S&T and technology transfer to promote sustainable industrial, economic and social development. The emergence of a free market, formation of international trading blocs, development of new technologies with low half-life periods, the incoming of an information age, and the necessity of improving quality to meet the requirements of international markets have strongly affected business and is forcing industry to look support from academia and the R&D Institutions.

There is an increased thrust on public-private partnership models to nurture and support the entire innovation chain in the country. Government is continuously enhancing the S&T outlays over the five year plan period and is allocating higher funds for supporting cutting-edge R&D and innovative projects. Apart from various funding schemes available in the country, new schemes such as Technopreneur Promotion Programme, Pharmaceuticals Research and Development Support Fund (PRDSF) and Small Business Research Industry (SIBRI) are continuously being launched. NGOs in tandem with government are turning enthusiastic to trigger an innovation movement in the country so as to enhance the share of innovative products in country's production and exports and thereby help the country to attain a competitive ranking in the national and international market. Foreign venture capital institutions and angel investors are also showing keen interest to support the innovation activity in the country. India is a global platform for R&D has already been

demonstrated by the presence of more than hundred R&D centers of MNCs in India. India, now aspires to establish itself as a manufacturing base for hi-tech products and services. The growth of Indian Innovation System in the coming years is expected to play a crucial role in realization of dream to take lead in the development of emerging technologies.

The national expenditure on R&D has steadily increased from Rs. 89.136/1 ,million in 1996-97 to Rs. 12,9015.4 million in 1998-99. The national investment on R&D activities attained a level of Rs. 18,0000 million in 2002-03. The same is estimated to be Rs. 197280 million in 2004-04 and Rs. 216390 million in 2004-05. Sector-wise percentage share of national R&D expenditure during 2002-03 was from Central Government 62.0%, State Governments 8.5%, Higher Education 4.2%, Public Sector Industries 5.0% and Private Sector Industries 20.3%.

During the year 2002-03, 84.1% of the R&D expenditure incurred by Central Government sources came from 12 major scientific agencies CSIR, DRDO, DAE, DBT, DST, DOS, DOD, ICAR, ICMR, MICT, MNEs, MoEn and rest came from other central ministries/ departments/public sector industries. Amongst the major scientific agencies, Defence Research & Development Organization (DRDO) accounted for 30.2% of the expenditure. R&D expenditure as percentage of GNP in 2002-03 was 0.80%.

The total investment on R&D by the industrial sector has increased from Rs. 4,505.6 million in 1985-86 to Rs. 34,414.2 million in 1998-99 and was Rs. 52,000 million during they year 2004-05. Industry spent about 0.5% of their sales turnover on R&D. About 128 companies which have recognized in-house R&D units by Department of Scientific & Industrial Research, Ministry of Science & Technology are claiming to have been spending more than Rs. 50 million on yearly basis.

TECHNOLOGY TRANSFER – OVERVIEW AND INITIATIVES IN INDIA

Technology transfer is a particular form of technology diffusion. It is a mode that emphasizes contractual relationships (as opposed to diffusion through imitation) as well as the assignment of the knowledge content of technology (as opposed to the diffusion of embodied technology such as the sale of machinery and equipment). As such, technology transfer involves the dissemination of both tacit and codified knowledge.

Much of this technology transfer occurs through foreign direct investment (FDI). In the course of investing in foreign countries, firms transfer technology across borders, either within the corporation (through wholly-owned subsidiaries) or through joint ventures (JVs) with local corporations. Research and Development institutions both in private sector and government sector have done lots of work in this and new technologies have been developed with are tested and available for transfers for commercialization. Council of Scientific and Industrial Research (CSIR) has documented all the researches and development works by the Government institutions and are available at a cost – fee for technology transfer and royalty. Similarly private R&D institutions and major industry houses also have carried out research and the technologies are available for the transfer.

INITIATIVES IN INDIA

Policy

The Government of India attached considerable importance to Science and Technology since independence. The real thrust came in 1958 with the adoption of Scientific Policy Resolution (SPR). It aimed at promoting scientific research in all its aspects – basic, applied and industrial. Consequently, the Government has created an impressive infrastructure over the years which include a chain of national laboratories, research and development (R&D) institutions, academic institutions and industrial R&D units. The thrust on S&T was further reinforced in the Technology Policy Statement (TPS) of Government of India announced in January, 1983. TPS, while emphasizing the importance of technology as a crucial resource for development of the nation, states – "In-house R&D units in industry provide a desirable and essential interface between efforts within the national laboratories and the educational sector as well as production in industry. Appropriate incentives will be given to the setting up of R&D units in industry including those on a cooperative basis. Enterprises will be encouraged to set up R&D units of a size to permit the accomplishment of major technological tasks."

The thrust on S&T, R&D and innovations has been further reinforced through the S&T policy, 2003. One of the objectives of Science and Technology Policy 2003 is to encourage research and innovation in areas of relevance for the economy and society, particularly by promoting close and productive interaction between private and public institutions in science and technology. The S&T policy 2003 in its implementation strategy states that – Intensive efforts will be launched to develop innovative technologies of a breakthrough nature; and innovation will be supported in all its aspects and a comprehensive national system of innovation will be created covering science and technology as also legal, financial and other related aspects.

The huge and diverse system of higher education and large R & D Lab system (particularly in the Govt. Sector)- has helped in the growth of scientific and technological culture and creation of a vast pool of science & technology manpower. Yet, the impact of these institutions in creation of new enterprises has been rather limited. In most cases, R&D output is not getting commercialized for want of initial investment, the needed enabling environment and networking. There have been some successes though. Recent initiatives of the Ministry of Science and Technology, Government of India on focusing its attention to plug the existing gaps and starting with several institution-based programmes and support measures like Fiscal Incentive and Support Measures for Industrial R&D and Innovation Centres, Technology Development and Demonstration Programme (TDDP), Drug Development Programme and Pharmaceuticals Research and Development Support Fund (PRDSF), New Millennium India Technology Leadership Initiative (NMITLI), Small Business Innovation Research Initiative (SBIRI). Entrepreneurship Development Cells (EDC), Science & Technology Entrepreneurs Park (STEP) and Technology Business Incubator (TBI) have some successes.

Fiscal Incentives and Support Measures for Industrial R&D and Innovation Centres

The Government has taken several measures towards promoting industrial research in industry itself besides making attempts to establish workable linkages between national laboratories, educational institutions and industry. Towards this end, several incentives have been provided which encourage

and make it financially attractive for private, joint and public sector industrial units to establish their own in-house R&D units. The Government of India has been encouraging industries to take up R&D activities by paying special attention for promotion and support to R&D.

The incentives and support measures presently available to in-house R&D units include:

- Income-tax relief on R&D expenditure as per Income-tax Act;
- Weighted tax deduction U/s 35 (2AA) of IT Act 1961 for sponsored research programs in approved national laboratories, universities and IITs;
- Weighted tax deduction u/s 35(2AB) of IT Act, 1961 on in-house R&D expenditure in chemicals, drugs, pharmaceutical (including clinical drug trials, obtaining approvals from any regulatory authority under any Central, State or Provincial Act and filling an application for a patent under Patent Act, 1970), bio-technology, electronic equipment, automobiles and its components; computers, telecommunication equipment and manufacture of aircrafts and helicopters as approved by the Prescribed Authority (Secretary, DSIR).
- Accelerated depreciation allowance under Rule 5(2) of IT Rules, on new plant and machinery set up based on indigenous technology;
- Customs duty exemption on goods imported by recognized in-house R&D units for use in Government funded R&D projects, under notification 50/96 – Customs;
- Customs duty exemption as specified goods (comprising of analytical and specialty equipment) and pharmaceutical reference standards imported by recognized in-house R&D units, for use in pharmaceutical and biotechnology sector under notification no.26/2003 – Customs dated 1st March, 2003.
- Excise duty waiver for 3 years on goods designed and developed by a wholly Indian owned company and duly patented in any two countries amongst India, USA, Japan and any one country of the European Union;
- 10 years tax holiday to commercial R&D companies approved by the Prescribed Authority (Secretary, DSIR) after 31 March 2000 but before 1 April 2004 u/s 80-IB (8A) of IT Act;
- Financial support for R&D projects;

Technology Development and Demonstration Programme (TDDP)

The Technology Development and Demonstration Programme (TDDP) of DSIR aims at catalyzing and supporting activities relating to technology absorption, adaptation and demonstration including capital goods development by involving industry and R&D organizations.

Under the programme, innovative technologies are up-scaled from the 'proof of concept stage' to 'pilot/pre-commercial stage' by the industrial R&D units. The projects involve research, design, development and engineering and are executed by industry and are evaluated by experts drawn from university/national laboratory/IITs etc.

The proposals can be made by industrial units, either on their own or jointly with research/educational institutions. If the projects involve collaboration with national research

laboratories, educational institutions, international bodies, companies, individuals, the same needs to be highlighted in the proposal mentioning the scope of work and responsibilities of each establishment participating in the project. Preference is given to proposals from in-house R&D units of industries recognized by DSIR. The financial support between 30% to 50% of the total project cost is given on the condition of lump-sum or royalty payments by the awardee after the commencement of commercial production.

Drug Development Programme and Pharmaceuticals Research and Development Support Fund (PRDSF)

The Department of Science and Technology (DST) lauched a Drug Development Programme during 1994-95 for promoting collaborative R&D in drugs and pharmaceuticals sector involving industries and institutions. 50 projects have been supported under the Programme involving 22 institutions and R&D establishments and 23 industries. These projects were about development of new chemical entities, new vaccines, assay systems, drug delivery systems and herbal drugs. These projects have resulted in filing of 4 product patents and 12 process patents. The Programme has also led to setting up of eight National facilities for R&D.

The Government established a 'Pharmaceuticals Research and Development Support Fund' (PRDSF) will an initial corpus of Rs.1500 million (US $ 35 million) in January, 2004. The fund will be used for supporting Pharma R&D projects by extending soft loan @ 3% interest.

New Millennium India Technology Leadership Initiative (NMITLI)

Government of India has recognized the power of innovation and had launched a new initiative during 2000 to enable Indian Industry to attain a global leadership position in a few selected niche areas by leveraging innovation-centric scientific and technological developments in different disciplines. The programme is backed by the National determination to turn sound technology ideas into realities by symbiotically promoting and fostering private-public partnership in a Team India spirit. Only companies that are registered in India and having more than 50% shareholding by Indians or Non-Resident Indians can participate. The R&D center of the applicant company must be recognized by the DSIR (or recognized must be obtained within 12 months). The financial support is provided as a grant to public institutions and as a loan with an interest rate of 3% to private sector companies.

In a very short span, NMITLI has crafted more than 25 path setting technology projects involving over 50 industry partners and 150 R&D institutions with an estimated outlay of Rs.1600 million. These projects are setting new global technological paradigms in the areas such as nano material catalysis, industrial chemicals, gene-based new targets for advanced drug delivery systems, bio-technology, bio-informatics, low cost office computers, improved liquid crystal devices and so on. The scheme is being implemented by Council of Scientific and Industrial Research (CSIR).

Small Business Innovation Research Initiative (SBIRI)

The commercialization of new technologies and high-tech projects in various biotech industries need to be accelerated to meet future challenges and realize full potential of biotechnology. The

SBIRI is the new scheme launched by the Department of Biotechnology to boost public-private partnership efforts in the country. The distinctive future of SBIRI is that its support to high risk, pre-proof of concept research and late stage development in small and medium companies led by innovators with science background which is unique in nature to support private industries and to get them involved in development of such products and processes which have high societal relevance.

Entrepreneurship Development Cell

The EDC scheme is aimed at creating entrepreneurial culture in S&T institutions to foster techno-entrepreneurship for generation of wealth and employment by S&T persons. The EDCs are established in academic institutions (science colleges, engineering institutes, universities, management schools) having requisite expertise and infrastructure. An EDC aims at developing and introducing curriculum on Entrepreneurship Development in the Host Institution and other such institutions in the vicinity besides conducting focused training programs for the benefit of S &T persons. Around 50 EDCs have been supported at various S&T Institutes and Universities.

Science and Technology Entrepreneur's Park

Science parks and similar initiatives create an atmosphere for innovation and entrepreneurship for active interaction between academics & industries, for sharing ideas, knowledge, experience and facilities for the development of new products and services and their rapid transfer to the end users. The Department has set up about 15 STEPs in various technical institutes of the country. Some of the successful STEPs are located at NIT Trichy, SJCE Mysore, PSG-College of Technology, Coimbatore and IIT Kharagpur. Each STEP has essentially the following features:

- Has formal and operational links with a University, other Higher Education Institution or Research Center.
- Is designed to encourage the formation and growth of knowledge based and technology led businesses and other organizations normally resident on site.
- Has a management function which is actively engaged in the transfer of technology and business skills to the organizations on site.

Technology and Business Incubators

A TBI is a recent initiative which has already been experimented successfully the world over to bolster economic development by stimulating growth of technology and knowledge based enterprises and generation of value added employment. A TBI helps in incubating knowledge based start-ups into sustainable businesses by providing specialized guidance, critical support services, innovative financing and networking support within a well equipped work space. As compared to STEP, a TBI is more service oriented with emphasis on value added services. Over 15 TBIs have been established by the Department in several Institutions of excellence including IIT Bombay, IIM Ahmedabad, National Institute of Design-Ahmedabad , BITS Pilani and ICRISAT Hyderabad in well identified thrust areas.

LEVELS OF TRIPLE HELIX COOPERATION AND KEY ISSUES

Universities, public and private research institutes, industry and government are becoming more closely involved and aware of the importance of cooperation in .S&T to promote sustainable industrial, economic and social development. Industrial development requires education, training and technology transfer. Universities offer education, training, research and advisory services. All over the world there is a new wave of cooperation between industries and institutions of higher learning. Universities are no longer seen as suppliers of graduates, but also viewed as possible source of new ideas on innovative approaches to issues like cost reduction, quality assurance, product diversification, customer satisfaction, etc.

University and industry cooperation can be observed at three different levels of organizational arrangement. At one level cooperation is occurring between universities and industry on a project basis as collaborative partners. In such cases cooperation may be short-term, on going, or long-term for specific minor or major activities. Such cooperation is usually formalized and structured. At another level, cooperation is occurring between individual academics (or groups of academics) and industrial partners. At this level, cooperation is also usually organized on a project by project basis, is short-term or on-going and often arranged through consulting contracts. Although often contract based, this level of cooperation is usually institutionally less formal and less structured and less open to control by the institution. The third level of cooperation is a more recent form and is characterized by structured institutional arrangements and the emergence of new patterns of research-business interaction. This third level of cooperation is both structured and formalized and reflects an important shift in the productive activities of both universities and industries toward new organizational forms. An interesting feature of these new organizational forms is that they are not driven purely by academic interests, nor are they driven purely by commercial interests. Rather, they are driven by interaction between the two. A significant feature of this third level of cooperation is that, while it blurs the boundaries between universities and industry, it also blurs the boundaries between teaching, research and consulting activities, creating an interdependent organizational environment. This level of cooperation is therefore more than simply university and industry cooperation, it represents a shift toward collaboration within integrated knowledge system.

Key Issues

Key issues that need to be addressed to increase the cooperation are

a) To increase the flow flexibility of university researchers
- To Modify the current personnel policies to improve the flexibility
- To design a suitable compensation system

b) To establish an incentive system to encourage university-industry cooperation
- To design a suitable promotional system to encourage university researchers to conduct industry-oriented research
- The current recruiting system to be modified to allow industrial experts to become an academic faculty member.

Proposed cooperation in Indian context:

Though universities and industries have much to gain from each other, the interaction between them has been very weak in India. There is a need to have a viable mechanism for effective exchange of information, and it has been suggested that liaison cells should be established in all our universities.

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Liaison Cells

Different ways by which universities and industries can help each other are summarized below.

The universities can:

- Set up *Liaison Cells* that have adequate data bases on facilities and expertise available in universities, as well as the features of industries in the region
- Provide material characterization, testing and certification facilities
- Keep the industries informed about new developments
- Provide consultancy services like the development of computer software, conduct of surveys, and solving of problems
- Help industries to induct and maintain modern technology
- Provide training programmes for technicians, scientists and engineers

The industries can:

- Support research programmes of applied nature
- Make available sophisticated and costly instruments to universities for research
- Provide financial assistance for the infrastructure development of the university
- Participate in teaching programmes
- Assist in the development of courses useful to industries
- Provide facilities for on-job training to students
- Assist teaching programmes by giving endowments

In order to facilitate university-industry cooperation, the Government of India has provided tax concessions to industry, which includes tax exemption for donations by industry to universities and tax deduction for supporting approved research projects.

MEASURES TO PROMOTE TECHNOLOGY TRANSFER

If university-industry technology transfer is to have a positive impact on state and local development, it must be oriented toward fostering state-based, industry R&D partnerships and licensing as well as promoting commercialization through local start-ups. However, many university-industry technology transfer actions occur in the bowels of institutions, places that have been relatively immune to state scrutiny or direct policy and program intervention. Research universities fiercely guard their organizational autonomy, particularly when it pertains to an internal staff function such as technology transfer. Consequently, in promoting university-industry technology transfer, Change should not be forced through line-item budgeting of technology transfer activities, which is likely to enrage the larger academic community; force change by intruding into the selection processes for deans and other high-level officials to secure candidates friendly to technology transfer; and criticize university officials at annual appropriation hearings on

their failure to contribute to the local and state economies. Yet several steps can be taken to promote university-industry technology transfer, which can be as follows:

Encourage university-technology partnerships through the following:

- Support University-Industry Research-Funding Programs
- Create and Maintain R&D Facilities
- Leverage Proximity – Getting faculty members and their industry counterparts to speak to one another and work in close physical proximity.

Invest in Entrepreneurial Support Organizations

To realize a greater regional impact from technology transfer, universities need to be more active and adept in local start-ups. Unfortunately, start-up companies often require a great deal of handholding early in their history. This assistance is beyond the capacity of most universities, so it often falls to local entrepreneurial support organizations to help start-ups. These organizations include small business development centers, mentoring programs of local chambers of commerce, private business service companies and investors. Technology based business incubators are particularly effective entrepreneurial support organizations.

Enable Private-Sector Investment in the new Technologies and Technology based Companies.

Technology oriented investment capital is critical to growing university-industry technology transfer. The following actions from the government would help in providing an enabling environment.

- Change tax laws by developing R&D tax credits with carry forward provisions as many technologies based start-ups have little revenue to tax in the early years.
- Increase the availability of capital – An incentive approach to selectively reduce capital gains taxes when the investments involve state based ventures in technology enterprises.

Remove Legal Barriers to University – Industry Technology Transfer

To best exploit their technology assets, universities need to be involved in a variety of intellectual property deals; some of these deals will strain the boundaries of what has previously been considered normal practice. For example, professor and/ or universities may want or need to take equity positions in new companies. If faculty members are considered state employees and universities are considered state agencies, such relationships may be explicitly or implicitly prohibited by law. It may also improve the general industry partnering culture of the university if faculty can easily consult with companies and engage industry-sponsored research.

Monitor Programmes and Policies affecting Technology Transfer

Monitoring of the research-funding agencies demands an understanding of the policies of the government and programme context. Unfortunately, there is still no consistent and coordinated interagency strategy or structure to address university technology transfer and commercialization,

particularly its relationship to economic development. This aspect needs to be appropriately addressed.

CONCLUSION:

Academia, Public and private research and development institutes, Industry and government are getting closely involved and aware of the importance of the interaction in the field of S&T to promote sustainable industrial, economic and social development. Industrial development requires education, training and Technology Development and Transfer. When the industry R&D institutions and university cooperate in the process of Technology development the process of Technology Transfer becomes much faster and absorption of Technology is much quicker.

In triple helix situation, the industry , the university and the R&D organization in performing their traditional function each assumes the roles of the other with academia creating and industrial penumbra as a regional or local innovation, organizer. I would like to quote here that "Triple Helix implies that paradigm of research in innovation studies has definitively incorporated a net work mode including uncertain relations with a plurality of environment".