Governability and vision of innovation inside Mexican Public Higher Education Institutions as a challenge to connect Mexican Innovation Government Policies and harmonized SME's needs on triple helix system.

Nunez-Merchand, A.[a], Pérez-Hernández P.[b]

a Instituto Politécnico Nacional, Escuela Superior de Ingeniería Química e Industrias Extractivas, Unidad Profesional Adolfo López Mateos, Zacatenco México City, Mexico; angelicanzmd@yahoo.com
b Instituto Politécnico Nacional, Centro de Investigaciones Económicas, Administrativas y Sociales, Casco de Santo Tomas, México City, México; mpilarmph@gmail.com

Abstract

Higher Education Institutions (HEIs) are functional innovation component of the triple helix system of a country, this study concentrate on performance and interaction of triple helix initiatives and actors, mainly centre on HEIs involvement. Latest decade Mexican Government has appreciatively promote and work for integration of opinion and call for action from several stakeholders that includes, academia, industrial sectors, HEIs, associations, NOGs, experts groups to strength and implement several strategies, comities, national projects and policies in Science, Technology and Innovation (STI). In view that Public HEIs in Mexico are potential players that contribute to produce knowledge for generating economic and social progress in a regional and national context. For that reason mechanism of participation of HEIs in the National Innovation System are examine, focusing in the HEIs governance framework of STI polices, strategies and creation of intermediate organism. Besides the performance of such schemes are reviewed on intellectual property indicators as measure for innovation activity. For instance, it is considered two of biggest public Mexican HEIs. Additionally, as part of the innovation country system it is also evaluated the degree of collaboration of Public HEIs with SME´s considering HEIs reports and National Innovation Statistics. From the innovation framework internal and external information is analysed, as well as, statistics, reports and STI indicators to determine the degree of appropriation and performance of such initiatives on the triple helix actors. To conclude Mexican Innovation schemes are promoted and supported by Government, nevertheless it is still with low performance overall industry and HEIs as core players. A major disadvantage is stagnant due to disarticulation on the whole STI system.

Moreover HEIs have to be dynamic and encourage major strategies with innovation vision in the governance context, redefining and strengthen schemes on intellectual property and technology transfer activities and developed indicators. Additionally HEIs shall actively enforce its participation on STI process to impel the national innovation system within articulation of Government and Industry collaboration.

Key Words: universities innovation, innovation initiatives, university triple helix

I. Introduction

The role of Higher Education Institutions (HEIs) in the era of knowledge and innovation goes far beyond the mission recognized on its organic functions, attributions and legal frame. HEIs are agencies that mark changes in time and space and broaden benefits overhaul individuals, societies and countries.

In this way, HEIs have to envisage and overwhelm continuously within and outside its boundaries numerous challenges regarding knowledge, research and technology matters, as they are a functional innovation component that contributes for economic growth and social progress.

Since Etzkowitz (1997) introduced the thesis of Triple Helix system in which states that the Universities played and enhanced innovation in increasingly knowledge-based society considering that triple helix innovation system fluxed and interrelated between public and private, science and technology, university, industry and government and their inter-relations among them. Universities have played a key role to generate alternative strategies for economic growth and social transformation.

Currently, countries University-Industry-Government models are evolving around to increase and potentiate their knowledge-innovation interrelationship as has been claimed by Etzkowitz et al. (1997) the concept that university nowadays has a third role, besides higher education and research purposes, university introduce an impact in the regional and economic development since the changing nature of both knowledge and economic production.

Recently, World Intellectual Property Organization (WIPO) released the Global Innovation Index 2012 where the top three innovators countries are still Switzerland, Sweden and Singapore, and the top ten contenders have repeated even though some countries are moving placements as the United States case.

It is undoubtedly that innovation is an endless dynamic and complex system OEDC (2000), thus university-industry-government structure shall be move vigorously according to initiatives, processes, strategies and interrelationship adopted by country stakeholders. It is clear that countries worldwide are in innovation sprint. Although, fare more than an innovation competition, countries in general are compelled to foster innovation to promote their social and economical development, fulfil citizenship aspirations providing higher standards of living, improved health, better security and environment, and enrich cultural life.

Regarding Mexico, as part of Organization for Economic Co-operation and Development (OECD) country, is in a transition phase moving forward from the second triple helix model described by Etzkowitz (1997) who defined a second policy model consists of separate institutional spheres with strong borders dividing them and highly circumscribed relations among the spheres, composition which have been called a "laissez-faire" model of university–industry–government relations.

Upon these considerations, the triple helix Mexican initiatives have been evaluated to determine the degree of performance and interaction among doers and how those proposals could support Mexico on innovation and globalization era. The main purpose is examining HEIs governance framework in accordance of how HEIs have evolved on STI polices, strategies and intermediate organism created. Moreover, this study focuses on how innovation national policies and schemes have permeated inside Mexican Public HEIs. The document have been divided in six parts including the introduction which describes the importance of HEIs in the economic and social country system; the state of art that defines highlights of knowledge and learning capacities and university third role; methodology clarifies the plan to achieve the research objective; finding and interpretation section explains national innovation framework, education context and exposes STI HEIs context; results examines several statistics on STI viewing national system, national education system, intellectual property indicators that have evolved in HEIs. Additionally, it is expose the recent innovation schemes for creation of technology transfer offices (OTTs) as a recent strategy adopted by Government and ending with conclusions.

II. State of the Art

Knowledge and learning capacities are valuable assets for individuals and organisations, outcomes of learning in any system helps and influence to survive and grow. (Pavitt, 1991; Shukla, 1997). Considering dynamic and changeable environment in terms of technology and markets, corporate learning in any kind of organisation is essential to hold and improve firm's productivity, competitiveness and innovation. Learning capacities help to adapt to changing environment demands, enable innovation strategies, build capacities of continuous improvements, and create conditions that facilitate radical transformation of the system. (Shukla, 1997).

Learning implies applied knowledge and be able to generate new one, thus knowledge and learning are key components to cope with "the Knowledge Society". Knowledge has expanded towards new fields of research, like innovation, entrepreneurship, and science and technology studies. (Faberberg J, et.al, 2012).

Cimoli (2000) conceived that nowadays it is generally accepted that a society's economic development is based on its capacity to generate and absorb innovation processes. New approaches assert that innovation has to be considered and defined as an interactive process in which firms almost never innovate in isolation. In this context, strategic alliances and interactions between firms, research institutes, universities and other institutions.

The economic performance is closely related to development of science, technology and innovation capacities as have been citied by Dutrénit, et. al. (2006), likewise such capacities are considered as a factor of countries competitiveness to face economical crisis.

On the other hand, it has been demonstrated that universities have a large potential to contribute to economic growth (Potts, 2002). Universities nowadays conduct additional activities

to their main academic, cultural and research purposes which are related to university industry interactions, enhanced entrepreneurial and knowledge transfer capacities, the latest refers on ability to protect its intellectual property assets and carry out commercially exploiting research outcomes.

Apaxt (2005) partner study manifested the role of HEIs in technology transfer activities in university which stands; technology transfer is all about transforming the fruits of university research into commercial value. In countries where entrepreneurial values are engrained successful innovation can achieve, this depends in part on cultural attributes, and how universities build important channels for disseminating cultural values, the universities can do much themselves to improve the wider context in which technology transfer occurs.

Hewitt-Dundas (2012) pointed out crucial components on technology transfer activities on universities in UK context several components on technology transfer activity are described which depends on how university respond according to organisation structure, organisation response, organisation support, strategy priorities and research intensity activity. Some highlights emphasized on organisation response to deliver value to stakeholders, how university policies promotes knowledge transfer activities and the presence of intermediates to facilitate transfer knowledge.

III. Methodology

The methodology follow on this research was analysed main components of triple helix in Mexico to determine the performance of interaction of Mexican Innovation System from the point of view of Mexican Public Higher Education Institutions (MPHEI) actors.

As has been exposed above HEIs involvement on STI system generate economic growth and social benefits. Even more, based on the significance of third role of University, It is important to look into Mexican public HEIs and determine how those institutions have evolved on the third role.

So far this paper examines in a broad context Mexican Innovation System performance and integration, mainly focused on HEIs governance and vision of innovation framework in which the third role is founded. On understanding that HEIs are innovation actor inside and outside its boundaries, besides in view of the advantage that major Mexican Public HEIs has due to fact of their R&D activities and capacities have increasingly made robust.

The analysis starts by describing key Government Innovation initiatives context that have been established through several policies and funding schemes from the latest decade, for that purpose several Government reports, OCDE reports, Mexican researchers and specialist were reviewed. To determine how national system has evolved, it is briefly described including the role, foundation and current innovation government scheme.

A second examination was shown on the current structure and situations that face HEIs in Mexican public system. Thirdly a comparison, between the two biggest, oldest and leading MPHEI´s in Mexico, is done on terms of industry collaboration and technology transfer intermediate units adopted by each institution. For this section several strategies, plans, policies, reports were analysed, then a brief description of this findings were disclosed and specific academic, R&D indicators and collaboration outcomes with SMEs are exposed in view to determine the governance of innovation inside each institution.

The results section includes an analysis of a set of statistics on Mexican public HEIs, enterprise innovation and intellectual property indicators available. This information derived from reports use to determine the impact of innovation system in Mexico and recognize how schemes have appropriated on innovation system actors. Besides, it is include OTTs participation a recent government strategy on STI programs. The performance of the system is reviewed by on intellectual property indicators as measure for innovation activity, as well to recognize the degree of interaction of innovation triple helix system.

Since Public Education Institutions are main players that contribute to create new knowledge for generating innovation in a regional context; HEIs should be recognized their role on country innovation system and be able to acknowledged the management of their R&D capacities

through define STI strategies, policies and administration of intermediate organism and mechanism; such as the creation office of technology transfer offices that support the activities of intellectual property and technology transfer between university community and industry and public sector in alignment of the national innovation system.

IV. Findings and interpretation

a. Mexican Government Innovation Scenery

The innovation system in Mexico has been broadly studied by national researchers and government bodies, as well as, external national and international entities. The system has been explored from the point of view of legal and macroeconomic country performance and development of innovation system.

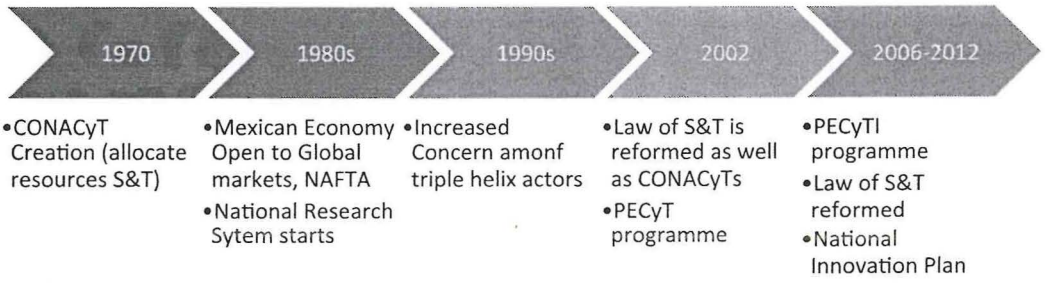
The innovation government model is pushing science, technology and Innovation (STI) strategies through industry, private sector and Higher Education Institutions. The starting point from these provisions starts in Mexican Constitution which claims juridical criteria to set up State obligations to support science and technology, besides to define that outcomes from knowledge must define public education policies, as it been discuss by Berrueco and Marquez (1998) who considered that Mexican Constitution is the centrepiece of economic policy in science and technology to allocate budget. Additionally, Berrueco and Marquez (1998) envisaged a delayed on designing better legal frame on science and technology system according to worldwide changes, so legal framework lag has not been suitable with national requirements and epochs to be applied on national, regional and Institutional or entities levels.

Federal government is obliged to promote necessary polices and create organism for the development of the education system and support research capacities through the Secretariat of Education (SEP), while National Council of Science and Technology (CONACyT Spanish initials) duties are mainly concentrated in research and technology development. Thus, SEP

and CONACyT are the federal schemes to conduce efforts on education, science, technology and are part of innovation national structure and process.

STI policies and structure have been progressing even though internal economical crises and political government changes. OEDC (2008, 2009) has judge Mexico Government to be slowly to establish an innovation system, design supporting schemes and policies, enhanced countries' scientific base that is shown on macroeconomic country performance. However, OEDC have recognized that recent Governments have made relevant efforts on STI system; a chronology of relevant legal and schemes towards STI is presented on the following diagram for a broad view.

Exhibit I: Evolution Innovation Schemes of STI Mexican policies



Source: OECD Reviews in innovation policies, CONACyT, FCCyT

The Government conception of this system is to achieve integration that harmonized and articulates several perspectives, objectives and action lines to enforce a major access to public and private finance to foster basic and applied research science, taking care of science and technology infrastructure to achieve technology competitiveness, rise quality of education, have a critical mass of scientists and technologist to ensure a regional economic equilibrium, that is visible on decentralized strategies on higher education institutions and research and technology capacities to The 32 Mexican States.

Current Mexican legal framework in science and technology is defined by the Law of Science and Technology (LS&T) authorized on 2002 with contemplates democratic involvement of various agencies and participation of both public and private sectors, furthermore science & technology regulation comprise mechanisms of participation to integrate opinion and defined actions on the National Science and Technology structure that consist on six schemes, from that the most active on pushing STI system are: CONACyT) and the Science and Technological Consultative Forum, (FCCyT Spanish initials).

Several actors joint to participate on consensus and designing strategies and objectives for several programmes that can be organized and managed by CONACyT. It can be observed that FCCyT in coordination of CONACyT has a very active participation, for instance FCCyT has conducted several studies and consensus regarding STI. Besides this entity has been very active for promoting, supporting, measure and define better mechanism for STI government policies and schemes. FCCyT has done a huge work to coordinate several stakeholders' from state and federal organization, public and private, HEIs, industry chambers, national and foreign specialist to discuss and work for national STI agenda. It can be appreciate that FCCyT captures, reconcile and report the national situation and demand of all sectors, communicate for instance the launching new governmental programs to stimulate research, technological development and Innovation, promote linkages, determine meetings to reinforce national STI information frame.

It can be visualised that FCCyT assembly reports are diverse and vast in opinions that are difficult to capture, besides there is hard to determine the degree of inclusion on how such consensus drive a government policy or initiatives; for that reason one view is presented from the 2012 report which is express by Dr. Francisco Marmolejo Cervantes, Executive Director of the Consortium for Collaboration of North Higher Education, declares that in knowledge era are best practices in terms of collaboration university–industry, however there is a requirement to define on clear STI policies for HEIs and its participation in regional development, it is urgent to increase budget, create indicators and monitor results from STI strategies.

From Government FCCyT is the main promoter of the triple helix-academia-government-business actors some of the evaluations regarding Country performance on STI. A report regarding science policy, technological development and the innovation in Mexico was accounted on 2000-2006 period. This study concentrates on assessment of the designed tools and implementation of the instruments contained in the Special Program of Science and Technology (PECYT) and legally set up on the LS&T.

It is important to mention that PECyT suffer a transformation and become The Special Program for Science and Technology and Innovation (PECyTI) during 2006-20012 (in the LS&T reformed in 2009) which is an integral plan that define national innovation strategies. Besides PECyTI must be linked with the National Development Plan (PND Spanish initials) developed in a Presidential period that last six years and it is coordinate democratically by Federal Government. From PECITI on 2010 a new scheme was launched named as The National Innovation Plan designed introduces new elements to deliver supplementary funds to support innovation called FINNOVA (Spanish initials).

CONACyT is the federal entity to encourage STI strategies budget from several Federal entities such as SEP and Secretary of Economy, among others. Then CONACyT captures resources and coordinates how to allocate them according to several funds, thus financing tools are design to support specific programs and activities to encourage research and technology development, and for building science, technology innovation capacities. Government plans are also design to increase critical mass of scientific and technologist; some other instruments encourage university-industry linkages, others objectives incorporate incentives for multidisciplinary network research groups and some other incentives are for researcher and technologist that carry out exceptional outcome and formation of specialized personnel.

CONACYT funds comprise essentially five types named as institutional, economic industry sector, international, mixed, trusts and some other stimulus approaches. The FINNOVA fund embraces the following issues point up in Table I:

Table I. Innovation support (FINNOVA) areas

Innovation Pillars	Strengthen national and international market, knowledge generation, intensification of business Innovation funding for Innovation, development of human capital fortify institutional and regional Policies
Productive Biotechnology Programme	Boost biotechnology capacity trough cluster formation and project in commercialization phase and enhance human capital capabilities
Pre-certification Office of Technology Transfer Programme	Encourage and strengthen the transfer of knowledge in the country, through the creation and strengthening of knowledge transfer offices
Certification of Office of technology transfer programme	Promote a high level of standardization of regulations and advices on transfer of knowledge to links private sector needs. Subsequently providing economic stimulus from medium to long term to those certified OTT for promoting them growth and building up technology transfer professionals.

Source: www.conacyt.gob.mx

Considering other incentives for critical mass CONACyT has reinforced the National Research System and gave support on postgraduate grant programs through postgraduate programs in Mexico and foreign postgraduate education. Besides to count with R&D areas, which are, prioritize national needs.

b. Mexican Educational System

Education system in Mexico has govern by SEP which is the federal instance that regulates education in Mexico to all levels and is the one to allocate major resources for teaching, and some other additional resources for research purposes. To build public education capacity, besides strengthen scientific and technological research, Federal government determine budget expenditures to allocated resources to public HEIs, strategies and goals are done by an institutional planning defined by PND, this budget support current and upgrading academic programmes and operating costs.

Despite the fact that public institutions are believed to offer a free education in deed funding HEIs have a very high costs, thus institutions sum up resources besides federal and/or states subsidies, such incomes comes from student tuitions feeds (which are low) and external sources like extend services to public and private organizations.

The tertiary education system has evolved to a decentralized system among 32 Mexican States. These transformations have broadened to public and private entities. Other organism such as National Association for Universities and Higher Education Institutions (ANUIES, Spanish initials) help to improve information of HEIs structure in Mexico (for the types of secondary education and higher education levels higher technical college and technical college degree, undergraduate and graduate students in regular education). The last ANUIES census statistics reported on 2011 were 825 public institutions versus 1619 private institutions across the country (records includes all ANUIES members or not members).

Public HEIs are governed by Federal and/or State government systems according to its structure, then National Congress approved Federal institutions and States approves their own institutions. There are basically two modes of HEIs governance framework, one is autonomous that depends on collegiate bodies who define policies, approve development plans, institutional budgets, new academic units and programs, besides collegiate bodies appointed a Dean responsible for policy execution and institutional administration. On the other hand, Non autonomous public HEIs such as technological, polytechnic and so called intercultural universities report and regulates directly to federal or state governments.

An OECD (2008) report in tertiary education system revels that tertiary education system has undergone successive differentiation and transformation make it a very complex and heterogeneous one. In fact OECD advise that tertiary education is an important player for innovation system and consider that Mexico are done a remarkable effort on policy regarding incentives for researchers some of the programs that promote research activities establish by SEP and/or CONACyT are so called[i] PROMEP, PIFOP and PNP programs. However Mexico requires increase budgets expenditures, research capacities and renewed their governance, planning and regulation to managing national system and reach development national goals. Key issues mention by OECD is the "benevolent support" given to tertiary education where public authorities need to define tertiary education priorities and strategies using agreed policy instruments in concern with quality, efficiency, coordination and results of HEIs.

c. Mexico HEIs-Industry Linkages

Considering university-industry collaboration Cimoli, Casas, et. al. (2000) establish that dominants trends come from HEIs, mainly by public HEIs and Research Public Centers which concentrates major capacities even though limited resources and relationships. Some other problems denoted by Cimoli, Casas argued that there is a lack of innovation culture on behalf of the firms, incipient strategies for linkages activities in HEIs, lack of coordination of three participants, inadequate or not existence policies and incentives to collaborate for innovation, dilemma between economic competitiveness and evaluation of scientific and technological activities, troubles between public and private knowledge and secrecy demand by industry.

In 2003 FCCyT made a consensus to find out the Status of Science and Technology in the Public Universities, which report a series of demands and needs. This document clearly identify problems on HEIs and ANUIES regarding its performance, focus on tertiary education system policies, hiring rules for professor-researchers, national development careers plan, strengthen colleges bodies to participate in academic decisions. Some others are regarding to promote quality system of manage government bodies of HEIS, define proficient management personnel, develop policies and conducive regulations for academia-industry collaboration, establish office of technology transfers to promote regional development. Other important highlights are to ensure consistency between the SEP, CONACYT and HEIs for undertaking evaluation on teaching and research activities and incentives. SEP should have established a policy on the public HEIs system that includes support policies, budgets allocation, promote research and developing indicators.

d. Main Mexican Public Higher Institutions

Governability and innovation vision actions in Mexican Public Higher Education System were reviewed and exemplified by two types of governance systems. Firstly, an autonomous governance system is illustrated by one of the biggest and oldest MPHEIs in Mexico and

secondly a governance system is exemplified by a Mexican Technical Federal State for Higher Education.

Autonomous Governance System in Higher Education

The National Autonomous University of Mexico (Universidad Nacional Autonoma de Mexico, UNAM Spanish initials) oldest in Mexico and Latin America, ranked at 146th place in the global university ranking and 5th in Latin America at 2012 (42).

UNAM is a public University and has a decentralized organism of Mexican State, with full legal capacity, its purpose is providing higher education (including medium higher education) aims are to vocational training on professionals, researchers, academics and technicians who are employed and serve to the society, besides UNAM is organize to conduct research to solve national problems and extend as widely as possible all benefits of culture. UNAM purpose is to serve integrally to the country and humanity, with an ethic and social service responsibility overcoming any individual interest.

The Dean and University Councils are empowered to issue all type of policies, rules and any other provisions and need to govern autonomous, manage and organized their own heritage, as it can be read in their Organic Law, University Statutes and general operation policies (www.unam.mx) and its current organization structure show an integrated organization, with flexible relationships in order to permeate what Dean and Council's pronounce to Implement strategies from top and down and horizontally.

The division that operates all activities regarding technology transfer matters is the Coordination of Innovation and Development (CID) was created on 2008. The central purpose is supporting transfer of knowledge, technologies and products produced in the UNAM to agencies and companies in the public, social and private sectors, promoting the benefits of scientific activities and cultural university to society as a whole. (CID Report, 2008)

CID work closely with the Vice-Rector Office of Collaboration and UNAM Office of Legal Affairs (Oficina del Abogado General de la UNAM OAG-UNAM Spanish initials) to comply with its substantive functions and activities that fall into three strategic areas: technology transfer, technology services and support to small and medium enterprises (SMEs); besides this unit counts with an incubator for developing on new technological base companies and participation in technology parks. Furthermore CID promotes and supports projects linking social benefit to communities with different types of needs.

During the investigation of several public UNAM´s documentation such as reports and several materials including statistics, it can be made known (1):

- There is a development plan; the recent one includes several strategies on technology transfer actions FOR 2011-2015.
- There are clear property and intellectual policies and properly agreement models for technology transfer activities that include technology development, technology transfer, and licensing and material transfer agreements among others.
- The policy of extraordinary Income defines the following activities as remunerations: collaboration projects with several public and private organizations, donations, voluntary contributions, professional services, product selling, leasing, transfers of rights and inheritance, licensing and exploitation of intellectual property titles, knowledge and technology transfer activities, among others.
- The same policy dictates the distribution for Technology transfer royalties.
- They have delivered on their Web Page several guides, process, procedures and legal templates on intellectual property and technology transfer activities.
- They have implemented several procedures and informatics systems that simplify, strengthen and speeds administrative issues such as registration and payment of intellectual property: some of other actions are legal help desk and counting that functioning 24 hours 365 days.

- They have implemented a System for Administration and Management Instruments Consensual, developed in a Web environment that follows the provisions and procedure defined in their policies for validation, registration and deposit of legal agreements.
- From 2009 CID has actively work on several collaboration agreements with industrial sector, since then they have design a novel proposal with an institutional impact, which is in a implementation phase and named Program for Promotion of Innovation and Patenting. That year 80 projects were received from 80 UNAMs institutions that have been evaluated for technology transfer activities.
- Reports from collaboration activities, last three reports mentioned that in 2011 UNAM received $23.7 million pesos and in 2010 earnings were about $10.3 million pesos.
- Specific Indicators from technology transfer activities cannot be found in agendas and statistics. Indicators are focus products from Researching, which are oriented in national and international publications; numbers of researchers certified by the National Research System (SNI Spanish initials) of CONACyT´s, other information are number of projects, number of personnel with doctorate degree. However reports from CID indicates for instance that in 2011 The Mexican Institute of Industrial Property (IMPI Spanish initials) admitted 17 applications national patents, 5 patent applications on the Patent Cooperation Treaty route and three patents were granted to the University, 2 in Mexico and 1 in the United States of America. Additional information reported was one license from a pharmaceutical company in 2008.

Technical Higher Education Governance System

The National Polytechnic Institute of Mexico (Instituto Politecnico Nacional, IPN Spanish initials) is the second biggest public Institution in Mexico and ranked 16th in Latin America at 2012 (42).

IPN is known as the Technical Mexican Federal Educational Institution created 1936 to consolidate, through education, scientific, technological and cultural knowledge economic independence and social progress of the nation, according to historical objectives of the

Mexican Revolution, contained in The Constitution of the United Mexican States. IPN is a decentralized body from the SEP.

IPN´s Organic Law declares that education will be free and its main aims are: contribute to educational process through the transformation of society and recognition for democracy and social progress within a regime of equality and freedom; perform scientific and technological research with a view to advancing knowledge, for the developing technological education and improved social conditions and sense of better use of natural resources and materials; train professionals and researchers in various fields of science and technology in accordance with the requirements of the economic, political and social country development.

To fulfill its goals IPN is authorized legally to adopt its own administrative and academic organization according with their general policies and legal frame, for that IPN plans, executes and evaluates their activities systematically; provide higher average education, bachelor's, master's and doctoral courses technical training and upgrading, specialization and academic improvement among others.

The General Director of IPN shall be appointed by the President of The United Mexican States. General Director Attributions are: direct and coordinate Institute activities; monitor strictly compliance of policies and rules; issue forth rules and general provisions for better academic and administrative organization for well management of the Institute, taking into account the opinion of the General Advisory Council.

Council Board and Administrative Officials, in accordance with The Office of Legal Affairs (Oficina del Abogado General del IPN, OAG-IPN Spanish initials), will delineate and organized strategies, policies, and operation actions defined by General Director. It can be envisaged that IPN organization structure is vertical and with rigid operation system. Schools and others supporting units are on the equal and end organization level. Supporting units are identified to help Schools to achieve substantial attributions such as education, research, development and wide collaboration dealings with social and private sectors.

Schools and supporting units (SU) are the lowest in organization level considering other functional administrative units, thus this is a strictly top down organization. There are three SU created with a view to offer industry services, such units are Enterprise Incubator recognized as CIEBT (Center of Incubation Technological Base Enterprises), an enterprise unit called UPDCE (Polytechnic Unit for Enterprise Competitiveness and Development) and a recent unit called Technopoli (Technological Pole).

Business Units depend of Secretariat of Extension and Social Integration, (SEIS) each one has relationship inside and outside IPN´s, works and assist with specific purposes and has its own organizational authorized system. Collaboration agreements with industry or public organism that have an additional income to IPN are handling by UPDCE.

UPDCE main attributions are managed and authorized in collaboration with OAG-IPN and Collaboration Committee within SEIS attributions. All Schools and SU are obliged to conduct collaboration instruments through UPDCE only unit with that attribution. Besides this activities, there exits another subunit recognized as Technology Transfer Unit which purposes are advice and manage intellectual property rights in collaboration of OAG-IPN office. This office has also other services those are: a Patent Center (comes from collaboration with Mexican Institute of Intellectual, federal Institution for industrial property, IMPI), technology commercialization department and its subsequent agreement follow up by the department of technology adoption and assimilation.

There are found Guidance's for Intellectual Property on OAG-IPN web page with only one collaboration agreement model frame defined to perfume several collaborations purposes including technology transfer agreements. There are not includes a specific policy to manage on technology transfer and licensing, neither specific legal agreements.

Authorized Policies that refers to intellectual property matters and technology transfer are manifest in internal Police of IPN that briefly describes that the Scientific and Technological Research are substantive functions that allows the generation of knowledge and strengthening

of basic and applied science to contribute to solving the problems of national development. Disseminate research results to promote scientific knowledge and technological advances. The Institute will promote innovation projects and technological development related to the technological needs of the public, social and private sectors. It is found that the only specific policy in IP rights with too broad view on technology transfer is consider in the Regulation of Social Integration of the National Polytechnic Institute, which set up general concerns and unique chapter for Intellectual Property. Products of intellectual property belong to the Institute, which will give the respective credits to personnel in case of exploitation, royalties or other rights previously will agreed to personnel with no defined policy on royalties and its distribution.

Some of the results reported by UPDCE web page are three licensing agreements with no other additional information on licensing; there are also reported procedures for industrial protection and technology commercialization.

An important point for IPN is that counts with its own trust for Scientific Research and Technological Development (defined by LS&T) responsible for finance or supplement funding for specific research projects, the creation and maintenance of research facilities, equipment and materials supply and training of specialized human resources.

Indicators in collaboration with productive sectors have been increasing during the last five years and after UPDCE creation (2005). Annual Report during 2011 indicates that 288 collaboration projects were signed, 81 legal agreements were subscribed with private enterprises and amount received for that purpose was around $ 1,349,274,809.37 million pesos that represents an increase of 48.71% in amount according to 2010 that was $907,309,382.35 million pesos.

In terms of production of intellectual property activity it is shown that it has increased, in same report includes that UPDCE redefined the strategies of promoting a culture of intellectual property, continuing evaluation of the technologies that will shape the IPN technology portfolio susceptible to market, besides an active Campaign on Intellectual Property and Technology Commercialization that started on 2011 in several Schools and Research Centers. Additional, it

was report that 25 drafting patent applications were supported by specialized legal services which cost was supported by Science and Technology Institute of Federal District in Mexico City.

The Exhibit II considers some recent facts and indicators regarding size, academic staff and some research strengths for both institutions.

Exhibit II. Main Academic and R&D indicators of HEIs

Indicator	UNAM		IPN	
School population	2011	2010	2011	2010
Medium Higher Education	110,982	108,699	57,628	56,504
Higher Education	190,731	179,052	95,743	95,030
Postgraduate	26,878	25,036	6,384	6,422
Academic Staff	36,750	35,678	17,273	17,273
Academic Staff full time	11,805	i.n.r	8,208	8,117
National Publications	1,830	i,n,r	i.n.r.	i.n.r
International Publications	3,492	i.n.r	i.n.r.	i.n.r
SNI[a]	3,624	3442	771	759
Number of Research Projects	8,881	8,611	1,226	1,182
Federal Grant[b,d]	2.28	1.96	0.85	0.82

Source: www.unam.mx, www.ipn.mx

a. National Research System certified by CONACyT´s.
b. Estimated in USD Million dollars.
c. Mexican State authorized through approval of Mexican State Congress Chamber academic budget each year.
d. UNAM External Income is full amount and it's reported by Planning Management Office and for IPN income reported comes only from collaboration agreements and this amount represents net income reported in its 2011 Annual Report. i.n.r. Information not reported.

V. Results

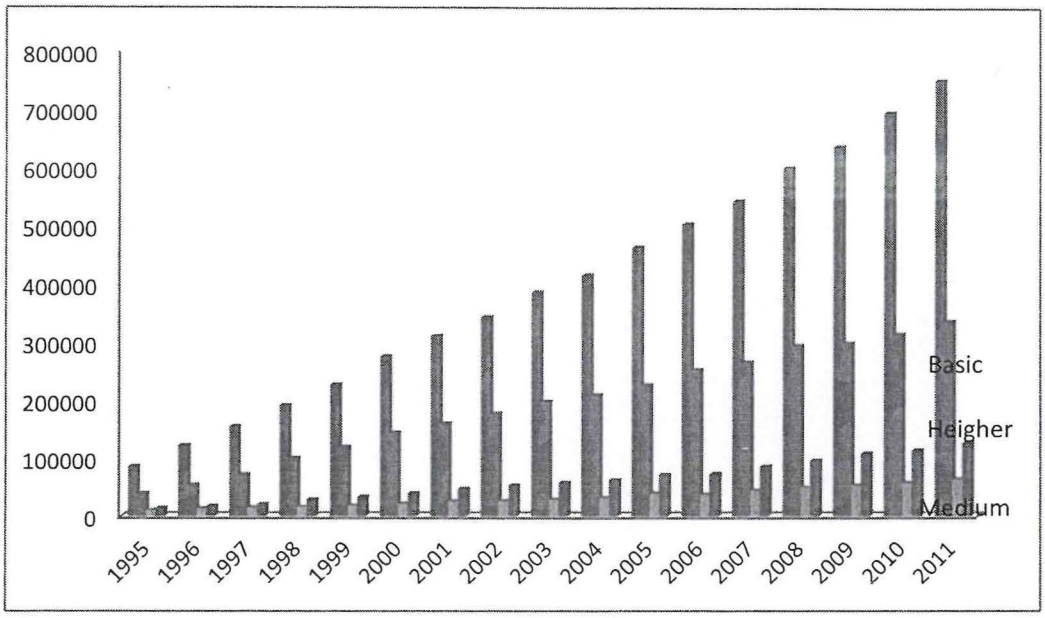
Mexican Government has build indicators according to OEDC Frascati and Oslo manuals, the main entities to developed and generate information on STI are conducted by CONACyT and National Institute of Geography and informatics (INEGI). Information use for this study comes

from the Statistical Yearbook of the United Mexican States 2012 (AEEUM 2012) which incorporate periods from 1995-2011 and selected indicators on STI available from INEGI and CONACyT statistic and reports. Additional information comes from specific institutions web sites, in case of information of HEIs and other entities mention in this paper.

The Exhibit III shows that budget in Mexican pesos allocated by Government on education have increase continuously. From data it can be seen that 90% represents Federal budgets allocate by SEP and the rest is used by State Governments. It also shows a steadily increase in budget since 1995, however the proportion of budget on basic education represents 52% in all years, and the same for other higher levels, hence 13% were spend on medium higher education and 16% for higher education. That expenditure includes the amount fixed for academic purposes and a quantity for R&D purposes, which were allocated to HEIs. The percentage of increase among years was around 15% on 8 first years, later on a reduction is shown between years, and for instance an increase in expenditure is presented from 2009 to 2010 on 9% but on 2011 diminish in 3%.

The information of Exhibit III does not measure results from HEIs on R&D purposes, however it is a measure of investment on education that have an impact on building human resources capacities. The government effort to provide free education in all levels is certainly a commitment to society. Though, on search of information no additional indicators or measure from result on academic and R&D expenditure supported by SEP or Mexican States are available or associated to determine the impact on policy, quality, performance, cost and efficiency on national education system in each level. Some questions arise from this gap, and it is reinforce FCCyT reports on HEIs face several difficulties and the whole education system. As an example of the cost of higher education per alumni reported by UNAM statistics, indicates their cost around $61,286 (2012) equivalent to $5000USD.

Exhibit III. Total Government Expenditure in Education Sector in Mexico in Million Pesos



Source: www.inegi.org.mx

The CONACYT and INEGI carry on a survey to enterprises related to research and technological development called ESIDET on 1999-2000, 2004-2005 and 2006-2007 results were concentrated in a report named Results technological innovation modules (MIT) 2008, 2006 and 2001, the latest reported by INEGI. The main purposes of this information are to explore innovative activities of the firms, technological innovation, resources for innovation and perception and source of innovation actions.

The type of industrial business that shape Mexican economic sectors is concentrated in two big categories manufacturing and services. Manufacturing enterprises comprise; food, beverages and snuff, textiles, clothing, leather and leather wood, paper, printing and publications, coal, oil, nuclear, and chemical products, rubber and plastic, basic metals and fabricated metal products (except machinery and equipment), machinery, equipment, instruments and transport equipment, other some other manufacturing economical activities.

Some of the results were analyzed to identify if there has been a change on innovation activities of the firms with national capital and foreign capital. The total numbers of firms on the three periods were 11,740 in 1999-2000, 16,093 in 2004-2005 and 15,824 in 2006-2007. It can be shown on the report that the percentage of enterprises that developed innovation activities were

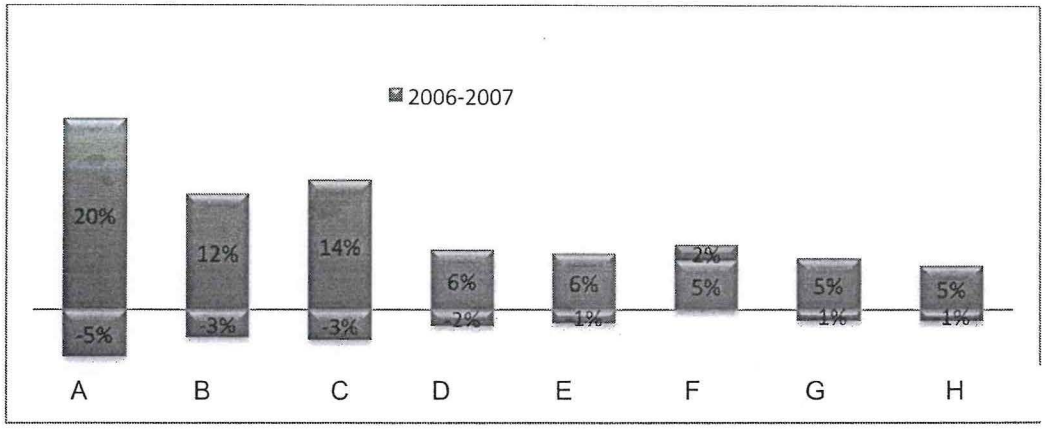
26% from 1999-2005 and 21% in 2006-2007, besides enterprises with major innovation activities were SME´s with (50-100 employees) which were the most innovative enterprises that account to 11% of the total, this indicators remains without or little change during the three periods a exception of 2004-2005 with a percentage of 10%, the second most innovative enterprises were those with 100 to 150 employees equivalent to a 6%,9% and 5% from each period respectively. Moreover, it is reported that foreign capital firms represent 2% average of the total that perform some innovation action and represents only 10% average of the total of enterprises with innovation activities.

Another crucial factor from the analysis of these MIT results can be shown in exhibit IV, it reveals almost no increase in the variables of financial support innovation using either own resources or government funds that in fact through 1999 to 2007 all measures presented in the exhibit diminish in relation to 2006-2007. On the other had it can appreciated that actions regarding innovation as R&D activities, personnel training an others activities did not increase at all in subsequent years, the only measure for the set that have increase during such period was collaboration with other enterprises or institutions.

It can be seen that this information is matching on above section regarding technology transfer HEIS organization which described the increase on collaboration agreements is noticeable. This is a support on the work on relationship between universities- industry is growing.

An additional significant measure on innovation are causes reported by firms regarding major difficulties to carry on innovation actions, this difficulties were reported by 2006-2007 periods that can be seen in exhibit V. This graph illustrates main causes, thus it can be seen that up to 25% reported obstacles related to lack of personnel, government funds, government legal framework, insufficient financial instruments and very high risk and cost to perform an innovation actions. A positive element on this was that the perception increase 35% from 1999-2000 and 10% from 2004-2005 periods that can be a result of awareness of the difficulties and demands to achieve major results. Thus, more firms are concerned on requirements to carry on innovation activities. However innovation processes on firms continue stagnate.

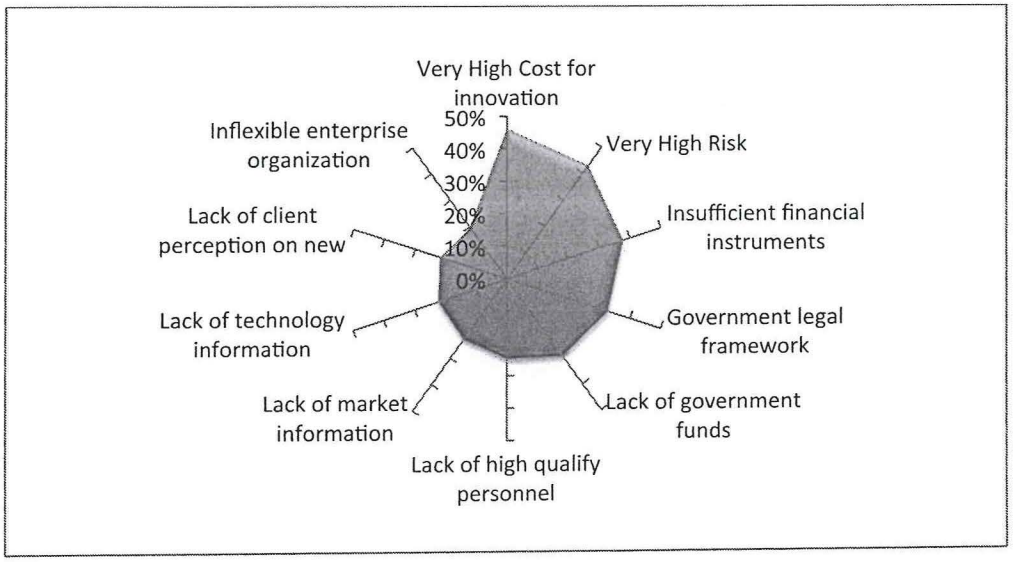
Exhibit IV. Representative Innovation activities and impact performed by firms in Mexico.



Source: Results technological innovation modules (MIT) 2008, 2006 and 2001, www.inegi.org.mx

A. Using own resources
B. Innovation with national level impact
C. R&D activities
D. Personnel Training
E. Using Government Funds
F. Collaboration with other enterprises and Institutions
G. Innovation activities inside enterprise
H. Innovation activities with global level impact

Exhibit V. Causes reported by firms on 2006-2007 to carry on innovation actions.



Source: Results technological innovation modules (MIT) 2008, 2006 and 2001, www.inegi.org.mx

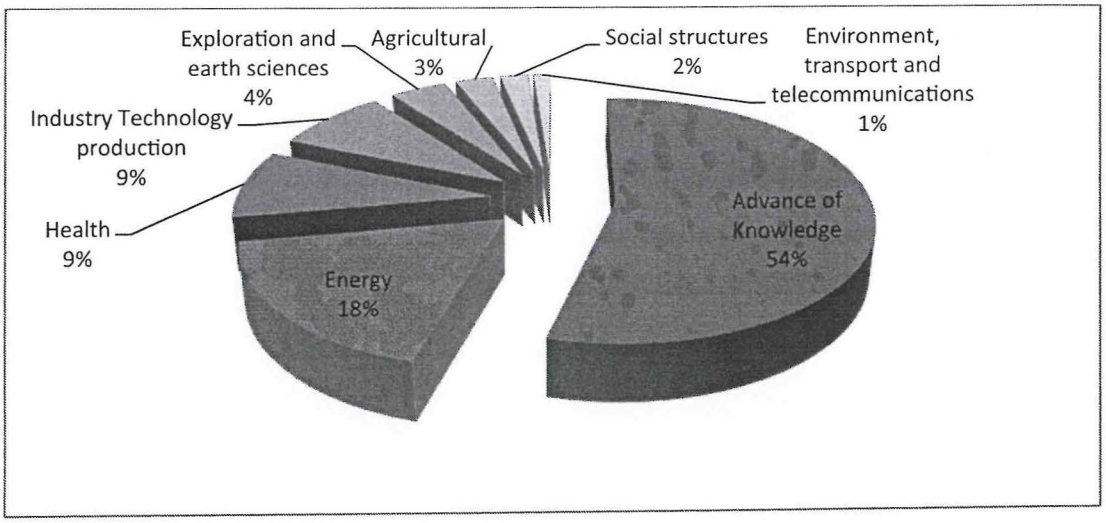
It is quite documented that innovation process is not easy; many companies have fail even having resources. Then there is awareness on major difficulties is accomplishing innovation

cost, but there is a question regarding Mexican companies capacities and how those manage risk as the major problem to face.

Mexico has still on the line to increase resources on STI, but nothing about have happened to raise resources to 1% of GDP become real. Resources applied for S&T have been increasing but remains the same proportion on Grow Domestic Product which is around 0.4% (15). Besides expenditure for R&D have remain the same for almost 15 years where the Government is the main funding sector with around 56.3% according to data reported by CONACyT (15) on 2011, after government private sector invest on R&D about 37.5%, and HEIs spend 4.6%. In all cases the amount of expenditure has increased but proportion stay more or less the same. From point of view of HEIs the main activity is education in which their resources are allocated for this purposes. For instance, UNAM reported that from the total expenditure, about 60% is employ for education purposes and 25% for and R&D.

As an example of the use of the resources Exhibits VI show how resources are exploit on several socioeconomic objectives, major expenses are used for advance knowledge that represents 54%, secondly an 18% of resources are spend on energy sector, thirdly 9% apply for health and industry technology purposes. Moreover exhibit VI shows slow proportion for spends in industrial economic sectors.

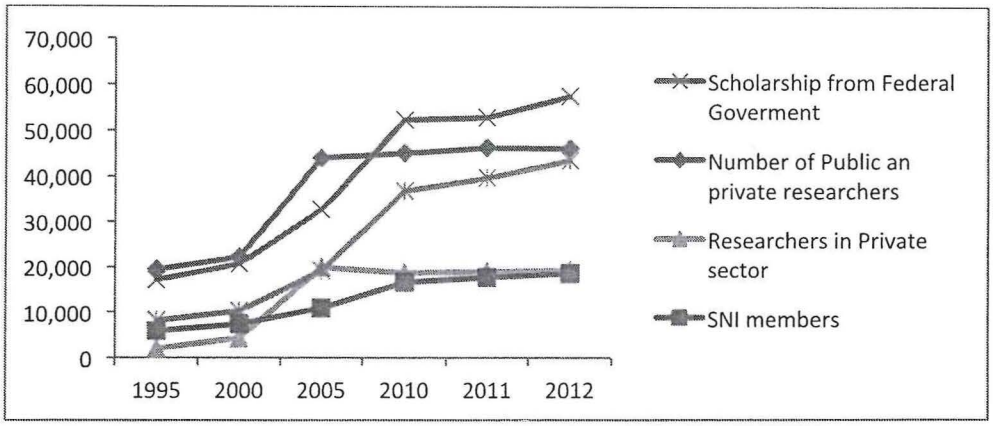
Exhibit VI Proportion of Federal expenditure by industrial sector on 2011



Source: www.inegi.org.mx

A further point is building of national capacities which are also increasing significantly after 2000 year as can be exposed in Exhibit VII.

Exhibit VII. Science and Technology Human Capital capacities on Mexican System



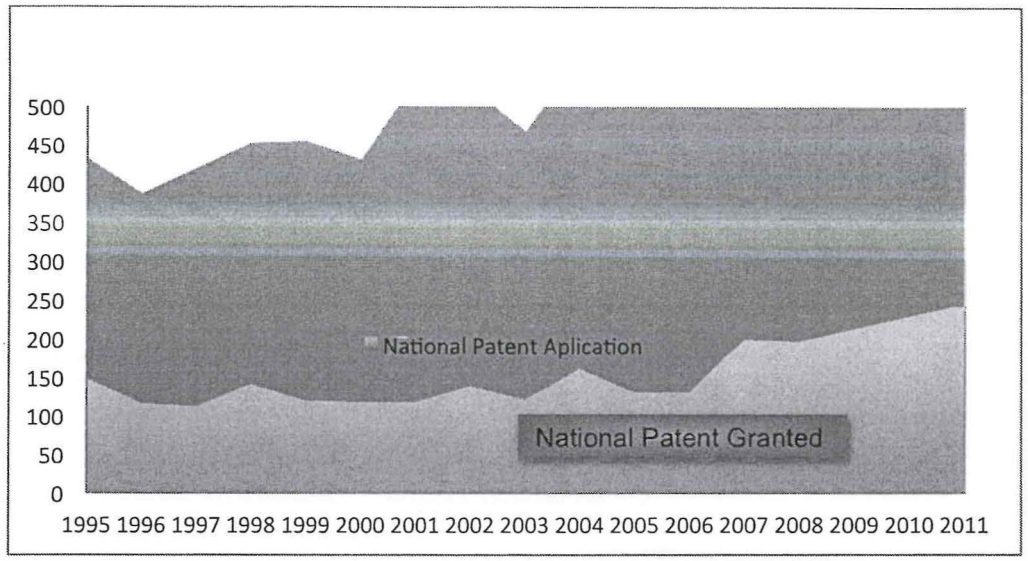
Source: Fifth National Presidential Report 2011.

Specific indicators regarding impact on social and economic benefits are not defined or described on Government Funding Schemes; diverse information was presented according to the type of funding, mainly focus on number of projects and amount of resources expenditures. For the moment no indicators are developed or reported on technology transfer activities for HEIs due to the fact that OTTs have born on 2002 according to LS&T.

One measures of country innovation are the number of patents; in case of Mexico national patents are roughly 4% from the total patents applications that counts about 14,000. Last five years around 10,000 patents were granted, but roughly 250 patents were national as can be seen on Exhibit VIII. This measure is also stagnant, on the other hand similar situation are presented on intellectual property numbers of HEIs, for instance UNAMs and IPN production of patents application and granted are very low.

The following exhibits IX indicates activity on intellectual property considering percentage of variation on previous year. Considering information below, it is possible to estimate the proportion of contribution on national patenting application that is roughly 5%.

Exhibit VIII. National Patent Applications and Granted from 1995 - 2011



www.inegi.org.mx

The results on intellectual property activity on HEIs is congruent with national patent results, some of the causes are due to the fact of SNI system prioritized scientific publications activity rather than patenting, however the last SNI policy have upgrade on November 2012, secondly HEIs policy researchers incentives schemes are still focus on scientific publications rather than patenting. Other possible reasons might be that knowledge outcomes have been greatly disseminate by publications in general to scientific and no scientific publications this can be seen on web pages and domestic publications on HEIs that promote through press communication their R&D advances. Moreover, there is no clear policy to define when patent or what to do first patent or published.

Exhibit IX. HEIs Indicators for Intellectual Property Activity.

Activity	UNAM				IPN			
	2011	2010	2009	2008	2011	2010	2009	2008
Copyright applications	11%	-13%	-22%	449	89%	10%	1209%	11
Patent applications	30%	43%	0%	23	43%	-22%	4700%	3
Patent granted	138%	-13%	125%	4	67%	0%	3	n.r.
Trademark granted	-62%	18%	83%	12	n.r.	-86%	7	n.r.

Sources (www.unam.mx and www.ipn.mx)

Notes: For this exhibit were included UNAM's literary works published and renewals.

In case of PCT application were not included as in some cases information were not reported or not well specified, it was difficult to determine PCT status was in application process or granted. n.r. no reported

HEIs have been slowly in changing towards creation and building OTT intermediaries which have legally born on Law of Science and Technology in 2002. Moreover results and impact indicators on technology transfer activities were no available, for instance no information of licensing benefits, spin out/off or other information are developed by HEIs.

A recent funding scheme which is part of PECITI, PND and PNI is the impact of FINNOVA funding, in this newly scheme includes precertification and Certification of public and private OTTs, results show few participation of HEIS and there were more participation of private and other public entities as can be seen on table II.

Table II. FINNOVA Funding entities participation on OTTs Pre-Certification and subsequent Certification.

Scheme	HEIs Granted	Public Research Centers Granted	Private Firms	Associations and other type of entities.
OTT Pre-Certification	25	14	13	14
OTT Certification	4	5	5	4

Source: www.conacyt.gob.mx

Pre-certification funding was closely to dates of certification, which was part of requisites as no funding was granted for certification. It can be seen for table II that few entities were able to fulfill all requisites to obtain certification in a very closely dates. Mexican public HEIs that got certification were three public and one private, considering total of public HEIs represents 0.4% of participation.

From what have been presented, in general the system presents lack of governance on intellectual property and innovation matters, besides other downsides previously expose. HEIs are more active in its core activity and mission which is educate, but HEIs are building university-industry relationship and are aware of the advantage that represents generate additional income, considering lack of budget on R&D. However, HEIs must look forward to

being advocated on technology transfer intermediates to promote and build innovation capacities inside and through the national system.

VI. Conclusions

It can be conclude that Mexico has been rising and build up science and technology capacities through several approaches such as increasing of numbers of SNIs, raise the number of postgraduate research areas, there are also an increase on R&D capacities even though low amount of expenditure, and have been promote university-industry relationship. It is recognized that innovation policies are good efforts from Mexican Government although it is envisage that major problems are on articulation of STI system.

On the other hand the government strategy is a pushing one in which it is visible that efforts to call for action for stakeholders have led to an intensive participation according to FCCyT reports with no impact, appropriation or increase of performance of the whole system. Those efforts are not sufficient; besides the vision on "benign support policies" conduces to integrate industry sector and HEIs in a reactive position. Government efforts may demand, in addition to comply with the governance of STI on national level, to integrate proactive players.

It is clearly that Mexican Innovation schemes are promoted and supported by Government with low performance overall industry and HEIs as main actors, then Mexican economy country performance continuing without an innovation momentum.

Mexican Public HEIs system shows an absence to promote actively the third role of universities; HEIs have been changing very slowly, for instance they need a deeply transformation for implementing a vision and governance innovation framework within; as it establish in their organic laws.

HEIs needs to strengthen strategies and schemes on intellectual property and technology transfer activities. Additionally HEIs shall actively enforce its participation on STI process to

impel the national innovation system within articulation of Government and Industry collaboration.

HEIs must recognize themselves as active players; consider redefined strategies and policies in managerial level to promote outcomes of R&D have an impact in the economy of the country and social benefits. General recommendation for HEIs are favour policies, processes and indicators to support communication channels on their technology transfer structure, define or redefine clearly collaboration policies on intellectual property matters and technology transfer activities, diminish complex and bureaucratic procedures; empowered OTTs structure according to organization system, define a specific budget and strategies for OTTS and become flexible and dynamic to communicate, promote and support specific innovation values.

VII. Further research

Following to the Mexican public HEIs and considering HEIs has a innovator role there is much to accomplish, for instance it can be conduce a research on intellectual property, entrepreneurial culture, considering that innovation and entrepreneurship is part of vision on HEIs. Other themes of further research are on the design on indicators of the collaboration university-industry, performance of technology transfer activities, conduce studies on industry to measure technology aptitudes, adoption and assimilation of knowledge capacities. Other considerations are on winning–winning relationship on legal agreements, how industry has enhanced its capacity to be able to adopt and assimilate knowledge.

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[i] SEP have proposed several programs PROMEP means Faculty Improvement Program, such program is a strategic program designed to permanently raise the level of qualification of teachers based on the appropriate profiles for each subsystem of higher education. The purpose is boost higher education quality by training, dedication and performance of academic bodies of institutions. PIFOP is a program for strengthening the National Graduate system on Mexican Public Institutions and it's collaboration between Sep and CONACyT. PNP means Nationals postgraduate program to enhanced quality of postgraduate studies are national level with emphasis of national priorities, this program is administer by CONACyT.