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Analysis of the technological development, innovation and technology transfer in México

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The present paper presents an analysis of the technological development in Mexico in recent years. The research focuses on the study of different factors such as innovation and competiveness levels, flows of FDI as a mechanism for technology transfer, intellectual property activity, and investment in science and technology. The research is aimed to generate a diagnostic of the technological development by the study of key aspects which might explain the technological lag in Mexico. Information from international economic organizations, governmental dependencies in Mexico as well as existing literature in the field, was analyzed in order to obtain relevant and accurate information which allowed the authors to construct indicators to measure, evaluate and diagnose the performance of Mexico in the technological field.

Technology transfer, Innovation, financing, development, enterprises

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Introduction

Technology is aimed to improve any human activity by the utilization of different tools, techniques and procedures. It is the technical knowledge that could also be associated as something physical (hardware) for example a machine, an electrical or mechanical component, or can also be associated to non-physical concept (software) for example a chemical process, codes, a patent, a technique, or even a person [1]. Technology can be viewed as the technique used to support daily activities either at work or at home and can be carried out by people or machines, regardless the item they use [2].

Technology itself can fall into four categories [3]:

1. *Commodities:* Defined as the technology explicitly related to purely civilian. The harvesting and production of commodities such as textiles and agricultural products.

2. *Military items:* Technologies that are directly linked with the army, such as weapons systems.

3. *Scientific or basic research:* Technology that is usually freely disseminated through academic journals and scholarly papers, however the projected applications of this type of information are highly uncertain.

4. *Dual-use technology:* Defined as those technologies whose development and application are ostensibly intended for civilian purposes, but could have potential application in the defence sector, such as computers and different informatics systems.

Technological development is aimed to generate not only physical devices, machinery or hardware, but also to generate knowledge aimed to improve processes and activities. Knowledge can be classified in two categories tacit and explicit knowledge. Tacit knowledge is based on subjective aspects such as experiences which cannot be written down in words, formulas, sentences, and most of the time refers to a specific context. Tacit knowledge involves cognitive skills for example beliefs, images, mental models or even technical skills such as craft and know-how. In contrast explicit knowledge is objective and rational which can be expressed in words, sentences, numbers or formulas; therefore it includes theoretical approaches, problem solving, manuals and databases [4].

Technological development involves the generation of knowledge which can develop new opportunities, creating value for customers, obtaining competitive advantages or improving performance. Activities of knowledge management include knowledge capture, documentation, retrieval and reuse, creation, transfer and sharing of its knowledge assets integrated in its operational and business processes [5].

Due to benefits gained by the utilization of technology aimed to improve efficiency in any actions carried out by human beings, technology is a key factor to increase competitiveness. Technological progress is one of the factors which impact the most on the economic growth. [6]. However, Mexico for many years, has underinvested in science, technology and innovation. Therefore, its competitiveness and economic is depleted by the dependency of technology from abroad, being Mexico unable to generate its own technology.

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Background: Technological development in Mexico

Since the Mexican economy has gone in the last 20 years from a development model characterized by import substitution industrialization oriented to the domestic market; to a model of openness and deregulation of the economy; Mexico have not been able to find a model which leads it to a technological development. Regardless the model applied, one of the fundamental constraints has been the insufficient investment in science, technology and innovation that would develop appropriate capabilities to achieve productive requirements [7].

In the model of import substitution industrialization, economic activity was mainly focused on the domestic market with leadership in manufacturing, a sector that had a high level of local integration but low international competitiveness. In the current context of openness of markets, the lack of innovation as well as scientific and technological capabilities has led to specialization in segments with little technological added value in the local and global production processes.

In the 90s, the economy and labour productivity grew at a slower pace than the replacement period. However, there was a significant change in the composition of production and employment, in which the results indicate a fall in production efficiency, reflecting the inability of the economy for the generation and appropriation of the fruits of technological progress.

Against the background of limited technological and innovative capacity, against an international process of rapid technological change, Mexico is limited in creating competitive advantages. Mexico is immersed in a productive and trade specialization recognized by the incorporation of a small technological added value.

Innovation in Mexico

In global economy, productive sector can only survive through quality, novelty and diversity of products and services, which can only be generated by innovation. Innovation means introducing modification into the process of production in order to improve the final result. Therefore, innovation can be considered as the modification of products, services or any economic or productive activity, aimed to improve quality [8].

The global economy has focused on the search of new processes of production, organization and commercialization, in which enterprises have undertaken activities aimed to innovate focusing on technological development. Innovation leads to competitiveness; nevertheless, Mexico is a country that has been inserted in a limited way in the development of innovations, focusing primarily on natural resource exploitation and utilization of available labour. Therefore, the lack of development of innovations, not only affects the national economy, but it is also reflected in the competitiveness of Mexico in an international framework [9]. According to the OECD (Organisation for Economic Co-operation and Development) and the IADB (Inter-American Development Bank), the states in Mexico have a 42-year lag in innovation and technological development over the average of the European Union. Therefore, Mexican states would take more than four decades to reach the levels of innovation that has the European average [10]. Mexico reached the place 53 in the Global Competitiveness and Innovation Index in 2013. Situation which, although, implies a position above the average, cannot be reflected in real innovation. The World Economic Forum defines an innovation process integrated by three stages of development, factor-driven, efficiency-driven and innovation-driven, complemented by two transition stages [11].

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Mexico has been unable to reach an optimal performance, figure 1 show the stages of development and it can be observed that in 2010-2011 Mexico was located in the stage 2 (efficiency-driven) which implies a period where countries should undertake efficient productive processes upgrading quality of products but keeping a wage level.

On the other hand in 2012-2013 Mexico is located in a transition stage between stage 2 and 3. Such stage implies an improvement of activities in order to reach innovation-driven in which wage levels increase and products and services are produced by sophisticated production processes and with state-of-the-art technology.

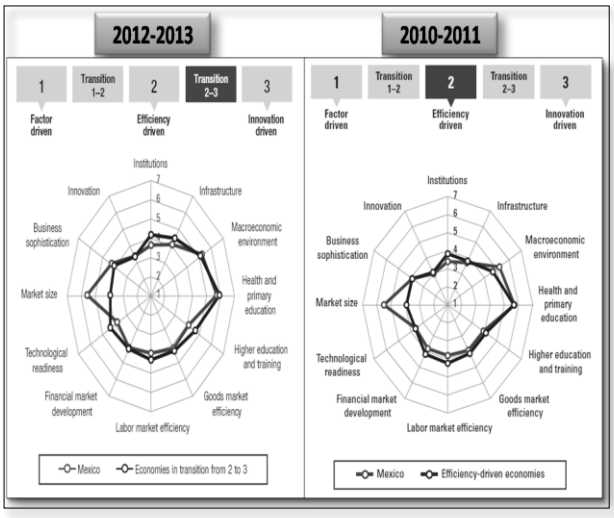

Figure 1

Due to stage of development in which Mexico is located, the country is incapable to impulse innovation and consequently, technological development.

The inconstant behaviour in innovation activities tends to a technological lag. Such lag implies the impossibility to develop technological capabilities to assimilate technology transfer.

This statement is based on the idea that the ability of selecting, adapting, improving, assimilating and crating new technology is the fundamental component of technological capabilities. Technology transfer is not only physical equipments, blueprints, manuals, or any other qualifications or skill that employees possess but also implies the capability of the receivers to use the technology transferred [12]. Technological capability can be seen as the set of knowledge needed to carry out a task; it is composed by technical knowledge, experiences and abilities to assimilate knowledge and technology. However, the development of technological capability is limited not only by innovation but also by the generation of appropriate environment which enables technological development supported by constant investment actions [13].

3 Technology transfer in Mexico

Technology transfer is a mechanism for the exchange of information across borders and its effective diffusion into recipient economies, which involves many complex processes, ranging from innovation, international technology marketing, as well as their absorption and imitation [14]. Technology transfer is an inflow of technical knowledge to the market where it is sold and bought. Such transfer is thought as a product which goes from one place to another where it could be bought or sold. Technology transfer is usually a basis for technical innovation and it is often a form of innovation diffusion [15].

Technology transfer can be vertical or horizontal. Vertical transfer refers to transfer of technology from basic research to applied research, development, and production respectively. Horizontal technology transfer refers to the movement and use of technology used in one place, organisation, or context to another place, organisation, or context [16].

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Technology transfer in Mexico has been poorly explored.

There are counted projects of technology transfer. Governmental institutions have not focused on technological development through technology transfer.

The lag in innovation and technological development faced by Mexico is the responsibility of federal and state governments, who must design new policy and allocate public resources, but also the private sector, which invests very little in this matter. Private sector has not used technology transfer as an alternative to improve competitiveness.

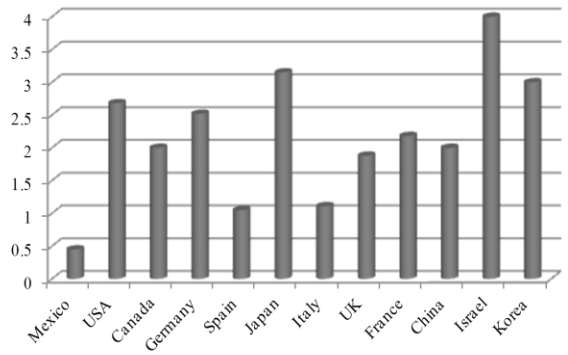
The adoption of new technology eventually can allow organizations to generate their own technology.

However, in order to encourage technology transfer, there must be more funding sources available to grant economic help to scientific research, technological development, innovation and technology transfer.

4 Technological development investment in Mexico

Mexico invests only 0.4% of its gross domestic product (GDP), while in developed nations is intended between 3.0 and 3.5 percent. OECD recommends developing countries to invest at least 1% of the GDP in science and technology development.

Nevertheless, Mexico does not even reach the 1% of investment, in contrast with other developing countries such as Israel and South Korea which invest the 4% and 3% respectively (figure 2).



Graphic 1

According to the federal budget of expenses for 2013, Mexico's federal government allocated $4,566 (1.6%) to the program for science, technology and innovation [17]. In developed countries the main investment flows come from the private sector and not from the government.

The figure 3 shows the financing structure in research and technological development, it can be appreciated that, in economies such as USA, Japan, South Korea and Canada, more than the 60% of the investment comes from the productive sector. On the other hand, in Latin-American countries such as Mexico, Brazil, Colombia and Chile, the tendency remains in the dependency of investment carried out by the government.

Country	Government	Private Sector	Other sources
Colombia	70.0	13.0	17.0
Greece	48.7	24.0	27.3
Mexico	59.1	24.5	16.4
Turkey	47.7	43.3	9.0
South Korea	24.9	70.0	5.1
Canada	31.8	42.6	25.6
Japan	19.5	72.2	8.3
USA	27.3	68.2	4.5
Germany	32.0	65.7	2.3
Spain	40.8	48.9	10.3
Chile	64.3	21.5	14.2

Figure 3

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It can be observed that 24.5% of the total investment in science and technology in Mexico comes from the productive sector; such low level implies a lack of innovation activities within Mexican enterprises. The National Institute of Statistics and Geography (in Spanish INEGI) informs that in 2010, on the one hand only 1,705 enterprises inverted in research and technological development within the productive process and on the other hand only 1,613 inverted in research and innovation activities for prevention and control of pollution. Ergo, lees than the 10% of the enterprises develop research and innovation activities. Based on the results of the INEGI-State Innovation Index 2012, the Federal District and Nuevo Leon concentrate the biggest companies operating in Mexico which have quality human resources, technological infrastructure, and access to markets and financial sector actors, however, there is not a constant technological development innovation activity yet, the few research activities carried out laid in the areas of coal, petroleum, nuclear energy, chemical products, rubber and plastic.

On the other hand, there are entities where there are not innovation activities such as Chihuahua, Queretaro, Baja California, Sonora, Coahuila and Guanajuato. Although such states present proven production capabilities, innovation and technological development lag is highly marked. Drastically, states such as Tlaxcala and Oaxaca would take over 100 years to reach the European average in innovation and technological development. The Mexican National Council for Science and Technology (in Spanish CONACYT) is the main entity responsible for promoting the technological development and innovation in Mexico. Although it undertakes programs aimed to encourage enterprises to develop technology by supporting and financing innovation activities, the scope of the programs is limited by the budget assigned to CONACYT by the federal government.

Such budget is not enough to improve their programs; therefore, new funding sources of technological development should be considered.

Funding for technology transfer

It has to be pointed out that according to the Mexican Enterprise Information System, the business characterization in Mexico lies on small and medium enterprises where 99% of the companies established are SMEs. SMEs in Mexico have to face important restrictions to access financing schemes which allow them to develop their business activities and stay in the market.

Therefore, the access to finance is limited due to only 2.5% of SMEs receive financing from the development bank. It has been mentioned previously that CONACYT is limited by the federal budget, therefore, the scope of its programs are limited as well.

However, within its means CONACYT aims to promote the technology transfer. Figure 4 presents 18 programs aimed to finance technology development and technology transfer within organizations, based on specific actions lines.

All programs aim to encourage the investment in technological research and development by the funding and granting of additional economic stimulus to enterprises which undertake R&D activities. Such activities should be focused on increasing competitiveness and generating employment and subsequently boosting the economic growth of Mexico [18].

Program	Support lines
1. AVANCE - New Business	Support scientific and technological developments proved in a pre-commercial stage.
2. AVANCE - Entrepreneurs fund CONACYT-NAFIN	Enable access to supports aimed to develop and consolidate high value-added business.

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3. AVANCE – Guarantee fund	Facilitate access to credit lines to businesses which have developed new products or lines of business based on development of scientists and technologists.
4. AVANCE – Technological packages	Integrate technological packages aimed to commercialize scientific and technological developments.
5. AVANCE – Technology transfer offices	Encourage the setting-up of technology transfer offices.
6. AVANCE – Business school	Encourage academic programs focused on business incubators aimed to manage and use of technology.
7. AVANCE – Strategic alliances and innovation networks for competitiveness	Stimulate creation of alliances and innovation networks.
8. AVANCE – Support to national patents	Encourage intellectual property protection.
9. New fund for science and technology	Strengthen of scientific and technological capabilities through economic supports.
10. Stimulus program to research, technological development and innovation: INNOVAPYME, INNOVATEC and PROINNOVA	Supports to business which carry out activities of research, technological development and innovation, preferably in collaboration with other organizations and institutions.
11. Mixed funds	Support scientific and technological development in states and municipalities.
12. Sectorial funds	Trusts for scientific research and technological development with a sectorial scope.
13. Innovation projects Iberoeka	Support and facilitate an important industrial, technological and scientific cooperation aimed at developing products, processes, services addressed to a potential market.
14. Institutional fund of regional support for scientific technological development and innovation	Promote scientific, technological and innovation actions with high impact and training of specialised human resources training aimed at regional development.
15. Technological innovation fund	Grant resources to technological development projects in small and medium enterprises.
16. Sectorial fund of innovation	Grant economic support aimed to develop scientific research, technological development and innovation.
17. Bilateral technological cooperation	Strengthen international technological cooperation through development of research projects, technological development and innovation in Mexican enterprises, universities, research centres, linked to foreign organizations.
18. International cooperation fund in science and technology European Union-Mexico (FONCICYT)	Creation and strengthen of networks, elaboration of joint research projects, technological development and innovation.

Table 1

Based on the programs listed above, three programs can be identified as the main source of financing for technology transfer INNOVAPYME, PROINNOVA and INNOVATEC. The operation of such programs is carried out as follows:

1. When a SME enters an individual project can only be funded up to 35% for INNOVAPYME program and up to 22% in the case of INNOVATEC. Therefore the rate of 75% to 88% will have to be financed by the company itself.

2. If SMEs are linked to a Higher Education Institution (HEI) or a large company, the support granted can represent 30% up to 75% of the investment.

3. There is a maximum amount that can be granted for the investments, which is 1.4 USD million with INNOVAPYME, 1.6 USD million with PROINNOVA, and 2.8 USD million with INOVATEC. It should be noted that each programs has a maximum amount of available resources to finance projects, $46.3 USD million, $54 USD million and $1.2 USD billion for INNOVAPYME, PROINNOVA and INNOVATEC respectably.

Foreign direct investment

The Foreign Direct Investment (FDI) is aimed to create a lasting interest for economic or business purposes by a foreign investor in the host country.

The literature and empirical evidence identify FDI as an important catalyst for development, as it has the potential to generate employment, increase savings and foreign exchange earnings, stimulate competition, and encourage transfer of new technologies and boost exports.

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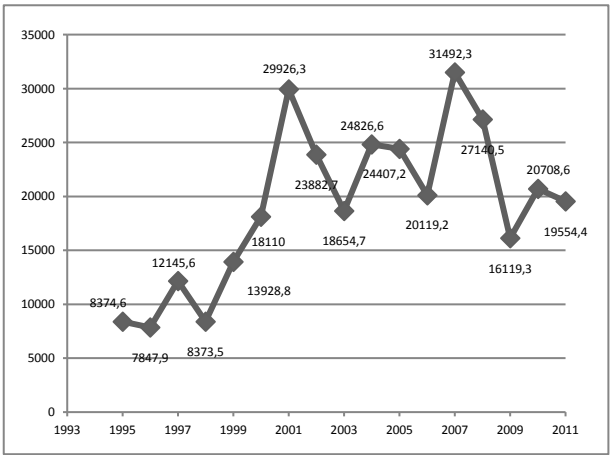
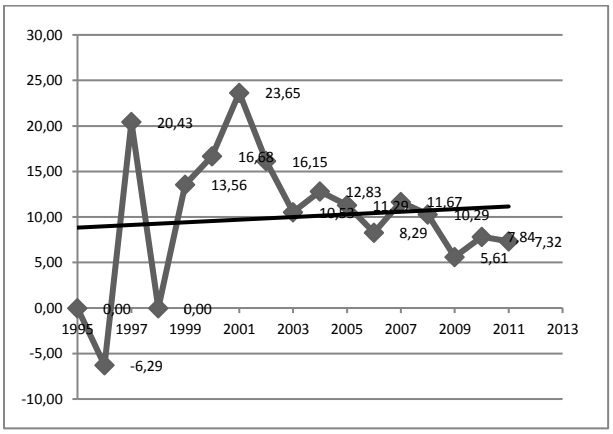
Different experts in the field such as Kumar *et. al* (1999), Wie (2001), Saad *et al.* (2002) recognise FDI as an important channel for technology transfer due to its characteristics and the actors involved [19][20][21]. FDI positively affects all productive and competitive environment of a country. FDI is an important vehicle for the transfer of technology, contributing relatively more to growth than domestic investment [22]. According to the Directorate General of Foreign Investment (in Spanish DGIE) FDI in Mexico has presented an unstable behaviour in recent years. The figure 5 presents the flows of FDI in Mexico since 1995, it can be seen that from 1998 to 2001 the FDI raised high levels; however from 2001 to 2003, there were several decreases. In 2007 the FDI raised $31,492.3 USD million, being this the highest level so far (2013), nevertheless, the following two years, in 2008 and 2009, there were decreases, rising again in 2010 but decreasing in 2011with $19,554.4 USD million.



Graphic 2

To clarify the behaviour of the FDI in Mexico, graphic 3 is presented. The graph shows the average annual growth rate taking 1995 a base year. In the figure can be seen the real increases and decreases expressed in percentage terms. Although the rates in the graph are mainly positive, the truth is that there has not been a real growth of the FDI in Mexico.

Since 2001 can be appreciated that the average growth falls gradually until 2007, although the lineal trend line presents a minimal upward trend, the fact is that if the average annual growth keeps falling in future years, the trend will tend downwards soon as well.



Graphic 3

Mexico should seek new investors as soon as possible in order to raise again its FDI levels. The recovery of the U.S. economy and the macroeconomic soundness in Mexico are key factors that, in future years, will help FDI to show a rising trend. Although the country is located away from the historical levels of 2001 and 2007 the FDI in Mexico is recovering on the strength and maintaining macroeconomic stability over its emerging competitors. Nevertheless, there are significant constraints due to lack of structural reforms as the labour, energy, telecommunications and taxation, which, according to the DGIE, could trigger an increase in the arrival of new capital above 20%. However, there are emerging economies that have become in more attractive countries to invest in. Therefore, although Mexico presents a solid economy in comparison with other Latin-American countries, the fact is that Mexico is not an attractive destiny for FDI in recent years. Mostly due to not only for the drug war started in 2006 which has propitiated a violent environment.

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But also for the different social movements against media and some sector of the government. Such unstable scenario has made countries and foreign organizations to decide to move their capital to most stables countries such as Brazil, which in recent years has gained an important increase in FDI in contrast with Mexico that has lose it.

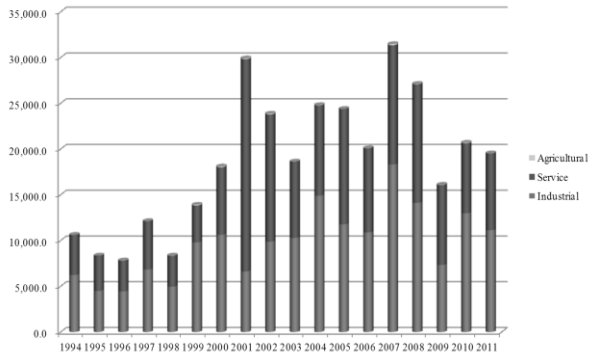
The table 2 presents the flows of FDI incomes in different countries in Latin America. As can be observed, Mexico still has a higher amount of FDI income compared with other countries in the region. However, the interesting point, is the case of Brazil, whilst Mexico has a variation of -18% between the first semester of 2010 and 2011, Brazil raised 157% of variation capturing in 2011 more than twice the FDI of 2010. Being Brazil now the principal receiver of FDI in Latin America.

Country	1st Semester 2010	Total 2010	1st Semester 2011	Variation 2011-2010 (1st Semester)
Argentina	3,447	7,049	2,406	-30%
Bahamas	384	862	482	26%
Bolivia	194	622	319	64%
Brazil	17,153	48,438	44,085	157%
Chile	7,969	15,095	6,883	-14%
Colombia	3,661	6,915	7,008	91%
Costa Rica	730	1,466	1,057	45%
El Salvador	25	78	376	140%
Guatemala	314	687	485	54%
Honduras	423	799	486	15%
Mexico	12,988	19,627	10,601	-18%
Nicaragua	218	508	284	30%
Panama	1,210	2,363	1,416	17%
Paraguay	52	222	36	-31%
Peru	3,512	7,328	3,577	2%
Dominican Republic	731	1,626	947	30%
Uruguay	1,065	2,358	1,020	-4%
Venezuela	-325	-1,404	1,184	464%
TOTAL	**53,751**	**114,639**	**82,652**	**54%**

Tablet 2

The case of fall in FDI in Mexico cannot be explained arguing that is a general case of Latin American and the Caribbean.

Due to as can be seen in the figure 6. In general terms the FDI income in the area has increased in 54% in the first semester of 2011. With the exception of Mexico, Argentina, Chile, Paraguay and Uruguay, all the other countries have increased their FDI incomes. In the case of Mexico, firstly it has to be analyzed the destination of the FDI. The graphic 4 shows the flows of FDI per economic sector in Mexico since 1994. As can be seen the main favoured is the industrial sector. However, in 2001 a year in which the FDI raised the second highest level in the last 15 years, the 77.53% of the total was captured by the service sector and it was used mainly for activities such as trade, financial services and transportation. On the other hand, not only in 2007 but also in years in which the industrial sector received most of the FDI, the main receiving activity has been historically the manufacturing sector with around the 90% of the total allocated in the industrial sector.



Graphic 4

It must be pointed out that although almost the total FDI in the industrial sector is intended at manufacturing, there are not innovation activities and technological development coming out of that investment. This is because the FDI is unstable and the flows from different countries vary significantly each year.

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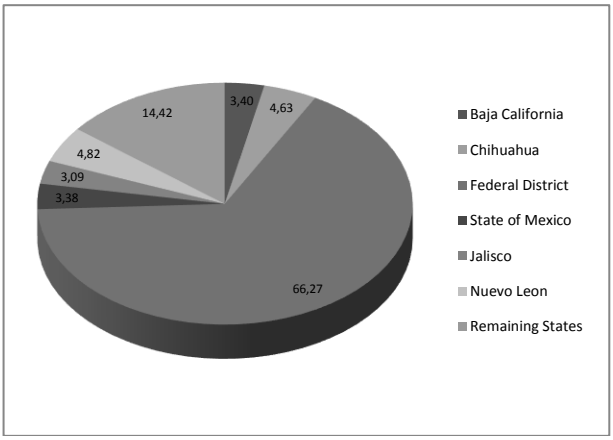
Table 3 shows the flows of FDI per country of origin, having that the United States of American is the main sender of FDI to Mexico. In average the FDI from USA represents the 50% of the total.

Country of Origin	2005	2006	2007	2008	2009	2010	2011
Canada	334.8	741.0	642.6	646.1	27.9	310.4	311.1
USA	480.3	627.7	482.4	3,069.9	1,631.5	1,512.8	664.0
Spain	1,692.7	1,436.3	5,402.3	4,940.8	2,685.9	1,445.1	3,073.6
France	11,769.9	12,938.3	12,885.0	11,367.7	7,337.9	5,631.9	10,073.2
Italy	386.1	156.0	231.8	205.3	263.6	133.1	166.7
Japan	27.3	26.2	47.6	108.6	30.9	43.7	113.1
Netherlands	166.3	-1,421.5	395.4	142.5	217.9	225.3	686.5
UK	4,013.3	2,807.4	6,630.2	1,855.5	2,074.1	8,923.8	1,409.2
Switzerland	1,349.1	972.0	607.3	1,393.5	344.0	623.1	51.0
Germany	323.9	578.3	606.3	224.3	87.5	246.0	1,157.7

Table 3

The instability of international markets in recent years has caused that the investment decisions of multinational corporations now are based on strategic considerations increasingly complex.

This situation, coupled with the increasing participation of Asian economies in world trade flows, has caused that the level of competition among countries to attract FDI flows has increased dramatically. From this perspective, it is important to analyze the evolution of FDI in Mexico with an emphasis on the main entities receivers of FDI in Mexico.



Graphic 5

The graphic 5 shows that the Federal District is the entity that receives the most of the FDI in Mexico, in 2011 from the total investment of $19,554.4 millions of US dollars; Mexico City received $12,958.7 (66.27%). However, such resources, present the same tendency as the national average. Inversions are allocated in the manufacturing sector but there is not a development innovation activity.

The development of technology within companies in Mexico remains seen as a waste of resources such as money and time especially when compared with the alternative of the purchase of technology abroad. The investment carried out, is not channelized to promote innovation but trade, therefore, not only enterprises but also all the country has a technological dependence from abroad.

Intellectual property activity in Mexico

One of the main factors used to measure innovation activity and technological development is intellectual property (IP) activity. IP activity can identify the main innovations carried out according to the number of patents, trademarks, and industrial design in a specific country.

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The United States Patent and Trademark Office (USPTO) defines intellectual property (IP) as "*Creations of the mind creative works or ideas embodied in a form that can be shared or can enable others to recreate, emulate, or manufacture them, and there can be four ways to protect* ***it:*** *patents, trademarks, copyrights and trade secrets*". The World Intellectual Property Organization (WIPO) mentions that Intellectual property refers to creations of the mind: inventions, literary and artistic works, and symbols, names, images, and designs used in commerce; and establishes two different categories:

1. Industrial property, this category includes inventions which are represented by patents. There are also trademarks, industrial designs which are commonly used for protections of logos and emblems, and finally there are also geographic indications of source.
2. Copyright, that focuses on the protection of artistic works which includes music, paintings, drawings, architectural designs, sculptures and photographs. There is also a section which protects literary works such as poems, novels, plays and films.

Therefore, one of the main factors used to measure innovation activity and technological development is intellectual property (IP) activity.

IP activity can identify the main innovations carried out according to the number of patents, trademarks, and industrial design in a specific country.

The specific case of Mexico, presents a very poor innovation activity due to technological research is carried out mostly within universities. The Mexican higher education institutions have contributed with technology to the productive sector of the country, but much remains to be done.

Most scientific and technological research carried out not lead to resources to be used significantly in the industry. Neither the results of all investigations are patentable.

The fact that institutions of higher education in Mexico do not generate a large number of patents may indicate that the support to the national productive sector is not among its priorities even though this sector can contribute substantially to finance research projects of different institutions. The national industry is not expected to develop technology in the country; therefore, enterprises have to purchase it directly on the international market. So there is a marked disconnection between the national higher education institutions and the productive sector.

Also, it seems that for most higher education institutions, the most important is the development of science and human resource training through teaching, instead of applying the knowledge in the industry. Universities and research institutes generate knowledge but not one applies primarily to national needs in a short or medium term (as done in other countries). Thus, scientific research in national institutions of public higher education does not necessarily lead to technological independence. This is due to in part to funding limitations which exist in Mexico for scientific and technological development.

Even assuming that all the national scientific research will be focused on developing of new technologies for different areas, the current levels of patents and industrial designs are too low to compete in the international technology markets.

The World Intellectual Property Organization (WIPO) provides information about innovations activities and technological developments measured in historical statistic data. Mexico is so far from being a leader in technological development.

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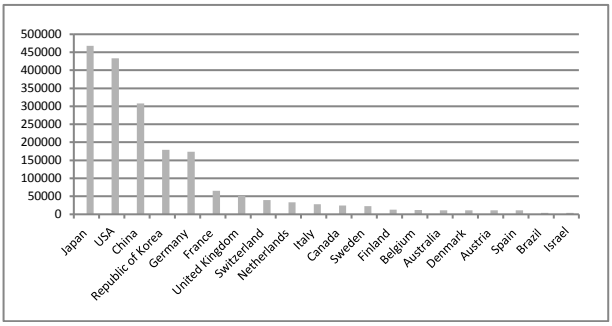
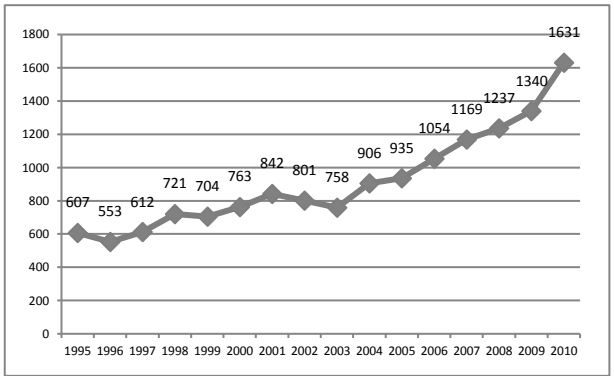
In fact, the main intellectual property activity worldwide has been carried out by two countries alone. Japan and the USA are the main actors in the field of innovation and technological development. The graphic 6 shows the principal twenty countries by patents applications, Japan and the USA lead the statistic followed by China, Korea and Germany. There is not point of comparison between Mexico and the leaders in patent application. Even taking the lowest of the 20 countries in the graph which is Belgium with 5,672 patent applications; this overcomes Mexico with 4,081 patents more due to Mexico only registered 1,591 patent applications in 2010.



Graphic 6

The graphic 7 shows the evolution of the patents applications made by Mexico in all the patent office worldwide. Although it is evident that since 2003 there has been a growth in the number of application, the fact is that, when comparing the number of Mexico with the rest of the member of the G20, the poor innovation activity emerges. Also the information of the figure 13 shows not only the patents of Mexico in the last fifteen years, but also the trademarks and the industrial designs registered, nevertheless, the situation is the same, there is an increase every year, but the level in comparison with other country are extremely lows.



Graphic 7

Year	Patent	Trademark	Industrial Design
1996	551	25,186	436
1997	610	25,462	421
1998	719	28,077	428
1999	704	33,650	640
2000	763	41,960	702
2001	842	44,976	831
2002	801	42,298	802
2003	758	39,791	944
2004	906	44,408	1,095
2005	935	50,277	1,078
2006	1,054	53,450	1,412
2007	1,169	65,863	1,130
2008	1,237	66,748	1,408
2009	1,340	66,219	1,434
2010	1,591	78,999	2,316

Table 4

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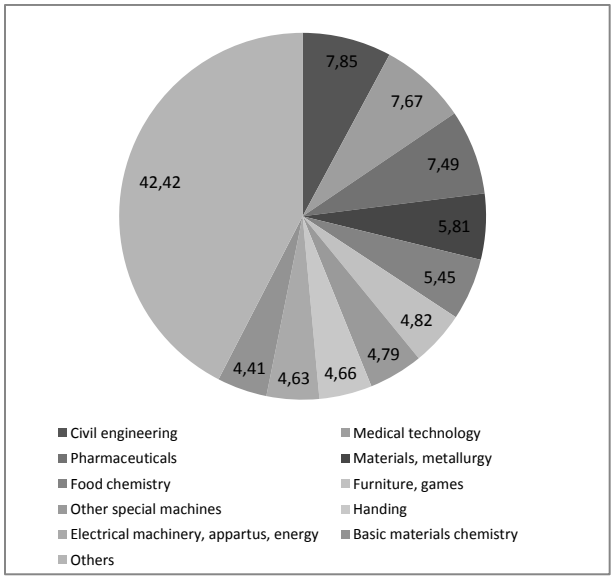
There is not much to analyze in the patent applications of Mexico due to their low level, however although they are few. It is important to know the main field of technology where the innovation and inventions are being made.

Graphic 8 shows that civil engineering alongside medical technology are the sectors where more patent application are carried out. There is a 42.42% of the patent application labelled as "other", although WIPE does not specify what that label is composed of, there are other 25 fields of technology not listed which WIPO consider when processing an application.



Graphic 8

Conclusions

Institutions and enterprises in Mexico have low levels of innovation because their economies have structural lags, due to their limited business, commercial and production skills, as well as for their social, cultural and educational background. Enterprises in Mexico see the investment in technology development and innovation as expenditure instead of as a cost which in the future can be recovered with big profits.

The problem to achieve technological independence can be summarized as follows: in Mexico, the vast majority of private companies have not invested significantly in technological development; they choose to purchase foreign technology instead. Meanwhile, multinational companies develop technology in their own countries and come to Mexico applying only the technology needed in Mexico. The principal problem of leaving the technological development in the hands of the private sector could be that, many enterprises may invest in technology in order to develop new products to increase their competitiveness in the market, not products that help to solve the principal national problems such as unemployment, poverty, high cost of energy, prevention of epidemics and pollution.

Technological independence does not result only from the existence of public and private universities, but from the net and the transfer of knowledge, abilities, skills, technology and innovation among institutions of higher education, national laboratories, institutes and industry. Industrialized countries are not always independent in technology; they are largely in strategic areas. In Mexico, the financing of research and technology programs sponsored by the National Council of Science and Technology has benefited largely science projects.

Prove of this is the fact that one of the field which registered more patents applications is the medical and biological area.

The problem shows when financing science programs and not technology programs. CONACYT need to receive more resources for the federal government in order to develop successful programs for technological innovation.

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It is therefore necessary to strengthen industrial application projects without reducing support for scientific research.The issue related to the FDI, which a channel of technology transfer, showed that Mexico presents acceptable levels of FDI; however the current violent environment in the country has caused that, international investors see unattractive Mexico a place of investment, moving their capital to other countries such as Brazil. It is necessary not only to develop new strategies to motivate the FDI but also to design new programs to destiny part of the flows of FDI to develop technology and undertake innovation activities within industries which nowadays is almost inexistent.

Therefore, in the last ten years the place that Mexico occupies among the world's countries in indicators such as the number of scientific articles published each year, the spending on research and experimental development per capita, the total number of researchers per 1.000 members of the economically active population, has not changed.

The only way to reverse the problem of lack of understanding between entrepreneurs and scientists and technologists is that the latter place above their fears and animosities, and promote a dialogue with entrepreneurs in order to demonstrate the advantages of investing in proprietary technology generation.

It has to be pointed out that, in order to develop proprietary technology that can satisfy at least part of domestic requirements and can be commercialized in international markets, there must be training of human resources capable of creating technological resources and not only capable of operating them, but also capable of creating infrastructure and funding focused on innovation, plans and programs of technological development.

Monitoring and evaluation of such programs and, of course, active participation of government to achieve better communication between research institutions and industry.

Technology transfer should be carried out in order to improve technological capabilities in Mexico and subsequently lead towards a technological development and optimal levels of innovation. Technology transfer process involves a serial of different elements and presents limitations. Therefore, the improvement of technology transfer scenery in Mexico should go further than the granting of more economic resources. There must be specific public policies focused on the field of technology which help receivers of technology to identify critical variables such as costs, economic and social context, political situation, stakeholders, cultural background and the openness to change of the receiver, the most appropriate mechanism and channel to transfer the technology, the role of the government and the support provided.

Innovation capacity in Mexico is limited and hardly can impact the market, the economy or the competitiveness of the country. Within organization resources, the financial aspect should support innovation. An organization without financial resources barely will achieve technology transfer and technological development. However, such resources should be increased by public funds aimed at innovation and R&D activities.

The National Model of Science and Technology should be focused on sum of actions from academia with the business vision of technology generation and innovation. Likewise with governmental dependencies and public bodies responsible for the design and implementation of technology policy, the evaluation and measurement of results.

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An integrated and efficient model should take into consideration all actors involved in science and technology as well as the important role of the government as a diffuser of the resulted achieved.

It should promote the creation of new support instruments seeking greater efficiency in the use of the available resources. The interaction of the various actors in the system academia- business-public administration should result in an integrated system through the inclusion of all agents necessary for the development of a chain science-technology-innovation. Only then, Mexico could overcome its technological lag, use technology transfer as mechanism to improve the innovation levels and subsequently the competiveness and the economy.

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