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# RIO COUNTRY REPORT 2015: MEXICO

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**Abstract**
The 2015 series of RIO Country Reports analyse and assess the policy and the national research and innovation system developments in relation to national policy priorities and the EU policy agenda with special focus on ERA and Innovation Union. The executive summaries of these reports put forward the main challenges of the research and innovation systems.

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## Foreword

The report offers an analysis of the R&I system in Mexico for 2015, including relevant policies and funding. The report identifies the main challenges of the Mexican research and innovation system and assesses the policy response. It was prepared according to a set of guidelines for collecting and analysing a range of materials, including policy documents, statistics, evaluation reports, websites etc.

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## Executive summary

The main objective of this RIO International Country Report 2015 for Mexico is to characterise and assess the evolution of Mexico´s national research and innovation policies. The report provides an overview of the R&I (Research and Innovation) system, recent policy and system developments, an analysis of funding, smart specialisation, and international cooperation, primarily with the EU for the 2012-2014 period (including 2015 when possible).

The registered population in Mexico in 2013 was 118.39 m inhabitants distributed over 1,943,945 km² in 32 states (see Figure 1).

Mexico is the 15th largest economy in the world[1], with GDP growth of 2.24% in 2014. It is the tenth biggest oil producer in the world and has a strong manufacturing industry with important links to the United States. Ranked by the World Bank as an upper middle income country, the average GDP per capita was approximately €8,000 in the 2012-2014 period. In the same period, the government debt as percentage of GDP increased from 28.67% to 35%, and the unemployment rate was below 5%.

The 2012-2014 period was marked by the coming to power of a new Government at the end of 2012. The new government introduced an important package of reforms and new policies; all of which have impacted on the economic structure of the country. These new measures include reforms in the financial, fiscal, labour, education, energy and telecommunications areas. A new R&I strategy was developed, the Special Programme for Science, Technology and Innovation (PECiTI 2014-2018). The STI (Science, Technology and Innovation) governance structure did not experience important changes, except for the introduction of the Coordinator of STI in the President Office. The National Council for Science and Technology (CONACYT) continued to be the core of the STI system, in charge of formulating and implementing public STI policies.

The new National Development Plan 2013-2018 and the new PECiTI 2014-2018 introduce objectives, strategies and action lines to tackle some serious challenges identified in the R&I system. These challenges included correcting the inadequate levels of national and private R&D expenditure, public-private collaboration, the number of full time researchers, the decentralisation of R&I activities, the number of publications and patents, and commercialisation of research results, or the number of innovative companies.

Important amendments were made in this period to the Law of Science and Technology, to improve the management of Intellectual Property Rights, and to open up new avenues for the exploitation and commercialisation of research results.

The Government increased its R&I budget in the period, despite the collapse of oil prices, and the volatility of the global financial markets. Results in terms of the quality of the publications and Intellectual Property Rights show that the share of international co-publications and co-inventions are above OECD levels. Although patent submissions remain dominated by non-resident authors, the success rate of resident authors increased, while the success rate of non-residents decreased.

The Government remained the main funding agent of the R&I system, with the private sector decreasing its participation as a funding and performing agent. Block funding was slightly reduced, in favour of competitive funding. With no fiscal incentives for R&I since 2009, incentives to increase the participation of the private sector in R&I were implemented through programmes where the government subsidises a percentage of the private R&I activities.

Since 2013, the Government has been working on the design of a new Public Procurement for Innovation policy, with the first pilot projects being developed in 2016.

[1] https://www.weforum.org/agenda/2015/05/top-10-things-to-know-about-the-mexican-economy/

Technology transfer, and the commercialisation of research results has been boosted by the creation of Knowledge Transfer Offices and amendments to the Law of Science. However, the development of policies and instruments that support the creation of high-technology start-ups and the progression towards achieving a critical mass of innovative companies remain a challenge.

In addition to the FOMIX (Mixed Funds) and the FORDECYT (Institutional Fund for Regional Development through the Promotion of Science, Technology and Innovation), which remain the main instruments to promote the decentralisation of the R&I activities, European style Smart Specialisation is also being introduced in Mexico. Between 2013 and 2015, Smart Specialisation strategies were developed in the 32 states in a coordinated manner to ensure that the same methodology is followed. Called *Agendas de Innovación*, the main objective of these strategies is to open a new path towards innovation, drawing on the specific capabilities and productive strengths of each State.

In the global economy, Mexico is well recognised for its strong manufacturing industry and the production of oil and gas. Although its trade economy is strongly linked to the USA, the Government has started an economic diversification strategy towards the Asian Pacific region. The STI internationalisation strategy follows a similar pattern, consolidating relations with the longstanding partners, i.e., the USA and Europe, and opening new opportunities in the Asian Pacific region. New opportunities for collaboration with DG JRC include issues related to the development of Science for Policy, regionalisation of R&I, as well as more thematically oriented collaboration in areas such as Energy, ICT, Food, and Health.

**Figure 1** - Map

# R&I Fact sheet
# Mexico

**Table 1** – General Data

| Indicator[2] | Mexico (2013) | *EU-28* |
|---|---|---|
| Number of inhabitants (Million)[3] | 118.39 | *506.6* |
| GDP MEUR[4] | 939,761.42 | *13,068,600* |
| GDP per head (index, EU28 = 100<br>EUR per capita)[5] | 7,937.51 | *100*<br>*26,600* |
| Real GDP growth rate (%)[3] | 1.34% | *0.1%* |
| Agriculture weight in the economy (%)[6] | 3.3% (GVA[7])<br>13.0% (employment) | *1.7%*<br>*5.1%* |
| Industry & construction weight in the economy (%)[5] | 34.5% (GVA)<br>24.0% (employment) | *24.8% (15.1%)*<br>*22.4% (14.3%)* |
| Services weight in the economy (%)[5] | 62.2%(GVA)<br>62.0% (employment) | *73.6%*<br>*72.4%* |
| Employment rate, aged 20-64 (% of population)[8] | 52.6% | *68.4%* |
| Unemployment rate (% of the active population)[5] | 4.9% | *10.9%* |
| Early leavers from education and training (% of population aged 18-24)[9] | 20.8% | *11.9%* |
| | No data | *Target 2020:10%* |
| Tertiary educational attainment (% of population aged 30-34) [7] | 25.14% | *37.1%* |
| | No data | *Target 2020: 40%* |
| Total government expenditure (MEUR<br>% of GDP)[10] | 206,795.2 | *6,412,328* |
| | 22.01% | *49.1%* |

[2] Eurostat data 2013 unless otherwise indicated
[3] Data from CONAPO
[4] Data from INEGI
[5] Author, based on CONAPO and INEGI
[6] Data from World Bank
[7] Gross Value Added (GVA) at basic prices equals GDP minus taxes on products plus subsidies on products.
[8] Data from OECD Stats
[9] Data from Ministry of Public Education
[10] Data from Bank of Mexico

**Table 2** - Institutional Structure of the Research and Innovation System

| | |
|---|---|
| MINISTRIES RESPONSIBLE | National Science and Technology Council |
| NAME OF THE MINISTER | Ph.D. Enrique Cabrero Mendoza - Minister for the National Science and Technology Council |
| ADVISORY BODY | Government Board:<br>Representative of the Ministry of Finance and Public Credit<br>Representative of the Ministry of Economy<br>Representative of the Ministry of Public Education<br>Representative of the Ministry of Environment and Natural Resources<br>Representative of the Ministry of Energy<br>Representative of the Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food<br>Representative of the Ministry of Health<br>General Secretary of the National Association of Universities and Higher Education Institutions<br>Member of the Advisory Forum for Science and Technology<br>Two researchers, members of the National Researchers System<br>Two representatives from the productive sector<br>website:<br>*http://www.conacyt.mx/index.php/el-conacyt/organigrama/junta-de-gobierno* |
| FUNDING AGENCIES | CONACYT: direct government funding assigned through category 38<br>Website: http://www.conacyt.mx/index.php/fondos-y-apoyos |
| | Mexican Space Agency: Co-financer in Sectorial fund<br>Website: http://www.aem.gob.mx/ |
| | Airports and Auxiliary Services: Con-financer in Sectorial fund<br>Website: http://www.asa.gob.mx/ |
| | Electricity Federal Commission: Co-financer in Sectorial fund<br>Website: http://www.cfe.gob.mx/paginas/home.aspx |
| | National Institute of Statistics and Geography: Co-financer in Sectorial fund<br>Website: http://www.inegi.org.mx/ |
| | Ministry of Energy: Co-financer in Sectorial fund<br>Website: http://www.gob.mx/sener |
| | National Security Commission: Co-financer in Sectorial fund<br>Website: http://www.cns.gob.mx/ |
| | National Forest Commission: Co-financer in Sectorial fund<br>Website: http://www.conafor.gob.mx/web/ |
| | National Water Commission: Co-financer in Sectorial fund<br>Website: http://www.conagua.gob.mx/ |
| | Ministry of Economy: Co-financer in Sectorial Fund<br>Website: http://www.gob.mx/se/ |
| | Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food: Co-financer in Sectorial fund<br>Website: http://www.gob.mx/sagarpa |
| | Ministry of Social Development: Co-financer in Sectorial fund<br>Website: http://www.gob.mx/sedesol |

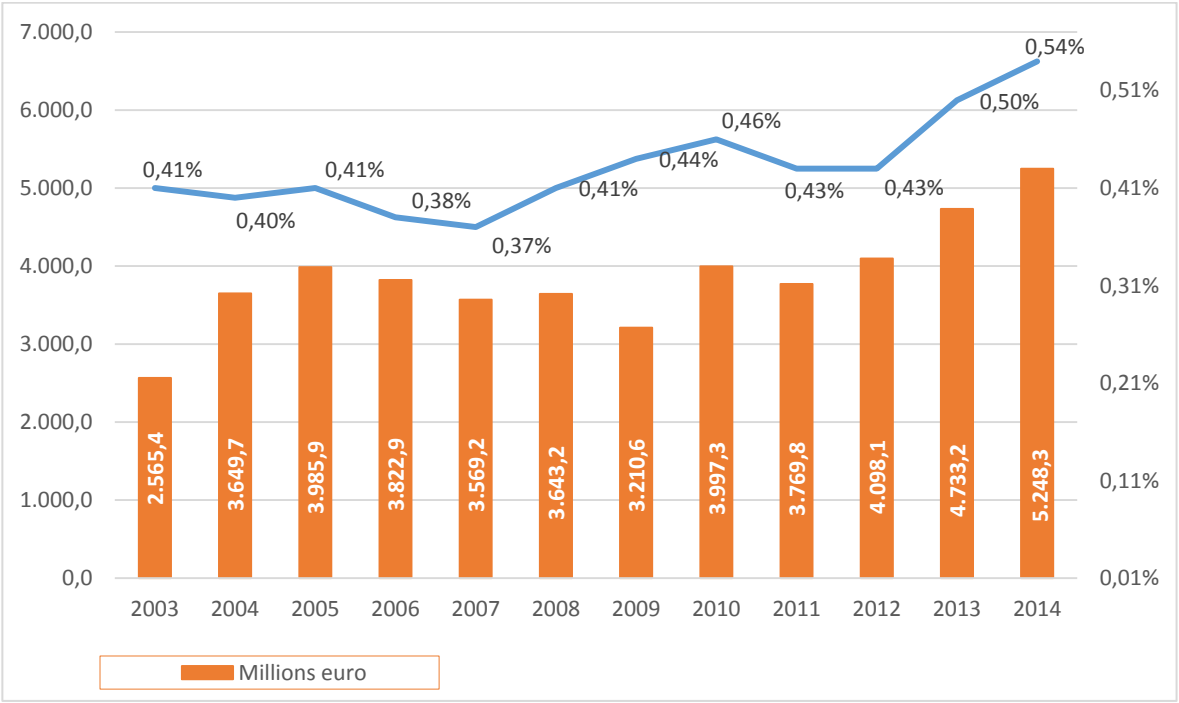
| |
|---|
| Ministry of Marine: Co-financer in Sectorial fund<br>Website: http://www.gob.mx/semar |
| Ministry of Foreign Affairs: Co-financer in Sectorial fund<br>Website: http://www.gob.mx/sre |
| Ministry of Health: Co-financer in Sectorial fund<br>Website: http://www.gob.mx/salud |
| Ministry of Public Education: Co-financer in Sectorial fund<br>Website: http://www.gob.mx/sep |

## Inputs – Investment & HR & Infrastructures

### Investment and flows

| | |
|---|---|
| Gross domestic R&D expenditure (GERD) (2013)[11] | **€ 4,692.05 million; 0.5% of GDP;<br>TARGET 2020: 1.1%** |

**Figure 2** - GERD trend in millions and as % of the GDP




[11] Data from CONACYT, 2014b

**Table 3** - R&D Sources of Funding and Expenditure

| | EUR / % |
|---|---|
| **R&D SOURCES OF FUNDING** | |
| Total R&D expenditure financed by government (2013)[11] | € 3,049.84 million (0.34% of GDP) |
| Total R&D expenditure financed by business enterprise (2013)[11] | € 1,501.46 million (0.16% of GDP) |
| Total R&D expenditure financed by abroad (2013)[11] | € 30.86 million (0.003% of GDP) |
| Core R&D structural funds (accumulative data 2007 2012)[11] | No data |
| FP7 funding (accumulative data 2007-2013)[11] | € 24 million ( 0.048% of the total) |
| **PUBLIC EXPENDITURE** | |
| Total public sector R&D expenditure (GOV&HEIs) (2013)[11] | € 2,819.92 million (0.30% of GDP) |
| GBAORD (2013)[11] | € 3,073.1 million (1.36% of total government expenditure) |
| GBAORD for defence (2014)[12] | € 5.67 million |
| **PRIVATE EXPENDITURE** | |
| Total private sector R&D expenditure (BES&PNP) (2013)[11] | € 1,872.13 million ( 0.20% of GDP) |
| BERD (2013) | € (% of GDP) |

**Table 4** - Human Resources & Research Infrastructures

| Human Resources in S&T / R&D personnel | Number/FTE (%) |
|---|---|
| Human resources in S&T activities (2013)[13] | 6,314,000 |
| Scientists & engineers (2013)[14] | 729,248 |
| Researchers FTE ( 2011)[15] | 43,592 |
| Researchers in the private sector (2012)[16] | 35,019 |
| Researchers in the public sector (2013)[17] | 19,747 |
| Female researchers(2012) | No Data |

| Research Infrastructures | |
|---|---|
| Number of key RIs [18] | |
| CONACYT Research Centres | 27 (98 offices in 30 states) |
| Public HEIs with block funding | 7 |

[12] Data courtesy of SIICYT-CONACYT, sent to the author for this report
[13] Data from CONACYT, 2014b. (page 215)
[14] Author, based on CONACYT, 2014b. (page 221), only postgraduate and graduates in professional and technical jobs
[15] This data was not requested as such, but it provides important information given the lack of information on FTE otherwise. Only data for 2011 was found (OEI, 2015)
[16] ESIDET, 2012, only data available for 2012
[17] Only includes members of the National System of Researchers (SNI-Sistema Nacional de Investigadores)
[18] Data from CONACYT, 2014b. (page 186)

| | |
|---|---|
| Sectorial RIs | 11 |
| CEMIES[19] | 5 |
| Involvement in international RI | CERN |
| Higher education system | 4,294 Universities |

## Framework conditions for knowledge-intensive economy

Investment process & conditions

**Figure 3** - R&D expenditure per R&D type of activity (MEUR, 2011) [20]

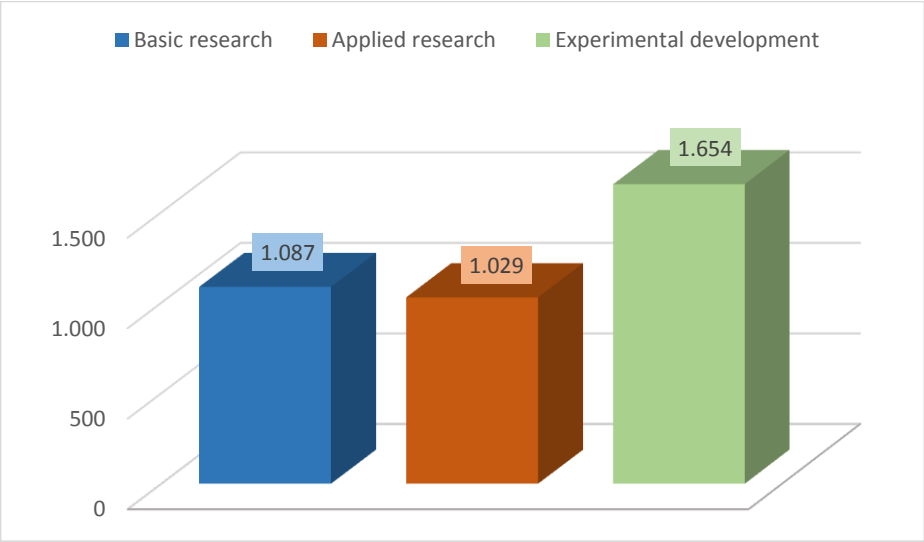
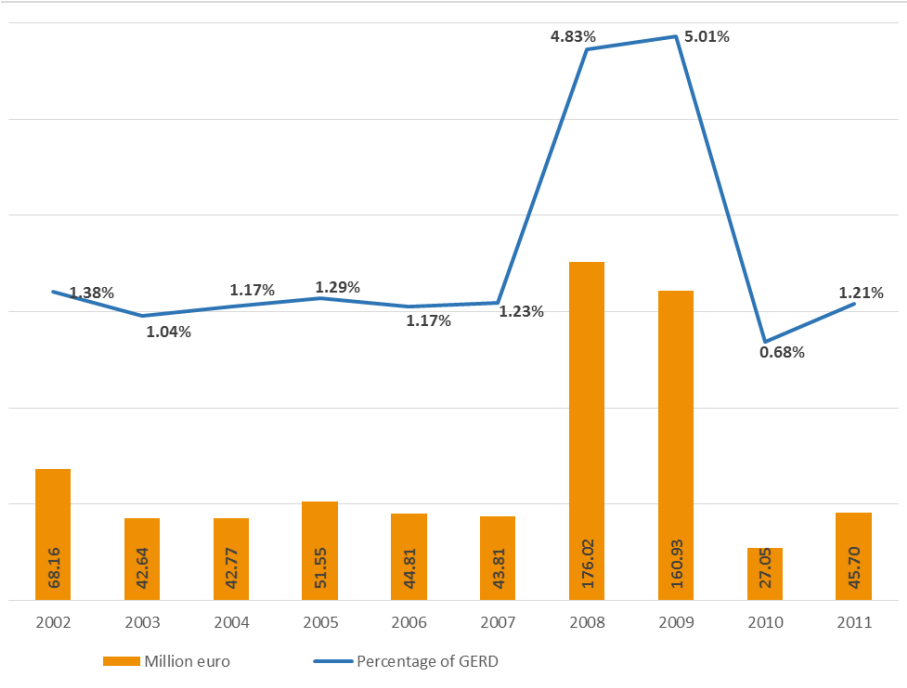



**Table 5** - Investment Process & Conditions

| | |
|---|---|
| Broadband – Households having access to the internet (2014)[21] | 33.7% |
| High-tech exports (2013)[22] | € 21.27 million (2.26% of total export) |
| Inward FDI stock (2013)[23] | € 209,386 million (30.9% of GDP) |
| Venture Capital (2014)[24] | € 58,248.7 million (0.06% of GDP) |
| Public expenditure in the field of education (2012)[25] | € 44,924.53 million (18.4% of total government expenditure) |
| Total number of students (2012)[26] | 35,251,068 |
| Female students (2012) | 49.77% |
| Students in scientific fields STEM (2012) | 1,084,589 (2.97% of total) |
| New graduates from tertiary education (2012)[27] | 498,441 |

[19] New Mexican Energy Centres of Innovation
[20] Data from CONACYT, 2014b, (page 201)
[21] Data from OECD, OECD.Stat- Regional Social Environmental Indicators
[22] Data from World Bank, World Development Indicators
[23] Data from OECD, OECD Data- Foreign direct investment
[24] Data from Latin American Private Equity & Venture Capital Association, 2014 Scoreboard Update
[25] Data from OECD, 2014b
[26] Data from Ministry of Public Education, main data 2012-2013
[27] Data from OECD, OECD.Stat

**Figure 4** - Public R&D financed by business enterprises




## Innovation outputs & impact

**Table 6** - Innovation outputs & impact

| **Bibliometrics[28]:** | **Number / Score (% / Rank)** |
|---|---|
| Publications (fractional counting, 2000-2012)[29] | 152,729 |
| Average relative citations (2000-2012) | 0.82 |
| Share of international co-publications (full counting; 2013)[30] | 38.8% |
| Percentage of Top-10% Most Highly Cited Publications (full counting; 2000-2013)[31] | 8% |
| Patents/Trademarks/Industrial designs | |
| Patents (applications to EPO, 2014)[31] | 55 (0.072% of total) |
| Patents (granted by EPO, 2014)[32] | 36 (0.114% of total)) |
| PCT patent applications (inventors country of residence, OECD, 2012) | 228.9 |
| PCT top applicants (WIPO, 2014)[32] | *Universidad Nacional Autónoma de México (12 applications)*<br>*Instituto Tecnológico y de Estudios Superiores de Monterrey (7 applications)*<br>*Centro de Investigaciones y de Estudios Avanzados – IPN (6 applications)*<br>*MEXICHEM AMANCO HOLDINGS S.A. DE C.V. (6 applications)* |

[28] Bibliometric data collection by Sciencemetrix from Scopus
[29] Data from SCImago Journal & Contry Rank, http://www.scimagojr.com/countryrank.php
[30] Data from Scival (Scopus based platform), last accessed December 2015
[31] Data from EPO, http://www.epo.org/about-us/annual-reports-statistics/annual-report/2014/statistics.html
[32] Data from WIPO, http://www.wipo.int/ipstats/en/statistics/country_profile/profile.jsp?code=MX

| | |
|---|---|
| | *EQUIPOS MEDICOS VIZCARRA S.A. (4 applications)*<br>*SIEGFRIED RHEIN S.A. DE C.V. (4 applications)*<br>*ELEVEN SOLUTIONS RFE S.A. DE C.V. (3 applications)*<br>*LANDSTEINER SCIENTIFIC, S.A. DE C.V. (3 applications)*<br>*UNIVERSIDAD AUTONOMA DEL ESTADO DE MORELOS (3 applications)*<br>*ALPARIS S.A. DE C.V. (2 applications)* |
| Trademark applications (WIPO, for residents, 2013)[33] | 77,263 (Rank 9) |
| Trademark registrations (WIPO, for residents, 2013)[33] | 55,086 (Rank 8) |
| Industrial design applications (WIPO, for residents, 2013) [33] | 1,749 (Rank 20) |
| Industrial design registrations (WIPO, for residents, 2013) [33] | 890 (Rank 24) |
| Composite indicators | |
| Research excellence composite indicator (2012) | No Data |
| Innovation Output Indicator (2011) | No Data |
| Innovation Union Scoreboard (2014) | No Data |
| Global Innovation Index (2014)[34] | 36.02 (rank 66) |
| PhD graduated (2012)[35] | 2,939 |
| Turnover from innovation (2010-2011) | 61.4% of total turnover (EU-28: 11.9) |
| | |
| Enterprises that have introduced new products to the market (2012)[36] | 2,363 |
| Employment in knowledge intensive activities (2013) | No Data |
| Employment in medium-high and high-tech manufacturing (2013) | No Data |
| Gender breakdown of employment in knowledge intensive business industries (2013) | Female: No Data ; Male: No Data |

[33] Data from WIPO 2014 annual report (WIPO, 2014)
[34] Data from WIPO, http://www.wipo.int/edocs/pubdocs/en/economics/gii/gii_2014.pdf
[35] Data from CONACYT, 2013b. (page 54)
[36] Courtesy of SIICYT-CONACYT with data from INEGI-ESIDET, 2014

# 1. Overview of the R&I system

This chapter provides a snapshot of the National R&I (Research and Innovation) system of Mexico. The period 2012-2014 is characterised by the entry of a new Government at the end of 2012, resulting in new policies that have affected the economic structure of the country, and that have also included a new R&I strategy. The chapter starts with an analysis of the main economic indicators and a comparison with the situation in the European Union. Section 1.2 introduces the new R&I strategy, the Special Programme for Science, Technology and Innovation, the PECiTI 2014-2018. Section 1.3 discusses the developments in the country´s policies, with the new Government from the end of 2012. It also presents the conclusions from evaluation exercises of the previous R&I strategy, the PECiTI 2008-2012. Section 1.4 describes the main features of the funding and governance of the R&I system in the 2012-2014 period, including the role of the Federal Government and of the State Governments. It also introduces the institutions that do the research, i.e., perform R&I activities. In section 1.5, the main results in terms of quality of the publications and Intellectual Property Rights are discussed, and in section 1.6 the main policy changes are summarised, including changes to the Law of Science and Technology that affect the management of Intellectual Property Rights, and that open new opportunities for the exploitation and commercialisation of research results.

## 1.1 Introduction

In 2013, the registered population in Mexico was 118.39 m inhabitants (approximately 25% of the EU-28 population), distributed over 1,943,945 km² (about half of the EU geographical area)[37].

**Table 7** - Main R&I indicators 2012-2014

| Indicator | 2012 | 2013 | 2014 | EU average |
|---|---|---|---|---|
| GDP per capita | 7,845.05 | 7,937.51 | 8,109.48 | 27,300 EUR |
| GDP growth rate | 4.03% | 1.34% | 2.24% | 1.30% |
| Budget deficit as % of public budget | -10.88% | -9.46% | -12.16% | -2.90% |
| Government debt as % of GDP | 28.67% | 33.64% | 35.09% | 86.80% |
| Unemployment rate as percentage of the labour force | 4.89% | 4.91% | 4.84% | 10.20% |
| GERD in €m | 4,079.08 | 4,692.06 | 5,253.83 | no data |
| GERD as % of the GDP | 0.43 | 0.50 | 0.54 | no data |
| GERD (EUR per capita) | 34.85 | 39.63 | 43.89 | no data |
| Employment in high- and medium-high-technology manufacturing sectors as share of total employment | No data | No data | No data | 5,6 (2013) |
| Employment in knowledge-intensive service sectors as share of total employment | No data | No data | No data | 39,2 (2013) |
| Turnover from innovation as % of total turnover | No data | No data | No data | 11,9 (2012) |
| Value added of manufacturing | No data | No data | No data | No data |

[37] See data in Table 7 and in section R&I Fact Sheet for a more detailed annual breakdown of the data discussed in this chapter

| | | | | |
|---|---|---|---|---|
| as share of total value added | | | | |
| Value added of high tech manufacturing as share of total value added | No data | No data | No data | No data |

Mexico is the 15th largest economy in the world[38], with a 2.24% GDP growth in 2014. It is the tenth oil producer in the world and has one of the largest oil and gas sectors in the world. Its strong manufacturing industry, mainly in the automotive sector, is heavily linked to the United States economy. Ranked by the World Bank as an upper middle income country, the average GDP per capita was approximately €8,000 in the 2012-2014 period, around 30% lower than that of the EU-28. In the same period, the government debt as percentage of GDP increased from 28.67% to 35%, and unemployment rate was below 5%. The GDP growth rate decreased from 4% in 2012, to 1.4% in 2013 and increased to 2.2% in 2014. However, despite the variations, the growth rate remained above the EU average of 1.3% for the same period.

In 2013, total government expenditure was, 22.01% of GDP, nearly half that of the EU (49.1%). The government´s budget deficit, as percentage of the public budget, was in the range of minus 10-12%, three times that of the EU (-2.90%). However, the budget deficit as percentage of GDP (-2.32%) was one point lower than in the EU (-3.3%). The government debt as percentage of GDP was between 28.67% and 35%, far below the 86.8% average of the EU for the period.

The rate of unemployment was slightly below 5% over the period, less than half the average rate in the EU (10.20%). However, the labour force participation rate in 2013 was 52.6% of the population, nearly 16 points lower than that of the EU. This means that although the unemployment rate was lower than in the EU, the amount of people in active employment (in the formal economy) was also lower. In Mexico, the number of people involved in the informal economy is significant. In 2015 the rate of workers involved in the informal economy[39] recorded a decline of 1.8 points, and at the end of the year stood at 57.8% (GOV, 2015).

The position of Mexico in the Human Development Index (HDI) and the ranking in the Programme for International Student Assessment (PISA) is a concern for the government. Between 2008 and 2012, 31 states reported continued growth in terms of HDI (with the sole exception of Baja California Sur), however, the UNDP (The United Nations Development Programme) has reported that there is a significant difference in the level of equality in human development among the different states (PNUD, 2015).

One of the first actions of the package of legislative reforms put in place by the government in education was to tackle structural problems in primary and secondary education. The results of the PISA 2012 scored Mexico (413) below the OECD average in mathematics (494), in reading (424 vs. 496) and in science (415 vs. 501). However, the PISA report highlights that, of the 39 countries and economies participating, with respect to the PISA 2003 results, Mexico, and countries such as Germany and Turkey, improved their performance in maths and in equity in the level of education; Mexico, Brazil and Colombia support disadvantaged families, with school going children, with money, food, and textbooks; and Mexico, Poland and Colombia improved the IT infrastructure of the educational system, to have a kind of help desk, to identify those schools and students with difficulties (OECD, 2014c).

In 2012, enrolment rates for 15-19 year-olds in education was low, and more than 20% of this age bracket were not engaged in employment, education, or training (OECD, 2014b). The rate of early leavers from education and training was high, 20.8% in the 18-24 age bracket, 8.9 points higher than in the EU. The percentage of 30-34 years old with tertiary educational was 25.14%, nearly 12 points lower than in the EU average.

[38] https://www.weforum.org/agenda/2015/05/top-10-things-to-know-about-the-mexican-economy/

[39] This is measured as the Informality Labour Rate (TIL)

Education attainment in Mexico is strongly, and sadly negatively, related to the labour market. According to the OECD 2014 Education Attainment report, higher educational attainment does not necessarily translate into better labour market outcomes. Employment rates for *people with below upper secondary education* in Mexico are above the OECD average, however, the rate for *people with higher levels of education* is below the EU average (OECD, 2014b).

The structure of the economy is similar to that of the EU. Services have the highest weight (approx. 62.4%), followed by industry (34.1%), with agriculture in third place (3.5%). However, the weight of agriculture in the economy is double that of the EU, the industrial sector is nearly 10 points higher, whereas the services sector is more than 11 points lower. The distribution of employment follows a similar pattern to that of the EU, with the services sector accounting for about 62% of employment, industry 24%, and agriculture 13%.

Following the introduction of the North American Free Trade Agreement (NAFTA) in 1994, the industrial sector in Mexico moved towards manufacturing. The manufacturing sector is dominated by what is known as the *maquila industry,* companies that process (assemble and/or transform in some way) components imported into Mexico, and which are, in turn, exported – usually to the United States. Although this *maquila* industry processes components for high and medium-high technology sectors (mainly the aeronautical and automotive sectors), local SMEs (Small and Medium Sized Enterprises) working in the industry operate in the low and medium-low technology manufacturing sector.

The Gross Domestic Expenditure on Research and Development (GERD) increased steadily in the 2012-2014 period, from 4,079.08 to 5,253.83 in millions of euros, from 34.85 to 43.89 in euros per capita. It also increased from 0.43 to 0.54 as percentage of the GDP.

## 1.2 National R&I strategy

The Programme for Science, Technology and Innovation, PECiTI (Programa Especial de Ciencia, Tecnología e Innovación) establishes the Mexican R&I strategy. According to the 2002 Law on Science and Technology, the PECiTI is the public policy where, the objectives, strategies and mechanisms for the consolidation of the capacities in Science, Technology and Innovation (STI) are defined. The programme has been in existence since 2002 and the latest version, the PECiTI 2014-2018, was approved in May 2014 (CONACYT, 2014c). CONACYT is the institution in charge of formulating and implementing the PECiTI. Created in 1970, the CONACYT is regulated by the Organic Law of CONACYT (Congreso, 2014).

Following the directives of the National Development Plan 2013-2018 (approved in May 2013), the PECiTI 2014-2018 was developed as a key instrument for the transition of Mexico to a knowledge economy. The mission of PECiTI 2014-2018 is to make knowledge and innovation the key instruments for the sustainable economic growth of the country, promoting human development, social justice, democracy, and peace, while reinforcing national sovereignty. In operational terms, the main priority for the 2014-2018 period is to strengthen and coordinate the country's capacities in STI. This involves consolidating and promoting these capabilities, transforming the institutional environment and amalgamating a large segment of innovative companies (CONACYT, 2014c).

In quantitative terms, the objective is to reach an investment level of 1% of GDP in R&D by 2018. The short to medium term vision is to make Mexico a relevant global actor in the Knowledge economy, achieving sustainable levels of competitiveness and productivity. The long term objective, with a projection of 25 years (2038) is to achieve an investment level of 2.3% of GDP in R&D.

Of the six main objectives of the PECiTI, the first five are directly related to the five strategies proposed in the National Development Plan 2013-2018, while the sixth

focuses on the development of Biotechnology[40] (a KET, Key Enabling Technology). The Programme also sets out seven thematic priorities: *environment*, *knowledge of the universe*, *sustainable development*, *technological development*, *energy*, *health*, and *society*. As part of the thematic area *technological development*, explicit priority is given to three other KETs: advanced materials, nanomaterials and nanotechnologies, and advanced manufacturing technologies. The thematic priorities established in the PECiTI are similar to the societal challenges addressed by the European Commission in the H2020 strategy: health, sustainable energy, climate action and environment, inclusive society and security.

The PECiTI is implemented through thirteen sectoral programmes and three transversal programmes, which contribute to the actions lines defined for each objective. The impact indicators of each of the six objectives are defined and the targets for each year are specified.

## 1.3 R&I policy initiatives, monitoring, evaluations, consultations,foresight exercises

Following the general election held in Mexico in July 2012, the new government of President Enrique Peña Nieto embarked on a package of structural reforms in areas relevant to STI in Mexico. In December 2012, a historic agreement on an ambitious package of reforms was reached amongst the three largest political parties. This agreement is known as the Pact for Mexico (Pacto, 2012). Since then, major structural measures have been legislated to improve competition, education, energy, the financial sector, labour, infrastructure, telecommunications and the tax system. This reform activity has been the most extensive carried out in an OECD country in the period 2013-2014 (OECD, 2015b).

The Government of Mexico is passing and implementing major legislative reforms in the areas of education, energy, financial, fiscal, and telecommunications, among others, with the long-term aim of improving competitiveness and economic growth. According to the OECD, these reforms should result in a potential increase in GDP growth, in the medium term, to 2.4% (OECD, 2015b).

To achieve this, the OECD has signalled the need to strengthen administrative capacity and improve the quality of governance at all levels of Government, as well as the need to improve and simplify the existing stock and quality of regulation at the State and national levels.

A new National Development Plan 2013-2018 (NDP, 2013) was developed to guide the policies and programmes of the Government. The plan established the objectives, strategies, indicators and targets for the following six years. Published in May 2013, the National Development Plan (NDP) is structured around five objectives aimed at raising productivity to realize the full potential of Mexico. Science, technology and innovation are considered to be the cornerstones on which to achieve sustainable economic and social progress. The third objective, *Mexico with Quality Education*, specifically deals with raising the quality of teaching and promoting STI, addressing research, innovation and education in an integrated way. This objective includes five strategies for development: 1) increasing R&D expenditure annually to reach 1% in 2018; 2) improving the supply of high-end Human Resources in Science and Technology (HRST); 3) promoting the development of vocations and STI capabilities at the local level to strengthen sustainable and inclusive regional development; 4) contributing to Knowledge and Technology Transfer through better linkages between the academic and research community and the public, private and social sectors; and 5) to strengthen public R&D capacity and infrastructure.

[40] See http://www.infochannel.com.mx/conacyt-e-inegi-anuncian-resultados-del-esidet-mbn-2012 for results in the biotechnology sector from the ESIDET 2012

The new PECiTI 2014-2018, approved in May 2014, was developed according to the previously described third objective of the NDP. Meanwhile, a new Institutional Programme 2014-2018 for CONACYT was also developed. The Institutional Programme, approved in April 2014, sets out the operative means for the implementation of the PECiTI (CONACYT, 2014d).

The PECiTI was developed through an intense consultation process (CONACYT, 2013c) and was preceded by an ex-post evaluation of the 2008-2012 period, carried out by national and international experts under the leadership of the Advisory Forum for S&T. It included a meta-evaluation of the PECiTI 2008-2012 and recommendations in relation to the funding programmes (FCCyT, 2014a). During the 2008-2012 period, CONACYT monitored the indicators established in the PECiTI 2008-2013. The final results (outcome vs target) were presented in the 2012 self-assessment report (CONACYT, 2012b). The development of the new PECiTI 2014-2018 included a diagnosis of the STI sector in relation to the National STI system, R&D investment, Human Resources in Science and Technology (HRST), infrastructure, regional development, technological development, the socialisation of knowledge, international cooperation, and biotechnology. Several important conclusions were drawn from this diagnosis (CONACYT, 2014c):

- Mexico has arrived late to the knowledge economy. The new PECiTI is understood as an important instrument, part of the government´s effort, to accelerate Mexico's transition to the knowledge economy.
- Good linkages exist between the Higher Education Institutions (HEIs) and the Public Research Centres (PRC). However, links with the productive sector, and between the financial and productive sectors are weak.
- R&D investment as a percentage of GDP has been stagnant for several years, despite attempts to increase it (the 1% of GDP objective had been established in previous PECiTIs, but never achieved).
- Private investment in R&D has been low (about 36% of total R&D investment), and the contribution of the State governments to the public R&D investment has also been low (less than 2% of total public investment).
- The number of researchers in Mexico is low for international standards.
- Despite unprecedented increases in the number of postgraduate grants in the 2006-2012 period (74.4%), to a great extent, lack of employment opportunities in the public and private sector.
- Good results have been achieved in strengthening the National System for Researchers (Sistema Nacional de Investigadores-SNI). Researchers from private research centres or working abroad might also need to be incorporated.
- There is a need to strengthen the infrastructure capacity of the country, mainly with the creation of PROs (Public Research Organisations) in states without these institutes, science and technology parks or clusters.
- The work carried out to regionalise R&D in 2006-2012 has positive results in terms of the distribution of CONACYT´s funds. In 2012 the states received proportionally more funds than Mexico City, thereby reverting the situation of 2006. However, funding is not distributed evenly across all states.
- The increase in direct subsidies to the private sector (R&D tax incentives were eliminated in 2008) and greater support for entrepreneurship has not resulted in the desired critical mass of innovative companies or increase in productivity. The need for a more discriminatory policy is identified, distinguishing between the types of companies (entrepreneurs, new high-tech firms, SMEs and big companies), different stages in the R&I process (proof of concept, applied research or technological development), links with HEIs and PROs, and the involvement of liaison agents such as Knowledge Transfer Offices (KTOs).
- Bibliometric results point to an increase in the rate of publications and citations, however, the rate is still low by international standards.
- The rate of patenting is low in Mexico, especially by Mexican nationals. This is a consequence of issues such as the lack of an IP culture within companies, HEIs and PROs. There is also a lack of incentives for researchers in PROs and HEIs.

- Work on increasing the dissemination of knowledge is underway, and greater emphasis is expected to be placed on open access.
- International cooperation activity in terms of STI is found to be dispersed across many countries, lacking clear prioritization.
- The development of modern biotechnology is found to have been hindered, between 2005 and 2012, by the introduction of a regulatory process that reduced the participation of the public sector. Further support is needed for infrastructure and HRST to develop this traditionally well supported sector.

The situation of STI in Mexico is regularly evaluated by international organizations. The results of these evaluations have been taken into account in policy making (Romero, 2009). The OECD's STI Scoreboard 2013 (OECD, 2013b) includes a section on "Mexico Highlights" which presents the following conclusions:

- Mexico has a weak innovation environment, and investment in STI is low by OECD standards, mainly due to low business investment in R&D.
- Although public funding for R&D has increased in recent years, it is still below the OECD average.
- In the business sector, a high prevalence of micro firms, skills gaps, and insufficiently developed and affordable ICT (Information and Communication Technology) infrastructure have been identified.
- Few scientific publications rank among the top cited, and the collaboration between companies and HEIs is low.

On the positive side:

- Mexico exhibits a degree of specialisation in some emerging technologies (bio and nano technologies) and emerging applications such as renewable energies.
- The level of international scientific collaboration, and the mobility of professionals are good. The citation impact of Mexican scientists involved in international networks, as a result of collaboration or mobility, is substantially higher than that of those who do not engage in either of these activities.

The OECD´s STI 2014 Outlook (OECD, 2014a) includes a country profile for Mexico, which stresses the need to increase productivity levels and diversify export markets for long-term growth. The Outlook includes a review of the new PECiTI in terms of how it tackles five hot issues (Governance, HRST, social challenges, industry-science linkages, and infrastructures). The report mentions the importance of the effectiveness of the Innovation Incentives Programme (PEI) to encourage business R&D and innovation, and the increase in budget for this programme, which has more than tripled between 2011 and 2013. The authors also point out that the support for technology transfer and commercialisation of R&D results through higher public funding for companies in collaborative projects with HEIs and PROs has been increased, and that more KTOs have been created and are commercialising more of their services. In relation to clusters and smart specialisation, the two main funds to support regional development through innovation, FORDECYT (Institutional Fund for Regional Development through the Promotion of Science, Technology and Innovation) and FOMIX (Mixed Funds), are discussed, mostly in terms of changes in the distribution of funding to help integrate excluded regions in the national innovation system. Under the new scheme, the contribution ratio of CONACYT-State will be 3 to 1 for the states in the lowest tier, 2 to 1 for those in the middle tier and 1 to 1 in the best performing states. Finally, in terms of globalisation, international co-authorship and co-invention rates (close to OECD levels) indicate a well-developed international network for STI collaboration, due in part to the educated Mexican diaspora.

According to the Global Competitiveness Report (GCR) 2015–2016 (WEF, 2015) of the World Economic Forum (WEF), Mexico is in a transition stage between an efficiency driven and an innovation driven economy.

Mexico´s position in the Global Competitiveness Index (GII, 2015) ranking decreased from 55 (2012) to 61 (2013), rising again to 57 (2014), despite achieving the same score (4.3) in each of the three years. According to this report, Mexico stands out as an economy performing above the average Global Innovation Index (GII) score for the Latin American region. In terms of infrastructure and market sophistication, the region, in general, is moving in the direction of improving its scores, largely as a result of consistent policies to invigorate this area. Mexico, together with Chile, Colombia, Costa Rica and Peru are increasingly performing well.

These reports are complemented by the OECD Economic Surveys report on Mexico where a review of the recent structural reforms is presented. It concludes that "*to make the most of this impressive package, Mexico will need to improve its governance and institutional capacity to ensure effective implementation*" (OECD, 2015b). The OECD "Better Policies" Series for Mexico discusses policy priorities to upgrade the skills and knowledge of Mexicans for greater productivity and Innovation (OECD, 2015c).

According to the Law on Science and Technology, it is the responsibility of CONACYT, to establish an independent system for the evaluation of the efficacy, results and impacts of the principles, programmes and instruments that support STI. As part of this, CONACYT Research centres, are evaluated annually according to their result oriented administration agreement (CAR, Convenio de Administracion por Resultados) (CONACYT, 2015a).

CONACYT is in charge of monitoring the STI system in Mexico. As part of this responsibility, the Council published annual STI monitoring reports in 2011, 2012 and 2013 (CONACYT, 2012c, 2013b, 2014b), as well as annual CONACYT self-assessment reports, for 2012, 2013, 2014 (CONACYT, 2012b, 2013a and 2014a). The self-assessment reports detail CONACYT´s annual activities in relation to its Institutional Programme for 2014-2018, and its annual Work Programme. Results in these self-assessment reports are presented according to the Result-oriented Matrix of Indicators (Matriz de Indicadores de Resultados-MIR).

The annual government reports by the President (GOV, 2013, 2014, 2015) include a section on government investment and activities performed to achieve the objective of making STI the cornerstones of sustainable economic and social progress.

CONACYT evaluates R&I programmes according to the Annual Evaluation Plan. Programmes are evaluated in collaboration with CONEVAL (Consejo Nacional de Evaluación de la Política de Desarrollo Social; CONEVAL, 2013) using the methodology of CONEVAL. Most of CONEVAL's programme evaluation reports for 2014-2015 state that no impact assessment was found as part of the execution of the programmes evaluated.

Using common methodology, the same variables for evaluation, and the same reporting format, the reports of CONEVAL provide an accurate picture and comparable information about the quality and efficiency of funding through R&I programmes.

CONEVAL´s evaluation reports are analysed by the CONACYT departments managing the Programmes and an opinion report is issued in response to CONEVAL´s evaluation. Several of these opinion reports indicate that results from the evaluation will be taken into account in future programme development.

It is only in recent years that Mexico has been using the feedback on these evaluation exercises as input for policy design and financing. In 2009, the OECD recommended that the practice of evaluating outcomes be further developed. They identified that most assessments tended to be a mere description of resource allocation and a simple revision of procedural and quality of management (OECD, 2009). They also made other recommendations on policy design that were taken into account in the development of PECiTI 2008-2012 (Romero, 2009).

## 1.4 Structure of the national research and innovation system and its governance

### 1.4.1 Main features of the R&I system

In 2012, the Federal government contributed 98.68% of the total public sector funding, and the states contributed 1.33%. In 2013, the difference was greater, 98.73% vs 1.27%. In absolute terms, between 2012 and 2013, both the Federal Government and the states increased their budgets, 31.54% and 27% respectively.

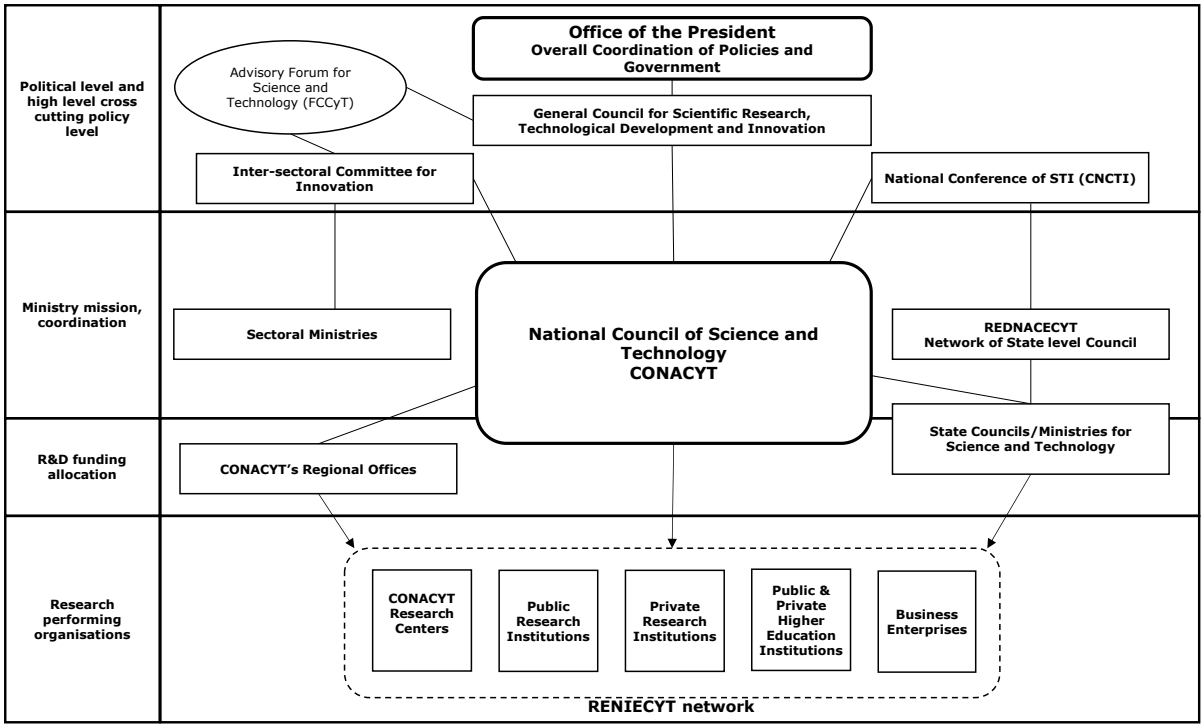
In recent years, progress has been made on the decentralisation of STI activities. Traditionally, STI capacity has been concentrated in Mexico City, which has been the main recipient of STI's funding. In 2012 however, several states received a greater share of STI's funding than Mexico City. Specifically, 90.8% of the Innovation Incentives Programme (PEI) funding was distributed in the States, with just 9.2% being allocated to Mexico City.

However, there are still important inequalities and asymmetries between the states (CONACYT, 2014c). Building on existing capabilities, the new PECiTI aims to encourage the creation and strengthening of STI systems at the State level. The objective is to reduce the gap between states, raising investment levels through differentiated policies. This involves considering the productive strengths, local capacity, and available resources of the different states, factors which give them comparative and competitive advantage. There are two funds aimed at strengthening the STI systems of the States, the FOMIX and the FORCECYT.

### 1.4.2 Governance

Mexico has had a STI structure in place for more than 40 years, since the creation of CONACYT in 1970. It went through different periods until the Law of Science and Technology was approved in 2002. This Law sets out the legal framework that has provided a stable structure to the STI system. In the 2012-2015 period, the main changes that the governance of the STI system has undergone have involved the Office of the President. In April 2013, the Coordination of STI was created, as part of the President´s office, to support the President, the Office of the Presidency, and the CONACYT to coordinate efforts better. After the cabinet changes in August 2015, the President introduced changes in the Office of the President and the Coordination of STI disappeared, with its functions passing over to the General Coordinator of Policy and Government. In April 2016, a new Coordinator for Science and Technology was designated. He will be in charge of assisting in the evaluation and design of public policies aimed at strengthening the STI capacities of the country, in the regional development, as well as in the public-private cooperation and in international STI collaboration.

**Figure 5** – Governance structure of Mexico´s STI system




As it can be seen in Figure 5, Mexico´s STI system is coordinated by the General Council for Scientific Research and Technological Development and Innovation (CGIDTI), which is in charge of defining the country´s policy on STI, of approving the PECiTIs and the annual R&I budget. The Council is responsible for establishing an independent system to evaluate the system´s effectiveness, and for proposing new priorities and mechanisms to improve the workings of the STI system and its impact. Regulated by the 2002 Law on Science and Technology, CGIDTI is chaired by the President of the Republic and has, amongst its members, representatives from different ministries, the head of CONACYT (who acts as the executive secretary) and the General Coordinator of the Advisory Forum for S&T (FCCyT). The FCCyT undertakes studies evaluating the results of the strategies as well as prospective studies to propose new strategies and policies (FCCyT, 2014a). CONACYT is at the heart of the STI system, in charge of formulating and implementing STI public policies and the promotion and dissemination of R&I activities. It interacts with the sectoral Ministries through the inter-sectoral committee for innovation, dealing with, among others, the coordination of the sectoral funds. CONACYT also interacts with the country's 32 STI State Councils through the National Conference of Science, Technology and Innovation (CNCTI), the permanent body for institutional coordination between CONACYT and the STI State Councils. The purpose of the CNCTI is to promote measures to support scientific research, technological development and innovation, as well as to participate in the definition of policies and programmes in this area at the State level. The STI State councils are organised in the National Network of State Councils and Organisations for Science and Technology, REDNACECYT, a permanent forum for discussion of programmes and actions to promote STI in the States. CONACYT also interacts directly with the STI State councils in the implementation of the regional programmes FOMIX and FORDECYT, i.e., for funding allocation and management of the calls. The 10 regional offices of CONACYT implement CONACYT´s policy of decentralisation. Their goal is to promote STI in the regions, where a region can include one or more states.

### 1.4.3 Research performers

In the 2012-2013 period, the proportion of the public-private R&D expenditure remained fairly constant, with the public sector accounting for approximately 60% of the expenditure vs 40% for the private sector. This contrasts strongly with the EU situation where in 2013 the public sector amounted for 36% and the private sector for 64%.

Within the public sector, the budget was divided nearly equally between the government (31%) and Higher Education Institutions (HEIs) (29%). In the private sector, businesses spent most of the budget (38%), with less than 2% spent by Private Non-Profit (PNP) organisations.

The two most active private sectors in 2011 were Manufacturing (with 59% of business expenditure) and Services (40%) with some residual R&I performed in the mining and construction sectors (CONACYT, 2012a). Within manufacturing, the most active sub-sectors were chemical products (mainly pharmaceutical), machinery (mainly motor vehicles and electrical machinery), metal mechanic products and agroindustry. In services, the most active sub-sector was telecommunications (CONACYT, 2014b). In terms of the technology intensity, approximately two-thirds of manufacturing R&D was carried out in high and medium-high tech sectors, the remaining third was carried out in low and medium-low sectors (OECD, 2013b).

The main R&I performing organisations in Mexico include entities from the public and private sector. Annex 3 shows a list of the main research performers, which are briefly discussed here.

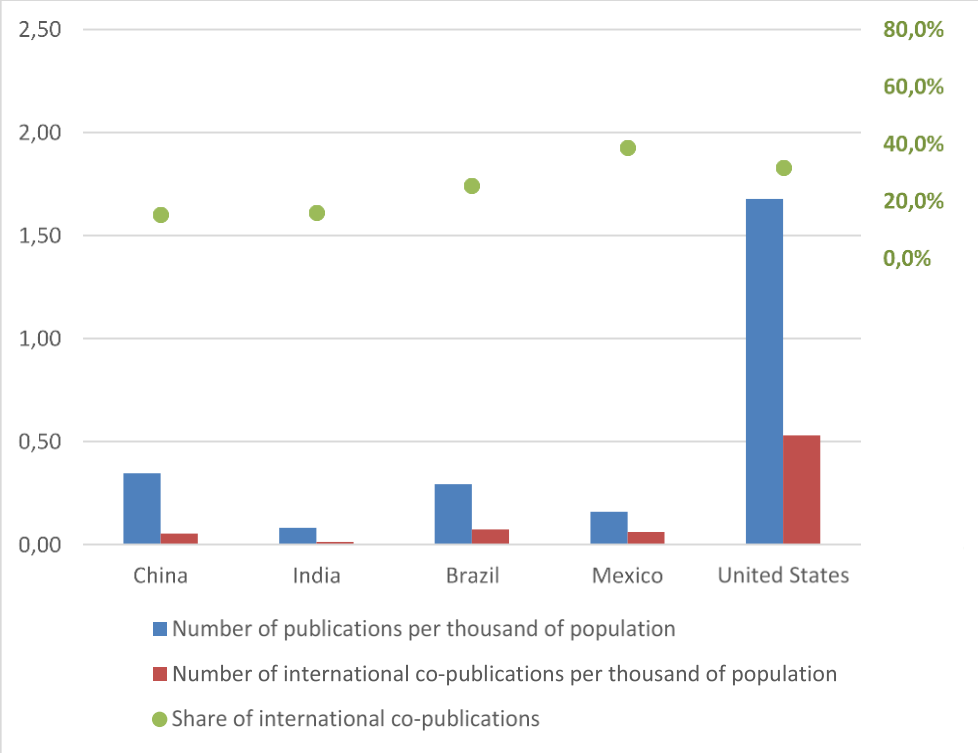
The Public Research Institutions in Mexico, according to the Ministry of Education, include Federal Public Universities, State Public Universities, State Public Universities with special additional financial support, Technological Institutes, Technological Universities, Polytechnic Universities, Intercultural Universities, Public Research centres, Public Testing Schools and other public institutions. Among them, it is worth mentioning the following ones for their active role:

- CONACYT Research Centres grouped into three major subsystems: Natural Sciences (10 centres); Social Sciences and Humanities (8 centres); Technological development services (8 centres); and one centre specialising in financing graduate studies.
- Mission-oriented research (PRO) organizations working in the following sectors: Energy, Agriculture, and health and social security.
- Higher Education Institutions (HEI). According to data from INEGI, there are 4,294 universities, including both public and private. The most active public HEI in the 2012-2013 period, according to the allocation of block funding, is the UNAM (Universidad Nacional Autónoma de México), followed at a certain distance by the CINVESTAV (Centro de Investigación y de Estudios Avanzados del Instituto Politécnico Nacional), the UAM (Universidad Autónoma de México), the IPN (Instituto Politécnico Nacional), the School of Mexico and the Universidad Autónoma Agraria Antonio Narro.

Private sector, including Private HEIs, Private Research and Technology Organisations (RTO) and Companies. Annex 3 includes a list of the companies participating in the Programme to Encourage R&I in the private sector through public private collaboration (PEI).

## 1.5 Quality of the science base

**Figure 6** - Comparison in terms of publications (2013)



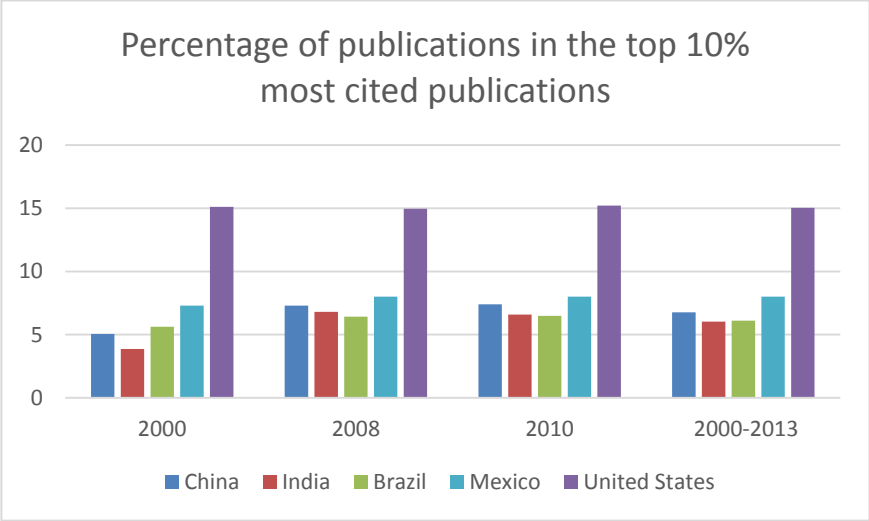

Source: Elaborated by the author with data from Scival (Scopus based platform, accessed 2/12/2015)

According to Scimago, between 2012 and 2013, the number of publications in Mexico increased by 3%, albeit at a slower rate than before 2011. As a result, Mexico´s share in the global production (0.83% in 2012, decreasing to 0.82% in 2013, 23rd in the OECD ranking out of 34 countries) is the lowest in the comparison group of Brazil (2.75%), India (3.74%), China (12.57%) and the USA[41]. As shown in Figure 6, while higher than India, Mexico´s production output per thousand population is the second lowest. In terms of international co-publications per thousand population, it ranks ahead of China and India, but still below Brazil and the USA.

Mexico stands out in terms of the share of international co-publications, ahead of all the other countries. According to the OECD, this is an indication of a well-developed international network of STI collaboration, partly due to the educated Mexican diaspora (OECD, 2014a). The CONACYT international scholarships programme for graduate studies helps to promote international linkages among researchers. In 2013, the scholarships for postgraduate studies abroad accounted for 10% of all the postgraduate scholarships. In the 2008-2012 period, Mexico´s co-publications were developed mainly with Europe (51.5% of co-publications), followed by the USA (21.2%), Latin America (12.7%) and Asia (10.2%). Africa and Oceania accounted for just 4.4% (CONACYT, 2014b).

[41] In this section a comparison of Mexico´s performance will be made against Brazil, China, India and the USA---the comparison group set by the JRC

**Figure 7** - Percentage of publications in the top 10% most cited publications




Source: Elaborated by the author with data from Mexico coming from Scival (Scopus based platform, accessed 2/12/2015)

Mexico´s percentage of publications in the top 10% most cited publications is clearly higher than those of China, India and Brazil, although still far from the USA (see Figure 7).

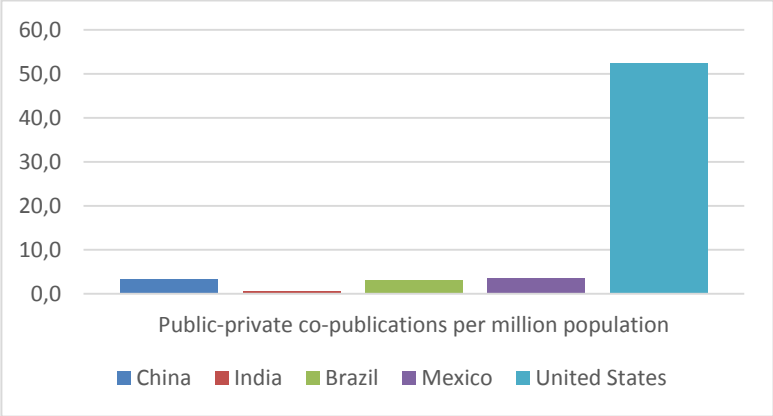
In terms of the Relative Impact of the scientific production (citations/publications), Mexico at 0.80 is ahead of Brazil (0.65) and India (0.71), although behind China (0.85) and the USA (1.45) (CONACYT, 2014b). According to the OECD, estimates suggest a positive relationship between measures of scientific research collaboration and citation impact (OECD, 2015a).

According to the Scimago Journal and Country Rank[42], of the 239 countries included in the 2012-2014 period, Mexico improved its position in the number of documents ranking (31 to 29) but fell behind in the citations ranking (36 to 38), remaining in the same position in the H index (35 in both years).

According to the Scimago HEIs ranking 2015[43], the UNAM, CINVESTAV and IPN produce the largest number of publications, but the Universities that lead in terms of excellence [44], international collaboration [45], and high quality publications [46] are the Iberoamerican University of Mexico, The Autonomous University of Sinaloa, and the Autonomous University of San Luis of Potosi.

[42] http://www.scimagojr.com/countryrank.php
[43] http://www.scimagoir.com/
[44] The set of the 10% of the most cited papers in their respective scientific fields
[45] Institution's output ratio produced in collaboration with foreign institutions
[46] Ratio of publications that an institution publishes in the most influential scholarly journals of the world, those ranked in the first quartile (25%) in their categories as ordered by SCImago Journal Rank (SJRII) indicator

**Figure 8** - Public–private co-publications per million population (2013)

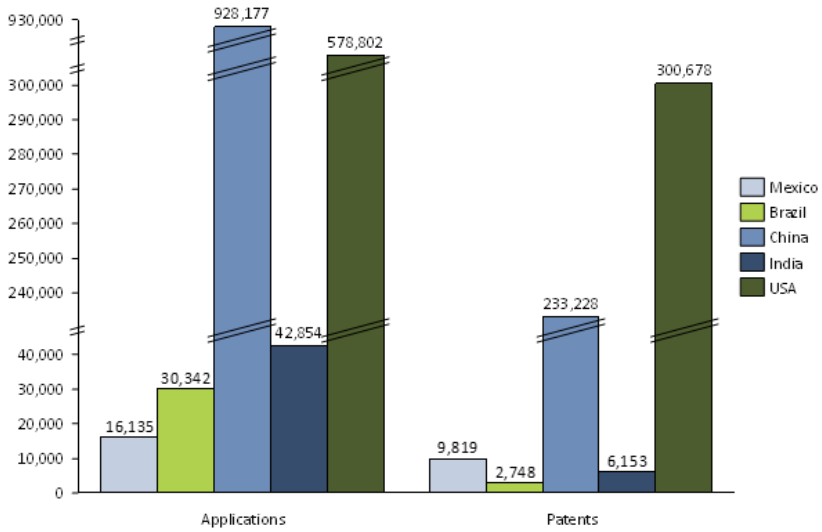



Source: Elaborated by the author with data from Scival (Scopus based platform, accessed 2/12/2015)

In terms of public private collaboration, it is worth noting that, despite weak linkages in STI between the public and private sectors, and a low level of innovation culture in the companies, the number of public-private co-publications per million population is the second highest, after the USA (see Figure 8). This might be due to a concentration in thematic areas where good public-private collaboration exists.

It can be concluded that, although Mexico´s scientific production is still low, an important share of it is of high quality and it is based on international and public-private co-publication, to an important extent. Data from the 2009-2013 period indicates that the highest number of publications and the highest impact were identified in the areas of food & animals, physics, chemistry, and medicine (CONACYT, 2012a).

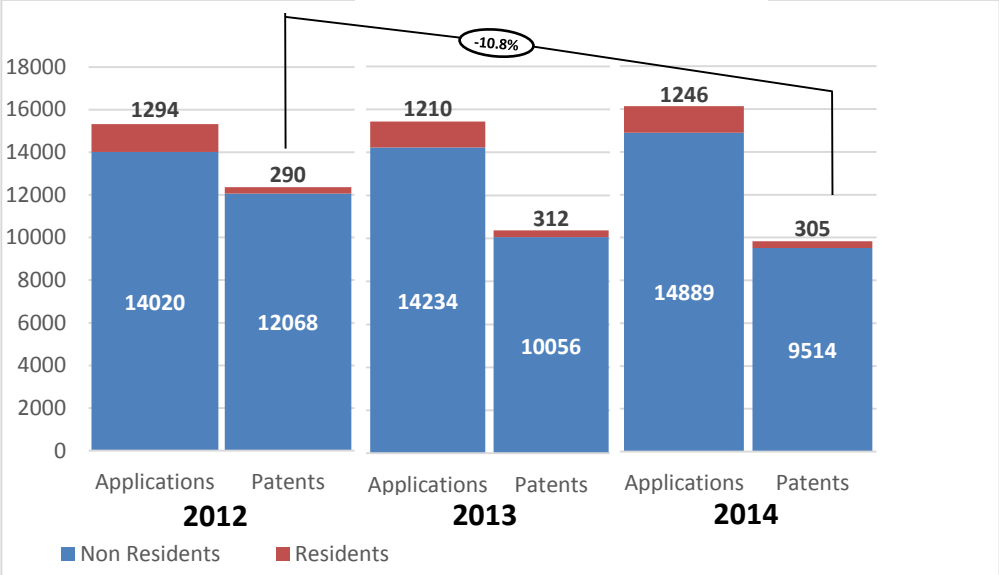
**Figure 9** - Number of patent applications vs patent granted in the five countries of comparison (2014)




Source: http://www.wipo.int/ipstats/en/statistics/country_profile/profile.jsp?code=MX

In 2014, Mexico ranked 75th out of 129 countries in the International Property Rights Index (IPRI). The country is in the IPRI middle group of performers together with Brazil (64th), India (62nd), and China (53rd), but far below the USA which is one of the top ranked countries (15th) (IPRI, 2015). However, as can be observed in Figure 9, the number of applications in Mexico is low compared to the other four countries of reference.

**Figure 10** - Patent applications vs patents granted, 2012-2014, by residents and non residents




Source: http://www.wipo.int/ipstats/en/statistics/country_profile/profile.jsp?code=MX

Although the number of patent applications increased steadily in the 2012-2014 period, from 15,314 to 16,135, the success rate declined from 81% to 61%. Mexico has traditionally had a high concentration of foreign patent ownership and this can be observed also in this period (see Figure 10). Non-residents filed 92% of patents applications, and only 8% were filed by residents. The success rate of non-residents decreased from 86% in 2012 to 64% in 2014, whereas the success rate of the residents increased from 22% to 24%.

From 2002 to 2012, patents in Mexico were granted mostly in the consumer good class (31.6%), followed by chemistry and metallurgy (20%) and industrial processes (18%), which seem to relate to its strong manufacturing and oil and gas industries (CONACYT, 2012a).

The 2014 energy reform is expected to have a positive impact on activities related to patenting and exploitation of research results. The evolution from a state-own monopoly to the open market had an impact on the Mexican Petroleum Institute (Instituto Mexicano del Petróleo-IMP). For 50 years, the IMP was considered the R&D centre of Pemex, the state-own petroleum company. As a result of the energy reform, in 2015 the IMP underwent an internal structural change to accommodate for the need to find new sources of funding. The objective is to become a R&D provider for the new petroleum operators, while still servicing PEMEX, and to obtain new financial resources through the sale of research products developed by IMP for the domestic and international market.

The IMP is a recognized patenting institution in Mexico, and it was reported to have registered 26 patents, and applied for 59 more, from September 2013 to June 2014 (GOV, 2014). However, according to Amaral (Amaral, 2014) the IMP lags well behind most global oil and gas companies in terms of technology development, and the new situation might hinder the development of more ground-breaking technology to keep Pemex competitive in the Mexican oil and gas marketplace.

The number of European Patent Office (EPO) applications decreased in the period, from 64 in 2012 to 55 in 2014, representing just 0.072% of total EPO applications (2014).

The EPO patents granted in the same year was also low, 36, which represented 0.114% of the total patents granted[47].

International patenting is mostly done via Patent Cooperation Treaty (PCT). The UNAM, the CINVESTAV, the Tecnológico de Monterrey, and the Autonomous University of Morelos are the most active agents in PCT patents. By way of example, in 2012, 215.7 PCT applications were filed by residents[48] while 64 were filed through EPO. In 2014, four universities and six companies filed the most PCT applications, with the UNAM filing 12 applications.

Mexico is relatively active in filing trademark applications with the World Intellectual Property Organisation (WIPO). In 2013 the country filed 77,263 trademark applications positioning the country in 9th position and obtained 55,086 registrations, 8th position. However, the index of performance is far below the average OECD level (OECD, 2014a). In terms of industrial design, 1,749 applications were filed, placing it in 20th position and 890 registrations were obtained, 24th position.

Similarly to international co-publications, Mexico´s share of international co-invention is above average OECD levels (OECD, 2014a). However, the country is at the lower end of the OECD levels in Triadic patent[49] families, and patents filed by University and Public Laboratories per GDP. The issue of improving the patenting activity of University and Public Research Centres has been addressed in the latest amendment to the Law on Science and Technology in December 2015. By allowing Research Centres and researchers to partake in the economic benefits from patents, the objective is to increase the number of patents by nationals.

## 1.6 Main policy changes in the last five years

**Table 8** - Timeline of policy changes related to STI (2011, 2015)

| |
|---|
| *Main Changes in 2011* |
| Amendments to the 2002 Law of Science and Technology: addition of priority areas of knowledge and technological innovation and strategic projects in STI |
| Main changes in 2012 |
| Elections and New Government |
| Pact for Mexico |
| Amendments to the 2002 Law for CONACYT |
| Main changes in 2013 |
| New NDP 2013-2018<br>New STI coordination office as part of the Presidential Office |
| Amendments to the 2002 Law of Science and Technology: addition of gender equality |
| Main Changes in 2014 |
| New PECITI 2014-2018 |
| New Institutional Programme for CONACYT, 2014-2018 |
| *Amendments to the 2002 Law of Science and Technology: addition of open access to scientific, educational, technological and innovation related information* |
| Amendments to the 2002 Law for CONACYT |

[47] EPO annual reports https://www.epo.org/about-us/annual-reports-statistics/annual-report.html
[48] http://stats.oecd.org/
[49] Series of corresponding patents filed at the European Patent Office (EPO), the United States Patent and Trademark Office (USPTO) and the Japan Patent Office (JPO), for the same invention, by the same applicant or inventor. Triadic patents form a special type of patent family

| Creation of INADEM (National Entrepreneurship Institute) |
| --- |
| Main Changes in 2015 |
| Amendments to the 2002 Law of Science and Technology: promotion of exploitation of research results in Public Research Centres though KTOs and by allowing researchers to partake of the economic benefits from patents |

As discussed in section 1.3, and shown in Table 8, since the new government took power in 2012, there have been several structural and policy changes. The Pact for Mexico in December 2012, the new National Development Plan 2013-2018 in May 2013, the new PECiTI 2014-2018 in May 2014, and a new Institutional Programme for CONACYT 2014-2018 in April 2014. The Law on Science and Technology, originally approved in 2002, was amended in 2004, 2006, 2009, 2010, 2011, 2013, 2014 and 2015 (Congreso, 2015). The reforms introduced between 2011 and 2015 are:

- January 2011: the addition in the PECiTI of priority areas of knowledge and technological innovation and strategic projects in STI across sectors and regions, and some operational improvements.
- June 2013: the addition of gender equality.
- May 2014: the addition of open access to scientific, educational, technological and innovation related information.
- December 2015: amendments to promote innovation in Public Research Centres through Knowledge Transfer Offices (KTOs) and to allow Research Centres and researchers be partakers of the economic benefits from patents. The objective is to boost their relation with industry and the number of patents by nationals.

The Organic Law that regulates CONACYT, originally approved in 2002, was also changed in 2012 and 2014 (Congreso, 2014). The more relevant changes were introduced in 2014 empowering CONACYT to implement additions to the Law on Science and Technology on open access.

# 2. Public and private funding of R&I and expenditure

In this chapter, data is presented on the evolution of R&I expenditure in the 2012-2014 period. The weight of R&I expenditure as percentage of GDP, and the distribution of the expenditure between funding and performing agents is discussed in section 2.1. In section 2.2, funding flows are presented, starting with the identification of public institutions funding R&I (ministries) and the institutions that receive the block funding[50] from the ministries. This is followed by an analysis of the flows of R&D funds between public and private agents. In section 2.3, the balance between non-competitive (block funding) and competitive funding is examined, followed by a discussion of the distribution of the competitive funding for R&I activities, mainly amongst public institutions. Section 2.4 introduces the existing mechanisms to stimulate private R&I activities, which are mainly, competitive programmes. An assessment of R&I funding is included in section 2.5.

## 2.1 Introduction

Mexico steadily increased its Gross domestic Expenditure on Research and Development (GERD) in the period, both as percentage of the GDP, and in euros per capita.

**Table 9** - Basic indicators for R&D investments

| Indicator | 2011 | 2012 | 2013 | 2014 | 2015* | EU average 2013 |
|---|---|---|---|---|---|---|
| GERD (as % of GDP) | 0.43% | 0.43% | 0.50% | 0.54% | N/A | 2,03%(2014) 2,03%(2013) |
| GERD (€ per capita) | 32.31 | 34.85 | 39.63 | 43.89 | N/A | 558,4p(2014) 542 (2013) |
| GBAORD (€m) | 2,114.92 | 2,354.59 | 3,073.15 | 3,770.7 | N/A | 92,828.145 (2014) |
| GBAORD (% of GDP) | 0.25% | 0.26% | 0.33% | 0.39% | N/A | 0,67%(2014) |
| R&D funded by GOV and HEIs (% of GDP) | 0.27% | 0.28% | 0.34% | 0.404% | N/A | 0.68% |
| R&D funded by PNP (% of GDP) | | | 0.022% | 0.023% | | |
| R&D funded by BES (% of GDP) | 0.168% | 0.162% | 0.160% | 0.108% | N/A | 1.12% |
| R&D funded from abroad (% of GDP) | 0.006% | 0.004% | 0.003% | 0.002% | N/A | 0.20% |
| R&D performed by HEIs (% of GDP) | 0.120% | 0.127% | 0.145% | 0.141% | N/A | 0.48% |
| R&D performed by GOV (% of GDP) | 0.129% | 0.138% | 0.155% | 0.207% | N/A | 0.25% |
| R&D performed by BES (% of GDP) | 0.189% | 0.172% | 0.190% | 0.189% | N/A | 1.29% |

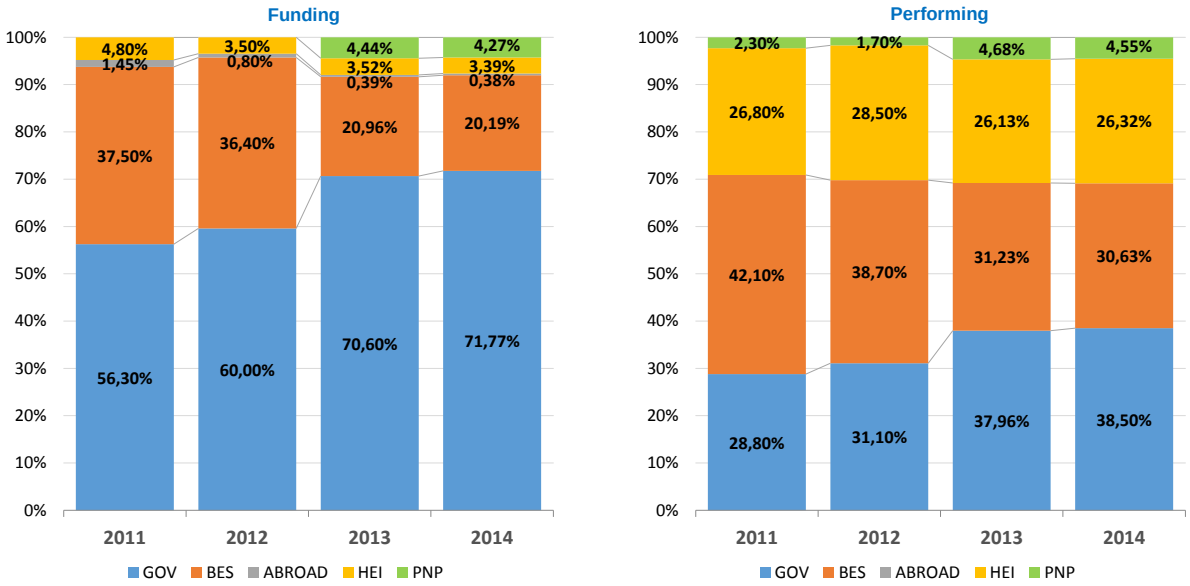
Source: STI Monitoring Reports 2013 and data courtesy of SIICYT-CONACYT

However, as can be observed in Table 9, GERD is still quite low in relation to more advanced economies. The estimate for 2014 is for 0.54% of GDP - a quarter of the EU average for the same year (2.03%). GBAORD increased steadily, in million euros from 2,354.59 to 3,770.7 and in percentage of GDP from 0.26% to 0.39%. The increase was stronger between 2012 and 2013 (0.07 points), coinciding with the start of the new

[50] Block funding is the Government´s budget allocated directly to named Institutions. It is also called institutional funding

legislative period. The increase between 2013 and 2014 (0.06 points) was slightly lower than the previous year, however, it does indicate an important commitment to R&I on the part of the Mexican government, despite the collapse of oil prices and the volatility of the global financial markets, factors which have a negative effect on the country's economy.

**Figure 11** - Distribution of GERD by funding and performing agents, 2011-2014




Source: CONACYT, 2013b, and data courtesy of SIICYT-CONACYT for 2014

In the period 2011-2014, the majority of **Funding of R&D** came from the Government (see *Funding* columns in Figure 11). Funding from the private sector (BES-Business Enterprise Sector) decreased steadily over the period, suffering an important reduction in 2014. The level of funding from abroad and from the Private Non-Profit sector (PNP) remain extremely low, with the funding from abroad actually decreasing. As shown in Figure 11 the gap between the public and the private funding is increasing, with the government increasing their financial contribution while the contribution of the private sector is contracting. The data in Table 9 shows how the government has been increasing the budget for R&D making up the shortfall of the private sector.

In terms of **Spending of R&D** in the 2012-2013 period the public sector spent approximately 60% of R&D resources, and the private sector spent the remaining 40%[51] (*Performing* columns in Figure 11). This contrasts strongly with the European Union (EU) situation where, in 2013, the public sector spent 36% of total expenditure and the private sector 64% (see Table 9).

Based on the estimates for 2014[52], the gap in spending between the public and the private sector increased, with the public sector spending around 65% of total expenditure and the private sector 35%. This indicates that the public sector received part of the increase in the government´s funding in 2014.

In 2012, government spending (31%) was almost equal to HEI spending (29%). This contrasts with the situation in the EU, where, in 2013, HEI spending (48%) practically doubled Government spending (25%). The business sector spent nearly all the private expenditure (38%) with less than 2% being spent by PNPs.

[51] Public sector includes the government and HEIs and private sector includes BES and PNPs
[52] Courtesy of SIICYT-CONACYT, sent to the author for this report

This distribution changed in 2013 and 2014, with the government increasing its spending from 31% to around 38%, HEIs decreased spending from 29% to around 26%, while business decreased from 38% to 31% and PNPs increased from 2% to 5%.

Again, this contrasts with the situation in the EU where, in 2013, the business sector was the main funding agent (1.12% of GDP) as well as being the biggest spender (1.29% of GDP).

According to the PECiTI 2014-2018, the target for GERD is 1.22% of GDP by 2020, 1.78 points below the EU target for the same year. In 2014, GERD was 0.54%[52] marginally below the target of 0.56%. The PECiTI 2014-2018 indicates that by 2020, BERD should amount to 41.70% of GERD. In 2014, the target was 36.65%, however, based on estimates, at 35.18%, this target has not been met.

## 2.2 Funding flows

### 2.2.1 Research funders

There are two mechanisms for allocating R&D budget to research performers[53]: block funding, and competitive funding

Block funding is distributed in various sectoral ministries and agencies, and CONACYT. CONACYT distributes block funding to the CONACYT Research Centres, whereas The Ministries of *Public Education*, *Energy*, *Health and Social Security*, *Agriculture, Rural Development, Fisheries and Food* distribute block funding to the institutes and/or Universities that are under their responsibility. Table 10 shows the institutions that received block funding from each Ministry in 2013 (CONACYT, 2014b).

**Table 10** - Institutions receiving Block funding from each Ministry (2013)

| Ministry | Institution |
|---|---|
| **Public education**<br>**(Educación Pública)** | ✓ Universidad Nacional Autónoma de Mexico<br>✓ Centro de Investigación y de Estudios Avanzados<br>✓ Universidad Autónoma Metropolitana<br>✓ Instituto Politécnico Nacional<br>✓ El Colegio de México, A.C.<br>✓ Universidad Autónoma Agraria Antonio Narro |
| **Energy**<br>**(Energía)** | ✓ Instituto Mexicano del Petróleo<br>✓ Instituto de Investigaciones Eléctricas<br>✓ Instituto Nacional de Investigaciones Nucleares<br>✓ Petróleos Mexicanos |
| **Agriculture, Livestock, Rural Development, Fisheries and Food**<br>**(Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación)** | ✓ Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias<br>✓ Colegio de Postgraduados<br>✓ Universidad Autónoma Chapingo<br>✓ Instituto Nacional de la Pesca<br>✓ Universidad Autónoma Agraria Antonio Narro |
| **Health and Social Security**<br>**(Salud y Seguridad Social)** | ✓ Institutos Nacionales de Salud<br>✓ Instituto Mexicano del Seguro Social<br>✓ Instituto de Seguridad y Servicios Sociales para los Trabajadores del Estado |

[53] Performers are the institutions that develop R&D projects

| Ministry | Institution |
|---|---|
| **Conacyt** | ✓ Centros de Investigación - Conacyt |

Source: CONACYT 2014b, page 186

Competitive funding is managed by CONACYT and is allocated through programmes and sectoral funds. The programmes cater for the transversal needs of the agents involved in the STI system, and include R&I projects and individual grants. Sectoral funds cater for needs related to specific ministries and are co-funded by CONACYT and the ministries themselves.

Participation in programmes and sectoral funds is through calls for proposals, managed by CONACYT, and which are opened one or more times a year. The Ministries are involved in the management of the sectoral funds, identifying needs and deciding on the focus of the calls for proposals.

### 2.2.2 Funding sources and funding flows

**Figure 12** - Flows of R&D funds (2013)[54]

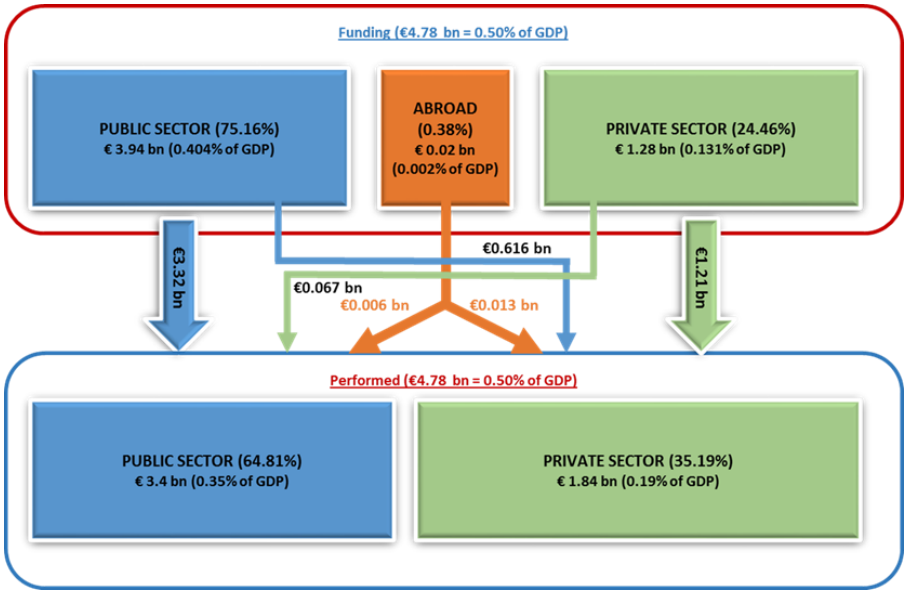
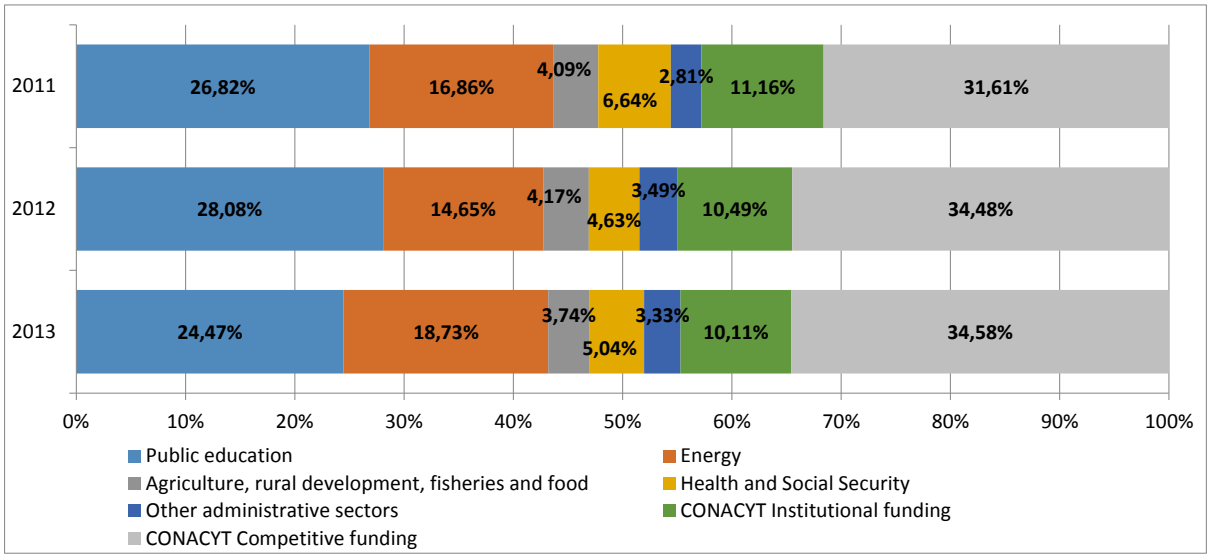



Figure 12 presents an analysis of the funding flow. As can be observed, most of the public funding (85%) is spent by the public sector, and likewise, most of the privateub funding (95%) is spent by the private sector. A relatively small proportion of the private funding is spent by the public sector (5% of private funding). This proportion is higher in the case of public funding spent by the private sector (15% of Government funding). Financing from abroad is distributed between the public and the private sector (33% and 67%, respectively).

[54] Data courtesy of SIICYT-CONACYT, sent to the author for this report

## 2.3 Public funding for public R&I

**Figure 13** – Distribution of total federal R&D budget (2011, 2013)




Source: Elaborated by the author with data from (CONACYT, 2014b)

Figure 13 shows the distribution of the Federal budget among sectoral ministries and CONACYT, from 2011 to 2013. As explained in section 2.2.1, sectoral ministries allocate bock funding, and CONACYT allocates both block funding (shown in green) and competitive funding (shown in light grey). Block funding decreased in the period, from 68.39% of total funding in 2011, to 65.52% in 2012 and 65.42% in 2013, whereas competitive funding increased from 31.61% in 2011, to 34.48% in 2012, and 34.58% in 2013. The reduction of block funding happened in all ministries, except in Energy and Health and Social Security, and in CONACYT.

CONACYT received approximately 45% of the total Federal R&D budget (block funding plus competitive funding), having increased from 42.77% in 2011 to 44.69% in 2013.

**Table 11** – Distribution of the budget allocated to CONACYT by the Congress, 2011, 2015

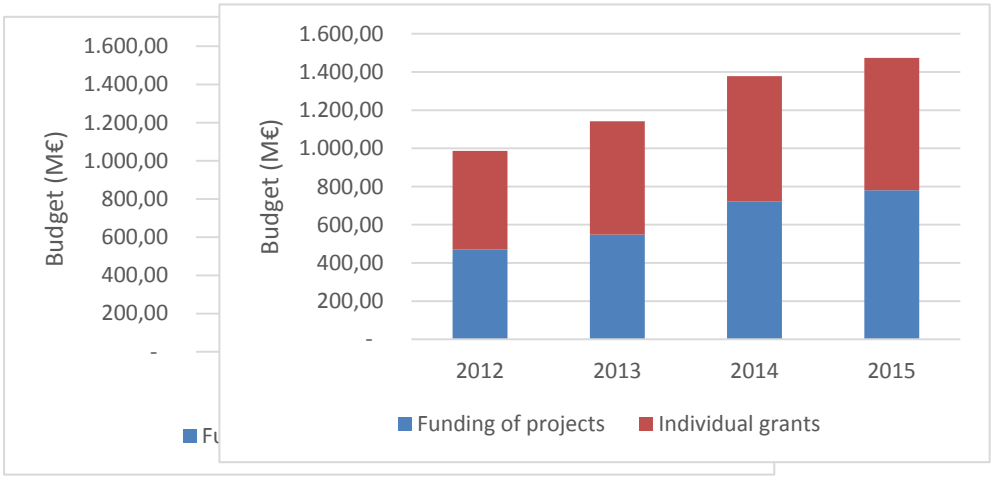
| | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|
| CONACYT TOTAL BUDGET (Item 38 of the Government budget) | €1,010.75m (MXN 17,619.00m) | €1,287.50m (MXN 21,872.18m) | €1,475.22m (MXN 25,245.96m) | €1,790.59m (MXN 31,586.32m) | €1,911.40m (MXN 33,706.70m) |
| CONACYT | €785.67m (MXN 13,695.50m) | €1,027.98m (MXN 17,463.44m) | €1,176.78m (MXN 20,138.66m) | €1,451.95m (MXN 25,612.55m) | €1,539.03m (MXN 27,140.10m) |
| CONACYT operational expenses (including salaries) | €38.75m (MXN 675.50m) | €40.91m (MXN 694.94m) | €35.41m (MXN 605.99m) | €73.49m (MXN 1,296.44m) | €65.58m (MXN 1,156.50m) |
| Competitive Funding (Substantive Programmes) | €746.92m (MXN 13,020.00m) | €987.07m (MXN 16,768.50m) | €1,141.37m (MXN 19,532.66m) | €1,378.45m (MXN 24,316.11m) | €1,473.45m (MXN 25,983.60m) |
| Funding of projects | €320.53m (MXN 5,587.40m) | €471.45m (MXN 8,009.00m) | €548.38m (MXN 9,384.66m) | €723.02m (MXN 12,754.11m) | €780.56m (MXN 13,764.90m) |
| For public institutions | €29.00m (MXN 505.60m) | €188.37m (MXN 3,200.00m) | €24.77m (MXN 423.83m) | €69.39m (MXN 1,224.00m) | €80.06m (MXN 1,411.90m) |
| For RENIECYT members | €291.53m (MXN 5,081.80m) | €283.08m (MXN 4,809.00m) | €523.62m (MXN 8,960.83m) | €653.63m (MXN 11,530.11m) | €700.50m (MXN 12,353.00m) |
| Individual grants | €426.39m (MXN 7,432.60m) | €515.62m (MXN 8,759.50m) | €592.99m (MXN 10,148.00m) | €655.44m (MXN 11,562.00m) | €692.88m (MXN 12,218.70m) |
| CONACYT centres | €225.08m (MXN 3,923.50m) | €259.52m (MXN 4,408.74m) | €298.44m (MXN 5,107.30m) | €338.65m (MXN 5,973.77m) | €372.37m (MXN 6,566.60m) |

Source: Elaborated by the author with data from (CONACYT, 2012d), (CONACYT, 2013d), (PEF, 2014), (PEF, 2015), (CONACYT, 2013b), (CONACYT, 2014b)

In 2015, the total budget of CONACYT was €1,911.40m (MXN 33,706.70m), with an increase of 54% in relation to 2012. Table 11 shows that the budget increased annually, with the highest being in 2014. The increase in 2015 was 6.7%, which although moderate, does indicate a commitment to R&I by the government, in spite of the global financial market volatility and the collapse of oil prices. The budget is divided between CONACYT headquarters (around 80% of the total) and the CONACYT centres (20%). The amount for headquarters is then split between operational expenses (between 3% and 4% of the total) and competitive funding (also called substantive programmes).

The competitive R&I funding is used to finance R&I projects and individual grants. It constitutes the largest portion of CONACYT´s budget (about 77%), and in 2015 it was 50% higher than in 2012.

**Figure 14** – Distribution between R&I projects and individual grants




Source: Elaborated by the author with data from Table 11

The weight of R&I project funding vs individual grants has changed significantly during the period. In 2012, funding for projects amounted to 47.76% of total competitive funding, with little change being observed in 2013. In 2014 it increased to 52.45% and to 52.98% in 2015. Figure 14 shows the distribution between R&I projects and individual grants.

The SINECYT (National System of Scientific and Technological Evaluation - Sistema Nacional de Evaluación Científica y Tecnológica) establishes the criteria, methodologies, and instruments for the ex-ante and ex-post evaluation of the projects funded through these programmes (SINECYT, 2008). Evaluators registered in the CONACYT Register of Accredited Evaluators perform the evaluation, and an Evaluation Committee coordinates the evaluation process. Results from this process are presented to the Technical and Administrative Committee (CTA-Comité Técnico y de Administración) where representatives of the funding agents are present. The CTA is responsible for the final approval.

Most programmes and Sectoral Funds are aimed at both public and private institutions registered in the National Register of Scientific and Technological Institutions and Enterprises (RENIECYT). However, there are some programmes specifically directed towards public institutions (public University, Research Centres, laboratories and public enterprises), while others are directed to private companies[55]. In order of importance, in

[55] ANNEX 4 includes information on the main programmes funding R&I projects that are part of the competitive R&I funding, and their budget for the 2012-2015 period

the 2012-2015 period, funding was allocated to: Infrastructure Strengthening Fund, DAPyB (Institutional Support for Scientific, Technological and Innovation Activities), PRODECYT (Program for Scientific and Technological development), Sectoral Funds, FOMIX and FORDECYT (see section 2.3.); PEI (see section 2.4.1.); and institutional consolidation.

Investment in infrastructure is operationalised mostly through the **Infrastructure Strengthening Fund**, which had a budget of €149.86m for the 2012-2015 period. This fund provided competitive funding for infrastructure and equipment. This fund was only available to the Public Research Centres (CPI) coordinated by CONACYT (The CONACYT centres). This fund increased more than 110% between 2012 and 2013. In 2014, the fund grew by approximately 66%. Finally, in 2015, inter-annual growth remained at just 7%. A second programme, available only to public institutions, was focused on reducing the digital divide, however, this programme was only active in 2012.

The **Institutional support for scientific, technological and innovation activities (DAPyB)** aims to supports R&I activities in the public, private or social sector. Funds are directly allocated by the Managing Director or CONACYT, after consultation with the Committee of Institutional Support. There are many different forms of support, which include projects, individual grants, outreach activities or innovation networks, among others. The DAPyB is the second largest programme in the period, augmenting from €101.36m (MXN 1,721.41m) in 2012, to €181.57m (MXN 3,202.92m) in 2014. 2015 saw a decrease, to €140.233m (MXN 2,472.95m).

The object of the **Program for Scientific and Technological development (PRODECYT)** is to foster high impact actions and projects aimed at capacity building to strengthen the STI System. Introduced in 2013, the budget of this first year of operation, €146.08m (MXN 2,499.92m), was subsequently cut in the following years. Nevertheless, PRODECYT has the third largest budget in the period.

**Sectoral Funds for technological development** are instruments to finance R&I oriented to strategic (sectoral) needs. The PECiTI 2014-2018 defines priorities in seven strategic areas: environment, knowledge of the universe, sustainable development, technology development, energy, health and society.

CONACYT and the sectoral Ministries co**-**fund and co-manage the Sectoral Funds; funds such as, the CFE-CONACYT fund for energy, the CONACYT-SENER and the CONAGUA-CONACYT funds for sustainable development and the SEDESOL-CONACYT fund for society related issues. There is also a relationship between the areas and priorities addressed in the PECiTI and the sectoral needs addressed by the Sectoral Funds. For instance, in the 2014 call of the SEDESOL-CONACYT fund, poverty characterisation, food security, and migration were specified as sectoral demands, in line with the area "society" of the PECiTI.

Some Sectoral Funds focus on technology development projects while others are directed towards basic scientific research. Although calls are open to both public and private institutions, and companies, most projects related to basic scientific research are awarded to public institutions (University and Research Centres) and some private Universities.

The EraWatch Country Report on Mexico 2012 (Rivera, 2013) reported that in May 2013 there were 21 jointly financed and operated sectoral funds. As of February 2016, there are 30 constituted sectoral funds, some of which are aimed at promoting scientific research, while others are aimed at fostering technological development.

The budget of CONACYT for Sectoral Funds increased substantially between 2012 and 2013, from €23.55m (MXN 400.07m) to €42.29m (MXN 723.72m). Since 2013, growth has remained relatively stable. The high number of calls and the lack of common eligibility criteria make these funds less attractive from the perspective of the beneficiaries. This can be seen in the low numbers of proposals for some calls, and the fact that the total budget is not used.

Territorial inclusiveness is the focus of the two funds, FOMIX and FORDECYT. Through these funds, the objective of CONACYT is to favour less developed regions in the country in order to bridge the gap between these and more developed ones (FCCyT, 2012a; FCCyT, 2012b; FCCyT, 2014b).

The **Mixed Fund (FOMIX)** is jointly funded by CONACYT and the State Governments. The aim of the programme is to foster the integral development of states and Municipalities. This involves identifying the strategic areas of development in the states, and developing solutions geared to the particular needs of the territory.

The other regional fund, the **Institutional Fund to Promote Regional Development in Science, Technology and Innovation (FORDECYT)** is funded by CONACYT. The main objectives of FORDECYT are to strengthen STI at the State level and promote cooperation between the states, resulting in a better regional integration. The regional needs are identified through a participative process involving collaboration between the private sector and regional public institutions to identify regional needs.

These two regional funds are further discussed in chapter 4.

## 2.4 Public funding for private R&I

### 2.4.1 Direct funding for private R&I

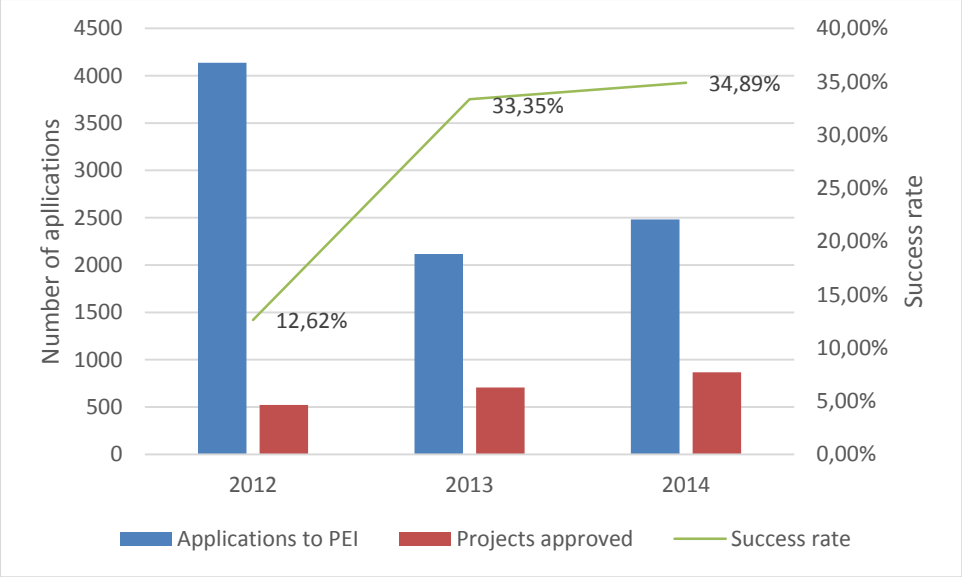
There are two R&I programmes specifically aimed at the private sector: the programme to Encourage Research, Technological Development and Innovation (PEI), and the Investment Fund for Technology Development. In addition, within the framework of the ECONOMÍA-CONACYT sectoral fund, the FIT (Technology Innovation Fund) programme is directed to private entities.

The **Programme to Encourage Research, Technological Development and Innovation (PEI)** has the highest budget of all the competitive funding programmes in the 2012-2015 period. This programme includes three subprogrammes: INNOVAPYME, INNOVATEC and PROINNOVA. INNOVAPYME focuses on SMEs, INNOVATEC on large companies and PROINNOVA fosters collaboration between the private sector and academia, supporting companies in collaborative projects involving two HEIs or Research Centres. Collaborative projects involving a HEI or Research Centres also receive greater funding from the government in the INNOVAPYME and PROINNOVA programmes. The number of public-private collaborations more than doubled in the 2009-2015 period, increasing from 485 in 2009 to 1,227 in 2014[56].

The allocation for the PEI more than doubled in the 2012-2015 period going, €117.73m (MXN 2,000.01m) in 2012 to €263.12m (MXN 4,640.01m) in 2015. In 2012, the PEI provided funding for 522 projects with €114.66m (MXN 1,947.86m), while in 2014, 866 projects were funded with €219.68m (MXN 3,875.18m). The level of support provided by the PEI to SMEs is important. In 2015 alone, the total funding for SMEs represented 77% of the total funding (CONACYT, 2016).

**Figure 15** - Evolution of the number of applications, number of projects approved and the success rate in the PEI 2012-2014.

[56] Elaborated by the author with data from (CONACYT, 2016)




Source: Elaborated by the author with data from (CONACYT, 2012b), (CONACYT, 2013a), (CONACYT, 2014a)

Figure 15 shows the evolution of the number of applications, number of projects approved and the success rate from 2012 to 2014. While the number of applications fell, the number of projects approved increased; i.e., the rate of success improved.

The **Inversion Fund in Technology Development** is a small programme (€0.119m), which was only available in 2014 and 2015. The aim was to develop productive investment projects, applied research and/or technological innovation in public-private collaboration.

One of the best-financed Sectoral Funds is the ECONOMÍA-CONACYT, which includes the programmes **FINNOVA** (Sectoral Innovation Fund) **and FIT** (Technology Innovation Fund). While FINNOVA is directed to both the public and private sectors, FIT finances agents in the private sector.

**Table 12** Evolution of the funding for projects supported by the ECONOMIA-CONACYT sectoral fund

| | FINNOVA | | | FIT | | |
|---|---|---|---|---|---|---|
| **Year** | **Number of projects** | **Total budget for supported projects** | **Average allocation** | **Number of projects** | **Total budget for supported projects** | **Average allocation** |
| 2012 | 136 | €13.09m | €96,218 | 69 | €10.58m | €153,389 |
| 2013 | 448 | €33.64m | €75,090 | 43 | €7.20m | €167,419 |
| 2014 | 337 | €18.44m | €54,721 | 40 | €6.18m | €154,619 |

Source: Elaborated by the author with data from (CONACYT, 2012b), (CONACYT, 2013a), (CONACYT, 2014a)

Table 12 includes data from 2012 to 2014: number of projects, total budget for the programme and average allocation per project. The budget for FINNOVA nearly tripled from 2012 to 2013. Total budget for FINNOVA in the period is nearly three times higher than the budget for FIT, which decreased substantially. The average cost of the projects financed by FINNOVA was lower than those financed by FIT.

Most of the Competitive Programmes involving private participation are designed to include additional private funding. This is achieved by a 50%-50% distribution between government and private funding on R&I projects. Private funding may be provided as a

financial contribution or resources and expertise (in kind). Examples of these types of contributions can be found in the calls for proposals opened by PEI, FOMIX, FORDECYT as well as some of the Sectoral Funds, such as CONAGUA-CONACYT. From 2009 to 2015, private investment in PEI amounted to €1.233m (MXN 21.756m). The most active sectors were Information Technology (IT), automotive, food industry, agro-industry, chemistry and biotechnology (CONACYT, 2016).

Existing programmes cover basic applied research, technology development and innovation. However, the focus of the programmes analysed seems to favour basic or applied research and capacity building (both infrastructure and human capital), with little work being carried out in the commercialisation of research results. The PEI is the only programme that makes reference to the generation of intellectual property.

Project funding is allocated following international standards[57]. For instance, in 2012, FORDECYT was evaluated by a peer review organised in commissions made up of 29 evaluators, four of which were international. CONEVAL, the National Committee for Social Development Policy Evaluation also participated in the process with eight of its members assuming the responsibility for the coordination of the commissions.

In FOMIX, evaluation is normally carried out by individual evaluators registered in the CONACYT Register of Accredited Evaluators. There is also an Evaluation Committee, which is in charge of coordinating the evaluation process. Although there are some standard criteria for the evaluation of projects submitted to the different calls of FOMIX, in general, the criteria are specific to each call. Some of the common criteria include the scientific quality of the proposal, the methodology, or the technical capacity of the project team. Criteria specific to a call include, for example, potential regional impact of the projects or their potential for technology transfer.

The Mexican Government has been working on the design of a new demand-side policy, i.e., Public Procurement of Innovation (PPI). Focusing on the demand for innovative products and services, this policy seeks to reinforce the role of the government in the promotion of innovation in companies.

During 2013, the Ministry of Economy and CONACYT, through the Interministerial Commission on Innovation, designed a Public Procurement of Innovation system following a previous analysis of the baseline situation. The main conclusion of this baseline study was that the Mexican legal framework (Government Acquisitions, Leasing and Services law, Public-Private Associations Law, Petróleos Mexicanos Law) allowed Public Procurement of Innovation in two categories: pre-commercial and commercial innovation. However, a profound process of cultural change was necessary within public entities and control agents to put it into practice.

**Figure 16** - Strategic lines and objectives of the Mexican Policy on Public Procurement of Innovation

[57] This applies to project-based funding of both public and private R&I


The design of the Public Procurement of Innovation policy centred on three strategic lines and nine specific objectives, as Figure 16 shows.

The design proposed included a three-stage action plan:

- **Short-term Pilot Projects** – Preparation of the resources required for the implementation of the System and the involvement of the necessary government entities in the PPI pilot projects under the conditions provided for in the legal framework.
- **Medium-term: Implementation of a PPI system** – at Federal level considering international best practices with the regulatory mechanisms, policies and actions promoted by PPI.
- **Long-term: Consolidating the System** – Incorporation of an Innovation Unit in each Governmental entity that promotes the culture of innovation and scientific development within the Public Administration.

In 2015, the initiative was in Stage 1 of its development, within the framework of the National Digital Strategy and the Science and Technology Law. The Inter-sectoral Committee for gave its support for the creation of a Working Group on Public Procurement of Innovation with the objective of "Fostering the introduction and adoption of innovation through Government Procurement; promoting the use of information technologies for the modernization of the Federal Public Administration."

As of May 2016, the Ministry of Economy and the Presidency started the definition of the first PPI pilot projects in the IT field.

### 2.4.2 Indirect financial support for private R&I

A significant number of countries are promoting optimization of R&D operations including re-location. Countries offering R&D tax incentives are often regarded as a favorable location for internationally-mobile R&D. When efficiently allocated, companies can effectively leverage their global R&D infrastructure resulting in the development of valuable intellectual properties (Deloitte, 2014).

Mexico does not have indirect financial support for Business R&I as tax incentives were discontinued by the Government in 2008.

This decision was taken mainly due to three reasons: almost 60% of all the requested incentives were allocated to big companies, many of them with foreign capital; projects with marginal innovation or with innovation developed in other countries were supported due to the laxity of the definition of an R&D project; and there was a lack of an annual integral evaluation of the fiscal incentives programme. Fiscal incentives were substituted by direct support in competitive programmes, such as the PEI and the FIT. Despite attempts at establishing a new system of R&I tax incentives (CEC, 2011), Mexico has not changed this policy yet.

## 2.5 Assessment

During the period 2012-2015, the budget of CONACYT, which amounts to 45% of the total Federal Expenditure in R&I, rose dramatically. This budget increase was mainly aimed at providing more support for the main public funding programmes. For most of these programmes, almost all the budget was used up.

Most programmes are aimed at public and private institutions. However, public institutions are more active when applying for public funding, and they tend to be, along with private Universities, the main beneficiaries.

The current R&I funding system is complex, with a large number of programmes (including the 30 sectoral funds), each of them with more than one call per year. This complexity of the system can create a barrier to accessing funding, especially for SMEs. This would seem more apparent in the case of Sectoral Programmes. Increased simplification of the administrative burden of the funding mechanisms, together with the introduction of supporting instruments to encourage and facilitate the participation of SMEs would probably result in greater private R&D investment

Few programmes, such as the PEI or the FIT are aimed specifically at private companies. These are the only programmes where public-private collaboration is either requested or incentivised. Programmes such as the PEI usually finance approximately 50% of the total project allocation, with success in the calls for participation increasing private R&I investment. Programmes aimed mainly at public institutions do not explicitly encourage the participation of private companies.

There is a recent tendency for various programmes to finance fewer projects with larger allocations, except in the case of FINNOVA, a programme that is aimed at SMEs. FINNOVA has been increasing the number of projects funded and reducing the average allocation per project.

Most of the programmes analysed have been in operation for some years, but there is a lack of data on their impact. Programme evaluation reports carried out by the Advisory Forum for S&T (FCCyT, 2011a), (FCCyT, 2011b), (CONACYT, 2015b) include a description of the projects financed but do not include an impact assessment of the projects or the programmes. CONEVAL reports on the difficulty of assessing the impact of the programmes using their evaluation methodology, and indicates the need for a special methodology to be developed for some of CONACYT´s programmes. Finally, the CONACYT self-assessment reports[58], include a description of the activities performed each year, associated with CONACYT´s Institutional Programme and the annual work programme, but they do not include an impact assessment of the activities.

[58] (CONACYT, 2012b), (CONACYT, 2013a), (CONACYT, 2014a)

# 3. Framework conditions for R&I

In this chapter, policies and results related to technology and knowledge transfer, open innovation, the commercialisation of research results and creation of high-tech companies are discussed. In section 3.1, the new labour, fiscal and financial reforms are introduced, and the latest position of Mexico in the Global Competitiveness Index and in the Ease of Doing Business ranking are examined. Section 3.2 looks at the policies and instruments developed to encourage the creation of high-tech start-ups and increase the number of companies involved in R&I activities. The collaboration patterns of companies when developing product innovation are explored in section 3.3, as well as the results of programmes aimed at encouraging open innovation. An assessment of the policies conductive to open innovation and technology transfer is presented in section 3.5.

## 3.1 General policy environment for business

The labour reform bill, approved in November 2012, includes major changes to make Mexico's labour market more flexible (with provisions to ease hiring and firing, of workers), and deal with non-discrimination issues.

In 2013, the government introduced new financial and fiscal legislation, as part of the overall package of reforms, with the aim of fostering competition in the financial sector, and increasing tax revenue[59]. State governments have also passed small business support measures, to make it easier to open new businesses. With this financial reform, access to credit was improved.

In terms of Mexico´s position in the Global Competitiveness Index (GCI), the country's position dropped, from 55 in 2012, to 61 in 2013, and rose again to 57 in 2014, despite having achieved the same score (4.3) in the three years (WEF, 2015). A comparative analysis of 2014 with respect to 2013, shows that there were improvements in the efficiency of financial markets, business sophistication, and in fostering innovation. The country's competitiveness also benefited from a large market, and a more efficient goods market, with enhanced, albeit low, levels of competition. These results indicate that the reforms, in place since 2012, are bearing fruit. However, some challenges remain. These challenges include rigidities in the labour market, and a deterioration of the institutional environment, with weak public and private institutions. Corruption is considered by the World Economic Forum to be the most problematic factor for doing business.

**Figure 17**: Mexico´s ranking in each of the 10 topics of *Doing Business*


[59] Mexico had the lowest level of tax revenue in the OECD countries– 9.7% of GDP in 2012. The objective of the fiscal reform was to increase revenue by approximately 1 percent of GDP in 2014

Mexico ranks 38 (of 189 countries) in the World Bank´s *Ease of Doing Business Rank* 2016. This means, that **it is in the group of the best countries in terms of business regulations for local firms** (WB, 2016). Figure 17 shows Mexico´s ranking in each of the 10 *Doing Business* topics. Mexico scores best in the topic of **getting credit** (ahead of China, India and Brazil). This means that the legal rights for borrowers and lenders are strong (regulations and institutions in Mexico support lending and borrowing), and that credit information is shared widely.

The country's position in the topic of **Resolving Insolvency** is also good, (ahead of China, Brazil and India). Resolving insolvency takes 22 months on average and costs 18% of the debtor's state. The average recovery rate is 0.50 euro per euro invested.

Mexico has made resolving insolvency easier by clarifying several rules, shortening the time extensions allowed during reorganization, facilitating the electronic submission of documents and improving the legal rights of creditors and other parties involved in bankruptcy procedure.

The **strength of insolvency framework index** indicates the adequacy and integrity of the existing legal framework applicable to liquidation and reorganization proceedings. Scoring 11.5/16, Mexico is just under the OECD average score of 12, the same as China, ahead of India (6), but behind Brazil (13). Mexico´s legislation gives good support in the commencement of proceedings (2.5/3) and in managing the debtor's assets (5.5/6). The legislation is not so supportive for reorganization proceedings (1.5/6) or creditor participation (2/4).

The **insolvency framework** in Mexico supports entrepreneurs that may have failed the first time round in how the debtor's assets are managed. In all the following indicators, Mexico scores well: allowing the continuation of contracts supplying essential goods and services to the debtor; the rejection by the debtor of overly burdensome contracts; avoidance of preferential transactions; avoidance of undervalued transactions and providing for the possibility of the debtor obtaining credit after commencement of insolvency proceedings.

It can be concluded that regulations exist in Mexico to commence insolvency proceedings and manage company assets, assisting enterprises in situations such as financial reorganisation, or entrepreneurs looking for a second opportunity. While involved in such a process, companies can continue to provide goods and services, and reject abusive contracts or preferential transactions from creditors. The financial reform also includes mechanisms that help, by facilitating the transfer of loan guarantees, in case of loan refinancing, and first loss coverage.

However, none of these instruments distinguish between traditional and innovative SMEs, and they do not provide specific support to technology-based start-ups or spin-offs.

## 3.2 Young innovative companies and start-ups

The diagnosis of the STI system, carried out during the preparation of the PECiTI 2014-2018, identified short comings in the support provided to young innovative companies and start-ups. Structural weaknesses related to framework conditions, and inefficiencies in innovation policy design and implementation were also identified by the OECD. According to the OECD, Mexico lags behind other countries with a higher or similar level of scientific and technological (S&T) development. This lag reflects the fact that Mexico suffers from a discrepancy between, on the one hand, the relatively significant S&T capacities developed in the country's higher education institutions and public research centres and, on the other, a rather low dynamism in the creation of knowledge-based start-ups (OECD, 2013a).

In the diagnosis of the STI system, carried out during the preparation of the PECiTI 2014-2018, it was indicated that Mexico had improved the legal framework to speed up the creation and expansion of businesses, but that access to financing (seed capital,

venture capital or angel investors) is one of the major barriers to the development of technology-based companies, particularly in the early stages. The new PECiTI identified the need to increase efforts to build a critical mass of innovative companies, and to increase the productivity of the companies. A need for a more specific policy was identified, distinguishing types of companies (e.g., new high-tech firms, SMEs and big companies), and innovation stages. The need for a better connection between the HEIs and the PROs with companies was also identified. To this aim, it was proposed that liaison agents, such as KTOs, were created, and that patenting activity within the research community was encouraged (CONACYT, 2014c).

The NDP 2013-2018 incorporates two strategies oriented towards young innovative companies, start-ups, and spin-offs. As part of the support to STI, the strategy (section 3.5.4) aims to improve knowledge transfer and the commercialisation of R&D results. Action lines within this strategy that target the creation of young innovative companies include the promotion of entrepreneurial development of HEIs and Research Centres, the creation of small high-tech companies, the promotion and simplification of intellectual property registration for HEIs and Research Centres, and the creation of KTOs. As part of the support to the productive system, the strategy (section 4.8.4) aims to encourage entrepreneurship, and strengthening SMEs. Action lines that target young innovative companies include the promotion of entrepreneurship, through the development of adequate educational, financial, legal protection, and competition environments, and easing access to capital.

The 2013 financial reform was aimed at fostering competition in the financial sector. It provides the means for the Development Bank (Banca de Desarrollo) to extend credit and to ease access to capital for the SMEs. SMEs in Mexico account for 74% of employment, however, they only access 15% of the formal credit available. SMEs try to avoid seeking formal credit for capital by delaying payment to providers until sales of their own product or service are completed, to manage daily cash flow, and asking for informal credit from family and friends. Although the financing instruments NAFIN (Mexican Development Bank) and BANCOMEXT (Banco Nacional de Comercio Exterior) do not distinguish between traditional and innovative SMEs, their financial mechanisms are important for young innovative companies. For example they include mechanisms to facilitate the transfer of loan guarantees in the case of loan refinancing, and first loss coverage. BANCOMEXT also has an instrument to support SMEs in export/import activities.

There are two sectoral funds, the FINNOVA and the FIT, promoted by CONACYT and the Ministry of Economy, which support technological development in companies[60]:

- The FIT-Technological Innovation Fund (Fondo de Innovación Tecnológica). Finances innovation initiatives from companies or individuals involving significant technological innovation projects with high market potential. Projects developed with the support of FIT are expected to develop technology in line with levels 4 to 9 of the Technology Readiness Levels (TRL). The FIT also funds hiring HRST and infrastructure for the development of new products, processes, marketing methods or organizational models. Of the projects funded in 2012, 14% developed technologies that were considered of international relevance (CONACYT, 2012b). In 2014 financed projects included the creation of technology-based start-ups, and of groups or centres for engineering, design, or R&D in SMEs. This support continued in 2015 (GOV, 2014, 2015).
- The FINNOVA Sectoral Innovation Fund Ministry of Economy-CONACYT (Fondo Sectorial de Innovación Secretaria de Economía-CONACYT) finances a wide range of types of projects, e.g., R&I project human resources, infrastructure, patenting, or the creation of networks. In particular, it finances technology-based start-ups,

[60] These funds have been previously described in chapter 2. Here, the discussion focusses on the support they provide to young innovative companies and start-ups

new knowledge-based companies, young innovative companies, and the creation of seed funds and risk capital. The FINNOVA has a voucher system for fostering innovation through certified KTOs. These include vouchers for SMEs to receive innovation services from KTOs (financing 70% of the cost). They also include vouchers for KTOs to develop activities related to the commercialization of R&D results, through contracts, patenting and licensing, or the creation of spin-off (financing 80% of the costs). From 2012 to 2015 FINNOVA financed projects to improve products and services, process improvement, and increase innovation capacity and productivity in SMEs, with special calls in the field of Biotechnology. The voucher system was heavily focused on the creation and the capacity building of KTOs (GOV, 2013, 2014, 2015).

However, as it was presented in section 2.4.1, the budget of these funds is rather low and it is mostly devoted to R&D activities and to the support of KTOs, rather than the creation of innovative or technology based companies.

In order to coordinate and implement the national policy in support of entrepreneurship, in January 2013, the National Entrepreneurship Institute (INADEM-Instituto Nacional del Emprendedor) was created, as an agency of the Ministry of Economy. The INADEM manages the National Fund for Entrepreneurship (FNE-Fondo Nacional Emprendedor) created in 2014 from the merger of the SME Fund (Fondo PYME) and the Entrepreneur Fund (Fondo Emprendedor). Through 25 calls, the objective is to strengthen entrepreneurship in the country, fostering innovation in SMEs in strategic sectors. The calls do not discriminate between types of SMEs, therefore, it is not possible to evaluate the impact of the FNE in terms of supporting innovative companies (GOV, 2014, 2015). The same was found when analysing the National System of Warranties, which was set up by the INADEM and the Development Bank to facilitate the access of entrepreneurs and SMEs to financing and capital.

One of the four main objectives of the INADEM is to strengthen innovation based entrepreneurship. However, so far, little progress has been made in terms of developing a policy and supporting instruments that discriminate between traditional SMEs, innovative companies and high-tech firms, or between the different stages of business development or maturity.

Before the creation of the INADEM, the CONACYT was mainly in charge of supporting the creation of technology based companies and innovative start-ups. With the setting up of the INADEM, the role of CONACYT in supporting high-tech start-ups and spin-offs was constraint. CONACYT´s AVANCE programme, for example, which included instruments to support new business development and commercialisation activities, based on R&D results, was discontinued.

Other instruments of the Ministry of Economy to support the creation of technology-based companies include seed capital funds (Fondo de Coinversión de Capital Semilla) and venture capital funds (Fondo de Fondos de Capital Emprendedor, México Ventures I). In 2013, €8.8m were allocated to the *Fondo de Coinversión de Capital Semilla*, with which 12 companies were supported in 2014 and 2015. The fund *Fondo de Fondos de Capital Emprendedor, México Ventures I*, invests in other national and international funds. In 2013 it invested in *Latin Idea Ventures*, *MES Capital*, *Adobe Capital*, Capital Índigo, *Gerbera Capital*, *Sierra Ventures*, *Excel Venture Management* y *Thayer Ventures*, and in 2014, €5.8m were allocated to Ventures I (GOV 2013, 2014, 2015). Although this is a good start, the amounts allocated to these funds are small for a country the size of Mexico.

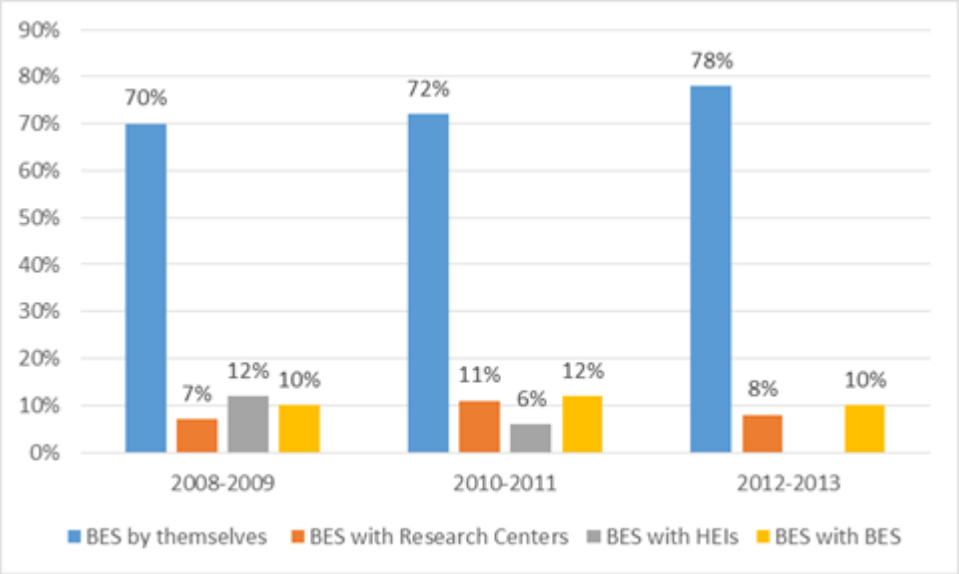
As a consequence, there is still a need to develop a specific policy to support the development of high-tech companies, and to put in place instruments to implement it.

## 3.3 Knowledge transfer and open innovation

Mexico´s performance in the area of academic-industry co-publication is high in terms of the number of public-private co-publications per million *population;* the second highest

country after the USA (in the comparison group). However, the output is low in terms of the share of public-private co-publications; the second lowest, just ahead of India (in the comparison group).

**Figure 18** - Percentage of companies developing product innovation in collaboration[61]



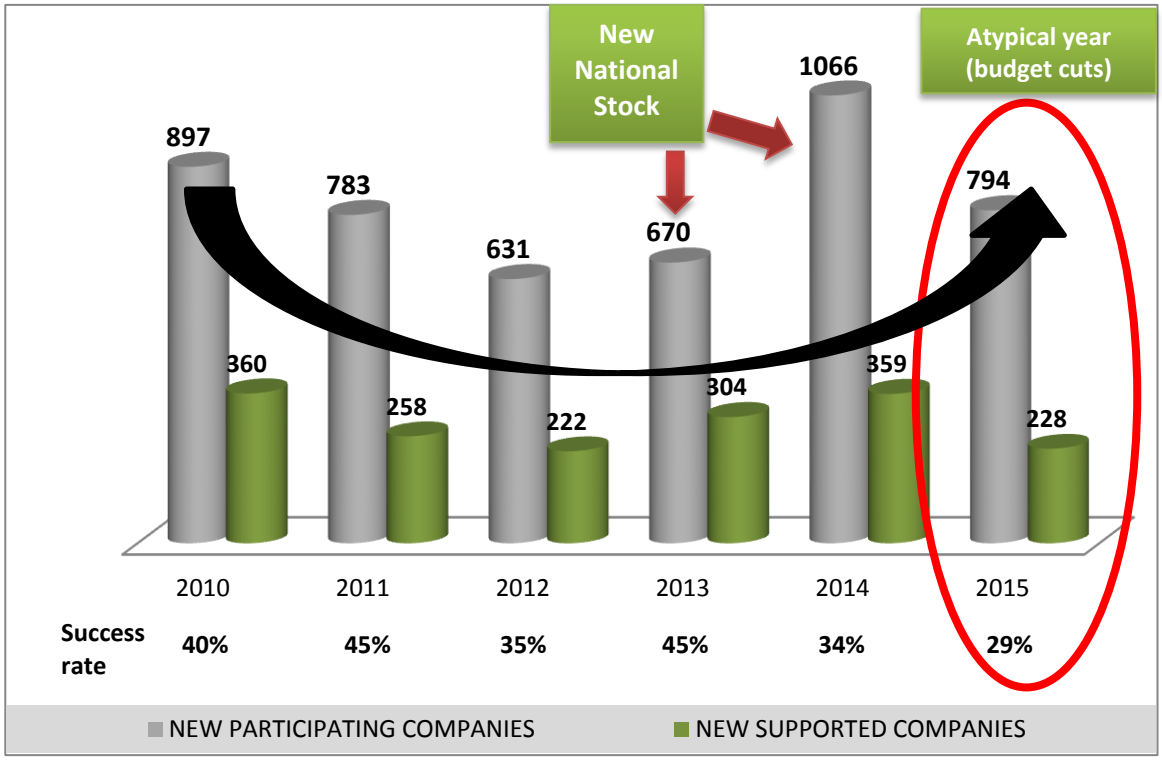

Source: SICYT-CONACYT with data from ESIDET, 2010, 2012, 2014

The high number of public-private co-publications per million population contrasts strongly with the recognised weak linkages between the public and private sectors in STI in Mexico. The pattern of collaboration of companies, in the 2008-2013 period, shows a lack of collaboration in product innovation (70-77% of all companies involved in product innovation, developed the products on their own) (see Figure 18). It also shows that the sparse collaboration of companies occurred mainly in private-private activities. The level of collaboration between companies remained stable (about 10% of companies collaborated with other companies in product innovation); the number of companies collaborating with Research Centres (either public or private) rose from 7% to 11% and then dropped again to 8%; and the number of companies collaborating with HEIs went from 12% in 2008-2009 to 6% in 2010-2011[62].

According to the Erawatch report 2012, in the 2010-2012 period, the main instrument for funding public-private collaboration, the PEI, suffered annual reductions in its budget. However, 89% of the projects approved involved public private collaboration (GOV, 2013).

[61] Data courtesy of SIICYT-CONACYT, sent to the author for this report
[62] No data is available for the collaboration between companies and HEIs in the 2012-2013 period

**Figure 19** – Number of new companies applying to PEI and number of successful new companies, 2010-2015

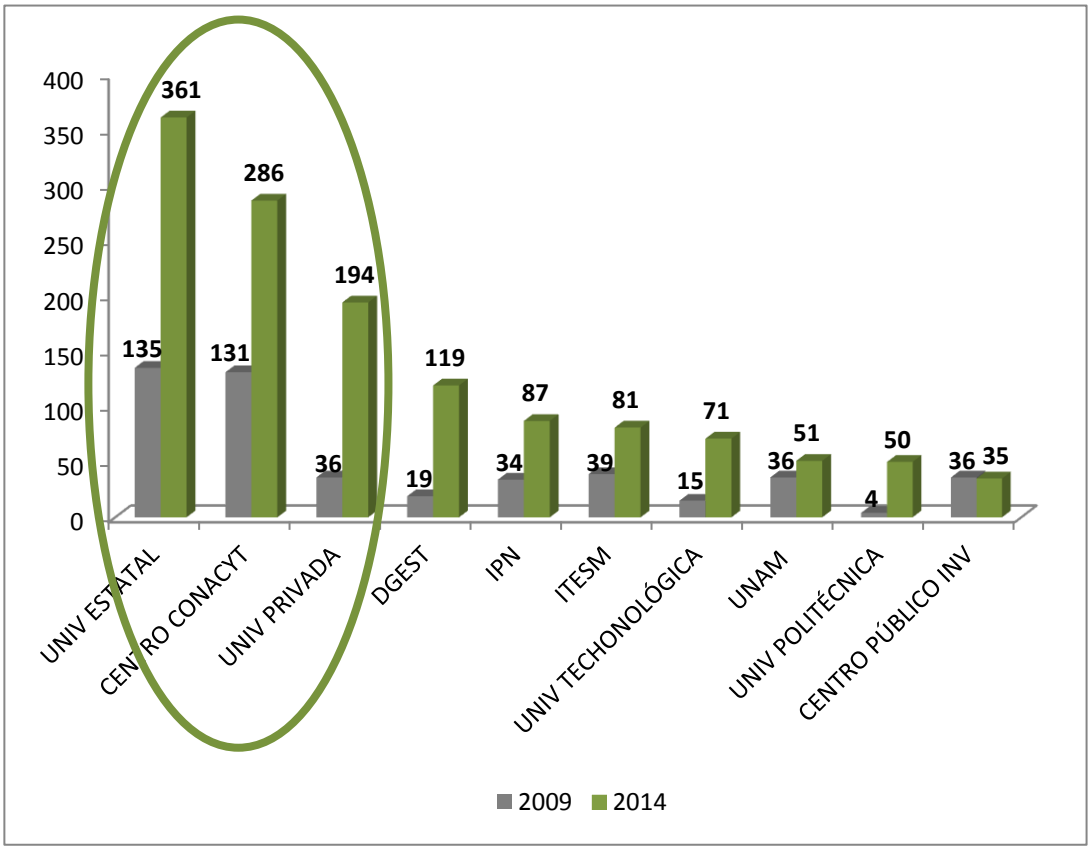



(CONACYT, 2016)

Important steps have been taken to promote open innovation, mainly through increases in the budget of the PEI in 2013 and 2014. The level of participation of new companies in the calls increased in these years, although the success rate for this group was lower than in previous years (see Figure 19). However, the overall number of companies participating was small (see Figure 15).

As detailed in chapter 2, in the 2012-2015 period, the budget for PEI rose from €117.73m (2012) to €263.12m (2015). In 2013, 91% of the total budget went to companies with projects involving Universities and/or Public Research Centres. This percentage rose to 93.5% in 2014 (GOV, 2014).

**Figure 20** – Participation of HEIs and Public Research Centres in PEI, 2009-2014,



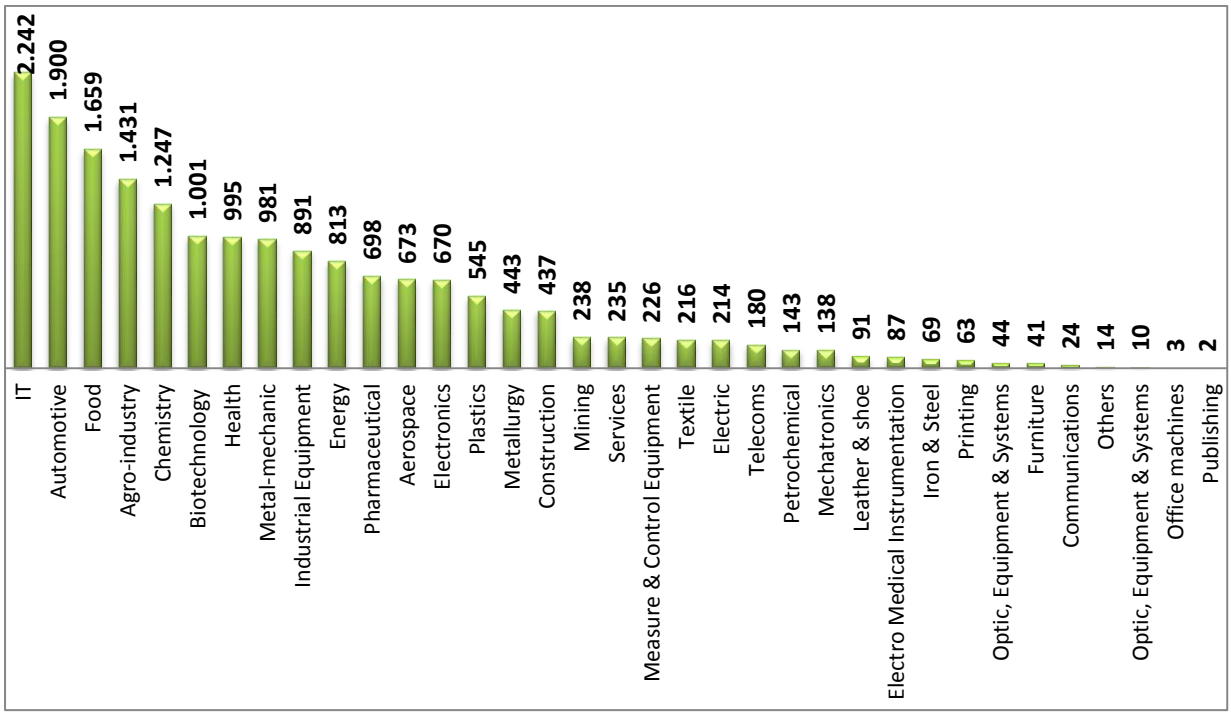

(CONACYT, 2016)

The most active participants amongst Universities and Research Centres are State-level Universities, followed by the CONACYT Centres and private Universities. State-level Universities have nearly tripled their participation, CONACYT centres have nearly doubled it, and private Universities have multiplied their participation by five (see Figure 20).

Federal Universities lag behind. Of these, the Technological Universities are more active than well-known Universities, such as the UNAM and the CINVESTAV, which have a (comparatively) low participation, a situation that has varied little in the six year period.

Universities with block funding (which are also well-known for their scientific production and IPR record) seem to have little incentive to participate in collaborative programmes, unlike the State-level Universities, CONACYT centres and private Universities.

**Figure 21** - PEI: Amount of support by Industrial Sector, 2009-2015 (Millions of pesos), (CONACYT, 2016)




The most active sectors were Information Technology, automation, food and agroi agroindustry (Figure 21).

The two most relevant changes to the Law on Science and Technology in the 2012-2015 period, refer to improving technology transfer through better conditions for patenting (and the promotion of KTOs), and open access to STI information.

Programmes to support patenting are not new. For example, the programme **Support to Patenting** (Apoyo a Patentes) provides financial support for the protection of Mexican inventions resulting from the application of scientific and technological knowledge. What is new, is that HEIs, PROs and researchers are now able to receive a share of the economic benefits from the exploitation of Intellectual Property Rights. The objective of the Government is to encourage researchers HEIs, and PROs to get involved in patenting the results of their research, thereby, increasing the national share of patents by nationals. Given that the amendments to the Law date back to December 2015, it is still too early to report on any results.

To improve public-private linkages, the Government is supporting the creation of KTOs in the public HEIs and the PROs. This is financed by the FINNOVA through vouchers for KTOs. It is also supported by the Committee on Institutional Support - Comité de Apoyos Institucionales (CAI). From 2012 to 2015, the vouchers for KTOs were mainly used for the creation and capacity building of KTOS (GOV, 2013, 2014, 2015). In 2013 there were 75 KTOs, 19 of which were certified (GOV, 2013, CONACYT, 2013a). In 2014, 41 KTOs were certified (GOV, 2014), and in 2015 through the voucher system, there were 116 projects executed involving 117 KTOs (GOV, 2015).

In Mexico there are also thematic research networks. In 2014, there were 20, 11 of which are focused on R&I issues, and have initiated, or already had, links with the business sector (GOV, 2014).

Open access to Educational and R&I information was included in the Law on Science and Technology in May 2014. The objective was to implement the National Repository of Scientific Information in two years. The new repository, created to open the access of Educational and R&I Information to Society in general, is expected to foster public-

private collaboration, by making R&I results available to Companies. In November 2014, CONACYT issued general guidelines of this policy and integrated a News agency whose main function is to publish scientific information. Since then, several workshops and meetings have been held, to develop the technical and content requirements of the system where the open information will be managed, and published.

Infrastructures to support the development of new companies and innovation ecosystems exist in the form of incubators, accelerators and technology and science parks, albeit with different degrees of development.

INADEM manages the national Network of Business Incubators. Since its creation in August 2013, the network has integrated 233 incubators, 17 of which are high impact incubators as they support the creation of companies aligned with the strategic sectors. Although there are some national level strategic sectors (automotive, aeronautic. metalworking, mining, agriculture and tourism), each State has defined its own strategic sectors, as part of the Smart Specialisation strategies developed in the 2013-2015 period (see chapter 4 for more details). From September 2014 to July 2015, 24 high impact incubators have been supported, and 250 companies were being developed (GOV, 2015).

INADEM also runs a certification scheme for incubators (both traditional and high-tech) and a scheme to support mentoring in the case of high-tech companies.

To contribute to the development of entrepreneurial skills, and improve the chances of success for new companies, INADEM manages the Entrepreneur Support Network, created in August 2013, and the **Online Incubation Program (PIL)**, created in February 2014. The network operates through 427 contact points connected to a call centre and to the electronic portal of INADEM-Move to Mexico. It supports entrepreneurs through the development of diagnosis of business management, and entrepreneurial skills, through 105 public and private programmes (38 programmes from 26 departments and agencies, 33 programmes of INADEM and 34 programmes of 26 institutions in the private sector). The PIL supports entrepreneurs in developing a business model, a financial plan, and an implementation plan.

There are also incubators in the HEIs and the PROs. For example, the Technological Universities have a network of incubators which in 2012 had 65 incubators for technology-based companies. These, together with the 14 business and innovation development centres in the Polytechnic University, accounted for 79 technology-based business incubators. This number increased to 89 in 2014 (GOV, 2014). Further to these, the main public and private HEIs (National and State level) also have incubators. Some of the most active ones are the IPN (Instituto Politécnico Nacional) with 60 projects involving tech-based companies in 2013.

Mexico is also supporting the development of business accelerators[63]. In 2013, the projects started in 2012 were followed up on and, in 2014, 113 new projects were approved.

Clusters and Science and Technology Parks are also promoted, as part of the Government policies to encourage the development of high impact innovative companies and open innovation. The development of clusters for agribusiness and agroparks is included in the NDP, as the means to promote partnership models that generate economies of scale, and greater added value for the food sector. In 2014 and 2015, this policy was instrumented through the creation of the National System of Agroparks. A budget of €60.9m (MXN 1,074.3m), is to be used for the creation of a network of strategically located agroparks. In 2015, 20 projects were financed in 15 states, and 135 applications for new agroparks were received from 32 states (GOV, 2015).

[63] Accelerators specialise in preparing companies for (sustainable) growth, facilitating their scaling up and the access to international markets as well as to national and international risk capital

The Ministry of Education grants an annual Business-University collaboration award. In 2013, 344 requests were received from 27 organisations, twice the number of 2012. In 2015, the intersectoral committee gave €0.198m (MXN 3.5m) to the Foundation "National

Technology and Innovation Award ", 44% higher than in 2014, to support the Foundation in the organization of the award.

CONACYT promotes several awards related to STI. In 2014, they included the Technology and Innovation National Award, the International Forum of Innovation Systems for Competitiveness, and Mexico´s Award for Science and Technology.

To promote competitiveness and innovation in industry, CONACYT has a programme, the National Programme of Quality Postgraduates (Programa Nacional de Posgrados de Calidad), to foster the recruitment of Masters and PhD graduates by industry, funding 50% of their salaries. In the framework of this programme, in the 2012-2015 period, CONACYT signed agreements with intermediate organisations such as chambers of industry (e.g., CANAME -National Association of Electrical Manufacturers-, CANACINTRA -National Chamber of Transformation Industries-, CANIETI -National Chamber of the Electronics, Telecommunications and Information Technology-) and State councils for STI (e.g., Tamaulipas, Morelos, Guanajuato, etc). In 2013, 117 contracts were co-financed, and in 2014 the number increased to 196 (CONACYT, 2014a).

## 3.4 Assessment

Mexico is a country open to national and international investment. It has a large internal market, at regional and national level, with most international trade being carried out with the USA. The government is intent on diversifying the country´s markets, opening opportunities in Europe and Asia (see chapter 5 for more details).

According to the GCR 2016, despite improvements resulting from the labour, financial and fiscal reforms, the country still suffers from rigidities in the labour market and weak public and private institutions. Corruption is still considered by the World Economic Forum to be the most problematic factor for doing business.

Good business regulation exists in Mexico for local firms. This regulation facilitates lending and borrowing, the sharing of credit information, and resolving insolvency, in terms of the timescales and cost. However, other aspects of insolvency regulations, such as proceedings for reorganisation, and the participation of creditors in the proceedings remain low in relation to OECD average levels.

Although the framework conditions in Mexico are conductive to business investment, there is a shortage of investment for business R&I, the commercialisation of results or the creation of innovative start-ups.

The policies and instruments favouring the regionalisation of R&I are increasing the participation of the State-level Universities, and CONACYT centres in the States. These institutions are also taking a leading role in public-private collaboration. Encouraging further participation is likely to have a positive impact on regional R&I development.

However, Universities that receive block funding (see Table 10), and that are also recognised for their scientific production and patenting activity (see section R&I Fact Sheet), seem to have little incentive to participate in collaborative programmes.

It is still early to assess the results of the amendments made to the Law of Science to improve the commercialisation of research results through licencing or the creation of spin-offs. However, supporting actions, such as the creation of KTOs to manage the Intellectual Property Rights of HEIs and research centres, seem to be encouraging more interaction between HEIs, and companies through the provision of services. Also, the new repository for open access to Educational and R&I Information is expected to foster public-private collaboration by making R&I results available to companies.

Infrastructure to support the development of new companies and innovation ecosystems exists in the form of incubators, accelerators and technology and science parks, albeit with different degrees of development. The INADEM runs the largest network of business incubators, a few of which are aimed at strategic sectors. However, no distinction is made between the types of companies supported, i.e. technology based start-ups versus traditional SMEs. There are other incubators run by HEIs and Research Institutions focusing on the creation of spin-offs. However, these initiatives lack the structure and cohesion of more longstanding innovation ecosystems.

Supply and demand-side R&I policies and instruments are co-evolving to a certain extent, however, greater effort is still being given to the development of supply-side policies. Demand-side innovation policies have, traditionally, focussed on the needs of the business sector. Since 2013, the important role that the public administration can play - in demanding innovation in the products and services they contract - has been highlighted and developed. A Public Procurement of Innovation (PPI) policy has been designed and, in 2016, pilot projects in the field of Information Technology are being launched.

# 4. Smart specialization approaches

The European Smart Specialisation approach is being introduced in several countries around the world, Mexico being one of them. This chapter starts by examining the evolution in the funding allocation for FOMIX and FORDECYT, the two instruments used to promote the decentralisation of R&I activities. Section 4.1 also presents a flow chart of the main Government institutions involved in STI at regional level. The situation of Smart Specialisation in Mexico is presented in section 4.2. Section 4.3 introduces issues on regional linkages to economic competitiveness. Finally, an assessment is presented in section 4.4.

## 4.1 Governance and funding of regional R&I

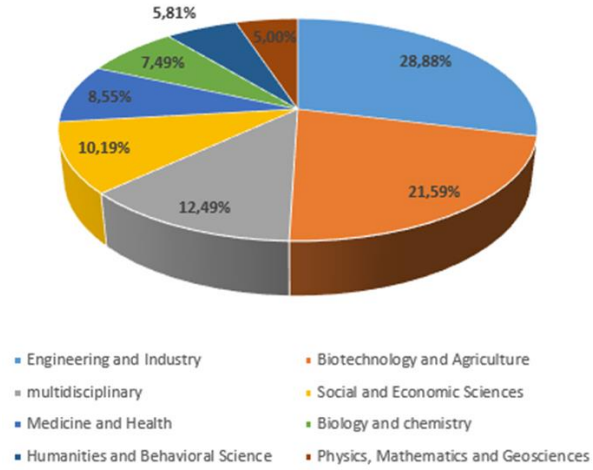
Policies to promote the decentralisation of the STI system have existed in Mexico since CONACYT was created. However, the concentration of R&I activities in Mexico City and certain states, and the asymmetries between these states is one of the main challenges facing policy-makers wishing to promote the decentralisation of the STI system.

As noted in chapter 2, of the instruments being used to engage the states (*entidades federativas*) in R&D activities, two stand out: the FOMIX Mixed Funds (*Fondos Mixtos-FOMIX*) and the Institutional and Regional Development Fund for Scientific, Technological Innovation-FORDECYT (*Fondo Institucional de Fomento Regional para el Desarrollo Científico, Tecnológico y de Innovación – FORDECYT*).

The **Mixed Fund (FOMIX)** is funded jointly by CONACYT and the State Governments. The aim of the programme, one of the oldest and more established Substantive Programs, is to foster the integral development of states and municipalities. One of the main goals is to identify the strategic areas of specialisation development in the states, developing solutions geared to their particular needs. These solutions could also be applicable to the broader context (nationally or even internationally).

In the period 2002-2015, a total of 5,750 projects were approved. FOMIX is aimed at both the public and private sector; 51.9% of the projects were in the academic sector and 13.67% were projects from the CONACYT centres. However, private companies accounted for just 15.8% of the support given (CONACYT, 2015b).

**Figure 22** - Number of Projects by area of specialisation, 2002-2015




The main areas of specialisation of the projects supported by FOMIX are Engineering and Industry with 1,669 supported projects, followed by Biotechnology and Agriculture with 1,248 (See Figure 22).

The evaluation of FOMIX carried out in 2013 by the Advisory Forum for S&T (FCCyT, 2013) described the two main challenges of the fund: 1) to improve the methodology used to identify strategic areas of R&D development, and 2) to provide better support to reduce the R&D asymmetries between the states.

Calls for these funds are aligned to the development policies of the states (the National Development Plan, the Sectorial Programs and the State Program of Science and Technology). They encourage sectorial participation through mechanisms, defined by each State, for consultation and decision-making. Given that each State has its own FOMIX, usually launching several calls each year, the complexity of managing such a large portfolio is high.

In the period 2012-2015, improvements were made to the design of the programme and the calls with the objective of optimising the submission process, the evaluation of proposals and the formalization of the resulting contracts. Steps were also taken to reduce the evaluation period. Strategic changes were made, moving from funding several low impact small projects to funding a reduced number of larger projects with greater potential impact. During the period, Engineering and Industry was the largest beneficiary, 28.88% of all projects, followed by Biotechnology and Agroindustry, 21.49% of approved projects (CONACYT, 2015b).

**Table 13** - Contribution to FOMIX by the states and by CONACYT, 2012-2015

| | **2012** | **2013** | **2014** | **2015** |
|---|---|---|---|---|
| **Total Contribution of FOMIX (2012-2015)** | €50.27m (MXN 853.94m) | €82.87m (MXN 1,418.18m) | €74.01m (MXN 1,305.47m) | €64.62m (MXN 1,139.58m) |
| Contribution of the States and Municipalities | €23.61m (MXN 401.12m) | €39.04m (MXN 668.18m) | €22.99m (MXN 405.47m) | €19.20m (MXN 338.58m) |
| Conacyt Contribution | €26.66m (MXN 452.82m) | €43.83m (MXN 750.00m) | €51.02m (MXN 900.00) | €45.42m (MXN 801.00m) |

Source: Elaborated by the author with data from CONACYT, 2015b

Table 13 shows the contribution of the states and municipalities and CONACYT to the FOMIX fund between 2012 and 2015. In this period the contribution of CONACYT was proportionally higher (61.43% of the total fund) than the contribution from the states and municipalities (38.58%).

**Table 14** - FOMIX projects, number, total and average funding amount, 2012-2015

| Year | Projects | Total | Average funding per project |
|---|---|---|---|
| 2012 | 481 | 1,162 | €0,134m (MXN 2.415m) |
| 2013 | 202 | 756 | €0,207m (MXN 3.742m) |
| 2014 | 70 | 905 | €0,718m (MXN 12.928m) |
| 2015 | 100 | 778 | €0,432m (MXN 7.78m) |

Source: Elaborated by the author with data from CONACYT, 2015b

Table 14 shows a breakdown of the number and total of projects funded in FOMIX. It shows the average funding for the projects supported. The average funding per project went up €0.134m (MXN 2.41m) in 2012, to €0.432m (MXN 7.78m) in 2015.

The other regional fund is the **Institutional Fund to Promote Regional Development in Science, Technology and Innovation (FORDECYT)**. The FORDECYT Fund was created to promote technological, scientific and innovation actions of high impact and high strategic value at regional level, offering support for the training of specialized human resources, contributing to regional development, cooperation and integration in Mexico.

Of the 109 projects approved between 2009 and 2015, REDNACECYT were the beneficiaries of 30% of the support, the CONACYT Centres received 27%, 25% went to the academic sector, and 11% to the Research Centres.

In November 2012, the Advisory Forum for Science and Technology evaluated FORDECYT (FFCyT, 2012c), and noted the need to review the terms of the fund and focus its strategy on becoming the regional instrument par excellence. For this purpose, the Advisory Forum for S&T recommended increasing the Fund and extending support to infrastructure and training of human resources. Another recommendation was to generate partnerships between states to capitalize on opportunities for development and the generation of local innovation systems.

**Table 15** - Evolution of number of projects supported by FORDECYT and budget 2012-2015

| Year | Number of projects supported by FORDECYT | Total budget of supported projects | Average allocation |
|---|---|---|---|
| 2012 | 9 | €18.82m (MXN 319.8m) | €2.09m (MXN 35.53m) |
| 2013 | 1 | €5.09m (MXN 87.1m) | €5.09m (MXN 87.1m) |
| 2014 | 1 | €5.31m (MXN 93.7m) | €5.31m (MXN 93.7m) |
| 2015 | 33 | €18.99m (MXN 334.9m) | €0.57m (MXN 10.14m) |

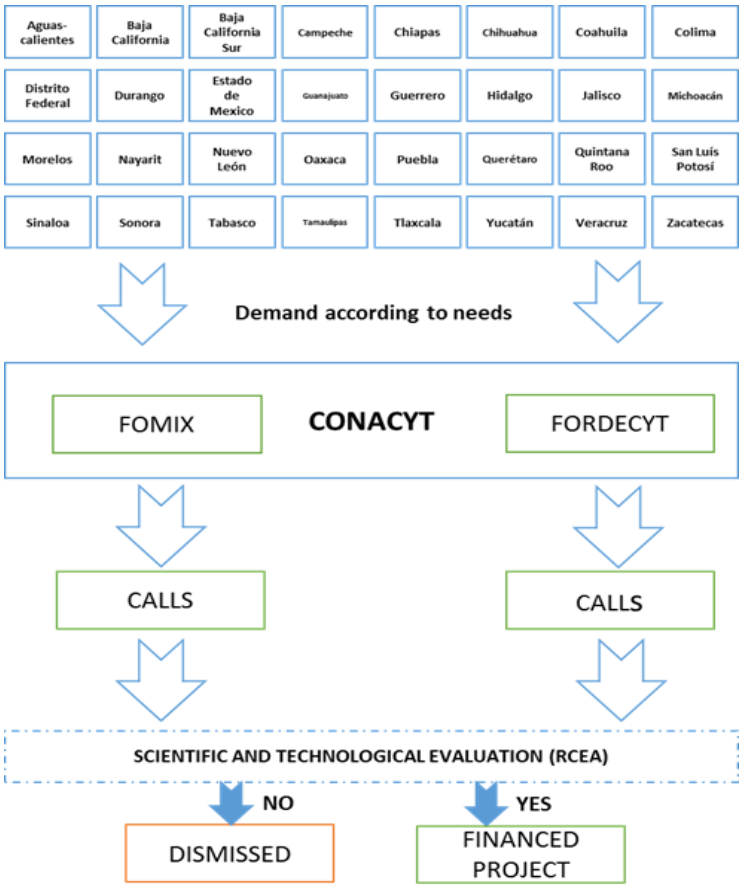
Source: Elaborated by the author with data from (CONACYT, 2015c)

As can be observed in Table 15, the number of projects supported by FORDECYT and the median allocation has changed significantly in the period.

While just one project was supported in both 2013 and 2014, in 2015, the number of projects the passed the technical threshold were 15.

As an example, in 2015, two sub-projects were launched as part of the *National Strategy to Enhance and Strengthen the Dissemination and Popularization of Science, Technology and Innovation in the states*: the Social appropriation of Science Technology and Innovation; and the 22nd National Week of Science and Technology. FORDECYT launched a specific call, opened to all 32 states, for the above sub-projects.

**Figure 23** - Flow-Chart of the main government institutions involved in STI development at regional level




The R&I governance structure and interrelationships are presented in Chapter 1. Figure 23 shows the interaction of FOMIX and the FORDECYT, at operational level, with federal and regional institutions.

As can be seen, FOMIX and FORDECYT are linked to Federal programmes. They support State scientific and technological development with contributions from the Federal and State governments, via CONACYT. For many states, these represent the only financing model for S&T projects. The budget of the State institutions is not normally sufficient to promote projects of scientific and technological development oriented to the social and economic needs of the region.

From the perspective of the region, these funding programmes are important in that the projects to be supported in each call can be prioritized. The State can set its own priority setting mechanisms, based on an internal diagnostics and aligned with the key needs set out in their development plans.

Once the states have defined their requirements/demands, CONACYT opens the calls for both funds, the proposals are then evaluated by the CONACYT Accredited Assessors Registry (RCEA), and the projects are approved or rejected.

## 4.2 Smart Specialization approaches

Mexico is committed to developing Smart Specialisation strategies as part of its effort to accelerate the country's transition to an advanced innovation economy based on regional development. This is viewed as a process of consolidating existing strengths in the regions to find solutions to new challenges through innovation and diversification.

Between 2013 and 2015, Smart Specialisation strategies were developed in all 32 states (including Mexico City) and three regions (north, centre-north and South-southeast). These strategies, based on the European RIS3 (Research and Innovation Strategies for Smart Specialisation) methodology, were called *Agendas de Innovación*. One of the main objectives of these *Agendas de Innovación* is to open a new path towards innovation, focusing primarily on the specific capabilities and productive strengths of each Mexican State. The innovation strategy and associated action plan for each State were defined with the aim of becoming the cornerstone for the territory's development and potential to innovate and compete in the regional, national and global context.

In Mexico, there are some strategic sectors [64] defined at the national level, e.g., automotive, aeronautic, metal-working, mining, agriculture and tourism. With the Smart Specialisation strategies, each State defined its own strategic sectors.

Smart Specialisation attempts to make two critical requirements compatible: "identifying priorities in a vertical logic (specialisation) and keeping market forces working to reveal domains and areas where priorities should be selected (smart)" (Foray and Goenaga, 2013). Forging the connection between the strategic approach of achieving transformation through Smart Specialisation, and the bottom-up process of entrepreneurial discovery involves the mobilization of actors linked to entrepreneurship within the Quadruple Helix (Business, Research, Public Administration and Society)[65]. Stakeholders from the quadruple Helix participated in the governance structure built in the *Agendas de Innovación*.

The Innovation *Agendas* were developed in a coordinated manner to ensure that they all followed the same methodology[66], and that they all had a common structure and format. Based on the European RIS3 methodology (Regional Innovation Strategies for Smart Specialisation), the *Agendas* are the only coordinated Smart Specialisation initiative that exists at national level. They were developed through a consensus building process which involved the participation of key stakeholders. The stakeholders were a sample of the Quadruple Helix from each State and region, representing business and social sectors, as well as Academia and the Government.

The role of global value chains is also a factor considered in Mexico. Comparative regional strengths are embedded in global value chains, and thus, it is also necessary to examine the comparative strengths of the other regions involved in the global value chains. This was mostly looked at in the three Regional Strategies developed.

The Smart Specialisation approach offers opportunities for regions in different stages of development. There is an important challenge for some regions that lack fundamental capacities to develop an innovation strategy, and the tools to prioritize regionally-based innovation actions (EPRC, 2012), which will return benefits for the actions carried out. Capacity-building was an important issue in the case of Mexico, especially in the states lagging behind in developing policies and instruments to support the innovation process.

All in all, 35 Innovation *Agendas* were developed and a total of 495 projects identified, covering 18 sectors and 10 action lines, with an estimated investment of €856.27m

[64] *Sectors* here mean thematic fields

[65] The Quadruple Helix is an extension of the originally Triple Helix model proposed by Etzkowitz and Leydesdorff in 1995 and 2000, where Society was not included.

[66] The European guide to Smart Specialisation was used as the standard methodology

(CONACYT, 2015d). The following table shows the number of projects according to the area of specialisation.

**Table 16** - Total No. of projects depending on the specialization area (State and Regional Innovation Agendas)

| Sector | % Projects | Number of Projects |
|---|---|---|
| Food Industry | 29.29% | 145 |
| Energy | 12.73% | 63 |
| IT & Electronics | 10.71% | 53 |
| Tourism | 8.69% | 43 |
| Automotive | 7.68% | 38 |
| Health & Pharmacy | 6.46% | 32 |
| Metal-mechanics | 3.23% | 16 |
| Logistics | 3.23% | 16 |
| Environment and sustainability | 2.83% | 14 |
| Biotechnology | 2.22% | 11 |
| Enabling capabilities | 2.42% | 12 |
| Aerospace & Aeronautics | 2.22% | 11 |
| Textile | 2.02% | 10 |
| Mining | 1.82% | 9 |
| Forest | 1.41% | 7 |
| Advanced manufacturing | 1.21% | 6 |
| Chemistry & polymers | 1.01% | 5 |
| S&T Services | 0.61% | 3 |

Source: Elaborated by the author with data from State and Regional Innovation Projects Report of CONACYT (December 2015)

The resulting *Agendas* focus on the decentralisation of scientific and technological activities according to the capacities and sectoral strategies of each State, while aligning them with the goals of the National Development Plan 2013-2018 of the Federal Government. However, as seen previously (Table 16), there is an important concentration in five sectors: Food Industry, Energy, IT and Electronics, Tourism, and automotive.

According to CONACYT, one of the objectives of the *Agendas de Innovación* was to become the main instrument for the states to decide on how to invest in innovation and technological development. They have become instruments of guidance to prioritise actions, based on a participatory and inclusive exercise, and to establish a common scheme for identifying strategic projects that support local and regional development (CONACYT, 2015d).

From the Federal perspective, the timing of the *Agendas* was crucial, since there is time in the legislation for the implementation of some of the projects identified. Success stories resulting from the *Agendas de Innovation* might trigger the design and implementation of public policies, based on Smart Specialisation, as a way to strengthen the competitiveness of the states through innovation.

## 4.3 Regional linkages to economic competitiveness

Most competitive programmes fund activities within Mexico. No incentives have been identified to promote the international cooperation of companies. The only reference to international cooperation in companies was found in the PEI, where the retention of Intellectual Property Rights in the country is a criteria that gives points in the evaluation of projects.

The states do not have identifiable R&I activities at Regional or international levels. International cooperation is managed at national level with a strong emphasis on supporting researchers going abroad to work with internationally recognised HEIs. The FONCICYT Fund, managed by CONACYT, finances activities of the international agenda to build and strengthen Mexico's relations with international partners in the area of STI. International cooperation activities are managed through bilateral or multilateral S&T agreements with different degrees of reciprocity in the funding schemes (see section 5.2.2).

As discussed in chapter 1.5, Mexico´s share of international co-publications is high (see Figure 6), and Mexico´s share of international co-inventions is above the average OECD level (OECD, 2014a), although there is no clear linkage between these results and the international cooperation policy of the country.

The action plan resulting from the EU-CELAC 2015 summit included, as the main objective in the area of R&I, the development of the "EU-CELAC Knowledge Area" through: i) improving cooperation in research and innovation; ii) strengthening scientific and technological capacities, and infrastructures; iii) enabling sustainable research, innovation and knowledge sharing taking into account the contribution of ancestral and traditional knowledge; iv) boosting the use of new and existing technologies and technology development and transfer underpinning sustainable socio-economic development and v) fostering cooperation between both regions as regards the digital-economy and the reduction of the digital divide for improving competitiveness while making social inclusion a cross-cutting issue.

## 4.4 Assessment

Smart Specialisation is an innovation policy that builds on a foundation of existing or future comparative advantages at a regional level, leading to economic growth.

Although Mexico does not have a specific national policy for Smart Specialisation, Smart Specialisation strategies have been developed in all States in the period 2013 to 2015, in a national wide coordinated project.

The strategies named *Agendas de Innovación* have been developed following the European approach to Smart Specialisation Strategies (RIS3). The process and implementation of the *Agendas* has been defined by the State governments, taking into account the opportunities for STI in Mexico (FUMEC, 2015), and being developed with the participation of the business community.

One of the main challenges that policy makers in Mexico face is achieving an appropriate balance between horizontal measures that focus on raising the overall level of innovation or research, as opposed to measures aimed at supporting clearly identified priority sectors in the Country. In economies where the level of research and innovation is low, there is a question as to whether resources are utilised more effectively through a broader approach as opposed to one which is narrowly focused on a relatively small number of sectors. In the case of Mexico, selecting the appropriate set of priority sectors is a key factor in the strategies being developed.

Mexico faces important challenges in terms of specialisation, augmented by the diversity, complexity and asymmetries that exist in the country. It is expected that the State Innovation *Agendas* become public policy instruments to coordinate the interaction

of the states with the different levels of support available for innovation, specifically, the programmes of CONACYT, promoting joint investment in sectors and niches of high impact on the economy. Therefore, a key factor will be to ensure funding for the projects identified as strategic in the Innovation *Agendas*.

# 5. Internationalisation of R&I

In this chapter, the role of Mexico as a global R&D player is examined, including the potential opportunities for collaboration with the EU and, in particular, the JRC. Section 5.1 introduces the main features that characterise Mexico in the global economy and the R&I landscape. The STI international cooperation policy, and its relation with the broader international policy of Mexico is discussed in section 5.2, as well as the participation of intergovernmental organisations, particularly in CERN (European Organisation for Nuclear Research), and STI agreements with the EU and EU countries. In section 5.3, the possibilities for STI collaborations are assessed, and the following section describes the linkages of Mexico with Brazil, China, India and the USA. Section 5.5 analyses the mobility of researchers, both to and from Mexico, as well as introducing the concept of joint laboratory collaboration either in Mexico or Europe. The capacity of Mexico to attract R&D related Foreign Direct Investment is examined in section 5.6, and an assessment of the findings of the chapter is presented in section 5.7.

## 5.1 Mexico in the global R&I system

According to the OECD STI scoreboard 2015, OECD countries, and major non OECD economies, are starting to move beyond the crisis, increasingly investing in the future. This section examines the position of Mexico in the global R&I system.

Investment in innovation in the OECD area is intensifying, mainly driven by business R&D whereas, government R&D has been hit by budget consolidation measures. In Mexico, however, the opposite is happening; investment in business R&D is decreasing while Government R&D expenditure is increasing.

The research mix in OECD countries (2013), is characterized by higher investment in technological development (62%) as against applied research (21%), and basic research (17%). Investment in all three areas has increased since the 1980s, however, spending on basic research has incremented at a faster pace, a result of the commitment of many governments to funding basic research. In Mexico, in 2011, technological development constituted 44% of total expenditure, applied research 27%, and basic research 29%. The percentage rate of investment in basic and applied research is higher than the average of OECD countries, with the percentage investment in technological development falling well below, 44% against 62%. The weight of basic research increased 5 points between 2009 and 2011, unlike applied research and technological development which saw their investment reduced, by 4 and 1 point, respectively, in the same period[67]. Similar to OECD countries, in Mexico basic research is concentrated mainly in Universities and government institutions.

The role of disruptive innovations[68] in enabling the next production revolution in the OECD area, is assessed in terms of patents in ICT, advanced materials, and health. In the 2007-2013 period, Mexico obtained 118 PCT patents in ICT, 35 in Biotechnology, and 25 in nanotechnology (OEI, 2015). These three areas are considered of strategic importance in the PECiTI.

In 2015, several OECD countries were using R&D tax incentives to support business R&D. As discussed in chapter 2, in Mexico, the main government support for business R&D is through subsidies. R&D tax incentives were removed in 2008 and the government has not changed this policy yet.

According to the OECD, scientific excellence relies on research hotspots and collaboration networks. Cited publications from Mexico as a percentage of the top 10% most cited

[67] The reduction of investment in applied research was mainly in the HEIs sector and the reduction in technological development in the business sector (although it increased in the HEIs sector). Elaborated by the author with data from CONACYT, 2013b, pp 200

[68] ICT technologies, plus advanced materials and health (OEI, 2015)

publications is higher than those of China, India and Brazil, and its share of international co-publications is higher than China, India Brazil and the USA.

The presence of leading R&D corporations performing frontier innovation is very low. According to the 2015 EU Industrial R&D Investment Scoreboard, from a total of 2,500 companies listed on the scoreboard, just one company had its headquarters located in Mexico; 908 companies had subsidiaries in the country (JRC-IPTS, 2015).

In the OECD, global value chains (GVCs) are mostly regional (OECD, 2015a).

Mexico´s main trade partners are the USA (64% of foreign trade), China (9.4%) and the EU-28 (8.2%) (DG Trade, 2015).

Mexico's trade economy is heavily linked to the United States with the country accounting for around 80% of exports and over 50% of imports. However, Mexico has lost pace against China in the supply manufacturing components to the USA. In 2014, China was the biggest supplier of manufactured components to the USA, ahead of Mexico and Canada.

According to the NDP, the average salary of Mexicans working in, or related to, the export sector is three times higher than the average of the national economy as a whole.

More workers are becoming engaged in GVCs across the OECD countries, and the proportion of highly skilled workers employed along the GVC is growing. Meeting foreign demand requires relatively high shares of low and highly-skilled workers, whereas domestic demand relies more on medium-skilled occupations.

## 5.2 Main features of international cooperation policy

The Mexican international STI policy is intertwined with the country's broader international cooperation policy, *Mexico with Global Responsibility*, one of the five main objectives driving the Government activities for the 2013-2018 period (NDP, 2013). Concluding from a previous diagnosis that Mexico can establish itself as an emerging power, the NDP established an action plan, with the overall purpose of strengthening the constructive role of Mexico in the world, and monitoring its progress with the Index of Globalisation (KOF-GI, 2015). Mexico ranks high in this index (75th position out of 207 countries), ahead of China, Brazil and India, but behind the USA. This index disaggregates the globalisation performance in terms of economic, social, and political globalisation. Mexico ranks well in economic globalisation (72th), ahead of all the above-mentioned comparison countries. It is also well positioned in social globalisation (95$^{th}$), ahead of Brazil and India, but behind China and the USA. In political globalisation, however, being 83$^{rd}$, it ranks last (and lagging behind) among the countries of comparison (KOF-GI, 2015).

The policy of *Mexico with Global Responsibility* seeks to expand and strengthen Mexico´s presence in the world; to reaffirm Mexico's commitment to free trade, mobility of capital, and productive integration; to promote the value of the nation in the world through economic, tourist, and cultural dissemination, and to ensure the interests of Mexicans abroad.

**In relation to North America**, where the trade relations are based on the 1994 NAFTA agreement, the main objective of the government is the promotion of democracy and human rights, with special emphasis on border security, migration issues, and the rights of Mexicans in the USA (there are 11.8m Mexicans in the USA). STI cooperation mirrors these areas, with agreements, for example, on home land security.

According to the NDP, the objective of Mexico in relation to cooperation **with Europe** is to expand commercial relations with EU-28, on a reciprocal basis, and open relations with European countries outside the EU-28.

Mexico has had a formal relationship with the EU since 1997 when the Economic Partnership, Political Coordination and Cooperation Agreement was signed. Since 2008, Mexico has been one of the EU's strategic partners (one of only 2 in Latin America, along

with Brazil) through the Partnership Agreement and the associated Joint Executive Plan. According to the European External Action Service (EEAS), the issues that the EU and Mexico are engaged in, include climate change, sustainable development, international peace & security, democracy & human rights, and global economic governance[69]. Since 2014, Mexico is considered a higher middle-income country and thus not entitled to bilateral EU development aid. However, Mexico will remain eligible to receive funding from several EU programmes/instruments, such as the Development Cooperation Instrument (DCI) thematic programmes, the Partnership Instrument (PI), the European Instrument for Democracy and Human Rights (EIDHR), all continental programmes for Latin America, and Horizon 2020. At the EU-Mexico Summit of 12 June 2015, the Presidents of both sides announced the launching of the process of starting negotiations on the modernisation of the EU-Mexico Global Agreement.

**With respect to Latin America**, the main objectives of cooperation activities are to have further commercial integration, support the stability of the region, to promote Mexico as a business logistic platform, between the north and the south of the continent. Mexico views its *participation in the Pacific Alliance* as a way to achieve its aims in the region, and as the means to project the region to the world, in particular to the Asian-pacific region. STI cooperation is structured through participation in organisations such as the United Nations Economic Commission for Latin America and the Caribbean (ECLAC or CEPAL- Comisión Económica para America Latina y el Caribe), the Organisation of Iberoamerican States for Education, Science and Culture (OEI-Organización de Estados Iberoamericanos para la Educación, la Ciencia y la Cultura), the Community of Latin American and Caribbean States (CELAC- Comunidad de Estados Latinoamericasos y Caribeños) and the Network for Science and Technology Indicators –Ibero-American and Inter-American (RICYT-Red de Indicadores de Ciencia y tecnologia-Iberoamericana e Interamericana).

Mexico is looking to enhance its relations **with the Asian-Pacific region** as a key element for the country´s economic diversification. Special emphasis will be devoted to the Trans-Pacific Partnership (TPP), which is seen as perhaps the most important, and ambitious, trade negotiations on a global level. Mexico joined trade negotiations in October 2012.

The main objective of STI international cooperation, for the 2013-2018 period, is to expand international cooperation in R&D, gaining information on successful international experiences, while promoting, and applying, national scientific, and technological achievements, abroad (NDP 2013). This policy differs from that of the previous period where international cooperation in STI was viewed as a means to increase funding for R&D (Mora, 2013).

The PECiTI identifies the need to concentrate international STI cooperation in a set of identified countries. Focusing efforts in a set of defined countries is expected to achieve a more efficient, and effective, use of resources, and yield better outcomes. The target countries for bilateral STI cooperation are the USA and Canada in North America; Argentina, Brazil, Chile, and Colombia, in South America; Germany, Spain, France, and the UK in Europe; and China, South Korea, India, Israel, and Japan, in Asia. The selection criteria for these countries is based on both the quality of the research carried out on in the countries (publications and patents), as well as considering geographic and economic strategic reasons.

The Mexican government has bilateral agreements in the area of STI with several of the targeted countries, together with the multilateral agreement with the European Union. The Agreement for scientific and technological cooperation between the European Community and the United Mexican States has been in force since 2005.

[69] http://eeas.europa.eu/mexico/index_en.htm

International cooperation in STI is mainly directed through CONACYT, and its department of International Cooperation. FONCICYT was created for the development and implementation of CONACYT´s international scientific and technological cooperation activities. It provides financial support for international activities of scientific and technological cooperation, in accordance with the procedures determined by FONCICYT´s Technical and Administrative Committee for each case. The other two agencies that carry out activities related to STI are PROMEXICO (Trade and Investment Agency) and AMEXCID (Mexican Agency for International Development Cooperation). PROMEXICO is the trade and investment agency, mainly concerned with attracting investment to Mexico, and supporting businesses in their internationalization efforts. As part of its portfolio, PROMEXICO promotes infrastructure, such as Technology Parks, to attract high tech businesses. AMEXCID is the main agency for International Cooperation for Development. It provides technical, and scientific international cooperation, in priority sectors: health, environment, education, infrastructure, and STI. It offers scholarships, and academic exchange programmes for students, teachers, researchers, and foreign experts. It also channels various scholarships, and academic exchange programmes, from foreign governments, to train Mexican students abroad.

### 5.2.1 National participation in intergovernmental organisations and schemes and multilateral agreements

Mexico is a member of the OECD, the United Nations, the Group on Earth Observations (GEO) and the World Trade Organisation (WTO). In 1994, it signed the NAFTA agreement with the USA and Canada; and the Economic Partnership, Political Coordination, and Cooperation Agreement with the EU in 1997. From 2000 to 2014, Mexico has signed 342 bilateral and multilateral treaties for international cooperation, including cultural and educational treaties, general cooperation, consular affairs, etc.[70]In 2012, Mexico formally joined the Trans-Pacific Partnership negotiations, forming the Pacific Alliance with Peru, Colombia and Chile.

Mexico has worked with CERN since the 1980s[71], with the participation of individual Mexican physicists in experiments at the organisation. Various institutes are participating in ALICE (A Large Ion Collider Experiment), working principally on the trigger system, and in connection with cosmic-ray physics. Other institutes have joined CMS (The Compact Muon Solenoid).

In 1998, a Co-operation Agreement between the CONACYT and CERN was signed in order to further develop the scientific and technical cooperation in high-energy physics. CERN signed an agreement with the UNAM to co-finance working exchange visits. Contacts have been strengthened by the participation in HELEN (High Energy Latin American European Network) (2005-2009), and in EPLANET (European Particle physics Latin America Network), since February 2011. After the visit of a Mexican Delegation, in September 2013, a Protocol was added to the 1998 Co-operation Agreement, with the aim of facilitating the participation in CERN Programmes of CONACYT and other Mexican Institutions.

### 5.2.2 Bi-and multi-lateral agreements with EU countries

Mexico is one of the four countries in Latin America which has signed an agreement with the EU for Scientific and Technological Cooperation. The other countries are Argentina, Brazil and Chile. Since 2014, EU-MEX INNOVA cooperation has evolved into a more reciprocal relationship. Co-funding mechanisms have been designed to work in selected areas of mutual interest. Examples of this are the joint call on Geothermal energy, which has a total allocation of €20m, with equal contribution from both sides for the work programme 2016-2017; and cooperation through multilateral initiatives on international manufacturing systems, and on infectious disease preparedness and chronic diseases.

[70] http://www.gob.mx/presidencia/datos-abiertos/566732d403c952eb83909cd5
[71] http://international-relations.web.cern.ch/international-relations/nms/mexico.html

Mexico was the first Latin American country to create a new mechanism to support the participation of Mexican researchers' in H2020. After Mexico was listed as a third country without the right to funding from the EC in 2014, CONACYT designed a new call: the *CONACYT Horizon2020* call, to supplement the funding required by Mexican institutions to participate in consortia in Horizon 2020.

The call focusses on strengthening cooperation between Mexico and the European Union in science, technology and innovation through the promotion of participation of Mexican entities in any of the calls of Horizon 2020. The main areas supported are those considered a priority in the PECiTI: Environment, Sustainable development, Knowledge of the Universe, Technological Development, Energy, Health, and Society. With an initial budget of €10m, CONACYT finances up to 85% of Mexico's participation in a project, in the case of public institutions, IES, research centres and individuals; and up to 70% in the case of private entities, except IES. The remainder is provided by the Mexican entity. The same percentages apply in the case of natural persons affiliated to entities participating in the Marie Sklodowska-Curie and ERC programmes.

The government of Mexico has established STI bilateral agreements with several European countries, such as Spain, Germany, France and the UK. Furthermore, CONACYT, the Ministry of Education, and individual HEIs and Research Institutes have agreements with counterparts in different EU countries. They involve the exchange of students, mostly postgraduate, and collaboration in R&D projects.

Instruments to support project based collaboration, under the bilateral agreements include the UK Newton Fund which has a large spectrum of priorities; the Spanish CONACYT-CDTI (Centro para el Desarrollo Tecnológico Industrial) bilateral call 2015 including priorities such as biotechnology and advanced manufacturing; the french ANR (Agence nationale de la recherche)-CONACYT joint calls, where the areas of biology, agronomy, materials, chemistry, energy and ICT are prioritized; or the *Programme 2+2* with Germany to promote linkages between industry and academia in both countries. The programme 2+2 is to be launched in 2016 as part of the Mexico-Germany dual year 2016-2017.

Mexico is involved in various triangular cooperation projects with Germany, through the German Regional Fund for the Promotion of Triangular Cooperation in Latin America and the Caribbean[72].

## 5.3 Assessment of options for JRC collaborations

DG JRC cooperates with Mexican institutions in several areas, including water management, climate change, soils, and nuclear safety. Most JRC cooperation with Mexico is undertaken at regional and international level, for example EUROCLIMA (Soil Atlas of Latin America and the Caribbean), RALCEA (Latin American network of knowledge centres in the water sector), and programmes funded by DG DEVCO.

In the area of the science to policy interface, the coordinator of STI, created as a new position in 2012 as part of the office of the president, is a natural interface for DG JRC. The main objective of the coordinator of STI is to develop Science for Policy, thus complementing the more developed area of Policies for Science, led by the CONACYT. The main boundary organisations are the General Council for Scientific Research, Technological Development, and Innovation, supported by the Advisory Forum for Science and Technology, as well as the Inter-sectoral Committee for Innovation, for specific sectoral issues, and the National Conference of STI, for policies at state level. All these entities collaborate with the CONACYT in the development of Policies for Science.

The JRC has a long standing relation with Mexico in the areas of Environment, resource scarcity, climate change and sustainability. The first ever Soil Atlas of the Latin America and the Caribbean was published by DG JRC in 2014, and included contributions from

[72] https://www.giz.de/en/worldwide/12942.html

several Mexican institutions such as the National Geographic Institute (INEGI), National Autonomous University of Mexico (UNAM), Nayarut University, and Mexico's Agriculture Ministry (SAGARPA), as well as scientists from the Community of Latin American and the Caribbean States (CELAC). DG JRC also has a bilateral cooperation agreement in place with the Instituto Tecnológico de Monterrey (ITESM), which aims to support water resources management activities.

In the area of Disaster risk management, frequent interactions take place between DG JRC and Mexican authorities such as the National Centre for Disaster Prevention (CENAPRED), which expressed interest in concluding a cooperation arrangement with the JRC and the National Agency for Science and Technology (CONACYT).

In the area of Energy and transport, the Energy and telecommunications reforms, open new opportunities for collaboration with the DG JRC. Mexican oil fields are opening up to foreign production for the first time in 77 years, however, security is an important factor in the bidding process. For example, satellite-based surveillance systems might be of interest to the stakeholders to make the bidding more attractive.

The New Mexican Energy Innovation Centres (Centros Mexicanos de Innovación en Energia, CEMIES) may also represent an open opportunity for collaboration with the JRC. Mexican Energy Innovation Centres are an initiative of the Ministry of Energy and the National Council of Science and Technology, seeking to boost research through the use of renewable energies[73]. According to the Minister of Energy, these CEMIES represent the largest investment in R&I carried out in the field of energy in the country. An important commitment has also been made by President Enrique Peña Nieto, on behalf of Mexico, with the signing the joint statement of Mission Innovation, in which member countries seek to double their investment and research in clean energy over a period of five years.

After a call for proposals in 2013, three CEMIES were launched through a guaranteed 4 years funding scheme:

- CEMIE-SOLAR: Led by UNAM´s Institute of Renewable Energies, involving 57 institutions- 47 research institutions and 10 firms- with a budget of €26m.
- CEMIE-WIND: Led by the Institute of Electrical Research (Instituto de Investigaciones Eléctricas (IIE), involving 32 institutions- 22 research institutions and 10 national and international firms- with a budget of €6m.
- CEMIE-GEOTHERMAL: Led by the CICESE Ensenada, involving 21 institutions- 12 research institutions and 9 firms- with a budget of €55m.

The creation of the CEMIE-GEOTHERMAL was an important element in identifying needs and establishing the joint call on Geothermal energy between the EU and Mexico. This joint call now has a total allocation of €20m, with equal contribution from Mexico and the EU for the work programme 2016-2017.

Two more CEMIES were created in 2015: CEMIE-BIOENERGY and CEMIE-OCEAN, with and approximate budget of €160m for four years[74]:

- CEMIE-BIOENERGY: It involves five thematic fields, each lead by an institution: Solid Biofuels, led by the Ecosystems and Sustainability Research Institute UNAM; Bio-alcohols, led by CINVESTAV IPN - Unit of Guadalajara; Biodiesel, led by the Centre for Research, Technical Assistance and Design of the Jalisco State A.C., and Biogas and bioturbosina, led by the Potosino Institute of Scientific and Technological Research A.C.
- CEMIE-OCEAN[75]: Led by the Engineering Institute of the UNAM, involving 56 partners including Research Centres, Institutions of Higher education, companies

[73] http://sustentabilidad.energia.gob.mx/res/CEMIE_General.pdf
[74] http://www.gob.mx/sener/articulos/se-dan-a-conocer-a-los-ganadores-de-los-centros-mexicanos-de-innovacion-en-energias-bio-y-oceano
[75] http://www.iingen.unam.mx/es-mx/BancoDeInformacion/BancodeImagenes/Documents/CEMIE_Oceano.pdf

and international advisers. The work will involve generating energy from the following technologies: wave energy, tidal current energy, energy from thermal gradients, and energy from salinity gradients. Transverse Lines will seek the integration of elements common to the four technologies by working on infrastructure management; Ecology and Integration to the environment; Materials, subsystems, and components; integration with the electric grid; physical and numerical modelling; training; and dissemination.

In the area of Data and Digital transformations, Mexico was the first Latin American country to deploy FI-WARE, a middleware platform promoted by the EU for the development and global deployment of applications for Future Internet.

Although hailing from Europe, FIWARE has been designed for a global use, and for the benefit of other regions around the world. The FIWARE Mundus programme is designed to establish worldwide links, engaging local ICT players and domain stakeholders, and eventually liaising with local governments in different parts of the world, including North America, Latin America, Africa and Asia.

The deployment of FIWIRE in Mexico has involved the creation of a FILAB with the collaboration of INFOTEC, CONACYT, TEC de Monterrey, CENIDET PLENUM and QoSLabs.

FILABs are non-commercial sandbox environments where innovation and experimentation based on FIWARE technologies takes place. Entrepreneurs and individuals have access to the technology to test and showcase their applications in the FIWARE Lab, exploiting open data published by other organizations.

The objective of FIWARE is to facilitate the cost-effective creation and delivery of Future Internet applications and services in a variety of areas, including smart cities, sustainable transport, logistics, renewable energy, and environmental sustainability76. This platform may present open opportunities for collaboration with DG JRC.

In the area of Food, Nutrition and Health, collaboration opportunities may be opened between the JRC´s European Union Reference Laboratories and the Mexican National Institute on Public health (INSP-Instituto Nacional de Salud Pública) and the CONACYT Centre CIAD-Centro de Investigación en Alimentación y Desarrollo.

In the area of Innovation systems and processes, new opportunities for collaboration may be opened with the new organization being adopted by the CONACYT research centres system, which seeks to align the diverse capacities and interests under 5 coordination areas:

- Advanced Manufacturing and Industrial Processes
- Applied Physics and Mathematics, and Information Sciences
- Food production, sustainable development and biotechnology
- Public Policy and Regional Development
- Social Anthropology and History

The reorganization of the system is intended to provide more and better communication between the centres and their research communities, to help detecting complementary capabilities, applying multidisciplinary approaches, and optimising human resources and administrative and scientific infrastructure.

Besides the reorganization into coordinations, the CONACYT research centres have implemented cross-coordinations strategies, one of them called PILA-Programas de Investigación de Largo Aliento[77]. The PILA is not a funding programme. It is a strategy

76 https://www.fiware.org/; https://www.fiware.org/2014/06/27/mexico-first-latin-american-country-to-deploy-fi-ware/
77 Information about the PILA was obtained by the author from http://www.conacyt.mx/index.php/el-conacyt/centros-de-investigacion-conacyt/pila-programas-de-investigacion-de-largo-aliento, and updated through an interview with personnel from CONACYT responsible for the PILA

to define, prioritize and align the research agenda of the CONACYT centres with a horizon of 10 years. Part of this effort involves the identification of national and international strategic partners, with whom to join efforts to enhance the quality and impact of research. The agenda is aligned with the thematic areas set out in the PECiTI 2014-2018. As of May 2016, the PILA under development are in the areas of:

- Climate change and sustainability
- Food systems
- Health (obesity, diabetes and metabolic syndrome)
- ICT and Logistics
- Knowledge of the Universe and earth sciences
- Smart manufacture and energy

Another cross coordinations strategy is the creation of consortia at regional level, i.e., groups of centres installed at a key location to jointly address major regional development challenges, or the strategy to address technological demands from industry (ECATI-Estrategia de Centros para la Atención Tecnológica a la Industria). The ECATI initiative targets four priority sectors in Mexico:

- Automotive
- Aeronautics
- Energy
- Manufacturing

Mexico is involved in important R&I collaboration with the USA, with the area of Migration and territorial development being of special interest. Building on this and promoting trilateral EU-Mexico-USA collaboration could represent an opportunity for DG JRC.

Collaboration opportunities can be materialised in the form of: collaboration with the JRC centres and European Union Reference Laboratories in the different areas mentioned above, applying European best practices in industry and academia partnerships; teaching and training of specialised courses, collaboration in research projects; research visits, conferences and workshops; mobility schemes for graduates and postgraduates; and innovation capability building.

## 5.4 R&I linkages between countries in this study

Linkages between Mexico and the countries in this study are presented in Table 17[78]:

**Table 17** – R&I linkages between countries in this study

| Country | Instruments & mechanisms for cooperation |
|---|---|
| **China** | Science and Technology Agreement 1989,<br>Cooperation Agreement between CONACYT and MOST[79], 2012<br>Specific Cooperation Agreement for the publication of joint calls for research projects, 2014. Mexican and Chinese partners prepare a joint project which is presented in parallel to CONACYT and MOST. Each institution funds the costs for their national researchers.<br>Joint Research Projects call for proposals 2015: one project was funded by FONCICYT. The project is carried out by the Autonomous University of San Luis de Potosi and de title is, *Geospatial technologies and their engineering applications-the case of Satellite-based Global Navigation Systems and Geographical Information Systems*.<br>Areas of work: Research projects<br>Fields: Aerospace research and Geosystems |

[78] Information on Collaboration with Brazil was not identified

[79] MOST- Ministry of Science and Technology (Ministerio de Ciencia y Tecnología de la República Popular China)

| Country | Instruments & mechanisms for cooperation |
|---|---|
| | Funding Allocation: Estimated combined investment €543,597 (USD 600,000) |
| **India** | Science and Technology Agreement 1975<br>Renewal of the Programme for S&T cooperation between CONACYT and the DST (Department of S&T at the Ministry of S&T) as part of the V Joint Committee Mexico-India, 2014<br>Call for proposals 2015: Mobility Joint Call 2015 (CONACYT - DST). Support for short stays, in the context of ongoing joint research projects.<br>Areas of work: Research mobility<br>Fields: Water, Biotechnology and Health, Seismology, Solar energy<br>Funding Allocation: To be determined according to availability of resources. Travel and perdiem expenses covered, about €5,000 for a 30 day stay. |
| **USA** | USA-Mexico Commission for Educational and Cultural Exchange (COMEXUS), 1990 (Fulbright grants)<br>USA-Mexico Bilateral Forum on Higher Education, Innovation and Research (FOBESII), 2014<br>CONACYT has signed agreements with several USA Universities, such as the University of California, the University of Arizona, the University of Texas at El Paso (UTEP) and The University of Chicago. It also has Memorandums of Understanding with the State of California, and with New Jersey.<br>As an example, the 2015 call for proposals between CONACYT and the University of Arizona included:<br>Areas: Research projects and postdoctoral fellowships.<br>Fields: Environmental sustainability in arid regions, and environment and social justice<br>Funding allocation: €54,000 per grant |

The developments in 2014 between Mexico and the USA are of special interest for the opportunities it might open for the JRC and for trilateral initiatives between the EU, Mexico and the USA.

The USA-Mexico Bilateral Forum on Higher Education, Innovation and Research (FOBESII), 2014[80] complements President Obama's *100,000 Strong in the Americas* initiative, which seeks to increase student mobility between the USA and the countries of the Western Hemisphere. It is also consistent with Mexico's *Proyecta 100,000* program that aims to send 100,000 Mexican students to the USA, and to receive 50,000 USA students in Mexico by 2018.

The main areas of work of the FOBESII are educational exchanges, scientific research partnerships, and cross-border innovation. The thematic fields are science, technology, engineering, and mathematics (STEM). From January to June 2014, six workshops were organized for over 450 USA and Mexican partners from government, academia, civil society and the private sector. The result was the 2015 action plan. Almost 27,000 Mexican students and teachers travelled to the USA in 2014. The 2015 Call for short stays in the USA, had a special focus on the thematic fields of the PECiTI, especially Telecommunications and Energy; and provided between €1,000 and €1,200 for a 30 day stay.

Mexico´s National Association of Universities and Higher Education Institutions (ANUIES) initiated collaborative arrangements with Universities and research centres in California, Massachusetts, and Texas, and launched a co-development and commercialization collaboration with the NASA Johnson Space Centre, as well as collaboration on cyber infrastructure with the University of Texas in El Paso (UTEP). It is also developing

[80] http://www.State.gov/r/pa/prs/ps/2015/01/235641.htm

entrepreneurship, innovation and internship programs with the American Chamber of Commerce of Mexico and the California Chamber of Commerce, and has initiated discussions with the Council for Higher Education Accreditation (CHEA) on ways in which Mexican and USA quality assurance and accrediting organizations might work together**.**

In scientific research partnerships, the National Science Foundation (NSF) and the *CONACYT* have strengthened their bilateral partnerships through FOBESII. *CONACYT* became an official partner in NSF's Partnership for the International Research and Education programme (PIRE). As a result, binational research projects on science and technology will be funded by the two agencies. The NSF and the USA-Mexico Foundation for Science (FUMEC), also expanded joint work with NSF's Innovation Corps (I-Corps) and Industry/University Cooperative Research Centres (I/UCRC) programs. Two workshops and one symposium, which brought together over 240 USA and Mexican participants from government, academia, and the private sector, provided forums to adapt the I-Corps model to Mexico (workshops) and to launch the Intelligent Manufacturing Initiative (symposium). Four NSF I/UCRCs partner ships, with Mexican institutions, were developed in the sectors of advanced nonferrous alloys, intelligent manufacturing, logistics/distribution and petroleum.

In 2015, NSF and *CONACYT* focused on exploring opportunities to: expand the I-Corps model and the I/UCRC program in Mexico; coordinate research programs related to energy, water, hazards, technology, and advanced manufacturing; collaborate trilaterally between USA, Mexico and Canada; and promote a multinational collaboration for addressing gender issues in research and innovation.

## 5.5 Research mobility and joint laboratories

### 5.5.1 Researchers from abroad and national researchers

According to reports from CONACYT (CONACYT, 2012b, 2013a, and 2014a), the pattern of flow of students/researchers in the 2012-2014 period shows a prevalence for an outward flow of postgraduate students with an inward flow of less than 1% (mainly from Germany, and a limited number from Japan).

The number of postgraduate students abroad accounts for around 10% of the total number of postgraduate students, a slight increase from between 2012 and 2014. The distribution between doctoral and masters students is in the range of 50% each, although the number of doctoral students decreased from 54% in 2012, to 49% in 2014.

Grants covering a full degree (masters, PhDs) accounts for about 80% of the total grants awarded. The number of national students travelling abroad for less than a year has risen from 16% to 19%. Science-oriented students amount to about 60%, while 40% were in the field of humanities. There has been little change in the countries of destination in the period. The USA receives around a quarter of all students (a slight decrease in the period), followed by the UK with about 22% of students. Spain receives 14-16%, Germany 8-9%, France 6%, and Canada 5%. In 2014, two new countries were reported on, the Netherlands with 4% and Australia with 2%.

Mexico´s National System for Researchers (SNI) was created in 1984 to tackle the brain drain suffered during the 1980s. Its main objective is to promote both the quantity and quality of research in Mexico, through a three-level compensation scheme depending on the researcher´s trajectory. As part of the funding scheme for researchers to join the system, there are two programmes related to internationalisation: the programme for retention, repatriation and consolidation, and the programme to support sabbaticals and postdoctoral stays abroad. In the 2012-2014 period, between both programmes, the number of researchers receiving support more than doubled, from 431 (2.3% of researchers in the SNI in 2012) to 939 (4.4% of researchers in the SNI in 2014). Of those, around 80% were sabbaticals and postdoctoral stays abroad, and only around 20% involved repatriations or retentions. Of that 20%, about 30% was for repatriation and 70% for retention.

### 5.5.2 Scope of joint laboratory collaboration in Mexico or in Europe

A study developed in 2015 in the EuropeAid Project *Technical Assistance for Strengthening of the Science, Technology and Innovation system in Uruguay (BENEF 2013 FWC Lot 10 2015/358838*, identified European Research Centres that had facilitated in Latin America (See Table 18).

**Table 18** – European RTOs with facilities in Latin America, 2015

| European RTOs with country of origin | Countries of destination in LA |
|---|---|
| Denmark | |
| DHI | Brazil, Peru |
| Finland | |
| VTT - Technical Research Centre of Finland | Brazil |
| France | |
| Crns Centre National de la Recherche Scintifique | Brazil |
| Commissariat à l'Energie Atomique et aux Energies Alternatives | Brazil |
| Instituto Pasteur | Brazil, Uruguay |
| INRIA | Chile |
| Germany | |
| Max Planck Gesellschaft | Argentina |
| Fraunhofer Gesellschaft zur Förderung der Angewandten Forschung e.V. | Brazil, Chile |
| Netherlands | |
| Wageningen | Brazil, Chile |
| Deltares | Brazil |
| Norway | |
| Sintef | Brazil, Chile |
| Spain | |
| Leitat Technological Centre | Chile |
| Fundacion Tecnalia | Colombia, Mexico |
| Switzerland | |
| CSEM | Brazil |

From a base of the 90 RTOs (Research and Technology Organisations), which are members of EARTO (European Association of Research and Technology Organisations), and the 50 more successful RTOs in the European 7$^{th}$ Framework Programme, a combined list of 127 RTOs was obtained. From the 127, 33 had facilities outside their country of origin, and of those, 13 had facilities in Latin America (LA). Table 12 shows the RTOs with facilities in LA, and the countries of destination. Only one, Tecnalia from Spain, has facilities in Mexico, working mainly on the commercialisation of R&D results developed in Europe.

The Pasteur institute is present in Mexico through a collaboration with SANOFI, the ANOFI-Pasteur centre[81].

As part of the USA-Mexico Bilateral Forum on Higher Education, Innovation and Research (herein referred to as FOBESII), in 2014[80], Mexico and the USA were working on the development of binational research and innovation centres, such as the Logistic and Distribution, the Intelligent Maintenance and Advanced Nonferrous Alloys and Materials consortia. This is in addition to the cooperation agreements between the Gulf of Mexico and the Caribbean Marine Research Institutions Consortium (CIIMAR-GOMC) and three USA organizations (USA Gulf of Mexico University Research Collaborative, the Harte Research Institute and the Northern Gulf Institute) as well as a binational virtual centre on Advanced Manufacturing between *CONACYT*'s Centre of Advanced Technology (*CIATEQ*) and the University of Texas (PanAM and Austin).

In collaboration with the Department of Energy (DOE), the National Autonomous University of Mexico (*UNAM*), and the National Institute of Astrophysics, Optics and Electronics of Mexico (*INAOE*), NSF and *CONACYT* funded the construction of the 14 million dollar High Altitude Cherenkov Observatory (HAWC) on the flanks of the Sierra Negra volcano near Puebla, Mexico.

## 5.6 R&D related FDI

In 2014, the inflow of FDI in Mexico represented 2% of GDP, with manufacturing accounting for more than 50%. FDI in medium-high and high technology sectors now accounts for some 60% of total inflows. The USA at 29% and Spain at 18% are the main investors in Mexico. FDI from Germany stands at 2% of the total FDI inflows to Latin America, mainly in the manufacturing sector, specifically in the automotive sector, and Mexico receives 22% of total German investment in LAC.

Export-oriented manufacturing, as it is the case in Mexico, tends to be a result of Greenfield [82] projects undertaken by transnational corporations. Global greenfield investment trends indicate that the automotive manufacturing is witnessing a substantial rise in capital investment (fDi Intelligence, 2015).

Mexico is expected to increase FDI in 2015 thanks to the large number of projects announced in manufacturing from car makers from all over the world. Among the largest projects, were investments by the USA-based Ford and General Motors for €1.812 billion (USD$ 2 billion) and €3.262 billion (USD$ 3.6 billion) respectively, and by the Republic of Korea's Kia Motors (largely owned by Hyundai Motors) for €0.906 billion (USD$ 1 billion). In a joint venture, Germany's Daimler and Japan's Nissan are building a €1.232 billion (USD$ 1.36 billion) factory. Other expansion plans are under way from Sweden's Volvo and Japan's Honda.

There are different government strategies to attract the R&I of multinationals, depending on the size of the country, the level of technological development, the institutional capacities, and the relevance of existing foreign subsidiaries in the national innovation system (Guimón, 2008).

An example of technology intensive investment is the case of Audi. According to ECLAC (ECLAC, 2015), Audi plans to commence car manufacturing in Mexico in late 2016. The car manufacturer has opened a training centre at its plant in San Jose Chiapa to prepare staff (and potentially suppliers) for the plant's high-end technology. The new Audi plant in Puebla, Mexico, is an example of the impact that more technology-intensive FDI can have. Following the inauguration of a new, highly advanced plant some years ago, the owners of Audi, the Volkswagen Group worked together with the local government and a local University to create a new training centre to be completed in 2015. As the plant

[81] http://www.sanofipasteur.com.mx/

[82] Greenfield investment occurs when a parent company sets as premises outside the country where the company has its headquarters by constructing new facilities

employs some of the most advanced production techniques used within the multinational enterprise, it was decided to build a training centre in order to ensure that the staff would be qualified to use the most up-to-date new technologies. Furthermore, in order to optimize efficiency, producers of intermediate suppliers are also trained at the centre. As a result, Audi's incorporation into the production structure will help raise the skill level of a large share of workers in the region. In addition to the Volkswagen Group, the project also involves another German company, Siemens, which produces some of the electronics for Audi vehicles.

In many cases, the direct investment of large companies or their existing local presence is a basis for R&D activities. For example, Germany´s technological cooperation builds on the longstanding presence of numerous major German companies. Investment in existing companies and new products is aligned with innovative processes and technologies, as well as technology imports (DBResearch, 2010, DBResearch, 2015).

In Mexico Greenfield investments are supported mainly by governments at State level via economic development incentives. Federal R&I funding is also available to the subsidiaries of foreign companies; companies involved in the automotive industry make use of these incentives. However, this is not considered sufficient to attract R&D FDI, when competing with other countries that also offer fiscal incentives for R&D.

A new system of fiscal incentives for R&D is being pushed by the association of car manufactures (AMIA-Asociación Mexicana de la Industria Automotriz)[83]. According to AMIA, there are seven centres of engineering and design OEM (Original Equipment Manufacturing), two belonging to General Motors, two of Nissan and one of Ford, Chrysler and Volkswagen. Also some suppliers, such as Delphi, Continental, Bosch and Metalsa have this type of infrastructure in Mexico. To further the technological development performed by these centres, representatives of AMIA are asking for a return to the fiscal incentives, on top of the available subsidies, as well as the instruments to promote this type of investment, so that the automotive industry set premises in Mexico not only for cheap labour or State provided economic incentives, but also for the innovation that they can develop in the country.

[83] http://www.cnnexpansion.com/negocios/2016/01/25/armadoras-piden-incentivo-fiscal-para-id

# 6. Conclusions

This chapter provides an assessment of the performance of the national research and innovation system in Mexico, and identifies the main structural challenges faced by the national innovation system.

## 6.1 Structural challenges of the national R&I system

In 2014, Mexico´s R&D expenditure was at its highest level for the last decade, reaching 0.54% of GDP. Although it is still low by international standards, it has been growing in the 2012-2014 period, albeit slower than the annual growth required to reach the objective of 1% by 2018 as stated in the PECiTI.

This growth is driven by the Government, who is the main funding and performing agent of the R&I system. Unlike the EU, where the R&I system is driven by the private sector, in Mexico, the private sector is reducing its participation in the funding and undertaking of R&I. The removal of fiscal incentives to R&I in 2008 was, and still is, controversial, and the private sector is calling for a new bill to reinstate them.

The number of postgraduate grants and of researchers in the National System of Researchers has increased, although it is still below international standards.

Unlike OECD trends, the weight of basic research is relatively high and is increasing, while the weight of technological development is low and dropping. This seems to suggest a tendency towards favouring basic research to the detriment of technological development.

At the same time, the commercialisation of research results, the development of technology-based start-ups, and the development of a critical mass of innovative companies remain a serious challenge.

The infrastructure in place to support of innovation, such as networks of incubators, and Science and Technology Parks, is being developed by institutions and agencies at different levels. However, there is a lack of a structured ecosystem in support of innovation.

The decentralisation policies developed in the last decade are bearing fruit, with the infrastructure capacity increasing and R&I activities being developed in the States themselves. However, in terms of financing, the Federal Government is the main contributor to the regionalisation of R&I, with very little financing coming from the State Governments.

According to the Index of Globalisation, Mexico has a globalised economy. It is one of the top ten countries in the world in terms of attracting Foreign Direct Investment, more than 50% corresponds to manufacturing. This is mainly due to large investments in the automotive sector implemented in greenfield projects. However, the R&D related Foreign Direct investment is very small, and, as shown in Figure 11, the R&D funding from abroad has been decreasing steadily in the 2012-2014 period.

## 6.2 Meeting structural challenges

The PECiTI 2014-2018 includes measures to address some of the main challenges listed above, e.g. increasing R&I expenditure, encouraging private participation, promoting regionalisation, strengthening human and infrastructure capacity, and the commercialisation of research results.

Given that the PECiTI was only approved in 2014, it is too early to evaluate the success of the proposed measures. However, some observations can be made.

Promoting the decentralisation of R&I might benefit from increased funding from the States.

The two mechanisms generally used to encourage private R&I spending include: direct support through competitive programmes and fiscal incentives for R&I. Addressing the

challenge of increasing private R&I investment might benefit from a policy mix where competitive programmes such as the PEI, which are attracting new SMEs (see Figure 19), are complemented with a new model of fiscal incentives for R&I. Maintaining a long term commitment to collaborative competitive programmes, with the objective of increasing the number of companies participating, will benefit the generation of a critical mass of innovative companies over time. Given their nature, it cannot be expected that SMEs invest large sums in R&D, therefore, their contribution to the increase of private R&I spending will be relatively small in the short term. In the medium-long term, it is possible that these SMEs form a critical mass of innovative companies. Increasing private R&I spending in the short and medium term might be achieved with a greater commitment from medium and large companies, both national and international, specifically foreign investment in the manufacturing sector. The energy and telecommunications reforms may offer opportunities to create a more competitive environment, where innovative products play an important role.

As of May 2016, Mexico is considering reinstating fiscal incentives for R&I. Any new mechanisms introduced might benefit from:

- Analysing models in other countries
- Considering the differences and limitations of small, medium and large companies (e.g. developing a simplified system for small companies)

As a top ten attractor of Foreign Direct Investment in the world, mostly in manufacturing, Mexico is in a good position to develop R&I related FDI policies. The policies are likely to have a positive impact on the R&I expenditure through an increase in R&I funding from abroad. A large number of investment projects announced have been announced that will involve transnational corporations in the near future. These greenfield investments are to be developed in different States, with the States having a direct influence on the conditions under which these investment projects will be implemented. A combined effort between the Federal and the States Government might result in a common framework for promoting R&I related FDI.

## 6.3 Main lessons and implications for the EU and its Member States

There are opportunities for the EU to support Mexico in the development of:

- R&I policies at State level, benefiting from the experience of lessons learned in the development and implementation of European Regional policies.
- R&I policies and instruments that provide specific support to high-tech companies, and that distinguish between different stages of their development.
- Ecosystem for innovation.
- Mechanisms to assess the outcomes of competitive programmes, and block funding.

The reforms in the Energy and Telecommunications sectors have created opportunities for European R&D players to invest in Mexico.

## References


Amaral, 2014. Managing Intellectual Property Magazine, September 2014.

CEC, 2011. Iniciativa con Proyecto de Decreto que reforma el Artículo 219 de la Ley del impuesto sobre la renta. Comisión Especial para la Competitividad, Mexico, 2011.

CONACYT, 2012a. Indicadores de Actividades Científicas y Tecnológicas. Consejo Nacional de Ciencia y Tecnología, Ciudad de Mexico, 2012.

CONACYT, 2012b. Informe autoevaluación enero-diciembre 2012. Consejo Nacional de Ciencia y Tecnología, Ciudad de Mexico, 2012.

CONACYT, 2012c. Informe General del Estado de la Ciencia, la Tecnología y la Innovación de México 2011. Consejo Nacional de Ciencia y Tecnología, Ciudad de Mexico, 2012.

CONACYT, 2012d. Programa de trabajo 2012. Consejo Nacional de Ciencia y Tecnología, Ciudad de Mexico, 2012.

CONACYT, 2013ª. Informe autoevaluación enero-diciembre 2013. Consejo Nacional de Ciencia y Tecnología, Ciudad de Mexico, 2013.

CONACYT, 2013b. Informe General del Estado de la Ciencia, la Tecnología y la Innovación de México 2012. Consejo Nacional de Ciencia y Tecnología, Ciudad de Mexico, 2013.

CONACYT, 2013c. Lineamientos del programa para el desarrollo Científico y Tecnológico. Programa Presupuestal U004 Abril. Consejo Nacional de Ciencia y Tecnología, Ciudad de Mexico, 2013.

CONACYT, 2014a. Informe autoevaluación enero-diciembre 2014. Consejo Nacional de Ciencia y Tecnología. Ciudad de Mexico, 2014.

CONACYT, 2014b. Informe General del Estado de la Ciencia, la Tecnología y la Innovación de México 2013. Consejo Nacional de Ciencia y Tecnología, Ciudad de Mexico, 2014.

CONACYT, 2014c. Programa Especial de Ciencia, Tecnología e Innovación 2014-2018, PECiTI, Consejo Nacional de Ciencia y Tecnología, Ciudad de Mexico, 2014.

CONACYT, 2014d. Programa Institucional CONACYT 2014-2018, Consejo Nacional de Ciencia y Tecnología, Ciudad de Mexico, 2014.

CONACYT, 2015a. Diagnóstico del Programa Presupuestario Investigación Científica Desarrollo e Innovación (E003). Consejo Nacional de Ciencia y Tecnología, Ciudad de Mexico, 2015.

CONACYT, 2015b. Fondos mixtos CONACYT-Gobiernos de los Estados y Municipios. Estadísticas al cierre de Diciembre 2015. Consejo Nacional de Ciencia y Tecnología, Ciudad de Mexico, 2015.

CONACYT, 2015c. Fondo Institucional de Fomento Regional para el Desarrollo Científico, Tecnológico y de Innovación. CONACYT. Estadísticas al cierre de Diciembre 2015. Consejo Nacional de Ciencia y Tecnología, Mexico DF, 2015.

CONACYT, 2015d. Agendas Estatales y Regionales de Innovación. Memoria del Proyecto. CONACYT. Fordecyt. Año 2015. Consejo Nacional de Ciencia y Tecnología, Mexico DF, 2015.

CONACYT, 2016. Programa de Estímulos a la Investigación, Desarrollo Tecnológico e Innovación, Convocatoria 2016. Consejo Nacional de Ciencia y Tecnología, Ciudad de Mexico, 2016.

CONEVAL, 2013. Fortalecimiento a Nivel Sectorial de las Capacidades Científicas, Tecnológicas y de Innovación. Ficha de Evaluación 2013 CONACYT. Consejo Nacional de Evaluación de la Política de Desarrollo, Mexico, 2013.

Congreso, 2014. Ley orgánica del Consejo Nacional de Ciencia y Tecnología. Última Reforma publicada DOF 20.05.2014. Congreso de la Unión, Ciudad de Mexico, 2014.

Congreso, 2015. Ley de Ciencia y Tecnología. Última Reforma publicada DOF 8-12-2015, Cámara de Diputados del H. Congreso de la Unión, Ciudad de Mexico, 2015.

DBResearch, 2010. Latin America and Germany build on collaboration. Deutsche Bank Research, Germany, 2010.

DBResearch, 2015. German Companies in Latin America. How have they fared?. Deutsche Bank Research, Germany, 2015.

DELOITTE, 2014. Global Survey of R&D Tax Incentives, Deloitte, 2014.

DG Trade, 2015. European Union, Trade in goods with Mexico. European Union, Directorate General for Trade, Brussels, 2015.

ECLAC, 2015. Foreign Direct Investment in Latin America and the Caribbean. Economic Commission for Latin America and the Caribbean, Mexico, 2015.

EPRC, 2012. Smart specialisation and cohesion policy. A strategy for all regions? European Policies Research Centre, Finland, 2012.

ESIDET, 2012. Resultados de la Encuesta sobre Investigación y Desarrollo Tecnológico y Módulo sobre Actividades de Biotecnología y Nanotecnología (Esidet-MBN), 2012.

FCCyT, 2011a. El impacto de los Fondos Mixtos en el desarrollo regional. Vol.I, Mexico DF, 2011.

FCCyT, 2011b. El impacto de los Fondos Mixtos en el desarrollo regional. Vol.II, Mexico DF, 2011.

FCCyT, 2012a. Fondos mixtos en la Generación de Infraestructura Científica y Tecnología Nacional. Aportes para la generación y aumento de capacidades en CTI en los estados. Foro Consultivo Científico y Tecnológico, Ciudad de Mexico, 2012.

FCCyT, 2012b. Fondo Institucional de Fomento Regional para el Desarrollo Científico, Tecnológico y de Innovación (FORDECyT). Integración regional para el surgimiento de territorios innovadores, Mexico DF, 2012.

FCCyT, 2013. Los Fondos Mixtos en la investigación científica aplicada y el desarrollo tecnológico. Foro Consultivo Científico y Tecnológico, Mexico DF, 2013.

FCCyT, 2014a. Informe de actividades del periodo Agosto 2012 - Julio 2014. Foro Consultivo Científico y Tecnológico, Ciudad de Mexico, 2014.

FCCyT, 2014b. Ranking Nacional de Ciencia, Tecnología e Innovación. Capacidades y oportunidades de los Sistemas Estatales de CTI. Ranking 2013. Foro Consultivo Científico y Tecnológico, Ciudad de Mexico, 2014.

fDi Intelligence, 2015. The fDi Report 2015 - Global greenfield investment trends. Global insight from the financial times LTD, Paris, 2015.

Foray and Goenaga, 2013. The Goals of Smart Specialisation. S3 Policy Brief Series No. 01/2013, Dominique Foray and Xabier Goenaga, 2013.

FUMEC, 2015. State Innovation Agendas, project for the development of Mexico, 2015.

GII, 2015. The Global Innovation Index 2015: Effective Innovation Policies for Development. Cornell University, INSEAD and WIPO, Fontainebleau, Ithaca and Geneva, 2015.

GOV, 2013. 1º Informe de Gobierno 2012-2013. Gobierno de los Estados Unidos Mexicanos, Ciudad de Mexico, 2013.

GOV, 2014. 2º Informe de Gobierno 2013-2014. Gobierno de los Estados Unidos Mexicanos, Ciudad de Mexico, 2014.

GOV, 2015. 3er Informe de Gobierno 2014-2015. Gobierno de los Estados Unidos Mexicanos, Ciudad de Mexico, 2015.

Guimón, 2008. Government Strategies to Attract R&D-Intensive FDI. OECD-Global Forum VII on International Investment. José Guimón, 2008.

IPRI, 2015. Property Rights Alliance. The International Property Rights Index 2015. Pais, 2015.

JRC-IPTS, 2015. The 2015 EU Industrial R&D Investment Scoreboard. EC, JRC-IPTS, Brussels, 2015.

KOF-GI, 2015. Index of Globalization, 2015. EHT Swiss Federal Institute of Technology, Switzerland, 2015.

Mora, 2013. Lineamientos para una política en Cooperación Internacional en materia de Ciencia, Tecnología e Innovación. Resumen Ejecutivo. Instituto Mora, Mexico, 2013

NDP, 2013. Plan Nacional de Desarrollo 2013-2018. Gobierno de los Estados Unidos Mexicanos, Ciudad de Mexico, 2013.

OECD, 2009. OECD Reviews of innovation Policy: Mexico 2009, OECD-library.org. Organisation for Economic Cooperation and Development, Paris, 2009.

OECD, 2013a. Knowledge-based start-ups in Mexico. Organisation for Economic Co-operation and Development, Paris, 2013

OECD, 2013b. Science, Technology and Industry Scoreboard. Organisation for Economic Cooperation and Development, Paris, 2013.

OECD, 2014a. Science, Technology and Industry. Outlook 2014 Organisation for Economic Cooperation and Development, Paris, 2014.

OECD, 2014b. Education at a Glance 2014: OECD Indicators, (Mexico–Country Note), Organisation for Economic Cooperation and Development, Paris, 2014.

OECD, 2014c. Resultados de PISA 2012 en FOCO. Organisation for Economic Cooperation and Development, Paris, 2014.

OECD, 2015a. Science, Technology and Industry Scoreboard. Organisation for Growth and society. Organisation for Economic Cooperation and Development Paris, 2015.

OECD, 2015b. Economic Surveys Mexico. Overview. Organisation for Economic Cooperation and Development, Paris, 2015.

OECD, 2015c. "Better Policies" Series MEXICO. Policy priorities to upgrade the skills and knowledge of Mexicans for greater productivity and Innovation. Organisation for Economic Cooperation and Development, Paris, 2015.

OEI, 2015. El Estado de la Ciencia. Principales Indicadores de Ciencia y Tecnología Iberoamericanos/Interamericanos, RICYT), 2015. Organización de Estados Iberoamericanos, Mexico, 2015.

Pacto, 2012. Pacto por Mexico, Partidos Políticos Mayoritarios de México, 2012.

PEF, 2014. Presupuesto de egresos de la federación 2014. Estrategia programática (Resumen). Ramo 38, Mexico DF, 2014.

PEF, 2015. Decreto de presupuesto de egresos de la Federación para el Ejercicio fiscal 2015. Presidencia de la República, Ciudad de Mexico, 2015.

PNUD, 2015. Índice de Desarrollo Humano para las entidades federativas, México 2015 Avance continuo, diferencias persistentes. Oficina de Investigación en Desarrollo Humano. Programa de las Naciones Unidas para el Desarrollo, Ciudad de Mexico, 2015.

Rivera, 2013. Lorena Rivera León. ERAWATCH, 2012: Country report 2012: Mexico, 2012.

Romero, 2009. Presentación del Programa Especial de Ciencia, Tecnología e Innovación. Juan Carlos Romero Hicks, Ciudad de Mexico, 2009.

SINECYT, 2008. Bases de Organización y Funcionamiento del Sistema Nacional de Evaluación Científica y Tecnológica. Sistema Nacional de Evaluación Científica y Tecnológica, Mexico, 2008.

WB, 2016. Doing Business, 13th Edition. Measuring Regulatory Quality and Efficiency. Economy Profile, Mexico, World Bank, 2016.

WEF, 2015. The Global Competitiveness Report 2015–2016, including México: Country

/Economy Profile. World Economic Forum, Geneva, 2015.

WIPO, 2014. WIPO 2014 Annual Report.

## Abbreviations

**List all abbreviations, including full names in English**

| | |
|---|---|
| ALICE | A Large Ion Collider Experiment (CERN) |
| AMEXCID | Mexican Agency for International Development Cooperation (Agencia Mexicana de Cooperación Internacional para el Desarrollo) |
| AMIA | Mexican Auto Industry Association (Asociación Mexicana de la Industria Automotriz) |
| ANR | French National Research Agency (Agence Nationale de la Recherche) |
| ANUIES | Mexican Association of University and Higher Education Institutions (Asociación Nacional de Universidades e Instituciones de Educación Superior) |
| BANCOMEXT | National Exterior Commerce Bank (Banco Nacional de Comercio Exterior) |
| BERD | Business Expenditures for Research and Development (Gasto Empresarial en Investigación y Desarrollo) |
| BES | Business Enterprise Sector (Sector Empresarial) |
| CAI | Committee on Institutional Support (Comité de Apoyos Institucionales) |
| CANACINTRA | National Chamber of Transformation Industries (Cámara Nacional de la Industria de la Transformación) |
| CANAME | National Association of Electrical Manufacturers (Cámara Nacional de Manufacturas Eléctricas) |
| CANIETI | National Chamber of the Electronics, Telecommunications and Information Technology (Cámara Nacional de la Industria Electrónica, de Telecomunicaciones y Tecnologías de la Información) |
| CAR | Result-Oriented Administration Agreement (Convenio de Administración por Resultados) |
| CDTI | Centre for the Development of Industrial Technology (Centro para el Desarrollo Tecnológico Industrial) |
| CENAPRED | National Centre for Disaster Prevention (Centro Nacional de Prevención de Desastres) |
| CELAC | Community of Latin American and the Caribbean States (Comunidad de Estados Latinoamericanos y Caribeños) |
| CEMIES | The Mexican Energy Innovation Centres (Centros Mexicanos de Innovación en Energia) |
| CERN | European Organisation for Nuclear Research (Organización Europea para la Investigación Nuclear) |
| CGIDTI | General Council for Scientific Research and Technological Development and Innovation (Consejo General de Investigación Científica y Desarrollo Tecnológico e Innovación) |

| | |
|---|---|
| CHEA | Council for Higher Education Accreditation (Consejo de Acreditación de Educación Superior) |
| CIAD | Research Center in Food & Development (Centro de Investigación en Alimentación y Desarrollo) |
| CIATEQ | Centre of Advanced Technology (Centro de Tecnología Avanzada) |
| CIIMAR-GOMC | Caribbean Marine Research Institutions Consortium and Gulf of Mexico (Consorcio de Instituciones de Investigación Marina del Golfo de México y del Caribe) |
| CINVESTAV | Centre for Research and Advanced Studies (Centro de Investigación y Estudios Avanzados del Instituto Politécnico Nacional) |
| CMS | Compact Muon Solenoid (Solenoide Compacto de Muones) |
| CNCTI | National Conference of Science and Technology (Conferencia Nacional de Ciencia, Tecnología e Innovación) |
| COMEXUS | USA-Mexico Commission for Educational and Cultural Exchange (Comisión México-Estados Unidos para el Intercambio Educativo y Cultural) |
| CONACYT | National Council for Science and Technology (Consejo Nacional de Ciencia y Tecnología) |
| CONAPO | National Population Council (Consejo Nacional de Población) |
| CONEVAL | National Council for the Evaluation of Social Development Policy (Consejo Nacional de Evaluación de la Política de Desarrollo Social) |
| CPI | Public Research Centres (Centros Públicos de Investigación) |
| CTA | Technical Administrative Committee (Comité Técnico y de Administración) |
| DAPyB | Institutional Support for Scientific, Technological and Innovation Activities (Programa de Apoyos para las Actividades Científicas, Tecnológicas Y de Innovación) |
| DCI | Development Cooperation Instrument (Instrumento de Cooperación al Desarrollo) |
| DG DEVCO | Directorate General Development and Cooperation (Dirección General de Cooperación Internacional y Desarrollo) |
| DG JRC | Directorate General Joint Research Centre (Dirección General del Centro Común de Investigación) |
| DGEST | Directorate General of Higher Education Technology (Dirección General de Educación Superior Tecnológica) |
| DOE | Department of Energy (Departamento de Energía) |
| DST | Department of S&T at the Ministry of S&T (Departamento de Ciencia y Tecnología) |
| EARTO | European Association of Research and Technology Organisations (Asociación Europea de Organizaciones de Investigación y. |

| | |
|---|---|
| | Tecnología) |
| ECLAC (CEPAL) | United Nations Economic Commission for Latin America and the Caribbean (CEPAL- Comisión Económica para América Latina y el Caribe) |
| EEAS | European External Action Service (Servicio Europeo de Acción Exterior) |
| EIDHR | European Instrument for Democracy and Human Rights |
| EPLANET | The European Particle physics Latin America NETwork |
| EPO | European Patent Office |
| EU | European Union |
| EU-MEX INNOVA | European Union-Mexico Bilateral Innovation Initiative |
| EUROSTAT | European statistics |
| FCCyT | Advisory Forum for Science and Technology (Foro Consultivo Científico y Tecnológico) |
| FDI | Foreign Direct Investment |
| FINNOVA | Sectoral Innovation Fund (Fondo Sectorial de Innovación) |
| FIT | Technology Innovation Fund (Fondo de Innovación Tecnológica) |
| FNE | National Entrepreneurship Fund (Fondo Nacional Emprendedor) |
| FOBESII | USA-Mexico Bilateral Forum on Higher Education, Innovation and Research (Foro Bilateral sobre Educación Superior, Innovación e Investigación) |
| FOMIX | Mixed Funds (Fondos Mixtos) |
| FONCICYT | Mexico Fund for Science and Technology Cooperation (Fondo Mexicano de Cooperación Internacional en Ciencia y Tecnología) |
| FORDECYT | Institutional Fund for Regional Development through the Promotion of Science, Technology and Innovation (Fondo Institucional de Fomento Regional para el Desarrollo Científico, Tecnológico y de Innovación) |
| FP7 | European Union 7th Framework Programme for Research and Technological Development (Séptimo Programa Marco de Investigación y Desarrollo Tecnológico) |
| FTE | Full Time Equivalent |
| FUMEC | USA-Mexico Foundation for Science (Fundación México Estados Unidos para la Ciencia) |
| GATT | General Agreement on Tariffs and Trade |
| GBAORD | Government Budget Appropriations or Outlays on R&D |
| GCI | Global Competitiveness Index |
| GCR | Global Competitiveness Report |

| | |
|---|---|
| GDP | Gross Domestic Product |
| GEO | Group on Earth Observations |
| GERD | Gross Domestic Expenditure on R&D |
| GII | Global Innovation Index (Índice Global de Innovación) |
| GVA | Gross Value Added |
| GVC | Global Value Chains |
| HAWC | High Altitude Cherenkov Observatory |
| HDI | Human Development Index |
| HEI | Higher Education Institutions |
| HELEN | High Energy Latin American European Network |
| HRST | Human Resources in Science and Technology |
| I-Coprs | Innovation Corps |
| I/UCRC | Industry/University Cooperative Research Centres |
| ICT | Information and Communication Technology |
| IMP | Mexican Petroleum Institute (Instituto Mexicano del Petróleo) |
| INADEM | National Entrepreneurship Institute (Instituto National del Emprendedor) |
| INAOE | National Institute of Astrophysics, Optics and Electronics of Mexico |
| INEGI | National Institute of Statistic and Geography (Instituto Nacional de Estadística y Geografía) |
| INSP | National Institute on Public health (Instituto Nacional de Salud Pública) |
| IP | Intellectual Property |
| IPN | National Polytechnic Institute (Instituto Politécnico Nacional) |
| IPR | Intellectual Property Rights |
| IPRI | International Property Rights Index |
| IT | Information Technology |
| ITESM | Technological Institute of Higher Studies of Monterrey (Instituto Tecnológico y de Estudios Superiores de Monterrey) |
| KET | Key Enabling Technology |
| JPO | Japan Patent Office |
| KTO | Knowledge Transfer Office |
| LA | Latin America |

| | |
|---|---|
| LAC | Latin America and Caribbean |
| MIR | Matrix of Indicators for Results (Matriz de Indicadores de Resultados) |
| MNE | Multinational Enterprise |
| MOST | Ministry of Science and Technology (Ministerio de Ciencia y Tecnología) |
| NAFIN | Mexican Development Bank (Nacional Financiera Banco de Desarrollo) |
| NAFTA | North American Free Trade Agreement (Tratado de Libre Comercio de América del Norte) |
| NDP | National Development Plan |
| NSF | National Science Foundation |
| OECD | Organisation for Economic Cooperation and Development |
| OEI | Organisation of Ibero-American States for Education, Science and Culture (Organización de Estados Iberoamericanos para la Educación, la Ciencia y la Cultura) |
| OEM | Original Equipment Manufacturing |
| PCT | Patent Cooperation Treaty |
| PECiTI | Special Programme for Science, Technology and Innovation (Programa Especial de Ciencia, Tecnología e Innovación) |
| PEI | Innovation Incentives Programme |
| PI | Partnership Instrument |
| PIL | Online Incubation Programme |
| PILA | Long Term Research Programmes (Programas de Investigación de Largo Aliento) |
| PIRE | Partnership for International Research and Education programme |
| PISA | Programme for International Student Assessment |
| PNP | Private Non Profit |
| PPI | Public Procurement of Innovation |
| PRC | Public Research Centres |
| PRO | Public Research Organisations |
| PRODECYT | Programme for Scientific and Technological development |
| PROMEXICO | Trade and Investment Agency |
| RALCEA | Latin American Network of knowledge centres in the water sector |
| RCEA | CONACYT Accredited Assessors Registry |
| REDNACECYT | National Network of State Councils and Organisations for Science and |

| | |
|---|---|
| | Technology (Red Nacional de Consejos y Organismos Estatales de Ciencia y Tecnología A.C.) |
| RENIECYT | National Registry of Scientific and Technological Institutions and Enterprises (Registro Nacional de Instituciones y Empresas Científicas y Tecnológicas) |
| RI | Research Infrastructures |
| RICYT | Ibero-American Network of Science and Technology Indicators (Red Iberoamericana de Indicadores en Ciencia y Tecnología) |
| RIO | Research and Innovation Observatory |
| RIS3 | Research and Innovation Strategies for Smart Specialisation |
| RTDI | Research Technological Development and Innovation |
| RTO | Research Technology Organisation |
| R&D | Research and Development |
| R&I | Research and Innovation |
| SAGARPA | Mexico's Agriculture Ministry |
| SIICYT | Integrated System for information on Scientific and Technological Research (Sistema Integrado de Información sobre Investigación Científica y Tecnológica) |
| SINECYT | National System of Scientific and Technological Evaluation (Sistema Nacional de Evaluación Científica y Tecnológica) |
| SMEs | Small and Medium Sized Enterprises |
| SNI | National System for Researchers (Sistema Nacional de Investigadores) |
| STEM | Science, Technology, Engineering y Mathematics |
| STI | Science, Technology and Innovation (CTI- Ciencia, Tecnología e Innovación) |
| S&T | Science and Technology |
| TecNM | National Technological Institute of Mexico |
| TIL | Informality Labour Rate (Tasa de Informalidad Laboral) |
| TPP | Trans-Pacific Partnership |
| TRL | Technology Readiness Levels |
| UAM | Metropolitan Autonomous University (Universidad Autónoma Metropolitana) |
| UNAM | National Autonomous University of Mexico (Universidad Nacional Autónoma de México) |
| UNDP | United Nations Development Programme (PNUD- Programa de las Naciones Unidas para el Desarrollo) |

| | |
|---|---|
| USA | United States of America |
| UTEP | University of Texas at El Paso |
| WEF | World Economic Forum |
| WIPO | World Intellectual Property Organisation |
| WTO | World Trade Organisation |

## List of Figures

## List of Tables

# Annexe 1 - List of the main research performers

Table 19 shows the classification of the Public Research Institutions in Mexico, according to the Ministry of Education.

Table 19 - Types of public Research Institutions in Mexico, Ministry of Education

| Institution subsystem | Description |
|---|---|
| Federal Public Universities | The institutions within this subsystem perform, additionally to teaching functions, a broad specter of research programs and projects (innovative generation and implementation of knowledge) and of culture extension and promotion. |
| State Public Universities | The State Public Universities are Higher Education Institutions created through decrees of local congresses, as public decentralized organisms. This State Institutions develop functions of teaching, innovative generation and implementation of knowledge, as well as culture extension and promotion. |
| State Public Universities with special additional financial support | This institutions are the ones that receive inputs from the public budget program and their financing comes mainly from State Governments. Additionally the Federal Government provides a special additional financial support, agreed with the corresponding State. Same as the State Public Universities, this institutions develop functions of teaching, innovative generation and implementation of knowledge, as well as culture extension and promotion. |
| Technological Institutes | National Technological Institute of México (TecNM). On July 23, 2014 within an official publication of the Federation Journal, the official presidential decree was issued, where biggest technological higher education institution in the country was created. According to said decree, the TecNM is founded as a decentralized organism of the Public Education Ministry, taking over the functions of the administrative unit in charge of coordinating said important higher education subsystem.<br>The National Technological Institute of Mexico is formed by 266 institutions, distributed within Mexico's 31 states and Mexico City. The technological institutes that form the TecNM have a solid tradition, built through over 65 years of providing high quality technological higher education services within the country. |
| Technological Universities | Technological Universities offer the students that have finished their upper secondary education and intensive training that enable them to incorporate in a short period of time (after two years), to the productive sector or to continue with a Bachelor degree program in other higher education institution. The education model of this institutions is oriented to learning as a process that takes place throughout life, focused in analysis, interpretation and appropriate usage of information.<br>Nowadays there are 61 technological universities in 26 states of Mexico. Whoever studies in this institutions may gain a Higher Technical Degree. |
| Polytechnic Universities | Polytechnic Universities are an educational project created on 2001 to offer engineering, bachelor degrees and postgraduate studies at a specialty level. Their programs are designed based on the Capabilities Based Education Model and is oriented to research applied to technologic development; simultaneously having a close collaboration relationship with organizations from the productive, public and social sectors. |
| Intercultural Universities | The mission of the Intercultural Universities is to promote the training of professionals committed to the economic, social and cultural development, mainly of the country's indigenous population and of the world. The professionals reassess the knowledge of the indigenous population and foster a process of synthesis with the progress of scientific knowledge. They also promote the dissemination of the community values and open up spaces for promoting the revitalization, development and strengthening of native languages and cultures.<br>This Universities have as an objective to instruct training programs at different levels, such as professional associate, bachelor, specialization and postgraduate, all relevant for regional, state and national development. They are oriented to train professionals committed to the economic, social and cultural development in the community sector, having activities that contribute to promoting a valorization and revitalization process of native languages and cultures. |
| Public Research Centers | Formed by Public Research Centers of CONACYT, Research Centers from the National Polytechnic Institute, as well as from the states of Tamaulipas, Jalisco and Chihuahua, and the Autonomous National University of Mexico. As their main objective they have: publishing within the science and technology society; innovate in the generation, development, assimilation and implementation of the science and technology knowledge; bonding science and technology in the society and the productive sector in order to solve problems and create and develop mechanisms and incentives that promote the contribution of productive sector in the scientific and technological development. |
| Public Teaching Schools | They are in charge of training the professors for preschool, elementary and secondary education. Said training activities are performed through their national teaching schools network. They offer, among various programs, bachelor programs for preschool education, elementary, bilingual and intercultural elementary, secondary, special, physical and artistic education. |
| Other Public Institutions | Being the higher education public system in Mexico so diverse, there are various institutions that according to their particular characteristics, can't be placed within any of the subsystems disclosed above. |

Source: http://www.ses.sep.gob.mx/instituciones-de-educacion-superior

Main R&I performing organisations in Mexico include (CONACYT, 2014b):

- 27 CONACYT Research Centres grouped into three major subsystems:
    - Natural Sciences (10 centres):
        - CIO – Centro de Investigaciones en Óptica, A.C.
        - CIAD – Centro de Investigación en Alimentación y Desarrollo, A.C.
        - CIBNOR – Centro de Investigaciones Biológicas del Noroeste, S.C.
        - CICESE – Centro de Investigación Científica y de Educación Superior de Ensenada, B.C.
        - CICY – Centro de Investigación Científica de Yucatán, A.C.
        - CIMAT – Centro de Investigación en Matemáticas, A.C.
        - CIMAV – Centro de Investigación en Materiales Avanzados, S.C.
        - INAOE – Instituto Nacional de Astrofísica, Óptica y Eletrónica
        - INECOL – Instituto de Ecología, A.C.
        - IPICYT – Instituto Potosino de Investigación Científica y Tecnológica, A.C.
    - Social Sciences and Humanities (8 centres):
        - CIDE – Centro de Investigación y Docencia Económicas, A.C.
        - CIESAS – Centro de Investigaciones y Estudios Superiores en Antroplogía Social
        - CIGGET – Centro de Investigación en Geografía y Geomática "Ing. Jorge L. Tamayo", A.C.
        - COLMICH – El Colegio de Michoacán, A.C.
        - COLSAN – El Colegio de San Luis, A.C.
        - ECOSUR – El Colegio de la Frontera Sur
        - EL COLEF – EL Colegio de la Frontera Norte, A.C.
        - MORA – Instituto de Investigaciones "Dr. José María Luis Mora"
    - Technological development services (9 centres):
        - CIATEC – Centro de Innovación Aplicada en Tecnologías Competitivas
        - CIATEJ – Centro de Investigación y Asistencia en Tecnología y Diseño del Estado de Jalisco, A.C.
        - CIATEQ – CIATEQ, A.C. Centro de Tecnología Avanzada
        - CIDESI – Centro de Ingeniería y Desarrollo Industrial
        - CIDETEQ – Centro de Investigación y Desarrollo Tecnológico en Electroquímica, S.C.
        - CIQA – Centro de Investigación en Química Aplicada
        - COMIMSA – Corporación Mexicana de Investigación en Materiales, S.A. de C.V.
        - FIDERH – Fondo para el Desarrollo de Recursos Humanos
        - INFOTEC – Centro de Investigación e Innovación en Tecnologías de la Información y Comunicación
- Mission-oriented research entities working in the following sectors:

- Energy: Instituto Mexicano del Petróleo, Instituto de Investigaciones Eléctricas, Instituto Nacional de Investigaciones Nucleares, Petróleos Mexicanos
- Agriculture : Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias, Colegio de Postgraduados, Universidad Autónoma Chapingo, Instituto Nacional de la Pesca, Universidad Autónoma Agraria Antonio Narro
- Health and social security: Institutos Nacionales de Salud, Instituto Mexicano del Seguro Social, Instituto de Seguridad y Servicios Sociales para los Trabajadores del Estado

- Public HEIs. The most active HEI in the 2012-2013 period, according to block funding allocation, is the UNAM (Universidad Nacional Autónoma de México), followed at a certain distance by the CINVESTAV (Centro de Investigación y de Estudios Avanzados del Instituto Politécnico Nacional), the UAM (Universidad Autónoma de México), the IPN (Instituto Politécnico Nacional), the School of Mexico and the Universidad Autónoma Agraria Antonio Narro.
- Private sector, including Private HEIs, Private Research and Technology Organisations (RTO) and Companies.

In the private sector, the following Table 20 shows the list of the 20 companies with the highest amount of funding in the PEI, 2009-2013

Table 20: List of 20 companies with highest funding from PEI, 2009-2013

| COMPANY | Sector |
|---|---|
| CONTINENTAL AUTOMOTIVE GUADALAJARA MEXICO, S.A. DE C.V. | Energy |
| INTEL TECNOLOGIA DE MEXICO, S.A. DE C.V. | Information Technologies |
| RESORTES Y PARTES SA DE CV | Metallurgy |
| KATCON, S.A. DE C.V. | Machinery industry |
| RUBIO PHARMA Y ASOCIADOS S.A. DE C.V. | Pharmaceutical |
| VOLKSWAGEN DE MEXICO, S. A. DE C. V. | Automotive |
| CORROSIÓN Y PROTECCIÓN, SOCIEDAD ANÓNIMA DE CAPITAL VARIABLE | Engineering Services |
| MABE S.A DE C.V | Electronics |
| LANDSTEINER SCIENTIFIC, S.A. DE C.V. | Pharmaceutical |
| LABORATORIOS SILANES, S.A. DE C.V. | Pharmaceutical |
| CIFUNSA DIESEL SA DE CV | Automotive |
| TURBORREACTORES, S.A. DE C.V. | Aerospace |
| FREESCALE SEMICONDUCTOR MEXICO, S. DE R.L. DE C.V. | Electronics |
| MODUTRAM MEXICO SA DE CV | Intelligent transport |
| MEXICHEM RESINAS VINILICAS S.A DE C.V. | Mining |
| COMERCIALIZADORA DE SOLUCIONES MÓVILES, S.A. DE C.V. | Telecommunications |
| HEALTH DIGITAL SYSTEMS S.A.P.I DE C.V. | Healthcare |
| GRUPO GAMESA, S DE RL DE CV | Food |
| NUCITEC, SA. DE CV. | Pharmaceutical |
| NACIONAL DE ALIMENTOS Y HELADOS SA DE CV | Food |

Source: Elaborated by the author with data from the PEI

## Annexe 2 - List of the main funding programmes

| Name of the funding programme | Duration | Budget | Target group |
|---|---|---|---|
| Program to Encourage Research, Technological Development and Innovation (PEI): Including INNOVAPYME, INNOVATEC and PROINNOVA) | 4 years (2012-2015) | €782.91m | Mexican companies registered with the National Register of Institutions and Scientific and Technological Companies (RENIECYT), and carrying out research, technological development and Innovation in Mexico, on their own or with public or private University and/or National Research Centres and Institutes |
| Institutional support for scientific, technological and innovation activities DAPyB | 4 years (2012-2015) | €534.19m | University and other Higher Education Institutions, both public and private, Research Centres , laboratories, public and private enterprises and others registered with the National Register of Institutions and Scientific and Technological Companies (RENIECYT) |
| Program for Scientific and Technological development (PRODECYT) | 3 years (2013-2015) | €332.30m | University and other Higher Education Institutions, both public and private, Research Centres , laboratories, public and private enterprises and others registered with the National Register of Institutions and Scientific and Technological Companies (RENIECYT). |
| Program to reduce digital divide | 1 year (2012) | €176.59m | Education and investigation centres. |
| Sectoral Funds for Technological development | 4 years (2012-2015) | €150.81m | University and other Higher Education Institutions, both public and private, Research Centres , laboratories, public and private enterprises and others registered with the National Register of Institutions and Scientific and Technological Companies (RENIECYT), and offering scientific and/or technological solutions to sectoral problems |
| Mixed Funds (FOMIX) | 4 years (2012-2015) | €150.45m | Institutions, public and private University, Research Centres , laboratories, public and private enterprises, and other physical persons, registered with the National Register of Institutions and Scientific and Technological Companies (RENIECYT) |
| Infrastructure Strengthening | 4 years (2012-2015) | €149.86m | Public and private University, Public Research Centres and Pubic Institutions, at federal or State level, that develop research activities in the scientific, social or humanistic field, or technological development |

| Name of the funding programme | Duration | Budget | Target group |
|---|---|---|---|
| Institutional Fund to Promote Regional Development in Science, Technology and Innovation (FORDECYT) | 4 years (2012-2015) | €99.22m | Institutions, public University, Research Centres , laboratories and public or private enterprises working in scientific research, technological development and innovation, and registered with the National Register of Institutions and Scientific and Technological Companies (RENIECYT) |
| Inversion Fund in Technology Development | 2 years (2014-2015) | €0.119m | Small and Medium enterprises |

## Annexe 3 - Evaluations, consultations, foresight exercises

The main national consultation exercises identified in the 2012-2015 period include those performed by the Advisory board for Science and Technology and the CONACYT in preparation for the PECiTI 2014-2018, the analysis of the STI systems at the State level, and in the reformulation of programmes such as FORDECYT or FOMIX. They following reports show results of these exercises:

- Informe de actividades del periodo Agosto 2012 - Julio 2014. Foro Consultivo Científico y Tecnológico, Ciudad de Mexico, 2014
- Lineamientos del programa para el desarrollo Científico y Tecnológico. Programa Presupuestal U004 Abril. Consejo Nacional de Ciencia y Tecnología, Ciudad de Mexico, 2013
- Ranking Nacional de Ciencia, Tecnología e Innovación. Capacidades y oportunidades de los Sistemas Estatales de CTI. Foro Consultivo Científico y Tecnológico, Ciudad de Mexico, 2014
- Fondos mixtos en la Generación de Infraestructura Científica y Tecnología Nacional. Aportes para la generación y aumento de capacidades en CTI en los estados. Foro Consultivo Científico y Tecnológico, Ciudad de Mexico, 2012
- Los Fondos Mixtos en la investigación científica aplicada y el desarrollo tecnológico. Foro Consultivo Científico y Tecnológico, Mexico DF, 2013.
- Fondo Institucional de Fomento Regional para el Desarrollo Científico, Tecnológico y de Innovación (FORDECyT). Integración regional para el surgimiento de territorios innovadores, Foro Consultivo Científico y Tecnológico, Mexico DF, 2012.
- Fondos mixtos CONACYT-Gobiernos de los Estados y Municipios. Estadísticas al cierre de Diciembre 2015. Consejo Nacional de Ciencia y Tecnología, Ciudad de Mexico, 2015
- Fondo Institucional de Fomento Regional para el Desarrollo Científico, Tecnológico y de Innovación. Estadísticas al cierre de Diciembre 2015. Consejo Nacional de Ciencia y Tecnología, Mexico DF, 2015
- Programa de Estímulos a la Investigación, Desarrollo Tecnológico e Innovación, Convocatoria 2016. Consejo Nacional de Ciencia y Tecnología, Ciudad de Mexico, 2016
-

National and international analysis of strengths and weaknesses at national level include:

- Informe autoevaluación 2012. CONACYT, Ciudad de Mexico, 2012
- Informe autoevaluación 2013. Consejo Nacional de Ciencia y Tecnología, Ciudad de Mexico, 2013
- Informe autoevaluación 2014. Consejo Nacional de Ciencia y Tecnología. Ciudad de Mexico, 2014
- Informe General del Estado de la Ciencia, la Tecnología y la Innovación de México 2011. Consejo Nacional de Ciencia y Tecnología, Ciudad de Mexico, 2012
- Informe General del Estado de la Ciencia, la Tecnología y la Innovación de México 2012. Consejo Nacional de Ciencia y Tecnología, Ciudad de Mexico, 2013
- Informe General del Estado de la Ciencia, la Tecnología y la Innovación de México 2013. Consejo Nacional de Ciencia y Tecnología, Ciudad de Mexico, 2014
- 1er Informe de Gobierno 2012-2013. Gobierno de los Estados Unidos Mexicanos, Ciudad de Mexico, 2013
- 2º Informe de Gobierno 2013-2014. Gobierno de los Estados Unidos Mexicanos, Ciudad de Mexico, 2014
- 3er Informe de Gobierno 2014-2015. Gobierno de los Estados Unidos Mexicanos, Ciudad de Mexico, 2015

- Fortalecimiento a Nivel Sectorial de las Capacidades Científicas, Tecnológicas y de Innovación. Ficha de Evaluación 2013 CONACYT. Consejo Nacional de Evaluación de la Política de Desarrollo (CONEVAL), Mexico, 2013
- Resultados de la Encuesta sobre Investigación y Desarrollo Tecnológico y Módulo sobre Actividades de Biotecnología y Nanotecnología (Esidet-MBN), 2012
- Lineamientos para una política en Cooperación Internacional en materia de Ciencia, Tecnología e Innovación. Instituto Mora,Mexico, 2013
- Economic Surveys Mexico. Overview. Organisation for Economic Cooperation and Development, Paris, 2015
- "Better Policies" Series MEXICO. Policy priorities to upgrade the skills and knowledge of Mexicans for greater productivity and Innovation. Organisation for Economic Cooperation and Development, Paris, 2015
- Science, Technology and Industry. Outlook 2014 Organisation for Economic Cooperation and Development, Paris, 2014
- Science, Technology and Industry Scoreboard. Organisation for Economic Cooperation and Development, Paris, 2013
- OECD Reviews of Regional Innovation: 15 Mexican states. Organisation for Economic Cooperation and Development. Paris, 2009
- OECD Reviews of innovation Policy: Mexico 2009, OECD-library.org. Organisation for Economic Cooperation and Development, 2009
- Education at a Glance 2014: OECD Indicators, (Mexico–Country Note), Organisation for Economic Cooperation and Development, Paris 2014
- The Global Competitiveness Report 2015–2016, including México: Country/Economy Profile. World Economic Forum, Geneva, 2015
- Doing Business, 13th Edition. Measuring Regulatory Quality and Efficiency. Economy Profile, Mexico, World Bank, 2016
- Sustainable Governance Indicators. 2015 Mexico Report (Bertelsmann Stiftung, 2015)
- El Estado de la Ciencia. Principales Indicadores de Ciencia y Tecnología Iberoamericanos/Interamericanos, RICYT), 2015. Organización de Estados Iberoamericanos, Mexico 2015

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