NATIONAL INNOVATION **INDEX**

venture INSTITUTE

INDEX

PREFACE

Innovation is a driver of a country's development and economic growth in the long-term. It enables productivity growth, the generation of employment and the promotion and creation of new industries. Given the uncertainty in global markets and the economic stagnation of recent years, it is essential to find new ways to boost the economy; one alternative to overcome the current economic and financial crisis is to stimulate and enable innovation.

Innovation has also become increasingly important to improve the social welfare of people. By creating new products and services, innovation plays a key role in addressing more complex problems such as health, poverty and education, among others.

Despite the importance of innovation, in Mexico there is no way to measure or quantify it at a regional and local level. Venture Institute, together with its partners, is pleased to present the **National Innovation Index** (INI, for its Spanish acronym), the first study that describes Mexico's innovation level. The INI is the first Mexican study that creates a conceptual framework to assess the multidimensional aspects determining innovation in the country, thus contributing to the understanding of the national innovation process. The INI is based on international best practices to measure innovation, and classifies 86 cities and 32 states according to their level of innovation.

With this study, Venture Institute -in its commitment to the development of the entrepreneurship and innovation ecosystem of Mexico- generates valuable information to enable a greater understanding of how innovation takes place in our country. The INI is a useful tool for individuals, organizations and companies interested in innovation and in the national innovation system. The index also facilitates the identification of strengths and weaknesses involved in the innovation process, so that decision makers can better allocate resources and design policies that encourage innovation.

The development of the INI was possible through the support of various partners. We thank the National Council for Science and Technology (CONACYT) and the Ministry of Economy who, through the Sectorial Innovation Fund (FINNOVA), sponsored this initiative. We also thank our strategic partners Micro-MercadosDescifra, one of the most important consulting firms offering geo-referenced analysis in the country, and IDEA Foundation, a public policy think-tank leader in Mexico, who both devoted time and resources to the creation of this study . We also make a special mention of the various partners that during the course of the project made significant contributions, to name a few: FUNDES México and Endeavor Mexico. Finally, we recognize those companies that were participants in obtaining the information that is published in this study.

The National Innovation Index is the result of an unprecedented collective effort to characterize innovation at a regional level. It is part of a vision to understand in depth the dynamics of innovation, as well as provide a tool for measuring and monitoring it. In this sense, Venture Institute seeks feedback from various stakeholders to further refine the study.

Venture Institute

Firm dedicated to the development of the entrepreneurial and innovation ecosystem of Mexico through an innovation platform comprising the formation of high-impact entrepreneurs, innovative business development and project financing with venture capital. Part of its mission is to create and develop research projects that increase the understanding of entrepreneurship and innovation in Mexico. Venture Institute is also involved in the design and implementation of academic programs at the undergraduate and graduate level.

Sectorial Innovation Fund (FINNOVA)

Fund created in 2010 by the Ministry of Economy together with CONACYT, in order to drive innovation. The FINNOVA supports scientific research, technological development and innovation.

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The following institutions supported the creation of the National Innovation Index:

Technology Partners

Micro Mercados Descifra

Knowledge Partners

Fundación Idea

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BOARD OF ADVISORS

The board of advisors was formed with the the goal of obtaining support and guidance throughout the development of the study. The council is composed of leading academics and highly regarded professionals in innovation within the country.

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1. RANKINGS

Results by States

Final Rank	State	General Score	Input Rank	Output Rank	Innovation Efficiency	Rank in Innovation Efficiency
1	Distrito Federal	70.65	1	1	1.00	7
2	Nuevo León	44.82	2	2	0.91	18
3	Jalisco	42.57	3	3	0.95	8
4	México	35.57	4	10	0.82	27
5	Puebla	35.04	18	4	1.13	4
6	Querétaro	34.06	5	14	0.82	29
7	Guanajuato	33.98	6	7	0.90	20
8	Chihuahua	32.18	8	13	0.87	25
9	Aguascalientes	31.99	7	17	0.85	26
10	Baja California	31.91	10	8	0.93	14
11	Coahuila	31.21	13	9	0.94	13
12	Sonora	30.75	16	11	0.95	11
13	Yucatán	30.54	15	12	0.93	16
14	Sinaloa	30.40	11	19	0.89	23
15	Campeche	30.36	21	6	1.02	5
16	Quintana Roo	29.42	14	21	0.88	24
17	Veracruz	28.82	19	18	0.94	12
18	Baja California Sur	28.66	9	25	0.79	32
19	Morelos	28.02	17	22	0.90	22
20	Colima	28.01	12	24	0.81	31
21	Tamaulipas	28.01	20	20	0.92	17
22	Tabasco	27.70	28	5	1.15	2
23	Hidalgo	26.85	24	16	1.01	6
24	Nayarit	25.96	22	23	0.95	9
25	Zacatecas	23.57	31	15	1.17	1
26	Durango	23.37	25	26	0.93	15
27	San Luis Potosí	22.93	23	30	0.81	30
28	Michoacán	22.19	27	29	0.90	19
29	Tlaxcala	21.42	29	28	0.95	10
30	Chiapas	20.65	26	32	0.82	28
31	Guerrero	19.36	30	31	0.90	21
32	Oaxaca	18.85	32	27	1.14	3

Results for cities

General Rank	Metropolitan Area	General Score	Input Rank	Output Rank	Innovation Efficiency	Efficiency Rank
1	Valle de México	61.21	1	1	1.14	1
2	Guadalajara	44.73	2	2	1.06	2
3	Monterrey	42.04	3	3	0.96	3

General Rank	Big City	General Score	Input Rank	Output Rank	Innovation Efficiency	Efficiency Rank
1	Toluca	35.48	1	3	0.70	5
2	León	35.29	2	2	0.85	2
3	Puebla-Tlaxcala	32.56	6	1	1.00	1
4	Juárez	29.98	3	5	0.72	4
5	La Laguna	29.69	5	4	0.75	3
6	Tijuana	28.84	4	6	0.69	6

General Rank	Medium City	General Score	Input Rank	Output Rank	Innovation Efficiency	Efficiency Rank
1	Hermosillo	32.43	1	7	0.73	15
2	Culiacán	31.66	2	9	0.73	16
3	Veracruz	31.60	11	2	1.02	3
4	Querétaro	31.51	3	6	0.78	8
5	Mérida	31.18	4	8	0.77	9
6	Xalapa	30.94	12	3	1.00	4
7	Saltillo	30.66	7	5	0.85	7
8	Chihuahua	30.41	5	11	0.75	12
9	Mexicali	30.16	6	10	0.77	11
10	Villahermosa	29.91	19	1	1.25	1
11	Tampico	28.56	17	4	0.99	5
12	Aguascalientes	28.54	8	13	0.75	13
13	Durango	26.86	13	14	0.74	14
14	Cuernavaca	26.77	9	17	0.68	17
15	Cancún	26.11	16	15	0.77	10
16	Reynosa	25.77	18	12	0.90	6
17	Morelia	24.30	14	18	0.58	19
18	San Luis Potosí	23.74	10	20	0.51	20
19	Tuxtla Gutiérrez	22.41	15	21	0.48	21
20	Acapulco	21.22	20	19	0.64	18
21	Oaxaca	21.14	21	16	1.09	2

General Rank	Small City	General Score	Input Rank	Output Rank	Innovation Efficiency	Efficiency Rank
1	Ocotlán	43.23	2	1	1.16	4
2	Puerto Vallarta	39.49	1	2	0.84	27
3	Irapuato	35.48	7	5	0.96	16
4	Celaya	35.40	3	8	0.77	37
5	Guanajuato	35.19	4	9	0.78	35
6	Salamanca	33.97	6	10	0.83	29
7	Campeche	33.25	20	4	1.13	5
8	San Francisco del Rincón	32.57	10	11	0.90	23
9	Orizaba	31.58	40	3	1.28	3
10	Delicias	31.30	5	30	0.65	50
11	Córdoba	30.81	21	12	0.97	14
12	Ensenada	30.23	12	21	0.79	32
13	Cuauhtémoc	30.07	23	16	0.93	18
14	Ciudad Obregón	30.05	9	25	0.71	44
15	Hidalgo Del Parral	29.98	28	15	0.96	15
16	San Juan Del Río	29.94	8	31	0.70	46
17	Piedras Negras	29.79	31	14	1.00	11
18	Coatzacoalcos	29.73	22	18	0.91	20
19	Tehuacán	29.37	37	13	1.04	8
20	Ciudad Del Carmen	29.33	29	17	0.95	17
21	Los Mochis	29.08	13	23	0.76	42
22	Mazatlán	29.05	14	22	0.76	41
23	Navojoa	28.86	15	27	0.76	40
24	Ciudad Victoria	28.77	11	38	0.70	47
25	Poza Rica	28.63	36	19	0.98	12
26	Guaymas	28.26	17	28	0.79	34
27	Minatitlán	27.81	45	20	1.03	10
28	Ciudad Acuña	27.77	19	34	0.77	38
29	Zacatecas-Guadalupe	27.48	53	7	1.35	2
30	Colima-Villa de Álvarez	27.37	26	35	0.79	33
31	Nuevo Laredo	27.11	27	40	0.77	36
32	Monclova-Frontera	27.07	30	33	0.81	30
33	Manzanillo	26.70	24	44	0.73	43
34	Matamoros	26.51	32	39	0.81	31
35	Heroica Nogales	26.46	39	26	0.89	24
36	La Paz	26.39	18	46	0.68	48
37	Tapachula de Córdova y Ordóñez	26.29	16	50	0.61	53
38	Pachuca	26.27	42	24	0.91	22
39	Tula	25.76	48	32	0.91	19
40	Tulancingo	25.76	44	36	0.88	25
41	Chetumal	25.57	25	48	0.66	49
42	Tepic	25.40	43	42	0.85	26
43	Cuautla	24.75	35	47	0.71	45

General Rank	Small City	General Score	Input Rank	Output Rank	Innovation Efficiency	Efficiency Rank
44	Tecomán	24.69	47	45	0.83	28
45	Fresnillo	24.65	57	6	1.86	1
46	San Luis Río Colorado	24.47	51	29	1.04	9
47	Tlaxcala-Apizaco	23.95	50	43	0.91	21
48	Playa Del Carmen	23.43	49	49	0.77	39
49	San Juan Bautista Tuxtepec	23.24	54	37	1.05	7
50	Iguala De La Independencia	22.41	55	41	1.10	6
51	Uruapan	22.35	41	52	0.62	52
52	La Piedad-Pénjamo	21.96	33	55	0.50	55
53	Ciudad Valles	21.27	46	53	0.57	54
54	San Cristóbal De Las Casas	20.83	34	57	0.43	57
55	Zamora-Jacona	20.69	38	56	0.48	56
56	Chilpancingo	19.26	52	54	0.65	51
57	Tehuantepec	19.25	56	51	0.98	13

The results of the classification of cities and states by pillars are presented in **Annex I.**

2. INNOVATION

2.1 What is innovation?

From a broad perspective, innovation may be considered as any change or creation that generates value. Innovation involves the adoption of new technologies and knowledge that transform the economy and productivity of a country, region or firm.

The Oslo Manual of the OECD defines innovation as *"the implementation of a new or significantly improved product (good or service), or process, a new marketing method or a new organizational method in business practices, workplace organization or external relations"* (OECD, 2005). From this definition, four types of innovation are distinguished:

- *Product innovation:* a good or service that is new or significantly enhances the characteristics or intended uses. This includes improvements in the components, materials, incorporated software, ease of use and other functional features.

- *Process innovation:* the implementation of a new or significantly improved production or delivery method. These include changes in techniques, equipment or software.

- *Marketing innovation:* the implementation of a new marketing method involving significant changes in the design or packaging, placement, promotion and pricing of the product.

- *Organizational innovation:* a new organizational method in business practices, workplace organization or external relations of the firm.

Depending on its diffusion, the impact of an innovation may be in a business, industry or market level. This study considers only business innovation, considering that firms are the ones that bring innovation to the market. Therefore, the study does not cover innovation in the industry or economy (e.g. the emergence of a new market) level.

Business innovation depends on a process in which knowledge and technology originate from various stakeholders: researchers, academia, entrepreneurs, political and financial institutions. This process generally consists of 5 stages (Desouza et al 2009.):

1. The generation and mobilization of ideas.

The generation of new ideas should be fostered bythe pressure generated by competition and creativity. The mobilization of ideas between different stakeholders is essential at this stage as it facilitates their development.

2. Review and selection of ideas.

This step is to consider only the ideas with the greatest potential for value creation and economic or social growth.

3. Experimentation.

The experiment proves the feasibility of the ideas in a given environment and helps to confirm that the invention or idea actually solves a problem.

4. Marketing.

Brings innovation to a larger scale and expands and deploys the new product, service , or method of organization in a market.

5. Difussion and implementation.

This stage is the final acceptance of innovation and implementation of structures and resources required for production, maintenance and dissemination of innovation.

These five stages do not necessarily follow a linear pattern; they provide a useful conceptual framework to understand how innovation emerges. In each stage, different actors interfere and, with their knowledge and experience, contribute to the generation of new products, services, marketing methods and organizational processes. Thus, innovation is seen as a dynamic process in which knowledge is accumulated through learning and economic and social interactions.

2.2 National System of Innovation

Traditional analysis of innovation focused on inputs, such as total amount spent on research and development (R&D) by the government and businesses. This approach perceives innovation as a result of R&D. However, we have seen that innovation is not generated spontaneously or in linear fashion: it requires a process that depends on how multiple conditions and agents interact. This has led in recent years to evaluate innovation within a wider framework that can include the institutional and economic context in which it is generated.

The innovation performance of a country depends on the trajectory of itsscience and technology policy and the circumstances that define how it is that innovation is generated. Public policies related to the regulation, taxation, finance, competition and intellectual property can block or facilitate interactions between actors and the flow of information among them. Furthermore, institutional differences

in the development and diffusion of new technologies play an important role in the determination of the growth rate of an economy (Freeman, 1995).

The concept of innovation system describes innovation as a process in which the importance of interactions between different actors, such as the transmission and dissemination of ideas and knowledge, and the importance of the social, cultural and political context that guides and defines innovation are emphasized. Definitions of national innovation systems vary, but the fundamental concept lies in describing the network of innovation agents and how these innovation agents interact.

The systemic focus of innovation has analytical advantages since it emphasizes the importance of the flow of ideas and knowledge and includes a greater number of actors in the generation of knowledge. This focus also includes the importance of conditions, regulations and policies in which markets operate; therefore the role of governments to monitor and define the overall context in which innovation takes place is fundamental.

The INI seeks to describe Mexico's innovation system. It considers a wide variety of variables that enable itto describe how innovation is developed in the country, in a context specific to the state or the city. In order to do this, the system evaluates Mexican innovation measuring both the inputs and outputs of innovation.

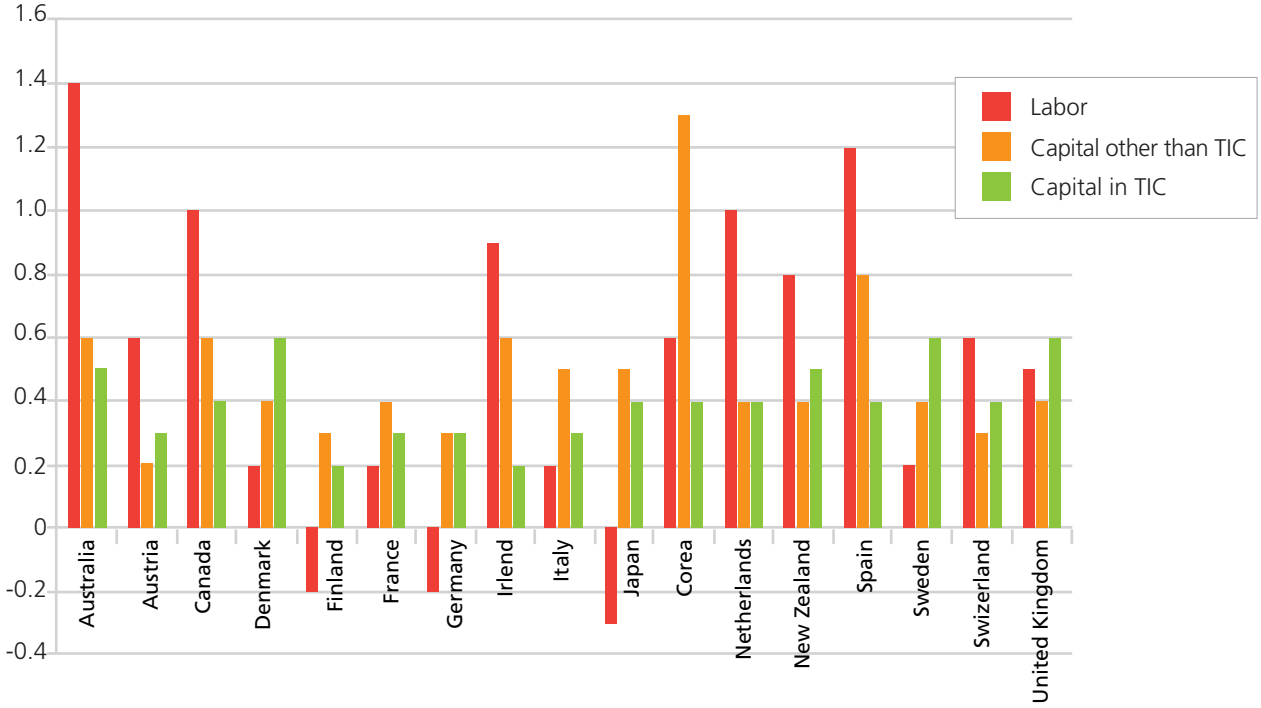
2.3 Why measure innovation?

Evaluating and measuring innovation is important, for it is the initial stepping stone to achieve a better understanding of how innovation develops within acountry. Measuring innovation provides useful elements to make betterdecision regardingbusiness strategy and public policy generation, dissemination, appropriation and the use of new knowledge. For businesses, having information about the characteristics of innovation and competition in a region may be useful to developbetter strategies for business growthand development. Furthermore, with a good measurement of innovation, research institutes and academia can easily identify the impact of knowledge generated and identify the difficulties in the dissemination and application of new knowledge.

Economic models showhow innovation is a key driver of economic growth in the long term. In a classic economics book, "Theory of Economic Development", Joseph Schumpeter notes the importance of innovation in economic growth and the role of "creative destruction" to create radical changes and increase wealth and productivity. Economists highlight the importance of new ideas and technology as determinants of economic growth, since they generate solutions to diminishing marginal returns (Romer 1986), and allow the generation of new industries and organizational models.

It has been observed that traditional sources of growth, such as capital or labor, are of minor importance in the growth of many countries (Figure 1), and are now being replaced by other sources of growth, such as Information and Communications Technologies (ICT). This is partly due to the stagnant or declining populations of many countries which reduce the influence of the amount of work in the long-term growth, and increase the importance of innovation activities (OECD 2010).

Figure 1. Annual percent contribution to GDP growth, average 1985-2009



Source: OECD. StatExtracts, 2013.

Understanding innovation in our country is important for economic growth and productivity, but also, to increase the social welfare of the population. Science and technology area fundamental attribute of the information and knowledge society we live in. The most critical elements of our society, such as transportation, education, environmental protection, medicine, agriculture, and increasingly democratic institutions, depend deeply on how and where science and technology is distributed and applied. In addition, creativity and innovation play an ever more important role to solve basic social problems such as illiteracy, disease, hunger, or energy production.

Currently, Mexican federal policies for economic development are focusing on ways to increase productivity and to reduce and democratize the productivity lags between sectors and regions. This implies reducing productivity gaps bringing the less productive regions the inputs they need to improve their productivity. Innovation can play a key role in removing these productivity gaps between states and regions, but it is necessary to differentiatethe gaps between them so that they can decrease.

2.4 How to measure innovation?

Innovation is not easy to measure, as it depends on multiple factors and arises in different contexts and conditions. The traditional methods for measuring a country's innovation is to measure and qualify the R&D investment that takes place within firms, or measure the most obvious product, for example the number of patents. However, these approaches have significant limitations for innovation because they do not assess the context in which innovation takes place, they do not evaluate the innovation system. An analysis of innovation systems must consider three general elements: a) the agents engaged in national innovation systems, b) the legal and institutional framework in which they operate, c) the network and links between agents (CIDAC, 2012).

The Oslo Manual creates a framework for measuring the factors included in the context in which innovation takes place. With this framework, new indices that evaluated both inputs and outputs of innovation were developed. Some of these factors are:

- The basic educational system for the general population
- The university system
- The specialized technical training system
- The science and research base
- Innovation policies and other government policies that affect innovation
- Legislative and macroeconomic settings
- Communications infrastructure, including roads and telecommunications.
- Financial Institutions
- Market accessibility
- Industry structure and competitive market.

In 2007 the European Union created a study for the measurement of innovation, the Innovation Union Scoreboard. This study includes a methodological model that divides the analysis into three segments: the enablers (human resources, research and funding systems), business activities (investments, linkages and business assets) and innovation products (innovations and their economic effects). Likewise, in 2010 the OECD published the Innovation Strategy report, which includes the measurement and evaluation of 100 indicators grouped in six different subjects. (Table 1)

Starting in 2011, INSEAD and WIPO developed an annual Global Innovation Index (GII). This is the first index that measures innovation at a global scale, emphasizing the importance of linkages and relationships between the various agents of innovation. The GII is composed by a set of variables that are grouped to form two sub-indexes: one that measures the inputs of innovation and the other one measuring the outputs of innovation.

Table 1. International Innovation studies and indexes.

Study	Countries	Key themes included
Innovation Union Scoreboard	European Union	1.Enablers: Human Resources; Research Systems, Finance and support; 2. Firm Activities: Investment ; Linkages and Entrepreneurship; Intellectual assets; 3. Output: Innovators; Economic Effects
Global Innovation Index	197 countries	1. Input: Institutions; Human Capital and Research; Infrastructure; Market Sophistication; Business Sophistication 2. Output: Technology and Knowledge, Creative goods and services
Innovation Strategy	OECD countries	1. Innovation today 2. Enabling innovation for the population 3. Enabling innovation for the firm 4. Investment in innovation 5. Returns on investment 6. Facing global challenges

3. OBJECTIVES

The generation, use and dissemination of knowledge is fundamental to economic growth, development and the well being of nations. Today it is widely accepted that innovation is necessary for sustained and long-term growth. Although the evaluation and measurement of innovation is essential to ensure the effectiveness and relevance of public policies, no clear way to measure innovation has been developed in Mexico.

To foster and boost innovation in the most effective way, it is imperative to have a good understanding of the context in which Mexican innovation originates and develops. Aware of the need to increase our understanding of innovation, the National Innovation Index (INI) was conceived to fill this information gap.

Based on international standards, the INI creates a way to measure innovation in Mexico that includes identification and characterization of the key factors that make up the national innovation system. Altogether, it classifies the 32 states and 86 cities of Mexico according to their innovation levels. The INI has a special focus on the innovation activities of cities as it is considered that cities have natural advantages that facilitate the development of innovation: increased information flow, increased flow of people, increased competitiveness, better infrastructure.

The study focuses on measuring innovation at the enterprise level; therefore it does not cover innovation at sector level or at a broader economic level. The firm is considered the fundamental unit of innovation as it is the lowest organizational level at which decisions about innovation activities are made. In particular, the INI only considers the firms that belong to the National Register of Scientific and Technological Institutions (RENIECYT, for its Spanish acronym, this companies distinguish from other firms due to theirr innovation activities)

Objective 1: Create a ranking of cities and states according to their innovation levels.

Existing indicators of innovation activities in Mexico are focused on the inputs that generate innovation rather than the outputs. Furthermore, innovation has not been the main subject of study of any indicator of the country (Table 1). This implies that the indexes created do not reflect the state of the innovation ecosystem and its context. Even more importantly, there is no index that ranks cities according to their level of innovation, since these are the main drivers of innovation activities in the country and have natural features that allow abetter flow and generation of knowledge.

The INI is thus the first index of Mexico that classifies 86 cities and 32 states according to their level of innovation. To properly characterize the national innovation system, it considers a wide variety of variables that help describe the different facets of the system. Both innovation inputs and outputs are evaluated.

Table 2. Innovation studies in Mexico

Study	Author	Innovation as the focus of the study	Scale	Online Platform
Global Innovation Index	INSEAD, OMPI, Cornell University	YES	National	YES
Competitiveness Index	IMCO	NO	Cities and states	YES
National Innovation Index	Venture Institute	YES	Cities and states	YES

Source: Venture Institute

There are still important limitations to comprehensively assess the national innovation system of the country and there are still many information gaps, especially as it regards the linkages and relationships between the different agents of innovation. Likewise, too often the information does not have a sufficient geographical breakdown. However, the index integrates for the first time information about the key agents and factors that have an impact on the innovation process, thus generating a reliable source of information that enables to contextualize the innovation ecosystem of the country.

Objetive 2: Develop a method to assess the evolution of innovation.

To ensure the long-term development of the country, it is necessary to assess how innovation evolves in different cities and states. Therefore, an objective of the study is to establish a conceptual framework and method to continuously assess the state of innovation in the country. Thus, in the long run it will also allow evaluating the quality of new public policies implemented to encourage innovation.

4. METHODS

The National Innovation Index (INI) ranks the 32 states and 86 cities based on their level of innovation. The INI is constructed from two sub-indexes: Input and Output, each constructed by five and two pillars respectively. The final score of the National Innovation Index is the simple average of the sub-indexes.

1 Input Sub-Index: five pillars that group the elements that facilitate innovation activities in states and cities: (1) Institutions (2) Human Capital and Research, (3) Infrastructure, (4) Market Sophistication, (5) Business Sophistication.

2 Output Sub-Index: consists of two pillars that evaluate the products of innovation activities: (6) Knowledge and Technology (7) Creative Products and Services.

Each pillar consists of individual variables, that add up to 64 variables for the whole index. Insideeach pillarall variables have the same weight. The weight assigned to each pillar depends on whether it belongs to the Input or Output Subindex, all pillars inside these categories weight the same, respectively. The Input Subindex is made up of five pillars, each of these pillars weights 0.2. The Output Subindex is made up of two pillars, each of these weights 0.5 each. while The final ranking ismade up of the average of the results of the two sub-indexes: Input and Output.

The study conducted at the city level is constructed with a previous segmentation of the cities by their level of urbanization. This is a classification of cities according to their urban characteristics which reduces the bias in favor of larger cities. Cities are classified according to four categories: metropolitan areas, large cities, medium cities, small cities.

Classification by level of urbanization was developed by Micro-MercadosDescifra and depends on population and economic factors (table 3).

Table 3. Levels of Urbanization

Level of urbanization	Number of cities	Population range (millions)	Examples
Metropolitan Areas	3	4 to 20	Guadalajara, Nuevo León, Ciudad de México
Big Cities	6	1 to 4	Toluca, León, Torreón, Juárez
Medium Cities	21	0.5 to 1	San Luis Potosí, Mérida, Querétaro
Small Cities	56	Less than 0.5	Guanajuato, Los Mochis, Cd. Victoria

Source: Micro-Mercados Descifra, 2013.

When available, the variables were processed at three different geographic levels: State, County and Locality. For those variables where the lowest level of disaggregation was not available, the value of the next higher geographic level was assigned: to the locality the value of the county was assigned, and to the county the state value was assigned. In total, 42 variables were integrated at the state level and 22 variables at the country or locality level, generating a total of 64 variables. In Annex I there is a detailed description of the pillars and in Annex II a description of the variables.

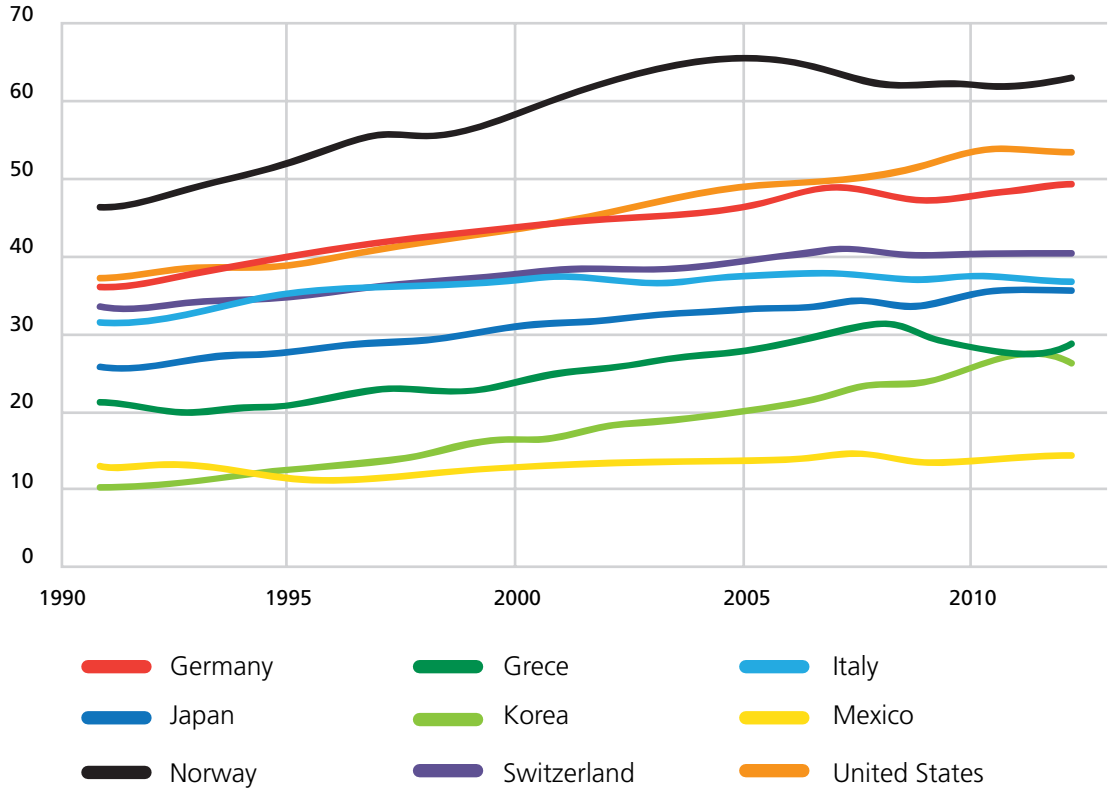
The variables were obtained from public databases, as well as a survey of 2,075 firms registered in the National Register of Scientific and Technological Institutions (RENIECYT) (a thorough explanation and results can be found in Annex III).

5. INNOVATION IN MEXICO

Overall, the innovation system of Mexico is characterized by low levels of investment in R&D, as well as weak linkages between innovation agents. Compared with other OECD countries, Mexico has a low R&D spending in both business and public sectors, as well as poor performance in the creation of knowledge and technology that is represented by a low rate of new patents and trademarks, as well as scientific articles in international journals (OECD 2012).

In terms of infrastructure and human capital, Mexico also has a population relatively uneducated in science and technology compared to other OECD countries, and a weaker information and communicationinfrastructure. The consequences of the disregard of the national innovation system can be reflected in the stagnation of productivity compared to other OECD countries over the past 20 years (Figure 2), which has led to an increased productivity gap with these countries.

Figure 2: GDP Growth per hours worked (1991-2012).



Source: OECD.

However, the outlook for innovation in Mexico remains positive. According to the Global Innovation Index 2013, Mexico was recognized among the countries that have taken a big leap along with Uganda, Costa Rica, Bolivia. In 2012, Mexico was ranked # 79, by 2013 the country scaled to # 63, an improvement of 16 places.

Amongst all 23 countries assessed in Latin America, Mexico is the seventh most innovative country. Costa Rica and Chile are the leaders in innovation. Globally, Mexico appears to be behind some high middle-income countries such as China, Costa Rica, Latvia, Colombia, South Africa and Russia. However, Mexico's score remains higher than that of Brazil, India, Peru and Lebanon. A closer look at the sub-indexes Input and Output allows to reach the conclusion that Mexico does not invest enough in innovation - making it # 68 in the Input Subindex, with a score of 40.73.

More specifically, Mexico's political and regulatory environmentis not supportive. There are low levels of security and press freedom. On the other hand, paying taxes is not easy, and obtaining credit is difficult, especially domestic credits to the private sector. Furthermore, net FDI inflows, as well as, access and use of information and communication technology are low. As for R&D and human capital, in Mexico public spending on education is lower than in other countries - such as pupil-teacher ratio in secondary schools. In addition, enrollment in tertiary education is low and the international flow of students is particularly low.

Mexico remains low but recovers with its innovative products- rising to #60 with a score of 32.90. The volumes of high,medium-high- and high-tech manufactured exports allow Mexico to remain stable thanks to the knowledge and technological products of the country, but it still remains #84 in the ranking. The production of scientific knowledge is also high. The score of creative goods and services exports improvethe classification of Mexico in the Ouput Subindex. Therefore, Mexico has potential human resources that could offer better results in innovation. Investments are needed for education and business environment to become more sophisticated - making Mexico's innovation potential flourish.

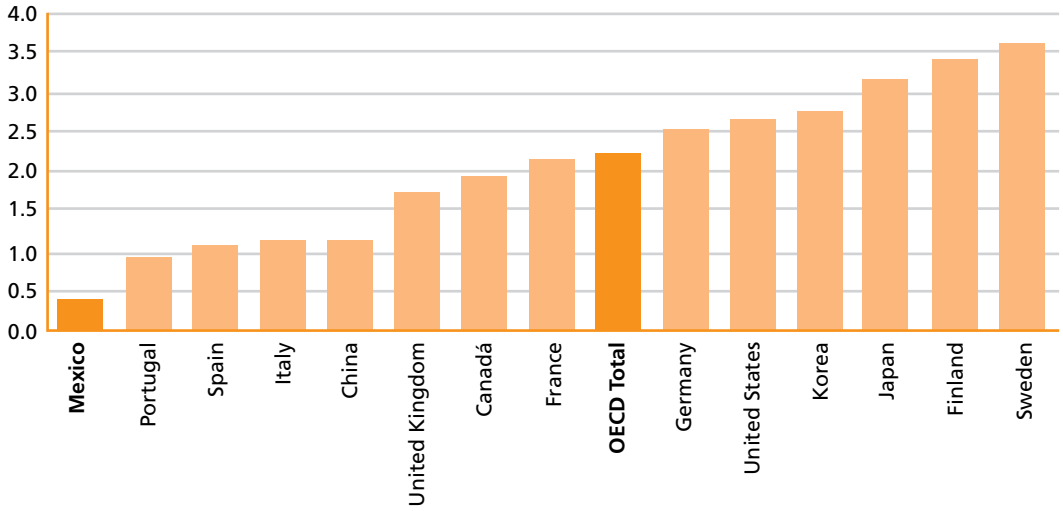
Improving regulatory and economic conditions in which the country develops innovation is necessary to increase productivity and competitiveness in the long run. It is necessary to identify the current state of the main innovation agents of the country. The following are the general characteristics of the innovation system of Mexico, taking into account three key players that define the conditions and the context in which innovation takes place: (1) human capital and research institutions, (2) the business sector, and (3) the government.

5.1 Human Capital and R&D

The sophistication and the amount of knowledge of the population are essential components of innovation, as the innovation capacity of an individual increases with his knowledge and experiences. Furthermore, Research and Development are basic sources of knowledge creation and technology; it is the first stage of the innovation process and the one that identifies problems and proposes solutions.

In 2010, Mexico spent only 0.48% of GDP in research and development, despite the goal of spending 1.2% that was established in the Special Program on Science, Technology and Innovation 2008-2012 (PECiTI) . Spending on Research and Development (GERD) is still well below other OECD countries, which spend 2.14% of GDP on average (Figure 3). An increase in GERD is necessary because no country has increased its ability to innovate without sustained public investment in science and technology.

Figure 3: Average GERD, 1997-2010



Source: OECDStats 2013.

The Mexican research system is mainly composed of two types of researchinstitutions: Public Research Centers (CPI for its Spanish acronym) and Higher Education Institutes (IES for its Spanish acronym). The CPIs are 27 parastatal institutions with certain level of administrative autonomy, as stipulated by the Law on Science and Technology. There are two kinds of CPIs: the ones monitored by the CONACYT and the ones supervised by other ministries.

In 2009, the budget for CPIs was 6, 130 million MXN, only 39% of these funds came from the institutes themselves, the rest of the funds were provided by the government. However, these centers, dedicated to technological development, raise the largest amount of resources captured by their own means, which constitute 73% of theresources. One possible explanation for this ability to obtain resources is that technological development centers havecloser links with businesses and possess the

largest number of intellectual property rights (CONACYT, 2009). These figures demonstrate the importance of establishing more and better relationships with businesses and intellectual property rights to secure funding and autonomy of research centers.

The IES contribute to innovation through both teaching and research. In 2005, IES represented 29% of total research efforts and were the second largest employers of researchers in Mexico. One difficulty faced by these institutions is the centralization of research since nearly half of the production of knowledge is concentrated in only four institutions, including the National Autonomous University of Mexico (UNAM), the Center for Research and Advanced Studies of IPN (CINVESTAV), the Metropolitan Autonomous University (UAM) and the National Polytechnic Institute (IPN), all headquartered in Mexico city. Also, in terms of the impact of published articles, only three states are highlighted: Morelos, Michoacán and Distrito Federal (CONACYT). Therefore, it is important to continue efforts to disseminate the creation and use of knowledge throughout the country.

In terms of human capital for innovation, the key component is the National System of Researchers (SNI, for its Spanish acronym). The SNI is intended to recognize the work of those engaged in research. Since its inception in 1984, the SNI has improved the performance and relevance of scientific research, and without it, the excellence of the research activities and the diversity of researchers in Mexico would not be what they are today. However, the system has disadvantages in terms of innovation because it leans toward assessing individuals by published scientific results (OECD 2012) and not recognizing other types of innovation. With this, it inhibits the undertaking of long-term projects and multidisciplinary research with potential for innovation, and acts as a disincentive to establish partnerships with the private and business sector.

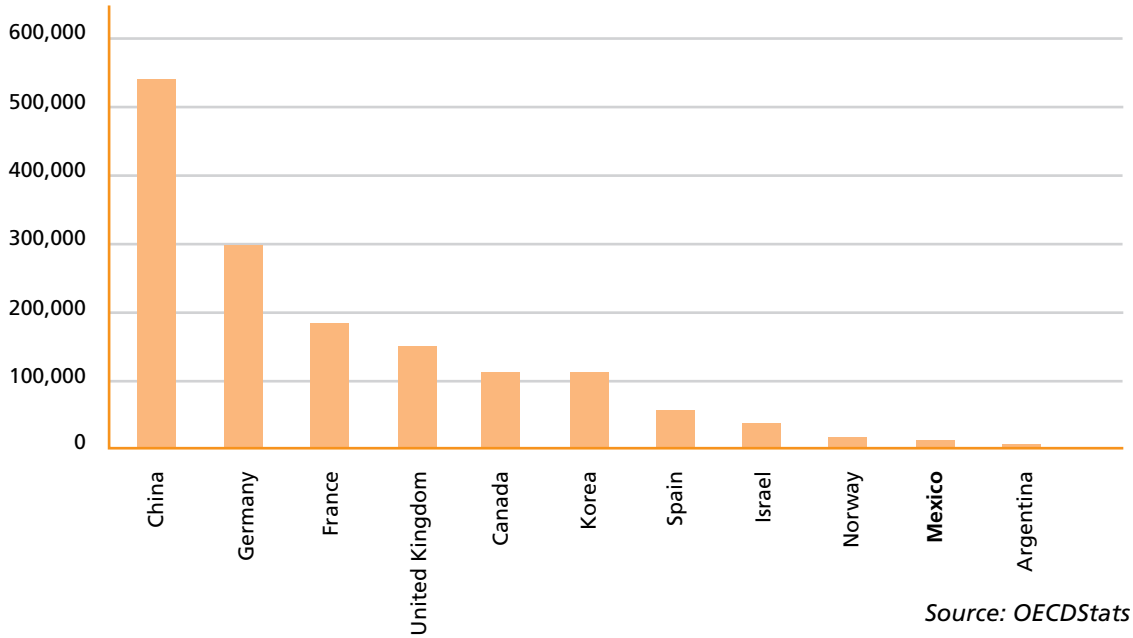
As for the training of researchers and scientists, currently 37.8% of Mexican students are enrolled in engineering and natural sciences (ANUIES 2010/2011), however the national research system absorbs only a small percentage of the graduates. It is also important to increase the number of graduate students in science and technology, as only 16.1% of graduate studies are engaged in these research areas. On another hand, the facilitation of international mobility of students and researchers is another area in which research institutesand academia have an important role to play, since greater flow of knowledge and technology transfer enable innovation.

5.2. Private Sector

Innovation depends not only on science and technology; it is also about the commercialization of new products and services in various sectors of the economy and/or the creation of new organizational models to increase and improve production. Thus, businesses are a key component of any innovation system with good performance. Besides frequentlybeing the creators of new products and services, businessesfacilitate the implementation and commercialization of new technologies and knowledge.

It is important to facilitate and encourage innovation and research within firms in Mexico because the country maintains a low average of corporate research and development relative to other OECD countries (Figure 4). The National Registry of Scientific and Technological Institutions (RENIECYT) was created by CONACYT to supportinstitutions, centers, organizations, companies and individuals or entities from the public, social and private sector, that conduct research and development of science and technology in Mexico. Since its inception, the number of companies and institutions that are part of RENIECYT has steadily increased, suggesting an increase in innovation activities within firms.

Figure 4: Full time equivalent in R&D of business sector, average 1997-2005



Source: OECDStats 2013.

Mexico's business sector is characterized by a high concentration of small and medium enterprises, with 99% of firms being micro, small and medium enterprises (SMEs). However, SMEs only contribute 26% of the country's production, despite employing 2/3 of the working population. This indicates that there is a very important difference between the productivity of large firms and SMEs difference.

According to the Survey of Research and Technological Development (ESIDET 2008-2009), approximately 21% of Mexican companies conduct innovation activities. Innovation activity in Mexico takes place mainly in medium and small businesses, as companies with no more than 250 employees perform 77% of business innovation, and large companies with more than 250 employees perform 23% (table 4).

Table 4. Firm Innovation activities

Size of the enterprise	Total	DID carry out innovation activities	DID NOT carry out innovation activities	Percent	Percent that DID carry out innovation activities
Total	15824	3305	12519	21%	100%
50-100	6993	1715	5278	25%	52%
101-250	4911	830	4080	17%	25%
251-500	2113	435	1678	21%	13%
501 o más	1807	324	1483	18%	10%

Source: ESIDET 2009

Most innovation focuses on the introduction of new processes and methods or products and services, activities in which Mexican firms take part. However, over 50% of Mexican companies do not adapt or modify the technology they use in order to establish higher levels of efficiency and production. This reflects in low technology transfer and absorption by businesses. Moreover, 10% of enterprises with innovations have yet to develop patented technologies (ESIDET 2009).

We know that small businesses are less likely to generate innovation and R&D in comparison to big firms, due to higher operating and marginal costs. However, in Mexico just over 40% of foreign direct investment is spent in companies with fewer than 250 employees, a significant proportion compared to other OECD countries. The importance and potential thatSMEs have to generate innovation lies mainly in three aspects (OECD, 2010): the ability to increase productivity through greater competitiveness, the commercialization of new knowledge that is not commercialized by large companies or universities, and the ability to generate radical innovations, thus creating new markets.

On the other hand, it is observed that larger companies play a minor role in innovation given that transnational corporations focus on static advantages (cheap work force or raw resources) rather than dynamic advantages, such as human resources and local technological capability. As a result, industrial activities are concentrated in assembly operations of imported components, which imply that local production links are weak. The decline in the competitiveness of a manufacturing industry is related to the low activity of innovation and little integration of production chains in economic areas (Carrillo 2009).

5.3 Public Sector

The proper functioning of a national innovation system requires a regulatory structure and legal framework that enables and encourages linkages between different actors. The role of government is also essential as it has the ability to facilitate innovation activities through funding or infrastructure improvement and communication technologies.

In Mexico, government actions on innovation have focused mainly on economic and financial support for research and development in institutions and firms. Most support programs emerged from the Special Program of Science and Technology (PECyT), developed in 2000. Here is a list containing the main programs that support innovation (FCCyT 2011):

- *Sector Funds:* financed and operated by the federal ministries and CONACYT. The selection criteria usually corresponds to the priorities of the Secretariat of State sector. Currently, there are 19 sector funds.

- *Mixt Funds:* developed in 2001these funds are funded and managedjointly by CONACYT and 32 state government agencies. These funds were designed to foster innovation and research at aregional level.

- *Programs for fostering innovation:* programs designed byCONACYT that provide support for companies investing in research, technology, development of new products, processes or services. These programs include three modes: INNOVAPYME (Technological innovation for micro, small and medium enterprises), INNOVATEC (Technological Innovation for large companies), PROINNOVA (Projects that have linkswith two research centers).

- *PROSOFT y PROSOFT 2.0:* a program designed by the Ministry of Economy that seeks to create the conditions to increase competitiveness in the information, technology and communication (ICT) sector. Its function is to support companies in the ICT sector.

- *SME Fund:* managed by the National Institute of Entrepreneurship (INADEM) of the Ministry of Economy, this fundsupports companies and entrepreneurs. Despite it not being a fund focused specifically on innovation, it contains programs for innovation and technological development aimed at specific sectors: new entrepreneurs, micro, small and medium firms,GACELA firms, and events.

- *AVANCE:* A program managed by CONACYT to encourage the creation of businesses based on the exploitation of scientific and/or technological developments. It also aims to promote the detection and generation of business opportunities. In addition to having a seed fund, it has eight operating modes (see table).

Table 5. Operating modes of AVANCE Program

Operating modes of AVANCE	Description	Objective
New Businesses	Encourages scientific and/or technological developments tested in pilot or pre-commercial scale that can become high-value business or new business lines.	Test scientific and/or technological developments in pre-commercial stage in order to achieve the integration phase of the business prospectus and investment.
Entrepreneurs' Fund CONACYT-NAFIN	Provides resources and facilitates access to capital with other investors, to develop and strengthen businesses with high added value. Additionally, itprovides technological, financial and legal assistance to strengthen the competitive position in the long term of firms based on the application of scientific knowledge and/or technology. In this scheme, CONACYT provides financial resources and ability to evaluate the business from a technological point of view. NAFIN, is involved in the financial validation of the project, determining the feasibility of the business model.	Offers complementary investment optionsto established firms, that have received investment from other strategic investors. The project has to create new lines of business with high added value obtained from scientific and technological developments.
Warranty Fund	Facilitates access tocredit for domestic firms. CONACYT operates this program together with Nacional Financiera and Banco del Bajío.	Facilitate access to preferential credit lines to firms that have developed new products or new business lines based on scientific and/or technological development, and require direct investment to increase and streamline their production capacities.
Support to National Patents	Designed to give financial support (via reimbursement) to protect Mexican inventions that are likely to arise as a strategy for the establishment of national and international competitive advantages.	Encourage and boost intellectual protection and property rights of Mexican inventions following the application of scientific knowledge and/or technology.

Technological Programs	Focused on the integration of all elements necessary so that scientific and/or technological developments previously tested and validated at laboratory or pilot plants, can be licenced, sold or transferred through a commercial, legal and technology strategy that facilitates commercial exploitation and/or assimilation into the sector or sectors users.	Promote scientific and/or technological developments that are in the institutions of Higher Education, Research Public Centers or are promoted by independent researchers, to integrate a technology package that facilitates commercial exploitation.
OTT (Knowledge Transfer Offices)	Focused on promoting the formation and acquisition of methodologies that can consolidate the groups, offices or technology transfer centers that promote integration, licensing and/or marketing of Technological Packages, the generation and launch of new businesses and/or the licensing of developments or proprietary technologies.	Encourage the design, integration and implementation of offices that facilitate: the commercialization and transfer of technologies developed by these institutions to user sectors, the identification and integration of strategic investors and sponsors in their own research, and contribute to the creation of opportunities business based on the application of scientific developments and/or technology.
AVANCE-Business School	Seeks to promote the participation of companies and institutions in the development and use of academic and outreach programs, focused on the management and use of technological factors to strengthen the enterprise culture for the technological development in Mexico	Encourage the design and implementation of academic, business incubation and accelerator programs focused on the management and use of technology to strengthen the entrepreneurial culture for technological development in Mexico and support the training of technical skills in innovation and management of technological development projects.
AERI- Strategic Alliances and Innovation Networks	It is a tool that aims to promote the linkages between research institutions and companies to create synergy and increase the competitiveness of the productive sector that concerns them.	Encourage the creation of Strategic Alliancesand Innovation Networks (AERI's) to help raise the competitiveness of productive sectors in the country, as well as research projects, technological development and innovation (R+Di).

Source: Venture Institute with CONACYT information, 2013.

National policies do not provide enough support for the development of technological and regional innovation clusters, however the allocation of resources with a regional focus is increasing. In 2009, the fund FORDECYT was created (Institutional Regional Development Fund for Scientific Development, Technology and Innovation), with the purpose of fostering regional development and linkages.

Only nine states report having two or more technology parks: Aguascalientes, Baja California, Nayarit, Michoacán, Querétaro, Hidalgo, Guanajuato and Jalisco (this state has four parks). From 2008 to2012, six new technology parks were created in the country (CONACyT 2011), but Mexico still faces an enormous regional technological varaition. As for creating innovation linkages abroad, few support mechanisms have been developed, highlighting the US-Mexico Foundation for Science (WSCF), which has programs for business development as TechBA.

The goal of the National Innovation Program is to strengthen the existing links between education, basic and applied science, technology and innovation. The program is based on six pillars that define the national strategy to boost innovation.

1. *The national and international market:* its aim is to strengthen internal and external demand for products, services, and innovative business models created in Mexico.
2. *Generating knowledge with strategic guidance:* its aim is to increase the availability and applicability of knowledge aimed at generating innovation.
3. *Strengthening innovation:* strengthening companies and public entities that require the generation of innovative ideas and solutions for the market.
4. *Financing innovation:* aims to promote the quantity of public and private resources to increase funding sources.
5. *Human Capital:* aims to improve and increase the productive, creative and innovative contributions of individuals.
6. *Regulatory and institutional framework:* it should lay the foundations for a regulatory and institutional framework conducive to innovation.

In Mexico, despite a wide variety of financing programs, the policies and support programs to foster collaboration between firms and public research institutions have been weak. It is important to continue the efforts of regional technology integration to foster innovation and reduce the regional gaps in productivity of the country.

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ANNEX I. RANKING OF PILLARS

Input Results by State

Rank	State	Input Score	Output Score	institution Rank	Human Capital and R&D Rank	Infraestructure Rank	Market Sophistication Rank	Business Sophistication Rank
1	Distrito Federal	70.78	1	8	1	1	1	1
2	Nuevo León	48.92	2	3	4	8	2	3
3	Jalisco	44.70	3	24	3	3	9	2
4	México	41.85	4	17	2	2	17	6
5	Puebla	30.65	18	27	10	21	19	9
6	Querétaro	40.34	5	4	11	24	3	7
7	Guanajuato	37.27	6	2	8	23	13	8
8	Chihuahua	36.24	8	13	15	9	14	4
9	Aguascalientes	36.85	7	1	16	12	12	10
10	Baja California	34.19	10	15	9	15	11	12
11	Coahuila	33.11	13	30	5	14	6	14
12	Sonora	32.39	16	16	18	16	10	11
13	Yucatán	32.79	15	10	6	13	20	18
14	Sinaloa	33.87	11	7	13	29	16	5
15	Campeche	29.72	21	9	26	22	7	27
16	Quintana Roo	33.08	14	22	21	11	4	21
17	Veracruz	30.56	19	14	12	4	23	28
18	Baja California Sur	34.81	9	5	17	25	5	22
19	Morelos	30.93	17	18	7	7	27	15
20	Colima	33.38	12	6	14	6	8	29
21	Tamaulipas	30.20	20	25	20	5	15	20
22	Tabasco	23.46	28	26	30	31	18	19
23	Hidalgo	26.55	24	19	24	17	26	24
24	Nayarit	27.27	22	11	19	28	24	26
25	Zacatecas	19.45	31	23	28	32	32	25
26	Durango	25.05	25	28	25	27	21	17
27	San Luis Potosí	27.25	23	21	23	30	22	13
28	Michoacán	24.33	27	29	22	10	29	23
29	Tlaxcala	22.50	29	20	27	19	30	32
30	Chiapas	24.46	26	12	29	20	28	30
31	Guerrero	21.24	30	32	31	18	25	16
32	Oaxaca	16.17	32	31	32	26	31	31

Output Results by State

Rank	State	Output Score	Output Rank	Technology and Knowledge Rank	Creative Goods and Services Rank
1	Distrito Federal	70.52	1	1	1
2	Nuevo León	40.73	2	4	4
3	Jalisco	40.43	3	3	6
4	México	29.28	10	6	24
5	Puebla	39.44	4	2	11
6	Querétaro	27.77	14	11	19
7	Guanajuato	30.70	7	5	25
8	Chihuahua	28.13	13	7	26
9	Aguascalientes	27.13	17	16	15
10	Baja California	29.62	8	10	17
11	Coahuila	29.31	9	9	22
12	Sonora	29.11	11	12	14
13	Yucatán	28.29	12	17	9
14	Sinaloa	26.92	19	18	13
15	Campeche	31.00	6	13	8
16	Quintana Roo	25.76	21	19	16
17	Veracruz	27.08	18	26	7
18	Baja California Sur	22.52	25	29	18
19	Morelos	25.11	22	8	28
20	Colima	22.64	24	22	23
21	Tamaulipas	25.81	20	24	12
22	Tabasco	31.94	5	30	2
23	Hidalgo	27.15	16	21	10
24	Nayarit	24.65	23	32	5
25	Zacatecas	27.69	15	31	3
26	Durango	21.69	26	27	21
27	San Luis Potosí	18.62	30	15	32
28	Michoacán	20.05	29	14	31
29	Tlaxcala	20.33	28	20	27
30	Chiapas	16.85	32	25	30
31	Guerrero	17.49	31	23	29
32	Oaxaca	21.53	27	28	20

Input Results for Cities

Rank	Metropolitan Area	Input Score	Input Rank	Institutions Rank	Human Capital and R&D Rank	Infraestructure Rank	Market Sophistication Rank	Business Sophistication Rank
1	Valle de México	57.19	1	1	1	2	1	1
2	Guadalajara	43.43	2	3	2	1	3	2
3	Monterrey	42.87	3	2	3	3	2	3

Rank	Big City	Input Score	Input Rank	Institutions Rank	Human Capital and R&D Rank	Infraestructure Rank	Market Sophistication Rank	Business Sophistication Rank
1	Toluca	41.75	1	3	1	1	1	2
2	León	38.17	2	1	3	5	3	3
3	Puebla-Tlaxcala	32.64	6	2	5	6	5	4
4	Juárez	34.86	3	4	6	3	6	1
5	La Laguna	33.95	5	6	4	2	2	6
6	Tijuana	34.07	4	5	2	4	4	5

Rank	Medium City	Input Score	Input Rank	Institutions Rank	Human Capital and R&D Rank	Infraestructure Rank	Market Sophistication Rank	Business Sophistication Rank
1	Hermosillo	37.48	1	10	1	7	8	6
2	Culiacán	36.60	2	8	2	19	11	2
3	Veracruz	31.35	11	12	12	1	4	18
4	Querétaro	35.41	3	9	11	17	2	3
5	Mérida	35.26	4	1	4	9	13	10
6	Xalapa	30.97	12	4	15	2	17	19
7	Saltillo	33.14	7	15	5	8	6	8
8	Chihuahua	34.83	5	13	8	14	16	1
9	Mexicali	34.17	6	14	7	6	9	4
10	Villahermosa	26.62	19	11	19	21	7	17
11	Tampico	28.64	17	16	18	4	15	13
12	Aguascalientes	32.69	8	6	13	15	12	5
13	Durango	30.86	13	17	3	12	5	15
14	Cuernavaca	31.78	9	2	6	11	21	9

Rank	Medium City	Input Score	Input Rank	Institutions Rank	Human Capital and R&D Rank	Infraestructure Rank	Market Sophistication Rank	Business Sophistication Rank
15	Cancún	29.53	16	18	17	13	1	12
16	Reynosa	27.14	18	20	16	3	19	14
17	Morelia	30.85	14	5	10	5	20	16
18	San Luis Potosí	31.43	10	3	14	20	14	7
19	Tuxtla Gutiérrez	30.35	15	7	9	16	3	21
20	Acapulco	25.81	20	19	21	10	10	11
21	Oaxaca	20.26	21	21	20	18	18	20

Rank	Small City	Input Score	Input Rank	Institutions Rank	Human Capital and R&D Rank	Infraestructure Rank	Market Sophistication Rank	Business Sophistication Rank
1	Ocotlán	39.99	2	41	3	2	41	2
2	Puerto Vallarta	42.90	1	29	5	1	6	1
3	Irapuato	36.21	7	5	4	54	24	11
4	Celaya	39.90	3	2	2	41	17	8
5	Guanajuato	39.51	4	1	8	52	18	6
6	Salamanca	37.10	6	3	9	53	14	10
7	Campeche	31.29	20	16	47	22	5	37
8	San Francisco del Rincón	34.31	10	4	16	55	36	9
9	Orizaba	27.67	40	14	54	10	55	44
10	Delicias	37.90	5	35	13	35	2	5
11	Córdoba	31.28	21	12	48	5	29	39
12	Ensenada	33.74	12	43	1	32	25	16
13	Cuauhtémoc	31.11	23	50	25	40	11	4
14	Ciudad Obregón	35.12	9	17	12	19	21	19
15	Hidalgo Del Parral	30.55	28	53	17	39	23	3
16	San Juan Del Río	35.18	8	18	14	49	8	7
17	Piedras Negras	29.75	31	40	18	23	44	24
18	Coatzacoalcos	31.13	22	6	42	14	33	48
19	Tehuacán	28.74	37	45	40	50	16	17
20	Ciudad Del Carmen	30.09	29	20	37	28	10	47
21	Los Mochis	33.12	13	21	23	36	32	12
22	Mazatlán	33.03	14	38	6	37	27	14
23	Navojoa	32.81	15	36	28	17	12	18
24	Ciudad Victoria	33.82	11	39	7	4	19	26
25	Poza Rica	28.94	36	15	53	9	47	43
26	Guaymas	31.61	17	46	32	26	3	15
27	Minatitlán	27.34	45	23	56	11	40	52
28	Ciudad Acuña	31.32	19	33	20	20	28	22
29	Zacatecas-Guadalupe	23.38	53	37	41	56	53	29
30	Colima-Villa de Álvarez	30.59	26	10	49	8	30	50

Rank	Small City	Input Score	Input Rank	Institutions Rank	Human Capital and R&D Rank	Infraestructure Rank	Market Sophistication Rank	Business Sophistication Rank
31	Nuevo Laredo	30.55	27	32	29	3	50	27
32	Monclova-Frontera	29.88	30	42	31	18	31	23
33	Manzanillo	30.95	24	26	30	12	15	49
34	Matamoros	29.34	32	34	36	13	46	25
35	Heroica Nogales	28.00	39	52	15	21	43	13
36	La Paz	31.49	18	31	11	34	7	36
37	Tapachula de Córdova y Ordóñez	32.65	16	7	24	31	4	51
38	Pachuca	27.55	42	24	19	46	52	32
39	Tula	26.92	48	22	44	48	34	40
40	Tulancingo	27.40	44	19	46	47	37	34
41	Chetumal	30.75	25	44	10	29	13	31
42	Tepic	27.46	43	25	21	44	48	46
43	Cuautla	29.00	35	8	22	38	57	28
44	Tecomán	26.95	47	27	52	7	42	56
45	Fresnillo	17.26	57	51	43	57	56	45
46	San Luis Río Colorado	24.05	51	55	33	24	35	20
47	Tlaxcala-Apizaco	25.11	50	11	50	51	51	55
48	Playa Del Carmen	26.49	49	56	38	15	1	30
49	San Juan Bautista Tuxtepec	22.62	54	47	55	43	26	54
50	Iguala De La Independencia	21.37	55	57	51	30	9	35
51	Uruapan	27.58	41	28	26	27	49	41
52	La Piedad-Pénjamo	29.33	33	13	45	6	54	38
53	Ciudad Valles	27.15	46	48	27	42	20	21
54	San Cristóbal De Las Casas	29.04	34	9	34	25	45	53
55	Zamora-Jacona	28.00	38	30	39	16	39	42
56	Chilpancingo	23.39	52	54	35	33	22	33
57	Tehuantepec	19.48	56	49	57	45	38	57

Output Results for Cities

Rank	Metropolitan Area	Output Score	Output Rank	Technology and Knowledge Rank	Creative Goods and Services Rank
1	Valle de México	65.24	1	1	1
2	Guadalajara	46.04	2	2	2
3	Monterrey	41.21	3	3	3

Rank	Big City	Output Score	Output Rank	Technology and Knowledge Rank	Creative Goods and Services Rank
1	Toluca	29.22	3	5	1
2	León	32.41	2	3	2
3	Puebla-Tlaxcala	32.48	1	1	6
4	Juárez	25.11	5	6	3
5	La Laguna	25.43	4	4	5
6	Tijuana	23.62	6	2	4

Rank	Medium City	Output Score	Output Rank	Technology and Knowledge Rank	Creative Goods and Servicaes Rank
1	Hermosillo	27.38	7	7	8
2	Culiacán	26.71	9	10	7
3	Veracruz	31.85	2	5	2
4	Querétaro	27.62	6	4	14
5	Mérida	27.10	8	12	5
6	Xalapa	30.91	3	5	3
7	Saltillo	28.18	5	2	15
8	Chihuahua	26.00	11	1	16
9	Mexicali	26.15	10	8	10
10	Villahermosa	33.20	1	16	1
11	Tampico	28.49	4	9	4
12	Aguascalientes	24.39	13	11	12
13	Durango	22.87	14	20	6
14	Cuernavaca	21.76	17	3	19
15	Cancún	22.69	15	17	13
16	Reynosa	24.41	12	14	9
17	Morelia	17.75	18	18	17
18	San Luis Potosí	16.06	20	13	21
19	Tuxtla Gutiérrez	14.47	21	21	18
20	Acapulco	16.64	19	15	20
21	Oaxaca	22.01	16	19	11

Rank	Small City	Output Score	Output Rank	Technology and Knowledge Rank	Creative Goods & Services Rank
1	Ocotlán	46.47	1	1	5
2	Puerto Vallarta	36.08	2	7	11
3	Irapuato	34.74	5	2	26
4	Celaya	30.89	8	2	44
5	Guanajuato	30.87	9	2	45
6	Salamanca	30.85	10	2	46
7	Campeche	35.21	4	17	4
8	San Francisco del Rincón	30.84	11	2	47
9	Orizaba	35.48	3	19	3
10	Delicias	24.71	30	9	51
11	Córdoba	30.34	12	19	9
12	Ensenada	26.71	21	32	17
13	Cuauhtémoc	29.03	16	9	35
14	Ciudad Obregón	24.99	25	24	30
15	Hidalgo Del Parral	29.41	15	9	29
16	San Juan Del Río	24.69	31	16	41
17	Piedras Negras	29.82	14	12	22
18	Coatzacoalcos	28.33	18	19	13
19	Tehuacán	29.99	13	8	28
20	Ciudad Del Carmen	28.56	17	17	16
21	Los Mochis	25.05	23	33	20
22	Mazatlán	25.07	22	33	19
23	Navojoa	24.91	27	24	32
24	Ciudad Victoria	23.71	38	37	23
25	Poza Rica	28.31	19	19	14
26	Guaymas	24.91	28	24	33
27	Minatitlán	28.27	20	19	15
28	Ciudad Acuña	24.22	34	12	50
29	Zacatecas-Guadalupe	31.58	7	47	2
30	Colima-Villa de Álvarez	24.15	35	29	36
31	Nuevo Laredo	23.67	40	37	25
32	Monclova-Frontera	24.26	33	12	49
33	Manzanillo	22.45	44	29	42
34	Matamoros	23.67	39	39	24
35	Heroica Nogales	24.93	26	24	31
36	La Paz	21.29	46	56	18
37	Tapachula de Córdova y Ordóñez	19.94	50	54	27
38	Pachuca	25.00	24	53	7
39	Tula	24.61	32	51	8
40	Tulancingo	24.12	36	51	10
41	Chetumal	20.39	48	43	38
42	Tepic	23.33	42	57	6
43	Cuautla	20.50	47	15	53

Rank	Small City	Output Score	Output Rank	Technology and Knowledge Rank	Creative Goods & Services Rank
44	Tecomán	22.43	45	29	43
45	Fresnillo	32.03	6	47	1
46	San Luis Río Colorado	24.90	29	24	34
47	Tlaxcala-Apizaco	22.79	43	35	37
48	Playa Del Carmen	20.36	49	43	39
49	San Juan Bautista Tuxtepec	23.85	37	49	12
50	Iguala De La Independencia	23.46	41	41	21
51	Uruapan	17.12	52	45	48
52	La Piedad-Pénjamo	14.59	55	40	57
53	Ciudad Valles	15.39	53	36	55
54	San Cristóbal De Las Casas	12.63	57	54	52
55	Zamora-Jacona	13.37	56	45	56
56	Chilpancingo	15.14	54	41	54
57	Tehuantepec	19.01	51	49	40

ANNEX II. INNOVATION PILLARS

Pillar 1: *Institutions (Input)*

The Institutions pillar evaluates the institutional framework in which innovation takes place. A good institutional framework that creates a safe environment where entrepreneurship and business thrive is essential to foster innovation. The backbone of the pillar consists of seven variables that measure the safety and freedom of the press, the rule of law and the quality of regulation for innovation and business development.

Pillar 2: *Infraestructure. (Input)*

Infrastructure allows the flow of information and people. A good communications infrastructure, transport and energy production facilitates the exchange of ideas, services and products. Infrastructure also contributes to the innovation system, generating greater market access. The Infrastructure Pillar rates the quality and availability of transport, energy, and communication.

Pillar 3: *Human Capital and Research*

Research and development activities are the primary source of new knowledge. Furthermore, education of the population is critical to develop aninnovative capacity. The Human Capital and Research pillar evaluates the quality of research and human capital through twelve variables that assess education spending, the number of researchers, R&D investment, the level of knowledge and entrepreneurship of the population.

Pillar 4: *Market Sophistication (Input)*

The ease of obtaining financial resources is critical to the innovation process. The Market Sophistication pillar is structured to measure the availability and access to credit, investment and trade of a region. The pillar is made up of six variables measuring credit, investment, trade and competition in a region or city.

Pillar 5: *Business Sophistication (Input)*

This pillar assesses the business environment of a region or city to characterize firms, a key component of the innovation process in the country. The Business Sophistication pillar is formed by 14 variables measuring linkages to innovation, the uptake of knowledge, research and development activities.

Pillar 6: *Knowledge and Technology (Output)*

The Technology and Knowledge pillar consists of nine variables that measure the production of new technology and knowledge of a region or city. The variables considered seek to assess the amount of knowledge-created articles, patents, and the impact of these on the economy.

Pillar 7: *Creative Goods and Services (Output)*

Creativity is a manifestation of innovation, the production of goods and services involves cultural innovation. The creativity pillar measures the creative capacity of the population, using six variables measuring access and cultural production of a region or city.

Cronbachs Alpha analysis of the pillars

Cronbach's Alpha	States	Cities
Institutions	0.5085	0.5452
Human Capitaland R&D	0.8729	0.7502
Infrastructure	0.6166	0.5291
Market sophistication	0.7735	0.4274
Business Sophistication	0.9301	0.8841
Technology and Knowledge	0.7813	0.7757
Creative Goods and Services	0.576	0.3904

Correlations

Input

The five pillars are correlated positively and significantly with the Input. In cities the lowest correlation coefficient is observed in the Institutions category(0.4670) and the highest in Business Sophistication (0.7807). High correlation between pillars is not seen, but most are positive and significant. Instates, the lowest correlation coefficient regarding theInput is presented in the Institutions category(0.4728) and the highest is Human Capital (0.9211).
In both analyses, all pillars are providing significant information to the Input.

Output

Both pillars have high, positive and significant correlations with theOutput, in both cities and states. However, between the pillars there is a low correlation: 0.3849 in states and 0.1300 in cities.

Both Pillars provide information to build the Output. However, it is important to note that there is no significant correlation between "Knowledge and Technology" and "Creative Services and Goods".

ANNEX III. SURVEY TO FIRMS AND INSTITUTIONS OF RENIECYT

The study considers the firm as the unit of innovation. Therefore, key components in developing the INI were the variables obtained from a survey made to 2,075 companies that belong to the National Register of Scientific and Technological Institutions (RENIECYT) of the CONACYT.

Entities forming part of RENIECYT are those that have been identified by the CONACYT for their research and development activities, as well as for having particular science and technology activities. Therefore, the understanding of the activity of these organisms is essential to understand how business innovation takes place in the country. The survey focused on the determination of the ability of firms to innovate and the nature of their innovation activities. The questions were aligned in three main topics:

(1) Public policies that encourage and foster innovation.

Innovation takes place in a context where governments intervene and design policies. Questions about the perception of firms about the importance of government in fostering innovation were made, particularly on the approach that the government should prioritize. Questions about particular barriers and external factors that drive innovation, the competition in the market and the sources of funding for innovation were also addressed. This approach will generate valuable information on the efficiency and effectiveness of government activities.

(2) Key to innovation linkages:

Linkages between firmsanddiverse stakeholders are key in innovation systems; however, they are often the most difficult qualities to measure due to insufficient data. Therefore, a focus of the survey was to obtain indicators of the degree of liaison and cooperation between firms and institutions. Questions regarding the relationship of domestic companies with foreign companies,the academy, suppliers and customers, were included. This approach allows identifying and addressing organizational structures and practices that promote the transfer and development of knowledge.

(3) Entrepreneurship in the innovation of the firm.

Entrepreneurship is an important part of the innovation process. The relationship between innovation and entrepreneurship may seem dual because more innovation entails more entrepreneurship but entrepreneurship is also a requirement for innovation. The survey allowed to assess the degree of entrepreneurial activity within firms and describes the relationship between entrepreneurship and innovation.

The survey created information about the characteristics of innovation of RENIECYT firms and institutions. In total, 2,075 interviews were completed and state representativeness was obtained. Of the agencies surveyed, 35% were micro, 41% small firms, 9% medium firms and 12% large companies.

From this survey, marketing innovation was the least popular, while innovation in products and services was dominant in the four types of companies. Additionally, customers are the main source of inspiration for companies except for small businesses whose greater inspiration are other companies.

Furthermore, it was found that innovation activities are mainly financed withcompany equity, since the financing of government funds are focused on small and medium-sized enterprises. This relates directly with the main obstacle for innovation, which is the lack of financing sources. However for large companies some of the main obstacle are also related with economic risks and high costs of generating innovation.

In terms of public policy, companies argue that the government's strategy to support innovation should focus on the financial support (57.75% of the total surveyed), followed by facilitating more linkages with research institutions (19.25% of total) and promoting regional economic development (9.25% of total).

Table 6. Results of survey to RENIECYT firms

Firm	Micro	Small	Mediana	Large
Total surveyed	719	859	195	250
	Exclusively within the firm	Exclusively within the firm	In cooperation with other institutions (not firms).	Exclusively within the firm
Dominant strategy for innovation	Clients	Other firms	Clients	Clients
Main Obstacle for innovation	Lack of financing sources	Lack of financing sources	High costs and lack of financing sources	High costs, economic risks, and lack of financing sources

Source: SIMO Survey, 2013.

ANNEX IV. DESCRIPTION OF VARIABLES

INPUTS

Pillar: Institutions

#	Variable	Description	Source	Geographic Scale
1.1	Homicides	Index composed of number of voters, political consistency and number of homicides	IFE (Electoral Federal Institute)	State
1.2	Government efficiency	Degree of efficiency and effectiveness of government.	IMCO	State
1.3	Free press and violence	Number of missing, tortured or abused, grievance to journalists from January to April 2013	Human Rights National Commission, Alert National System	State
1.4	Quality of Regulation	Basic regulation index	INAFED (Federalism and Municipal Development National Institute)	Municipality
1.5	Rule of Law	Confidence and objectivity of law system	IMCO	State
1.6	Ease of starting a business	Ease of starting a business variable	Doing Business Mexi-co-World Bank 2012	State
1.7	Ease of paying taxes	Average response to: ¿How easy is it to do tax returns?	RENIECIT (National Record of Scientific and Technologic Companies and Institutions) Survey	State

Pillar: Human Capital and R&D

#	Variable	Description	Source	Geographic Scale
2.1	Per student education expense	Per student education expense	CIEP (Center of Budgetary Economic Investigation)	State
2.2	Educational Level (average years of school)	Average education years of the population in 2010	INEGI – Household and Population Census	Locality
2.3	PISA test results	Ranking of PISA exam results 2009	SEP (Ministry of Public Education)	State

#	Variable	Description	Source	Geographic Scale
2.4	Education quality	Ratio of students and teachers in upper secondary education in 2009	SEP	Locality
2.5	Grado aprobado, nivel superior % de mayor a 18	% of population over 18 years old with bachelor´s degree	SEP	Locality
2.6	Population with graduate degree	Population with master and PhD degree	INEGI 2009	Locality
2.7	Students abroad (sponsored by CONACYT)	Averagestudents abroad sponsored by CONACYT, from 1996 to 2011	INEGI-CONACYT (Science and Technology National Council)	State
2.8	Number of researchers	Number of researchers members of the National Researchers System (SNI)	CONACYT	State
2.9	R&D Investment	Research and development services	DENUE-INEGI 2009	Locality
2.10	Quality of Research Institutes	Average response to: How would you assess the quality of scientific institutions in your city?	CONACYT	State
2.11	Number of Research Institutes	Total amount of CONACYT mixed funds in 2011	REINECYT Survey	State
2.12	Entrepreneurship Spirit	Applications received for "POSIBLE", a social business accelerator, divided amongst total mexican population	Venture Institute	State

Pillar: Infraestructure

#	Variable	Description	Source	Geographic Scale
3.1	ICT Access	Index composed by the number of telephonic and mobile subscriptions over% of population with a computer	INEGI 2010	Locality
3.2	Internet use	Internet users over population	INEGI 2010	Locality
3.3	Online Government	Number of Public Administration Institutions with online service	INEGI Government, Public Security and Municipal Justice National Survey 2009	Municipality
3.4	Online participation	Use of social network as an information source	Political Culture National Survey 2012	Municipality

#	Variable	Description	Source	Geographic Scale
3.5	Communications infrastructure	Frequency spectrum of AM, FM and TV channel signals	Descifra	Locality
3.6	Energy production	Electric energy generation per capita in 2012 (megawatts/hour)	SENER	State
3.7	Energy consumption	Energy per capita consumption in 2012 (megawatts/hour)	SENER	State
3.8	Quality of transportation	Highway density (number of highway kilometers within a state)	SCT-INEGI	State
3.9	Gross fixed capital formation	Gross fixed capital formation as GDP %	INEGI Economic Census 2009	Locality
3.10	Energy efficiency	GDP over energy consumption (megawatts/hour)	INEGI and SENER 2012	State
3.11	Environmental performance	Sum of number of environmental complaints from 1994 to 2009	INEGI 2010	Municipality

Pillar: Market Sophistication

#	Variable	Description	Source	Geographic Scale
4.1	Credit access	Number of bank branches	Financial Inclusion Report CNVB 2012	Municipality
4.2	Credit use	Number of credit contracts for every 10,000 adults	Financial Inclusion Report CNVB 2012	Municipality
4.3	Microfinance	Number of microfinance companies for every 10,00 adults	Financial Inclusion Report CNVB 2012	Municipality
4.4	Market capitali-zation	Total market capitalization of companies listed in BMV (Mexican Stock Exchange)	BMV 2012	State
4.5	Stock exchange	Value of stocks traded of companies listed in BMV, 2012	BMV 2012	State
4.6	Local competition intensity	Average responseto: How would you assess the market competition in your industry?	RENIECYT Survey	State

Pillar: Business Sophistication

#	Variable	Description	Source	Geographic Scale
5.1	Employed professionals	% of companies responding YES to: Does your company offer training to employees?	RENIECYT Survey	Locality
5.2	Number of companies with training programs	Porcentaje de empresas que respondieron SI a: ¿Su empresa ofrece un programa de capacitación a sus empleados?	Encuesta RENIECYT	State
5.3	R&D in Companies	Innovation activities performed by companies	ESIDET 2009-INEGI	State
5.4	Company R&D expenditure	Average response to: What percentage of the Company'sannual income is invested in innovation activities?	Encuesta RENIECYT	State
5.5	Number of science and technology companies	Number of companies in RENIECYT over number of total economic units	CONACYT 2012	State
5.6	Collaboration degree	Average response of: Has your Company collaborated with universities and research institutes?	RENIECYT Survey	State
5.7	Strategic Alliances	Average response to: How many Collaboration Agreements for innovation activities has your company taken on? and: Is your Company a member of an association in your sector?	RENIECYT Survey	State
5.8	**Number of clusters**	Number of clusters over economic units	Descifra	Locality
5.9	Intellectual Property use	Companies responding YES to: Does the Company incur in payments of copyrights or intellectual property?	RENIECYT Survey	State
5.10	Import of high technology goods	Companies responding YES to: Does the Company import high technology goods?	RENIECYT Survey	State
5.11	Foreign direct investment	IDE in millions of dollars per state, Average FDI from 1989 to 2011 in US million	SE (Ministry of Economy)	State
5.12	Number of incubator and accelerators	Number of incubators and accelerators over population	INADEM (Entrepreneur National Institute)	State
5.13	Startups and SME´s	Average response of: In what degree the Company has startups and SME´s as suppliers or clients?	RENIECYT Survey	State

OUTPUTS

Pillar: Technology and Knowledge

#	Variable	Description	Source	Geographic Scale
6.1	Patents	Number of registered patents 2012	IMPI (Intellectual Property Mexican Institute)	State
6.2	Patent growth rate	Difference in registered patents from 2008 to 2012	IMPI	State
6.3	Published articles impact	Impact of published articles in 2011	CONACYT	State
6.4	Labor productivity	GDP in 2010 over PEA	INEGI	State
6.5	Software use	Companies responding YES to: Does the Company use computer systems in administrative processes?	INEGI-ESIDET 2009	State
6.6	Quality certifications (ISO 9001 and 14001)	Institutions certified with ISO 9001 and 14001 over economic units	INEGI	State
6.7	Impact of innovation in the market	Average response to: What is the scope of your Company's innovation? (Within company, regional, national, international)	RENIECYT Survey	State
6.8	Royalties from intellectual property use	% of companies responding YES to: Does the company receive royalties for the use of intellectual property?	RENIECYT Survey	State
6.9	Export of high technology goods	% of companies responding YES to: Does this company export high technology goods?	RENIECYT Survey	State

Pillar: Creative Goods and Services

#	Variable	Description	Source	Geographic Scale
7.1	ICT and business model creation	Average response of: In what degree is ICT creating new products or improving goods and services in your Company?	RENIECYT Survey	State
7.2	ICT and organizational model creation	Average response to: In what degree is ICT creating new products or improving the organizational methods and processes in your company?	RENIECYT Survey	State
7.3	Expenditure in cultural activities	Number of libraries and museums per capita	DENUE-INEGI 2009	Locality
7.4	Production and transmission of movies and television	Number of economic units in the film industry per capita	DENUE-INEGI 2009	Locality
7.5	Newspaper and journal printing	Number of economic units in newspaper editions and printing per capita	DENUE-INEGI 2009	Locality
7.6	Tweets per capita	Number of tweets in a week per capita	Descifra	Locality