National Science Technology and Innovation Index 2018

#INCTI-CAIINNO2018

CAIINNO®
CENTRO DE ANÁLISIS PARA LA INVESTIGACIÓN EN INNOVACIÓN

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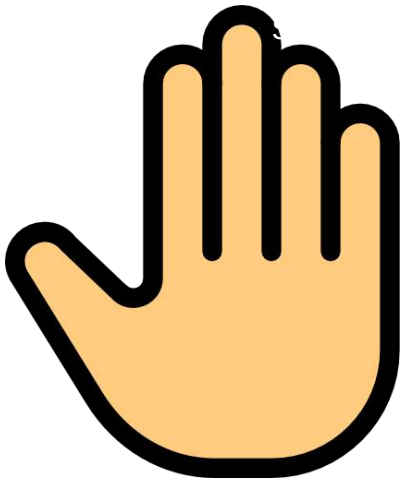
INTRODUCTION

The national science technology and innovation index **(#INCTI-CAIINNO)**, done by the The Center of Analysis for Research in Innovation, NGO. **(CAIINNO)** is the second since the organization was created.

Mexico has tried not to fall behind on matters of science, technology and innovation (CTI) However, according to the results obtained by sources such as the innovation Index of World Intellectual Property Organization, **this growth has been slow**. For CAIINNO, State participation is critical as their development directly reflects on the entire country.

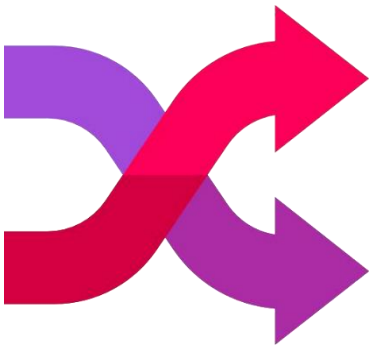
Unlike other innovation indexes, from its first edition (2015) the #INCTI-CAIINNO, was designed with a social perspective in mind, to consider the challenges faced by Mexico in areas such as gender and poverty. CTI should be a tool used for combating the countries social issues. In addition, it is important to fix other problems such as the **gender participation gap** before improving the conditions for CTI.

The objective of #INCTI-CAIINNO 2018 is very straightforward: **Contribute to informed decision-making**. Now that there is a new government in place and changes have been made to all three branches, it is imperative to determine where we stand in order to determine where we are headed.



This index, as many others Uses the most current public information.

Some of the data used for the previous version have not been updated by the original sources since the last index. It is possible that some changes to the data happened during the year of development, giving way to inconsistencies, since during the time information was being collected these updates were not available.



"A 2017 version was not developed given the electoral process that happened during this year as it could have negatively impacted on electoral campaigns by being employed for negative purposes."

INDEX DESCRIPTION

The index responds to what **CAIINNO** believed to be the elements that will allow reaching A Knowledge-based-Economy but remaining focused on the social dimension. The recommendations and indicators of organizations such as the **World Economic Forum**, **The United Nations Conference on Trade and Development and the World Intellectual Property Organization were reviewed.**

After identifying the indicators used and endorsed by these organizations and considering the social dimension of this index the organization performed an index selection.

Finally, a research was conducted seeking sources that harbored relevant information and excluding

those that only had old data that could not be used for the index.

METHODOLOGY

In order to homogenize and reduce bias, data conversions were done to all units expressed as averages, percentages, or rates for each 10,000 or 100,000 members of the total economically active population or others.

Subsequently, the weights and factor scores were calculated for each of the pillars in the index (12 in total) through the Principal component analysis.
This transforms each set of different variables into a single complex variable that maximizes the amount of information included in each variable and avoids any multicollinearity.

Once the principal component analysis has been performed, the normalized values (from 0 to 1) were calculated for each indicator employing the *max-min* normalization method as shown:

$$\widetilde{X_i} = \frac{X_i - MIN(\forall_i \tilde{X}_i)}{MAX(\forall_i \tilde{X}_i) - MIN(\forall_i \tilde{X}_i)}$$

Finally, the index for Science Technology and Innovation (CTI) 2018 was obtained by averaging the rank obtained by each State in every sub index through the same method used for the pillars.

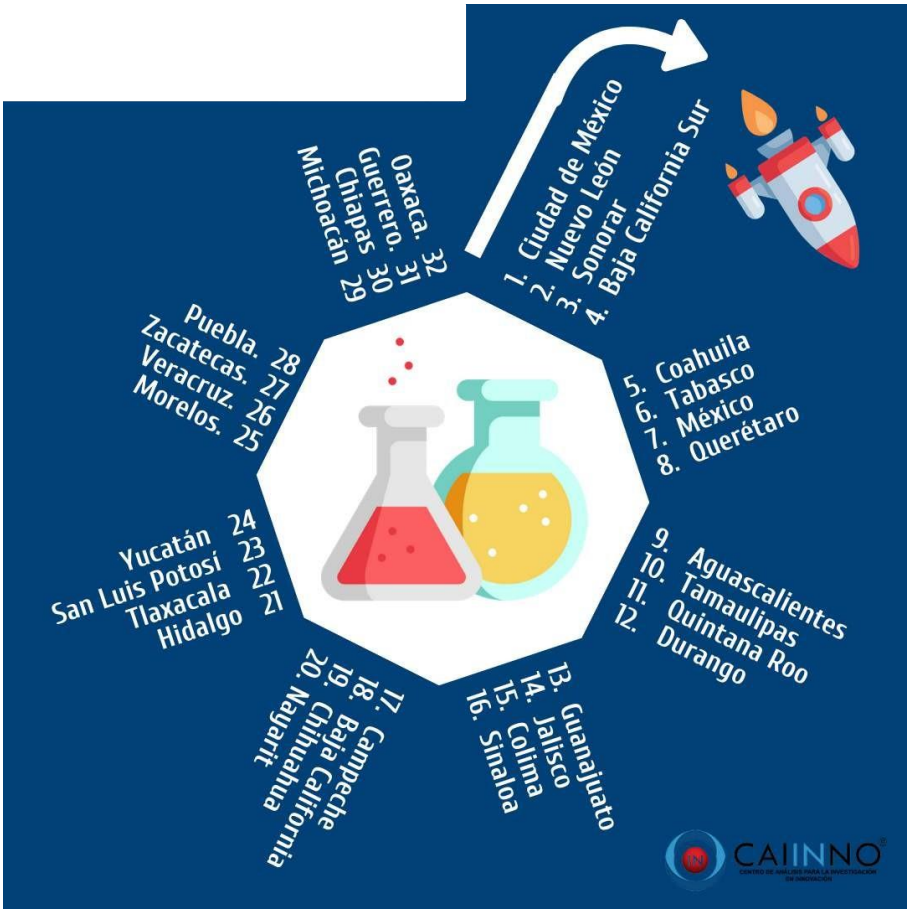
General Ranking

EDUCA-

	General Context	Private and public investment	Higher Eddcation	Basic Education	Inclusivity	Scientific Output	Innovative Companies	Bussiness Entrpreneurship	Infrastructure and Intellectual Matters	Industry Property	Gender	Communication Technology
Aguascalientes	9	17	13	18	18	18	10	7	16	8	32	7
Baja California	18	8	2	13	31	6	32	28	20	12	31	2
Baja California Sur	4	4	19	9	2	8	13	3	15	21	11	6
Campeche	17	30	26	26	9	16	19	4	7	15	30	17
Coahuila	5	11	7	6	32	13	7	20	8	7	16	16
Colima	15	7	24	21	17	11	14	1	3	20	4	9
Chiapas	30	31	32	29	14	29	2	15	26	31	7	32
Chihuahua	19	10	12	27	29	17	30	22	19	16	6	8
Ciudad de México	1	1	1	1	22	1	1	32	1	1	17	1
Durango	12	22	23	25	24	23	15	10	5	27	23	20
Guanajuato	13	20	17	17	30	12	16	24	22	5	14	25
Guerrero	31	27	27	30	12	32	18	9	28	32	2	30
Hidalgo	21	14	31	2	16	19	21	8	14	19	21	21
Jalisco	14	18	6	23	10	14	3	18	27	3	13	12
México	7	19	11	11	7	24	17	25	31	17	3	10
Michoacán	29	21	20	31	13	15	29	27	18	22	28	28
Morelos	25	2	14	15	25	2	24	17	2	6	18	13
Nayarit	20	23	29	20	20	25	25	5	25	26	24	19
Nuevo León	2	12	3	3	11	4	5	23	12	2	26	3
Oaxaca	32	25	28	32	4	31	20	31	32	30	15	31
Puebla	28	16	9	5	21	10	12	14	6	10	27	26
Querétaro	8	3	10	7	8	3	11	16	11	4	8	5
Quintana Roo	11	28	22	8	23	28	23	6	29	11	1	11
San Luis Potosí	23	6	5	16	15	7	27	29	24	24	19	24
Sinaloa	16	13	4	12	19	20	4	2	23	14	29	14
Sonora	3	15	8	19	28	9	9	12	10	13	5	4
Tabasco	6	32	18	10	3	27	8	19	30	23	10	22
Tamaulipas	10	26	30	28	6	30	31	13	17	18	20	15
Tlaxcala	22	9	25	4	5	26	28	21	21	28	25	23
Veracruz	26	24	16	24	27	22	26	30	13	29	12	27
Yucatán	24	5	21	14	1	5	6	11	4	9	22	18
Zacatecas	27	29	15	22	26	21	22	26	9	25	9	29

State Ranking for each pillar

General Context



Considering the index's social dimension elements that illustrate the general circumstances of each State were examined. This was determined by several indicators such as:

- **Gross Domestic Product per capita of the primary and industry sectors and the State's public services.**
- **Rate of unemployed youth (men)**

This pillar was developed through a transversal approach
which considers challenges such as poverty and unemployment. Innovation in Mexico,
at least the kind which uses public funds, should not be used to generate a profit
only for its owners. On the contrary,
as it is a key tool to mitigate or solve problems that affect the entire population of the State.

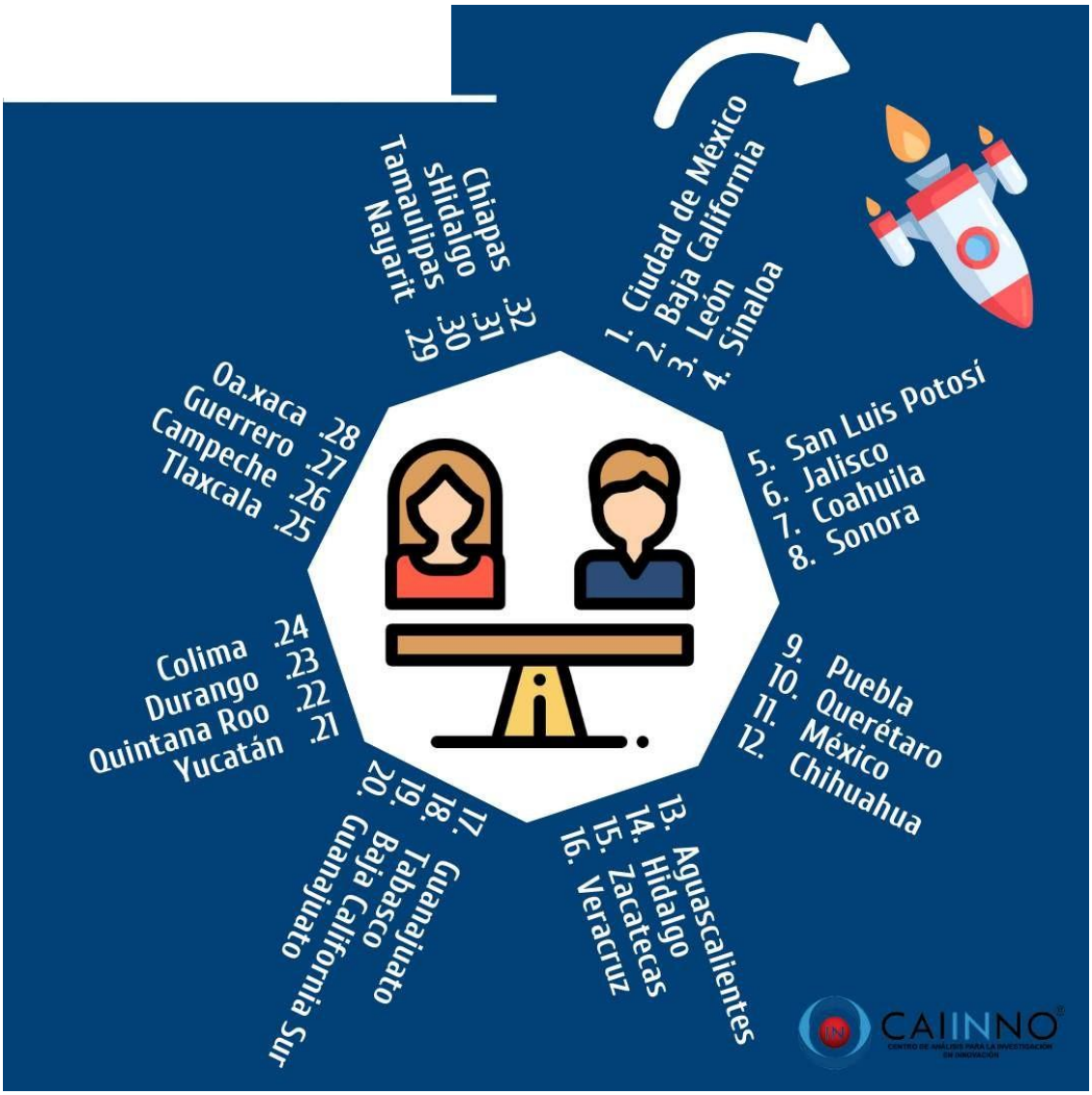
Private and Public Investment on Science, Technology and Innovation (CTI)

This pillar considers investments on CTI from the public and private sector, It is made up by indicators such as:

- **Innovation Stimuli Program regarding the State's GDP**
- **Budget Assigned to Promotion of Initiatives for Innovation from the National Institute of Entrepreneurship Innovation with relation to the State fund total, 2017**
- **CONACYT budget for technological innovation to increase business productivity in relation to the State's GDP.**
- **CONACYT mixed funds regarding the State's GDP**

As it was previously mentioned, in order to improve CTI in Mexico, it is necessary for all responsible parties to get involved. Only then will the country's ecosystem and situation improve.

Higher Education



This pillar integrates various elements regarding higher education and establishing a direct bond to the economically active population and the education system. These elements are:

- **Number of admissions to an undergraduate program per state.**
- **Number of undergraduates per State**
- **CONACYT coverage for quality graduate programs**
- **Number of CONACYT scholarships per State.**

Completion rates can be used as a way to gauge the efficacy of education. Similarly, a link between the State's economically active population and the level of education could be established. It is fundamental for the educational ecosystem that graduates can obtain a job in which they may apply their knowledge in order to contribute to the cycle of innovation.

Basic Education

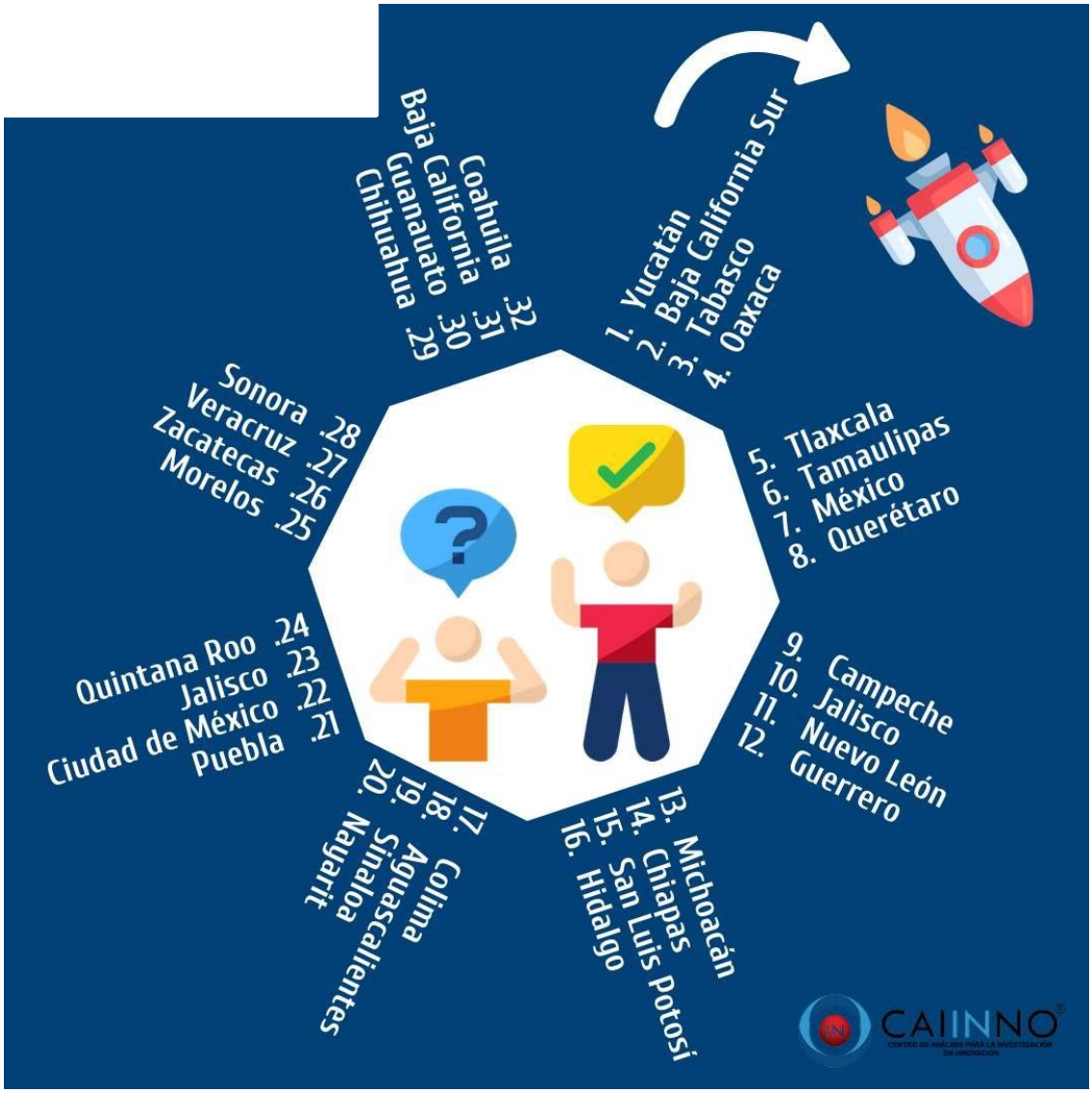
Basic education is critical as evidence points out that it influences the present and the future of CTI. Some countries have decided to focus heavily on its development. This pillar considers:

- **Enrollment to primary school (6 to 11 years old).**
- **Primary school completion rates.**
- **Net rate of secondary school enrolment (12 to 14 years old).**
- **Secondary school completion rates.**
- **High school completion net rates.**

Many studies reveal the need to pay special attention to these early stages of childhood and education, particularly between 0 and 8 years old. This is why this was considered in this study.

It is necessary to think about the future inventors and scientists in order to generate a change for CTI in the country.

Inclusivity



This is one of the main pillars of this index. Granting access to all people is fundamental. This pillar considers:

- **Number of people with disabilities who joined a graduate program.**
- **Number of people with disabilities who joined an undergraduate or technical education program.**

Opportunities and support should be available for people with disabilities in order to maximize what they may contribute to CTI such as in the case of scientist Stephen Hawking.

Scientific Output

This pillar considers the productivity of the National Researchers' System (SNI) and its contribution to each State as well as its relationship with the private sector.

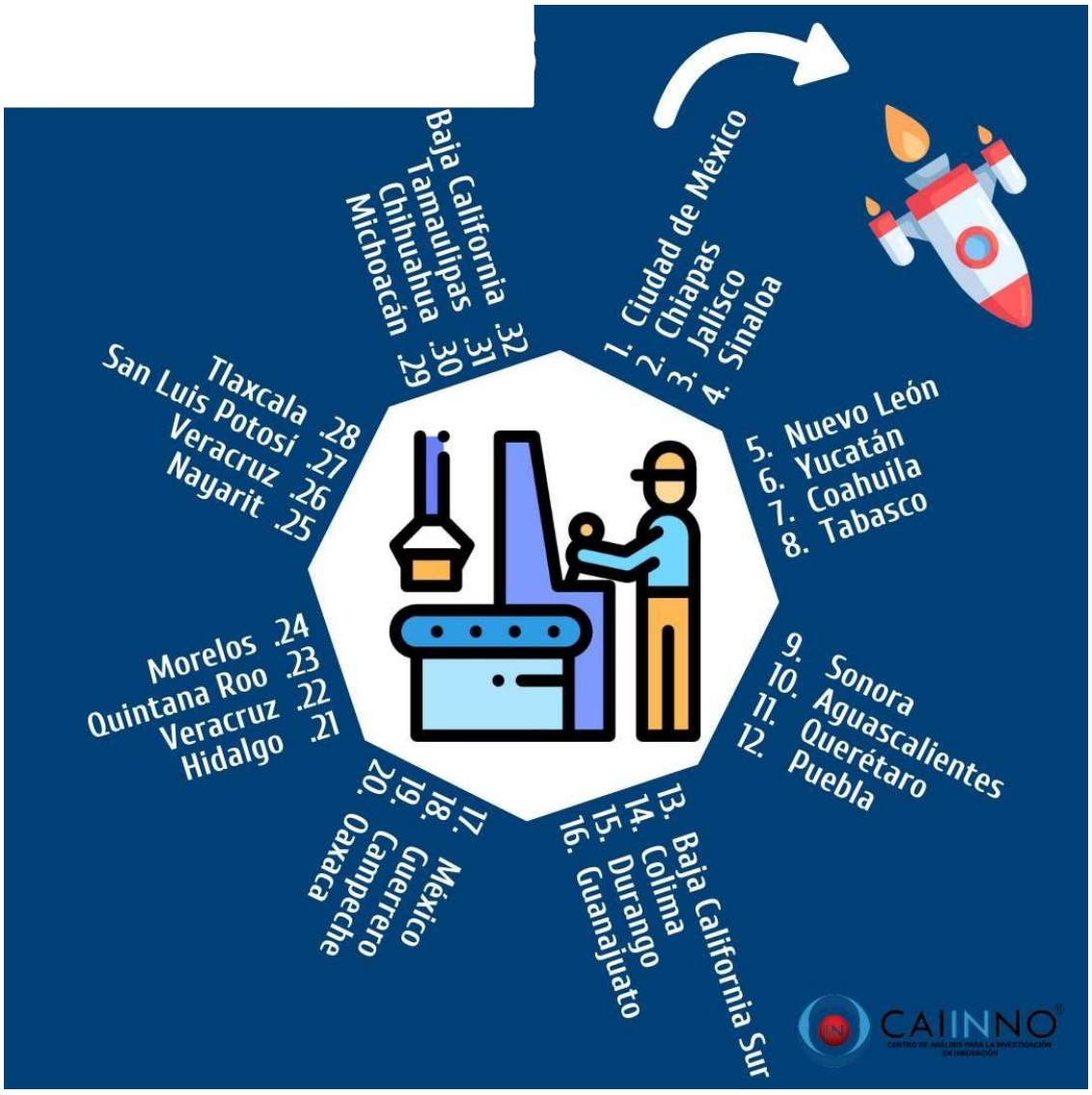
This pillar includes indicators such as:

- **SNI members in relation to the economically active population.**
- **ISI (Institute for Scientific Information) articles from Mexican universities per each 10,000 members of the economically active population in 2016.**
- **Patent applications and grants of Mexican universities per each 10,000 members of the economically active population in 2016.**

By evaluating scientific productivity, it was possible to determine the field's efficacy.

To do this it was necessary to establish a criterion that seeks equity as logically, the States with larger populations would have more SNI researchers. Due to this, numbers were calculated using the State's economically active population.

INNOVATIVE COMPANIES



This pillar focuses on identifying the performance of companies, as well as their link to other sectors, corporations or institutions. This is gauged through:

- **The proportion of projects approved by the Innovation Stimuli Program.**
- **Increase on the number of projects reviewed by the Innovation Stimuli Program.**
- **Average project grade given by the Innovation Stimuli Program.**
- **Members of the National Registry of Scientific and Technological Institutions and Companies (RENIECYT) per 10,000 economic units in each State.**

#INCTI-CAIINNO aims to be a tool that empowers the private sector and the improvement of national CTI,
hence the relevance of the present pillar for CAIINNO. As the responsibility to improve CTI in Mexico, this falls on the business sector as well.

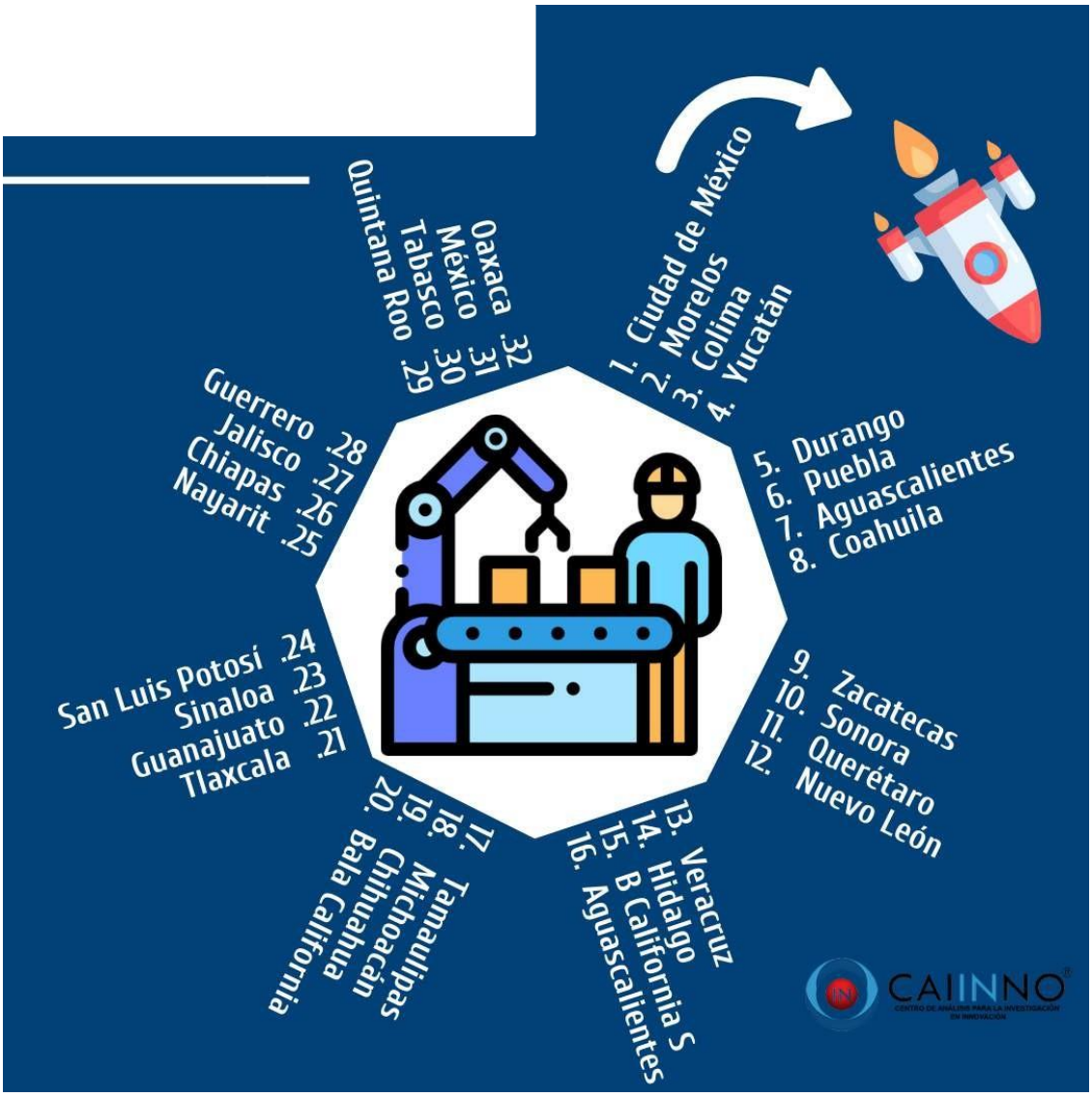
BUSINESS AND ENTREPRENEURSHIP

This pillar examines the entrepreneurial and its relation to CTI. Keeping in mind the role played by entrepreneurialship when it comes to innovation as proposed by the Oslo Manual, the following pillar considers:

- **Business incubators for each 100,000 members of the State's working population.**
- **Total of beneficiaries of the National Fund for Entrepreneurs (Fondo Nacional del Emprendedor) regarding the members of the economically active population.**
- **The probability of bankruptcy before the business is 5 years old (Esperanza de vida de los negocios en México - INEGI 2017.)**

Sometimes businesses or institutions that work on innovation do not support others in the same field. This is why, inventors choose to become entrepreneurs and commercially exploit their own projects. Thus, the importance of this pillar.

INFRASTRUCTURE AND INTELLECTUAL MATTERS



This pillar focuses on infrastructure, which is a fundamental for the CTI ecosystem. It considers the following:

- **Public and private research centers.**
- **State infrastructure for graduate-level education in 2017.**
- **Rate of graduate-level teaching faculty members 2017**
- **Rate of undergraduate-level faculty members 2017**

Having spaces for the development of CTI is crucial, this is specially the case for areas like engineering and ICTs that depend entirely on the availability of this space.

INDUSTRIAL PROPERTY

This pillar evaluates the performance of the industrial property. This is gauged through:

- **Trademark applications and registries in 2017**
- **First Holder patent applications per State in 2017**
- **Granted First Holder patents per State in 2017**

It is not uncommon to find news praising the number of patent applications but it is rare to hear about the ones that are granted or registered. Mexico is still very far from the numbers seen in other countries like the United States that reached 10 million patents in 2018.

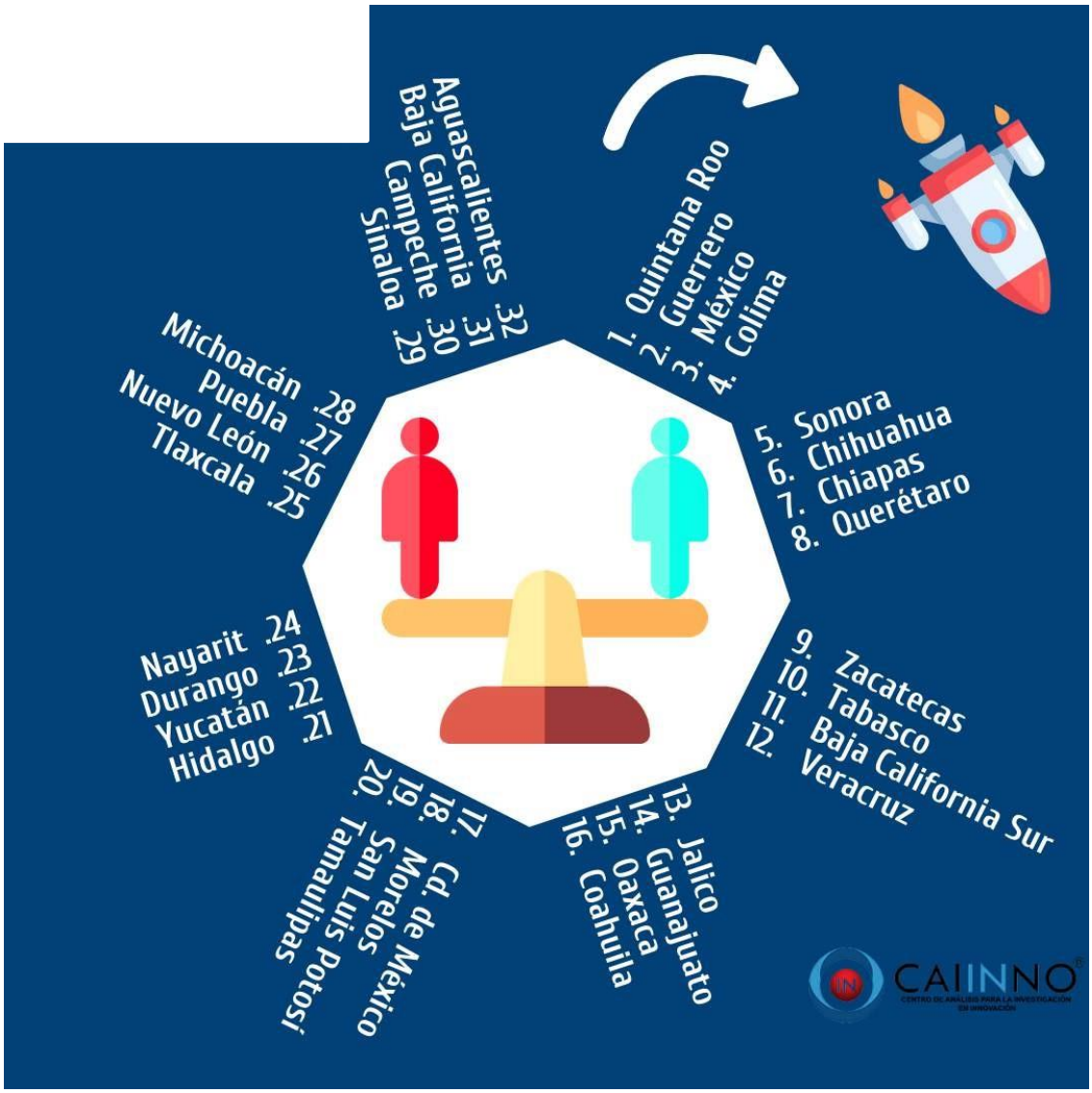
Industrial property has become a missing piece in the innovation puzzle.

This piece is necessary as it allows innovation to be protected.

The numbers are alarming as they do not show improvement based on the 2015 index.

However, it is important to point out that data regarding Mexicans living in foreign countries was not considered.

Gender



This pillar studies gender involvement and participation in CTI in order to understand the country's position when it comes to gender from a wider perspective. This pillar considers the following:

- **CONACYT scholarships awarded to each gender.**
- **SNI researchers of each gender in every State.**
- **Women legislators in CTI State commissions.**

This information can be used to visualize the field of CTI and the place women hold in it.

Despite the fact that more women have been granted a CONACYT scholarship, the men to women ration in National Researchers' System is still very uneven.

COMMUNICATION TECHNOLOGY

This pillar employs indicators which take into account information that can be found in international CTI indexes, such as:

- **Computer users per each 1,000 of the State's economically active population.**
- **Daily internet users for each 100,000 inhabitants 6 years or older.**

Communication technologies are a very wide topic. The index focuses solely on specific indicators as information needed to be obtained from other sources.

As opposed to other countries, some technologies

like blockchain are just starting out in Mexico.

CONCLUSIONS AND RECOMMENDATIONS FROM THE ORGANIZED CIVIL SOCIETY

1

The results show some relevant changes regarding State ranking compared to 2015 version. This is due to several elements that are not significant when it comes to the index. However, among them raise several issues that could be considered meaningful.

This is because of the increase or decrease of budget for science and technology. Some States saw their budget increase while for others, unfortunately, the opposite was true. **Budget cuts are not recommended as they negatively impact State development and the ranking on several indicators such as, private investment.**

2

The Survey on Research and Technological Development (Encuesta Sobre Investigación y Desarrollo Tecnológico) published on 2014, was the main source of data for the 2015 version of the index but it was not republished granting changes to some of the indicators.

A possible solution would be to fund a new survey using the money CONACYT receives through electoral fines. This fund's purpose would be to generate statistic information related to CTI.

3

The performance of government agencies does not show significant improvement from 2016. When it comes to several indicators such as patent grants and applications, inclusivity or number of graduates, numbers have become more stable. This suggests that government involvement is critical to the CTI ecosystem and that not enough efforts are being made to represent an improvement to the field, with the exception of some States and indicators. **The elements that hold back development should be carefully analyzed to identify the causes that inhibit government involvement. Subsequently, public policies or legislative amendments should be made in order to benefit the ecosystem and empower businesspeople, entrepreneurs, universities, civil societies and others. This is a very drastic but necessary and urgent measure.**

4

Some issues have not shown any improvement but rather, the gap between States that ranked the highest and the 15 lowest has grown. Some disparity is inevitable due to population size but that is why measures were taken to homogenize and reduce bias by converting the data into units represented as averages, percentages and ratios for each 10,000 or 100,000 members of the economically active population. Nevertheless, some States still performed very poorly in relation to others. **This could be addressed through government programs, public policies, legislation or reforms aimed at reducing the gap. This effort should be conducted by federal and local instances.**

The fact that a State can claim that they ranked higher on this or any other index hinders the development of Mexico as a country and in relation to the rest of the world as clearly illustrated by the innovation Index of World Intellectual Property Organization.

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