Skills for innovation

briefing

This is a translation and briefing of a document prepared for the British Council. The original version is in Spanish and can be found in the following link:
https://www.britishcouncil.org.mx/sites/default/files/resumen_ejecutivo_habilidades_para_la_innovacion.pdf

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INTRODUCTION

The objective of this research was to identify the skills and high-level human resources seeked by employers for research and development applied to innovation. In addition to this, was the description of Mexico and other countries' general context when comes to science, technology, innovation and skill development.

This briefing shows the most important details regarding the findings of the research. First, a brief overview of education, labor force and graduate education. Subsequently, a discussion of programs aiming to link the academia and the private sector and focusing mainly on *Posgrados con la Industria* (Graduate Programs with the Industry) which despite its youth is expected to produce influential outcomes.

After this, a display of the skills framework, especially those related to increasing innovation. In this section there is also a discussion of models employed by other countries such as *Doctorados Industiales* (Industry Doctorates). Followed by the results of interviewing relevant agents. The skills most seeked by employers regarding research and development for innovation purposes were obtained through the answers of these interviews.

Lastly, the findings of surveys which aimed to locate the specific areas that require employees who perform research and development tasks and the skills that play the biggest role when it comes to choosing human resources.

It is important to state that, in order to obtain a wider perspective, a particular definition of innovation was not employed. Regarding the surveys, the main focus was on the development of new technologies and intellectual property. For the interviews, each agent provided their own concept which is what was taken into account. Given the national and international context as well as the topic's complexity, it is fundamental to use research as a tool that eases the understanding of skills and innovation.

Overview of the Mexican Labor Force

Historically the most common way to measure the labor force is through the population's average schooling. In Mexico, this has improved significantly during the las two decades as secondary education was made mandatory in 1993 and high school in 2003. It should be pointed out that it has taken twenty years to ensure the universal access to basic education (3 to 14 years old). On the other hand, recent data shows that in 2014-2015 access to all levels of education increased significantly. It should also be pointed out that student enrollment rates increased faster than investment: student expenditure decreased 6% between 2008 and 2011.

Graduate programs in Mexico

As of 2014-2015 there were 11,147 graduate programs being offered in Mexico with 287,324 students enrolled and distributed as follows: 21% in a specialized program 66% in a master program and 13% in a doctorate.

Taking into account all areas related to science and technology from 2014-2015 there were 84,907 students enrolled in a graduate program which represents a 23.8 % increase in relation to the previous number. During the last school year most of the students belonged to the medical field (46.4%), followed by engineering and technology (33.9%), Natural and exact science (14.9%) and lastly Agro-livestock science (4.8%).

From the academy to the industry

The Special Science Technology and Innovation Program (PECITI for its initials in Spanish) 2014-2018, points out the strategies employed by the National Science and Technology Council (CONACYT):

1) Promotion graduate programs in the fields of engineering and technology with the help of the business sector. **Graduate Program with the Industry** created in 2013 is a clear example of the success of these programs.
2) The addition of young professors and doctors to Higher Education Institutions (IES), Research Centers (CI) and in the industry. Two examples of how these youth employability programs are the CONACYT professorships focused on IES and CI and introduced in 2014, and the **Inclusion of professors and doctors in the industry** introduced in 2013.

These programs meet the training requirements of a specific company or meet general requirements useful for many companies. Due to this, the curriculum is designed to fulfill the demands of the companies that exist within each field of the industry. As of 2015 there were a total of 21 programs with these characteristics, 4 for doctorates, 13 for masters and 4 for specialized areas. In 2015 9 more programs were approved; 8 for masters and 1 for doctorate.

Graduate Programs with the Industry

Objective.

Contribute to the strengthening of company competitiveness and productivity through the training of high-level human resources able to apply knowledge to develop technological solutions and innovation.

a) Increasing the country's ability to innovate and consolidate the intellectual assets of companies, institutions, higher education centers and public research institutes.

b) Optimize the joint use if the infrastructure and personnel of institutions, centers and public institutes. research institutes and companies.

c) Strengthen research collaboration, technological development and innovation between agents of the national Science - Technology - Societal system.

d) Contribute to the training of the labor force that process of innovation required by the sectors considered to be strategical.

e) Stimulate growth and acknowledgement of technological networks that boost innovation in institutions, centers and public research institutes.

f) Back research in the industry and services which contributes to the companies' ability to innovate.

g) Promote industry participation, especially regarding SMEs and other projects that facilitate innovation in areas such as technology with a financial and commercial influence.

Incorporación de maestros y doctores a la industria **program**

Introduced in 2013, it consists on hiring a professor or doctor in a company for a year (preferably an SME) to work on a specific project. During said period CONACYT will provide half of the paycheck and the company will cover the other half. The total annual wages per level of education are: Maters degree: $20,000 Mexican pesos and Doctorate degree: $30,000 Mexican pesos.

1.- Producing highly valued jobs by integrating professors and doctors that apply their knowledge and experience so that companies can reach their objectives.

2. Boosting high value knowledge application during the production process. Benefiting companies, fostering innovation and competitivity due to differences in products, production, and services.

3. Promoting innovation culture and the links between companies and educational institutions and knowledge application diagrams that provide new solutions to company problems.

How the lack of skills affects business-university links in Mexico.

One of the main challenges faced by Mexico when it comes to establishing a knowledge - based economy is the quality of the resources that can be found in the higher education institutions. Highly trained labor forces are fundamental to innovative businesses. Despite the educational reforms and the recent achievements regarding higher education, companies still express their trouble finding employees with the adequate skills and competency level they need (OECD, 2013a, p. 1). Therefore, it is not surprising that Mexico has the lowest productivity rate out of all the countries in the OECD.

The shortcomings of educational institutions are enhanced by the customary lack of company investment on staff training and ongoing training. The lack of qualified employees represents a big issue for the development and growth of innovation focused companies. Thus, it has a negative impact on the company's ability to create new paying jobs and the potential future growth of innovative companies. Companies have a need to invest on staff

training and ongoing training programs which ensure that they will have access to the kind of human resources they require.

Additionally, there is a historical lack of cooperation between higher education institutions, public research centers and the production sector. These linking problems are the main reason for this paper and they are in fact, one of the pending challenges faced by the Mexican government. Three aspects of this issue have been identified:

a) The fragility of the bonds between higher education and the production sector damaging collaboration, innovation, links and partnerships (including business incubators, continued education, etc.)

b) The disparity between educational offering (particularly graduate programs) and the industry's demand for research, innovation, and development.

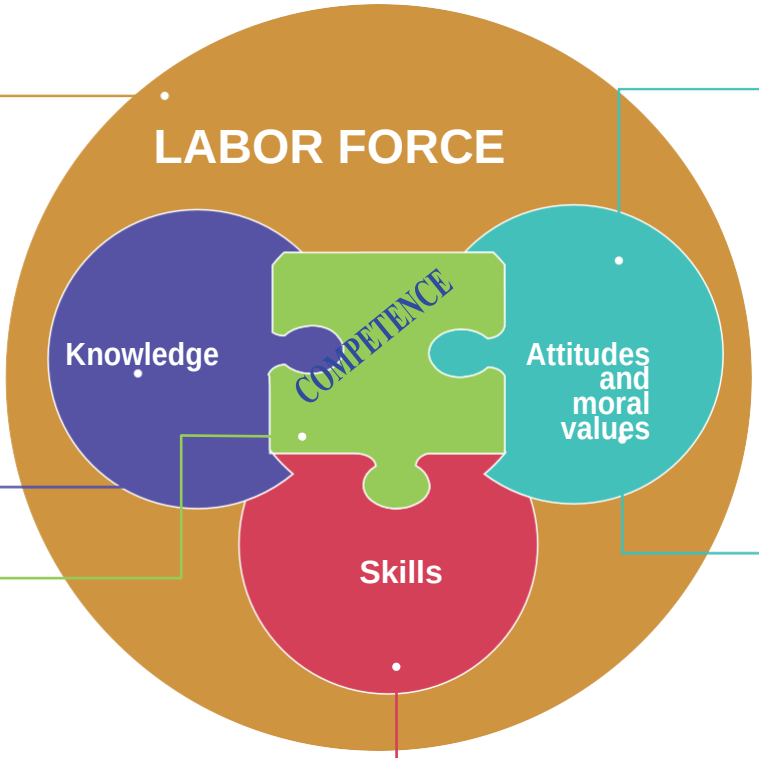
c) The limited emphasis on the skills needed to increase employability.

Only a few studies in Mexico show results that discuss current and former issues regarding skills, competency and the labor force such as their scope and components. As research shows, this challenge is faced worldwide but on a smaller scale in comparison to Mexico.

Skills or Competencies? New innovation concepts

Traditional literature sometimes makes a distinction between "competencies" and "skills", while in other cases they are interchangeable. Thus, there is no consensus regarding their standard definition or classification despite their relevance. Both terms refer to an individual's ability to apply knowledge (explicit or tacit) to make use of tools, cognitive strategies or routine practices appropriately, given the situation (OECD, 2013b). This paper used the definitions of competencies and skills suggested by the OECD which establishes both concepts as synonymous to navigate and simplify this complex issue (OECD, 2013a, p. 12).

As Díaz Barriga (2006) points out, the country has been in the pursuit of innovation for many years. The las four decades have brought many educational reforms and the perception of the "new" as the path to improvement. The popular consciousness thinks of "the new" as "that which surpasses the previous", "The need to add new models, concepts or work methods just to be able to call it innovation" (p. 9). The objective as not been the identification of the merits and limits of innovation, but to "establish" new innovative measures (p. 10). Therefore, the constant shift in educational policies inhibits each strategy from producing positive or negative results that could be used for learning and improvement. Change and innovation have been prioritized over the analysis of the goals achieved.



Knowledge, skills, competences and other important attributes in people for economic activities

Attitude: to show a consistent and persistent tendency to behave in particular manner given a specific type of situations, objects, events or people.

Learning about facts, concepts and principles

Moral Value: ability to regulate one's behavior according to principles dictated by a specific moral value.

A set of abilities that make knowledge, skills, attitudes, and moral values more dynamic so a person can respond to diverse situations on a personal, social and professional context.

Ability to learn a procedure, apply knowledge and use techniques in diverse situations and in different ways in order to complete tasks and solve problems.

Cognitive, inter and intrapersonal, technical and communicative

Writing, calculating and solving problems

Teamwork, entrepreneurship

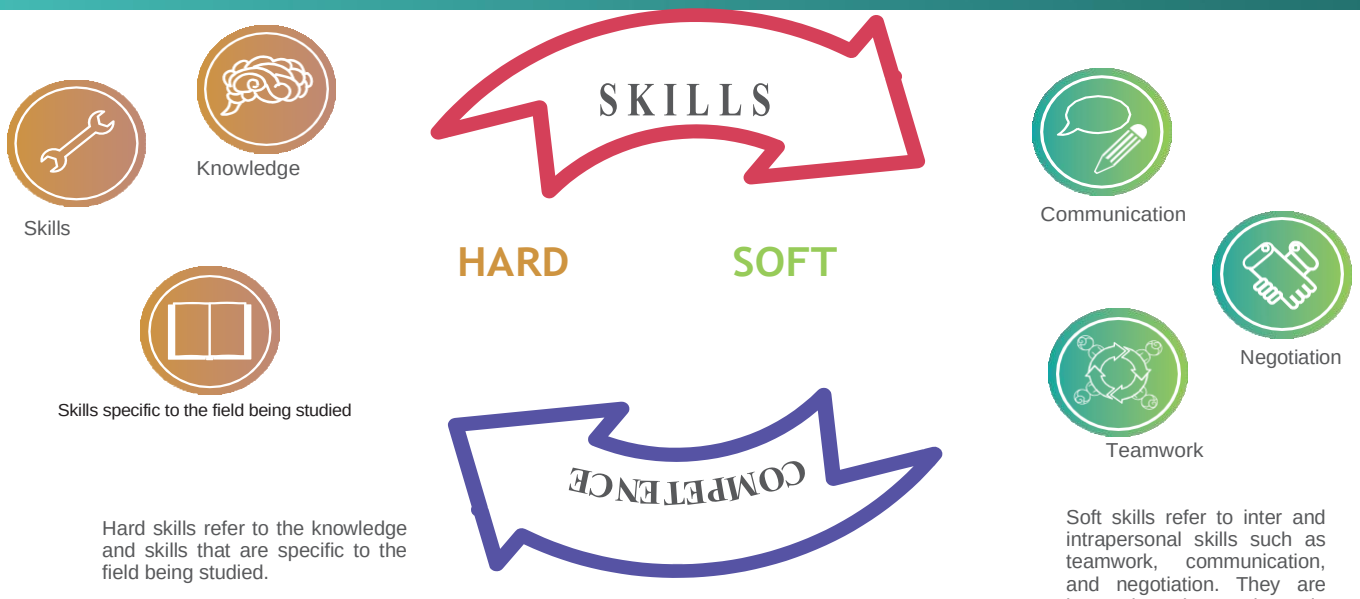
Use of ITs, Office, etc.

Written and oral expression

SKILLS & COMPETENCE

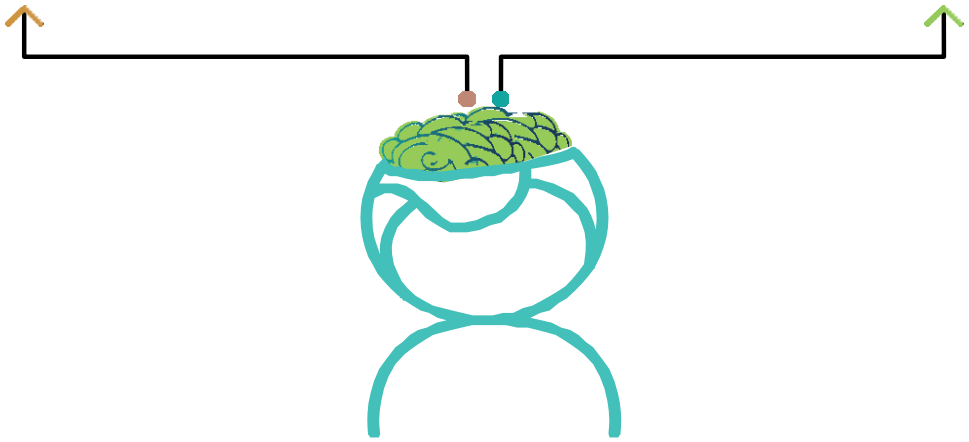
"Skills" and "competence" are concepts used interchangeably in Skills strategies.

Competences (or skills) are defined as a group of knowledge, attributes, and abilities that can be learned and allow individuals to perform an activity or task successfully and consistently. They can be built on and extended through learning.



Hard skills refer to the knowledge and skills that are specific to the field being studied.

Soft skills refer to inter and intrapersonal skills such as teamwork, communication, and negotiation. They are learnt through experience in the real world.



Skills for innovation

Beyond country and regional visualization, conceptualization and measurement of skills the research of the last three or four decades has found a tendency. The general consensus (with some important distinctions) is that "the demand for highly qualified labor forces has increased in most countries since 1970" (Toner, 2011: 13). Consequently, for human resources, “a higher-level workplace skill requires more knowledge updates" (Kim, 2002, p. 91). This translates into a continuous expansion of the tasks and skills required to face the employers' needs, new technology and the speed of innovation.

Mexico is the only country in the OECD that has a lower rate of employment for people with higher levels of education. While there are other factors besides skills, the research done by the OECD establishes a direct link to this phenomenon.

However, this is expected to change in the future. As time goes by and as a result of the changes derived from innovation, the skills required by the market will be more specific, diverse and may increase in comparison to the ones needed nowadays.

The skills or competencies linked to innovation include specialized knowledge, conflict resolution, thinking skills, creativity (succeeding in creating something new) and entrepreneurship (launching individual or team projects, taking initiative and creating a positive environment). Likewise, there is a need for social skills and behavior such as the ability to work in a team.

Human Resources and Skills in CTI (Science, Technology and Innovation)

As policies for innovation are created, one must ask which human resources are most adequate and which skills are necessary for a specific country, due to their importance to achieve high levels of innovation in national economy (OECD 2009). It is also important to emphasize that these two variables are dependent upon other elements, for example, the national economy's structure and the level of development. This means that it would be irresponsible to create an "ideal" list of human resources and skills required to create an innovative national economy.

In this sense, decision-makers must embark on the task of understanding their country's economic situation (its level of education, the industries with highest economic potentials, available skills, and more), with the purpose of promoting the necessary and adequate skills to go from economic activities with a low amount of innovation and added value to activities that would significantly propel the country's economy forward.

Which skills are necessary for innovation?

Public policies for innovation should take a broader approach into consideration and not be limited to skills for science and engineering, given that promoting innovative abilities should

be the goal of every institute for higher education. Internationally, three categories of skills for innovation have been identified, that is, skills necessary for an employee to achieve innovation in their environment (Avvisati, Jacotin, & Lancrin, 2013):

- **Hard skills:** technical knowledge (know what and know how).
- **Soft Skills:** thinking and creativity (critical thinking, imagination, etc.) as well as behavioral and social (persistence, assiduousness, trust, communication, collaboration).

A different education and a different set of skills contribute to incomparable results. In this sense, it is important to precisely identify goals for the national innovation environment. This with the purpose of promoting adequate education and skills for specific circumstances.

Interviews

With the purpose of obtaining the best possible results, the decision of carrying out a series of interviews to four types of relevant parties was made. This allowed knowledge about the two key goals of this research to be expanded:

- The type of top-level resources employers seek.
- Skills expected in human resources.

In order to select interviewees, the five priority fields established were taken into consideration for this research:

- Alternative and renewable energy.
- Agricultural and food industry.
- Pharmaceutics.
- Environment and natural resources
- Health.

Consequently, the parties that would be interviewed were selected because of their traits and the importance of their contributions to research. Through this, four parties were designated, identified and interviewed:

- Graduate Program with the Industry (*Posgrados con la industria*)
- Chambers of commerce/Business associations
- Businesses
- Technology transfer offices

Interviewed parties play a fundamental role in the development of innovation in the country, which is why they were in condition to contribute with commentary from their perspectives. Their input contained valuable pieces of the innovation process puzzle. It was an environment where everyone coexisted and got along well.

Finally, a sample of twenty parties was gathered to work with.

They were all asked about the type of skills they seek in human resources to carry out activities related to research, development and innovation.

It is possible to conclude that almost all actors in the private industry (businesses and chambers), believed that finding personnel with the necessary skills for innovation and development is a significant challenge for them. Similarly, the relationship between time and administration remained a problem that, according to them, should be addressed by institutions given that market periods are very short.

Relevant opinions:

BUSINESSES

"It is very hard to find personnel with the skills necessary for research and development"

"Sending research results out into the market [...] if it does not reach the market it is not innovation."

"The business does recognize talent."

TECHNOLOGY TRANSFER OFFICES

"businesses consider that they do not need what they offer since they prefer to acquire finished products rather than to create them through development"

POSGRADOS CON LA INDUSTRIA

"what is important is scientific novelty" "a new technological development" "as an example, one of our graduates created their own business by developing patents"

CHAMBERS

"People that only have a B.A. are not useful for innovation. They know about the latest developments and theory but they are not educated or interested in transforming theory into products and services."

Survey

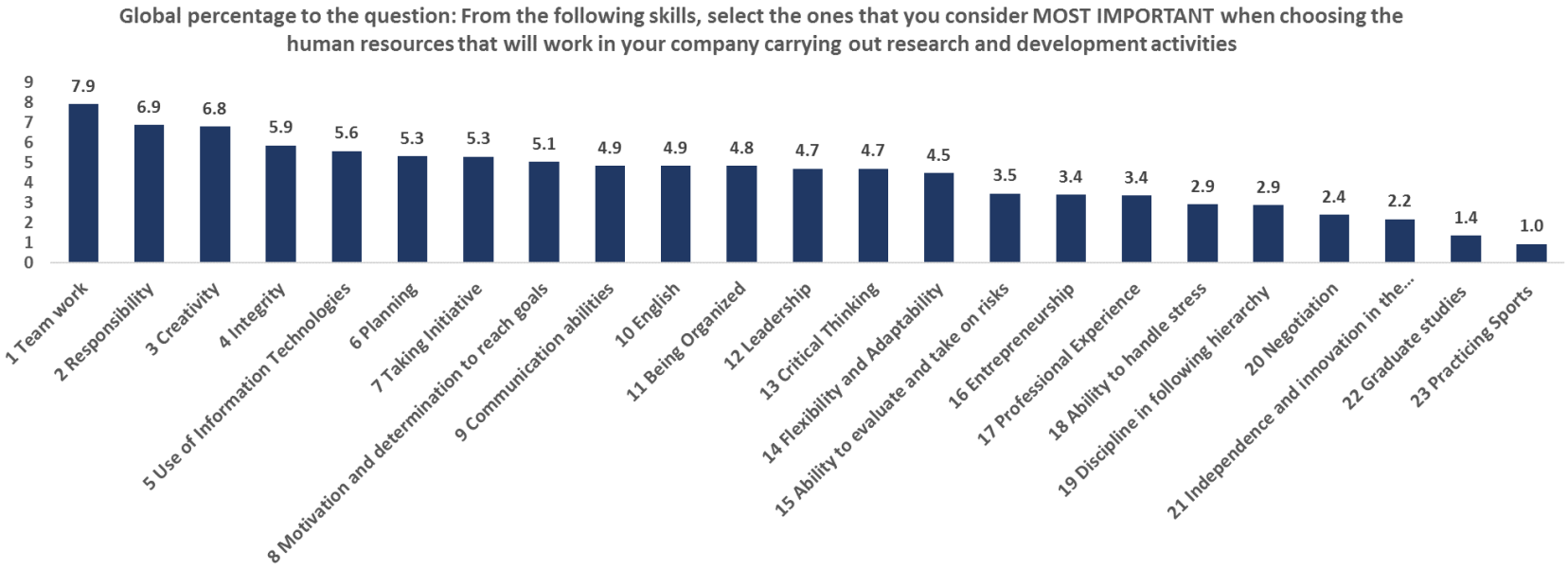
The goal was to identify the areas of opportunity for research, specific areas and skills within Mexican businesses in need of high-level human resources to carryout research and development that lead to innovation in products and processes.

The strategy used to solve this problem was to distribute invitations via email to participate on an online survey, where, from the start, the intention was to use a database with information about a large number of businesses. The *Directorio Estadístico Nacional de Unidades Económicas* (DENUE) from the National Institute of Statistics and Geography was used. It contains data regarding the identification, location, economic activity, and size of all businesses active on national territory; mainly, it is updated in the portion of data referring to large retailers.

This database is public, available online and contains information about more than five million establishments. Additionally, businesses registered at the *Registro Nacional de Instituciones y Empresas Científicas y Tecnológicas* (RENIECYT) led by the CONACYT were included. This register allows the identification of businesses that carry out activities related to research and science and technology development in Mexico.

The industries where mostly human resources for innovation and development are required are: Energy (renewable and sustainable energy), sustainable water management, biotechnology, food and agriculture industry, information technology (software development), project management, and health.

Finally, skills related to human resources dedicated to innovation and development considered the most valuable by business are: teamwork, responsibility, creativity, integrity and use of information technology. As it was previously observed, having graduate studies is not considered a top priority by businesses in Mexico that answered the survey, as it appears practically at the end of the list of over 20 skills and attributes. The complete results can be found in the following graphic:


Global percentage to the question: From the following skills, select the ones that you consider MOST IMPORTANT when choosing the human resources that will work in your company carrying out research and development activities
9
8
7
6
5
4
3
2
1
0
7.9
6.9
6.8
5.9
5.6
5.3
5.3
5.1
4.9
4.9
4.8
4.7
4.7
4.5
3.5
3.4
3.4
2.9
2.9
2.4
2.2
1.4
1.0
1 Team work
2 Responsibility
3 Creativity
4 Integrity
5 Use of Information Technologies
6 Planning
7 Taking Initiative
8 Motivation and determination to reach goals
9 Communication abilities
10 English
11 Being Organized
12 Leadership
13 Critical Thinking
14 Flexibility and Adaptability
15 Ability to evaluate and take on risks
16 Entrepreneurship
17 Professional Experience
18 Ability to handle stress
19 Discipline in following hierarchy
20 Negotiation
21 Independence and innovation in the...
22 Graduate studies
23 Practicing Sports