

THE UNIVERSITY AND THE CREATION OF COMPANIES TO INNOVATION IN MEXICO'S NATIONAL TECHNOLOGY CENTERS

THE UNIVERSITY AND THE CREATION OF COMPANIES TO PROMOTE THE INNOVATION OF THE NATIONAL TECHNOLOGICAL OF MEXICO

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Abstract -- The main objective of this research work is to carry out an exploratory-documentary analysis of the role that universities play today in the current knowledge economy and specifically with respect to the TecNM, as well as to highlight the importance of strengthening the entrepreneurial system for the development of innovations that seek the welfare of our country. The bibliography consulted, provides information that determines an existing relationship between the generation of new knowledge, with competitiveness and innovation. It also establishes that universities/technological institutes can contribute to this through the promotion of entrepreneurship and the creation of companies.

Key words: Entrepreneurial university, SMEs, University-industry linkage.

Abstract -- The main objective of this research work is to carry out an exploratory-documentary analysis about the role that universities play today in the current knowledge economy and specifically regarding the TecNM as well as highlighting the importance of strengthening the business system for the development of innovations that seek the well-being of our country. The bibliography consulted provides information that determines an existing relationship between the generation of new knowledge, with competitiveness and innovation. In addition to establishing that the universities / technological institutes can contribute to this, by promoting entrepreneurship and business creation.

Key words: Business university, SMEs, University-business relationship.

INTRODUCTION

, universities must face the challenge of orienting the training of professionals towards social needs and find innovative ways to take advantage of the human resources created [1]. The opening of borders as a of globalization has led to the emergence of new markets and the

are constantly changing. The emergence of more competitors has forced companies to improve the design of their products and services.

The ways of working, thinking and even buying have changed. The consumer has become a much more demanding and conscious decision-maker in relation to the products he or she purchases. This has led companies to redesign their strategies to adapt their products to the tastes and preferences of consumers. In this sense, innovation is positioned as the key element that contributes to the various institutions to achieve the changes demanded by the environment in which they are immersed.

An innovative country is considered to be one with the capacity not only to generate but also to transform technology into profitable products and services [2]. An innovation can only be considered successful if there is an economic return and the investment used is recovered [3]. In this sense, the main organizations for generating innovations are companies [4]. Their main resource is knowledge [5].

Based on the importance that research and development activities have taken to adapt to the new world scenarios, the university has re-emerged as the main body for knowledge generation and research [6].

Currently, educational institutions are seen as generators of new ideas and innovations that contribute to the economic development of a country, carrying out research with a sense of application and directed towards the commercialization of knowledge [7].

Thus, the university is the main institution where knowledge is produced [8]. At the end of the 20th century, its role in the new era of knowledge began to be reviewed. Aspects mainly related to innovation, entrepreneurship and social responsibility are analyzed [9].

Based on this, universities are beginning to create content aimed at promoting an entrepreneurial culture and fostering a relationship with the business sector.

productive for personal and professional development [4].

Thus, the university becomes a center for teaching and research development, transforming the traditional university into an entrepreneurial one [10]. With this, the social and entrepreneurial university emerges, whose main objective is to solve the problems of a given region, as well as to contribute to economic development, promoting technology and the development of science [11].

Despite all of the above, the most important challenge is cultural change; there is little willingness to undertake new activities, as well as the adoption of new patterns relationship and cooperation with companies, governments and research systems. [2]. From

likewise Similarly, [12] agree with the above by stating that the biggest problem is the existence of two totally opposed cultures, in addition to bureaucratization in the processes, the setting of objectives based on the expected timeexpected from the results from

results of the research, as well as their commercialization. Likewise, [13] and [14] mention that the company will not be motivated to invest in development and innovation if there is no protection for technology and knowledge transfer, since it requires exclusivity in order to obtain profits on the investment made. It seeks the appropriation of the results and not their dissemination. On the contrary, universities want to make public the results of their research and disseminate the knowledge obtained in order to have an impact on the economy, seeking social welfare. In addition, university researchers work under a scheme of freedom in terms of the choice of research topics. Thus, being the university the starting point for the creation of new companies which, in turn, generate an innovative environment, it is necessary to implement strategies that promote research and development [15]. The main challenge to define its main function in relation to research and development [15]. in relation a the generation of knowledge, technology and innovation [16].

The entrepreneurial university encompasses aspects from the commercialization of knowledge to the development of patents and startups.

That is, it refers to all those ways in which the academy commercializes the knowledge it produces [15].

However, questions remain as to whether the university is the appropriate body to transfer and commercialize knowledge and whether the costs and benefits are sufficiently cost-effective to adopt an entrepreneurial approach [17].

Manuel Quintero Quintero, who served as general director of the National Technological Institute of Mexico in the 2012-2018 administration affirms that it is essential to offer spaces that promote innovation in higher education institutions, with the aim that young people acquire the necessary tools to face the working world.

It stipulates that in order to have higher level graduates, it is essential that education be linked to research, technological development and innovation; this makes it necessary to review curricula and programs in order to update them so that students can scientific, innovative and entrepreneurial competencies.

With this in mind, he asked the various directors of the TecNM technological institutions to prepare a diagnosis of the capabilities, problems and challenges they face in each of their institutions [18]. Based on the above, it is necessary to continue researching the role that the university should currently play, as well as the importance of entrepreneurship and the creation of university-based companies and the relationship between all the elements that make up the country's innovation system. Therefore, this research work seeks to establish an approach to these issues and thus lay the groundwork for future work that can be developed in greater depth.

DEVELOPMENT

Through an exhaustive review of the literature, an exploratory-documentary analysis of the university-business-government linkage is carried out. Likewise, a study of the Institutional Program of Innovation and Development of the TecNM is carried out, breaking down its objectives and the main areas opportunity. In addition, as a complement, information is obtained from INEGI regarding the business sector, establishing the importance of SMEs for our economic system.

Thus, based on the information gathered, it is possible to establish a relationship between innovation,

knowledge, competitiveness and the role of technological institutes in its generation.

Thanks to innovation, it is possible to develop projects through which it is possible to be productive and at the same time compete in today's markets. For this, it is necessary to create and develop knowledge, as well as to apply and disseminate the results obtained from them. The term innovation refers to a process integrated by systems, which involves changes in processes, policies, products and services that help to adapt to the constant changes in the market. Thanks to innovation it is possible to develop and maintain new projects that generate value and at the same time improve the quality of life of a society [10].

In this sense, knowledge generation is the main strategy in relation to productivity, competitiveness and innovation in any sector [19]. In turn, the production and dissemination of knowledge depend to a large extent on the country's innovation systems, as well as on its internal capacities and the organizations involved in these processes (universities, companies and government, among others). The innovation system is understood as a country's capacity to generate and produce scientific and technological knowledge, in accordance with its economic infrastructure and the activities carried out by the aforementioned bodies [16].

Likewise, it can be affirmed that one of the primary functions of universities is the development of skills necessary for future professionals to be able to solve any problem that society demands [20].

To this end, the university must take advantage of its organizational structure and articulate its research activities to the current needs of its environment [21].

In order to face the global challenges related to the production of science and technology, the universities of the 21st century must adapt the way in which they are organized, as well as rethink the various activities that are carried out, in order to adapt to the needs of their socioeconomic environment, thus achieving the strengthening of the relationship between science, technology, society and production [22] and [23].

There are different types of universities: academic universities, where only teaching is provided and resources are used to improve this activity.

The classical one, where teaching is combined with research activities and the importance of the latter is well known.

The social, focused on solving problems. The entrepreneurial, where the knowledge generated is marketable and finally the entrepreneurial, which, unlike the previous one, the knowledge is used for the socioeconomic benefit of the environment where it is developed [24].

We can say that there are universities that stand out for having a business focus and others for being purely academic [21].

When we talk about entrepreneurial universities, we refer to sharing, cooperating and competing as the basis of a strategic network of knowledge and its application possibilities. Therefore, university proposals must be based on the capabilities of the various companies, industries, local governments, national entities and research centers [2].

The entrepreneurial university develops a relationship with public and private organizations, forming networks to generate and transfer scientific and technological knowledge. Having in common, the exploitation of entrepreneurial activities [25].

However, [26] comments that the main barrier to being able to develop innovation lies in the direction of research efforts based on business needs. Universities operate on the basis of non-privacy of knowledge while companies operate in the opposite scheme [12].

Therefore, it is of vital importance to strengthen the channels for the exchange of information through which it is possible to know the projects, initiatives, objectives and motivations of the various organizations involved in the innovation system, in order to effectively address business, social and educational needs. Thus, there is an urgent need to implement innovative measures to improve the educational system and to enable universities to establish systems and methodologies with a focus on entrepreneurship to provide solutions to current problems [21].

Therefore, the entrepreneurial university becomes an economic organism immersed in the innovation market, from which entrepreneurship is promoted to achieve economic-social development. It evolves from an academic function to a business mission, focused on technology transfer, with the ability to adapt to the environment in which it operates, focused on meeting its needs, flexible, creative and provider of new lines of research [17].

The Tecnológico Nacional de México has established itself as the most important technological higher education institution in the country. It trains almost one out of every two engineers and concentrates 14 percent of the total higher education enrollment in the country. As a result, around 46 percent of engineers in Mexico are graduates of the TecNM [27].

In this sense, the TecNM affirms that it is of vital importance to promote education in science and technology, strengthening quality in middle and school education. Therefore, in its Institutional Innovation and Development Program 2013-2018, it establishes several objectives that will help to achieve this. Two of have to do with innovation and scientific and technological development. Objective 4 Promote science, technology and innovation, has to do with the formation and performance of human capital. It seeks to develop and take advantage of the results obtained from scientific research in order to increase the country's technological capacity and competitiveness. And objective 5 Consolidate the linkage with the public, social and private sectors, which has to do with actions focused on strengthening cooperation between these sectors and education. After a documentary analysis in relation to the capacity of the TecNM for the development of science and technology, a compilation of the main points exposed in the Institutional Program of Innovation and Development for the 2013-2018 administration is made through which the following information is obtained:

This first table shows the main difficulties and challenges faced by the TecNM associated with promoting the development of science and technology. These are part of the fourth objective of the Institutional Innovation and Development Program of the TecNM. These elements were detected during the

2013-2018 administration in order to diagnose the situation that the Tecnológico Nacional de México was going through during the previous administration and, with this, design strategies that contribute to improve the scientific and technological activities carried out.

Table 1. Diagnosis in relation to the development of science and technology of the TecNM.

Problems	Challenges
Little infrastructure and equipment to carry out scientific research, technological development and innovation projects.	To expand infrastructure and equipment capabilities for the implementation of research projects research projects scientific, technological development and innovation.
Lack of a regulatory framework and incentive policies to promote and facilitate research, technological development and innovation activities.	Promote applied research and innovation as well as increase the number of professors and students who participate in activities and students who participate in activities and technological development.
Regulatory restrictions that make it difficult to use federal resources for the acquisition of fixed assets requested in the projects. of research	Increase the number faculty members joining the SNI. As well as the formation of Academic Bodies.
Lack of incentives to promote the formation of researchers and their entry into the National System of Researchers (SNI).	Promote and support the establishment of as sociations, societies and funds whose purpose is to promote scientific research, technological development, and the and innovation in high schools, technological institutes and

Source: Own elaboration based on the 2013-2018 Institutional Innovation and Development Program of the TecNM.

The main problems have to do with infrastructure issues that facilitate the generation of science. It also has to do with the lack of incentives and support for the personnel who participate in research activities, as well a lack of encouragement for the teaching staff in relation to their preparation as researchers. Therefore, the main challenges have to do with improving the laboratories, machines, tools and

other IT infrastructure to help generate new knowledge.

Likewise, it is important that such knowledge has a sense of application and is focused on solving real needs. And finally, to increase the number of researchers and the formation of networks or work whose purpose is scientific research. , the following table shows the problems and challenges detected within objective number five of the Institutional Innovation and Development Program, which is related to the strengthening of linkages.

Table 2 Diagnosis in relation to the consolidation of the TecNM's links with the public, social and private sectors.

Issues	Challenges
Inefficiency of Institutional due to the lack of norms and indicators for the evaluation of evaluate y follow up a its performance	To formulate, strengthen and operate a regulatory framework that favors linkages between institutes between institutes, units and centers in all areas of research. institutional.
Mechanisms for the transfer of knowledge and technological development towards the sector productive ineff	Update and strengthen the organizational structure of the institutes, units and centers to favor knowledge transfer models and technological development, business incubation, creation of technology-based companies, and development of the of talent development entrepreneur
Framework inadequate regulatory framework to promote the culture intellectual property and knowledge transfer, as well as a limited structure for the proper operation of incubators	Updating the organizational structure of the institutes, units and centers to favor the transfer of knowledge knowledge and technologies, as well as the mechanisms linkage mechanisms

Source: Own elaboration based on the Institutional Program for Innovation and Development 2013-2018 of the TecNM.

In the area of linkages, the deficiencies are found in the processes of knowledge transfer and everything related to intellectual property, as well as in improving the operability of the linkage councils and the efficiency of the incubators. To this end, it is necessary to restructure the organization of these areas and at the same time establish regulations that encourage linkages.

All of this serves as a basis for establishing strategies to help achieve the objectives set and through which the Tecnológico Nacional de México will continue to position itself as one of the country's leading institutions of higher education.

On the other hand, companies have become active participants in innovation systems by creating and disseminating new knowledge, technologies, skills and values required by society. It is necessary then, the creation of adequate business management processes that promote innovation and competitiveness demanded by the market [28]. In addition, the knowledge generated should be able to be put into practice and solve real problems or needs, taking it to the market through the creation of university enterprises [9].

The creation of new companies is the main source of a country's development. Thanks to them, wealth is produced, the quality of life of a region is increased, economic growth, sources of employment, innovation, greater productivity and technological development are achieved; companies are the driving force of the economy and therefore, it is essential that universities promote the development of competencies and skills.

entrepreneurial activities [1]. The generation of wealth, employment and social development is thanks to entrepreneurial activities [29]. In recent years, the issue of competitiveness has taken on a very important role. It can be stated that competitiveness of a company depends on its productivity, its infrastructure, the sector in which it is located, its market share and the level of its profitability [30]. Competitiveness has been positioned as a key factor for the survival and fulfillment of a company's objectives [31]. Innovation is an element that is closely related to competitiveness [10].

innovative have qualified personnel and technological development necessary to survive [32]. However, the success of an innovation goes beyond the creation of companies; it is necessary to implement new procedures that contribute to position, grow and maintain them within the current markets [33]. SMEs represent an important percentage for the economic sector of any country [19]. Their contribution in terms of job creation, income generation and, therefore, wealth generation, is well known worldwide [31]. Thanks to them, it is possible to achieve an increase in the gross national product, as well as greater citizen welfare [34]. This makes it necessary for society, government, private initiative and universities to become actively involved, each in their own sphere, to increase the competitive level of the business system [31].

In the Economic Census conducted by INEGI between February 1 and July 31, 2014, it was determined that the total of establishments in the country is 5,654,014, in which 29,642,421 people work.

Figure 1 shows that Commerce, Private non-financial services and Manufacturing account for 98.0% of the economic units and 88.9% of the total employed personnel. Figure 2 shows that, of the total number of economic units, 95.4% have up to 10 employed persons; 3.6% occupy from 11 to 50; 0.8%, from 51 to 250; and 0.2%, from 251 and more people. In other words, the concentration of the business sector is determined by SMEs.

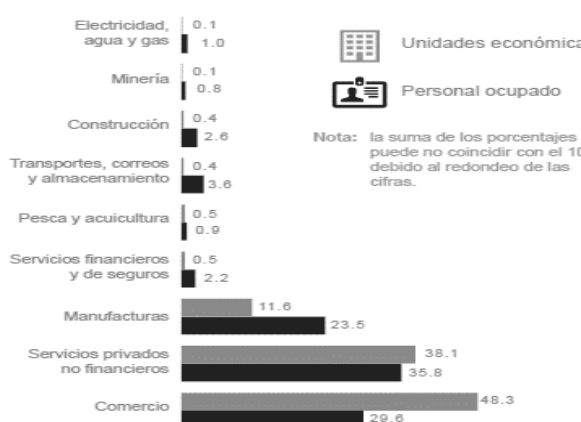
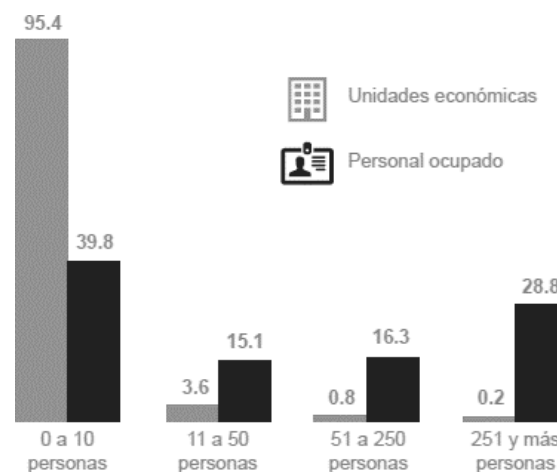


Figure 1. Economic units and employed personnel by economic activity.

Source: Own elaboration.



Economic units and employed personnel according to size of the economic unit.

Source: Own elaboration.

DISCUSSION AND ANALYSIS OF RESULTS

The following results are obtained:

Theory indicates that there is a relationship between competitiveness, scientific and technological development, innovation and knowledge. A knowledge economy provides opportunities and spaces for economic, technological and social development [16].

Universities are the main institutions where knowledge is generated, while companies develop innovations. The processes for the development of research and innovation in universities depend on the creation of structures that allow interaction between the educational, business and governmental areas [36].

There is a great area of opportunity for the development of science and technology by establishing collaborations between universities and companies. However, one of the main obstacles has to do with the culture and objectives of each. On the one hand, universities want to disseminate their research findings, while companies want exclusivity. Likewise, the issue of intellectual property and commercialization must also be taken into account. The success of an innovation lies in its application to solve real problems or needs.

This can be achieved through the creation of companies. An innovative country is considered to be one with the capacity not only to generate but also to transform technology into profitable products and services [2].

The positioning and maintenance of companies in the market depends on their capacity to innovate.

There is discussion about whether the university can be the institution within which young people can create their own businesses by implementing their ideas in a practical way.

At present, the term "entrepreneurial university" has emerged, whose focus is on the generation and transfer of knowledge that can be taken to the market through the promotion of entrepreneurial activities.

In order to maintain its position as one of the leading higher education institutions, the Tecnológico Nacional de México has established several objectives and strategies in relation to the promotion of science and technology, as well as collaboration with other public and private organizations to achieve this goal.

TecNM faces multiple challenges in achieving its objectives. The main ones have to do with infrastructure issues, policies to encourage research activities, bureaucratic processes for the granting of financial resources, inefficient technology transfer processes, as well as inadequate intellectual property regulations and little focus on business development and the incubation model.

More than 90% of the business system is concentrated in companies with less than ten workers, i.e., micro and small companies. Most of them are in the commerce sector and generate more than 80% of the total employment in the country. The Tecnológico Nacional de México will be able to develop innovations by fostering and promoting entrepreneurial activities, which in turn will be able to be marketed in to respond social needs.

The new global trends are forcing both educational institutions and the business sector to look for creative ways to solve problems, with innovation being a central theme.

TecNM seeks to be an innovative institution by establishing strategies that promote applied research, the updating of its teaching and research staff, and its regulations,

policies and organizational structure with the aim of having efficient processes for the transmission of knowledge and technology, science-based development and all those activities that promote entrepreneurship.

CONCLUSIONS

When we talk about innovation, we refer to the generation of new knowledge through which changes are achieved in the various subsystems that make up an institution. These changes range from policies, procedures, structure, culture, processes, materials, technologies, ways of working, to the products and services provided. Through innovation it is possible to achieve real change.

However, how does one arrive at innovation?

What elements must be integrated in order to be innovative? The theory agrees that it is through education that new discoveries can be .

Governments are betting on education as the main tool in the economic and social development of their country. Knowledge provides a different perspective on how things can be done, gives us a broader vision and helps us to find creative solutions to the various problems a society is going through. In this sense, the question also arises: Where is knowledge generated?

The university is one of the main personnel training institutions. Currently, there is a broad debate about what its main function is in the current knowledge era.

On the one hand, we can observe the position that the university should be purely academic. Focused on professional training, as well as basic research. However, there is also the opinion that research conducted within universities should be put into practice, solving real problems and in turn, generate value to society.

In this sense, the business sector is the one that can finally add that value by integrating itself as a fundamental part of the economic development of any country. Through the creation of companies, jobs and sources of income are generated.

The company's activities include the provision of income generation, social needs, technological development, training and professional development, as well as an increase in the productivity levels of any region.

Therefore, on the one , we can say that higher education institutions are one of the main organizations where knowledge is generated. On the other hand, companies are the ones who add value to this knowledge by putting it into practice through its commercialization.

In this sense, it is necessary to ask: Will the university have not only the capacity, but also the task of generating new knowledge and at the same time directing it to its application in society through its commercialization? Will university entrepreneurship be the basis for generating innovations that lead to economic development?

Taking into account the above, Tecnológico Nacional de México will face the challenge of establishing and following up on strategies that guarantee the development of science and technology. A new administration began in 2019, which will have to analyze the results obtained from the plans and objectives set and assess to what extent they have been fulfilled and thus set the course to be followed in order to continue being an institution that contributes to the social and economic development of our country.

The purpose of this research was to highlight the importance of innovation, scientific and technological development . Likewise, the role that universities play in the generation of knowledge and the promotion entrepreneurial activities, since it is also possible to observe that there is a relationship between innovation, education and business.

Thus, it is necessary to continue research on the entrepreneurial university, the university-business linkage and the challenges in the process and its relationship with the development of science and technology.

It would be interesting to analyze the success stories and best practices of other technology companies in this regard. Also, there could be a study on the positioning of the system of incubators that make up the TecNM and the contribution they make to the economic development of their region, as well as the Research Centers that currently exist.

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