Forming Entrepreneur in Engineering

The case of Tecnologico de Monterrey

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I. INTRODUCTION

The University that promotes entrepreneurship is a trend that has been consolidating since the end of the twentieth century; this trend impacts the way of teaching as well as future professional characteristics. In this article we study the case of Tecnologico de Monterrey, a university that evolved from teaching, to research and entrepreneurship. Tecnologico de Monterrey's vision is: We form leaders, with an entrepreneurial spirit, human sense and competitive internationally. This research will analyze how entrepreneurship impacts on the profile of leaders in engineering of the Tecnologico de Monterrey; for this, it will be used the qualitative method, with case study strategy and semi-structured interview technique to engineering students (primary source) and the Tecnologico de Monterrey study through secondary sources - books, statistics, reports, etc. to diagnose and understand how they are forming entrepreneur engineers.

II. NEW PARADIGM OF UNIVERSITIES

Since their creation in the 11th century in Europe, universities have been focused on transmitting knowledge from teacher to student, with an emphasis in the teaching activity. From the 17th century onwards, the first academic revolution took place, where research activity was added to teaching, becoming part of the mission of universities. This first took place in universities in Germany, followed by universities in the USA, England and France [1].

This first revolution still generates debates and challenges in the academic world, concerning how to integrate teachers and researchers in their activities, and even in university management, on how to conduct both activities within the same academic environment [1].

From the 19th century onwards, notable changes occurred, such as the expansion of public research institutes and the creation of research and development R&D departments established in companies and organizations, as well as new forms of telephony, etc. This caused the market to obtain demand for scientists, engineers and the consequence was the massification of universities.

At the same time as the first academic revolution still raises debates, a second revolution takes place, beginning in the middle of the 20th century. In this new university mission, besides teaching and research, economic and social development are also incorporated. of a university that includes in its functions the agent of innovation and entrepreneurship [1].

This new mission, from an entrepreneurial university, comes from experiences at universities such as MIT (Massachucets Institute of Technology), Stanford and Harvard. This new vision of an active and entrepreneurial university approaches the university of society and positions the academy as an important agent of economic and social transformation [8].

The role of the university is discussed by various specialists, and in the area of entrepreneurship it can be said that Etzkowitz is an author who is concerned about returning his studies to this topic: the entrepreneurial university. According to him, the future of the university or university of the future has its foundations in the change between producers and users of knowledge [5, 6].

In this way, the university assumes a position of generating knowledge, in a society that makes it fundamental in the gear of innovation, new ventures, as well as sustainable economic and social growth. For [7] the university can be considered essential for innovation in knowledge-based societies, and can even replace companies in the main source of regional development.

The emergence of entrepreneurial universities involves an expansion of research groups, existing in universities focused on basic and applied research. According to this situation, this logic of investing in research enabled the creation of research groups that can be called almost companies, because through the invention of products and processes and with the help of companies, they can become innovations for development market. In this way, business incubators are created within the structures of universities, fostering academic entrepreneurship and strengthening the roots of groups to become Spin-offs, residents of technology parks, one of the innovation environments that universities provide.

Spin-offs are types of companies created within universities, through technologies generated by students and researchers and the infrastructure of academic laboratories. Together, they form motivators of the commercialization of knowledge. Academic entrepreneurship is an important tool for generating new jobs and the emergence of new industrial sectors. In addition, it contributes to improving competitiveness in existing sectors [10].

The universities have welcomed the participation of their undergraduate and postgraduate students in the generation of

these companies based on their research. However, these students need support for innovative entrepreneurship through disciplines that can instruct them managerially, enabling a possible marketing vision of the invention [2]. However, it is not only with a discipline of entrepreneurship that an entrepreneur is formed, there is something beyond that. Therefore, create a context where the student is inserted in a critical and creative university, with professionals with an entrepreneurial mentality, that is, it would not be possible to create an entrepreneur only in a classroom, but in a university [8].

For an enterprising university the evolution of some phases is necessary, which according to [4] are classified into three: i) first phase: the university needs to establish its strategic vision, redefining mainly financial priorities, to provide necessary resources for its investigations; ii) second phase: focus on the commercialization of intellectual property and the transfer of technologies; iii) third phase: as a result of the sum of the first two phases, the university becomes regionalized, with commitment to the generation of new ventures, new products and new processes. After the third phase, the university starts to build relationships with other actors, such as government and companies, designing a new role in the performance of innovation for the region to which it is inserted. This role is not only about the commercialization of knowledge, but also about development that is concerned with producing social and sustainable impacts in the region [4].

The university needs to rethink its performance in training and leading new professionals to the labor market, since they are inserted in fully agile companies and organizations with a new dimension of time and space, where information and innovation play a prominent role [9].

For [9] the university affirms itself as an important institution for the knowledge society, from a simple analogy, because, if these institutions were important in an industrial society, with the paradigm shift to the knowledge society, this importance increases. It is highlighted not only as a generator of knowledge but also as an agent of transformation in the service of training and technological and social development needs inserted in the environment of the knowledge society.

Some authors work with the concept of knowledge society or information, but according to [12] the notion of information society is based on technological advances and the knowledge society comprises social, ethical, and political dimensions.

For [13] growth should be the main paradigm to be followed by contemporary higher education. This means an endogenous and sustainable human development, that is, a development based on one's own productive forces, capabilities and competitiveness at the service of the human being, respecting the human being and the right of future generations and preserving the cultural identity of the people.

The World Declaration on Higher Education reports that a country will not achieve sustainable endogenous development without adequate tertiary education to enable it to form critical mass and educated and qualified people. This should be the focus of the university [13].

III. TECNOLOGICO DE MONTERREY

This university is composed of 26 campuses throughout Mexico and has 18 international offices around the world. It has 89,641 students including high school, graduation and postgraduate and has 10,117 teachers. In the area of entrepreneurship Tecnologico de Monterrey has helped 1,776 companies incubated, 9 accelerators and has a portfolio of 3,819 companies already graduated. In all its campuses Tecnologico de Monterrey has a total of 15 entrepreneurship and innovation parks [11].

The Tecnologico de Monterrey has a history based on entrepreneurship, because since 1970 the university was concerned to offer their students that they could have entrepreneurial attitudes and not only wish to occupy positions in established companies. With this objective in 1978 began to operate the Entrepreneur Program, which initially had a group of teachers guiding some students in the process of creating a new company. With the evolution of this program in 2017, Tecnologico de Monterrey has an academic entrepreneurship structure that supports its students, and enables contact with entrepreneurship tools and innovation environments that drive the entrepreneurial spirit of the academic community [11].

The programs then divided by levels, in the middle school the student has a compulsory discipline in which the student must develop a project that allows him to understand that entrepreneurship is not only to open and manage a company, but a life model that identifies opportunities of development and take risks in any field. There is a program where the high school student must participate in a social impact project where he develops leadership skills and social commitment [11].

For the graduation of engineers there is a compulsory discipline on entrepreneurship, and has the objective of developing the attitude and disposition for innovation and entrepreneurship, such as identifying opportunities in the market, business modeling, generation of ideas and solutions and development of prototypes focused on the market In addition to another discipline in which entrepreneurship has a social focus where social problems are addressed in the low-income sector, social innovation as a mechanism for solving social problems, the role of the social entrepreneur, among others. In the postgraduate program, the program focuses on encouraging the student to identify opportunities to create new businesses connected to the market, including the development of a commercial proposal [11].

IV. METHOD

The research method for this article, the case study is presented as a strategy and as a data collection technique, the technique of focal group was adopted, where the group able to discuss elements of the interviewer or interviewer as soon as it was conducted. The script used this article was validated by two specialists in the area of entrepreneurism. This research is also done by collecting data in reports and sites for a documentary analysis. The data will be processed by means of a technical content analysis.

For this article, a focal group participated in some of the fourth quarter semester, Tecnologico de Monterrey. The

compost class for 20 students was invited to collaborate with research and only those interested students were in the classroom for the activity not afraid. With a script previously defined were investigators interrogating and instigating them students so that they could respond and interact with the theme. This episode lasts for 50 minutes and was recorded for later content analysis. The content of group was transcribed for a better analyzed two researchers.

For [3], the categories are important for the analysis of content, and the emergence of the theoretical construct or the emergence of two craps. In this investigate the categories emerged two dices collected, that is, *a posteriori*.

In this sense the dice was grouped in 2 categories: entrepreneurial university; engineering education. Following the presentation of the results analysis.

V. PRESENTATION OF THE RESULTS ANALYSIS

As explicit in the method of this study, the data were collected with students of the Tecnologico de Monterrey engineering course, and will be presented here through the categories.

A. Entrepreneurial University

The students were asked if they considered Tec an entrepreneurial university, and they said yes. In their opinion, "since the creation of the university, it has the understanding that entrepreneurship can help change the reality of our people, and with that, everything we have here brings us to that goal. I think this can be classified as an entrepreneurial institution, and I really like to see it "(Interviewee 1). It was also highlighted by an academic who studied at another university, that there are no tools or programs to undertake as Tec offers, events and disciplines that make students think and act critically, and this is considered by them as a differential of the entrepreneurial university. According to [8], the entrepreneurial university is one that enables the student to have the possibility of change in their surroundings, that is, outside the walls of the university.

For students, having a good business idea is important because Tec offers the infrastructure to develop, with the help of laboratories, the incubator itself and the technology park are important spaces for ideas to evolve and become a reality. According to them it is not the fact of undertaking to undertake, but to do so with a goal, be it social or economic, which can be understood through [2], where the author states that for an idea to be realized tools are needed, which in this case are the innovation environments that help in improving the idea until it becomes a new business or a new product.

The students interviewed have motivation to undertake, because according to them, there are social problems in the surroundings, which require bold solutions and courage to change. For these academics, entrepreneurship with social focus is one of the possibilities that they work to develop, whether in the classroom or in laboratories.

B. Engineering Teaching

Some students reported that they consider themselves motivated to be in the classroom, because the classes are not monotonous and the knowledge is put to the test at all times. "The classes are carried out with real problems, and according to them the main challenge is the coexistence within the company. It's the best way to learn because you face the real world and what you learn theoretically here in the company is very different there you have to solve problems with the people you have around you and learn to socialize with those who are there you do not is in a classroom "(interviewee 2)

According to the students, what really motivates them is when something they do can impact on society. And this they find in social entrepreneurship, and for these engineering students all professionals must be aware of their surroundings and motivated in the constant search for tools and solutions for the welfare of society in general, be it through a new product in the company, or by a new company with a service for the common good.

This differential in the training of engineering students is well-regarded by them, who not only perceive this concern of the university with their surroundings, but also act directly on that goal, or vision. One of the students mentioned that for him each of the course subjects offers a different challenge: "This has to do with teaching entrepreneurship, because you will fail several times and learn from it, until in some challenge you can overcome" (interview 3).

The students emphasize that the university assists in the development of an entrepreneurial culture because it encourages new ideas, either through the discipline that all the students must take, or through the events that are realized like week, that is a week dedicated to the new ideas that inspire and innovate. Some students cited examples of university interaction with companies, such as some projects developed together, where the company's real problems are solved in class by the students with the guidance of the teachers. According to them, trips are made to the company to test some solutions together with the employees. For them, this activity of coping with real problems motivates them to solve, since besides being problems in which the company is happening at the moment, their work is being seen by specialists in the area what can lead to a contracting.

VI. CONCLUSIONS OR DISCUSSION OF RESULTS

The findings of this research report the importance of the mission of the university in the 21st century. It is necessary to understand that university education needs to move through new issues and concerns that are greater than the labor market, such as economics and concern for socioeconomic problems. The entrepreneurial university is an approach that cares about these themes and through entrepreneurship seeks to develop skills in its students as future leaders and motivators of change in the region in which they operate.

In this sense, Tecnológico de Monterrey can be considered a university with this vision and mission, and seeks to create in its culture more than students, citizens engaged and committed to this change. In the Mexican reality in which the Tecnológico de Monterrey is inserted, this posture of the university is well regarded by university engineering students, according to the data of this research, where they affirm that they feel motivated to study in an environment where everyone has the challenge to improve the country in which they live.

For the students of engineering courses this vision is important in their training, since they are responsible as professionals in the marketplace, for changes in society, in improving the quality of life of the people, through their characteristics as engineers, but for them, more than engineers, as people inserted in a society lacking in change and improvement.

REFERENCES

[1] Audy, J. L. N. Between Tradition And Renewal: Challenges Of The Entrepreneurial University. In: Audy, Jorge Luis Nicolas; Morosini, Marília Costa (orgs.). "Innovation and entrepreneurialism in the university". Porto Alegre: EDIPUCRS, 2006.

[2] Carayannis, E.G.; Rogers, E.M.; Kurihara, K.; Allbritton, M.M. "High-technology spin-offs from government R&D laboratories and research universities". Technovation, n. 18 v. 1, pp. 1-10, 1998.

[3] Denzin, N. K.; Lincoln, Y. S. "Collecting and interpreting qualitative materials". 3.ed. Thousand Oaks, Calif.: Sage, 2008.

[4] Etzkowitz, H. Anatomy of the entrepreneurial university. "Social Science Information". v. 52. n. pp. 486-511, 2013.

[5] Etzkowitz, H. Leydesdorff, L. "The triple Helix- University, Industry, Government Relations: a laboratory for knowledge Based Economic Development". EASST Review, v. 14, n. 1, pp. 14-19, 1996.

[6] Etzkowitz, H. Webster, A.; Gebhardt, C.; Terra, B. R. C. "The future of the university and the university of the future: evolution of the ivory tower business paradigm". Research Policy. v. 29. p. 313-330, 2000.

[7] Etzkowitz, H.; Zhou, C. "Triple Helix twins: innovation and sustainability". Science and Public Policy, v. 33, n.1, p.77-83, 2006.

[8] Guerrero, M.; Urbano, D. "The impact of Triple Helix agents on entrepreneurial innovations' performance: An inside look at enterprises located in an emerging economy". Technological Forecasting & Social Change. v.119, pp. 294-309, 2016.

[9] Mora, J. G. "The modernization process European universities: the challenge of the society of knowledge and globalization". In: Audy, Jorge Luis Nicolas; Morosini, Marília Costa (orgs.). Innovation and entrepreneurialism in the university. Porto Alegre: EDIPUCRS, 2006.

[10] Pérez, M.; Sánchez, A. M. "The development of university spin-offs: early dynamics of technology transfer and networking". Technovation. v. 23, pp. 823–831, 2003.

[11] Tecnologico de Monterrey. Available in: <https://tec.mx/es>. Access 18 October 2017.

[12] UNESCO. United Nations Educational, Scientific and Cultural Organization. "Declaración mundial sobre la educación superior en el siglo XXI: visión y acción. Aprobado en la Conferencia Mundial sobre Educación Superior". UNESCO, Paris, 5-9 oct. 1998.

[13] UNESCO. United Nations Educational, Scientific and Cultural Organization. "Challenges of the university in the knowledge society, five years after the World Conference on Higher Education. Paris: UNESCO, pp. 44, 2003.