ANALYSIS AND EVALUATION OF EXPERIENCES IN TECHNOLOGY TRANSFER AND KNOWLEDGE OF HIGHER EDUCATION INSTITUTIONS IN MEXICO

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Introduction

In recent years, university-industry collaborations have aroused substantial interest as a source of knowledge production and new technological advances [1], “fostering the economic and innovative competitiveness of the regions [2], [3], [4]”. Usually, university-industry collaborations refer to associations between one or more academic or research institutions and one or more companies operating in industrial markets focused on collaborative R&D activities [5], [6], [7].
One of the useful tools for generating innovations is the transfer of technology and knowledge as a means by which public R&D can be transferred to the market to give rise to new products or services or to the improvement of existing ones. In other words, technology transfer is one of the sources of innovation for companies.

Therefore, universities and research centers must know and understand the type of science that is developed and at the same time they must know the characteristics and needs of their client, the company.

It is necessary the existence of people who, from a knowledge and vision of the functioning of the market and the opportunities it offers.
Methodology

In a first stage, systematic searches were conducted in journals indexed in the Scopus database, to identify scientific articles that document cases of technology and knowledge transfer (TKT) at an international level, then they were purified to identify those documented cases of transfer experiences in Mexico and subsequently those cases from higher education institutions were selected.

As a second stage, the review of HEIs websites and official institutions that can be involved in this type of processes for example, National Council for Science and Technology (CONACYT), Ministry of Economy, Consultative Forum of Science and Technology, etc; was carried out to search for news or reports on documented cases of TKT made by IES in Mexico.
From the first stage, a total of 2,617 papers were obtained from the different search strategies, of which the majority were rejected because they presented international cases and only 27 talked about TKT in Mexico.

Subsequently, 19 documents were discarded because they did not meet the criteria of being cases of TKT. Only 4 complied with cases from the HEIs or research centers (RC), among which 13 TKT cases of HEIs or RC in Mexico are documented.

In the second stage, 9 documents were identified with 190 cases in total, of which 48 were eliminated because they were not cases of HEIs, leaving 142 records. Finally, adding the cases of both stages, it was possible to identify a total of 155 documents to analyze, of which 16 are presented in this paper.
The analysis performed on 16 different documents is summarized in Table 1 which contains information associated with different elements that were presented in the documented TTC cases:

<table>
<thead>
<tr>
<th>Document Title</th>
<th>Transfer case</th>
<th>Results / Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desarrollo del primer fungicida 100% Mexicano: Fungifree AB®</td>
<td>Bio-Fungicide, formula to attack the fungus in the mango</td>
<td>- Fungifree AB® market launch&lt;br&gt;- Protect development through a patent&lt;br&gt;- Creation of the company (spin off) that would license the technology and take it to the market.</td>
</tr>
<tr>
<td>Caso de éxito. Crea investigador universitario empresa transnacional.</td>
<td>Training of high quality human resources in the area of corrosion and engineering protection</td>
<td>- Spin-off company with exclusive license of the training and certification program&lt;br&gt;- More than 70 NACE International certifications&lt;br&gt;- More than 60 training courses</td>
</tr>
<tr>
<td>Casos de éxito vinculación academia - industria</td>
<td>Anaerobic technology transfer</td>
<td>- Formal constitution of the technology-based company IBTech S.A. from C.V.&lt;br&gt;- Locate in the Mexican environmental market.</td>
</tr>
<tr>
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| Centro de Innovación y Transferencia de Tecnología Agropecuaria de Sinaloa, CITTAS | In vitro propagation | -Creation of training and technological packages generated  
-Certified sorghum and corn seed for temporary  
-Benefit for low-income producers (the seed is delivered free of charge directly to the producer) |
| Programa de Estímulos a la Investigación, Desarrollo Tecnológico e Innovación. Resultados y casos de éxito. | Feeding technology to trigger the production of captivity tuna | -A product that contains all the nutritional needs to trigger the growth of any marine fish was achieved.  
-Formulation and elaboration of dry and wet ingredients that come from the natural environment to be consumed by fish  
-Offer foods with higher protein and fat content to fish with higher nutrient requirements |
| Programa de Estímulos a la Investigación, Desarrollo Tecnológico e Innovación. Resultados y casos de éxito. | Technological tool that will optimize production in the wine industry | -It was possible to integrate information generated by remote sensing, classification and edaphic monitoring in a WEBGIS platform compatible with mobile devices. |
Programa de Estímulos a la Investigación, Desarrollo Tecnológico e Innovación. Resultados y casos de éxito.

**Development of a new product for the wireless communications market**
- It has a technological process of manufacturing a microcircuit that integrates stacked ceramic multilayers
- A functional prototype with new differentiating attributes incorporating LTCCShielding technology.

**Experiencia de empresas spin-off**
- Sweet potato flour and business creation to market it.
- Creation of the Alnubio company
- Creation of the Camorina brand
- Formulation of flour with 100 percent natural ingredients, without preservatives, and ready to bake.

**Crea emprendedor mexicano bioplástico a partir de la semilla de aguacate que da pie a prometedora empresa.**
- Generation of a biopolymer obtained from avocado seed for various uses
- Creation of a thermoplastic resin that degrades in less than a year and has a useful life close to four years
- With the created resin they are produced from thin bags to rigid pieces such as containers or kitchen utensils.
- Creation of the Biofase company with three business units.
The cases shown here are an extract of the total cases in the process of analysis, however, during the purification and review it has been observed that most of the cases have been published through work carried out by federal government agencies as part of the dissemination work on the results of its support policies, but there are very few cases that appear in publications indexed in scientific journals as national and international dissemination.
Conclusions

TKT can be a valuable element to contribute to the economic development of a country, but in particular for HEIs in Mexico, which are increasingly suffering from a greater budget cut, it can mean an attractive source of income to support the development of new knowledge and technologies through the financing of the research lines involved in the transfer processes, at the same time that they could have important elements to convince society of their relevance and contribution to economic development.

During the study, it was perceived, during the process of debugging cases, that countries such as Spain have a greater path in terms of TKT of academic institutions towards the social and productive sectors, or at least have had a greater concern for documenting and spread their success stories unlike Mexico.

Although the federal government in Mexico has made efforts to document success stories and disseminate them to make knowledge available to society, there is still much to do from the field of scientific dissemination and there is a gap of research to explore as an area of opportunity for scientific community.

It is still pending in the investigation tasks for cases of experiences in technology transfer and knowledge in Mexico, the identification of transfer mechanisms and valuable elements to ensure that these processes are carried out successfully and, based on this, propose a model of technology and knowledge transfer model that is useful for the innovation ecosystem in Mexico.


• Freeman, Ch. Innovation and Growth En Dodgson/Rothwell (Ed), 1994.

• CONACYT. Programa de Estímulos a la Investigación, Desarrollo Tecnológico e Innovación. Resultados y casos de éxito. 2018. Retrieved from https://cdn.webiste-editor.net/912129f9f65b44e3af47e16a02a27cf4/files/uploaded/Obtenci%25C3%25B3n_de_Resultados_y_Casos_de_%25C3%2589xito%2520%2525281%252529.pdf


¡¡Thank you!!

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