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*In Number 1st presented an article *The Importance of Linking the Academic Bodies with the Productive Sector in Problem Solving* by FLORES-LICON, María del Rocío, VALLES-CHÁVEZ, Adolfo y CASTILLO-PÉREZ, Martha Lina with adscription in the Universidad Tecnológica de Chihuahua, in the next section an article *Binding educational model (bem) for the training of competences in innovation and entrepreneurship of business projects based on technology* by SALGADO-ORTIZ, Francisco J., RUIZ-BÁRCENAS, Lilia, REYES-LÓPEZ, Octavio y TAMAKLOE, Elvis K in the next article *Opinion of the fulfillment of fiscal obligations in the farmers* by SILVA-CONTRERAS, Juan, ANDRADE-OSEGUERA, Miguel Ángel, BARCENAS-PUENTE, José Luis and MORENO-GONZÁLEZ, Claudia Adriana with adscription in the Universidad Politécnica de García and Universidad Politécnica de Cataluña, in the next section an article *Evaluation of production costs of biodiesel from jatropha curcas oil with two zirconia based catalysts* by CRUZ-NETRO, Liz Del Carmen, MENDOZA-HERNÁNDEZ, Ana Viriginia, CRUZ-NETRO, Zahira Gabriela y PADILLA-TORRES, Sergio Antonio with adscription in the Universidad Politécnica de Altamira.*

## Content

Article	Page
<b>The Importance of Linking the Academic Bodies with the Productive Sector in Problem Solving</b> FLORES-LICON, María del Rocío, VALLES-CHÁVEZ, Adolfo y CASTILLO-PÉREZ, Martha Lina	1-8
<b>Binding educational model (bem) for the training of competences in innovation and entrepreneurship of business projects based on technology</b> SALGADO-ORTIZ, Francisco J., RUIZ-BÁRCENAS, Lilia, REYES-LÓPEZ, Octavio y TAMAKLOE, Elvis K.	9-16
<b>Opinion of the fulfillment of fiscal obligations in the farmers</b> SILVA-CONTRERAS, Juan, ANDRADE-OSGUERA, Miguel Ángel, BARCENAS-PUENTE, José Luis and MORENO-GONZÁLEZ, Claudia Adriana	17-27
<b>Evaluation of production costs of biodiesel from jatropha curcas oil with two zirconia based catalysts</b> CRUZ-NETRO, Liz Del Carmen, MENDOZA-HERNÁNDEZ, Ana Viriginia, CRUZ-NETRO, Zahira Gabriela y PADILLA-TORRES, Sergio Antonio	28-35

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## **The Importance of Linking the Academic Bodies with the Productive Sector in Problem Solving**

FLORES-LICON, María del Rocío\*†, VALLES-CHÁVEZ, Adolfo y CASTILLO-PÉREZ, Martha Lina

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### **Abstract**

In the city of Chihuahua, there exists an important maquiladora sector that is dedicated to plastic injection; they mainly produce connectors for the automotive industry.

The Technological Education Management academic group of the UTCH along with student interns participated in coordination with the multidisciplinary team in the areas of design and automation of the ACC plant in the project of designing and fabricating semi-automatic equipment that guarantees the assembly of several components, it has to meet certain requirements such as: safe to operate, operated pneumatically, operated by a collaborator, comply with a cycle time, ensure specifications of assembly according to the standards of the automotive industry.

Through the use of this equipment, it is sought to reduce the participation of the workforce in the assembly of the components for the connector, to prevent and avoid incidents of poor quality due to human error variations such as fatigue, distraction, boredom, mood swings, etc.

**Academic group, internship, tie-up, problem-solving**

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## Introduction

The Academic Body Management of Technological Education of the Universidad tecnológica de Chihuahua and the University Superior Technicians Ramón Parra Díaz, Eladio Chavira Hernández and Sergio Alejandro Alicano Valdiviezo in connection with the productive sector develop in the company AUTO CONECTORES DE CHIHUAHUA ELCOM, S. de R.L. of C.V. (ACC) a project for the solution of an existing problem in the area of design and automation. This company belongs to the Yazaki Corporation which was founded in the year of 1929, its headquarters are located in the city of Hibara Japan.

In 1966 the first companies of the Yazaki Corporation were established in the North American continent, locating their headquarters in Michigan.

ACC was established in the state of Chihuahua in 2001. In July 2004, Auto Connectors of Chihuahua opened plant 2, taking its turn in the molding of connectors and wedges by means of plastic injection, within the automotive industry.

In the production area it is necessary to have a semiautomatic equipment that guarantees the assembly of several components, which must meet the following requirements: be safe to operate, be pneumatically activated, operated by a collaborator, comply with a certain cycle time, ensure assembly specifications according to the standards of the automotive industry.

Currently the sub-assembly operation is performed manually; For this reason, it is not guaranteed that the product meets the required quality specifications.

With the implementation of this team, it seeks to reduce the participation of the workforce in the assembly of the components of the connector, to avoid incidents of poor quality due to causes of the variation of the human factor such as fatigue, distraction, boredom, mood, etc.

The academic body, the students in stay in coordination with the multidisciplinary team of the design and automation area of the plant. Conduct previous meetings in order to identify the root cause of the problem in the production area.

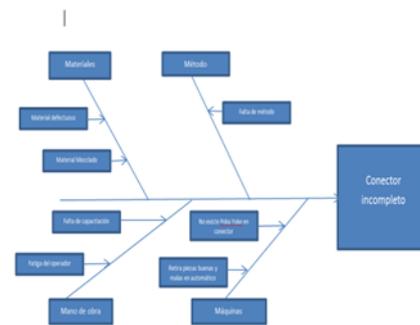


Figure 1. Diagrama de Ishikawa

Figure 1 shows the Ishikawa diagram where the materials used, method, labor and machines are analyzed. The analysis results in the need to design a semiautomatic team of connector assembly which is designed, manufactured and implemented by the young TSU during their stay at the ACC company in the period September-December 2016.

During this advisory stage, potential defects of the connector assembly are identified such as: badly assembled wedge, sunken wedge, missing wedge, use of damaged or defective connector in the molding, wrong model, defects in raw material, badly assembled arrowheads, damaged seal, poorly assembled CPA, sunken CPA, prolonged cycle time.

The conclusion of these work sessions was that these defects must be detected and eliminated with the design of the equipment in question.

### **Justification**

The present project is considered viable because it has the support of ACC for the design, manufacture, implementation and monitoring of the semiautomatic equipment that guarantees the assembly of several components and comply with the quality standards required by the automotive sector.

This project allows the connection of the university with the productive sector for the solution of problems in their processes with the participation of the academic bodies, being the linking one of the pillars on which the creation of the Technological Universities is based and also the student during his stay in the productive sector, he applies the skills acquired to solve problems during his school career.

With the development of said project in the area of design and automation of the company, it is intended to reduce the possible defects in the sub-assembly as shown in the Ishikawa diagram, with this it is intended to guarantee the quality of the product, as well as to avoid customer complaints.

### **Problem**

In the assembly area of the plant defective connectors are produced, because the operations are carried out manually and there is no poka yoke device (error-proof) that guarantees the correct assembly of all its components.

### **Hypotesis**

With the design, manufacture and implementation of a semiautomatic equipment, the correct assembly of all the components of the connector is guaranteed, the potential defects in the connector assembly will be reduced, such as: badly assembled wedge, sunken wedge, missing wedge, use of the damaged connector or with defect in the molding, wrong model, defects in raw material, badly assembled arrowheads, damaged seal, poorly assembled CPA, sunken CPA and prolonged cycle time.

### **Objective**

Design, manufacture and implement a semiautomatic equipment that guarantees the assembly of several components in the production area of the ACC plant to eliminate the quality defects in the connector assembly.

### **Theoretical framework**

The basic principles of pneumatics, mechanics, automation and industrial safety are investigated for the design, manufacture and implementation of said semiautomatic equipment. Here are some of them:

#### **Tire Circuits**

The compressed air distribution network must guarantee the pressure and velocity of the air at all points of use of the pneumatic installations. The regulation and control elements are responsible for regulating the passage of air from the accumulators to the actuating elements; These elements, called valves, can be activated in various ways: electrical, hydraulic, manual, pneumatic or mechanical. The classification of these valves can be done in three large groups:

- Directional valves.
- Anti-return and selector valves.

- Pressure and flow regulation valves.

The cylinders transform pneumatic energy into mechanical energy, with reciprocating rectilinear motion. There are two types:

- Single effect cylinders
- Double effect cylinders

To produce rotary movement, compressed air motors are used. Here are some types and examples of application:

- Rotary piston motors with paddles: for right and left travel. For example they are used in compressed air screwdrivers.
- Star motors, for example, are used in mining.
- Turbine engines for example are used in dental drills.

The combination of pneumatic devices with electrotechnical devices (magnets and others) leads to electro-pneumatics.

### **Safety in pneumatic fastening devices**

The handling elements of pneumatic clamping devices must be made and arranged in such a way that unintentional actuation is avoided. This can be done by:

- Manually operated switching elements with locking caps or locks.
- A blockage at the control level.

Precautions must be taken to avoid injury to the hand by the clamping device. This can be done by:

- Clamping cylinders outside the feeding area.

- The use of safety clamping cylinders that exerts the full clamping pressure only on the work piece.

- The use of a two-hand shot.

### **Transducers**

Transducer is a device that transforms a type of variable or physical quantity (for example, force, pressure, temperature, speed, etc.) into an electrical signal.

Sensor is a transducer that is used to measure a physical variable of interest. Some of the most frequently used sensors and transducers are voltage calibrators (used to measure force and pressure), thermocouples (temperatures), speedometers (speed). Any sensor or transducer needs to be calibrated to be useful as a measuring device. Calibration is the procedure by which the relationship between the measured variable and the converted output signal is established.

Transducers and sensors can be classified into two basic types, depending on the shape of the converted signal. The two types are:

- Analog transducers
- Digital transducers

Analog transducers provide a continuous analog signal, for example, voltage or electrical current, this signal can be taken as the value of the physical variable that is measured. The digital transducers produce a digital output signal, in the form of a set of parallel state bits or forming a series of pulses that can be counted. In one form or another, the digital signals represent the value of the measured variable.

Digital transducers usually offer the advantage of being more compatible with digital computers than analog sensors in automation and process control.

Desirable characteristics of the transducers: accuracy, precision, range of operation, speed of response, calibration and reliability.

Classification of the sensors according to the type of magnitude:

- Linear or angular position
- Displacement or deformation
- Linear or angular speed
- Acceleration
- Strength and torque
- Pressure
- Flow
- Temperature
- Presence or proximity
- Tactile
- Luminous intensity
- Artificial mink systems

Classification of the sensors according to the operating principle

- Contact
  - Position switches
  - Tactile
- Proximity
  - Inductive
  - Capacitive

- Ultrasonic
- Photoelectric

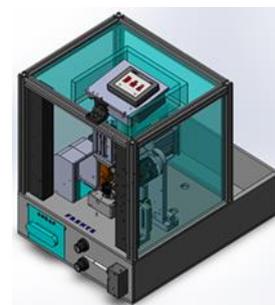
## Method

### Project development

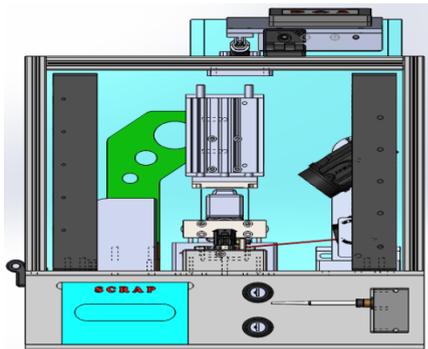
To start with the design of the equipment, the FMEA format is necessary (format to analyze possible failures and solutions in the connector) which is delivered together with the work order, where the operation of the equipment to be manufactured is explained, movements to be made, adjustment tests or new schedules.

As a second step, the prototype of the 3D machine is designed using Solid Works design software. Figure 2 shows the semiautomatic equipment in 3D modeling where it is observed:

- Nests and pieces.
- Vision sensor.
- Robbery cylinders with which the equipment acts.
- Acrylic and extruded aluminum guard.
- Safety curtains to avoid any type of accident in the operator.



**Figure 2** Semi-automatic equipment Designed in 3D



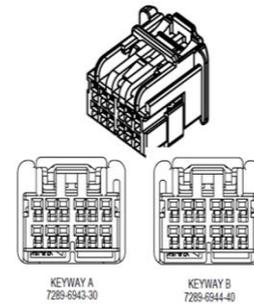
**Figure 3** Front View of the Semiautomatic Equipment

In figure 3 it is observed:

- Vision sensor.
- Cylinder that joins the CPA (connector cover)
- Ejection of the piece to the waste container.
- Key switch to open waste drawer.
- Key switch to release the equipment.

This equipment is designed with the relevant safety measures to avoid any accident. It has a sensor to detect the presence of the hands of the operator and interrupt the operation if necessary and two key switches one is to open the waste drawer once it is full and the other is to perform the release of the equipment.

Figure 4 shows in graphic form the correctly assembled components, which are: the connector, CPA and the wedge. These connectors have to be assembled according to the visual aid, this ensures the correct assembly and proper operation of the part in vehicles.



**Figure 4** Components assembled correctly

For the assembly of the CPA (connector cover) a robbery cylinder is placed which is programmed by means of a software that allows it to give millimeter distances and thus leave in the best position assembled in the connector.

The vision sensor checks the CPA height, presence of the wedge and checks the equipment's release pieces so that it operates perfectly. It also has a device that automatically sends the defective parts to the waste container, thereby preventing the operator from having contact with parts rejected by the equipment and guaranteeing the quality of the product.

A marking point system is placed. Each time the team makes a good piece, it will be marked and then the operator will make the packaging in the finished product box.

In addition, a touch screen is installed which allows you to keep statistical records such as: observe the cycle time of the equipment, the number of pieces made per hour or shift, as well as observe the quantity of defective pieces in the scrap drawer (waste). This statistic allows the machine operator to release the day's production, repair or release.

To complement the project, a manual for the use of automotive connector assembly equipment is developed and standardized for the execution of new electrical connectors manufactured in the plant, the manual refers to the steps to be followed to facilitate the development of new equipment:

### Equipment design and automatic machine, for which it is necessary

- Request plans of the new product.
- Generate work order to manufacture the new equipment.
- Formats for design and standardization are filled.
- Verify the specifications of the pieces to be built.
- Make the final plans of each machining.
- The design acceptance format is filled.
- The programmer tests for finished work review.
- Validation tests are carried out.

### Machining of parts

- Basic revision of the machine.
- Reception of plans.
- Machining in simulator.
- Final machining.

### Integration of components

- Identify the components of the equipment.
- Prototype assembly.

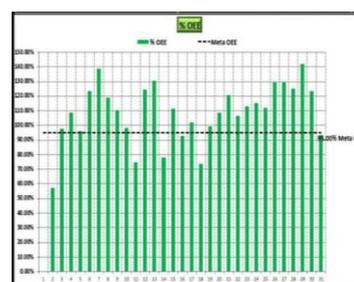
### Machine programming

- Verify the necessary PLC for the equipment.
- Schedule the required activities.
- Routines are run to detect defects.

Following each of the steps proposed in the manual facilitates the manufacture of new equipment, allows the training and training of new personnel to the area of design and automation.

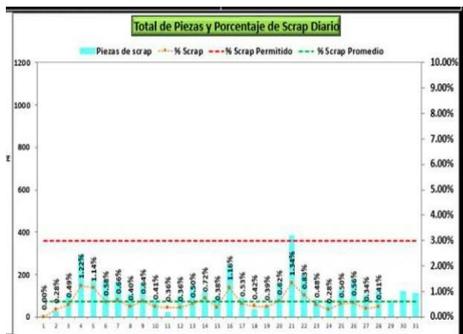
### Results

As a result, the design, manufacture and implementation of a semi-automatic equipment that guarantees the assembly of the new part number was obtained, this equipment makes the function of a Poka Yoke device fail-safe in the insertion of its components. This ensures that all the elements of the connector are assembled correctly according to the manufacturing plan of this part number and it is possible to develop a general manual of the process of design and automation of new products that allows the manufacture of different equipment, facilitates the training and training for new staff in the area of design and automation, as it is important to have procedures for the development and control of new products and ensure compliance with the requirements demanded by different customers.



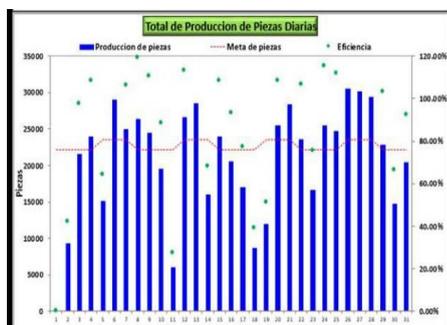
**Graphic 1** Total equipment efficiency (% OEE)

Graphic 1 shows the percentage of the total efficiency of the equipment (% OEE) for the month of December 2017, where a good performance of the designed semiautomatic equipment (108.00%) is observed, remaining above the established goal (95%).



**Graphic 2** Total pieces and percentage of scrap daily

Graphic 2 shows us the total of defective parts in the month of December, which is below the allowed percentage.



**Graphic 3** Total pieces produced

To complement the good functioning of the machine in Graphic 3 we can see a production of parts above the established goal.

**Conclusions**

During the collaboration of the academic staff with the productive sector through the stays of the students of the Technological University of Chihuahua, the importance of solving problems that the industry faces every day and in which the students help to improve the productive processes through the implementation of solutions that have an impact on productivity and the cost of manufacturing. In addition it is verified that the student reaches one of the specific competences of the TSU in industrial area maintenance which is to automate operations that were carried out manually by operators and to make more efficient the production in the companies, said competence is necessary to obtain their title of Superior University Technician in Industrial Area Maintenance.

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## **Binding educational model (bem) for the training of competences in innovation and entrepreneurship of business projects based on technology**

SALGADO-ORTIZ, Francisco J.\*†, RUIZ-BÁRCENAS, Lilia, REYES-LÓPEZ, Octavio y TAMAKLOE, Elvis K

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### **Abstract**

This article describes an Binding Educational Model (BEM) in the Superior Technological Institute of Salvatierra (ITESS), proposed to increase the generation of technology-based companies in Mexico. This approach aimed at linking university education with the social, technological and entrepreneurial sectors, because the high unemployment rate and the low creation of innovative high impact companies are relevant factors for the competitiveness of the country.

The present research has a qualitative approach, with a descriptive scope. In this context, seven managers, eight students, eight *ex-alumni* and seven ITESS teachers interviewed.

The study concludes that an educational scheme on innovation and entrepreneurship should be developed that promotes the development of attitudinal and professional competences in ITESS students. The program surrounded by an internal and external entrepreneurial ecosystem that promotes assists and supports the projects generated in the technology.

### **Educational Model Binding, innovation and entrepreneurship**

**Citación:** SALGADO-ORTIZ, Francisco J., RUIZ-BÁRCENAS, Lilia, REYES-LÓPEZ, Octavio y TAMAKLOE, Elvis K. Binding educational model (bem) for the training of competences in innovation and entrepreneurship of business projects based on technology. *Journal Health, Education and Welfare* 2017, 1-1: 9-16

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## Introduction

According to the Organization for Economic Cooperation and Development [OECD], there is a lot of entrepreneurship in Latin America, but most of it is informal and not original, which explains the high rate of early mortality, as shown by the GEM studies (2016). These results indicate that, in order to promote the development of a quality enterprise in the region, the capacity of entrepreneurs to innovate with scalable products and services of greater value must be improved (OECD, 2009).

Training in innovation or entrepreneurship must take into account the development of the necessary attitudes so that learners can start high impact projects, efficiently facing the barriers that arise in the course (OECD, 2012).

At the same time, students are required to acquire the technical and practical knowledge of the business management process, which ranges from the conception of the idea, to the formation of the company and the management of its growth.

This article proposes an academic model that promotes innovation and entrepreneurship in the Higher Technological Institute of Salvatierra (ITESS) in Mexico. This proposal is based on interviews with different actors involved in the entrepreneurial ecosystem of the same institution.

A documentary review was also made about the competences that innovative and enterprising people should possess.

## Justification

It is undeniable that the economic advance of any nation is intimately linked to that of its technological and business sector.

In general, this proposal is related to the priorities of the country because, although innovation and entrepreneurship in Mexico have grown in recent years, the contribution that has been made to the country's economic and technological development is questionable. Very few young people with university training start a technology-based business (Pro-Mexico, 2014).

The knowledge obtained through this research has made it possible to identify the educational needs in terms of innovation and entrepreneurship required by ITESS. The purpose of this knowledge is the generation of an educational model on topics of innovation and entrepreneurship that allows students to develop the necessary skills in these areas and that besides employing or self-employed professionally, they dare to generate technology-based companies, contributing to the technical, economic and social development of the region.

It is worth mentioning that the generation of this educational model may serve as a working scheme for other institutions of higher and higher secondary education interested in the entrepreneurial and innovative training of their students.

## Problem Statement

The role of small and medium enterprises in Mexico is of the utmost importance. According to the data of the INEGI (2016), in our country there are approximately 4 million 15 thousand business units, of which 99.8% are SMEs that generate 52% of the Gross Domestic Product (GDP) and 72% of the labor occupation. In this sense, it is necessary to encourage the creation of new formal companies, as a mechanism of economic growth that generates employment, promotes innovation and therefore competitiveness.

However, the report of the GEM (2016) shows that we are in the 30th position of the countries of Latin America and the Caribbean in relation to the ranking of business perception of opportunities, capabilities, intentions and failure. In turn, we are located in the 45th position of the business education section in the school stage of the same area.

According to the INEGI (2016) in the aforementioned year, there were 1,039,173 unemployed people in Mexico who have a degree of higher and higher education.

This figure represents 46.5% of the total number of unemployed people in the nation and is the highest proportion since registration since 2005, a period in which this rate increased by 11.1 percentage points. On the other hand, in the state of Guanajuato this indicator represents 35.7% of the total of the unemployed (STPPS, 2016)

The annual follow-up survey of graduates carried out by the Salvatierra Technological Institute shows that only 3% of graduates are undertaking any type of business and none of these is technology-based (ITESS, 2016).

At present, the Higher Technological Institute of Salvatierra does not have a development model of innovation and entrepreneurship competencies adapted to its specific context, which allows the management of high-impact, technology-based business projects.

### **Research question**

Thus, the following research question arose:  
How to develop the training of competencies in innovation and entrepreneurship of technology-based business projects in ITESS students?

### **Investigative Assumption**

Derived from the previous approach, the following investigative assumption was formulated (working hypothesis):

Through a Binding Educational Model (BEM), it is possible to develop skills training in innovation and entrepreneurship of technology-based business projects by ITESS students.

### **General purpose**

Generate a proposal for a binding educational model (BEM) to develop the training of innovation and entrepreneurial skills of IT-based business projects by ITESS students, through a heuristic analysis, with a hermeneutic scheme and phenomenological nature, supported by the grounded theory.

### **Literature Review**

#### **Competencies for innovation**

Innovation is defined as: the introduction of a new and improved product, service, process, work method and marketing or the use of a new organizational scheme in the internal practices of the company, also the organization of the workplace and as a result this significantly favors the growth and development of the company. (OECD and European Communities, 2005).

Dyer, Hal, and Clayton (2011) identify five capacities demonstrated by the best business innovators, these are: 1) Associate: establish connections between questions, problems or ideas from unrelated fields; 2) Question: pose questions that challenge common wisdom; 3) Observe: examine the behavior of customers, suppliers and competitors to identify new ways of doing things; 4) Experiment: build interactive experiences and elicit unorthodox responses to see what ideas emerge; and 5) Networking: meeting people with different ideas and perspectives.

For Huberman (1973) the individuals who most often produce innovations have a series of common traits, among them self-confidence, risk acceptance, youth, a high social position, more intense contacts outside of normal life. his immediate community and a tendency to direct opinion among his colleagues.

### **Competencies for entrepreneurship**

Furnham (1995) tells us that an entrepreneur is a person who detects an opportunity and creates an organization (or acquires it or is part of a group that does it) to face it.

Entrepreneurship is the attitude and aptitude of the person or company that undertakes new challenges projects; is what allows you to advance a step forward, go beyond where you have already arrived, is what makes a person or company is dissatisfied with what is and what has been achieved, and as a consequence, wants to achieve greater achievements (Cañibano, 1988).

According to Kao, (1989) the entrepreneur is a person with very particular characteristics, including: Total commitment, determination and perseverance, ability to achieve goals, orientation to goals and opportunities, responsibility and initiative, persistence in solving problems, Realism, self-confidence, high energy levels, search for feedback, high internal control, calculated risk taking, integrity and reliability and tolerance to change.

### **Competencies and professional training**

Bunk (1994) states that he has professional competence: who has the knowledge, skills and attitudes necessary to practice a profession, can solve the problems of his professional performance in an autonomous and flexible way and is able to collaborate with his professional environment and in the work organization

For the current university, which is increasingly focused on the student's attention as a person that is built in the process of professional learning, the humanistic training of competent professionals committed to social development is a concern and a reason to be occupied. The simple idea that a competent professional is one who possesses the knowledge and skills that enable him to perform successfully in a specific profession has been left behind, replaced by the understanding of professional competence as a complex phenomenon, which expresses the potential of the person to guide their performance in the exercise of the profession with initiative, flexibility and autonomy, in heterogeneous and diverse scenarios, based on the integration of knowledge, skills, motives and values that are expressed in an efficient, ethical and socially committed professional performance ( Delors, 1996).

In this sense, every university should add to the scientific and technical education of students the development of the so-called generic competences. These are cognitive, social, emotional and ethical competences, which represent the initiative, effort for quality, responsibility, etc.) that are transferable and constitute the know-how in the professional education of the university student (Corominas, 2001).

The ILO (1993) points out in this regard, that attitudinal competences are directly related to know-how or know-how to act in a given situation, and professional competences are related to know-how.

### Research Method

This report is the result of a longitudinal investigation, with a two-year journey, with a qualitative approach and based on a heuristic analysis, with a hermeneutical scheme and phenomenological nature, supported by grounded theory. The technique of semi-structured interviews with an instrument validated by three experts was also used. As tools we rely on an interview guide and audio recordings.

To apply the research instrument, a non-probabilistic intentional sampling was carried out. There were 7 interviews with managers, 8 with students, 8 ex-students and 7 teachers from the institution. In total, the interviewees totaled 30 people.

Reyes, Blanco and Chao (2014) point out that in qualitative research it is correct to establish an average of 4 or 5 semi-structured questions and in the same way the sample size may be small, considering enough 12 people to be interviewed, where important is the rigorous analysis and for this purpose we used the EMFIS Methodology, V-4.0 (Reyes and Hernández-Moncada, 2015).

### Results

The results of the qualitative analysis of the data revealed three types of educational needs related to innovation and entrepreneurship that are required in the Higher Technological Institute of Salvatierra, these were: 1 ° Development of attitudinal skills, 2nd generation of professional skills and 3 ° Support for the generation of innovation and entrepreneurship projects. These three types of educational needs are defined as dimensions, and it was determined that each dimension was composed of different number of categories. The dimensions and their respective categories are explained in the following sections.

### Attitudinal competences

In this dimension, six categories emerged that the interviewees described as important to develop an ITESS innovation and entrepreneurship program, namely: (1) To be self-aware, which means to recognize who it is, as well as to know its weaknesses and strengths. (2) Be sure that you express yourself as not being afraid to expose yourself socially or to failure, it is knowing that you can achieve your goals. (3) Be collaborative, that is, have the ability to work with other people in a harmonious way to achieve common goals. (4) Being sociable, we define it as the ability to relate to other people to weave networks of interaction. (5) Being creative refers to the ability to solve problems or create something in an original way. (6) To be resilient, which is the capacity of human beings to adapt positively to adverse situations. Subsequently, the interpretation and categorization of the information obtained was carried out.

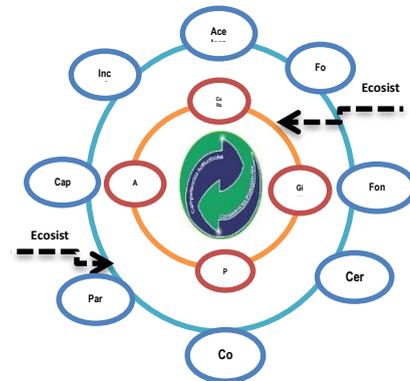
### Professional competences

For the second dimension, six categories emerged that the interviewees expressed as necessary to be able to develop professional competences related to innovation and entrepreneurship, these were: (1) Knowing innovation techniques. (2) Know how to generate models and business plans. (3) Know how to manage your network of professional contacts (Networking). (4) Have knowledge about property and intellectual capital. (5) Manage project management tools. (6) Know how to sell your ideas, that is, acquire technical skills on discourse management, sales and persuasion.

### Support for the generation of innovation and entrepreneurship projects

The third dimension consists of seven categories that are considered highly relevant to be able to generate innovation and entrepreneurship projects, which are: (1) Declaration and dissemination of institutional policies aimed at fostering innovation and entrepreneurship. (2) Create an academy or committee for innovation and entrepreneurship, this academy will generate strategies to promote these subjects. (3) Event management to inspire the community to innovate and undertake, these events can be conferences, workshops, seminars, congresses, contests, forums, etc. (4) Develop mentoring, that is, strengthen a link between mentor and mentee so that all projects can work together. (5) Participating in collaborative work among teachers, refers to generating strategies for teachers to work harmoniously with each other when a project of this nature is generated. (6) Promoting a culture of innovation and entrepreneurship throughout the institution, refers to propitiate an organizational communication so that this culture is developed in all the members of the organization. (7) Generate an electronic platform to disseminate the opportunities of the entrepreneurial ecosystem.

In this way, the theoretical construct obtained is represented in the following figure:



**Figura 1** Binding Educational Model (BEM) for the formation of Competencies in Innovation and Entrepreneurship of technology-based business projects. Source: self made

### Description of the Binding Educational Model (BEM)

The figure of the center expresses the development of attitudinal and professional competencies in students. The intermediate circle represents the ecosystem that should be promoted within the institution and is composed of the innovation and entrepreneurship academy, the entrepreneurial gym, the entrepreneurial culture, as well as the institutional policies related to these aspects.

The outer circle symbolizes the external ecosystem, which is made up of accelerators and business incubators, technology parks, fundraisers, access to training, competitions, forums, congresses and to Information and Communication Technologies (ICT), as well as coworking.

## Conclusions

Up to now, the educational programs used in ITESS focused mainly on the development of technical skills. The proposed model includes both the strengthening of professional skills and the attitudinal competencies of students, which promote individual reprogramming towards the creation of technology-based companies, consolidating patterns of conscious, creative, and collaborative thinking, basic aspects in the innovative enterprise. This in recognition of the fact that the student must interact and be nourished by innovation and entrepreneurship ecosystems, who have the mission of offering significant help to the participants.

Thus, with the work developed, the general objective formulated is fully complied with, that is, a specific proposal was generated on a Binding Educational Model (BEM) to develop the training of competencies in innovation and entrepreneurship of technology-based business projects by the ITESS students, through a heuristic analysis, with a hermeneutic scheme and phenomenological nature, supported by the grounded theory.

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## **Opinion of the fulfillment of fiscal obligations in the farmers**

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### **Abstract**

The tax authorities at the beginning of their training, have submitted a myriad of laws and regulations, where underlying obligations, which have to meet taxpayers depending on the regime that taxed, to these new dissipation, we have today present a new way of analyzing whether the taxpayer has complied with its obligations regardless of the regime are taxed. All taxpayers who pay tax under any regime, may request an opinion on compliance or 32-D. Compliance is a trade issued by the authority, Secretariat of finance and public credit, which consists of a general period of time report, informing the information not submitted, interim and annual taxpayer. In specific is going to present an analysis on farmers, where the regime that taxed is analyzed and which generates them, perform the procedure to the opinion on compliance. What is the or...?.

### **Tax, schemes, presentation of statements, management and informality**

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## Introduction

The 32 D or also called as "opinion to compliance", is a process that applies the tax authority, is to request the authority a report, of all the tax obligations that the taxpayer has to submit, existing of a period, of said taxpayer.

The 32 "D" is a fiscal state of the taxpayer in which it shows all the necessary information, of its current fiscal situation, in it the trade shows all the taxpayer's debts as monthly statements, informative declarations and annual declarations.

When a taxpayer wants to manage a procedure, loan to a private or government authority, or wishes to request a benefit or support, said stays request the taxpayer the 32 "D" format, in the same if he has fulfilled fiscally with the authority with its obligations, in this case to the Ministry of Finance and Public Credit.

In the event that a taxpayer has not complied with its obligations, it is informed that it has a certain period to regularize its fiscal situation, presenting what it has omitted, in a period.

Once the taxpayer has fulfilled its obligations, the Ministry of Finance and Public Credit in conjunction with the Tax Administration Service. Issues again an opinion where it comes out positive in favor of the taxpayer, indicating that it has fulfilled all its obligations and does not have pending with the tax authority, issuing an office.

The present investigation is developed with a taxpayer, is a farmer, and who is guided and supported, with accounting and tax orientation, for the application of the trade 32 "D" or Opinion to the Compliance of Fiscal Obligations, as social work for the benefit of the taxpayer.

## Theoretical framework

Part of the development of the present investigation, the concepts used in it were analyzed:

### Consulting

In its first study and analysis is:

The LXII Legislature of the honorable Congress of the Union, member of the Parliamentary Group of the Institutional Revolutionary Party, based on the provisions of articles 71, section II, of the Political Constitution of the United Mexican States; as well as 6, numeral 1, fraction I, 77 and 78 of the Regulation of the Chamber of Deputies of the Congress of the Union, submits to the consideration of this sovereignty, the present initiative with draft decree by which the article is reformed and added 32 D of the Fiscal Code of the Federation. (MEDINA, WWW.SAT.GOB.MX. 2017). Article 32-D of the Fiscal Code of the federation establishes the federal, centralized and parastatal public administration, together with the Attorney General's Office, in no case will they contract acquisitions, leases, services or public works with individuals, who are in charge of firm tax credits; that they have to their charge certain tax credits, firm or not, that are not paid or guaranteed in any of the ways allowed by this Code; and they are not registered in the Federal Taxpayers Registry; having expired the term to present some declaration, provisional or not, and with independence, in the same one, it turns out or not quantity to pay, this one has not been presented; or, for lack of compliance with the provisions of article 31-A of this Code in relation to submitting applications for federal registration of taxpayers, declarations, notices or reports, in digital documents with advanced electronic signature through the means, electronic formats and with the information indicated by the Tax Administration Service through general rules. (MEDINA, WWW.SAT.GOB.MX. 2017)

This legal provision of the tax code of the federation, seeks to prohibit taxpayers who are not up to date on their tax obligations, may be recipients or beneficiaries of contracts in the matter of acquisitions, leases, services or public works in charge of the dependencies and entities dependent on the federal government. To carry out the objective of these prohibitions, it is considered that the breach is not only fiscal obligations of a federal nature in tax matters, but also those obligations of a state and municipal nature and those corresponding to social security contributions. .

It also says, Article 32-D.

The Federal, Centralized and Parastatal Public Administration, as well as the Attorney General's Office, will in no case contract acquisitions, leases, services or public works with individuals that:

I. Have firm tax credits. II. Have in their charge certain tax credits, firm or not, that are not paid or guaranteed in any of the ways allowed by this Code. III. They are not registered in the Federal Taxpayers Registry. IV. Having expired the deadline to submit a statement, provisional or not, and regardless of whether or not it amounts to pay, it has not been submitted. The provisions of this section are not applicable in the case of omission in the presentation of statements that are exclusively informative. (RAMIREZ, 2015. The prohibition established in this article will not be applicable to individuals who are in the cases of fractions I and II of this article, provided that they enter into an agreement with the tax authorities in the terms established by this Code to cover installments, either as deferred payment or in installments, the tax debts that are in charge with the resources obtained by alienation, lease, services or public works that are intended to be contracted and that are not located in any other of the assumptions contained in this article.

For these purposes, the agreement will establish that the aforementioned agencies retain a part of the consideration to be informed to the federal treasury for the payment of the corresponding debts. The same obligation will have the federal entities when they perform these contracts with full or partial charge to federal funds. Individuals will be entitled to the granting of subsidies or incentives provided in the applicable laws, provided they are not located in the cases provided for in the sections of this article, except that in the case of fraction III, they are not required to register in the Federal Register of Taxpayers

The entities and dependencies that are responsible for the application of subsidies or incentives must refrain from applying them to persons who are located in the cases provided for in the sections of this article, except that in the case of section III, they are not required to register in the Federal Taxpayers Registry. Individuals who are entitled to the granting of subsidy or incentives and who are located in the cases of fractions I and II of this article, are not considered covered in these cases when they enter into an agreement with the tax authorities in the terms established by this Code for to cover in installments, either as deferred payment or in installments, the tax debts that are in their charge. When they are located in the cases of fractions III and IV, the individuals will have a term of fifteen days to correct their fiscal situation, from the day following that in which the authority notifies them of the irregularity detected. (RAMIREZ, 2015)

### **Argumentation**

With disposition in the article 32-D of the Fiscal Code of the federation it prohibits to the federal, centralized and parastatal public administration, also to the Attorney General of the Republic, to contract acquisitions, leases, services or public work to individuals that are not to the current fiscal obligations of a federal nature.

This prohibition is also extensive for states and municipalities with respect to contracting acquisitions, leases, services or public works to individuals who are not up to date with their fiscal obligations in federal matters.

On the other hand, many taxpayers, who are not aware of their fiscal obligations of character, such as payroll tax, property tax and additional taxes, are beneficiaries of contract awards in procurement, services and public works. , so it is considered convenient, necessary and appropriate to reform and add article 32-D of the Fiscal Code of the Federation in order to extend the prohibition, specifying the obligations must be accredited as fulfilled to be a candidate for the award of contracts in the matter of acquisitions, services or public works.

### **The Ministry of Finance and Public Credit Together with the Tax Administration Service**

Tells us.

#### **OPINION OF THE FULFILLMENT OF TAX OBLIGATIONS**

Tax Obligations Compliance Opinion: Online service through the SAT Portal and in its facilities, is an instrument through which taxpayers know their tax situation in accordance with article 32-D of the C.F.F. for purposes of contracting with the Federal Public Administration, to be a beneficiary of stimuli or any procedure that requires making subsidies or any procedure that requires to be performed.

To be able to issue the opinion of compliance in a positive sense, authority is necessary:

- That the taxpayer is registered in the RFC and that his password is active.
- That does not count firm fiscal credits.

- That he is aware of the fulfillment of all his fiscal obligations:

1. - Annual declarations of Income Tax and Multiple Informative Return, corresponding to the last four years, as well as IETU of the fiscal year 2013 only of that year in said case.
- 2.- Provisional ISR payments, withholding of income tax for salaries, final VAT and IEPS payments, DIOT for the year in which you request the opinion and in the last four years prior to this, as well as the provisional IETU payments corresponding to 2013, only that year in that case.
3. - Informative statements of IEPS referred to in rule 2.1.39, subsection a, numeral 2, second paragraph, of the Miscellaneous Fiscal Resolution for 2017.

#### **Justification**

Individuals and corporations that participate in bidding processes, and wish to be beneficiaries of stimuli and subsidies or go to carry out some fiscal procedure or obtain an authorization in the matter of taxes. It consists in requesting an official letter from the Tax Administration Service, and issuing an opinion on compliance with its tax obligations, as it is an indispensable requirement that farmers must meet, when they are located in the cases provided for in the fiscal ordinances. The Tax Administration Service issues an opinion on compliance in a positive sense or indicates the credits it has pending to its charge and / or declarations that it has to comply with; for this, the Tax Administration Service considers the situation of the taxpayer in the institutional electronic systems, checks that the consulted farmer is active and located in the RFC, that the farmer has presented the provisional payments of income tax, and withholdings for salaries, definitive payments of VAT and IEPS and the annual declaration, as well as if you have firm tax credits depending on the assumption, and that each farmer is in a different fiscal situation.

It is important to mention that the opinion of the fulfillment of tax obligations issued in a positive sense, towards the farmer, is valid for 30 calendar days from the date of issuance. In the last two decades, the policy of the primary sector corresponding to agriculture, livestock, fishing, forestry, apiculture and mining in Mexico has privileged farmers who represent no more than 10% of the total rural production units. 10% of rural production over 20 hectares receive 65% of the productive subsidies channeled by the federal government, while rural production with 5 hectares or less that represent 70% of rural production and contribute 40%. % of agricultural production and 60% of rural employment is national, they only receive 17% of the productive subsidies of special programs. Notwithstanding the above, it was assessed as an advance to various and different programs by the federal government, SAGARPA and SHCP, will have a program called S266, which will be applied for the fiscal year 2018, for all farmers in the country, this will clearly reflect the operation rules.

The S266 programs for 2018 represent an opportunity for the administration to change some subsidy policies for inequality and food dependency.

### Literary review

In rule of Operation of National Financial Support Programs for Agricultural, Rural, Forestry and Fishing Development to Access Credits and Promote Economic and Financial Integration for the Rural Development of the Country.

The National Agricultural, Rural, Forestry and Fisheries Development (formerly Financiera Rural), is a decentralized agency of the Federal Public Administration, sectorized in the Ministry of Finance and Public Credit, with legal personality and its own assets constituted in accordance with the Law Organic of the Rural Finance.

Published in the Official Gazette of the Federation on December 26, 2002 and amended by the Decree by which various provisions in financial matters are amended, added and repealed and the Law to Regulate Financial Groups is published in the Official Gazette of the Federal Government. the Federation on January 10, 2014, specifically to the Article Nineteenth where the name of the Organic Law of the Rural Finance is amended to become the "Organic Law of the National Agricultural, Rural, Forestry and Fisheries Development Financing", in whose article 1 is modified the name of the Entity to remain as it has been expressed at the beginning of this paragraph.

### Method

The present investigation is descriptive, not quantitative or experimental. It describes the process carried out by a taxpayer. An exploratory analytical research was carried out to have a broader vision of the situation in which it is administered, and it organizes fiscal-accounting. The form of taxation of a farmer is very different from any other natural person, since it has support from the federal government, which is located in the so-called administrative facility, consistent, in not presenting provisional information, nor the annual, is only required to report the total of their income received in the current year to the authority. You are only required to submit an information, called statement of information with third parties, which consists of presenting all the billed income received in a regular year, as long as your income has been greater than \$ 400,000.00 M.N. In the first exploratory study the qualitative method was used with the support of the observation technique, mainly the taxpayer, who has agricultural activity in a community of Salamanca, Gto.

Gathering useful information in the accounting and fiscal aspects, consists in keeping an accounting where all the sales of the seeds cultivated in different cultivation cycles are recorded, as well as recording all the expenses that it entails at the time of cultivation, mentioning also the expenses of the day laborers, and it is also an expense that involves the taxpayer.

### **Objective**

The object of the study is to know the causes involved that lead to farmers to obtain the form, making various approaches related to the problem they have in terms of compliance with their accounting and fiscal obligations, as well as identify the development of administrative activities.

### **Object of study**

The object of study, is, the taxpayer has agricultural activities in the community of Salamanca, Gto. The taxpayer is originally from the community of Salamanca, Gto. All his life he has lived there, he inherited the temporary farmland of his parents who in turn belonged to his grandparents, the man grows corn, sorghum, barley, all crops are seasonal, he has to wait for the season of time called Summer that is when it rains to do the cultivation of seeds and so on, wait for a temporary cycle to be able to carry out the cultivation of these seeds. Sometimes the farmer does a procedure to make an irrigation crop but this is very expensive. At the same time, analyze a procedure for the obtaining of some economic resource by some authority, federal, state or federal.

### **Instruments**

To obtain the information in this study, we took the case of a farmer who grows seasonal seed, and analyze the costs incurred in the growth of the seed, although you have in your favor the farmers that have administrative facilities before the authority, same that will be developed next.

A process was developed consisting of four parts, with the purpose of evaluating the administrative accounting process of the farmer, which consists of: organization, integration, development and application. Evaluating the same phases of the administrative process. The content of each instrument varies according to the assumption of the farmer to be evaluated:

a) For the Organization stage: it is aimed at organizing all the accounts of the entity, considering the revenues that are derived from the resources downloaded from government institutions in support of farmers, loans requested to financial institutions, and likewise from the sale of seeds generated from crop cycles, if any, or in the case of farmers, depending on their case. b) In the Integration stage: all incomes received in a regular accounting period are considered, the income received by the farmer. In this regime case, it is not necessary to keep a control per week and do not perform a concentrate per month, where all the information related to income is recorded, but if it is necessary to classify them, according to their type of origin derived from the activity, carried out as it is mentioned, and thus be registered, considering that it is not necessary to keep a diary book either. Since the farmer is with administrative facilities. c) In the Development stage: Once you have gone through the Organization and Integration stage, a table where it is displayed is developed in excel; considering only the income. For this purpose, another table is also developed where we record the expenditures that constitute them. d) In the last stage called application, is where we have the results thrown after having applied the corresponding procedure in accordance with the law, the calculation, for example you get the total income and expenses, in the case of expenditures are considered all the expenses generated for the cultivation of the seed or vegetable depending on the cycle.

Maintenance of facilities, purchase of articles or supplements, purchase of all types of fertilizers, payment of wages (day laborers or laborers) are the people who take care of the crop.

## Results

The development of the present investigation carried out. Practically it was developed in an existing administrative accounting process, to the taxpayer who carried his informal accounting where there was an incorrect procedure, there was no order in the incomes, expenses and diverse expenses and therefore a bad administration, planning, organization and control of the generated resources. As part of the study and analysis of the article, it is also to give support, social work in bringing accounting and tax to the farmer, also in the presentation of the multiple informative statement.

## Accounting information

The results obtained from the instrument that was applied, is obtained, from the consulted taxpayer, presents a formal accounting, in accordance with the existing provisions that govern our accounting system in our country, those disposed to the financial information standards.

## Final tax payments

At the same time, it involves submitting in due time and form your taxes corresponding to the periods to be declared, corresponding to the tax system that governs our country. For example, part of the accounting information is used as a sample, where it is based on keeping the accounts to a taxpayer. Thanking you for giving the information to the taxpayer.

## Accounting activity

The presentation of the accounting, among other things, is nothing more than the capture of the information collected during a regular and irregular accounting period due to its activity of the cultivation of seeds or vegetables

	ENERO-JUNIO	JULIO-DICIEMBRE
<b>INGRESOS</b>		
Apoyo de SAGARPA	\$ 50,000.00	\$ 50,000.00
Ventas de semillas	\$ 500,000.00	\$ 650,000.00
	\$ -	\$ -
	\$ -	\$ -
subtotal	\$ 550,000.00	\$ 700,000.00
IVA cobrado	\$ 1,120.00	\$ 1,040.00
Total	\$ 551,120.00	\$ 701,040.00
<b>EGRESOS</b>		
compra de semilla	\$ 1,500.00	\$ 1,500.00
pozo de agua	\$ 1,500.00	\$ 1,500.00
gago de jornaleros	\$ 4,500.00	\$ 4,500.00
gasolina	\$ 5,000.00	\$ 5,000.00
	\$ -	\$ -
	\$ -	\$ -
	\$ -	\$ -
Retenciones ISR honorarios	\$ -	\$ -
IVA retenido	\$ -	\$ -
IVA pagado mensual	\$ -	\$ -
	\$ 12,500.00	\$ 12,500.00
Total	\$ 538,620.00	\$ 688,540.00

Table 1 Accounting information

Information where a table shows a concentration of income, expenses and miscellaneous expenses, showing information with a better administration of the resources of a corresponding period.

trabajador	A
ingreso gravado	3800
(-) limite inferior	496.08
(=) excedente	3303.92
(*) % sobre excedente	0.06
(=) importe marginal	211.45
(+) cuota fija	9.52
(=) impto. determibado	220.97
(-) subsidio	382.46
(=) ISR a retener del mes	161.49
total neto a pagar	3961.49

Impuesto sobre nomina	
total de ing. pagados por sueldos y salarios	10.50
(-) total de ingresos x los que no se paga impuesto	0.00
(=) base	10.50
(*) tasa	0.02
(=) impuesto sobre nomina mensual	210.00 al mes

Table 2 Payments Salaries and Wages

There is a procedure for the calculation of the payment of an employee, in this supee is only informative, how should the calculation of the payment to a day laborer be done, the farmer is told how to keep the accounts but the farmer chooses to do analysis and later applylp. This information where an existing procedure for the payroll calculation is shown, where it can be applicable to each of the existing workers to the day laborer.

### Definitive payments of IRS

Based on articles 16 and 31 of the Organic Law of the Federal Public Administration; 33, section I, subsection g) of the Fiscal Code of the Federation; 14, section III of the Tax Administration Service Law; 8, first paragraph of the Internal Regulation of the Tax Administration Service; Ninth, sections XXIII and XLI of the Decree by which various provisions of the Law on Value Added Tax are amended, added and repealed; of the Law of the Special Tax on Production and Services; of the Federal Law of Rights, the Law on Income Tax is issued, and the Law on Corporate Tax at a Single Rate and the Law on Cash Deposits, published in the Official Gazette of the Federation, are repealed. December 2013 and 77 of the Regulation of the Law on Value Added Tax The farmer is exempt from filing income tax payments.

### Definitive VAT Payments

The farmer is exempt from filing income tax payments. You are only required to present an informative and it is annual called MULTIPLE INFORMATIONAL DECLARATION. It consists of presenting a list of all your clients to whom you gave a fan sale for the sale of seeds and for the total amount. There is a program called DIM, which is downloaded from the SAT page and there the customers are captured and with their sales made, then the information is encrypted to be valid by the SAT. Once fulfilled with the authority, the office can be issued, or pinion to the fulfillment of obligations.

### Accounting activity

#### Presentation of the DIOT

#### General information

#### Generate a new rfc of the Taxpayer

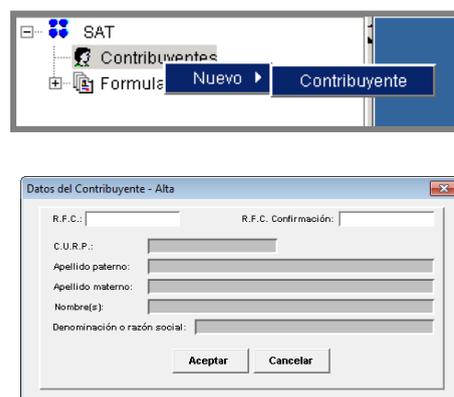


Figura 1

In the main window of the system, with the command "Taxpayer" is selected; the "New" option is chosen, and subsequent the "Taxpayer" instruction Subsequently, capture the general information of the Taxpayer. And finally select the "Accept" button. Once you send the encrypted and contained information of all the information in relation to VAT, you get the acknowledgment of receipt by the authorities.

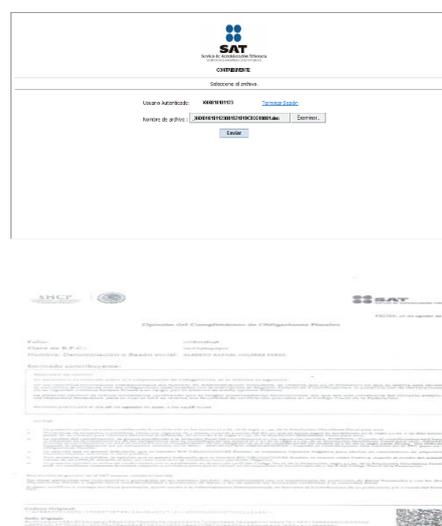


Figura 2

Obtaining the office 32-D, Opinion of the Compliance with Fiscal Obligations, can be observed in the office, it is a positive opinion, since it does not show in the same information pending to be presented by the taxpayer C. Alberto Rafael Aguirre Pérez. In the event that the 32-D, left negative, in the document would show the outstanding debts to be fulfilled, which would be bound by the taxpayer to comply. In this case the taxpayer can manage any type of procedure, with all types of dementias, governmental, state or municipal, to obtain any type of paperwork that may be; download your own resource in your favor, or request a loan. This accounting and tax information was given to the taxpayer free of charge, in gratitude for the information obtained, as social work for the development of this article.

## Discussion

According to the results of the research carried out to the farmers that in specific. The control of obligations can be analyzed, it is a process, where unpaid taxpayers are identified, omitted obligations and actions are determined to achieve compliance with the tax obligations of said taxpayer. Said processes, is to give a timely and timely follow-up to compliance, in the presentation of tax returns.

Obligations control monitoring considers:

1. An analysis is made of the list of obligated persons in the compliance structure, taxpayer with active periodic tax obligations and localized domiciles, registered in the RFC registry, according to the type of surveillance to be executed.
2. Taxpayers complied with and disregarded in the filing of their returns and / or payments of their periodic tax obligations are identified.
3. Separate taxpayers are separated according to the type of surveillance, considering the regime and type of periodic tax obligations and the contact channel through which the surveillance will be issued.

The fulfillment of fiscal obligations can be generated according to the farmer's fiscal situation in the following ways:

- Positive.- When the farmer is registered and up-to-date in complying with the obligations that are considered.
- Negative.-When the taxpayer is not up to date in complying with the obligations that are considered.
- Not registered.- When the taxpayer is not registered in the RFC.
- Registered without obligations.- When the taxpayer is registered in the RFC but has no tax obligations.

Based on sections XXIII and XLI of Article Ninth of the Decree by which various provisions of the Law on Value Added Tax are amended, added and repealed; of the Law of the Special Tax on Production and Services; of the Federal Law of Rights, the Law on Income Tax is issued, and the Law on Business Tax at a Single Rate, and the Law on Tax on Cash Deposits, published in the aforementioned Official body, on April 11, are repealed. December 2013, establish that the Tax Administration Service, through rules of a general nature, may grant administrative and verification facilities for compliance with tax obligations of primary sector taxpayers, it should be mentioned that farmers have administrative facilities. Same as facilitating the taxpayer not presenting information before the authority, but if the taxpayer receives more than \$ 400,000.00 per year, if he is obliged to submit the DIOT.

## Proposals

Part of the investigation, a proposal is made to the fiscal, state and municipal authorities, in order to facilitate harvests for farmers, it was possible to identify that sometimes the farmer lacks the knowledge to comply with the authorities in the fulfillment of obligations, we are ablendo of taxpayers who have approximately age for more than 70 years and sometimes women.

Without mentioning the existing requirements to comply with these obligations, derived from the investigation an invitation is made to the authorities, to be, more accessible with the requirements, an example, an 85-year-old person request an email and a memory, has to go to a stationery store, and sometimes does not have a family member to help them, it is unfair to behave like that with a person from that outpost. Only one procedure is mentioned, it is necessary to mention when you have to submit the DIOT. It is convenient that the authorities make a change in their protocol of attention, and they can make use of the technologies to be able to support these elderly people and it is necessary to mention those with disabilities that this is another issue. The situation raised in the present investigation; is that of all those farmers that are developed in this sector, they are considered areas of opportunity to design projects and strategies, that allow the support and growth of the same, that are carried out by the people who wanted and saw themselves in the need to deal with and better apply the accounting and fiscal provisions that are governed in our country by government agencies. Some of them can have a resounding success in our society and above all consider the impact they have on the livelihood of families in our society in a direct or indirect way in the realization of one or several activities proposed by the same companies. A basic and relevant factor that should be considered, these farmers, are enterprising people, whose attitude is very positive and honest without hesitation. Analyzing the results of the investigation, an attentive invitation is made to the federal, governmental and state tax authorities, be more accessible with the requirements since there are farmers by advanced age and do not have relatives for their support. And make a special treaty those taxpayers who are like intermediaries and pose as farmers,

From here, it is where we must leave to create support programs in government agencies, to strengthen a better tax culture.

## Conclusion

The purpose of this project was to provide an easy way to comply with tax obligations, as well as to address the simple way of presenting tax information, combined with this information it is necessary to develop the federal tax returns that still apply in our country according to the federal and government tax regulations,

It is important to mention that at the time of doing this investigation the C. Alberto Rafael Gutiérrez Pérez they did not count an accounting administration, they only received the income, from there the expenses were covered, when the farmer provided the accounting information, the existing procedures were applied according to the financial information norms and the fiscal dispositions, making a big difference in the administration of the resources of the farmer, how it was carried out previously and the way it is carried out today, and as a result it is shown that a better accountable organization, prepared to face the corresponding governmental dispositions and the new fiscal reforms in which we see ourselves exposed to contribute to the nation.

## Collaborators

C. Alberto Rafael Gutiérrez Pérez  
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## **Evaluation of production costs of biodiesel from jatropha curcas oil with two zirconia based catalysts**

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### **Abstract**

This paper presents the results of the cost evaluation for the production of biodiesel from jatropha curcas oil and methanol using heterogeneous types of zirconium base catalysts, in order to establish the most economically viable catalyst. The comparative tables of the production costs for both catalysts were made considering the capacity of recovery and reuse of the same catalysts as the operational costs considering a capacity of 2000L per lot on a batch process. Costs are for laboratory conditions (retail purchase). The basic catalyst ZrO<sub>2</sub>-Na is the best alternative to get 98% after using up to four cycles of the transformation process without losing its catalytic property, costing approximately \$2,601,872.24 which corresponds to a cost of \$1,300.94 per liter. By making the performance comparison by the catalyst considering its number of reusable cycles, the cost of biodiesel with the basic catalyst reduces up to 40% in the fourth cycle obtaining a total cost of production per liter of \$791.75.

**biodiesel, jatropha curcas oil, production cost, catalyst, zirconia**

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## Introduction

In this last century, the main environmental problem worldwide has been global warming with the large accumulation of pollutants and the excessive exploitation of the planet's natural resources. This has generated serious consequences such as the extinction of flora and fauna, terrible natural disasters, the evident perceived sensation of diverse climatic changes and contamination by crude or refined oil accidentally or deliberately generated. It is estimated that 3,800 million liters enter the oceans every year as a result of human activities, of these, only 8% is due to natural sources; at least 22% at intentional operational discharges from ships, 12% from ship spills and another 36% from wastewater discharges [1].

Therefore it is important to create awareness, replace the main sources of energy and proceed to a positive change in our excessive habits. The reason for the investigations to replace oil as the main energy resource is because the world reserves sooner or later will be exhausted [2]. Diesel or diesel, the main derivative of petroleum, is used as a domestic fuel and in diesel engines. An additional reason to replace diesel with biodiesel is that the latter does not contain sulfur, so it does not generate SO<sub>2</sub> (sulfur dioxide), a gas that contributes significantly to environmental pollution [3].

## Theoretical framework

In order to improve the competitiveness of biofuels, new technologies and raw materials capable of reducing the cost of the production process are investigated; so they call the attention seeds not suitable for human consumption as alternatives for obtaining oil [4].

The plant *Jatropha curcas* L. is a shrub resistant to drought belonging to the Euphorbiaceae family, its toxic characteristics and adaptation to arid lands, besides its low cost by not competing with food, make this an attractive raw material for production of biodiesel [4].

Biodiesel from *jatropha curcas* oil or other non-consumable plant oils has economic, as well as energetic and environmental advantages; generally it does not require major modifications for its use in common diesel engines, it allows the producer to become independent of the oil-producing countries. It has a great power of lubrication and minimizes the wear of the engine; reduction of polluting emissions of carbon monoxide (CO), hydrocarbons (HC), sulfur dioxide (SO<sub>2</sub>), polycyclic aromatic hydrocarbons (PAH), and particulate matter (PM), visible smoke particles; it is not considered a contaminant for surface water sources or underground aquifers, it is degraded 4 to 5 times faster than fossil diesel and can be used as a solvent to clean fossil diesel spills; generates positive effects for health, since it reduces carcinogenic compounds; in addition, global warming decreases through the reduction of CO<sub>2</sub> (carbon dioxide) in the environment [3-4].

The competitiveness of biodiesel depends on the costs of raw materials and the type of catalyst. Recent, various investigations evaluated the economic viability of the production of biodiesel with waste vegetable oil in a homogenous acid process, resulting in a low total manufacturing cost compared to alkaline transesterification with pure vegetable oil. In supercritical conditions (high pressure and temperature) the economic viability is very high due to the high cost of equipment when needing a reactor capable of withstanding high pressures.

Choosing between a homogeneous and heterogeneous catalysis is very important, since it affects the cost associated with the separation and purification method. With a homogeneous catalysis, the process requires an extensive separation process to remove the catalyst and purify the final product increasing costs of production; With a heterogeneous catalysis the separation process is reduced but often require high temperatures and / or long reaction times. A sensitivity analysis indicated that plant size and raw material are the most important parameters of the economic viability of biodiesel production [5].

### Methodology

This study includes the comparison between the catalysts  $ZrO_2-Na$  and  $ZrO_2-SO_4$  during the transesterification process with jatropha curcas oil and methanol. The precursors for the preparation of the catalysts are zirconium butoxide, tert-butyl alcohol, demineralized water for both catalators; Sulfuric acid for the acid catalyst and sodium hydroxide for the basic catalyst. The number of cycles to which the catalyst is subjected after recovery and reuse in the process was also considered.

The acid catalyst can be reused in the transesterification process about 3 times and in the case of a basic catalyst it achieves a total reuse of approximately 4 cycles.

In the production of biodiesel, the catalyst is mixed with the jatropha oil with methanol at a rate higher than 1200 rpm and  $75^\circ C$  at two hours of reaction [6-7]. The next step is to recover the catalyst by washing with hexane and ethanol, filter and put in the oven at  $120^\circ C$  for 1 hour [8-9].

### Cost analysis

According to the data presented by the company Petróleos Mexicanos (PEMEX), the average consumption of diesel in Mexico is 333 thousand barrels per day, equivalent to 53 million liters, of which in Tamaulipas, through the Storage and Distribution Terminal (TAR), indicates that this state is supplied with an average of 46 million liters-diesel [10]. Due to climate change, one of them has been chosen to make transformations in fuels, biodiesel because it is a source of clean, renewable, economically viable energy and contributes to the environment, which entails reducing environmental damage little by little. in this way improve the quality of life for future generations. The following analysis has been made in order to compare two types of biodiesel, one with acid catalyst and another with basic catalyst.

### Estimation of costs

#### Fixed costs

Costs have been considered for a laboratory process, for which an industrial agitation reactor with a 2000 L capacity has been taken as a base.

Considering shifts of 8 hours per day (hours allowed in a working day by Mexican laws), the cost of the personnel was calculated with three rotating daily shifts of 8h, working 3 days time required for the preparation of the catalysts and an initial batch with an engineer in charge and two operators per team for the production of biodiesel. Personnel costs are calculated based on the Secretary of Labor and Social Prevention considering the legal minimum wage in force in 2017 [11], for operating officer of \$ 105.77 pesos per shift and for an industrial engineer \$ 11,000.00 pesos per month including contributions legal for each one. Table 1 shows the total labor cost per initial batch.

Workforce	Salary per batch
2 operators	951.93
1 engineer	3,535.71
<b>Total</b>	<b>4,487.64</b>

**Table 1** Labor costs per initial batch of 2000 L of biodiesel

According to the tariff of CFE (National Commission of Electricity) 2017 [12] the price will be of \$ 195.03 pesos per kilowatt / hour, elaborating the energy calculations for the elaboration of a batch of biodiesel with a reactor with industrial agitator that generates 15.75 Kw7 per lot would have a total cost of \$ 3071.73 pesos per lot. For water consumption according to the Municipal Commission for Drinking Water and Sewerage of Altamira (COMAPA) [13], the industrial rate for a range of 0-20 m3 valid for 2017 will be \$ 427.09 pesos per month, considering to obtain the cost per lot the previous price, the approximate water cost will be \$ 42.70 pesos per lot.

### Cost of raw material

Using prices obtained by different suppliers at the laboratory level, for the production of biodiesel based on a reactor with a capacity of 2000 L, the following costs were obtained; In Table 2 are shown for biodiesel with basic catalyst and for biodiesel with acid catalyst shown in table 4.

Biodiesel with basic catalyst 2000 L			
Reagents	Amount per reagent (L)	Unit cost (\$ / L)	cost (\$)
Zirconium butoxide	294.81	2,604.00	767,694.10
Terbutyl Alcohol	925.93	609.00	563,888.89
DM water.	111.11	9.47	1,052.63
Sodium hydroxide (kg)	44.44	624.00	27,733.33
Methanol	2,242.78	190.25	426,688.47
Jatropha curcas oil	2,037.04	400.00	814,814.81
<b>Total cost for 2000L</b>			<b>2,601,872.24</b>

**Table 2** Raw material costs for a 2000 L biodiesel batch

Making a quick comparison of prices we could choose to choose the most economical, in this case biodiesel with basic catalyst (table 2) with a cost of \$ 2,601,872.24 pesos per lot, however, before opting to choose any of the above, a detailed comparison analysis taking into account that the catalyst can be recovered by a simple treatment and reused by means of the transesterification process obtaining in this way for the basic biodiesel a maximum yield of 4 times and in the case of acid biodiesel can be reused until 3 times its catalyst, because in both cases the catalyst is deactivated by poisoning by-products.

<b>Biodiesel with acid catalyst 2000 L</b>			
	<b>Amount per reagent (l / Lot)</b>	<b>Unit cost (\$ / L)</b>	<b>Cost (\$)</b>
<b>Zirconium butoxide</b>	303.24	2,604.00	789,628.22
<b>Terbutyl Alcohol</b>	952.38	609.00	580,000.00
<b>DM water.</b>	114.29	9.47	1,082.71
<b>Sulfuric acid</b>	19.05	770.00	14,666.67
<b>Methanol</b>	2,306.86	400.00	922,742.86
<b>Jatropha curcas oil</b>	2,095.24	190.25	398,619.05
	<b>Total cost for 2000L</b>		<b>2,706,739.50</b>

**Table 3** Raw material costs for a 2000 L batch of biodiesel with acid catalyst

Considering as batch 1 the capacity of 2000 L, table 5 shows the comparison of costs for basic biodiesel, maximizing up to 4 times the reuse of the catalyst with 8000 L, against the assumption that in order to obtain the same quantity it would have to add new catalyst for each batch.

<b>BASIC BIODIESEL</b>	<b>Cost</b>	
	<b>Batch 1 (2000L)</b>	<b>Batch 4 (8000L)</b>
<b>Without maximizing utility of the catalyst</b>	\$ 2,601,872.24	\$ 10,407,488.96
<b>Maximizing catalyst utility 4 times</b>	\$ 2,601,872.24	\$ 6,326,360.00
<b>Cost per liter of biodiesel</b>	<b>\$ 1,300.94</b>	<b>\$ 790.80</b>

**Table 4** Cost comparison maximizing the performance of the basic catalyst up to 4 times (8000 L)

Table 4 shows that the higher the amount per initial batch, the cost per liter of biodiesel is decreasing because only for the first batch generates the cost of the catalyst because it is used 4 times more, in this case having a reactor with a capacity of 2000 L with a cost of \$ 2,601,872.24 pesos per lot (lot 1), and using the same catalyst on four occasions generates a total yield for 8000 L at a cost of \$ 6,326,360.00 pesos per lot (lot 4), thus obtaining the decrease in the cost of biodiesel basic from \$ 1300.94 to \$ 790.80 pesos per liter generating 39% less of the total cost for 4 lots.

In the same way, for biodiesel with acid catalyst the comparison has been made in the yield of its catalyst (acid) up to 3 times with the same quantity of 2000 L, consequently the maximum yield of the obtained catalyst will be 6000 L.

In the table 5 you get the cost of acid biodiesel with the maximum yield of the catalyst 3 times from \$ 1,353.37 to \$ 1,082.21 pesos per liter of biodiesel reducing up to 20% of the total cost.

<b>BIODIESEL ACID</b>	<b>Costo</b>	
	<b>Batch 1 (2000 L)</b>	<b>Batch 3 (6000 L)</b>
<b>Without maximizing utility of the catalyst</b>	\$ 2,706,739.50	\$ 8,120,218.49
<b>Maximizing catalyst utility 3 times</b>	\$ 2,706,739.50	\$ 6,493,276.83
<b>Total cost per liter of biodiesel</b>	<b>\$ 1,353.37</b>	<b>\$ 1,082.21</b>

**Table 5** Cost comparison maximizing the performance of the acid catalyst up to 3 times (6000 L)

Analyzing tables 4 and 5 it can be concluded that it will be better to use the basic catalyst, because with its higher yield (4 times) we can reduce the cost of biodiesel to almost 40%, therefore to a greater amount of the first batch greater is the decrease in the cost per liter of biodiesel which generates greater utility ensuring the feasibility of biodiesel.

### Total cost of production per batch

In order to obtain the costs per lot, the fixed costs, labor and cost per lot have been considered because this research was elaborated at the laboratory level. Table 6 shows the total costs for the production of biodiesel with basic catalyst, obtaining a production cost per liter of \$ 791.75 pesos per liter.

Costs per batch (8000 L)	Biodiesel básico
Raw material	\$ 6,326,360.00
Fixed costs	\$ 3,114.38
Workforce	\$ 4,487.64
Total cost of the lot	\$ 6,333,962.02
Production cost 1L	\$ <b>791.75</b>

**Table 6** Cost of production per liter for biodiesel with basic catalyst

In the same way table 8 has been generated where the production costs of biodiesel with acid catalyst are broken down.

Costs per batch (6000 L)	Biodiesel ácido
Raw material	\$ 6,493,276.83
Fixed costs	\$ 3,114.38
Workforce	\$ 4,487.64
Total cost of the lot	\$ 6,500,878.85
Production cost 1L	\$ <b>1,083.48</b>

**Table 7** Production cost per liter for biodiesel with acid catalyst

Analyzing tables 6 and 7, it can be seen that the biodiesel with the highest production cost will be that of the acid catalyst with a production cost of \$ 1,083.48 pesos per liter, so the most economically viable would be to produce biodiesel with a basic catalyst with a total production cost of 791.75 pesos per liter.

### Results

As can be seen in this analysis of production costs of biodiesel with two types of zirconia base catalysts, one basic and one acid, in the costs of raw material per batch of 2000 L (2 and 3) the biodiesel with acid catalyst is more expensive with total cost of \$ 2,706,739.50 per lot. On the contrary, the most economical is the basic catalyst with a total cost of \$ 2,601,872.24 per lot. However, considering the tables of cost comparison with the maximum reuse of the catalysts (4 and 5), it is obtained that the biodiesel of basic catalyst generates a cost of \$ 790.80 pesos per liter due to the reuse of its catalyst on 4 occasions.

Acid catalyst biodiesel generates a cost per liter of \$ 1,082.21 pesos since its maximum reuse is 3 times. Therefore, the comparison analysis of costs per batch or per liter generated in the tables (2-5) confirms that the best option to make biodiesel is with a basic catalyst because it generates less costs, generating costs of Total production approximate to \$ 791.75 pesos per liter.

### Conclusions

Undoubtedly, climate change has forced us to create awareness about what we are doing to our planet and for this reason we seek to generate new energy sources trying to reduce the ecological damage that traditional fuels have caused. Biodiesel has emerged as a good alternative for the replacement of diesel.

In this article focused on the comparison of costs of biodiesel based on jatropha curcas oil with two types of catalysts, one acid and one basic, which results in biodiesel with basic catalyst is the most affordable option due to its high reuse decreasing thus the costs for its production. As future work, its viability will have to be analyzed for implementation at an industrial level, through a cost-benefit study, looking to consider the base oil biodiesel of jatropha curcas with heterogeneous basic catalyst as an alternative to conventional diesel

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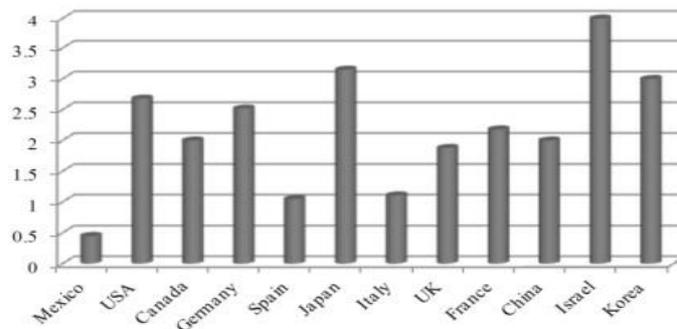
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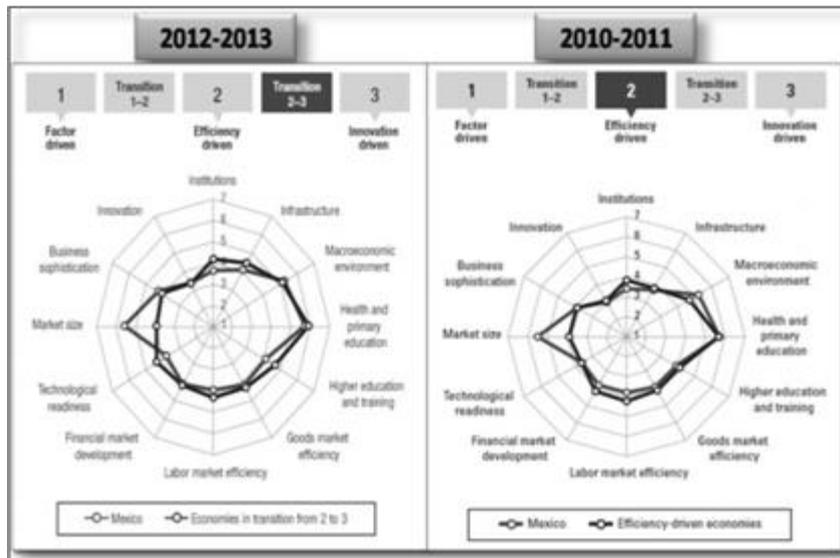
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