Mini-Report 2015
Industrial Outreach Program in Mexico (IOPM); 19 years…!

West Virginia University
Council for Science and Technology of the State of Queretaro

Participating Universities:
- University of Nevada Reno
- Autonomous University of Queretaro
- Technological Institute of Queretaro
- Aeronautic University in Queretaro
- Technological University of Queretaro
- Technological Institute of San Juan del Rio
- Technological University of San Juan del Rio
- Polytechnic University of Santa Rosa de Jauregui

Participating Industries in Queretaro::
- BROSE – Automotive equipment
- Case New Holland – Agricultural machinery

Participating Technology Development Centers:
- CENAM – Metrology Center
- CIDEC-ConduMex – Wire and cable technology
- CIDEC-Delphi – Automotive electronics
- MABE- Appliances – Electro domestic appliances
- CIDESI-Technology Development Research Center

Bridging the gap between Mexico and the USA in academia and industry

Engineering is a global profession that plays a prominent role in a technologically-driven global market. Common technological products; from commodities, to processed materials and finished products are the result of global collaborations between groups of professionals with different backgrounds and disciplines, for whom national borders and distances are no longer restrictive while cultures and languages are more relevant than ever. In this context, West Virginia University, the University of Nevada-Reno and seven Mexican universities have just concluded the 19th year edition of the Industrial Outreach Program in Mexico during June and July of 2015. A total of 22 students from 9 different universities participated in an intense eight-week industrial internship, with a full professional and cultural immersion in Queretaro. Diverse groups of students worked full time in industry on meaningful projects under the guidance of industrial practitioners and under the advice of faculty members from WVU and Mexico. Prior to the summer activity, selected Mexican students spent the spring semester at West Virginia University providing a strong cultural bridge between academia and industry in Mexico and the USA. The focus is on global competencies, experiential learning and professional competitiveness of students.

Time to play ball WVU-UNR vs "Las Catrinas de Queretaro"

Join us in Mexico 2016…… !!

First the News: Queretaro Governor Jose Calzada received the visit of the IOPM group

Governor Jose Calzada met with the outstanding students who spent the spring semester of 2015 at West Virginia University and at Purdue University. The Rectors of UAQ. UNAQ. ITQ. UTEQ and UTSJR were present during this visit.

An agreement between WVU and CONCyTEQ signed in 2012, allows the 8 best students from Queretaro to spend the spring semester at WVU, prior to their participation in the summer program in industry. These students go through a very rigorous mathematics course organized by CONCyTEQ with the top 8 performers (of a group of 40 students from various institutions) are given this study abroad opportunity. For the past three years these students have come to WVU with the expectation of performing at the top of their classes. The results have been impressive with 5 students from Queretaro reaching the "President's List" for "perfect" grade average (4.0/4.0). These students then team up with WVU students in Mexico to conduct the industrial projects. The quality of the work done by these and WVU students has been felt both at WVU and in Queretaro.

Governor Jose Calzada Rovirosa is presented with WVU's Mascot, "The Mountaineer" and a report of the last six years of the IOPM.

Governor Jose Calzada, has taken the time each year to personally greet and recognize the outstanding students who have spent the semester abroad, to acknowledge, encourage and remind them of their commitment to pursue higher levels of excellence in their profession and to engage in life-long learning and civic engagement.

Double Master's Degree Program between WVU, UNAQ and CONCyTEQ

Dr. David Stewart (WVU VP for Global Affairs), Dr. Fernando de la Isla (Secretary of Education Qro.), Ing. Jorge Gutierrez de Velasco (President UNAQ) and Ing. Angel Ramirez (Director CONCyTEQ) in the agreement signing ceremony at UNAQ.

West Virginia University and the Aeronautic University in Queretaro (one of the key participating institutions in the IOPM) have signed an agreement creating the first "Double-Master's Degree Program in Aerospace Engineering" for both States.

Under this Program, selected Mexican students will be eligible get two master's degrees: one from WVU with emphasis on aerospace system performance and a second degree from UNAQ with an emphasis on manufacturing. This Program involves distance learning courses and collaborative research while students spend the first year at UNAQ and the second year at WVU.

Tour of WVU Delegation and USA Embassy representatives through the facilities at UNAQ

The Industrial Outreach Program in Mexico has produced synergy amongst several participating institutions. One specific outcome is this double degree agreement, which is consistent with the intent of the "*100K-Strong in the Americas"* Initiative in which WVU and UAQ recently participated. Additional double-degree programs are expected in subsequent years with other Queretaro institutions. The signature ceremony was presided by Ing. Jorge Gutierrez de Velasco, President of UNAQ; Dr. David Stewart, WVU VP for Global Affairs; Dr. Fernando de la Isla Herrera, Secretary of Education of the State of Queretaro and Ing. Angel Ramirez Vazquez, Director of the Council for Science and Technology of Queretaro. Ms. Araceli Partearroyo and Ms. Rebecca Thompson, Cultural Attaches from the USA Embassy in Mexico; Mr. Michael Wilheim, WVU Director of International Students and Scholars and Dr. Victor H. Mucino Professor of Mechanical and Aerospace Engineering were also present.

IOPM Program Introduction

After nineteen years of operation, the Industrial Outreach Program in Mexico (IOPM) has produced an educational model that allows engineering students, practitioners and faculty members to team up to produce a simple but effective "win-win" relationship with three basic objectives:

1. Add value of engineering education for students.
2. Bring value to industry through student projects.
3. Bridge the gap between practitioners and professors.

The focus of the Program is in the development of Global Competencies, through experiential learning, while practicing engineering abilities and honing interpersonal skills. These competencies include:

1. The ability of working effectively with people of different background and cultures.
2. The ability to communicate effectively (assertively and respectfully) with peers despite language and cultural barriers.
3. The ability to adapt and develop sensibility while working in a different cultural environment.
4. The ability to identify and resolve cultural issues that may affect professional work.

Students participating in this Program at WVU are eligible to obtain the certificate described next.

Certificate of Global Competency

This certificate requires the fulfillment of the following three requirements:

1. Culture and Language requirement. 9 cr/hr of GEC Coursework dealing with Hispanic culture and Spanish language.
2. International experiential learning. 6 cr/hr of activity such as the activity described in this Program (other similar programs are available).
3. Social Service component. 1 cr/hr of structured volunteer engineering work with a social engagement component.

Accommodations and logistics

USA students are housed with local families, who have been thoroughly screened and provide safe, clean, healthy and friendly environment. These families are located within walking distance from each other in such a way that all the visiting students have their own support network within reach at any time.

A faculty advisor from WVU is within reach on location 24/7 providing coordination of logistics and supervision of all activities pertaining to the program; starting with technical engineering advice as well as transportation, housing, weekend plans and any other unforeseen situation.

Typical day of work

Every day at 7:30 in the morning, all the visiting students congregate outside a designated house for the "*buenos dias muchachos*" chat… The WVU faculty advisor and the local coordinator meet all the students along with the designated drivers to have a 10-15 minute chat prior to transportation to the workplace. While simple and casual, this is an important activity that allows the coordinators to check on several aspects which include; wellbeing of all the students, issues that may come up with housing, roommates, fellow team members, projects, industrial associates etc. Typically everything is fine; otherwise the coordinators address the issues that come up at once. The chat is followed by transportation to the workplace between 8:00 and 8:30 am and the day begins at work.

The faculty advisor and other local faculty members visit the various teams in industry twice during the week to make sure projects are moving forward and issues are being addressed and resolved. Student teams are provided with cafeteria service at each company along with all other employees.

At the end of the day, transportation is provided to bring the students back to their home, where dinner awaits. Housing typically provides room and board in addition to basic cleaning and looundry service.

In the evenings students have time to relax a little or to pursue social activities including exercise (in the park nearby), or cultural activities in Queretaro. Several days a week a "Spanish Table" takes place while the Mexican students seek to socialize with the visiting students.

Friday Sessions and Reporting

Every Friday afternoon, all the students (visiting and local) gather at a designated conference room to conduct a "round-robin" project report presentation given to the rest of the group. Each team is asked to make a 10 minute presentation of their progress in "Spanglish;" USA students do their presentation in Spanish while Mexican students do it in English. On Monday mornings, all students are expected to produce a one page executive summary of the work done during the week and to be done the week ahead. These presentations build up during the eight weeks until the final presentation day given to managers and engineers of the company.

Friday round-robin "progress-report" presentation session

The emphasis is on effective written/oral communication and planning skills. At the end of the eight weeks all teams also produce a final written report, a final presentation document and a poster to be shown during the closing event of the Program.

Typical day at home and social scene

In the evenings, some students opt to go to the gym or go out for a jog in the neighborhood. After dinner, around 7:00 pm students have opportunities to socialize with Mexican students, on occasion participating in sports activities like soccer, softball etc.

At least six of the eight weekends are scheduled with cultural sightseeing field trips; Teotihuacan Pyramids, Pena de Bernal, San Miguel Allende, Freixenet vineyards and Guanajuato City are typical sites for weekend leisure. Queretaro City also offers plenty of cultural events during the summer, for example "Iberica Contemporanea" (Spanish Flamenco Festival), Montreal Jazz Festival in Queretaro and of course, the amazing "Gallos Blancos de Queretaro" (the local professional soccer club). These are typical attractions.

"Iberica Contemporanea" Festival, Queretaro, July 2015

Finally Queretaro City offers excellent opportunities for very fine and reasonable cuisine and a family friendly ambiance, with street cafes, art galleries, shopping boutiques. Yet, students manage time to make sure their projects progress according to schedule.

Students after a "Gallos Blancos" soccer game

FCLT360 Course: Cultures of Mexico by UAQ

The State University of Queretaro (UAQ) offeres a course on Mexican Cultures equivalent to WVU "FCLT360-Cultures of Mexico" with 3 cr. This course taugh in Queretaro included a 3 hr. session every Saturday morning followed by guided visits to museums, archeological sites, markets, villages and cities with cultural various cultural events. Visits to Pena de Bernal, Guanajuato City, Teotihuacan Pyramids, Tequisquiapan and Queretaro city monuments, churches, museums and cultural events provide an excellent oportunity to showcase, taste, feel and see first-hand the richness of various aspects of Mexican Culture.

Students were immersed in the Mexican culture by living with a local family, working with Mexican students and engineers in industry, by participating in popular cultural events in Queretaro including festivals and social events, as well participation in focus groups on cutural and social aspects of the Mexican culture. Essays and on-site assignments provided an opportunity to engage students in a cultural experience beyond the reach of a classroom setting. This course taught by instructors from UAQ provide yet another dimension of value in this Program.

Visit to Penha de Bernal on a Saturday Excursion

Description of Sample Projects of the 2015 cycle

This year (2015) a group of 22 students from the USA and Mexico worked on seven industrial sites at MABE, CIDEC-ConduMex, CIDEC-Delphi, CNH, CENAM, BROSE and CIDESI. Students engaged with engineers from each company and contributed to the solution or design and analysis of a variety of mechanical and industrial systems.

By teaming up with Mexican students, visiting students experience a full cultural immersion that is reciprocated to the Mexican students when they spend the spring semester abroad. The mix of professional environment with a different culture provides a framework that brings an added dimension to the engineering experience. Students learn and fine-tune their technical skills while they hone their communication and interpersonal skills.

At the end of the eight-week exercise each team makes a final professional presentation of the sponsor in the opposite language. This is a character-building exercise that brings the cultures and personalities to the forefront of the projects and provides a multi-cultural professional experience. The eight different projects are described next.

Team 1. Brose: "Data Collection System: FTQ in Real Time"

The main objective of this project was to develop and implement a production control system to facilitate the automatic recording of First-Time Quality (FTQ) data to allow for that data to be consulted in real time. This system was established in the form of software developed using Visual Studio forms and SQL Server databases, creating a user-friendly platform where the data is displayed both numerically and graphically. From any computer in the Brose network, engineers can use the program to access real-time FTQ data, as well as historical data, provided that the information is available from the desired time period.

The Brose team, gathering information from a work line for use in the FTQ monitoring program

While it was initially intended to be implemented in only one production line, the program was written to be dynamic and to be capable of running with any line in any area within the Brose plant. As it stands, the program is running with three different lines, but only requires the proper input from one line to the database to begin expanding to other production lines. The result is not only time savings but scrap reduction during production.

Team 3. Cidec-Delphi: ¨Hardware Tools for SW Integration Testing¨

The project objective was to develop tools to efficiently and precisely shorten the amount of time used to test radios, and radio related equipment in automotive applications. More specifically, the original goal was to simply design a schematic for one of the available modules to help in very specific areas of testing.

CIDEC-Delphi team designing the modular layouts

A modular digital input monitor, an analog input monitor, a module for digital high speed USB multiplexor, a module for ASWC (Analog Steering Wheel Control) electronic simulator were integrated. The team produced schematics for all desired modules and various final casing layouts to be used in future testing operations by the company.

Team 2. CIDESI: Preliminary Design of "San Pedro Martir" Telescope

The objective of this project was to develop a preliminary design configuration and the corresponding mathematical model of a large optical telescope in order to describe the mechanics for design development purposes. The model incorporates the wind effects and the torque requirements in the azimuth and elevation actuators.

CIDESI Team developing design models for the Telescope of San Pedro Martir, Baja California.

The the optical elements are assumed to be rigidly mounted to the structure. The Lagrange equations of motion were used to develop the mathematical model and simulations were conducted in MATLAB, with static and dynamic wind effects.

The team used a similar telescope (Large Synoptic Survey Telescope) to verify the functionality of the basic mathematical model. The simulation produced results that will be used to help the design of the San Pedro Martir Telescope in Baja California currently under development at CIDESI.

Team 4. MABE: Automatic water dispenser for a low-end refrigerator

In this project the objective was to design and implement a pumping system that will allow to dispense cold and hot water and to make ice automatically for a low-end refrigerator. In order to do this the team constructed the hardware and software for the prototype. The hardware consists of the hydraulic network, human interface, and electronic system components. These components have been fully integrated into a Sirius 360 model refrigerator. In order to control all of these elements, the team developed the software based on Arduino programming (C language).

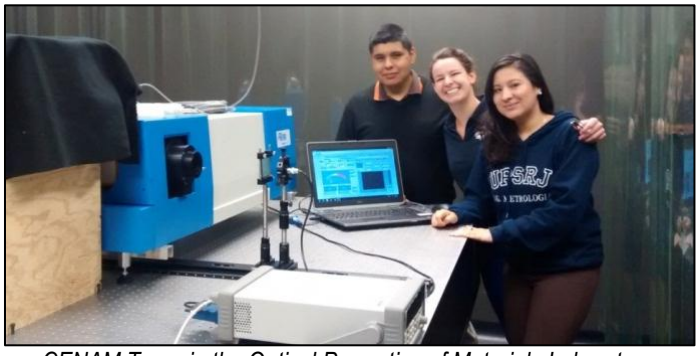
MABE Team and the water dispenser for a low-end refrigerator prototype

In addition, a data logger acquisition program was created to allow the company to monitor critical variables as well as the interaction between the customer and refrigerator. Bill of materials, design diagram of connections hardware and software guide were provided at the end of the project for a working original prototype.

Team 5. CENAM: Basic Design and Development of a Spectrometric Measurement System

This project established the basis of a reference measuring system of optic spectroscopy, by performing the installation of the basic components of the system and developing the control software for its initial operation.

The system was created to emulate the functions of a spectrophotometer, which is used to measure magnitudes such as absorbance and transmittance (the amount of light that can pass through an object).



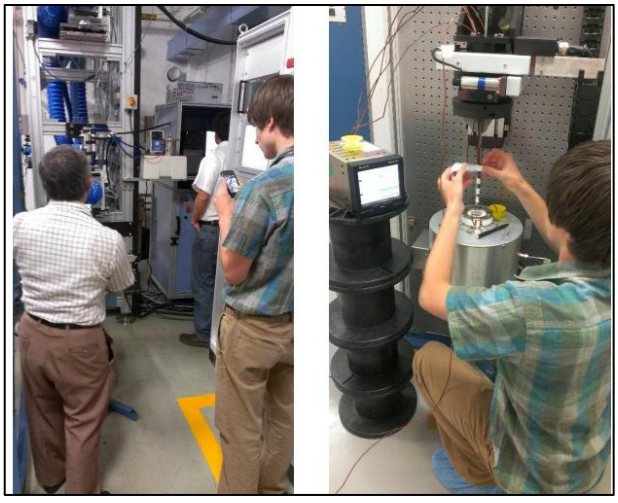
CENAM Team in the Optical Properties of Materials Laboratory, conducting a spectrometric test with the reference blue crystal.

In order to perform the measurements for the spectrometric system, the CENAM team worked in a specially designed dark room inside of the Optical Properties of Materials Laboratory. The system is composed of a light source, a monochromator and a detector. Once the light source enters the system, the monochromator selects a very narrow region of the light spectrum and directs it towards the sample. Then, the detector measures the incoming light and sends the data to a computer by utilizing a DAQ as a bridge to the control software. The user operates the system with an application coded in LabVIEW Development Environment.

The system produces a similar response to a commercially produced spectrophotometer. This system will eventually replace the national primary standard as the most accurate instrument of spectrometric measurement in México.

Team 6. CIDEC-CONDUMEX: Numerical and Experimental Analysis of the Optical Fiber Drawing Process

The objective of this project was to develop a model and a program to simulate the polymer drawing process and redesign the furnace to produce it. The team was asked to replicate a specific published work following the procedure described.

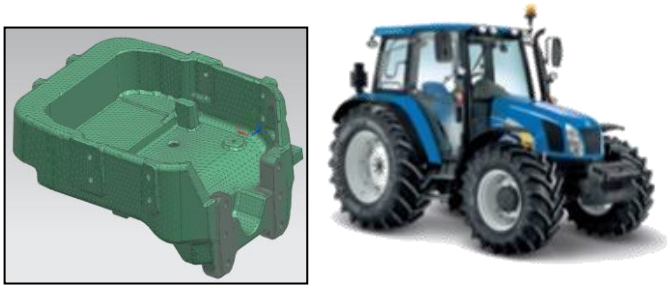


Team conducting experiments of the optic fiber drawing process

The model and simulation were to be verified experimentally in order to improve the process currently available. A model of the furnace was also developed to simulate the heat transfer phenomena in the process and determine the temperature profile of the preform of the polymer cylinder. Various recommendations for a new furnace were made to reduce the time needed to manufacture the fibers and to create more stable conditions inside the heated furnace.

Team 7. Case-New Holland: Design analysis and improvements of the Frontal End Support of a Tractor

As a part of a major economic improvement project, several tractor models in their two wheel and four wheel drive versions had a change in the design of the engine. This change requires several peripheral parts to be redesigned. The frontal end support is one of them.



Model of the front end support of a CNH agricultural tractor

By applying critical design loads on a two wheel drive frontal support, a model and analysis was conducted to predict potential failures. A finite element model and analysis were developed to verify laboratory loading cases and then for critical loading cases.

Several potential improvements to the current design were identified for a more reliable performance and for manufacturing ease.

FCLT360 Course: Cultures of Mexico by UAQ

The State University opf Queretaro (UAQ) offered a course on Mexican Cultures equivalent to WVU FCLT360-Cultures of Mexico with 3 cr. This course taugh in Queretaro included a 4 hr. session every Saturday morning followed by guided visits to museums, archeological sites, markets, villages and cities with cultural features.

Visits to Pena de Bernal, Guanajuato City, Teotihuacan Pyramids, Tequisquiapan and Queretaro city monuments, churches, museums and cultural events provided an excellent oportunity to showcase, taste, feel and see first-hand the richness of various aspects of Mexican Culture.

Students engaged with the Mexican culture by living with a local family, working with Mexican students and engineers in industry, by participating in popular cultural events in Queretaro including festivals and social events, as well participation in focus groups on cutural and social aspects of the Mexican culture.

Group at Teotihuacan Pyramids

Essays and on-site assignments provided an opportunity to immerse students in a cultural experience beyond the reach in a classroom setting. This course, taught by instructors from UAQ provides yet another dimension of value in this Program which enables students to become eligible to obtain WVU Certificate of Global Competency mentioned above.

Cultural highlights

This year, a group of Mexican students joined WVU and UNR students in a series of field trips to museums, parks, villages and sites which provided ample opportunities for students to socialize and gain a better understanding of each other's culture.

Group visiting colonial San Miguel de Allende and Mexico City

At the Museum of Anthropology in Mexico City

Panoramic view of Guanajuato City

Replica of a Mayan Temple at the National Museum of Anthropology

Closing of the Program at the Poster Session Finale

Escapade to Cancun at the end of the program

Acknowledgements:
The companies that made this program possible this year are: MABE, CASE-NEW-HOLLAND, CIDEQ-Delphi, CIDEC-ConduMex, CIDESI, BROSE, CENAM and Gupo SSC of San Miguel de Allende. The coordinators of the IOPM Program are greatful to all these companies and their personnel, for the opportunity of real engineering projects given to students.

The student teams:
This year, twentytwo students participated in seven intermixed teams in seven industrial sites. The teams are listed below.

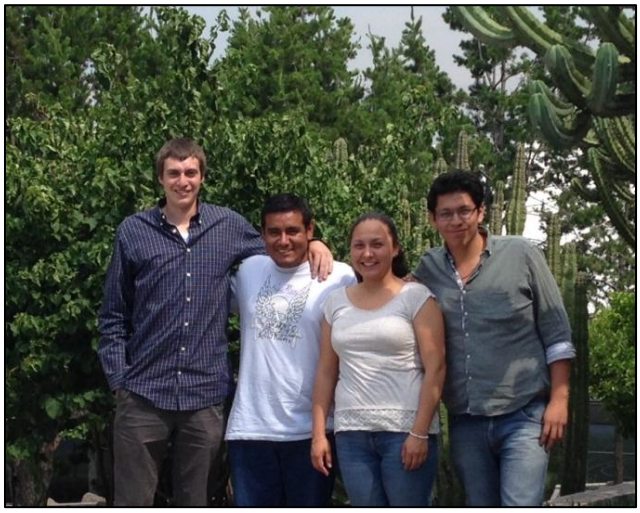
Team Case-New Holland: Chikeluba Enoka (WVU), Willebaldo Mendez Salcedo (UPSRJ) and Jose Pablo Lopez Aguado (UNAQ)

Team CIDEC-ConduMex:, Alberto Fabian Espinosa Naranjo (UAQ), Julio Cesar Gachuzo Elias (ITQ) and Luke William Doud (WVU)

Team MABE; Juan Carlos Munoz Sanchez (UAQ), Stuart Doss (WVU), and Edmundo Salgado Martinez (ITQ)

Team CENAM: Eduardo Pecina Gonzalez (ITQ), Alexis Robertson (UNR) and Yamilka Jocelyn Munoz Macias (UPSRJ)

Team BROSE: Rodrigo Olguin Hernandez (UTSJR), Jesus Alejandro Lopez Garces (UNAQ) and Matthew Golub (WVU)



Team CIDESI: Brian Flowers (WVU), Daniel Garcia Gonzalez (UTEQ), Roxana Ramirez Perez (UNAQ) and Luis E. Nieves Alvarez (UTEQ)

Team CIDEC-Delphi: Joseph T. Kotula (WVU), Ariel Sanchez Padilla (UAQ) and Sofia Ponce Vela (UTSJR)

Ing. Angel Ramirez, (CONCyTEQ), Dr. Victor Mucino (WVU) with recognition plaque after 19 years of the Program, and Dr. Fernando de la Isla Herrera (Secretary of Education of Queretaro).

The magnificent view of "The Sun Pyramid in Teotihuacan"

Institutions Involved	Student Participants	Faculty from both countries	Industrial Liaisons	Industries/Research Centers	Projects developed
Local Institutions: • CONCyTEQ • University of Guanajuato • University of Queretaro (UAQ) • Institute of Technology of Queretaro (ITQ) • Tech. University of San Juan del; Rio. • ITESM (Tec. De Monterrey) • CICATA (IPN) • Aeronautical University in Queretaro (UNAQ) • Polytechnical Univ. of Queretaro (UPQ) • UNAM • Tech. Inst. Of San Juan del RIo • Technological University of Qro (UTEQ) • Universidad Politecnica de Santa Rosa de Jauregui **International Institutions:** • West Virginia University • Clemson University USA • Universidad De Roma Tor Vergata, Italy • University of Nevada Reno	158 (WVU) 10 (UG) 71 (UAQ) 62 (ITQ) 31 (ITESM) 7 (CICATA) 9 (UTEQ) 6 (UPQ) 22 (Clemson) 6 (UTSJR) 6 (ITSJR) 7 (UNAQ) 1 (UNR) 2 (UPSRJ)	9 (WVU) 2 (UG) 5 (UAQ) 6 (ITQ) 4 (ITESM) 2 (CICATA) 2 (UTEQ) 1 (UPQ) 2 (Clemson 2 (UTSJR) 2 (ITSJR) 2 (UNAQ) 1 (UPSRJ)	(2) GM (Gto) (4) TREMEC (Qro) (2) Transm-TSP (Qro) (1) Micro-Troq. (Qro) (3) IMT (Qro) (2) LAPEM (Gto) (2) I. Turbo Reactores (1) Terramite (WV) (3) KOSA (4) Case- New Holland (3) InMec (8) CENAM (2) ANSYS Mexico (1) Irving de Mexico (1) Crown Mexico (10) Mabe-GE Appliances (2) CIDEC-ConduMex (2) Arvin-Meritor (2) Gabriel (5) CIAT-GE Aircraft E. (3) VRK (Automotive) (2) CIATEQ (2) Bombardier (2) Messier Services (3) Brose (3) CIDEC-Delphi (2) CIDESI	GM TREMEC Transmisiones-TSP Micro-Troquelados IMT* LAPEM* ITR (TurboReactores) Terramite Corp.** KOSA New Holland InMec CENAM* Group SSC (ANSYS) Irving- Composites Crown Mexico MABE CIDEC-ConduMex CIDEC-Delphi Arvin Meritor Gabriel CIAT-GE Aircraft E. VRK Automotive CIATEQ*(B. Quintana) Bombardier Messier Services CIDEC-Delphi BROSE CIDESI * Research Centers ** From West Virginia	(1) GM Mexico (13) TREMEC (4) SPICER-TSP (1) Micro-Troq. (5) IMT (2) LAPEM (2) I. TurboReactores (1) TerramiteCorp.** (3) KOSA (9) Case-New Holland (1) InMec (11) CENAM (1) Irving (1) Crown (8) CIAT-GE (17) CIDEC-ConduMex (21) Mabe (2) Arvin Meritor (2) Gabriel (6) VRK Automotive (6) CIATEQ (2) Messier Serv. (4) Bombardier (2) CIDEC-Delphi (2) Brose (1) CIDESI ** From West Virginia
17 Institutions	**399 Students**	**40 Faculty**	**77 Liaisons**	**28 Companies**	**128 Projects**

Nineteen year summary table for the Industrial Outreach Program in Mexico

Join us in Queretaro, Summer 2016!