

Mini-Report 2014 Industrial Outreach Program in Mexico



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

Participating Universities:

- Autonomous University of Queretaro
- Technological Institute of Queretaro
- Aeronautic University in Queretaro
- Polytechnic University of Queretaro
- Technological University of Queretaro
- Technological Institute of San Juan del Rio
- Technological University of San Juan del Rio
- University of Rome Tor Vergata, Italy

Participating Industries in Queretaro::

- BROSE – Automotive equipment
- Case New Holland – Agricultural machinery
- TREMEC – Automotive transmissions

Participating Technology Development Centers:

- CENAM – Metrology Center
- CIDEC-ConduMex – Wire and cable technology
- CIDEC-Delphi – Automotive electronics
- MABE- Appliances – Electro domestic appliances



Bridging the Gap between Academia and Industry in Mexico and the USA



Students visiting the Teotihuacan Pyramids in Mexico

West Virginia University, the University of Rome Tor-Vergata and seven Mexican universities conducted the 18th year edition of the Industrial Outreach Program in Mexico in June and July of 2014. A total of 25 students from 5 different countries participated in an intense eight-week industrial internship, with a full professional and cultural immersion in Queretaro. Intermixed 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 experience, 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 and of course, the outmost competitiveness of our graduates.....!!

Join us in Mexico 2015.....!

Program Introduction

After eighteen 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, 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 a **Certificate of Global Competency**, by fulfilling the three requirements listed below:

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 social engagement work with a professional student society chapter, such as EWB, SAE, ASME, etc.

News: 100K-Strong in the Americas Assessment Grant

Under the 100K-Strong in the Americas Initiative, the IOPM received a Grant aimed at the assessment of the impact of this program. This is an on-going effort directed at conducting an external formal evaluation of the program, to determine the viability and feasibility of expansion and replication of this program model in other disciplines and venues. The assessment consists in a series of surveys, interviews and focus groups with various constituents to produce a summary of recommendations to be used to strengthen the organization, structure, support and impact of this program on all participants from industry and academia. Next year a brief description of the outcomes of this assessment will be made in the Mini-Report of next cycle. An most important aspect is the participation in the 100K-Strong in the Americas initiative, which will further consolidate the ties between USA and Mexico in education, academia and industry.

For the assessment activity, external reviewers were invited from Mexico, Argentina, as well as from the University of Nevada Reno and West Virginia, in addition to practitioners from industry in Queretaro. Several university presidents from Mexico and government officials also participated in the assessment activity and provided useful and insightful observations. Dr. Gonzalo Macias of UAQ is leading this effort.



Focus Group in Industry- MABE (above) and with the Secretary of Education (below), as part of the IOPM Assessment under the Grant of the 100K-Strong in the Americas Initiative.

News: University of Rome Tor Vergata (URTV) joins the Program

A recent sabbatical visit in the spring semester of 2014 by Dr. Victor H. Mucino to the University of Rome Tor Vergata in Italy resulted in a new institution Joining the IOPM Program. Two Italian students; Antonio Loquercio and Davide Brambilla from URTV joined the program and participated in two different projects teaming up with students from West Virginia University and students from seven other institutions in Mexico.



Agreement between the University of Rome Tor Vergata and the Council for Science and Technology of the State of Queretaro, July 14, 2014.

In a brief ceremony with the Secretary of Education of the State of Queretaro, Dr. Fernando de la Isla Herrera and the Director of the Council for Science and Technology of the State of

Queretaro, Ing. Angel Ramirez Vazquez, the agreement between the two universities was signed in the presence of the two Italian students.

It is believed that the addition of a European University to the Program will certainly add value to the multi-cultural dimension and will further expand opportunities to students in Mexico, Italy and the USA.

News: Program description gets ASME Best Paper Award

A paper published in the ASME (American Society of Mechanical Engineers) Conference and Exhibit in Houston Texas, which described the IOPM Program with emphasis on how to bridge the gap between the cultures of academia and industry was recently honored with the Process Industries Division "Best Paper Award". The paper was presented in the 2012 Conference in Houston and in the fall of 2013, the announcement was made about the award. The title of the paper is "Bridging academia and industry gap, through global competencies: Industrial Outreach Program in Mexico," ASME Paper IMECE2012-86444.



ASME 2013 Best Paper Award to a paper describing the IOPM

Back to the Program: 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 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. 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 raised and resolved. Student teams are provided with cafeteria service at each company along with all other employees.



"Buenos dias muchachos" morning session prior to transportation to the workplace

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 cleaning service.



Students building a prototype of a design in industry

In the evenings students have time to relax a little or to pursue other activities including exercise (in the park nearby), or social 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.

These presentations build up during the eight weeks until the final presentation day given to managers and engineers of the company. In addition to this form of audiovisual reporting, every Monday morning students are required to submit a one-page “executive summary” of their work, where they describe what they have done and what is to be done next.



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

The typical day starts with a home-made breakfast prior to the morning “buenos dias muchachos” chat at 7:30. Students are transported to their industrial sites and around 5:30 pm, students are brought back to their home where dinner is served by the host families. Some students opt to go to the gym or go out for a jog in the neighborhood. After dinner, around 8:00 students have the option to socialize (many times with Mexican students who find time to share with US students). Fridays typically ends up with a friendly soccer game at local institution facility.

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 Queretaro’s “Gallos Blancos” (the local professional soccer club) games are typical attractions.



Students enjoying the hospitality of a local family in Queretaro

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

FCLT360 Course: Cultures of Mexico by UAQ

The State University of Queretaro (UAQ) offered a course on Mexican Cultures equivalent to WVU FCLT360-Cultures of Mexico with 3 cr. This course taught in Queretaro included a 3 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 opportunity to showcase, taste, feel and see first-hand the richness of various aspects of Mexican Culture.



Students visiting Pena de Bernal during a weekend fieldtrip

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 cultural and social aspects of the Mexican culture. Essays and on-site assignments provided an opportunity to immerse 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.

Description of Sample Projects of the 2014 cycle

This year (2014) a group of 25 students from the USA and Mexico worked on seven industrial sites at MABE, CIDECONduMex, CIDECONDelphi, CNH, CENAM, BOSE and TREMEC. Students engaged with engineers from each company and contributed to the solution or design and analysis of a variety of mechanical and industrial systems.

Seven Mexican Universities teamed up with WVU; University of Queretaro (UAQ), the Technological Institute of Queretaro (ITQ), the Aeronautical University in Queretaro (UNAQ), the Technological University of Qro. (UTEQ), the Technological Institute of San Juan del Rio (ITSJR), the Polytechnic University of Queretaro (UPQ), the Technological University of San Juan del Rio (TUSJR) and the new addition; University of Rome Tor Vergata of Italy.

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. Meanwhile US students live with local families who provide a home away from home, for a rich and total cultural immersion. The eight different projects are described next.

Team 1. CENAM: Brake friction torsional and flexural vibrations

This project involved the coupling of the flexural off-plane vibrations produced by braking torsional forces applied during the braking of a disk at the critical speeds. The vibration resonances produce noises that are detrimental to the operation of automotive and industrial brakes. While the coupled non-linear vibration phenomenon is well known, improved experimental and analytical methods are needed for calibration purposes and as a tool for efficient designs for automotive and industrial applications. The team worked in the vibrations laboratory of CENAM and used a laser vibrometer measuring system as well as a Fast Fourier Transform data acquisition system and also used ANSYS to simulate the actual braking disk dynamics and the resonance conditions.



CENAM Team in the vibration laboratory conducting tests and modeling the brake disk for flexural and torsional vibrations

The CENAM student team used two experimental methods as well as analytical-numerical methods to validate models, which will be used as tools in the design of improved performance automotive and industrial breaks.

Team 2. CIDECONDelphi: GSM-Enabled Multiclient Assessment

This project called "GEMA, was directed at reducing the amount of time spent testing Bluetooth-enabled car stereo (infotainment) systems by the creation of a system that uses a GSM-enabled development board to send pre-programmed test SMS messages and phone calls, instead of manually performing tests from another cell phone. Implemented as a software library (DLL file), GEMA can be integrated into Delphi's existing automation workflows.

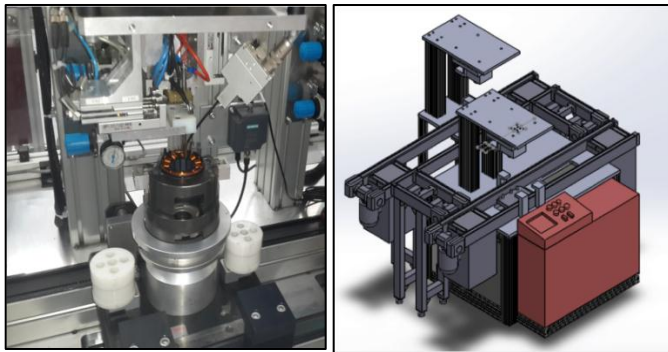


Infotainment system with camera for message verification and GEMA Structure

The objectives were to create the client and server as a software library compatible with National Instrument's TestStand sequencing software to allow engineers to automatically perform tests, in order to make the testing proces more efficient and reliable.

Team 3. BROSE Feeding pallets optimization in EOL

The purpose of this project was to modify and optimize aprocess for the configuration of the production line of the stators to increase productivity and eliminate possible delays; such as bottlenecks, dual cycle of the testers and line stoppages for maintenance. This involved a close look at the equipment and process set up in order to identify potential improvements to the process or the equipment. The result was a new configuration of the equipment with added features to improve the process and to eliminate the possibility of bottle necks in their production.

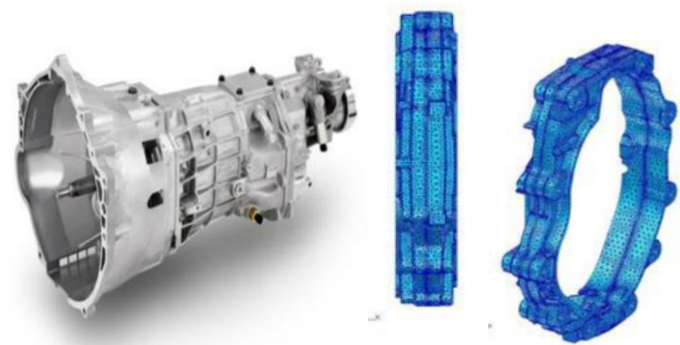


Stator production line with improved equipment configuration model.

The team delivered equipment improvement plans with prototype tests to verify operation and effectiveness of proposed solution.

Team 4. TREMEC: Bolted flangees in transmissions

This project was directed at developing models for the analysis of bolted joints in automotive applications to assess the sealing effectiveness and to develop a tool for making design enhancements in the design of bolted flanges in automotive transmissions. Parametric finite element models and experimental methods were used to determine the contact pressure of the sealing flanges under different bolting conditions, and parametric table were developed as tools to be used in the design and evaluation of new models.

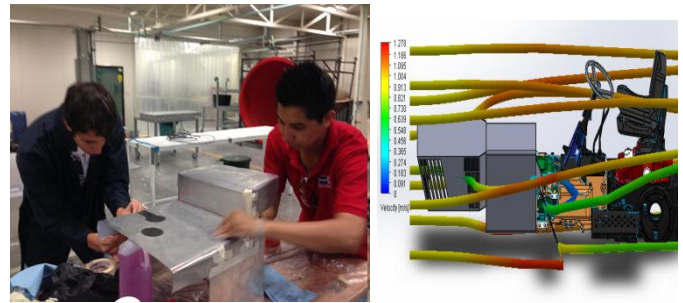


Automotive transmission finite element models of the flange

The Student group conducted various experimental tests to verify the finite elements models, including pressure distribution and bolt tightening torque relaxation to provide confidence in the models and design charts produced.

Team 5: CNH: Heat release of the drivetrain in a tractor

In this project, the objective was to design a protective device to reduce the level of heat exposure to the operator of an existing agricultural tractor, without affecting the cost or the functionality of the tractor. Several alternatives were considered and compared in effectiveness to produce a prototype, to address the issues brought to the team. Heat transfer modeling and analysis, as well as air flow analyses were conducted to evaluate the alternative designs proposed. Alternate options were evaluated

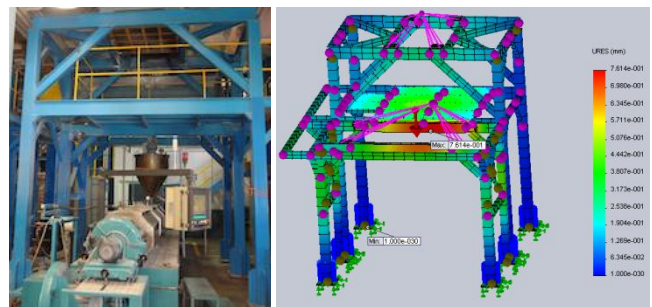


Prototype model of a heat diffuser for the agricultural tractor

The team produced a prototype of a diffuser design and the corresponding improvements in the levels of heat exposure to the operator. The prototype was built at one of the participating universities' facilities. Cost, manufacturability and performance effectiveness were showcased at the end of the project.

Team 6. CIDEQ-ConduMex: structure resonance

The objective of this project was to determine the cause of a resonance condition in the structure of an industrial turbo mixer used in the manufacturing process of cables and wires. The structure supports several rotating components which produce excessive vibrations. Structural analysis and redesign were conducted considering the excitation sources including the turbo-mixer and the cooler fan and associated transmissions. Experimental measurements in-situ were conducted and used to verify the models. Proposed structural improvements were modeled and selectively chosen to reduce the levels of vibration to improve the process.



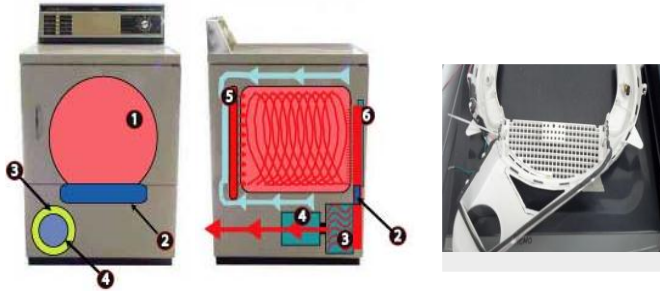
Industrial turbomixer and cooler of an extrusion processwith

While the structure is currently in operation, the structure modification will allow the turbo mixer operate a higher speeds making the process more efficient.

Team 7 MABE: Self-cleaning lint filter for dryers

This project posed the challenge of developing innovative ways to remove the lint accumulated in the filters used in domestic clothes dryers. The presence of lint in dryers reduces the efficiency of the dryer, increasing the demand of energy in the drying process. A "self-cleaning" system to remove the lint in the dryer was further constrained to maintain the cost of the dryer at a minimum, not changing the overall size of the dryer, and to not obstruct or affect other components in the dryer, specifically the

exhaust fan and motor. Several alternatives were considered, to remove the lint from the filter and various concepts were developed and tested for evaluation purposes. The best alternative was showcased to the company

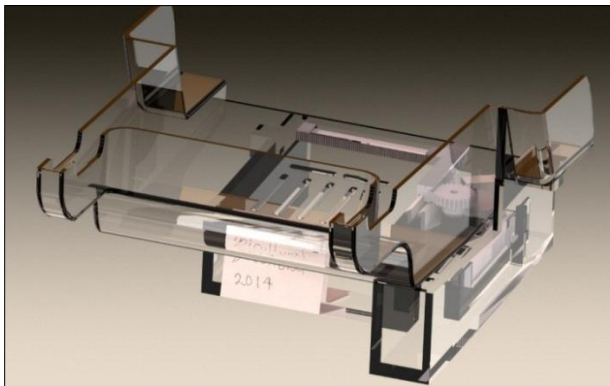


Dryer configuration for self-cleaning lint filter with prototype

Team 8 MABE: Damper actuated by muscle wires

One of the more important parts of a fridge is the damper which is a gate that allows the cool air coming from the freezer to move to the fresh food compartment depending on the desired temperature. The objective of the project was to design an automatic damper actuated by muscle wires instead of stepper motors. These muscle wires are capable of change their length depending on the temperature.

A prototype model was proposed that works on the principle of operation of a ballpoint pen mechanism. When the muscle wire is heated and reaches a determinate activation temperature it produces a little displacement, just 4% of its total length. When current flows through the first muscle wire, it is heated and it produces a small displacement which opens the damper through a series of gears and racks. The prototype was built and tested to satisfaction.



Refrigerator damper model actuated by muscle wires

FCLT360 Course: Cultures of Mexico by UAQ

The State University of Queretaro (UAQ) offered a course on Mexican Cultures equivalent to WVU FCLT360-Cultures of Mexico with 3 cr. This course taught 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 opportunity 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 cultural and social aspects of the Mexican culture. 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 and Italian students joined WVU 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 Guanajuato City over a weekend



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, CIDECONduMex, TREMEC, BROSE and CENAM. The coordinators of the IOPM Program are grateful to all these companies and their personnel, for the opportunity of real engineering projects given to students.

The student teams:

This year, twentyfive students participated in eight intermixed teams in seven industrial sites. The teams are listed below.



Team MABE1: Gabriel, Carlos Lua Morales, Gabriel Ramirez Zarazua and Julian Pastor Che Noh



Team BROSE: Mario Ivan Rodriguez Delgado, Wilfred Nakhoubanh Coulibaly and Carlos Fajardo Tovar



Team CENAM: Angel Ivan Gonzalez Garcia, Mauricio Alvarado Roa, Lisbeth Hernandez Leon, Antonio Loquercio and Roberto Aaron Pacheco Ugalde



Team TREMEC: Odette Camacho Montano, Sara Cicely Miguel Martinez, and Mofetoluwa Fagbemi



Team CIDECONDUMEX: Gustavo Buenrostro, Temitope Agboola and Jair Bautista Romero



Team CNH: Davide Brambilla, Santiago Z. Aguillon Salazar and Eduardo Daniel Bravo Solis



Team CIDECONDUMEX: Alan Torres-Kulik, Emma Leal Correa and Adan Radames Ramirez



Team MABE 2: Carlos Daniel Pizano Gomez and Jose Trejo Guzman

Sightseeing over weekends



Dramatic view of "Peña de Bernal," Queretaro



"Plaza de Armas" at the heart of Queretaro City



Visiting the "Castillo de Chapultepec" in Mexico City



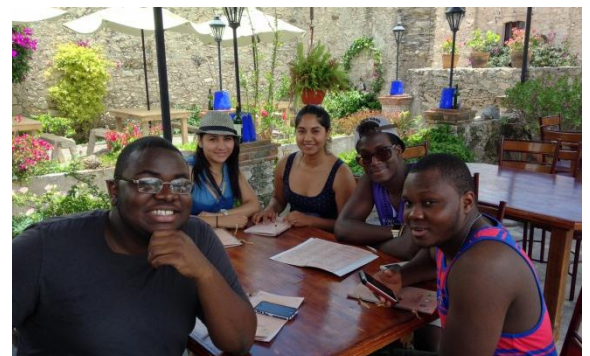
At the "Independence Monument" in Mexico City



At the top of a pyramid in Teotihuacan



Ready for a "Friday Reporting Session" at Queretaro Tech.



Looking at the menu (and texting) at "El Mezquite" in Bernal



Final Presentation day at BROSE: Attended by representatives of West Virginia University, University of Nevada-Reno, University of Cordoba Argentina, University of Queretaro, Polytechnic University of Queretaro and representatives of the Council for Science and Technology of Queretaro, in the picture with engineers from BROSE.

| Institutions Involved | Student Participants | Faculty from both countries | Industrial Liaisons | Industries/Research Centers | Projects developed |
|---|---|--|--|---|--|
| <ul style="list-style-type: none"> • West Virginia University • University of Guanajuato • University of Queretaro (UAQ) • Institute of Technology of Queretaro (ITQ) • CONCYTEQ • ITESM (Tec. De Monterrey) • CICATA (IPN) • Aeronautical University in Queretaro (UNAQ) • Polytechnical Univ. of Queretaro (UPQ) • UNAM • Clemson University USA • Tech. Inst. Of San Juan del Rlo • Technological University of Qro (UTEQ) • Tech. University of San Juan del; Rio. • Universidad De Roma Tor Vergata | 152 (WVU) 10 (UG) 68 (UAQ) 60 (ITQ) 31 (ITESM) 7 (CICATA) 8 (UTEQ) 6 (UPQ) 22 (Clemson) 4 (UTSJR) 5 (ITSJR) 4 (UNAQ) | 8 (WVU) 2 (UG) 5 (UAQ) 6 (ITQ) 4 (ITESM) 2 (CICATA) 2 (UTEQ) 1 (UPQ) 2 (Clemson) 2 (UTSJR) 2 (ITSJR) | (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 (3) Case- New Holland (3) InMec (6) CENAM (2) ANSYS Mexico (1) Irving de Mexico (1) Crown Mexico (8) 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 (2) Brose (2) CIDEC-Delphi | 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 Arvin Meritor Gabriel CIAT-GE Aircraft E. VRK Automotive CIATEQ*(B. Quintana) Bombardier Messier Services CIDEC-Delphi BROSE * 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 (8) Case-New Holland (1) InMec (10) CENAM (1) Irving (1) Crown (8) CIAT-GE (15) CIDEC-ConduMex (20) Mabe (2) Arvin Meritor (2) Gabriel (6) VRK Automotive (6) CIATEQ (2) Messier Serv. (4) Bombardier (1) CIDEC-Delphi (1) Brose ** From West Virginia |
| 15 Institutions | 353 Students | 34 Faculty | 68 Liaisons | 26 Companies | 120 Projects |

Eighteen year summary table for the Industrial Outreach Program in Mexico

Join us in Queretaro, Summer 2015!