



















Statler College of Engineering and Mineral Resources

INDUSTRIAL OUTREACH PROGRAM IN MEXICO

Mini-Report 2016 20 years delivering results and Competitive Graduates...!!

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



The IOPM (Industrial Outreach Program in Mexico) is a unique international program, which combines the traits of study abroad, industrial internship and experiential learning with a full professional immersion, and self-discovery through a full cultural immersion.

This is also a program that bridges the gap between academia, industry and government, and between the cultures of Mexico and the USA with a focus on professional competitiveness...!

Participating Institutions, 2016

Host Mexican Agency:

 Consejo de Ciencia y Tecnologia del Estado de Queretaro (CONCyTEQ)

USA Institutions:

- West Virginia University (WVU), Lead Institution
- Universidad de Nevada Reno (UNR), Guest Institution

Mexican Institutions:

- Autonomous University of Queretaro (UAQ)
- Technology Institute of Queretaro (ITQ)
- Aeronautic University in Queretaro (UNAQ)
- Technological University of Queretaro (UTEQ)
- Technological Institute of San Juan del Rio (ITSJR)
- Technological University of San Juan del Rio (UTSJR)
- Technological University of Santa Rosa de Jauregui (**UTSRJ**)
- Polytechnic University of Queretaro (UPQ)

Industrial Sites, 2016

Industrial Technology Development Centers:

- CIDEC ConduMex Wire and cables R&D
- CIDEC Delphi Automotive electronics R&D
- MABE Domestic Appliances R&D Center

National Technology Development Centers:

- CIDESI Industrial National R&D Center
- CIATEQ Technology National R&D Center
- CENAM Metrology Center, R&D Standards Tech.

Industries in Queretaro:

- BROSE Automotive implements
- CASE NEW HOLLAND Agricultural machinery
- SAFRAN MESSIER SERVICES Landing gear systems



A Fiat Group Company

Technik für Automobile

Welcome by the Lead Institutions





Ing. Angel Ramirez Vazquez, Director of CONCyTEQ welcomes WVU students to participate in the Industrial Outreach Program in Mexico, also known as "Programa Bicultural de Alcance Industrial." CONCyTEQ is committed to promote and support the Program and to coordinate the participation of universities, industries and research centers in Queretaro. CONCyTEQ also supports and coordinates the selection of students who will spend the spring semester at WVU.

Dr. Victor H. Mucino is a Professor of Mechanical and Aerospace Engineering at WVU. He is also the director and founder of the IOPM at WVU. He leads the day-to-day operations of the Program in Queretaro, acting as advisor and supervisor of all students and projects and provides the overall stewardship of the Program.

Program Description and Activities



Senior students in good standing in the Statler College of Engineering and Mineral Resources at WVU have the opportunity to participate in the Industrial Outreach Program in Mexico (IOPM) during the summer of each year (June and July), to earn a total of 9 credits (described below) toward their BS degree requirements. This program is open to students in various areas of engineering in which practical projects in industry can be established; typically, mechanical, aerospace, electrical, civil, and industrial engineering.

In this program, students are teamed up with

Mexican students from local universities and conduct meaningful engineering projects in industrial sites, where they work full time for 8 weeks, under the supervision of practicing industrial engineers. Faculty members from the USA and Mexico provide further guidance and oversight to all student teams and projects.

Practical engineering problems from well-established companies in Mexico are presented to each team, with specific objectives and technical deliverables to be attained during the 8 week duration (June and July) of the program. Students are required to report on a weekly basis and produce a final report and a presentation, which are delivered to the company at the conclusion of the 8 weeks. A poster session is conducted for all participants at the closing of the program, which is open to the public.

Objectives Program

- **1.** To add value to student's education through international experiential learning.
- 2. To solve meaningful engineering problems of value to industry.
- 3. To bridge the gap between academia and industry in the USA and Mexico.



Housing and Logistics of Program

Students are placed in home-stay with local families in a well-established residential area of Queretaro

(Col. Alamos 2a. Sec.) The families provide safe, healthy, comfortable and friendly family environment for the students, who are in close proximity to each other all the time. Homes are conveniently located near shopping areas, recreational parks, convenience stores, and just a few minutes from the colonial downtown area of Queretaro. Room and board includes meals and cleaning service for the duration of the stay.

Students are also provided with daily transportation to and from their home to the workplace (typically a 15 to 30 minute commute) using vehicles provided by the host institution. CONCyTEQ, and a local university, UNAQ. A typical weekday starts at 7:30 outside their homes in order to be at the industrial site by 8:00 am. The return commute starts at 5:00 pm. On Saturdays a culture class is offered by





the University of Queretaro followed by a field trip to parks, museums, towns and villages nearby.

Mexican Students at WVU in the Spring 2016



Just like in the previous four years, a selected group of Mexican students from the 3 major universities in Queretaro (UAQ, ITQ and UNAQ) spent the spring semester of 2016 at WVU, conducting a one semester study-abroad. These students carried a full academic load of 4 regular courses of the Junior/Senior Year (3rd/4th year) plus the involvement in an undergraduate research student project. Students were highly motivated to deliver top performance in all their classes and were encouraged to contribute significantly to each

research project they were assigned. This cohort of Mexican students traveled back to Mexico to join the group of 9 students from WVU and UNR, who participated in the summer program in Queretaro. Ten additional students from local universities joined the summer activity producing 10 intermixed teams, who worked on 9 industrial sites. The 10 projects are briefly described next.

Project Descriptions, IOPM Spring 2016



1. Team CIDEC-ConduMex. This project involved the use of three technologies for the predictive maintenance of machinery used in the fabrication of wire and cables at different factories of

ConduMex. The student team looked into the applicability of ultrasound, thermography and vibrations instrumentation in order to identify potential failures on the machinery



and to establish the trends and likelihood of failures, in order to produce a preventive maintenance schedule for the company.

2. Team CIDESI. This team was involved in the early design and analysis of the structure of an optical telescope to be built and mounted in the San Pedro el Martir location in Baja California.



Design, analysis and construction of this telescope has been assigned to CIDESI and the student team was involved in the modeling of the telescope structure to predict bearing loads and displacements as well as the vibratory response of the



structure and mirror under gravitational and dynamic wind loads. The student team assisted CIDESI engineers in integrating models produced by the University of Arizona into CIDESI's model.



3. Team BROSE. The project assigned to this team was aimed at the design and fabrication of retrofit fixtures required to prevent machine failures in the assembly of electric motors used in the HVAC system in automotive applications. The team observed the operation of the production line and identified the nature of certain failures of a machine



in the assembly process, which led to the design of fixtures to retrofit the new assembly machine to avoid failures. The parts were designed, machined and tested in operation.

4. Team CASE NEW HOLLAND. This team worked on the redesign of the front-end support of a series of agricultural tractors



in order to reduce the number of castings by combining the mounting features of various applications, without affecting the strength and rigidity properties of







5. Team CIDEC-DELPHI. This team was challenged to produce software and hardware to reduce human errors and with the capability of configuring a radio used in automotive applications. The practice used prior to this project development involved the

manual configuration by a systems engineer, which was

extremely time-consuming and inefficient. The project results showed that the entire configuration process can be made in few minutes, resulting in substantial time savings to an otherwise tedious but necessary process.



6. Team MABE. Mabe manufactures different models of washing machines. All washers use the same main board, with the same software. This project required the design and development of a circuit capable of communicating via USB to a PC and via serial to the main board. A hardware interface was also developed to couple the main board to USB, and a



microchip - microcontroller was implemented to convert serial communication to USB protocols. The

code has been made in C language. To use the PC it was required to develop a USB driver and a user interface using LabVIEW Software.





7. Team CENAM-Dynamometer. This project involved the characterization of the inertial properties of a dynamometer used for testing of passenger vehicles according to official norms. The parameters of interest for the characterization process were the linear and angular velocity of the dynamometer's rollers, the deceleration

rates at different brake loads, the

braking force profile and its derivatives such as torque and power, and the equivalent inertia and equivalent moment of inertia of all rotating components of the system. A laser surface velocimeter (LSV) and tachometer were used for velocity profiles of the rollers. A proposal for a portable dynamometer calibration device was also proposed.

8. Team CENAM-Pressure Chamber. This project challenged the students to design a pressure chamber to be used in the calibration of microphones used for urban traffic studies. The chamber must comply with leakage sealing requirements and to allow precise calibration as per



standard norms of testing. The new design must be structurally sound







Team CIATEQ-Fixture Device. In this project the student 9. team was required to design a fixation device to precisely position a

large industrial stator on a CNC Machining platform with very tight tolerance for the location of the center line of the stator. The stator is to be placed on a milling horizontal machine. Amona the challenges addressed were the precise

location of a center void of material and the mechanism to provide 3D mobility to a heavy component (stator) for precise machining, as per design tolerance specifications.





10. Team Safran-Aerospace. In this project the complete manufacturing process of a component used in the landing gear mechanism of airliners was considered in order to reduce the time currently required to manufacture and certify the part, as per federal regulations. The

manufacturing process involves several heat and surface treatments and involved economic and technical considerations for the acquisition, installation and operation of industrial equipment for "in-house" operations as

opposed to third party providers. Various feasible scenarios were proposed with a cost-benefit comparison that could produce substantial time and production cost savings without compromising quality of the component.



Culture Class, Mexican Cultures, Spring 2016





FCLT 260 Cultures of Mexico Class. An equivalent of this 3 credit course is taught by the Autonomous University of Queretaro with Prof. Shaila Alvarez as the instructor. The course is offered on Saturdays from 9:00 to 12:00 at the UAQ Downtown Campus, and is

followed by field trips to archeological sites, museums, parks, villages and markets. In this course students learn about language, traditions, history and culture, including gastronomy, folklore and cultural sightseeing.





The journey ends with a long weekend in Cancun and the Maya Riviera.



The City of Queretaro also offers outstanding cultural opportunities during the summer. The International Jazz Festival in the Summer is a tradition, free of charge in the he main plazas of colonial downtown. The festival "Iberica Contemporanea" is another



summer cultural event free of charge.

Distinguished visitors to the Program, 2016



Alexis Robertson. A former participant in this Program from the University of Nevada-Reno. She spent the 8 weeks assisting with the operation of the Program in order to develop a roadmap for its implementation of at UNR. Alexis focused on the logistic structure and communications with industry, professors, service providers and of students to conduct the program and involve students from UNR in the near future.



Stuart Doss. Stuart was a participant of this program in the past and had the experience of a full semester studying at Monterrey Tech. of Queretaro prior to joining this year as an Executive Program Assistant. He was in charge of assisting the Program Director in the day-to-day follow-up of all the projects, in communicating and coordinating with all participants on the agenda for the entire 8 week program.



Mr. Lorenzo Ramirez of SIEMENS, Orlando FI. Visited the

program and facilitated a visit to the Siemens Plant in Queretaro for potential future involvement. The visit was attended by the Program coordination team formed by WVU, UNR and CONCyTEQ personnel.



Dr. David Wyrick,

Associate Dean for academic Affairs at WVU, Dr. Eduardo Sosa and Dr. David Mebane, both professors in the Department of Mechanical and Aerospace Engineering at WVU visited the Program and offered two seminars at CIDESI and at CENAM on "Inflatable Structures" and on "Bayesian Calibration Methods."

From the University of Wisconsin-Milwaukee; Dr. Ethan V. Munson and Dr. Hugo F. Lopez, visited the program in Queretaro as observers, considering the possibility of teaming up with WVU in the near future. Thank you all for your visit, we look forward to future collaboration...!!

20 Year Summary IOPM - 2016

Institutions Involved	Student Participants	Faculty from	Industrial Liaisons	Industries/Research	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 	Participants 167 (WVU) 10 (UG) 73 (UAQ) 64 (ITQ) 31 (ITESM) 7 (CICATA) 11 (UTEQ) 8 (UPQ) 22 (Clemson) 8 (UTSJR) 8 (ITSJR) 14 (UNAQ) 1 (UPSRJ)	9 (WVU) 2 (UG) 5 (UAQ) 6 (ITQ) 4 (ITESM) 2 (CICATA) 2 (UTEQ) 1 (UPQ) 2 (Clemson) 2 (UTSJR) 2 (UTSJR) 2 (UTSJR) 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) 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) Irving de Mexico (1) Irving de Mexico (1) Irving de Mexico (1) 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 (10) Case-New Holland (1) InMec (13) CENAM (1) Irving (1) Crown (8) CIAT-GE (18) CIDEC-ConduMex (22) Mabe (2) Arvin Meritor (2) Gabriel (6) VRK Automotive (7) CIATEQ (3) Messier Serv. (4) Bombardier (3) CIDEC-Delphi (3) Brose (2) CIDESI ** From West Virginia
17 Institutions	421 Students	40 Faculty	(/ Liaisons	28 Companies	130 Projects





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