MINI-REPORT 2011

INDUSTRIAL OUTREACH PROGRAM IN MEXICO – QUERETARO

WEST VIRGINIA UNIVERSITY
in collaboration with
CLEMSON UNIVERSITY
and our Mexican Host Institution
COUNCIL FOR SCIENCE AND TECHNOLOGY OF QUERETARO (CONCyTEQ)

With Participating Institutions:

- UNIVERSIDAD AUTONOMA DE QUERETARO, (UAQ)
- INSTITUTO TECNOLOGICO DE ESTUDIOS SUPERIORES DE MONTERREY, (ITESM)
- INSTITUTO TECNOLOGICO DE QUERETARO, (ITQ)
- CENTRO DE INVESTIGACION DE CIENCIA Y TECNOLOGIA APLICADA del IPN, (CICATA)
- UNIVERSIDAD POLITECNICA DE QUERETARO (UPQ)
- UNIVERSIDAD TECNOLOGICA DE QUERETARO (UTQ)

Global Competencies Anyone?....

What is the likelihood that engineers have to travel abroad as part of the job? What are the chances that engineers have to deal with or negotiate with professionals from different countries, with different backgrounds cultures and languages? How many job opportunities are there in engineering today which require meaningful international experience?…

…..More than ever !!

Introduction

West Virginia University has now teamed with Clemson University and at least four universities in Queretaro, Mexico to provide engineering students with the opportunity of gaining international and professional experience through the ***Industrial Outreach Program in Mexico***. This is a unique program which provides an ideal environment for students to immerse themselves in a different culture while applying and honing engineering skills in practical industrial projects in a professional international setting. In this Program, students learn the dynamics of teamwork to achieve common goals despite language and cultural differences. In the process, students learn about themselves as individuals and gain a new perspective on the role of their profession in a global society.

Objectives of the Program

The objective of this program is first and foremost, to add value to engineering education and to produce top quality engineering graduates with global competencies, by providing a meaningful industrial experience in a multicultural and multilingual professional environment. The program also seeks to bring value to industry through the projects assigned to the participating students, who apply practical engineering skills, interpersonal and communication skills and ultimately leadership skills to attain deliverables. Finally, this program seeks to bring participating faculty members and engineers from industry to share expertise, capacities and experiences in formulating and solving meaningful engineering problems.

Global Competencies

A definition of a globally competent engineer is one who is capable of working effectively with people who define problems differently. This program complies with this concept by focusing in the following global competencies:

1. The ability of working effectively in teams with people of different backgrounds and disciplines.
2. The ability of effective communication in spite of language and cultural barriers.
3. Cultural adaptability and sensitivity in the work environment.
4. The ability to identify and resolve cultural issues that may affect professional work.

Certificate of Global Competency Eligibility

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

Description of Sample Projects of the 2011 cycle

This year a group of 40 students from the USA and Mexico worked on eight industrial sites at CIDEC, MABE, CNH, TREMEC, CENAM, BOMBARDIER, INMEC and CIATEQ. Students engaged with engineers from each company and contributed to the solution or design and analysis of a variety of mechanical and industrial systems.

Six Mexican Universities teamed up with WVU and CU; IPN-CICATA-Queretaro, University of Queretaro (UAQ), Monterrey Tech-Queretaro Branch (ITESM) the Technological Institute of Queretaro (ITQ), The Technological University of Queretaro (UTEQ) and the Technological Institute of San Juan del Rio (ITSJR).

By teaming up with Mexican students, USA students experience a cultural immersion that is reciprocated to the Mexican students. 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 six-week exercise each team makes a final professional presentation of the sponsor. US students make their presentation in Spanish while Mexican students make their presentation in English. 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.

Typical day at work

All US students and few Mexican students gather every morning at 7:30 at a designated location within walking distance to their homes. Every morning US faculty advisors greet students in the morning for few minutes to exchange daily news bits in a relaxed friendly manner. A transportation schedules is arranged to deliver the various teams at their industrial sites from 8:00 to 9:00 depending on the site. Students work the full day at the industrial site where the other Mexican students arrive on their own. Faculty advisors carry out a weekly schedule of visitations to each industrial site to guide, monitor and assist each project. These visitations become the mechanism for faculty-practitioner interaction and exchange. At the end of the day,

students are picked up and transported back to their host family home.

Fridays are a little different, after the lunch break, all students are transported to a designated conference room, where each team delivers a brief presentation to the rest of the group to report progress and to solicit suggestions. Faculty members from the US and Mexico take the opportunity to advice, question and assess the progress in each project.

Typical day at home and social scene

The typical day starts with a home-made breakfast prior to the morning "buenos dias" chat at 7:30. Students are transported to their industrial sites and around 5:30 pm, students are back 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 Monterrey Tech soccer facility.

At least four of the six weekends are scheduled with cultural sightseeing tours; 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 Festival), Montreal Jazz Festival in Queretaro and Queretaro's "Gallos Blancos" Soccer Club games are typical attractions. Finally Queretaro City offers excellent opportunities for very fine and reasonable cuisine and family friendly street cafes, galleries, shopping and the like. Yet students find time to make sure their projects progress according to schedule.

1. Project at CIDEC (CONDUMEX)

The name of the project that was developed in CIDEC is "The Chapulin or Grasshopper". The Chapulin is a conveyor or a mobile band which is used to transport material from one place to another location. This conveyor is used in mining applications. The objective of this project was to design a mobility system for the rear of the Chapulin. The mobility system must be located near of the loading end of the Chapulin. It must be able to support the weight of the Chapulin whether it is empty or loaded. The mobility system must also be able to move under its own power and/or roll freely depending on the input of the user. This subsystem must be able to change its direction of movement 135 degrees parallel to the plane of the ground and perpendicular to the centerline of the Chapulin under its own power or freely.

"Chapulin or Grasshopper" .Center for Research and Development of Group Carso in Queretaro (CIDEC)

The student team was comprised by one student from WVU, one from Clemson, one student from ITQ and one from UTEQ. They worked under the advice of CIDEQ engineers and faculty advisors.

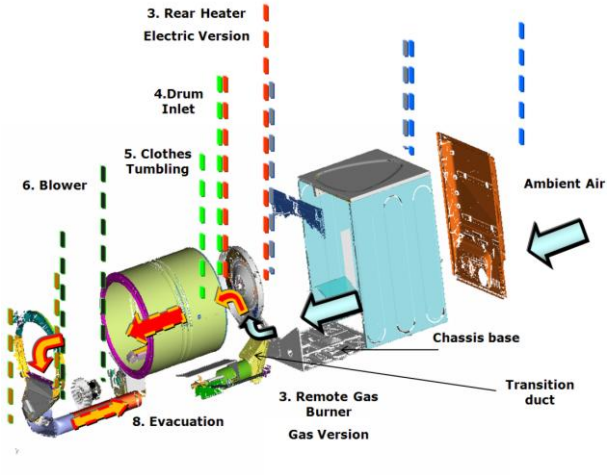
2. Project at MABE

Two projects were developed in the company that called MABE (GE-Appliances). This company designs and builds washers, dryers, refrigerators and other appliances. MABE is always developing new technology in its systems because its products are competitive in the international market.

The first project was called "Implementation of a data acquisition in the Washing Machine Reliability Lab". The objective of the project was to implement an electronic data acquisition system for the washers which can replace the current system. The new system must be a

reliable to reduce the time and errors in the process of data acquisition.

The second project was aimed at reducing energy consumption in a dryer. The objective of this project was to reduce energy consumption in a dryer by 5 % as compared to the current model. In this project, the students used different engineering tools and software in order to formulate and solve the problem. The problem involved design and heat transfer issues. Finally, the students designed a prototype with appropriate characteristics and easy to manufacture.



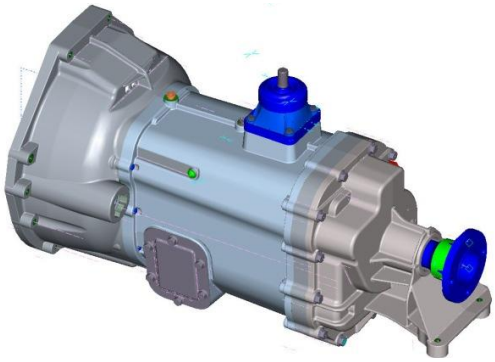
Air flow in a dryer appliance system

The teams were compromised by one student of WVU, two of Clemson, one from UTEQ, one from ITESM and finally one from UTEQ.

3. Project at TREMEC

TREMEC is a company that produces a full line of transmissions and components for vehicles ranging from high–performance passenger cars and light- duty trucks to medium–duty and commercial vehicles. TREMEC is one of the most important suppliers of transmissions with a worldwide customer base. The team in this company worked on development of a finite element model of a transmission for vibration analysis of the transmission, which will be in the market in next year. In this project the students learned how to use different commercial software (ANSYS, PATRAN, etc) which are used for running simulations of FEA in the transmissions.

The finite element models developed provided useful modal characteristics, which are necessary to decide what configuration will eventually be commercialized.



TREMEC Transmission model with flanged housing

In this project one student from WVU teamed up with one student from Clemson, one from Queretaro Tech and one from ITESM.

4. Projects at CIATEQ

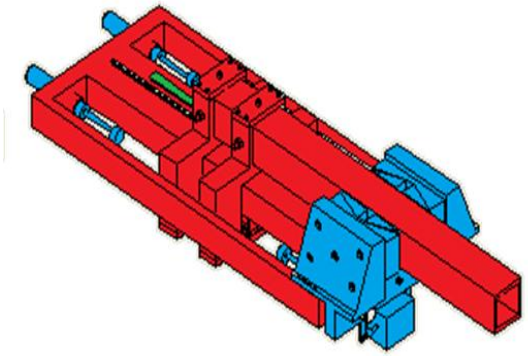
Three projects were developed at the Center for Advanced Engineering and Technology of the State of Queretaro (CIATEQ).

The first project is called “Mexican Wind Machine Frequencies Analysis”. The objective of the project was to determine and analyze the frequencies in a gear train box. Basically, the project consisted in two approaches for solving the problem. On one hand, an analytical model was created in order to find the natural frequencies in the system. On the other hand, an experimental modal acquisition method was developed in the laboratory to compare the results with the theoretical results. A student from WVU teamed up with one student from ITESM.

Project 1.Physical modal testing of the gear train components

The second project was called “Design of Linear Actuators Brakes of a Parallel Robot”

CIATEQ requested the design of a linear actuator that must contain a safety system that will halt the actuator in the case of a loss of main electrical power before any damage could occur. The students designed an actuator system which contains multiple subsystems. One particular aspect that the student's focused was the design of an emergency brake system that can prevent damage to the end effectors in the event of a power failure. This team consisted of 3 students, one from WVU, one from CLEMSON and one from the Queretaro Tech.



Project 2. Actuator system with emergency brake system.

Finally the "The secondary Gyratory Cone Crusher" was the third project developed in this site. A CIATEQ customer requires a new rock crusher design for gravel applications. This machine will be introduced to the Mexican market.

Project 3. Rock crusher Mainframe

The customer provided a technically obsolete rock crusher (with expired design patents) for design modification. CIATEQ does not have complete analysis and design for the new crushing system. The objective of the project was for students to provide analytical support for the new design model and offer design recommendations towards system improvement. Two students from CLEMSON teamed up with one student from Queretaro Tech.

5. Project at INMEC

The objective of this project was to provide design recommendations for building a new 5-axis CNC milling machine intended for the local Mexican market with a footprint of approximately 3 x 5 m and capable of handling a work piece up to 20 metric tons. This machine is to be manufactureable with 85 % of the components available from local suppliers. Benchmarking was used for the purpose of evaluating different subsystems for integration.

INMEC Team and Advisors with CNC Machining Centers

This team consisted of 4 students, two from CICATA, one from WVU and one student from CLEMSON under the direction of researchers from INMEC and faculty advisors.

6. Projects at Bombardier

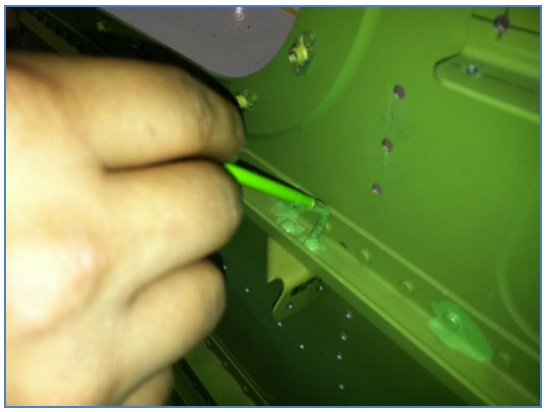
Bombardier is a global transportation company with 69 production and engineering sites in 23 countries, and a worldwide network of service centers. Bombardier manufactures state-of-the-art planes and trains that help people and goods get where they need to go.

Two projects were developed at Bombardier. The title of the first project was: "Waste Identification in Wire Harness Assembly". The objective of this project was to reduce the production time of the wire harness to meet its required standard time of 123 hours. This was done by analyzing the production process and identifying the eight waste areas that will have the highest impact, to concentrate on eliminating them.

Project1. Harness assembly line in Bombardier.

One student from CLEMSON teamed up with one student from UPN.

The other project is called: "Global Express Fuselage Touch-Up". The objective of this project was to develop a general plan to categorize candidate areas on the Bombardier Global Express line for spray touch-up and how to implement it. This general plan will be part of a continuous improvement effort to reduce the time involved in the touch-up process on the entire line.



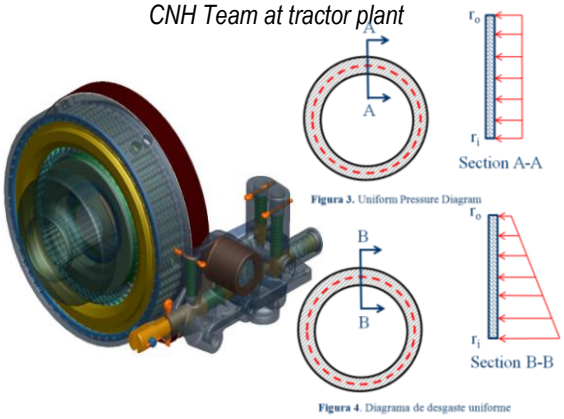
Project 2.Fastener Hand Touch-Up

This group consisted of one student from CLEMSON and one from UTEQ who worked under close supervision of engineers at Bombardier and faculty advisors.

7. Project at Case New Holland (CNH)

Case New Holland (CNH) designs and manufactures tractors and components. The objective of this project was to determine the maximum torque capability and wear life of a power take-off (PTO) clutch assembly. This PTO is used in 3 different models of tractors. In this project the student team developed knowledge in different areas like, fluids, heat transfer, tribology and finite element analysis. Also, the students used experimental methods in order to obtain certain responses and parameters to characterize the clutch system. The members of this team: one student from WVU, one from CLEMSON, one from ITESM and one from UAQ.

CNH Team at tractor plant



PTO Clutch for agricultural Tractor (Case New Holland)

8. National Metrology Center (CENAM)

The project at CENAM involved the measurement of acoustic characteristics of automotive engines for standard testing. Design of acoustically transparent structures was conducted to perform testing in an acoustic chamber.

Cultural Highlights

Cultural opportunities are plentiful on a daily basis in the city of Queretaro, with imposing colonial buildings, and a well preserved Spanish style architecture. The city offers many cultural attractions and a vibrant cultural life in the city with excellent and affordable restaurants, bistros and shops in a family-friendly ambiance. Host families also provide a major cultural opportunity, as they provide a "home away from home" environment, clean and safe

Architectural touch of colonial San Miguel de Allende

along with some kind of an "extended family" feeling. Students learn about Mexican food, Spanish, traditions and participate fully on social activities with the friendly local people of Queretaro.

Throughout the six weeks. Visits to archeological sites, hiking rides, and visits to small towns are conducted in the company of local students. Weekend tours included visits to picturesque San Miguel Allende, the magic city of Guanajuato, the traditional town of Tequisquiapan, also a visit and hike to Pena de Bernal (a monolithic rock), and a visit to the Teotihuacan Pyramids archeological site. The program culminates with a long weekend at the Ixtapa resort at the golden pacific coast of Mexico….

Conclusion

This program is unique in the USA and Mexico. It pursues the main objective of adding value to student's engineering education through the development of global competencies acquired through a meaningful engineering project in an international professional setting, providing an exhilarating intense full cultural immersion.

The program addresses issues that range from communication skills and cultural differences to human relations in the context of a practical project that requires engineering knowledge and skills. This experience has brought forward not only the practical engineering dimension and technical skills, but also the human dimension that comes with the territory.

The international dimension in engineering education has acquired an added significance in today's globalized economy. Many major and midsize firms have rapidly expanded their industrial operations beyond borders, and it is more likely than ever, that engineering graduates will have to deal with professionals from different cultures and languages in professional situations. Under these circumstances, being able to understand, appreciate and moreover anticipate cultural differences and communication approaches may very well make the difference to attain success...

Institutions Involved	Participant students	Faculty from both countries	Industrial Liaisons	Industries/Research Centers	Projects developed
• West Virginia University • University of Guanajuato • University of Queretaro • Institute of Technology of Queretaro • CONCyTEQ Queretaro • ITESM (Tec. De Monterrey) • CICATA (IPN) • UPQ • UNAM • UTEQ • Clemson Univ.	127 (WVU) 10 (UG) 54 (UAQ) 45 (ITQ) 24 (ITESM) 7 (CICATA) 2 (UTEQ) 2 (UPQ) 22 (Clemson)	3 (WVU) 2 (UG) 4 (UAQ) 6 (ITQ) 4 (ITESM) 2 (CICATA) 2(Clemson)	(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) New Holland (1) InMec (4) CENAM (2) ANSYS Mexico (1) Irving de Mexico (1) Crown Mexico (4) Mabe-GE Appliances (2) CIDEC-ConduMex (2) Arvin-Meritor (2) Gabriel (5) CIAT-GE Aircraft E. (3) VRK (Automotive) (2)CIATEQ (4) Bombardier	General Motors 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 * Research Centers ** From West Virginia	(1) GM Mexico (10) TREMEC (4) SPICER-TSP (1) Micro-Troq. (5) IMT (2) LAPEM (2) I. TurboReactores (1) TerramiteCorp.** (3) KOSA (4) New Holland (1) InMec (5) CENAM (1) Irving (1) Crown (8) CIDEC (2) ConduMex (12) Mabe (2) Arvin Meritor (2) Gabriel (6) CIAT (6) VRK Automotive (2) CIATEQ (4) Bombardier ** From West Virginia
11 Institutions	**293 Students**	**23 Faculty**	**56 Liaisons**	**23 Companies**	**86 Projects**

Fifteen Year Summary Table Industrial Outreach Program in Mexico

For further Information Contact		
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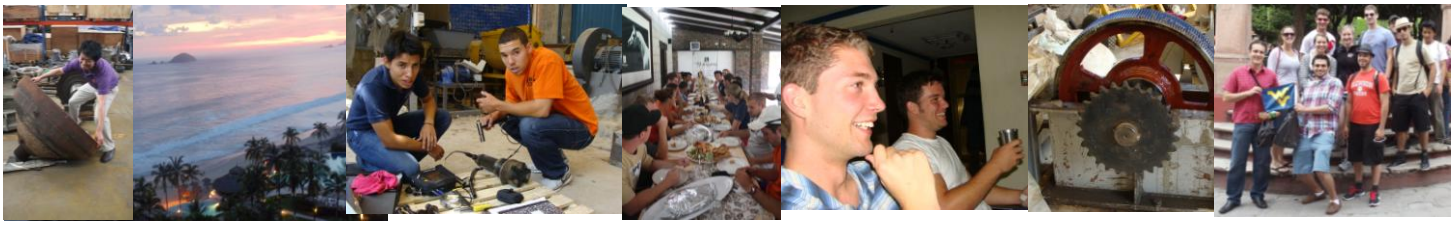

Join us in Queretaro, Summer 2012!