
AC 2011-98: INCREASING BROADER INDUSTRIAL PARTICIPATION IN ENGINEERING & TECHNICAL UNDERGRADUATE PROGRAMS

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Stimulating Broader Industrial Participation in Undergraduate Programs

Abstract

It is common knowledge among college of engineering educators that while engineering and engineering technology students obtain solid academic knowledge during their college years, the missing component typically seems to be the knowledge of the engineering work-world that only industry can provide. While common outside activities such as internships and co-op programs fulfill this void for some students, there are many other ways to incorporate industry as to enhance the educational experience to the broader student population. The challenge is to successfully and quickly create a variety of programs and avenues to engage the industrial engineering community into the undergraduate program and reach all the majors and student populations.

Our colleagues at Colorado State University have an outstanding Professional Learning Institute¹ which is available to all students. Their PLI offers a variety of programs that connect employers to the undergraduate students. In speaking with them back in 2009, their Assistant Dean, commented that he feels the topics they choose to focus on may have been too narrow.

In our review of peer institutions² we found several engineering colleges utilize the engineering community to broaden the undergraduate experience for their students but they are typically offered only within a certain major or individual department. For those engineering colleges who do not engage in employer development for the undergraduate students, their university's continuing education or career center services offer some forms of employer outreach and connection.

We have found at our own units on campus:

- 1) The Career Center Services³ offers a basic level of services for employers such as job fair, internships and co-op postings. These programs are developed for the general student population. While beneficial, we have found the career center' does not offer tailored programs for engineering and technology students
- 2) The Continuing Education⁴ offers programs or courses for a fee and their target audiences typically are degreed engineers or the general public looking to engage in life-long learning.

While both of those units/organizations serve an important role in the higher education environment, they normally do not offer specialized in programming specifically for currently enrolled engineering and technology undergraduate students.

At university X's College of Engineering, our comprehensive approach has been to take full charge of the employer outreach and professional development for all currently enrolled undergraduates. Unlike other engineering colleges, we take a much more collaborative and strategic approach in order to maximize the relationship and support from employers. That approach is extended to our faculty as well as our students to help satisfied the multi-faceted needs of the employers.

This paper presents the current menu of programs established at university X's College of Engineering in efforts to provide ALL the College of Engineering students opportunity to connect with members from the engineering community during their undergraduate program. Due to many years of operating with tight budgets, we had to create programs at no or very little financial cost to the students, college or companies. Benefits for both the students and industries will be highlighted.

1. Introduction

The Industrial-University relationship is one that is multifaceted. There are the philanthropic, the technology research, the short term employment, and the long-term employment. At university X's College of Engineering one of the most common motivating factors for employers to become "connected" with our university is to establish name recognition and recruit a future workforce. The large and household name companies such as Microsoft, IBM, Ford, GM, and Dell have made a name for themselves through their products and product advertising. There are thousands of other companies that are not household names but provide a great working environment for engineers. We work with both types of companies at university's X College of Engineering and each has their own challenges.

We are always doing a balance act and serving two parties:

Students (getting students to connect with industry)

- Increasing their knowledge of the engineering work world
- Introducing global, societal, contemporary topics that affect the business and engineering industries (i.e. ethics, technology, outsourcing, diversity, etc)
- Honing their professional development skills and professional behaviors
- Expanding/broadening their knowledge of the engineering profession in hopes to create retention both in college and in the industry

Industry (getting employers to connect with students)

- Name recognition as a method to fill their pipeline for qualified applicants
- Getting to know the top performing students
- Establish relationships with faculty (we have found that faculty are one of the top resources students use in the job search process)
- Ability to influence the undergraduate curriculum and helping to invest in the future workforce
- Access to the college and university leadership
- Solving engineering problems at a low cost while previewing potential applicants for future job openings

2. Satisfying the need

Each of the reasons specified above is addressed in one or more of the programs that we have established to engage the industrial community into University life. This topic can be presented and organized by program type or by student population. We have chosen to present it by program and will have a handout which will illustrate it by student population.

Current Menu of Programs

Professional Development Presentations:

Each semester we invite a variety of industry speakers to present to our engineering and engineering technology students through various methods: classes, student organization groups and special events.

Example 1: for the Multi-disciplinary Engineering Professional Development course which is designed for juniors and seniors, the syllabus offers topics such as: Leadership, Ethics, Project Management, Diversity, Life-long Learning and other Global, Societal and Contemporary issues that are affecting the engineering profession and need to be measured by ABET. Table 1 illustrates the Post-Course Survey results for the past three semesters however we have data as far back as fall 2003.

As mentioned earlier, these speaking engagements are open to all students and faculty in the college. Anytime we bring a guest speaker onto campus for our students, one major benefit is that students are learning about relevant business and engineering issues/problems and/or about a particular industry. Another benefit is that they are able to hone their networking skills. We never have a problem locating an appropriate guest speaker, as many of the engineers and business leaders truly enjoy “giving back” to our students by the way of knowledge transfer but also find that it is a great way to market their product, company or industry to a specific student audience.

Table 1	% Students \geq "Agree"		
	F09 n=160	Sp10 n=91	F10 n=155
As a result of the MD PD course, I:			
Can identify ethical dilemmas and articulate solutions	91.9%	93.4%	95.5%
More prepared for a successful job search	80.0%	75.8%	82.6%
Intend to engage in PD and life-long learning	87.5%	82.4%	85.8%
Can evaluate solutions in global and societal context	77.5%	83.5%	83.9%
Can discuss issues facing technical professionals	82.5%	84.6%	87.7%
To what extent are you able to do the following?			
Apply prof. and ethical standards to the practice of engineering	91.9%	93.4%	95.5%
Interpret engineering problems to current events and issues	82.5%	84.6%	87.7%
Analyze engineering solutions with a global perspective	77.5%	83.5%	83.9%
Understand the characteristics of an effective leader	90.0%	92.3%	91.6%
Conduct a thorough job search	80.0%	75.8%	82.6%
Conduct a professional job interview	85.6%	81.3%	89.7%
Develop a plan for PD, life-long learning, grad.school and licensure	87.5%	82.4%	85.8%

Example 2: To address the retention of our female student population, we organized three all-female events specifically tailored for female engineering and technology students. We invite

female engineering executives to present on topics found important among female students in the STEM disciplines. We also invite local female College of Engineering alumni to participate in round table discussions. We use a variety of methods to obtain financial support for these programs, most are through employer donations.

Ethics Luncheon

In joint conjunction with the university’s Center for Professional and Applied Ethics, each spring semester we work with an engineering executive to present an Ethics Dilemma over a lunch which is open to all of our students, faculty, university administration and other members of the engineering community.

Site Visits

For our college of engineering freshmen learning community, we offer several site visits/field trips to a variety of company facilities to help education the freshmen students about the various careers and industries within the engineering profession. Many employers also use this activity to help market their own internship and co-op programs.

Co-op Panel

With our college’s co-op participation decreasing and employers being frustrated with the lack of candidates in the program, for the 2010-2011 we held an Employer-Student Panel discussion on the Co-op program. We had 10 panelists which included employers and current or past co-op students. The program was targeting freshmen and sophomores in the engineering and engineering technology disciplines. It was well received by all and provided a great networking opportunity for our students who were seeking co-ops.

Engineering Picnic

Our annual College of Engineering fall picnic is similar to a job fair but outside and more casual. It allows juniors and seniors a chance to network with companies to find a job as well as an opportunity for freshmen and sophomores to meet employers and learn more about how to make them more marketable as well as gain some insight into the local engineering community. The event is free for all college of engineering, students, faculty, staff and alumni. The employers pay a minimal fee to attend to cover the parking, lunch, tables, etc...). Each event draws more than 50+ employers and over 1200 individuals.

Employer Mock Interviews

Unlike the Career Center’s general mock interview day, the mock interview activity that our college hosts is part of the Multi-disciplinary Professional Development course. It is an event where an employer will interview a student without the intention of filling an open position. Employers participate in Mock Interview Day to assist the college in educating the students in proper interview etiquette. Each employer also evaluates each individual student’s performance. A summary is shown in Table 2 for those who performed at or above average.

% of EN students receiving an overall rating by employer of “A” or “B”	
Fall 2010 (n=154)	84.46%
Spring 2010 (n=123)	85.36%
Fall 2009 (n=186)	83.87%

Four Mock Interview Days are scheduled for juniors and seniors who are enrolled in a Professional Development Course (2 for fall and 2 for spring semester). Companies that participate, get exposure to over 300 students- plus the Dean, Dept. Chairs, and key faculty as they join the interviewers for lunch.

Each day's schedule is predetermined by the staff and students request companies and time slots. Each student is expected to treat the mock interview as a real one and come dressed appropriately with notebook and resume. Table 3 reports the students' opinions of the mock interview day event.

	Table 3		
	% Students \geq "Agree"		
	F09 n=160	Sp10 n=91	F10 n=155
Mock Interview Day			
Prepared for co-ops, internships or FT employment	84.4%	94.4%	89.7%
Interviewer gave useful feedback	81.9%	85.4%	83.2%
Found it valuable	86.3%	96.6%	85.8%

Sponsored Senior Design Program

The sponsored Senior Design Program aligns teams of students to work on company sponsored technical projects. The companies provide a technical contact for the team to work with. This contact insures that the team is working on a solution the company can actually use and at the same time can evaluate who on the team is really making a significant contribution. The University provides a faculty mentor to guide the team from a technical skills viewpoint, giving the team ideas on how to apply their recently learned skills and tools to the problem. The University supports this program from a college level hence all disciplines are treated equally and multidiscipline projects are highly regarded.

Many sponsors invite the teams to participate in department meetings, presenting the status of their project and listening to feedback from experienced engineers. Almost all of the sponsors have on-site team meetings so the teams visit the workplace of graduate engineers and see how they work together to solve problems. A few sponsors provide work space for teams, especially those involved with proprietary products or processes.

This program permits the sponsor to get a good look at the team members for possible employment after graduation. The University in return gets feedback on the expected skills that the employer is looking for in new hires. Quite often, curriculum changes are made when the skills learned in class do not match what the employers are expecting or when students don't appear to have confidence in a recently learned topic such as Finite Element Analysis or Printed Circuit Board design.

Recently, two sponsored projects received no applicants and upon investigation, the better students felt they were not confident in FEA to tackle such a project. Curriculum changes were made and a year later, the project was staffed and is proceeding nicely.

Currently, approximately 50% of the students working on sponsored projects get an offer of employment from a sponsor.

The Sponsored Senior Design Program is combined with the Departmental Sponsored Projects so that each team is held to the same standards of achievement across department levels. In the same manner as working in industry, teams have to submit regular status reports, prepare and deliver formal design review presentations which are attended by corporate sponsors and faculty mentors as well as submit purchase requisitions that mimic those used in industry to purchase the parts they need to complete their prototype or model.

In comparing our program with our 16 peer institutions², we find that:

- 81% have a capstone design program (some one semester, most are two semester)
- 54% have a multidisciplinary program of those that have a capstone program
- 46% utilize corporate sponsors to provide “real world” projects

Employer-Student Etiquette Dinner

Each fall semester we partnership with a local company to host a formal Etiquette Dinner for the engineering and engineering technology seniors. This event not only educates the students about proper dining behaviors but also allows an opportunity to hold roundtable discussions with the sponsoring employer. The sponsoring employer is able to bring several engineers to the event to ensure each student table has an appropriate company representative.

Sponsored Research

Many times a company does not have the resources to perform their own research or development or they need to solve a problem that is outside their field of expertise. The local University is a well of varied knowledge that they can draw from.

At university X’s College of Engineering, we have an organization dedicated to helping companies with independent and assisted research. The Research Institute (RI) is the portal for business-university partnerships at university X. Locally, the RI works in the community to accelerate the growth of small businesses and university start-ups. Globally, RI develops intellectual capital through collaborations with industry, government and academia. New business and research ventures, university partnerships with regional and national enterprises, and RI spin-off companies all draw research and businesses to the region and spur economic growth. RI also offers affordable space to start up companies on the university campus so that they can associate with faculty researchers and employ students.

Leadership Academy

The Leadership Academy is a program designed after several leadership programs found in industry. Several large local companies were instrumental in helping us establish this unique educational experience for our undergraduate students who are seeking to explore the various leadership characteristics within themselves. Each module is sponsored by a different employer and we ask the employers and past Leadership Academy alumni to participate in facilitating the weekend modules. It really gives employers access to our highly motivated students which are

highly recruited by employers we have found. Typically we have 75-100 sophomores, juniors and seniors in the program at various stages of the academic year.

Mentoring

A decade old program, known as MAPS (Maximizing Academic and Professional Success) has really improved our retention in our college. In recent years, we began to offer an opportunity for engineers from a variety of industries to engage and participate with our MAPS program and its various events. Events such as spring golf tournament, a speed mentoring night and year-long mentoring program allow for employers to network with the upperclassmen while also allowing students to hone their professional development skills and learn more about a particular company or industry.

3. Measuring Success

The College of Engineering is actively engaged in a continuous improvement process of planning, measurement, evaluation, and feedback. This work is aided by the College's Strategic Planning and Assessment Resource Team (SPART), which is comprised of a faculty member from each department. Additional support is provided by faculty associates, who assist with collecting data and summarizing, reporting, and interpreting results. Seniors are measured each year, prior to graduation. Alumni and Employer are surveyed every other year. We use *Student Voice*⁵ to conduct our surveys.

Several assessment results were indicated under the program however when possible and deemed necessary, we conduct both student and employer surveys to capture feedback about the various programs.

4. Summary

The continuous challenge is to successfully match employers needs with the students needs and vice versa. Program and relationship maintenance is a critical element of making any relationship successful and meaningfully for all involved. Soliciting feedback from both parties involved ensures that lessons are learned and processes are improved. It also allows us to evaluate the benefit of each program and/or event. We truly feel that our college has gone to many lengths over the years to create a variety of programs and avenues to engage the industrial engineering community into the entire undergraduate program. We have planted many seeds and are very excited to the growth happening.

By creating and adapting new programs quickly as the need arises we have successfully maintained a healthy industrial relationship with many companies. Over time, several of these companies have become significant benefactors to the University.

References

1. Colorado State University's Professional Learning Institute, Fort Collins, CO, www.engr.colostate.edu/pli/

2. Listing of peer institutes reviewed via the internet:

North Carolina State, Raleigh, NC, <http://www.ncsu.edu/outreach/engagement/index.php>

East Carolina University, Greenville, NC,

http://www.ecu.edu/cs-studentaffairs/career/employers/get_involved.cfm

University of Iowa, Iowa City, IA, <http://www.engineering.uiowa.edu/epd/>

Clemson, Clemson, SC, <http://www.clemson.edu/ces/psu/index.html>

University of Texas-Austin, Austin, TX, <http://www.engr.utexas.edu/undergraduate>

George Mason University, Fairfax County, VA

http://volgenau.gmu.edu/about_ite/student_services.php

University of Delaware, Newark, DE, <http://www.udel.edu/CSC/students.html>

Western Michigan University, Kalamazoo, MI,

<http://www.wmich.edu/engineer/current-students.htm>

University of Louisville, Louisville, KY,

<http://louisville.edu/speed/academics/academic-affairs/career-development/employers.html>

Portland State University, Portland, OR, <http://www.pdx.edu/cecs/student-resources>

University of Nevada-Las Vegas, Las Vegas, NV,

<http://engineering.unlv.edu/students/current-undergrad.html>

University of South Carolina-Columbia, Columbia, SC,

<http://www.engr.sc.edu/career/index.html>

Georgia State University, <http://www.gsu.edu/>

University of Central Florida, <http://www.ucf.edu/>

University of Massachusetts- Lowell, <http://www.uml.edu/>

University of Texas- San Antonio, <http://utsa.edu/>

University of Rhode Island, <http://www.uri.edu/>

3. UNC Charlotte, University Career Center: www.career.uncc.edu

4. UNC Charlotte, Office of Continuing Education: <http://continuinged.uncc.edu/>

5. Student Voice, 210 Ellicott Street Ste 200, Buffalo, NY 14203, www.studentvoice.com