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## **AC 2011-977: BENEFITS OF SMALL COLLEGE-INDUSTRY PARTNERSHIPS FOR TRAINING PROGRAM DEVELOPMENT**

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# **Benefits of Small College-Industry Partnerships for Training Program Development**

## **Abstract**

The paper describes the numerous benefits that a small college has experienced by working more closely with its industry partners to improve training of our students. Benefits have included the following: (1) keeping instructors up-to-date on the current trends in local industries; (2) providing students with the course examples and experiential learning that help ensure student readiness to meet the needs of the industries in which they plan to become employed because their instructors are engaged with the industries in which they plan to become employed; (3) helping the College equip labs with the latest materials and equipment needed to provide current and relevant training with commitment and assistance from these same local industries; (4) receiving awards and discounts from manufacturers selling equipment to our local industries and our labs because we are training students in the same technologies our industries are using; (5) helping local industries save money by reducing their training costs and engaging student assists in their applied research and development projects rather than bringing in specialized trainers and consultants; (6) decreasing local industries' repair costs by preparing a well-trained workforce and (7) by providing the training employees need. Our College has further benefitted by the increased enrollment, retention and program quality.

The continual improvements realized from these experiences have led to the development of our Education for Industry on Demand (Edison) program and our Applied Research Assistantship Program (ARAP). These programs have evolved through operation of the Center for Applied Research and Technology (CART) at our College that was created to help meet the needs of local industries for a better educated workforce. The programs were developed to respond to the constantly changing trends in technology applications that serve the manufacturers and energy industries in our region. By delivering college-approved courses that often count for credit in our TAC-ABET approved engineering technology programs, local industries are assured that the training courses delivered to their employees will stay current and help them integrate the latest technology.

## **Background**

Several years ago, graduates of our school were encountering difficulty finding local and regional employment in their field of study. The potential employers' need for theoreticians and engineering researchers had declined and new need for technologists and applied researchers arose in replacement. The coal industry had been "king" in this area, and we are located at the heart of the vast Pocahontas coal fields. As new technologies replaced workers and many smaller companies closed, job opportunities for some of our graduates declined in coincidence. Ancillary companies that conducted coal-related business subsequently contracted or shut down. At that time, our college recognized the need to diversify the education of its students to move more easily into markets located outside our immediate area and any one industry concentration.

For example, technological innovations were plentiful in the field of electrical measurements and controls and companies were not able to find employees readily able to work the new machinery. Computers were built to perform industrial operations, but there was a noted scarcity of programmers available to write, configure, and troubleshoot the necessary program code. Graduates often lacked skills necessary to immediately use new software to run equipment.

## **Introduction**

Based on these experiences, we could readily see the need to change the educational format and continually improve courses in our Engineering Technology programs. It became imperative that our faculty not only continue their own education in the fields relative to their teaching assignments, but that faculty also develop, maintain, and cultivate professional relationships with their target industries. There was an obvious need for faculty to remain cognizant and better understand the work assignments that their students would be expected to perform and industry expectations that their graduates were expected to meet. Also, new criteria for meeting TAC of ABET standards for our Engineering Technology programs included an inherent requirement for faculty to have a greater understanding of the expectations of technicians and technologists employed in today's industries.

This paper will illustrate how one school department has changed its program by better managing classrooms such that students supplement more traditional assignments with hands-on training. It will emphasize improved training provided by instructors willing to maintain an open and ongoing relationship with the industries that operate within our school's radius of influence. We will further demonstrate that these activities have proven successful over the past several years, that our graduates are better prepared for secure employment in their chosen fields and make greater immediate contributions to successful, growing companies located both within our area and beyond the College's more traditional sphere of influence.

## **Working Hand-in-Hand with Industry**

Pursuant to continual improvement programs and the requirements of TAC of ABET, the College maintains Industrial Advisory Committees (IAC's) made up of individuals from industries relative to the different School of Engineering Technology (SET) disciplines. It was a suggestion from the Electrical Engineering Technology (ELET) committee that first led the program to look into the development of training for our students related to Programmable Logic Controllers or PLC's. At the time, industries in our region were just beginning to learn industrial computing applications. Our IAC concluded that it was important that ELET begin such training if the program was to stay relevant and beneficial to industry and our graduates. Another pertinent influence was that a major brewery company decided to build a plant elsewhere, in part, because of a lack of a readily-trained employment pool proficient in the application of PLCs.

Following the IAC lead, this ELET faculty member was able to augment previous education and industrial experience with training in PLCs through manufacturer's training seminars conducted to demonstrate capabilities and applications of their specific units. These seminars provided better insight to the many possibilities for the use of PLCs and also reinforced the determination that ELET needed to expand such training immediately.

The first problem we encountered as a small college was a lack of any suitable PLC laboratory equipment to develop the training we wanted to create. An obvious second issue was that textbooks alone could not adequately address the students need for hands-on training related to this field, which was mandatory if students were to become able to meet the needs of future employers. Once again, our Industrial Advisory Board was able to assist us. Working closely with an active and energetic member of our IAC, this ELET faculty member was able to secure

PLC equipment valued at approximately \$100,000.00 and suitable to begin lab work. As our PLC laboratory began to take shape, we were also able to secure other units from various manufacturers. The demonstrated commitment of the IAC and our industrial partners encouraged the College to make supplementary purchases of various PLC-enabling software and supporting programs that would not have occurred otherwise. Today, our PLC laboratory is the best equipped in our State and the western area of a neighboring state, and we are a regional leader for PLC training.

Encouraged by working closely with the ELET-IAC and equipment manufacturers, we have found it beneficial to keep up with various local industries in other areas as well. Through increased associations with different companies, we have been able to supplement traditional and text-based learning with applications labs that allow our students to experience real-world, hands-on experiences that they can see put to work during field trip visits locally. Such industry contacts have also benefitted the entire SET by placing us in a favorable position to offer training to personnel within various companies.

Due to our early adoption and establishment of PLC labs and training for their successful operation, the College was able to confidently offer and provide training for a local bakery company when it rebuilt its plant to introduce PLCs. This stands in stark contrast to previous experience with the major brewery company. As other local companies implemented the PLCs into their workplace, we also opened our labs, classroom facilities, and training services to them. This ELET faculty member was able to spend several days visiting another local plant and reviewing their systems in preparation for a training session with their employees. As a result of contacts made through the PLC training, we were also able to provide a basic electrical training class for the same company. Again, these training activities and basic interaction between our School and local industries will prove invaluable to our continual improvement efforts, maintaining a high-quality program, ensuring our decades-long commitment to TAC of ABET reaccreditation, as well as, generally equipping our students with most current training and offering them an increasingly industry-relevant education.

As anyone in the engineering technology teaching field will attest, our own education never ends. Equally important to maintaining our relationships with our industrial partners is our continuing endeavors to keep our own training current and our skills up-to-date. In order to qualify and maintain certification as a registered Professional Engineer, this ELET faculty member has offered electrical refresher training classes for industrial professionals at the College and offering these classes has subsequently required even more concurrent interaction and keeping up with changes in our local industries. In addition, the College currently offers classes covering the National Electric Code (NEC), which are attended by employees of different area companies. Of course, this leads to the further need to participate in the newest seminars regarding annual changes in the NEC to prepare classes for the College.

Another applied research experience for this ELET faculty member involved working with a local manufacturing plant in a neighboring state, on a possible PLC update to one of their systems. We were asked to incorporate a Human Machine Interface (HMI) display into their system that would be used by Company personnel as an aid in troubleshooting. The HMI display would indicate any problems which may arise during operation of their system.

The purpose of the new system was to provide the proper carbonation for bottling products at a more efficient cost to the company with better maintenance procedures and, hopefully, reduced maintenance costs.

The work involved a system which consisted of four compressor stations. The stations were made up of two-4 cylinder compression banks driven by 75-hp motors; one-6 cylinder compression bank driven by a 125-hp motor and one-8 cylinder compression bank driven by a 150 -hp motor. Also associated with the operation of this system were four-20-hp evaporation condensers and four-15hp pumps.

Originally, the compressors came on simultaneously causing a high-demand, premium-rate electric charge from the power company. There was no set pattern as to which compressor started first. There was no display for indication of potential problems. When a problem inevitably arose both time and money were wasted, while employees determined the source.

Conversely, the new system allows operators to select the sequence of compressors to be activated, thereby reducing demand charges and providing balanced wear on all cylinders. Warning lights were also incorporated to indicate potential problems. When problems arise an HMI message is displayed allowing maintenance personnel to go directly to the problem and more rapidly correct the situation.

Finally, a "Cost of Power" study prepared for this company as justification for the project was then completed. Subsequently, the power savings study was then implemented as a case study into this instructor's ELET 209 Power Systems course. This provided the students with a real-world experience for a company that was also well-known to them. Presentations showing the results of the Cost of Power case study allowed students to view comparison techniques used to justify costs of the changes. Completion of the case study allowed them to see how their future work directly becomes a vital part of the company's decision-making process and realistically reinforced the text-based course material.

The bottling company also needed to develop a backup system, complete with follow-up training in place, for the line operations at their plant. At that time, a shutdown of the can line required managers to call in a service engineer resulting in considerable cost and downtime. This can line used PLC's that were programmed with an industrial software package. Because we were currently using the same units in our own ELET PLC labs, solving this problem broadened and deepened this instructor's knowledge of the uses of the PLCs in industry and provided us with new examples and case studies for incorporating their use in our labs.

As previously described, the Professional Engineer refresher course which was then offered later that year was also tied to the use of those PLC units, and we received software for their use from the manufacturer. By completing the can line backup project, the instructor was able to gain new skills in the use of the units and more knowledge about how the industrial software works. At the same time, the project helped to make a local company more cost competitive and allowed the instructor to share this experience with our students. The results of these training and skill development case studies are now being used locally and in industries nationwide because many companies are also using the same model programmable logic controller. The instructor hopes to continue using the experience gained from completing these projects to offer training programs for other companies and provide services that will add to the body of knowledge in their uses and benefit our students in the future.

Solving real problems for our industrial partners and following through on the completion of these projects provided this instructor with a better understanding of how PLCs are incorporated into today's industries. The projects required extensive instrumentation and transducers interfaced with programmable logic controllers. Practical application of theories being taught in several classes provides better insight into how the instructor can best prepare students to use the skills they are learning to prepare themselves for future employment. After accepting the project and beginning work on it, the students recently took a field trip to another bottling plant. Because of the depth of study regarding the operations of the neighboring state's plant, the instructor was able to point out to our students the various areas of interest at the visited plant that would be unique to a future engineer's involvement in the operation of a bottling plant.

Continued work with local industries has the added benefit of assisting our students by providing them with realistic materials for service projects within their communities. For example, our students have assisted in preparing PLC programs to judge Boy Scouts of America Pinewood Derby competitions along with other projects for industrial shows in the local area. This activity is an example of the type of pleasant surprise and unplanned benefit that often occurs as a natural outgrowth of a synergetic relationship with local industry.

## **ARAP**

College-Industry Partnerships such as described have also encouraged CART to develop an Applied Research Assistantship Program (ARAP). ARAP will be a "cooperative education" or "cooperative learning," program and co-op is the combination of traditional classroom learning with practical, competitively paid, work experience. Students enrolling in our program will combine semesters of full-time study with half-time work experience over the course of their undergraduate degree curriculum.

CART's ARAP would combine the proven benefits of traditional university cooperative education with an industry-centered approach. Our program will allow a student to complete up to four semester-long paid work experiences related to his/her major and career interests, while still earning a bachelor degree in four years. ARAP students would graduate on-schedule and ahead of the curve.

ARAP is designed to offer students the opportunity to "learn while they earn" and to:

- Explore different professional positions related to their major and career interests before graduation.
- Practically apply classroom knowledge and laboratory experiences in real-world problem-solving scenarios, preparing them for more advanced coursework and exciting careers of the future.
- Better accomplish goals and financial success, both in the short and long-term; ARAP earnings can be used to pay for tuition or living expenses and students graduating with ARAP experience would earn higher starting salaries.
- Gain insight into their professional strengths, making them better able to assess personal career interests and goals, and to confidently pursue them.
- Build valuable workplace experience and hone transferable professional skills, demonstrating that they are a viable prospect in the eyes of future employers.

- Experience the application of technologies and trends of the future in industries that will set the standards for tomorrow's cutting edge work environment.
- Expand their professional network by making important industry contacts and building relationships with leaders in their field.
- Certify their experience with the ARAP contract employer's name and record of program completion on a certificate of completion.

### ARAP Majors

The program will be open to students admitted to any School of Engineering Technology degree program, including:

- Architectural Engineering Technology
- Civil Engineering Technology
- Computer Science
- Electrical Engineering Technology
- Mechanical Engineering Technology
- Mining Engineering Technology

In development and testing of ARAP over the past two years, the program has proven successful. The earlier concentration placed on responding to our IAC and specifically their need to better integrate PLC's into their applications is truly starting to pay dividends in many areas. For example, we were able to attract a large international conveyor belt manufacturer to our area. CART's ARAP students have helped the company develop a "smart system" that anticipates failures and pinpoints problem locations within a conveyor belt system and relies on programmable logic control. The company and the Center were named recipients of an "Innovation Award" at a regional Technology Council's 10th annual gala, tech expo and awards ceremony.

CART and its ARAP students collaborated for several months at their location in a nearby Business and Technology Park to develop the smart conveyor belt system. The technology permits belt operators to plan repairs rather than just react to failures, saving business owners a substantial amount of money by preventing unscheduled down-time due to unanticipated belt breakage. Conveyor belt systems are primarily utilized in our region by the coal industry and a single broken belt can result in a production loss of more than \$250,000 per day.

At the Business and Technology Park, the company and CART are working together on the product manufacturing process and have started production of the unit. The company has received approximately 50 orders prior to product completion, and a full scale belt is in place at their facility, while the technology continues to be refined and augmented on a daily basis.

While the transition from college life to work life can be challenging, and we have all been faced with the dilemma or heard the question - "How do you get a job without experience and how do you get experience without a job?" ARAP is specially designed to help students gain real world experience while fostering economic development at the same time. Taking the initiative to develop these College-Industry projects gives engineering technology students access to real world problem solving.

Our students respond to real projects with real applications, and these projects encourage and excite them about what they are learning in the classroom. Projects like this state of the art belt monitoring system require applied research in electronics, mechanics, computer science, and mining. The PLC driven display can notify the operator when maintenance is needed saving the company a substantial amount of money. Similar to the bottling plant example, this system monitors weaknesses in the belt and detects rips, tears and delays. This is an applied research project with worldwide potential, that affords students an invaluable experience and opens their eyes to the many the possibilities in their new careers.

One ELET - ARAP student described the experience as a “golden opportunity” and hoped that it would “open the door for possible employment” with the company, and it did. The company hired him following his graduation with a B.S. in ELET from our college. Local media described this as “a win-win partnership with education-led economic development,” and we are working to duplicate this experience with other companies.

### **Conclusion**

Working closely with the ELET Industrial Advisory Committee to improve the program, focusing on continually updating instructor training, and maintaining excellent working relationships with industry are all part of the programs that strengthen our College’s capability to offer students the most current and relevant education possible. These activities simultaneously satisfy TAC of ABET criteria for accreditation related to faculty maintaining active involvement with professional organizations in Engineering Technology. In this example, a professor of ELET has been able to maintain contacts with industries active in his field and has made valuable contacts for future program development.

If colleges are to continue providing their students with training that prepares them for the workplace of the future, then faculty members must look beyond text-based and traditional training of the past. Courses must incorporate the needs of the industries students are preparing to enter. Laboratories must allow, enable, and encourage students to work on real-world projects that augment more traditional methods with the controls and measurements that will be used daily in their professional practice. In order to accomplish these objectives, faculty members will also need to continue their own education and professional development. While seminars and training programs will provide one method for accomplishing some tasks, we cannot afford to overlook the need for faculty to go out into the industries they serve and perform supplemental work that will keep them abreast of the continual changes taking place. Not only will this approach allow schools to respond to mandates and meet the criteria set forth by accreditation bodies such as TAC of ABET, but it will more importantly strengthen faculty. Engineering technology faculty can then offer instruction and a much improved learning environment to their students and bring alive the importance of entering their careers with marketable skills that are vital to industry.