PARALLELING THE WORKPLACE ON THE UNIVERSITY CAMPUS: THE EiR PROGRAM AT OHIO NORTHERN UNIVERSITY

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Abstract ¾ The Engineer-in-Residence (EiR) program is a collaborative initiative between the T.J. Smull College of Engineering at Ohio Northern University (ONU), and Marathon Ashland Petroleum LLC (MAP). The program provides an office within the college of engineering from which a practicing professional – the Engineer-in-Residence – operates. The Engineer-in-Residence is an employee of MAP, not ONU. The EiR office space is leased under an annual contract, which includes the provision of some support services. The facility is a scaled-down professional office providing a dedicated office for the EiR, and several engineering cubicles for use by college of engineering undergraduate students. Each station contains a computer workstation, which is linked to the ONU LAN thereby enabling students to gain access to MAP's LAN. Currently MAP has more than fifty projects on which students work under the direction of the EiR. Therefore the program provides students with opportunities to work on real world projects in an environment that parallels the workplace. The agreement also provides a mechanism whereby college of engineering faculty members may invite the EiR to participate in class activities. For up to 15 hours per academic quarter the EiR may be called upon to address workplace-related issues, thereby providing students with a better preparation for professional practice. Example topics include engineering standards, economic, environmental, sustainability, manufacturability, ethical, health and safety, social, and political issues. This paper describes the program, includes comment from the Engineer-in-Residence, undergraduates students, and the dean of engineering at Ohio Northern University.

Index Terms ¾ Professional practice, Co-operative education, Experiential work, and Innovative program.

Introduction

The Engineer-in-Residence (EiR) Program was initiated on September 19th, 2001. It is a unique collaborative effort between the Thomas Jefferson Smull College of Engineering at Ohio Northern University (ONU), and Marathon Ashland Petroleum Company (MAP). The program provides professional workspace located within the Biggs Engineering building at ONU, which includes an office for the EiR and four engineering cubicles for use by college of engineering students. During its first year of operation MAP provided more than 50 projects to the EiR for engineering students to work on.

The EiR is Mr. Michael Chow, PE, a 1992 electrical engineering graduate of Ohio Northern University. Mr. Chow is has worked for the company for 10 years and continues to be a MAP employee. He brings a wide range of company experience to this newly created, independent position.

The EiR Office

The goal of both ONU and MAP is to bring the professional workplace into the academic environment. The office occupies about 560 square feet of space – a previously unused, small classroom, designated to become a materials laboratory, but which had not been developed due to funding constraints. ONU made improvements to the facility and MAP provided all the furniture for a fully equipped manager's office and four engineering workstations. The workspace replicates the engineering environment at MAP – professional quality workspaces, Pentium computers, printer, fax machine, etc., all of which were supplied by the company. Access to the office is facilitated by the use of an electronic lock that enables students to work hours that suit their particular schedules. Mr. Chow's normal workweek runs from Tuesday through Saturday, thereby enabling him to be present outside of regularly scheduled academic (M-F) time. These arrangements guarantee students' access to the EiR on a weekly basis. The computer workstations are equipped with MAP standard software and

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other applications needed for engineering project work. Each is connected via the ONU high speed LAN backbone to the MAP LAN thereby providing essentially the same access to corporate resources as are available at the corporate headquarters located in Findlay, OH.

Comments from the Engineer-in-Residence

The EiR program developed by MAP and ONU adds a new facet to the college of engineering's programs. The EiR program brings the co-op experience to the University campus. A traditional co-op program usually requires students to take time off from their college education to work at a company's facility. MAP has co-op students working in both the traditional and EiR programs.

There are some differences between the traditional co-op program and the EiR program. The EiR students are challenged by the additional task of taking classes full-time while working part-time. These students need good time-management skills in order to be successful at both their studies and their work. In a traditional co-op program, the student is not taking classes and is a full-time worker.

Another difference between these programs is that students in the EiR program are scheduled to graduate in four years. In a traditional co-op program, the students typically take five years to graduate due to the time spent away from college. The EiR program targets those students who normally would not participate in the traditional co-op program, but desire engineering work experience.

The EiR program is a win-win-win situation. The University benefits from its strong tie to a regional and national leader in the industry. The union helps support ONU's engineering accreditation status. The EiR program also provides the University with a strong student recruitment tool.

The co-op students in the EiR program help MAP complete engineering projects, which provide value added service to the company and its business partners. Most of the projects are design-related and having the EiR office in the University's engineering building is an advantage.

The EiR program provides MAP an additional recruiting resource. The EiR program allows MAP to recruit students who normally would not partake in the traditional co-op program. With the opportunity to evaluate the students in the EiR program, MAP has a broader method to appraise a student before he or she receives a full-time job offer.

The students win by gaining valuable engineering work experience working on diverse projects. The students also receive a salary, and they learn how to manage their schoolwork, social life, and work schedule. The challenges of working in the office have not been a detriment to their studies. All the students made the Dean's List the first quarter the office opened.

The EiR serves as the on-site mentor and supervisor for the co-op students. He shares his engineering experience with the students and provides guidance with their projects. There are individual meetings once a week to go over each project. The students meet collectively once a week to discuss projects and issues. The EiR also participates in classroom discussions.

Having the EiR speak about engineering topics in the classrooms has, and will continue to help, both the students and the company. These discussions involve workplace issues and include case studies, helping students to understand how engineers rely on teamwork in the modern engineering environment, discussing design-related issues, and discussing topics such as the need for engineering standards, communications skills, professional ethics, etc.

The discussions provide an avenue to share ideas between industry and educators. The University can adjust its curriculum to better prepare their students for dealing with workplace issues. The company gains knowledge of the skills a graduating engineer will possess and can tailor his or her training appropriately.

MAP is very pleased with the EiR program, which allows the company to tap into a resource of engineering talent and offer students relevant work experience while on campus. The response from ONU's faculty, the co-op students, and MAP to the EiR program has been tremendous.

Comments from the students

An opportunity is provided here for five of the present EiR program students to share their experiences. **Student #1, Shiloh Archer : Senior - Civil Engineering**

With a strong interest in Structural Engineering and since Ohio Northern University's Engineering college does not offer a specialization in this area of Civil Engineering, the opportunity to work as a Structural Coop with MAP has had a tremendous impact on my education and future career. Over the past thirteen weeks with MAP, I have been able to apply the following classes to my structural engineering projects: Structures I & II, Reinforced Concrete, Steel Design and Project Management.

My initial project with MAP was to verify and or redesign the structural supports for Marathon and Speedway SuperAmerica LLC convenience store signs. I was given the engineering drawings for proposed signs to be built, and would determine if the sign had sufficient support to satisfy all building codes. Also, I would determine if the structural support of the signs could be reduced while still meeting the building codes to help reduce the cost of construction. Principles learned in Structures I & II were applied to calculate the design moments caused by wind loads and self-weight. When designing the dimensions of the support pole, base plate and anchor bolts Steel Design was utilized. Perhaps the most important class with this project was Reinforced Concrete. The structural foundation of these signs is a reinforced concrete caisson, therefore the required area of steel had to be designed, specifying the size and amount of rebar.

Another major Structural Engineering project I am currently working with is verifying the structural design of both block and brick convenience store buildings. These verifying calculations associated with this project depend directly on a thorough understanding of Structures I & II. The design strength of the buildings' walls and roof systems was calculated based on appropriate dead, live, wind, snow and seismic loads. This design strength has to be sufficient enough to satisfy all building codes.

I have also managed an economic study to determine if a more cost effective approach could be taken to construct the external shell of our convenience stores. Many aspects of the Project Management class were utilized during this study. For example, I developed a task completion order with a corresponding time schedule for myself and the contractors submitting bid proposals to follow. Engineering economics was also utilized to compare the contractor's bids with our current construction costs. Once again, a strong understanding of Structures I & II allowed me to knowledgably communicate with other company's Structural Engineers.

The experiences and knowledge I have gained through the Engineering-in-Residence program have been remarkable. This program helps develop professionalism, an essential part of engineering that cannot be taught completely in the classroom, while continuing the engineering curriculum. MAP and ONU together have given four other students and myself the opportunity to experience the best of two programs, cooping and attending school full-time. The benefits and confidence from this program far outweigh the time commitment, a drawback to many students at ONU, to working with MAP. I truly feel this opportunity has created a solid foundation for me to build my engineering career from.

Student #2, Ann Pfirsch: Senior – Electrical Engineering

For me, the biggest benefit of the EiR program has been applying the theoretical knowledge I learn in the classroom to practical, real world situations. In college, laboratories do a good job of simulating real world experience to a certain extent, but these still have controllable results to a point. Working for MAP, I not only design and simulate an idea but it is actually implemented across the company. This prompts me to think of other factors such as ease of installation/implementation, increased costs for multiple installations, and sustainability of the design for example. Although when designing in classroom labs it is stressed to think of the greater implications, it is easier to do so if the end product can be seen.

Although I have only worked here a short time, several projects that I have completed directly relate back to classroom work that I have done. I had to develop a procedure/specification to test the electrical continuity of gas dispensers. For this

project I used basic circuit analysis/testing skills as well as basic knowledge of circuit safety that I learned about in our Circuits 1 and 2 courses. I also have an ongoing project working with a Programmable Logic Controller (PLC) that entails working with the controller hook-ups as well as programming the PLC. Currently I am enrolled in the second of a three course sequence that deals with analyzing and designing control systems with a lab that looks into the programming aspect. With this project I have had benefits from both sides. I was able to apply knowledge that I learned in the classroom to understand the operation of the PLC in this project. Also working on this project will help me in the lab when we program our controllers because I will already know the language and the logic used. Another example of applying my classroom knowledge was calculating the savings of switching to a new lamps for convenience store lighting. I am currently in an engineering economy class that is focusing on calculations of this sort.

Overall, I would say that this has been an invaluable experience for me. Not only have I learned how to apply my engineering knowledge to projects with real world significance, but I have learned important skills about communication and working with others in a team situation beyond what we do in a typical classroom setting. After working in this program I would highly recommend that anyone who has the chance to take this opportunity.

Student #3, Jason Bandy: Senior – Electrical Engineering

I have gained valuable experience through working for MAP EiR program while pursuing my undergraduate degree.

I am currently also participating in ONU's Senior Design. I feel that I have developed project planning skills and information gathering skills while working for MAP. Project planning and information gathering skills are crucial to my Senior Design experience and any other engineering projects in the future. Mike Chow, the director of the ONU/MAP EiR office presented to the Electrical Engineering Senior Design Seminar class about project planning on several occasions. During project planning phases of projects I have also utilized technical abilities that I have learned through my undergraduate studies.

Several months ago I created a document describing and depicting the standard procedure and design of grounding for an above ground storage tank. This project touched on many different aspects of my classroom studies. In fact, I referred to my Material Science text book on a number of occasions to refresh myself on galvanic series information. I also participated in a project at the MAP Cleveland asphalt terminal in which I met with contractors to install a new section to a motor control center. This installation and discussion with contractors required the use of knowledge form my Power Systems and Controls courses. I am currently beginning a project involving Transmix and Red Dye injection systems. This project will be related to my Control Systems courses and probably will require research beyond what I already know.

Overall the Engineer-In-Residence program has been a great experience for me. It can be difficult at times to balance the schedule between work and school, but I feel that this is improving my time management skills. I would recommend the Engineer-In-Residence program to any engineering student.

Student #4, Tracy Schroeder: Senior - Mechanical Engineering

Through my academic and work experiences, I have found that doing both has been both challenging and rewarding. Sometimes, the projects at work, in addition to a large homework load, constitute a very busy week. However, I believe that, most of the time, the additional effort required results in increased enthusiasm and focus in each area. Also, many of the projects that I have been given both this year and last year at work have been directly related to what I am learning in the classroom.

For example, in April 2002, I completed a car wash study for work in which I evaluated different construction options for convenience store installations. In order to complete the study, I used the five-step engineering method to ensure that all parts of the project were completed in an organized and timely manner. I also used engineering economics skills learned in Numerical Methods class to calculate comparable costs for the options presented.

Another project, which I am currently working on, is creating an electronic picture library of "correct" and "incorrect"

methods used in building new convenience stores. This will be an online library of best practices for those people involved in the construction and/or renovation of convenience stores. This project involves many communication skills, including both oral and written, through presentations, emails, etc. These skills were learned in classes such as Engineering Analysis, where each week, a case study was written for an engineering problem, and every three weeks, a 50-minute individual presentation was given to explain the solution..

Also, I completed a project at work which involved evaluating ways to provide cribbing to support the floating roofs of petroleum-product tanks while the tanks are out of service for routine maintenance. For this, I chose one design and created a program that calculates the number of cribbing locations that would be needed for a particular roof. The resulting numbers were unreasonable in both cost of labor and cost of materials. The recommendation from this evaluation was to use the current cribbing method, in order to save in labor time and equipment. This program was created using skills learned in Statics and Dynamics classes, dealing with static loadings on trusses and deflection of members.

Then Engineering-in-Residence program is a great opportunity for MAP to evaluate potential long-term employees, and the program also gives students a chance to test their engineering skills in a real work setting while gaining valuable experience. Looking ahead, I see continued success and lasting value from the ONU/MAP Engineer-in-Residence program at Ohio Northern University.

Student #5, Tricia Schroeder: Senior – Mechanical Engineering

Through my Junior and Senior years at Ohio Northern University, I was given the unique opportunity to be a part of the Engineer in Residence initiative. For the students participating in this program, there are numerous opportunities and advantages.

For example, I am given experience in projects that allow me to gain exposure to the field of mechanical engineering. Perhaps the leading benefit from this type of program is the opportunity I have to apply classroom knowledge as it is learned. Last year, in the classroom, I learned various methods for gathering engineering information, such as how to find manufacturers of specific products in the United States. These specifics became immediately useful as I was assigned to select the most economically sized water heater for the Speedway SuperAmerica LLC convenience stores. Another one of my projects at MAP involved comparing insulation types to find the most cost-effective system. For this project, several abilities learned in the classroom were utilized, such as calculating R-values, finding and compiling various insulation options, and comparing insulation properties. Finally, several abilities I learned in thermodynamics class were used to calculate the time necessary for an oil tank to cool after it had been heated to a specified temperature.

As a two-year participant in the Engineer-in-Residence program being employed by MAP, I have learned several valuable skills. The communication skills I obtained became immediately applicable in communicating with co-workers inside and outside of the immediate Ohio Northern office. Another valuable outcome was the opportunity to improve my time management skills. I am involved in school activities such as the American Society of Mechanical Engineers, the Society of Women Engineers, Phi Sigma Rho (an engineering social sorority) and Tau Beta Pi, as well as activities outside of school, such as playing the piano at church on Sundays. Keeping a reasonable balance between work, school, and other activities can sometimes be a challenge.

Overall, my experience with the Engineer-in-Residence program has been positive in many aspects. From gaining engineering experience to improving my time management skills, the experience has improved my performance capability in the workplace.

Comments from the dean of engineering

This initiative has exceeded my most optimistic expectations! Prior to joining ONU I had experienced a similar program but wanted to improve on that experience by making the engineer much more visible to undergraduates. Certainly Mr. Chow has done an excellent job of mentoring the students in the program who have worked in excess of 1600 hours, completing more than 40 projects.

There are several benefits, which accrue to the college of engineering. Firstly, the presence of the EiR makes it possible to have a practicing professional engineer discuss work-related issues in the classroom. Written into to EiR contract with MAP is a clause that provides for classroom presentations. Engineering faculty members may invite Mr. Chow to class for a variety of purposes – perhaps to present a case study, or to lead a discussion on contemporary issues such as those relating to "economic, environmental, sustainability, manufacturability, ethical, health and safety, social, and political" issues. Readers familiar with the requirements of the Accreditation Board for Engineering and Technology (ABET's) Criteria 2000 will recognize the specific wording!

From the student perspective the opportunity to undertake "real" engineering project work for an external client has provided them with an outstanding preparation for professional practice. They have certainly had to learn how to manage their time because the engineering degree programs at ONU all exceed 200 quarter-credit hours. Those students who participated in the program in this inaugural year have completed their bachelor's degree requirements in addition to a co-operative education program, in four years, without having to leave campus.

The university has enhanced its relationship with an employer of its engineering graduates and been able to use the program as an example of innovation within the college of engineering. The financial income derived from the EiR lease, although not a huge sum does represent additional income that has been generated from a previously unused space within the engineering building. This income can be used to support the academic programs within the college, or simply to help contain the increasing costs associated with engineering programs. In addition, the remuneration received by students has enabled them to continue their studies while providing resources to pay for the rather high cost associated with private education in the USA.

Lessons Learned From Year 1 From the Engineer-in-Residence

Working in the EiR office helped one student get a job with MAP. Mike Woodruff, a senior electrical engineering student who worked in our office in year 1, accepted a full-time job offer with MAP. Having worked in our EiR office gave MAP the opportunity to evaluate Mr. Woodruff's potential as a full-time Engineer for MAP. This job opportunity may not have been presented had Mr. Woodruff not worked in the MAP EiR office.

Due to the mostly complex engineering design work undertaken in the EiR office, upper-class (Junior and Seniors) engineering students are preferred. The upperclass students have taken the engineering classes and are able to apply this knowledge in completing their work assignments. Two students in the EiR program graduated last year and three senior engineering students were hired for the 2002-2003 school year. They are: Shiloh Archer (civil), Ann Pfirsch (electrical), and Jason Bandy (electrical).

Fifteen hours of work is the average time the co-op students can work in a week. The students are expected to work most of their hours between 8:00 AM and 5:00 PM, Monday through Friday. Since most of the co-ops' work involves working with other Engineers outside of our office, they need to be available during these core business hours. This allows the Engineers and co-ops to be available for discussions during normal business hours.

Three of our students (Tracy Schroeder, Tricia Schroeder, and Jason Bandy) worked in the MAP headquarters in Findlay, Ohio during the summer. The decision was made to place the co-ops in a corporate environment and allow them to gain the experience of working in a much larger office than the EiR office. The students were able to work in different departments within MAP's engineering organization. They helped spread the awareness of the EiR office within the engineering organization. By networking these three students with other Engineers in MAP's main office, they helped generate work for the EiR office once it opened again in the fall. The students brought back projects from their organizations for the EiR office. Twenty-five projects were brought into the EiR office from these three students.

MAP continues to be very pleased with the value-added services the EiR program has provided.