AC 2007-1402: COOPERATIVE EDUCATION AS A PRIME MOVER AND KEY CONSTANT IN INDUSTRY ? UNIVERSITY RELATIONSHIPS

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Cooperative Education as a Prime Mover and Key Constant in Industry - University Relationships

Abstract

The Cooperative Education Experience underpins the educational development of the student, provides an opportunity for the student to become familiar with industry and industry practice, allows industry to become familiar with students and creates a comfortable vehicle for interaction between faculty and industry colleagues. It is the critical crucible where strong individual first-impressions are formed, and more importantly an integrator over time which is the foundation of the association between the industry and the university and the basis for their rapport. When correctly developed and administered by industry and university stakeholders, the coop can be not only the beginning of a longer term relationship between student and industry, but the harbinger of a strong and deep relationship between the company and the university. This paper discusses the development of one such successful relationship and the maturation of a relationship initiated in the cooperative education experience which blossomed into project work at the university, participation on advisory boards, sponsored laboratories, distance learning activities, help retaining faculty and the development of a consortium to support student projects and Accreditation Board for Engineering and Technology (ABET) learning outcomes.

Introduction

All too often the plethora of opportunities presented by cooperative education programs go unrealized. In the minimal case the university perceives the coop program only as a tool to provide students the opportunity to gain professional work experience, and earn money. Again in this minimal case, industry perceives coop only as a "try-out" for potential employees, and as an opportunity to get make temporary hires to accomplish low-level work. In this scenario, neither the university nor the industry invest in an infrastructure to leverage the coop program to maximize outcomes for students and employers. Cooperative education should be much more. It is a low risk vehicle for growth of a relationship between the university and industry, and a device which allows for the evolution of this relationship. Through this device the university and the industry become familiar with each others structures, strengths and limitations.

Cooperative education has inherent educational value. The Accreditation Board for Engineering and Technology implies that engineering education needs to become more holistic in nature. It demands graduates that are integrative as well as analytical. Academia must develop programs that are capable of producing graduates who are adept at functional thinking as well as analytical thinking, alumni as capable of integrating and connecting parts as they are at reductionism. Engineering education must provide exposures that extend a students desire to develop order into an ability to orchestrate chaos, experience which push students beyond a need to create certainty to enable them to develop a tolerance for and an understanding of risk and an attendant ability to embrace ambiguity. It requires engineers to practice problem forming as well as solving. It will stress engineering design and the ability to realize products. To be successful, engineers will need to have facility with intelligent technology to enhance creative opportunity. They will need the ability to manage complexity and uncertainty as members of productive teams rather than

independent investigators. The engineer will need to be sensitive in and to interpersonal relationships. The engineer will need proficiency with language and a cosmopolitan sense of multi-cultural understanding. The engineer will need a capability to advocate and influence rather than to simply advise. Graduates must see the world as whole and sense the coupling among seemingly disparate fields of endeavor. Out of necessity, engineers will become entrepreneurs and decision-makers. In short we must create unbiased attitudes of inquiry at the academic institution, finding balance between synthesis and analysis, research and design and process exposures and device centered education and theory.

One certain method to create meaningful exposures for students which incorporate these features is to enlist the partnership of industry in our educational process. Industry lives the requirements sought in academia each day. Not only can coop experiences provide many of the exposures desired, but returning students and a persisting relationship with corporate sponsors can bring similar exposures to the campus setting. Cooperative education provides one powerful vehicle to embellish the abstract learning which characterizes our academic institutions with valuable experiential learning and to infuse the academic environment with key features desired by ABET.

The Basic Relationship

The bromide that the world is changing is particularly confounding today because the rate of change is accelerating. Industry is forced to design new products ever more rapidly, leading to shorter and shorter lifetimes before they must be replaced with new generations of product. This requires evermore effective manufacturing, and more rapid return on development costs in order to become profitable before obsolescence occurs. Similarly, in many cases industry must amortize equipment over ever shorter periods to remain competitive with world-wide best practices. In academia, we speak of a knowledge explosion which engenders a continuously evolving curricula. The potential of a misstep to wreak havoc in each setting is magnified by the rapidity of change.

Universities desire to be characterized by an acceptance of diverse opinions, and closely guard academic freedom. The purists consider the pursuit of knowledge justification enough for their existence, but most in academia, particularly those in engineering, have come to realize that the search for truth must be combined with an effort to make that truth serve the public good. Companies are characterized by a need to “meet the bottom line” and to create competitive advantage. Historically, companies have viewed universities, and even the government, at best as inert players in their economic competition – as suppliers of talent and unpolished ideas and the definer of rules in the economic milieu respectively. Now however, industry understands that academic institutions may offer more direct support, and that an active engagement with academia may enhance a company’s ability to recognize valuable change and to implement it. Academia and industry are active co-participants in a global economic match, and the relationships among the entities become more vigorous, continuous and co-dependent. This change presents opportunities (and some dilemmas) for all who participate.

It is a long standing premise of U.S. national policy that our economic and social well being and future vitality depend on the ability to make continuous advances in engineering. It is hard to

imagine our lives today without innovations like the microchip, polio vaccine, television, or synthetic materials. Similarly, today's discoveries foreshadow breakthroughs in biomedical engineering, information science and nanotechnology. Work in these areas will have profound impact on the human condition and on world economy.

Industry must remain firmly grounded in its ability to draw upon technical innovation. The National Science and Technology Council has reported that science and technology have generated about half the productivity growth the United States has enjoyed over the last fifty years and created millions of high-skill, high-wage jobs. The Department of Commerce estimates that technology industries have contributed more than one-half of the growth in real output for the economy over the last four years. The future depends on our ability to sustain scientific and technical progress. To do this we must meet the growing demand for the highly trained science and engineering workers whose knowledge and inspired work make continued progress possible.

Partnering Crucial

The relationship between the triad of academia, industry, government in their service to society is complex. Simply stated, the goal of our economic engine is to create wealth. To create sustainable wealth in the 21st century we must maintain a steady flow of technically competent people, we must continuously foster new ideas and thought which will form the basis for both evolutionary advances in productivity and revolutionary advances in capability, and we must develop novel tools to empower new ways of measuring and visualizing the complex world around us. No one entity in our triad can accomplish these goals, to be successful industry, academia and government must come together in meaningful ways to form partnerships, to integrate research and practice with education, and to provide solid venues for technology transfer.

Plainly, the primary role of industry is to be profitable! Industry is the heart of the economic engine that drives our society. No academic relationship with industry can or should be based on altruism or pity. Rather, corporate involvement with academia should be based on a progressive self-interest. Industry should recognize the need to create graduates who can compete in the global environment of the 21st century as well as the need to empower students and academics to generate the ideas which will form the intellectual capital of the coming decades.

Academia has the responsibility to foster such graduates and to incubate these ideas. It must create a scientific, mathematical and engineering literacy in its graduates, coupled with an ability to communicate, an appreciation for arts and humanities, and an understanding of the roles and responsibilities of technology in a modern society. In a real sense the goal of academia is to create the capacity for learning and innovation in a meaningfully large and diverse population. Academia must participate in dissemination, discovery, integration and employment of new information in service to our society.

Clearly, for each to accomplish its mission, effective partnership is required. Academia does not, can not and should not attempt to tell industry how to make money. Similarly, industry does not, can not and should not tell academia how to educate students. Rather we are informed by each other in a synergistic partnership.

The Value of Cooperative Education

Cooperative education is the key component, and often the seminal component in any company's relationship to the university. Correctly managed, it is the first encounter in a mating dance and subsequent happy union which leads to stronger relationships and continued activities. Properly applied cooperative education is a dynamic plan for learning and professional development that integrates classroom theory with the world of work. Students combine academic course work with paid employment in fields related to their course of study. They secure academic credit through course registration and pay fees for all quarters on work assignment. Cooperative education in the United States began in the early 1900's at the University of Cincinnati. It was designed primarily for engineers, but has since expanded to include all colleges and disciplines. The most rapid development took place in the late 1970's through the 1980's, when grants from the federal government enabled many colleges and universities to develop cooperative education programs. Today, thousands of colleges and universities maintain active cooperative education programs; not only in the United States but throughout the world. Still, cooperative education remains an underutilized resource or an overlooked opportunity in many cases. It is the most common first contact between a company and an academic entity. Too often it is seen simply as a tactical exercise by both industry and academia rather than as the strategic opportunity it represents.

In the proper industrial context, the coop activity is the lynchpin not only for university recruiting, but for the development of collaborative research and for employee and student career development. Effective coop exposures can eliminate hiring guesswork, cut down on training time for new hires and leverage corporate time and resource. From the industrial standpoint, the coop is, at a minimum, an effective probationary period for potential employees. However, when correctly managed, it can provide continued project efforts on-site. An effective coop experience can lead to follow-on work in the context of a senior project or even a thesis. It is in the corporate interest to maintain contact with coop students when they return to campus. **The concept of students returning to campus with continued sponsored project support from their industrial partner is the key component to enhanced relations with industry**. Interestingly, many students continue their relationship even further and develop projects used for advanced degree thesis credit. A corporate partner actually encourages more students to go on to grad school! These projects are financially supported, create excitement in the student population, and enhance salary prospects. When a critical mass of coop students return to campus, and bring supported work with them, they provide a mentoring group that reinforces corporate culture on campus and provides leadership competencies when students attempt to work together.

In fact, this nucleus can develop into a consortium on the campus. A *de-facto* industry/academic partnership that matches multidisciplinary teams of undergraduate and masters-level engineering students with the project needs of industrial partners. Developers provide an infrastructure to simultaneously work on the confidential projects of competing companies. Industry provides the project topics and technical mentors, extending the educational abilities of the faculty and providing leadership opportunity for industry participants. Projects are self-selected by students based upon a match with their background skills and educational goals. Flexible project space,

with physical isolation between company projects, is provided by the campus, often with industrial sponsorship. This physical space serves as the focus of continuity for more complex, longer-term, multi-disciplinary projects. Older students who are returning from coops at a consortium member company serve as sources of corporate culture and mentorship, while academic advisors from multiple disciplines round out the advising trio and ensure that balanced learning objectives are met.

Success is only possible with a long-term commitment, so buy-in by industrial partners must be more than superficial. Champions on both the industry and university sides are required! Demonstrated company benefits include additional resource for company engineering projects, the support of training goals for recruiting by providing real-world challenges to potential employees, more work done for less cost, a company may utilize students to supplement heavy peak loads, a company can identify and recruit promising candidates early, and finally the activity provides a head start on training, reduced training requirements by providing experiences that immerse students in company challenges while still in school.

In addition, the growth of the coop program creates a community, on the industrial site, with an interest in both real time and asynchronous curricula. Initially this starts as a vehicle to provide formal instruction to the pool of coop students on-site, who wish to continue to make progress toward degree completion. It quickly expands into a system that provides curricular material to industry employees interested in knowledge enhancement, and then grows into an advanced degree granting endeavor, often with the participation of particularly capable industrial partners as content providers.

A crucial synergy exists between laboratory education, cooperative education experience and the capstone senior project experience. It is only through our long-standing partnership with industry that we are able to provide these three facets of experiential learning, facets which underpin many key elements critical to the education of Twenty-first Century Engineers. Indeed, it is these very elements which provide a unique character to the educational experience. Cooperative education is a personal and institutional commitment. Laboratory education, cooperative education experience and the capstone senior project experience provide opportunities to further integrate the public and private sectors.

Conclusion

In summary, in cooperative education, several basic needs of industry, students, faculty and the university are met. Nascent engineers get an opportunity to gain professional work experience, earn money and embellish their classroom learning with practical on-the-job training, make professional contacts, affirm and develop informed career goals, build confidence and develop the traits ABET sees as critical to become an empowered global engineer. Faculty members are provided the opportunity to expand their pool of colleagues, match their expertise to industrial needs, be informed of industrial needs and develop capabilities which will allow them to interact with corporate partners, recruit partners for proposals, use underutilized capabilities and capacities on industrial sites in their own work and embellish their curricular endeavors with industrial partnership. Industry is provided with increased capability based on faculty expertise and/or unique laboratory equipment, access to bright young engineers, the opportunity to inform

the curriculum, surge capabilities, access to distance learning programs, enabled employee retention and the opportunity to partner with universities on initiatives of mutual interest. The college is provided an enabling device for its students, tools that enable the recruitment and retention of faculty, vehicles for faculty professional development, capable adjunct faculty, partners in the development of laboratory space and equipment acquisition, a source of meaningful project exposure, partners in the assessment process and an able cadre of interested advisors.

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