AC 2012-3008: RESPONDING TO THE CALL: EXTENDING THE UNIVERSITY RELATIONSHIP VIA CONTINUING EDUCATION

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Responding to the Call: Extending the Rose-Hulman Relationship via Continuing Education

Abstract

In August 2010, Indiana State legislators passed the Continuing Education Rule (Indiana Code 25-1-4), requiring Professional Engineers possessing active certificates to complete thirty (30) hours of continuing education in order to renew his or her Professional Engineer registration. In addition, the legislation stipulated that continuing education acquired every biennium must include at least one hour of instruction on ethics as well as Indiana statutes and rules applicable to the practice of professional engineering.

During the fall of 2010, in response to alumni in search of options for satisfying the new requirement, the Department of Engineering Management (EMGT) at Rose-Hulman Institute of Technology (RHIT) presented a solution and began offering a short course entitled *Engineering Ethics: An Overview of Ethics and Indiana Statutes and Rules for Professional Engineers*. The overwhelming success of the course brought to light a greater opportunity for Engineering Management to address the broader issue of lifelong learning for engineers in the state of Indiana. Since then, over 450 professional engineers have engaged in one or more of the 30 continuing education courses offered by the newly formed Continuing and Professional Studies (CPS) unit of Engineering Management. Courses are not restricted solely to professional engineers and are open to the general public, and offered on campus, off campus, and on-site (in-house).

This paper will outline the establishment of the Continuing and Professional Studies unit. To this end, issues pertaining to unit architecture, marketing, challenges and opportunities of on-site programs, as well as the outlook for future opportunities will be addressed. Additionally, the author will discuss how a quick response assessment technique was employed to evaluate participant satisfaction and assist with our continuous improvement practices.

Keywords

Continuing Education, Professional Engineers, Lifelong Learning, Professional Development

Introduction

The idea of continuing education (aka lifelong learning) is not a new phenomenon to engineers. In a discipline that requires its stewards to be adaptive, agile, and creative; continuing education serves as a means to achieve those characteristics. In fact, most professionals, regardless of discipline or position, will agree there is a need for post-baccalaureate training and education in order to remain relevant in their careers. Given that engineers are continually charged with using

ever-changing technologies to deliver innovative processes/products and business solutions, it is impossible to rely on the skills learned during their undergraduate education.

In an effort to maintain competence and competitiveness in their domain, most engineers employ some means of continuous learning. In their Blueprint for Lifelong Learning the Leadership Group on 21st Century Skills stated, "as business changes accelerate and require ever-higher skill levels, continuous workforce learning is becoming a more critical priority"[1]. More specifically, licensed Professional Engineers (PEs) in the United States are required to maintain and improve their professional and managerial skills through continuing education courses and other opportunities for professional development as an element of the recertification process. As of May 2011, all but eight (8) states enforce this requirement[2]. Though the requirements may vary from state to state, each state has the goal of structuring a process to ensure PEs engage in useful learning experiences that foster professional growth. Indiana's legislation specifically requires its licensed engineers to take courses relating to and enhancing the practice of engineering. As a part of the continuing education requirement it requires at least one professional development hour (PDH) each on the subject of Ethics and Indiana Laws and Rules for Engineers. Providing a course to satisfy this requirement served as the impetus for the unit's outreach efforts.

In the state of Indiana there are more than 3000 licensed professional engineers who at some point in their career will need to recertify their credentials and therefore will participate in a structured form of continuing education[3]. In an attempt to provide a response to the growing demand for continuing education within the state's engineering community, Rose-Hulman Institute of Technology has established the Continuing and Professional Studies (CPS) unit as an extension of Engineering Management. The primary function of CPS is to deliver high-quality, face-to-face engineering, technical, professional, and managerial curricula to engineers, both professional and non-professional. In this paper the author will discuss the following topics:

I. Unit Structure
II. Marketing
III. Initial Course: Professional Engineering Ethics
IV. On-site Program Development
V. Satisfaction and Program Assessment
VI. Future Opportunities

Unit Structure

The Department of Engineering Management served as the original governing agency for off-campus post-baccalaureate instructional efforts of the Institute. When the opportunity to deliver short courses to professional and practicing engineers began, the alignment with Engineering Management activities was seamless. However, as the instructional opportunities began to grow and diversify it quickly became evident a new structure was necessary to separate

responsibilities. Continuing and Professional Studies was developed to market, organize, manage, and deliver continuing education and professional development activities.

From the onset the managerial framework and staffing for CPS was easily operationalized as a result of the collaboration between the Office of Sponsored Programs (OSP) and Engineering Management. The division of labor allowed Engineering Management to coordinate faculty and instructional issues, while the Office of Sponsored Programs dealt with administrative concerns. Additionally, a Project Coordinator and Project Advisor were added to the team. This four-person staff has served as the inaugural management group for the unit.

Table 1 shows the project lifecycle and responsible parties for short courses delivered by CPS. Currently, CPS provides learning activities to the general public and on-site for private organizations seeking to serve large internal constituencies. In the subsequent paragraphs the process will be discussed further.

Table 1. Project Life Cycle and Responsible Parties

Stage	Responsible Party
Opportunity Identification and Development	Engineering Management
Contracting	Office of Sponsored Programs
Administrative Arrangements	Office of Sponsored Programs
Project Deployment	Engineering Management and Rose-Hulman Faculty
Assessment	Office of Institutional Research, Planning and Assessment

Once an opportunity has been proposed or identified by CPS, faculty resources will be generated. In situations in which the area of expertise is not covered within the Rose-Hulman curriculum or faculty capability, an alumnus or qualified professional representing the area is contracted. If the opportunity requires or involves on-site delivery of instruction, we move into the contracting phase. Working with OSP and the Institute's attorney, a Statement of Work (SOW) is drafted to outline the terms and conditions of the engagement. Typically, the SOW will contain the detailed of responsibilities for each party, intellectual property rights, and termination and/or modifications to the contract. Additionally, the SOW presents a draft budget and the payment terms and conditions. If the short course is being offered to the general public, a contract is not used. Instead an event website is deployed to outline course details. Website development and maintenance are controlled by the Institute's Marketing and Communications Department.

After the SOW is completed and a timeframe scheduled, a request is made to selected faculty for course objectives. At this time faculty are made aware of the compensation model for their off-campus short course offering. The current financial model incorporates four factors to determine compensation: current nine-month salary, development hours, delivery hours, and travel. The actual salary payment is a function of the number of face-to-face delivery hours and the time incorporated for preparation. Reimbursement for travel is handled as normal business travel which is defined by the Business Office and the IRS. All salary affairs are handled by the Office of Sponsored Programs and Payroll to maintain the highest levels of privacy. With a fully-

executed contract and faculty in place, the Project Coordinator begins the process of defining the tactical activities necessary to deliver instruction. Once those details are solidified, the focus is shifted to the actual deployment of the short course(s).

Upon completion of the short course(s) all participants are emailed an evaluation request. The assessment instrument is available electronically for approximately two weeks after each session. At the end of the first week a response rate is provided by the Office of Institutional Research, Planning and Assessment (IRPA) and a secondary email is sent if the response rate is lower than 60%. To date our average response rate is approximately 73%.

Marketing

To assist in developing a new communicating strategy we returned to our alumni to discuss new services offered by Continuing and Professional Studies. As previously mentioned, members of the Alumni Advisory Board had previously voiced a desire for Rose-Hulman to offer continuing education courses. However, most of the previous attempts to provide such services were limited to on-campus courses that transpired during the academic year. For most of our alumni this did not fit their needs. As such, we shifted our sights to offering short courses in Indianapolis, IN to compliment what we offered on campus (Terre Haute, IN). In doing so, we are able to serve the largest concentration of our alumni and attract other professional engineers looking for relevant, face-to-face engineering short courses. There exists a large number of agencies offering continuing education courses in the Indianapolis area, but our value proposition is the face-to-face, interactive delivery of engineering topics to small groups of professionals. This approach mirrors the on-campus instruction that alumni have come to appreciate.

A three-pronged approach was selected to advertise the course offerings for the 2010/2011 academic year. The first mode of advertising employed a mass email campaign. Emails were sent to alumni who graduated within the last 20 years and lived within a one-hour radius of Indianapolis. The second approach communicated the course offerings to the professional engineering societies (e.g. ASME, IEEE, ASCE, etc.) with chapters in Indianapolis. Last, and possibly the most effective, was the word-of-mouth communications with alumni and colleagues.

Initial Course

Professional Engineering Ethics was the first course offered by the Continuing and Professional Studies (CPS) Unit. This course was developed in direct response to Indiana Legislation which stated that a professional engineer shall complete 30 hours of continuing education during each biennium renewal period in order to maintain his or her registration. More specifically, the ruling mandated that at least one hour of continuing education should be focused on ethics and at least one hour should focus on Indiana statutes and rules. Each of the courses must be specific to the practice of professional engineering. The new law further stated each course must contain three specific qualifications to be approved. These qualifications required that the courses 1.) to

utilize qualified instructors with demonstrated competence in the subject area, 2.) be held in adequate facilities to allow for an effective program, and 3.) employ a variety of educational methods and teaching aids to enhance the learning process[4].

In response to these criteria, CPS created a two-hour short course to satisfy the mandatory components of the law. We employed three instructors per course: two attorneys and one faculty member. One attorney provided instruction relevant to administrative issues, while the second attorney discussed case law related to engineering litigation. In addition to their law degrees, both attorneys possess at least one degree in engineering. Two different faculty members were selected to teach the ethics portion of the course. The first faculty member qualified by virtue of being an Ethicist and having taught for 20 years at an engineering institution. The second faculty member was selected due to his industrial experience and leadership in engineering arenas where ethical scenarios are regularly encountered. Each general public course was hosted by the presenting attorney's law office and held at that location. Enrollment was limited to 20 students for each. This provided an environment where dynamic and interactive instruction could be facilitated. The limited number of participants facilitated a better opportunity for personal (specific) questions to asked and answered immediately. In some instances, actual legal documentation was reviewed in response to a participant's query. Overall, participants enjoyed the experience, both instructionally and logistically. The feedback from these sessions can be viewed in the assessment section of this paper.

On-site Program Development

As word-of-mouth advertising took effect in the professional engineering community in Indianapolis, a new opportunity was presented to CPS. An alumnus representing the largest employer of Rose-Hulman graduates in the Indianapolis area requested that the two-hour Professional Engineering Ethics course be delivered on-site for their engineers, of which there are approximately 350+. Not all participants would be professional engineers. For non-PEs the instruction would count toward their personal professional development plans. While CPS was willing to satisfy this need, we reached an understanding that capped the limit of classes to 30 and expanded the instruction time to 1.5 hours per topic. The additional time was requested to allow organic discussions to develop and ensure questions could be thoroughly answered without compromising the instruction.

Four sessions were initially scheduled to pilot the program during the first quarter of 2011. The sessions went well and an additional four were scheduled for the second quarter of 2011. However, the enrollment limit was reduced to 25 students. It was noticed that the previous sessions would run over the established time limits as instructors responded to questions posed. This didn't sit well with some of the participants. Therefore, during the second set of sessions additional efforts were made to better manage the allotted time. Course evaluations from all sessions were positive and led to a larger proposal being presented to CPS.

The second proposal requested CPS develop a four-day, 30-hour Mechanical Engineering Design Seminar. The purpose of this seminar would be two-fold. The first objective would be to fulfill all continuing education requirements for recertification, while the second objective would be to provide updated instruction on designing mechanical devices with plastics. The following table outlines the topics covered during the seminar, which was delivered in July 2011.

Table 2. Mechanical Engineering Design Topics

Day One	Day Three
Mechanical Behavior of Polymers The Effect of Solvent on Polymers Material Properties of Polymers	Failure of Plastics Design for Manufacturing Design for Injection Molding
Day Two	Day Four
Material Testing of Polymers Degradation of Polymers Viscoelastic Design	Six Sigma Methodologies Machine Design Ethics and Law

Participant feedback indicated the instruction met the organization's requirements. Overall, 100% of participants stated they were "very satisfied" or "satisfied" with the courses. Additionally, 94% of the participants recorded their understanding of Mechanical Engineering Design and its related topics "greatly increased" or "increased" as a result of the seminar. Aggregate assessment data from these 12 sessions is presented later in the paper.

Currently, CPS is in the process of designing and deploying a 36-hour, on-site Chemical Engineering Seminar for a regional chemical manufacturer. This seminar will be delivered as a series of six one day (six-hour) sessions. Of the six sessions, Day One is mandatory for all participants as it includes the ethics session required by Indiana law. The first session will begin in December 2011 and the last session will be offered before the end of June 2012. The initial plan is to offer one session per month and leave a time buffer in case a session needs to be canceled or rescheduled. This format change is one of the lessons learned from the Mechanical Engineering Design Seminar. Furthermore, this is critical since participants will have the luxury of selecting which four days they will attend in addition to the one mandatory day. To date, the session topics have been agreed upon and the first two sessions have been scheduled. The following table contains the initial list of topics to be covered.

Table 3. Chemical Engineering Topics

Day One (Mandatory)	Day Two	Day Three
Ethics Presentation Skills/Technical Writing	Fluid Mechanics Thermodynamics	Process Instrumentation Process Control
Day Four	Day Five	Day Six
Process Safety Management Heat Transfer	Manufacturing Optimization Powder Handling	Project Management Manufacturing Economics

Assessment Activities

Designing short courses to meet the learning needs and styles of practicing engineers [adult learners] can be daunting. Older students present the instructors with unusual challenges since they don't necessarily respond well to traditional methods of teaching[5]. However, it is still necessary to make every effort to ensure the delivery of quality instruction is deemed "useful" by the participants. This means that as a result of participating in the short course the learner feels they have received instruction that facilitates "deep learning" which allows him/her to perform their job functions better (i.e. enhances their practice of engineering)[6].

One means of ensuring impactful short course instruction is the development of an evaluation system that assesses the delivery and cost-effectiveness of the course or multi-day seminar. To achieve this goal, CPS, working in conjunction with the Office of Institutional Research, Planning and Assessment, established an electronic data gathering instrument to be used in each course. The questionnaire asked participants to provide their assessment of the course and its instructor(s). Participants are sent an email requesting their feedback within 12 hours of completing the course. In the case of on-site, multi-day sessions, participants received a prompt at the close of each day directing them to the assessment hyperlink. This provided the author the ability to glean opportunities for improvement each evening and communicate any concerns to faculty slated to teach the next morning or later in the program. This quasi-real-time assessment paid great dividends and will be replicated in future multi-day, on-site programs. The following paragraph describes the five-item questionnaire survey used to evaluate CPS courses.

Item One used a five-point Likert scale (excellent, very good, good, fair, and poor) and asked participants to assess four elements of cost-effectiveness for each session: overall impression of the session, value of session, quality of course materials (thoroughness and presentation), and quality of location (logistical and learning appropriateness). The "strongly agree" to "strongly disagree" five-point Likert scale was employed in Item Two to capture participants' thoughts on the instructor(s). Each instructor was evaluated on their knowledge of subject, preparation for the session, and ability to present/communicate the relevant information. In addition to these specific component-level queries of Items One and Two, Item Three asked participants the more general question: Would they recommend the course to others (friend or colleagues)? The questionnaire allowed respondents to select from the options: definitely yes, probably yes, undecided, probably not, and definitely not. Finally, to achieve a balanced assessment of the sessions, two open-ended items were presented to capture qualitative data related to the session. The first item (Item Four) sought to capture any suggestions or comments that CPS could use to improve the overall learning experience for future courses, while the last item (Item Five) solicited input for other topics/courses participants would like to see offered in the future.

Below are the aggregate results from the short courses offered during the 2010-2011 academic year.

Professional Engineering Ethics (General Public) – Six Sessions

Ratings of the Course	E	VG	G	F	P
Overall impression of the course	33%	37%	24%	2%	3%
Value of course information and content	32%	34%	29%	3%	1%
Quality of course notes	26%	36%	27%	9%	1%
Quality of facilities	38%	45%	14%	3%	0%
Opinions of the Instructor(s)	SA	A	N	D	SD
Instructor's knowledge: very knowledgeable about the subject	54%	41%	4%	1%	0%
Instructor's preparation: well-prepared for this course	52%	38%	7%	2%	1%
Instructor's communication skills: ability to convey the relevant information	50%	41%	5%	4%	0%
Recommendation	DY	PY	U	PN	DN
Recommend this course to a friend or colleague	60%	32%	3%	5%	0%

Professional Engineering Ethics (In-House) – Four Sessions

Ratings of the Course	E	VG	G	F	P
Overall impression of the course	15%	44%	35%	2%	4%
Value of course information and content	15%	35%	46%	4%	0%
Quality of course notes	10%	29%	48%	13%	0%
Quality of facilities	33%	52%	13%	2%	0%
Opinions of the Instructor(s)	SA	A	N	D	SD
Instructor's knowledge: very knowledgeable about the subject	40%	56%	4%	0%	0%
Instructor's preparation: well-prepared for this course	38%	50%	13%	0%	0%
Instructor's communication skills: ability to convey the relevant information	33%	54%	6%	6%	0%
Recommendation	DY	PY	U	PN	DN
Recommend this course to a friend or colleague	46%	46%	0%	8%	0%

Mechanical Engineering Design Seminar (In-House) – 13 sessions

Ratings of the Course	E	VG	G	F	P
Overall impression of the course	45%	42%	12%	1%	0%
Value of course information and content	46%	38%	14%	2%	0%
Quality of course notes	49%	36%	13%	2%	0%
Quality of facilities	47%	47%	6%	0%	0%
Opinions of the Instructor(s)	SA	A	N	D	SD
Instructor's knowledge: very knowledgeable about the subject	70%	30%	0%	0%	0%
Instructor's preparation: well-prepared for this course	70%	29%	1%	0%	0%
Instructor's communication skills: ability to convey the relevant information	60%	39%	1%	0%	0%
Recommendation	DY	PY	U	PN	DN
Recommend this course to a friend or colleague	64%	32%	3%	2%	0%

Overall, the data analysis indicates the majority of participants are satisfied with the professional development short course offered by CPS. This assessment data was consistent across the two-hour Professional Engineering Ethic courses and the thirty-hour Mechanical Engineering Design Seminar ratings and comments.

In addition to normal instruction comments, a significant process improvement opportunity was uncovered while reviewing the comments gathered following the ME Design Seminar. Given the varying backgrounds and engineering responsibilities among participants, it was suggested that a pre-seminar exchange between the participants and CPS representatives be held to aid in

packaging the presentation topics. Additionally, they suggested future seminars could be completed in a shorter duration. The four consecutive days (seven hour days) of technical instruction seemed to be too much given the professional responsibilities of the participants. The pre-engagement information exchange has been incorporated in the workflow process and is now a line of responsibility in our Statement of Work.

In total, participants believe the previous courses have provided them learning experiences that positively affected their ability to deal with the ethical and technical challenges which they may encounter in their positions. Going forward, CPS and IRPA will continually evaluate the assessment program to ensure the delivery of high quality and relevant short courses for professional and practicing engineers.

Forecast for Future

Given the success of year one, the future of Continuing and Professional Studies at Rose-Hulman is promising. In spite of the current economic environment, organizations and individuals are still looking to participate in short courses germane to their workplace needs. As the lines of responsibilities between engineering and management continue to blur, the need for more non-technical skills, like communication and negotiation, will present a number of diverse opportunities for CPS. Over the next year the author hopes to develop an array of technical and non-technical short courses that reflects the full academic offerings of the Institute in a truncated format. Once completed, the academic menu will be used to provide individuals the option to choose engagements on a bi-monthly basis. Also, organizations will have the opportunity to select from a menu of courses to build a seminar series relevant to their technical and non-technical training needs.

In addition to expanding the course offerings of CPS, a comprehensive marketing plan will be developed. The intent will be to devise a marketing strategy that better aligns with our target audience. This plan will deploy a dynamic strategy that matches not only the current demographic we serve, but the untapped markets as well. The campaign will incorporate both print and electronic communications that will target individuals, organizations, and professional societies showcasing the value proposition of CPS course offerings. Even though this approach is currently being utilized, it will be refined and enhanced to meet newly established goals of increasing course offerings by 25%. Furthermore, the marketing strategy will include a continuous improvement framework to ensure the efficacy of our efforts toward this goal. Given that most effective organizations employ some means of continuous improvement, CPS will not differ in its operating strategies. While continuous improvement is innate to our academic activities via assessment, we will utilize the same principles on our marketing activities to ensure effectiveness.

Summary

The short course programs presented in this document will assist in maintaining and building mutually satisfying professional relationships between engineering practitioners (Alumni and non-Alumni) and Rose-Hulman Institute of Technology. Recent trends indicate the need for continuing education and professional development programs will continue to be a strong component of the technical workforce. According to the Industry Advisory Council of the Accreditation Board for Engineering and Technology (ABET) Inc., competitive organizations understand they must prepare employees to compete in the global economy, to meet and exceed service expectations, to adjust to changing roles and new technologies, and to respond to current and future global pressures. Continuing education and training is no longer considered a cost to cut, but rather an investment to attract and retain the best workforce[7]. From Rose-Hulman's perspective, it is also a way to stay connected with practicing professionals and be aware of their current needs. Thus, continuing education promotes excellence in fulfilling the on-campus educational mission by helping to assure that curricula, materials and delivery techniques are appropriate for the challenges that will be faced by the Institute's graduates.

To paraphrase Jim Collins, Continuing and Professional Studies is not a significantly new educational venture[8]. It is a natural and important extension of Rose-Hulman Institute of Technology's commitment to Engineering education, utilization of effective teaching techniques, and culture of innovation. These three elements define our on-campus learning environment which serves as the kernel for off-campus short courses. This is an evolutionary step in the Institute's efforts to provide high quality, academically rigorous, and relevant technical education to professional and practicing engineers who want to maintain a competitive edge and advance their careers.

References

1. Leadership Group on 21st Century Skills. (2000). *Skills for a New Century: A Blueprint for Lifelong Learning*, Retrieved December 1, 2011, from http://novel.nifl.gov/nifl/skills.htm
2. National Society of Professional Engineers. (2011). *Continuing Education Requirements*, Retrieved December 2, 2011, from http://www.nspe.org/resources/pdfs/education/state_ce_requirements.pdf
3. Indianapolis Professional Licensing Agency Database, December 1, 2011.
4. Indianapolis Professional Licensing Agency. (2011). *Continuing Education Requirements*, Retrieved December 7, 2011, from http://www.in.gov/legislative/iac/20100818-IR-864090788FRA.xml.pdf
5. Giles, J. G., (2006). *Strategies to Assess the Adult Learner*, Retrieved December 10, 2011, from http://www.maa.org/saum/maanotes49/152.html
6. McGonigal, K., (2005). *Teaching for Transformation: From Learning Theories to Teaching Strategies*, Stanford's Center for Teaching and Learning Newsletter, Vol. 14, No. 2.

7. Collins, J. & Hansen, M. T., (2011). Great by Choice: Uncertainty, Chaos, and Luck—Why Some Thrive Despite Them All. New York, NY: HarperCollins Publishers.
8. ABET Inc. (2001). *Issues of Accreditation in Higher Education Vol. II Continuing Education*, Retrieved December 10, 2011, from http://www.abet.org/uploadedFiles/Publications/Special_Reports/Viewpoints_Vol2.pdf