

## University-Industry Partnerships for ABET EC 2000 Preparation: A Case Study

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### Abstract

Preparation for a first ABET EC 2000 visit requires new ways of thinking and organization. Industrial partners can be of strategic help in making the transition from the old to the new Criteria for an Engineering Program or a College of Engineering because most corporations have embraced the “Quality” transitions of the last two decades, including Quality Teams, ISO 9000, Malcolm Baldrige competitions and the like. These companies, therefore, are a resource for the institutional change required to implement EC 2000. This paper presents a case study of how an engineering college teamed with a strategic industrial partner can use expertise and external viewpoint to introduce the concepts of total quality management and Continuous Quality Improvement (CQI) among the faculty. The purpose of this partnership is to focus the thinking of the faculty and administration and to identify areas of strength and weakness within the programs. This paper describes how such a partnership was established over the two-year period – 1999-2000 between the College of Engineering at the University of Texas at El Paso and Raytheon Corporation in preparation for an ABET EC 2000 visit in Fall 2001. An assessment of the faculty after a 1999 joint workshop and 2000 ABET Mock Visit showed: (i) significant improvements in faculty understanding of ABET EC 2000; (ii) significant gains in knowledge of areas of strength and weakness; and (iii) enhanced interdepartmental interaction among faculty in the college.

### The Strategic Partnership

Most university engineering programs now have industrial advisory boards. From the corporate viewpoint, membership on such boards focuses on recruiting students, access to research expertise, and influence on curricular matters of concern to industrial members. From the academic side, industrial members are often sought for corporate placement of student graduates, research funding or collaboration, design project opportunities, financial support and curricular advice. These goals form a solid foundation for the industry-academic partnership. However, to move to the level of a “*strategic* partnership,” a deeper commitment on both sides and longer-term thinking are required. If both the University and the corporate partner are committed, ABET related issues naturally arise. After all, the new EC 2000 criteria are based on outcomes, require dialogue with constituents, and call for data reporting on student performance in the workplace. Although ultimately the burden of responsibility for accreditation falls to the academic institution, industrial partners are also stakeholders in that most want to hire students from accredited programs.

In this case study of the Raytheon-UTEP partnership, all of these core elements were in place. Additionally, Raytheon's extensive experience with "Quality" issues, such as ISO 9000, Total Quality Management, Continuous Quality Improvement (CQI), made Raytheon uniquely qualified to assist the College in its ABET preparation. Specifically, Raytheon knew how to survey constituencies, put a quality team together, measure and assess outcomes, and use the data for establishing a process for continuous improvement. From Raytheon's perspective, there was a commitment to work with its academic partner, but also an awareness that this joint effort would strengthen the relationship, significantly benefiting Raytheon for the reasons outlined above. More importantly, Raytheon personnel had something to contribute that was truly needed and helpful.

This partnership was also intended to help faculty in the College of Engineering focus on ABET's EC 2000 – utilizing industrial expertise and experience with Quality-related processes to teach faculty about Quality, its importance and using Raytheon success stories to illustrate how it can lead to positive change. Although industry is more concerned with ISO 9000 and Six-sigma approaches to CQI, the principles are the same even if the vocabulary is different. Because their knowledge, experience, expertise, and confidence in what they were advocating were so credible, industry representatives were successful in making faculty appreciate the value Quality could bring to their academic processes.

#### Year 1 and Year 2 Retreat and Mock Visit Activities – The UTEP Perspective

College efforts to adopt EC 2000 needed a serious jumpstart. At a meeting of the College Industrial Advisory Group (IAG), discussions of accreditation-related issues made it apparent that nothing less than a college-wide initiative, involving faculty, staff and students, was necessary. Furthermore, discussions suggested that a two-year, two-step process should be put in place, starting with a college-wide retreat. The College of Engineering had not had a college-wide retreat and/or workshop in over 20 years. This alone, then, would be a monumental first step. Thus, the College began plans for an off-campus retreat that would take place during the late summer before classes began. Raytheon would provide facilitators experienced in Quality issues – focused on supporting College faculty and administrators in developing ABET-specific vision and mission statements and educational objectives –both for the college and for each individual program. Several meetings were held in anticipation of the retreat to delineate processes, outline operating procedures and define desired outcomes. At the end of this first retreat, the college and departments left with ABET action plans to work on over the year as preparation for the accreditation visit moved forward. Raytheon facilitators generated detailed documentation that included graphical illustrations and narrative overviews of the entire event including relationships between UTEP's mission and the program's educational objectives, between educational objectives and program outcomes, and between program outcomes and curriculum.

The second step directly involving Raytheon was to have a second college-wide retreat one year later, which would be arranged as a mock ABET visit. The Raytheon Team, consisting of Raytheon personnel and academicians from other institutions, conducted a mock review utilizing EC 2000 criteria and an assessment of progress made on the goals identified the previous year. At the conclusion of the second retreat, the team presented their findings of strengths and

weaknesses for each program in much the same way an ABET visiting team leader would report to the president of a university being reviewed. That presentation was made to the entire group in a manner that was useful –with honesty and forthrightness. Again, the credibility of the outside team members allowed for a very straightforward approach to issues, which led to action plans focusing on ABET-related activities for each program.

This process was well received by both the faculty and administration of the college and provided a focus to help grasp the objectives of EC 2000 in a way that could not have occurred using an insulated/internal self-study approach or a mock visit with feedback from other academics, exclusively. The corporate perspective, especially during the first workshop/retreat in 1999, was a very important driver for shifting faculty thinking from the old input-based ABET criteria to the new outcomes-/CQI-based EC 2000 model. Additionally, the mix of academics and Raytheon engineers during the mock review insured a balanced review – one where both the academic and industry perspectives would be accounted for. The realization that ABET EC 2000 and the corporate quality movement were closely aligned helped faculty accept the new criteria. Finally, industrial participants’ interaction with university faculty helped the industry representatives come to a deeper understanding of those issues currently relevant to engineering education.

#### Year 1 and Year 2 Retreat and Mock Visit Pre-planning Activities--The Raytheon perspective

In 1998, Raytheon Engineering University Relations concluded that assisting universities in their preparations for ABET accreditation would be one of their major thrusts and would represent a key element in their strategic planning. Thus, Raytheon developed a comprehensive approach to providing their strategic university partners the added support to have them adequately and effectively prepared for the ABET Engineering Criteria 2000 Evaluation.

Raytheon decided to utilize its Knowledge Center Southwest (KCSW) team to support the UTEP ABET EC 2000 Retreat Process. The KCSW team charter is to facilitate and conduct workshops to develop and improve Raytheon products using Total Quality Management; Six-Sigma Methodology; Design for Manufacturing and Assembly, Process Characterization, and other techniques. Moreover, the team had experience in auditing engineering and manufacturing processes. Also, KCSW personnel had assumed a leadership role in creating the Raytheon Arizona Governor Quality Award – an award of excellence in the same order as the Malcolm Baldrige Award.

During the planning period, the Raytheon team developed an ABET EC 2000 Retreat/Workshop Process delineating eleven steps. Step 1 was to clearly identify the retreat goals, objectives and outcomes. In other words, how would success for the retreat be defined? – and what would be the expectations of various participants – the College Dean and administrators, faculty, students and the Raytheon KCSW team? To this end, Raytheon solicited the advice of key faculty in the College of Engineering at the University of Arizona [U of A]. U of A faculty had already undergone the formal ABET review and, thus, their insights would be invaluable. It was determined that success for the retreat would be defined by having each engineering program complete the 13-item Kit 1 that had been designed to guide the process. Each item in the kit identified a particular assignment or task for program faculty to complete – resulting in their having devised specific EC 2000 Educational Objectives and Program Outcomes, vision and

mission statements, and laying other groundwork for generating their Self-Study Report and, ultimately, in their adopting CQI processes for ensuring managed and effective change over the long run.

Using the retreat goals, objectives and outcomes as a guide, Raytheon prepared schedules, budgets and agendas for the KCSW team to prepare for the workshop. It was decided that the Retreat participants should be the actual ABET EC 2000 Evaluation stakeholders; that is, Office of the Dean personnel, faculty, students, and supporting university departments (i.e., Physics, Chemistry, Mathematics).

In Steps 2 and 3, the KCSW team collected and read ABET documentation, prepared materials, selected retreat dates, arranged for travel and facilities, notified participants, and started the Vision/Mission development process. Throughout this process, the Raytheon/UTEP Teams had extensive discussions on the deliverables and action plan outputs. It was decided that the primary focus would be ABET's EC 2000, Criteria 2 and 3, and that identifying the educational objectives and program outcomes and assessments for each engineering program would inform all retreat discussions and define deliverables/outcomes of the retreat.

The Year 1 retreat goals and objectives of getting the faculty, staff, and students together, educating them in CQI principles, increasing discussion among the faculty of the college were met with overwhelming success. The quality and quantity of the deliverables varied from program to program – due in part to varying levels of preparedness of individual programs.

The pre-planning process for the Year 2 Mock Visit was done in a similar manner as the Year 1 Retreat Process. For Year 2, it was decided to use ABET's EC 2000 Evaluation Manual (the forms used by actual ABET visitors) as the primary guide. An eight-person team composed of four academicians and four industry representatives led and facilitated the various program level workshops and activities. The team had pre-workshop meetings and teleconference calls to clarify their roles and to review the extensive documentation, including drafts of the programs' draft Self-Study Reports, Year 1 educational objectives, program outcomes and proposed assessment tools and methodologies.

The two workshops are excellent examples of how Raytheon and UTEP developed and nurtured their burgeoning long-term strategic collaboration and partnerships to achieve the strategic goals and mutual interests of both organizations.

The actual Mock Visit Retreat spanned three days. The first day was on campus and involved about 20 faculty and staff in the college. The entire faculty participated in Days 2 and 3, which were held off-site so that all attending would not be distracted, but instead expressly focused on the business at hand.

Day 1 was a structured tour and assessment of the instructional laboratories. Each program had a host team and contributed faculty to form teams that would visit other programs. The host team was typically the head of the program, the key laboratory staff technicians, and faculty who had traditionally taken on responsibilities associated with the undergraduate labs.

Each department prepared for the visit and tour of their undergraduate laboratories as if being visited by an ABET evaluator. Teams of visitors from other programs were formed, consisting of a member from each department not their own. These teams “visited” a program, heard a presentation, toured the lab space, visited with students who have actually taken laboratory courses, and evaluated the program labs, lab processes, and lab strategies according to a “score sheet” that was developed at UTEP and proposed questions on quality, safety, etc.

Program representatives connected to the laboratories gave presentations lasting 30-45 minutes. These presentations included:

- a. Descriptions of the laboratory spaces including square footage.
- b. A listing and description of equipment.
- c. A list of responsible people and/or positions (for instance, a committee might be responsible for a lab or all the labs so the chairman would be the responsible party, but since the person changes, mentioning the position makes the documentation and process more informative).
- d. Safety issues.
- e. Plans for keeping the labs and lab equipment up-to-date (money and maintenance).
- f. Plan for Continuous Quality Improvement.

About 30 minutes were allotted for the tour of the labs, and an equal amount of time was allotted for focus group-type discussions with about five students from the program including recent graduates with some experience taking the laboratory courses.

Finally, 30 minutes were allotted for the visitors to meet alone to consolidate their findings and generate a report, which was delivered to the chairman.

Total time for the entire exercise was about 2 hours. The product of this exercise is that each program now has on file documented plans for dealing with labs, lab courses, and lab equipment for the undergraduate curriculum, and each department has a thorough evaluation of those plans and its facilities by an independent team of experienced academics. It was suggested that the documents, plans, and their critique by the visiting team were then to be shared with the department’s advisory board. This exercise was so successful that the department chairs recommended that it become an annual activity.

The rest of the Mock Visit was held off campus. Day 2 started with breakfast, opening remarks by a number of people with Raytheon and with UTEP, and a presentation describing how the Mock Visit would work. Before the visit, the faculty of each program was divided in two equal halves. For Stage I of the Mock Visit, in the morning, one half of the faculty would be hosts and they would be visited by a team of faculty outside their department, led by an outside industrial or academic expert. For Stage II of the Mock Visit, the hosts of each program became visitors and those who were visitors became hosts. Program Directors were hosts all day.

The visiting team members were given specific assignments to determine how well the program had met the elements of EC 2000. Team leaders were given the same forms as those used by ABET visitors during actual visits. The Program Directors were responsible to make all the resources they could available, including course packets for all courses in the program (excepting, at this early stage, some Core courses served by departments outside the College),

faculty, and students. The visitors were to treat this as a sort of scavenger hunt, seeking answers to the questions posed in their individual assignments. If visitors were unable to find the information they needed from the faculty, the director, the materials provided or from the students, the program was typically identified as deficient for that element of the Criterion. (If one cannot find it, it does not exist!)

Each Stage was followed by a discussion (away from the Program hosts) by the visiting team. After the discussion, the assignments were collected and the Team Leader prepared a report.

After a break and dinner (which included a speaker with significant insight into ABET's EC 2000), the College as a whole was debriefed by the individual Team Leaders as to the current status of the program's compliance with EC 2000. The Team Leaders were instructed to be brutally yet tactfully honest in their overall assessments.

Day 2, following breakfast, opening remarks, and many thanks to those who had donated personal time for the benefit of the College, the day was left to the programs to generate action plans, including action items, timeline, and responsible party or parties for the next year.

#### Participant Feedback and Comments

At the end of the ABET Mock Visit, participants were asked to complete a nine-item questionnaire. Six of the items were close-ended and asked participants to rate the Mock Visit in terms of "prior to Mock Visit" and "after Mock visit" levels of understanding of ABET, levels of understanding of the importance of ABET, levels of knowledge of what their program needed to do to get ready for ABET, levels of knowledge about the College and other engineering programs, levels of interaction with faculty from other departments in the College and overall value of the visit. Two of the items were open-ended and asked participants for suggestions on how to improve the Mock Visit and ways the Mock Visit was helpful and/or useful. Participants completed the questionnaire in about ten minutes.

Twenty-six participants completed the College of Engineering Retreat/ABET Mock Visit questionnaire. Three of the participants had been at UTEP for less than one year. Twelve participants had been at UTEP for 1-10 years and eleven participants had been at UTEP for more than 11 years.

Findings from the questionnaire indicate an increase in participants' understanding of ABET, the importance of ABET, knowledge of next steps for their departments, knowledge of the College and other departments, and level of interaction with faculty in departments other than their own. On a scale of 1 (low) to 5 (high), 72% of the participants reported that they would rate the Mock Visit as having a "somewhat high" to "high" value. The mean for the overall rating of the value of the Mock Visit was 3.92 with a standard deviation of 1.04.

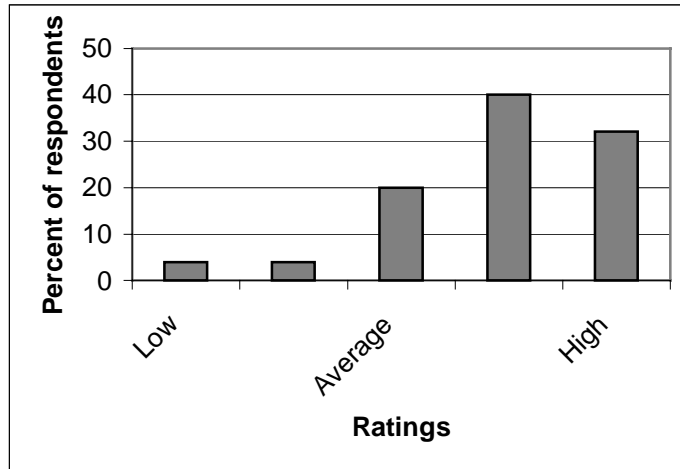


Figure 1. Overall value of Mock Visit

Based on an analysis of the difference between responses “prior to the mock visit” and “after the mock visit” levels, the largest increase was found to be in participants’ knowledge about what their program has to do to get ready for the ABET/CSAB accreditation visit (“prior to the mock visit”  $X = 2.73$ ,  $SD = 1.15$ ; “after the mock visit”  $X = 4.08$ ,  $SD = 1.06$  with 1 = low and 5 = high). “Knowledge about the College and other engineering programs in the College” also showed a large increase (“prior to the mock visit”  $X = 2.73$ ,  $SD = 1.15$ ; “after the mock visit”  $X = 3.92$ ,  $SD = .69$ ).

Table 1. Survey Results

Item	Mean		SD		Difference
	Prior	After	Prior	After	
Knowledge of what my program has to do to get ready for the ABET/CSAB accreditation visit.	2.73	4.08	1.15	1.06	1.35
Knowledge about the College and other engineering programs in the College.	2.73	3.92	1.15	.69	1.19
Level of interaction with the faculty from other departments in the College of Engineering	3.00	3.42	1.10	.86	.42
Understanding ABET	3.29	3.92	1.12	.76	.23
Understanding the importance of ABET	4.31	4.45	1.01	.65	.23

Participants began the Mock Visit with a somewhat high level of understanding of the importance of ABET, probably based on a combination of experience and the retreat from the previous year, and ended the Mock Visit with a slightly higher level of understanding of ABET.

Recommendations on “how to improve the Mock Visit,” ranged from wanting “more guidance and explanation” to “providing more preparation before the visit,” such as receiving more instructions and procedures. One participant remarked that

“It would probably be too much to ask of us, but we could have done a much better job (evaluating another program) if we had reviewed the self-study prior to evaluating each other.”

Two other participants supported the need for getting more prepared when one wrote, “Distribute Self-Study Document to evaluators (faculty from other programs and the College and industry volunteers) a week before the Mock Visit,” and “material should be received prior to the experience (e.g., self-study should be given to visiting team 1-2 days before) and clear instructions (with relevant questions) should be given to the visiting team.”

Another participant suggested that the Mock Visit would have been more valuable if “the self-study document was more complete.”

Several participants recommended that there be “more detailed information about the visit prior to the visit,” “providing a clear description of the process before sending visitors” or “providing better pre-Mock Visit documentation that explained the entire process.”

Analysis of the comments on the usefulness/helpfulness of the Mock Visits revealed that the visit provided a way of “scaring faculty to get on board while clarifying the importance of the process descriptions.” In addition, the Mock Visit provided participants with a way to think about their own department deficiencies based on descriptions of the deficiencies of other departments, to think about the ABET process, and provided an opportunity to reiterate what needs to be done in the department to get ready for the ABET review. Most of all, the Mock Visit “forced programs to become more serious about the ABET visit.”

The ABET Mock Visit provided participants with (1) the opportunity to reflect on their department’s ABET process and documentation before the ABET accreditation visit; (2) critical review of the College’s and department’s ABET process; (3) feedback on the strengths and weaknesses of each program’s self study; and (4) recommendations for improvement of the process and self-study in time to improve both.

## Summary

UTEP and Raytheon have taken the university-industrial constituency relationship to the level of a Strategic Partnership with Raytheon’s contribution of financial and human resources – experience and expertise – to UTEP’s College of Engineering in their efforts to adopt CQI principles for addressing ABET’s EC 2000. The major result of this collaboration, which extends beyond the focus of this paper, is that engineering faculty are ready and prepared for their ABET visit in the fall of 2001. Moreover, college programs are uniquely informed to address the needs of its industry partners by educating and producing engineers capable of meeting the demands of today’s corporate environment.



## Biographical Information

### ANDREW SWIFT

Andrew Swift is currently the Dean of Engineering at the University of Texas at El Paso. He received his BS degrees in Mathematics and Mechanical Engineering from Union College, Schenectady, NY; his MS and Sc. D. degrees in Mechanical Engineering from Washington University in St. Louis, MO. Dr. Swift's technical research area is in power and energy systems, and he is currently a co-investigator on an NSF funded Model Institutions for Excellence Grant over 8 years focused on improving undergraduate science and engineering student retention and graduation rates. He also regularly teaches a freshman engineering seminar.

### DR. GREGORY B. LUSH

Gregory Lush is the Executive Director of the ABET-CQI committee which is the committee leading UTEP's efforts to address EC 2000. He obtained his B.S. from the University of Notre Dame and his M.S. and Ph.D. from Purdue University, all in Electrical Engineering. His interests range from electronic materials and devices, to programming, to teaching and learning strategies and educational issues.

### CONNIE KUBO DELLA-PIANA

Dr. Connie Kubo Della-Piana is currently the Director of Evaluation for two National Science Foundation projects, the Model Institutions for Excellence and the Partnership for Excellence in Teacher Education. She has been involved in the evaluation of projects funded by the Smithsonian Institution, the Red Cross, the National Institutes for Health, the Department of Education and NASA.

### ISADORE T. DAVIS

Isadore Davis is currently the Manager of Raytheon Engineering University Relations. He received his B. S. in Mathematics with a minor in Physics from Prairie View A & M University; M.S. in Engineering Mechanics and Minor in Civil Engineering from Iowa State University in Ames, Iowa. He was an Asst. Professor of Civil Engineering at Prairie View A & M University from 1976 -1978. Over the last ten years he has regularly taught engineering, mathematics and management courses at Pima County Community College. He has twenty years of industry experience in Structural Analysis (Stress and Dynamics Analysis), Six Sigma Methodologies and Design for Manufacturing and Assembly and Management. He is currently the Chair of UTEP's Industrial Affiliates Group and is Raytheon's Campus Manager for UTEP.