Session 2532

CONTINUOUS DEVELOPMENT OF A NEW ECE PROGRAM

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Abstract - We have developed a new Electrical and Computer Engineering (ECE) program at Rowan University. The first class graduated in May 2000. Features include: a continuous Engineering Clinic sequence, a mixture of two-, three-, and four-credit courses, and technology focus electives. Project and laboratory based instruction are employed as a tool for motivating students and to demonstrate the relevancy of material. Multidisciplinary courses provide the opportunity for students in different disciplines to work together. Some of the approaches—and lessons learned—may be of interest to other start-ups and programs considering transformation.

Introduction

Rowan University's engineering programs are the result of an endowment by Henry and Betty Rowan. The Rowan challenge was to create quality programs to develop engineers who could compete in the new global economy. Four engineering disciplines (Chemical, Civil and Environmental, Electrical and Computer, and Mechanical) were started in 1995; the first class enrolled in 1996; the engineering building was completed in early 1998. Accreditation under criteria 2000 was granted to all four engineering programs in 2001.

ABET's Criteria 2000 [1], the ASEE report, "Engineering for a Changing World," [2] and discussions with engineering practitioners provide motivation for changing the way engineering is taught. Engineering education needs to be transformed to an outcomes-oriented, student-centered, total quality environment. We need to do a much better job of demonstrating relevance of the material we teach and more actively involve students in the learning process so that they can *do*.

Unlike previous curriculum "fixes," squeezing in a few new courses can't solve the problem. Instead the entire curriculum content and structure need reengineering. Additionally, ABET's new criteria defines a process modifying the way we evaluate program results. First, desired outcomes must be defined, then diagnostic measures taken in order to assess progress toward desired outcomes**.** Only then should modifications to the process be made. This process of continual improvement defines a quality engineering education environment. In this paper, we describe the continuous development of a new ECE program to meet these challenges.

Goals

It is tempting to generate an extensive list of goals—until serious consideration is given to how progress toward those goals will be measured. Instead, we have tried to develop a minimum set of college-wide goals, which are then augmented by each discipline. In addition, there are university-wide vision elements that we also embrace. Goals, attributes, and assessment tools condensed from an internal draft are summarized in Table I. The overarching program goal is to create effected Electrical and Computer Engineers. Example assessment tools are cited for each goal. The list is not exhaustive; for example, employer feedback will be used as an assessment technique for all goals.

Core Electrical and Computer (ECE) Engineering Curriculum

The structure of the curriculum is shown in Figure 1. Many of the course titles suggest content that is familiar in typical ECE programs. Features that differ substantially from traditional offerings are described next.

The core content of the curriculum has been planned to include both Electrical and Computer Engineering as a combined degree. The early curriculum focused only on Electrical Engineering. However, it became obvious from our marketing efforts that there was strong demand from prospective students for Computer Engineering. In addition, we believe that Computer Engineering is an integral component of the practice of modern Electrical Engineering. The recent ABET Criteria 2000 guidelines for electrical and/or computer engineering make explicit distinctions between electrical and computer engineering based only on mathematics. Electrical Engineering requires differential equations, linear algebra, complex variables, and discrete mathematics. Computer Engineering requires discrete mathematics.

Engineering Clinics

All four engineering programs share an *Engineering Clinic* component, which is an eight-semester sequence of laboratory-based instruction. One of the members of the Rowan Advisory Board was from Harvey Mudd—the Engineering Clinic was proposed as one component of the upper-division programs of study. In addition, there were some “workshops” in the curricula as well. Planning is one thing—course preparation is quite another. One of the early results of delivering of the curriculum was the transformation of the Engineering Clinic sequence into a core component of all four programs.

Objective	ATTRIBUTES	ASSESSMENT
Cultivate capable communicators	• Writing skills • Oral skills • Multimedia skills	• Informal and formal work • Self-assessment • Seminar presentations
Develop agile technologists	• Tool (computer/equipment) users and tool makers • Adapts to & learns new technologies (life-long learning)	• Course work • Project work and scope • Employer feedback • Seminar presentations
Instill entrepreneurial spirit	• Entrepreneurial attitude • Understands business process • Calculated risk taking	• Employer (Employ<u>ee</u>) feedback Intrapreneurial • Business acumen • Scope/diversity of projects
Facilitate multidisciplinary discourse	• Work in multidisciplinary teams • Contribute to out-of-discipline design projects • Communication across disciplines	• Multidisciplinary design project work • Out-of-discipline evaluation
Sensitize to contemporary issues	• Professional issues • Ethics • Societal concerns • Impact of engineering decisions	• Total project scope • Interpretation and interaction • Professional societies • Outside activities
(ECE) Impart essential ECE knowledge	• Breadth and depth in math, foundations, systems, computing • Aware of the state-of-the-art • Product design (function & form) • System design	• Exams (written, oral) • Project work • Employer feedback

Table 1. Program Objectives and Assessment Techniques

FIRST YEAR			
Freshman Engineering Clinic I	2	Freshman Engineering Clinic II	2
Composition I	3	Computer Science & Programming	4
Calculus I	4	Calculus II	4
Advanced College Chemistry I	4	Physics I	4
General Education I	3	General Education II	3
Total Units	**16**	Total Units	**17**
SECOND YEAR			
Sophomore Engineering Clinic I w/ Composition II	4	Sophomore Engineering Clinic II w/ Public Speaking	4
Engineering Analysis I	4	Engineering Analysis II	4
Physics II	4	Dynamics	2
Statics	2	Network II	2
Network I	2	Digital I	2
		Electronics I	**2**
Total Units	**16**	Total Units	**16**
THIRD YEAR			
Junior Engineering Clinic I	2	Junior Engineering Clinic II	2
Clinic Consultant	1	Clinic Consultant	1
Systems and Controls I	3	Data Structures	3
Engineering Electromagnetics I	2	Digital Signal Processing	3
Engineering Electromagnetics II	2	Communication	4
Digital II: Microprocessors	2	Electronics II: VLSI Design	3
General Education III (μEcon)	**3**		
Total Units	**15**	Total Units	**16**
FOURTH YEAR			
Senior Engineering Clinic I	2	Senior Engineering Clinic II	2
Clinic Consultant	1	Clinic Consultant	1
Computer Arch. I	2	Seminar: Engineering Frontiers	1
Computer Arch. II	2	Elective	3
Software Engineering	3	Technology Focus Elective	3
Elective	3	General Education IV	3
Technology Focus Elective	3	General Education V	3
Total Units	**16**	Total Units	**16**

Total Program Credits: 128

Figure 1. Electrical and Computer Engineering Program at Rowan University

Clinics provide the structure needed to deliver many of the hallmarks intended to define the Rowan engineering experience:

- Hands-on instruction
- Treatment of integrated topics
- Teamwork
- Effective communication
- Multidisciplinary experience
- Entrepreneurship

Each level of the Clinic sequence has a general theme:

- Freshman Clinic I: Measurements
- Freshman Clinic II: Competitive assessment
- Sophomore Clinic I: Multidisciplinary design
- Sophomore Clinic II: Structured design project
- Junior Clinic I, II: Small system design projects
- Senior Clinic I & II: More complex system design project

The Freshman and Sophomore Clinics are similar to Introduction to Engineering courses now found at many universities; however, we emphasize a multidisciplinary experience. Currently, our freshman year is common for all programs; Freshman Clinic also serves as an introduction to each discipline to give students an opportunity to sample some aspects of each before committing to their final program of study choice. Details of the freshman and sophomore Clinic experience can be found in [3-14]. Upper-division (junior and senior) Clinics are project driven, with multidisciplinary projects and industry sponsorship as objectives. In addition they include module-based instruction to cover additional discipline-specific topics, Rowan vision elements, and to provide project-related instruction. Examples of the junior and senior clinic experiences can be found in [15-18].

Laboratory Courses

The program does not contain any explicit ECE laboratory courses; however, a strong hands-on component pervades the entire program of study. First, the Clinics provide continuous laboratory experience. Secondly, some amount of laboratory instruction is provided as part of most core and elective courses. This is also a consequence of using project-based instruction as a key structural element [19]. For example, Electronics I includes a regularly scheduled laboratory period, some of which is used for formal lab instruction with the balance available for project work. Similar lab/lecture instruction models are used throughout the program. Of particular note are courses such as Electromagnetics that also have a laboratory component. Later, a more explicit discussion of ongoing efforts to improve laboratory instruction is presented.

Two Credit Courses

All programs share a number of 2-credit hour courses at the sophomore level. For example, Statics, Dynamics, Network I, and Electronics I. One motivation is to allow diversity in the number of foundation engineering science courses that students take. So far, we have stopped short of a more ambitious reworking of this part of the curriculum along the lines of some of the NSF Coalitions [20], but will continue to revisit this topic. The 2-hour courses are also the result of trying to balance an overall reduction in program credit hours to 128 with the commitment to maintaining significant Clinic credit hours. Some of the 2-credit courses are taught in half a semester; others run the full 14-week term.

Electives

There are four electives (12 semester credit hours) in the program to provide additional breadth and depth of engineering topics. Electives can serve both senior undergraduates and first-year graduate students. Examples of electives include Digital Image Processing, Digital Speech Processing, Artificial Neural Networks, Architectures for Digital Signal Processing, Wavelets, Wireless Communication, Fiber Optics, Instrumentation, and Design for Sustainability. Two "technology focus electives" are intended to target multidisciplinary audiences. Example tech-focus electives include Principles of Nondestructive Test and Evaluation, State Variable Control, Robotics, and Rocket Propulsion (taught by the Mechanical Engineering department). We have "Topics" courses at the undergraduate level to provide the flexibility to teach new content without having to always deal with the 18-month University course approval process.

Seminar

Engineering Frontiers is a senior seminar taken in the final semester. There are several motivations for this course. We want students to be aware of the state-of-the-art. Entering the seminar, students will have had different experiences depending on which Clinic projects they have been on and which electives they took. We want students to investigate an area of technology that interests them; doing it as seniors should give them the background to understand significantly more. With every student giving a presentation, a great deal of state-of-the-art information is exchanged. Finally, the seminar is a chance to practice some of the skills needed for life-long learning

Clinic Consultant

One of the unique features of the ECE program is the "Engineering Clinic Consultant." These 1-hour courses occur in all four semesters of the junior and senior years. The Clinic Consultant was originally spawned from the College's decision to reduce the Junior and Senior Engineering Clinics from 3 semester hours to 2, returning four credits to each department. Our on-going ABET planning was fortuitous; we were searching for ways to provide additional curriculum feedback mechanisms, particularly ways to feedforward as opposed to the normal feedback processes that are often the only methods available. The Clinic Consultant provides a means to correct deficiencies identified in a previous course—students can be grouped to ensure they get the additional instruction in the topic.

Another key objective of the Consultant course is to provide opportunities for students to experience a consultant experience. They must identify and market key skills to a potential client. This can be an internal client such as another discipline's clinic project, or it can be an external client such as a business or individual with a need. This component of the Clinic Consultant course directly supports the objective of providing students with entrepreneurial experience.

Minors in Mathematics and Computer Science

Agreements with the Computer Science and Mathematics departments in the College of Liberal Arts and Sciences allow ECE students to graduate with a minor in Computer Science or Mathematics by taking just two additional classes in the respective program. The Computer Science minor has proved particularly popular with many students in the ECE program.

Internships

ECE students are strongly encouraged by faculty and administrators to obtain summer internships in engineering industries. The College of Engineering has an Internship Coordinator who acts as a liaison between students and industries seeking interns. Internships provide opportunities for students to gain experience in their chosen profession, develop connections in industry, and apply all skills learned in school. Internships allow us to assess the students' abilities in technical skills relative to program outcomes in two ways: Evaluations of student completed by a supervisor, and student self-assessment of the internship.

Resources

As of spring 2002, the ECE program has seven faculty and approximately 140 students. We have invested approximately $650k—much of it leveraged through NSF grants and other sources—to equip two primary instructional laboratory spaces – the Electronics Lab and the Design Studio. We also share a multidisciplinary control systems laboratory (funded by NSF) with the Mechanical and Chemical Engineering departments.

The Electronics Lab consists of 10 complete work centers consisting of triple-voltage power supplies, two RF signal sources, a digital multimeter, 100-MHz digital storage oscilloscope with integral logic analyzer, and a Windows/Intel computer for data acquisition. In addition to the individual work centers, additional equipment is available for specific projects. This additional equipment includes a microwave network analyzer, electromagnetic compliance tester, active load, lightwave source/detector, high-bandwidth oscilloscopes, and a digital/analog communications signal generator. This lab is used for core ECE courses (Networks I, Networks II, Electronics I, Electronics II, Digital I, Digital II, Digital Signal Processing, and Communications), technical electives, and for all four years of Engineering Clinic.

The Design Studio is a laboratory setting loosely modeled after industrial design facilities. Individual work centers for electronics testing, cubicle conference rooms, workstations, and rapid prototyping equipment are arranged as they might be in an industrial setting. This lab is primarily designed for the Junior/Senior Engineering Clinics in which externally funded projects are designed, fabricated, and tested. It also houses additional digital systems design equipment (FPGA systems, logic analyzers, etc.). The Design Studio contains four stations of Competitive Assessment work centers, which belong to the Mechanical Engineering Department. The Competitive Assessment stations are based on mobile benches, which incorporate equipment similar to the standard lab complement available in the Electronics Lab. Additional equipment includes a power analyzer. The data acquisition switch unit has a pre-wired access panel (located just above the LCD monitor) that has 24 channels of thermocouple input, 8 channels of generalpurpose voltage input, two digital-to-analog converter outputs, and 16-bits of digital I/O. The mobile tables allow these work centers to be utilized for projects throughout Rowan Hall.

The shared multidisciplinary control systems laboratory is used for the Systems and Controls course in ECE and the corresponding controls courses in Mechanical and Chemical Engineering. The equipment in the laboratory include (1) TecQuipment CE106 ball and beam apparatus, (2) TecQuipment CE107 engine speed control apparatus, (3) Feedback DC Servo motor and (4) Feedback Process Control Unit 38-200/38-300. Portable PC stations form an interface with this equipment.

Ongoing Laboratory Development for Instruction

We believe that one of our critical success factors has been an ongoing commitment to innovation in laboratory education. We briefly describe three development efforts:

<u>Macroelectronics</u>

The first effort is to change the conventional microelectronics approach to teaching electronics and instrumentation to a more general, systems-level approach [21]. We have shifted the focus in the first electronics course from individual devices and circuits (microelectronics) to the system as a whole (what we term *macroelectronics*). We have cooperatively developed the approach (Kansas State University is the lead developer) assisted by an NSF grant (CCLI DUE #9981139) has helped further this work.. The macroelectronics approach can be summarized as consisting of two primary elements: (i) treatment of topics chosen by the instructor—later complemented by topics derived from student projects, and (ii) utilization of a project-based learning environment to increase motivation, highlight important topics, and facilitate knowledge-integration.

Change can range from adjustments to how courses are configured and delivered, to more fundamental changes in the engineering curriculum. We have used the macroelectronics approach primarily as a tool for re-engineering traditional courses. Project-based components have been introduced with a goal of enhancing students' teamwork skills. Cooperative learning is not a new concept, but it is an effective teaching strategy. For example, it has been revealed that small groups of students working together in a cooperative-learning environment improve problem-solving skill [22]. We sought to

- Introduce fundamental concepts of electronic systems through the use of macroelectronics.
- Employ a project-based learning environment to increase motivation.
- Selectively cover microelectronics topics, partially guided by project requirements.

Materials developed to support the macroelectronics approach include courseware such as a variety of exemplar project descriptions.

Multidisciplinary Control Systems Laboratory

The control systems laboratory is an integrated effort by the Electrical and Computer, Mechanical, and Chemical Engineering programs to configure a novel hands-on method of teaching Control Systems from a multidisciplinary point of view. Although Control is an interdisciplinary technology, there has historically been a tendency for the different engineering departments to teach the subject from their very own somewhat narrow perspectives without any semblance of collaboration. This project attempts to address the demands of industry for control engineers with a broad set of skills and a comprehension of the diverse practical applications of Control [23][24]. This project is in accordance with the multidisciplinary aim of our new programs and strives to meet the requirements of industry in hiring control engineers who can move across rather artificial disciplinary boundaries with ease. Multidisciplinary experiments that integrate hands-on experience and software simulation are employed. The experiments expose the students to proportional-integral-derivative (PID) control using a DC motor [25], engine speed control apparatus, and feedback process control.

Our aim is to accomplish the following:

1. Give students an exposure to the different aspects of control theory in the form of multidisciplinary laboratory experiences that include electrical, mechanical, and process control systems.
2. Ensure that our laboratory resources impact a wide variety of courses in our curricula.
3. Expose students to data acquisition and digital control for multidisciplinary purposes, since digital technology is predominant in today's industry.
4. Integrate software simulation with hands-on laboratory work using MATLAB, its associated SIMULINK package and C++ programming.

5. Expand student teamwork experience by having them work in groups on the laboratory experiments.
6. Continue to improve written and oral communication skills of our students.

The laboratory manuals developed to support this project are available on the Web (see http://engineering.eng.rowan.edu/~ravi/nsf_control/nsf_control.html). This work is supported by a grant from NSF (CCLI DUE #9950882).

An Integrated Communications, Signal Processing and VLSI Laboratory

This "proof of concept" project is an effort by the ECE Department to configure a novel method of teaching the junior level Communications (COMM), Digital Signal Processing (DSP) and Very Large Scale Integration (VLSI) courses using a common framework. These three courses are taken concurrently during the spring semester of the junior year.

There has been a historical division and separation of the fields of Communications, DSP and VLSI in ECE education. This separation makes it harder for engineers specialized in one area to collaborate with colleagues in a different area. The rapid convergence of these technologies in the marketplace means that we need similarly integrate these areas at the undergraduate level. This will better prepare graduates for industry or graduate school by giving tham a better comprehension of the relationships among COMM, DSP and VLSI.

A grant from NSF (CCLI DUE # 0088183) has supported development of twelve interdisciplinary experiments that cut across individual course boundaries and integrate hands-on experience and software simulation. The first four experiments deal with basic concepts. The next four experiments expose the students to multimedia standards approved by industry. The last four experiments deal with various applications that link COMM, DSP and VLSI. Software is integrated with the experiments through MATLAB and SIMULINK, C/C++ and Mentor Graphics.

Examples of experiments include:

- Exploring the Continuous and Discrete Fourier Transforms [26]
- Illustration of the Central Limit Theorem [26]
- VLSI Implementation of a Pulse Code Modulation System [27]
- VLSI Implementation of the Hamming Single Error Correcting Code [27][28]
- Digital Phase Locked Loop [29]

- Comb Filter for Noise Suppression [30]

A laboratory manual will summarize the experiments; a long term goal is to use this prototype to develop a laboratory oriented textbook.

Outcomes Assessment

The Electrical and Computer Engineering Program at Rowan has developed a variety of assessment tools. These tools help evaluate our progress toward meeting the matrix of outcomes supporting our program goals. We have adopted successful assessment strategies employed by others within the College of Engineering at Rowan and within the broader engineering education community. In addition, we have developed what we believe to be other novel assessment tools and curricular feedback mechanisms to ensure the vitality and health of our program. Student course evaluations are only part of our outcomes assessments. The faculty are heavily involved in assessment of each course they teach [31]. One method of monitoring and tracking specific outcomes very closely by the faculty is by using a checklist called the "course-outcomes tracking sheet," shown in Figure 2 [31]. These tracking sheets provide a formal mechanism for identifying non-compliance with desired curricular outcomes. In addition, we needed to provide opportunities for the stakeholders in our enterprise (students, faculty, industry and alumni) to identify issues of concern. Another method is to use an X-File. This is a novel technique for identifying, capturing and tracking required programmatic changes as perceived by faculty and other stakeholders. To be of most value, curriculum issues need to be described as soon as they are identified and articulated. The issue needs to be managed over a relatively long time period. For example, faculty proponents generate X-Files every semester in response to a variety of inputs such as course-outcomes tracking sheets, Engineering Clinic design reviews, observations made in conducting laboratory or lecture sessions, comments received from industrial partners, recruiters and employers, student comments, etc. An example of a typical X-File is shown in Figure 3.

X-Files are subjected to periodic follow-up in program assessment meetings until the issue has been satisfactorily resolved. A user-friendly nomenclature and archival system has been developed to make the X-File generation and review process as efficient and easy as possible [31].

ECE Program Course-Outcomes Tracking Sheet

Course: **Semester:** **Level:**
Instructor:
No. Students:

Goals	Outcomes	Practice	Avg. (0-4)	X-File No.
Develop agile technologists	Contribute effectively to an engineering design project			
Cultivate capable communicators	Present ideas in oral/audio-visual/written form			
Instill entrepreneurial spirit	Contribute to economic analysis and business planning			
Facilitate multidisciplinary discourse	Contribute to the success of a multi-/inter-disciplinary team project			
Sensitize to contemporary issues	Develop and bring knowledge of social and political issues to contribute to design projects			
	Demonstrate ethical behavior and professional responsibility			
Impart essential ECE knowledge	Acquire knowedge of basic and engineering science and math for practice of ECE			

Assessment Criterion:
Average student score for each category is at least 3.0

Conclusions: ________________________________

See X-Files: ________________________________

Figure 2 Course Outcomes Tracking Sheet

X–File

Electrical & Computer Engineering Department

No.: XF_SAM_00_001
Date: 5/24/2000

ECE Goal/s:

Develop agile technologists.
Cultivate capable communicators.
Instill entrepreneurial spirit.
Facilitate multidisciplinary discourse.
Sensitize to contemporary issues.
***X** Impart essential ECE knowledge*

Course Affected: Electrical Communications Systems (0909.331.01)
Semester: Spring 2000
Proponent: S. Mandayam

Outcomes	Recommendation/s	Follow-up
Probability, statistics and random variables could not be covered in detail during the earlier offering (Spring 1999 – see XF_SAM_99_01) and was offered as a Fall 99 Clinic Consultant Module. These topics were incorporated into the course during the present, Spring 2000, offering. (see attachment for topics covered)	None	

Figure 3 Example of an X-File

Future Directions

The period of growth and accompanying surge of entrepreneurial start-up activities fully engaged the faculty up to the first accreditation visit. We now need to sustain what we have created, but we now have the opportunity to consider our next significant directions and begin to answer new questions: Where do we go from here? Where should we innovate? How do we better support our community of stakeholders? We have outlined four strategic planning areas.

1. Enhancement of the graduate program. Strengthening the graduate component will better prepare our students for a broader array of opportunities in both industry and academia. An improved graduate program better delivers on our obligation to provide support for regional industry. More graduate activity will enhance the opportunities for students—graduate and undergraduate—to interact with faculty doing cutting-edge research and development activities. A strengthened graduate program better prepares us to support regional aspirations for technology industry growth.
2. Enhancement of the undergraduate program. The ECE curriculum successfully meets ABET criteria for both Electrical Engineering and Computer Engineering. Assessment processes have been developed and validated. The ECE Program is now in a position to significantly enhance the undergraduate experience. We should build on our innovation strengths in instructional and experiential methods particularly to enhance the integrative, multidisciplinary laboratory components of the program. Program enhancements can provide new opportunities for specialization in keeping with significant technology trends especially involving work at technology boundaries. There will be more emphasis on entrepreneurship as measured by amount of state-of-the-art technology infused in the curriculum and better business model integration in more aspects of the program.
3. Increased involvement with program stakeholders. There is a growing community of stakeholders vested with the future of the ECE program. New opportunities are emerging for our role in the region. The South Jersey Technology Center will be a catalyst for new venture formation. It will be a springboard for faculty who seek expanded opportunities for larger-scale business-driven research and development efforts. We must increase the diversity of participants in our program to better serve a wider cross-section of the community. The depth, range, timeliness and quality of services offered to our customers need to be continuously improved. We should work with other institutions to help export the best of the Rowan model, while continuing to import the best of other programs.

4. Support for major elements of program focus. Following through with continuous improvement and with expansion into new focus areas will require resources to acquire and sustain these ambitions. The diversity of the skills within the Rowan team should be expanded through continuous education and by adding new team members with different skills such as Technical Writing, Industrial Design, Entrepreneurship and Intellectual Property Law. The technology resource base available to support undergraduate and graduate education and projects will need to continually improve. The program characteristic of high resource efficiency and availability cannot be diminished. New models for expanding the range of capabilities will need to be applied; for example, the use of cost centers as a means for leveraging scarce internal capital.

Discussion

We have described some aspects of the ongoing development of a new ECE program at Rowan University. One of the most unique features of the program is the continuous Engineering Clinic sequence. This lab-intensive component provides the means of achieving a number of program goals such as hands-on/minds-on immersion in a team-oriented learning environment. Another key feature is the emphasis on multidisciplinary education. Continuous program assessment is accomplished using a combination of tried-and-true methods combined with innovative techniques such as our X-Files better supports timely continuous improvement.

Rowan Engineering's first class graduated in May 2000. Of the 100 students who entered in 1996, 85 graduated in four years. We had 21 ECE graduates: Fifteen took jobs; six entered graduate school. Our first ABET accreditation visit occurred in October 2000; we were evaluated under the EC 2000 criteria and achieved accreditation.

Acknowledgements

The authors wish to acknowledge the vision and commitment of Mr. and Mrs. Henry Rowan, who made the Rowan Engineering programs a reality. We salute the students who joined our program in the early days when the entire curriculum was nothing but concepts that lay ahead and Rowan Hall was only a stack of drawings. We thank the many companies and agencies that have invested in our program to help it flourish; in particular, the National Science Foundation (CCLI grants, DUE # 9981139, DUE # 9950882 and DUE # 0088183).

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