ASSESSMENT STRATEGIES: FEEDBACK IS TOO LATE!

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Abstract *— The newly started Electrical and Computer Engineering program at Rowan University was visited by ABET's EAC for the first time in October 2000. As we prepared for our program evaluation under EC 2000, we explored novel mechanisms for assessing our curricular outcomes and "closing the loop" in an effort to develop ongoing methods for continuous program improvement. We were motivated by a strong desire to make the assessment process minimally intrusive, yet maximally effective. We have developed an assessment instrument called an X-File and a unique course called "Clinic Consultant" – both these mechanisms are closely related to each other. This paper describes our implementation efforts.*

Index Terms — Accreditation preparation, assessment, closing the loop.

INTRODUCTION

The Electrical and Computer Engineering (ECE) program at Rowan University began in 1996; our first class of twenty-one students graduated in May 2000. As we prepared for our ABET's EC 2000 [1] visit in the Fall, we explored novel mechanisms for assessing our curricular outcomes and devised new strategies for feeding forward assessment results. We were motivated by a strong desire to make the assessment process minimally intrusive, yet maximally effective. Furthermore, we wanted to provide opportunities for students to develop entrepreneurship skills – this is one of our program goals. We have developed an assessment instrument called an X-File and a unique course called "Clinic Consultant" – both these mechanisms are closely related to each other. We strongly believe that these two mechanisms provide us with an integrated and comprehensive strategy that leads to continuous program improvement. This paper describes our implementation efforts.

Program Goals

The mission of the ECE program at Rowan University is to create effective engineers. We have articulated the following six goals for serving the program constituencies:

- Develop agile technologists
- Cultivate capable communicators
- Instill entreprenurial spirit
- Facilitate multidisciplinary discourse
- Sensitize to contemporary issues
- Impart essential ECE knowledge

These six program goals are translated into the following seven measurable outcomes. Students in the ECE program will:

- Use their technological agility to contribute effectively to an engineering design project.
- Use their communication skills to contribute in an effective manner to the completion of design projects by presenting ideas in oral/audio-visual/written form.
- Contribute to more than the technical aspects of a design project; in particular, they will contribute to economic analyses and business planning.
- Use their theoretical and laboratory skills to contribute towards the success of a multidisciplinary and/or interdisciplinary team project.
- Develop and bring their knowledge of contemporary social and political issues to contribute in an effective manner to the completion of design projects.
- Become "world citizens" in the practice of their profession, bringing their understanding of contemporary issues to bear on their ethical behavior, professional responsibility and commitment to advancing the practice of engineering.
- Acquire knowledge of basic and engineering science and mathematics for the practice of electrical and computer engineering

The following practices provide opportunities for the students to achieve these measurable outcomes:

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- The curriculum – this is the primary means of developing technical and non-technical skills in the classes, laboratories and clinic projects.
- Student advising – effective advising allows us to target specific deficiencies and foster improvements in student performance.
- Courseware – simulation software and on-line multimedia content provide asynchronous learning opportunities.
- Infrastructure – the classrooms, laboratories and other "learning spaces" (real and virtual) provide a platform for implementing all of the educational objectives.
- Summer Internships – outside experiences that expose our students to the real world context of engineering practice (although this is an optional activity, students are strongly encourage to participate in the Summer internship program that is facilitated by the College Internship Coordinator and a majority do so).

These specific outcomes are monitored and tracked very closely by the faculty using a checklist called the "course-outcomes tracking sheet," shown in Figure 1. These tracking sheets provide a formal mechanism for identifying non-compliance with desired curricular outcomes. In addition, we needed to provide opportunties for the stakeholders in our enterprise (students, faculty, industry and alumni) to identify issues of concern.

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. 1
COURSE OUTCOMES TRACKING SHEET.

Assessment Objectives

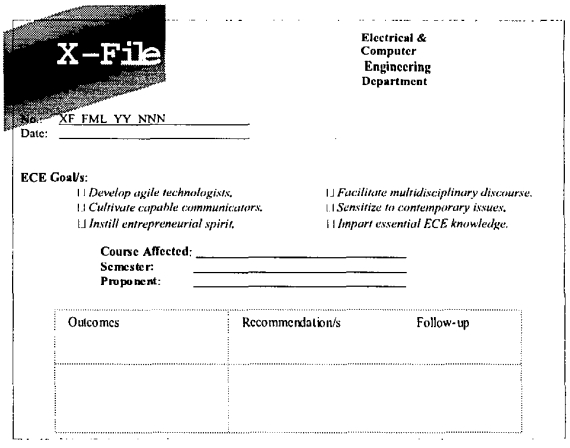
Our primary objectives in arriving at the assessment strategy described in this paper are:

- Provide a formal mechanism for documenting issues of concern and successes as perceived by all the stakeholders in the program.
- Feedforward immediate "fixes" to address these issues of concern and not wait until subsequent offerings of a particular course related to this concern.
- Track the entire process and measure related outcomes and resulting program improvement.

The following sections describe the mechanisms that we have developed and their implementation.

X-FILES

The X-File 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. The format of a typical X-File is shown in Figure 2.


X-File

Electrical & Computer Engineering Department

No: XF_FML_YY_NNN
Date: _____

ECE Goal/s:
- ☐ *Develop agile technologists.*
- ☐ *Cultivate capable communicators.*
- ☐ *Instill entrepreneurial spirit.*
- ☐ *Facilitate multidisciplinary discourse.*
- ☐ *Sensitize to contemporary issues.*
- ☐ *Impart essential ECE knowledge.*

Course Affected: _____
Semester: _____
Proponent: _____

Outcomes	Recommendation/s	Follow-up

FIGURE. 2
FORMAT OF AN X-FILE.

Issues of concern that are articulated in the X-Files lead to the development of "course-modules" in the ECE Clinic Consultant course (described in the next section). X-Files are

subjected to periodic follow-up in the 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.

CLINIC CONSULTANT

A unique feature of the ECE program is the "Clinic Consultant" [2]. These 1-hour courses occur in all four semesters of the junior and senior years. The Clinic Consultant is a complement to the eight-semester Engineering Clinic design sequence. This course was originally spawned from the College's decision to reduce the Junior and Senior Engineering Clinics from 3-s.h. to 2-s.h., 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. For example, if an outcomes assessment (documented in an X-File) determines that students in a certain course did not learn a critical concept, the normal way of "fixing" the problem would be to correct the next offering of the course. But what about the students who have moved on? Perhaps a downstream course could squeeze the topic in, but what would be displaced there? Particularly in response to this need, we created the Clinic Consultant to be that downstream, or feedforward, mechanism. In addition to this role, the Clinic Consultant has two other functions: provide opportunties for developing and exercising entrepreneurship, and to serve as a professional forum. All three elements are described below.

- **A Vehicle for Multidisciplinary Entrepreneurship**: ECE students are required to serve in a consultant role. They are asked to market their skills as a service to a client who can be internal to Rowan — e.g., to another clinic project team — or external to Rowan. Examples of external consultant projects have included additional project work for an employer (above standard employee obligations), community service work of a technical nature, etc. We will also allow consulting work done for hire, believing that the process of learning what a consultant does, how to engage work, and how to satisfy a client, are all attributes that we would like our graduates to possess. Regardless of the type of consultant opportunity chosen, students petition one of the ECE Discipline Managers (who are responsible for coordinating the Clinic activities) for approval. They must describe the proposed work and include coordination with their client. When the work is completed, they must obtain the signature of the client as proof of satisfactory work to receive credit.
- **A Forum for Discussing the Profession**: We are able to regularly convene (T:1230-1330) our juniors and seniors. This provides the opportunity to present seminar speakers (S00 examples: J. Spencer on "Basics of Business Planning," and Dr. D. Hardin on "Embedded Java Processors."). It is also a chance to discuss our program goals and how they relate to the curriculum and current issues, etc. It is also an excellent forum for student advising.
- **An Opportunity for Curricular Feedback**: We believe that this is perhaps the most exciting role of the Clinic Consultant. It provides an opportunity to correct a curricular deficiency that has been elevated to the "must solve" level. An actual example of how we have used it can be found during S99 and F99. One of the objectives for S. Mandayam's "Electrical Communications Systems" (ECOMMS) was to include topics in probability and random variables. However, they were not covered due to the press of topics. During assessment meetings that followed the spring 1999 semester, the faculty agreed that the omission was a serious curricular deficiency that needed to be corrected. It was proposed that the F00 offering of Clinic Consultant include additional modules on probability and random variables. Since the plan was to adjust the scope of ECOMMS in subsequent semesters, it was decided that only seniors would have to take the modules. As an illustration, the next section provides the complete docmentation trail for this particular X-File/Clinic-Consultant sequence. A total of four modules were delivered to the seniors during F00. At the same time, we used the four modules to provide the juniors with additional instruction in active filter synthesis and high-frequency device design, which were two topics that the faculty responsible for "Electronics I" identified as deficiencies.

IMPLEMENTATION

We present an example of a typical assessment-improvement cycle using the X-File mechanism. The events described here span the following semesters: S99, F99 and S00.

The X-File shown in Figure 3 was generated by the instructor at the conclusion of the Junior-level Electrical Communications Systems course.

Following this recommendation, the Clinic Consultant platform was employed in Fall 1999 for providing the required instructional module [3]. The original X-File was up-dated as shown in Figure 4.

Clinic consultant instructional modules are seen as remedial measures – they should not be the instructional norm for the particular topic. During the subsequent offering Electrical Communications Systems, the course structure was reorganized so that the required topics were integrated into the course content. The X-File shown in Figure 5 was generated to document this process.

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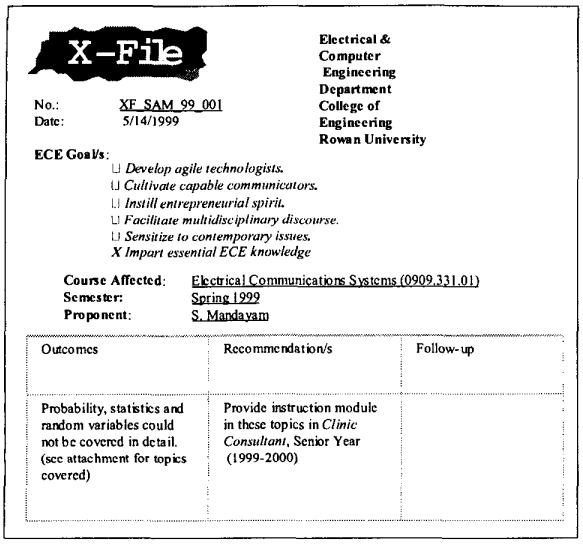


X-File

Electrical & Computer Engineering Department College of Engineering Rowan University

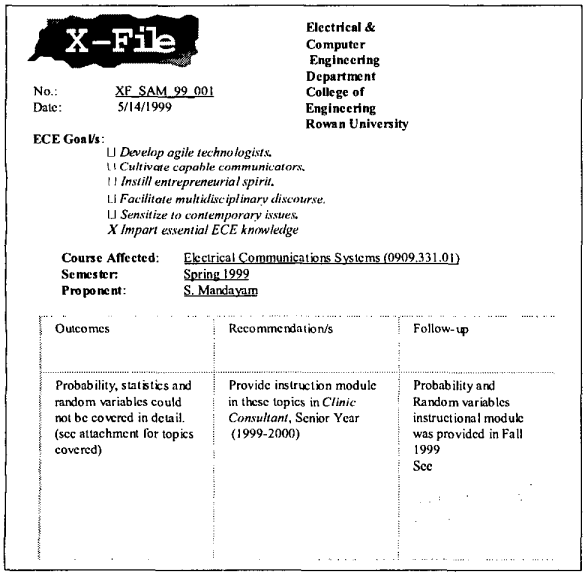
No.: XF_SAM_99_001
Date: 5/14/1999

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 1999
Proponent: S. Mandayam

Outcomes	Recommendation/s	Follow-up
Probability, statistics and random variables could not be covered in detail. (see attachment for topics covered)	Provide instruction module in these topics in *Clinic Consultant*, Senior Year (1999-2000)	

FIGURE. 3
SPRING 1999 X-FILE.



X-File

Electrical & Computer Engineering Department College of Engineering Rowan University

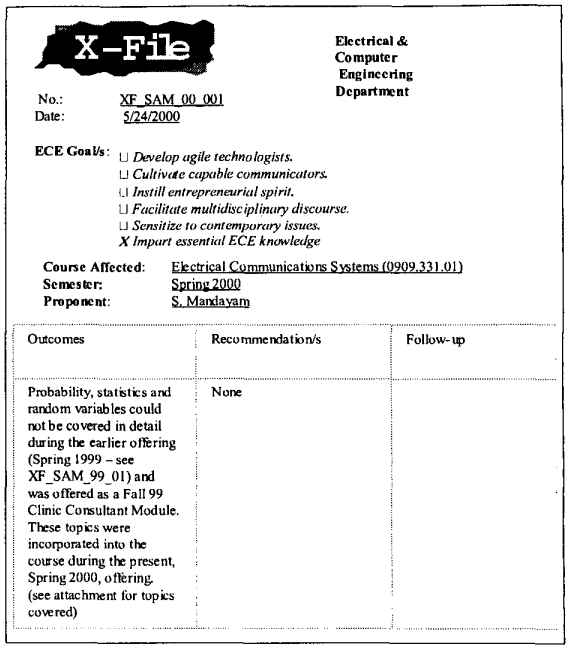
No.: XF_SAM_99_001
Date: 5/14/1999

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 1999
Proponent: S. Mandayam

Outcomes	Recommendation/s	Follow-up
Probability, statistics and random variables could not be covered in detail. (see attachment for topics covered)	Provide instruction module in these topics in *Clinic Consultant*, Senior Year (1999-2000)	Probability and Random variables instructional module was provided in Fall 1999 See

FIGURE. 4
FALL 1999 X-FILE.



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. 5
SPRING 2000 X-FILE.

The X-Files were designed to support mechanisms for handling both short-term and long-term needs. Due to their brevity, an X-File can be completed easily; due to their structure, the proponent of an X-File can track its progression. Since an X-File can be written by any of our constituents, the process helps the sense of ownership in the program.

CONCLUSIONS

Both the X-Files and the Clinic Consultant offer us the flexibility needed to adapt our curriculum to address future problems and is a vital part of our continuous assessment and improvement processes. We have developed a strategy that all the faculty believe in, is easy to implement and is effective for meeting our program objectives.

REFERENCES

[1] Accreditation board for Engineering and Technology, Inc., *http://www.abet.org/eac/eac.htm*, accessed March 9, 2001.

[2] Jansson, P. M., "Electrical Engineering Clinic Consultant," *http://engineering.eng.rowan.edu/~jansson/spring01/clinic/*, accessed March 9, 2001.

[3] Mandayam, S. A., "Senior-I Clinic Consultant Module", *http://engineering.eng.rowan.edu/~shreek/fall99/probrv/*, accessed March 9, 2001.