Criterion 3. Program Outcomes

Introduction

As described in the previous section, the Faculty developed a Mission, Goals and Objectives statement at a Faculty Retreat in May 1990. The current Program Outcomes have evolved from that original exercise. In this section, the Forest Engineering Program Outcomes are first discussed in comparison to the appropriate ABET criteria and then our Program Objectives.

Statement of Program Outcomes

Current Program Outcomes for the Forest Engineering curriculum delivered by the Faculty of Environmental Resources and Forest Engineering are to produce graduates who:

1) Are competent to perform in an engineering environment
2) Have sufficient backgrounds/tools to function effectively
3) Have the ability to conceptualize problems in terms of unifying principles
4) Are capable of utilizing an engineering approach to problem solving
5) Can communicate their ideas and expectations effectively
6) Exhibit the following attributes of a competent engineer:
    (a) Knowledge - both in understanding basic principles and in creativity in problem solving
    (b) Skills - originality and method of problem solving
    (c) Attitude - professional ethics, self-disciples, and perseverance
7) Can function effectively in a multidisciplinary team/environment
8) Understand the need for life-long learning

Relationship of Program Outcomes to Criterion 3.

The Program Outcomes listed above provide good agreement with 2006-2007 Criteria for Accrediting Engineering Programs: Criterion 3. Table B.3-1 maps the Forest Engineering Program Outcomes to the 2006-2007 Criterion 3 (a) - (k). The (a) – (k) statements are

a. an ability to apply knowledge of mathematics, science and engineering
b. an ability to design and conduct experiments, as well as to analyze and interpret data
c. an ability to design a system, component, or process to met desired needs within realistic constraints such as economic, environmental,

social, political, ethical, health and safety, manufacturability, and sustainability

d. an ability to function on multi-disciplinary teams
e. an ability to identify, formulate, and solve engineering problems
f. an understanding of professional and ethical responsibility
g. an ability to communicate effectively
h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
i. a recognition of the need for, and an ability to engage in life-long learning
j. a knowledge of contemporary issues
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

It should be noted that many of our outcomes coincide with multiple Criterion 3 statements. We believe that "utilizing an engineering approach to problem solving" includes, in a broad sense, "engineering design."

Table B.3-1: Mapping of Forest Engineering Program Outcomes to 2006-2007 Statement of Criterion 3 (P = Primary; S = Secondary											
Forest Engineering Program Outcome	**2006 – 2007 Criterion 3**										
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
1. Competent Engineer										P	S
2. Sufficient Background/Tools	S							P		S	P
3. Unifying Principles					P						
4. Engineering Approach			P								
5. Communication							P				
6. Attributes:											
6a. Knowledge	P							P			
6b. Skills		P									
6c. Attitude						P					
7. Team Worker				P							
8. Life-Long Learner									P		

Relationship of Program Outcomes to Program Educational Objectives

The Forest Engineering Program Outcomes were designed to allow us to observe and assess our Program Educational Objectives. Each of the outcomes captures some essence of a competent, successful engineer. Table B.3-2 maps the Program Outcomes and Objectives.

Table B.3-2: Mapping of Forest Engineering Program Outcomes to Program Objectives			
Program Outcome	Forest Engineering Program Objectives		
	Professional Engineering Success	Academic Advancement	Professional Growth
1. Competent Engineer	x		x
2. Sufficient Background	x	x	
3. Unifying Principles	x	x	
4. Engineering Approach	x	x	
5. Communications	x	x	x
6. Attributes			
6a. Knowledge	x	x	
6b. Skills	x	x	
6c. Attitude	x	x	x
7. Team Worker	x		x
8. Life-Long Learner	x	x	x

Curriculum Design and Program Outcomes

EXPLANATION AND PERFORMANCE MEASURES

The Faculty has agreed on the following explanations of the Program Outcomes in order to:

- facilitate the internal outcome assessment process
- ease coordination with and "mapping" to the ABET Criterion 3 outcomes "a-k."
- enable discussions of curriculum and course revisions.
- promote instructor understanding of relationship between course objectives and program outcomes.

1. Are competent to perform in an engineering environment

- This outcome is intentionally broadly stated to express the desire that each graduate is capable of entering and performing expected duties within a professional engineering workplace upon completion of the degree requirements.

- Students should demonstrate that they understand the effects of engineering decisions on contemporary society (ABET Criterion 3j), and how engineering decisions can be implemented given society's needs and feedback.

    - Students should be able to describe and discuss the influence of technology on public policy and decisionmaking.
    - Courses are selected that provide broader perspective for the application of knowledge gained from math, science and engineering courses considered relevant to engineering professionals, such as the engineering sciences, engineering design.
    - The ability to perform in an engineering environment extends beyond the cognitive domain. Courses that develop the students' affective domain, reaching understanding and empathy, help the students understand how to apply appropriate engineering practices in the modern world (ABET Criterion 3k).
- Courses that support student development of this outcome will have an engineering-related focus (e.g. fundamental engineering science/design) or a broader perspective on the social sciences or ecological systems.

2. Have sufficient backgrounds/tools to function effectively.

- This outcome is addressed by considering the two areas of engineering education: background and tools.
- The first area, background, is addressed by providing a sufficiently broad education that includes what are considered "general education" or "social sciences and humanities" courses such that the engineer can understand the of engineered solutions from a variety of viewpoints and contexts, including global and local, societal, economic and environmental (ABET Criterion 3h).
- The second area, tools, is addressed by teaching techniques, skills and effective use of the tools that are commonly found in the modern practice of forest/environmental resources engineering (ABET Criterion 3 k), including:

    - Use of hardware and software tools for research, communication and data analysis, especially software to facilitate:
        - Word processing (e.g. MS Word)
        - Database (e.g. MS Excel)
        - Computation (e.g. MathCad)
        - Computer-aided drawing and design (e.g. AutoCAD)

        - Oral Presentation (e.g. MS PowerPoint)
        - Programming (e.g. Fortran, MathCAD, Basic)
    - Technical graphics tools, such as engineer's scale, straight edge, pencil and paper, for freehand sketching and mapmaking
    - Spatial measurement tools such as survey instrumentation, photogrammetry, maps, GPS
    - Environmental measurement tools, such as flow meters and soil sampling equipment
    - Research tools and methods such as accessing and summarizing new information from a variety of sources, including:
        - Library database
        - Technical journal
        - Codes and regulations
        - World Wide Web

- Proficiency in using these techniques, skills and tools needed for practicing engineering is inextricably linked to other program outcomes, notably an ability to apply knowledge of math, science and engineering (ABET Criterion 3a).
- Courses that support student development of this outcome will have an engineering technology-related focus or component.

3. Have the ability to conceptualize problems in terms of unifying principles

- We consider this outcome to be the foundation for students to demonstrate that they have the ability to identify, formulate and solve engineering problems (ABET Criterion 3e).
- Curriculum is developed to expose and familiarize students with unifying principles of basic sciences, notably Newtonian principles, conservation of mass and energy principles, etc. and their application in engineering sciences (e.g. thermodynamics, fluid mechanics, electrical science).
- The ability to solve engineering problems is fundamental to success in the "testing and analysis" of alternative solutions during the design process.
- Students should be able to identify engineering problems (as opposed to medical, legal or *wardrobe malfunction* problems). Students should be able to apply a methodical process of developing the framework for solving the problem.
- Students should be able to define and describe the relevant principles and appropriate assumptions, as well as describe the relevant theories and formulas.
- Students should apply these principles to solving "closed-ended" engineering problems, which entails

- Defining problem
- Stating assumptions
- Defining system boundaries
- Describing known inputs and desired output
- Defining unknown conditions
- Preparing visual models, such as diagrams, charts, tables, to aid in the analysis
- Applying appropriate analytical formulae and principles

- Use of Dimensional Analysis
  - Fundamental quantities of a system (e.g. mass, length, time
  - Relative importance of parameters
  - Interpreting model data
- Note there is a distinction here between what we call problem-solving and what we call design. Design is an open-ended, iterative process characterized by the application of constraints and design criteria to a complex problem where the constraints extend beyond the minimal ones imposed by fundamental principles.
- We can also distinguish "design" in that it also entails optimization, whereas engineering "problem solving" implies that there is one satisfactory output for a given set of input conditions.
- "Design" also considers multiple alternative solutions that all satisfy project requirements and a process of determining which alternative will be deemed "best" for the given conditions.
- Courses that support student development of this outcome will have an engineering science-related focus that applies fundamental knowledge.

4. Are capable of utilizing an engineering approach to problem solving

- The distinction we make here is that this outcome expressing the ability of Forest Engineering students to use an "engineering approach to problem solving" is most closely aligned with the "engineering design" process.
- The engineering design process is commonly expressed as an iterative process that culminates in a solution that satisfies the stated need within the constraints applied to the system, process or component (ABET Criterion 3c). The process may include:
  - Identify the problem
    - Define Present State
    - Define Desired State
  - Define the problem
    - identify constraints, key issues, variables, opportunities
    - collect and assess information

        - identify assumptions
        - break the problem into subproblems
        - determine design life and production volume
    - Develop alternative solutions
        - define decision criteria
    - Analyze and compare alternative solutions
        - test and validate against decision criteria and constraints
    - Select the best alternative
        - integrate solutions
    - Implement the solution
        - communicate the solution
    - Evaluate the results
- Students should be able to demonstrate that they understand and use the engineering design process in solving open-ended, complex problems.
    - Students can define the steps in the process
    - Students plan their approach, including required knowledge and schedule
    - Students follow the process to arrive at a solution
    - Stduetns communicate solution
    - Students implement solution and assess performance
- Courses that support student development of this outcome will have an engineering design component or focus.

5. Can communicate their ideas and expectations effectively

- Students can satisfy this outcome if they demonstrate throughout the curriculum that they are able to communicate effectively in a variety of contexts and through a variety of media.
- This Program Outcome satisfies ABET Criterion 3g.
- We consider that students should be able to communicate effectively in three forms:
    1. ORAL:
       a. Speaks clearly; makes eye contact; appropriately uses language; is organized
    2. WRITTEN:
       a. Organized logically; uses proper grammar; written for appropriate audience
    3. GRAPHIC:
       a. Visual aids follow accepted convention and approved standards; support text and oral statements

- The emphasis is on communication, assuming that the technical content is sufficiently robust and appropriate to the subject of discussion.
- Courses that support student development of this outcome will have an explicit communication objective, or will have expressly integrated development of communication skills into the course.

6. Exhibit the following attributes of a competent engineer:

6a.Knowledge – both in understanding basic principles and in creativity in problem solving.

- The appearance of "problem solving" in this outcome is related to the ability of the student to apply their knowledge of the basic principles of math, science and engineering (ABET Criterion 3a), as well as enhanced creativity brought about by their broad education and understanding how they function in modern culture (ABET Criterion 3h).
- We expect that students can apply mathematical principles to obtain analytical solution
    - For example, students can apply concepts of linear algebra to solve complex problems in the context of photogrammetry

6b.Skills – originality and method of problem solving

- Students satisfying this outcome will have an ability to design and conduct experiments as well as analyze and interpret data (ABET Criterion 3b).
    - Students perform experiments following standard procedures
    - Students use appropriate data collection methods
    - Students use appropriate tools to analyze data
    - Students apply appropriate statistical procedures
    - Students analyze and interpret data using robust techniques

6c. Attitude – professional ethics, self-discipline, perseverance

- We find that this Program Outcome relates directly to ABET Criterion 3f: "an understanding of professional and ethical responsibility."
- Students are self-motivated to participate in professional development activities, rather than required as part of a course grade.
- For example, we encourage students to take the FE exam in their final semester. We provide reminders and logistical support.

- We encourage participation in the Order of the Engineer.
- We embed exposure to and discussion of engineering ethics in courses. Students are encouraged to use the NSPE Code of Ethics as guidance beginning as early as ERE 225 in the Student Workbook.
    - Reading and Discussion in FEG 300
    - Discussion and assessment in FEG 489.
- Students should be able to describe their personal views on ethical decisions made in case studies and in dealing with classmates.
- Teamwork situations create conditions that test students' ability to persevere in the face of demanding and challenging decisions and teammates.
- Courses that support student development of this outcome will have an embedded course objective and activities that develop an understanding of engineering ethics and professional practice.

7. Can function effectively in a multidisciplinary team/environment

- Students will be able to explain the functional roles and responsibilities of team members.
- Students will be able to demonstrate that they are capable of functioning in an assigned role within a team.
- Students will be able to assess the performance of themselves and other team members to improve the effectiveness of individual and team performance.
- Students will engage in behavior that demonstrates respect of team members and their functional roles.
- Courses that support student development of this outcome will have an embedded objective that directly develops teamwork abilities.

8. Understand the need for life-long learning.

- ABET Outcome: 3i. a recognition of the need for, and an ability to engage in life-long learning
- Students that satisfy this outcome will be able to:
    - List examples of significant technological changes over the last 20 years in environmental resources engineering that have influenced how engineers perform their jobs, and the types of problems that engineers have to address.
    - identify the continuing education requirements for licensed engineers
    - describe various opportunities for engineers to continue their education while engaged in professional practice

- appraise their own learned knowledge while enrolled in Forest Engineering,
- create a plan for post-graduation continuing education.

- Courses that support student development of this outcome will have an integrated objective that addresses the need for lifelong learning, as well as a focus on changes in society and/or the engineering profession.

HIERARCHY OF LEARNING OUTCOMES

Learning occurs in all courses, but to different degrees. We categorize some courses as Exposure courses, in that a student is exposed to material to be used in subsequent courses. We categorize other courses as Familiarity, in that an instructor can reasonably expect that students enter the course with some background information. Finally, we categorize some courses as In-Depth in that students are expected to apply material from previous courses. We present a summary of our categorization in the next table.

Table B.3-3: Hierarchy of Learning Outcomes in Forest Engineering Curriculum (E = Exposure; F = Familiarity; D = Depth)

Semester	Course	ERFEG Program Outcome									
		1	2	3	4	5	6a	6b	6c	7	8
Fall - I	Calc I						E				
	Physics						E	E			
	Botany						E	E			
	Writing		E			E	E		E	E	
	Orientation										
Spring - I	Calc II						E				
	Physics						E	E			
	Compt. Methods		F			E	F	E	E		
	Gen Ed		E								E
	Gen Ed		E								E
Fall-II	Calc III						F				
	Gen Chem					E	E				
	Statics	F		E							
	Eng. Graphics	E	E			E					
	Economics		E			E	E	E			
Spring II	Diff Eqns	D	D	D			D				
	Dynamics	F		E			F				

	Elec Sci	F		E	E		F				
	Gen Chem					E	E				
	Mech Materials	F		E	E		F				
	Presp. Env.		E			D	F	E	F		
Fall-III	Surveying	F	D			D	F	F	F	F	
	Fluid Mech	F		F							
	Dendrol		F				F				
	For Ecol/ Silvic					D	F	E	E		F
	Engr Design	F			F				F	F	E
	Gen Ed		E								E
Spring-III	Engr Hydrol	D	F	F	F	F					
	Remot Sens	F	F	F			F				
	Photogr	D	F		E		D	F	F	F	E
	Prob & Stats	D	F				D	D			
	Eng Thermo	F		F			F				
	Gen Ed		E								E
Fall-IV	Structures	D		D	D						
	Harv Sys	F		F				F			
	Eng Dec Analysis	D			D		D				
	Soil Mechanics	D		D		F		D			
	Res Policy/ Manage	F	F						F	F	
	Water Poll Eng	D	D	D	D	F	D				
Spring-IV	Transpo Sys	D		D	D		D				D
	Power Sys	F		F	F		D				
	Plan Design	D			D	D			D	D	
	Design Elective	D			D						
	Design Elective	D			D						
Notes: See Table B3-1 for numerical key to Forest Engineering Program Outcomes. See discussion in Criterion One for key to formal course names and numbers.											

The information in Table B3.3 is essentially a simplified version of Bloom's Taxonomy, with Exposure roughly equivalent to the first two levels (Knowledge and Comprehension), Familiarity roughly equivalent to the third level (Application), and Depth roughly equivalent to Analysis, Synthesis and

Evaluation. It can be seen that Table B3.3 shows a logical flow of expectations throughout the Forest Engineering curriculum. Assessment activities are generally associated with the Depth courses.

ILLUSTRATIVE LEARNING ACTIVITIES

The following table shows the relationship between program outcomes and instructional activities in specific courses. Please note that the information in the table is for the instructional activities in *engineering* courses only and excludes, for example, activities in the Writing and the Environment course. Please note that, while all of these activities could be monitored as a part of our on-going assessment program, we have been strategic and selective in targeting specific activities for assessment purposes, as will be discussed later in this section.

Table B3-4. Forest Engineering Program Outcomes and Illustrations of Specific Course/Instructional Activities to Achieve Outcomes

Program Outcome	Course(s)/Instructional Activity
1. Are competent to perform in an engineering environment.	FEG 132 Orientation: Discussion of differences between science and engineering FEG 300 Engineering Design: Students learn formal engineering methodology **FEG 489 Planning and Design: Semester long design project with formal oral presentation, written report, and class discussions related to professional behavior and expectations.**

2. Have sufficient back-ground/tools to function effectively	The Math and Science and Engineering Science courses are intended to provide technical background, while the General Education courses are intended to place technical activities in a broader social context. Some engineering courses provide tools to be used in other courses. APM 153 Computing Methods: Students introduced to Mathcad ERE 225 Engineering Graphics: Students display engineering data. **ERE 371 Surveying: Mapping activities assist in visualizing topographic and spatial information.** **ERE 440 Water Pollution Engineering. Students use Mathcad in design problems**
3. Have the ability to conceptualize problems in terms of unifying principles	The curriculum includes theory-rich courses followed by applications courses that reinforce fundamental principles. Examples: MAE 341 Fluid Mechanics followed by FEG 340 Engineering Hydrology, which includes hydraulics. ERE 351 Thermodynamics followed by FEG 454 Power Systems.
4. Are capable of utilizing an engineering approach to problem solving	FEG 300 Engineering Design: Students are introduced to formal engineering design process. ERE 440 Water Pollution Engineering: Students apply design process to two design problems **FEG 489 Planning and Design: Formal design process is applied to semester long project.**

5. Can communicate their ideas and expectations effectively	ERE 225 Engineering Graphics: Preparation of engineering drawings FEG 300: Engineering Design: Oral and written report of class design project ERE 371 Surveying: Design and preparation of topographic map **FEG 340 Engineering Hydrology: Poster presentation of design project.** CIE 337 Soil Mechanics: Formal, written laboratory reports **ERE 440 Water Pollution Engineering: Preparation of engineering drawing to document design** **FEG 489 Engineering Planning and Design: Formal oral presentation and written report of semester long design project**
6a. Exhibit attributes of a competent engineer: Knowledge	Math and Science, Engineering Science, and Engineering Science and Design courses
6b. Exhibit attributes of a competent engineer: Skills	APM 153 Computing Methods for Engineers and Physical Scientists: Students write and document several computer programs. ERE 225 Engineering Drawing: Students create engineering drawings using appropriate software. FOR 360 Principles of Management: Students discuss management styles. ERE 371 Surveying for Engineers: Students plan and create a topographic map. FEG 430 Engineering Decision Analysis: Students analyze and interpret data for a water resources project. **APM 395 Engineering Statistics: Students analyze data to determine significance of data.**
6c. Exhibit attributes of a competent engineer: Professional ethics	FEG 132 Orientation: Introduction to Professional Licensure FEG 489 Planning and Design: Class discussion led by guest lecturer (a lawyer) on professional responsibilities and potential sanctions for misconduct.
7. Can function effectively in a team environment	ERE 225 Engineering Graphics: Students work on project as a team FEG 300 Engineering Design: Students work on project as a team

	ERE 371 Surveying: Teams of students plan and execute a survey, and generate a topographic map based on their survey design. FEG 363 Photogrammetry: Students work on final design project as a team FEG 340 Engineering Hydrology: Students work on final design project as a team. CIE 337 Soil Mechanics: Students work on final laboratory assignments and generate reports as a team. **FEG 489 Planning and Design: Students work on semester design project as a team. Guest instructor discusses group dynamics and effective strategies for teamwork.**
8. Understand the need for life-long learning	**FEG 300 Introduction to Engineering Design. Review of recent technological developments**

Steps to Ensure Program Outcomes Are Achieved

EFFECTIVENESS OF INSTRUCTION

Individual Course Assessment Techniques

Many faculty elect to use informal instructional assessment techniques. These might include early course surveys, one-minute assessments, or other instruments. One example of the use of an in-class assessment technique is given in the information pertaining to FEG 489 Engineering Planning and Design provided in the discussion of Criterion 4 of this report.

Formal Evaluation Processes

The SUNY-ESF Faculty Governance Committee on Instruction has adopted a semester end survey form for use in the improvement of instruction. The summary data from the survey, as well as the responses from the open-ended items, are returned to the instructor; the Faculty Chair receives a statistical summary of all courses. While not particularly useful in program assessment, the data are designed to be useful in terms of improving instruction, which is of course related to achievement of outcomes.

Table B.3-5. Summary of Selected Items from SUNY-ESF End-of-Course Student Questionnaire For Courses Taught by Faculty of Environmental Resources and Forest Engineering, Fall 2005 and Spring 2005			
Courses Fall 2005 (except as noted)	**Item (Scale is 1 Strongly Disagree to 5 Strongly Agree)**		
	Course and subject matter were well organized	**Instructor communicated effectively**	**Instructor Enthusiastic about teaching**
FEG 132 (Fall 2004)	4.1	4.6	4.7
ERE 225	4.1	3.8	3.7
FEG 300	4.0	4.3	4.3
ERE 371 (Fall 2004)	4.4	4.1	4.2
FEG 420	4.7	4.6	4.4
FEG 430	4.7	4.6	4.9
ERE 440 (Fall 2004)	4.2	4.7	4.8
ERE 596 (1)	4.6	4.6	4.9
Overall Forest Engineering Average	**4.35**	**4.36**	**4.49**
Overall ESF Average (Typical)	**4.1**	**4.0**	**4.3**
Courses Spring 2005			
FEG 340	4.1	4.2	4.7
FEG 350	4.7	4.5	4.6
ERE 351	2.8	2.5	3.2
FEG 363	4.2	3.3	4.1
APM 395	4.7	4.5	4.9
FEG 437	3.7	4.3	4.6
FEG 448	4.3	4.5	4.8
FEG 454	4.3	4.2	4.4
FEG 489	4.3	4.5	4.4
Overall Forest Engineering Average	**4.12**	**4.06**	**4.41**
Overall ESF Average (Typical	**4.0**	**4.0**	**4.3**

The data in Table B.3-4 indicate that, in general, the Forest Engineering students feel they are well served by their instructors. It is of note that the students rate highly the item related to 'enthusiasm for teaching'. This gratifying result is a reflection of the ERFEG's commitment to teaching excellence.

The faculty use the End-of-Course Questionnaire data for their own efforts to improve instruction. The Faculty Chair can (and does) consult with individual faculty to discuss issues raised in the data and to suggest opportunities to further improve instruction delivered by the Faculty.

Assessment Tools/Program Assessment

A variety of tools have been developed to aid in the assessment of the Forest Engineering Program Outcomes. We use both direct and indirect measures in our assessment program. We monitor the number of students who choose to take the Fundamentals of Engineering Examination, and their performance on certain sub-sections of the examination. In addition, exit surveys, employer surveys, analysis of activities embedded within courses, and other methods are used as appropriate. These are discussed in terms of the assessment of each Program Outcome. We discuss our assessment techniques, when appropriate, in terms of Metric, Trigger, Analysis, Response, Discussion, and Changes Implemented. As will be seen, we our assessment program involves different cycles, with some activities occurring annually, and others (e.g., employer surveys) at less frequent but regular intervals.

Assessment data are shared by the Faculty Chair with the rest of the Faculty as they become available, and at semester end retreats.

Table B3-6 shows the range of assessment techniques currently employed.

Table B3-6. Forest Engineering Program Outcomes and Methods Used in Outcome Assessment

Program Outcome	Assessment Technique	Type of Measure	Frequency	Comment
1. Competent Engineer	FE Exam	Direct	Yearly	Overall pass rate
	Exit Survey	Indirect	Yearly	Student self assessment
	Alumni Survey	Indirect	3 to 6 years	Analysis of items directed at recent graduate
2. Sufficient Background	Embedded activity	Direct	Yearly	Analysis of use of Mathcad
3 .Unifying Principles	Embedded activity	Direct	Yearly	Review of assignments in Principles of Management

				course
4. Engineering Approach	FE Exam	Direct	Yearly	Analysis of one subtest
5. Communication	Employer survey	Indirect	6 years	Last done in 2001
	Assessment by Writing Faculty	Direct	6 years	Last done in 2002
	Embedded activity – FEG 340	Direct	Yearly	Review of poster prepared to document bioswale design
	Embedded activity – ERE 440	Direct	Yearly	Review of engineering drawings created by class mates
	Evaluation – FEG 489	Direct	Yearly	Ratings of final oral presentations
6a. Knowledge	FE Exam	Direct	Yearly	Analysis of sub tests
	Embedded activity – FEG 363	Direct	Yearly	Analysis of lab project
6b. Skills	Embedded activity – APM 395	Direct	Yearly	Analysis of data/ design of experiments
6c. Attitude	FE Exam	Direct	Yearly	Per cent of seniors taking exam
	FE Exam	Direct	Yearly	Performance on one sub test
	Embedded activity – FEG 489 (2005, 2006)	Direct	Yearly	Survey before/after class discussion
7. Team Worker	Instructor Assessment – FEG 489	Direct	Yearly	Review of self and peer assessments
8. Life-Long Learner	Exit Survey	Indirect	Yearly	Student self-assessment
	FEG 300	Direct	Yearly	Review of recent technological developments

Program Outcome 1: Are competent to perform in an engineering environment

We use multiple measures to assess this outcome.

FUNDAMENTALS OF ENGINEERING EXAMINATION

We monitor the pass rate of students of students who take the Fundamentals of Engineering examination.

Metric: Annual pass rate for Forest Engineering students who take the FE examination in April of their senior year. Forest Engineering students will pass the FE examination at a rate higher than the New York State average.

Trigger: A pass rate in a given year lower than the New York State average.

Analysis: The data in Table B3-7 show the results in terms of pass rate for the Fundamentals of Engineering examination for the period 1999-2005. The data are limited to the April test date, and include only first-time test takers from the Forest Engineering program.

Table B3-7. Pass – Rate Results for the April Fundamentals of Engineering Examination

Year	Number of Students	Self-declared Major	Afternoon Exam Selected	Number Passing	Forest Engineering Pass Rate	State Pass Rate
2000	1	Agricultural	Civil	1	100	100*
	1	Forest	Civil	0	0	0*
	1	Agricultural	General	1	100	100
	6	Environmental	General	4	67	74
	7	Forest	General	5	71	71*
2001	1	Civil	Civil	1	100	78
	2	Civil	General	2	100	88
	1	Environmental	Civil	1	100	100
	1	Environmental	General	1	100	83
	2	Forest	Civil	2	100	100*
	5	Forest	General	5	100	100*
2002	2	Environmental	General	2	100	100
	1	Environmental	Environmental	1	100	80
	6	Forest	General	4	67	67*

	1	Other	Civil	1	100	100*
2003	1	Civil	Civil	1	100	82
	1	Environmental	General	1	100	100
	5	Forest	General	4	80	80*
	1	Other	General	0	0	40
2004	7	Environmental	General	3	43	71
	5	Forest	General	5	100	100*
	1	Other	General	1	100	50
2005	2	Environmental	Civil	2	100	100
	3	Environmental	General	3	100	92
	1	Environmental	Environmental	1	100	93
	7	Forest	General	7	100	100*
	2	Other	General	2	100	67
	Note: Data from Form 5 as supplied to SUNY-ESF from the State Education Department of State University of New York. * Data for Forest Engineering and New York State identical.					

Response: We have in general been pleased with the results shown in Table B3-5. There was an issue with the overall pass rate in 2000, which was identified more clearly in the sub-test analysis (shown below). The issue was addressed.

Discussion: We have discussed the metric itself. As a small, specialized engineering program, it is clear that our students describe themselves in terms of this examination in a variety of ways. For example, in 2005, 7 students identified their major as Forest Engineering, and selected the General Engineering examination in the afternoon. They were in fact the only 7 students to do so in New York State, and therefore the results for the Forest Enginnering and New York State pass rates are identical. This occurred at other points in the table identified by the asterisk in the New York State column.

EXIT SURVEY

We send a survey instrument to graduating seniors, and track the results from that survey.

Metric: One hundred per cent of the graduating seniors who return the exit survey form will feel they are prepared to enter the engineering work force.

Trigger: There is no specific trigger for this metric. Data from multiple sources are evaluated to discern the meanings associated with these data.

Analysis: A summary of survey data is presented in the next table.

Table B3-8. Summary Data from Forest Engineering Exit Survey in Answer to Statement 'I feel this program has prepared me for am prepared for: Full-time employment or Full-time graduate/professional study'		
Year	**Number of respondents**	**Per Cent Checking**
2001	8	100
2002	5	100
2003	3	100
2004	9	89
2005	6	100

Response: The data in Table B3-8 would not seem to require a response, in that the respondents feel they are well prepared for an entry-level job or graduate school or both. However, the survey instrument was critically reviewed in preparation for the Fall 2006 accreditation visit, and it was decided that the survey instrument could be improved.

Discussion: The May 2006 survey instrument is different in many regards from the previous exit surveys. The survey attempts to measure more directly student perceptions against explicit statements of Program Outcomes. These data are not available at the time of this writing. A pdf of the survey instrument is included on the enclosed CD.

ALUMNI SURVEY

The alumni survey provides information on this outcome, as was discussed in the discussion of Criterion 2, and is suggested by the mapping shown in Table B3-2.

Program Outcome 2: Have sufficient backgrounds/tools to function effectively

ANALYSIS OF EMBEDDED ACTIVITY IN ERE 440

The ERFEG unit has long been concerned with the computational skills of the students in the program. In 2003, we adopted MATHCAD as the default computational environment for all forest engineering instructional activities. We conducted two intra-faculty training sessions, and incorporated MATHCAD exercises into all of our fall and spring semester courses. We allocated funds to upgrade the campus license to the newest version.

Metric: Students were evaluated on their use of MathCAD in their final design project.

Trigger: The instructor generated a scale for assessment. The table below shows the scale and the results. The trigger is considered to be <50% in the first four categories.

Table B3-9. Analysis of Embedded Activity – ERE 440

Outcome Element	Bloom's Taxonomy Category	Performance Criteria	Maximum Number of Points	Points Earned
2. Sufficient Background /Tools	Knowledge	Uses MathCAD with units	4	3.7
	Comprehension	Uses MathCAD for calculations and carries variables through several subroutines	4	3.8
	Application	Uses MathCAD to extract biokinetic values from given experimental data	3	1.6
	Analysis	Uses MathCAD and documents steps in design analysis	3	2.7
	Synthesis	Completes design analysis demonstrating a novel approach	2	0.9
	Evaluation	Concludes whether design met design objectives and constraints	2	0.7
	Valuation	Provides statements comparing design choices to alternatives	2	0

Analysis: The results are as shown, and indicate the Program Outcome, as measure by this technique, has been attained.

Discussion: In retrospect, the choice of project to evaluate was not particularly inspired. The project was a bit too 'cook book'. The assessment would have been more valid if applied to a more open ended design exercise.

Actions To Be Taken: The assessment will be applied to a more open ended design exercise, probably a design for a flow measurement device in a circular channel.

Program Outcome 3: Have the ability to conceptualize problems in terms of unifying principles

ANALYSIS OF EMBEDDED ACTIVITY IN FOR 360

Method: The FOR 360 course instructor provided the ERFEG facuty with FEG student work products that were submitted in response to in-class assignments for Fall 2004 and Fall 2005. Students were directed to select a problem of their choosing from within their field of expertise and to submit a paper detailing the problem, problem constraints, potential alternative solutions, recommended solution and management implementation plan. Students submitted one report for grading, then revised and resubmitted it based on instructor feedback.

The instructor's grading rubric evaluated: Problem Definition (25%), Use of Problem Solving Framework (25%), Project Implementation/Management (25%), Writing Style (20%) and Ability to Follow Directions (5%).
I developed Performance Criteria based on my expectations that FEG students in this course are typically in their senior year, often within one semester of graduation. In particular, I believe that all of the FEG students should be able to apply a problem solving framework, having been exposed to problem solving in engineering science and design-based courses (e.g. FEG 300, FEG 340) prior to their senior year, as well as instruction in FOR 360.

The ERFEG assessment of the students' abilities focused on two aspects of problem solving and their related measurable performance criteria:

1. student is able to describe a problem

    a. recognizes that a change is possible

    b. identifies current state (a.k.a. existing conditions

    c. identifies desired state (a.k.a. improved conditions)

    d. identifies constraints on the system, process or product

2. student is able to recommend a preferred solution using a systematic process (a.k.a. the Decision Framework)

    a. identifies and ranks solution criteria

    b. identifies alternative solutions

c. tests alternative solutions against solution criteria

d. recommends "best" or "preferred" solution

Metric: The ERFEG faculty used these student work products to assess students' abilities in satisfying the performance criteria. Each performance criterion was weighted equally, and student performance was rated on a scale of 1 to 5, where:

- 5 = Clearly identified
- 3 = present, but needs significant improvement
- 1 = absent or lacking any development

The ratings for each criterion were summarized in a matrix, and scores were computed to describe individual and group performance for comparison to performance targets.

Triggers:

1. All Individual Total Scores should exceed 24 (i.e. all students can achieve a score of three (3) in each of the eight (8) criteria).
2. Group Average Score should exceed 32 (i.e. the average student can achieve a score of four (4) in each of the eight (8) criteria.
3. The Average Criterion Score should equal or exceed 4.0.

Action Items: When scores are less than the Performance Target Score:

1. Individual Total: refer to instructor for remedial action, review of product, and explanation of circumstances. Review similar work products using these performance criteria.
2. Group Average: Consult with instructors in FEG 300 and FOR 360 to institute course activities to improve proficiency in engineering problem solving process. Advise instructors in engineering design courses (FEG course prefix) of assessment findings. Implement followup assessment in subsequent year.

3. Average Criterion: Advise and consult with instructors in FEG 300 and FOR 360 to improve student proficiency in satisfying performance criterion. Advise and consult with instructors in all FEG engineering design courses to integrate and reinforce problem solving framework. Institute followup assessment in subsequent year.

Analysis: The most common shortcoming in the report that was identified by the instructor and the assessor was the ability of the students to explain about the problem solving framework. There is a tendency towards brevity, where the students seem to provide minimal explanation of each step in the problem solving process on the assumption that the reader (i.e. instructor) already knows about the framework. While this shortcoming is associated with students' abilities in effective communication, it is clearly integrated with learning about the problem solving process.

The enclosed table summarizes individual performance over two academic cycles in FOR 360. Note that the total number of student work products (14) is approximately half of the FEG students that have taken the course during the last two years.

Individual Scores: One student failed to meet the threshold performance criterion, largely due to underperforming in the area of identifying and applying solution criteria. Two other students underperformed on one or more criteria, but performed well in other areas to "make up the difference."

Recommendation: The instructor in FOR 360 is using an approach that provides feedback to students on their draft report. I suggest that students that exhibit serious deficiencies in one or more performance criteria at the draft report stage be required to meet minimum performance requirements in ALL areas before receiving a final grade on the paper. The current grading system allows students to be deficient in some areas, yet receive passing grades.

Group Average: The Group Average Score of 33.07 slightly exceeds the threshold target. No further action is required.

Criterion Average: Two performance criteria fell short of the target score: identifies constraints and identifies and ranks solution criteria. In the assessor's opinion, and from personal observation, these two criteria are the most difficult concepts for students to grasp. As many reflected in their papers, the students recognize the importance of applying the problem solving framework, if for no other reason than it makes them "slow down" and really look at the problem. In my experience, I find that when students are in a hurry to get to the obvious solution, taking time to identify constraints and criteria seems wasteful and will hardly affect the outcome.

Recommendation: Share these findings with the instructor of FEG 300, where students are first formally introduced to the engineering design process. Consider integration of problem solving framework in other junior-level ERE/FEG courses (e.g. FEG 340).

Program Outcome 4: Are capable of utilizing an engineering approach to problem solving

We employ multiple measures to assess this outcome.

FUNDAMENTALS OF ENGINEERING EXAMINATION

Metric: We monitor the number of correct responses on the engineering economics questions in the morning portion of the FE exam.

Trigger: We expect Forest Engineering students to perform better than the New York State average for these questions.

Analysis: The graph below tracks the percent correct for Forest Engineering and comparison groups. The graphs are weighted averages from the Form 6 data received from the State Education Department. The data for the 1997-99 examinations are not available because of changes implemented at the state level in FE exam administration.

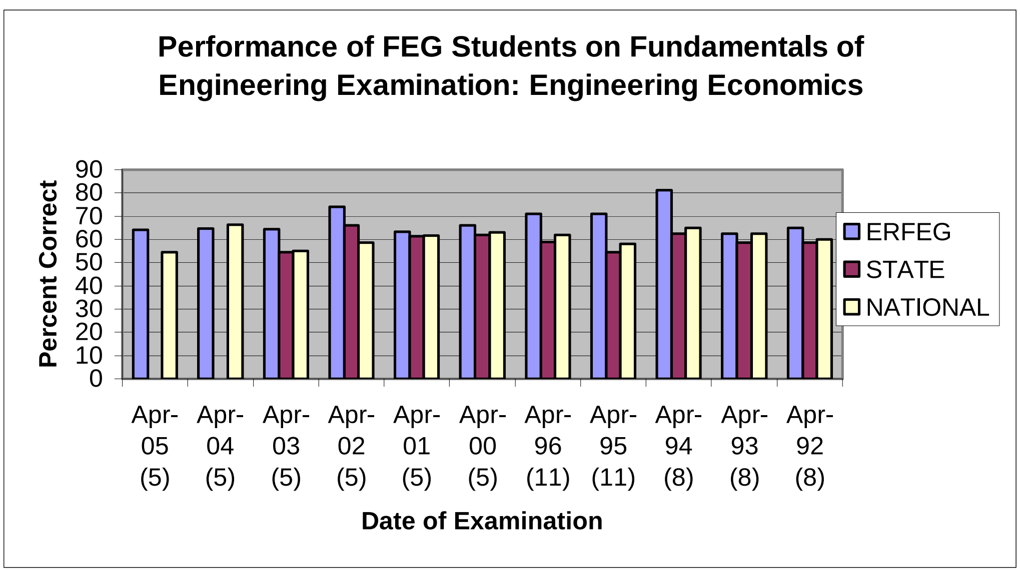


Figure 1. Results from Engineering Economics Subtest of the Morning Portion of the Fundamentals of Engineering Examination.

Response: The data support the attainment of this Outcome, and do not suggest the need for any programmatic changes.

Discussion: The results reflect directly the experience of Forest Engineering students in FEG 430 Engineering Decision Analysis, which they take in the fall semester of their senior year.

Changes Implemented: None

Program Outcome 5: Can communicate their ideas and expectations effectively

Background: Of all the Program Outcomes, this one has proven to be the most problematic. As will be shown below, we are convinced of the importance of this outcome, and have adopted a unit-wide strategy to address it. However, we have struggled with finding the appropriate assessment techniques. We have met with the staff of the college writing program to help us understand this issue, and we have used their expertise to help us with this assessment.

EMPLOYER SURVEY AND WORKSHOP

Metric: In April 2001, we invited representatives from firms who had employed recent graduates of our program. The invitation read as follows:

An Invitation from the Faculty of Environmental Resources and Forest Engineering

We are writing to ask your help in a matter of great importance to us. We know you have hired graduates from our engineering program, and we need your help in assessing how we can improve the educational opportunities for our students.

We invite you to meet for a morning with the faculty and other employers of our graduates to share views on questions such as

- What are the desired attributes of an entry level engineer?
- Does the ERFEG program produce graduates with the desired attributes?
- Are the expectations of employers different than the expectations of faculty?

We are planning a facilitated discussion for the morning of April 20, 2001.

Trigger: The discussion was lively and fruitful, and the consensus was that forest engineering graduates were at least as well prepared technically as graduates of other programs. However, most attendees agreed that recent engineering graduates were not proficient in terms of communications skills, and that forest engineering students were neither better nor worse than their peers in this regard.

Analysis: The comments of the employers echoed the observations of the ERFEG faculty.

Response: The faculty devoted the June 2001 semester end retreat to the issue of communications skills across the curriculum.

Changes Implemented: We adopted a strategy to imbed communications skills within designated courses and to communicate our expectations clearly to the forest engineering students. We created *A Guide to Effective Communications: A Handbook for Forest Engineering Students*[1], and distributed a copy to each student starting in the Fall 2001 semester. The Handbook has been updated as we add or alter new material in response to faculty and student feedback.

REVIEW OF ERFEG COMMUNICATIONS PROGRAM BY WRITING FACULTY

In the Spring of 2002, the Writing Faculty, as a part of their college-wide assessment program, conducted interviews with a focus group of forest engineering students and email interviews with ERFEG faculty. The writing faculty presented their results to the ERFEG faculty in a five page memo. Some of their findings are reproduced in the next table.

Table B3-10. Excerpts from ESF Writing Faculty Assessment of ERFEG Communications Efforts – Spring 2002

Area	Assessment	Recommendations
Writing and Communicating to Learn	Faculty commented that it is important for their students to gain competency in a range of writing and communication skills, including listening; speaking; record keeping; interpreting and creating graphics; and reading. Most students said they use writing to help them reflect and learn, and to think critically.	Students are getting a clear message that writing and communication skills are valuable in helping them to discover and learn. Teachers should continue to emphasize this important concept.
Feedback on Student Writing	Almost 90% of the faculty expressed frustration because they spend a tremendous amount of time responding to student writing, yet they have recognized little to no improvement in writing skills. Faculty members feel their main responsibility is to teach students engineering skills, which leaves little time to address writing skills, even though they feel writing is very important.	Faculty could benefit from workshops on strategies for responding to student writing. Workshops on designing writing assignments could also be useful.
Writing Guidelines	About 60% of the students felt teachers gave "fairly clear" guidelines for writing assignments, while 40% felt there could be improvement in this area. 100% of students were familiar with your Communications Handbook, and they felt it was an outstanding document.	It may be useful for teachers to review their writing assignments to make sure they express clear guidelines. Continue to promote the use of your unit's Communications Handbook. It sets an excellent standard that other units on the

[1] A pdf of the current version of the Handbook cab be found on the attached CD.

		ESF campus should follow.
Resources for Writing	Around 30% of students said they have used the ESF Writing Center, and they felt their Writing Center experience was worthwhile. Only two faculty members said they have referred students to the Writing Resource Center.	Faculty should consider referring their students to the Writing Resource Center at all stages of the writing process.

Discussion: The ERFEG faculty were generally given high marks for the communications strategies employed.

ANALYSIS OF EMBEDDED ACTIVITY IN FEG 340

Students in FEG 340 are required to present a poster describing their design of a bioswale.

Metric: The posters were evaluated according to six criteria, as described below.

Table B3-11. Analysis of Embedded Activity – FEG 340

Outcome Element	Bloom's Taxonomy Category	Performance Criteria	Maximum Number of Points
Communicate Effectively:	Knowledge	Can outline the six major categories of the stormwater biorention design process in the abstract and poster	2
	Comprehension	Can explain the environmental stormwater problem motivating the design in the abstract and poster	2
	Application	Can illustrate the location and dimensions of bioretention design specifications in the abstract and poster	2
	Analysis	Can breakdown the multiple design solution steps to move from design rainfall rates to runoff volume and bioretention size in poster	2
	Synthesis	Can create an abstract and a poster that meet conference specifications of formatting, layout, and content	2
	Evaluation	Can conclude whether design met design objective and constraints in abstract and poster	2
	Valuation	Can defend design steps taken in poster presentation when question	2

		arises on methods	

Trigger: Average scores are calculated for the class. An average score below 80% represents our trigger.

Analysis: The average scores for the Spring 2005 class are presented below.

Table B3-12. Analysis of Embedded Activity – FEG 340

Bloom's Taxonomy Category	Average	Percentage of Maximum
Knowledge	1.6	81.3%
Comprehension	2.0	97.9%
Application	1.8	89.6%
Analysis	1.8	87.5%
Synthesis	1.8	89.6%
Evaluation	1.9	95.8%
Valuation	1.6	79.2

Response: No response was required, as the average scores were above the trigger level. The score for Valuation was considered acceptable given it represents the highest level of the taxonomy.

Discussion: We chose to assess this means of communications because we think many of our graduates will be involved with poster presentations in their professional careers. We have found the posters to be useful in other regards as well. We display them prominently at College Open Houses for potential students to reinforce our marketing messages (i.e., Hands-on Learning) as described in the discussion of Criterion 1.

ANALYSIS OF EMBEDDED ACTIVITY IN ERE 440

A group of three or four students creates a design to remove marbles and sand from wastewater. They document their design with an engineering drawing. The drawing is given to a different team of students who have to construct a scale model of the system from the drawings. Each team has to write a memo critiquing the engineering drawings they had to work with.

Metric: We review the memos written, and the memos are shared with the instructor of the engineering drawing class.

Trigger: We do not have a numerical trigger for this assessment technique.

Analysis: The memos revealed a general weakness in this area. Here are some representative comments from the critiques.

"Dimensions of the weir width, the location of the screen, and the depth of water would all be helpful in your plans. To build this model we had to guess at these locations."

"The channel design was presented decently. Some of the more subtle points of the design were however a bit more challenging to figure out. . . . There is also no scale on the drawing, or any form of a title block. It could be presented in a more professional fashion."

"Information on the operation of the gate was also missing and made it difficult to construct."

"A scale model was created with relative ease after making certain assumptions regarding the design drawings."

"The plans that you created were clear and concise. . . . To improve your plan the following point should be considered.

- Include units on your drawings
- Draft your drawings in AutoCAD."

"The exercise helped us understand the detail and clarity necessary in an engineering drawing in order for it to be taken to the next step of construction."

Response: The memos were shared with the instructor of the engineering drawing class. These issues will be discussed with the students in that class, typically sophomores.

Discussion: Fall 2005 was the first year the drawings were exchanged, and the students were asked to assess the drawings of their classmates. We will work to establish a numerical scale for this assessment activity.

EVALUATION OF FINAL ORAL PRESENTATIONS IN FEG 489

Purpose: The ability of students to satisfy the communication-based Forest Engineering Program Outcome is assessed in FEG 489 Engineering Planning and Design on a regular basis as part of the course requirements. The main focus of this assessment is on oral communication in a professional setting. The results of the assessment have historically been reported to the Faculty of

Environmental Resources and Forest Engineering as part of ongoing discussions about program quality. The assessment results are reported formally about every three years.

Method: In 2006, we used "outside" reviewers to supplement the instructor's and faculty's assessment of the students' presentations and individual oral communication abilities. An example of the assessment form is included on the attached CD.

Student teams are expected to present the technical details of their proposed design. Students typically work in teams of 4 to 6 students, and all students are expected to materially participate in the project design throughout the semester, including report preparation and oral presentations.
The final oral presentations are presented to an audience comprised of student peers, College faculty, family and invited guests, including Forest Engineering alumni and representatives from local business and government agencies. Oral presentations are typically 25 minutes long, followed by 10 minutes of question and answers. Students are expected to wear professional attire, and to use presentation software such as Microsoft Powerpoint, including graphics generated from AutoCAD, GIS, and Excel.

Basis for Assessment: I expect that the students enter the course being familiar with the mechanics of oral presentations from previous course work. I provide guidelines for public speaking in the Course Handbook that all students are required to purchase. I typically reinforce their public speaking skills by having at least one informal presentation at mid-semester, followed by at least one practice session within the week prior to the final formal presentations.

I consider that all of the students in the course should be able to score a rating of 3 or better in all of the areas of individual assessment.

Collectively, the teams should score at least a rating of 3 in each of the "team effort" areas, such as Design Process, Technical Approach, Organization, Visual Aids and Time Management. Individual students are expected to perform at an "Acceptable" level (rating of 3), meaning that, in the assessor's opinion, they satisfied minimum expectations all of the time.

Any scores less than 3 will be reviewed by the instructor to determine possible reasons, and to identify and recommend potential remedies, if needed.

Review Process – 2006: The final presentations in 2006 were assessed by a group of professional engineers from the local community, including the president of a local engineering consulting firm, a senior managing engineer, and a senior engineer from a regulatory agency. In addition, three faculty from the Forest Engineering program provided assessments.

Comments: One of the obvious comments is that the results of the assessment process rely heavily on the paradigm that the assessor uses. The external reviewers generally rated the presentations higher than did the internal reviewers. Each assessor views the presentations differently depending upon his background. The tabulated results should be viewed with these differences in mind.

Results: Two teams scored less than the minimum average score of 3.0 in one of the following three categories, as determined by internal (i.e. faculty) reviewers:

- Identified criteria for evaluating alternative solutions
- Conclusion - Summarized important points of design
- Described alternative solutions
-

One individual was rated less than the minimum average score of 3.0 in his ability to "display enthusiasm" during the oral presentation.

Table B3-13a. Ratings of Final Design Presentations – FEG 489
Team One: Lake Source Cooling

Design Process and Technical Approach - Team	**Ratings by Internal Reviewers**	**Ratings by External Reviewers**
• Provided a complete problem description	4/3/4/4 = 3.75	3/4/4 = 3.7
• Demonstrated thorough understanding of the design constraints	5/4/3/5 = 4.25	4/5/4 = 4.3
• Identified components of design	4/3/4/5 = 4.0	4/5/4 = 4.3
• Identified critical design elements	4/4/3/5 = 4.0	4/5/4 = 4.3
• Described alternative solutions	4/3/4/5 = 4.0	3/4/4 = 3.7
• Understands technical issues	3/3/4/5 = 3.75	4/5/4 = 4.3
• Identified criteria for evaluating alternative solutions	5/4/4/4 = 4.75	3/5/4 = 4.0
• Applied robust technical analysis	5/3/3/4 = 3.75	3/4/4 = 3.7
• Solution is logically developed	5/3/4/5 = 4.25	4/5/3 = 4.0
• Solution is appropriate for stated problem	5/3/3/5 = 4.0	4/5/4 = 4.7
	40.5 / 50	41 / 50
Communication: Oral Presentation – Team		
Organization		
• Introduction told audience purpose of	5/3/4/4 = 4.0	3/5/4 = 4.0

presentation		
• Used logical approach to present material	5/4/4/5 = 4.5	3/5/4 = 4.0
• Included appropriate level of supporting detail	5/3/4/5 = 4.25	3/4/4 = 3.7
• Conclusion - Summarized important points of design	5/4/3/5 = 4.25	3/5/4 = 4.0
• Question and Answer session was well-managed	5/3/3/4 = 3.75	3/5/3 = 4.0
	20.75 / 25.0	19.7 / 25.0
Visual Aids		
• Appropriate	5/4/4/5 = 4.5	4/5/4 = 4.7
• Readable	5/4/4/5 = 4.5	4/5/4 = 4.7
• Support Oral Presentation	5/4/4/5 = 4.5	4/5/4 = 4.7
	13.5 / 15	14.2 / 15
• Finished within the allotted time	5/4/4/4 = 4.25	4/5/4 = 4.7
TOTAL SCORE (SUM)	79 / 95	79.6 / 95

Table B3-13b. Ratings of Final Design Presentations – FEG 489
Team Two – Orenda Facilities Plan

Design Process and Technical Approach - Team	**Ratings by Internal Reviewers**	**Ratings by External Reviewers**
• Provided a complete problem description	5/3/3 = 3.7	3/4 = 3.5
• Demonstrated thorough understanding of the design constraints	4/3/4 = 3.7	3/4 = 3.5
• Identified components of design	5/3/3 = 3.7	3/4 = 3.5
• Identified critical design elements	3/3/3 = 3	3/3 = 3.0
• Described alternative solutions	4/3/3 = 3.3	4/4 = 4.0
• Understands technical issues	4/3/3 = 3.3	4/3 = 3.5
• Identified criteria for evaluating alternative solutions	3/2/3 = 2.7	3/4 = 3.5
• Applied robust technical analysis	4/3/3 = 3.3	4/3 = 3.5
• Solution is logically developed	4/3/3 = 3.3	4/4 = 4.0
• Solution is appropriate for stated problem	4/3/3 = 3.3	4/3 = 3.5
	33.3 / 50.0	35.5 / 50.0
Communication: Oral Presentation – Team		
Organization		
• Introduction told audience purpose of presentation	5/3/4 = 4.0	3/4 = 3.5
• Used logical approach to present material	5/4/3 = 4.0	3/4 = 3.5
• Included appropriate level of supporting detail	5/3/3 = 3.7	4/4 = 4.0
• Conclusion - Summarized important points of design	3/3/2 = 2.7	4/4 = 4.0
• Question and Answer session was well-managed	4/3/3 = 3.3	3/5 = 4.0
	17.7 / 25	19 / 25

Visual Aids		
• Appropriate	4/2/3 = 3.0	4/4 = 4.0
• Readable	3/3/4 = 3.3	3/3 = 3.0
• Support Oral Presentation	4/2/3 = 3.0	4/4 = 4.0
	9.3 / 15	11 / 15
• Finished within the allotted time	5/3/3 = 3.7	4/4 = 4.0
TOTAL SCORE (SUM)	64 / 95	69.5 / 95

Table B3-13c. Ratings of Final Design Presentations – FEG 489
Team 3 - Low Impact Stormwater Design

Design Process and Technical Approach - Team	Ratings by Internal Reviewers	Ratings by External Reviewers
• Provided a complete problem description	5/3/4 = 4.0	4/4 = 4.0
• Demonstrated thorough understanding of the design constraints	4/3/3 = 3.3	3/4 = 3.5
• Identified components of design	3/3/4 = 3.3	3/4 = 3.5
• Identified critical design elements	3/3/3 = 3.0	4/4 = 4.0
• Described alternative solutions	3/2/3 = 2.7	3/4 = 3.5
• Understands technical issues	4/2/3 = 3.0	4/4 = 4.0
• Identified criteria for evaluating alternative solutions	5/3/3 = 3.7	3/4 = 3.5
• Applied robust technical analysis	5/3/3 = 3.7	3/4 = 3.5
• Solution is logically developed	5/3/3 = 3.7	4/4 = 4.0
• Solution is appropriate for stated problem	3/3/4 = 3.3	4/4 = 4.0
	33.7 / 50	37.5 / 50
Communication: Oral Presentation – Team		
Organization		
• Introduction told audience purpose of presentation	5/3/4 = 4.0	4/4 = 4.0
• Used logical approach to present material	5/4/4 = 4.3	4/4 = 4.0
• Included appropriate level of supporting detail	5/2/3 = 3.3	3/4 = 3.5
• Conclusion - Summarized important points of design	3/2/3 = 2.7	3/4 = 3.5
• Question and Answer session was well-managed	5/3/4 = 4.0	3/4 = 3.5
	18.3 / 25	18.5 / 25
Visual Aids		
• Appropriate	5/2/5 = 4.0	4/4 = 4.0
• Readable	5/3/5 = 4.3	3/4 = 3.5
• Support Oral Presentation	5/3/5 = 4.3	4/4 = 4.0
	12.6 / 15	11.5 / 15
• Finished within the allotted time	5/5/3 = 4.3	4/4 = 4.0
TOTAL SCORE (SUM)	68.9 / 95	71.5 / 95

Analysis and Interpretation; I would not consider any of the cited shortcomings to be a "fatal flaw" in determining the students' abilities to communicate effectively using oral presentation methods. Rather, considering the sum total of the entire experience, it is evident that the internal and external reviewers find that the team and student technical presentations surpass all expectations. Anecdotal comments made by external reviewers indicate a very high degree of satisfaction with the teams and individuals, expressing that the students conducted themselves "professionally." In all cases, the students demonstrated that they have the ability to communicate effectively, albeit they all need continued development as their careers progress.

Recommendations:

- As the course instructor, I recommend continued diligence in FEG 489 in teaching the elements of effective oral presentations. The current approach seems to work well.
- The addition of the mid-semester oral presentation this year was effective for two reasons. First, it required the students to stay true to the project schedule, which helps develop time management and team management skills. Second, it gave the students an opportunity early in the semester to learn to work together as a team in a stressful situation. Having had that experience, they were very receptive to the suggestions I made later in the semester that would improve their skills.
- I also suggest that ERFEG instructors that currently use, or intend to use, oral presentation methods in their courses consult the assessment form included herein for guidance. I find that students desire instructors to have consistent standards of performance. I suspect that using a similar assessment/evaluation method in junior-level courses would make the students comfortable with oral presentations before entering FEG 489.

SUMMARY: We are concerned about the communications skills of our students. While we are convinced we have seen an improvement in some areas (e.g., oral presentations) we still see weakness in written communication skills.

Program Outcome 6: Exhibit the following attributes of a competent engineer:

The next three Program Outcomes are in essence sub-sets of this Program Outcome, and therefore speak to this one. We consider successful attainment of the next three Outcomes to be evidence of the successful attainment of this overarching Program Outcome.

Program Outcome 6a: Knowledge - both in understanding basic principles and in creativity in problem solving

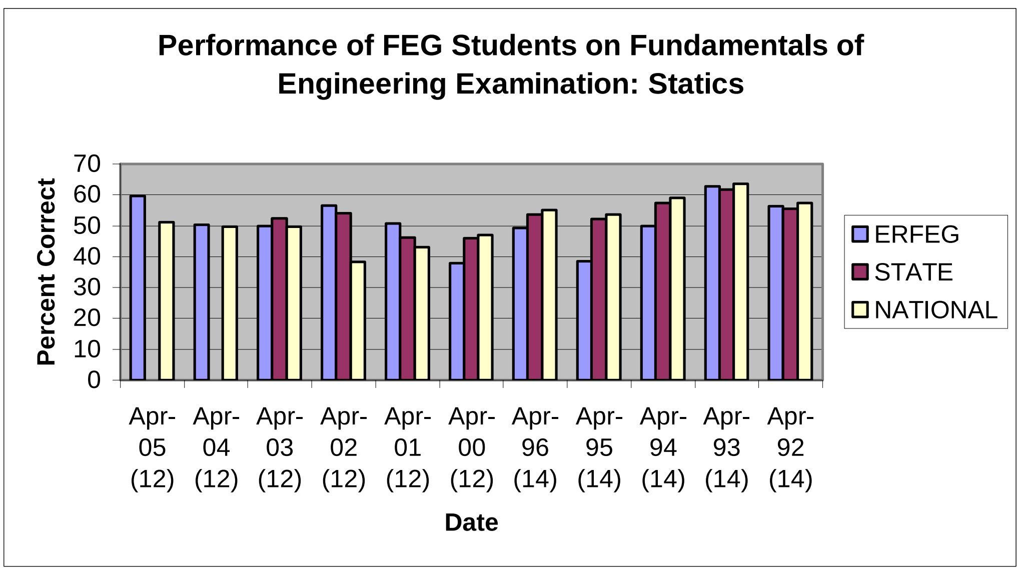
We rely on the Fundamentals of Engineering examination as one means to assess this Program Outcome. We monitor several sections of the morning portion of the FE examination.

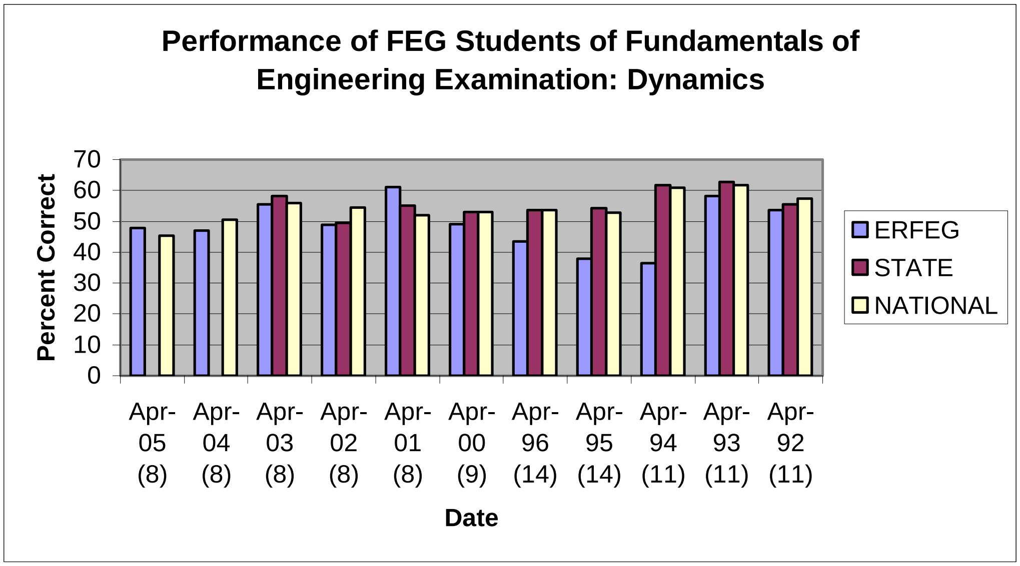
FUNDAMENTALS OF ENGINEERING EXAMINATION

Metric: We monitor the number of correct responses on several subtests in the morning portion of the FE exam.

Trigger: We expect Forest Engineering students to perform better than the New York State average for these questions.

Analysis: The graphs below tracks the percent correct for Forest Engineering and comparison groups. The graphs are weighted averages from the Form 6 data received from the State Education Department. The data for the 1997-99 examinations are not available because of changes implemented at the state level in FE exam administration.




Performance of FEG Students of Fundamentals of Engineering Examination: Dynamics
Percent Correct
70
60
50
40
30
20
10
0
Apr-05 (8)
Apr-04 (8)
Apr-03 (8)
Apr-02 (8)
Apr-01 (8)
Apr-00 (9)
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Apr-94 (11)
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Date
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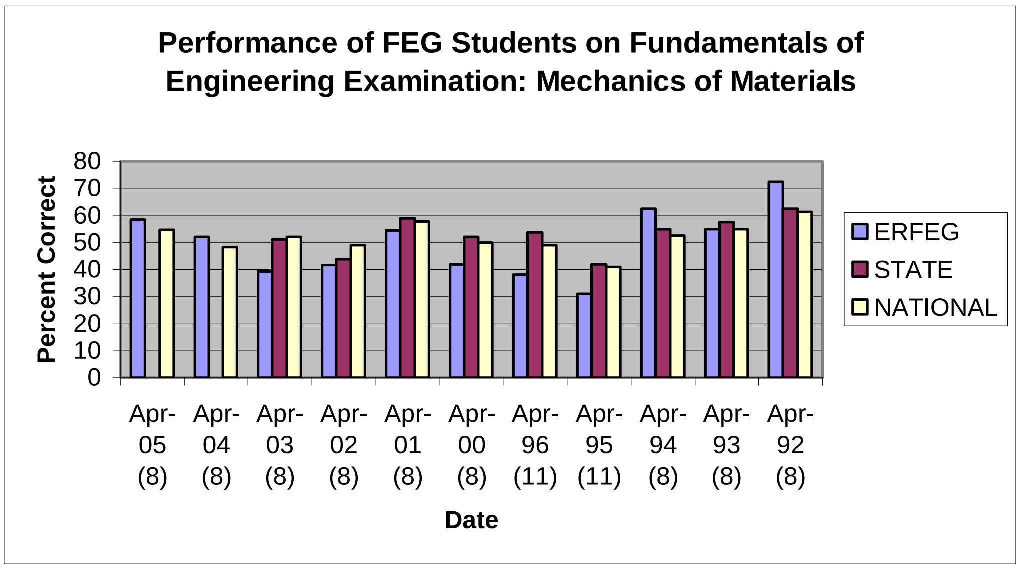
Performance of FEG Students on Fundamentals of Engineering Examination: Mechanics of Materials
Percent Correct
80
70
60
50
40
30
20
10
0
Apr-05 (8)
Apr-04 (8)
Apr-03 (8)
Apr-02 (8)
Apr-01 (8)
Apr-00 (8)
Apr-96 (11)
Apr-95 (11)
Apr-94 (8)
Apr-93 (8)
Apr-92 (8)
Date
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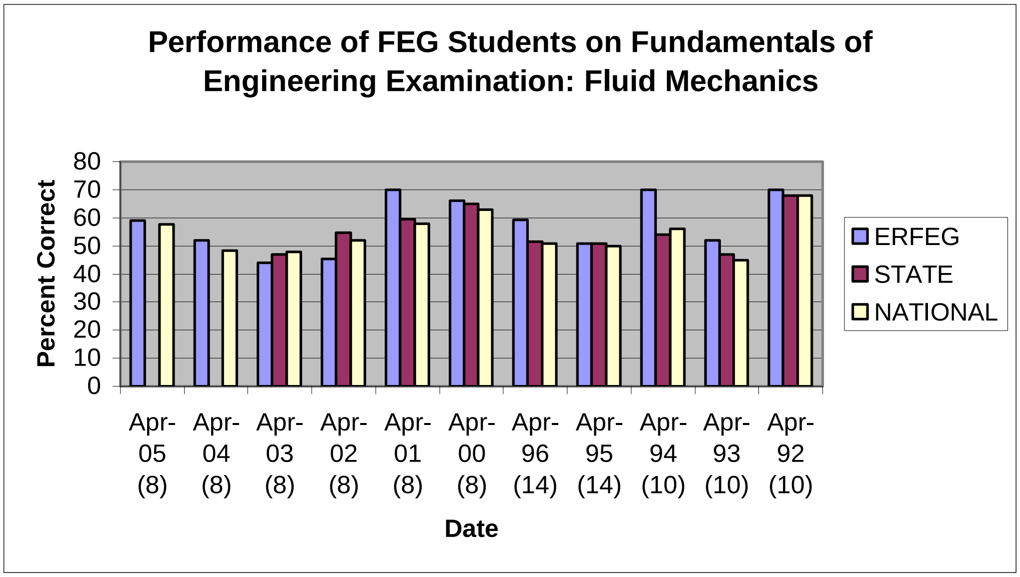

Figure 2 - 5. Results from Four Subtests of the Morning Portion of the Fundamentals of Engineering Examination.

Response: The data showed a disturbing trend in the statics, dynamics, and mechanics of materials subtests, in the Forest Engineering students consistently did not meet the metric and performed poorly as compared to the norm groups. This situation proved to be somewhat awkward in that the Forest Engineering students receive instruction in these courses from another faculty unit (see Table B4-2). The ERFEG faculty chair met, starting in the 1999-2000 academic year, with the Chair of the Faculty of Construction Management and Wood Products Engineering and shared these assessment data with him. Several hypotheses were discussed, and ultimately the Forest Engineering students were assigned to their own sections of these courses, with special care made in instructor assignment to the sections.

Discussion: The recent performance of the Forest Engineering students has improved, and now meets or exceeds our established performance metric. We have considered using the results of the afternoon portion of the FE examination, but the forest engineering students choose one of several afternoon categories (see Table B3-5) and so we would have a very small number of results to analyze.

ANALYSIS OF EMBEDDED ACTIVITY: FEG 363.

Method: During the eighth week of the Spring 2006 semester, FEG 363 students were given a lab session on Matrix Manipulation and Coordinate Transformation (attached). Being an important subject in photogrammetry, interior orientation converts photo coordinates to camera image plane coordinates through matrix manipulation. The following mathematic principles were used in the lab to solve the interior orientation problem: affine transformation and least squares adjustment. Most students in the course were in their junior year.

Assessment Criteria: Student needs to show their understanding of affine transformation models and least squares adjustment, and their ability of applying these mathematical principles to solving the photogrammetric problem. Student lab reports were used as their work products in the assessment. Student lab reports were assessed using the following criteria and grading rubrics:

1. Have knowledge on affine transformation model for coordinate transformation (i.e., Problem #1 in the lab assignment) [10 points];
2. Understand least squares adjustment (i.e., Problems #2 and #3) [20 points];
3. Apply mathematical principles to develop a transformation model (i.e., Problem #4) [30 points];
4. Evaluate and refine the model through error analysis (i.e., Problem #5) [30 points];
5. Apply the developed model to solve the interior orientation problem (i.e., Problem #6) [10 points].

Each performance criterion was weighted using the number of points, and student performance on each criterion was rated using percentage, where:

- 100% = clear and correct finish
- 75% = showing clear understanding of the principle
- 50% = on the right track
- 25% = present, but needs significant improvement
- 0% = absent or lacking any development

Performance Targets

1. Individual Total Scores should exceed 75%.
2. Averaged Group Score on each criterion should equal or exceed 75%.
3. The Grand Average Score should exceed 80%.

Result Analysis: The ratings for individual students on each criterion were summarized in the following matrix, which serves as the raw data for the analysis.

Table B3-14 Assessment of Application of Mathematics Knowledge - FOR 363							
Performance Criterion and Percentage(%)							
Forest Engineering Students	**1 [10]**	**2 [10]**	**3 [10]**	**4 [30]**	**5 [30]**	**6 [10]**	**Total Score**
1	100	60	70	100	80	100	**88**
2	100	50	50	100	80	100	**85**
3	100	80	80	90	90	70	**89**
4	100	80	100	50	100	100	**83**
5	90	100	80	100	80	100	**92**
6	100	80	100	100	90	60	**92**
7	70	80	100	100	80	100	**88**
8	100	100	100	100	100	100	**100**
9	100	100	80	70	80	70	**80**
10	50	0	0	80	90	50	**62**
11	100	100	80	90	80	100	**89**
12l	100	100	80	90	90	70	**91**
13	100	80	0	100	30	40	**62**
Average	**93**	**78**	**71**	**90**	**82**	**82**	**85**
Notes: 1 = knowledge on affine transformation; 2 = understanding of least squares adjustment; 3 = further understanding of least squares adjustment; 4 = application of least squares adjustment in model development; 5 = model evaluation and refinement; 6 = model application							

1. Individual Scores: Note: Fourteen Forest Engineering students took the course Spring 2006. One did not submit the lab report; therefore, this assessment is based on the records of 13 students. Two students out of thirteen failed to meet the threshold performance criterion (<75%). They both missed problems to answer, largely due to carelessness. Rest students performed well (>80%), with four of them higher than 90%.

Recommendation: The instructor in FEG 363 should re-emphasize the importance of carefulness and understanding the problem itself. Also suggest the instructor require re-submission of incomplete work.

2. Criterion Average: The third performance criteria (i.e., further understanding of least squares adjustment) appeared 71% and fell short of the target score (75%). The related question that needed to be answered was "Why least squares solution can help to develop an affine transformation model for the photogrammetric problem provided?" This is an open-mind problem, and needs some critical thinking. Four students addressed the problem correctly; seven students (with a score between 50% and 80%) either were on the right track or showed understanding of the principle involved, but failed present clearly and correctly. Two students did not answer the question again due to carelessness.

Recommendation: The instructor of FEG 363 should more frequently expose students to critical thinking problems and give students more opportunity to express themselves during the lecture and lab discussions.

3. Group Average: The Group Average Score of 85 exceeds the threshold target. No further action is required.

Conclusion: Students in FEG 363 are able to apply knowledge of mathematics to solving problems. **Program Outcome 6b: Skills - originality and method of problem solving**

ANALYSIS OF EMBEDDED ACTIVITY IN APM 395

This project involves the analyses and interpretation of streamflow data, the estimation of flood percentiles, and the development of a regional regression model that can be employed to estimate flood percentiles at ungauged river sites. The assessment results are documented in an end of course memo prepared by the instructor.

Metric: Students were evaluated on a project and given a numerical score indicating their understanding of the concepts.

Trigger: The instructor generated a scale for assessment.

Table B3-15. Analysis of Embedded Activity – APM 395

Average Score	Action
20 – 25 (80% - 100%)	No Action Needed
15 – 20 (60% - 80%)	Changes to APM395 course and project needed
< 15 (< 60%)	ERFEG faculty to make necessary curriculum changes

Analysis: The average score on this assessment was 19.1. This score is a trigger within our program assessment (as it is between 15 and 20), indicating a need for changes within APM395 to better prepare ERFEG graduates to meet this program outcome.

Actions Taken: The following actions are to be taken in APM395:

1) More thoroughly discuss this program outcome and the importance of this outcome in their engineering careers;
2) Hand out the assessment rubric prior to performing this project; and
3) Provide additional classroom discussion of the techniques necessary to adequately perform the semester project.

Discussion: In addition, the instructor analyzed the results in terms of individual Bloom's Taxonomy categories. These results are as follows:

Table B3-16. Analysis of Embedded Activity – APM 395 in Relation to Bloom's Taxonomy

Bloom's Taxonomy	Maximum Number of Points	Average	Percentage of Maximum
Knowledge	2	2.0	100.0%
Comprehension	6	4.6	77.3%
Application	5	4.2	83.6%
Analyze	4	3.4	84.1%
Synthesis	5	3.9	78.2%
Evaluation	1	0.5	45.5%
Valuation	2	0.5	27.3%
Total Number of Points	**25**	**19.1**	**76.4%**

Forest Engineering students exceed 80% in 3 of the 7 Bloom's Taxonomy categories, and exceed 77% in 5 of 7 categories. In general they perform better in knowledge, comprehension, application, analysis, and synthesis, and worse in evaluation and valuation. These results are consist with the general understanding that Bloom's taxonomy represents a progression, where student must first master the initial taxonomy categories before being able to adequately perform within the latter categories.

Table B3-17. Analysis of Embedded Activity – APM 395			
Outcome Element:	**Maximum Number of Points**	**Average**	**Percentage of Maximum**
Design Experiment	7	6.6	94.8%
Conduct Experiment	3	2.6	87.9%
Analyze Data	7	5.3	75.3%
Interpret Data	8	4.5	56.8%
Total Number of Points	**25**	**19.1**	**76.4%**

These results indicate adequate proficiency in designing and conducting experiments, while student are less proficient in analyzing and interpreting data. For the outcome element of interpreting data, student performance was close to the trigger for overall curriculum changes (i.e. less than 60%). This indicates that more time and effort is needed in training our student to develop further insight on interpreting the meaning of their data analyses.

Program Outcome 6c: Attitude - professional ethics, self-disciples, and perseverance

Again, we rely on data from the Fundamentals of Engineering examination to provide evidence in support of this Outcome.

FUNDAMENTALS OF ENGINEERING EXAMINATION - I

Metric: We compare the number of graduates from the Forest Engineering program with the number of students who take the FE exam in their senior year.

Trigger: We will react to anything less than 100% participation.

Analysis: The data in the next table show the number of Forest Engineering graduates by year and month as compared to the number of students registered to take the Fundamentals of Engineering examination.

Table B3-18. Numbers of Students Certified to Take the Fundamentals of Engineering Examination Compared to Numbers of Graduates

Date of Fundamentals of Engineering Examination	Number of Eligible Students	Date of Graduation	Number of Graduates
April 2001	13	May 2001	13
		August 2001	1
October 2001	-	December 2001	2
April 2002	11	May 2002	8
October 2002	-	December 2002	1
April 2003	8	May 2003	8
October 2003	-	December 2003	2
April 2004	19	May 2004	13
		August 2004	1
October 2004	-	December 2004	4
April 2005	17	May 2005	13
		August 2005	1
October 2005	-	December 2005	5
April 2006	19	May 2006	14
Totals:	**87**		**86**

Response: The data support the attainment of this Outcome, and do not suggest the need for any programmatic changes.

Discussion: We feel this is an appropriate metric in that we **encourage** but do not **require** our students to take the FE examination. Further, we do not hold formal review sessions – the faculty will provide sessions if asked by the seniors, but it is up to the students to organize themselves, purchase review books, schedule review sessions, and otherwise manage their time to prepare for the exam. We therefore feel this is an appropriate metric for this Outcome.

FUNDAMENTALS OF ENGINEERING EXAMINATION - II

We also monitor the performance of Forest Engineering students on the ethics questions on the morning section of the Fundamentals of Engineering examination.

Metric: We monitor the number of correct responses on the ethics questions in the morning portion of the FE exam.

Trigger: We expect Forest Engineering students to perform better than the New York State average for these questions.

Analysis: Figure 6 below tracks the percent correct for Forest Engineering and comparison groups.

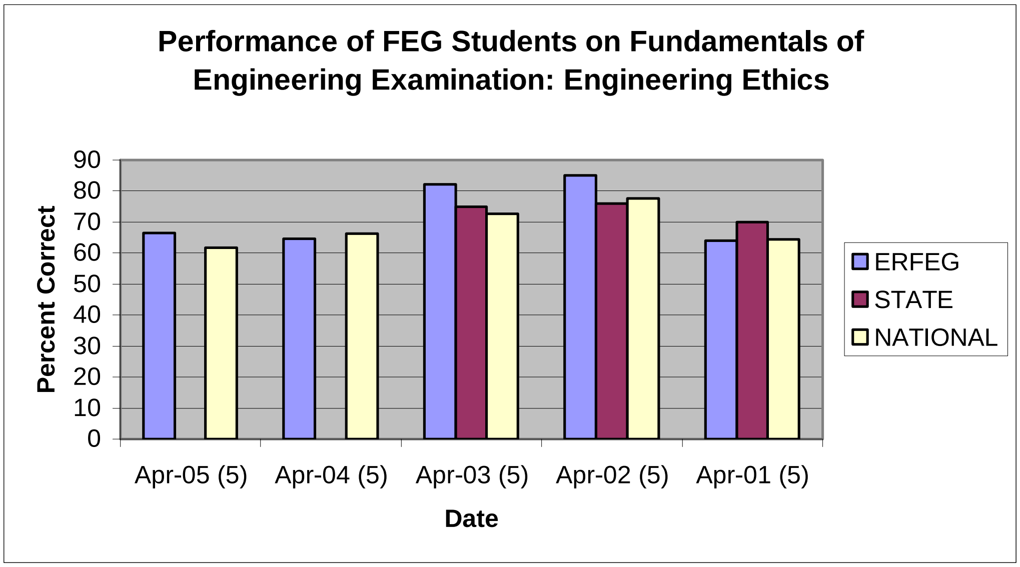

Figure 6. Results from Engineering Ethics Subtests of the Morning Portion of the Fundamentals of Engineering Examination.

Response: The data support the attainment of this Outcome, and do not suggest the need for any programmatic changes.

Discussion: The FE data were analyzed as described earlier, and are subject to the same limitations as noted previously.

Changes Implemented: We continue to develop strategies to emphasize the importance of professional and ethical behavior in the curriculum, and it is likely the assessment of this outcome will change as new strategies are employed.

ANALYSIS OF EMBEDDED ACTIVITY IN FEG 489 (2006)

Method: A four class period instructional module developed by a guest lecturer professional engineer engaged students in discussion of leadership, the NSPE Code of Ethics, Principles of Green Engineering, WFEO guidelines and AAES Action Principles for the Engineering Profession as well as an engineering ethics video. The module is designed to provide students with an understanding of the nature of professional and ethical responsibility along the career growth path from highly capable individuals to team members to competent project managers. Students applied those principles and the NSPE Code to write: 1. a viewer's response to the video *Incident at Morales* as well as 2. to complete both a pre-module and a post-module Six Item Survey on statements about engineering practice as adapted from *"Assessment of an Engineering Ethics Video: Incident at Morales"*- Journal of Engineering Education, January, 2006. In addition students engaged discussion that rationalized their responses to the Six Item Survey and changes that occurred between the pre and post module responses.

Two components of assigned student work and the applicable assessment tool were:

1. instructions for the students viewer's response to the *Incident at Morales* guided each student to choose from four open-ended problematic situations depicted or related to the video and write a professionally based response.
2. in completing the pre and post module Six Item Surveys and in discussion students rationalize their decision as to whether or not the individual exercise of professional responsibility can affect change in a corporate culture.

Assessment tool: Student is able to recognize and incorporate in written responses the problematic situation in terms that reflect a robust understanding of professional and ethical responsibility as drawn from the NSPE Code of Ethics and/or the AAES Action Principles for the Engineering Profession and a five tiered leadership responsibility pyramid.

Metric: We characterize students ability to apply codes and action principles when describing a problematic situation in the context of the referenced assessment tool and rate their performance on a scale of 1 to 5, where:

5 = Clear link with code of ethics / or action principles
3 = Logical analysis, but link to formal professional codes and principles needs development
1 = Lacking any substantive development, relying instead on assertions and beliefs only

The ratings were computed for both assessment components.

Triggers: The class average performance rating should equal or exceed a Performance Target Score of 3.5 for both sets of assigned work.

Action Items: When performance ratings are less than the Performance Target Score the instructor will institute course activities designed to strengthen students understanding of the link between the NSPE Code of Ethics and the AAES Action Principles for the Engineering Profession with professional practice and ethically based problematic situations.

Ratings: Viewer's response average rating was 4.5. No student was ranked below 3.0

Six Item Survey with rationale rating was 3.75. Two students failed to provide suitable attempts of rationale.

Analysis: The viewer's responses sometimes lapsed in part to a description of a story line rather than a response in the sense of a professionally based robust thinking process. Every student did very well in some aspect of their written response and more than one-half of the students did very well throughout. Students need better guidance about developing each paragraph in their responses in line with the instructions. The Purdue University Online Writing Lab paragraph development methods will be demonstrated in an assignment that links problematic engineering practice situations to the NSPE Code of Ethics and the AAES Action Principles for the Engineering Profession. Since NSPE has recently incorporated sustainability into its code of ethics, this would be a good teaching tool.

The results of the Six Item Survey pre module and post module, in terms of Strongly agree, Agree, Neutral, Disagree or Strongly disagree differed in only the slightest terms (effective change of none means only one student opinion changed and that change was two or fewer positions in the response range):

1. The first obligation of an engineer is to fulfill an assignment with an employer, or a contract with a client. No effective change, however, all students clarified that human safety must be embedded in the matter as the top priority, an issue originally identified by only one-half the class in a pre discussion show of hands.
2. When working in a foreign country, an American engineer should comply with local regulations and should avoid more stringent American standards for safety. No effective change
3. Ethical considerations are an integral part of making engineering decisions. Two students shifted from Agree to Strongly Agree and no other changes occurred.
4. A code of ethics can provide guidance in making engineering decisions. No effective change.

5. Many ethical problems encountered by engineers have technical solutions. Significant change occurred as students were originally two-thirds neutral on this matter and became quite active in their thinking in both the agreement and disagreement directions. This became a good topic for lively class discussion. The primary source of disagreement was semantically based.
6. The exercise of professional responsibility can affect change in a corporate culture. Modest changes from mainly neutral to some agreement and some disagreement became a focal pointfor class discussion.

Recommendation: This assessment validates that by the end of their senior year Forest Engineering students / graduates to exhibit the attitude and understanding of professional responsibility intended for the program**.** Strengthening of sustainability in the current module should be considered by the ERFEG Faculty in the year ahead.

ANALYSIS OF EMBEDDED ACTIVITY IN FEG 489 (2005)

Metric: FEG 489 students were given an assignment in the Spring 2005 semester. The Forest Engineering students in the course are principally in their final (senior) year.

Assignment:

Read the article *Ethics and the Professional Engineer* by John Speed, P.E. found at URL http://www.nspe.org/ethics/eh1-eth.asp
Reflect upon your experience by addressing the following comments/questions in an essay

- How you achieved your goals in FEG 489 in a trustworthy manner.
- How you treated your team mates and instructor in an honest and complete manner.
- How you selected an appropriate design using an objective assessment process.
- How you promoted appropriate ethical behavior amongst your team and class mates.
- How will you use these experiences as you conduct business (including continued education) over the next 2 years.

Criteria: Student essays were assessed using the following criteria:

1. Comprehends need for engineering ethics based on the reading assignment

2. Expresses an understanding of ethics and trust
3. Expresses relevant example(s) of ethical behavior
4. Proposes relevant ethical model for post-graduation activities

Results: Results from the assessment of individual papers are included in the following table. The criteria are scored based on the integer scale of 1-5, where

1 = skill or knowledge is absent
2 = skill or knowledge is apparent, but lacks sufficient development
3 = skill or knowledge satisfies minimum expectation
4 = skill or knowledge exceeds minimum expectations some of the time
5 = skill or knowledge is mastered

Trigger: All students are expected to achieve a minimum score of 3/5 for each criterion.

Analysis:

Table B3-19. Analysis of Embedded Activity – FEG 489 (2005)

Name n = 14	Comprehends Ethics from Reading	Understanding of Ethics and Trust	Cites Relevant Examples	Proposes Ethical Model	TOTAL
1	4	4	4	4	16
2	3	3	3	2	11
3	4	4	4	4	16
4	5	5	4	3	17
5	3	4	5	3	15
6	4	5	4	3	16
7	5	5	5	4	19
8	1	3	4	3	11
9	2	3	3	2	10
10	2	2	3	4	11
11	3	3	4	5	15
12	2	4	4	3	13
13	2	3	3	3	11
14	5	4	4	5	18
AVERAGE	**3.21**	**3.71**	**3.86**	**3.43**	

Response and Discussion:

1. ***Comprehends need for engineering ethics based on the reading assignment***

10/14 students satisfied the minimum expectations for this assessment criterion. The shortcoming was largely due to the students failing to make a direct reference in the essay to the key statements from the reading assignment. This may be explained by the difference between the instructor's explicit assignment requirements (which did not require an analysis of the reading) and the assessor's criteria. As there is some overlap with the other assessment criteria, these shortcomings are not considered detrimental if the other criteria are satisfied.

2. ***Expresses an understanding of ethics and trust***

13/14 students met or exceeded this assessment performance criterion. The one student that fell short seemed confused about the difference between the ethical behavior model and the project management responsibilities.

3. ***Expresses relevant example(s) of ethical behavior.***

All students met or exceeded the minimum expectations for this criterion.

4. ***Proposes relevant ethical model for post-graduation activities.***

12/14 students met or exceeded the minimum expectations for this criterion. The two that fell short of the expectation failed to expressly state what type of model they would follow (e.g. NSPE Code of Ethics), but did allude to taking their learned knowledge and experience in dealing with teammates into the next phase of life.

For the most part, the student essays demonstrated that all of the students have a reasonably good understanding that engineering ethics is vital to continued success and that honesty, trustworthiness and objectivity are important behaviors in dealing with their peers, supervisors, clients and the public. They all expressed that the course FEG 489 and the project gave them the experience they needed to go forward in pursuit of their continued education and career. Several expressed that the code of ethics is "common sense," an affirmation that these students in particular already subscribe to an ethical model. Application of ethical behavior to the engineering profession seems natural to these students.

Most cited relevant examples of actions that they consider "ethical". Notably, many expressed the idea that they would limit their practice to their area of expertise and would put the needs of the public and the client before their own.

I believe the shortcomings are not indicative of any lack of understanding on the part of the students, but rather an inability to clearly express their ideas on this particular writing assignment. The assignment was completed at the end of the semester, in the midst of intense preparations for the final oral presentations and written reports in this class. Is suspect that the two students did not give the assignment sufficient attention.

Recommendation: The ability of the student to reflect upon the NSPE code of ethics and their own behavior is important. I suggest that the assignment be completed earlier in the semester to allow time for reflection without undue stress from other assignments. In addition, the assignment could include classroom discussion after the written portion is graded.

Program Outcome 7: Can function effectively in a multidisciplinary team/environment

The Faculty considers teamwork to be an essential skill that all engineering graduates must possess. While numerous opportunities are integrated throughout the curriculum for students to work in small groups or with partners, teaching the process of teamwork is explicitly stated as a course objective for two required engineering design courses, FEG 300 and FEG 489. As a result of these experiences, the Faculty considers the following performance criteria to be essential indicators that this outcome is met:

- Students are able to explain the functional roles and responsibilities of team members.
- Students are able to demonstrate that they are capable of functioning in an assigned role within a team.
- Students are able to assess the performance of themselves and other team members to improve the effectiveness of individual and team performance.
- Students engage in behavior that demonstrates respect of team members and their functional roles.

INSTRUCTOR ASSESSMENT – FEG 489

Performance Criterion:

- Students are able to explain the functional roles and responsibilities of team members.

Method: Students were given a quiz during the first week of the Spring 2006 semester and asked to describe four principal functional roles and at least two responsibilities for teamwork.

Results: 100% of the students responded satisfactorily to the quiz.

Performance Criterion:

- Students are able to demonstrate that they are capable of functioning in an assigned role within a team.

Method: Students were assigned to project teams and were given an activity to assign team functional roles. Team functional roles were reinforced by the instructor performing formative assessments throughout the semester. Instructor would observe teams, address questions to the "Captain", review "Recorder's" notes, and ask for oral summaries from the "Reporter".

Results: All students responded satisfactorily to performing within assigned functional roles. Students demonstrated respect for the various roles, and became proficient in satisfying their responsibilities by the end of the semester. All students materially participated in the end of semester oral project presentations, further evidence of their trust in one another and their evidence that they can function in a team environment.

Performance Criterion:

- Students are able to assess the performance of themselves and other team members to improve the effectiveness of individual and team performance, and
- Students engage in behavior that demonstrates respect of team members and their functional roles.

Method: The Self- and Peer-Assessment is the principal tool used by the students to improve their own and team members' performances throughout the semester. Students assess their own performance and their teammate's performance in several categories, namely:

- Committed to Team (e.g. attends all team meetings)
- Commitment to Team (e.g. material participation in all activities)
- Able to resolve conflict within team (e.g. reach consensus, or compromise)

- Able to perform within assigned functional team role
- Meets deadlines
- Willing to work as part of a team (respectful of team members)

Assessments are usually performed in about the sixth and tenth weeks of the semester strictly for the purpose of process improvement. Students discuss the assessment results with each other and the instructor in team-level meetings and are encouraged to develop an action plan to improve their performance based on these assessments. The end-of-semester assessment is completed by the students, with affirmation by the instructor that the student ratings are appropriate and consistent with the instructor's assessment.

Metric Peer and self-assessment scores are aggregated to compute an average score based on the number of assessors. There are six categories used for assessment of teamwork. Scoring a maximum of five points in each category yields a maximum score of 30. We expect that all students will score at least three points (3) in each category (Average Total Score of 18 points) reflecting that they have met the minimum expectations all of the time. Individuals scoring less than 18 out of 30 points will be reviewed to determine if there are any trends within the team or within the class; any individual scoring less than 12 (an average score of 2 in each category) will not be considered effective in teamwork.

Analysis Seventeen (17) Forest Engineering students were assigned the Self- and Peer-Assessment at the end of the Spring 2006 semester. Thirteen (13) students returned the forms as required.

Self Assessment Scores ranged from 17 to a perfect 30. These scores are derived from individuals assessing their own performance in each category.

Individual Peer Assessment Scores ranged from 14 to a perfect 30.

The Combined Average Score ranged from 16 to 26. These scores combine the peer and self assessment scores for the entire team.

Response: Non-responsive students participated in earlier assessments, and were generally responsive to all class assignments. Their lack of response in this case is unusual, but did not adversely affect the instructor's assessment process.

The Combined Average Scores exceeded the 18-point threshold in all but one instance. The instructor concurs that the individual student scoring 16 out of 30 points in the team assessment underperformed on more than one area. It is known to the instructor that this particular student was dealing with personal circumstances outside of the academic environment that hampered the student's academic success. Despite intervention efforts by the instructor, this student was not able to meet the minimum performance expectations in the team environment due to these conflicts.

In all instances, the instructor's assessment concludes that all students are capable of functioning in a team environment. They all understand the need for working on teams, and all work together to try to overcome adversity and conflict. While instructor intervention is sometimes needed to pull the teams back into the process, once intervention occurred the teams moved beyond the conflict and seemed to thrive and succeed.

Actions: Instructor will need to continue formative assessment process and intervention with teams and individuals that are not functioning as needed. Faculty may give consideration to requiring each individual to demonstrate satisfactory team performance before receiving course grade.

Program Outcome 8: Understand the need for life-long learning

We assess this outcome by two measures.

EXIT SURVEY

We send a survey instrument to graduating seniors, and track the results from that survey.

Metric: We review the numerical scores on the exit surveys returned.

Trigger: We expect an average score of at least 4 on a scale of 1 (Strongly Disagree) to 5 (Strongly Agree)

Analysis: A summary of 2006 survey data is presented in the next table.

Table B3-20. Summary Data from Forest Engineering Exit Survey in Response to Statement 'I understand the need for me to engage in life long learning'

Year	Number of respondents	Average Score
2006	3	3.67

Response: The results are from the 2006 survey only, as that survey instrument was modified to provide better feedback from the graduates. Earlier versions of the survey did not explicitly address this issue. Still, the results show the need to better inculcate this outcome into the Forest Engineering curriculum.

Discussion: The May 2006 survey instrument is different in many regards from the previous exit surveys. The survey attempts to measure more directly student perceptions against explicit statements of Program Outcomes. A pdf of the survey instrument is included on the enclosed CD.

EMBEDDED ACTIVITY IN FEG 300

Method: FEG 300 students were given the following assignment during the third week of the Fall 2005 semester. The Forest Engineering students in the course are principally in their junior year.

1) Read text Chapter 1 and Sections 2.1 through 2.4 (Text: *Design Concepts for Engineers*, 3rd Ed, Mark N Horenstein, ISBN: 0-13-146499-X, Prentice Hall)

    a) Prepare a two-page statement of your own that reflects on the statement at the bottom of page 19 – "… the prudent engineer also acquires knowledge through … a lifetime of study and exploration."

        i) Give two examples of civil/environmental engineering and technology in common use today that either did not exist 20 years ago, or has significantly improved the effectiveness of civil/environmental engineering and management systems over the past 20 years.
        ii) Reflect on how ESF engineering students graduating in 1985 have kept informed of and proficient with this technology development over the past 20 years. Identify at least two ways that these alumni may have continued their lifetime of education.
        iii) Describe two examples of how you might continue your study and exploration for the 10 years after you graduate from ESF.

Assessment Criteria: Student work products were assessed using the following criteria:

1. identifies need for continued education in engineering
2. provides one relevant example of technology change
3. identifies at least two methods for continuing learning after graduation
4. reflects upon personal interests in continued learning

Results from the assessment of individual papers are included in the following table.

Table B3-21. Summary of Responses in FEG 300

Name	1. Need	2. Change	3. Learning Processes					4. Reflection
			Field Observation	Reading Journals	Work-shops	Formal Education	Professional Meetings/ Conference	
1	•	•	•		•			•
2	•	•		•	•	•		•
3	•	•	•	•		•	•	
4	•	•	•	•	•		•	
5	•	•	•	•	•	•		
6	Incomplete							
7	Incomplete							
8	Incomplete							
9	•	•		•			•	
10	•	•	•	•		•		
11	•	•						
12	•	•						
13	•	•	•	•		•	•	•

The reading assignment exposes students to the concept of continuous learning in an engineering environment. A related assignment regarding professional registration underscores the need for continuing education as part of professional engineering. Classroom discussion is used to explore the students' perceptions and to present opportunities for continued learning after graduation.

The writing assignment assessment underscores that all of the students that completed the assignment understand the need for continuous learning, especially in the context of technology changes. All of the students were able to identify at least two methods that they would use to continue their learning after graduation. Although it was not part of the assignment, three of the students did reflect upon their personal interests and what method would be most successful for themselves.

Conclusion: Students in FEG 300 understand that lifelong learning is an essential part of the engineering profession.

Reflections on Assessment Activities and Future Directions

Our efforts described in this Criterion have reminded us that we are not experts in assessment. While we have as a faculty embraced the concept of finding ways to improve our program, we have struggled with the details of the implementation. What is described here is a work in progress, subject to refinement as we learn more.

It is also fair to say that our assessment efforts, off to a good start in 2000, suffered a setback when our faculty numbers declined during the middle of the assessment cycle (see discussion under Criterion 5). We have had to train new faculty in the basics of assessment, and otherwise bring them into our culture.

Our Program Outcomes (originally cast as Objectives) predate the ABET Criterion 3 a – k statements. Our Outcomes were generated with the help of our Advisory Council, and so we are convinced we have to honor them in our assessment program. However, as we have gained experience with program assessment, we realize that our Outcome statements can be improved to make them more ‘assessable’. We will discuss this as a faculty and bring our ideas to our Advisory Council as we move forward.