

DEPARTMENT of CIVIL ENGINEERING and SURVEYING
UNIVERSITY of PUERTO RICO
MAYAGUEZ CAMPUS

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Departmental Plan for the Assessment of Student Learning



July 1, 2001



Prof. Hiram Gonzalez, PE
Accreditation Coordinator
hiram@ce.uprm.edu

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Plan for the Assessment of Student Learning; Department of Civil Engineering and Surveying (July 1, 2001)

1. Introduction

The University of Puerto Rico at Mayagüez (UPRM) recognizes that excellent institutions are self-reflective and continually seeking to improve. The Department of Civil Engineering and Surveying (CE&S) at UPRM continually assesses its programs in a process consistent with its established vision and mission. As part of a continuous process of refinement and upgrade of our programs, our faculty maintains direct contact with practitioners in industry and government and with professional societies, which provide continuous support and collaboration. The CE&S continuously revises its curriculum to implement the feedback from our established student learning assessment processes. These processes are mostly based on the Accreditation Board for Engineering and Technology (ABET) EC 2000 Outcomes Assessments Criteria.

The *assessment of student learning* is one component of the department's overall assessment and, in fact, *the most important one*. The assessment of student learning has the *student as its primary focus of inquiry*; therefore the department recognizes that the assessment of student learning first occurs on an individual student basis within a particular course, is processed mainly at the department/ program level, and is supported by the institution when and where appropriate.

In fact, over the last three years, our College of Engineering (CoE) has been formalizing the *continuous quality improvement (CQI)* processes used in such matters as establishing program educational objectives, program outcomes, assessment tools and strategies, making changes in the curriculum, introducing new courses in response to the needs of industry, and incorporating outcomes assessments principles, among others.

2. Purpose of the Plan

The primary purpose and focus of this plan is on the design and implementation of programs or processes to assess student learning outcomes and lead to continuous quality improvement (CQI). The intention is to begin the assessment process by building and documenting on existing practices. Although some of the processes established in this plan are new, most are simply formalizations of procedures we have followed for many years.

It is important to recognize, however, that this student learning assessment plan will undoubtedly evolve, as academic programs evolve. Additionally, the plan is intended to be a source of guidance without constraining experimentation or alternate approaches that may be developed by the faculty or have already been proven effective elsewhere.

3. Applicability

This plan applies to all student-credit-generating academic units of the Department of CE&S at UPRM, its faculty, students and support staff.

4. Key Terms Definitions

For the purpose of avoiding confusion between our main professional accreditation agency (ABET), the Department of CE&S, and the Institution, and for the equal interpretation of key terms in the development of student learning assessment plans throughout UPRM, *the following definitions shall be adhered to:*

- **Program Educational Objectives (PEOs):** Statements that describe the expected accomplishments or performance of graduates during the first few (5) years after graduation.
- **Program Outcomes (POs) = Program Student Learning Outcomes/Goals:** Statements that describe what students are expected to know and be able to do by the time of graduation.
- **Course Learning Outcomes/Goals (CLOs):** Statements that describe what students are expected to know and be able to do by the end of the course.

5. Constituencies

The main four constituencies of the Department of CE&S are current *students, faculty, alumni*, and the *employers/supervisors/managers* of our alumni. On a less regular basis the department will seek input from other constituencies, such as: graduate schools, the CIAPR (College of Engineers and Land Surveyors of Puerto Rico), government agencies, parents, local community members, the UPR system administrators, and anyone who is willing to share experiences and needs. Each group plays an important role in establishing and evaluating the success of the program outcomes and educational objectives, and in providing direction for the department's future. Nevertheless, the emphasis will be on the main four.

6. Mission Statements

The Department's most recent vision and mission statements are the result of extensive review by faculty, students, and other members of our constituency. These versions were approved at a Faculty Meeting on 29 March 2001.

VISION

We provide society with people serving, problem solving professionals in civil engineering and surveying.

MISSION

Provide our society with high quality professionals having a strong education in civil engineering and/or land surveying; with rich cultural, ethical, environmental, and social sensitivities; capacity for critical thinking; and the entrepreneurial skills to solve civil infrastructure problems. Search for and disseminate new knowledge. Provide services to solve engineering problems as members of interdisciplinary teams.

In line with the vision and mission statements, a departmental *Slogan* was developed to motivate our students around their service to society and their problem solving responsibilities:

$CES = (PS)^2$ → ***(Civil Engineers and Surveyors = People-Serving, Problem-Solvers).***

The CE&S curriculum is designed to meet the needs of all students within the context of this vision and mission. This mission statement served as the basis for the development of specific program educational objectives and program outcomes and for the selection of evaluation and assessment methods and tools to determine whether the outcomes and objectives are being met. These will all be discussed in the sections ahead.

The Civil Engineering Program's mission and objectives are clearly consistent with the mission of the UPRM College of Engineering (CoE), as approved by the College's faculty on 8 May 2001. It reads as follows:

“Provide Puerto Rico, our neighbors, and the rest of the world with professionals having a strong education in engineering and related areas, with rich environmental, ethical, cultural, and social sensitivities; with capacity for critical thinking and for becoming leaders on their fields.

It is also our mission to conduct research, expand and disseminate knowledge, promote an entrepreneurial spirit, provide service to the community, and pursue the innovation and application of technology for the benefit of our global society, with particular emphasis on Puerto Rico.”

And in turn, the CoE's mission statement is consonant with the UPRM's Institutional Mission Statement, which clearly describes our institutional academic product or outcome, as follows:

“Within the philosophical framework established by the University of Puerto Rico Act, the Mayagüez campus directs its efforts towards the development of educated, cultured citizens, capable of critical thinking, and professionally qualified in the fields of agricultural, social, and natural sciences, engineering, humanities and business administration. They should be able to contribute in an efficient manner to the cultural, social, and economic development of the Puerto Rican and international community. This process is aimed at endowing our alumni with a strong technical and professional background and to instill a strong commitment to Puerto Rico and our hemisphere. Our alumni should have the necessary skills and knowledge to participate effectively in the search for solutions to the problems facing us, to promote the enrichment of the arts and culture, the development and transfer of technology as well as to uphold the essential attitudes and values of a democratic society.”

The structure and scope of all UPRM's student learning assessment plans must flow from this mission. Thus, these mission statements and the student learning assessment program at the Department of CE&S are clearly interdependent – each more clearly defined and understood in light of the other.

7. Program Educational Objectives (PEOs)

The Department of CE&S has developed and published **Program Educational Objectives (PEOs)** that are consistent with the institutional mission and goals of the UPR, with ABET's General Criteria for Engineering Accreditation in the United States, with ASCE's Program Criteria for Civil Engineering Programs, and with the expressed needs of its constituencies. The department's faculty approved the following six (6) PEOs on **29 March 2001**.

Our Department graduates will be able to:

1. *Address the challenges that they will face in their careers.*
2. *Pursue life-long learning and continue to develop their problem-solving skills.*
3. *Exhibit leadership and team-building skills in a bilingual setting.*
4. *Provide quality service to the profession, to our government, and to our society.*
5. *Function as effective members of interdisciplinary teams.*
6. *Apply current and innovative engineering technologies and criteria.*

8. Program Outcomes (POs)

Goals or outcomes for student learning are the foundation of meaningful assessment. The Department of CE&S has developed and published **Program Outcomes (POs)** that resulted from an extensive outreach effort and analysis, and based on our program educational objectives. These student learning outcomes are consistent with the previously stated program objectives and with the mission of the institution, the college, and the program. They are also directly linked to the minimum learning outcomes defined in ABET Engineering Criteria 2000 (Criterion 3), and to the **Program Criteria** established for the practice of the profession by the American Society of Civil Engineers (ASCE). The department's faculty approved the following eleven (11) POs on **29 March 2001**.

By the time of their graduation, our student will develop:

1. *Ability to understand and apply fundamental knowledge of mathematics through differential equations, probability and statistics; science (calculus based physics and general chemistry); and engineering sciences.*
2. *Proficiency in a minimum of four (4) recognized major civil engineering areas, such as; construction management, environmental, geotechnical, structural, transportation, and water resources.*
3. *Ability to conduct experiments and to critically analyze and interpret data in more than one of the major civil engineering areas.*
4. *Ability to perform civil engineering integrated design of systems, components, or processes by means of practical experiences throughout the professional component of the curriculum.*
5. *Ability to identify, formulate, and solve civil engineering problems using modern engineering tools, techniques, and skills.*
6. *Play an effective role in multidisciplinary professional work groups solving engineering problems.*
7. *Ability to communicate effectively in English and Spanish.*
8. *Understand the importance of compliance with professional practice and ethical issues, such as: bidding; procurement; professional interaction; and professional licensure, among others.*

9. **Broad education necessary to understand the impact of civil engineering solutions on health, general welfare, safety, environmental quality and economy in a global context.**
10. **Commitment to engage in lifelong learning.**
11. **Awareness of contemporary social, cultural, economic, artistic, aesthetic, environmental and engineering issues.**

9. Course Learning Outcomes/Goals (CLOs)

The Department of CE&S has developed and published *Course Learning Outcomes/Goals (CLOs)* for each and every course taught within the department. These CLOs are consistent with the previously stated program objectives and student learning outcomes, and are published within the individual *Course Syllabuses*. The syllabi of individual courses also specify which educational objectives and outcomes each course contributes to. An example of such a Syllabus is presented in *Appendix 1*.

10. Conceptual Relationship of Learning Outcomes at Different Levels

a. Conceptual Approach: Students learn specific content and skills in each *course*. In aggregate, those courses, together with other program experiences such as academic advising, internships, and research should result in the desired student learning outcomes at the *department/program* level. Similarly, outcomes at the program level combine with general education goals and other goals to create *institutional* outcomes. In other words, learning outcomes at the institution, department (or program), and course (or activity) levels are interconnected, complimentary, and reciprocal.

The relationship between our program outcomes and our program educational objectives is very direct, as shown in *Tables 1, 2* and *3* ahead. Therefore, by nature of their direct association with the same ABET (a-k) outcomes, our own program outcomes and program educational objectives are implicitly related. We placed most effort and care to ensure a precise relationship among them and to include the requirements of established Program Criteria within our program outcomes.

Ideally, a better approach would be to first design the objectives and outcomes of the program, and then design the curriculum based on that information. Clearly we could not do this since we already had a full curriculum in place long before we drafted the first statement of objectives and outcomes for our programs and courses under the new ABET EC2000 Outcomes Assessments Criteria. What the department did therefore was to ask professors involved in each particular course for their consensus on what contribution that particular course makes to each of our objectives and outcomes. These results are presented in the form of matrixes in *Tables 4, 5, and 6* further ahead. Having a clear understanding of the relation between the courses and the various program objectives and outcomes ensures that all required skills and outcomes are covered in the 5-year program curriculum.

b. Program Outcomes vs. Institutional Outcomes: The UPRM directs that every department/program within the institution shall develop and include in their Student Learning Assessment Plans a matrix depicting the relationship or connection of their program outcomes

with these institutional learning outcomes. *Table 1* reflects this relationship for the Department of CE&S.

c. Program Educational Objectives vs. Engineering (ABET's) Outcomes: *Table 2* reflects the relationship between our program educational objectives and ABET's **Criterion 3 Engineering (a-k) Outcomes**. This table shows multiple links between objectives and outcomes. The matrix is a result of a participatory process with departmental consensus.

d. Program Outcomes vs. Engineering (ABET's) Outcomes: *Table 3* reflects the relationship between our program outcomes and ABET's **Criterion 3 Engineering (a-k) Outcomes**. These outcomes are consistent with the previously stated program objectives and with the mission of the Institution, the College of Engineering, and the department/program. They are also directly linked to the **Program Criteria** established for the practice of civil engineering by the ASCE. This table shows multiple links between the two sets of outcomes. The matrix is a result of a participatory process with departmental consensus.

e. Curriculum Courses vs. Program Outcomes & Educational Objectives: The Department of CE&S examined all core curriculum courses and main civil engineering elective courses to ensure total coverage of proposed student learning outcomes and of ABET's EC2000 outcomes criteria. This coverage is reflected on each individual syllabus and on various matrixes. *Table 4* provides a mapping of the program objectives and learning outcomes to the **required core curriculum** courses in the Civil Engineering Program. *Table 5* does the same for all **civil engineering electives**. All **other core curriculum courses** are mapped in *Table 6*. These three tables demonstrate that all outcomes and objectives are addressed in numerous courses, although often to different degrees.

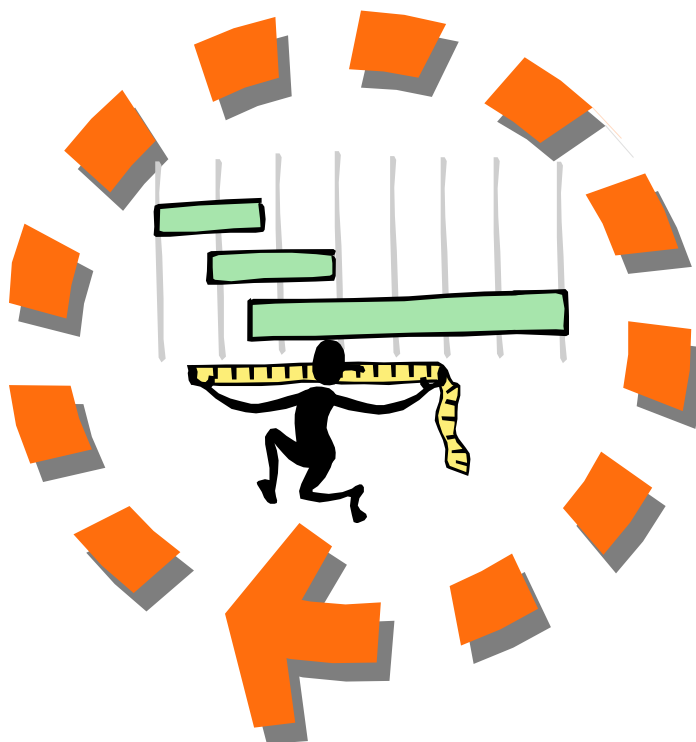


TABLE 2

PROGRAM EDUCATIONAL OBJECTIVES vs. ENGINEERING OUTCOMES*Our Civil Engineering graduates will ...*

1. *Address the challenges that they will face in their careers.*
2. *Pursue life-long learning and continue to develop their problem-solving skills.*
3. *Exhibit leadership and team-building skills in a bilingual setting.*
4. *Provide quality service to the profession, to our government, and to our society.*
5. *Function as effective members of interdisciplinary teams.*
6. *Apply current and innovative engineering technologies and criteria.*

Criterion 3 (a-k Outcomes)	Program Educational Objectives					
	1	2	3	4	5	6
a. math/science/engineering ...	X	X	X	X	X	X
b. conduct experiments ...	X	X				X
c. engineering design ...	X	X		X	X	X
d. multi-disciplinary teamwork...		X	X		X	
e. problem solving ...	X	X			X	X
f. professionalism & ethics ...	X			X	X	
g. communication skills ...			X		X	
h. broad educ & global impact...	X			X	X	X
i. lifelong learning ...				X		X
j. contemporary issues ...	X		X	X	X	X
k. modern tools & techniques ...	X		X	X		X

TABLE 3

PROGRAM OUTCOMES vs. ENGINEERING OUTCOMES
(What we expect to develop in our students by time of their graduation)

1. *Ability to understand and apply fundamental knowledge of mathematics through differential equations, probability and statistics; science (calculus based physics and general chemistry); and engineering sciences.*
2. *Proficiency in a minimum of four (4) recognized major civil engineering areas, such as; construction management, environmental, geotechnical, structural, transportation, and water resources.*
3. *Ability to conduct experiments and to critically analyze and interpret data in more than one of the major civil engineering areas.*
4. *Ability to perform civil engineering integrated design of systems, components, or processes by means of practical experiences throughout the professional component of the curriculum.*
5. *Ability to identify, formulate, and solve civil engineering problems using modern engineering tools, techniques, and skills.*
6. *Play an effective role in multidisciplinary professional work groups solving engineering problems.*
7. *Ability to communicate effectively in English and Spanish.*
8. *Understand the importance of compliance with professional practice and ethical issues, such as: bidding; procurement; professional interaction; and professional licensure, among others.*
9. *Broad education necessary to understand the impact of civil engineering solutions on health, general welfare, safety, environmental quality and economy in a global context.*
10. *Commitment to engage in lifelong learning.*
11. *Awareness of contemporary social, cultural, economic, artistic, aesthetic, environmental and engineering issues.*

Criterion 3 (a-k Outcomes)	Program Outcomes										
	1	2	3	4	5	6	7	8	9	10	11
a. math/science/engineering ...	X	X	X	X	X						
b. conduct experiments ...	X	X	X	X							
c. engineering design ...	X	X	X	X	X						
d. multi-disciplinary teamwork...				X		X		X	X		
e. problem solving ...	X	X	X	X	X		X	X	X		X
f. professionalism & ethics ...				X		X		X	X	X	X
g. communication skills ...						X		X	X	X	X
h. broad educ & global impact...							X	X	X	X	X
i. lifelong learning ...									X	X	X
j. contemporary issues ...					X		X	X	X	X	X
k. modern tools & techniques ...	X	X	X	X	X	X	X			X	X

TABLE 6
PROGRAM OBJECTIVES and OUTCOMES vs. OTHER CORE CURRICULUM COURSES

Course	Program (a-k) Outcomes Engineering Criteria ABET 2000 (Criterion 3)											Program Educational Objectives					
	a	b	c	d	e	f	g	h	i	j	k	1	2	3	4	5	6
INGE 3011				x			x				x			x		x	x
INGE 3012				x			x				x			x		x	x
INGE 3016	x				x						x		x				x
INGE 3031	x				x								x				x
INGE 3072	x				x								x				x
INGE 4001	x				x								x				x
INGE 4011	x		x		x								x				x
INGE 4012	x		x		x								x				x
INGE 4015	x				x								x				x
INGE 4016	x	x		x	x		x				x		x				x
MATE 3031	x				x								x				
MATE 3032	x				x								x				
MATE 3063	x				x								x				
MATE 4009	x				x								x				
FISI 3171	x	x			x						x		x				x
FISI 3172	x	x			x						x		x				x
FISI 3173	x	x		x	x		x				x		x	x		x	x
FISI 3174	x	x		x	x		x				x		x	x		x	x
GEOL 4015	x	x		x							x		x			x	x
ECON 3021	x				x						x		x				x
INGL 3101				x			x							x		x	
INGL 3102				x			x							x		x	
INGL 3201				x	x		x							x		x	
ESPA 3101				x			x	x						x		x	
ESPA 3102				x			x	x						x		x	
PHED 3058				x			x							x		x	
PHED 3076				x			x							x		x	
PHED 3077				x			x							x		x	
PHED 3205				x			x							x		x	
PHED 3215				x			x							x		x	
QUIM 3001	x	x			x		x				x		x				x
QUIM 3002	x	x			x		x				x		x				x

11. Assessment Process, Methods, and Tools

a Conceptual Assessment Cycle: The assessment processes at UPRM are cyclical and continuous, as conceptually reflected on *Figure 1*. These assessments cycles are repeated after changes have been implemented. The time for completion of a cycle up to implementation, or the “*closing of the loop*”, as it is commonly referred to, may be different for the different assessment levels. An assessment cycle or loop at the course level will likely take the least time to complete as professors, within their authority, can use assessment results to make positive changes in their courses almost immediately. In the other hand, at the program level, the implementation of a course or curricular change may take months or years, as the approval may take it through various levels of authority within the institution.

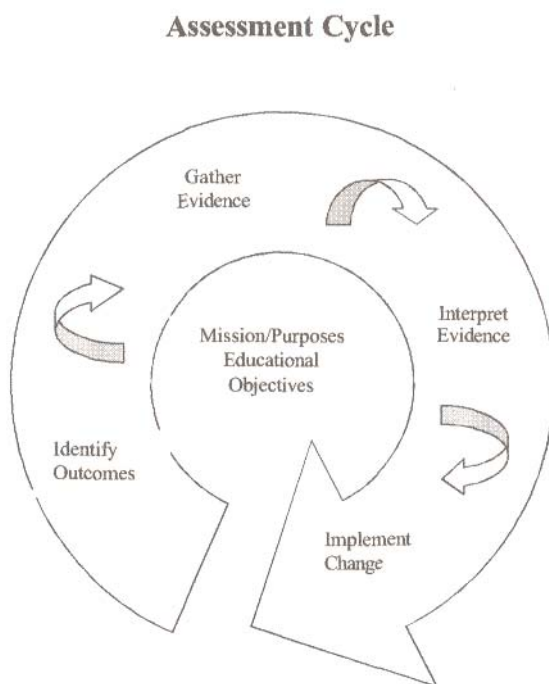


Figure 1. A conceptual assessment cycle or loop

b. Assessment Process: The Department of CE&S put into place a well-defined *continuous quality improvement (CQI)* process to ensure that the results of the assessments are used in an on-going manner, to ensure the achievement of our educational objectives and outcomes, and to improve the quality of our programs. *Figures 2* and *3* complement each other in graphically outlining this process. Although elements of this process are continuous in nature, we have recognized our responsibility to assure that the cycles are completed and documented.

Figure 2 depicts graphically our main *data gathering mechanisms* within their place in our assessment process. A detailed listing of assessment tools, with strategies and timing, is presented in *Tables 7, 8, and 9* further ahead in this plan.

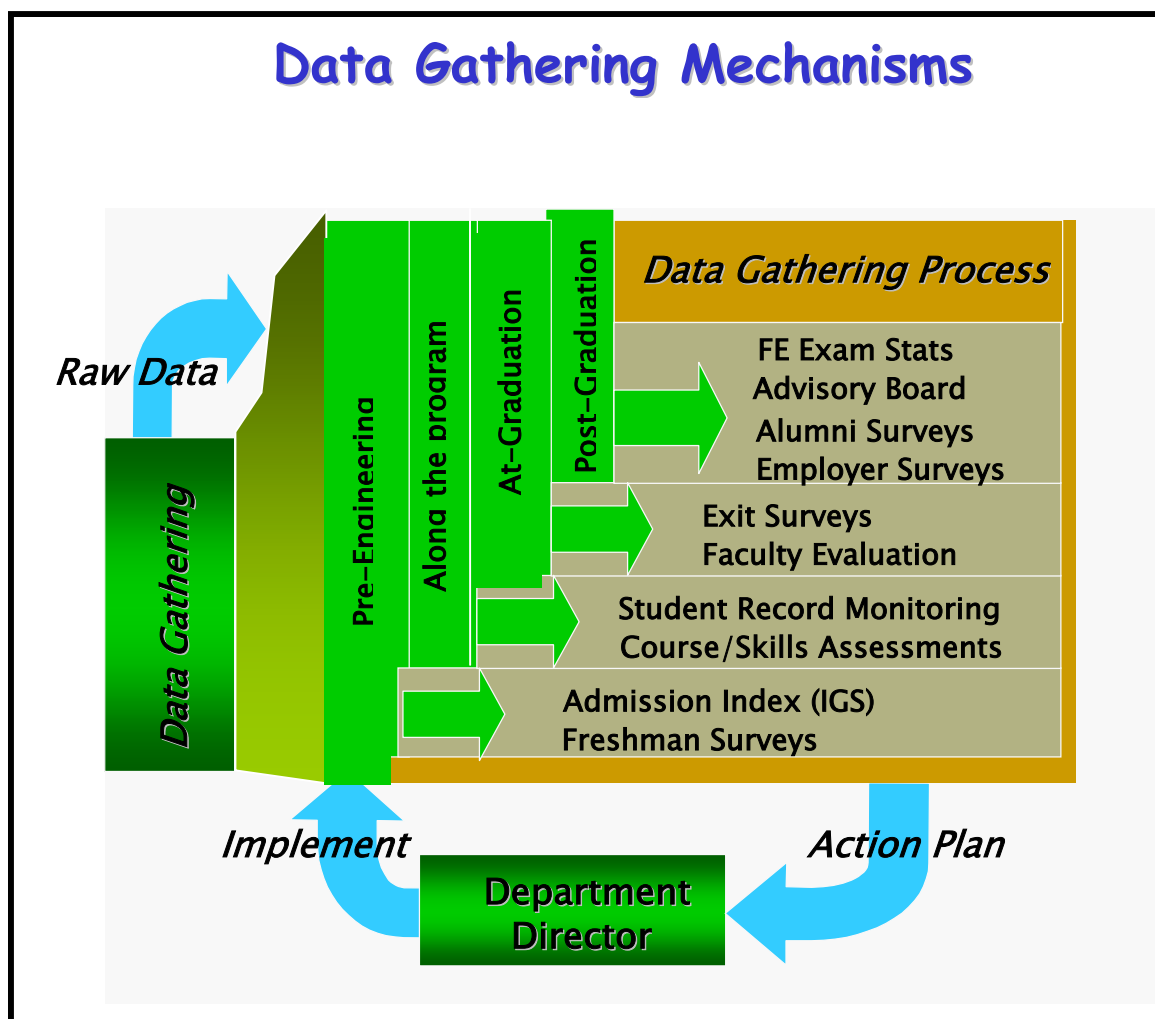


Figure 2. Data Gathering Mechanisms

Good assessment mechanisms or instruments, by themselves, are not of much use. We also need to use the data they provide to identify and implement program improvements. *Figure 3* is a graphic depiction of a *full assessment cycle* for our program.

c. Assessment Office: For a continuous quality improvement (CQI) process to be effective and “continuous”, the process must be institutionalized; it must become part of the formal infrastructure of the department. With that purpose the Department of CE&S developed a new educational research office, namely, *System for the Evaluation of Education (SEED) Office*, to support the department’s outcomes assessment efforts. A conceptual diagram of the Department’s SEED Office is depicted in *Figure 4*.

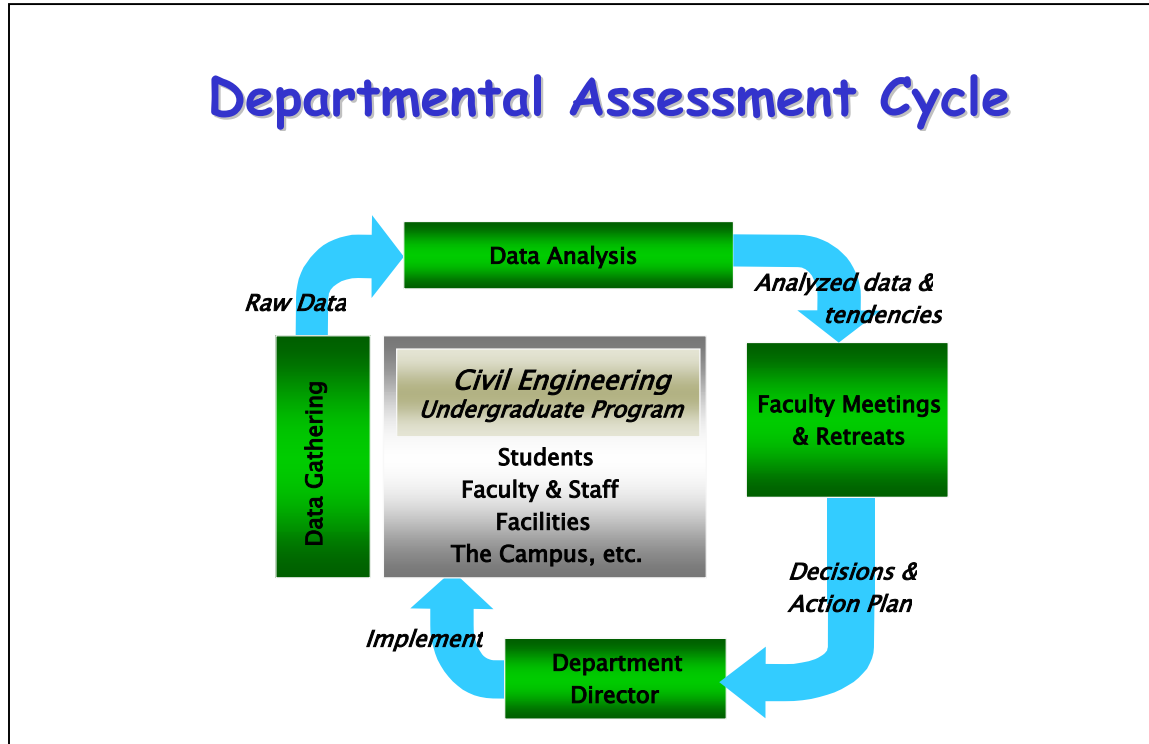


Figure 3. Departmental Assessment Cycle/Process

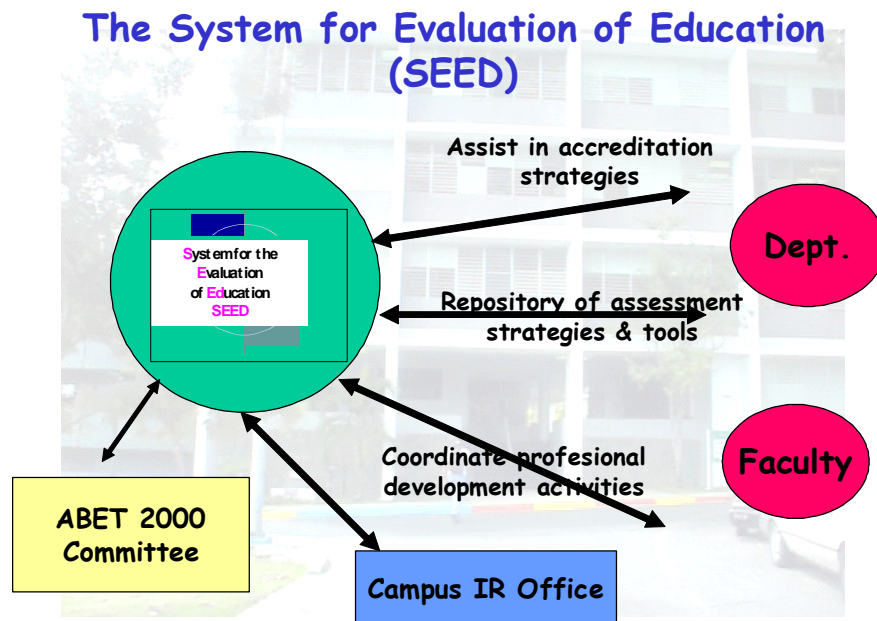


Figure 4. Conceptual Diagram for the Department's SEED Office

d. Assessment Methods/Tools:

The *primary assessment tools* used to monitor and to assure achievement of program outcomes and objectives are listed in **Table 7**. The assessment tools and procedures set forth in this Student Outcomes Assessment Matrix have been developed in the Department of CE&S through consensus, with great acceptance by all involved. When analyzed closely, most professors execute only one, two, or three of these assessments per semester, on things they are already doing in their courses, which does not necessarily constitute an additional heavy load on the faculty. The actual *tools, rubrics, and forms* chosen are available in **Appendix 2** of this plan.

The concept behind the more commonly used is briefly discussed below:

- ***Evaluation of Student Performance in the Classroom (Assignments, Examinations, Quizzes, among others)***: Each course in the program relies heavily on the time-tested method of assignments and examinations. Course grades based on performance on homework, quizzes, exams, and projects remain an important standard evaluation component. The faculty is confident that course evaluation tools are designed so that grades generally provide an accurate measure of the knowledge and skills learned in the course. Course syllabi clearly state the *metrics* used in evaluating student performance.

- ***Examples of Student Work***: Notes, project work, homework assignments, quizzes and exams compiled from students during a course provide evidence and means to monitor student learning of the course material as well as their organizational and communications skills. They will be maintained in individual Course Binders/Portfolios located in the department's SEED Office.

- ***Student Evaluations of Teaching (SET)***: The SET is a standardized assessment tool used throughout the university near the end of every course. The SET form consists of a set of questions for students to rate a whole range of items concerning the course. This includes, for example, the effectiveness of the instructor in communicating the subject matter and stimulating interest in it, and the appropriateness of textbooks, homework and programming labs, and exams. The form also provides space for students to provide general comments on the course material and suggestions for changes. While the assignments and exams often allow instructors to identify a problem in the course, the SETs allow them to also identify the *reason* for the problem.

- ***Placement Data for B.S. Graduates***: The successful placement of civil engineering graduates in industrial positions, graduate schools, and other professional positions is obviously a key measure of the quality of the program. The data collected by the UPRM Placement Office is useful in assessing our product.

- ***Exit Survey***: This survey contains several standard sets of questions that are asked in exit surveys performed by other departments in the College, while other questions that are specific to civil engineering students. Perhaps the most useful parts of the survey are the written comments that students provide. Periodically the raw responses are analyzed and the results discussed by the SEED and Academic Affairs Committees as indicated earlier.

TABLE 7
STUDENT OUTCOMES ASSESSMENT MATRIX

Assessment Tools	Program (a-k) Outcomes										
	a	b	c	d	e	f	g	h	i	j	k
<i>Pre-Engineering</i>											
Freshman Orientation Questionnaire	X	X		X	X	X	X				
Ethics Integration Assessment Form						X					
<i>Course Assessment</i>											
Laboratory Reports (copies of)	X	X		X	X		X				X
Exams, Quizzes, Homeworks (copies of)	X	X	X		X		X			X	X
EIT Exam Statistical Report	X				X						X
Written Report Evaluation		X		X			X				
Oral Presentation Assessment				X			X				
Teamwork Assessment Form (I)				X							
Teamwork Assessment Form (II)				X							
Peer Evaluation Form				X							
Undergrad Research Exp Assessm. Form		X	X		X		X				
Course/Project Skills Assessment Form	X	X	X	X	X	X	X	X	X	X	X
Student Evaluation of Teaching (SET)	X	X	X		X	X	X	X	X	X	X
Video of Presentations			X	X	X		X			X	X
<i>Program Assessment</i>											
Ethics Integration Assessment Form						X					
Graduating Student Exit Survey (Part I)	X	X	X	X	X	X	X	X	X	X	X
Graduating Student Exit Survey (Part II)	X	X	X	X	X	X	X	X	X	X	X
Internship Assessment Form (Student)				X	X					X	
Internship Assessment Form (Mentor)				X	X					X	
COOP Supervisory Evaluation Form				X	X					X	
COOP Student Evaluation Form				X	X					X	
Student Resume (<i>Special Format</i>)**	X	X	X	X	X	X	X	X	X	X	X
<i>Post Graduation</i>											
Alumni Survey	X	X	X	X	X	X	X	X	X	X	X
Employers Survey	X	X	X	X	X	X	X	X	X	X	X
FE Exam Statistics	X		X		X	X	X	X	X	X	X
Advisory Board Input	X	X	X	X	X	X	X	X	X	X	X

NOTE: Student **RESUME (Special Format)**: Students are instructed about this requirement, to maintain up-to-date throughout their time as students in the Civil Engineering Program, and to be turned in on the 1st week of the senior year to the Department's Academic Counselor, who will collect/file them in Resume Binders, for use at employment opportunities and/or for statistical analysis. The Resume will not exceed 2 pages in length, and will include as a minimum:

-
- Name
 - Mailing Address
 - Contact Telephone Numbers, emails, etc.
 - Education
 - Schools/Colleges/Universities
 - Departmental GPA
 - General GPA
 - Undergrad Research and Work Experiences
 - Seminars and Workshops Attendance
 - DESIGN Projects and Engineering Competitions
 - Special Skills
 - Membership in Professional Societies
 - Honors, Recognitions and Awards
-

- **Alumni Survey:** The Department of CE&S conducts alumni surveys on an annual basis. As stated previously, every year this survey is mailed out to alumni who graduated either one year or five years ago; this allows us to gather input from alumni who graduated relatively recently as well as some who graduated a while ago, without at the same time asking for input from the same group of people year after year. The intent of this survey is to gauge how well the program has prepared our graduates for positions in industry and graduate school

- **Employer's Survey:** The department and the UPRM Placement Office will routinely perform employer surveys of supervisors of our graduates to find out how well the program prepared our graduates that they supervise with respect to our learning outcomes.

- **Course and Skills Assessments:** On-going course and skills assessments are complete by all students for every course they take. Some of these assessments are performed during the semester at targets of opportunity; i.e., oral presentations, written reports, group (team) experiences, and ethical considerations. Others are performed at the end of the semester, at the same time of the *SETs*. Faculty will summarize the results, identify areas needing attention, and either take action themselves within their course or bring them to the attention of the faculty for action at the program level. Faculty will maintain completed assessment forms as evidentiary documentation in individual course binders.

- **Internship/Undergraduate Research/Co-op Surveys:** The Civil Engineering Co-op, Internship, and Undergraduate Research Programs routinely survey both students and employers. All working students are asked to evaluate their experiences. At the end of each work term, students must also submit a written performance appraisal from their supervisor.

e. Metric Goals:

The initial metric goals for the first two to three years of this implementation are simple. We intend to review them and possibly increase them as we analyze value-added charts throughout the process.

Most of the department' assessment tools rate responses from *1* to *5*, where *5* is "excellent" or "extremely satisfied," and *1* is "poor" or "extremely dissatisfied."

For *Student Evaluations of Training (SETs)*, students anonymously evaluate all professors in all classes. The professor's score is calculated by averaging the responses to all of the questions on a 5-point scale as the one mentioned above.

On *Exit, Alumni, and Employer Surveys* we address all program objectives and outcomes. Responses to each question are averaged. For now the goal is to have averages of **3.00** or more for all outcomes, with at least 75% of the answers at 3.00 or higher.

For the *Course/Skills Assessment Forms*, which are completed by all students in all courses at the end of every semester, they rate classes and level of skills experience, both on content and administration. We analyze these the same way as for the surveys just mentioned, with a goal of **3.00** or more for all outcomes, with at least 75% of the answers at 3.00 or higher.

The *Fundamentals of Engineering Exam (FE/EIT)* is required to obtain a professional engineering license. Although taking the test before graduation is optional, there seems to be an increase in the number of students taking it. Our goal is to have a **passing rate at or higher than the national rate**, and always higher than the passing rate among the civil engineering programs in Puerto Rico.

Passing/approval metrics for each course are clearly stated in each course syllabi. In most cases, an average score of **70%** is required for approval of the course, and for continuation into the next level or sequential course.

f. Assessment Strategies and Operational Actions for Achieving Outcomes: To implement these strategies more effectively we came up with this general **action plan**:

- Maintain regular correspondence with graduates and their employers to know their needs and to evaluate whether modifications to the program are necessary and appropriate.
- Establish an annual process in which a faculty/student committee reviews course and senior design projects to evaluate how well students in the capstone design course are applying material throughout the curriculum.
- Draw upon students' co-op/intern/undergraduate research experiences as a source for interdisciplinary experiences, class problems, and information to other students.
- Require students to prepare written reports and oral presentations targeted to different audiences and topics.
- Make use of available resources to present case studies of actual examples in which the consequences of ethical and safety-related decisions were not properly considered.
- Require a large number of civil engineering courses to have at least one major writing assignment.
- Require students to evaluate peer performance in team settings.
- Document and distribute official department policies on sexual harassment and academic and ethical misconduct.
- Have faculty design research projects appropriate for undergraduate students.
- Establish seminar series for undergraduates to present their research work results.

- Promote the use of programming, spreadsheets and the most modern hardware and software tools at all levels in the curriculum.
- Have faculty make greater use of informational sources beyond the course textbook.
- Promote student participation in the local student chapter of ASCE and support activities sponsored by this organization. Encourage and provide funds for student participation in local and regional events sponsored by professional and civic organizations.

g. Evidence to Show Achievement of Learning Outcomes: Listed below is the evidentiary documentation that will be filed/maintained (as appropriate for the particular levels) to prove that processes for the Assessment of Student Learning that lead to the continuous improvement of our educational programs are in place.

At Course level -- COURSE PORTFOLIOS/Binders, for each course, with:

- Syllabi with detailed course outlines, descriptions, and course learning outcomes
- Examples of student works for required courses, including representative samples of homework assignments, quizzes, exams, and project works.
- Copies of completed assessment tools/instruments and summaries of results
- Videos of student oral presentations
- Any other materials that support student learning outcomes assessment efforts

At Department/Program level -- PROGRAM PORTFOLIOS/Binders and/or FILES, with:

- Posters/Catalogs/Brochures listing Student Learning Outcomes, Educational Objectives, etc.
- Graduation Exit Survey documentation and results
- Alumni Survey documentation and results
- Employer Survey documentation and results
- Stats from Licensing Exam (where applicable)
- Copies of minutes of the Department's Faculty Meetings, Academic Affairs Committees, and Advisory Board meetings and recommendations (where applicable)
- Copies of curriculum development/revisions
- Student transcript samples
- Copies of completed assessment instruments and summaries of results
- Minutes of faculty meetings where assessment results considered and actions taken
- Any other materials that support student learning outcomes assessment efforts

At Other levels/Offices -- GOOD FILES, with:

- Institutional research results/statistics, with their analysis, recommendations, and actions taken (if any).
- Students/Graduates/Alumni/Employer Satisfaction Survey results/statistics, with their analysis, recommendations, and actions taken (if any).
- GPA/Grade trends, Graduation Rates, Retention Rates, etc., and any other statistical data gathered throughout the institution, with their analysis, recommendations, and actions taken (if any).

12. Reporting and Utilization of Assessment Results

All reporting shall be accomplished in upon completion of the assessments at the end of each semester, and in accordance with the Timeline and Strategies presented in *Section 14* of this plan. Utilization of assessment results shall be in accordance with guidelines and suggestions presented throughout this plan.

13. Responsibility for Enacting and Maintaining the Plan

The following is a brief listing of the major responsibilities of key personnel as related to the assessment of student learning within the Department of CE&S. This list is not necessarily all encompassing, as additional guidance is presented throughout this plan.

a. Director of the Department:

- Lead the department's development and implementation efforts of a student learning assessment process with documented results.
- Encourage the full participation process of faculty, students, staff, and other stakeholders of the department.
- Ensure that evidence is maintained and that the results of the assessment process are applied to the further development and improvement of the department's programs.
- Provide the support, infrastructure, resources, and constructive leadership to assure the quality and continuity of the continuous quality improvement (CQI) process.
- Lead the academic advising activities of the department.
- Ensure that all of this planning and execution is done in accordance with the general guidelines established throughout this plan.

b. Associate Director of the Department:

- Support the Director's responsibilities and assume them in his absence.
- Supervise the department's centralized *Academic Advising* activities, including the efforts of the professional and academic Counselors.
- Conduct the assessment activities in accordance with this plan.

c. Department's SEED Office:

- Be the lead agent of the Director in the development, implementation, and continuous support of the department's outcomes assessment efforts.
- Lead the educational research efforts of the department.
- Send out, receive, and analyze the annual Alumni and Employer's Surveys.
- Prepare the Annual Assessment Summary Reports for the Department.
- Provide clerical and operational support to the Department's SEED Committee.
- Maintain the assessment evidentiary documentation listed in *Section 11g* of this plan.

d. Department's SEED Committee (which includes student representatives):

- Initiates discussions on program objectives and outcomes, based on the inputs from the various constituencies.
- Conduct regular Committee meetings, announced in advance and open to all interested students and faculty.
- Analyze and discuss summary data and results from each of the assessment instruments to make recommendations to the Department.

e. Department's Academic Affairs Committee:

- Coordinates all curriculum related processes.
- Following appropriate discussion approves relatively minor changes in individual courses, such as minor changes in prerequisite courses.
- Submits proposals for major changes in course content and for new courses to the appropriate academic authorities.

f. Department's Faculty:

- Support all departmental student learning assessment efforts as outlined in this plan.
- Participate in the assessment efforts review process that leads to its improvement and further development.
- Perform the scheduled assessments and evaluations in accordance with the processes and timelines outlined in this plan.
- Collect and analyze summary data from each of the assessment instruments.
- Based on the assessment results, prepare proposals for changes in courses and for new courses.
- Provide academic and professional advice to students continuously during published office hours.
- Maintain Course Binders (at SEED Office) with up-to-date assessment evidentiary documentation, as suggested in *Section 11g* of this plan.
- Use assessment information to make appropriate adjustments on how to present the courses, to suggest changes in courses and prerequisites, and to ensure that program objectives and outcomes are met.

h. Department's Counselors:

- Monitor student learning and academic progress through the program.
- Review student grades at the end of each semester.
- Identify and help students having problems.
- Take steps to correct irregularities in student academic records as soon as possible.
- Conduct thorough reviews of student academic records with the assistance of the Registrar's Office to ensure that students complete all institutional requirements for the degree.

14. Time Line

The Program Educational Objectives (*PEO*) system focuses on outcomes the graduates are required to demonstrate, interfaces with external constituencies, and deals mostly with *long-term* issues. The Program Outcomes (*PO*) system focuses on *short-term (annual loop)*, day-to-day issues faced by faculty and administration, and interfaces with students.

Although the general timeline for this plan calls for **immediate implementation**, *Table 8* sets *timing* and *responsibilities* for each assessment tool and/or mechanism. *Table 9* graphically depicts a typical Annual Student Learning Assessment Schedule for the Department of CE&S.

15. Process for Reviewing the Plan

The Departments of CE&S will review this assessment plan during and, as part of, the cyclic reviews of assessment results. This review should lead to the refinement or improvement of the plan and to the elimination of ineffective assessment practices. Furthermore, the Department's SEED Office shall review this student learning assessment plan on an annual basis.

The process to establish and review the current Program Educational Objectives and Student Learning Outcomes within this plan involves the following steps:

- a. A review of the institution's, college's, and department's mission statements;
- b. A review of the ABET EC2000 criteria, along with definitions and examples of key terms;
- c. The writing of broad program objectives and outcomes that could be linked to the department's mission statement;
- d. The identification of Strategies and Actions, i.e., statements that described how the program objective could be achieved;
- e. The linking of these outcomes to ABET's EC2000, specifically to Criterion 3 (a-k); and,
- f. The identification of effective Assessment *strategies, methods/tools, metrics, and benchmarks* that can measure the impact of the program objectives and outcomes.

TABLE 8
TIMING STRATEGIES for OUTCOMES ASSESSMENT

Assessment Tools	Timing – Utilization Strategy – Responsibility
<i>Pre-Engineering</i>	
Freshman Orientation Questionnaire	at UNIV-0004 Freshman Orientation Course (by Departmental Counselor)
Ethics Integration Assessment Form	at UNIV-0004 Freshman Orientation Course (by Departmental Counselor)
<i>Course Assessment</i>	
Laboratory Reports (<i>copies of</i>)	at all Laboratory Courses (by Lab Instructors)
Exams, Quizzes, Homeworks (<i>copies of</i>)	retain examples of these tools (by all Professors/Instructors)
EIT Exam Statistical Report	obtain annually from Examining Board (by Department)
Written Report Evaluation	anytime written reports are required (labs, etc) (by all Professors/Instructors)
Oral Presentation Assessment	at all student oral presentations (by all Professors/Instructors)
Teamwork Assessment Form (I)	at end of any semester where work done in groups (Professors/Instructors)
Teamwork Assessment Form (II)	at end of any semester where work done in groups (Professors/Instructors)
Peer Evaluation Form	at end of any semester where work done in groups (Professors/Instructors)
Undergrad Research Exp Assessm. Form	at end of any such experience (by Mentors)
Course/Project Skills Assessment Form	at end of every course (by all Professors/Instructors)
Student Evaluation of Teaching (SET)	at end of every course (by all students)
Video of Presentations	at Design/Project Presentations (by all Professors/Instructors)
<i>Program Assessment</i>	
Ethics Integration Assessment Form	at end of CAPSTONE Courses (by CAPSTONE Professors)
Graduating Student Exit Survey (Part I)	at end of CAPSTONE Courses (by CAPSTONE Professors)
Graduating Student Exit Survey (Part II)	at Graduation time (by Department)
Internship Assessment Form (Student)	at completion of all Internships (by Mentors)
Internship Assessment Form (Mentor)	at completion of all Internships (by Mentors)
COOP Supervisory Evaluation Form	at completion of COOP terms (by Mentors)
COOP Student Evaluation Form	at completion of COOP terms (by Mentors)
Student Resume (<i>Special Format</i>)**	start at UNIV-0004 Course; maintain up-to-date thru college years
<i>Post Graduation</i>	
Alumni Survey	mail to 2 nd and 5 th year alumni, every year, Feb-Apr (by Department)
Employers Survey	mail to employers with 5-yr graduates, every year, Feb-Apr (by Department)
FE Exam Statistics	obtained by CoE every year
Advisory Board Input	obtained at annual meeting, Jun-Jul

TABLE 9

ANNUAL STUDENT LEARNING ASSESSMENT SCHEDULE
Department of Civil Engineering and Surveying

Assessment Action	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<i>Pre-Engineering</i>												
Freshman Orientation Questionnaire												
Ethics Integration Assessment Form												
<i>Course Assessment</i>												
Laboratory Reports (copies of)	(Sample copies of these technical evaluations)											
Exams, Quizzes, Homeworks (copies of)	(Sample copies of these technical evaluations)											
EIT Exam Statistical Report												
Written Report Evaluation	(At every possible such experience)											
Oral Presentation Assessment	(At every possible such experience)											
Teamwork Assessment Form (I)												
Teamwork Assessment Form (II)												
Peer Evaluation Form												
Undergrad Research Exp Assessm. Form												
Course/Project Skills Assessment Form												
Student Evaluation of Teaching (SET)												
Video of Presentations	(At every possible such experience)											
<i>Program Assessment</i>												
Ethics Integration Assessment Form												
Graduating Student Exit Survey (Part I)												
Graduating Student Exit Survey (Part II)												
Internship Assessment Form (Student)	(At the end of any such experience)											
Internship Assessment Form (Mentor)	(At the end of any such experience)											
COOP Supervisory Evaluation Form	(At the end of any such experience)											
COOP Student Evaluation Form	(At the end of any such experience)											
Student Resume (Special Format)**												
<i>Post Graduation</i>												
Alumni Survey												
Employers Survey												
FE Exam Statistics												
Advisory Board Input												

16. Provision for Funding and Support Resources

Resources can be generally defined as any input to an educational program that is necessary for the program to succeed, as shown in *Figure 4*. Adequate resources must be available to the department/program at all times to be successful and have on-going accreditation.

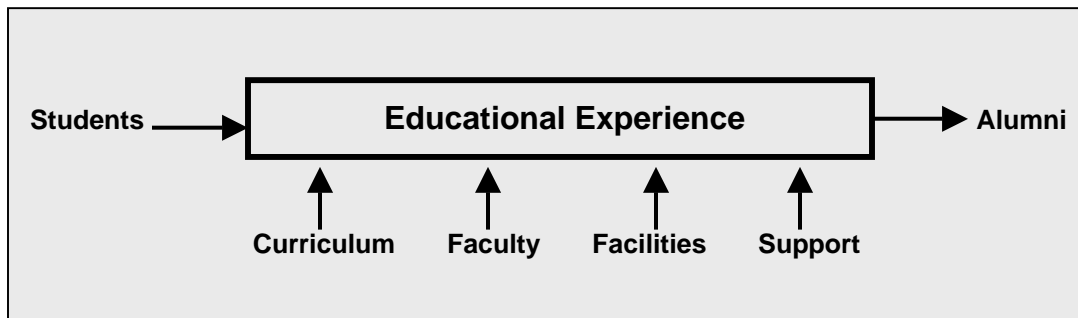


Figure 4. Resource Perspective

The following subsections highlight the major resource categories and the means by which the department will monitor progress in each category.

a. Students:

- The department will evaluate, advise, and monitor students to determine long-term success in meeting learning outcomes.
- The institution will retain responsibility to ensure that students admitted to the departments/programs meet the qualifications needed and that correspond to the expected achievement level.
- Further, the department will have assessment processes and improvement mechanisms in place to monitor the progress of their students. The department will also monitor the progress of its alumni and solicit their input for program improvement.

b. Curriculum:

- The department establishes its uniqueness through its educational objectives, learning outcomes, and curriculum design.
- The institution assumes responsibility to ensure that all departments/programs operate within a certain envelope and to ensure that all graduates matriculate with specific qualifications. Towards this end, the Office of the Dean of Academic Affairs is charged with the responsibility to "Review and approve or disapprove proposals for new courses and proposals for changes in courses and curricula which are recommended by departments."

c. Faculty:

- The faculty must be sufficient number; and must have competencies to cover all of the curricular areas of the program.
- It is the responsibility of the department to assure that no Program of Study is offered or continued unless requirements for faculty are met or exceeded.

d. Facilities:

- Classrooms, laboratories, and associated equipment must be adequate to accomplish the program educational objectives and provide an atmosphere conducive to learning.
- The department assumes the responsibility to periodically assess priorities for equipment purchase and replacement, and to plan for the maintenance of adequate laboratory facilities.
- The institution will support by coordinating the distribution of student computing funding based on the student laboratory fees and matching funds.

e. Institutional Support and Financial Resources:

- Institutional support, financial resources, and constructive leadership must be adequate to assure the quality and continuity of the engineering program.
- To assure that this is monitored, the Department Chairs must keep their faculty informed about resources and expenditures of the departments in all categories, using both internal and external benchmarks.

17. Implementation Deadline

This plan shall be implemented **UPON RECEIPT**.

APPENDICES

1. Course Syllabus (ABET Outline – Short Version) Template and Samples
2. Civil Engineering Program (UPRM) Assessment Tools Package

APPENDIX 1

Course Syllabus (ABET Outline – Short Version) Template and Samples

SYLLABUS OUTLINE (ABET)

Course number & title: INCI _____ - _____

Course catalog description:

Prerequisites:

Corequisite:

Textbook:

Course objectives and student learning outcomes: *By the end of this course, students will be able to ...*

Topics covered:

TOPIC	TEACHING / LEARNING STRATEGIES	ASSESSMENT TOOLS STRATEGY
1.		
2.		
3.		
4.		

Grading Plan (course evaluation metrics):

Partial Exams	Final Exam	Quizzes	Home Works	Lab Works	Class Particip.		TOTAL
							100%

Important Note: A final grade of at least "C" ($\geq 70\%$) is required in order to pass the course

Class/laboratory schedule:

Relationship of course to ABET Criterion 3 (a-k Outcomes): *(applicable a-k criteria)*

a	b	c	d	e	f	g	h	i	j	k

Relationship of course to Program Educational Objectives: *(applicable 1-6 program educational objectives)*

1	2	3	4	5	6

Person(s) who prepared this description and date of preparation: Hiram Gonzalez, Associate Professor, 5 July 2001

Relationship of course to Program Educational Objectives: (Colocar "X" bajo los "Program Educational Objectives (PEOs)" de nuestro programa, que se puedan practicar/experimentar y evaluar en este curso. Ver ejemplo adjunto)

1	2	3	4	5	6

Person(s) who prepared this description and date of preparation: (Nombre, Rango Académico, Fecha en que se completó la revisión del Prontuario)

SYLLABUS OUTLINE (ABET)

*****Completed Sample*****

Course number & title: INCI 4139 - Introduction to Geotechnical Engineering

Course catalog description: Index properties of soils and classification systems. Clay minerals and soil structure. Soil improvement by compaction. Hydraulic properties of soils, permeability, seepage, and effective stress concept. Consolidation theory and settlement calculations. Stress distribution. Strength theories and Mohr's Circles. Stress-strain properties of soils.

Prerequisites: INGE 4015 **Corequisite:** GEOL 4015.

Textbook: Principles of Geotechnical Engineering, Braja M. Das, 4th Edition, 1998, PWS - Publishing Co., Boston.

Course objectives and student learning outcomes: By the end of this course, students will be able to identify, understand, describe, and discuss the behavior and properties of natural soil deposits, as described in the Course Description, stressing the importance of Geotechnical Engineering in Civil Engineering projects. Students should be able to apply the basic concepts of soil mechanics in the analysis and solution of practical problems in a global perspective and societal context. Participants will identify, comprehend, analyze, predict, imagine, discuss, and evaluate the ethical implications related to the practice of the profession as it pertains to this area. Students working in teams will be able to conduct hands-on experiments and exercises, analyze the data, and effectively communicate their results and recommendations through oral and written means. Cooperative learning will be emphasized to develop teamwork skills.

Topics covered:

TOPIC	TEACHING / LEARNING STRATEGIES	ASSESSMENT TOOLS STRATEGY
1. Introduction to Soil Mechanics. Soil problems in Civil Engineering. (2 classes)	Motivation, Visualization, Cases	Homework, Questions, Interactive discussion, Analysis of cases
2. Index Properties of Soils. Grain size distribution. Mineralogical Composition. Weight-Volume Relationships. (4 classes)	Lecture, Questioning, Discussion, Hands-on Demos, Lab Exercises, Teamwork	Homework, Lab Report, Written Report Evaluation Form, Teamwork Evaluation, Exam I
3. Atterberg Limits. Classification Systems. (4 classes)	(same)	(same)
4. Hydraulic Properties of Soils. Permeability. Effective and Pore water Pressures. Seepage and Flow Nets. (9 classes)	(same)	(same), but Exam II
5. Soil Compaction. (3 classes)	(same) + Field Work	(same)
6. Stresses in a soil mass. (2 classes)	(same)	(same), but Exam III
7. Consolidation Characteristics of Soils. (9 classes)	(same)	(same)

8. Shear Strength Characteristics of Soils. (8 classes)	(same)	(same)+ Peer Evaluation Form, Course/Project Skills & Ethics Integration Assessments & Fin Exam
---	--------	---

Grading Plan (course evaluation metrics):

Partial Exams	Final Exam	Quizzes	Home Works	Lab Works	Class Particip.		TOTAL
45%	25%	10%	5%	15%	NA		100%

Important Note: A final grade of at least "C" ($\geq 70\%$) is required in order to pass the course (move to next level).

Class/laboratory schedule: Four credit hours total; three hours of lecture and one three-hour laboratory (*) per week.

Relationship of course to ABET Criterion 3 (a-k Outcomes):

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>
X	X		X	X	X	X	X		X	X

Relationship of course to Program Educational Objectives:

1	2	3	4	5	6
X	X	X	X		X

Person(s) who prepared this description and date of preparation: Hiram Gonzalez, Associate Professor, 5 July 2001

(*) Laboratory projects:

- Identification and Description of Soils.
- Water Content Determination.
- Grain-Size Analysis.
- Liquid and Plastic Atterberg Limits.
- Permeability Tests and Flow Nets.
- Compaction Test
- Field Density Determination.
- Consolidation Test. (2 weeks)
- Unconfined Compression Test.
- Triaxial Tests

APPENDIX 2

Civil Engineering Program (UPRM) Assessment Tools Package

**DEPARTMENT OF CIVIL ENGINEERING AND SURVEYING
UNIVERSITY OF PUERTO RICO
MAYAGUEZ CAMPUS**



Assessment Tools & Strategies Package

[Omitted; provided separately in hard copy]

**ABET
ACCREDITATION**

July 1, 2001

