"Focusing on Outcomes"

A workshop on engineering education reform

Prof. David A. Lange
University of Illinois
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Greetings from Illinois

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About Illinois

- University ~ 40,000 students
- College of Engineering ~ 8000 students
- Dept of Civil Engineering ~ 1000 students
- Illinois' Land Grant University founded 1867

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The BIG picture

- Education is a PEOPLE BUSINESS
- Our goal is to prepare professionals
- Accreditation is a TOOL, not a TEMPLATE
- Accreditation processes should not DICTATE against your better judgment
- You are the LEADERS at HKUST
  - Quality at HKUST is your responsibility

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Workshop Outline

- Session 1: An Introduction to ABET accreditation
  - Principles of outcome based education
- Session 2: Conducting a Self Study of Your Department
  - Assessment issues
- Session 3: Implementation of Outcome Based Approaches

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What is “outcomes assessment”?

- An analogy…
  - Prescription vs. performance specifications
- Prescriptive specifications tell you exactly what to do
- Performance specifications tell you what result is required

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Outcome assessment

- A comprehensive approach for educational program development
  - Encompasses all stages of building your curriculum and programming in an engineering department
- An ongoing process aimed at understanding and improving student learning

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The Assessment Cycle

- Step 1. Set educational objectives consistent with department goals which flow from the mission of the university
- Step 2. Identify desired outcomes to meet the objectives
- Step 3. Select/develop measures of assessing the outcomes
- Step 4. Gather data
- Step 5. Analyze and interpret findings
- Step 6. Make appropriate changes

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Another view

- Plan it
  - making expectations explicit and public
- Do it
  - setting appropriate criteria and high standards for learning quality
- Check it
  - systematically gathering, analyzing, and interpreting evidence to determine how well performance matches expectations and standards
- Revise it
  - using the resulting information to document, explain, and improve performance
- Repeat it

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Isn't *Grading* a sufficient assessment method?

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No, this is different than grading students

- Full curriculum perspective, not limited to a isolated concepts
- Grading asks “Did the student learn what was taught?”
- Outcomes assessment asks “Did we teach the right stuff?”
  - AND “Did the students learn it?”

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Session 1: Introduction to ABET Accreditation

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Some background

- ABET began in 1932 as a joint effort to build up the engineering profession
- Partnership of engineering societies
- ABET currently accredits 2700 programs at 550 colleges/universities
- Take Note: PROGRAMS are accredited. Universities are not accredited. Departments are not accredited.

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Why do all this?

- **Engineers do important things that require serious preparation**
- Universities are in a competitive marketplace to provide the needed formal education
  - And that marketplace has moved from local (long ago) to regional (past) to global (now & the future)
- Accreditation is a mark of Excellence…and an indicator of positive attitude toward serving students

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Basic Idea

- ABET accreditation cycle is six years
- Each university program conducts a “self-study”
- ABET visitor team provides outside critique
- Problems may be identified; university must fix those problems

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Goal of Accreditation

- Document accomplishment
- Assure quality
- Cultivate excellence

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Method

- An “outcomes assessment” approach
- Shifts focus from INPUTS to OUTPUTS
  - Input focus = *prescriptive* approach
  - Output focus = *performance* approach
  - EC2000 criteria was adopted in 1996
- 11 specified outcomes
- Colleges now required to assess their ability to achieve the outcomes

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CRITERIA FOR ACCREDITING ENGINEERING PROGRAMS

Effective for Evaluations During the
2009-2010 Accreditation Cycle

Incorporates all changes
approved by the
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Engineering Accreditation Commission

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Website: www.abet.org

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Criteria

GENERAL CRITERIA FOR BACCALAUREATE LEVEL PROGRAMS .....

- Students.....
- Program Educational Objectives.....
- Program Outcomes.....
- Continuous Improvement.....
- Curriculum .....
- Faculty.....
- Facilities.....
- Support.....
- Program Criteria.....

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Program-specific criteria

PROGRAM CRITERIA FOR
CIVIL
AND SIMILARLY NAMED ENGINEERING PROGRAMS
Lead Society: American Society of Civil Engineers

These program criteria apply to engineering programs including "civil" and similar modifiers in their titles.

1. Curriculum

The program must demonstrate that graduates can: apply knowledge of mathematics through differential equations, calculus-based physics, chemistry, and at least one additional area of science, consistent with the program educational objectives; apply knowledge of four technical areas appropriate to civil engineering; conduct civil engineering experiments and analyze and interpret the resulting data; design a system, component, or process in more than one civil engineering context; explain basic concepts in management, business, public policy, and leadership; and explain the importance of professional licensure.

2. Faculty

The program must demonstrate that faculty teaching courses that are primarily design in content are qualified to teach the subject matter by virtue of professional licensure, or by education and design experience. The program must demonstrate that it is not critically dependent on one individual.

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11 program outcomes

Criterion 3. Program Outcomes

Engineering programs must demonstrate that their students attain the following outcomes:

(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 meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary 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.

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The traditional components

Criterion 3. Program Outcomes

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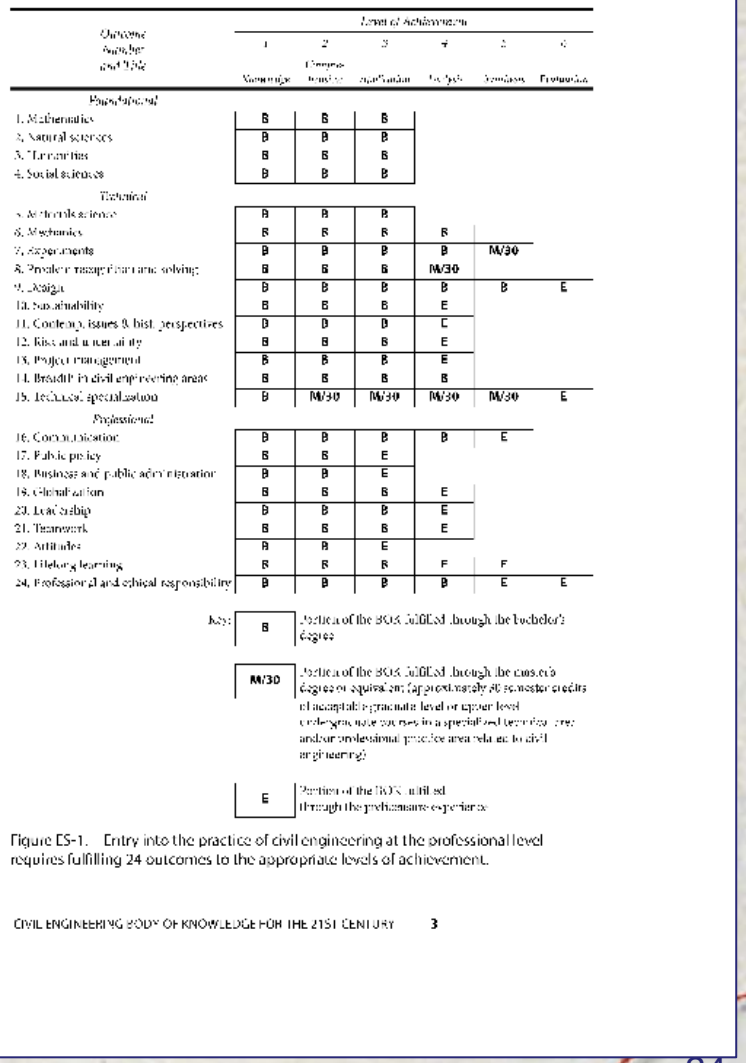
A quick look at the future?

…

ASCE BOK2



Outcome number and title	Level of Achievement					
	1 Knowledge	2 Comprehension	3 Application	4 Analysis	5 Synthesis	6 Evaluation
Foundational						
1. Mathematics	B	B	B			
2. Natural sciences	B	B	B			
3. Humanities	B	B	B			
4. Social sciences	B	B	B			
Technical						
5. Materials science	B	B	B			
6. Mechanics	B	B	B	B		
7. Experiments	B	B	B	B	M/30	
8. Problem recognition and solving	B	B	B	M/30		
9. Design	B	B	B	B	B	E
10. Sustainability	B	B	B	E		
11. Contemporary issues & hist. perspectives	B	B	B	C		
12. Risk and uncertainty	B	B	B	E		
13. Project management	B	B	B	E		
14. Breadth in civil engineering areas	B	B	B	B		
15. Technical specialization	B	M/30	M/30	M/30	M/30	E
Professional						
16. Communication	B	B	B	B	E	
17. Public policy	B	B	E			
18. Business and public administration	B	B	E			
19. Globalization	B	B	B	E		
20. Leadership	B	B	B	E		
21. Teamwork	B	B	B	E		
22. Attitudes	B	B	E			
23. Lifelong learning	B	B	B	F	F	
24. Professional and ethical responsibility	B	B	B	B	E	E

Key:

B	Portion of the BOK 2 fulfilled through the bachelor's degree
M/30	Portion of the BOK 2 fulfilled through the master's degree or equivalent (approximately 30 semester credits of acceptable graduate level or upper level undergraduate courses in a specialized technical area and/or professional practice area related to civil engineering)
E	Portion of the BOK 2 fulfilled through the professional experience

Figure ES-1. Entry into the practice of civil engineering at the professional level requires fulfilling 24 outcomes to the appropriate levels of achievement.

CIVIL ENGINEERING BODY OF KNOWLEDGE FOR THE 21ST CENTURY 3

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Bloom's Taxonomy

- Very useful idea to calibrate level of achievement for outcomes

Level 1 **(L1)** - Knowledge
Level 2 **(L2)** - Comprehension
Level 3 **(L3)** - Application
Level 4 **(L4)** - Analysis
Level 5 **(L5)** - Synthesis
Level 6 **(L6)** - Evaluation

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Foundational Outcomes

Foundational Outcomes	
1 Mathematics	***Solve*** problems in mathematics through differential equations and ***apply*** this knowledge to the solution of engineering problems. **(L3)**
2 Natural sciences	***Solve*** problems in calculus-based physics, chemistry, and one additional area of natural science and ***apply*** this knowledge to the solution of engineering problems. **(L3)**
3 Humanities	***Demonstrate*** the importance of the humanities in the professional practice of engineering **(L3)**
4 Social sciences	***Demonstrate*** the incorporation of social sciences knowledge into the professional practice of engineering. **(L3)**

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Technical Outcomes

Technical Outcomes	
5 Materials science	**Use** knowledge of materials science to ***solve*** problems appropriate to civil engineering. **(L3)**
6 Mechanics	**Analyze** and solve problems in solid and fluid mechanics. **(L4)**
7 Experiments	***Specify*** an experiment to meet a need, conduct the experiment, and analyze and ***explain*** the resulting data. **(L5)**
8 Problem recognition and solving	***Formulate*** and solve an ill-defined engineering problem appropriate to civil engineering by ***selecting*** and applying appropriate techniques and tools. **(L4)**
9 Design	***Evaluate*** the design of a complex system, component, or process and ***assess*** compliance with customary standards of practice, user's and project's needs, and relevant constraints. **(L6)**
10 Sustainability	***Analyze*** systems of engineered works, whether traditional or emergent, for sustainable performance. **(L4)**
11 Contemporary issues and historical perspectives	***Analyze*** the impact of historical and contemporary issues on the identification, formulation, and solution of engineering problems and ***analyze*** the impact of engineering solutions on the economy, environment, political landscape, and society. **(L4)**
12 Risk and uncertainty	***Analyze*** the loading and capacity, and the effects of their respective uncertainties, for a well-defined design and ***illustrate*** the underlying probability of failure (or nonperformance) for a specified failure mode. **(L4)**
13 Project management	***Formulate*** documents to be incorporated into the project plan. **(L4)**
14 Breadth in civil engineering areas	***Analyze*** and solve well-defined engineering problems in at least four technical areas appropriate to civil engineering. **(L4)**
15 Technical specialization	***Evaluate*** the design of a complex system or process, or ***evaluate*** the validity of newly created knowledge or technologies in a traditional or emerging advanced specialized technical area appropriate to civil engineering. **(L6)**

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Professional Outcomes

Professional Outcomes	
16 Communication	***Plan, compose,*** and ***integrate*** the verbal, written, virtual, and graphical communication of a project to technical and non-technical audiences. **(L5)**
17 Public policy	***Apply*** public policy process techniques to simple public policy problems related to civil engineering works. **(L3)**
18 Business and public administration	***Apply*** business and public administration concepts and processes. **(L3)**
19 Globalization	***Analyze*** engineering works and services in order to function at a basic level in a global context. **(L4)**
20 Leadership	***Organize*** and ***direct*** the efforts of a group. **(L4)**
21 Teamwork	***Function*** effectively as a member of a multidisciplinary team. **(L4)**
22 Attitudes	***Demonstrate*** attitudes supportive of the professional practice of civil engineering. **(L3)**
23 Lifelong learning	***Plan*** and ***execute*** the acquisition of required expertise appropriate for professional practice. **(L5)**
24 Professional and ethical responsibility	***Justify*** a solution to an engineering problem based on professional and ethical standards and ***assess*** personal professional and ethical development. **(L6)**

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An MS degree is important for the future

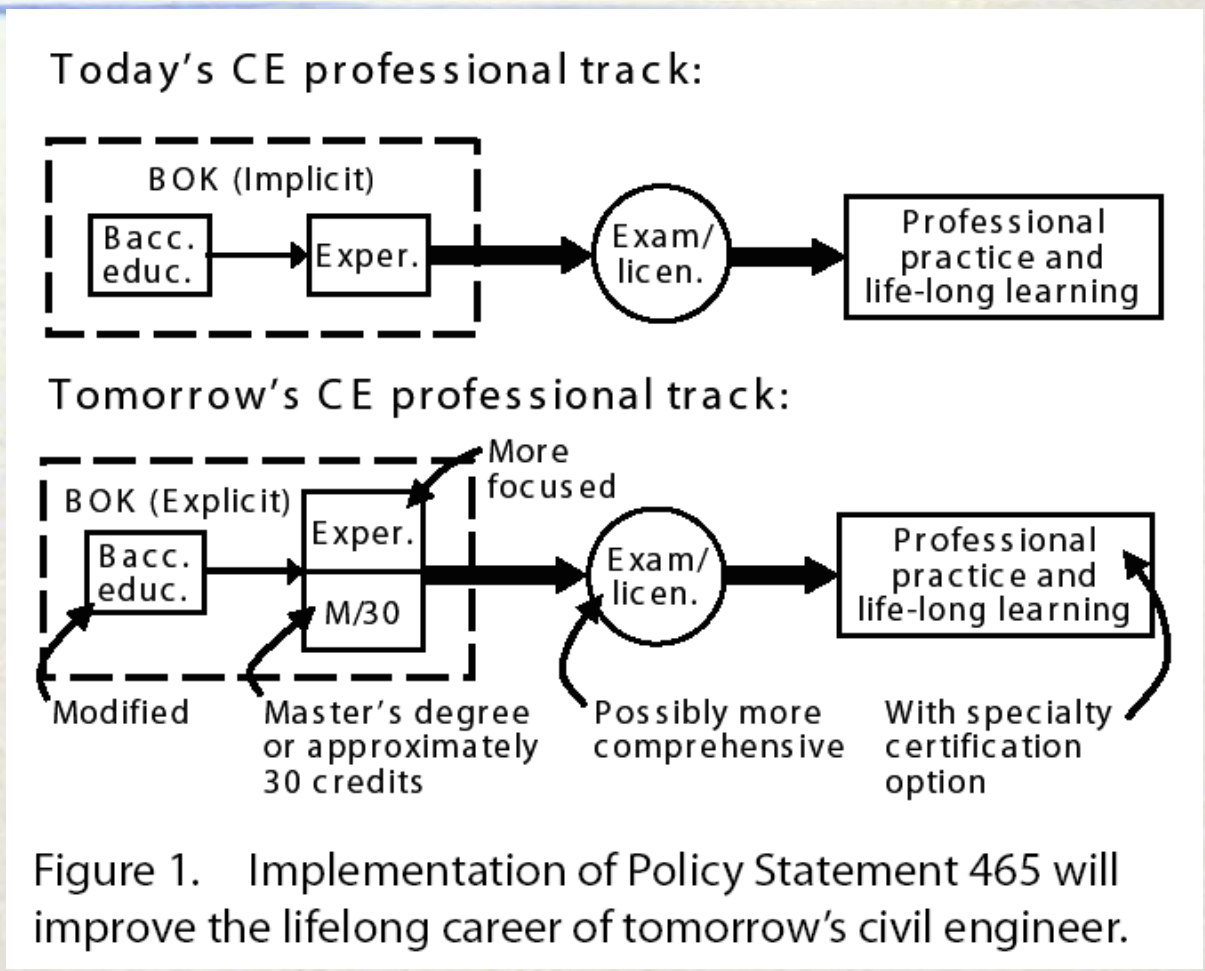

Figure 1. Implementation of Policy Statement 465 will improve the lifelong career of tomorrow's civil engineer.

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Does this approach work?

- EC2000 was implemented in 1996
- A study was commissioned in 2002 to assess effectiveness
  - Penn State, Center for the Study of Higher Education

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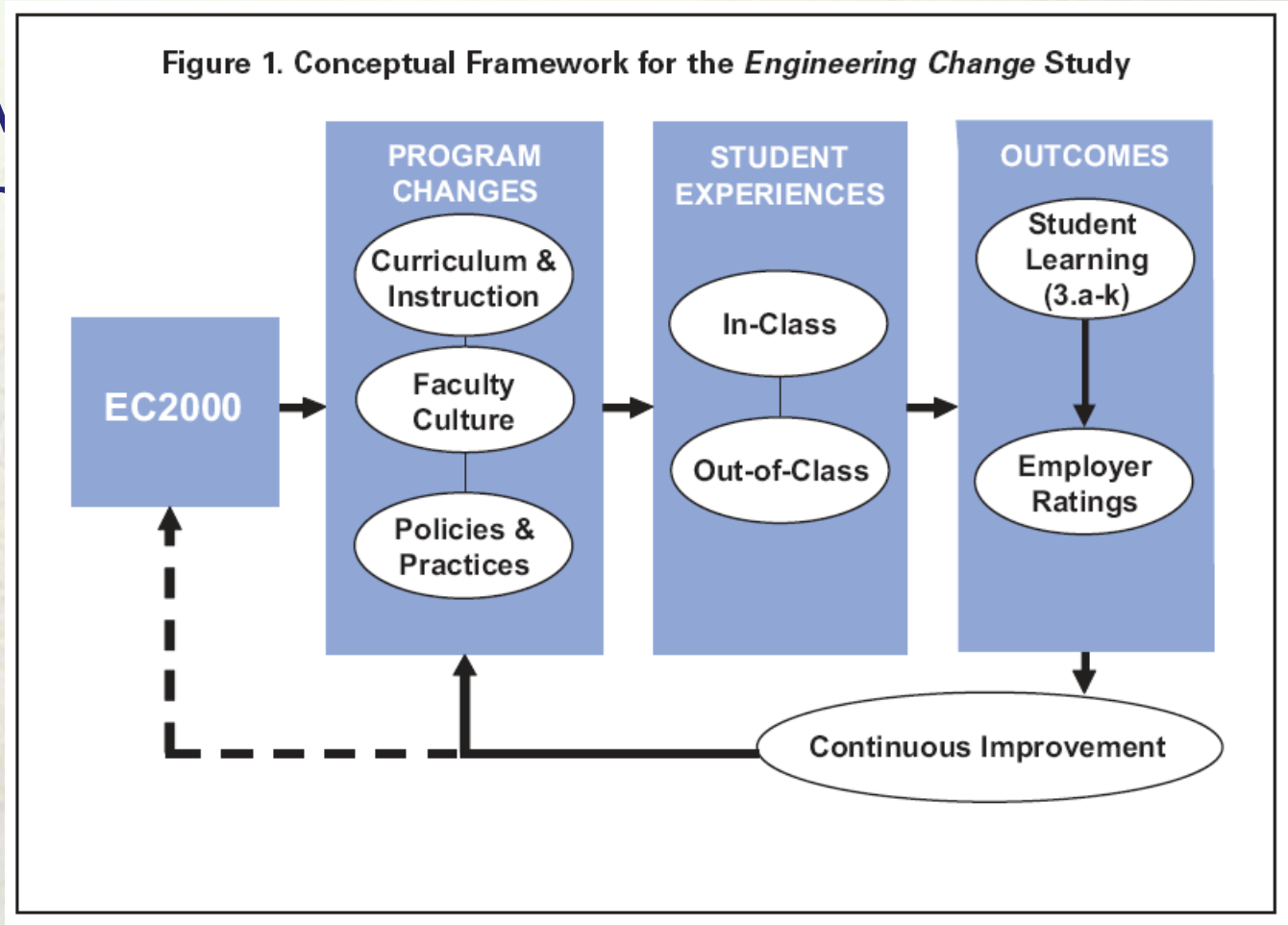
EC2000

- A … nt" ir…



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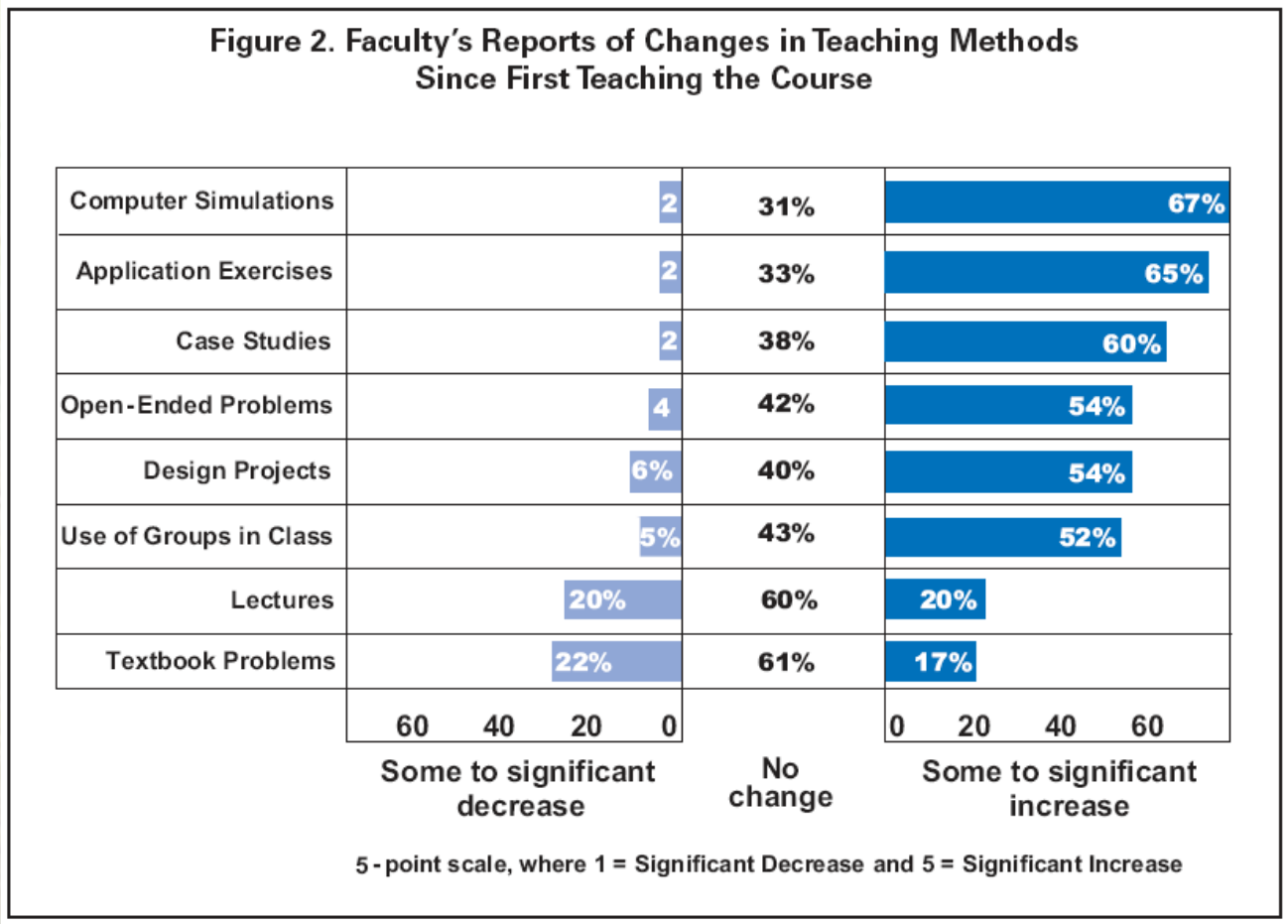
EC2000 guides change



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Real impact on students

- More active engagement in their own learning;
- More interaction with instructors;
- More instructor feedback on their work;
- More time spent studying abroad;
- More international travel;
- More involvement in engineering design competitions; and
- More emphasis in their programs on openness to diverse ideas and people.

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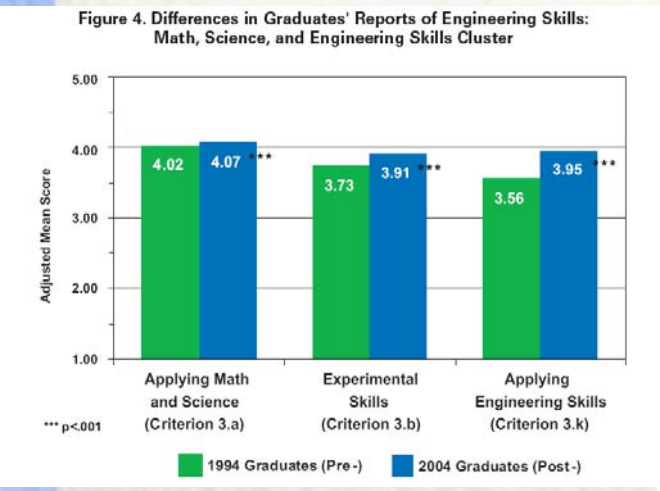
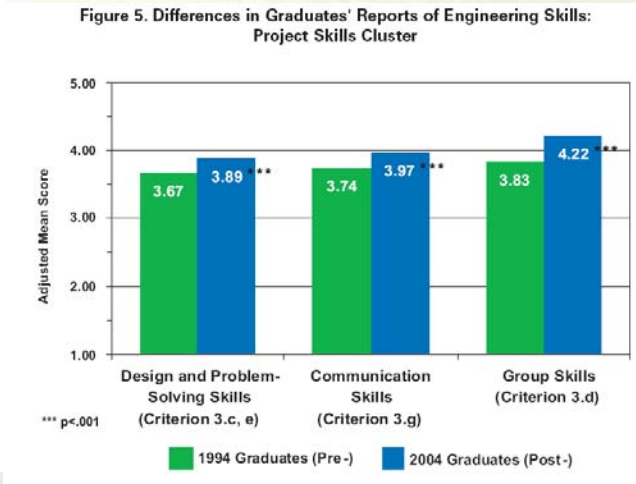
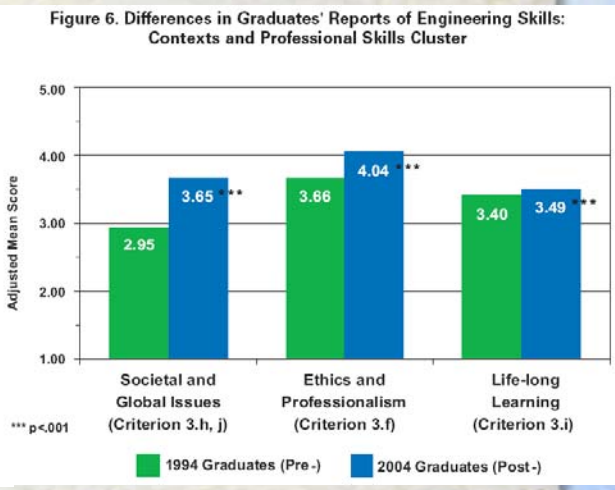
Impact







Technical Base

Project Skills

Professional Skills

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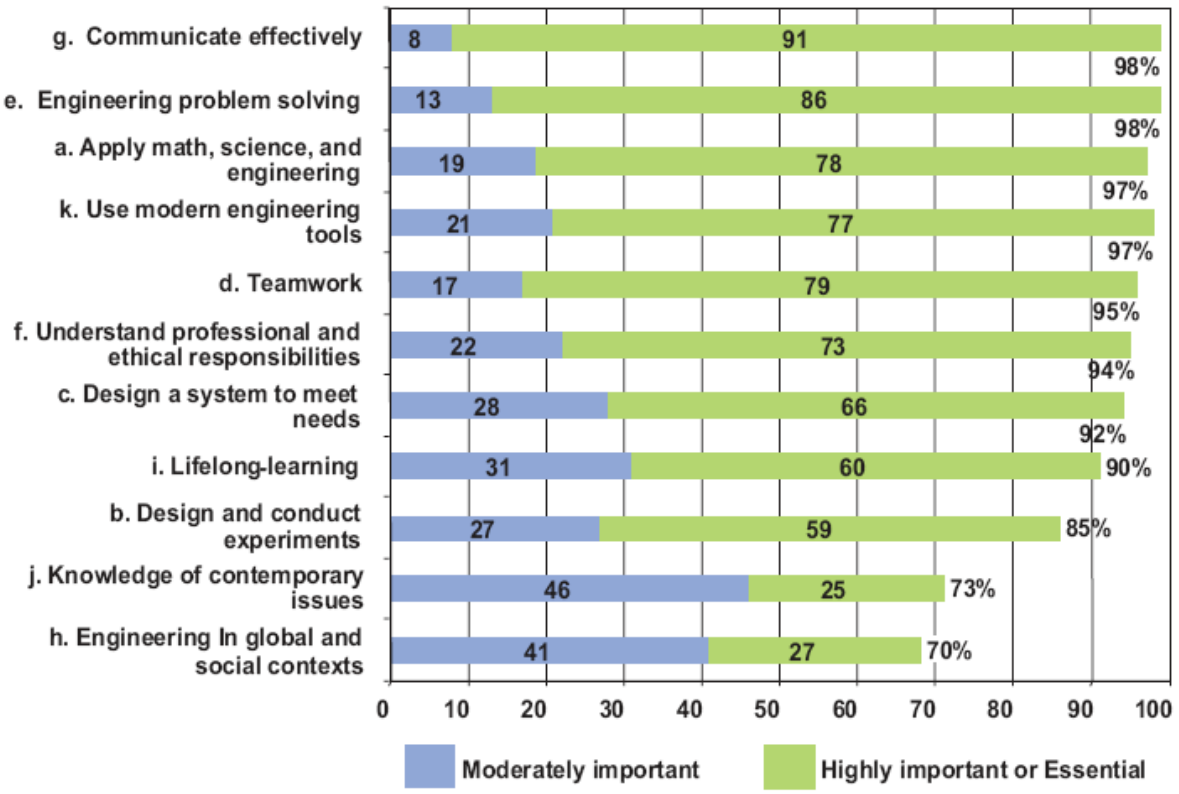
Importance of Outcomes

Figure 8. Employers' Ratings of Importance of a-k Outcomes for New Hires



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Conclusion of Study

- EC2000 has had positive impact
- Greatest impact is on understanding societal and global issues, group skills, ethics, professional issues

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Non-domestic accreditation

Non-Domestic Accreditation

In fall 2005, the ABET Board of Directors unanimously approved proceeding with developing a plan for non-domestic accreditation that will continue to honor existing mutual recognition agreements and memoranda of understanding and phase out substantial equivalency evaluations.

Substantial equivalency evaluations have since been phased out, a draft non-domestic accreditation plan has been created, and the first non-domestic accreditation visits were held in fall 2007.

The non-domestic accreditation visits are conducted using the same accreditation criteria and the same policies and procedures as domestic visits. Interested parties should learn more about ABET accreditation by visiting the links listed under "Resources for programs" on the left-hand navigational menu. You may also contact us.

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Session 2:
Conducting a Self Study of Your Own Department

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What are you getting yourselves into?

- College & University must provide leadership, vision, and resources
- Individual programs conduct self studies
- College usually provide survey tools that help the programs collect data
- It IS a lot of work. But process leads to improvements for students.

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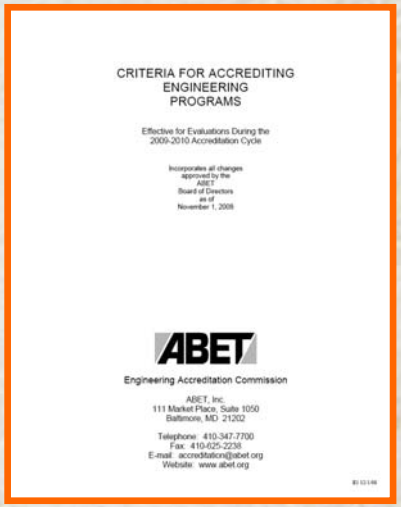
Accreditation body provides guidance

- Once you commit to this process, you will find that ABET is very helpful
- Templates for the self study to prompt you for necessary sections
- They are a “transparent” (although not always predictable) process, letting you learn how the visitors are taught to evaluate you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Criteria

GENERAL CRITERIA FOR BACCALAUREATE LEVEL PROGRAMS

- Students
- Program Educational Objectives
- Program Outcomes
- Continuous Improvement
- Curriculum
- Faculty
- Facilities
- Support
- Program Criteria

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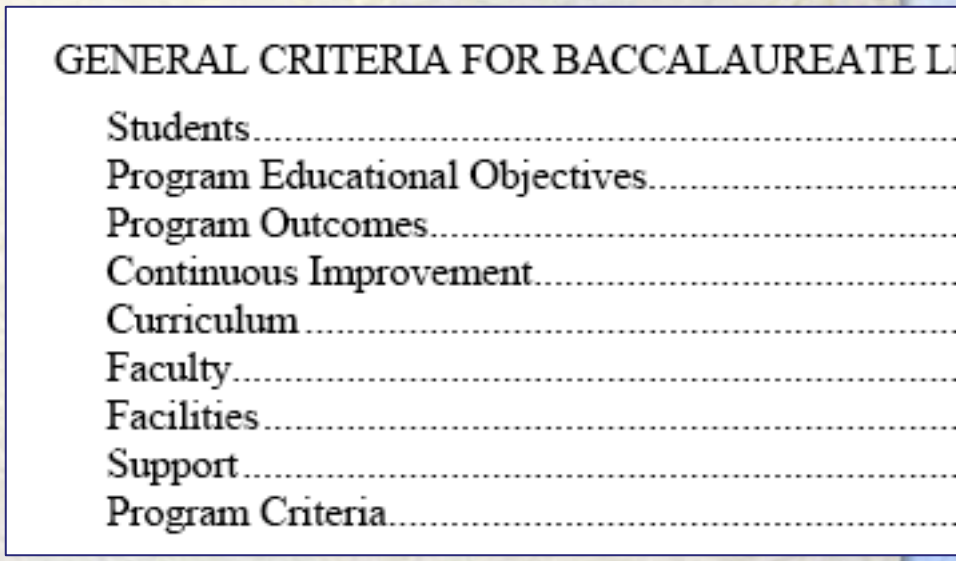
Self Study: The Easy Parts

- Students
- Faculty
  - Statistics, CVs
- Facilities
  - Statistics, Lab info
- Support
- Program criteria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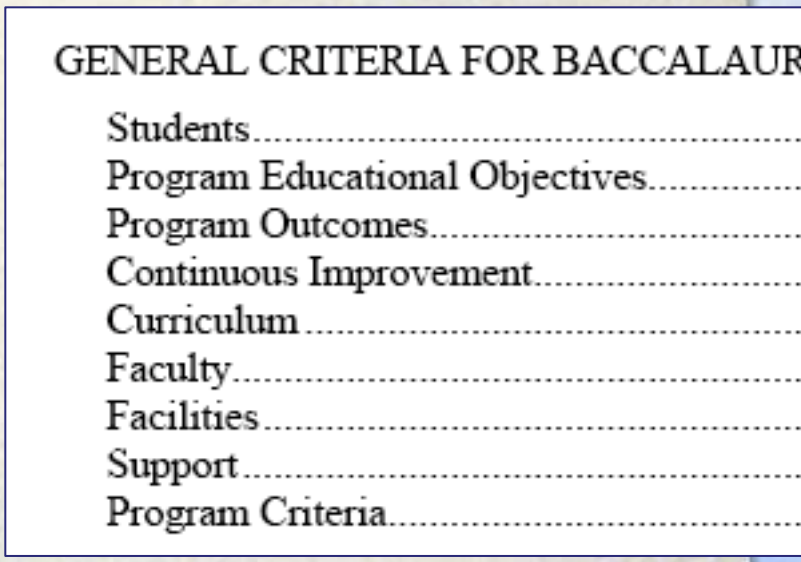
Self Study: The Hard Parts

- Program Education Objectives
- Program Outcomes
  - The entire mission-objective-outcomes structure is complex
- Continuous Improvement
  - The assessment part will test your commitment to this process
- Curriculum
  - The curriculum design task to meet outcomes is unending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Mission statements

- You need to start at the beginning…
- Why do you exist?
- What is your unique role?
- What are your aspirations?

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University Mission

- A statement of mission or vision of what your university is about
- For example:
  - Enhancing the quality of teaching, research, and service programs through the aggressive recruitment and support of the best faculty, staff, and students;
  - Remaining a leader in the creation and synthesis of knowledge for the benefit of current and future generations;
  - Continuing to improve the quality of the undergraduate and graduate programs that prepare our students for professional life, leadership, and citizenship in a changing world;
  - Using the resources of its three campuses in an integrated fashion to strengthen the services to the state through the education of a modern labor work force, research and development, technology commercialization, and partnership with business, government, and community groups.
  - Strengthening mutually beneficial relationships and building new ones with communities, governmental entities, alumni groups and the private sector, and
  - Improving the efficiency and effectiveness of the management and administrative services that support the university mission.

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College Mission

- For example:
- The mission of the College of Engineering is to meet the needs of the state and nation through excellence in education, research, and public service. The goals are to instill in students the attitudes, values, vision, and training that will prepare them for lifetimes of continued learning and leadership in engineering and other fields; to generate new knowledge for the benefit of society; and to provide special services when there are needs that the college is uniquely qualified to meet.

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Department Vision

- We have separate mission and vision statements (although that may seem redundant)
- Our vision statement:
  - We are a large, comprehensive civil and environmental engineering department committed to excellence in education, research, and public service. We believe that our excellence derives from high-quality students and faculty, a dedicated and capable support staff, a collegial and cooperative spirit, well-equipped and maintained experimental and computational facilities, the achievements of our graduates, and research that makes a difference for the engineering community and society at large. *Our goal is to be the preeminent department of civil and environmental engineering worldwide as measured by the quality of our faculty, students, the impact of our scholarly output, and our reputation for excellence.*

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Department Mission

- Our mission is *education*. We achieve this mission through our teaching, research, and public service activities by:
  - Educating, inspiring, and mentoring future leaders of our profession and society that are prepared to meet 21st century challenges in a global economy.
  - Performing forward-looking research — both applied and theoretical — that will positively impact and improve our profession and society.
  - Serving as a reliable, highly capable resource for society, the profession, and the university through activities in professional organizations, campus committees, consultancy, and continuing education.

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Mission reflects constituencies

- Civil engineering students.
- Civil engineering faculty members.
- Employers of graduates of the civil engineering program, including
  - consulting firms
  - public agencies, such as highway departments
  - other public and private sector companies (engineering and non-engineering)
- Graduate schools.

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Program Educational Objectives

- Programs need to define objectives consistent with the mission
- For example:
  - Prepare graduates with a comprehensive technical education to be professional practitioners of civil and environmental engineering. *(measurable by job placement statistics)*
  - Prepare graduates to be well-rounded by being knowledgeable of the historical context, multidisciplinary character, contemporary issues, and global nature of civil engineering. *(measurable by post grad survey)*
  - Prepare graduates to be leaders who exhibit team-building skills, professional responsibility, and effective communication skills. *(measurable by survey, anecdote and job statistics)*
  - Prepare graduates to pursue post-graduate education in engineering or other professional fields. *(measurable by MS/PhD statistics)*

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Another example of PEOs

- Within 5 years of graduation, civil engineering alumni will demonstrate:
  - 1. A sound understanding of engineering concepts and the interrelation of these concepts to non-technical issues in business and society,
  - 2. Commitment to life-long learning,
  - 3. Effective communication skills in a wide variety of situations,
  - 4. Effective team membership skills,
  - 5. Active contribution to the engineering discipline and/or society as a whole.

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Processes to involve constituents

- Regularly interact with constituents to give feedback about Program Educational Objectives (and how well you are meeting them)

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Next, Program Outcomes

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Program Outcomes

- Almost all schools utilize the basic ABET outcomes, although you can invent your own
- Most want to keep this simple, and ABET gives you a template

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11 program outcomes

Criterion 3. Program Outcomes

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Show that your students experience those outcomes

- Every course contributes something, but not *every* course addresses *all* outcomes
- COLLECTIVELY, the courses meet all outcomes

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A big task: Map your courses to your outcomes

- Evaluate each course for its contribution to the 11 outcomes
- Of course, we want this process to influence curriculum, so faculty might consider how to improve their courses to serve desired outcomes

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CEE310

Page 1

Rubric *Title of course* *Instructor*	**CEE 310** Transportation Engineering Erol Tutumluer/Yanfeng Ouyang
Course catalog description, prerequisites, and credit	This course provides an introduction to the design, planning, operation, management, and maintenance of transportation systems. Principles for planning integrated multi-modal transportation systems (highways, air, rail, etc.) are presented. Introduction is provided on the layout of highways, airports, and railroads with traffic flow models, capacity analysis, and safety. Functional design concepts are introduced for both the facilities and systems areas of study with life-cycle costing procedures and criteria for optimization. *Prerequisite*: TAM 251, credit or concurrent registration in CEE 202. *Credit:* 3 hours.
Textbook(s) and/or other required material	Garber, N. J., and L.A. Hoel, *Traffic and Highway Engineering*, Revised 2nd Edition, PWS Publishing, 1996.
Course objectives	The course objectives are as follows: To introduce planning, materials selection, design, operation, management, and maintenance of transportation infrastructure. To introduce functional design concepts, life cycle costing, and criteria for optimization for transportation facilities and systems.
Topics	The following topics are covered in this course: • Introduction (importance of transportation, transportation modes, functions, issues, disciplines, contemporary issues, key historical notes) • Transportation infrastructure (modes of transportation, transportation economics, modal usage and loadings, forces of change, organizations that influence transportation • Facilities: Performance and structural characteristics (statistics, equipment, structure, deterioration and condition assessment, load conditions for track, flexible and rigid pavements, stress, strain, and deflection responses for typical track and pavement structures • Subgrade soil properties (subgrade characteristics, analysis of soil properties, unified and AASHTO classification procedures, compaction issues relative to moisture-density relationships, effects of compaction on subgrade properties, compaction methods) • Aggregate properties (definition and purpose of aggregates, sources, strength and modulus, particle size, moisture effects on ballast and granular subbases and base courses, quality of aggregates) • Surface materials (Portland cement, Portland cement concrete, testing and paving, asphalt cement and liquid asphalts, asphalt concrete properties, testing, paving, surface treatments, SUPERPAVE binder, mixture tests and specifications • Systems: Safety and design elements (characteristics of driver, pedestrian, vehicle, road, sight distances, horizontal and vertical curves, stopping distances) • Traffic flow, capacity, level of service (traffic issues, e.g., elements of flow, fundamental behavior; capacity, e.g., levels of service and maximum flow rates) • Planning and forecasting (transportation planning process, trip forecasting, generation, distribution, mode choice, assignments, traffic study engineering)
Computer usage	Spreadsheet programs and internet
Laboratory projects	None, except some live classroom demonstrations
Class/laboratory schedule	Lecture/Discussion: 3 hours/week
Contribution to the professional component	100% engineering topics Design content: 1.0 hours

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CEE310

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Relationship to program objectives	The course contributes to the (1) through (5) program objectives as follows: 2. Develop and refine analysis and problem-solving abilities. Detailed homework assignments develop both. 4. *Provide a balance of in-depth knowledge and breadth in civil engineering.* This course helps students develop breadth in civil engineering knowledge, particularly in the area of transportation systems, facilities, and materials and also includes an introduction to the detailed design and analysis of transportation facilities and systems. 5. *Prepare students for practice or graduate school.* This course helps students to be prepared for entrance into the civil engineering practice with a broad exposure to transportation engineering topics, and serves as a pre-requisite course for senior-level courses in the areas of traffic analysis, geometric design, bituminous materials and mixture design, and pavement design.
Relationship to program outcomes	This course contributes to the (A) through (K) program outcomes as follows: A. *Ability to apply math and science.* This course allows the students to apply the knowledge they have obtained in mathematics, physics, and engineering mechanics, and computer science to solve practical transportation engineering problems. E. *Solve problems in five areas of civil engineering.* This course involves problem solving in the area of transportation engineering through weekly homework assignments, quizzes, and exams. J. *Knowledge of contemporary issues.* Contemporary issues in transportation systems, air traffic operations, pavements and materials are presented in lectures, readings, and through guest speakers. K. *Ability to use techniques, skills, and modern engineering tools.* This course involves problem solving in the area of transportation engineering and students develop skills and utilize modern engineering tools such as spreadsheets, software programs, internet, etc., which are capabilities that will benefit the student in engineering practice.
Prepared by	E. Tutumluer
Date	February 7, 2006

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We must also show how EVERY student experiences ALL outcomes

- Usually accomplished through rules of your program
- Students must take ….1, 2, 3, 4…

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Assurance of Achieving CEE Program Outcomes

The CEE Self Study Report presents syllabi for all undergraduate courses (Appendix B), and these syllabi address how the courses relate to our program outcomes. Our students can take many different paths through the curriculum depending upon their primary/secondary and selection of elective courses.
We demonstrate that all students achieve all program outcomes by observing that all A-K outcomes are met within our requirements for 200-level courses, 300-level core courses, and a laboratory course. We require every student to take five of seven available 300-level courses, and so there are many possible combinations. As shown in Table 1, no combination of the 300-level courses creates a gap in achieving outcomes.

Table 1. Subset of required courses that assure coverage of CEE Program Outcomes

			PROGRAM OUTCOMES										
Dept.	No.	Course Title	A	B	C	D	E	F	G	H	I	J	K
Both 200-level courses are required													
CEE	201	Systems Engineering & Economics	X		X	X			X	X	X	X	X
CEE	202	Engineering Risk & Uncertainty	X		X								X
Five of Seven 300-level courses are required													
CEE	300	Behavior of Materials	X	X	X	X	X	X	X		X	X	X
CEE	310	Transportation Engineering	X				X					X	X
CEE	320	Construction Engineering	X		X	X		X	X	X		X	X
CEE	330	Environmental Engineering	X		X	X			X	X		X	
CEE	350	Water Resources Engineering	X	X	X	X	X	X	X	X	X	X	X
CEE	360	Structural Engineering	X				X	X			X		X
CEE	380	Geotechnical Engineering	X		X		X	X				X	
One of the following laboratory courses is required													
CEE	300	Behavior of Materials	X	X	X	X	X	X	X		X	X	X
CEE	400	Welding and Joining Processes	X	X		X	X	X	X	X		X	X
CEE	401	Concrete Materials	X	X	X		X		X				X
CEE	405	Asphalt Materials I		X	X		X	X	X			X	

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The Self Study Report

- Let’s take a look at an example…

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Session 3: Implementation of Outcomes Based Assessment

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The basic tasks

- Define desired outcomes
- Design curriculum to deliver on those outcomes
- Assess outcomes
- Provide feedback loop so that assessment leads to improvement

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Define outcomes

- This we have discussed.
- Outcomes arise from …
  - Mission of university & department
  - Expectations of accrediation process
  - Faculty ideas, priorities, expertise
    - It is most important to emphasize unique innovations that arise from the faculty!

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ABET outcomes (A-K)

Criterion 3. Program Outcomes

Engineering programs must demonstrate that their students attain the following outcomes:

(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 meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary 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.

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Show that your students experience those outcomes

- Every course contributes something, but not *every* course addresses *all* outcomes
- COLLECTIVELY, the courses meet all outcomes

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A big task: Map your courses to your outcomes

- Evaluate each course for its contribution to the 11 outcomes
- Of course, we want this process to influence curriculum, so faculty might consider how to improve their courses to serve desired outcomes

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CEE310

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Five of Seven 300-level courses are required													
CEE	300	Behavior of Materials	X	X	X	X	X	X	X		X	X	X
CEE	310	Transportation Engineering	X				X					X	X
CEE	320	Construction Engineering	X		X	X		X	X	X		X	X
CEE	330	Environmental Engineering	X		X	X			X	X		X	
CEE	350	Water Resources Engineering	X	X	X	X	X	X	X	X	X	X	X
CEE	360	Structural Engineering	X				X	X			X		X
CEE	380	Geotechnical Engineering	X		X		X	X				X	
One of the following laboratory courses is required													
CEE	300	Behavior of Materials	X	X	X	X	X	X	X		X	X	X
CEE	400	Welding and Joining Processes	X	X		X	X	X	X	X		X	X
CEE	401	Concrete Materials	X	X	X		X		X				X
CEE	405	Asphalt Materials I		X	X		X	X	X			X	

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Be prepared to demonstrate that your claims are real

- If a course claims to meet certain outcomes, faculty must defend that assertion
  - Syllabus of course
  - Textbook
  - Lecture material
  - Labs, presentation experiences etc.

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There are “hard ones”

- Lifelong learning…
  - How do courses teach lifelong learning?
  - Well, professional seminars, essays, peer-lead labs that are “self-taught” etc.
- Ethical responsibility
  - Ethics seminars, case studies within technical courses etc.

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Yes, but how MUCH content in a course is required to assert that the outcome is met?

- This issue exposes a weakness of the outcomes approach (unfortunately)
- You will encounter a “bean counting” mentality…
- There IS no firm answer to this question, so there becomes a “gamesman-ship” to the self study
- My advice: Keep your focus. Take the high road. Don’t worry about this stuff.

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A strategic issue

- Do we assess at the **Program** level or at the **course** level or **student** level?
- All ways are done.
- Within our College, we see both program level and course level outcome assessment
- I’m aware that other schools have even tracked this information for each student

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Assessing at the Program level

- Our “holistic” approach demonstrates that our program as a comprehensive unit is successful.
- We do not require faculty to fully document assessment data for each outcome of their courses.
- Eg. If you claim that the course serves “Life Long Learning”, can you assess this on an exam? Do essays or assignments prove this? Can you survey graduates to show that your course taught them life long learning?

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Assessment of outcomes achieved at program level

- Data:
  - Grades
  - Student Course Evaluations
  - Surveys of Seniors
  - Surveys of Graduates
  - Input from Alumni Advisory Committees
  - Employment statistics
  - Standardized Exams (e.g. Fundamentals of Engineering Exam)
  - Anecdotes of successful graduates
  - Reputation of programs

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Example: Alumni Evaluation

Assessment of Illinois CEE Program in ABET Program Outcomes (A-K)

by the

CEE Alumni Board of Directors

June 1, 2007

The Board of Directors of the Civil and Environmental Alumni Associate comprises eighteen members who represent a diverse cross-section of the practice of civil and environmental engineering. The Directors are elected by the general membership of the CEE Alumni Association. The Directors work for consulting engineering firms, contractors and public agencies and represent all major disciplines of civil engineering. They range in experience from 8-10 years beyond graduation to those nearing retirement.

In the spring of 2007, each member of the Board of Directors of the Civil and Environmental Engineering Alumni Association was contacted to participate in a survey. The survey asks for their

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Assessing at the Course Level

- Each faculty can identify data that measures each outcome of the course.
- E.g. If an outcome is “To Communicate Effectively”, you could add specific conceptual questions or essays on an exam that show that students learned that point.
- We judged this to be tedious and perhaps difficult to execute throughout our program.
- We can discuss this more…what do you think?

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Assessment of outcomes achieved by single course

- Data:
  - Exams
  - Final Grades
  - Project results
  - Papers
  - Presentations
  - Student Course Evaluations

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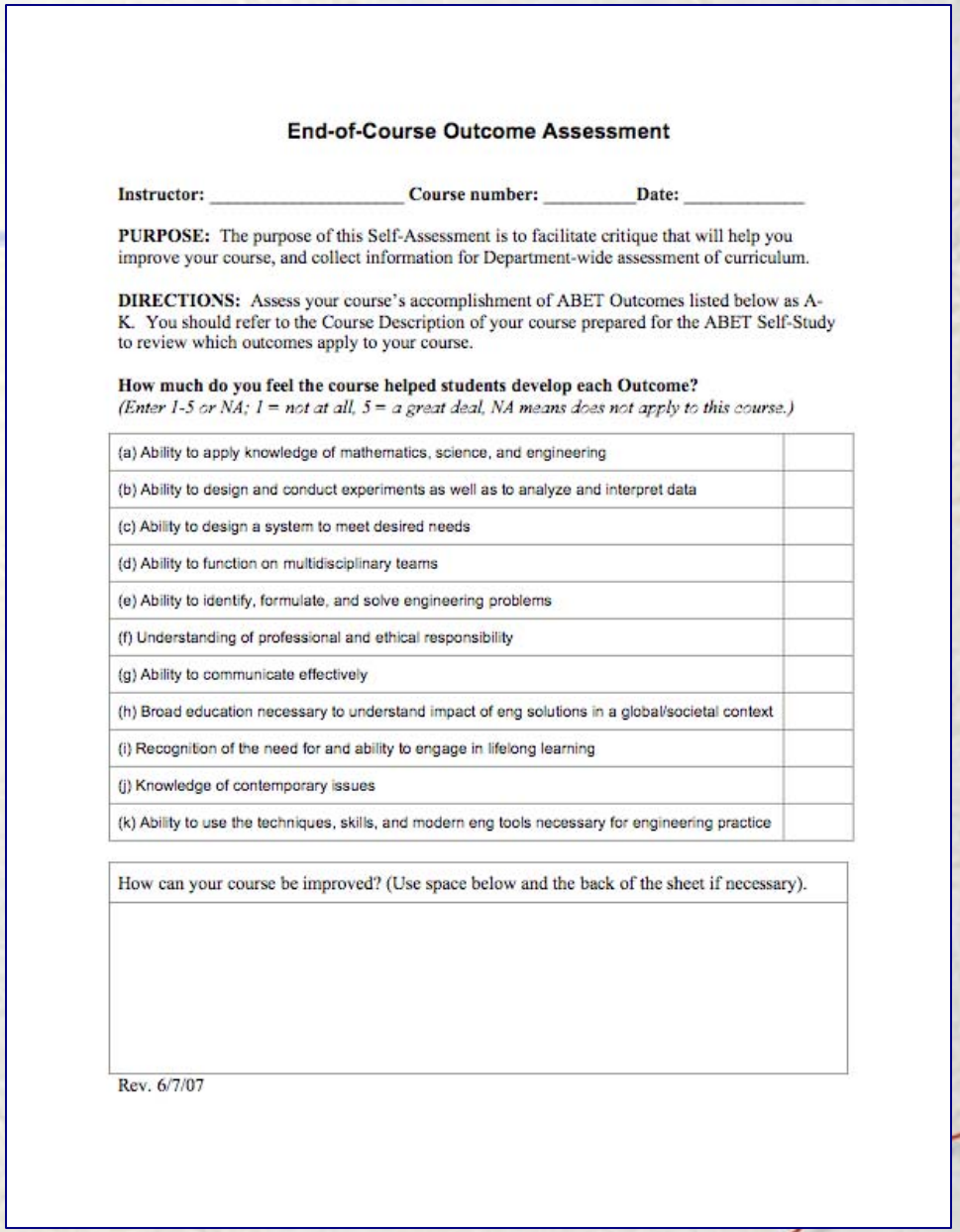
Faculty Assessment

- We implemented a post-semester self-assessment for our faculty



End-of-Course Outcome Assessment

Instructor: _____ **Course number:** _____ **Date:** _____

PURPOSE: The purpose of this Self-Assessment is to facilitate critique that will help you improve your course, and collect information for Department-wide assessment of curriculum.

DIRECTIONS: Assess your course's accomplishment of ABET Outcomes listed below as A-K. You should refer to the Course Description of your course prepared for the ABET Self-Study to review which outcomes apply to your course.

How much do you feel the course helped students develop each Outcome?
(Enter 1-5 or NA; 1 = not at all, 5 = a great deal, NA means does not apply to this course.)

(a) Ability to apply knowledge of mathematics, science, and engineering	
(b) Ability to design and conduct experiments as well as to analyze and interpret data	
(c) Ability to design a system to meet desired needs	
(d) Ability to function on multidisciplinary teams	
(e) Ability to identify, formulate, and solve engineering problems	
(f) Understanding of professional and ethical responsibility	
(g) Ability to communicate effectively	
(h) Broad education necessary to understand impact of eng solutions in a global/societal context	
(i) Recognition of the need for and ability to engage in lifelong learning	
(j) Knowledge of contemporary issues	
(k) Ability to use the techniques, skills, and modern eng tools necessary for engineering practice	

How can your course be improved? (Use space below and the back of the sheet if necessary).

Rev. 6/7/07

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Followup and Feedback Loop

- Faculty must see this process as a tool to improve…
  - Give them access to data
  - Ask faculty to self-assess
- “Institutionalize” this process
  - Charge faculty committees to oversee process
  - Department Curriculum Committee
  - College Assessment Committee
- Dean & Dept Heads must care about this process and give visibility to it

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Self Study Report

- Finally, this report every six years is a valuable resource
- We formally do this only at the six year mark….
- [We could do better at this process in the intermediate years.]

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