A Longitudinal Study of the ABET Outcomes-Based Accreditation Model

INQAAHE Madrid 2011







Outline of the Presentation

Context

- What was the *Impetus for Change*?
- What was the Change?
- What is the Impact The Longitudinal Study?
- Key findings of the Longitudinal Study
 - Program Changes
 - Student Experiences
 - Student Learning Outcomes
- Conclusions and Implications
 - The good and the opportunities for improvement

Impetus for Change

Circa 1990...

- Industry seeks graduates with quality technical AND professional skills, but dense accreditation criteria leave programs no room cover both.
- Deans attempt to innovate engineering education to meet the needs of industry, but face brick wall in prescriptive accreditation criteria.
- ABET adopts new leadership philosophy and strives to ensure quality AND stimulate innovation in engineering education.

New Philosophy

- Institutions and programs define mission and objectives to meet the needs of their constituents – enables program differentiation.
- Emphasis on outcomes What students learn, less on what they were taught.
- Programs demonstrate how criteria and educational objectives are being met
- Practice of Continuous Quality Improvement
 - Input from Constituencies
 - Process focus
 - Outcomes and Assessment Linked to Objectives

Basic Level Criteria

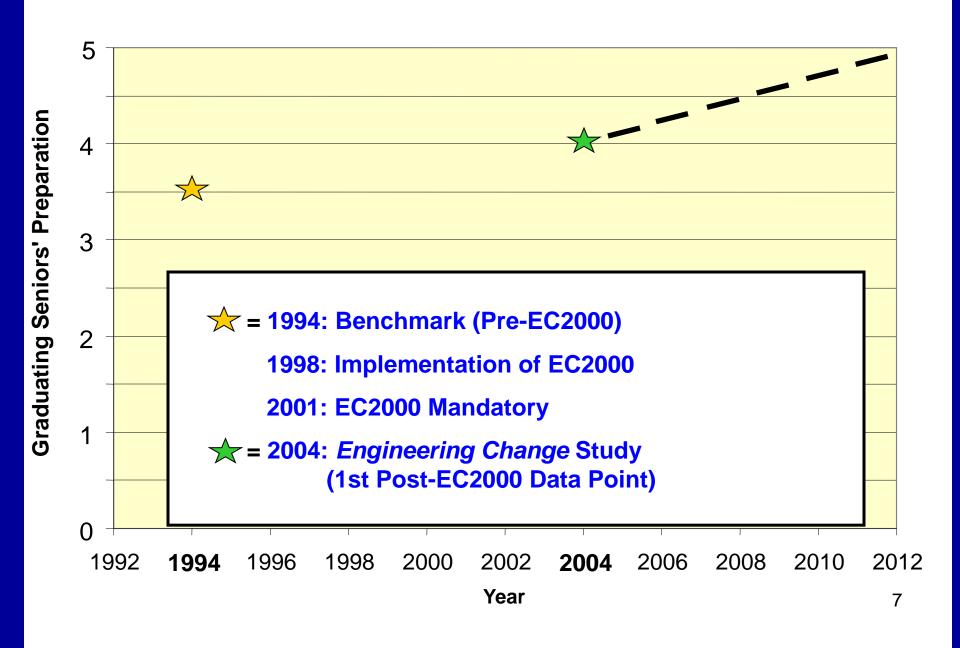
- 1. Students
- 2. Program Educational Objectives
- 3. Program Outcomes and Assessment
 - 4. Professional Component
 - 5. Faculty
 - 6. Facilities
 - 7. Institutional Support & Financial Resources
 - 8. Program Criteria

Student Learning Outcomes

EC2000: Criterion 3, a-k

- 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
- d. An ability to function on multi-disciplinary teams
- e. An ability to identify, formulate and solve engineering problems
- f. An understanding of professional and ethical responsibility
- g. An ability to communicate effectively
- h. The broad education necessary to understand the impact of engineering solutions in a global 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
- → A twelfth outcome, "ability to manage a project," was added to the research study because it is frequently mentioned in the literature on engineering education

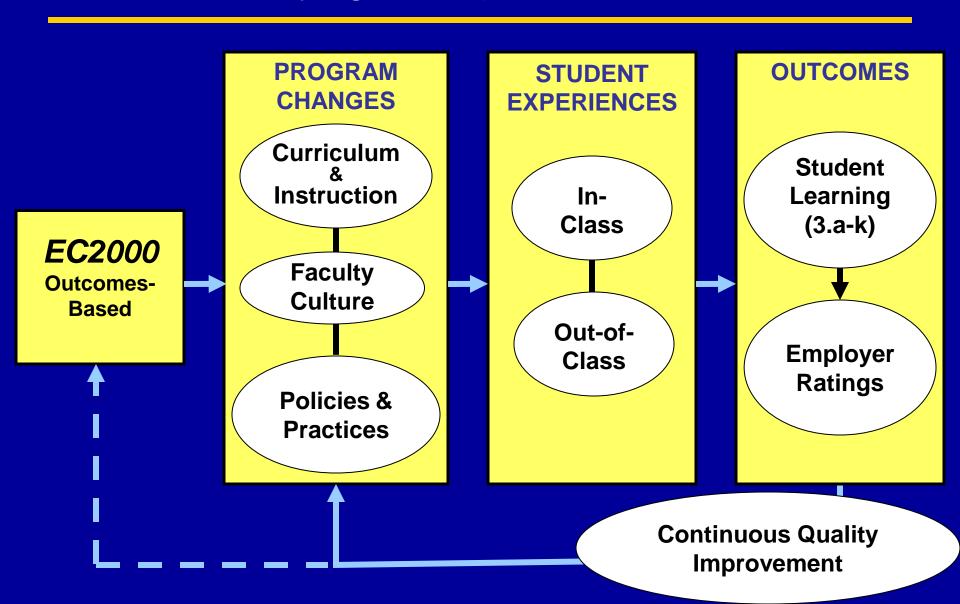
Tracking Student Learning Outcomes



Key Questions

1. What impact, if any, has EC2000 had on graduating seniors' preparation to enter the engineering profession?

2. What impact, if any, has EC2000 had on practices that may be related to changes in student preparation?



Data Sources and Response Rates

Data Sources	Target Population	Number of Responses	Response Rate
Programs	203	147	72%
Faculty	2,971	1,243	42%
Deans	40	40+	98%
1994 Graduates (Pre-)	13,054	5,494	42%
2004 Graduates (Post-)	12,921	4,330	34%
Employers	unknown	1,622	N/A ₁₀

Participating Institutions: Doctoral

Arizona State University Case Western Clemson University **Cornell University** Georgia Tech **Howard University** Illinois Institute of Tech. **Iowa State University** Lehigh University Marquette University MIT Ohio State University **Princeton University Purdue University Syracuse University**

Temple University Texas A&M University **University of Arkansas UCLA** University of Florida University of Illinois, Chicago University of Michigan University of Missouri, Columbia University of Notre Dame University of Texas, Arlington University of Texas, Austin University of the Pacific Virginia Tech

Western Michigan University

Worcester Polytechnic Institute

Participating Institutions: Master's and Bachelor's

Master's

Cal. Polytechnic, Pomona

Cal. State, Sacramento

Embry-Riddle, Daytona

North Carolina A & T

Tuskegee University

Youngstown State Univ.

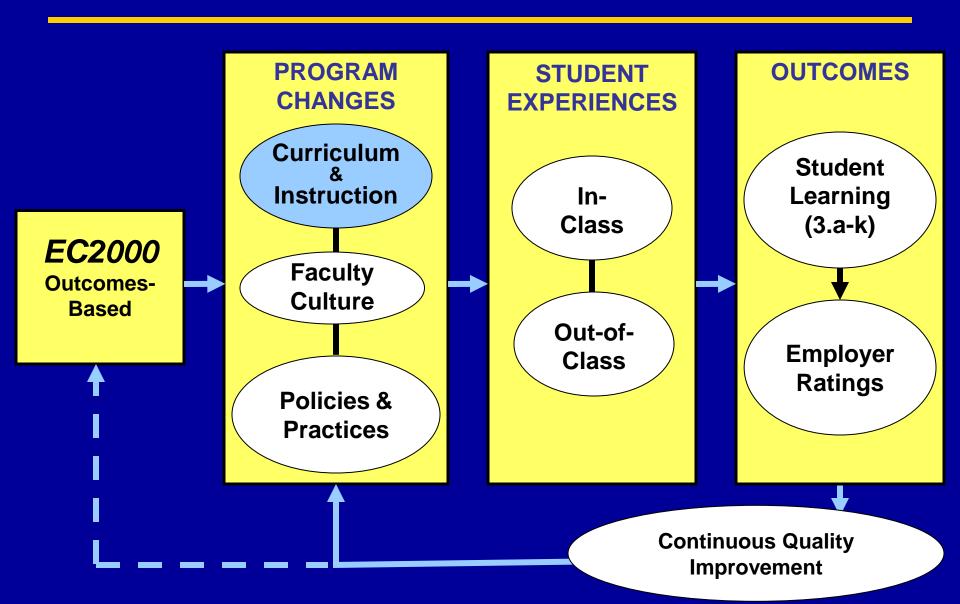
Bachelor's and Others

South Dakota School of Mines

Tri-State University

Union College

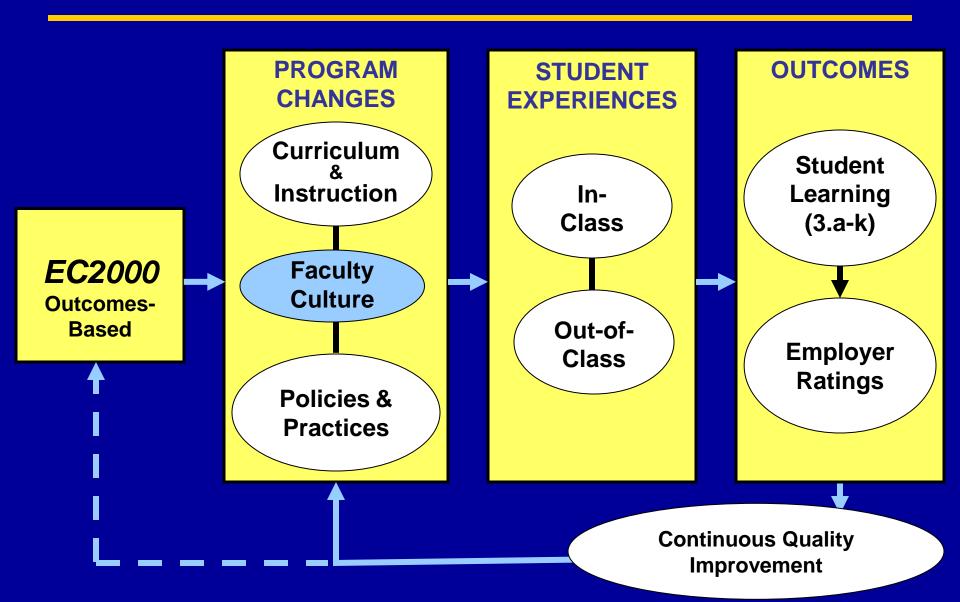
United States Military Academy



Significant Findings: Curriculum and Instruction at Course Level

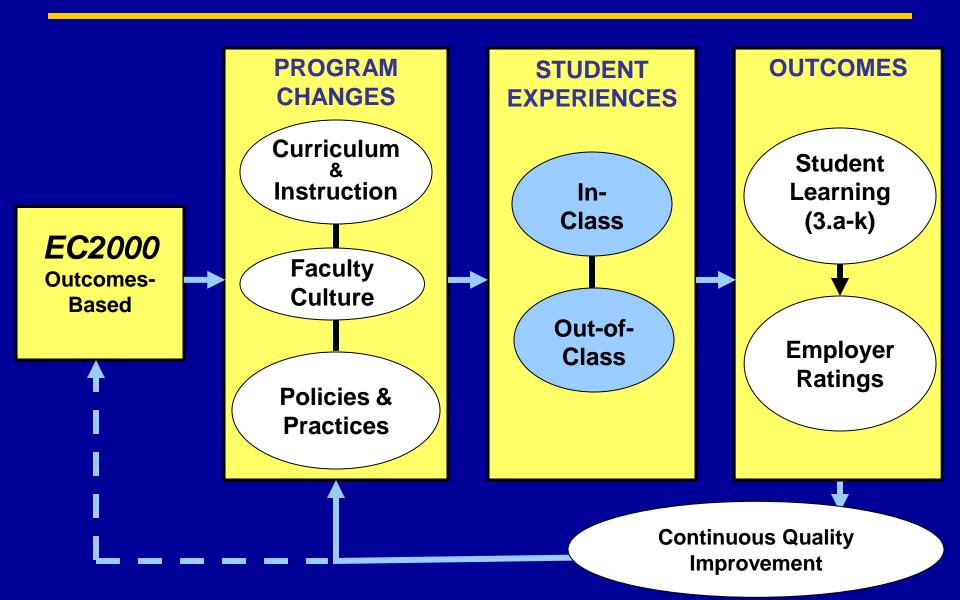
Faculty report:

- Increased emphasis on engineering tools, design, teamwork, and contemporary issues and contexts.
- Increased use of active learning methods.
- Greater increases in emphasis on teamwork, communication skills, and use of engineering tools.
- Faculty and chairs report little change in emphasis on basic math and science.



Significant Findings: Faculty Culture

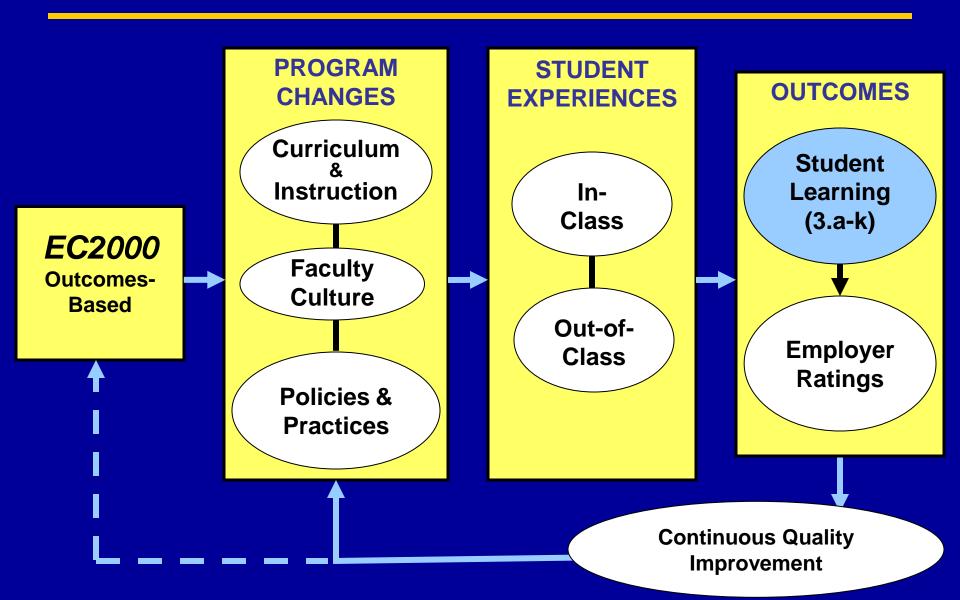
- More than 70% of program chairs indicate high levels of faculty support for continuous improvement.
- 88% of faculty report at least some personal effort in program assessment.
- 68% of faculty consider their level of effort in assessment to be "about right."
- 20 25% of faculty say they have increased their personal efforts to improve their courses.



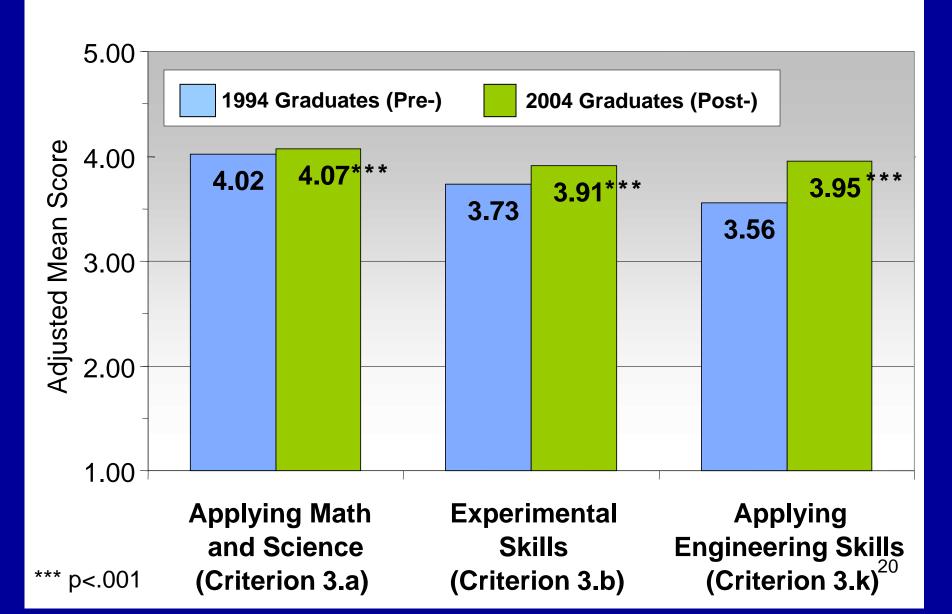
Significant Findings: Students' In- and Out-of-Class Experiences

Compared to 1994 graduates, 2004 graduates reported:

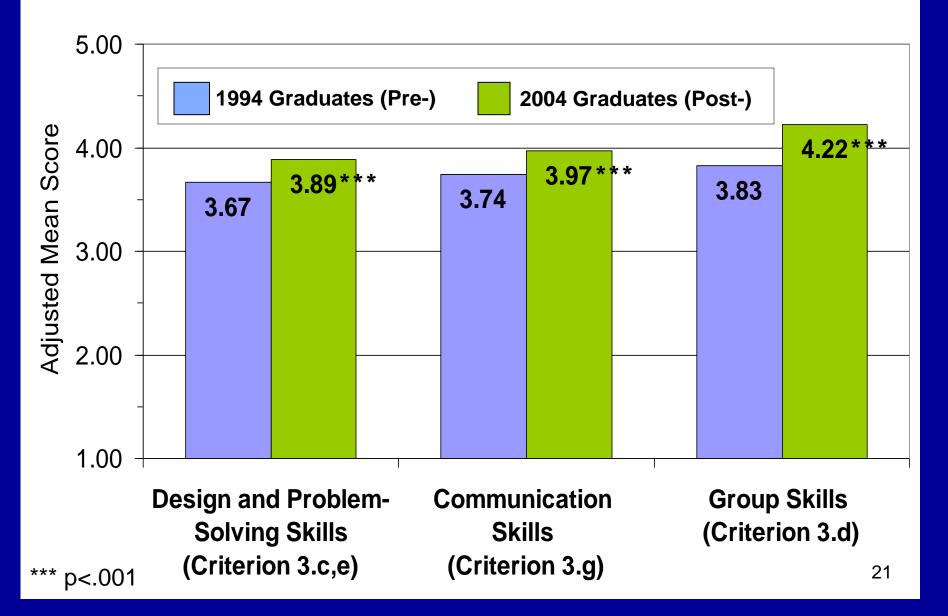
- Greater active engagement in their own learning
- More interaction with instructors
- More feedback from instructors
- More time spent in cooperative or internship experiences
- More international travel
- More involvement in engineering design competitions
- Greater emphasis on openness to new ideas and people
- Some uncertainty about changes in diversity climate.



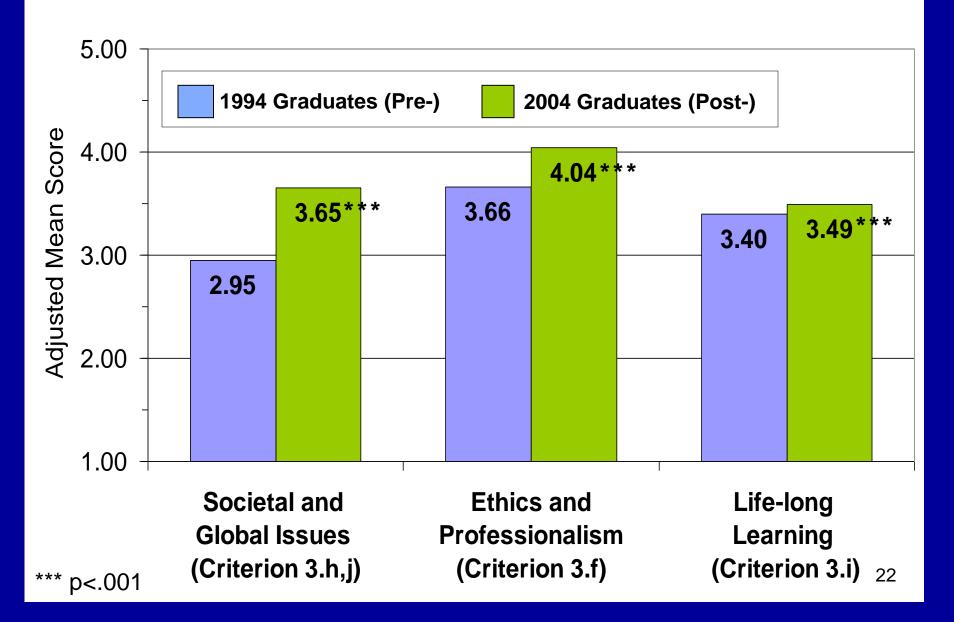
Math, Science, and Engineering Skills Cluster



Project Skills Cluster



Contexts and Professionalism Cluster

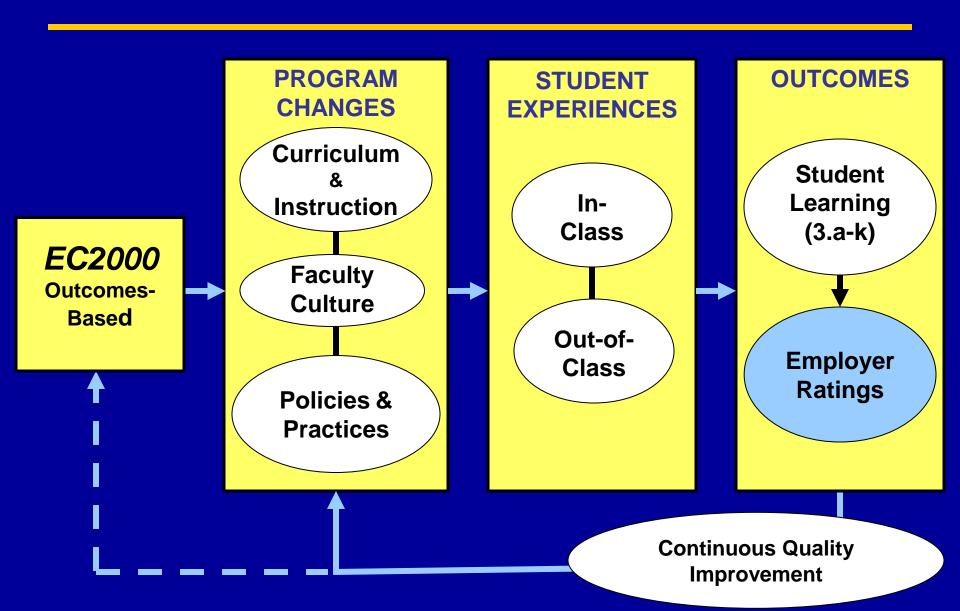


Deans' Comments

- Interviews with Deans of participating institutions resonated with many of the findings.
 - EC2000 credited with promoting good educational planning processes.
 - EC2000 "enabled" change.
 - Deans comment "...ABET is one of several important influences on curriculum, teaching, and learning in engineering programs."

Deans' Comments

- Deans rarely reported that EC2000 changed their priorities or direction.
- A few worried EC2000 might have misdirected faculty efforts.
- Many reported EC2000 increased administrative and/or faculty workloads.
- Typically, Deans reallocated existing funds for EC2000-related activities.
- Few reported EC2000 affected promotion and tenure policies.



The Employer Respondents Diversity

Industry Sectors:

- Respondents represent all 19 industry sectors
- About half work in companies engaged in manufacturing or providing scientific and technical services.

Geographic Spread:

Respondents represent all US states, territories, and 24 foreign countries.

Company Sizes:

25%
39%
24%
13%

Significant Findings: Employers

- Greatest increases seen in teamwork and communication skills and in life-long learning.
- About 1 of 4 employers report decreases in problem-solving skills and understanding of social and environmental contexts.
- Large national employers are more positive in their Pre- and Post-EC2000 ratings than are smaller local and regional employers.
- Majority of employers rate nearly all the a-k criteria as highly important or essential for new hires.

Conclusions and Implications

 America's engineers are measurably better prepared than their peers of a decade ago.

- Some differences are substantial:
 - Societal and Global Issues
 - Applying Engineering Skills
 - Group Skills
 - Ethics and Professionalism
- Reported decreases in technical skills areas from some faculty and employers may suggest where more work needs to be done.

Conclusions and Implications

25% of the employers also report decreases in problem-solving skills...but 75% report recent graduates adequately or well-prepared in problemsolving.

Fewer employers than faculty report decreases in abilities to apply math, science, and technical skills.

More than 90% report recent graduates adequately or well-prepared to apply math, science and technical skills.

Thank you on Behalf of





