A Longitudinal Study of the ABET Outcomes-Based Accreditation Model

INQAAHE Madrid 2011

PENNSTATE

Center for the Study of Higher Education

ABET

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

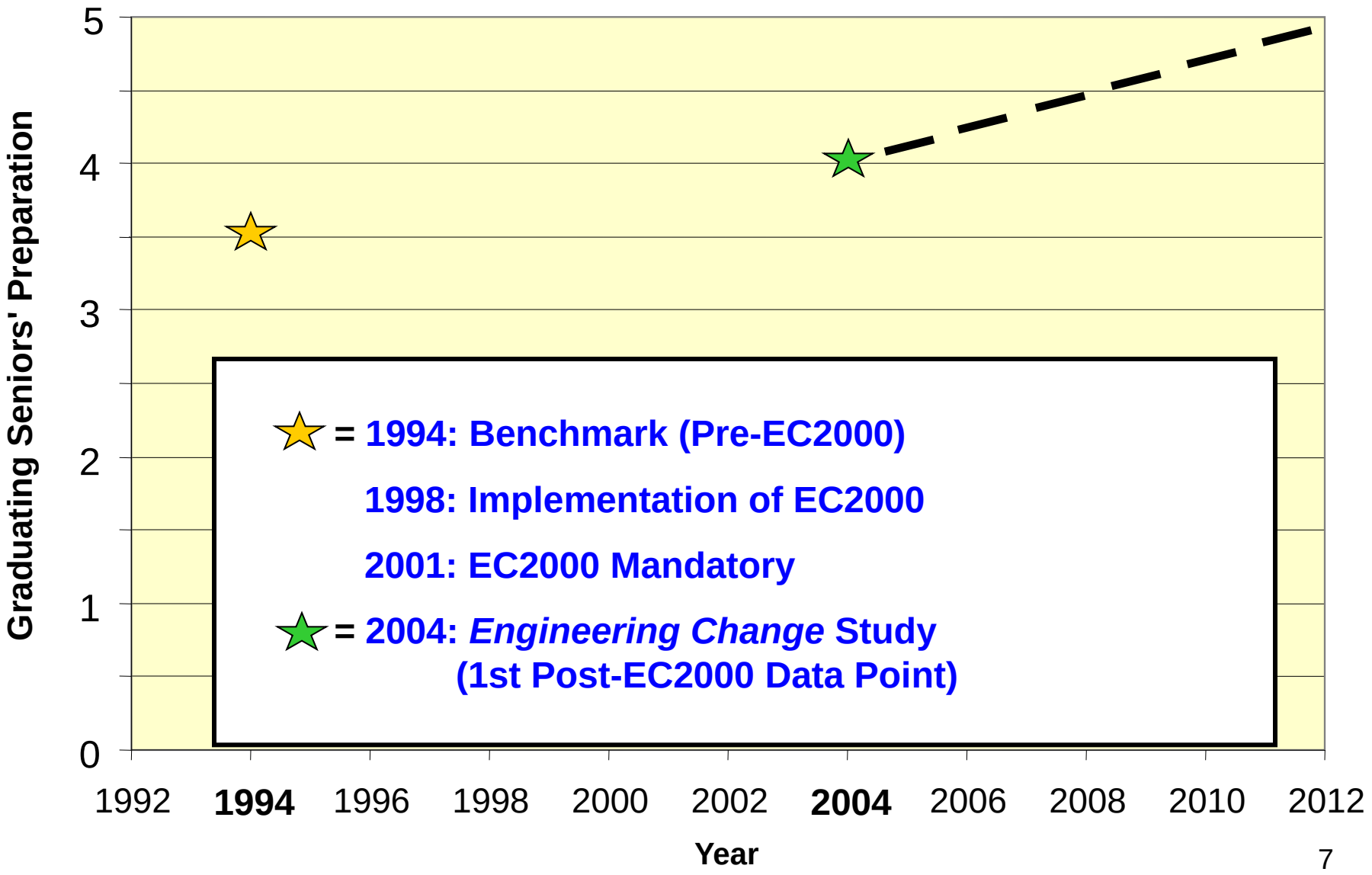
i. A recognition of the need for and an ability to engage in life-long learning

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



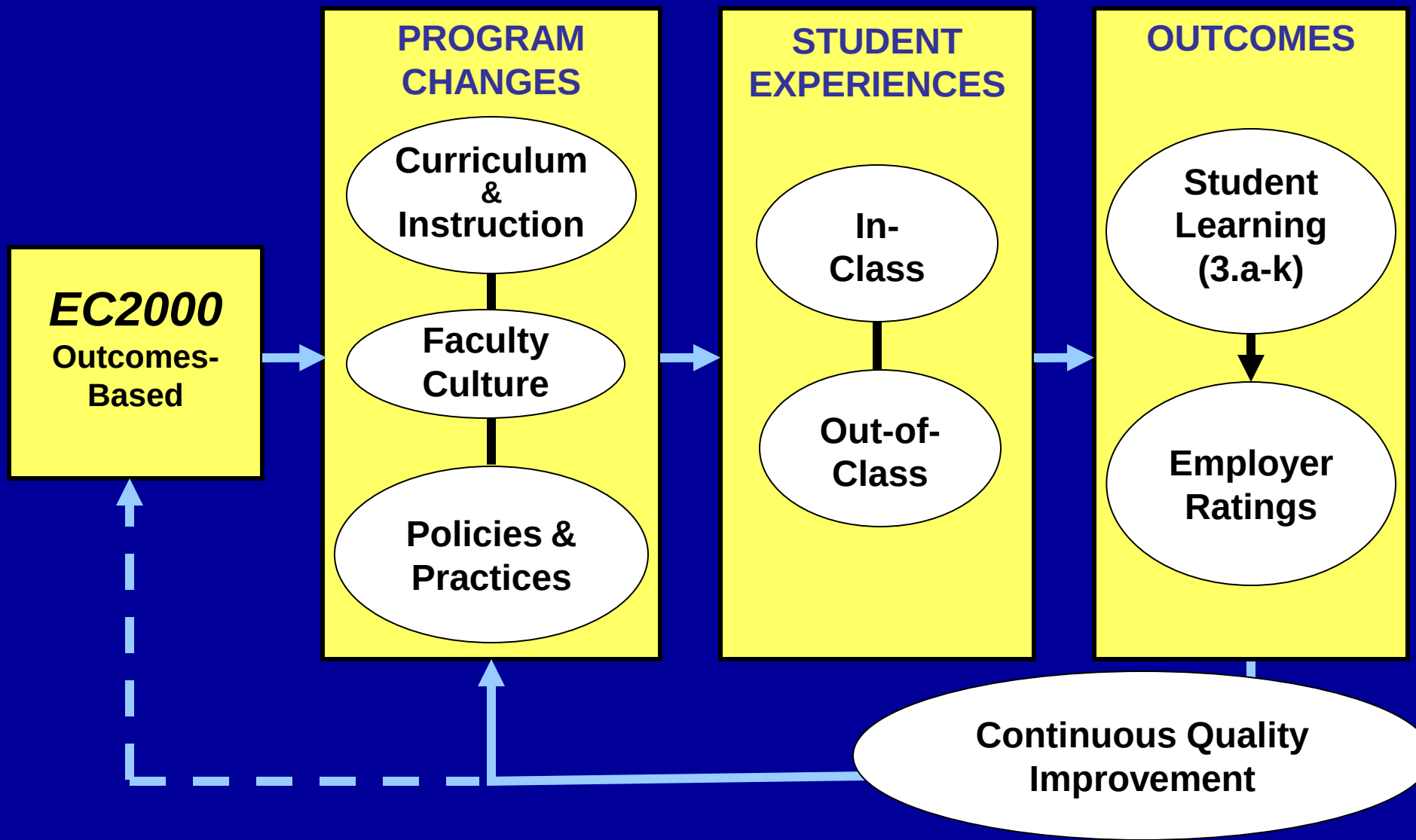
Key Questions

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?

The Longitudinal Study

Studying the Impact of EC2000



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

Participating Institutions: Doctoral

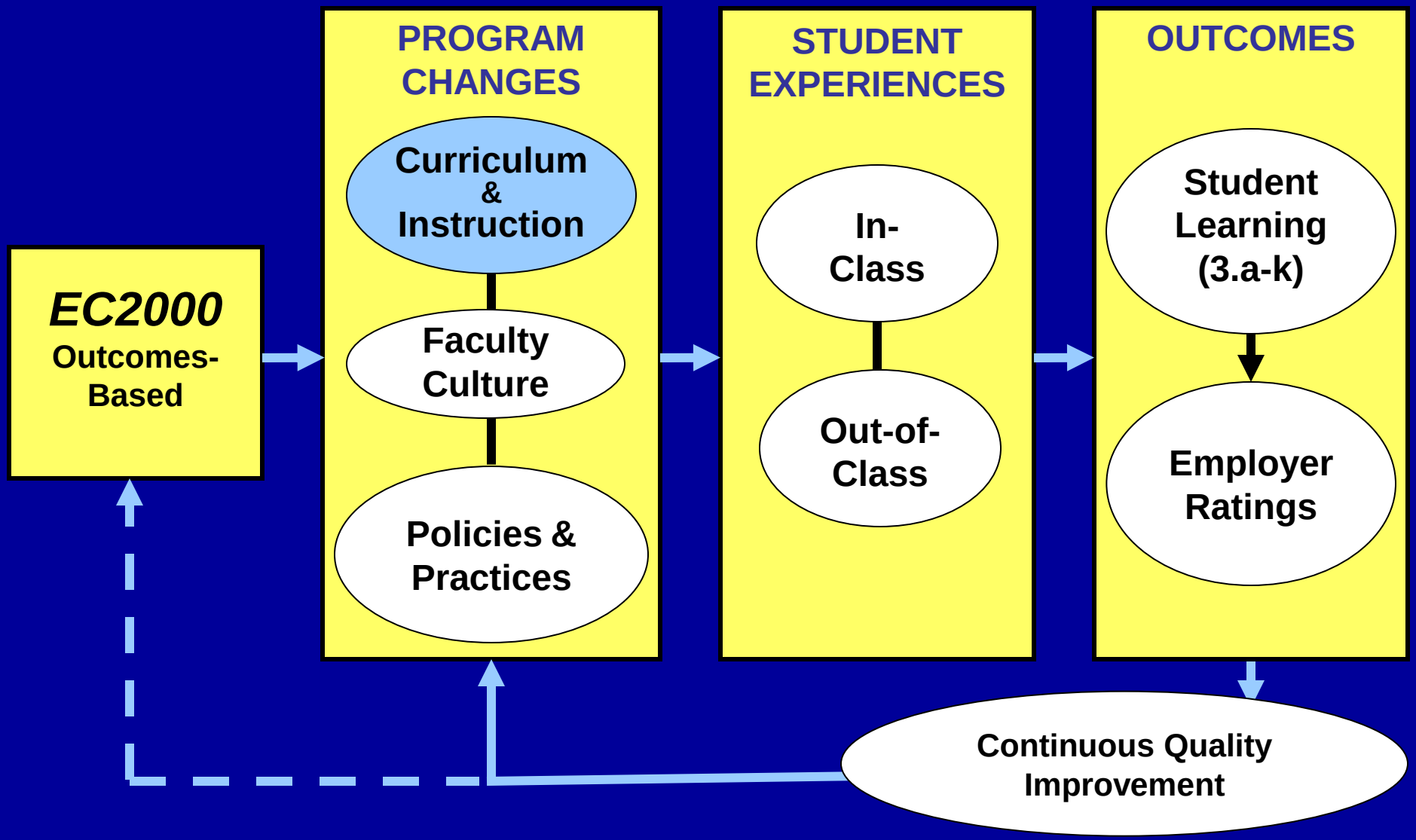
Arizona State University
Case Western
Clemson University
Cornell University
Georgia Tech
Howard University
Illinois Institute of Tech.
Iowa State University
Lehigh University
Marquette University
MIT
Ohio State University
Princeton University
Purdue University
Syracuse University
Temple University
Texas 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	Bachelor's and Others
Cal. Polytechnic, Pomona	South Dakota School of Mines
Cal. State, Sacramento	Tri-State University
Embry-Riddle, Daytona	Union College
North Carolina A & T	United States Military Academy
Tuskegee University	
Youngstown State Univ.	

The Longitudinal Study

Studying the Impact of EC2000



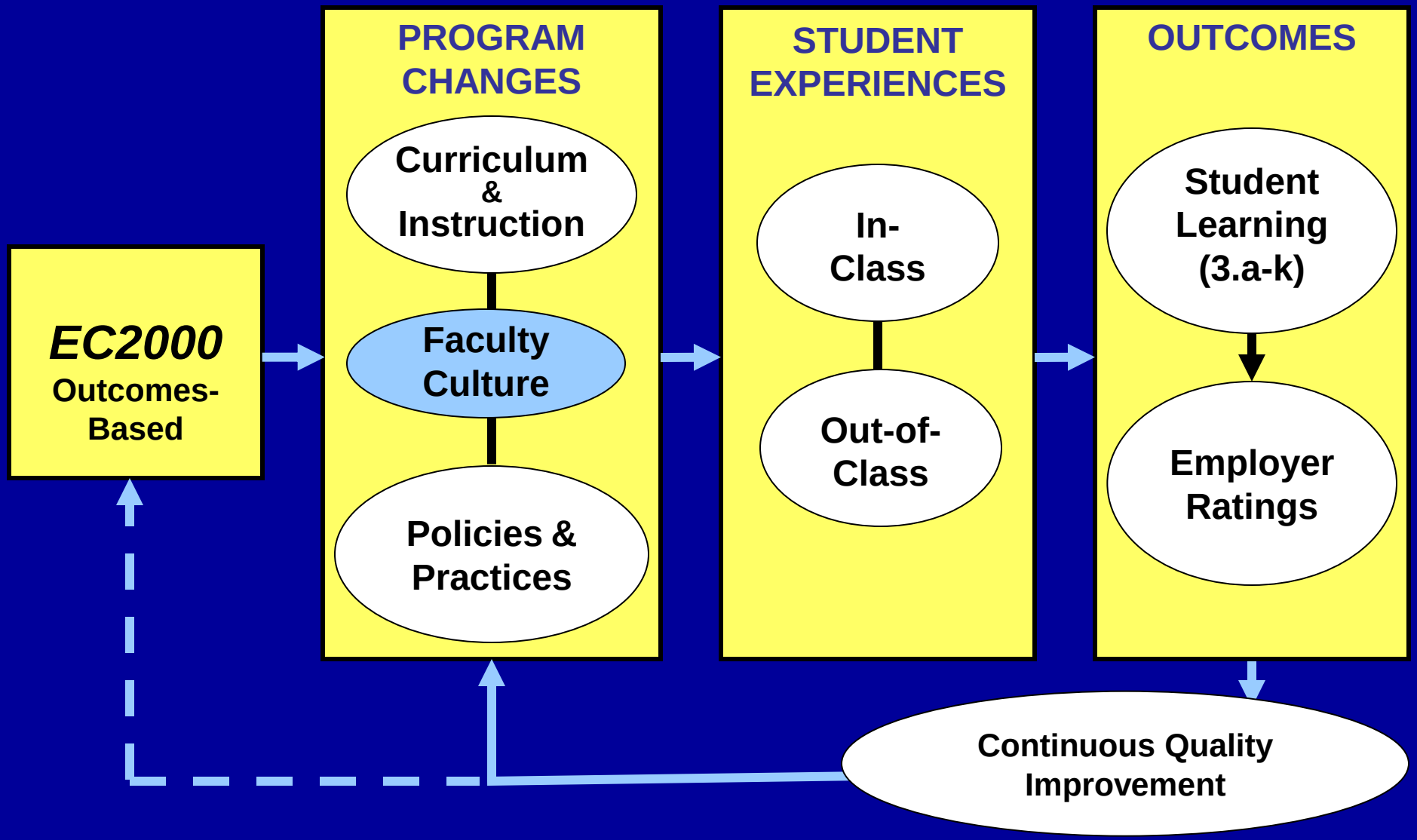
Significant Findings: Curriculum and Instruction at Course Level

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.

The Longitudinal Study

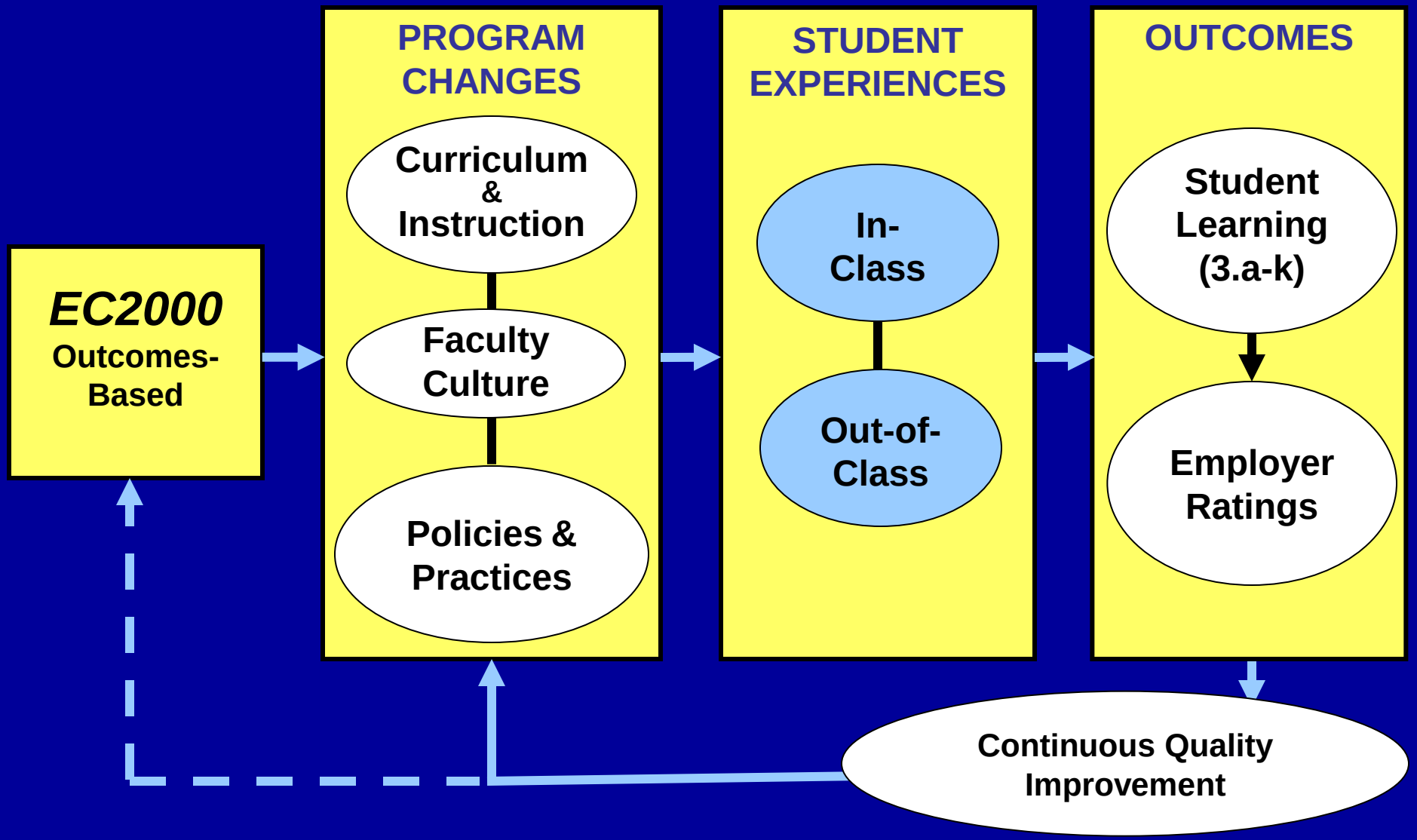
Studying the Impact of EC2000



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.

The Longitudinal Study
Studying the Impact of EC2000

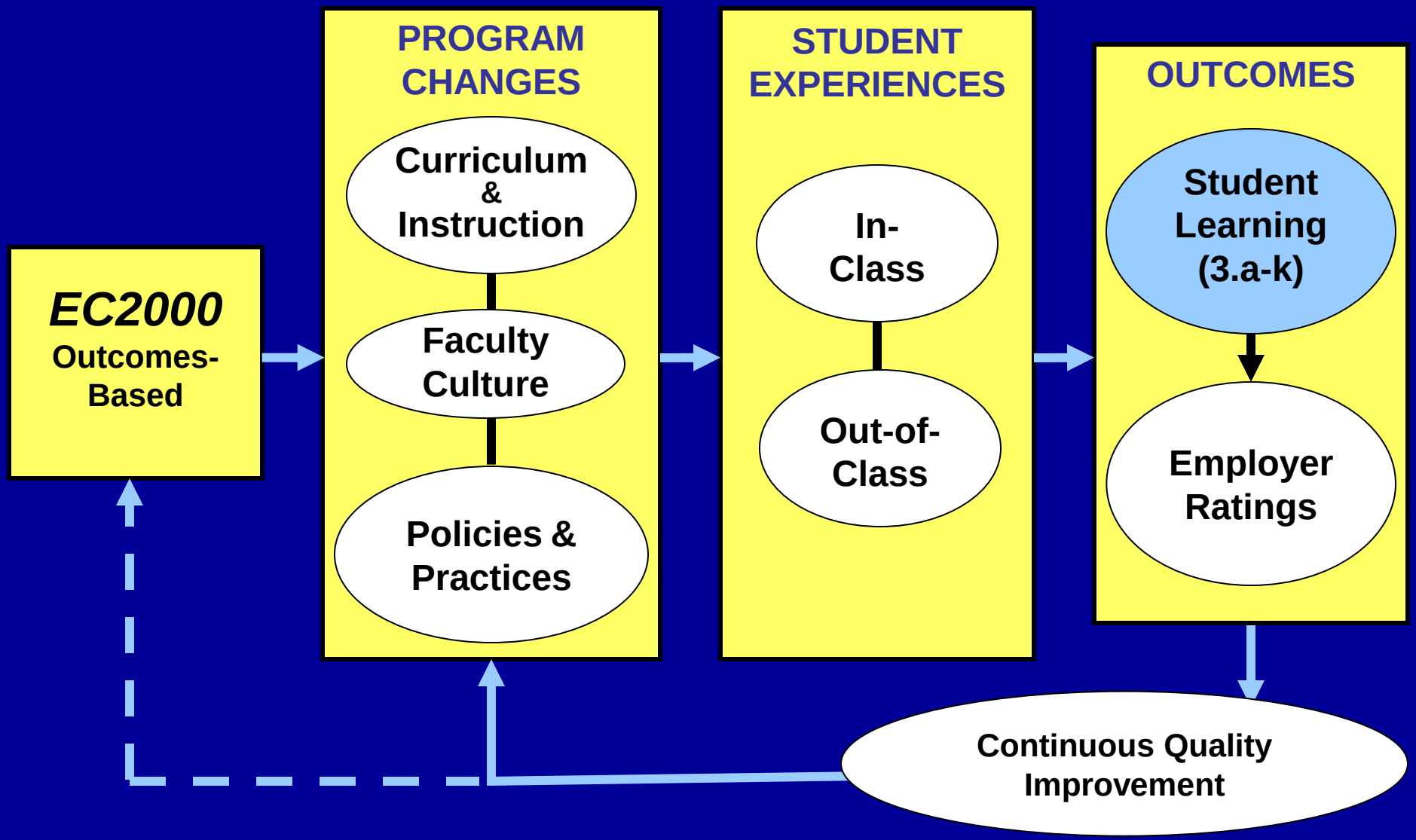


Significant Findings: Students' In- and Out-of-Class Experiences

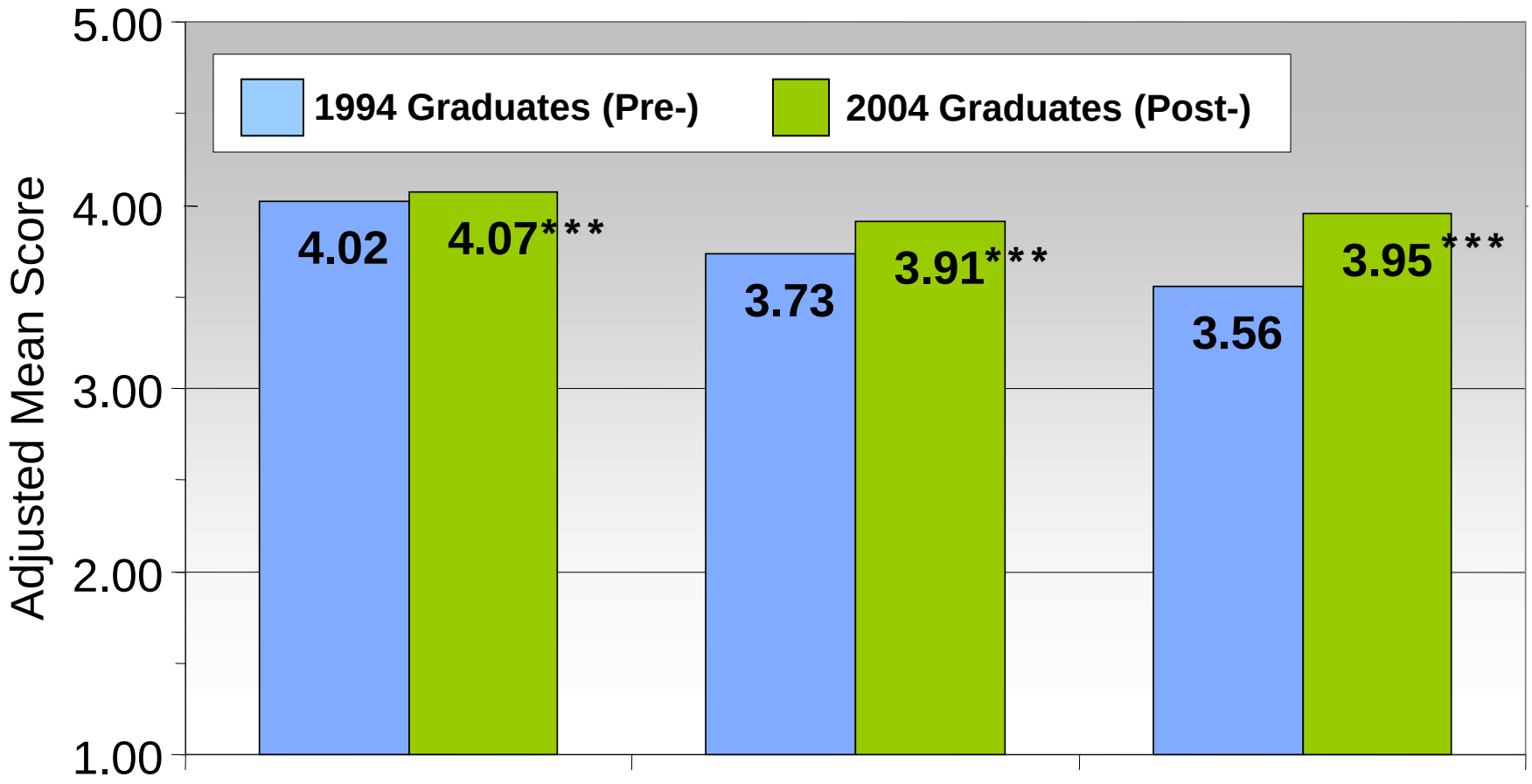
Compared to 1994 graduates, 2004 graduates reported:

- 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.

The Longitudinal Study
Studying the Impact of EC2000

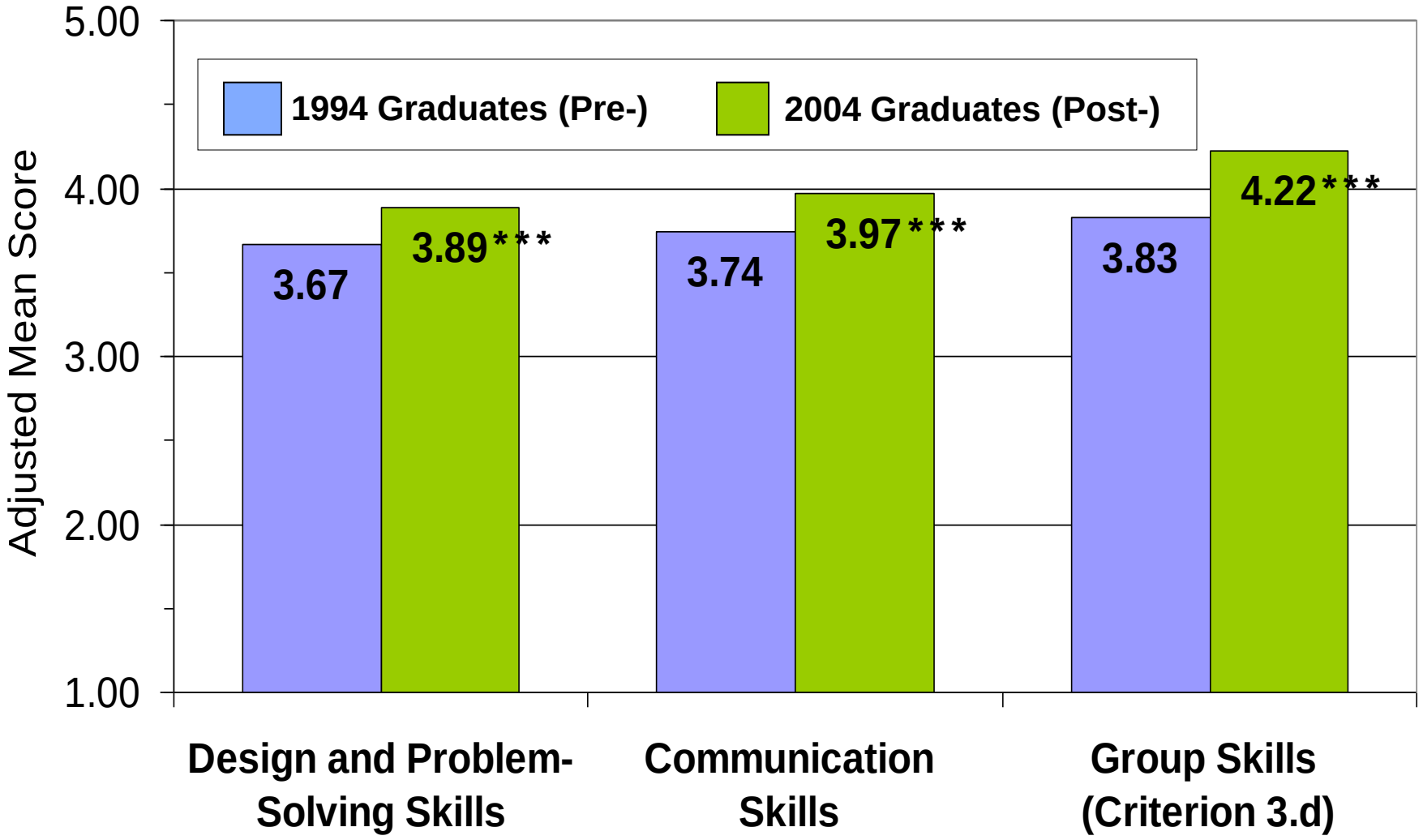


Math, Science, and Engineering Skills Cluster



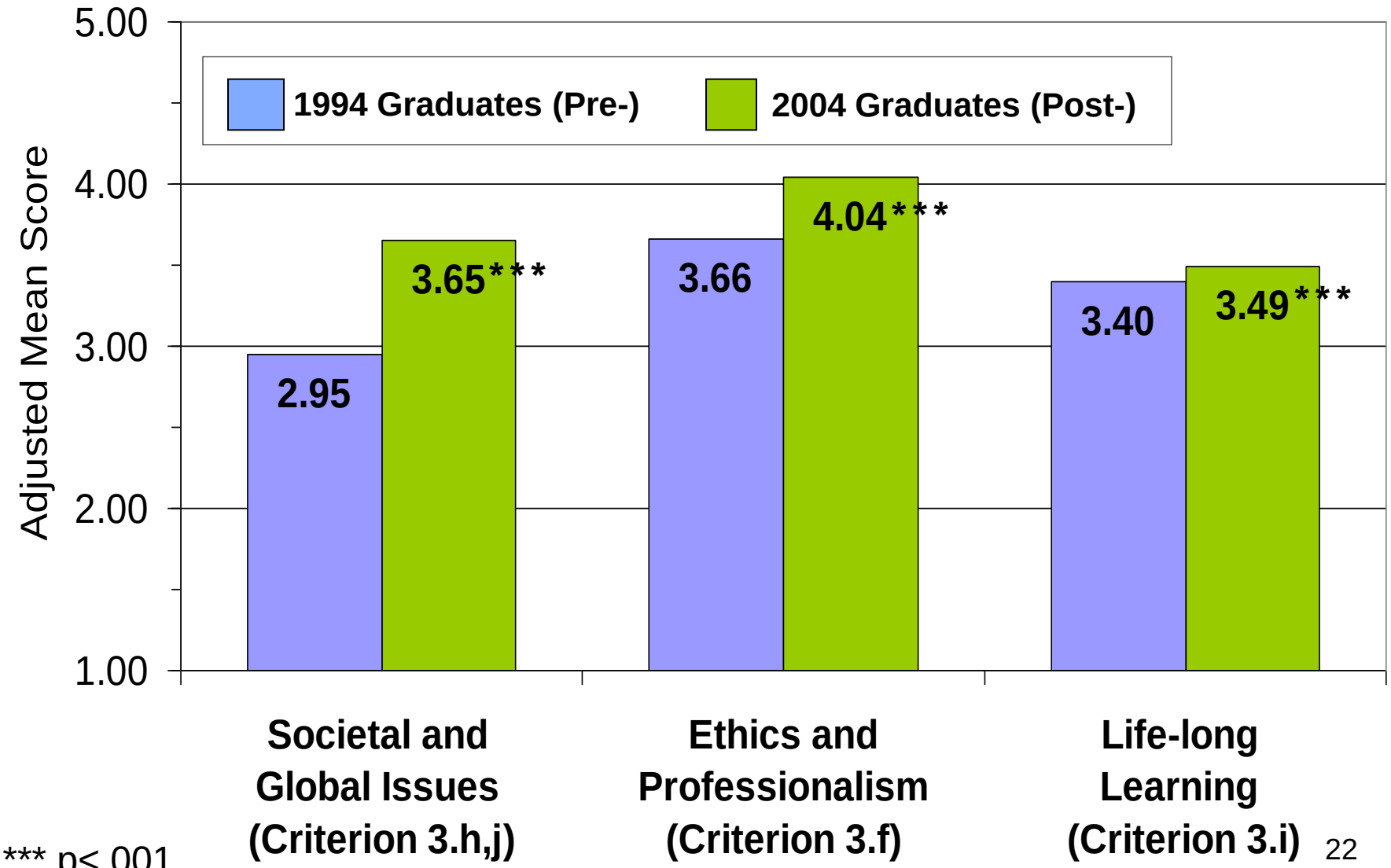
*** p<.001

Project Skills Cluster



*** p<.001

Contexts and Professionalism Cluster



*** p<.001

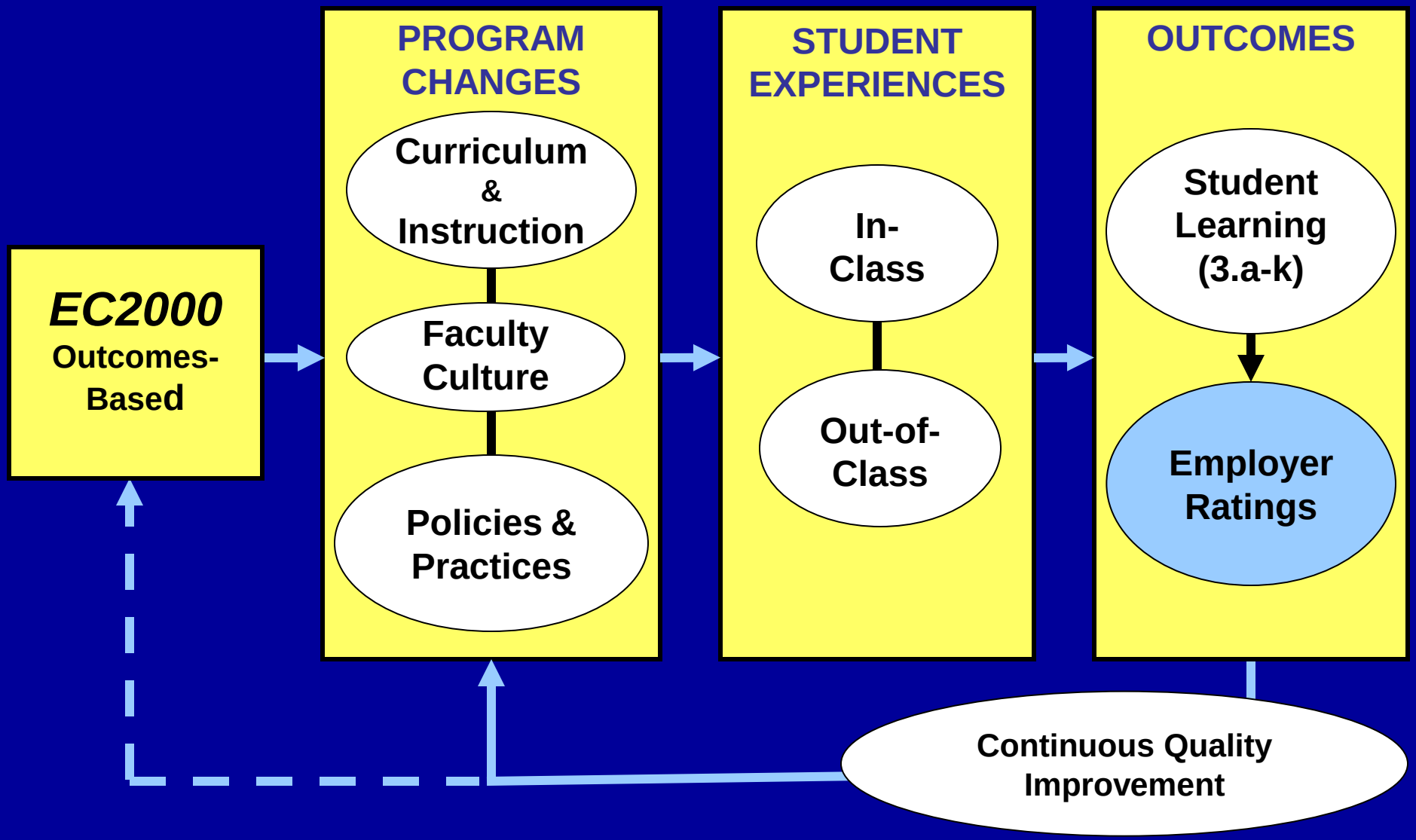
Deans' Comments

- 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 Longitudinal Study
Studying the Impact of EC2000



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:

Less than 50 employees	25%
50-499	39%
500-3,000	24%
More than 3,000	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 problem-solving.
- 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

PENNSTATE

Center for the Study of Higher Education

ABET