Assessment Tools Used to Enhance the Mechanical Engineering Curriculum on a Continuing Basis

Darrell W. Guillaume, Ph.D., P.E.
Associate Professor
Department of Mechanical Engineering
California State University, Los Angeles

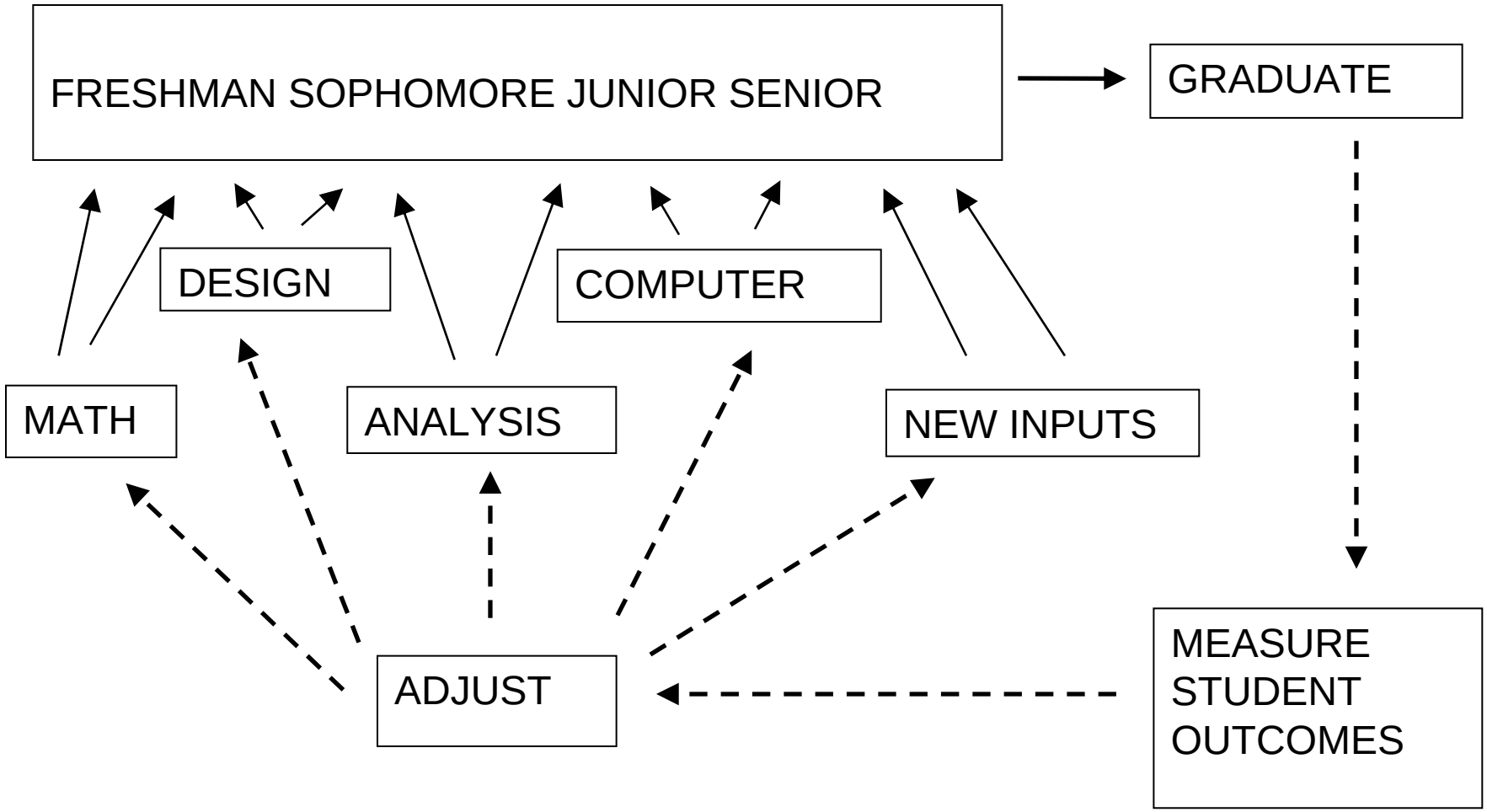
February 27, 2006
Best Assessment Processes VIII
Rose-Hulman Institute of Technology
Terre Haute, Indiana

Assessment Process

Evaluation versus Assessment

- Evaluation
  - Performance is measured
  - A score or label is assigned
  - Judgment is rendered (comparison with others)
  - Praise or condemnation ensues
- Assessment
  - Performance is measured
  - Comparison is made with past results
  - Improvement is made (key: continuous Improvement)

Assessment Model



Student Learning Outcomes

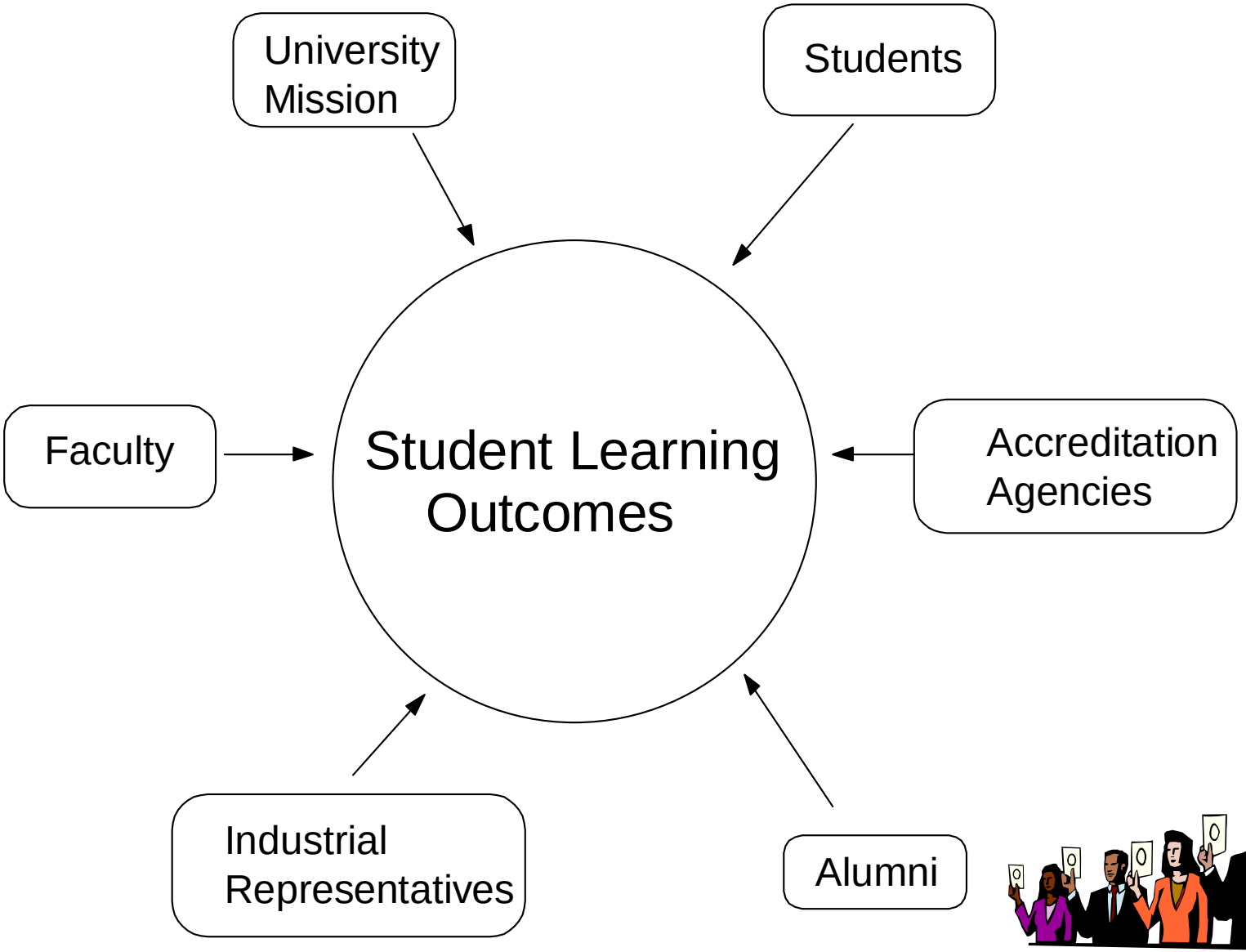
- Student learning outcomes are defined in terms of the
  - knowledge
  - skills
  - and attitudes

  that students have attained as a result of their involvement in a particular curriculum
- They must be specific and measurable

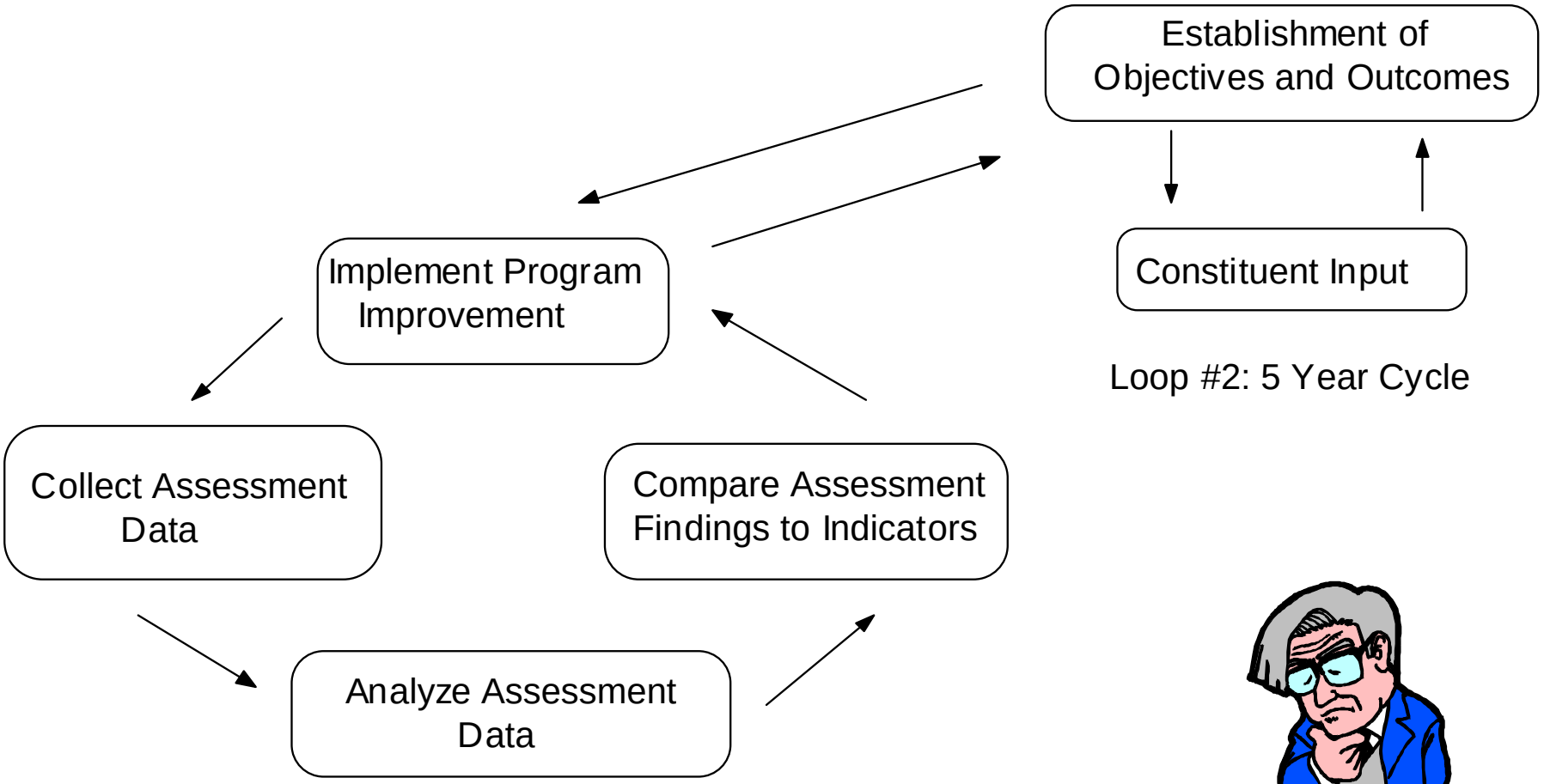
CSULA's Format

- Objective statement about knowledge
  - Knowledge outcome #1
  - Knowledge outcome #2
- Objective statement about skills
  - Skills outcome #1
  - Skills outcome #2
- Objective statement about attitudes
  - Attitude statement #1
  - Attitude statement #2

Constituents



The On-Going Process



Yearly Cycle

Data Collection and Analysis

Needs to be able to withstand external scrutiny

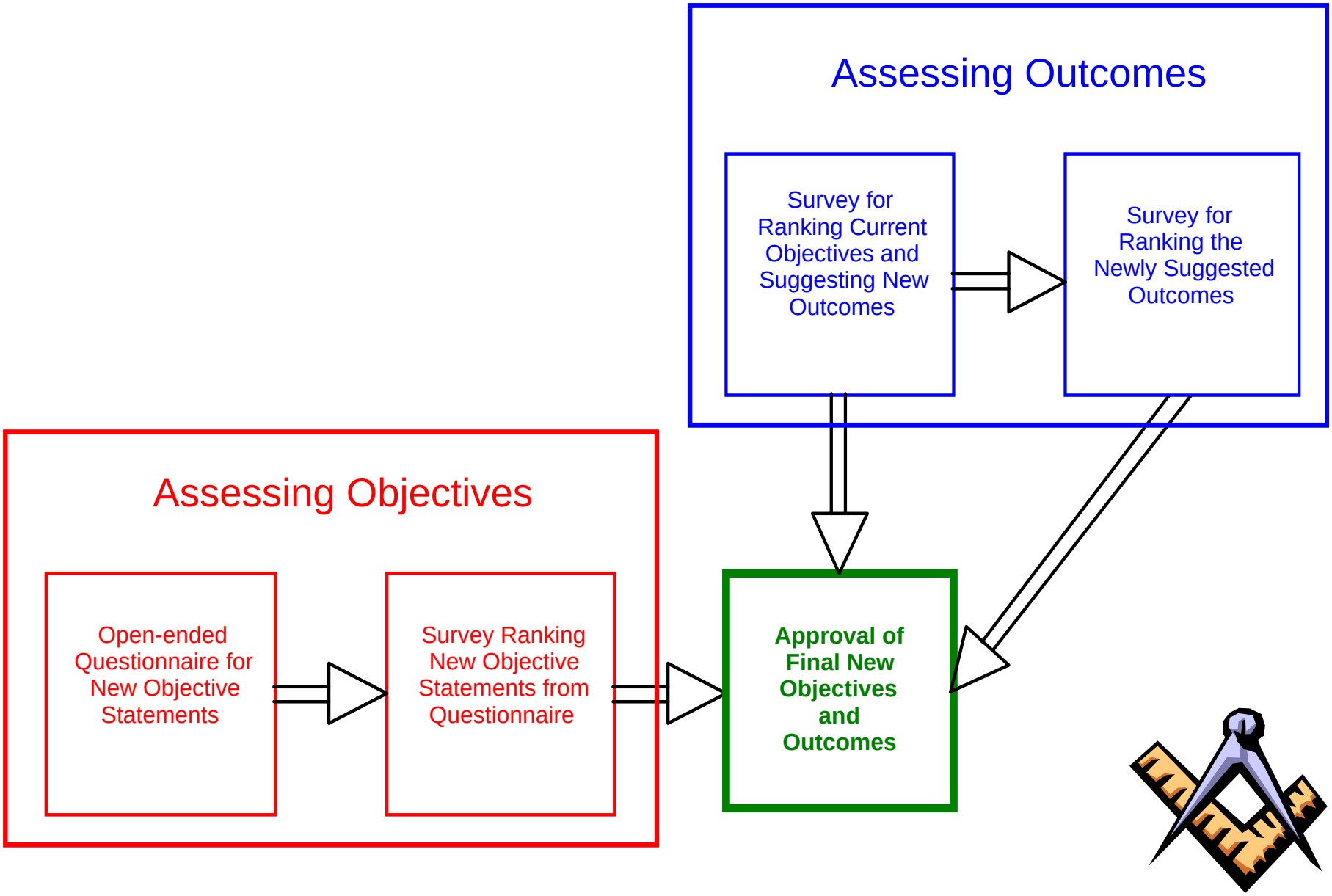
Assessment

Program strengths
1.
2.
3.
Program areas for improvement
1.
2.
3.

Improvement

Program changes for continuous improvemer

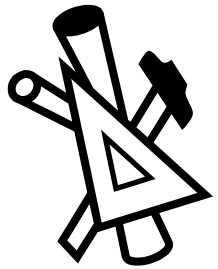
Five-Year Cycle

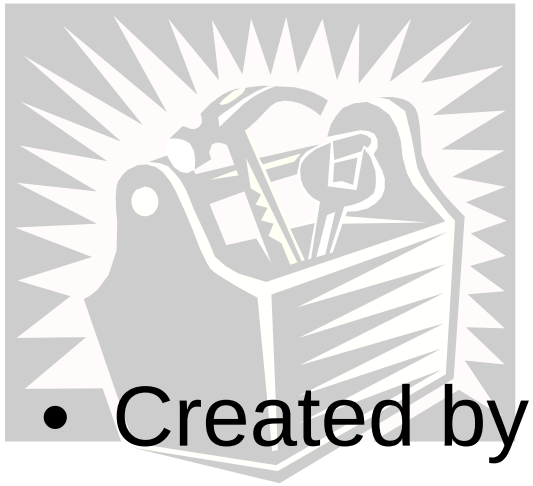


Assessment Tools

Measurement Tools

- Surveys
- Collection and presentation of sample work
- Exams and tests
- Capstone course experience



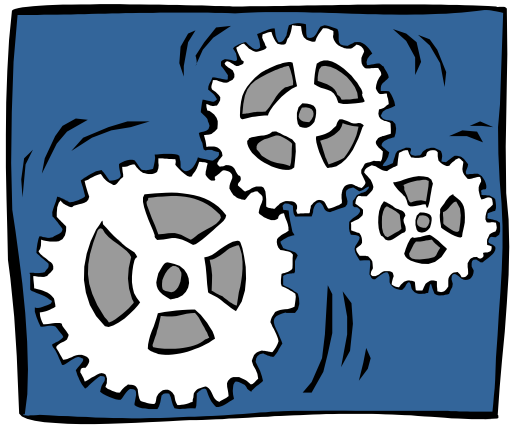


Surveys

- Created by faculty
  - Better tailored to fit needs
  - Could have some bias or other flaws
  - Faculty has to process data
- Purchased from vendor
  - General questions
  - Data are processed when delivered

Created by Faculty

- For each outcome we asked:
  - Student performance
  - Outcome importance
- Target
  - Faculty
  - Students
  - Industry
  - Alumni



- We attempted alumnus-employer link

Sample Survey Created by Faculty

important not important	**1 is very important - 5 is not important** How important are the following attitudes to employers of new engineering graduates	**(1 is agree …….. 5 disagree)** How well is CSULA doing in providing graduates that have the following:	outstanding poor
	<u>Attitudes</u>		
1 2 3 4 5 NA	1. An understanding of professional and ethical responsibility.		1 2 3 4 5 NA
1 2 3 4 5 NA	2. A Recognition of the need for life-long learning.		1 2 3 4 5 NA
1 2 3 4 5 NA	3. An understanding of responsibility and accountability.		1 2 3 4 5 NA
1 2 3 4 5 NA	4. A desire to be a professional that exhibits values, dedication, and a need for continual improvement.		1 2 3 4 5 NA
1 2 3 4 5 NA	5. A desire to be a flexible and adaptable team player.		1 2 3 4 5 NA

Alumnus-Employer Link

- Plan was to contact alumni
  - ask for their supervisor's name and permission to contact
  - Send supervisor a survey
- Not a successful tool
  - Most alumni said no (too threatening)
  - Most supervisors said no (concern about the legal ramifications of an assessment of an employee shared with a third party)

Purchased from Vendor

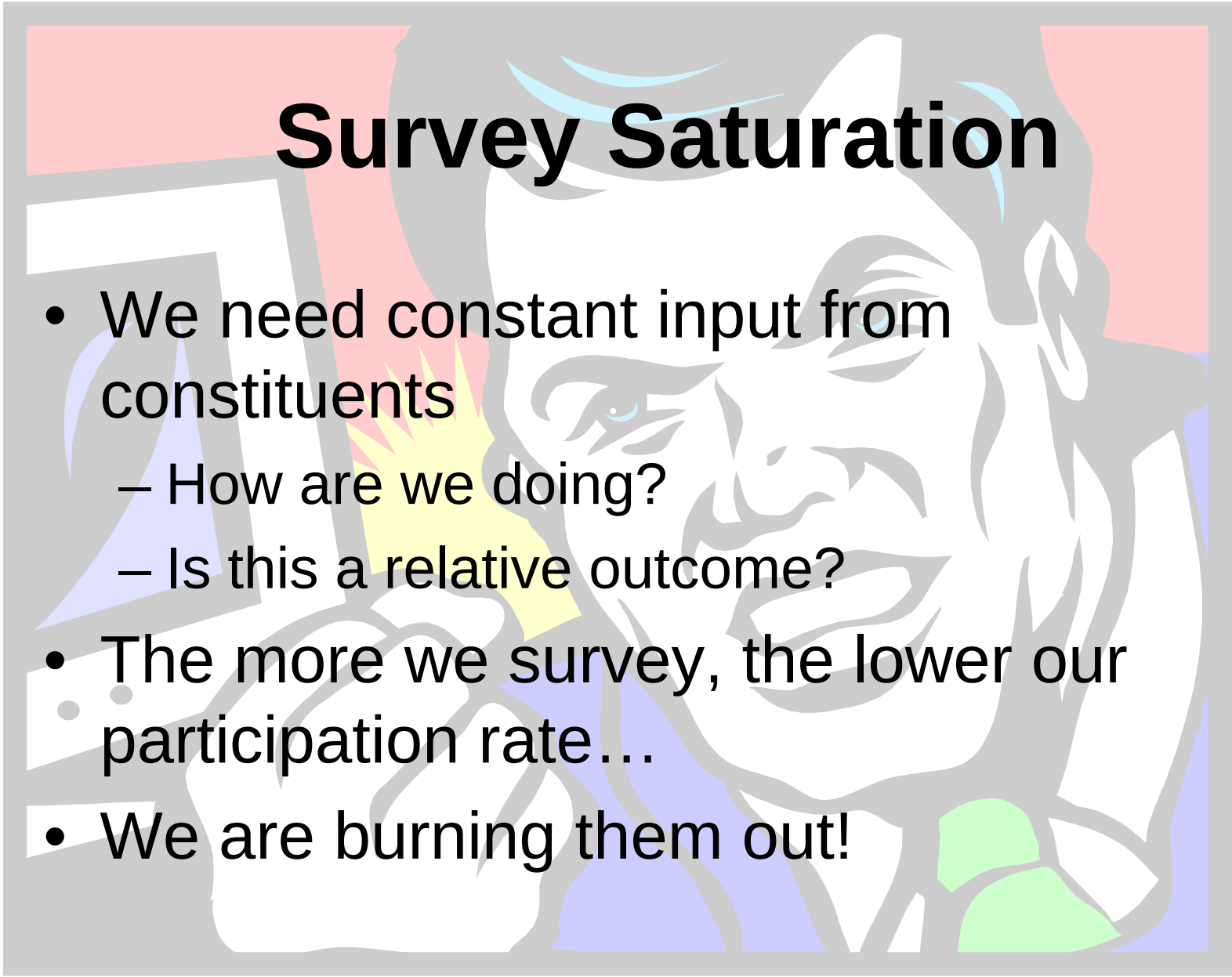
EBI: Engineering Benchmark Inc

- Questions directed at engineering outcomes (see survey)
- Survey can be customized with program specific questions
- Allows you to pick 6 other schools and compare results

EBI Participants for 2004

- Auburn University
- Boston University
- Bucknell University
- **California State University-Los Angeles**
- California State University-Northridge
- Carnegie Mellon University
- Christian Brothers University
- Columbia University
- Dartmouth College
- Duke University
- Florida Atlantic University
- Geneva College
- George Mason University
- Gonzaga University
- Grove City College
- Kettering University
- Louisiana State University
- Loyola Marymount University
- Northeastern University
- Northwestern University
- Old Dominion University
- Prairie View A & M University
- Rice University
- Santa Clara University
- Smith College
- Stevens Institute of Technology
- Syracuse University
- Texas A & M University-Kingsville
- Texas Christian University
- The University of Texas at Austin
- The University of Vermont
- Universidad de Monterrey
- University of Alabama
- University of Arkansas
- University of California-Riverside
- University of Connecticut
- University of Dayton
- University of Delaware
- University of Houston
- University of Illinois at Chicago
- University of Kansas
- University of Missouri-Columbia
- University of New Orleans
- University of Notre Dame
- University of Rochester
- University of Southern California
- University of Texas at Dallas
- University of Toledo
- University of Utah
- University of Virginia
- University of Wisconsin-Madison
- Vanderbilt University
- Villanova University
- Walla Walla College
- Youngstown State University

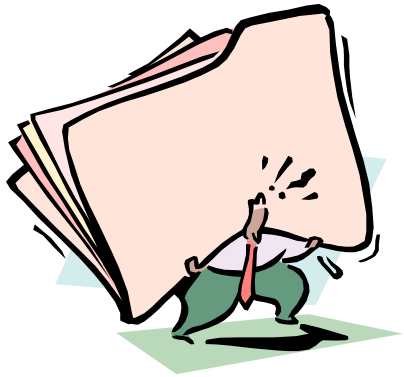
Survey Saturation



- We need constant input from constituents
  - How are we doing?
  - Is this a relative outcome?
- The more we survey, the lower our participation rate…
- We are burning them out!

Collection/Presentation of Sample Work

- Student work to be evaluated by constituents
- Web based portfolio (Webfolio)
  - Resume
  - Essay on contemporary issues
  - Essay on lifelong learning
  - Sample lab report
  - Abstract from senior design project

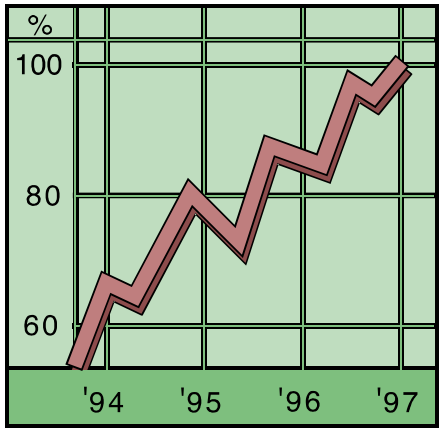


Webfolio

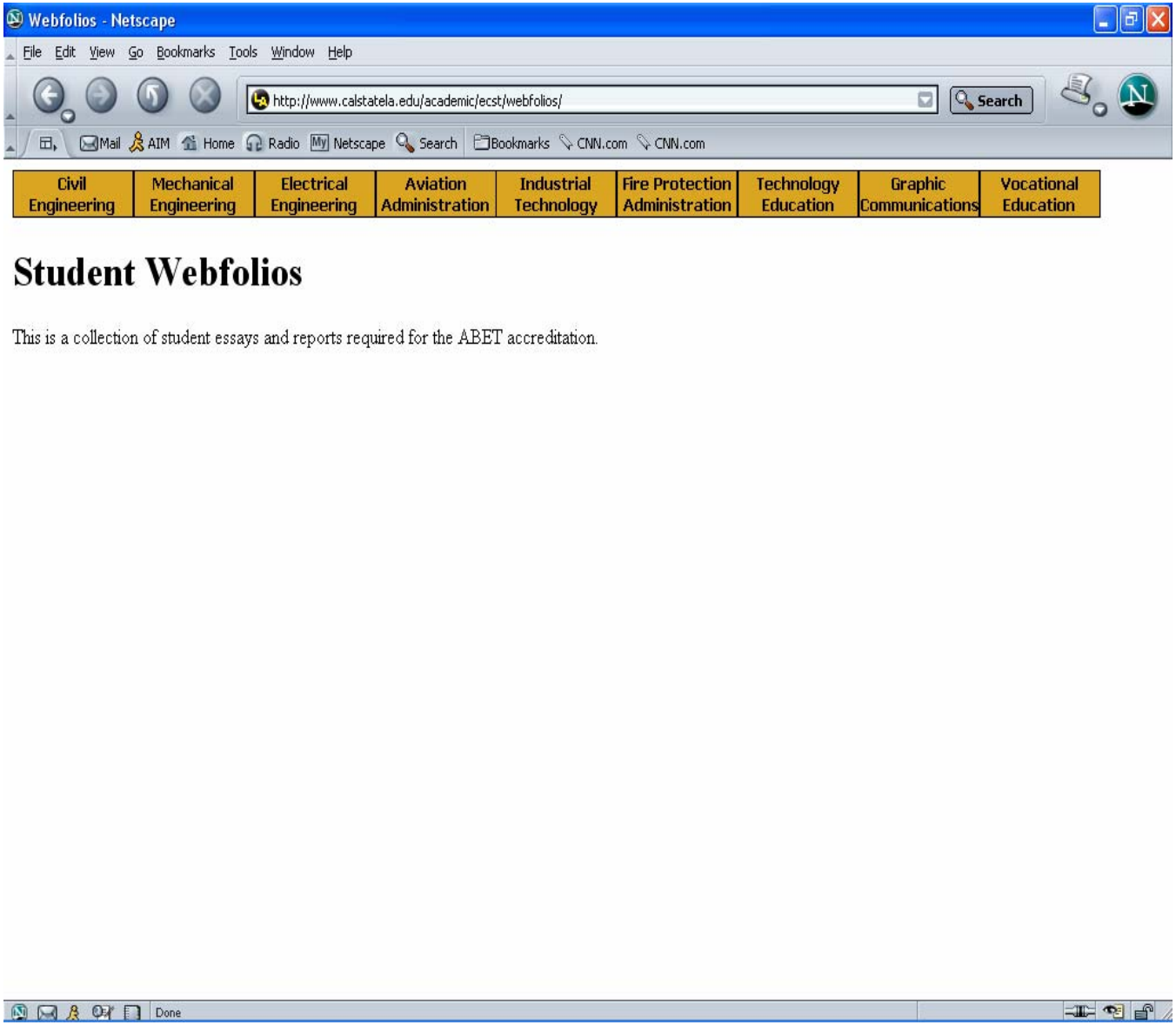
- Website sent to constituents

http://www.calstatela.edu/academic/ecst/webfolios/

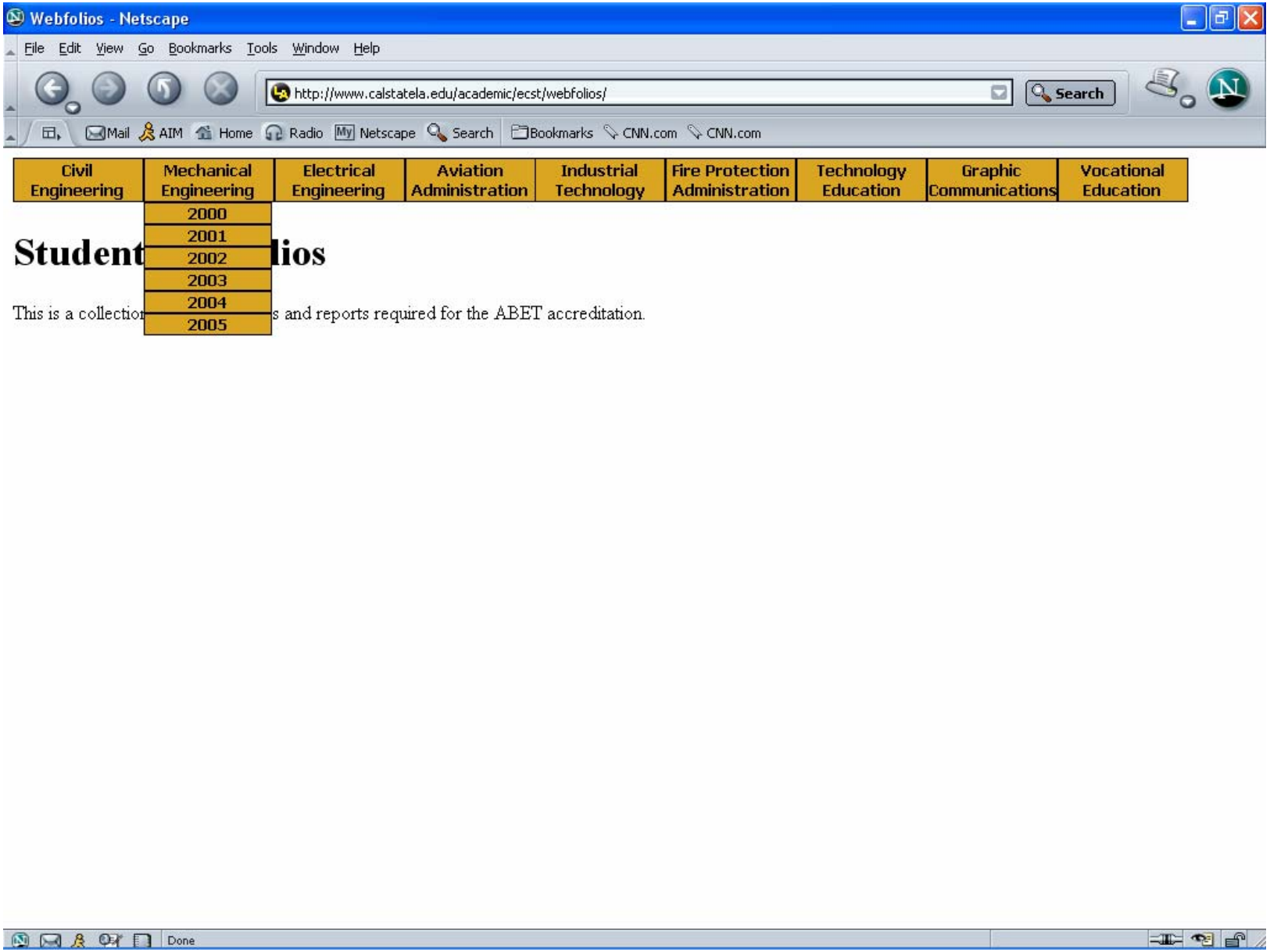
- Password provided
- Assessment rubric included



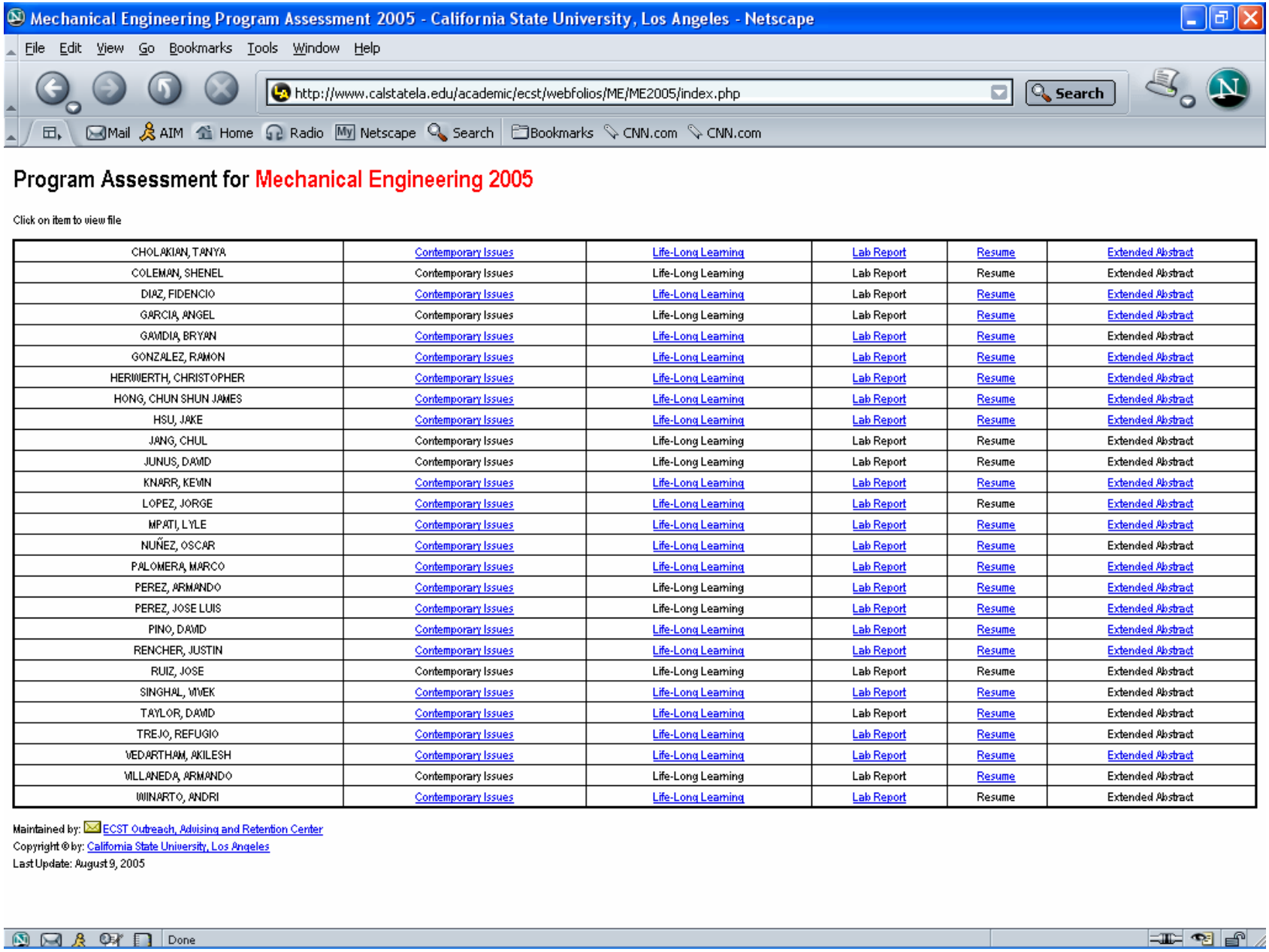
Screen-Capture #1



Screen-Capture #2



Screen-Capture #3



Program Assessment for Mechanical Engineering 2005

Click on item to view file

CHOLAKIAN, TANYA	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
COLEMAN, SHENEL	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
DIAZ, FIDENCIO	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
GARCIA, ANGEL	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
GAMDIA, BRYAN	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
GONZALEZ, RAMON	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
HERWERTH, CHRISTOPHER	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
HONG, CHUN SHUN JAMES	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
HSU, JAKE	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
JANG, CHUL	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
JUNUS, DAMD	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
KNARR, KEVIN	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
LOPEZ, JORGE	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
MPATI, LYLE	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
NUÑEZ, OSCAR	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
PALOMERA, MARCO	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
PEREZ, ARMANDO	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
PEREZ, JOSE LUIS	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
PINO, DAVID	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
RENCHER, JUSTIN	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
RUIZ, JOSE	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
SINGHAL, VIVEK	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
TAYLOR, DAVID	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
TREJO, REFUGIO	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
VEDARTHAM, AKILESH	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
VILLANEDA, ARMANDO	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract
WINARTO, ANDRI	Contemporary Issues	Life-Long Learning	Lab Report	Resume	Extended Abstract

Maintained by: ECST Outreach, Advising and Retention Center
Copyright © by: California State University, Los Angeles
Last Update: August 9, 2005

Exams and Tests

Direct assessment (indirect are surveys)

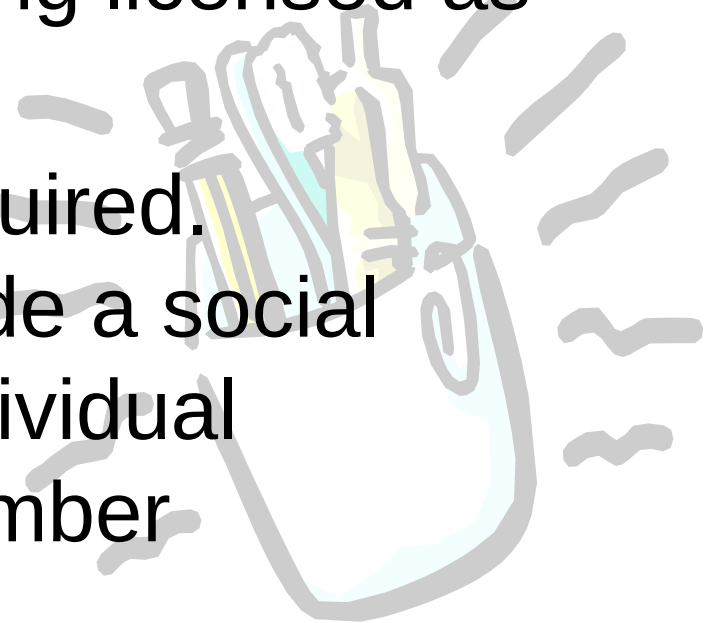
- Course exams
- Prerequisite examinations
- Engineering-in-Training Exam (F.E.)
  - Externally controlled
  - Nationally normed

Prerequisite Examinations

- Not a successful tool
- Purpose was to test students' knowledge of prior completed courses at the beginning of the subsequent course
- Very threatening to faculty

Engineering-in-Training Exam

- Certification as an Engineer-in-Training (EIT) is the first step required under State law toward becoming licensed as a professional engineer
- U.S. citizenship is not required. However, you must provide a social security number or an individual taxpayer identification number

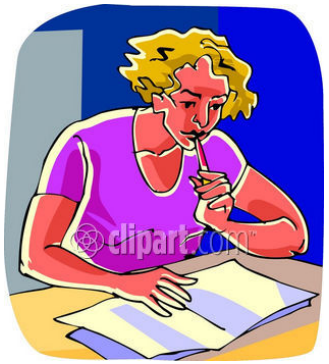


EIT Requirements

- Three years of course work in an ABET-approved engineering curriculum

OR

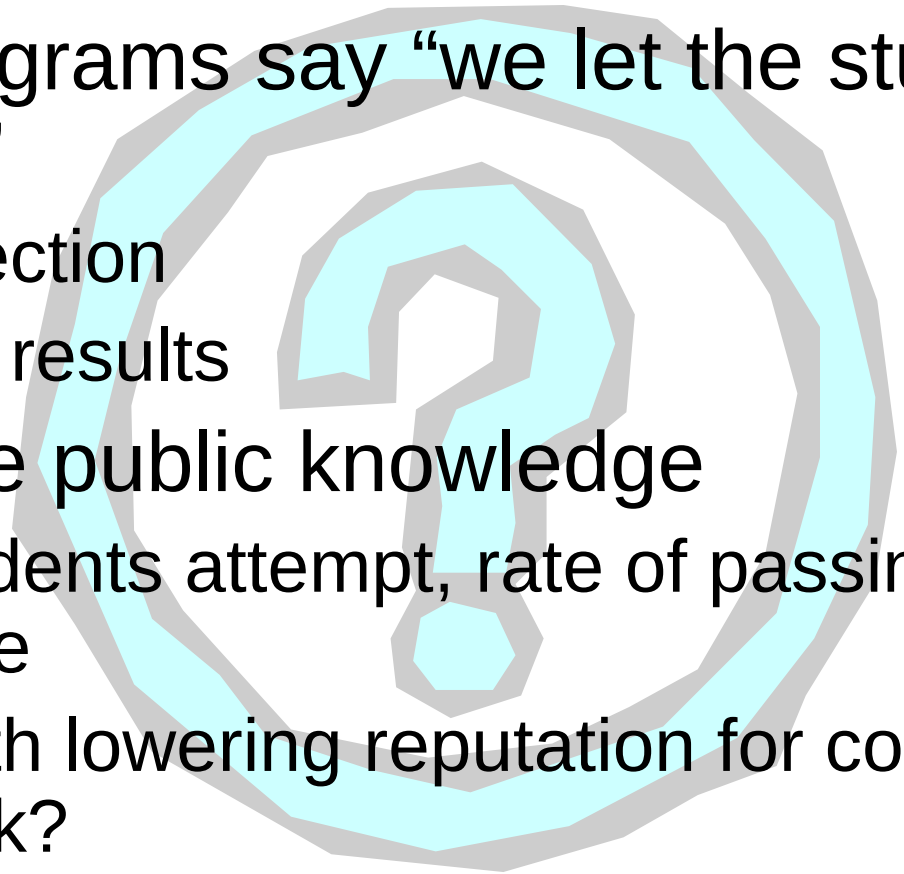
- Three years or more of engineering-related work experience anywhere in the world



EIT Scope

- Exam covers fundamental engineering subjects including mathematics and the basic sciences
- Two sessions: four-hour morning and four-hour afternoon
- In the morning, all examinees answer the same 120 questions covering the breadth of knowledge in engineering
- In the afternoon, examinees choose one of seven subject areas

Who Should Take It?

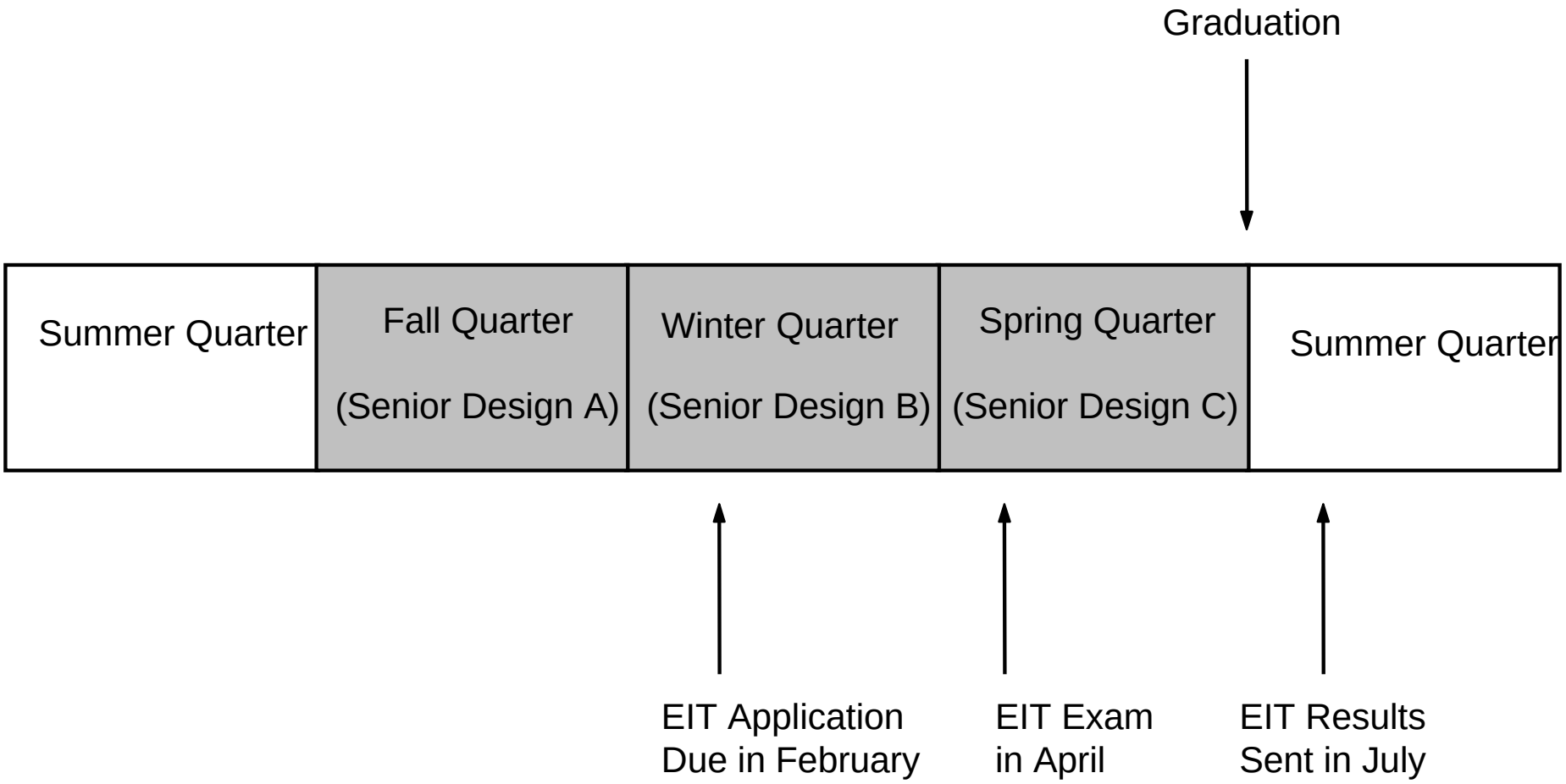


- Many programs say “we let the students decide…”
  - Self selection
  - Skewed results
- Result are public knowledge
  - If all students attempt, rate of passing will decrease
  - Is it worth lowering reputation for concrete feedback?

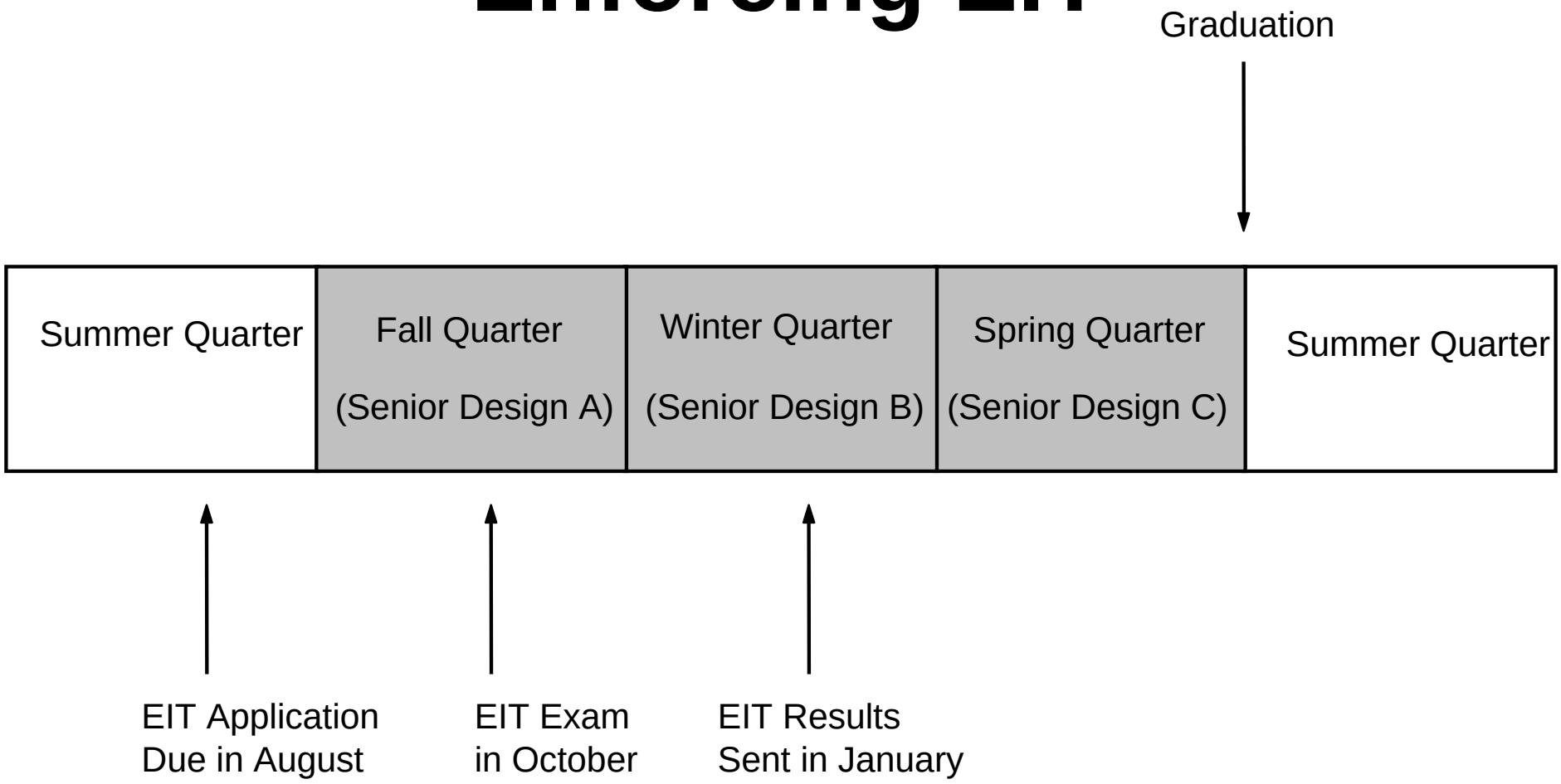
Implementation of EIT

- How do we make it required?
  - Students will not attempt without motivation
  - Required during the capstone (senior design) course
- How do we entice students to take it seriously?
  - Effort to do well will be reflected in scores
  - Reimburse students who pass

First Attempt at Enforcing EIT

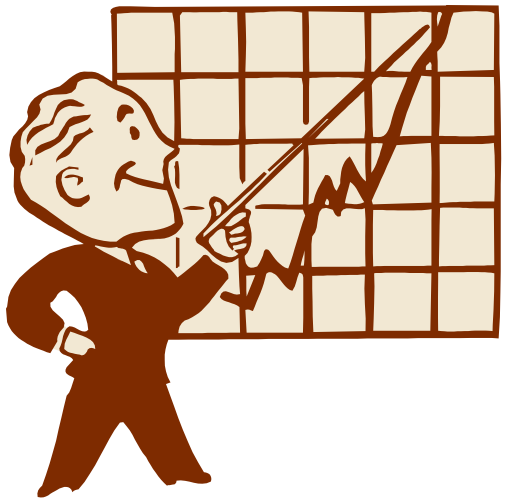


Second Attempt at Enforcing EIT



EIT Results

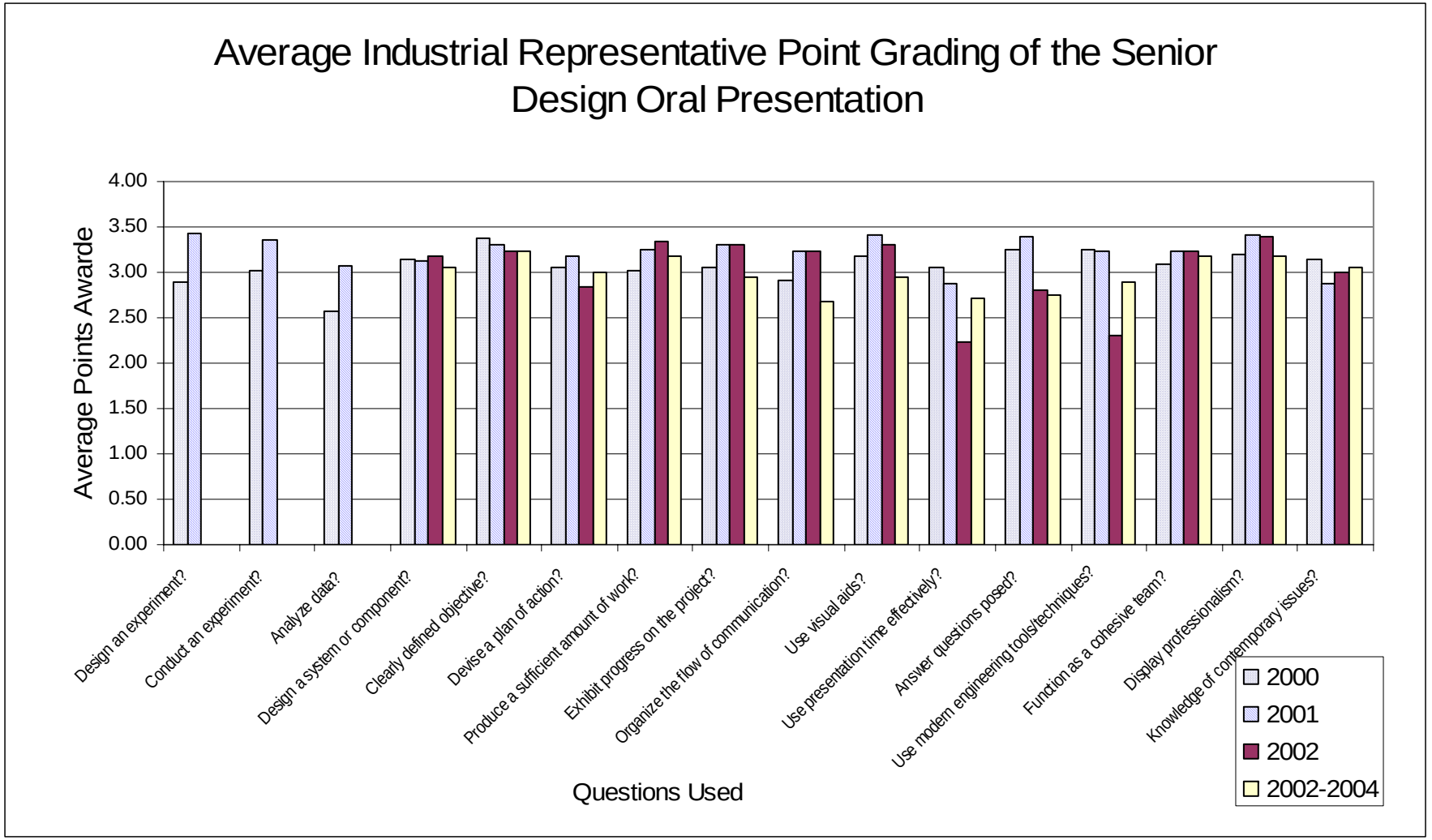
- Pass/fail for overall examination
- Unanimous statistics sent to dean
  - Subject (fluid mechanics, statics, etc.)
  - Average number of questions answered corrected by:
    - Your program
    - Statewide
    - National



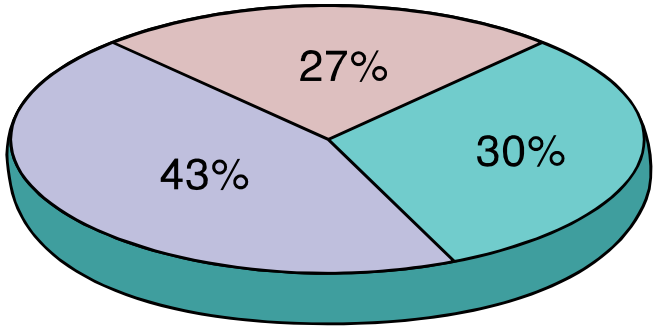
Capstone Course Experience

- Students are hungry to finish program (a little more motivated to help us)
- Students have completed most of the program
- Good opportunity data collection
  - Senior survey
  - Writing sample
  - Final oral presentation

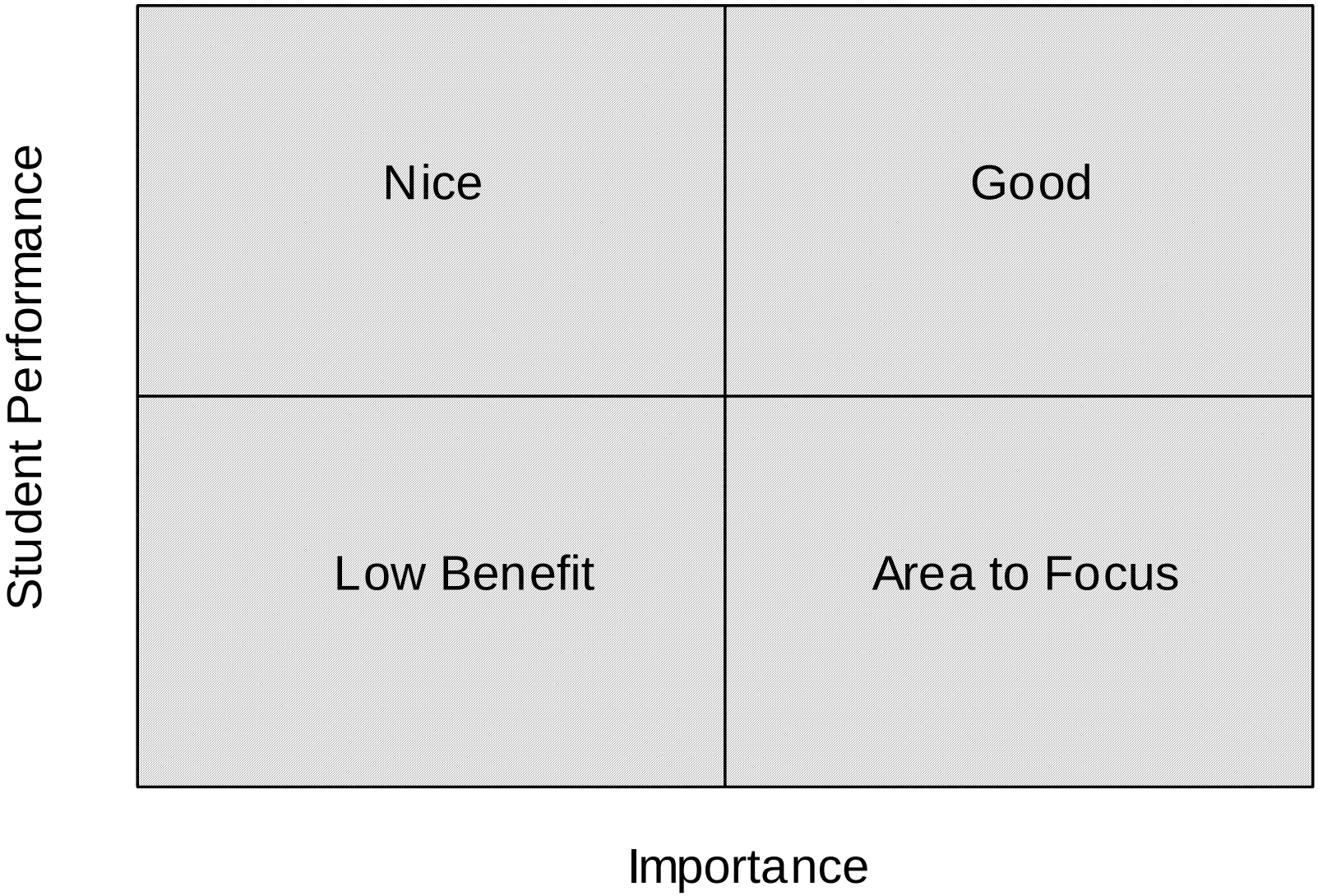
Sample Presentation Results



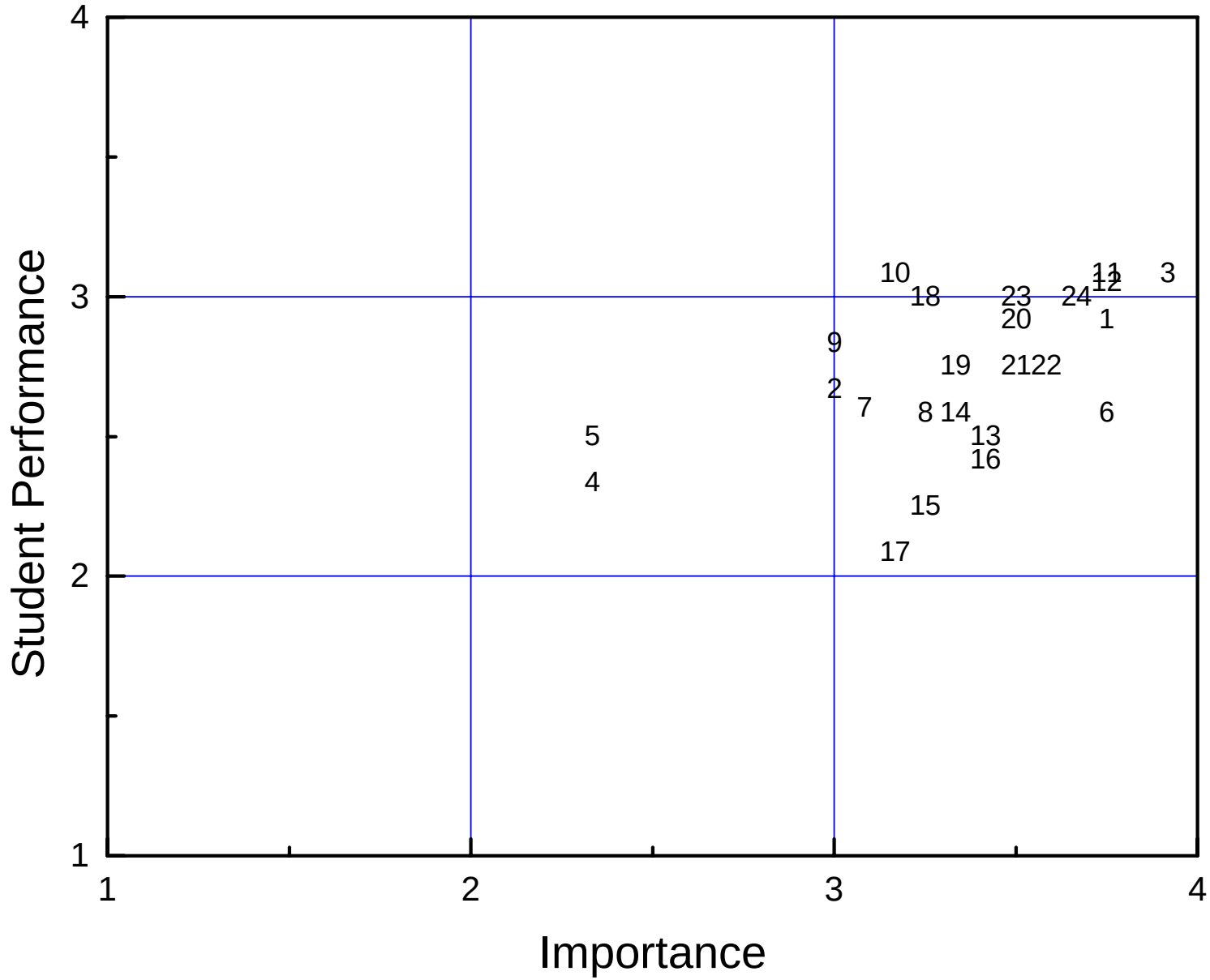
Analysis



Scatter Graph Interpretation



Sample Survey Results



Weighting Factors #1

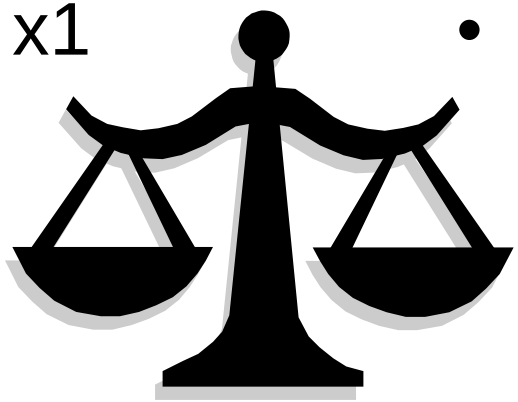
How do we decide how much value to place on each constituent?

Equal Weighting:

- Faculty vote x 1
- Indust. reps. x 1
- Alumni x 1
- Students x1

Unequal Weighting:

- Faculty vote x 10
- Indust. reps. x 20
- Alumni x 15
- Students x 5



Weighting Factors #2

How much value to place
on each tool?

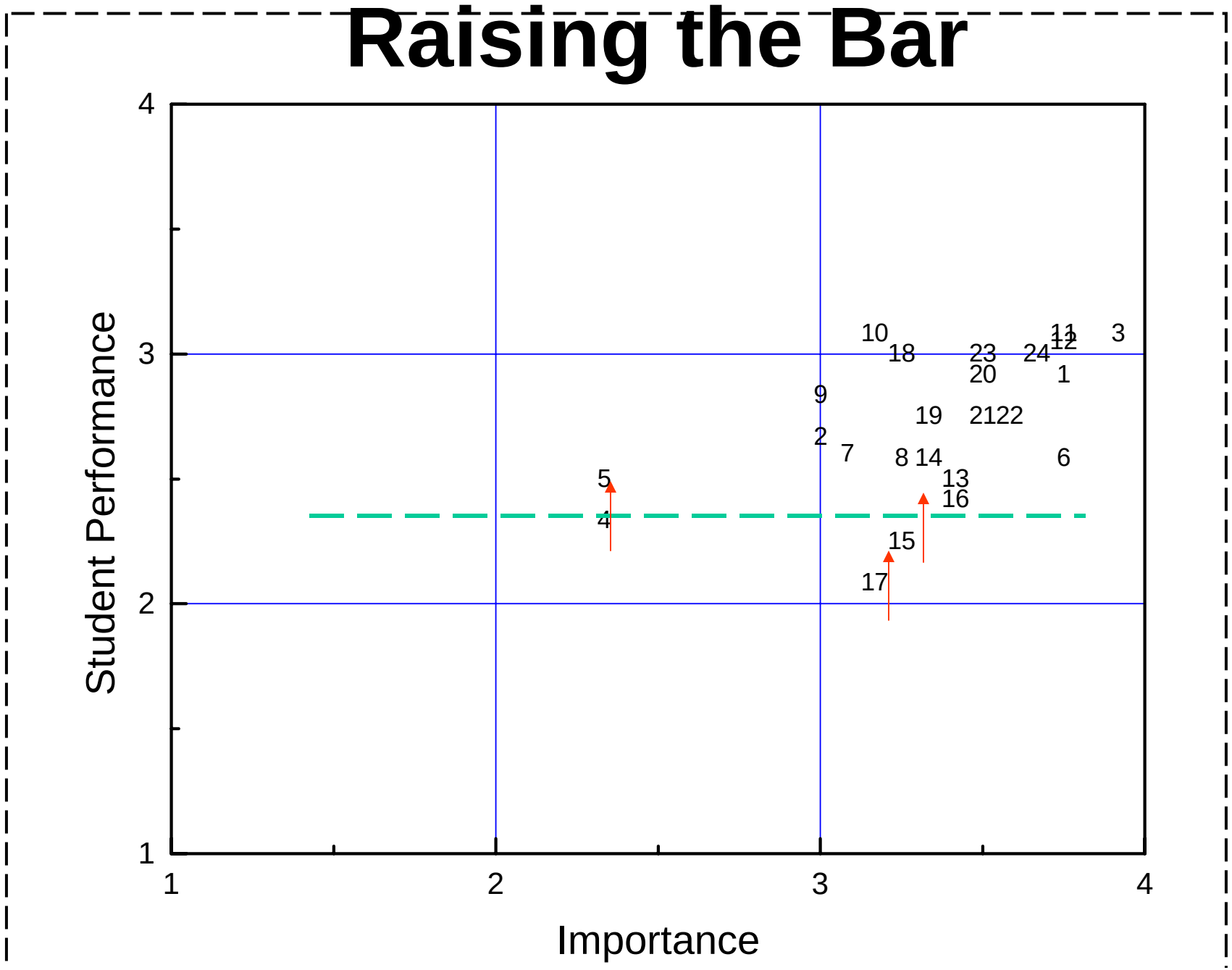
Equal weighting:

- Survey vote x 1
- Webfolio x 1
- Exams x 1
- Capstone x1

Unequal weighting:

- Survey vote x 10
- Webfolio x 20
- Exams x 15
- Capstone x 5

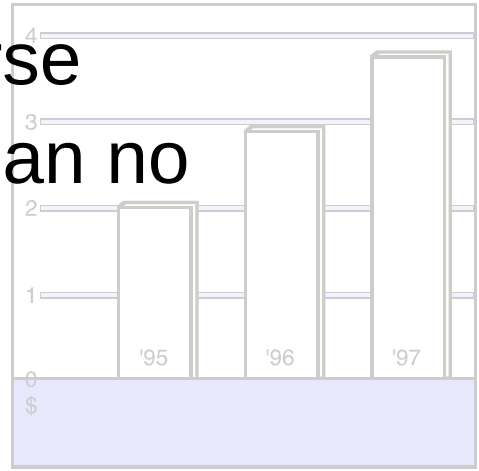
Raising the Bar



Program Modifications

Strengths and Areas for Improvement

- Identifying strengths are great
  - Uplifting to faculty so see things working
  - Can be used for recruitment of students
- Areas for improvement need action
  - Change is difficult
  - Some changes make things worse
  - A wrong modification is better than no modification



Examples of Program Modification

- Minor (changes to existing courses)
  - Students now design their own experiments in lab courses
  - Increase group activities in classes
  - Assign current engineering event projects

- Major (adding and deleting courses)
  - A second dynamics/kinematic course is now required
  - A technical writing course has been added

End Result

- Participation from all constituents
- Data collected on a regular basis using assessment tools
- Data analyzed, and strengths and weaknesses identified
- Programs modified to address weaknesses