California State University, Los Angeles

Department of

Mechanical Engineering

College of Engineering, Computer Science, and Technology

PROGRAM ASSESSMENT

2002-2004

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I Introduction

The Mechanical Engineering program provides instruction in the basic sciences, in economic, ethical and social issues, and in engineering design and analysis. The undergraduate program has approximately 150 students and awards the Bachelor of Science in Mechanical Engineering to its graduates. Because mechanical engineering is one of the most general branches of engineering, the breadth and flexibility of a mechanical engineer's education provide a wide choice of careers and movement into a variety of engineering areas.

In general terms, mechanical engineers are concerned with the production, transmission, and use of energy. A series of core courses that is completed by all students in the program provides a general mechanical engineering knowledge. Following the completion of the core courses, the students select their area of specialization from applied mechanics, machine design, thermal-fluid sciences and manufacturing. The undergraduate educational experience is brought to closure with a capstone experience in which teams of seniors are assigned design projects. This capstone experience allows students to utilize of the skills and knowledge they have gained throughout the program.

In 1999, the Mechanical Engineering program implemented a program assessment strategy based on student learning. The motivation for implementing originated in four places:

1. The faculty
2. Accreditation Board for Engineering and Technology
3. The WASC Accreditation guidelines
4. The University faculty handbook

This assessment program that is used to ensure achievement of the objectives and outcomes can be described as in a two-loop figure.

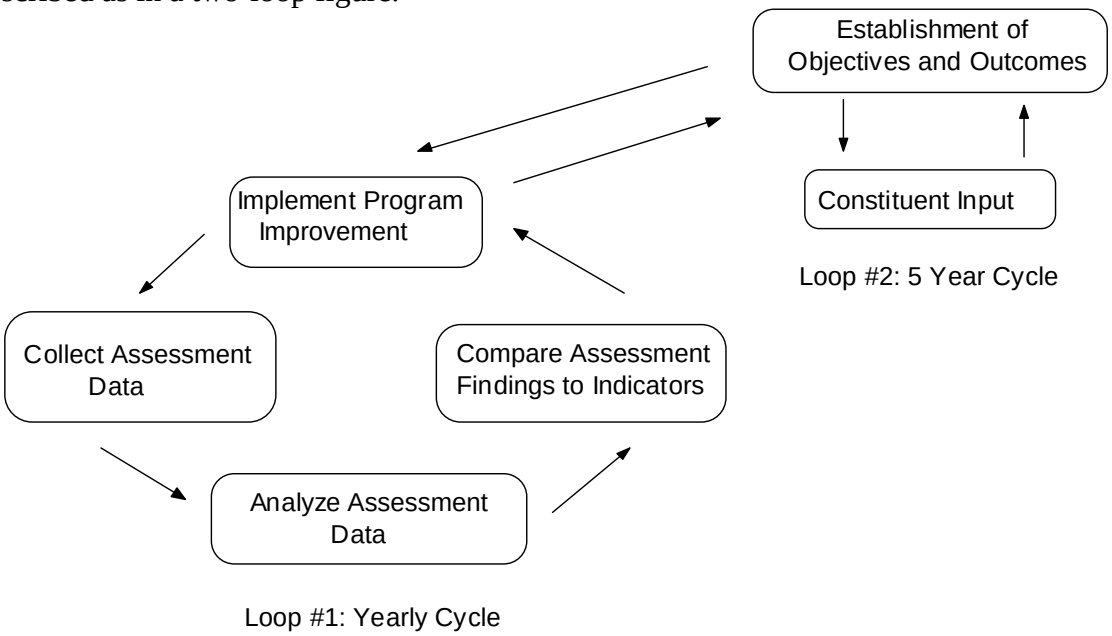


Fig. 1. Yearly implementation of assessment program

Loop #1 is implemented each year. This ensures continual improvement and development of the Mechanical Engineering program. Loop #2 will be implemented every 5 years. This will ensure that the direction in which the program is developing is in line with the desires of the program constituents.

II Combined Resources of the College of Engineering and Technology

Although each of the three mandates above refer to "program" assessment and ultimately, it is the responsibility of the leadership and faculty in each of our five "program" areas (civil engineering, electrical engineering, mechanical engineering, technology, computer science) to handle this task, because each of our units is relatively small we decided that it would be inefficient to have each program launch its own program assessment process. Rather choose to use a co-operative, College-wide effort in which representatives of each of the programs work along with the associate dean to implement the program assessment process. The current assessment team is:

- Jane Dong – EE
- Charles Liu* - EE
- Rupa Purasinghe – CE
- Chengyu Sun – Computer Science
- Darrell Guillaume – ME
- Keith Mew - Technology
- Russ Abbott – Computer Science
- Martin Roden – Associate Dean

III Status of College Vision and Mission Statement

Since the beginning of this assessment process, the definitions of key terminology have been understood to be important. The table below provides the current definitions used by the assessment task force. This is a "living" list in that the number of terms grows and the definitions change over time.

Definition of Key Terms

Term	***Definition***	***Applicable Unit***
Vision	*Where we want to be or how we want to be viewed*	*College*
Mission	*Description of what we do (i.e., what "business" are we in)*	*College*
Educational objectives	*Broad statements of what knowledge our graduates will have, what skills they will possess, and what attitudes they will hold*	*Programs*
Program outcomes	*Measurable indicators that educational objectives have been met (Generally more specific)*	*Programs*
Performance indicators	*Detailed metrics (measures) that indicate whether a specific out-come has been achieved*	*Program*
Performance criteria	*Performance level required to satisfy a particular performance indicator*	*Program*
Constituents (Stakeholders)	*A group of people with common expectations of an educational program (e.g., students, alumni, faculty, staff, employers)*	*College/ Program*

Fig. 2. Definition of Key Terms

The Vision and Mission statements of the College of Engineering, Computer Science, and Technology are:

Vision Statement

To be a pre-eminent engineering and technology program that prepares students from diverse backgrounds for productive careers by providing them with a student-centered, practically-focused quality learning experience.

Mission Statement

The mission of the College of Engineering and Technology is to graduate well-educated engineers and technologists who are prepared to meet the challenges of a rapidly changing, increasingly complex world. This will be accomplished through:

- *A well-qualified faculty who care about students and their success.*
- *A dynamic, up-to-date curriculum that has an optimal balance between theory and practice.*
- *Laboratories, computer facilities, and instructional classrooms on par with any engineering and technology program in the nation.*
- *Unique co-curricular opportunities for students such as participation in student design competitions, professional student organizations, and pre-professional employment.*
- *Opportunities for undergraduate and graduate students to participate in research and industry-funded design clinic projects.*
- *Mutually beneficial partnerships with area industry that take advantage of our location in one of most concentrated high-tech centers in the nation.*
- *Strong cooperative relationships with local high schools and community colleges and with other four-year institutions.*

IV Status of Educational Objectives and Program Outcomes

The next task for assessment was to develop the following:

- Educational objectives for each program
- Program outcomes for each educational objective

Educational outcomes were defined as broad statements of attributes of graduates of the program. We decided to develop three such statements as follows:

1. One statement describing the knowledge that graduates will have
2. One statement describing the skills that graduates will possess
3. One statement describing the attitudes graduates will hold

Every five years these objectives will be reassessed. The process used to develop these statements was to seek input from various "constituencies" (program faculty, program students, industry representatives, employers, alumni) as to what knowledge, skills, and attitudes they believe graduates of the specific program should have.

- As a starting point for the input from the industry representatives, the assessment coordinator used the ABET a) - k) criteria. For additional input from industry, the assessment coordinator used the findings of the SME (Society of Manufacturing

Engineers) Manufacturing Education Plan: Phase 1 Report which was a 1997 study that used.

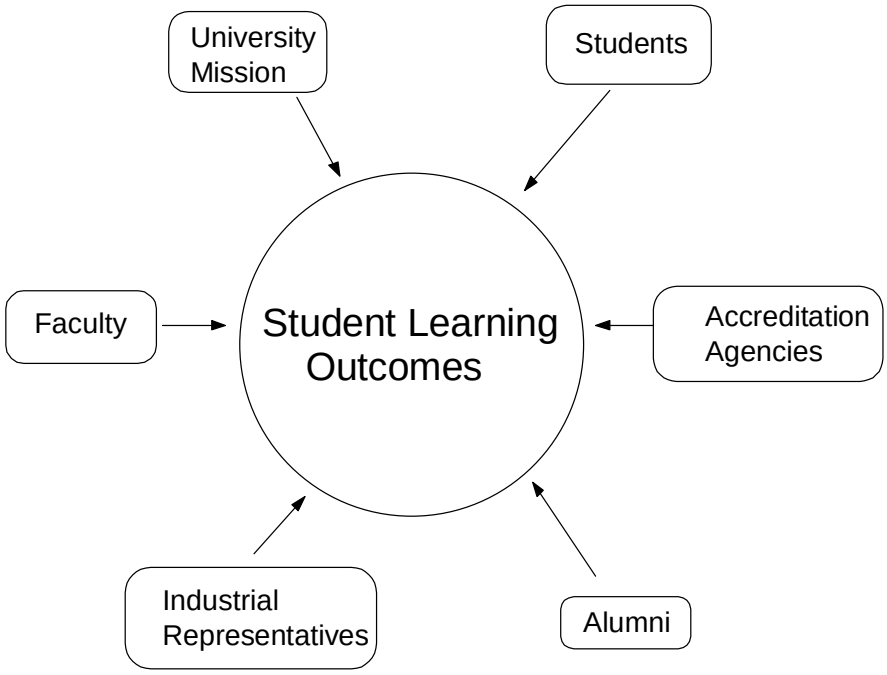


Fig. 3. Determining Student Learning Outcomes

Specifically, the procedure that will be used to update the Mechanical Engineering program objective statements and student outcomes is:

1. Survey the constituents to obtain their opinion of the educational objective statements we are currently using and to determine their desired student outcomes for each objective statement.
2. Use the constituent input to modify the objective statements and all of the desired student outcomes.
3. Resurvey the constituents to obtain approval of the modified objective statements and to obtain a ranking of all the desired student outcomes.
4. Send the final draft of the Mechanical Engineering objective statements and corresponding student outcomes to all constituents for final approval.

The educational objective statement for the Mechanical Engineering program is shown below.

Educational Objectives and Program Outcomes
For the Mechanical Engineering Program

The following describe the characteristics that the Cal. State LA Mechanical Engineering program is seeking to produce in its graduates in the three areas:

- *The knowledge they will have*
- *The skills they will possess*

- *The attitudes they will hold*

Knowledge

Graduates of the Mechanical Engineering program will have the knowledge in math, science and engineering fundamentals, as well as societal issues, that allows them to approach real-world Mechanical Engineering problems with an understanding of their impact on society.

This educational objective will be demonstrated by the following outcomes:

1. *an ability to apply knowledge of mathematics, science, and engineering (abet a)*
   In particular, an ability to apply knowledge of:
   a) chemistry and calculus-based physics.
   b) advanced mathematics through multivariate calculus and differential equations.
   c) statistics and linear algebra.
2. *an understanding of professional and ethical responsibility (abet f)*
3. *the broad education necessary to understand the impact of engineering solutions in a global/societal context (abet h)*
4. *knowledge of current events and societal contemporary issues -- non-engineering related. (abet j)*
5. *a knowledge of computer aided design and simulation software*
6. *a knowledge of measurement and manufacturing techniques*
7. *a knowledge of how mechanical engineering integrates into inter-disciplinary systems*

Skills

Graduates of the Mechanical Engineering program will be able to work in group and individual settings to define and solve problems related to thermal and mechanical systems and manufacturing processes by applying engineering fundamentals and engineering tools with a logical approach and be able to clearly communicate their findings.

This educational objective will be demonstrated by the following outcomes:

1. *an ability to design and conduct experiments as well as to analyze and interpret data (abet b)*
2. *an ability to design a system, component, or process to meet desired needs (abet c)*
3. *an ability to function on multidisciplinary teams (abet e)*
4. *an ability to communicate effectively (abet g)*
5. *an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (abet k)*
6. *an ability to select materials and manufacturing processes*
7. *an ability to visualize designs from engineering drawings*
8. *an ability to think in a logical sequential process*

Attitudes

Graduates of the Mechanical Engineering program will be confident in their abilities to be successful in industrial, academic, and governmental positions and will have the positive and inquisitive outlook on life and learning necessary to promote their continued professional and personal development throughout their careers.

This educational objective will be demonstrated by the following outcomes:

1. *an understanding of professional and ethical responsibility (abet f)*
2. *a recognition of the need for an ability to engage in lifelong learning (abet i)*
3. *an understanding of responsibility and accountability*
4. *a desire to be a professional that exhibits values, dedication and a need for continual improvement*
5. *a desire to be a flexible and adaptable team player (collaborative attitude)*

V The Assessment Process

Standing Committee

To ensure a continuous assessment process, a permanent committee within the department has been formed. This committee has a 3 year, rotating membership that allows all department faculty to participate in the assessment process. It meets on a bi-monthly basis.

Members: Maj Mirmirani (Chair)
Lih-Min Hsia
Darrell Guillaume
Steve Felszeghy

The purpose of this committee is to ensure that data are collected and analyzed for the current year. Specifically, the committee is charged with:

- specifying the assessment tools
  - ⇒ assessing the effectiveness of current tools
  - ⇒ evaluating possible new tools
- determining the timing for the implementation of assessment tools
  - ⇒ specifying the audience and location
  - ⇒ verifying that the tools are implemented
- analysis of results
- reporting assessment results to the department
- specifying where changes in the curriculum are implemented
- verifying that changes have been implemented
- documenting evidence of the changes

VI Relation between Curriculum and Program Outcomes

The process of documenting where within the curriculum and to what extent each program outcome is being accomplished was conducted during summer, 1999. A subcommittee at the college level consisting of Rupa Purasinghe and Charles Liu developed a template for this purpose. A sample of this template is presented in Appendix 1.

Each program has a list of course coordinators. Each course coordinator was asked to indicate what program outcomes are being addressed in their course and at what level. Nine points were awarded where the focus on the program outcome is "high," three points where the focus is "medium," one point where the focus is "low," and no points where there is no focus. With these data, the total points were computed for each program outcome. This provided initial indications of where the curriculum is doing a good job in achieving the program outcome and where there are deficiencies.

Educational Outcome	**Current Curriculum Strength**
Knowledge	
Graduates of the Mechanical Engineering program will have the knowledge in math, science and engineering fundamentals, as well as societal issues, that allows them to approach real-world Mechanical Engineering problems with an understanding of their impact on society.	

This educational objective will be demonstrated by the following outcomes:	
1. an ability to apply knowledge of mathematics, science, and engineering (abet a) In particular, an ability to apply knowledge of: a) chemistry and calculus-based physics. b) advanced mathematics through multivariate calculus and differential equations. c) statistics and linear algebra.	120
8. an understanding of professional and ethical responsibility (abet f)	94
9. the broad education necessary to understand the impact of engineering solutions in a global/societal context (abet h)	56
10. knowledge of current events and societal contemporary issues -- non-engineering related. (abet j)	33
11. a knowledge of computer aided design and simulation software	115
12. a knowledge of measurement and manufacturing techniques	87
13. a knowledge of how mechanical engineering integrates into inter-disciplinary systems	75
Skills	
Graduates of the Mechanical Engineering program will be able to work in group and individual settings to define and solve problems related to thermal and mechanical systems and manufacturing processes by applying engineering fundamentals and engineering tools with a logical approach and be able to clearly communicate their findings.	
This educational objective will be demonstrated by the following outcomes:	
9. an ability to design and conduct experiments as well as to analyze and interpret data (abet b)	74
10. an ability to design a system, component, or process to meet desired needs (abet c)	118
11. an ability to function on multidisciplinary teams (abet e)	62
12. an ability to communicate effectively (abet g)	124
13. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (abet k)	133
14. an ability to select materials and manufacturing processes	74
15. an ability to visualize designs from engineering drawings	48
16. an ability to think in a logical sequential process	159
Attitudes	
Graduates of the Mechanical Engineering program will be confident in their abilities to be successful in industrial, academic, and governmental positions and will have the positive and inquisitive outlook on life and learning necessary to promote their continued professional and personal development throughout their careers.	
This educational objective will be demonstrated by the following outcomes:	
6. an understanding of professional and ethical responsibility (abet f)	92
7. a recognition of the need for an ability to engage in lifelong learning (abet i)	93
8. an understanding of responsibility and accountability	128
9. a desire to be a professional that exhibits values, dedication and a need for continual improvement	124
10. a desire to be a flexible and adaptable team player (collaborative attitude)	124

Fig. 4. Current Curriculum Strength for Each Outcome

VII Assessment Tools and Process

The schedule for implementation of the assessment tools is shown in Fig. 5.

Assessment Tool	Implementation Frequency	Year Results are Reported
1 Capstone design course		
a Oral presentation (Appendix 2)	Every Year	**This Report**

	b Written presentation	Every two Years*	**This Report**
2	Webfolio		
	a Industry Assessment	Every Two Years	**This Report**
	b Faculty Assessment (Appendix 3)	Every Two Years	2002-2003
	c Alumni Assessment (Appendix 3)	Every Two Years	**This Report**
3	Surveys of seniors (Appendix 4)	Every Year	**This Report**
4	Surveys of recent graduates	Every Five Years	2004-2005
5	Survey of Faculty	Every Five Years	2004-2005
6	Surveys of employers	Every Five Years	2004-2005
7	Educational Benchmarking Inc. Survey (Appendix 5)	Every Year	**This Report**
8	Engineering-in-Training Exam	Every Year	**This Report**

* Implementation was delayed one year since program modification is currently being implemented

Fig. 5. Implementation Schedule for Assessment Tools

A matrix of which program outcome can be assessed by each assessment tools is shown below.

Assessment Tool versus Student Outcome

	Capstone Course	**Webfolios**	**Surveys of Employers**	**Surveys of Students**	**Pretests/ Tests**
Knowledge					
Math/Science/Engineering	No	No	**Yes**	**Yes**	**Yes**
Contemporary Issues	No	No	**Yes**	**Yes**	No
Broad Education	No	No	**Yes**	**Yes**	No
Ethics	**Yes (Test)**	No	**Yes**	**Yes**	No
Skills					
Experimental work	Maybe	**Yes**	**Yes**	**Yes**	No
Problem solving	**Yes**	No	**Yes**	**Yes**	No
Design	**Yes**	**Yes**	**Yes**	**Yes**	No
Communication skills	**Yes**	**Yes (written)**	**Yes**	**Yes**	**Yes (WPE)**
Work in teams	**Yes**	No	**Yes**	**Yes**	No
Use tools	**Yes**	No	**Yes**	**Yes**	No
Information competency	Maybe	No	**Yes**	**Yes**	No
Attitudes					
Lifelong learning	No	No	**Yes**	**Yes**	No
Professionalism	**Yes**	**Yes**	**Yes**	**Yes**	No
All other attitudes	No	No	**Yes**	**Yes**	No

Fig. 6. Corresponding Assessment Tool for Each Student Outcome

The data obtained from these initiatives were compiled, analyzed, and interpreted during the 2002-2004 assessment period.

VIII Results of Assessment

Summary of the Strengths and Areas for Improvement 2001-2002

In last year's study, we determined the strongest outcomes and the areas for improvement that were identified by 1) student input, 2) alumni input, and 3) industry input. These are presented below along with the corresponding changes that have been identified to improve the program.

Strengths **(for 2001-2002)**

- Ability to apply knowledge of engineering for solving problems
- A knowledge of current events and societal contemporary issues – non engineering related
- A desire to be a professional that exhibits values, dedication and a need for continual improvement
- An ability to design a system, component, or process to meet desired needs
- An recognition of the need for an ability to engage in lifelong learning

Areas for Improvement (for 2001-2002)

- Ability to write technical documents
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
- An ability to design and conduct experiments as well as to analyze and interpret data
- An understanding of professional and ethical responsibility

(See Mechanical Engineering program Assessment 2001-2002 for more details).

The assessment presented in this section of this year's report measures these outcomes again to determine if the program changes are effective. Thus, for each tool presented, the areas for improvement identified during the 2001-2002 assessment period are examined and compared to the results obtained during the 2002-2004 assessment period.

The major goal of this report period is to compare the results of this assessment period with last year's results. Thus, for each tool, the areas for improvement identified in the 2001-2002 report will be reviewed to determine if the outcome that corresponds to the area has:

1. improved
2. declined
3. not changed

in the 2001-2002 results. If an outcome being studied is not addressed by a particular tool, a dashed line (----) is given.

For each assessment tool, thresholds are identified. Although all outcomes vary in performance from year to year, only the weakest performing outcomes (those scoring below threshold levels) are considered an "area for improvement." As those are improved, the threshold is raised and other outcomes will then be identified as an Area for Improvement based on their measured performance.

Capstone design course

Oral Presentation

For the 2001-2002 assessment process, the final oral presentation in the senior design capstone course was used to assess the following outcomes:

- Design an experiment
- Conduct an experiment
- Analyze data
- Design a system or component
- Use modern engineering tools/techniques
- Function as a cohesive team
- Display professionalism
- Knowledge of contemporary issues

The following are included in the chart and are assessed but are not currently one of the identified outcomes for the Mechanical Engineering program. They are documented here for possible future use.

- Clearly define an objective
- Devise a plan of action
- Produce a sufficient amount of work
- Exhibit progress on the project
- Organize the flow of information
- Use visual aids
- Use presentation time effectively
- Answer questions posed

Each student group presented a formal oral presentation which was 15 minutes long and addressed audience questions in a subsequent 5-minuute question period. There are typically between two and three students per group and each group member is required to participate in the oral presentation (i.e. each student speaks for approximately five minutes).

Using the instrument shown in Appendix 2, the following constituents were assessed:

- fellow students
- faculty
- industrial constituents

The results, shown below, are based on a 0 to 4 point scale with 4 being the highest.

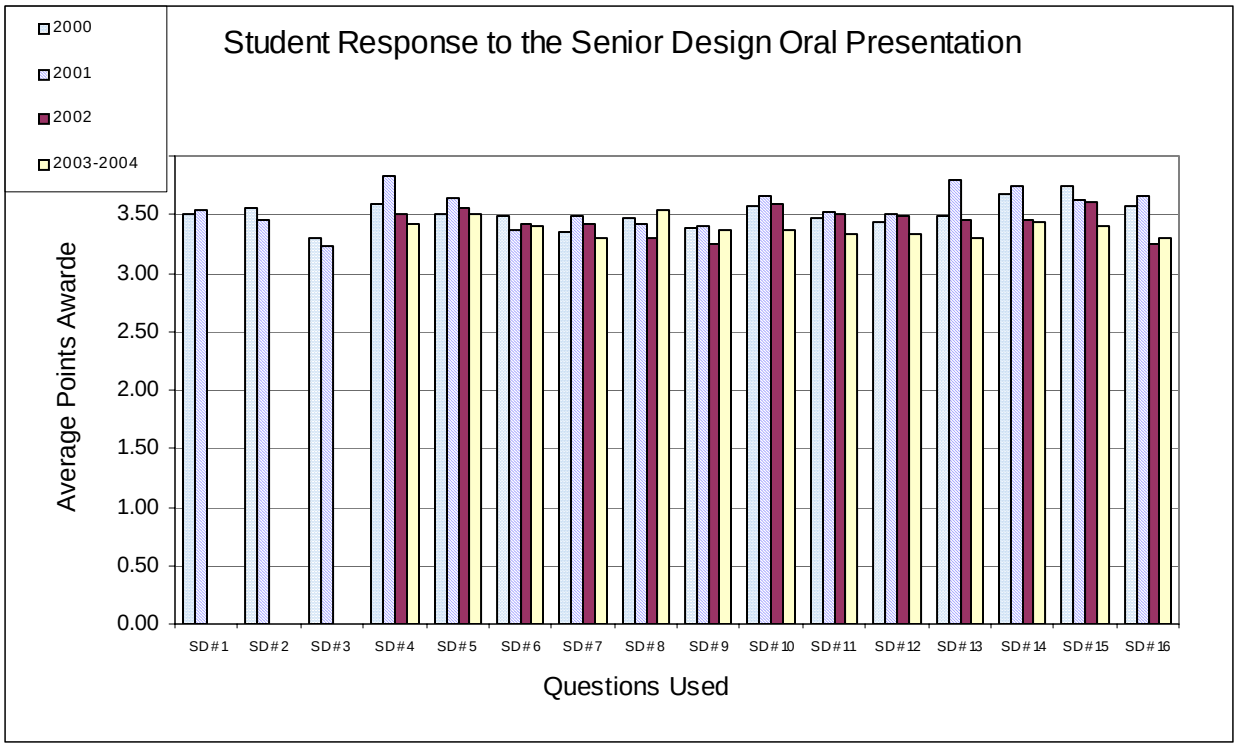


Fig.7. Student Assessment of the Final Oral Presentation in the Senior Capstone Course

2001-2002 Areas for Improvement	2002-2004 Performance
Devise a plan of action	declined
Exhibit progress on the project	declined
Use presentation time effectively	**declined**
Display professionalism	**declined**

2002-2004 Observations

Strength identified: Knowledge of contemporary Issues

Area for improvement identified: Organized flow of Communication

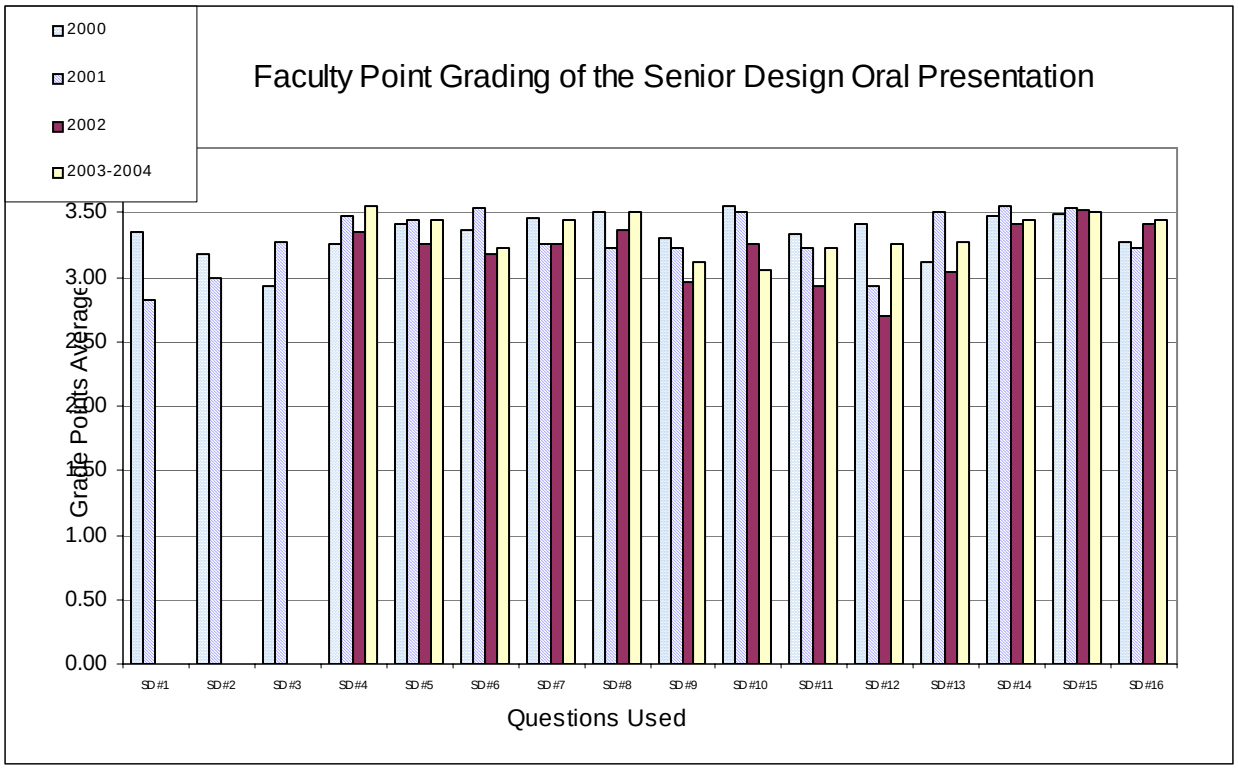


Fig.8. Faculty Assessment of the Final Oral Presentation in the Senior Capstone Course

2001-2002 Areas for Improvement	2002-2004 Performance
Produce a sufficient amount of work	improved
Exhibit progress on the project	improved
Answer questions posed	**improved**

2002-2004 Observations

Strength identified: Design a system or component
Knowledge of contemporary Issues

Area for improvement identified: Devise a plan of action

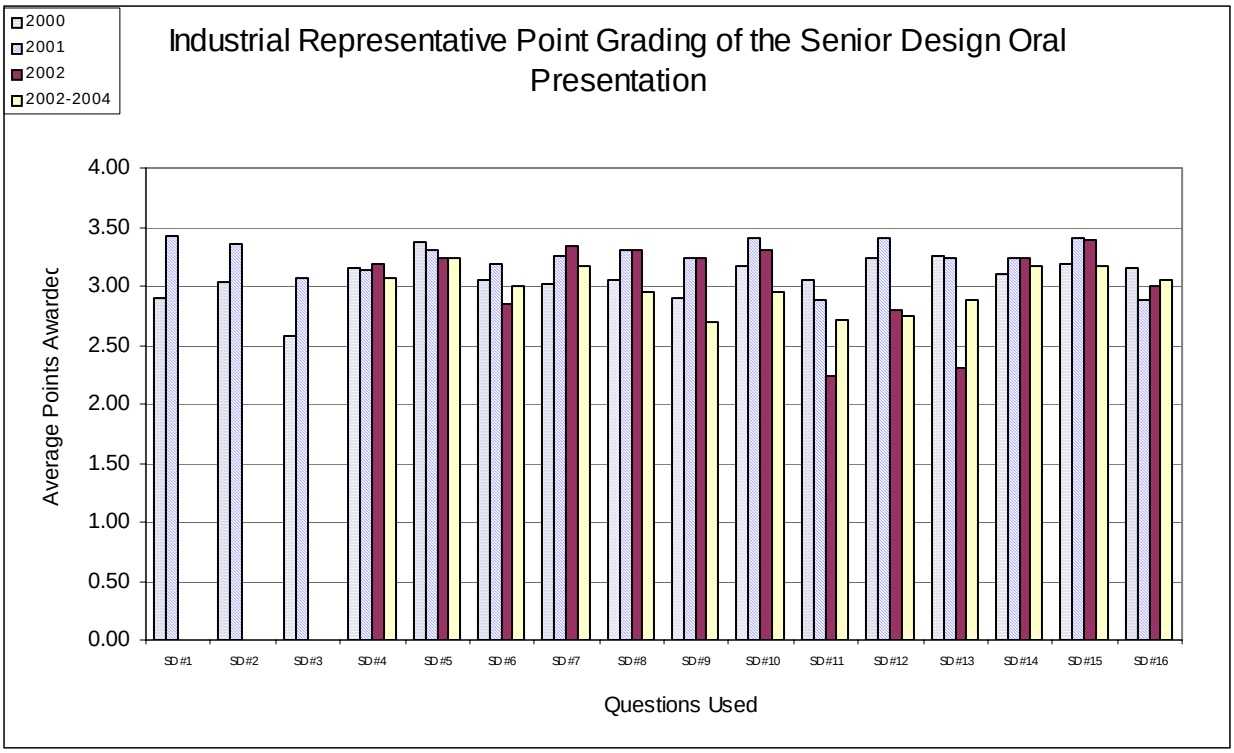


Fig.9. Industry Assessment of the Final Oral Presentation in the Senior Capstone Course

2001-2002 Areas for Improvement	2002-2004 Performance
Design a system or component	declined
Use presentation time effectively	declined
Knowledge of contemporary issues	improved

2002-2004 Observations

Strength identified: None

Area for improvement identified: Clearly define an objective

Surveys of seniors

The opinions of senior students were assessed using the survey shown in Appendix 4 on the following outcomes:

Key for Curriculum Assessment

1 An ability to apply knowledge of math, science, and engineering (abet a)
  In particular, an ability to apply knowledge to:
  - a chemistry and calculus-based physics
  - b advanced math through multivariate calculus and differential equations
  - c statistics and linear algebra

2 An understanding of professional and ethical responsibility (abet f)
3 A broad education necessary to understand the impact of engineering solutions in a global/societal context (abet h)
4 A knowledge of current events and societal contemporary issues – non-engineering related (abet j)
5 A knowledge of computer aided design and simulation software
6 A knowledge of measurement and manufacturing techniques
7 A knowledge of how mechanical engineering integrates into inter-disciplinary systems
8 An ability to design and conduct experiments as well as to analyze and interpret data (abet b)
9 An ability to design a system, component, or process to meet desired needs (abet c)
10 An ability to function on multidisciplinary teams (abet e)
11 An ability to communicate effectively (abet g)
12 An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (abet k)
13 An ability to select materials and manufacturing processes
14 An ability to visualize design from engineering drawings
15 An ability to think in a logical sequential process
16 An understanding of professional and ethical responsibility (abet f)
17 An recognition of the need for an ability to engage in lifelong learning (abet i)
18 An understanding of responsibility and accountability
19 A desire to be a professional that exhibits values, dedication and a need for continual improvement
20 A desired to be a flexible and adaptable team player (collaborative attitude)

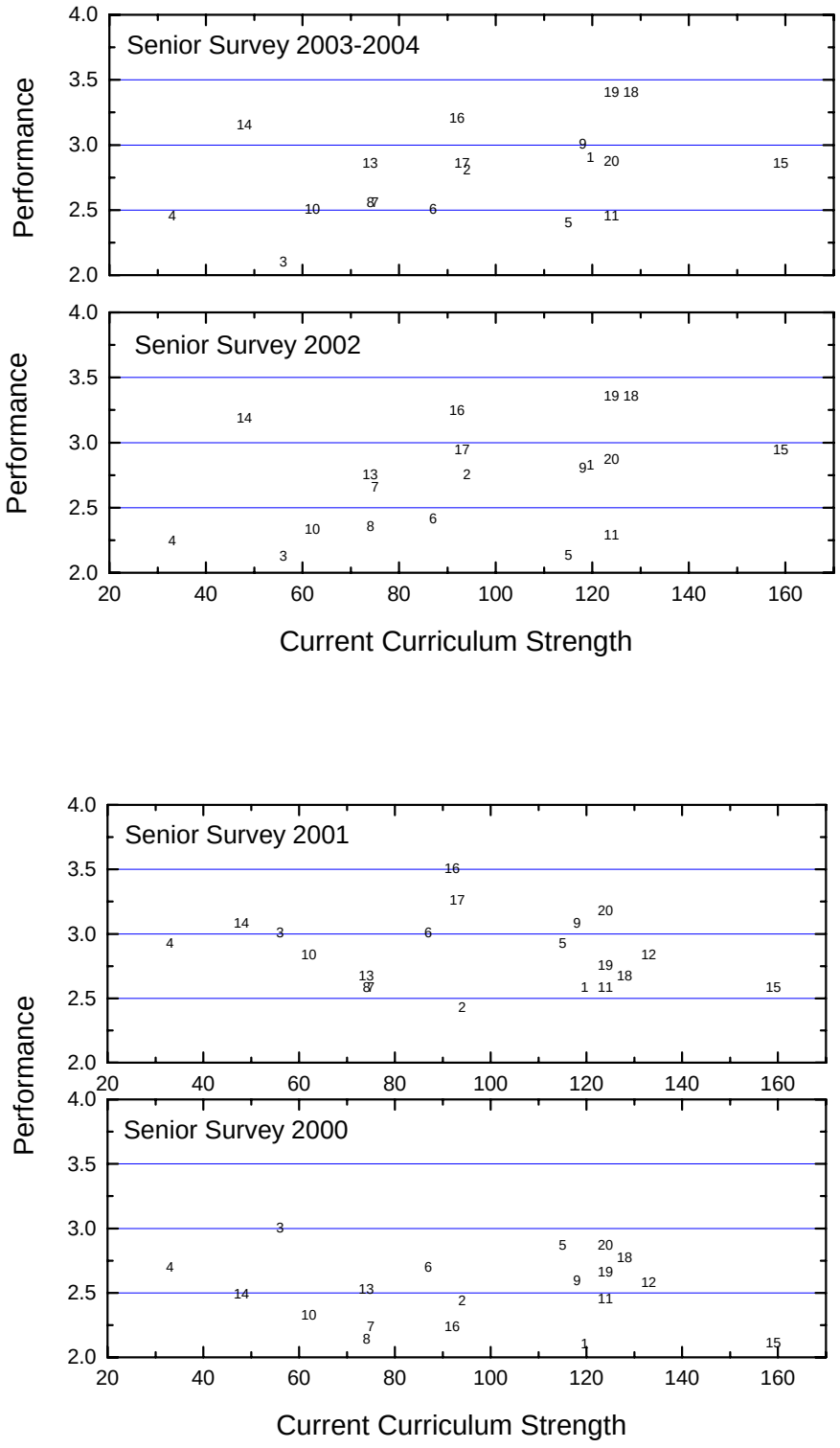


Fig. 10. Graphs Showing Student Opinion of Outcome Performance Versus the Current Curriculum Strength (See Key for Curriculum Assessment on previous page)

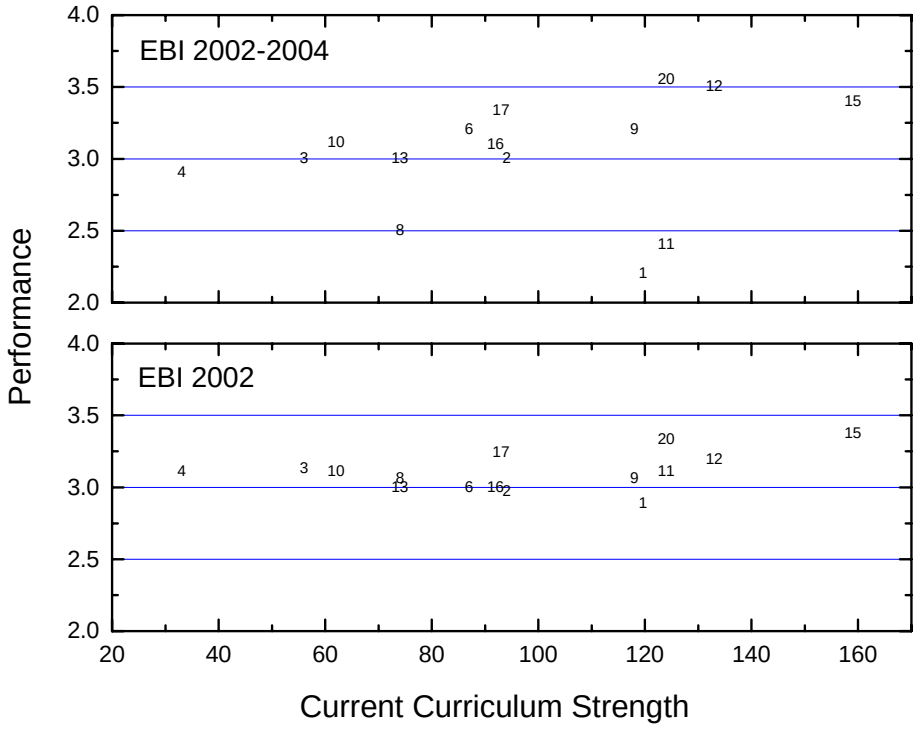
2001-2002 Areas for Improvement	2002-2004 Performance
A broad education necessary to understand the impact of engineering solutions in a global/societal context	---
A knowledge of current events and societal contemporary issues – non-engineering related	improved
A knowledge of computer aided design and simulation software	improved

2002-2004 Observations

Strength identified: An understanding of responsibility and accountability
A desire to be a professional that exhibits values, dedication and a need for continual improvement

Area for improvement identified: None

EBI Data and Analysis



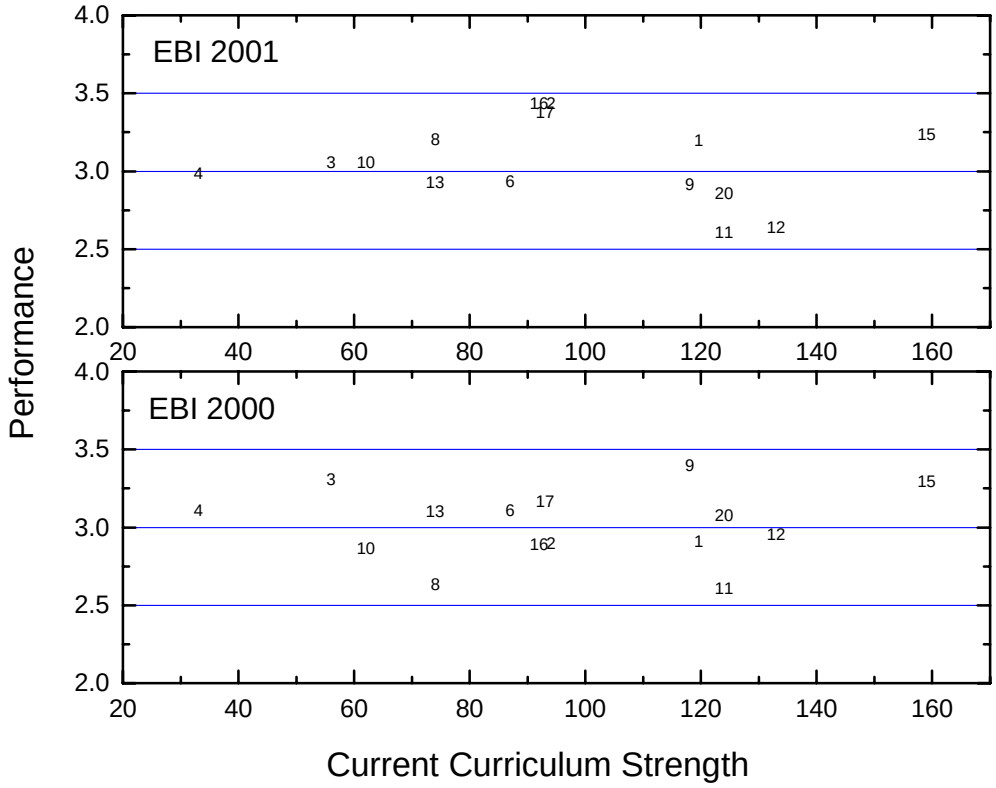


Fig. 11. Graphs Showing EBI Results of Outcome Performance Versus the Current Curriculum Strength

2001-2002 Areas for Improvement	2002-2004 Performance
An ability to apply knowledge of math, science, and engineering	declined
An understanding of professional and ethical responsibility	---
A knowledge of measurement and manufacturing techniques	improved

2002-2004 Observations

Strength identified: A desired to be a flexible and adaptable team player (collaborative attitude)

Area for improvement identified: An ability to design and conduct experiments as well as to analyze and interpret data

Webfolio

Webfolios are web-based portfolios that are used to collect key elements that correspond to the program's student learning outcomes. These elements are collected throughout the students' academic career at Cal. State LA with the final design element collected in the students' senior level capstone course. The complete portfolios are assessed by selected members of the program's constituents with a rubric based on the program's outcomes. The elements included in the portfolio are:

- A lifelong learning plan
- A resume'
- A laboratory report
- An executive summary of the student's capstone design project

The Internet location of the webfolio along with an assessment rubric were emailed to Industrial Representatives, Faculty, and Alumni to obtain their assessment of this sample work. The goal of these webfolios is to evaluate the following outcomes:

- abet (b) An ability to design and conduct experiments as well as to analyze and interpret data
- abet (c) An ability to design a system, component, or process to meet desired needs
- abet (e) An ability to think in a logical sequential process that lends itself to identifying, formulating and solving engineering problems
- abet (f) An understanding of professional and ethical responsibility
- abet (g) An ability to communicate effectively
- abet (i) A recognition of the need for an ability to engage in lifelong learning
- abet (j) Knowledge of current events and societal contemporary issues -- non-engineering related.

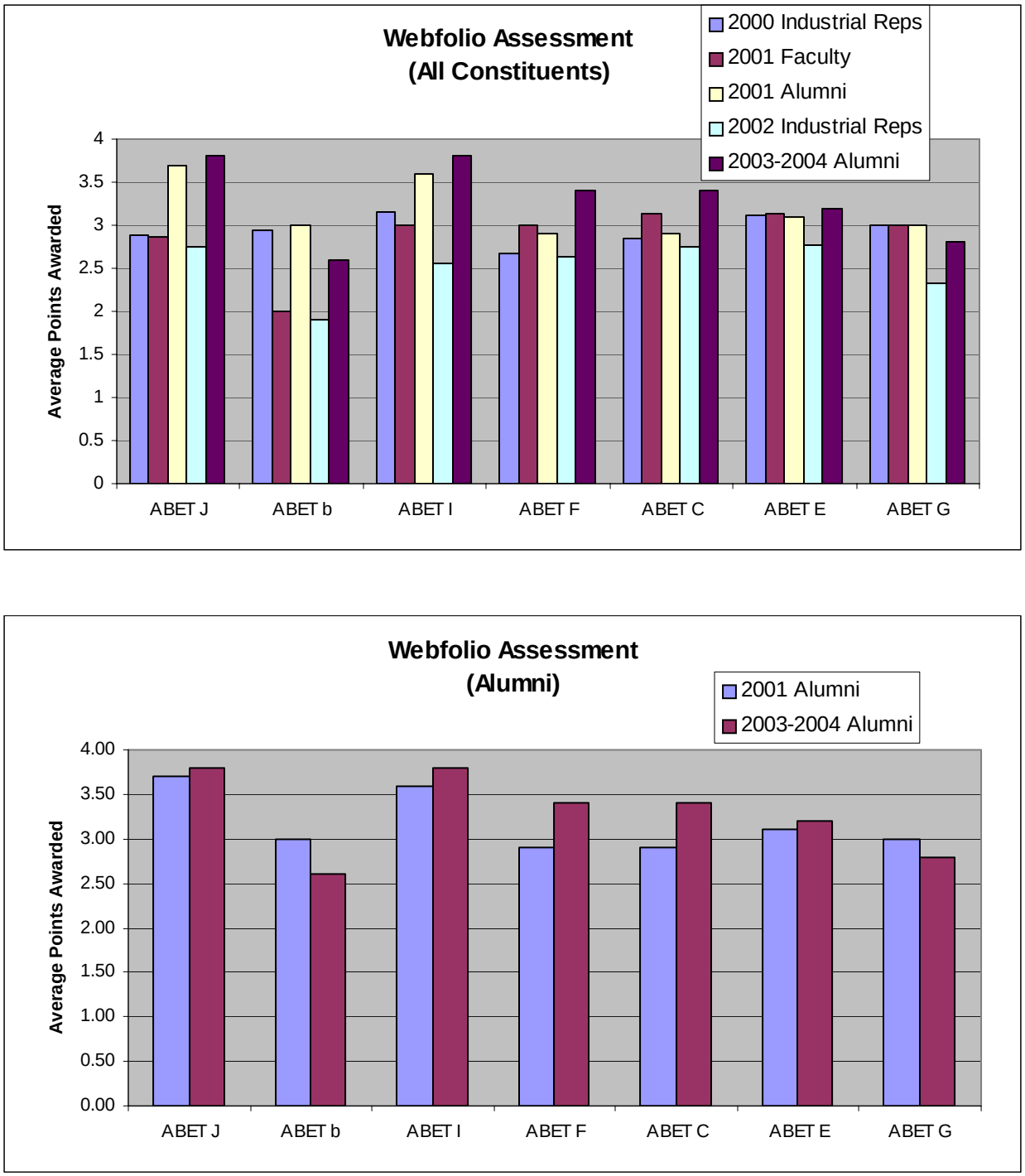


Fig. 12. Graphs Comparing Webfolio Results Obtained from Alumni in 2001 with Faculty and Alumni Results Obtained in 2004

2000-2001 Areas for Improvement (Alumni)	2002-2004 Performance
An ability to design and conduct experiments as well as to analyze and interpret data	declined
An ability to design a system, component, or process to meet desired needs	improved
An understanding of professional and ethical responsibility	improved

2002-2004 Observations

Strength identified: A recognition of the need for an ability to engage in lifelong learning
Knowledge of current events and societal contemporary issues -- non-engineering related.

Area for improvement identified: None

Engineer in Training Exam (EIT)

ABET Criteria 2000 include "nationally-normed subject content examinations" as one component of an effective assessment program. Because the EIT is designed to focus on the basic "*ability to apply knowledge of mathematics, science, and engineering (abet a)",* it is the ideal nationally-normed exam to assess engineering programs. Nationwide, colleges are beginning to make the attempt at this exam a requirement for graduation.

Currently, the Mechanical Engineering program is collecting data from the senior students who have attempted the EIT. Although passing the exam is not a graduation requirement, attempting the exam is. The college currently reimburses students who successfully pass the exam to provide motivation for success. Because we graduate a small number of students per year, we are waiting to utilize this information once we have data on a significant number of students. However, some trends have been clear. On average, our students are not performing well on the dynamics sections. This is consistent with information we have learned in student focus groups.

For this assessment period, 21 students attempted the exam and 11 passed. A separate report has been produced with the EIT data (see Mechanical Engineering EIT Report)

Writing Assessment

During the first quarter of the senior design course, all students are required to follow the entire design process given a simple mechanism. This is an individual project that requires a formal report at the end of the quarter. The following two quarters of senior design are larger design projects that require team efforts. Thus, the first quarter of senior design is the last time that all of the students in the program must write an individual report. We collected these reports and delivered them to our industrial constituents and asked them to critique them as if they were written by practicing engineers using the rubric in Appendix 6. The following table presents the result based on a 3 point scale with 3 being best.

Design:		Results
	Concept	2.64
	Description	2.18
Analysis:		
	Thoroughness	2.09
	Relevance to Design	2.50
	Usage of Math/Science	2.40
	Use Modern Software	2.27
Drawings:		
	Completeness	2.18
	Use of Modern CAD software	2.67
	Correct Dimensioning and Tolerancing	2.11
Details:		
	Organization and Flow	2.45
	Use of Technical Terms	2.08
	Grammar and Spelling	1.45
Professional Component:		
	Economic Issues Addressed	2.82
	Environmental Issues Addressed	2.55
	Sustainability Issues Addressed	2.27
	Manufacturability	2.36
	Ethical Concerns Addressed	2.73
	Social Concerns Addressed	2.73
	Safety Concerns Addressed	2.45
Overall Comments:		2.18

2002-2004 Observations

Strength identified: Economic issues addressed
Ethical concerns addressed
Social concerns addressed

Area for improvement identified: Grammar and spelling

Faculty-Student Focus Groups (personal interaction with students)

To add to the knowledge gained during the assessment of our program, faculty members have formed small focus groups of students The students were asked about ways that the Mechanical Engineering program could be modified to improve their learning experience. Through this direct interaction with students we could ask more direct questions regarding their responses on the Senior Survey and the EBI survey. Students in general agreed that they were not receiving

enough instruction for dynamics. They felt that this was their weakest area when they were attempting the EIT.

IX Program Strengths and Areas for Improvement Identified

Mechanical Engineering Strengths and Areas for Improvement 2002-2004

Interpretation of the assessment data can be very difficult because often an outcome identified as a strength by one constituent is identified as an "area for improvement" by another constituent. Thus, for the department's analysis of this data, the majority of the constituents had to identify and agree that a particular outcome was a strength or "area for improvement." These are presented below along with the corresponding changes that have been identified to improve the program.

Strengths

- Knowledge of contemporary Issues
- An understanding of responsibility and accountability
- A recognition of the need for an ability to engage in lifelong learning
- A desire to be a flexible and adaptable team player (collaborative attitude)
- A knowledge of current events and societal contemporary issues – non engineering related
- A desire to be a professional that exhibits values, dedication and a need for continual improvement
- Ability of the students to address economic issues, and ethical and concerns social concerns

Areas for Improvement

- An Ability to Design and Conduct Experiments as Well as to Analyze and Interpret Data
- An Ability to Communicate Effectively
- An Ability to Apply Knowledge of Mathematics, Science, and Engineering – Specifically, an "Area for Improvement" in Dynamics

X Program Modifications

The department believes that these areas of improvement can be addressed by making three major modifications to the curriculum:

Area of Improvement #1:

An Ability to Design and Conduct Experiments as Well as to Analyze and Interpret Data

Solution:

Students Need to be Able to Design and Conduct an Experiment to Study an Assigned Phenomenon

During the 2001-2002 assessment period, the department proposed significantly altering the structure of the ME laboratories to address this "area of improvement." The plan was to discontinue the joint laboratories with the Civil Engineering department and offer two, 2 unit Mechanical engineering laboratories in which the department had absolute control. However, due to enrollment size and budget limitations, this solution was deemed not practical by the college curriculum committee. Thus, we have developed a new approach to addressing this "area of improvement." We have submitted a program modification that increases the number of required labs while decreasing the number of elective labs.
Specifically, there is one elective upper division lab and three required labs. The required labs are:

1. CE/ME 312 (Strength of materials)
2. CE/ME 313 (Fluid Mechanics I)
3. ME 315 (Thermal systems)

The advantage to this new curriculum is that all ME students are required to complete ME 315 which is not a shared lab with any other program. Thus, the ME department has complete control over its contents. The final lab in this course is an open ended experience where the instructor describes a phenomenon to be studied and assigns the students the task of designing and conducting the experiment.

Area of Improvement #2:

An Ability to Communicate Effectively

Solution:

Create a Required Mechanical Engineering Writing Course

The Mechanical Engineering Writing Laboratory (ME 310) has been developed and made required. The new course focuses on technical and laboratory report writing. The main objective of this course is to provide students with methods, strategies and contexts for developing clear and effective writing suitable for the mechanical engineering profession. Special attention is paid to issues of format, audience, purpose, organization, clarity, and style. To pass the course students must demonstrate, through reading, discussing, writing, and revising, that they can produce technical and business documents such as memos, letters of transmittal, technical presentations, procedures, proposals, abstracts and summaries, laboratory and research reports, and resumes. Workgroups and peer review comprise a significant part of the class.

Area of Improvement #3:

An Ability to Apply Knowledge of Mathematics, Science, and Engineering – Specifically, an "Area for Improvement" in Dynamics

Solution:

Modify the Curriculum to Include an Additional Required Dynamics Course

We have added 4 units to the Upper Division Major Requirements; it is now 53 units. Students have a choice to select ME321, Kinematics, or ME421, Dynamics of Machinery as the added course. Both of these courses were formerly listed under the Upper Division Technical Electives. Previously the Upper Division Major Requirements comprises a total of twenty-four units (6 lecture courses). This has been reduced to twenty units (five lecture courses). If a student chooses to take both ME321 and ME421, one will automatically be counted as an elective. This change was made as a direct result of analysis of FE exam data, knowledge gained with student focus groups, and observation by the faculty. Both strongly suggesting that only one required course is dynamics, ME320, Dynamics I, is grossly inadequate. The contents of ME321 and ME421 has been modified and tailored to fill the gap of knowledge in dynamics.

Appendices

Appendix 1: Sample Course Coordinator Survey

To: Professor _____
Course Coordinator for _____

From: Assessment Coordinator
Subject: ABET Course Coordinator Survey

We are seeking your input to determine which, and to what degree, the mechanical engineering program outcomes are 1) currently being met by ME_____ and 2) could be met in ME_____ with minor course modifications in the future. If you have any questions, please do not hesitate to contact me.

Please indicate with
H=High M=Medium L= Low N= No

1) knowledge:

Graduates of the Mechanical Engineering program will have the knowledge in math, science and engineering fundamentals, as well as societal issues, that allows them to approach real-world Mechanical Engineering problems with an understanding of their impact on society.

Measurable outcomes:	current	future
an ability to apply knowledge of mathematics, science, and engineering (abet a) In particular, an ability to apply knowledge of: a) chemistry and calculus-based physics. **b) advanced mathematics through multivariate calculus and differential equations.** c) statistics and linear algebra.		
an understanding of professional and ethical responsibility (abet f)		
the broad education necessary to understand the impact of engineering solutions in a global/societal context (abet h)		
knowledge of current events and societal contemporary issues -- non-engineering related. (abet j)		
a knowledge of computer aided design and simulation software		
a knowledge of measurement and manufacturing techniques		
a knowledge of how mechanical engineering integrates into inter-disciplinary systems		

2) Skills

Graduates of the Mechanical Engineering program will be able to work in group and individual settings to define and solve problems related to thermal and mechanical systems and manufacturing processes by applying engineering fundamentals and engineering tools with a logical approach and be able to clearly communicate their findings.

Measurable outcomes:	current	future
an ability to design and conduct experiments as well as to analyze and interpret data (abet b)		
an ability to design a system, component, or process to meet desired needs (abet c)		
an ability to function on multidisciplinary teams (abet e)		
an ability to communicate effectively (abet g)		
an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (abet k)		
an ability to select materials and manufacturing processes		
an ability to visualize designs from engineering drawings		
an ability to think in a logical sequential process		

3) Attitudes

Graduates of the Mechanical Engineering program will be confident in their abilities to be successful in industrial, academic, and governmental positions and will have the positive and inquisitive outlook on life and learning necessary to promote their continued professional and personal development throughout their careers.

Measurable outcomes:	current	future
an understanding of professional and ethical responsibility (abet f)		
a recognition of the need for an ability to engage in lifelong learning (abet i)		
an understanding of responsibility and accountability		
a desire to be a professional that exhibits values, dedication and a need for continual improvement		
a desire to be a flexible and adaptable team player (collaborative attitude)		

Appendix 2: Sample Capstone Oral Presentation Assessment Tool

Date: _____

Please circle the appropriate response.

Student **Faculty** **Industrial Representative**

If applicable to the senior design report being assessed, to what extent has the team demonstrated their ability to:

(1 shows high ability ……...…. 5 shows poor ability)	High Low
1) Design an experiment?	1 2 3 4 5 NA
2) Conduct an experiment?	1 2 3 4 5 NA
3) Analyze data and interpret data?	1 2 3 4 5 NA
4) Design a system or component?	1 2 3 4 5 NA
a) Clearly defined objective?	1 2 3 4 5 NA
b) Devise a plan of action?	1 2 3 4 5 NA
c) Produce a significant amount of work?	1 2 3 4 5 NA
d) Exhibit progress on the project?	1 2 3 4 5 NA
5) Communicate?	1 2 3 4 5 NA
a) Organize the flow of communication?	1 2 3 4 5 NA
b) Use of visual aids?	1 2 3 4 5 NA
c) Use presentation time effectively?	1 2 3 4 5 NA
d) Answer questions posed?	1 2 3 4 5 NA
6) Use Modern Engineering tools/techniques?	1 2 3 4 5 NA
7) Function as a cohesive team?	1 2 3 4 5 NA
8) Display professionalism?	1 2 3 4 5 NA
9) Knowledge of contemporary issues?	1 2 3 4 5 NA

Appendix 3: Sample Webfolio Assessment Sheet

Date: _____ **Reviewer's Name: _____**
Student's Name: _____

MECHANICAL ENGINEERING WEBFOLIO ASSESSMENT

Industrial Representatives:

Please consider the 5 Folders in the Student's Web folio and rate the student's performance.
5 shows high ability ……...…. 0 shows poor ability
NA shows that there is insufficient evidence to make a judgment

For the **Benefits of Current Issues** Folder, how well has the student demonstrated:	
Knowledge of current events and societal contemporary issues -- non-engineering related. (abet j)	5 4 3 2 1 NA

For the **Lab Report** Folder, how well has the student demonstrated:	
An ability to design and conduct experiments as well as to analyze and interpret data (abet b)	5 4 3 2 1 NA

For the **Life Long Learning Plan** Folder, how well has the student demonstrated:	
A recognition of the need for an ability to engage in lifelong learning (abet i)	5 4 3 2 1 NA

For the **Resume** Folder, how well has the student demonstrated:	
An understanding of professional and ethical responsibility (abet f)	5 4 3 2 1 NA

For the **Senior Design Project Extended Abstract** Folder, how well has the student demonstrated:	
An ability to design a system, component, or process to meet desired needs (abet c)	5 4 3 2 1 NA
An ability to think in a logical sequential process that lends itself to identifying, formulating and solving engineering problems (abet e(abet e)	5 4 3 2 1 NA

For the **Overall Webfolio Presentation**, how well has the student demonstrated:	
An ability to communicate effectively (abet g)	5 4 3 2 1 NA
An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (abet k)	5 4 3 2 1 NA
A desire to be a professional that exhibits values, dedication and a need for continual improvement	5 4 3 2 1 NA

Appendix 4: Sample Student Survey

Senior Survey **Today's Date: _____**
Mechanical Engineering **Expected Graduation Date: _____**

Question	**Rating**
How satisfied are you with your education at CSULA in meeting the following: **(1 is very satisfied …….. 5 is very dissatisfied)**	**Satisfied Dissatisfied**
Knowledge	
1. Ability to apply knowledge of mathematics to solving engineering problems.	1 2 3 4 5 NA
2. Ability to apply knowledge of mathematics to solving science problems.	1 2 3 4 5 NA
3. Ability to apply knowledge of engineering to solving problems.	1 2 3 4 5 NA
4. An understanding of the global impact engineering solutions can have on society.	1 2 3 4 5 NA
5. A knowledge of contemporary issues.	1 2 3 4 5 NA
6. A knowledge of computer aided design and simulation software.	1 2 3 4 5 NA
7. A knowledge of measurement and manufacturing techniques.	1 2 3 4 5 NA
8. A knowledge of how mechanical engineering integrates into inter-disciplinary systems.	1 2 3 4 5 NA
Skills	
9. Ability to design a statistically valid experiments.	1 2 3 4 5 NA
10. Ability to conduct an experiment	1 2 3 4 5 NA
11. Ability to analyze and interpret data obtained from an experiment.	1 2 3 4 5 NA
12. Ability to design a system, component or process to meet a desired need.	1 2 3 4 5 NA
	1 2 3 4 5 NA

13. Ability to function on multi-disciplinary teams.	1 2 3 4 5 NA
14. Ability to orally present ideas on engineering designs or solutions.	1 2 3 4 5 NA
15. Ability to write technical documents.	1 2 3 4 5 NA
16. Ability to use modern engineering tools necessary for engineering practice.	1 2 3 4 5 NA
17. Ability to select materials and manufacturing processes.	1 2 3 4 5 NA
18. Ability to visualize designs from engineering drawings.	1 2 3 4 5 NA
19. Ability to think in a logical sequential process.	
Do you agree that your education at CSULA provided the following: **(1 is agree …….. 5 disagree)**	**Agree Disagree**
<u>Attitudes</u>	
20. An understanding of professional and ethical responsibility.	1 2 3 4 5 NA
21. A Recognition of the need for life-long learning.	1 2 3 4 5 NA
22. An understanding of responsibility and accountability.	1 2 3 4 5 NA
23. A desire to be a professional that exhibits values, dedication, and a need for continual improvement.	1 2 3 4 5 NA
24. A desire to be a flexible and adaptable team player.	1 2 3 4 5 NA

Appendix 5: Survey of Recent Graduates (EBI)

Educational Benchmarking Inc. develops national benchmarking studies that allow the user to analyze their performance and compare the results to select peers and competitors.

In the survey instrument used in this study, questions 38 to 66 come directly from ABET Criteria 2000 standards. Participating colleges will be sent surveys and asked to distribute and collect surveys from graduating students either in senior design sections or as part of a "filing for graduation" process.

Colleges are able to choose six peer institutions from which to receive specific comparative data. Confidentiality of all college data is maintained by the reporting structure which does not identify who is who within the comparison group.

Seventy-one questions were asked covering satisfaction of graduates in the following fourteen major categories:

Quality of instruction in major courses (Questions 1-5)
Quality of teaching in math and science courses (Questions 6-9)
Other aspects of major courses (Questions 10-13, 14-17,20, 21)
Co-curricular activities (Questions 18-19)
Academic advising (Questions 24, 25)
Computing resources (Questions 26-29)
Characteristics of fellow students (Questions 30-32)
Career services and placement (Questions 33-37)
Engineering Skill Development (Questions 38-44, 47, 50, 51)
Ethics, global context, lifelong learning (Questions 45, 46, 52)
Oral and written communication (Questions 48, 49)
Capstone design experience (Questions 53-63)
Laboratory facilities (Questions 64-66)
Overall satisfaction with engineering program (67-71)

Appendix 6: Sample Senior Project Report Evaluation

Mechanical Engineering Senior Project Report Evaluation

Student's Name: _____

Evaluator's Name: _____

Title: _____

Affiliation: _____

Design:			
Concept	Good	Average	Poor
Description	Good	Average	Poor
Analysis:			
Thoroughness	Good	Average	Poor
Relevance to Design	Good	Average	Poor
Usage of Math/Science	Good	Average	Poor
Use Modern Software Tools	Good	Average	Poor
Drawings:			
Completeness	Good	Average	Poor
Use of Modern CAD software	Good	Average	Poor
Correct Dimensioning and Tolerancing	Good	Average	Poor
Details:			
Organization and Flow	Good	Average	Poor
Use of Technical Terms	Good	Average	Poor
Grammar and Spelling	Good	Average	Poor
Professional Component:			
Economic Issues Addressed	Good	Average	Poor
Environmental Issues Addressed	Good	Average	Poor
Sustainability Issues Addressed	Good	Average	Poor
Maintainability/Reliability	Good	Average	Poor
Ethical Concerns Addressed	Good	Average	Poor
Social Concerns Addressed	Good	Average	Poor
Safety Concerns Addressed	Good	Average	Poor
Overall Comments:	Good	Average	Poor
What grade would you give?	A	B	C	D	F

Comments: