California State University, Los Angeles

Department of

Mechanical Engineering

College of Engineering, Computer Science, and Technology

Report on the ABET (a) Through (k) Outcomes

1999-2000

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Introduction

This document reports the individual assessment results obtained for the mandatory a-through-k criteria in ABET EC 2000. For each outcome, the report presents:

1. the interpretation of the outcome by the engineering faculty at Cal State L. A.
2. the degree of focus on the outcome by the current Mechanical Engineering curriculum.
3. a list of the tools utilized to measure each outcome.
4. a description of the implementation of the tools and graphical representation of the results for each outcome.
5. a summary of the findings in a “program-strengths” and “program-areas-for-improvement” format.
6. a discussion of the changes made to the Mechanical Engineering program based on the assessment findings.
7. a summary demonstrating the Mechanical Engineering departmental effort toward each outcome that verifies that each outcome is met by each graduate of the program.

ABET a : an ability to apply knowledge of mathematics, science, and engineering (Knowledge Outcome #1)

In particular, an ability to apply knowledge of:

a) chemistry and calculus-based physics.

b) advanced mathematics through multivariate calculus and differential equations.

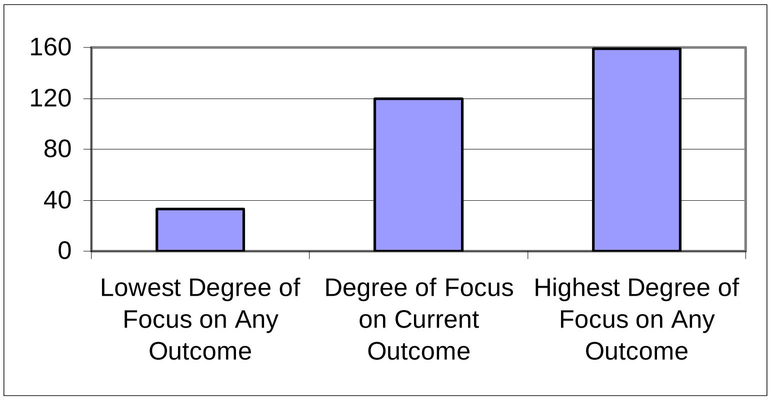
c) statistics and linear algebra.

Definition: We describe knowledge of mathematics as proficiency in mathematics through differential equations, probability and statistics, linear algebra, and logical thinking. Knowledge of science includes proficiency in calculus-based physics and general chemistry. While the engineering core includes topics such as statics, strength of materials, and basic circuits for all students in engineering, each program has greater breath and depth in topics relevant to its program. Engineering is the profession in which a knowledge of materials, natural sciences, and mathematics is applied to develop ways to economically utilize the materials and forces of nature for the benefit of humanity. Therefore one of the most important attributes an engineering graduate can have is the ability to apply knowledge of math, science, and engineering to the problems of designing systems and devices.

Students are expected to be proficient in basic mathematics, science, and engineering and be able to use the approaches taken by scientists/ mathematicians/engineers to solve engineering problems. (i.e., the scientific method, postulates and proofs)

Curriculum Focus:

The degree to which the current curriculum focuses upon each of the ABET a-k outcomes was assessed during summer/fall 1999. All courses were analyzed by their respective course coordinators. 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 the topic is not a focus in the course. With these ratings, the total points were computed for each program outcome. These sums are used to 1) show that all ABET a-k outcomes are addressed to some degree by the curriculum and 2) to search for correlations between a low focus on an outcome by the curriculum and low performance by the students on the corresponding outcome. The figure below compares how much the current Mechanical Engineering curriculum focuses on "**an ability to apply knowledge of mathematics, science, and engineering**" with the student outcomes that have the lowest and highest degrees of focus in the Mechanical Engineering curriculum.



Current Curriculum Strength
(note: this is not a measure of performance, merely a measure of the quantity of input delivered by the curriculum towards each outcome)

As the Current Curriculum Strength graph indicates, the curriculum of the Mechanical Engineering program has an intermediate degree of focus on "**an ability to apply knowledge of mathematics, science, and engineering** ."

Tools: The following tools were used to assess this outcome:

- Mathematics Pretests/Tests
- Survey of Students
- Survey of Industrial Representatives
- Survey of Employers
- EBI Student Assessment Study

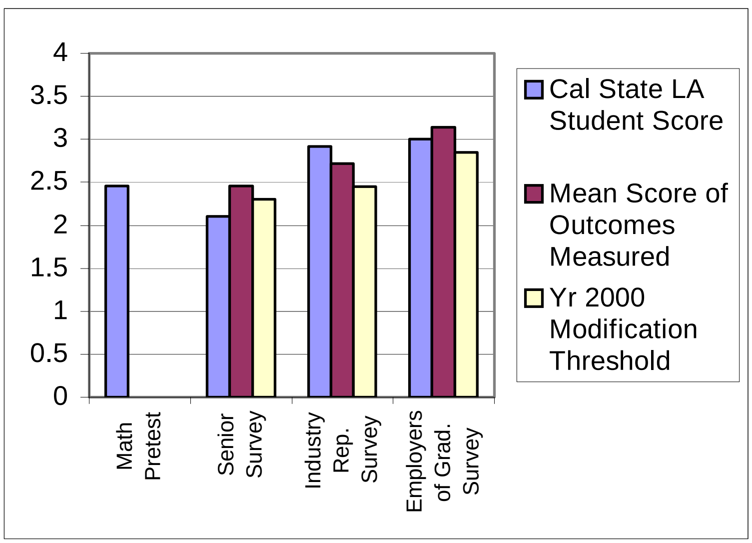
Results:

The first graph (titled "Pretest and Survey Results") below shows the results of the mathematics pretest and the results of several surveys. The mathematics pretest is an exam given to students at the beginning of senior and junior level courses that are known to be mathematics intensive. Since students entering these course have completed all of their basic mathematics courses, the exam measures their retention and their ability to apply this knowledge. The surveys were administered to senior level students, industry representatives (who frequently give input to the program), and employers of recent graduates of the program.

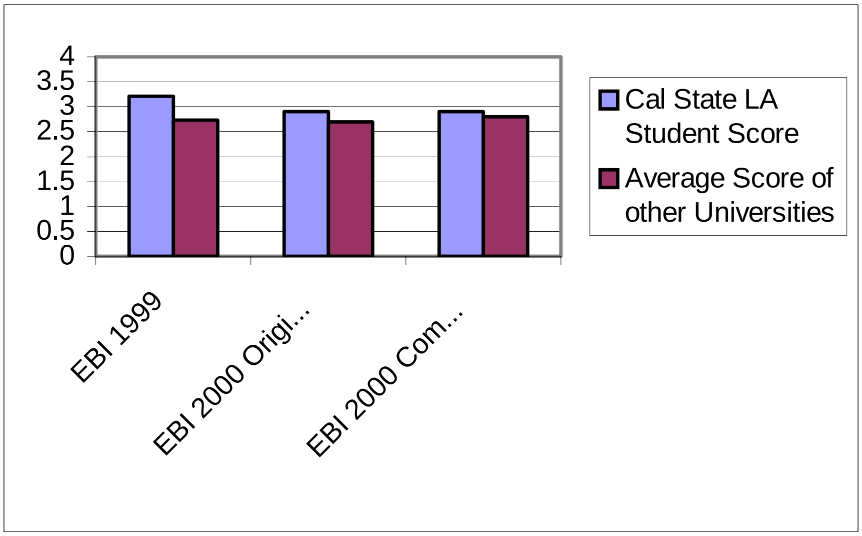
The threshold level for the year 2000 was set by the faculty as described in the 1998-1999 Mechanical Engineering program assessment report. As the report explains, all of the student learning outcomes were measured and their relative scores were compared. The threshold level was set such that the scores of the three outcomes that showed the highest need for improvement from each of the program's three primary constituents (senior level students, industrial representatives, and employers of recent graduates) were less than the threshold value. Thus, the threshold levels for 2000 (Yr 2000 Modification Thresholds) are:

Constituents	Yr 2000 Modification Threshold
Senior	2.30
Industrial Representatives	2.45
Employers of Recent Graduates	2.85

The second chart (titled "EBI Results") shows three representations of the results related to this outcome from the survey conducted by Educational Benchmarking Inc. (EBI). The first EBI survey was conducted in 1999, and it compared Cal State LA student performance with performance at University of California, Berkeley, Penn State University, University of Washington, Loyola Marymount University (deemed "original universities"). The second survey was performed in 2000 and again compares the Cal State L. A. results with those same schools. Added to the "original universities" during the 2000 study were the Ohio State University, and the University of Texas at Austin. The third EBI survey compares the Cal State LA performance with the performances of students from CSU Chico, CSU Northridge, Youngstown State University, Villanova University, University of Toledo, and Florida Atlantic University (deemed "comparable universities").



Pretest and Survey Results



EBI Results

Assessment of Outcome:

Strengths

1. Employers of our recent graduates and the industrial representatives to the program rank our students' basic mathematics, science and engineering knowledge near a 3.0 ("B") level.
2. All Cal State LA scores on this outcome measured with the EBI survey were near or above a 3.0 ("B") level.
3. For all three representations of the EBI study, Cal State LA student performance was above the average performance of the other six universities.

Areas for Improvement

1. Students have a lower opinion of their own mathematics, science and engineering knowledge than do all of the other constituents.
2. The score for this outcome from the student survey is lower than the threshold score set by the department for this constituent group.
3. Although students obtained a relatively high score on the mathematics pretest, the department would like the score to reach a 3.0 ("B") level.

Corresponding Changes to the Program

The department is further refining the mathematics pretest and will use the exam as a screening tool for mathematics competency. Students who perform below the set criteria must attend the University Tutorial Center to receive assistance in their areas of weakness. Further, the department will be offering workshops operated by graduates to all students who would like to strengthen their mathematics skills. Further, the course structure of ME 319 is being modified such that half of its focus is on developing the students' fundamental mathematics skills and knowledge.

Summary

The Mechanical Engineering faculty demonstrated that all graduates of the Mechanical Engineering program have the ability to **apply knowledge of mathematics, science, and engineering** as evidenced by:

1. scores above the threshold for program change in all cases
2. high survey ratings from the employers of recent graduates and from the program's industrial representatives
3. high performance of the Cal State LA students on the EBI study relative to the performance of the students representing the other six universities

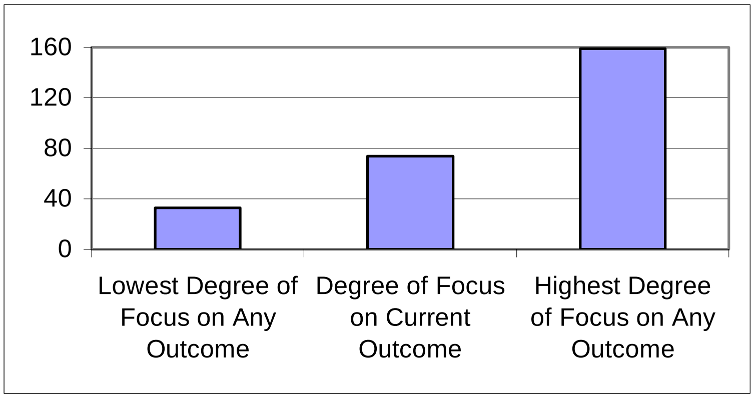
ABET b: an ability to design and conduct experiments as well as to analyze and interpret data (Skills Outcome #1)

Definition: Experiments are an integral part of the engineering design process. Generally, the purpose of experiments is to ensure that design goals and specifications are being met, and that the product from the design process is economical and achieves the highest level of safety. Experiments are performed at various stages of the design process, and in a variety of ways. For example, in the process of designing, developing and building an automobile, tests may be run to determine the unknown mechanical properties of materials needed for analysis, such as for plastics, metals and rubber. Experiments may also be performed on an individual component of a system to determine its performance characteristics. For example, an automobile battery may be tested to determine its service-life characteristics. Experiments may be performed on entire systems as well. For example, an automobile may be tested to determine its crash-worthiness characteristics.

Generally, experimentation involves planning, selection of samples, selection of test equipment, selection of sensors and instrumentation, development and execution of procedures, acquisition of data, analysis of data, interpretation of data, and drawing of conclusions. Common measurements may involve such quantities as time, length, mass, force, temperature, current, charge and voltage. Engineering students should acquire the knowledge and skills associated with the above experimentation activities. Included in this is familiarity with the discipline called “Design of Experiments (DOE)” which maximizes the results-to-cost ratio in situations when a multitude of test variables need to be examined. More specifically, DOE is a planned approach for determining cause-and-effect relationships that can be applied to any process with measurable inputs and outputs. DOE provides a statistical means for analyzing how numerous variables interact.

Curriculum Focus:

The degree to which the current curriculum focuses upon each of the ABET a-k outcomes was assessed during summer/fall 1999. All courses were analyzed by their respective course coordinators. 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 the topic is not a focus in the course. With these ratings, the total points were computed for each program outcome. These sums are used to 1) show that all ABET a-k outcomes are addressed to some degree by the curriculum and 2) to search for correlations between a low focus on an outcome by the curriculum and low performance by the students on the corresponding outcome. The figure below compares how much the current Mechanical Engineering curriculum focuses on "**an ability to design and conduct experiments as well as to analyze and interpret data**" with the student outcomes that have the lowest and highest degrees of focus in the Mechanical Engineering curriculum.



Current Curriculum Strength
(note: this is not a measure of performance, merely a measure of the quantity of input delivered by the curriculum towards each outcome)

As the Current Curriculum Strength graph indicates, the curriculum of the Mechanical Engineering program has an intermediate degree of focus on "**an ability to design and conduct experiments as well as to analyze and interpret data**."

Tools: The following tools were used to assess this outcome:

- Capstone Course
- Survey of Students
- Survey of Industrial Representatives
- Survey of Employers
- EBI Student Assessment Study
- (may add webfolio)

Results:

The first graph (titled "Capstone and Survey Results") below shows the assessment results of the capstone course oral presentations and the assessment results of several surveys. During the final oral presentation of the senior design class, students, faculty, and industry representatives were all asked to complete an assessment of the strength of several student outcomes. The surveys were administered to senior level students, industry representatives (who frequently give input to the program), and employers of recent graduates of the program.

The threshold level for the year 2000 was set by the faculty as described in the 1998-1999 Mechanical Engineering program assessment report. As the report explains, all of the student learning outcomes were measured and their relative scores were compared. The threshold level was set such that the scores of the three outcomes that showed the highest need for improvement from each of the program's four primary constituents (Senior level students, industrial representatives, and employers or recent graduates) were less than the threshold value. Thus, the threshold levels for 2000 (Yr 2000 Modification Thresholds) are:

Constituents	Yr 2000 Modification Threshold
Senior	2.30
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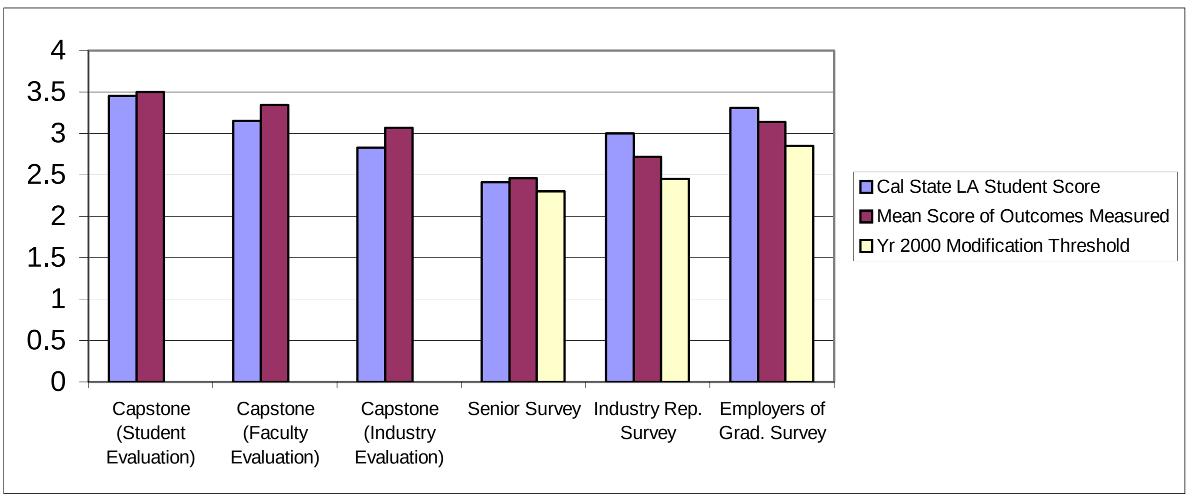
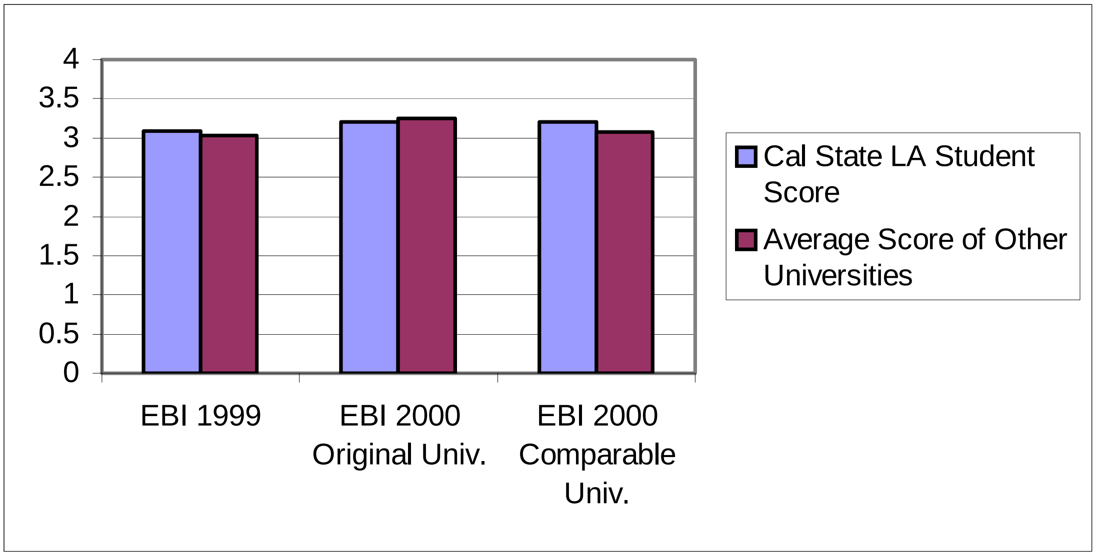


Capstone and Survey Results



EBI Results

Assessment of Outcome:

Strengths

1. In the capstone presentation, faculty, industry representatives and fellow students all judged that our senior level students can conduct an experiment near or above a 3.0 ("B") level.
2. Actual employers of our recent graduates rank our students' ability to conduct an experiment higher than do the students and industrial representatives who are advisors to the program.
3. In all survey cases, results for the outcome related to the ability of the student to conduct experiments are nearly at the mean score obtained for all other outcomes. An average-to-strong performance means that the program does not need modification to improve student performance on this outcome.
4. For all three representations of the EBI study, Cal State LA performance was nearly equal or above the average performance of the other 6 universities.

Areas for Improvement

1. Since the surveys show that all constituents give high ratings to Cal State LA students' abilities to design and conduct an experiment but the capstone assessment show some deficiencies, further assessment is required. Future assessment of this outcome will be performed in more appropriate laboratory classes designed to address experimental techniques.

Corresponding Changes to the Program

None at this time.

Summary

The Mechanical Engineering faculty demonstrated that all graduates of the Mechanical Engineering program have **an ability to design and conduct experiments as well as to analyze and interpret data** as demonstrated by:

1. high survey ratings from faculty, industry representatives and fellow students during the capstone presentation
2. high survey ratings from the employers of recent graduates and from the program's industrial representatives
3. high performance of the Cal State LA students on the EBI study when compared to the performance of the students representing the other 6 universities

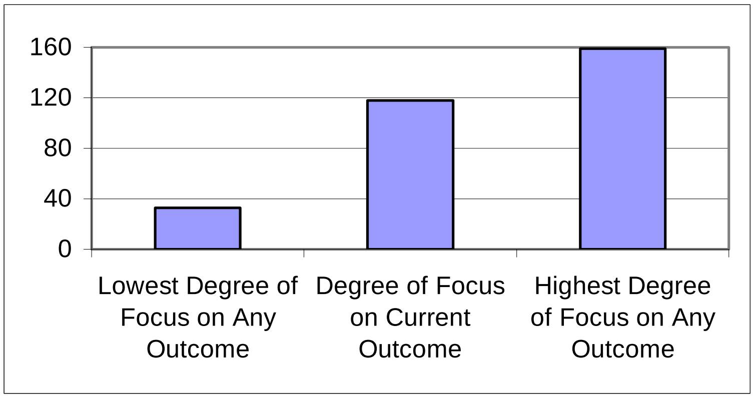
ABET c: an ability to design a system, component, or process to meet desired needs (Skills Outcome #2)

Definition: Design may be broadly defined as the process of creating a new or improved product, system, or service. The ability to design to meet a desired need is a distinguishing trait of an engineer. It is probably the most challenging process because it requires an engineer to take an idea and convert it into a useful, functional, and economical system, product or service. The engineer must rely on acquired engineering knowledge and skills (e.g. knowledge of math and science principles; and communication, teamwork, and organizational skills), external input from constituents, intuition, and creativity, and guide the process from conception to completion. During this process an engineer must also understand the end product, system, or service from a user's perspective in order to achieve a good design.

Frequently, the design process is iterative and may require several revisions to best meet the desired need. Sometimes the design may involve solving a new problem, but more often it involves improving an existing design. Since several design alternatives may be possible, an engineer must also consider such factors as cost, efficiency, and ease of production in order to achieve an optimum design. The engineer must also often satisfy external design constraints such as aesthetics, safety, reliability, and societal concerns.

Curriculum Focus:

The degree to which the current curriculum focuses upon each of the ABET a-k outcomes was assessed during summer/fall 1999. All courses were analyzed by their respective course coordinators. 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 the topic is not a focus in the course. With these ratings, the total points were computed for each program outcome. These sums are used to 1) show that all ABET a-k outcomes are addressed to some degree by the curriculum and 2) to search for correlations between a low focus on an outcome by the curriculum and low performance by the students on the corresponding outcome. The figure below compares how much the current Mechanical Engineering curriculum focuses on "**an ability to design a system, component, or process to meet desired needs**" with the student outcomes that have the lowest and highest degrees of focus in the Mechanical Engineering curriculum.



Current Curriculum Strength
(note: this is not a measure of performance, merely a measure of the quantity of input delivered by the curriculum towards each outcome)

As the Current Curriculum Strength graph indicates, the curriculum of the Mechanical Engineering program has an intermediate degree of focus on "**an ability to design a system, component, or process to meet desired needs**."

Tools: The following tools were used to assess this outcome:

- Capstone Course
- Pretests/Tests (WPE) -- All students must pass to graduate
- Survey of Students
- Survey of Industrial Representatives
- Survey of Employers
- EBI Student Assessment Study
- (may add webfolio)

Results:

The first graph (titled "Capstone and Survey Results") below shows the assessment results of the capstone course oral presentations and the assessment results of several surveys. During the final oral presentation of the senior design class, students, faculty, and industry representatives were all asked to complete an assessment of the strength of several student outcomes. The surveys were administered to senior level students, industry representatives (who frequently give input to the program), and employers of recent graduates of the program.

The threshold level for the year 2000 was set by the faculty as described in the 1998-1999 Mechanical Engineering program assessment report. As the report explains, all of the student learning outcomes were measured and their relative scores were compared. The threshold level was set such that the scores of the three outcomes that showed the highest need for improvement from each of the program's four primary constituents (Senior level students, industrial representatives, and employers or recent graduates) were less than the threshold value. Thus, the threshold levels for 2000 (Yr 2000 Modification Thresholds) are:

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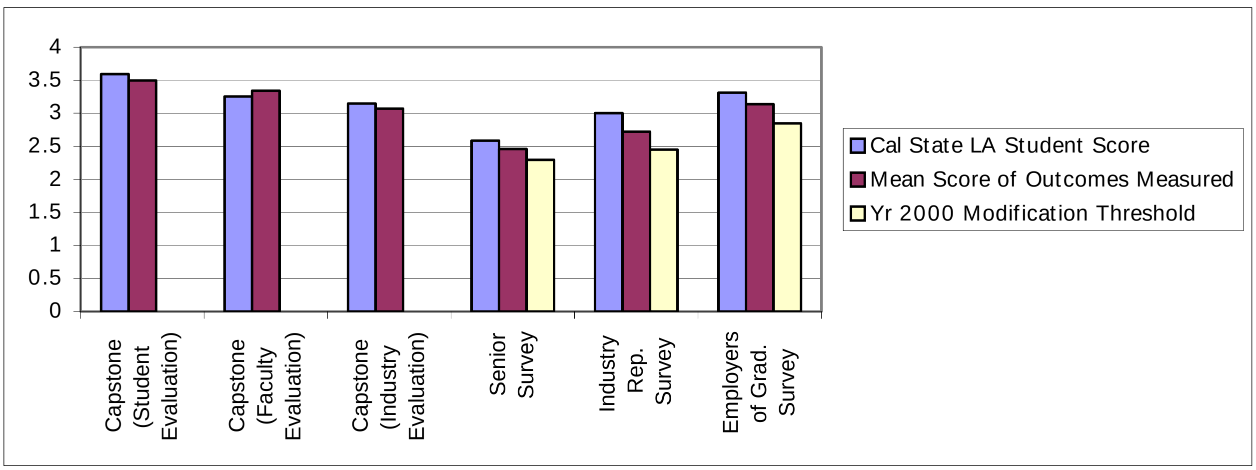
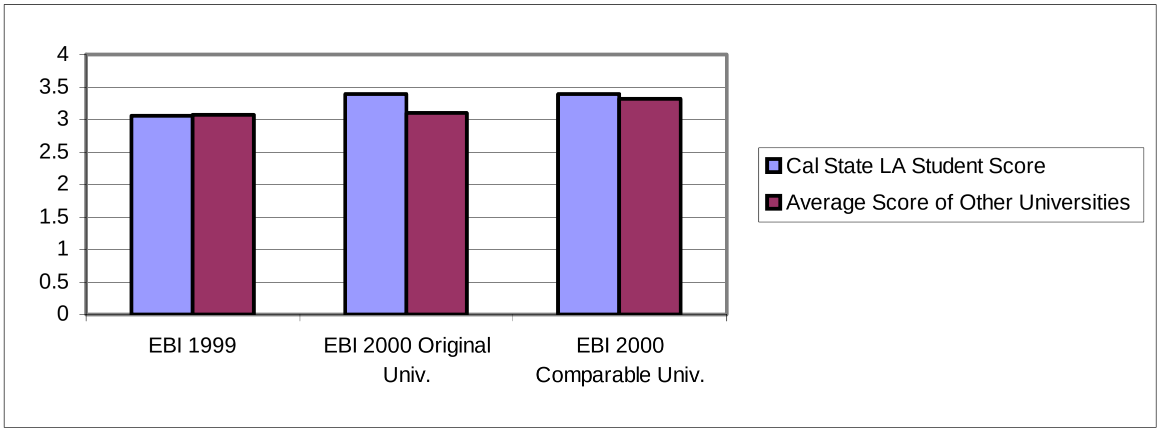


Capstone and Survey Results



EBI Results

Assessment of Outcome:

Strengths

1. In the capstone presentation, faculty, industry representatives and fellow students all judged that our senior-level students score near or above a 3.0 ("B") level on their ability to design.
2. In all survey cases, the results related to the outcome which corresponds to the ability of the student to design are above the mean score obtained for all other outcomes. An average-to-strong performance means that the program does not need modification to improve student performance on this outcome.
3. For all three representations of the EBI study, Cal State LA performance was nearly equal to or above the average performance of the other 6 universities.

Areas for Improvement

1. The only constituent to assess Cal State LA student performance as being below the mean was the faculty. Thus, a line of communication will be opened between the employers of Cal State LA graduates and the faculty so that standards of both constituents can be compared and adjusted.

Corresponding Changes to the Program

None at this time.

Summary

The Mechanical Engineering faculty demonstrated that all graduates of the Mechanical Engineering program have **an ability to design a system, component, or process to meet desired needs** as demonstrated by:

1. high survey ratings from faculty, industry representatives and fellow students during the capstone presentation
2. survey scores on this outcome were judged by all constituents to be above the mean scores of all other outcomes measured
3. high performance of the Cal State LA students on the EBI study when compared to the performance of the students representing the other 6 universities

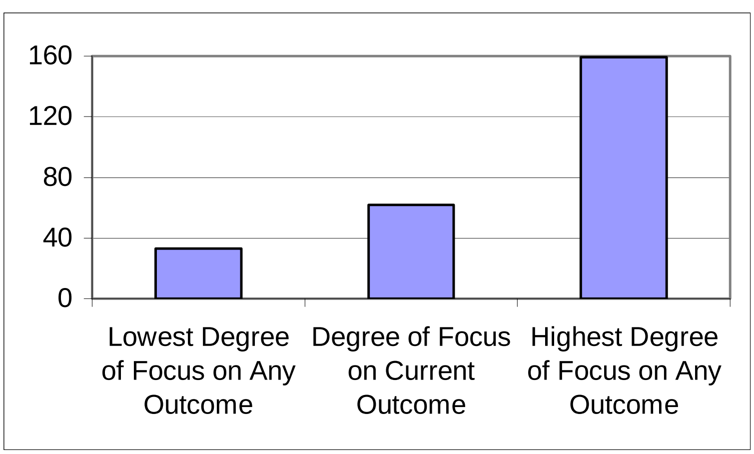
ABET d : an ability to function on multidisciplinary teams (Skills Outcome #3)

Definition: Take a moment to consider how you would build a multi-disciplinary team. Suppose you had the task of building a team responsible for designing an artificial hand. Whom would you include? The easier part of this task is deciding what technical expertise is needed. To design an artificial hand, you would need a mechanical engineer to design the robotics; an electrical engineer to design the control hardware; a hand surgeon who understands the physiology of the hand and how to attach it; and an occupational therapist to train patients to use the hand.

Besides their technical expertise, what other skills would you look for? Clearly for such an eclectic group to effectively work together, they need to be able to communicate effectively. This requires the ability to express your ideas to people outside your area of expertise, both orally and in written communications and to understand the ideas expressed by others. In addition, you have to be able to respect the diversity of the group members, both technically and culturally. Finally, you have to be able to apply a rational process to collectively determine the best solution based on the input from all the group members.

Curriculum Focus:

The degree to which the current curriculum focuses upon each of the ABET a-k outcomes was assessed during summer/fall 1999. All courses were analyzed by their respective course coordinators. 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 the topic is not a focus in the course. With these ratings, the total points were computed for each program outcome. These sums are used to 1) show that all ABET a-k outcomes are addressed to some degree by the curriculum and 2) to search for correlations between a low focus on an outcome by the curriculum and low performance by the students on the corresponding outcome. The figure below compares how much the current Mechanical Engineering curriculum focuses on "**an ability to function on multidisciplinary teams**" with the student outcomes that have the lowest and highest degrees of focus in the Mechanical Engineering curriculum.



Current Curriculum Strength

(note: this is not a measure of performance, merely a measure of the quantity of input delivered by the curriculum towards each outcome)

As the Current Curriculum Strength graph indicates, the curriculum of the Mechanical Engineering program has an adequate, albeit low, degree of focus on "**an ability to function on multidisciplinary teams**."

Tools: The following tools were used to assess this outcome:

- Capstone Course
- Survey of Students
- Survey of Industrial Representatives
- Survey of Employers
- EBI Student Assessment Study
- (may add webfolio)

Results:

The first graph (titled "Capstone and Survey Results") below shows the assessment results of the capstone course oral presentations and the assessment results of several surveys. During the final oral presentation of the senior design class, students, faculty, and industry representatives were all asked to complete an assessment of the strength of several student outcomes. The surveys were administered to senior level students, industry representatives (who frequently give input to the program), and employers of recent graduates of the program.

The threshold level for the year 2000 was set by the faculty as described in the 1998-1999 Mechanical Engineering program assessment report. As the report explains, all of the student learning outcomes were measured and their relative scores were compared. The threshold level was set such that the scores of the three outcomes that showed the highest need for improvement from each of the program's four primary constituents (Senior level students, industrial representatives, and employers or recent graduates) were less than the threshold value. Thus, the threshold levels for 2000 (Yr 2000 Modification Thresholds) are:

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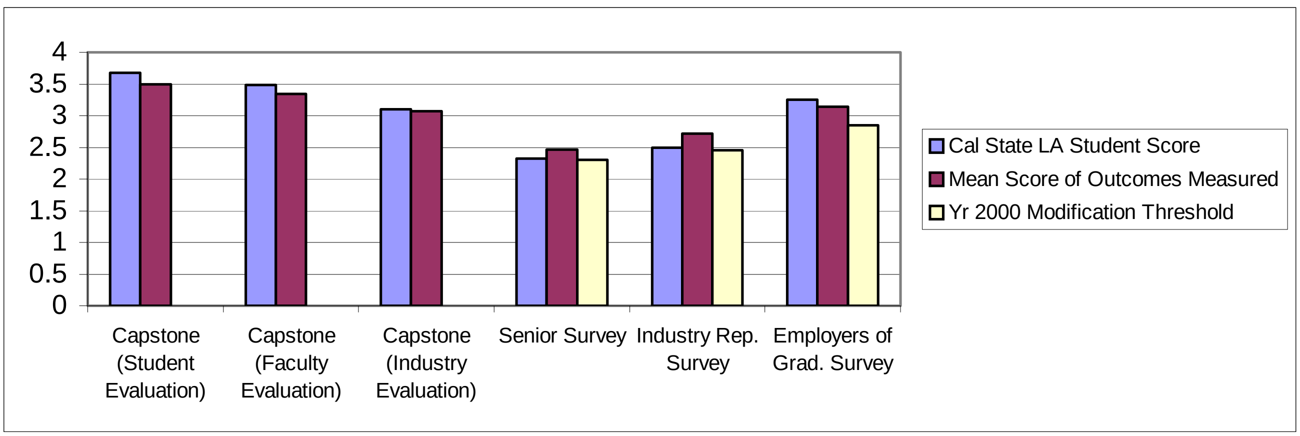
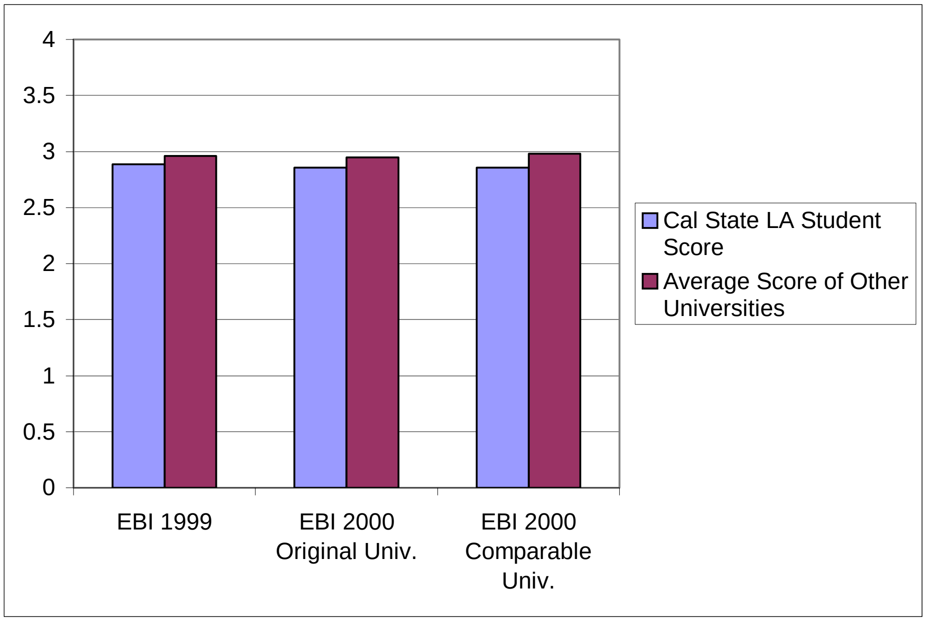


Capstone and Survey Results



EBI Results

Assessment of Outcome:

Strengths

1. The result from the capstone course presentations all show that students, faculty, and industrial representatives score our students' ability to function on multidisciplinary teams near a 3.0 ("B") level.
2. All results from the capstone course show that the ability to function on multidisciplinary teams corresponds to an outcome score which is above the mean score obtained for all other outcomes. An average-to-strong performance means that the program does not need modification to improve student performance on this outcome.
3. Actual employers of our recent graduates rank our students' ability to function on multidisciplinary teams above a 3.0 ("B") level.
4. For all three representations of the EBI study, Cal State LA performance was near the average performance of the other 6 universities and approximately at a 3.0 ("B") level score.

Areas for Improvement

1. Students and the industrial representatives to the program have a lower opinion of the students' ability to function on multidisciplinary teams than do the actual employers of our recent graduates.
2. Although the seniors in the capstone course scored high on this outcome, student surveyed in traditional lecture courses scored themselves lower than they did on all other outcomes, as shown in the mean score.

Corresponding Changes to the Program

The department is implementing more group and active learning activities in its traditional lecture courses. Group projects and homework will also be encouraged. Further, special student projects will be included in core courses that require all students to become involved with many disciplines (business, economics, design). The department also stresses the importance of student participation in externally funded research projects and in student competitions. Participation in these activities strengthen students' teamwork skills.

Summary

The Mechanical Engineering faculty demonstrated that all graduates of the Mechanical Engineering program have **an ability to function on multidisciplinary teams** as evidenced by:

1. high scores from all the constituents on the students' performance during the capstone presentation.
2. high survey ratings from the employers of recent graduates on the students' abilities to function on multidisciplinary teams.
3. a nearly 3.0 ("B") performance of the Cal State LA students on all the EBI studies. This rating is equal to the performance of the students representing the other 6 universities.

ABET e: an ability to think in a logical sequential process that lends itself to identifying, formulating and solving engineering problems (Skills Outcome #8)

Definition: While scientists collect and analyze data for the sole purpose of studying natural phenomena, the primary job function of an engineer is to solve human related problems. This is the niche of the engineer. Engineering problems are generally identified by, 1) a malfunction of an existing product (e.g. a software bug), 2) a need to improve human efficiency or comfort (e.g. development of a new tool), or 3) the awareness of new technology that leads to a new tool that people desire (e.g. cellular phones and microwave ovens).

The graduate of an accredited engineering program is required to have the ability to identify, formulate and solve an engineering problem. The definition of an engineering problem ranges from "there is something missing or wrong" to the ability to "meet a customer need" to the usage of new technology to "meet a need that a customer is unaware that he or she has." An example of an engineering problem "where something is missing or wrong" is the lack of a tool that is necessary on an assembly line to perform a desired function or the correction of a "bug" in computer software. An example of a engineering problem where "a customer need is unknown to the customer" is the development of a new toy that kids would find enjoyable. This need is often determined by means of a marketing survey.

After the graduate identifies the engineering problem, the graduate must have the ability to specify the exact requirements and goals for the solution. These specifications will range from technical requirements to aesthetic considerations. Technical requirements include elements such as the cost, physical geometry, accuracy and the life expectancy of a device. Examples of aesthetic requirements include things like the color and shape of the final product.

The next step is a brainstorming exercise. The graduate will be able to use his or her creativity to list all the solutions (possible and impossible) that he or she can imagine.

Once all solutions are defined, the graduate will use his or her scientific background and/or the input from the background of knowledgeable peers or experts to narrow the solutions to only those physically possible (e.g., no perpetual motion machines). Graduates from an accredited engineering program are not expected to always personally know what is physically possible or impossible, but they are expected to know how or where to get the answer.

The engineering problem is formulated by 1) specifying the problem in a clear and concise question statement and 2) attempting to match possible solutions to the question created from the problem with the technical and other specifications.

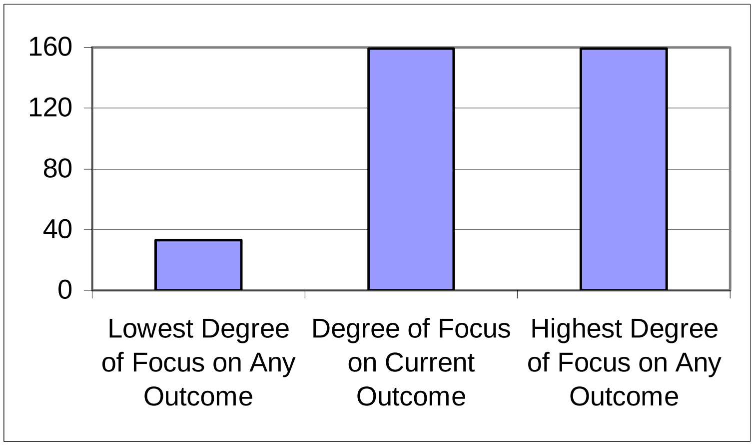
To solve the problem, the proper tools need to be selected and utilized. These tools include software programs, analytical techniques, experimental techniques and other methods. For example, the determination of the strength of a metal rod would be made using many methods.

Once the problem is defined and the techniques are selected, a series of problem solving attempts are made. Upon each attempt and corresponding failure, more is learned about the engineering problem. This iteration process is key to the engineering solution technique and will lead to one of many possible solutions to the problem.

The engineering problem is solved when the graduate narrows the solutions that he or she has determined are possible down to the most optimal solution using appropriate set of engineering tools.

Curriculum Focus:

The degree to which the current curriculum focuses upon each of the ABET a-k outcomes was assessed during summer/fall 1999. All courses were analyzed by their respective course coordinators. 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 the topic is not a focus in the course. With these ratings, the total points were computed for each program outcome. These sums are used to 1) show that all ABET a-k outcomes are addressed to some degree by the curriculum and 2) to search for correlations between a low focus on an outcome by the curriculum and low performance by the students on the corresponding outcome. The figure below compares how much the current Mechanical Engineering curriculum focuses on "**an ability to think in a logical sequential process that lends itself to identifying, formulating and solving engineering problems**" with the student outcomes that have the lowest and highest degrees of focus in the Mechanical Engineering curriculum.



Current Curriculum Strength
(note: this is not a measure of performance, merely a measure of the quantity of input delivered by the curriculum towards each outcome)

As the Current Curriculum Strength graph indicates, the curriculum of the Mechanical Engineering program has a high degree of focus on "**an ability to think in a logical sequential process that lends itself to identifying, formulating and solving engineering problems**."

Tools: The following tools were used to assess this outcome:

- Survey of Students NO CAPSTONE COURSE HERE?

- Survey of Industrial Representatives
- Survey of Employers
- EBI Student Assessment Study
- (may add webfolio)

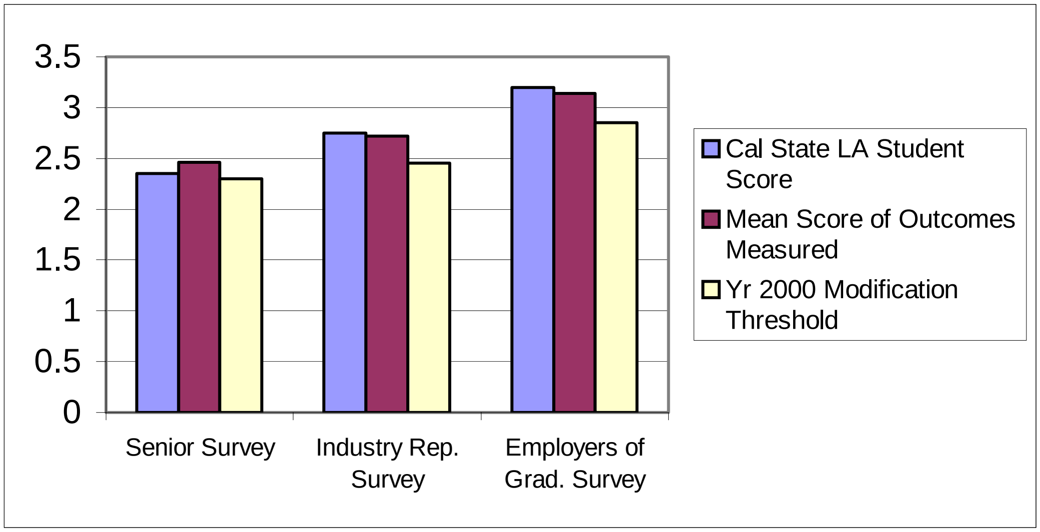
Results:

The first graph (titled "Survey Results") below shows the assessment results of several surveys. The surveys were administered to senior level students, industry representatives (who frequently give input to the program), and employers of recent graduates of the program.

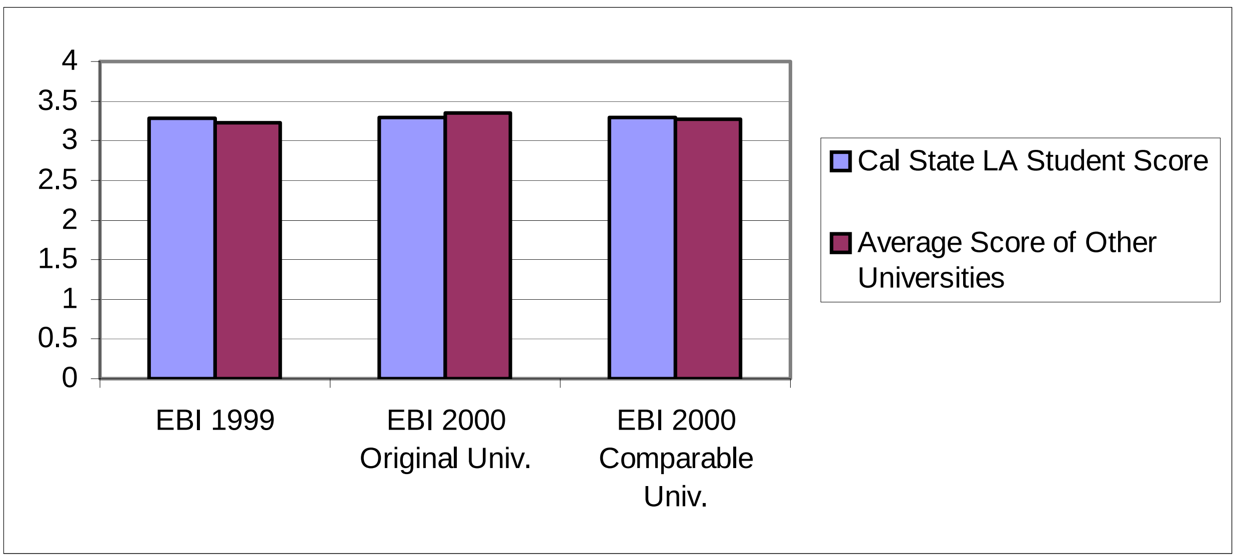
The threshold level for the year 2000 was set by the faculty as described in the 1998-1999 Mechanical Engineering program assessment report. As the report explains, all of the student learning outcomes were measured and their relative scores were compared. The threshold level was set such that the scores of the three outcomes that showed the highest need for improvement from each of the program's four primary constituents (Senior level students, industrial representatives, and employers or recent graduates) were less than the threshold value. Thus, the threshold levels for 2000 (Yr 2000 Modification Thresholds) are:

Constituents	Yr 2000 Modification Threshold
Senior	2.30
Industrial Representatives	2.45
Employers of Recent Graduates	2.85

The second chart (titled "EBI Results") shows three representations of the results related to this outcome from the survey conducted by Educational Benchmarking Inc. (EBI). The first EBI survey was conducted in 1999, and it compared Cal State LA student performance with performance at University of California (Berkeley), Penn State University, University of Washington University, Loyola Marymount University (deemed "original universities") The second survey was performed in 2000 and again compares the Cal. State LA results with those same schools. Added to the "original universities" during the 2000 study were the Ohio State University, and the University of Texas at Austin. The third EBI survey compares the Cal State LA performance with the performances of students from CSU Chico, CSU Northridge, Youngstown State University, Villanova University, University of Toledo, and Florida Atlantic University (deemed "comparable universities").



Survey Results



EBI Results

Assessment of Outcome:

Strengths

1. Actual employers of our recent graduates rank our students' ability to function on multidisciplinary teams above a 3.0 ("B") level.
2. The industrial representatives to the program rank the performance of this outcome above the mean score obtained for all other outcomes. An average-to-strong performance means that the program does not need modification to improve student performance on this outcome.

3. For all three representations of the EBI study, Cal State LA performance was near the average performance of the other 6 universities and scored above a 3.0 (“B”) level.

Areas for Improvement

1. Students have a lower opinion of the their own “ability to think in a logical sequential process that lends itself to identifying, formulating and solving engineering problems” than do any of the other constituents.

Corresponding Changes to the Program

The department feels that these findings show that our seniors have unjustified self doubt in their problem solving abilities. This can be corrected by sharing the findings of our alumni surveys and having student social functions that include alumni where design experiences can be shared.

Summary

The Mechanical Engineering faculty demonstrated that all graduates of the Mechanical Engineering program have **an ability to think in a logical sequential process that lends itself to identifying, formulating and solving engineering problems** as evidenced by:

1. high survey ratings from the employers of recent graduates and from the program's industrial representatives.
2. performance above the 3.0 (“B”) level of the Cal State LA students on the EBI study. This is nearly equal to the performance of the students representing the other 6 universities.

ABET f: an understanding of professional and ethical responsibility (Knowledge Outcome #2)

Definition: Ethics is a study of what is right and what is wrong. The problem is engineers often face "ethical dilemmas", i.e., situations where it is difficult to decide what is right or what is wrong.

Engineers must have an understanding of three key elements of ethical responsibility: 1) ethical awareness; 2) broader perspective on consequences of their actions; and 3) understanding of the interrelation between what they do and the rest of the system. The first element refers to the fact that engineers may simply be unaware that what they do may be unethical. This element may have cultural influences that are often deeply rooted. The second element deals with the scenario where engineers may be aware that what they do may not be entirely ethical, but they pursue the course of action irrespective of this knowledge to achieve a short range goal. The third element arises from the high complexity of today's engineered systems. Engineers need a proper understanding of how the different parts of the puzzle fit together before they can appreciate the ethical consequences of their action. In this regard, it is the responsibility of the industry to provide the environment whereby such knowledge can get disseminated among the various engineering teams.

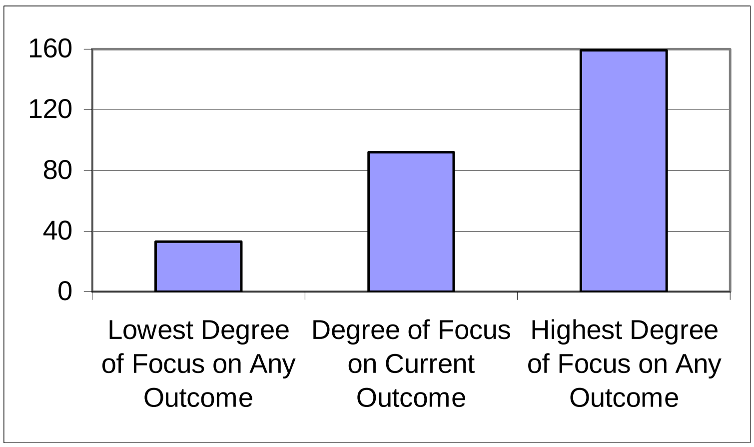
Professionalism refers to a set of attitudes and attributes that engineers must posses in order to be effective and fruitful in the conduct of their lives in relation to the society they live in.

The key elements of professionalism that all engineers must understand are: 1) engineering implies life-long learning; 2) today’s complex engineering tasks require a large amount of "socializing" and group work and understanding of the importance of interpersonal relationships among the members of the group; 3) group members need to develop a deep sense of duty and obligation toward their work by understanding the social, economical, and environmental consequences of their actions which may in fact be global in nature, and 4) the engineer must understand and appreciate the importance of membership and continued support and contribution to social groups in their communities, their areas of expertise in professional societies, at the national level via political participation, and at a global level.

Understanding of engineering ethics and professionalism is developed in the engineering graduates through formal coursework, modeling of ethical and professional behaviors by faculty and other key management or senior staff in their work environment, through interaction with professionals from industry, and other similar interactions.

Curriculum Focus:

The degree to which the current curriculum focuses upon each of the ABET a-k outcomes was assessed during summer/fall 1999. All courses were analyzed by their respective course coordinators. 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 the topic is not a focus in the course. With these ratings, the total points were computed for each program outcome. These sums are used to 1) show that all ABET a-k outcomes are addressed to some degree by the curriculum and 2) to search for correlations between a low focus on an outcome by the curriculum and low performance by the students on the corresponding outcome. The figure below compares how much the current Mechanical Engineering curriculum focuses on "**an understanding of professional and ethical responsibility**" with the student outcomes that have the lowest and highest degrees of focus in the Mechanical Engineering curriculum.



Current Curriculum Strength
(note: this is not a measure of performance, merely a measure of the quantity of input delivered by the curriculum towards each outcome)

As the Current Curriculum Strength graph indicates, the curriculum of the Mechanical Engineering program has an intermediate degree of focus on "**an understanding of professional and ethical responsibility**."

Tools: The following tools were used to assess this outcome:

- Survey of Students
- Survey of Industrial Representatives
- Survey of Employers
- EBI Student Assessment Study
- (may add webfolio)

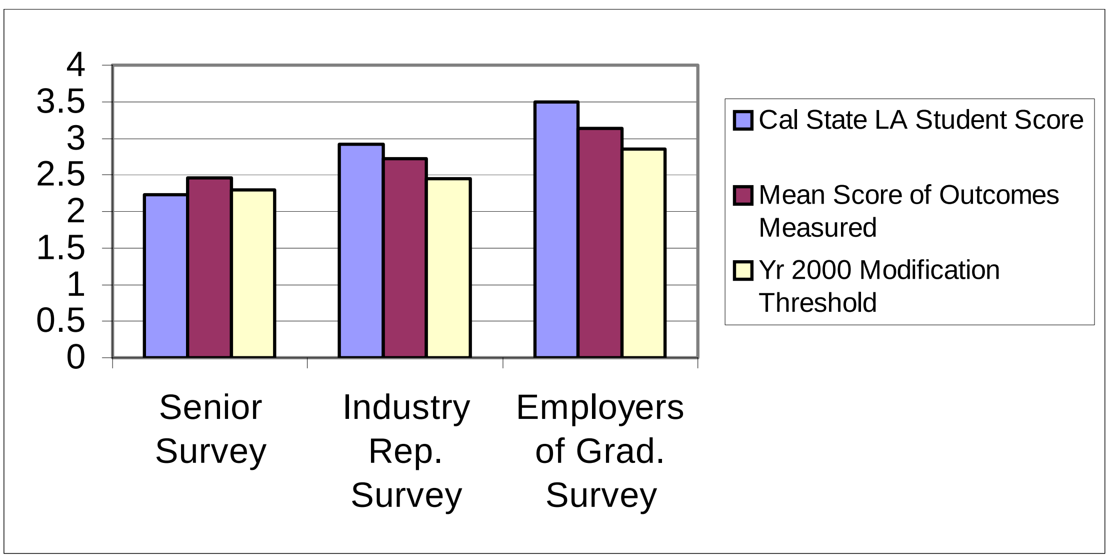
Results:

The first graph (titled "Survey Results") below shows the assessment results of several surveys. The surveys were administered to senior level students, industry representatives (who frequently give input to the program), and employers of recent graduates of the program.

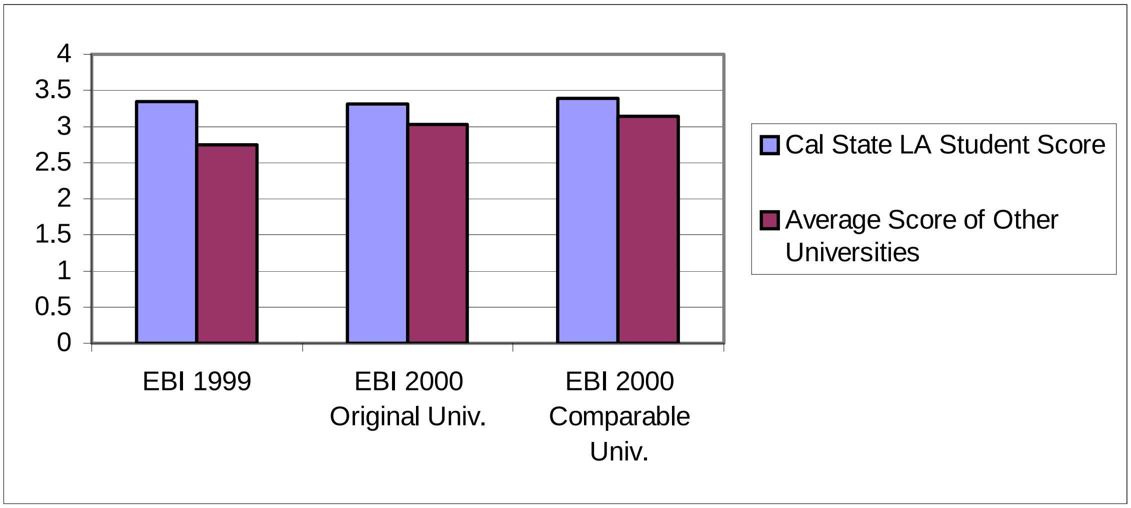
The threshold level for the year 2000 was set by the faculty as described in the 1998-1999 Mechanical Engineering program assessment report. As the report explains, all of the student learning outcomes were measured and their relative scores were compared. The threshold level was set such that the scores of the three outcomes that showed the highest need for improvement from each of the program's four primary constituents (Senior level students, industrial representatives, and employers or recent graduates) were less than the threshold value. Thus, the threshold levels for 2000 (Yr 2000 Modification Thresholds) are:

Constituents	**Yr 2000 Modification Threshold**
Senior	2.30
Industrial Representatives	2.45
Employers of Recent Graduates	2.85

The second chart (titled "EBI Results") shows three representations of the results related to this outcome from the survey conducted by Educational Benchmarking Inc. (EBI). The first EBI survey was conducted in 1999, and it compared Cal State LA student performance with performance at University of California (Berkeley), Penn State University, University of Washington University, Loyola Marymount University (deemed "original universities") The second survey was performed in 2000 and again compares the Cal. State LA results with those same schools. Added to the "original universities" during the 2000 study were the Ohio State University, and the University of Texas at Austin. The third EBI survey compares the Cal State LA performance with the performances of students from CSU Chico, CSU Northridge, Youngstown State University, Villanova University, University of Toledo, and Florida Atlantic University (deemed "comparable universities").



Survey Results



EBI Results

Assessment of Outcome:

Strengths

1. Employers of our recent graduates and the industrial representatives to the program rank our students' performance of this outcome above the mean score obtained for all other outcomes. An average-to-strong performance means that the program does not need modification to improve student performance on this outcome.
2. Actual employers of our recent graduates rate our students as having an **understanding of professional and ethical responsibility** near a 3.0 ("B") level.
3. For all three representations of the EBI study, Cal State LA performance was significantly above the average performance of the other 6 universities.

Areas for Improvement

1. Students have a lower opinion of their understanding of professional and ethical responsibility than do all of the other constituents.

Corresponding Changes to the Program

The department is concerned about the low score obtained from the student opinion survey. Faculty-student focus groups will be formed to determine the cause of the belief by students that they feel their colleagues have a poor understanding of professional and ethical responsibility.

Summary

The Mechanical Engineering faculty demonstrated that all graduates of the Mechanical Engineering program have **an understanding of professional and ethical responsibility** as evidenced by:

1. high survey ratings from the employers of recent graduates and from the program's industrial representatives
2. very high performance of the Cal State LA students on the EBI study when compared to the performance of the students representing the other 6 universities

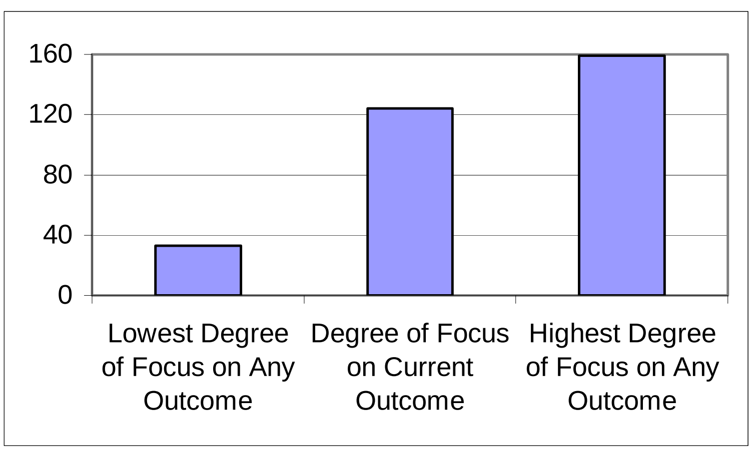
ABET g: an ability to communicate effectively (Skills Outcome #4)

Definition: Engineers must effectively communicate at various technical levels with colleagues, managers, clients and others. Communication is mainly oral and written but also includes electronic, graphical, and listening skills. As an example, an engineer will be required to write technical reports, develop product specifications, prepare technical documentation for designs and processes, and lead and participate in meetings. At these meetings, engineers make use of graphical illustrations and electronic media to enhance their written and oral presentations.

Students acquire these skills through courses, which emphasize written, oral and graphical communication. In addition, courses in technical report writing, written assignments in courses, capstone design project report writing and presentation, and participation in student organizations and professional societies provide other avenues to develop these communication skills.

Curriculum Focus:

The degree to which the current curriculum focuses upon each of the ABET a-k outcomes was assessed during summer/fall 1999. All courses were analyzed by their respective course coordinators. 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 the topic is not a focus in the course. With these ratings, the total points were computed for each program outcome. These sums are used to 1) show that all ABET a-k outcomes are addressed to some degree by the curriculum and 2) to search for correlations between a low focus on an outcome by the curriculum and low performance by the students on the corresponding outcome. The figure below compares how much the current Mechanical Engineering curriculum focuses on "**an ability to communicate effectively**" with the student outcomes that have the lowest and highest degrees of focus in the Mechanical Engineering curriculum.



Current Curriculum Strength
(note: this is not a measure of performance, merely a measure of the quantity of input delivered by the curriculum towards each outcome)

As the Current Curriculum Strength graph indicates, the curriculum of the Mechanical Engineering program has a high degree of focus on "**an ability to communicate effectively**."

Tools: The following tools were used to assess this outcome:

- Capstone Course
- Pretests/Tests (WPE) -- All students must pass to graduate
- Survey of Students
- Survey of Industrial Representatives
- Survey of Employers
- EBI Student Assessment Study

Results:

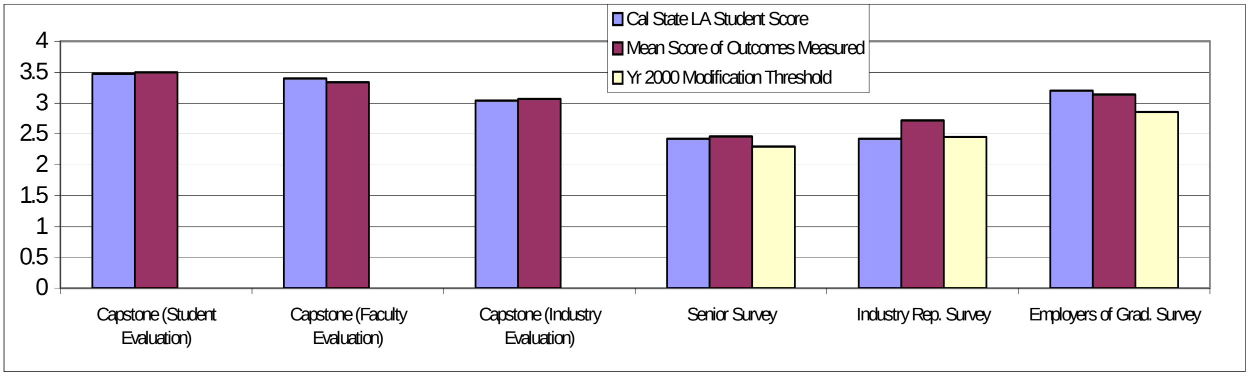
The first graph (titled "Capstone and Survey Results") below shows the assessment results of the capstone course oral presentations and the assessment results of several surveys. During the final oral presentation of the senior design class, students, faculty, and industry representatives were all asked to complete an assessment of the strength of several student outcomes. The surveys were administered to senior level students, industry representatives (who frequently give input to the program), and employers of recent graduates of the program.

The threshold level for the year 2000 was set by the faculty as described in the 1998-1999 Mechanical Engineering program assessment report. As the report explains, all of the student learning outcomes were measured and their relative scores were compared. The threshold level was set such that the scores of the three outcomes that showed the highest need for improvement from each of the program's four primary constituents (Senior level students, industrial representatives, and employers or recent graduates) were less than the threshold value. Thus, the threshold levels for 2000 (Yr 2000 Modification Thresholds) are:

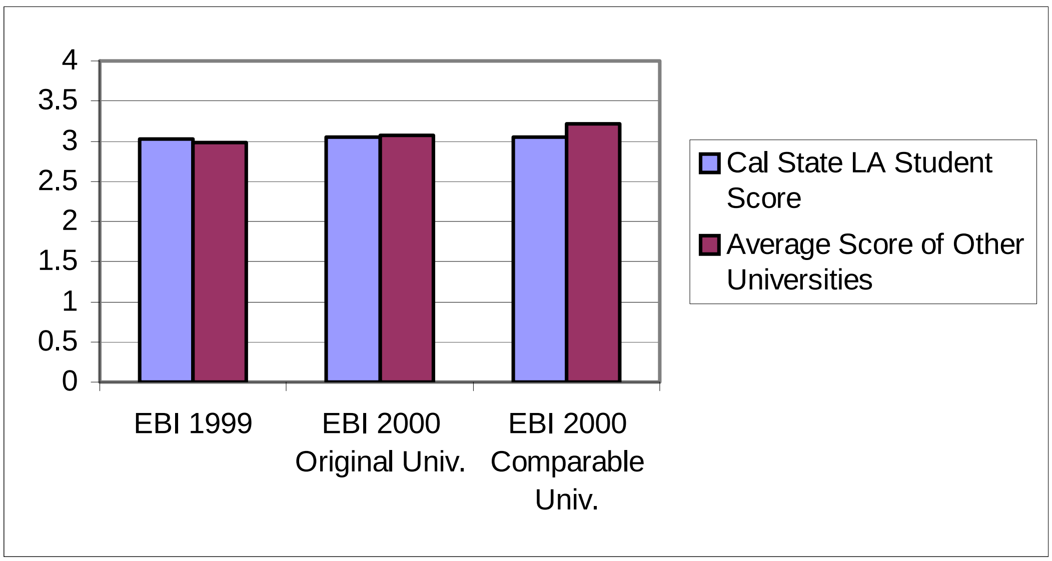
Constituents	**Yr 2000 Modification Threshold**
Senior	2.30
Industrial Representatives	2.45
Employers of Recent Graduates	2.85

The second chart (titled "EBI Results") shows three representations of the results related to this outcome from the survey conducted by Educational Benchmarking Inc. (EBI). The first EBI survey was conducted in 1999, and it compared Cal State LA student performance with performance at University of California (Berkeley), Penn State University, University of Washington University, Loyola Marymount University (deemed "original universities") The second survey was performed in 2000 and again compares the Cal. State LA results with those same schools. Added to the "original universities" during the 2000 study were the Ohio State University, and the University of Texas at Austin. The third EBI survey compares the Cal State LA performance with the performances of students from CSU Chico, CSU

Northridge, Youngstown State University, Villanova University, University of Toledo, and Florida Atlantic University (deemed "comparable universities").



Capstone and Survey Results



EBI Results

Assessment of Outcome:

Strengths

1. In the capstone presentation, faculty, industry representatives and fellow students all judged that our senior level students can communicate at and above a 3.0 ("B") level.
2. Actual employers of our recent graduates rank our students' communication skills higher than do the students and industrial representatives who are advisors to the program.
3. In all capstone and survey cases, the results that correspond to the communication outcome are nearly at the mean score obtained for all other

outcomes. An average-to-strong performance means that the program does not need modification to improve student performance on this outcome.

4. For all three representations of the EBI study, Cal State LA performance was nearly equal to the average performance of the other 6 universities.

Areas for Improvement

1. Most of the measured results correspond to oral communication. More assessment data must be obtained regarding students' written communication skills.
2. A line of communication should be opened between the students and industry representatives and the employers of recent graduates. Since the scores are different, the needs of employers may not be fully understood by the students and industry representatives.
3. The EBI survey shows that, although our students have communication skills that are comparable to the students who attend more research-oriented universities, our scores are slightly lower than the mean when compared to universities that are more similar to ours. The difference in the communication skills required by the two types of institutions needs to be evaluated, and corrections need to be made if necessary.

Corresponding Changes to the Program

Assessment of individual and group written communication needs to be increased. The department has decided to increase the amount of individual report writing required in the first quarter of the senior design series. Samples of these reports will be sent to faculty, students and industry representatives for assessment.

Summary

The Mechanical Engineering faculty demonstrated that all graduates of the Mechanical Engineering program have **an ability to communicate effectively** as demonstrated by:

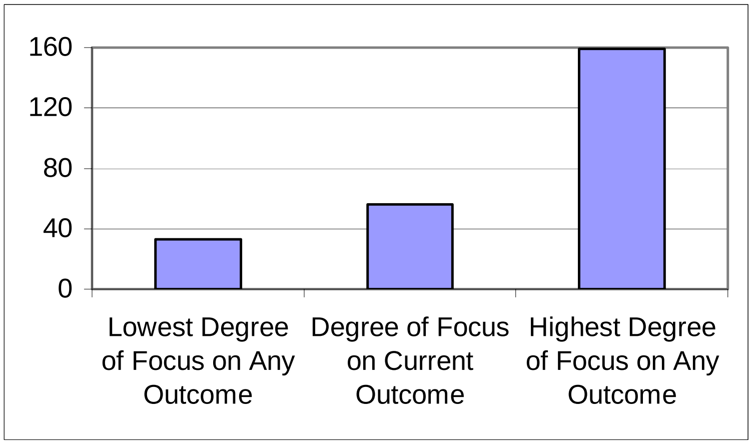
1. high survey ratings from faculty, industry representatives and fellow students during the capstone presentation
2. survey scores on this outcome were judged by all constituents to be above the mean scores of all other outcomes measured
3. high performance of the Cal State LA students on the EBI study when compared to the performance of the students representing the other 6 universities

ABET h: the broad education necessary to understand the impact of engineering solutions in a global/societal context (Knowledge Outcome #3)

Definition: The system or product an engineer designs may be used nearby, or it may be used 13 000 km in another nation, by people he will never see. Either way, it will affect people's lives. If it is a medical device, it may save their lives. If it is a communication system, it will probably enable them to interact with others in the world. Today's engineer's work will affect people, economies, and nations in more dramatic ways than ever before and therefore, its effect needs to be analyzed and predicted in socioeconomic context as well. Also, the globalization of economies and the prevalent accessibility of the tools of communications, even in the remotest areas, have resulted in heightened consumer consciousness and awareness everywhere around the world. To be able to compete, engineering firms will employ graduates who understand, in addition to their discipline, language, cultures, needs, and desires of communities in their own country and on other nations. This will require a departure from the existing paradigms in engineering education and a radical change in the curriculum so that engineering graduates speak foreign languages, receive formal education and become knowledgeable in global cultural, societal, political, economical, and environmental subjects. It will also require instilling in them an attitude and desire to continue to learn these issues throughout their lives.

Curriculum Focus:

The degree to which the current curriculum focuses upon each of the ABET a-k outcomes was assessed during summer/fall 1999. All courses were analyzed by their respective course coordinators. 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 the topic is not a focus in the course. With these ratings, the total points were computed for each program outcome. These sums are used to 1) show that all ABET a-k outcomes are addressed to some degree by the curriculum and 2) to search for correlations between a low focus on an outcome by the curriculum and low performance by the students on the corresponding outcome. The figure below compares how much the current Mechanical Engineering curriculum focuses on "**the broad education necessary to understand the impact of engineering solutions in a global/societal context**" with the student outcomes that have the lowest and highest degrees of focus in the Mechanical Engineering curriculum.



Current Curriculum Strength
(note: this is not a measure of performance, merely a measure of the quantity of input delivered by the curriculum towards each outcome)

As the Current Curriculum Strength graph indicates, the curriculum of the Mechanical Engineering program has an adequate, albeit low, degree of focus on "**the broad education necessary to understand the impact of engineering solutions in a global/societal context**."

Tools: The following tools were used to assess this outcome:

- Survey of Students
- Survey of Industrial Representatives
- Survey of Employers
- EBI Student Assessment Study

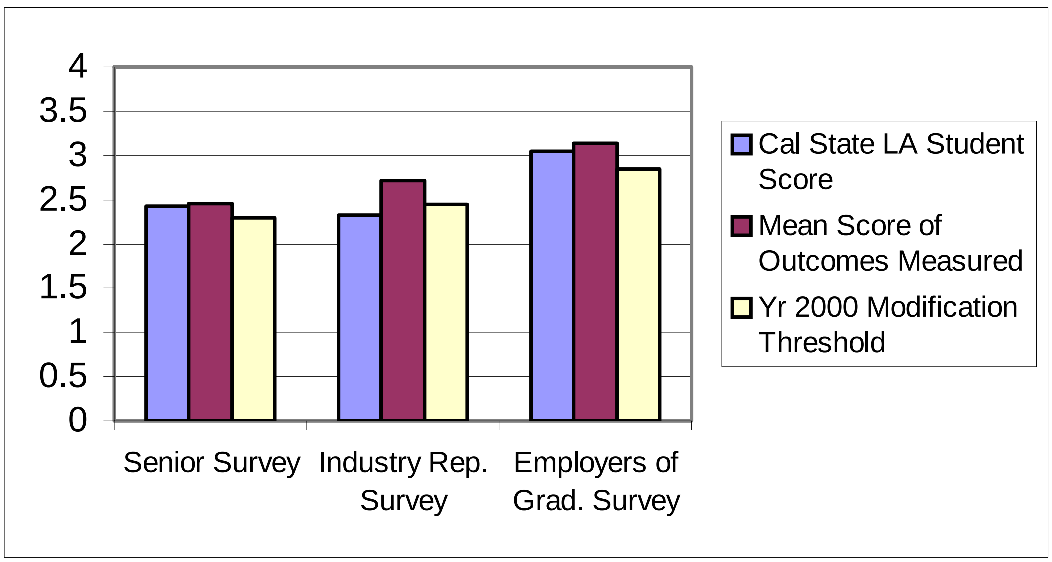
Results:

The first graph (titled "Survey Results") below shows the assessment results of several surveys. The surveys were administered to senior level students, industry representatives (who frequently give input to the program), and employers of recent graduates of the program.

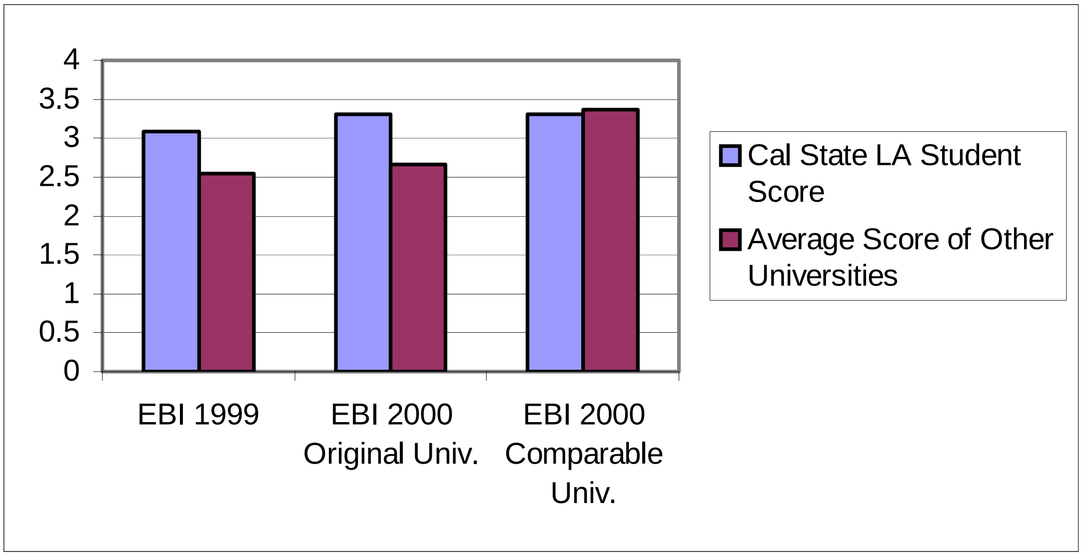
The threshold level for the year 2000 was set by the faculty as described in the 1998-1999 Mechanical Engineering program assessment report. As the report explains, all of the student learning outcomes were measured and their relative scores were compared. The threshold level was set such that the scores of the three outcomes that showed the highest need for improvement from each of the program's four primary constituents (Senior level students, industrial representatives, and employers or recent graduates) were less than the threshold value. Thus, the threshold levels for 2000 (Yr 2000 Modification Thresholds) are:

Constituents	Yr 2000 Modification Threshold
Senior	2.30
Industrial Representatives	2.45
Employers of Recent Graduates	2.85

The second chart (titled "EBI Results") shows three representations of the results related to this outcome from the survey conducted by Educational Benchmarking Inc. (EBI). The first EBI survey was conducted in 1999, and it compared Cal State LA student performance with performance at University of California (Berkeley), Penn State University, University of Washington University, Loyola Marymount University (deemed "original universities") The second survey was performed in 2000 and again compares the Cal. State LA results with those same schools. Added to the "original universities" during the 2000 study were the Ohio State University, and the University of Texas at Austin. The third EBI survey compares the Cal State LA performance with the performances of students from CSU Chico, CSU Northridge, Youngstown State University, Villanova University, University of Toledo, and Florida Atlantic University (deemed "comparable universities").



Survey Results



EBI Results

Assessment of Outcome:

Strengths

1. Actual employers of our recent graduates rate our students' understanding of the impact of engineering solutions in a global/societal context slightly above a 3.0 ("B") level which is higher than the rating given by both the students and industrial representatives who are advisors to the program.
2. For all three representations of the EBI study, the Cal State LA performance on this outcome was above a 3.0 ("B") level.
3. For all three representations of the EBI study, Cal State LA performance was nearly equal to, or above the average performance of the other 6 universities.

Areas for Improvement

1. In all survey cases, the results that correspond to this outcome are below the mean score obtained for all other outcomes. Thus the understanding of the impact of engineering solutions in a global/societal context is a weak outcome and demands some action for improvement.
2. The score given by the industrial representatives for this outcome is below the threshold score set for the 2000 assessment period. This also indicates that some change to the program is necessary to produce improvement for this outcome.

Corresponding Changes to the Program

The curriculum of the Mechanical Engineering program will be modified to provide more education related to the impact of engineering solutions in a global/societal context. Specifically, reading assignments of current magazines and newspapers and guest speakers on current effects of engineering on society will be added to several core courses (Engr 100, 300 ME 327, 428, 416, 420, 497). Specifically, during the capstone course (ME 497C) students are now required to address the relevance of their project to society during the final, oral presentation.

Summary

The Mechanical Engineering faculty demonstrated that all graduates of the Mechanical Engineering program have **the broad education necessary to understand the impact of engineering solutions in a global/societal context** as demonstrated by:

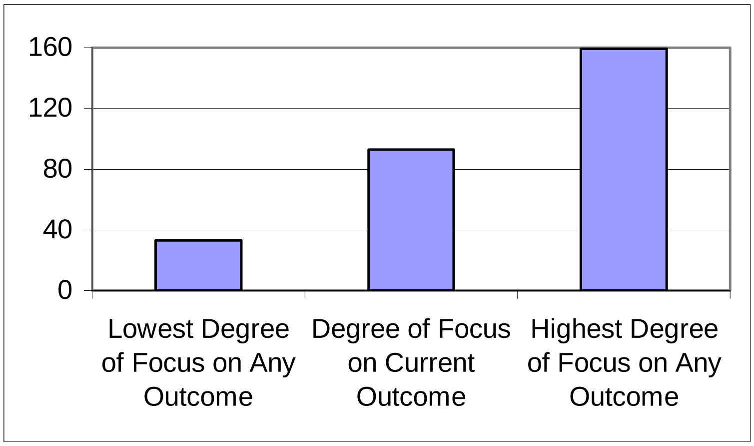
1. high survey ratings from the actual employers of our most recent graduates.
2. scores on the EBI survey in all cases above the 3.0 ("B") level.
3. higher performance of the Cal State LA students on the EBI study than the performance of the students representing the other 6 universities.

ABET i: a recognition of the need for an ability to engage in lifelong learning (Attitudes Outcome #2)

Definition: Life-long learning contributes to a fruitful and interesting career for every professional. Changes in the environment and the development of new technologies require professionals to be flexible and open-minded and to engage in constant re-education. At the end of their undergraduate education, students know how to learn, know when they know something, and can assimilate new knowledge because they can think critically. These qualities provide graduates with the skills and knowledge to begin a professional career chosen from a wide selection of jobs. Recognizing the benefits and necessities of life-long learning, graduates use their skills and knowledge to enhance their career advancement, overall productivity, personal satisfaction and growth, and self-esteem. Students take additional courses, engage in self-learning activities (with particular emphases on use of technologies like the Internet), and network with professionals from their own and other fields as a part of their life-long learning experience. These activities will not only broaden future career choices and career advancement opportunities, but will also encourage personal growth through a process of continuous learning.

Curriculum Focus:

The degree to which the current curriculum focuses upon each of the ABET a-k outcomes was assessed during summer/fall 1999. All courses were analyzed by their respective course coordinators. 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 the topic is not a focus in the course. With these ratings, the total points were computed for each program outcome. These sums are used to 1) show that all ABET a-k outcomes are addressed to some degree by the curriculum and 2) to search for correlations between a low focus on an outcome by the curriculum and low performance by the students on the corresponding outcome. The figure below compares how much the current Mechanical Engineering curriculum focuses on "**a recognition of the need for an ability to engage in lifelong learning**" with the student outcomes that have the lowest and highest degrees of focus in the Mechanical Engineering curriculum.



Current Curriculum Strength
(note: this is not a measure of performance, merely a measure of the quantity of input delivered by the curriculum towards each outcome)

As the Current Curriculum Strength graph indicates, the curriculum of the Mechanical Engineering program has an intermediate degree of focus on "**a recognition of the need for an ability to engage in lifelong learning**."

Tools: The following tools were used to assess this outcome:

- Survey of Students
- Survey of Industrial Representatives
- Survey of Employers
- EBI Student Assessment Study

Results:

The first graph (titled "Survey Results") below shows the assessment results of several surveys. The surveys were administered to senior level students, industry representatives (who frequently give input to the program), and employers of recent graduates of the program.

The threshold level for the year 2000 was set by the faculty as described in the 1998-1999 Mechanical Engineering program assessment report. As the report explains, all of the student learning outcomes were measured and their relative scores were compared. The threshold level was set such that the scores of the three outcomes that showed the highest need for improvement from each of the program's four primary constituents (Senior level students, industrial representatives, and employers or recent graduates) were less than the threshold value. Thus, the threshold levels for 2000 (Yr 2000 Modification Thresholds) are:

Constituents	Yr 2000 Modification Threshold
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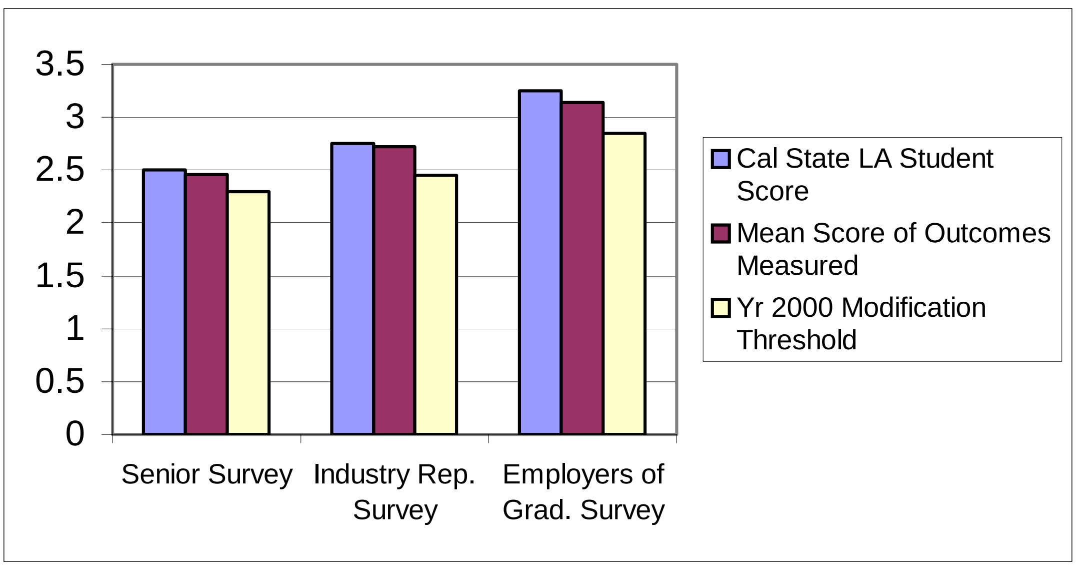
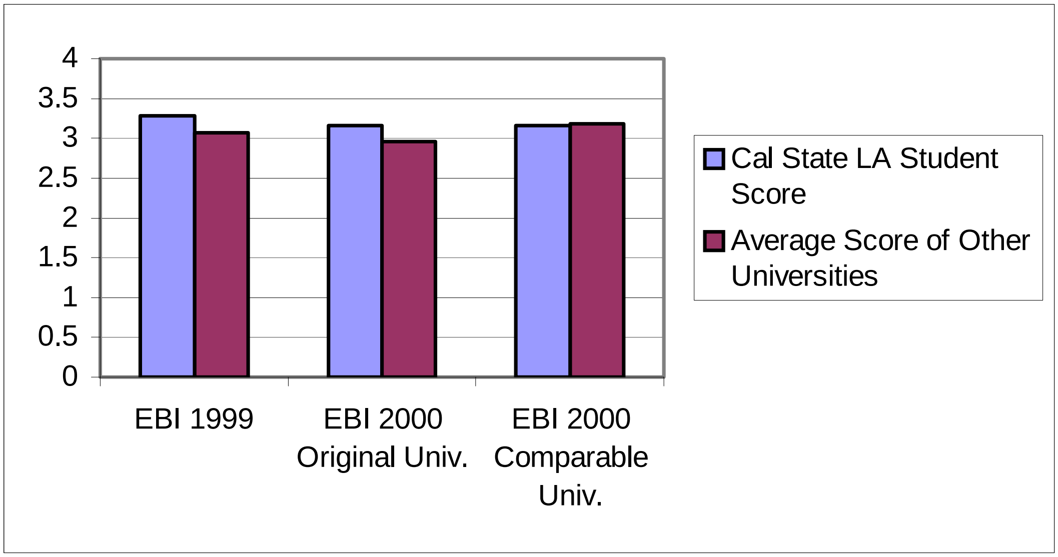
Employers of Recent Graduates	2.85

The second chart (titled "EBI Results") shows three representations of the results related to this outcome from the survey conducted by Educational Benchmarking Inc. (EBI). The first EBI survey was conducted in 1999, and it compared Cal State LA student performance with performance at University of California (Berkeley), Penn State University, University of Washington University, Loyola Marymount University (deemed "original universities") The second survey was performed in 2000 and again compares the Cal. State LA results with those same schools. Added to the "original universities" during the 2000 study were the Ohio State University, and the University of Texas at Austin. The third EBI survey compares the Cal State LA performance with the performances of students from CSU Chico, CSU Northridge, Youngstown State University, Villanova University, University of Toledo, and Florida Atlantic University (deemed "comparable universities").



Survey Results



EBI Results

Assessment of Outcome:

Strengths

1. In the surveys, the score on this outcome was above the threshold score set for the year 2000 assessment period.
2. Actual employers of our recent graduates rank our students' commitment to life-long learning higher than do the students and industrial representatives who are advisors to the program.
3. In survey cases, the results that correspond to the life-long learning outcome are above the mean score obtained for all other outcomes. An average-to-strong performance means that the program does not need modification to improve student performance on this outcome.
4. For all three representations of the EBI study, Cal State LA performance was above or nearly equal to the average performance of the other 6 universities.

Areas for Improvement

1. The rating given by students to this outcome is relatively the lowest among the survey results. The reason for this needs to be explored.
2. The EBI survey shows that, although our students have an understanding of life-long learning that is above that of students who attend more research-oriented universities, our scores are equal to the mean when compared to universities that are more similar to ours. The difference in the attitude fostered by the two types of institutions needs to be evaluated, and improvements need to be made if necessary.

Corresponding Changes to the Program

None at this time.

Summary

The Mechanical Engineering faculty demonstrated that all graduates of the Mechanical Engineering program have **a recognition of the need for an ability to engage in lifelong learning** as demonstrated by:

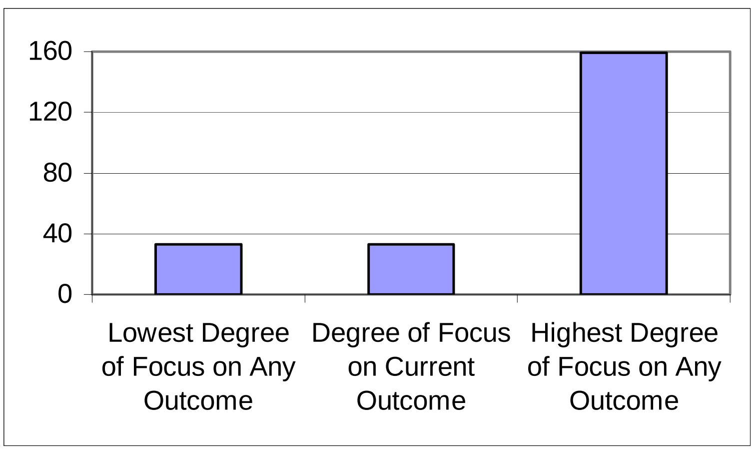
1. higher than mean scores obtained from all constituents surveyed
2. all scores from the constituents surveyed are above the threshold scores set by the faculty
3. high performance of the Cal State LA students on the EBI study when compared to the performance of the students representing the other 6 universities

ABET j: knowledge of current events and societal contemporary issues -- non-engineering related. (Knowledge Outcome #4)

Definition: Engineers should be aware of current political, social, economical and environmental issues, and understand their potential impact on new challenges to engineering design and practice.

Curriculum Focus:

The degree to which the current curriculum focuses upon each of the ABET a-k outcomes was assessed during summer/fall 1999. All courses were analyzed by their respective course coordinators. 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 the topic is not a focus in the course. With these ratings, the total points were computed for each program outcome. These sums are used to 1) show that all ABET a-k outcomes are addressed to some degree by the curriculum and 2) to search for correlations between a low focus on an outcome by the curriculum and low performance by the students on the corresponding outcome. The figure below compares how much the current Mechanical Engineering curriculum focuses on "**knowledge of current events and societal contemporary issues -- non-engineering related**" with the student outcomes that have the lowest and highest degrees of focus in the Mechanical Engineering curriculum.



Current Curriculum Strength
(note: this is not a measure of performance, merely a measure of the quantity of input delivered by the curriculum towards each outcome)

As the Current Curriculum Strength graph indicates, the curriculum of the Mechanical Engineering program has an adequate, albeit low, degree of focus on "**knowledge of current events and societal contemporary issues -- non-engineering related**."

Tools: The following tools were used to assess this outcome:

- Capstone Course
- Survey of Students

- Survey of Industrial Representatives
- Survey of Employers
- EBI Student Assessment Study

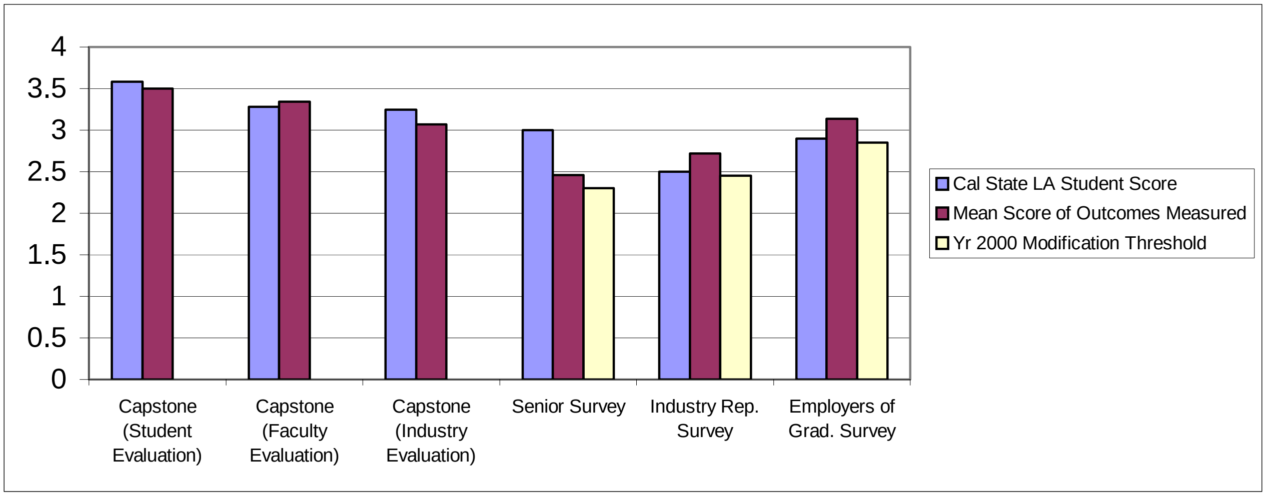
Results:

The first graph (titled "Capstone and Survey Results") below shows the assessment results of the capstone course oral presentations and the assessment results of several surveys. During the final oral presentation of the senior design class, students, faculty, and industry representatives were all asked to complete an assessment of the strength of several student outcomes. The surveys were administered to senior level students, industry representatives (who frequently give input to the program), and employers of recent graduates of the program.

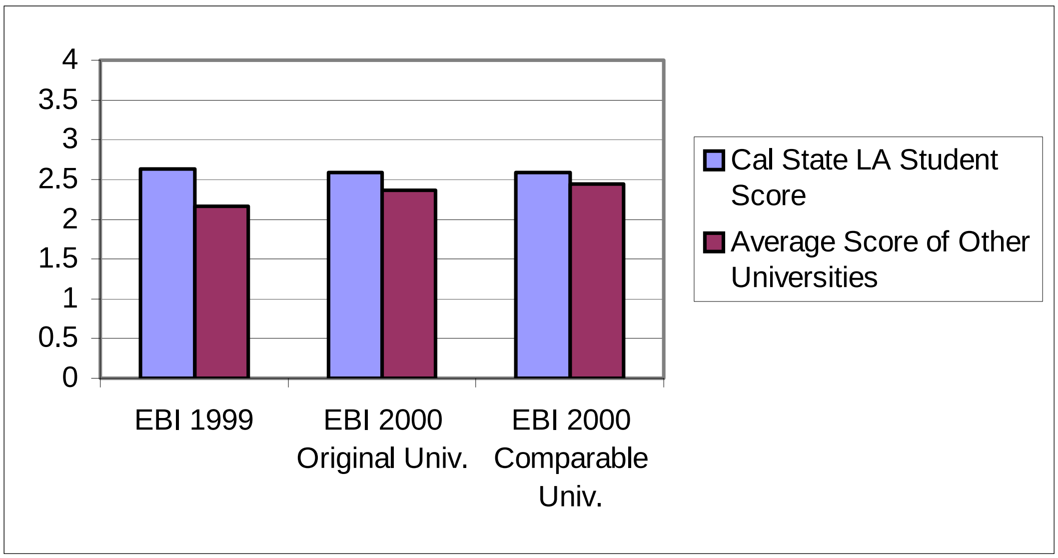
The threshold level for the year 2000 was set by the faculty as described in the 1998-1999 Mechanical Engineering program assessment report. As the report explains, all of the student learning outcomes were measured and their relative scores were compared. The threshold level was set such that the scores of the three outcomes that showed the highest need for improvement from each of the program's four primary constituents (Senior level students, industrial representatives, and employers or recent graduates) were less than the threshold value. Thus, the threshold levels for 2000 (Yr 2000 Modification Thresholds) are:

Constituents	Yr 2000 Modification Threshold
Senior	2.30
Industrial Representatives	2.45
Employers of Recent Graduates	2.85

The second chart (titled "EBI Results") shows three representations of the results related to this outcome from the survey conducted by Educational Benchmarking Inc. (EBI). The first EBI survey was conducted in 1999, and it compared Cal State LA student performance with performance at University of California (Berkeley), Penn State University, University of Washington University, Loyola Marymount University (deemed "original universities") The second survey was performed in 2000 and again compares the Cal. State LA results with those same schools. Added to the "original universities" during the 2000 study were the Ohio State University, and the University of Texas at Austin. The third EBI survey compares the Cal State LA performance with the performances of students from CSU Chico, CSU Northridge, Youngstown State University, Villanova University, University of Toledo, and Florida Atlantic University (deemed "comparable universities").



Capstone and Survey Results



EBI Results

Assessment of Outcome:

Strengths

1. In the capstone presentation, faculty, industry representatives and fellow students all judged that our senior-level students meet this outcome at a level that is near or above the mean scores of all other outcomes.
2. In all survey cases, the results that correspond to this outcome are above the threshold outcome score set by the department.
3. For all three representations of the EBI study, Cal State LA performance was nearly equal to the average performance of the other 6 universities.

Areas for Improvement

1. In both the capstone presentations and survey findings, students appear to believe they know current events and societal contemporary issues better than the other constituents. The reason for this needs to be explored.
2. For most other outcomes, the employer's ratings of our recent graduates is greater than the scores given by other constituents. The reason for this discrepancy needs to be explored

Corresponding Changes to the Program

None at this time.

Summary

The Mechanical Engineering faculty demonstrated that all graduates of the Mechanical Engineering program have a **knowledge of current events and societal contemporary issues** as demonstrated by:

1. ratings above a 3.0 ("B") level given by faculty, industry representatives and fellow students during the capstone presentations
2. survey scores on this outcome were judged by all constituents to be above the threshold outcome score set by the department for each constituent
3. high performance of the Cal State LA students on the EBI study when compared to the performance of the students representing the other 6 universities

ABET k: an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (Skills Outcome # 5)

Definition: Human beings possess the ability to create and use “tools”. Engineers are problem solvers who use science and mathematics as their “tools”. It is essential and necessary for engineers to have the techniques, skills and abilities to use modern tools to perform their jobs efficiently and effectively. Modern engineering tools include but are not limited to computer hardware and software, the electronic calculator, and other up-to-date equipment that are commonly and currently in use for engineering practice but were not available in the past.

The engineering curriculum is designed for students to develop the ability to use modern engineering tools. In their freshman year, students use computer software for graphics, spread sheets for computation, and word processors for presentations. In their sophomore year, students are required to take a computer language course and a numerical methods course, which requires the use of computers for computing. In their junior and senior years, students are expected to use the computer proficiently for graphics, computation, analysis, organization and presentation. These abilities are required for many design and lecture courses throughout the engineering curriculum.

The laboratory courses in the engineering curriculum provide the opportunity for students to develop the skills to operate the up-to-date testing and measuring instruments necessary in engineering practice. The use of a sophisticated electronic calculator is almost mandated for homework, quizzes and examinations.

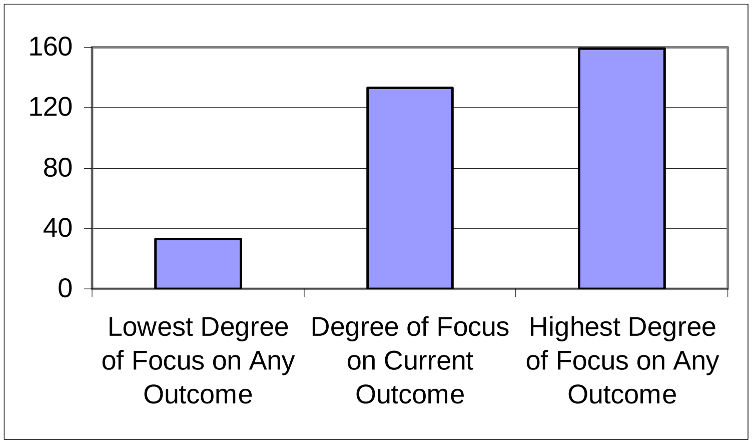
Design courses in the engineering curriculum introduce the specific software packages, which are widely used in the industry and also require students to integrate theory and technological tools for their design projects. Some engineering courses encourage students to use the Internet to obtain information and data for their research project or independent study.

The use of modern engineering tools is not only necessary for engineering practice; it is also necessary for engineering education. It helps students to understand the underlying concepts and theories of science and mathematics. Learning to use modern engineering tools, particularly the electronic calculator and computer software, has become an integral part of engineering curriculum. Graduates of the engineering program will not only have the ability to use modern engineering tools, they will also have the ability to identify and interpret the answers that are being sought.

Curriculum Focus:

The degree to which the current curriculum focuses upon each of the ABET a-k outcomes was assessed during summer/fall 1999. All courses were analyzed by their respective course coordinators. 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 the topic is not a focus in the course. With these ratings, the total points were computed for each program outcome.

These sums are used to 1) show that all ABET a-k outcomes are addressed to some degree by the curriculum and 2) to search for correlations between a low focus on an outcome by the curriculum and low performance by the students on the corresponding outcome. The figure below compares how much the current Mechanical Engineering curriculum focuses on "**an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice**" with the student outcomes that have the lowest and highest degrees of focus in the Mechanical Engineering curriculum.



Current Curriculum Strength
(note: this is not a measure of performance, merely a measure of the quantity of input delivered by the curriculum towards each outcome)

As the Current Curriculum Strength graph indicates, the curriculum of the Mechanical Engineering program has a high degree of focus on "**an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice**."

Tools: The following tools were used to assess this outcome:

- Capstone Course
- Survey of Students
- Survey of Industrial Representatives
- Survey of Employers
- EBI Student Assessment Study

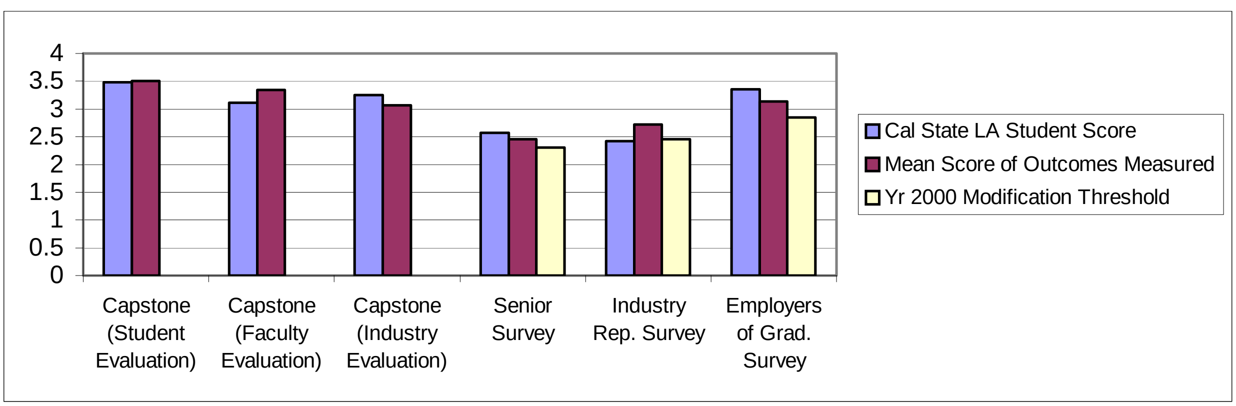
Results:

The first graph (titled "Capstone and Survey Results") below shows the assessment results of the capstone course oral presentations and the assessment results of several surveys. During the final oral presentation of the senior design class, students, faculty, and industry representatives were all asked to complete an assessment of the strength of several student outcomes. The surveys were administered to senior level students, industry representatives (who frequently give input to the program), and employers of recent graduates of the program.

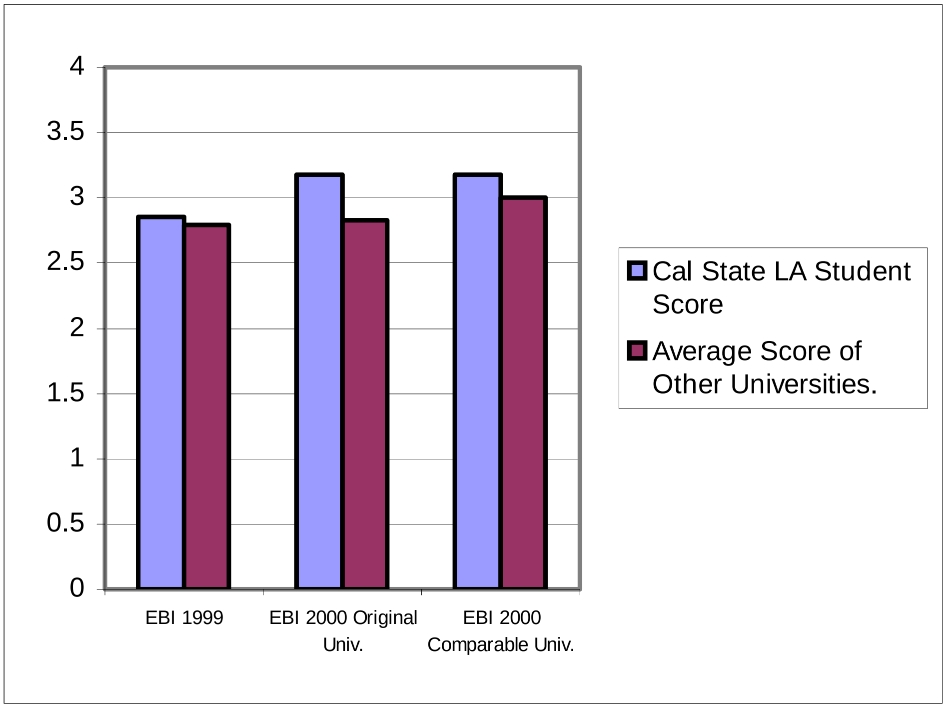
The threshold level for the year 2000 was set by the faculty as described in the 1998-1999 Mechanical Engineering program assessment report. As the report explains, all of the student learning outcomes were measured and their relative scores were compared. The threshold level was set such that the scores of the three outcomes that showed the highest need for improvement from each of the program's four primary constituents (Senior level students, industrial representatives, and employers or recent graduates) were less than the threshold value. Thus, the threshold levels for 2000 (Yr 2000 Modification Thresholds) are:

Constituents	**Yr 2000 Modification Threshold**
Senior	2.30
Industrial Representatives	2.45
Employers of Recent Graduates	2.85

The second chart (titled "EBI Results") shows three representations of the results related to this outcome from the survey conducted by Educational Benchmarking Inc. (EBI). The first EBI survey was conducted in 1999, and it compared Cal State LA student performance with performance at University of California (Berkeley), Penn State University, University of Washington University, Loyola Marymount University (deemed "original universities") The second survey was performed in 2000 and again compares the Cal. State LA results with those same schools. Added to the "original universities" during the 2000 study were the Ohio State University, and the University of Texas at Austin. The third EBI survey compares the Cal State LA performance with the performances of students from CSU Chico, CSU Northridge, Youngstown State University, Villanova University, University of Toledo, and Florida Atlantic University (deemed "comparable universities").



Capstone and Survey Results



EBI Results

Assessment of Outcome:

Strengths

1. In the capstone presentation, faculty, industry representatives and fellow students all judged that our senior level students have an ability to use the techniques, skills, and modern engineering tools at a level above a 3.0 ("B").
2. Actual employers of our recent graduates rate our students' performance on this outcome higher than do the students and industrial representatives who are advisors for the program.
3. For all three representations of the EBI study, Cal State LA performance was nearly equal to the average performance of the other 6 universities.

Areas for Improvement

1. The scores given by the industrial representatives of the Mechanical Engineering program are below the threshold score set by the faculty. Thus, some change in the curriculum must be made to improve student performance on this outcome.
2. During the capstone presentation, the faculty rated student performance on this outcome significantly below the mean performance of other outcomes.

Corresponding Changes to the Program

The types of modern tools of concern to the industrial representatives are software programs. This constituency desired increased student training in both office software (Word, Excel, and PowerPoint) and in analysis software. The curriculum of ME 410 has been modified to include the instruction of MATLAB, CAD and finite-element software. The Mechanical Engineering curriculum has been modified so that the senior design course will emphasize office software, and the upper-division fluid-thermal courses will require analysis using finite-element software.

Summary

The Mechanical Engineering faculty demonstrated that all graduates of the Mechanical Engineering program have **an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice** as demonstrated by:

1. above 3.0 ("B") scores from faculty, industry representatives and fellow students during the capstone presentation
2. high survey scores from the actual employers of our recent graduates
3. high performance of the Cal State LA students on the EBI study when compared to the performance of the students representing the other 6 universities

Appendices

Appendix 1: Educational Benchmarking Incorporated (EBI) Survey

Educational Benchmarking Inc. develops national benchmarking studies that allow the users 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 Engineering Criteria 2000 standards. Participating schools 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.

Schools are able to choose six peer institutions from which to receive specific comparative data. Confidentiality of all school 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)

The student learning outcome data used in this report is derived from three surveys compiled by EBI. The first EBI survey was conducted in 1999 and compared Cal. State LA performance with performance from University of California (Berkeley), Penn State University, U of Washington University, Loyola Marymount University (deemed "original universities") The second survey was performed in 2000 and again compares the Cal. State LA results with those same schools with the addition of Ohio State University, and the University of Texas at Austin (deemed "expanded original universities"). The third EBI survey compares the Cal State LA performance with the performances of students from CSU Chico, CSU Northridge, Youngstown State University, Villanova University, University of Toledo, and Florida Atlantic University (deemed "comparable universities").

Appendix 2: Sample Employers of Recent Graduates Survey

Rating	Question		**Rating**
important / not important	1 is very important - 5 is not important How important are the following outcomes to employers of new engineering graduates	1 is outstanding - 5 is poor How well is CSULA doing in providing graduates that have the following	outstanding / poor
	Knowledge		
1 2 3 4 5 NA	1. Ability to apply knowledge of mathematics to solving engineering problems.		1 2 3 4 5 NA
1 2 3 4 5 NA	2. Ability to apply knowledge of mathematics to solving science problems.		1 2 3 4 5 NA
1 2 3 4 5 NA	3. Ability to apply knowledge of engineering to solving problems.		1 2 3 4 5 NA
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
1 2 3 4 5 NA	5. A knowledge of contemporary issues.		1 2 3 4 5 NA
1 2 3 4 5 NA	6. A knowledge of computer aided design and simulation software.		1 2 3 4 5 NA
1 2 3 4 5 NA	7. A knowledge of measurement and manufacturing techniques.		1 2 3 4 5 NA
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		
1 2 3 4 5 NA	9. Ability to design statistically valid experiments.		1 2 3 4 5 NA
1 2 3 4 5 NA	10. Ability to conduct an experiment		1 2 3 4 5 NA
1 2 3 4 5 NA	11. Ability to analyze and interpret data obtained from an experiment.		1 2 3 4 5 NA
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
1 2 3 4 5 NA	14. Ability to orally present ideas on engineering designs or solutions.		1 2 3 4 5 NA
1 2 3 4 5 NA	15. Ability to write technical documents.		1 2 3 4 5 NA
1 2 3 4 5 NA	16. Ability to use modern engineering tools necessary for engineering practice.		1 2 3 4 5 NA
1 2 3 4 5 NA	17. Ability to select materials and manufacturing processes.		1 2 3 4 5 NA
1 2 3 4 5 NA	18. Ability to visualize designs from engineering drawings.		1 2 3 4 5 NA
1 2 3 4 5 NA	19. Ability to think in a logical sequential process.		1 2 3 4 5 NA

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	20. An understanding of professional and ethical responsibility.		1 2 3 4 5 NA
1 2 3 4 5 NA	21. A Recognition of the need for life-long learning.		1 2 3 4 5 NA
1 2 3 4 5 NA	22. An understanding of responsibility and accountability.		1 2 3 4 5 NA
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
1 2 3 4 5 NA	24. A desire to be a flexible and adaptable team player.		1 2 3 4 5 NA

Appendix 3: Results from the Survey of Employers of Recent Graduates

Graph showing the results of the Survey administered to the employers of our recent graduates.

1	An ability to apply know 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 that lend itself to identifying, formulating and solving engineering problems (abet e)
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)

Appendix 4: Sample Screen Capture of Student Webfolio Page

Student Webfolios are another assessment tool used by the Mechanical Engineering program to measure student learning outcomes. During various courses in the curriculum, students are required to submit specific items that are placed into a web-based portfolio. These, items include:

- an essay on the benefits of current issues
- a lab report
- an essay on their life long learning plan
- a resume
- an extended abstract of their senior design project

The figure below is a sample image of the webfolio as sent to industrial representatives for it to be evaluated.

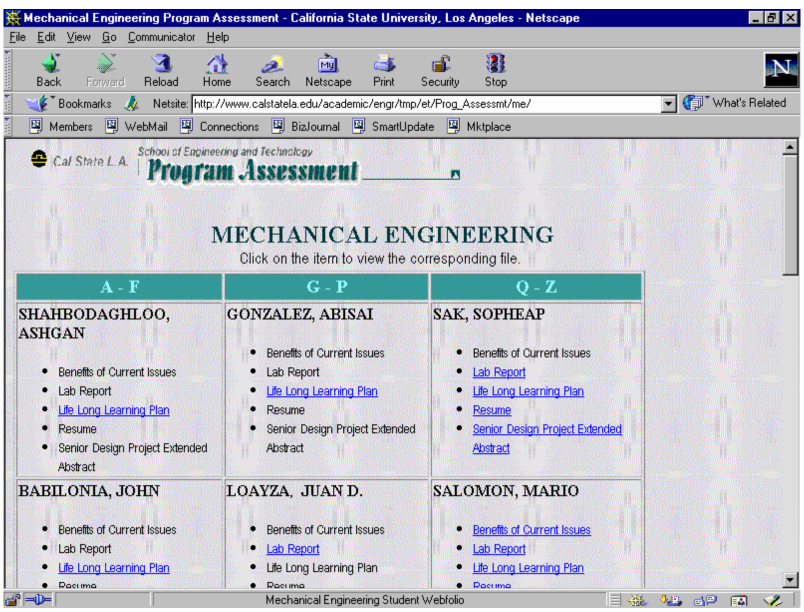


Image of Webfolio

Towards the end of the students' senior year, the Webfolio becomes complete, and it is assessed by industrial constituents. The specific outcomes measured are:

- *a knowledge of current events and societal contemporary issues -- non-engineering related. (abet j)*
- *an ability to design and conduct experiments as well as to analyze and interpret data (abet b)*
- *a recognition of the need for an ability to engage in lifelong learning (abet i)*
- *an understanding of professional and ethical responsibility (abet f)*
- *an ability to design a system, component, or process to meet desired needs (abet c)*

- ***an ability to think in a logical sequential process that lends itself to identifying, formulating and solving engineering problems (abet e(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)***

Appendix 5: Sample Webfolio Assessment Sheet

Date: ________ **Reviewer's Name: _____________________**
Student's Name: Roberto Seminario

MECHANICAL ENGINEERING WEBFOLIO ASSESSMENT

<u>Industrial Representatives:</u>
Please Consider the 5 Folders in the Student's Webfolio and rate the student's performance.

5 shows high ability …………...…. 0 shows poor ability
NA shows that there is insufficient evidence to make a judgement

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

For the **<u>Lab Report</u>** 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 **<u>Life Long Learning Plan</u>** 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 **<u>Resume</u>** Folder, how well has the student demonstrated:	
an understanding of professional and ethical responsibility (abet f)	5 4 3 2 1 NA

For the **<u>Senior Design Project Extended Abstract</u>** 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 **<u>Overall Webfolio Presentation</u>**, 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