California State University, Los Angeles

Department of

Mechanical Engineering

College of Engineering, Computer Science, and Technology

PROGRAM ASSESSMENT

2004-2005

Reassessing Program Objectives/Outcomes
(Closing the Five Year Loop)

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8/05

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I Introduction

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

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

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

1. We, **the faculty** of mechanical engineering, feel that the *assessment and utilization of student outcomes* will provide an improved learning experience for our students and strengthen the mechanical engineering program.

2. The new criteria from the **Accreditation Board for Engineering and Technology** states that "Each program must have an assessment process with documented results. Evidence must be given that the results are applied to the further development and improvement of the program. The assessment process must demonstrate that the *outcomes important to the mission of the institution and the objectives of the program …* are being measured."

3. The **WASC Accreditation guidelines** mandate that "the institution evidences clear and appropriate educational objectives and design at the …program level, and employs processes of review, including the collection and use of data that assures the delivery of programs and *learner accomplishment* at a level of performance appropriate for the degree awarded."

4. The **university faculty handbook** clearly states that "Assessment is a significant portion of the academic program review. It should assist in unit planning and improvement. Program review shall include an evaluation of the extent of *assessment measures have been used to document effectiveness* and to improve the program."

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

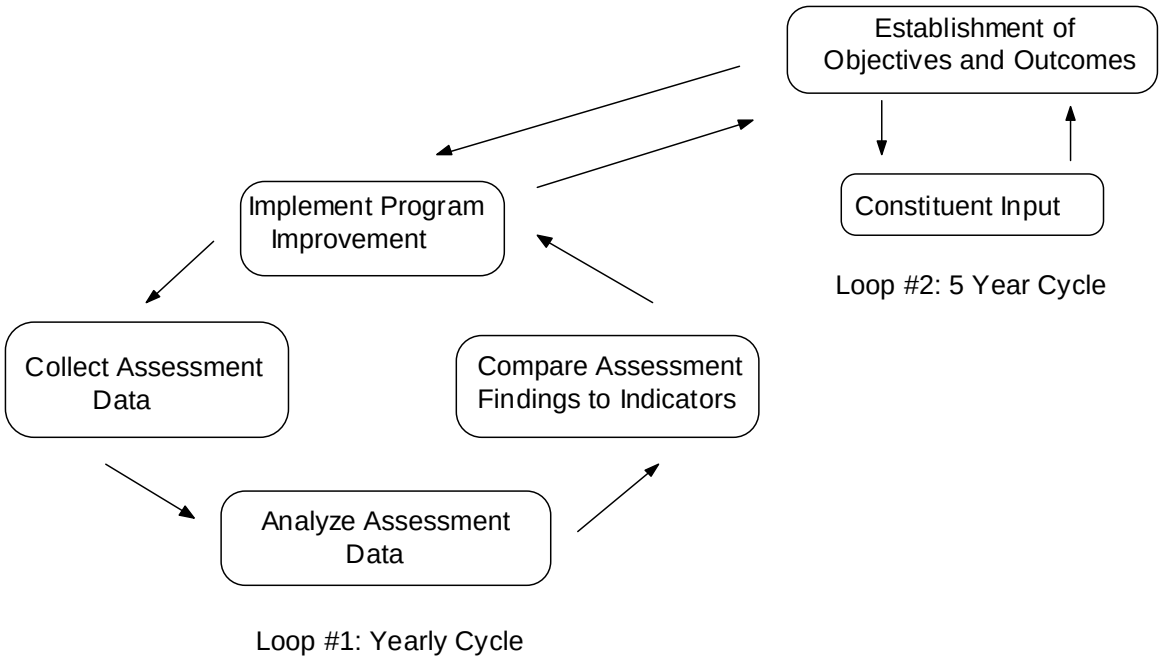

Fig. 1. Yearly implementation of assessment program

Since the 1998/1999 year, Loop #1 has be implemented each year. Specifically, data has been collected, analyzed, and modifications have been implemented to improve the program each year. Figure 2 shows a table of reports produced that describe the assessment activities for the Mechanical Engineering program.

Academic Year	Report Type
1998 - 1999	Development of Current Outcomes and First Cycle of Assessment
1999 - 2000	Assessment of a-k Outcomes
2000 - 2001	1-Year Outcomes Assessment Report
2001 - 2002	1-Year Outcomes Assessment Report
2002 - 2004	2-Year Outcomes Assessment Report
2004 - 2005	Assessing Program Objectives/Outcomes
2004 - 2006	2-Year Outcomes Assessment Report

Fig. 2. Reports of assessment findings and program modifications

Since the assessment program has been in place for five years, Loop #2 will be implemented this year. Although data will still be collected on the present outcomes, no program changes will be determined and implemented this year since the program outcomes will be changing.

II Combined Resources of the College of Engineering, Computer Science and Technology

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

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

III Assessing the Program Objectives and Educational Outcomes

The 2004/2005 academic year represents the fifth year in which the program has been using assessment as a continuous improvement tool. Thus, it is time to reassess the following:

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

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

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

The objective and outcomes must be consistent with the College mission and vision statements. These college visions and mission statements were created in 1999 and been updated in 2005.

Definition of Key Terms

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

Fig. 3. Definition of Key Terms

Vision Statement

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

Mission Statement

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

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

1989 to 2004 Objectives and Outcomes

The program objective statement and student learning outcomes for the Mechanical Engineering program from 1989 to 2004 is shown below.

Educational Objectives and Program Outcomes
For the Mechanical Engineering program

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

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

Knowledge

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

This educational objective will be demonstrated by the following outcomes:

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

Skills

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

This educational objective will be demonstrated by the following outcomes:

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

Attitudes

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

This educational objective will be demonstrated by the following outcomes:

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

Updating the Objectives and Outcomes

The current Educational Objectives and Program Outcomes for the Mechanical Engineering program describe the characteristics of CSULA Mechanical Engineering graduates in three areas:

1. The knowledge they will have
2. The skills they will possess
3. The attitudes they will hold

New educational objectives are being established simultaneously with new student learning outcomes. Extensive input was obtained from the various "constituencies" (ME faculty, ME students, employers, ME alumni), by asking them what knowledge, skills, and attitudes are important for our graduates to have.

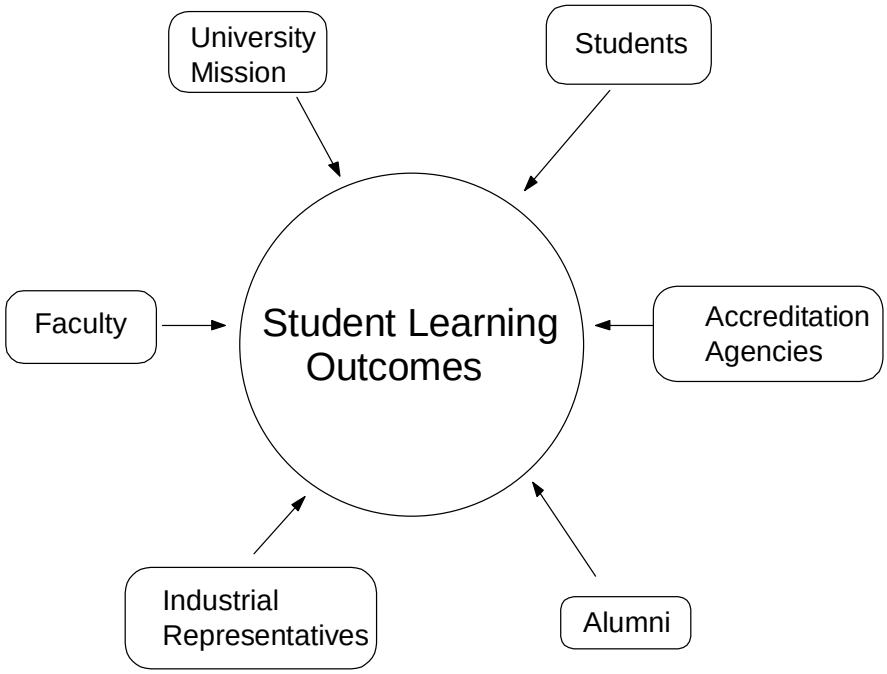

Fig. 4. Determining Student Learning Outcomes

The diagram below shows the two paths that are being used to create the final educational objectives and student learning outcomes for the Department of Mechanical Engineering.

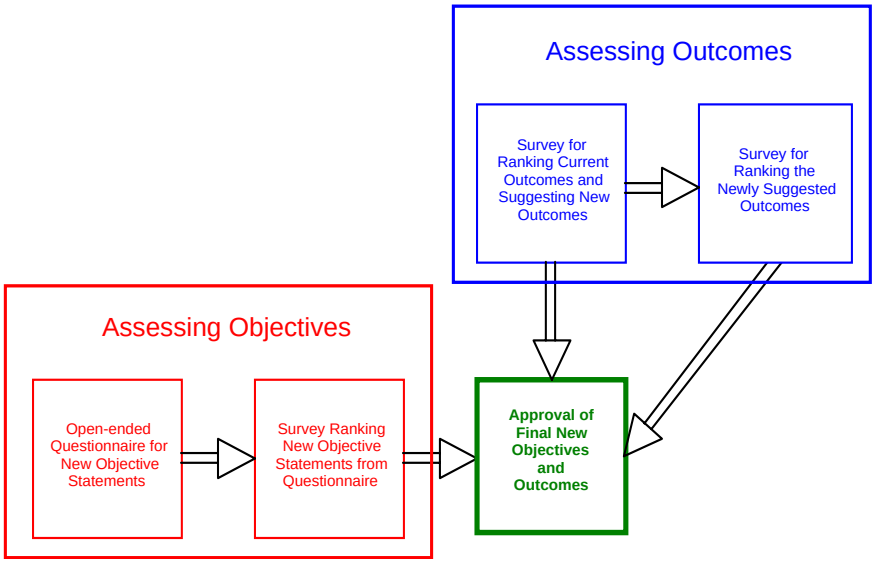

Fig. 5 Schematic Showing Paths used to Update the Program Objectives and Outcomes

Shown below are the specific steps taken towards assessing, updating, and finalizing the Mechanical Engineering program educational objectives and outcomes, ensuring that they addressed the needs and expectations of all constituencies.

Assessing / Developing Objectives

1. The Department drafted an open-ended survey that stated the purpose of an objective, the old object and asked the constituents to draft new objective states for knowledge, skills, and attitudes.
2. The Department drafted a second survey which listed all viable outcome statements and asked the constituencies to rank all statements. These sample objective statements are shown in the tables below along with the survey data that were processed by the student assistant supported by this grant.

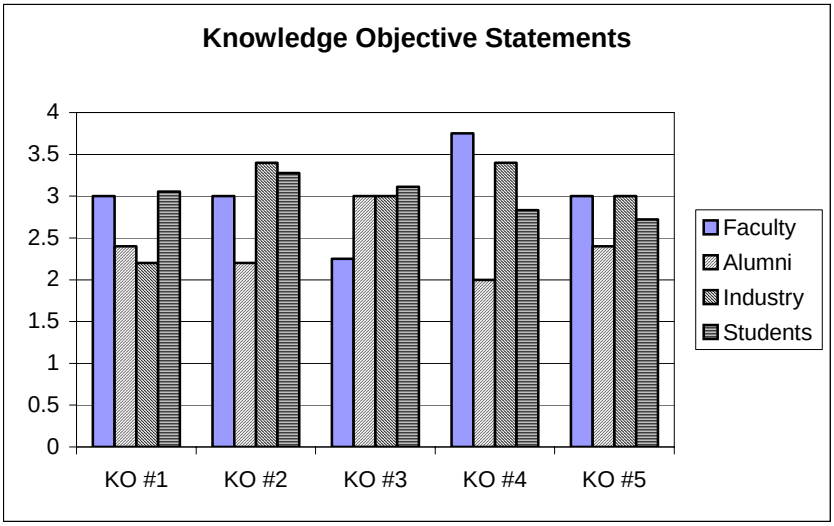

Fig. 6. Ranking of Knowledge Objective Statements (1 being best)

Knowledge Objective Statements

1.	Graduates of the Mechanical Engineering program will have the knowledge in math, science and engineering fundamentals, as well as societal issues, that allows them to approach real-world Mechanical Engineering problems with an understanding of their impact on society.
2.	Graduates of the Mechanical Engineering program will have the knowledge in math, science and mechanical engineering topics, as well as societal issues, that enables them to deal with real-world engineering problems with an understanding of their impact on society.
3.	Graduates of the Mechanical Engineering program will have the proper knowledge in math, science and engineering fundamentals to allow them to deal with real-world Mechanical Engineering problems with confidence. They are well aware of the impact their work might have on the broader issues relating to the environment and the society at large.
4.	Graduates of the Mechanical Engineering program will have the appropriate knowledge of basic and applied mathematics, engineering science and societal issues that will enable them to work on solution of mechanical engineering problems for the advance of the whole society.
5.	Graduates of the Mechanical Engineering program will have the knowledge in math, science, engineering fundamental, and current and emerging societal needs that allows them to competently solve the practical Mechanical Engineering problems considering all the aspects of the impact of the solution. The knowledge base shall be amply broad to enable our graduates to become professional engineers within three to five years of professional practice.

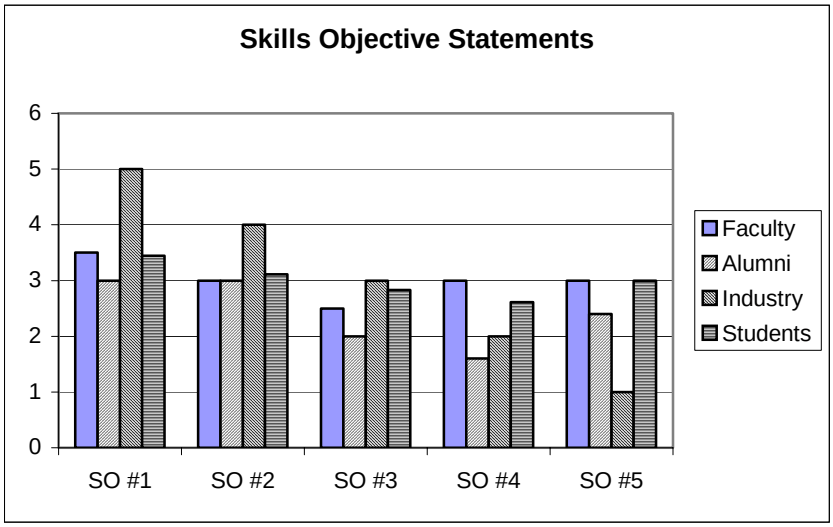

Fig. 7. Ranking of Skills Objective Statements (1 being best)

Skills Objective Statements	
1.	Graduates of the Mechanical Engineering program will be able to work in group and individual settings to define and solve problems related to thermal and mechanical systems and manufacturing processes by applying engineering fundamentals and engineering tools with a logical approach and be able to clearly communicate their findings.
2.	Graduates of the Mechanical Engineering program will have the skills to work individually and in teams, to define and solve problems related to thermal and mechanical systems, and manufacturing processes, by applying engineering principles and tools with a logical approach, and be able to clearly communicate their findings.
3.	Graduates of the Mechanical Engineering program will be able to work in group and individual settings to define and solve problems related to mechanical systems and manufacturing processes. They will apply engineering fundamentals and engineering tools with a logical approach to problem-solving. They are also able to effectively communicate their work orally and in writing.
4.	Graduates of the Mechanical Engineering program will be able to work independently as well as in groups to analyze, design and improve thermal, mechanical and manufacturing products, systems and processes and be able to clearly communicate their funding by applying knowledge and experience obtained during their study.
5.	Graduates of the Mechanical Engineering program will be able to function competently as an individual or part of a team. They shall be able to analyze, define, and solve thermal, mechanical, manufacturing problems through application of engineering fundamentals and Mechanical Engineering tools logically and effectively as well as communicating the problems and their solutions clearly. They are expected to acquire professional competence in the aforementioned skills within five years.

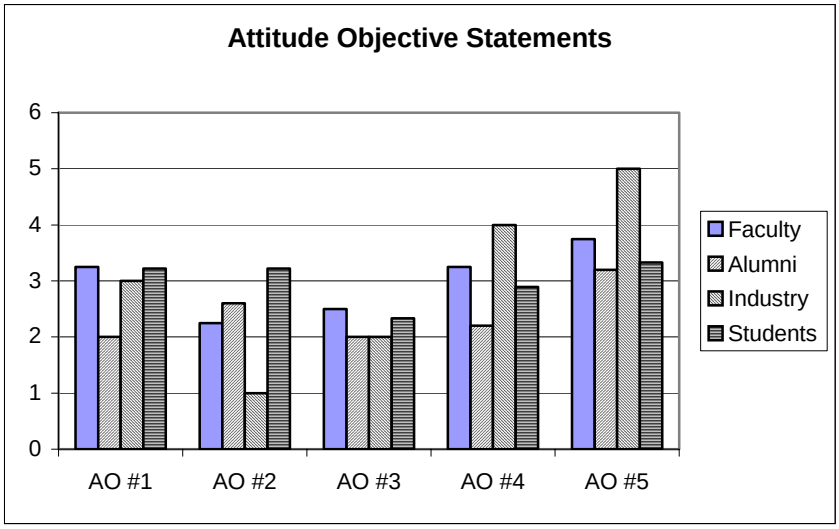

Fig. 8. Ranking of Attitude Objective Statements (1 being best)

Attitude Objective Statements	
1.	Graduates of the Mechanical Engineering program will be confident in their abilities to be successful in industrial, academic, and governmental positions and will have the positive and inquisitive outlook on life and learning necessary to promote their continued professional and personal development throughout their careers.
2.	Graduates of the Mechanical Engineering program will have the confidence in their abilities to be successful in either industrial, governmental, or academic positions, and will have a positive and inquisitive outlook on life and continuous learning, necessary to promote their professional and personal development throughout their careers.
3.	Graduates of the Mechanical Engineering program will be adequately prepared to face challenges and be confident to be successful in industrial, academic, and governmental positions. They will also have the positive and inquisitive outlook on life and learning necessary to promote their continued professional and personal development throughout their careers.
4.	Graduate of the Mechanical Engineering program will be able to seamlessly adapt to different employment settings and engineering tasks in industrial and governmental positions and they will be confident in their abilities and eager to continue their education, ether formally or informally, to promote their life long professional and personal development. Three or five years after completing undergraduate study our graduate will be able to successfully transfer and adapt knowledge received in Mechanical Engineering study at CSULA as well as complement it with the team work and management and technical skills developed at their place of employment.
5.	Within three to five years from their date of graduation, our alumni will be confident in their abilities to be successful in industrial, academic, and governmental positions. An important part of their confidence will follow from the result of their positive and inquisitive outlook on learning, practicing engineering, training young engineers, and application of knowledge to life instilled in them as students of Mechanical Engineering.

Assessing and Developing Outcomes

1. The department assessment coordinator drafted a survey that asks all constituents to rank the importance of all current outcome statement and asked for input for new outcome statements. Since most of these outcomes are required by our accreditation agency (ABET), no real decisions can be made regarding these findings.
2. A second outcome survey was then generated that asked all constituents to rank the importance of all “write-in” outcomes from the previous survey and all outcomes that were not the ABET required a-k. Results from this survey, tabulated by the student assistant, can be seen in the figures below.

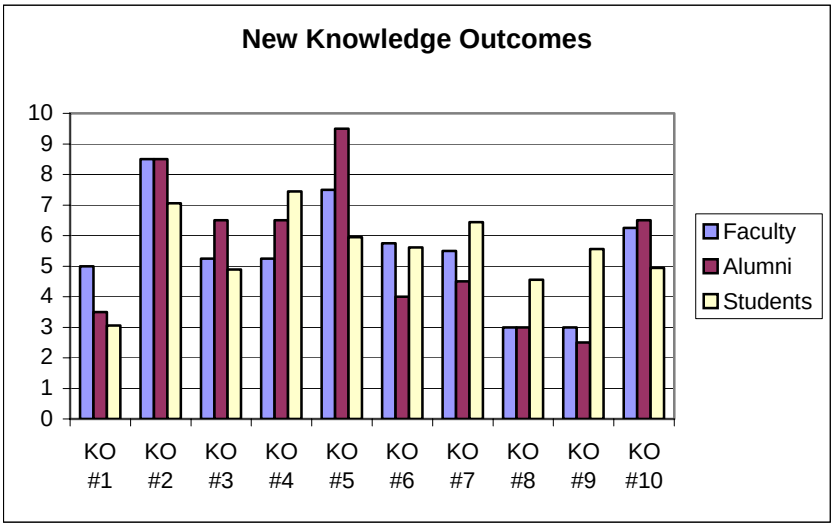

Fig. 9. Ranking of New Knowledge Outcome Statements (1 being best)

Knowledge Outcome Statements

1.	Ability to apply common sense
2.	An understanding of newer disciplines such as biomedical and electro-mechanical
3.	A knowledge of project team management
4.	A knowledge of electro-mechanical fundamentals
5.	A knowledge of the financial and managerial aspects of project engineering
6.	A knowledge of quality standards
7.	A knowledge of geometric dimensioning and tolerances
8.	A knowledge of computer aided design and simulation software
9.	A knowledge of measurement and manufacturing techniques
10.	A knowledge of how mechanical engineering integrates into inter-disciplinary systems

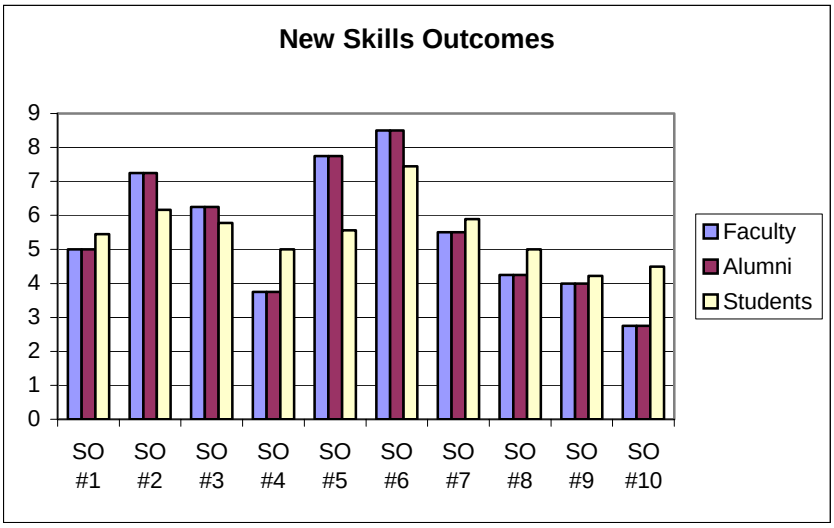

Fig. 10. Ranking of New Skills Outcome Statements (1 being best)

Skills Outcome Statements

1.	Ability to perform manual sketching and drafting
2.	Ability to manage people and show leadership
3.	Ability to understand the “engineering language” effectively
4.	Ability to think in a logical, holistic process
5.	Ability to interact with supervisors and equals in a professional and honest way
6.	Ability to apply a “business model” to engineering
7.	Ability to present oneself well on a resume and during an interview
8.	Ability to select materials and manufacturing processes
9.	An ability to visualize designs from engineering drawings
10.	An ability to think in a logical sequential process

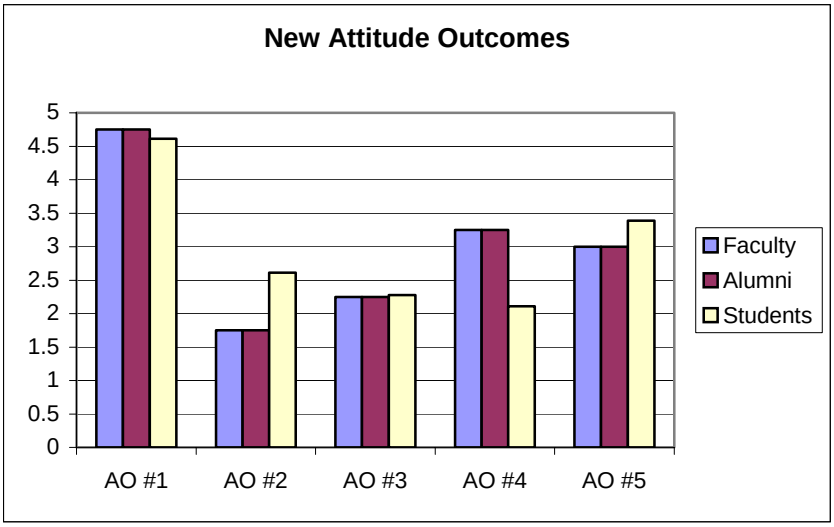

Fig. 11. Ranking of New Attitude Outcome Statements (1 being best)

Attitude Outcome Statements

1.	A recognition of the benefits of diversity in human resources
2.	A desire to have critical thinking and organizational skills
3.	An understanding of responsibility and accountability
4.	A desire to be a professional that exhibits values, dedication and a need for continual improvement
5.	A desire to be a flexible and adaptable team player (collaborative attitude)

A final draft of the Mechanical Engineering educational objectives and program outcomes will be sent to all constituencies for final comment and approval once these results are interpreted.

Analyzing the Data

To determine which objective statement should be used, the votes of all four major constituents were weighted equally and added together. Since the rankings listed number one as being the top choice, the objectives with the lowest totals are the ones that will be selected at the new program objectives. The following three graphs show these results.

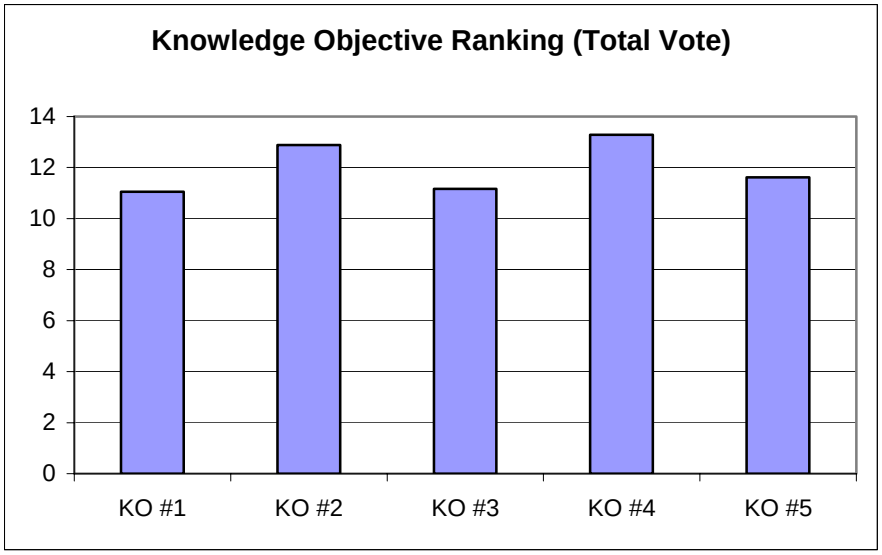

Fig. 12. Total Ranking of Knowledge Objective Statements (lowest is best)

Knowledge Objective Statements

1.	Graduates of the Mechanical Engineering program will have the knowledge in math, science and engineering fundamentals, as well as societal issues, that allows them to approach real-world Mechanical Engineering problems with an understanding of their impact on society.
2.	Graduates of the Mechanical Engineering program will have the knowledge in math, science and mechanical engineering topics, as well as societal issues, that enables them to deal with real-world engineering problems with an understanding of their impact on society.
3.	Graduates of the Mechanical Engineering program will have the proper knowledge in math, science and engineering fundamentals to allow them to deal with real-world Mechanical Engineering problems with confidence. They are well aware of the impact their work might have on the broader issues relating to the environment and the society at large.
4.	Graduates of the Mechanical Engineering program will have the appropriate knowledge of basic and applied mathematics, engineering science and societal issues that will enable them to work on solution of mechanical engineering problems for the advance of the whole society.
5.	Graduates of the Mechanical Engineering program will have the knowledge in math, science, engineering fundamental, and current and emerging societal needs that allows them to competently solve the practical Mechanical Engineering problems considering all the aspects of the impact of the solution. The knowledge base shall be amply broad to enable our graduates to become professional engineers within three to five years of professional practice.

As can be seen from Fig. 12, knowledge objective statement number 1 is the selection based on the votes of the constituents.

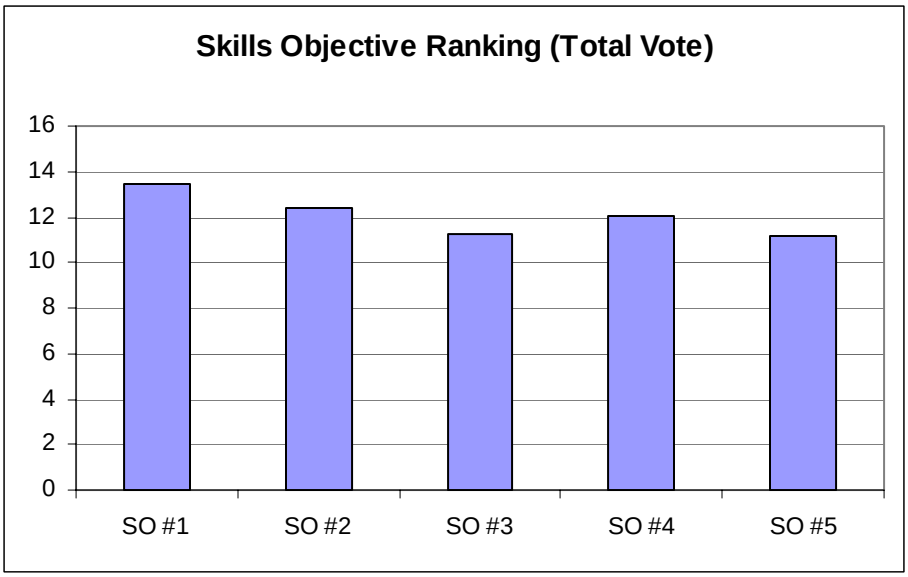

Fig. 13. Total Ranking of Skills Objective Statements (lowest is best)

	Skills Objective Statements
1.	Graduates of the Mechanical Engineering program will be able to work in group and individual settings to define and solve problems related to thermal and mechanical systems and manufacturing processes by applying engineering fundamentals and engineering tools with a logical approach and be able to clearly communicate their findings.
2.	Graduates of the Mechanical Engineering program will have the skills to work individually and in teams, to define and solve problems related to thermal and mechanical systems, and manufacturing processes, by applying engineering principles and tools with a logical approach, and be able to clearly communicate their findings.
3.	Graduates of the Mechanical Engineering program will be able to work in group and individual settings to define and solve problems related to mechanical systems and manufacturing processes. They will apply engineering fundamentals and engineering tools with a logical approach to problem-solving. They are also able to effectively communicate their work orally and in writing.
4.	Graduates of the Mechanical Engineering program will be able to work independently as well as in groups to analyze, design and improve thermal, mechanical and manufacturing products, systems and processes and be able to clearly communicate their funding by applying knowledge and experience obtained during their study.
5.	Graduates of the Mechanical Engineering program will be able to function competently as an individual or part of a team. They shall be able to analyze, define, and solve thermal, mechanical, manufacturing problems through application of engineering fundamentals and Mechanical Engineering tools logically and effectively as well as communicating the problems and their solutions clearly. They are expected to acquire professional competence in the aforementioned skills within five years.

As can be seen from Fig. 13, skills objective statement number 5 is the selection based on the votes of the constituents.

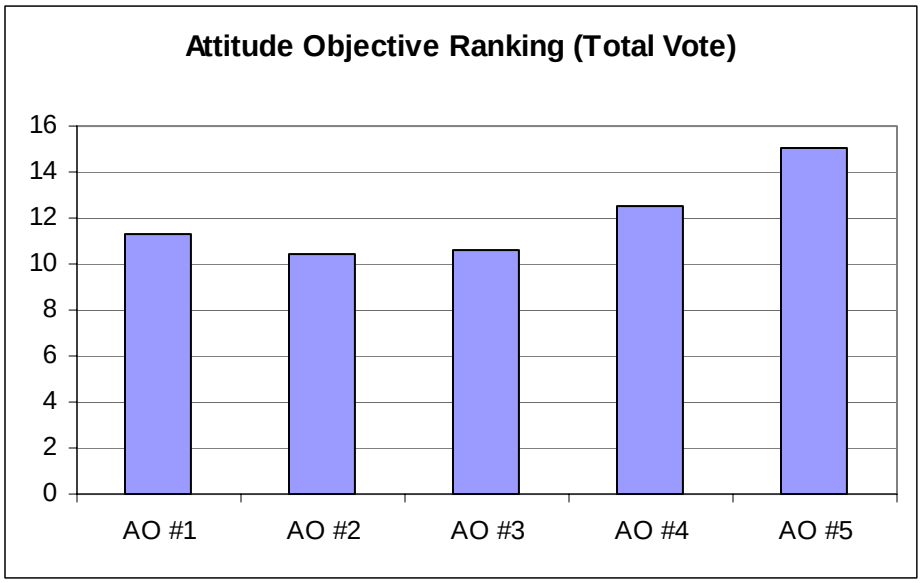

Fig. 14. Total Ranking of Attitude Objective Statements (lowest is best)

Attitude Objective Statements

1.	Graduates of the Mechanical Engineering program will be confident in their abilities to be successful in industrial, academic, and governmental positions and will have the positive and inquisitive outlook on life and learning necessary to promote their continued professional and personal development throughout their careers.
2.	Graduates of the Mechanical Engineering program will have the confidence in their abilities to be successful in either industrial, governmental, or academic positions, and will have a positive and inquisitive outlook on life and continuous learning, necessary to promote their professional and personal development throughout their careers.
3.	Graduates of the Mechanical Engineering program will be adequately prepared to face challenges and be confident to be successful in industrial, academic, and governmental positions. They will also have the positive and inquisitive outlook on life and learning necessary to promote their continued professional and personal development throughout their careers.
4.	Graduate of the Mechanical Engineering program will be able to seamlessly adapt to different employment settings and engineering tasks in industrial and governmental positions and they will be confident in their abilities and eager to continue their education, ether formally or informally, to promote their life long professional and personal development. Three or five years after completing undergraduate study our graduate will be able to successfully transfer and adapt knowledge received in Mechanical Engineering study at CSULA as well as complement it with the team work and management and technical skills developed at their place of employment.
5.	Within three to five years from their date of graduation, our alumni will be confident in their abilities to be successful in industrial, academic, and governmental positions. An important part of their confidence will follow from the result of their positive and inquisitive outlook on learning, practicing engineering, training young engineers, and application of knowledge to life instilled in them as students of Mechanical Engineering.

As can be seen from Fig. 14, attitude objective statement number 2 is the selection based on the votes of the constituents.

The same procedure that we used to select the new objective statements was used to pick the top two new outcome statements based on constituent input. Specifically, the votes of all four major constituents were weighted equally and added together. Since the rankings listed number one as being the top choice, the outcome statements with the lowest totals are the ones that will be selected and added to the required ABET a-k outcome. The following three graphs show these results.

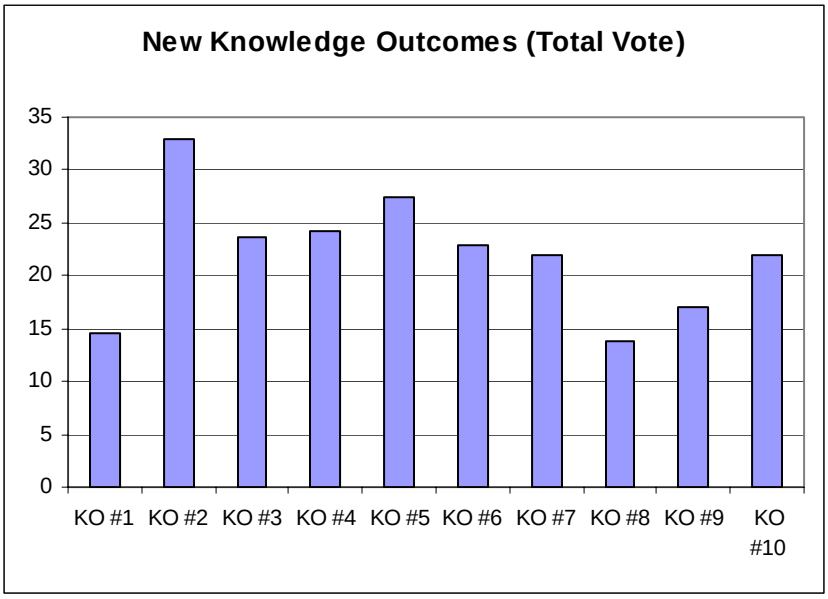

Fig. 15. Total Ranking of New Knowledge Outcome Statements (lowest is best)

Knowledge Outcome Statements

1.	Ability to apply common sense
2.	An understanding of newer disciplines such as biomedical and electro-mechanical
3.	A knowledge of project team management
4.	A knowledge of electro-mechanical fundamentals
5.	A knowledge of the financial and managerial aspects of project engineering
6.	A knowledge of quality standards
7.	A knowledge of geometric dimensioning and tolerances
8.	A knowledge of computer aided design and simulation software
9.	A knowledge of measurement and manufacturing techniques
10.	A knowledge of how mechanical engineering integrates into inter-disciplinary systems

As can be seen from Fig. 15, knowledge outcome statement numbers 1, 8, and 9 are the additional outcomes that were selected by the constituents.

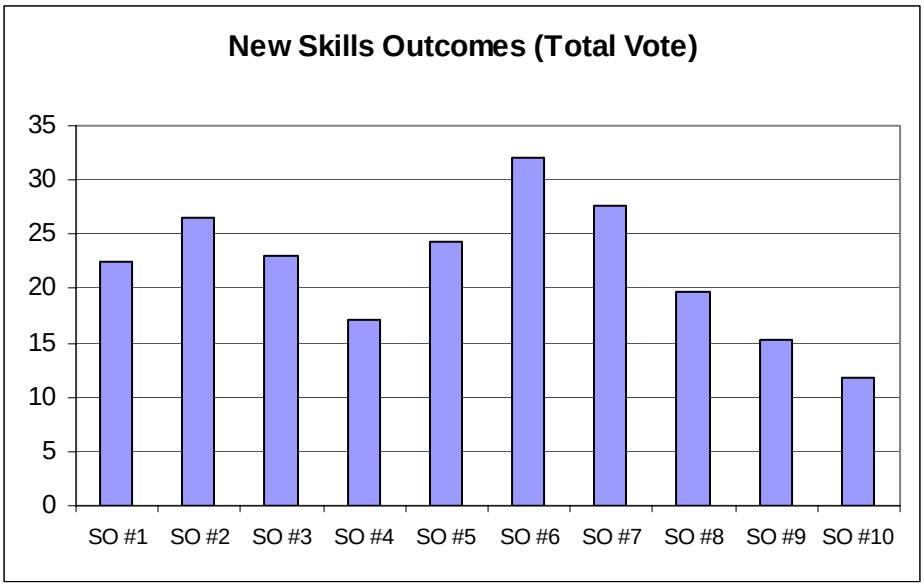

Fig. 16. Total Ranking of New Skills Outcome Statements (lowest is best)

Skills Outcome Statements

1.	Ability to perform manual sketching and drafting
2.	Ability to manage people and show leadership
3.	Ability to understand the "engineering language" effectively
4.	Ability to think in a logical, holistic process
5.	Ability to interact with supervisors and equals in a professional and honest way
6.	Ability to apply a "business model" to engineering
7.	Ability to present oneself well on a resume and during an interview
8.	Ability to select materials and manufacturing processes
9.	An ability to visualize designs from engineering drawings
10.	An ability to think in a logical sequential process

As can be seen from Fig. 16, skills outcome statement numbers 4, 9, and 10 are the additional outcomes that were selected by the constituents. Since 4 and 10 are essentially the same thing, they will be combined in the final draft.

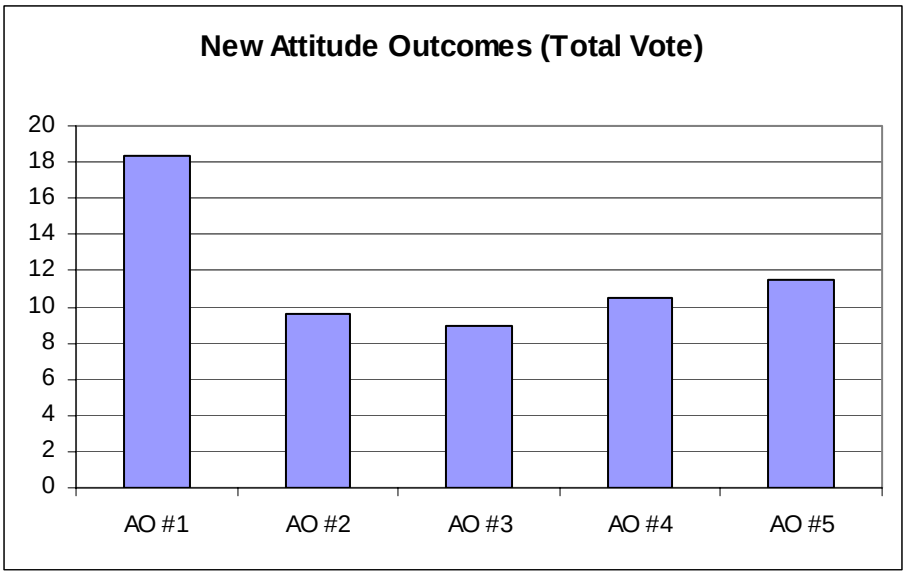

Fig. 17. Total Ranking of New Attitude Outcome Statements (lowest is best)

Attitude Outcome Statements

1.	A recognition of the benefits of diversity in human resources
2.	A desire to have critical thinking and organizational skills
3.	An understanding of responsibility and accountability
4.	A desire to be a professional that exhibits values, dedication and a need for continual improvement
5.	A desire to be a flexible and adaptable team player (collaborative attitude)

As can be seen from Fig. 17, attitude outcome statement numbers 2, 3, and 4 are the additional outcomes that were selected by the constituents.

Final (approved) new Objectives and Outcomes

The new objective statements were determined from input from all constituencies and the outcome statements are a combination of the required a-k statements and non –required statements voted on by the constituencies.

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

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

Knowledge

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

This educational objective will be demonstrated by the following outcomes:

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

Skills

Graduates of the Mechanical Engineering program will be able to function competently as an individual or part of a team. They shall be able to analyze, define, and solve thermal, mechanical, manufacturing problems through application of engineering fundamentals and Mechanical Engineering tools logically and effectively as well as communicating the problems and their solutions clearly. They are expected to acquire professional competence in the aforementioned skills within five years.

This educational objective will be demonstrated by the following outcomes:

1. *an ability to design and conduct experiments as well as to analyze and interpret data (abet **b**)*
2. *ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability (abet **c**)*
3. *an ability to function on multidisciplinary teams (abet **d**)*
4. *an ability to communicate effectively (abet **g**)*
5. *an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice (abet **k**)*
6. *an ability to visualize designs from engineering drawings*
7. *an ability to identify, formulate, and solve engineering problems (abet **e**)*
8. *an ability to think in a logical, sequential, holistic process*

Attitudes

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

This educational objective will be demonstrated by the following outcomes:

1. *an understanding of professional and ethical responsibility (abet f)*
2. *a recognition of the need for an ability to engage in lifelong learning (abet **i**)*
3. *an understanding of responsibility and accountability*
4. *a desire to be a professional that exhibits values, dedication and a need for continual improvement*
5. *a desire to have critical thinking and organizational skills*

Appendices

Appendix 1: Sample Open-Ended Objectives Survey

1/5/05

Dear Constituent,

Thank you for your previous input on the desired program outcomes for CSULA's Bachelor of Science program in Mechanical Engineering.

Our next goal is to reassess the program objective statements for the Bachelor of Science program in Mechanical Engineering at CSULA.

We believe that the program objectives are global statements that describe:

- The knowledge our graduates should have
- The skills graduates should possess
- The attitudes graduates should hold

after practicing engineering for 3 to 5 years.

It is important for us to stress that we **do not want you to describe our current program**. We want your ideas on the **needs that graduates of an up-to-date Bachelor's degree program in Mechanical Engineering should meet**.

Please answer the attached survey by;

a) reviewing our current program objective statements

b) writing an improved program objective statement

Please help us include the "3 to 5 year" period within the statement. Examples of inclusion include:

a) Beginning the statement with, "After 3 to five years, graduates of our Bachelor of Science program in Mechanical Engineering at CSULA…

b) Ending the statement with "…after 3 to five years as a practicing engineer."

c) Or something more clever

Thank you for your time and energy in completing this survey. The information you provide is greatly appreciated and will be used to update our Bachelor of Science program in Mechanical Engineering.

Sincerely,

Knowledge Objective Statement:

Current:

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

Your Proposed Statement:

Skills Objective Statement:

Current:

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

Your Proposed Statement:

Attitudes Objective Statement:

Current:

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

Your Proposed Statement:

Appendix 2: Sample Ranking Objectives Survey

Dear Constituent,

Thank you for your previous input on the desired program outcomes for CSULA's Bachelor of Science program in Mechanical Engineering.

Our next goal is to reassess the program objective statements for the Bachelor of Science program in Mechanical Engineering at CSULA.

We believe that the program objectives are global statements that describe:

- The knowledge our graduates should have
- The skills graduates should possess
- The attitudes graduates should hold

after practicing engineering for 3 to 5 years.

It is important for us to stress that we **do not want you to describe our current program**. We want your ideas on the **needs that graduates of an up-to-date Bachelor's degree program in Mechanical Engineering should meet**.

Please rank the objective statements shown on the following tables from 1 to 5 with **1 being the best choice**. Please start over with each new objective category so that there is a number one ranking for knowledge, a number one ranking for skills, and a number one ranking for attitudes.

Thank your for you time and energy in completing this survey. The information you provide is greatly appreciated and will be used to update our Bachelor of Science program in Mechanical Engineering.

Sincerely,

Knowledge Objective Statements:	Rank
Proposed Statement #1 Graduates of the Mechanical Engineering program will have the knowledge in math, science and engineering fundamentals, as well as societal issues, that allows them to approach real-world Mechanical Engineering problems with an understanding of their impact on society.	
Proposed Statement #2 Graduates of the Mechanical Engineering program will have the knowledge in math, science and mechanical engineering topics, as well as societal issues, that enables them to deal with real-world engineering problems with an understanding of their impact on society.	
Proposed Statement #3 Graduates of the Mechanical Engineering program will have the proper knowledge in math, science and engineering fundamentals to allow them to deal with real-world Mechanical Engineering problems with confidence. They are well aware of the impact their work might have on the broader issues relating to the environment and the society at large.	
Proposed Statement #4 Graduates of the Mechanical Engineering program will have the appropriate knowledge of basic and applied mathematics, engineering science and societal issues that will enable them to work on solution of mechanical engineering problems for the advance of the whole society.	
Proposed Statement #5 Graduates of the Mechanical Engineering program will have the knowledge in math, science, engineering fundamental, and current and emerging societal needs that allows them to competently solve the practical Mechanical Engineering problems considering all the aspects of the impact of the solution. The knowledge base shall be amply broad to enable our graduates to become professional engineers within three to five years of professional practice.	

Skills Objective Statements:	Rank
Proposed Statement #1 Graduates of the Mechanical Engineering program will be able to work in group and individual settings to define and solve problems related to thermal and mechanical systems and manufacturing processes by applying engineering fundamentals and engineering tools with a logical approach and be able to clearly communicate their findings.	
Proposed Statement #2 Graduates of the Mechanical Engineering program will have the skills to work individually and in teams, to define and solve problems related to thermal and mechanical systems, and manufacturing processes, by applying engineering principles and tools with a logical approach, and be able to clearly communicate their findings.	
Proposed Statement #3 Graduates of the Mechanical Engineering program will be able to work in group and individual settings to define and solve problems related to mechanical systems and manufacturing processes. They will apply engineering fundamentals and engineering tools with a logical approach to problem-solving. They are also able to effectively communicate their work orally and in writing.	
Proposed Statement #4 Graduates of the Mechanical Engineering program will be able to work independently as well as in groups to analyze, design and improve thermal, mechanical and manufacturing products, systems and processes and be able to clearly communicate their funding by applying knowledge and experience obtained during their study.	
Proposed Statement #5 Graduates of the Mechanical Engineering program will be able to function competently as an individual or part of a team. They shall be able to analyze, define, and solve thermal, mechanical, manufacturing problems through application of engineering fundamentals and Mechanical Engineering tools logically and effectively as well as communicating the problems and their solutions clearly. They are expected to acquire professional competence in the aforementioned skills within five years.	

Attitudes Objective Statements:	Rank
Proposed Statement #1 Graduates of the Mechanical Engineering program will be confident in their abilities to be successful in industrial, academic, and governmental positions and will have the positive and inquisitive outlook on life and learning necessary to promote their continued professional and personal development throughout their careers.	
Proposed Statement #2 Graduates of the Mechanical Engineering program will have the confidence in their abilities to be successful in either industrial, governmental, or academic positions, and will have a positive and inquisitive outlook on life and continuous learning, necessary to promote their professional and personal development throughout their careers.	
Proposed Statement #3 Graduates of the Mechanical Engineering program will be adequately prepared to face challenges and be confident to be successful in industrial, academic, and governmental positions. They will also have the positive and inquisitive outlook on life and learning necessary to promote their continued professional and personal development throughout their careers.	
Proposed Statement #4 Graduate of the Mechanical Engineering program will be able to seamlessly adapt to different employment settings and engineering tasks in industrial and governmental positions and they will be confident in their abilities and eager to continue their education, ether formally or informally, to promote their life long professional and personal development. Three or five years after completing undergraduate study our graduate will be able to successfully transfer and adapt knowledge received in Mechanical Engineering study at CSULA as well as complement it with the team work and management and technical skills developed at their place of employment.	
Proposed Statement #5 Within three to five years from their date of graduation, our alumni will be confident in their abilities to be successful in industrial, academic, and governmental positions. An important part of their confidence will follow from the result of their positive and inquisitive outlook on learning, practicing engineering, training young engineers, and application of knowledge to life instilled in them as students of Mechanical Engineering.	

Appendix 3: Sample Constituent Student Outcomes Survey to Determine New Student Learning Outcomes

Dear Constituent,

We are seeking your input for use in the process of updating the attributes (program outcomes) desired of the graduates of our Bachelor of Science program in Mechanical Engineering at CSULA. It is important for us to stress that we **do not want you to describe our current program**. We want your ideas on the **needs that graduates of an up-to-date Bachelor's degree program in Mechanical Engineering should meet**.

We believe that all program outcomes can be subdivided into three categories. These are:

- The knowledge graduates will have
- The skills graduates will possess
- The attitudes graduates will hold

Please answer the attached survey by;

a) scoring the outcomes statements one (1) to five (5), with five indicating high emphasis and one indicating no emphasis.

b) adding other attributes in the comments area at the bottom of each page, and

c) ranking each attribute (last page).

In answering this survey, you will help us decide:

1. Which of our current Bachelor's degree outcomes should be included and if necessary, expanded upon?
2. Which of these current Bachelor's degree outcomes are no longer relevant to a modern Bachelor's program and should be excluded (i.e. no emphasis)?
3. What new outcomes should be sought after in the Bachelor's program?
4. What is the relative importance of each outcome?

Thank you for you time and energy in completing this survey. The information you provide is greatly appreciated and will be used to update our Bachelor of Science program in Mechanical Engineering.

Sincerely,

STUDENT OUTCOMES SURVEY **Name:** _____
Mechanical Engineering

Title: _____

Date: _____

PLEASE CIRCLE ALL THAT APPLIES

You can be described as a(n):

Employer Faculty Alumnus Student*

*If student, number of units completed:_____

Knowledge Outcomes	**Emphasis**
How much emphasis should the Mechanical Engineering Undergraduate Program place on their graduates having:	**high emphasis** **no emphasis**
an ability to apply knowledge of mathematics, science, and engineering?	5 4 3 2 1
an understanding of professional and ethical responsibility?	5 4 3 2 1
the broad education necessary to understand the impact of engineering solutions in a global/societal context?	5 4 3 2 1
knowledge of current events and societal contemporary issues -- non-engineering related?	5 4 3 2 1
a knowledge of computer aided design and simulation software?	5 4 3 2 1
a knowledge of measurement and manufacturing techniques?	5 4 3 2 1
a knowledge of how Mechanical Engineering integrates into inter-disciplinary systems?	5 4 3 2 1
Additional knowledge outcomes 1.	5 4 3 2 1
2.	5 4 3 2 1
3.	5 4 3 2 1
4.	5 4 3 2 1
5.	5 4 3 2 1

Skills Outcomes	**Emphasis**
How much emphasis should the Mechanical Engineering Undergraduate Program place on their graduates having:	**high emphasis** **no emphasis**
an ability to design and conduct experiments as well as to analyze and interpret data?	5 4 3 2 1
an ability to design a system, component, or process to meet desired needs?	5 4 3 2 1
an ability to function on multidisciplinary teams?	5 4 3 2 1
an ability to communicate effectively?	5 4 3 2 1
an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice?	5 4 3 2 1
an ability to select materials and manufacturing processes?	5 4 3 2 1
an ability to visualize designs from engineering drawings?	5 4 3 2 1
an ability to think in a logical sequential process?	5 4 3 2 1
Additional skill outcomes 1.	5 4 3 2 1
2.	5 4 3 2 1
3.	5 4 3 2 1
4.	5 4 3 2 1
5.	5 4 3 2 1

Attitudes Outcomes	**Emphasis**
How much emphasis should the Mechanical Engineering Undergraduate Program place on their graduates having:	**high emphasis** **no emphasis**
an understanding of professional and ethical responsibility?	5 4 3 2 1
a recognition of the need for an ability to engage in lifelong learning?	5 4 3 2 1
an understanding of responsibility and accountability?	5 4 3 2 1
a desire to be a professional that exhibits values, dedication and a need for continual improvement?	5 4 3 2 1
a desire to be a flexible and adaptable team player?	5 4 3 2 1
Additional attitude outcomes 1.	5 4 3 2 1
2.	5 4 3 2 1
3.	5 4 3 2 1
4.	5 4 3 2 1
5.	5 4 3 2 1

What other types of outcomes or general issues should the Department consider as it plans for the future?

Most Important Outcomes:

Please examine this following list of all the outcomes grouped together and rank your TOP FIVE that should have the highest degree of emphasis in our Bachelor's program in Mechanical Engineering.

	an ability to apply knowledge of mathematics, science, and engineering?
	an understanding of professional and ethical responsibility?
	the broad education necessary to understand the impact of engineering solutions in a global/societal context?
	knowledge of current events and societal contemporary issues -- non-engineering related?
	a knowledge of computer aided design and simulation software?
	a knowledge of measurement and manufacturing techniques?
	a knowledge of how Mechanical Engineering integrates into inter-disciplinary systems?
	an ability to design and conduct experiments as well as to analyze and interpret data?
	an ability to design a system, component, or process to meet desired needs?
	an ability to function on multidisciplinary teams?
	an ability to communicate effectively?
	an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice?
	an ability to select materials and manufacturing processes?
	an ability to visualize designs from engineering drawings?
	an ability to think in a logical sequential process?
	an understanding of professional and ethical responsibility?
	a recognition of the need for an ability to engage in lifelong learning?
	an understanding of responsibility and accountability?
	a desire to be a professional that exhibits values, dedication and a need for continual improvement?
	a desire to be a flexible and adaptable team player?
	Additional outcomes 1.
	2.
	3.

Appendix 4: Sample Survey for Ranking of Constituent Desired Outcomes (additional outcomes that are not required by ABET)

Dear Constituent,

Thank you for your previous input on the desired program outcomes and objectives for CSULA's Bachelor of Science program in Mechanical Engineering.

Our next goal is to rank the "unrequired outcomes" that describe the desired qualities of a graduate of the Bachelor of Science program in Mechanical Engineering at CSULA. "Unrequired" are those outcomes that are not set by ABET. By ABET rules, we need to include all of their required outcomes and some outcomes that we believe describe our graduates. The unrequired outcomes listed in this survey have been suggested by our constituents (Industry, Faculty, Alumni, and Students).

Remember, it is important for us to stress that we **do not want you to describe our current program**. We want your ideas on the **needs that graduates of an up-to-date Bachelor's degree program in Mechanical Engineering should meet**.

Please rank the outcome statements, shown on the following tables, from 1 to the total number present with **1 being the best choice**. Please start over with each new outcome category so that there is a number one ranking for knowledge, a number one ranking for skills, and a number one ranking for attitudes.

Thank your for you time and energy in completing this survey. The information you provide is greatly appreciated and will be used to update our Bachelor of Science program in Mechanical Engineering.

Sincerely,

Knowledge Outcome Statements (Rank these outcomes from 1 to 10 with 1 being the best choice)	**Rank**
Ability to apply common sense	
An understanding of newer disciplines such as biomedical and electro-mechanical	
A knowledge of project team management	
A knowledge of electro-mechanical fundamentals	
A knowledge of the financial and managerial aspects of project engineering	
A knowledge of quality standards	
A knowledge of geometric dimensioning and tolerances	
A knowledge of computer aided design and simulation software	
A knowledge of measurement and manufacturing techniques	
A knowledge of how mechanical engineering integrates into inter-disciplinary systems	

Skills Outcome Statements (Rank these outcomes from 1 to 10 with 1 being the best choice)	**Rank**
Ability to perform manual sketching and drafting	
Ability to manage people and show leadership	
Ability to understand the “engineering language” effectively	
Ability to think in a logical, holistic process	
Ability to interact with supervisors and equals in a professional and honest way	
Ability to apply a “business model” to engineering	
Ability to present oneself well on a resume and during an interview	
Ability to select materials and manufacturing processes	
An ability to visualize designs from engineering drawings	
An ability to think in a logical sequential process	

Attitudes Outcome Statements (Rank these outcomes from 1 to 5 with 1 being the best choice)	**Rank**
A recognition of the benefits of diversity in human resources	
A desire to have critical thinking and organizational skills	
An understanding of responsibility and accountability	
A desire to be a professional that exhibits values, dedication and a need for continual improvement	
A desire to be a flexible and adaptable team player (collaborative attitude)	