



# MECHANICAL ENGINEERING STRATEGIC PLAN

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## VISION

The vision of the Mechanical Engineering department at Northern Arizona University is to be the first choice in the Southwest region for students desiring an education in a personalized environment.

This plan was developed by the Mechanical Engineering Planning Task Force, which included:

Dr. Pamela A. Eibeck, Chair, Mechanical Engineering Department  
Dr. Tom Acker, Assistant Professor, Mechanical Engineering Department  
Dr. David Hartman, Professor, Mechanical Engineering Department  
Dr. David Lamkin, Associate Professor, Mechanical Engineering Department  
Mr. Jeffrey Coury, student, Mechanical Engineering Department  
Mr. James Battaglia, student, Mechanical Engineering Department  
Mr. Michael Radoccia, industrial representative, Arizona Public Service  
Mr. Rodger Payne, industrial representative, Autodesk, Inc.  
Mr. Charles Henry, industrial representative, Boeing Commercial Aircraft Group

## **MISSION**

The mission of the mechanical engineering department is to serve our students by offering an outstanding, professionally oriented undergraduate and graduate engineering education in a personalized environment.

We will achieve our mission through offering a rich learning environment, including:

- innovative and challenging curricula;
- excellent instruction;
- professional practice opportunities;
- research opportunities for undergraduates and graduate students;
- active student societies; and
- meaningful faculty advising and mentoring.

Our faculty, who serve as models of engineering professionals, will be intellectually active in applied research and professional activities that serve the technical needs of society and also benefit the education of our students. Our graduates will be prepared for engineering practice, advanced education, and leadership in the technical community and society at large.

## ENVIRONMENTAL SCAN

Higher education is currently undergoing a transformation as significant as the rapid expansion that occurred in universities during the post-WWII era. Below the major external pressures on engineering programs are listed, along with their implication regarding the ME department's strategic direction.

### **Trend: Decrease in research funding to support the individual faculty member to pursue faculty-centered research.**

- Drop in defense-related research funding due to demise of Cold War.
- Growth in research-focus universities, hence more faculty competing for funding.
- Decrease in corporate-based R&D efforts.

### **NAU/ME Response: Avoid pursuing the “Research-1-wanna-be” path.**

- Develop applied research projects that serve the technical needs of industry partners and/or the regional community and benefit our students.
- Solicit funding for research activities from a broad base, including federal government, regional funding agencies and industry partners.
- Do not pursue adding a doctoral program, due to lack of R&D jobs for graduates.

### **Trend: Economy is shifting from manufacturing-based economy to a global, distributed knowledge-based economy.**

- Engineers work in global environment with diverse peers, customers and cultures.
- Life-time jobs for engineers with one firm are a rarity.
- Engineers must operate as entrepreneurs, whether at a small or large firm, who must sell and justify their ideas.
- Engineers no longer function in technical isolation, and instead must work in cross-disciplinary teams.
- Technology is changing so rapidly that continual education/self-learning is essential.
- Graduating engineers are expected to be immediately productive on the job, and know greater technical content along with functional skills at the end of four years.

### **NAU/ME Response: Offer a curriculum that serves educational needs of the new economy.**

- Offer an undergraduate program that balances fundamentals with context of engineering practice.
- Emphasize student responsibility and initiative in being a self-learner.
- Presume the masters degree will be the “degree of choice” in future due to increased technical demands on engineers.
- Offer a flexible, multi-disciplinary Masters of Engineering degree to residential students, as well as place-bound practicing engineers.

**Trend: Greater accountability and financial pressures on higher education.**

- Finances will be constrained due to decreased state support, pressure to keep tuition low, and increased infrastructure needs
- Higher expectations for teaching quality and educational outcomes from society, employers and ABET.
- Rapid changes and improvements in instructional technology, leading to greater costs to stay current in both dollars and faculty training time.
- No student market is cornered anymore; distance delivered course materials are available from top institutions and private educational institutions, such as Univ. of Phoenix are providing “student-friendly” education and services.
- Greater accountability to our stakeholders, including students, legislature, employers, parents, and public in general.

**NAU/ME Response: Operate as an entrepreneurial organization with the student as primary customer.**

- Continue faculty’s focus on high-quality teaching, advising and student mentoring.
- Increase our regional and national visibility to attract a breadth of external funding support that assist educational and research efforts.
- Emphasize educational services that are unique to a campus-based program, including faculty attention, team-building skills, public speaking and presentation skills, a personalized professional community and access to quality laboratory and computer facilities.
- Develop meaningful strategic plans plus a system for continuous improvement.

**Trend: Students no longer meet the traditional 18-22 year old model.**

- An increase in the number of re-entry students.
- Larger number of students who are supporting their own education and work 10–30 hours/week while in school – hence time to BSE graduation is greater than 5 years.
- Students leave high school poorly prepared in writing, mathematics and study skills.
- Continually increasing fraction of our students come from community colleges.

**NAU/ME Response: Shift educational paradigms to enable success for the new student.**

- Increase scholarship and internship opportunities for students.
- Coordinate with community colleges to develop pre-engineering programs that can address the remedial educational needs (HS level courses) and provide flow of prepared engineering students.
- Offer BS/M.Eng. degree path to enable students to efficiently complete two degrees.

## **GOALS & STRATEGIES:**

The following are the goals of the Mechanical Engineering department. Following each goal are strategies used to achieve the goals:

### **Goal 1.**

#### **Graduate high-quality B.S. engineers who are prepared for modern engineering practice.**

Our graduates will grasp the fundamentals and their application, have practiced the application of engineering through diverse design experiences, and understand the context within which engineering is practiced.

#### Strategies:

- 1.1 Achieve high academic expectations of students in the classroom and program.
- 1.2 Encourage student applications of math, science and engineering science fundamentals through curricular design projects, research opportunities, internships, and student society projects. Emphasize effective and meaningful design experiences across the four years of the BS.
- 1.3 Reinforce fundamental engineering and science principles and mathematical analysis skills throughout the curriculum.
- 1.4 Provide state-of-the-art experimental facilities and a strong education in experimental design, methods and data analysis.
- 1.5 Emphasize skills for modern engineering practice including strong communication skills, teamwork, ethics, and the social/corporate context within which engineering decisions are made.
- 1.6 Emphasize student self-learning by incorporating a greater number of assignments, projects, and experiments in which students must access and learn new engineering content autonomously.
- 1.7 Integrate the use of computer design and analysis tools across ME curriculum.
- 1.8 Encourage cross-disciplinary course-work.
- 1.9 Develop challenging, in-depth upper-division mechanical engineering electives.
- 1.10 Support industry involvement in the curriculum through capstone design projects, seminars, student research projects and co-instruction.

### **Goal 2.**

#### **Offer a practice-oriented masters-level graduate education.**

The graduate program will serve the educational needs of place-bound professionals and residential students who intend to practice engineering.

#### Strategies:

- 2.1 Aggressively pursue the ABOR approval of a master's of engineering program for the CET.
- 2.2 Develop a M.Eng. graduate curricula in collaboration with industry to assure a relevant curriculum with a wide student market.
- 2.3 Develop graduate courses that will be offered in a flexible format and by alternative delivery methods.

- 2.4 Assure the graduate curricula strengthen the undergraduate program and utilize the faculty's expertise.
- 2.5 Become comfortable with Web-programming to support distance education.

### **Goal 3.**

#### **Steadily increase the applied engineering research and/or pedagogical research conducted by ME faculty.**

These activities will benefit our faculty members' professional development, enhance the quality of our academic programs, enable collaboration between faculty and students, and enhance our national reputation through dissemination.

#### Strategies:

- 3.1 Develop applied research programs in two areas to leverage efforts.
- 3.2 Develop composite materials research plus fabrication & test facility to serve industry.
- 3.3 Develop alternative energy systems research and demonstration facility and link to Southwest needs.
- 3.4 Steadily increase external funding at a modest rate to increase student support, faculty support, and facilities without over-committing to research efforts.

### **Goal 4.**

#### **Provide high-quality educational experience and career guidance to our students.**

#### Strategies:

- 4.1 Achieve high standards for instructional quality.
- 4.2 Continuously improve our advising effectiveness.
- 4.3 Provide small classes (<20) wherever possible to enable close faculty and student interactions.
- 4.3 Implement mechanisms for continuous assessment of performance.
- 4.4 Provide effective mechanism for student informal feed-back.
- 4.5 Facilitate student access to internships and job placement.
- 4.6 Support student societies and projects through faculty advising and departmental support.

### **Goal 5.**

#### **Educate and graduate outstanding engineers reflecting the diversity of the American Southwest population.**

#### Strategies:

- 5.1 Increase the quality and quantity of students in ME by recruiting top high school students to the undergraduate program.
- 5.2 Increase the number of scholarships available for ME majors.
- 5.3 Develop recruiting materials that reflect the friendly atmosphere and desired diversity of our students.

- 5.4 Work closely with the College to assure we are serving our underrepresented students effectively.

**Goal 6.**

**Improve our relationships with our constituents to stay cognizant of external expectations and opportunities for the program.**

Strategies:

- 6.1 Achieve an effective departmental advisory council, and steadily increase their participation in departmental activities.
- 6.2 Continue to support the capstone design project as a vehicle for continued communications and support with industry.
- 6.3 Establish low-overhead communications with alumni and parents via annual newsletter.
- 6.4 Implement an informative and attractive Web-site.

## OUTCOMES

The following attributes of our graduates and program reflect the priorities of our faculty and industrial advisory council. These attributes will be used to assess the success of our program.

### Attributes of Bachelor of Science in Engineering graduates

Highest priority:

Well grounded in application of fundamental principles
Well grounded in fundamental engineering & science principles
Ability to communicate effectively, oral and written
Equipped to be "self-learner"
Ability to identify, formulate and solve engineering problems
Ability to work on teams

Important, but lower priority:

A recognition of the need to pursue life-long learning
Ability to design a system, component or process to meet needs
Interdisciplinary design ability
An understanding of professional and ethical responsibility
Ability to use computers effectively
Ability to analyze and interpret data
Strong mathematical analysis skills
Ability to design and conduct experiments
A broad education to understand global/societal context of engineering
Interdisciplinary expertise across engineering
Ability to use the techniques, skills and modern tools for engineering practice
Disciplinary expertise within ME

### Attributes of the program

Highest priority:

High quality instruction.
Academically rigorous and challenging
Faculty members that are professionally current and active.
Faculty focus on undergraduates
Strong mentoring between faculty and students
Continuous self-assessment program in place.
Computer useage integrated throughout curriculum.
High quality student academic performance
Maintains close relationships industry.

Emphasis on team work
Active industrial advisory board.
External funds available to support facility improvement.

Important, but lower priority:

High quality academic advising.
Extensive internship and technical employment opportunities
Hands-on design integrated throughout curriculum over all four years.
Easy access of students to technically current computers.
Small class sizes (average < 20)
Current technical issues integrated throughout curriculum.
Good financial support available for undergraduates (scholarships, etc.)
External funds available to support applied research efforts.
Modern experimental facilities
Attract and retain top high school students
Cross-disciplinary opportunities via minors, merged majors, breadth electives
Active student groups supported by faculty advising/mentoring.

The attached matrix indicates the correspondence between the attributes and the goals and strategies for the ME department. Departmental goals that were not ranked important by the faculty and industrial advisory council included:

- Diversity of ME graduates
- Development of Web- programming ability plus distance course delivery

Since these goals are consistent with the mission of the University, they were included in our strategic plan. The only industrial and faculty desired attributes that is not a specific ME goals is “Easy access of students to technically current computers.” This is a goal at the College level, and hence, was not included at the departmental level strategic plan.