ASME Vision 2030 project:

Drivers for Change
Data
Actions & Advocacy

2013
Drivers for Change

Increased Professional Expectations

– Engineering expertise is needed at both the practitioner and research/development level to meet our challenges

– Greater expertise in professional skills of communications, leadership, and creativity will be required along with increased invention and innovation skills

– Global competency in engineering practice is becoming a necessity

– Needed … engineers who can enable sustainable growth.
Drivers for Change

Increased Professional Expectations  (continued)

– Needed … engineers who can innovate and create new jobs, new companies and maintain sustainable growth

– Needed … engineers who can solve the grand challenges and provide the leadership needed to create adequate living conditions for all people

– Needed … engineers (and engineering degree programs) that can embrace New Knowledge and adapt to the Blurring/Widening of Disciplinary Boundaries.
1,400 Industry Managers
1,200 Early-career Engineers
80 ME Department Heads
15 Assessment Categories
6 Action Agenda Items
Where the BSME is regarded as: “weak and needs strengthening”

% Industry Supervisors/Managers | % Early Career Engineers | % ME Department Heads

Practical Experience - how devices are made/work
Communication - oral, written
Engineering Codes and Standards
Overall systems perspective
Problem solving & critical thinking - analysis
Design - product creation
Project management
Experiments - laboratory procedures
Business Processes
Leadership
Interpersonal/teamwork
Technical fundamentals - traditional ME subdisciplines
New technical fundamentals - bio, nano, info, etc.
Computer modeling and analysis - software tools
Information processing - electronic communication

(1,404 engineering managers) (1,198 early-career ME’s) (80 universities)

Vision 2030
Mechanical Engineering Education

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Where there’s agreement ...

Practical Experience - how devices are made/ work

Engineering Codes and Standards
Overall systems perspective

Project management
Business Processes
Leadership

% Industry Supervisors/Managers  % Early Career Engineers  % ME Department Heads

Vision 2030
Mechanical Engineering Education
Where there’s not …

% Industry Supervisors/Managers | % Early Career Engineers | % ME Department Heads

Communication - oral, written

Problem solving & critical thinking - analysis

Design - product creation

Experiments - laboratory procedures

Interpersonal/teamwork

Technical fundamentals - traditional ME subdisciplines

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Vision2030
Mechanical Engineering Education

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Design spines are four-semester sequences of team-based, hands-on projects emphasizing core mechanical engineering requirements. The task force recommends broadening ME design spines with students from other engineering areas for multidisciplinary projects. In addition, additional senior “capstone” courses should concentrate on device/system design followed by analysis, building, testing, and operation in industry-supported projects.

To foster discovery-based learning, the task force recommends that design spines and capstone courses be enriched by tackling more difficult projects.

We recognize that expanding design spines with multidisciplinary coursework means that some of today’s required engineering science courses may become electives. Representing ME design spine coursework to strengthen young engineers’ professional skills is recommended as way to add emphasis on innovation, leadership, systems-level perspectives, interdisciplinary teamwork, project management, and entrepreneurship. As shown in the Vision 2030 response, the importance placed on these subjects should approach that accorded to technical topics.

The Vision 2030 Task Force recognizes that practical engineering experience has been overlooked in many previous educational reform efforts. Debates sparked by these efforts centered on ideal mixes of math, science, engineering analysis and design knowledge rather than their real-world applications.

A role we call “professors of practice” would creates faculty positions to be filled by senior engineers with real-world experience who would be instructors, especially in the design spine and capstone courses. These faculty newcomers would help students gain a broader understanding of everyday engineering challenges such as determining product specifications, identifying constraints, and managing supply chains—no to mention practical mentoring.

Professors of practice could also free tenured faculty to pursue more externally funded research. Their industrial perspective would inform senior faculty of current industry practices, and ensure that standards and codes are better understood.

No one doubts that the engineered systems of the future will continually grow more complex. An obvious example is the search for oil. Drillers will go deeper; producers will operate in harsher environments; risks to companies, careers, and society will inevitably rise. Analogous challenges are found in every industry.

Strengthening the areas highlighted by the Vision 2030 findings may mean new coursework, shifts in faculty makeup and incentives, adjustments to established programs, new criteria for faculty evaluations, and closer involvement with industry. Given the consensus-based decision making in most programs and colleges, none of this will be easy.

ME programs at the University of California, Berkeley, Georgia Institute of Technology, Massachusetts Institute of Technology, Pennsylvania State University, Purdue University, and of course many other schools are adopting practices in line with the task force’s recommendations.

If the proposed reforms are to succeed, the importance of ASME role cannot be overestimated. Individual ASME members must act specifically, and locally.

ASME and its industry leaders can play vital role by initiating faculty-industry exchanges, by enlarging industry-based faculty chairs, by pressing for better faculty-student ratios, and by seeking out new faculty candidates with more industry experience. They can also join schools’ industrial advisory boards. When advisory boards can offer more suggestions from recent graduates about improving academic programs, faculty and administrators are more likely to take action.

The successful implementation of a broader ME curriculum, with a tighter focus on professional skills, will produce savvier, more well-rounded, and more professional graduates. They must have the skills and abilities to conceive, coordinate, manage and lead global projects. And in a tightly interconnected and increasingly interdependent world, these graduates will be involved in policy and regulatory decisions at all levels.

These graduates will become leaders at all levels of society and will foster economically and environmentally sustainable solutions for the good of all. Tomorrow’s ME graduates will foster sustainable growth in myriad ways; they will regularly re-create their own jobs and create new jobs for others.

The Vision 2030 Task Force predicts that these graduates will always be thinking about the world’s greatest, most daunting challenges.
Industry Supervisor Perceptions of Entry-level BSME Graduate Weakness (n = 1404)

- Practical experience (how devices are made/work): 55.5%
- Communication (oral, written): 48.4%
- Engineering Codes and Standards: 46.9%
- Overall systems perspective: 44.3%
- Project management: 34.6%
## Early Career Engineers Perceptions of Own Weakness (n = 1198)

<table>
<thead>
<tr>
<th>Area</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Engineering Codes and Standards</td>
<td>48.3%</td>
</tr>
<tr>
<td>Practical experience (how devices are made/work)</td>
<td>37.3%</td>
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<tr>
<td>Project management</td>
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<tr>
<td>Business processes</td>
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<tr>
<td>New technical fundamentals (new ME applications - bio, nano, info, etc)</td>
<td>31.3%</td>
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<tr>
<td>Overall systems perspective</td>
<td>29.5%</td>
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ASME Vision 2030 Action Agenda

1) Richer practice-based engineering experience for students

2) New balance of faculty research/practice skills in ME programs

3) Greater cultivation of Innovation and Creativity

4) Increased curricular flexibility

5) Development of students’ professional skills to higher standards

6) Greater diversity among students and faculty

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1) **Richer practice-based engineering experience for students**

- Increase applied engineering design-build-test experiences **throughout degree program**
- More exposure to engineering codes and standards
- More pervasive systems perspective
- Re-launch the Society’s Ben C. Sparks Medal to focus on outstanding achievement in practice-based engineering education *(done 2013)*

**Systemically Increase:**
- Student Exposure to Practicing Engineers and their experiences
- Student Design/Build Project Experiences in the degree program
2) New Balance of Faculty Research/Practice Skills in ME programs

- Increase faculty expertise in professional practice.
- Use ‘Professor of Practice’ positions to attract and retain faculty with significant industry experience in product development, manufacturing and management.
- Create opportunities for faculty development related to industry practice.
3) **Greater Innovation & Creativity**

- Expand the kinds of problems that we are asking students to address.
- Use of ‘grand challenges’ in energy, water, health, poverty.
- Engage students throughout their degree program with active discovery-based learning.
4) **Increased Curricular Flexibility**

- Modify ABET ME Program Criteria to support more flexibility *(done October 2013)*
- Designate a mechanical engineering core of first-course fundamental ME discipline areas
- Create a student elective array of MME Concentration Options (mechanical & multi-disciplinary engineering)
5) **Develop Students’ Professional Skills to a Higher Standard**

- Strengthen teamwork, communication, problem solving, interpersonal, and leadership skills.
- Systematic focus on integration of such skills into curricula must approach the priority given to technical topics.
6) **Achieve Greater Diversity among ME Students & Faculty**

*Implement effective strategies to attract and retain a more diverse ME student body.*

Recruitment messages, mentorship, faculty diversity, and emphasizing that mechanical engineering is about solving the problems that impact people lives are all important strategies.

ME is now the #1 choice of women studying engineering in the U.S.

2012 ASEE Enrollment Data
Next ---- What might the next 5 years of ASME efforts look like?

Strategy development and implementation projects are underway for each of the action items.

Care to join the effort?

Mo Hosni, Kansas State  
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