Mechanical Engineering Education Under Pressure

Growth, Change, and the Persisting Challenges of Success

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Degree Program Quality Standards
- ABET Accreditation
- ASME/ABET Preparation Workshops

Leadership Development
- ASME ME Department Heads Community
- Department Head Leadership Summits & Workshops

Research, Best Practices & Advocacy
- Vision 2030 Research & Advocacy
- ME Department Management & Curriculum Studies
- Best Practice Awards and Visibility
- 140,000+ members in > 150 countries
- 500+ standards in > 100 countries
- 35+ major conferences annually
- 180 technical courses/seminars for engineers
- 460 ME/MET degree programs accredited through ABET
- Digital collection of technical papers
- Offices in China, India, Belgium & US
  (New York - New Jersey - Washington, DC - Houston)
ASME Role and Purpose in Engineering Education

– Establish and assess **standards of quality** in mechanical engineering degree programs...... via ABET

– Provide **guidance and advocacy** to colleges and universities to enhance the quality, content and relevance of engineering degree programs.

– Provide and participate in **influential forums for academic, government and industry leaders** on the education of mechanical engineers.

– and we do this by **cultivating and maintaining respected presence and communication channels** between ASME and those who educate the next generation of mechanical engineers – the ME Department Heads and faculty.
Engineering Education

Who?

15 Cmte on Engineering Education Members
18 V2030 & Other Project Committee Members
10 Award/Fellowship Committee Members
23 ME/MET Department Head ExCom Members
37 ASME/ABET Commission & Board Members
147 ASME/ABET Program Evaluators
**ABET** accredits over **3,200 college & university programs** in applied science, computing, engineering, & engineering technology.

**ABET** accreditation criteria/standards are **developed by technical professionals** from ASME and the other 27 ABET-member societies.

**ABET** is an independent, multi-national, peer-review, accreditation process involving more than **2,200 university & industry experts** serve as Program Evaluators (PEV’s).

**ABET** Program Evaluators (PEV’s) are not paid. They are volunteer members of the professional societies who are selected, trained on accreditation assessment, and are evaluated by their peers.

**ABET** is a **voluntary & confidential process** – only successful programs are successful are made public.

**ABET** is an independent, nonprofit, non-government organization.

**ASME** is a founding creator and leader in ABET.
ABET/ASME Engineering Education

Degree Program Accreditation

Universities – Colleges – Community Colleges
Criterion/Outcomes-based Program Assessment (AAS/BS/MS)

Countries and Growing

150 Experienced Degree Program Evaluators From University, Industry & Government

462 Degree Program Accreditation Assessments Conducted 6-year cycle

150,000+ ME/MET Students Benefit

Bahrain  Chile  China  Colombia  Egypt  Ecuador  India  Kuwait  Lebanon  Mexico

Oman  Palestine  Peru  Philippines  Qatar  Saudi Arabia  Spain  Turkey  UAE  USA
ASME International ME Education Leadership Summits

2016 Tampa, FL
2015 Newport Beach, CA
2014 San Juan, Puerto Rico
2013 San Diego, CA
2012 Clearwater Beach, FL
2012 Beijing, China (w/CMES)
2011 Clearwater Beach, FL
2011 Hong Kong, China (w/CMES)
2010 Istanbul, Turkey
2010 Newport Beach, CA
2009 Hilton Head, SC
2008 Galveston, TX
2007 Dorado, Puerto Rico
2006 Beijing, China (w/CMES)
2005 San Diego, CA
2004 Clearwater Beach, FL
2002 Clearwater Beach, FL
2000 Fort Lauderdale, FL
1997 San Diego, CA
1995 Nashville, TN
1993 Orlando, FL
1989 Orlando, FL

https://www.asme.org/events/meed
Advanced Manufacturing
The Digital Mechanical Engineer
Creating & Sustaining Inclusive and Diverse Environments in ME Departments and Programs (WEPAN/ASME TECAID)
Update on Proposed ABET General Criteria Changes
Project-based Curriculum Transformation: Strategies, Tactics & Resources (Vision 2030)
Ben C. Sparks Medal
Edwin F. Church Medal
Zweip Innovation Award  (new)

... celebrating strong emphasis on design-build/industry-practice, achievement, and innovation in ME degree programs.

... the honorees now give featured presentations at the ME Education Leadership Summit.

Tim Simpson
Penn State
2014 Sparks Honoree
1. March 2016 ME Education Leadership Summit, Tampa, FL
2. 2016 UPADI Engineering Education Track/Workshop, October 24-28, Panama City, Panama
3. 2016 IMECE, Houston, TX – MEDH Forum, Professional Development Session, TECAID/Diversity project Session, Tips for Tenure Workshop
4. 2016 Sep-Dec – 100+ ME/MET ABET Program accreditation visits
8. V2030 Degree Program/Department Benchmark Study
9. ME Undergraduate Women Study
10. NSF/WEPAN/TECAID Project – Workshops/Content Capture
Data & Advocacy Strategy

ME Degree Programs and Industry Needs
1,400 Industry Managers
1,100 Early-career Engineers
80 ME Department Heads
15 Assessment Categories

Surveyed about the skills of ME graduates and curriculum
Where to increase BSME Program Emphasis

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

Comparative emphasis in different areas:
- 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
Where we agree

- 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

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Where we differ

- Communication - oral, written
- Problem solving & critical thinking - analysis
- Design - product creation
- Experiments - laboratory procedures

- Interpersonal/teamwork
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ASME Vision 2030 Advocacy Agenda

1) Richer and more extensive practice-based engineering experience for students
2) New balance of faculty research/practice skills in ME programs
3) Greater cultivation of Diversity, Creativity, and Innovation among students and faculty
4) Development of students’ professional skills to higher standards
5) Increased curricular flexibility in ME Programs
1) Richer and more extensive practice-based engineering experience for students

- Increase understanding of how devices are made and work
- Increase applied engineering design-build-test experiences throughout degree program
- More exposure to engineering codes and standards (Changing ABET MET program criteria to require industry standards infusion in programs – final ABET/ETAC vote July 2016)
- More pervasive systems/design context perspective

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2) New Balance of Faculty Research/Practice Skills in ME programs

- Increase faculty expertise in professional practice
- Increase and incorporate ‘Professor of Practice’ positions (particularly with industry-endowed support) as critical to the department mission to evolve a faculty cadre with significant industry experience in product design, development manufacturing and management

Create opportunities for faculty development related to industry practice
3) Greater Diversity, Creativity and Innovation among Students & Faculty

- 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 programs universities & community colleges with active discovery-based learning.

- Engage ME departments in research-informed understanding and best practice approaches to increasing diversity in their programs and inclusion in their instruction and practices.

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4) Develop Students’ Professional Skills to a Higher Standard

- Strengthen teamwork, communication, problem solving, interpersonal, inclusion and leadership skills.

- Systematic focus on integration of such skills into curricula must approach the priority given to technical topics.
5) Increased Curricular Flexibility

- Modify ABET ME Program Criteria to support more flexibility *(done October 2013)*

- Identify a mechanical engineering core of first-course fundamentals in the ME discipline

- Create a student elective array of **MME Concentration Options** (mechanical & multi-disciplinary engineering)

- Begin the stakeholder conversation about the **Digital Mechanical Engineer**
Degree Program/Department Benchmarking Study
Spring 2016
State of ME Programs in 2016?

• What practice-based curricular changes have occurred in ME departments in the last three (3) years?

• In January 2016, ASME Engineering Education Committee developed and sent out a curriculum survey to the U.S. ME Department Heads.

• Summary of survey results (n=54 ME Programs) follows:
Q. What year(s) do students engage in…

Design/Build/Test

YEAR 4
YEAR 3
YEAR 2
YEAR 1

(Aggregated responses)
Q. What year(s) do students engage in…

![Industry Codes and Standards Graph]

- Year 4
- Year 3
- Year 2
- Year 1
Q. What year(s) do students engage in…

Team based Problem Solving

- Year 4
- Year 3
- Year 2
- Year 1
Q. What year(s) do students engage in Innovation/Discovery-based Learning?
Q. What year(s) do students engage in…

Sample comments

• ‘We have increased codes and standards, project based learning, discovery based learning’.
• ‘Will include additional aspects of design/build/test in years 2 and 3’.
• ‘More experiential learning opportunities’.
• ‘More design/build/test’.
Q. Change in fraction of students graduating with co-op/internship experience?
Q. Over the last three years, industry support has:

- About the same: 30%
- Decreased: 20%
- Increased: 50%
What does industry support look like?

Sample comments

• Defining and financing senior design projects
• Capstone projects have real industry partners
• New full time faculty focused on increased industrial relations
• Advisory committee reviews capstone projects’
• Funding “Professors of Practice”
• Industry-funded “maker space” and product innovation center’
• Guest lecturers
• Internships for students
Q. Expanded Laboratories and Design/Build Spaces?

![Bar Graph]

- Expanded
- No change
- Contracted
If facilities have expanded, what has been role of industry?

Sample comments

- ‘Mostly alumni and university’,
- ‘From an alumnus, not too much from industry’,
- ‘State bond funding’,
- ‘Funded by government and not by industry’
- ‘Industry provides software support’
Q. Do you employ full time Professor(s) of Practice or equivalent?

- Yes
- No
- In the future
Q. Have you increased your curricular flexibility?
Sample comments

• ‘We now allow students to take more classes in an area of interest’

• ‘Yes, as students have broad interests in technical and policy issues.’

• ‘Replaced 9 credits of technical electives with 9 credits of professional electives.’

• ‘Wish to allow additional flexibility for students to pursue broad interests.’

• ‘We decreased technical electives from 5 to 4 to make room for a required course in mechatronics.’
Does any of what you have heard align with where you are headed in Colombia?

To what degree is industry supporting your progress? To what degree is industry support desired?

Can the ASME voice and advocacy help?

Thank you!