Innovation in Curriculum: Incorporating Consideration of Global, Economic, Environmental, and Societal Contexts

ABET Annual Meeting
Baltimore, MD
27 October, 2011

Bob Warrington, Director, Institute for Leadership and Innovation, Michigan Tech
Chair, Vision 2030 Task Force, ASME
Outline

• ASME Vision 2030 Task Force
  – Case for Change
  – What’s Needed & A Bit of Supporting Data
• Examples from Michigan Tech
  – Enterprise Program
  – Pavlis Institute for Global Technological Leadership
• Barries to Change (ME Department Heads)
The 2030 Study

Academic Feedback/Support

Industry Feedback/Support

Phase I
Research & Issues Assessment

Phase II
Advocate Specific Changes

Phase III
Support & Reward Implementation

Communications
Accreditation Standards
Global Feedback & Adaption

2030 Engineering Graduates
The Need for Change

“Either the engineering profession will broaden greatly or the society will suffer because the matching (between society and technology) will be too haphazard..., a greater engineering needs to evolve...it will come to embrace much more the issues at the technology-society interface.”

Simon Ramo
National Academy of Engineering
Drivers for Change

Increased Professional Expectations

– Engineering expertise will be required at a higher level than “routine” engineering

– Greater expertise in communications, leadership, and creativity will be required – increased invention and innovation

– Global competency is becoming a necessity

New Knowledge and the Blurring/Widening of Disciplinary Boundaries
The Most Compelling Drivers have Always been Societal Need

The Grand Challenges & Unsustainable Growth – The State of the Planet....A Call for Engineering Leadership
Energy
Some consider it the greatest engineering challenge of this century

Note the date
Nov. 1983
The Case for Change Points to the Need For

- Increased Invention and Innovation – **Active Discovery (or Project) Based Learning**
- More **Leadership** at all Levels
- Unprecedented **Global Cooperation**
- Increased and Continual Stewardship of the **Environment**
- Understanding and Implementing **Sustainable** Growth that supports Industry, the Community, Nation and Planet
A Bit of the Data

**Difference on Practical Experience (How devices are made/work) between Industry Mgrs, Early Career Engineers, and Academic**

- **Industry Managers**
  - 23% “sufficient”
  - 55% “weak”

- **Early Career Eng**
  - 28% “sufficient”
  - 42% “weak”

- **Academic**
  - 42% “sufficient”
  - 34% “weak”
About entry-level mechanical engineers …

“Afraid to get hands dirty and learn how products are made and assembled’, ‘have never disassembled and reassembled anything substantial’ –→ Practical experience
Difference between Industry and Academic/ECE on Communication Skills (oral and written) preparation

Industry Managers: 43% “sufficient/strong”, 48% “weak”
Academic: 65% “sufficient/strong”, 22% “weak”
Early Career Eng.: 75% “sufficient/strong”, 17% “weak”
Early Career Engineers Areas of Greatest Professional Development Need
rated 8,9,10 on scale of 1-10

Q. Below is list of professional content areas. For each, provide your own assessment of your current professional development need . . .a ten indicates a strong need and one no need at all.
Vision 2030 Action Items
A Partial List

- Offer more *practice-based* engineering experiences
- Develop students’ *professional skills* to a higher standard
- Create *curricular flexibility* and efficiency with core requirements and specialization options
- Create a curriculum that inspires *innovation and creativity*
- **Specialization/Depth** at the Graduate Level
US Engineering graduates from most colleges and universities typically have strong technical skills, but tend to lack the interpersonal, leadership, business and entrepreneurial skills needed to succeed in today’s global workplace.
Two of Michigan Tech’s Solutions
Enterprise and Pavlis

Enterprise

• Given a traditional General Education Program
• A Traditional Capstone/Senior Design Experience
  – small groups of students
  – a single discipline
  – working together over a short period of time
  – Without integration of H/SS or Business.
• Created the Enterprise Program
  – Larger teams of students
  – highly multi-disciplinary team-based projects
  – starting in the beginning of their second year (they can audit in the first year).
  – Integration of H/SS & Business students and curricula
  – Students Have a Chance to Lead
Blazing an Entrepreneurial Trail
by Barbara Mathias-Riegel

“Engineering students who graduate from Michigan Tech’s Enterprise Program have a choice. They can work for someone else, or they can start their own companies.”
# Enterprise Enrollment

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Enterprise Teams

Enterprise Teams:
- Aerospace Enterprise: satellite and other aero-based projects
- Alternative Fuels Group: alternative fuels for industrial and commercial applications
- AquaTerraTech: ground water evaluation and planning
- Automotive Systems Engineering: engineering consulting services
- Blue Marble Security: homeland security technologies
- BST: innovative boarding products, materials, and processes
- Challenge X: hybrid electric SUV design and competition
- Consumer Products Manufacturing: disposable consumer products
- Entrepreneurial Enterprise: identification, assessment, and marketing of new technologies
- Formula SAE Car: Indy-style race car design and competition
- Husky Construction Enterprise: low-cost, energy efficient construction solutions
- Husky Game Development: gaming products and technologies
- ITOxygen: internet-based solutions for technical education
- Innovative Castings Enterprise: casting methods and materials
- Integrated Microsystems: wireless integrated microsystem technologies
- International Business Ventures: business development services with international collaboration
- Mini-Baja SAE: mini-baja vehicle design and competition
- NVH Enterprise: noise and vibration reduction for industry
- Pavement Design: design, materials development, and construction
- PrISM: integrated sustainable manufacturing
- Robotic Systems Engineering: robotic manufacturing technology
- STC/Arts Enterprise: documentation, media development, and communication solutions
- Wireless Communication: wireless communications, hardware, and software development
- Clean Snowmobile Challenge: noise/emissions reduction
The Pavlis Institute for Global Technological Leadership

• It is an interdisciplinary leadership institute that focuses on understanding global issues including:
  – Sustainability & Technology
  – International Relationships & Cultural Awareness
  – Communications, & of course LEADERSHIP

• Currently one 20 student cohort per year
• 4 Year, 25 Semester Hour Certificate Program
• 13 SH’s between 3rd and 4th Years, 5 weeks abroad
• Major difference from other programs, the international experience is not faculty led, on-site local support person employed for logistics, emergencies only…THE STUDENTS LEAD
Barriers to change...in order of increasing concern

- Faculty availability (no time)
- Faculty availability (short staffed)
- Funding (insufficient)
- Faculty expertise (lacking)
- Faculty buy-in (resistance to change)
- Administration Support (lacking)
- ABET Accreditation (too restrictive)