

Inspiring Change Agents to Transform Engineering Education:

An Emergent Engineering Curriculum

June 18, 2014

ASEE Distinguished Lecture Series

Gary R. Bertoline, Dean & Distinguished Professor

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Engineering

- The Behavior vs. the Discipline
 - **Engineering** (from Latin *ingenium*, meaning "cleverness" and *ingeniare*, meaning "to contrive, devise") is the application of scientific, economic, social, and practical knowledge in order to invent, design, build, maintain, and improve structures, machines, devices, systems, materials and processes.

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Historical Context

- The Grinter Report 1955, *Report of the Committee on Evaluation of Engineering Education*
 - Move to a scientifically oriented engineering curricula
 - Abandoned practical engineering curriculum
 - Development of Engineering Technology programs in the early 1960's
- Industry views engineering education as too theoretical
 - Integration of design and lab experiences into engineering education
 - Constraints as to how much can be done
- Higher Education in the nation is being questioned



Emergence of “Boutique” Engineering Programs

- Fills a void but not the one left by the original Grinter Report
- Smaller programs not at large public research intensive universities where there are the most engineering graduates
- Examples include: Rose Hulman, Harvey Mudd, WPI, Olin, etc.



The German Model for Engineering Higher Education

- Technical Universities
 - Scientifically prepared engineering
- Universities of Applied Science (Fachhochschulen)
 - Applied engineers
 - Required internships
 - Year-long senior thesis-based, industry-sponsored projects
- Germany graduates twice as many Applied Engineers as Theoretical Engineers
 - [PBS interview with BMW's head of Workforce Development for the Americas](#)
 - [WSJ- Behind Germany's Success Story in Manufacturing](#)



Can Americans compete with quality- driven Germans?



191



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EMAIL

BY PAUL SOLMAN June 4, 2014 at 4:10 PM EDT



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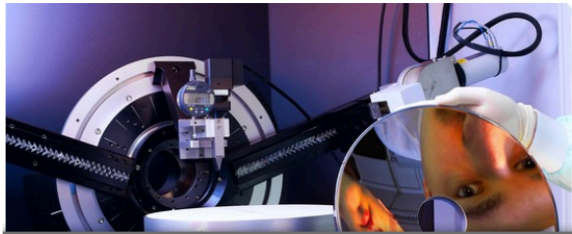
JOURNAL REPORTS: LEADERSHIP

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By CHASE GUMMER
June 1, 2014 4:48 p.m. ET






RECOMMENDED STORIES OPEN


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Engineering Education is a Continuum Based on Behaviors

Very Applied → Very Theoretical



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Today 3-types of Engineering Programs

- Engineering at Research Intensive Universities that are slanted towards the theoretical and scientific approach
- Engineering at the Boutiques that are more applied and design oriented.
- Engineering that is applied that are primarily at the Engineering Technology programs that are AS and BS and mostly not at the Research Intensive Universities.



A Fourth-type of Engineering Program

- Similar to the German Fachhochschule (university of applied science) but for the 21st century needs of industry and society.
 - Blends theory with practice
 - Integration of the humanities, science and math
 - Application oriented at the system/enterprise level (Product design & production, construction management, transportation & logistics, computing & informatics, etc.)
 - The T-shaped professional



The Purdue Polytechnic Institute

- Original definition of a Polytechnic from the first create in France in 1794.
 - Relating to or devoted to instruction in many technical arts or applied sciences.
 - A blend of scientific theory and engineering practice.
- Purdue Polytechnic adds the blending of liberal arts and industry needs to scientific theory and engineering practice

The world has changed

WHAT THE ECONOMY OF TODAY AND TOMORROW DEMANDS

- Ability to ask good questions,
- Thinking and analytical skills to seek answers
- Information
- Literacy
- Collaboration & Communication
- Civil duty and sense of community
- Lifelong curiosity and learning



Top 5 Needs of Employers



Education Technology Expert **Alan November** has included **Empathy** as Number One In His Surveys

Are They Really Ready To Work: (Employer's Perspectives on the Basic Knowledge and Applied Skills of New Entrants to the 21st Century U.S. Workforce.)



21 centuryedtech web site provides total ranking

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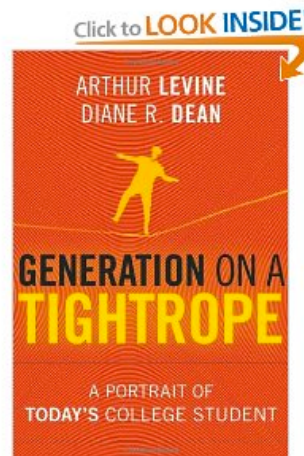
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The students have changed

THEY COME WITH DIFFERENT MIND HABITS

- Connected, multi-taskers, digital natives
- Used to creating and sharing;
- Learning with and from others
- Informal interest-based exploration and learning
- Learning through exploration and discovery



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New culture for students

- Students are mentored into discovering and creating a purposeful path rather than given a one size fit all plan.
- Students work in classroom with multi-disciplinary teams of faculty (mostly) rather than through fragmented mono-disciplinary courses.
- Students learn just in time following their passion and purpose rather than just in case it comes up in the test.
- Students receive credit for demonstrating mastery rather than for seat-time served.
- Students receive credit for everything they learn however they learn it rather than only through our lectures.
- Students are trusted and respected rather than tested and suspected.



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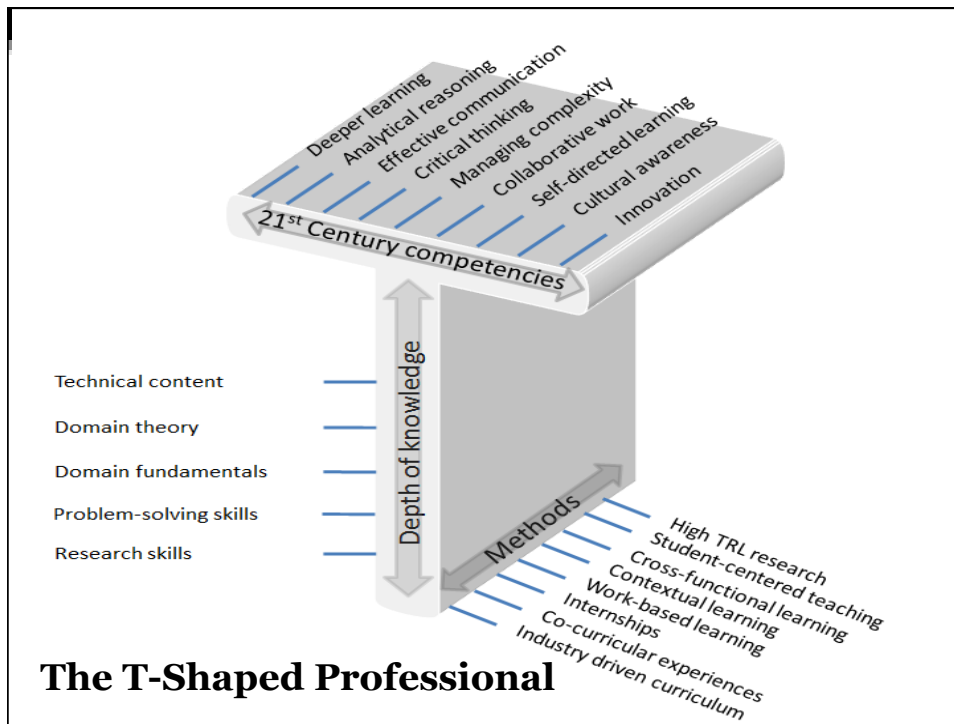
New culture for faculty

- Working with students is our highest form of scholarship rather than a routine different from scholarship.
- Faculty trust the students, nurture their passion, and follow their lead rather than be the sage on the stage.
- Faculty model openness, growth mindset, risk-taking, and lifelong learning, the same values and skills we expect from students.
- Faculty are collaborative, cooperative and reflective in their working with students.
- Faculty expect the highest standards from themselves, from each others, and from the students.



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Curriculum Transformation

- Common core curricula may include
 - Common Core & First-year Experience
 - Learn by Doing
 - Real-world Immersive Capstone Experience
 - Global Perspectives Program
 - Polytechnic Field Experience
 - Applied Innovation Certificate Program
 - Humanities, science and math integration



Challenges

- Challenges the status quo in engineering education.
- Culture change for faculty and the current higher education model.
- Industry expected to actively engage with higher education.