From the Ground Up: Rethinking Engineering Education

David V. Kerns, Jr.
Founding Provost
Sherra E. Kerns
Founding VP for Innovation and Research
Richard K. Miller, Ph.D.
First President

Olin College of Engineering
Needham, Massachusetts

NATIONAL ACADEMY OF ENGINEERING

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Outline

1. The Founding of Olin College
2. The Olin Learning Model
3. Lessons Learned
4. Decade Two
F.W. Olin Foundation

Timeline

• 1997 – Charter
• 1999 – First employee
• 2000 – Founding Faculty, begin campus construction
• 2001 – Olin Partner Year
• 2002 – first courses taught
• 2006 – first commencement

“There is a lot of unhappiness about the way engineering is taught today…”

Lawrence W. Milas, President, F.W. Olin Foundation, Founding Chairman, Olin College Board of Trustees
“Olin College is intended to be different, not for the mere sake of being different, but in order to become an important and constant contributor to the advancement of engineering education in America and throughout the world,…”

Founding Precepts, Olin College

→ Olin College is intended to become a laboratory school.
The current Olin model for engineering education
Undergraduate residential engineering education
Total enrollment of about 350
50% women
BS degrees in ECE, ME, Engr only
9-to-1 student/faculty ratio
75 acres and 400,000+ sq. ft. new buildings
Endowment > $1 million/student
Research expenditures > $1 million/yr
Adjacent to Babson College, Wellesley College

No academic departments
No tenure
Low tuition
Everything has expiration date
Some Features of the Olin Curriculum

- **Candidates’ Weekend**: interviews required for admission
- **Extensive DESIGN** core required
- Multiple Team design projects required in 6+ semesters
- **SCOPE** senior project: corporate sponsored, year-long ($50k/project)
- **EXPO** at end of each semester: “stand and deliver”
- **Olin Self Study** self-directed independent research required for graduation
- **AHS/E! Capstone** project required for graduation
- Study Away in Junior year
- Summer internships: REU and corporate experience
- Business and entrepreneurship: all students must start and run a business or enterprise for a semester
- Continuous improvement: **continuous curriculum review and renewal**

- **BUT, the learning culture** is far more important than the curriculum!

**The Culture Is the Curriculum**

“We’ve never worked this hard in our life, and there is nothing we would rather be doing!”
Expanded Design Spectrum at Olin College

What is engineering?

- People
- Problem
- Concept
- Specifications
- Design
- Prototype
- Product
- Market

User-Oriented Design
Design Nature
Modeling Compartment Systems
Fundamentals of Entrepreneurship
Three College Collaboration

“A Virtual University”

ENGINEERING
Franklin W. Olin College of Engineering

BUSINESS
BABSON

LIBERAL ARTS
Wellesley College

Students freely cross-enroll
Lessons Learned

Education must change

- *Who we teach*
- *What we teach*
- *How we teach*
1. Why education must change

Global, Complex, Multidisciplinary Challenges
- Unintended Consequences
- Coupled Scientific-Social-Economic-Political-Religious
- Need New Kind of Engineering Innovators
BUT,

Our traditional approach to higher education may be preventing us from producing innovators!
Innovation

Feasibility
Engineering and Science

Viability
Business and Economics

Desirability
Psychology, Arts, Humanities, etc.
2. What changes are needed in education?
Are we teaching the right stuff for this century?
What We Teach vs. What They Need to Know

- Engineering alumni report that engineering science is not as useful in their careers as design, communication, teamwork, and entrepreneurial thinking (Kristen Wolfe, “Understanding the Careers of the Alumni of the MIT Mechanical Engineering Department,” SB Thesis, June, 2004, MIT (supervised by Prof. Warren Seering)).


YouTube: Prof. Woodie Flowers on Education Reform

- Attitudes, Behaviors, Motivations
- Learning How to Learn Independently
- Deciding What to Learn
The Need for Change in Engineering Education


**THE MISSING BASICS FOR THE 21st CENTURY:**

- Teamwork, communication, creativity, leadership, entrepreneurial thinking, ethical reasoning, global contextual analysis
We need a broader definition of Engineering for the 21st Century
What is an Engineer?

- Applied Scientist

  • noun: “a person who carries through an enterprise by skillful or artful contrivance,” (Merriam-Webster Dictionary)

- Designer/Architect of a System, Process, or Device

- Project/Team Leader

  • “To Engineer is to Make” (D. Chapman-Walsh)

- “An Engineer is a person who envisions what has never been, and does whatever it takes to make it happen” (Olin College)
Engineering vs. Science

The Process of Engineering Design

There Must be a Better Way! (Analysis)

Why Not...? (Idea)

Why Doesn’t it Work? (Test)

Let’s Try It! (Prototype)

Engineering is a Process, not a Body of Knowledge!
Creativity may now be as important as knowledge(!)
What is Creativity?

YOUTUBE:
Sir Ken Robinson (TED 2006)
Can Creativity be Taught?

Learning to Improvise
Are we attracting the right people into Engineering?

- All people have at least 7 “intelligences”
  - Linguistic
  - Logical/mathematical
  - Spatial
  - Bodily-kinesthetic
  - Musical
  - Interpersonal
  - Intrapersonal

  **Academic Intelligence (IQ, SAT, etc.)**

  **Artistic Intelligence**

  **Persuasion, Management**

What is the best way to teach today?
A New Culture of Learning

**Traditional**

- Knowledge Transfer
- “Can’t Do”
- Follow Orders
- Learn in Class
- Learn Alone
- Problem-based

**New**

- Construct Knowledge
- “Can Do”
- Follow Your Passions
- Learn 24 x 7
- Learn in Teams
- Design-based

“Pedagogy like Graduate School

“For most of the twentieth century our educational system has been built on the assumption that teaching is necessary for learning to occur.”
Intrinsic vs. Extrinsic Motivation
“Grit” is 3 x better predictor of success than knowledge(!)
“Making universities and engineering schools exciting, creative, adventurous, rigorous, demanding, and empowering milieus is more important than specifying curricular details,”

Dr. Charles Vest, former President of MIT and of the US National Academy of Engineering.
Outcomes at Olin College

2013 Bernard M. Gordon Prize for Innovation In Engineering and Technology Education
US National Academy of Engineering

Princeton Review:
#2 – Students Study the Most
#8 – Happiest Students

US News & World Report - #4

Newsweek/Kaplan – “New Ivies”

Among top producer of NSF Grad Res Fellowships, Fulbright Scholarships

40% of alumni pursue graduate degrees, 25% of these at Harvard, Stanford, or MIT

2013 starting salaries for Olin graduates were more than $18,000 above US national average for engineers
DECADE TWO

- Visited by more than 200 universities in past 3 years
- Some of our many university collaborators:

  - Through consultation, co-design, and collaboration with other universities, we intend to become an important and constant contributor to the advancement of engineering education in America and throughout the world.

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