# The Double Bind in Engineering and Computer Science

### Building Capacity for Institutional Transformation in the Twenty-first Century

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# Why STEM? - Grand Challenges

- Three Major Forces
  - Population Issues (7 Billion people)
    - Energy/Environment
    - Infrastructure
    - Poverty
    - Food
  - Global Market
     Economies
  - Telecommunications and Aviation Revolution





1-25 Bridge Collance - Minnecota

# **Why STEM? - Great Opportunities**

- In April 2003, Human Genome (3 Billion DNA sequenced and encoded on 25K genes).
- By 2013 computers will eclipse humans in Computational Capacity. Laptops by 2029.
- Communications Bandwidth has increased by 100K since 2000.
- Rise of Nanotechnology as a Discipline



### Why STEM? – Real Competitors: SINGAPORE 1960s



http://www.country-data.com/cgi-bin/query/r-11828.html



http://inhabitat.com/marina-bay-sail-by-nbbj-architects/

### The New Battlefield: Science and Engineering Ed



National Science Board, S&E Indicators, 2010

### **The Problem**

- Women make up about 51% of the population but produce less than 30% of the Ph.D. degrees
- African-Americans and Chicano/Latino-Americans make up about 24% of the population but combined make up less than 8% of the Ph.D. graduates
- The U.S. is losing "market share" globally in the production of Science and Engineering (S&E) degrees
- 85% of US growth is attributable to advancements from science and engineering



Changes must be put in place now so that we can ensure US dominance in the future

### **STEM Demographics differ from Broader Metrics**

#### COLLEGE CLASS OF 2010

Degree	Male	Female	Difference
Associate's	293,000	486,000	193,000
Bachelor's	702,000	946,000	244,000
Master's	257,000	391,000	134,000
Professional	46,800	46,400	-400
Doctoral	31,500	32,900	1,400
Total	1,330,300	1,902,300	572,000

- In engineering its NOT a numbers game is a matter of choice
- While women out number men in the broader disciplines, in engineering they trail in every degree discipline.
- Since 85% of our growth is tied to STEM, this limits future opportunities for women.

### SCIENCE TECHNOLOGY ENGINEERING MATHEMATICS

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#### SCIENCE + TECHNOLOGY + ENGINEERING + MATHEMATICS

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Promoting STEM subjects is a national priority to ensure American competitiveness in the 21st Century. To maintain a steady pipeline of STEM-capable graduates, we need to start by investing in more quality STEM-capable teachers to educate and spark student interest in these subjects.

**Sources:** U.S. Bureau of Labor Statistics, National Science Foundation, National Center for Education Statistics, Business-Higher Education Forum

#### OF 3.8 MILLION 9TH GRADERS, ONLY 233,000 END UP CHOOSING A STEM DEGREE IN COLLEGE. THAT'S JUST 6 STEM GRADS OUT OF EVERY 100 9TH GRADERS.



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### Left brain

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I am the right brain. I am creativity. A free spirit. I am passion. Yearning. Sensuality. I am the sound of roaring laughter. I am taste. The feeling of sand beneath bare feet. I am movement. Vivid colors. I am the urge to paint on an empty canvas. I am boundless imagination. Art. Poetry. I sense. I feel. I am everything I wanted to be.

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# **Bachelors Degrees Awarded - 2011**



 The differentiation begins here. 22% of all BS degrees go to women

# Percentage of Bachelors Degrees awarded to women by Discipline - 2011



Not all programs are created equal

The Henry Samueli School of Engineering UC Irvine

# **Masters Degrees Awarded 2011**



27% of all US, MS Engineering degrees go to women 

The Henry Samueli School of Engineering UC Irvine

# **Doctoral Degrees awarded 2011**



# What does the data tell us?

- Women are **not** choosing to be in Engineering in the same proportion as men.
- The specific field **does** matter. Some disciplines are doing a better job than others
- As degree attainment increases, women become a higher percentage of the graduates
- The data gives insight on what we should be doing at UCI to improve

# What must we do to improve?

- This is not a hard problem to solve.
- Create more women PhD's of all races
  - Benchmark other programs nationally who are doing well (University of Michigan, Georgia Tech)
  - Recruit, Recruit! This includes UCI students
  - Incentivize more women PhD and MS production Hold educational workshops for those units that are underperforming
- Identify talented women early in their bachelors degree training and partner them with the right faculty.
  - Professor Dunn-Rankin has developed a program to teach fabrication skills to female UG students
- Partner with Industry.
  - Diversity Advisory Board to help solve this problem
- Marginalize those faculty who don't get it

## **UCI-HSSoE Grad Student Recruitment Data**

Program	Dept. Faculty Head- count	PhD Appli- cants	PhD Admits	PhD Accept (SRI Yes)	M.S Accept (SRI Yes)	# PhD Accept - Female	PhD Accept Fall 2012 - %Female
HSSoE MMT Manufact. Concentr.		13	3	2	8	1	50%
BME	18	215	44	17	8	7	41%
ChE & MSE	15	172	29	13	25	7	54%
Civil & Env. Eng.	22	247	32	12	11	4	33%
Elect. Eng & 3 CS Eng.	32	672	192	21	10	1	5%
MAE	25	285	54	18	30	2	11%