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
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
SINGAPORE Today

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

<table>
<thead>
<tr>
<th>Degree</th>
<th>Male</th>
<th>Female</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Associate’s</td>
<td>293,000</td>
<td>486,000</td>
<td>193,000</td>
</tr>
<tr>
<td>Bachelor’s</td>
<td>702,000</td>
<td>946,000</td>
<td>244,000</td>
</tr>
<tr>
<td>Master’s</td>
<td>257,000</td>
<td>391,000</td>
<td>134,000</td>
</tr>
<tr>
<td>Professional</td>
<td>46,800</td>
<td>46,400</td>
<td>-400</td>
</tr>
<tr>
<td>Doctoral</td>
<td>31,500</td>
<td>32,900</td>
<td>1,400</td>
</tr>
<tr>
<td>Total</td>
<td>1,330,300</td>
<td>1,902,300</td>
<td>572,000</td>
</tr>
</tbody>
</table>

- In engineering it's NOT a numbers game, it's a matter of choice.
- While women outnumber 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.
THE STEM DILEMMA

SCIENCE + TECHNOLOGY + ENGINEERING + MATHEMATICS

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.


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.
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
Masters Degrees Awarded 2011

- 27% of all US, MS Engineering degrees go to women
30% of all US, Doctoral Engineering degrees go to women
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, 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
<table>
<thead>
<tr>
<th>Program</th>
<th>Dept. Faculty Headcount</th>
<th>PhD Applicants</th>
<th>PhD Admits</th>
<th>PhD Accept (SRI Yes)</th>
<th>M.S Accept (SRI Yes)</th>
<th># PhD Accept - Female</th>
<th>PhD Accept Fall 2012 - %Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSSoE MMT Manufact. Concentr.</td>
<td>13</td>
<td>3</td>
<td>2</td>
<td></td>
<td>8</td>
<td>1</td>
<td>50%</td>
</tr>
<tr>
<td>BME</td>
<td>18</td>
<td>215</td>
<td>44</td>
<td>17</td>
<td>8</td>
<td>7</td>
<td>41%</td>
</tr>
<tr>
<td>ChE &amp; MSE</td>
<td>15</td>
<td>172</td>
<td>29</td>
<td>13</td>
<td>25</td>
<td>7</td>
<td>54%</td>
</tr>
<tr>
<td>Civil &amp; Env. Eng.</td>
<td>22</td>
<td>247</td>
<td>32</td>
<td>12</td>
<td>11</td>
<td>4</td>
<td>33%</td>
</tr>
<tr>
<td>Elect. Eng &amp; 3 CS Eng.</td>
<td>32</td>
<td>672</td>
<td>192</td>
<td>21</td>
<td>10</td>
<td>1</td>
<td>5%</td>
</tr>
<tr>
<td>MAE</td>
<td>25</td>
<td>285</td>
<td>54</td>
<td>18</td>
<td>30</td>
<td>2</td>
<td>11%</td>
</tr>
</tbody>
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