Career trajectories in engineering education – Where are they now?

Robin S. Adams, Tyler Cummings-Bond, Jr.

University of Washington

Center for the Advancement of Engineering Education (CAEE)

NSF Grant # ESI-0227558
Motivation

• Building capacity in engineering education scholarship
  – Increase community
  – Rigorous contributions to engineering education scholarship
  – Engineering education as a professional endeavor
  – Models

• Examples
  – Institute for Scholarship on Engineering Education (CAEE)
  – Center for the Advancement of Scholarship in Engineering Education (NAE)
  – Schools of Engineering Education (Purdue, Virginia Tech)
  – Rigorous Research in Engineering Education (ASEE, PI)
  – Bootstrapping in Computer Science Education (Tenenberg, PI)

• A challenge – What do we know about engineering education as a career?
We know…

• Leadership support essential
• “Balancing act” (e.g., Colbeck, 2002)
• Diversity issues
• SRI study on the Coalitions (Coward et al, 2000)
  – Cultural change “spotty” and “immature” – examples of
    • Increased valuing of engineering education contributions
    • Shifts from a research-only culture
    • Tenure and promotion success
We don’t know…

• Few rigorous studies, much anecdotal

• Career trajectories in engineering education
  – Who is this population?
  – Career choices?
  – Challenges?
  – Navigation strategies?

• Use
  – Support policy and culture change
  – Provide resources for successful career trajectories
A Pilot Study

What do we know about career trajectories in engineering education?

For a sample population with different career pathways
- What is their current employment in academia?
- What are the institutional characteristics at this position?
- Are there trends in where subjects received doctorates?
- Are there patterns across groups in the sample?
Study Design

- Descriptive study
- Timeline ranges from 1990 to 2003
- Publicly available data (replicability)
- 3 “pathway” populations to maximize insight

<table>
<thead>
<tr>
<th>PhD Group</th>
<th>AFG Group</th>
<th>CAREER Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engr educ thesis</td>
<td>Engr educ award</td>
<td>Engr educ grant</td>
</tr>
<tr>
<td>Interdisciplinary</td>
<td>Not in tenure track</td>
<td>In tenure-track</td>
</tr>
<tr>
<td>Non-traditional research</td>
<td>Mixed research</td>
<td>Integrated research and education plan</td>
</tr>
<tr>
<td>Focus</td>
<td>Measure</td>
<td></td>
</tr>
<tr>
<td>------------------------------</td>
<td>----------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Career types</td>
<td>Current position</td>
<td></td>
</tr>
<tr>
<td><strong>Institutional characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research / Teaching focus</td>
<td>Carnegie classifications</td>
<td></td>
</tr>
<tr>
<td>Likelihood of community support</td>
<td>Coalitions schools</td>
<td></td>
</tr>
<tr>
<td>Likelihood of community support</td>
<td>Engineering focused Teaching &amp; Learning Centers</td>
<td></td>
</tr>
</tbody>
</table>
Locating Subjects

<table>
<thead>
<tr>
<th>Group</th>
<th>Located</th>
<th>Employed in academia</th>
<th>Final N</th>
</tr>
</thead>
<tbody>
<tr>
<td>PhD</td>
<td>66%</td>
<td>73%</td>
<td>91</td>
</tr>
<tr>
<td>AFG</td>
<td>96%</td>
<td>88%</td>
<td>21</td>
</tr>
<tr>
<td>CAREER</td>
<td>94%</td>
<td>96%</td>
<td>416</td>
</tr>
</tbody>
</table>

- Cross validated web-based searches
- Greater difficulty in locating PhD subjects
- AFG more likely than CAREER to work outside of academia
Geographic Dispersion (PhD group)

Consistent with geographic distribution of US institutions

PhD Density
1 Dot = 1 Person
Results

- Current academic position
- Institutional characteristics
  - Research / teaching focus
  - Likelihood of community / supports
## Current Academic Position

<table>
<thead>
<tr>
<th>Position</th>
<th>PhD (N=91)</th>
<th>AFG (N=21)</th>
<th>CAREER (N=416)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof</td>
<td>19%</td>
<td>0%</td>
<td>8%</td>
</tr>
<tr>
<td>Assoc Prof</td>
<td>20%</td>
<td>0% (10%)*</td>
<td>40%</td>
</tr>
<tr>
<td>Asst Prof</td>
<td>21%</td>
<td>43% (33%)*</td>
<td>50%</td>
</tr>
<tr>
<td>Lecturer</td>
<td>3%</td>
<td>19%</td>
<td>0%</td>
</tr>
<tr>
<td>Prof Staff</td>
<td>29%</td>
<td>14%</td>
<td>1%</td>
</tr>
<tr>
<td>Grad Student</td>
<td>2%</td>
<td>19%</td>
<td>-</td>
</tr>
<tr>
<td>Other</td>
<td>5%</td>
<td>0%</td>
<td>1%</td>
</tr>
</tbody>
</table>
Current Academic Position

• Current position
  – All groups have tenure track subjects
  – AFG more likely to have Professional Staff and Lecturers
  – PhD more likely to have Professional Staff
  – CAREER most likely pathway for tenure track / tenured
Examples

• PhD
  – Professor and Associate Dean of Student Affairs at Research Extensive school, thesis on minority retention in engineering

• AFG
  – Asst. Professor at Research Extensive school
  – Director of an engineering learning and teaching center at Research Extensive school

• CAREER
  – Assoc. Professor at Research Extensive school, grant integrates research on microelectronics and computer-aided curriculum
  – Assoc. Professor at Research Intensive school, grant integrates research on student design processes and related learning intervention

• 3 subjects in more than one group
  – All women
  – All received doctorates at Coalition schools
  – 2 employed at school with Teaching / Learning center
Research / Teaching Focus

- **Carnegie definitions**
  - **Research Extensive**
    - 15+ disciplines, graduate 50+ PhD’s / year
  - **Research Intensive**
    - 1+ discipline, graduate 20+ PhD’s / year
  - **Master’s Level I**
    - 3+ disciplines, graduate 40+ Master’s / year
  - **Other**
    - Baccalaureate Colleges, Associate Colleges, Specialized Schools
# Research / Teaching Focus

<table>
<thead>
<tr>
<th>CARNEGIE</th>
<th>GROUP</th>
<th>PROF</th>
<th>ASSOC PROF</th>
<th>ASST PROF</th>
<th>LECTURER</th>
<th>STAFF</th>
<th>GRAD</th>
<th>OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESEARCH EXTENSIVE</td>
<td>PhD</td>
<td>4</td>
<td>9</td>
<td>9</td>
<td>2</td>
<td>20</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>AFG</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>CAREER</td>
<td>27</td>
<td>149</td>
<td>183</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>RESEARCH INTENSIVE</td>
<td>PhD</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>AFG</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>CAREER</td>
<td>3</td>
<td>13</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MASTER’S I</td>
<td>PhD</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>AFG</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>CAREER</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>OTHER</td>
<td>PhD</td>
<td>7</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>AFG</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>CAREER</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>50</td>
<td>186</td>
<td>237</td>
<td>8</td>
<td>33</td>
<td>6</td>
<td>8</td>
</tr>
</tbody>
</table>
Research / Teaching Focus

• All most likely at Research Extensive
  – PhD (53%), AFG (76%), CAREER (88%)
• PhD’s more dispersed across classifications
• AFG’s and CAREER’s most likely at research schools
Community Support

- Employed at Coalition schools
- Received PhD at Coalition schools
- Current position at school with engineering focused Teaching & Learning Center
Community Support

- On average, half of the subjects in the PhD and AFG groups received their doctorates at Coalition schools.
- More than 20% of CAREER subjects are employed at a school with an engineering focused Teaching and Learning centers (even though these schools represent 13 out of 350 possible schools).
- More than a third of AFG and CAREER subjects are employed at Coalition schools.
## Summary

<table>
<thead>
<tr>
<th></th>
<th>PhD</th>
<th>AFG</th>
<th>CAREER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic</td>
<td>63%</td>
<td>88%</td>
<td>98%</td>
</tr>
<tr>
<td>Non-academic</td>
<td>27%</td>
<td>12%</td>
<td>2%</td>
</tr>
<tr>
<td>Tenure-track</td>
<td>21%</td>
<td>43%  (33%)</td>
<td>50%</td>
</tr>
<tr>
<td>Tenured</td>
<td>39%</td>
<td>0 (10%)</td>
<td>48%</td>
</tr>
<tr>
<td>Prof Staff</td>
<td>29%</td>
<td>14%</td>
<td>1%</td>
</tr>
<tr>
<td>Carnegie class</td>
<td>53% Research</td>
<td>76% Research</td>
<td>88 % Research</td>
</tr>
<tr>
<td>Employed at Coalition school</td>
<td>22%</td>
<td>52%</td>
<td>36%</td>
</tr>
<tr>
<td>Received PhD at Coalition School</td>
<td>47%</td>
<td>59%</td>
<td>NA</td>
</tr>
<tr>
<td>Employed at Teach / Learn Center school</td>
<td>11%</td>
<td>43%</td>
<td>24%</td>
</tr>
</tbody>
</table>
Implications

• **Short term – “mountain top” view**
  – Multiple pathways into engineering education careers
  – Coalitions appear to be a good pipeline
  – Professional Staff positions reflect diversity of careers
  – CAREER most likely pathway for tenure track / tenured
  – May be gender dimensions

• **Long term – “sea level” view**
  – A database of subjects!
  – Understanding choices, challenges and navigation strategies
    • Choices between faculty and professional careers
    • Social networks
    • Working across disciplines – interdisciplinary agents
Acknowledgements

This work was funded through the Center for the Advancement of Engineering Education (NSF Grant # ESI-0227558 and associated REU) and with the support of the Institute for Scholarship on Engineering Education team (Cindy Atman, Phil Bell, Lorraine Fleming, Larry Leifer, Karl Smith, and Ruth Streveler)