Computing Research and Human Resources: The Current Situation

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Research: Overview

- The CISE disciplines are changing our lives, driving our economy, and transforming all fields.
- Despite increases in the NSF CISE research budget, proposal success rates continue to fall, with many negative implications for the nation.
- The reasons are clear:
  - Expansion in the breadth and depth of the field
  - Behavior of other Federal agencies
ECONOMIC FUTURES
By Michael Mandel

The Budget's Misguided Parsimony
Cuts in R&D and education spending are shortsighted because they'll hurt something called MFP, a key force behind U.S. economic oomph
obligations in billions of constant FY 2003 dollars

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The graph illustrates the comparison between the PITAC Recommendation and NITRD Funding (Actual and Est) from FY 1999 to FY 2005. The PITAC Recommendation shows a steady increase in funding, peaking just below 2,800 million by FY 2005. In contrast, the NITRD Funding line is lower, with a peak of around 2,350 million in FY 2005. The sources for this graph are Investing in Our Future, PITAC, 1999; NCO/IT R&D, 2004.
FY06 budget proposal: a further 7% decrease
DARPA support of fundamental research in Computer Science - January 2005

- DARPA/DoD support at major university programs has dropped by 50% in the past 5 years
  - Classification of research programs
  - Shorter research horizons
  - 12-month go/no-go decisions

- DARPA “mind-share” (proportion of research that is DARPA-supported) has dropped by an even greater percentage
  - From more than 60% of all research at top programs to less than 25%, in just 5 years
Annual research expenditures
(non-adjusted dollars, normalized to FY1999 level)
("Other" does not include non-overheaded research dollars)
DoD will be much the worse for this!

Every General Officer understands that information operations, information superiority, and information technology are critical to military superiority.

Other nations (the EU now, others following) are ramping up along the old DARPA model.

They can be expected to gain a competitive advantage from this in the long run.
The NSF story

Despite budget increases, the proposal success rate in NSF CISE has fallen from 34% to 16% in the past five years

- Far below the NSF-wide average of 24% for competitive awards

- It’s even worse for some new high-priority programs - e.g., 8% for Cyber Trust in FY2004
  - The theory program just awarded 15 of 140 proposals (11%), at a fixed level of $200K spread over 3 years!
Multiple factors have led to a nearly 3-fold increase in proposals in the past 5 years:

- Increased size of the field - more strong researchers
- Increased breadth of the field - greater diversity of CISE-supported research
- Behavior of other agencies, such as DARPA

NSF CISE now provides 86% of the Federal obligations for basic research in computer science at universities and colleges
Situation even worse in specific high-priority areas

- NSF Cyber Trust program - FY04 awards announced 9/21/2004
  - Funded 8.2% of proposals
    - 32 of 390 proposals
      - 2 of 25 Center proposals
      - 12 of 135 Team proposals
      - 18 of 230 Small Group proposals
  - Awarded 6.2% of requested funds
    - $31.5M of $510M
Department of Homeland Security FY05 budget request

- $1,069M Science & Technology budget request
- $17.8M for Cyber Security - 1.67%
- One is led to conclude that DHS simply does not care about Cyber Security
- (Also, 90% of the DHS S&T budget goes to development/deployment rather than research - fails to prepare us for the future)
DARPA Cyber Security research

- DARPA’s new Cyber Security research programs have tended to be classified
- Let’s assume there are good reasons. There still are two major negative consequences:
  - Many of the nation’s leading cyber security researchers (namely, those at universities) are excluded from participation
  - The results may not rapidly impact commercial networks and systems - upon which much of the government, and much of the nation’s critical infrastructure, rely
Human Resources: Overview

- The vast majority of recent S&E workforce increases have been in information technology
- The vast majority of future S&E workforce increases are projected to be in information technology
- The greatest disparity between supply and demand is in information technology
- Clear link between research and education
Recent Occupational Growth

Growth in Numbers

Employment Growth in S&E Occupations
1996-2001, in thousands

- Computer Systems Analysts & Scientists
- Electrical/Electronic Engineers
- Computer Programmers
- Civil Engineers
- Medical Scientists
- Chemists
- Biological/Life Scientists
- Aerospace Engineers
- Engineers, n.e.c.
- Atmospheric/Space
- Industrial Engineers
- Geologists/Geodesists
- Forestry/Conservation Scientists
- Mathematical Scientists, n.e.c.
- Agricultural Engineers
- Nuclear Engineers
- Agricultural/Food Scientists
- Metallurgical/Materials Engineers
- Petroleum Engineers
- Mining Engineers
- Physical Scientists, n.e.c.
- Physicists/Astronomers
- Marine Engineers
- Mechanical Engineer
- Chemical Engineers


IT, Science and Engineering Occupational Projections, 2002-2012

Employment Growth: 2002-2012

The Market Perspective
Degree Production vs. Projected Job Openings

Annual Degrees and Job Openings in Broad S&E Fields

SOURCES: Tabulated by National Science Foundation/Division of Science Resources Statistics; degree data from Department of Education/National Center for Education Statistics; Integrated Postsecondary Education Data System Completions and Earned Doctorates; Projected Annual Average Job Openings derived from Department of Commerce (Office of Technology Policy) analysis of Bureau of Labor Statistics 2002-2012 projections.

Figure 2. Newly Declared CS Majors

CRA Taulbee Survey
U.S. GRADUATE INSTITUTIONS: FOREIGN STUDENTS OUTNUMBER U.S. STUDENTS

Compiled by the APS Office of Public Affairs.
Source: National Science Foundation, Science and Engineering Indicators 2002, Appendix Table 2-41.
Adapted from Diana Hicks, “Asian countries strengthen their research,” Issues in Science and Technology, Summer 2004.
Compiled by the APS Office of Public Affairs.
Equal opportunity

“the largest phenomenon, by far, is the general clash between people’s legitimate family desires and employers’ current desire for high power and high intensity, ... in the special case of science and engineering, there are issues of intrinsic aptitude, ... and ... those considerations are reinforced by what are in fact lesser factors involving socialization and continuing discrimination.”
“Even in the best of circumstances, it's questionable whether [he] was the perfect person to free-associate on why women have trouble getting tenure ... Whatever Dr. Summers was doing at the conference, it had nothing to do with serious intellectual inquiry ... It was every woman's nightmare of what a university president thinks privately about equal opportunity.”

A teachable moment that we must seize!