Engineering Investments at the National Science Foundation

Thomas W. Peterson
Assistant Director
Directorate for Engineering
ASEE – ERC Meeting, 6 March 2012
The US employment decline in this recession was more than twice as large as in previous postwar recessions.

US employment decline from peak

- July 1974—January 1976
- March—November 1980
- July 1981—October 1983
- June 1990—January 1993
- February 2001—January 2005
- January 2008—April 2011

1 Total nonfarm employment, seasonally adjusted.

US manufacturing employment has been shrinking since 1980, but the pace dramatically accelerated after 2000.

Manufacturing employment, 1942–2010, 5-year moving average

Millions of jobs

<table>
<thead>
<tr>
<th>Year</th>
<th>Jobs</th>
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</thead>
<tbody>
<tr>
<td>1942</td>
<td>36</td>
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<tr>
<td>50</td>
<td>36</td>
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<td>55</td>
<td>34</td>
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<td>60</td>
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<td>70</td>
<td>25</td>
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<tr>
<td>80</td>
<td>19</td>
</tr>
<tr>
<td>90</td>
<td>16</td>
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<td>2010</td>
<td>11</td>
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</table>

Manufacturing share of US employment %

US Trade Balance in Advanced Technology

Includes

- Advanced materials
- Aerospace
- Biotechnology and life sciences
- Electronics, optoelectronics
- Flexible manufacturing
- IT and Communications
- Nuclear
- Weapons

NSF Science and Engineering Indicators, 2010
Charting the course in challenging times

Vision/Strategy grounded in core principles

Human capital development (GRF, post-doc, CAREER)
Supporting the best ideas and the best people

Catalyzing Innovation

Broadening participation

OneNSF
Engineering Prioritizes Research Critical to the Nation’s Challenges

• National Priorities
  – National Nanotechnology Initiative
  – National Robotics Initiative

• OneNSF Initiatives
  – Advanced Manufacturing
  – Communications and Cyberinfrastructure
  – Education and Workforce
  – Interdisciplinary Research
  – Sustainability and Clean Energy
  – Innovation Ecosystem
National Nanotechnology Initiative

- The directorate will continue support for
  - nanomaterials and nanodevices
  - nanosystems
  - nanomanufacturing
  - environment, health, and safety

- ENG will direct additional funds towards three Signature Initiatives
  - Nanoelectronics for 2020 and Beyond
  - Sustainable Nanomanufacturing
  - Nanotechnology for Solar Energy Collection and Conversion

$174 M
National Robotics Initiative

• ENG will support
  – Assistive mechanisms for those with physical disabilities and/or cognitive impairments
  – Systems integration that enables ubiquitous, advanced robotics to be realized
  – Next-generation robotics for manufacturing, healthcare and rehabilitation, surveillance and security, education and training, and transportation

$10 M
ENG collaborates through OneNSF
ENG will be a major contributor to Advanced Manufacturing

- **Advanced Manufacturing**
  ENG will support multi-scale modeling, nanomanufacturing, and complex engineering systems design

- **Cyber-Enabled Materials, Manufacturing, and Smart-Systems (CEMMSS)**
  ENG will invest in breakthrough materials and design, advanced techniques and processes, and smart systems

- **Research at the Interface of the Biological, Mathematical, and Physical Sciences, and Engineering (BioMaPS)**
  ENG will focus on nanoscale biosensing, neuro-engineering, cellular biomechanics, metabolic engineering, and engineering aspects of synthetic biology

**Funding**

- $110 M for CEMMSS
- $5 M for BioMaPS
ENG will strategically support better Communications and Cyberinfrastructure

- **Enhancing Access to the Radio Spectrum (EARS)**
  ENG will prioritize research on more efficient radio spectrum use and energy-conserving device technologies

- **Cyberinfrastructure for the 21st Century (CIF21)**
  The ENG investment will focus on cyber–physical systems, engineering modeling and simulation, smart networks, and sensors

- **Secure and Trustworthy Cyberspace (SaTC)**
  ENG support will focus on the engineering aspects of the Networking and Information Technology Research and Development (NITRD) strategic plan

$14 M for EARS

$11 M for CIF21

$4 M for SaTC
Education and Workforce

• The directorate emphasizes support for
  – Expeditions in Education (E²)
  – CAREER awards
  – Activities that promote the entry and retention of veterans and other non-traditional students in engineering programs

$1 M for E²

$53 M for CAREER
NSF Investments in Workforce

Primary focus: Enhancements to Flow (*all levels*)

- K12 Pre-college programs – EHR, EEC, RET
- Recruitment of undergraduate Engineers
  - GI Bill, PEEC
- Encouragement to pursue Graduate degrees
  - REU
- Support during graduate studies
  - GRF, IGERT
- Support for transition to Academia and Industry
  - Innovation Fellows, BRIGE, CAREER
ENG will continue its long-standing support for Interdisciplinary Research

• INSPIRE (Integrated NSF Support Promoting Interdisciplinary Research and Education)
  ENG will support creative, important research collaborations between disciplines that may lead to new opportunities

• Emerging Frontiers of Research and Innovation (EFRI)
  ENG will provide strategic support for fundamental research that may overcome scientific and/or national challenges and lead to breakthrough technologies

$6 M for INSPIRE

$32 M for EFRI
ENG will invest heavily in Sustainability and Clean Energy

• **Science, Engineering, and Education for Sustainability (SEES)**
  ENG’s investment will focus on sustainable research networks, sustainable chemistry, and human dimensions

• **Clean Energy Technologies**
  ENG will support novel research for smart grid technologies, solar energy technologies, biofuels and bioenergy, wind energy generation, and renewable energy storage

$20 M for SEES

$128 M for Clean Energy
ENG will invest strategically in the Innovation Ecosystem

• **Innovation Corps (I-Corps)**
  The ENG investment will provide mentoring and resources to help determine the commercial readiness of technology built on NSF-funded basic research

• **Partnerships for Innovation**
  – ENG support for Accelerating Innovation Research (AIR) will foster connections with an existing NSF innovation research alliance
  – ENG support for Building Innovation Capacity (BIC) will enable collaboration between academia and business to advance basic research for market-accepted innovations

$6 M for I-Corps

$23 M for PFI
Research Centers

• Engineering Research Centers (ERCs)
  – EEC will continue support for the first class of Nanosystems ERCs from FY 2012 and 17 others

• Science and Technology Centers (STCs)
  – CBET will continue supporting the Center on Emergent Behaviors of Integrated Cellular Systems
  – ECCS will continue supporting the Center for Energy Efficient Electronics Science

$69 M for ERCs

$10 M for STCs
I-Corps in A Nutshell

• **A Public/Private Partnership**: to support the translation of NSF research into the development of technologies, products and processes

• **Increasing Network Opportunities**: aims to help create a national network of scientists, engineers, innovators, business leaders and entrepreneurs building on existing NSF grantee events

• **Supporting NSF Strategy**: I-Corps will enhance our nation’s economic competitiveness by “reaching out to a range of communities that play complementary roles in the innovation process and are essential to ensuring the impact of NSF Investments.” *

*From “Empowering the Nation through Discovery and Innovation” NSF Strategic Plan, April 2011*
I-Corps Projects are Team-Based

• Team Composition:
  – Entrepreneurial Lead: Post-doc or Student to move it forward
  – I-Corps Mentor: Domain-relevant volunteer guide
  – PI: Researcher with current or previous award

• Program Outcomes
  – Functioning network of Mentors/Advisors
  – Scientist and Engineers trained as Entrepreneurs
  – Increased impact of NSF-funded basic research

• 30 Hours of Curriculum
• $50,000 per award
• F&A $5,000 maximum
• 25 awards in FY2011
• 100 awards in FY2012
NSF Career-Life Balance Initiative

Announced at the White House on Sept. 26, 2011
Career Life Balance

- Deferral of grants for child birth/adoption
- Grant suspension for parental leave
- Technician support for parental/family leave
SAVI: Science Across Virtual Institutes

Launched October 5, 2011
Science Across Virtual Institutes (SAVI)

• Create a uniform platform for International Collaborations between NSF funded US researchers and other institutions around the world.

• Facilitate collaboration among scientists, engineers and educators across the globe to help solve society's most vexing problems.

• Early pilots VIs:
  – Mathematical and Statistical Sciences (VI-MSS) with India
  – Physics of Living Systems Student Research Network (PoLS SRN) with Israel and others
  – Wireless Innovation (WiFiUS) with Finland
NSF ENG Organization

Office of the Assistant Director
Thomas Peterson, Assistant Director
Kesh Narayanan, Deputy Assistant Director

Emerging Frontiers in Research and Innovation (EFRI)
Sohi Rastegar

Senior Advisor for Nanotechnology
Mihail Roco

Program Director for Diversity
Omnia El-Hakim

Engineering Education and Centers (EEC)
Theresa Maldonado

Chemical, Bioengineering, Environmental, and Transport Systems (CBET)
John McGrath

Civil, Mechanical, and Manufacturing Innovation (CMMI)
Steven McKnight

Electrical, Communications, and Cyber Systems (ECCS)
Robert Trew

Industrial Innovation and Partnerships (IIP)
Grace Wang
## ENG Budget ($M)

<table>
<thead>
<tr>
<th></th>
<th>FY 2011 Actual</th>
<th>FY 2012 Estimate</th>
<th>FY 2013 Request</th>
<th>Change over FY 2012 Estimate</th>
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<tr>
<td><strong>CBET</strong></td>
<td>$158.82</td>
<td>$171.45</td>
<td>$179.40</td>
<td>$7.95</td>
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<td><strong>CMMI</strong></td>
<td>189.62</td>
<td>203.58</td>
<td>217.06</td>
<td>13.48</td>
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<td><strong>ECCS</strong></td>
<td>97.54</td>
<td>106.73</td>
<td>114.30</td>
<td>7.57</td>
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<td><strong>EEC</strong></td>
<td>125.76</td>
<td>120.00</td>
<td>123.27</td>
<td>3.27</td>
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<tr>
<td><strong>IIP</strong></td>
<td>162.65</td>
<td>193.41</td>
<td>210.30</td>
<td>16.89</td>
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<tr>
<td><strong>SBIR/STTR</strong></td>
<td>126.47</td>
<td>152.76</td>
<td>165.20</td>
<td>12.44</td>
</tr>
<tr>
<td><strong>EFRI</strong></td>
<td>28.95</td>
<td>31.00</td>
<td>32.00</td>
<td>1.00</td>
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<td><strong>ENG TOTAL</strong></td>
<td><strong>$763.33</strong></td>
<td><strong>$826.17</strong></td>
<td><strong>$876.33</strong></td>
<td><strong>$50.16</strong></td>
</tr>
</tbody>
</table>
ENG and SBIR/STTR Budgets ($M)


$0  $200  $400  $600  $800  $1,000  $1,200

ENG and SBIR/STTR
OneNSF

catalyze human capital development

improve organizational efficiency

create networks and infrastructure for the nation

spark greater innovation and opportunity for scientific discoveries

address multidisciplinary challenges of national/global significance

support fundamental research in all disciplines
Questions