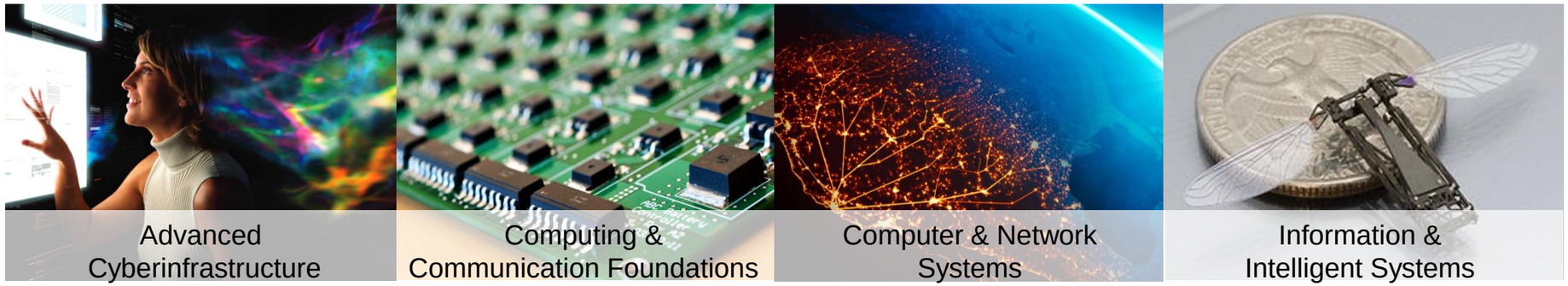
Basic Research and Innovation: a Computer and Information and Science Perspective



Jim Kurose
Assistant Director, NSF
Computer & Information Science & Engineering

International Seminar on the Promotion, Development Support, and Evaluation of Innovation
Brazilian Academy of Sciences, FINEP
August 27-28, 2017

Outline


NSF/CISE: Overview
From Basic Research to Innovation
Innovation Programs
Collaboration With Industry

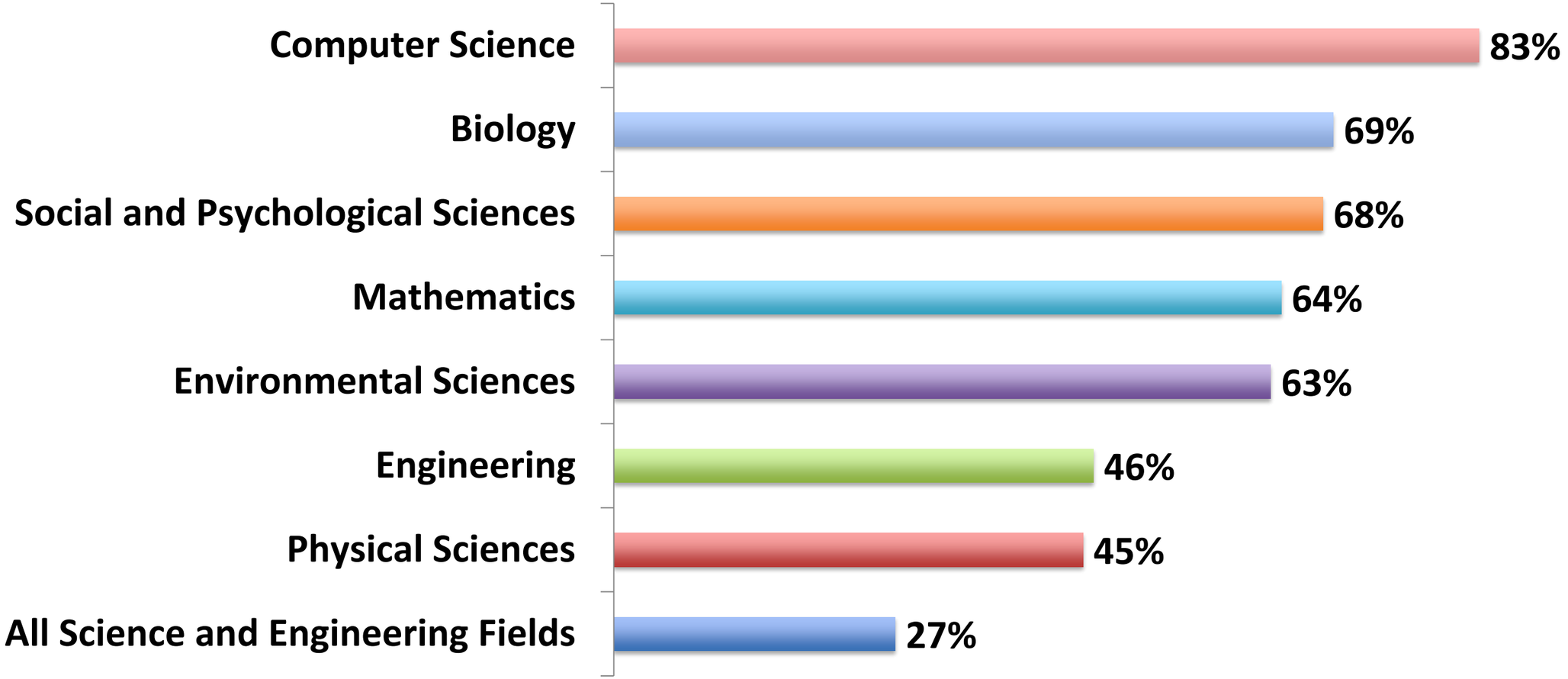
National Science Foundation's Mission

National Science Foundation's Mission

"To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense..."

NSF Supports All Areas of Fundamental Research

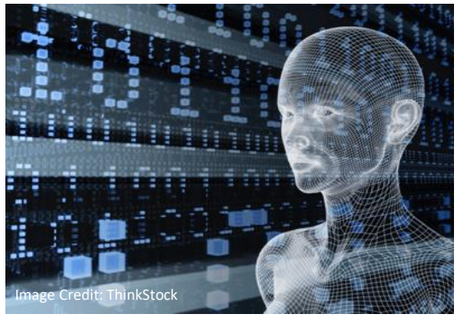
NSF support as a percentage of total federal support for basic academic research



Source: NSF/NCSES, "Survey of Federal Funds for Research and Development"

CISE programs address national priorities

Big Data



Cybersecurity

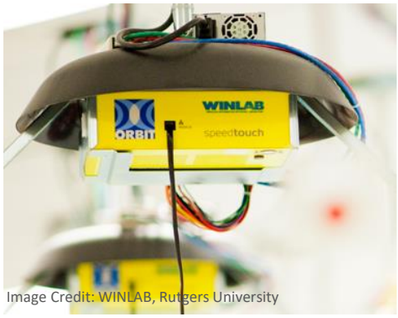
National Robotics Initiative

Understanding the Brain

National Strategic Computing Initiative

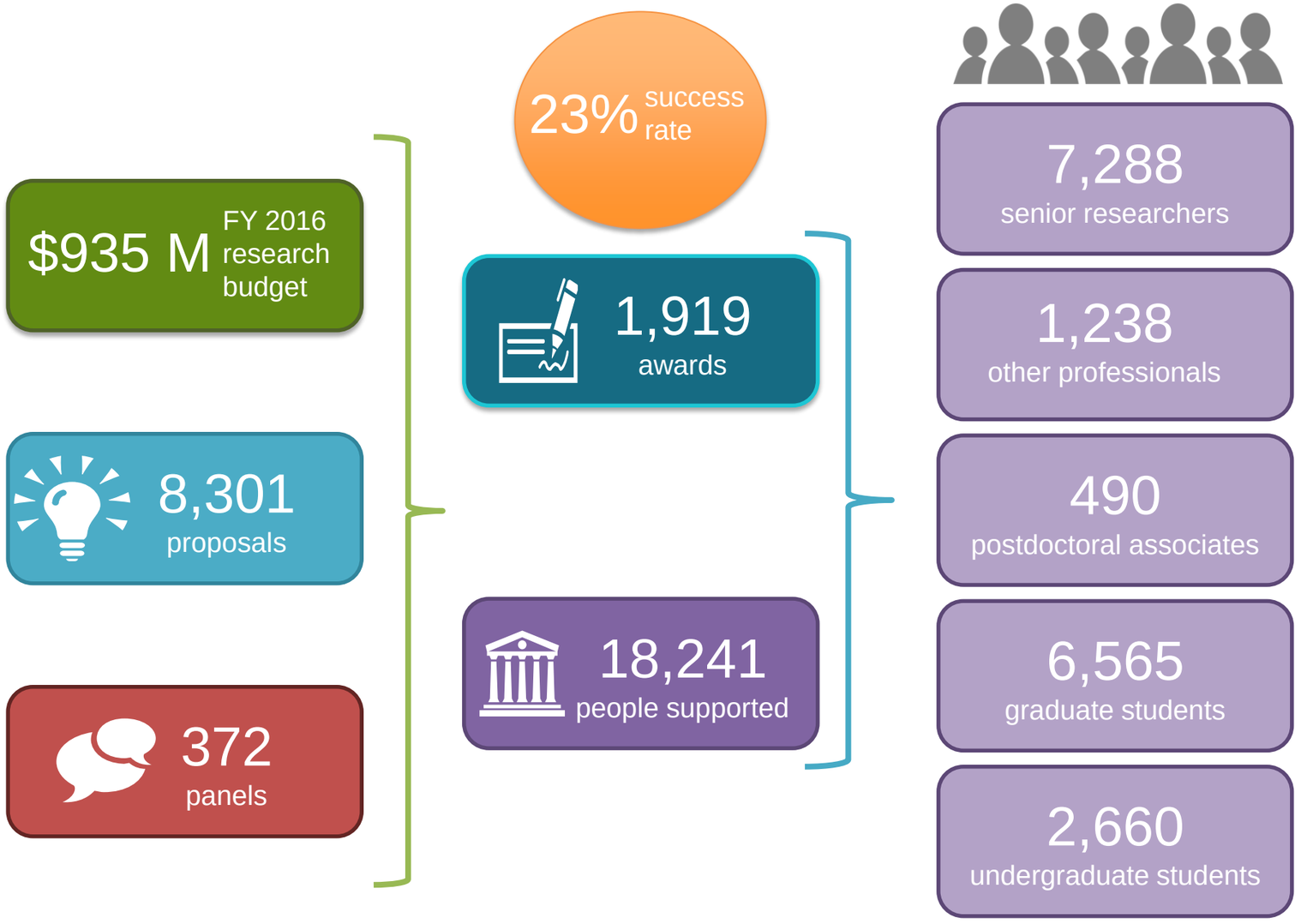
Smart Communities

Computer Science for All



Advanced Wireless Research

CISE by the Numbers: FY 2016



Outline

NSF/CISE: Overview

From Basic Research to Innovation

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From Research to Economic Growth

Short NSF-produced video

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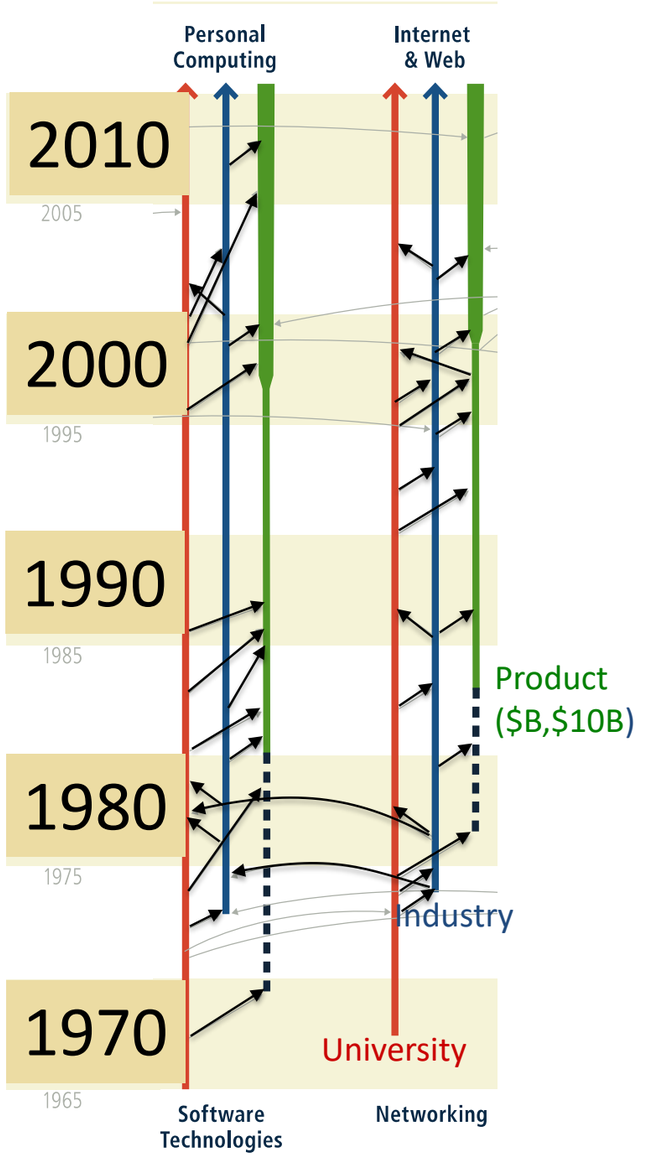
Economic impact of CISE: From Federally-funded research to billion-dollar industries

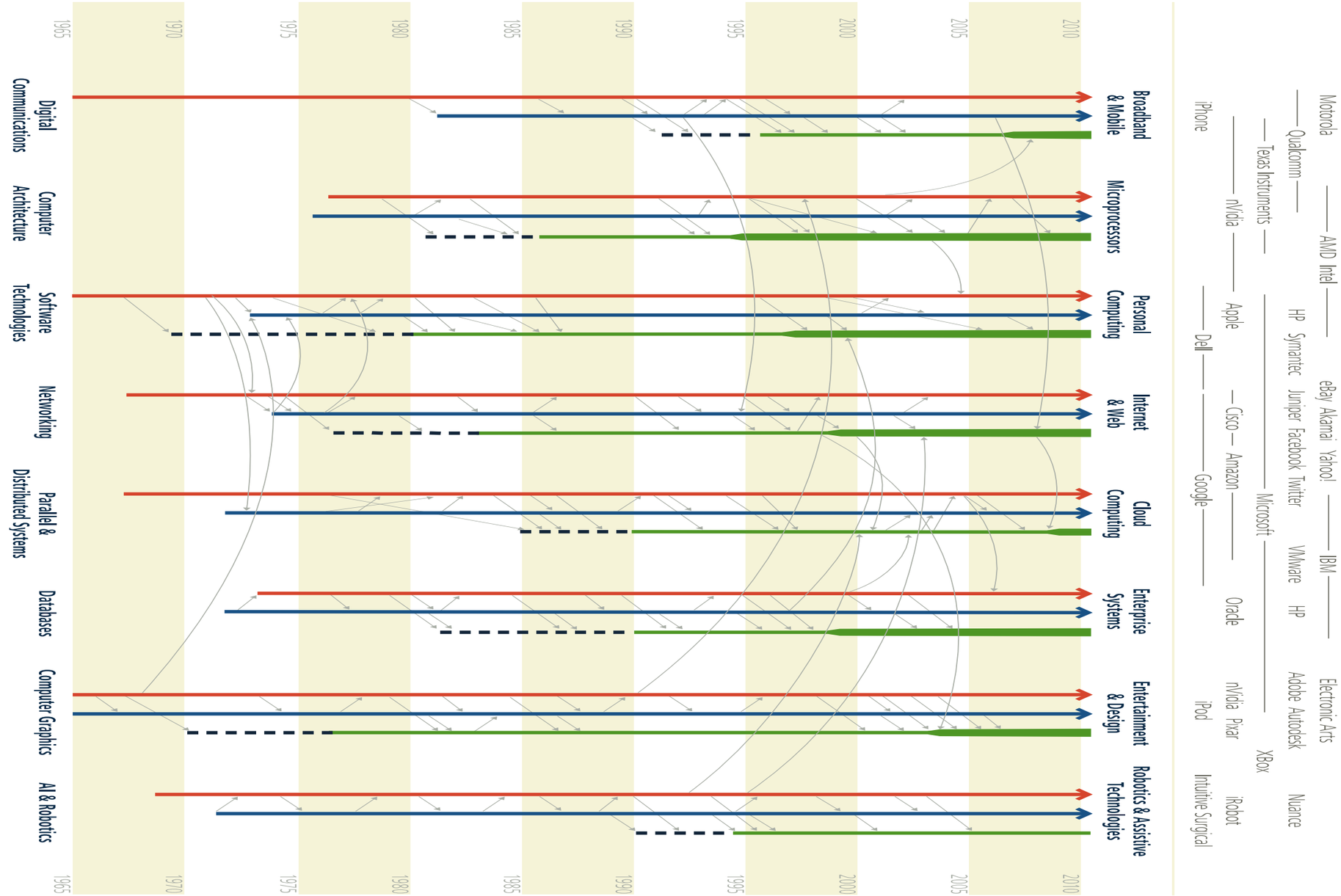
Advances in computing, communications, information technologies, and cyberinfrastructure:

- drive U.S. competiveness
  - IT accounts for 25% of economic growth since 1995;
  - resulted in many billion-dollar industries: networking, software, digital communications, computer graphics, AI and robotics, and more
- have profound impacts on our daily lives.



Source: National Research Council. 2012. *Continuing Innovation in Information Technology*.

…. across many industries



This impact continues today

Machine Learning

- Big Data Analytics Market: $125B (Forbes)
- Deep learning rooted in NSF-funded research on neural networks, reinforcement learning

"NSF is where all interesting research gets started…" - Eric Schmidt, Google / Alphabet

Software-Defined Networking (SDN)

- SDN Market: $18B in 2018 (IDC)
- SDN resulted from NSF-funded foundational research

Open Programmable Mobile Internet 2020 project funded by NSF/CISE Expeditions program, 2008, N. McKeown, Stanford U.

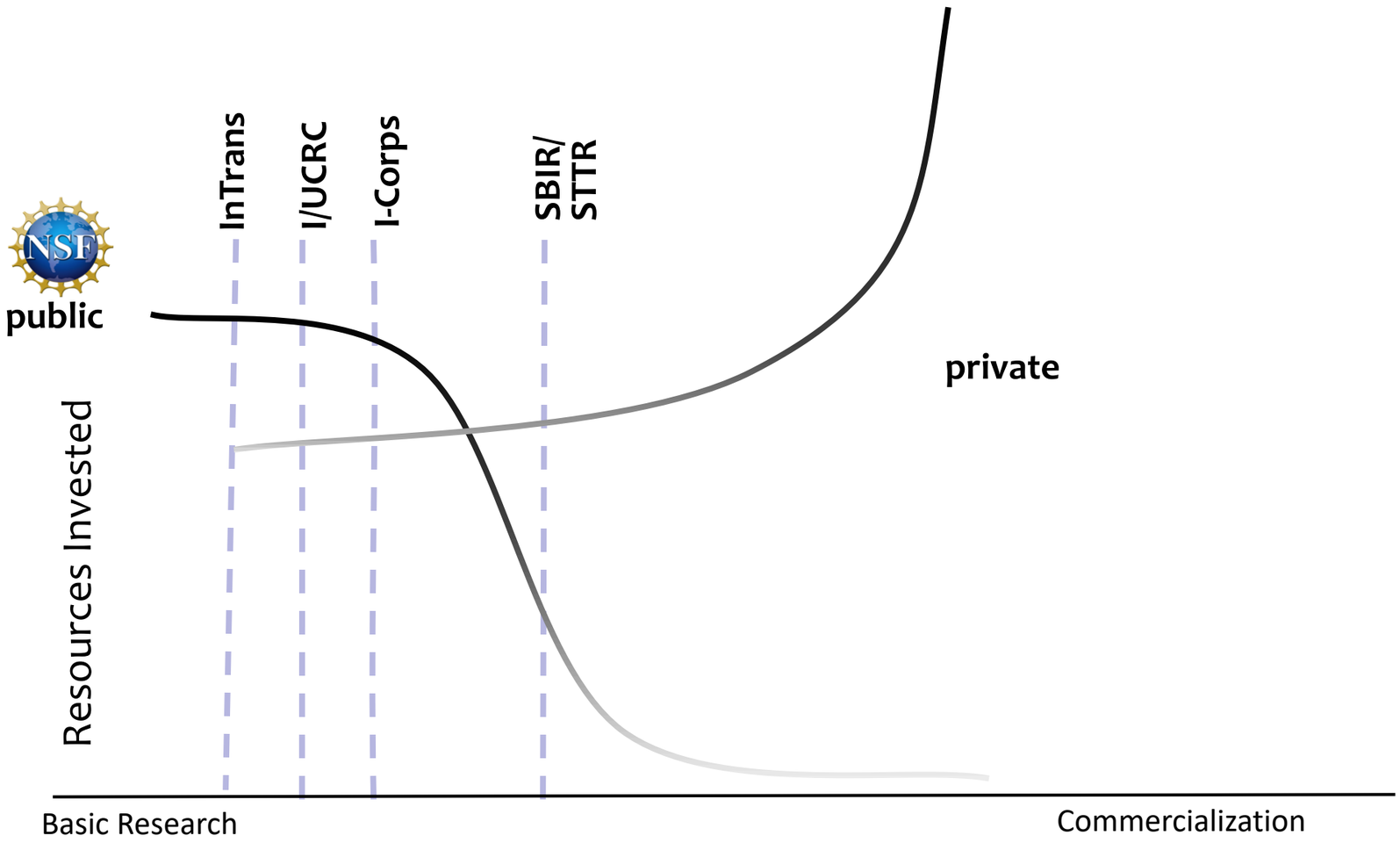
Fundamental research powers innovation

Outline

NSF/CISE: Overview → From Basic Research to Innovation → **Innovation Programs** → Collaboration With Industry

- I-Corps
- SBIT/STTR

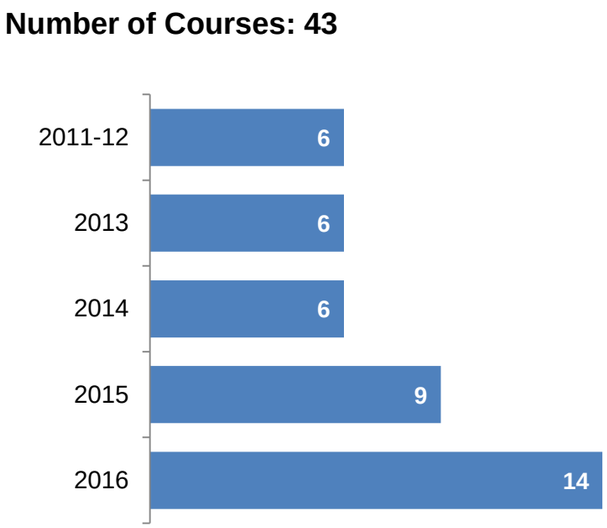
From Research to Innovation

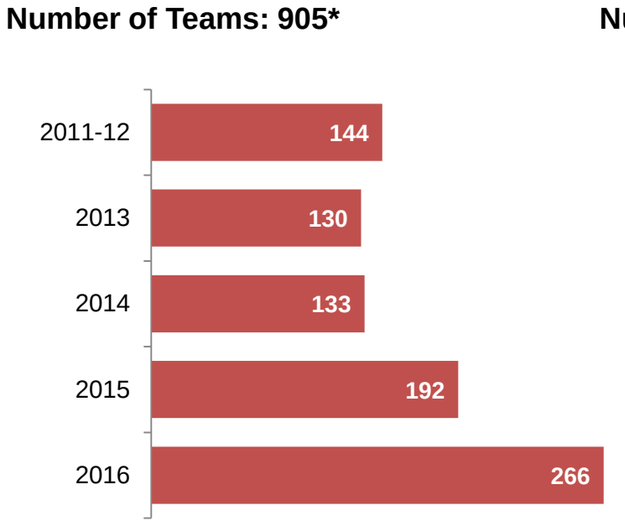


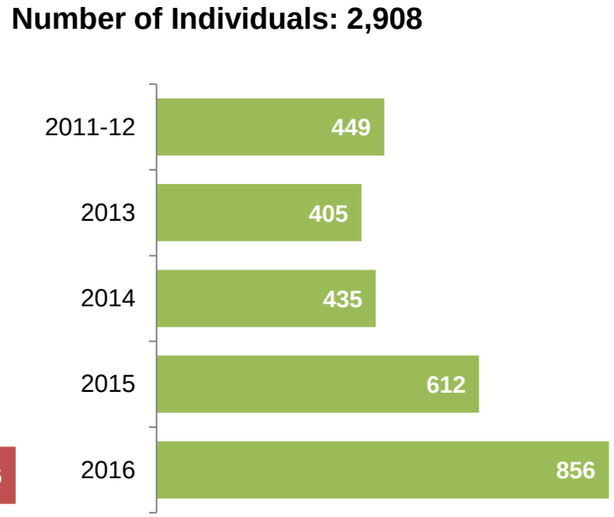
Innovation Corps (I-Corps)

- Foster entrepreneurship, commercializing NSF-funded research
  - Uses customer discovery and business model development to validate commercialization opportunities
  - *common model: two-week "boot camp"*
  - Successful I-Corps projects will be prepared for business formation
- I-Corps program components:
  - **Team:** Technical Lead, Entrepreneurial Lead, Mentor
  - **Site:** Academic institutions catalyzing local team engagement
  - **Node:** Hubs for education, infrastructure, and research

I-Corps Teams and Training







- 2011-2016: **865** teams,**2,757** participants have gone through **41** NSF I-Corps courses
- 361 startups created
- 9 MOUs with other Federal agencies

Small Business Innovation Research Program (SBIR)
Small Business Technology Transfer Program (STTR)

- Both provide small business with equity-free funding to conduct research and development (R&D) work and de-risk technology for commercial success
- Proposals made (NSF 17-544), then reviewed via NSF's peer-review process
- 11 federal agencies have SBIR programs (NSF since 1976); 5 agencies have STTR programs
- SBIR, STTR differ in PI eligibility, % effort by small business, collaborating non-profit research institution

SBIR · STTR
America's Seed Fund

NSF Totals
FY 2014 – $159.99 M
FY 2015 – $177.11 M
FY 2016 – $188.56 M (Estimate)

Phase IIB
Third-Party Investment Plus
1:2 NSF Match (up to $500,000)

SBIR-STTR Federal and Private Investments

Phase I
Feasibility Research
6-12 Months
$225,000

Phase II
Research Towards Prototype
24 Months
$750,000

Phase III
Product Development to Commercial Market

Federal SBIR-STTR Program Investments

Non-SBIR-STTR Federal or Private Investments

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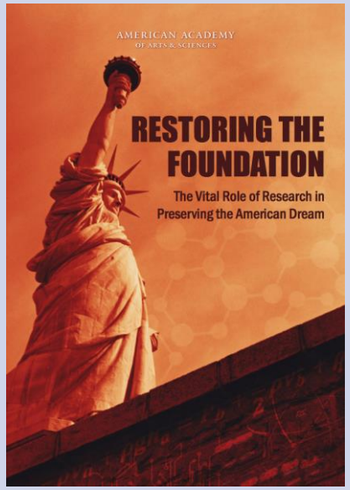
NSF/CISE Industry Partnerships

Partnerships: the big picture

Expanded models for collaboration between federal government, industry, academia

- collaborative research
- shared research infrastructure
- workforce: people



Partnerships: Why?

Enhanced opportunities for fundamental, long-term research

- leveraging resources: research challenges, funding, infrastructure
- technology transfer: economic competitiveness
- enhancing, not replacing, existing industry-university partnerships

Restoring the Foundation: The Vital Role of Research in Preserving the American Dream, American Association for the Advancement of Science, https://www.amacad.org/content/Research/researchproject.aspx?d=1276

NSF/CISE Industry Partnerships, 2014-2017

Joint research solicitations

- joint NSF/industry research solicitations in targeted areas
- Intel (4), SRC (5), VMware (1)

Research-Infrastructure-based collaborations:

- cloud credits for BIGDATA, BD Hubs & Spokes programs: AWS, Google, Microsoft
- Platforms for Advanced Wireless Research (PAWR)

Workforce, Broadening Participation

- Typically via separate co-funding
- CSforAll, BPC Alliances (e.g., NCWIT)

Individual-project based

- I/UCRC: center co-funding
- GOALI: faculty/student/industry-researcher exchange
- InTrans: technology-transition co-funding

The Value Proposition: NSF/CISE and industry

- **Shared goals:** robust research ecosystem, educated 21st-century science and engineering workforce
- NSF as a *convener*:
  - *nationwide* network of researchers, educators
  - gold-standard process soliciting, reviewing, funding of academic research and education
- **Leverage**: perspectives, experience, resources

CISE and Intel Partnership

Joint Solicitations:

- Cyber-Physical Systems Security and Privacy (CPS-Security)
- Visual and Experiential Computing (VEC)
- Computer-Assisted Programming for Heterogeneous Architectures (CAPA)
- Information-Centric Networking in Wireless Edge Networks (ICN-WEN)

Typical model for each joint solicitation:

Total investments: $6-8 million total

Funding ratio: 1:1 NSF:Intel

Awards: ~2-6 awards, $500,000-$3 million used over 3 years

Platforms for Advanced Wireless Research (PAWR)

- at-scale experimentation on advanced wireless technology (e.g., robust new wireless devices, communication techniques, networks, systems, and services)
- PAWR Project Office leads design, development, deployment, and initial operations of a set of research platforms
  - $50M NSF/CISE
  - $50M in-cash & in-kind contributions from Industry Consortium

Conclusion

- "Innovation": many sizes, timescales
  - foundational research that creates, sustains entire industry sectors
  - Nearer-term, smaller-scale startups
- Specific programs
- Partnerships with industry

Partnerships: the big picture

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