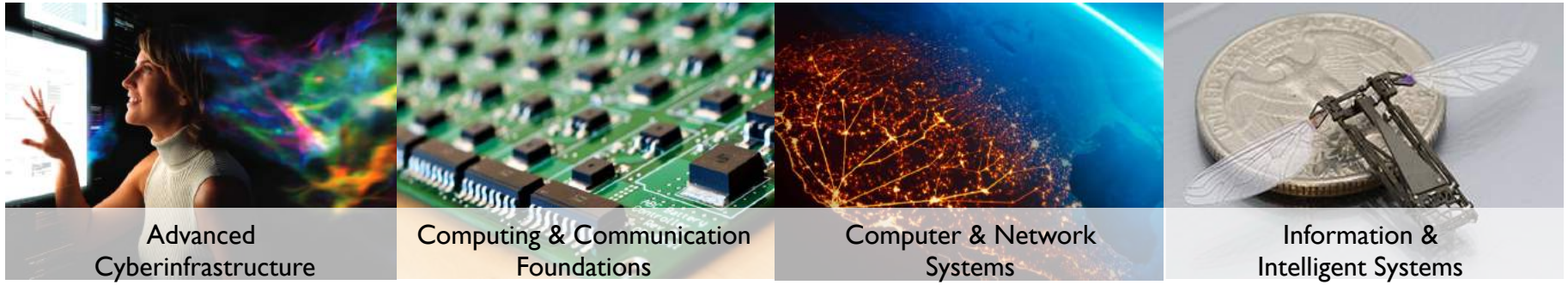
NSF/CISE: a very quick update, and a longer look forward (with challenges)



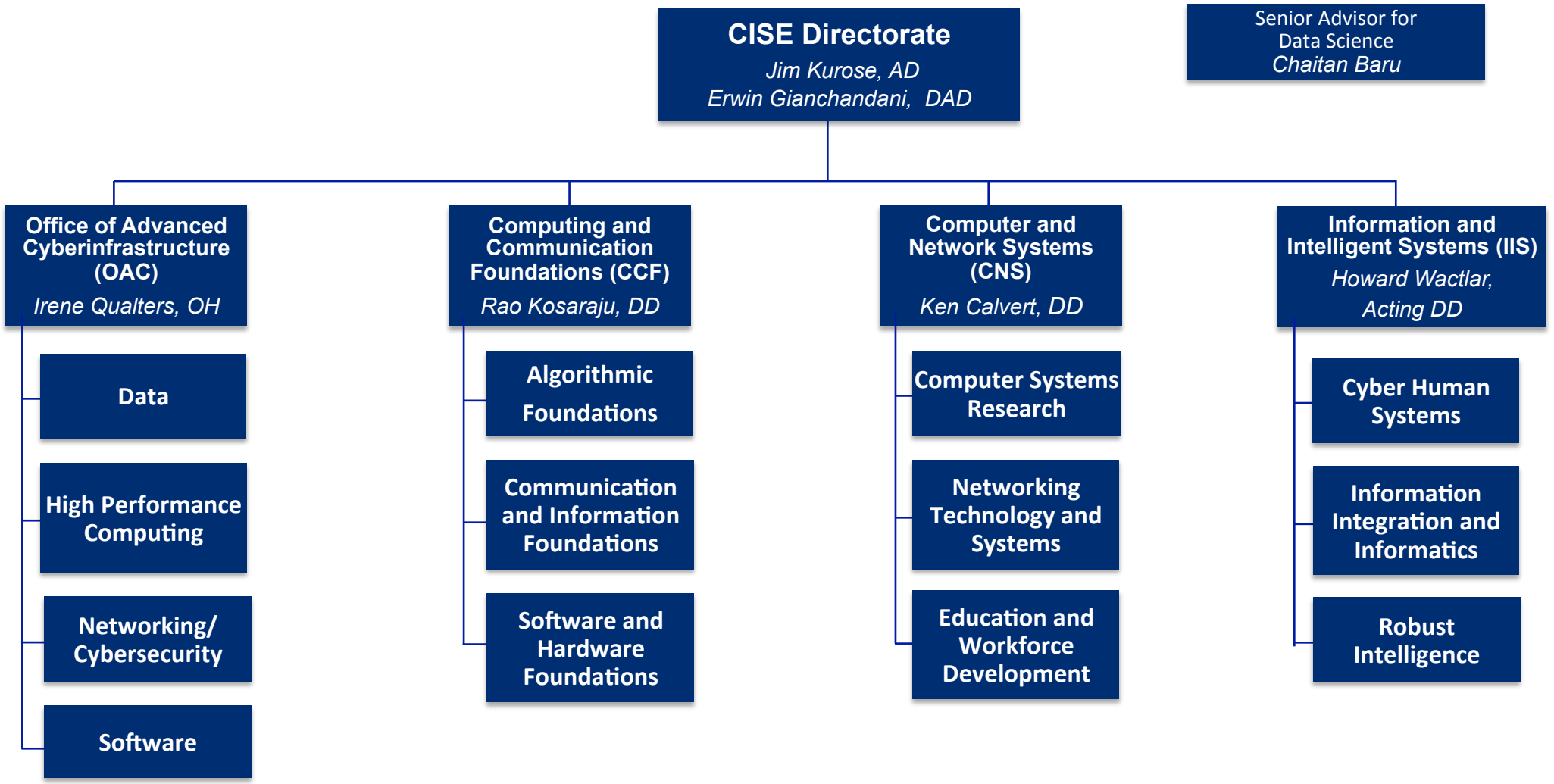
Jim Kurose
Assistant Director, NSF
Computer & Information Science & Engineering

CCC Fall Meeting
November 2017

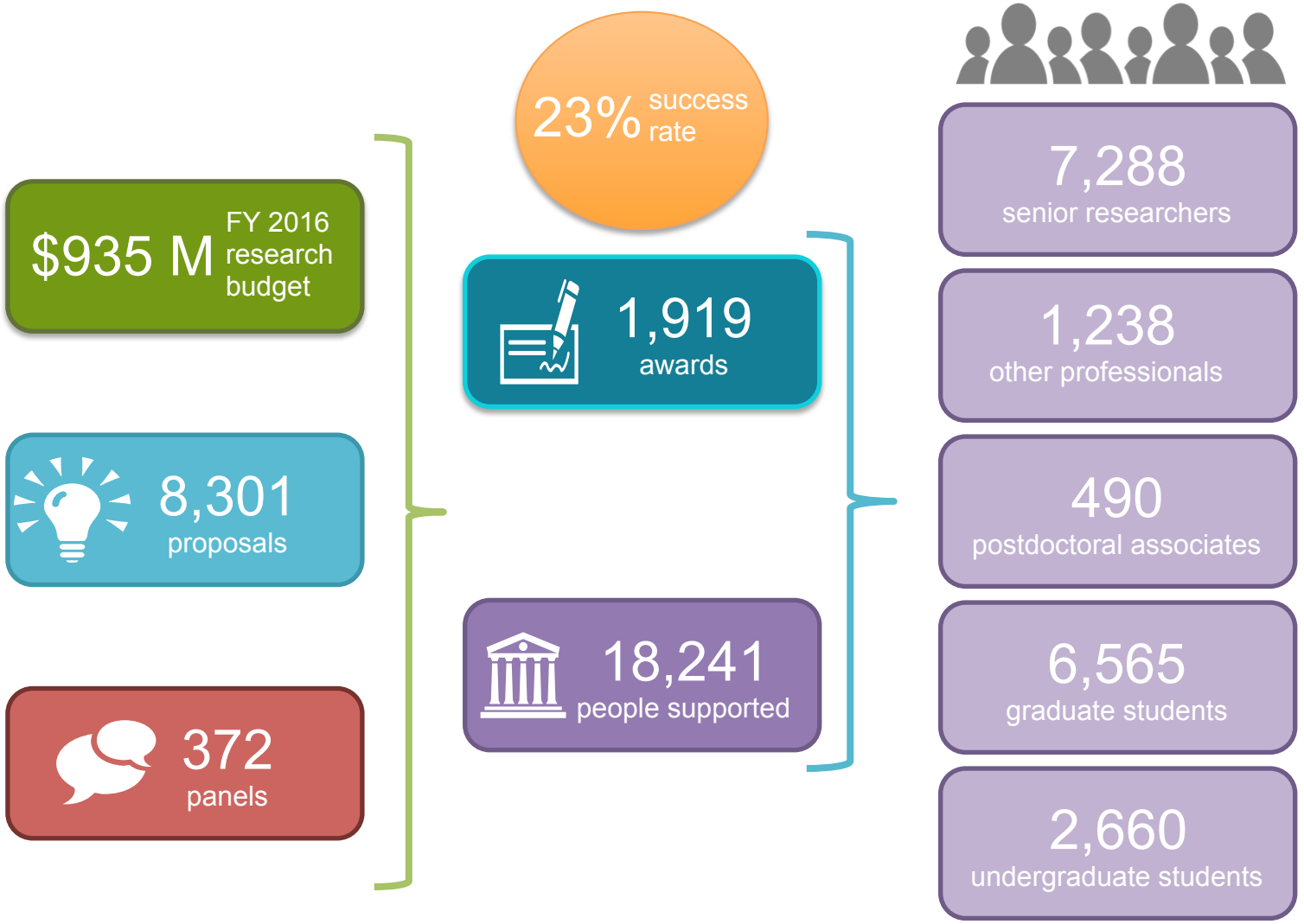
Outline


CISE: a quick update
Budget info
Big Ideas
Education Workforce
Partner-ships

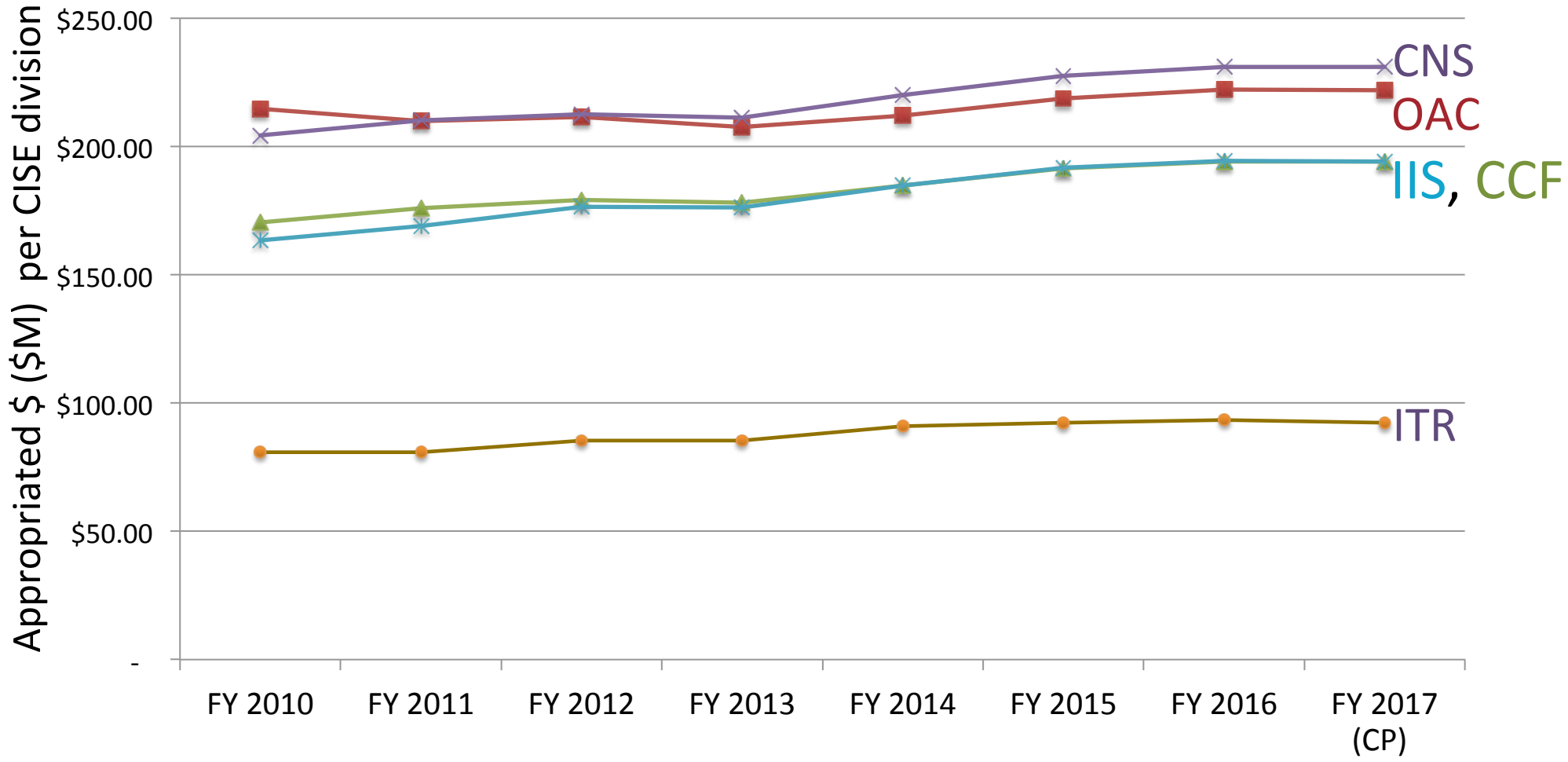
CISE Organization



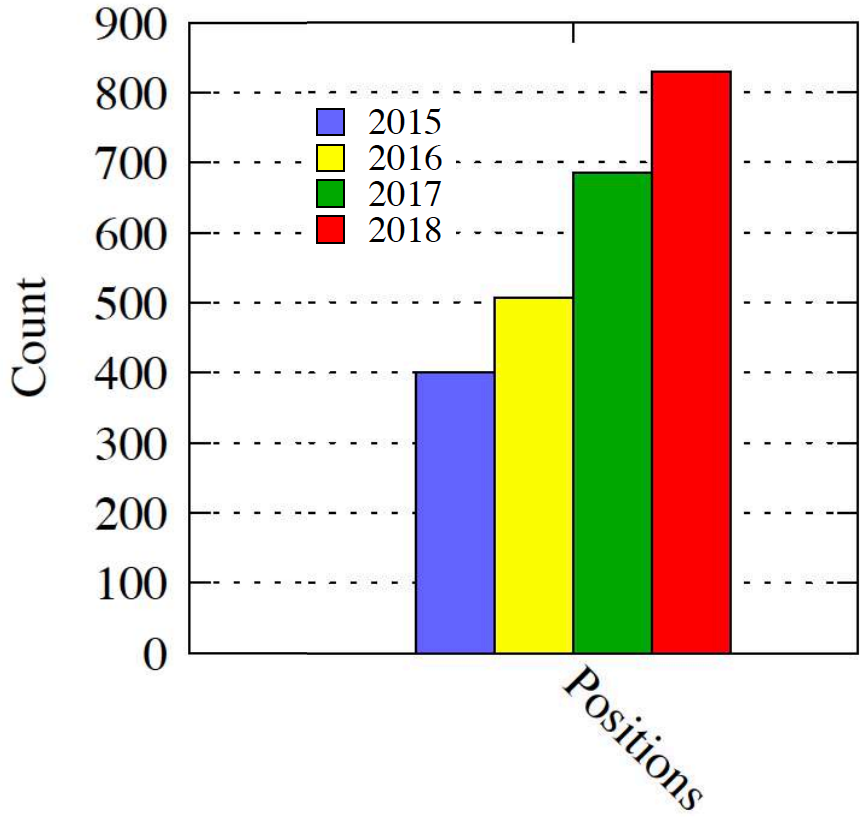
CISE by the Numbers: FY 2016



NSF/CISE Division Budgets



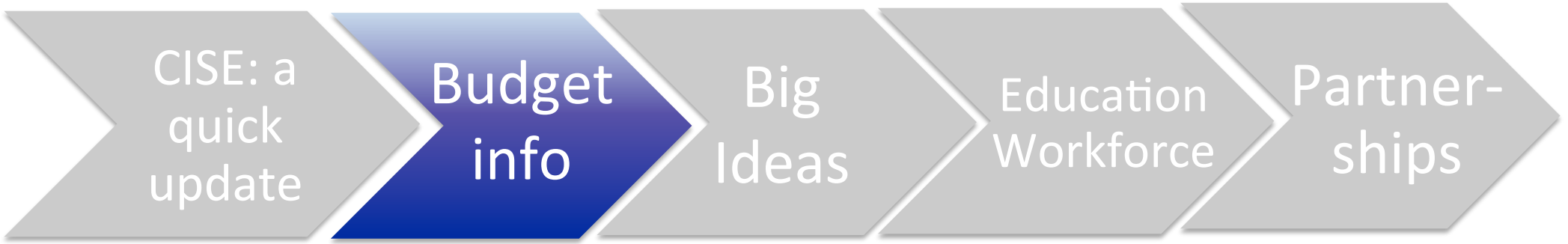
CS Tenure Track Positions: Growing!



"21% one-year, a 64% two-year, and a 107% three-year increase in the number of [tenure track CS faculty] positions being searched for"

"Analysis of Current and Future Computer Science Needs via Advertised Faculty Searches for 2018," C. Wills, WPI-CS-TR-17-04, Nov. 2017

Outline


CISE: a quick update
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Reminder: Budget Process

A long, complicated process, reflecting many priorities, with numerous iterations along the way

Markup, reconciliation of appropriation bills

THE WHITE HOUSE
WASHINGTON

BUDGET

NSF

BUDGET

2018 Request

May 23, 2017

Subject: FY 2018 Budget Request
From: "Kurose, James" <JKUROSE@NSF.GOV>
Date: Tue, May 23, 2017 5:20 pm
To: CISE-ANNOUNCE@LISTSERV.NSF.GOV

Dear CISE Community,

Each year, the President transmits to Congress a budget request for the Executive Branch of the Federal government, including a request for the National Science Foundation (NSF). Today, the President officially submitted that request for fiscal year (FY) 2018, which begins October 1,

Reminder: Budget Process

A long, complicated process, reflecting many priorities, with numerous iterations along the way

2019 Request

~ Feb. 2018

FY 2018 Budget Request

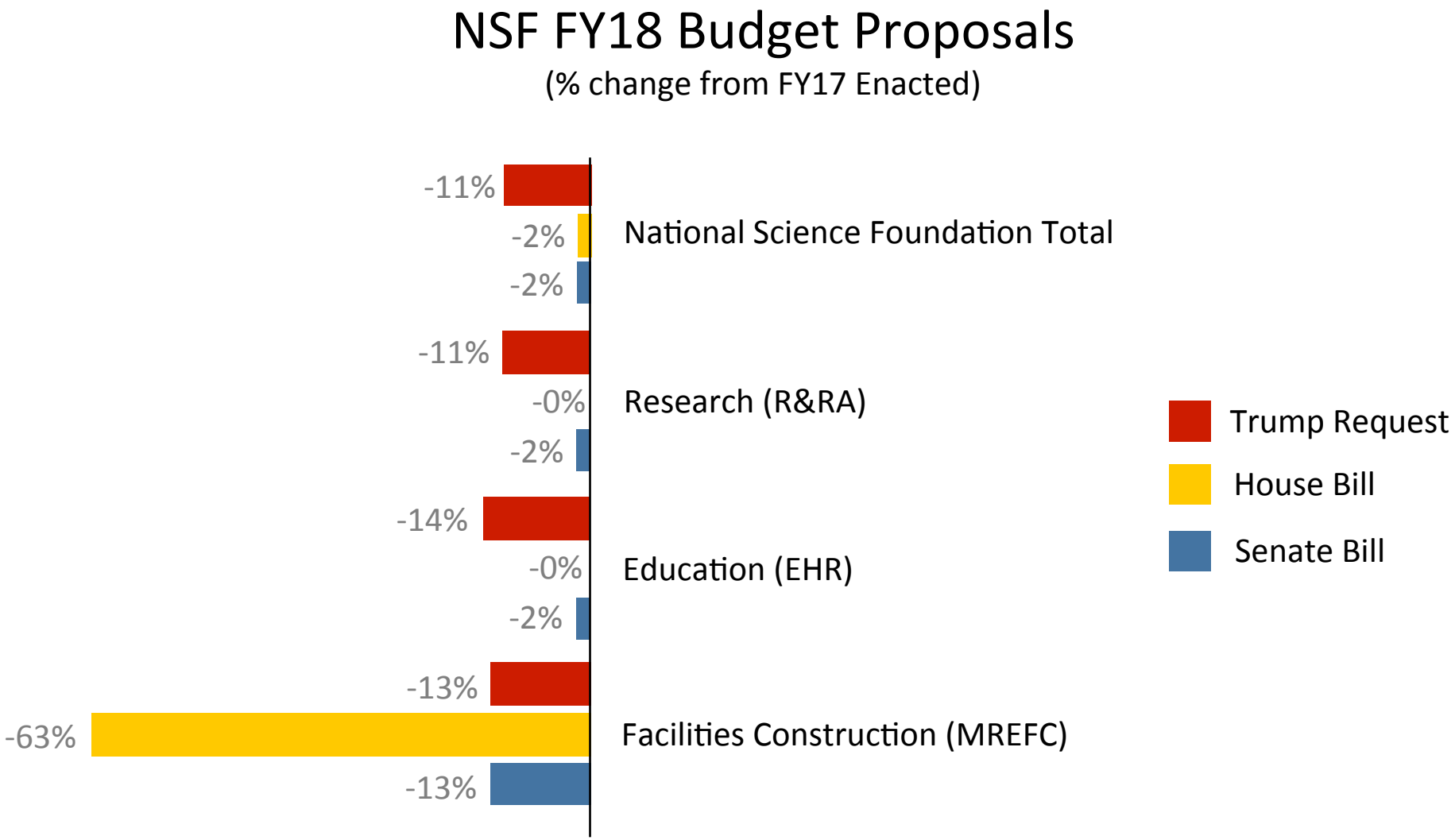
NSF

- FY 2018 Budget Request: $6,653M.
  Comparison to FY 2016 Actual:
  -$841 M, -11.2%

CISE

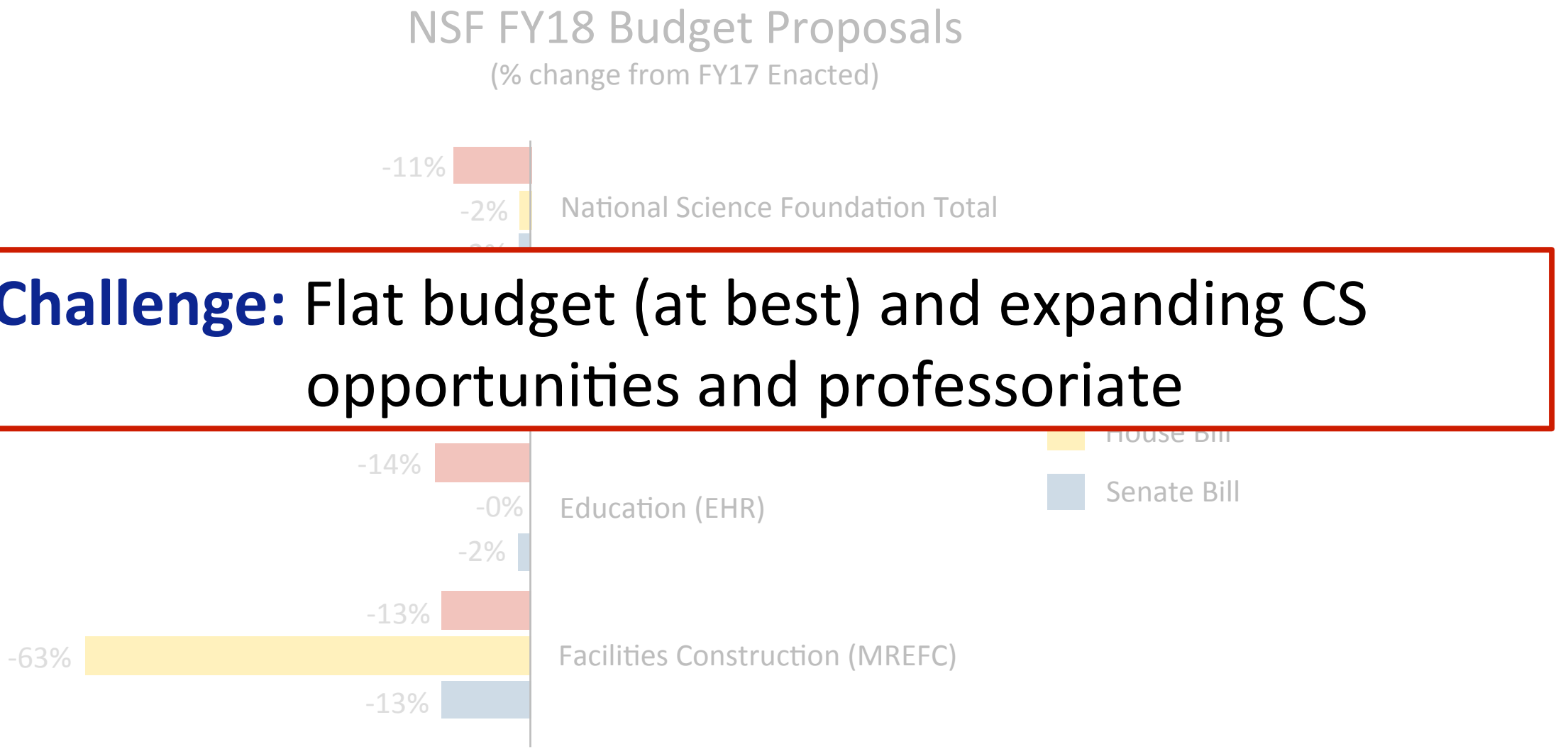
- FY 2018 Budget Request: $839M.
- Comparison to FY 2016 Actual:
  -$96 M, -10.3%

FY 2018 Budget Request



Source: American Institute of Physics / www.aip.org/fyi

FY 2018 Budget Request



Challenge: Flat budget (at best) and expanding CS opportunities and professoriate

Source: American Institute of Physics / www.aip.org/fyi

Outline

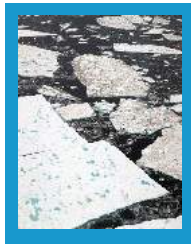
- Overview
- Harnessing the Data Revolution
- Future of Work at the Human Technology Frontier
- Quantum Leap

NSF Big Ideas

RESEARCH IDEAS

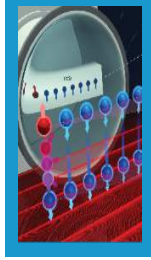
Harnessing Data for 21st Century Science and Engineering

Work at the Human-Technology Frontier: Shaping the Future



Navigating the New Arctic

Windows on the Universe: Multi-messenger Astrophysics



Quantum Leap: Leading the Next Quantum Revolution

Understanding the Rules of Life: Predicting Phenotype

PROCESS IDEAS

Mid-scale Research Infrastructure

NSF 2026

Growing Convergence Research at NSF

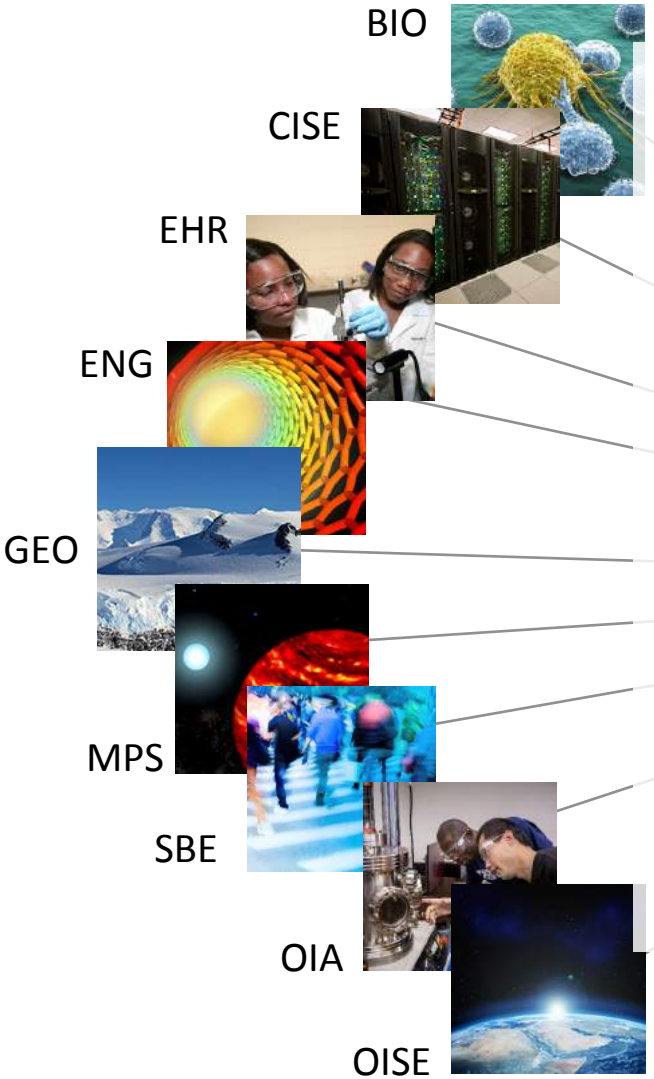
NSF INCLUDES: Enhancing STEM through Diversity and Inclusion

" … bold questions that will drive NSF's long-term research agenda -- questions that will ensure future generations continue to reap the benefits of fundamental S&E research. "

"AI is the universal connector that interweaves all of our Big Ideas; data science is changing the very nature of scientific inquiry, and AI's use of data has the potential to revolutionize everything we do in science."

F. Cordova, Director, NSF, 9/11/17

*"engage NSF's research community in the pursuit of **fundamental research in data science and engineering**, the development of a cohesive, federated, national-scale approach to **research data infrastructure**, and the development of **a 21st-century data-capable workforce**."*

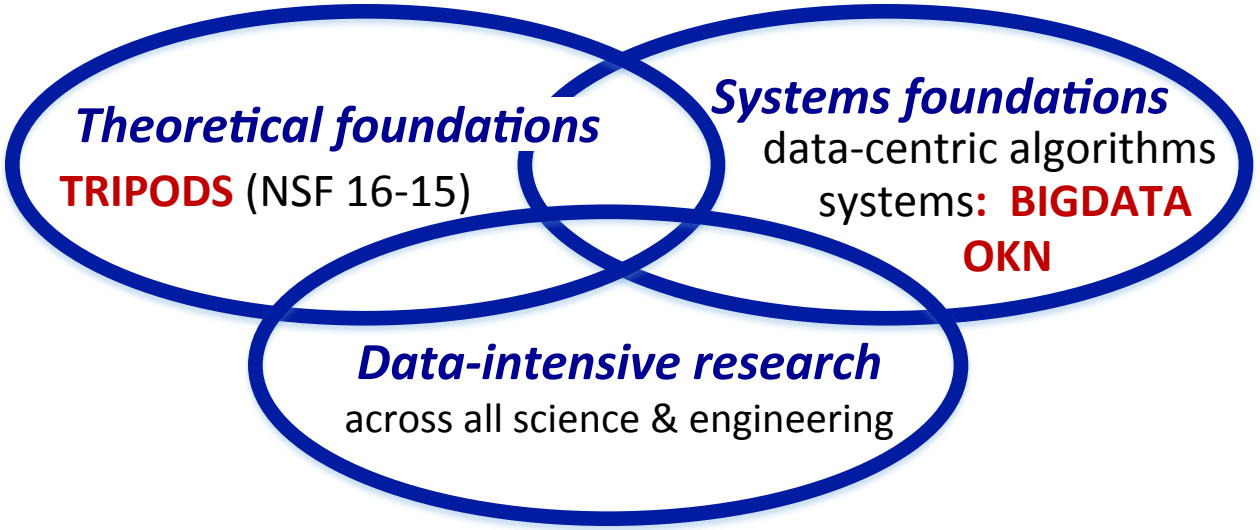


Directorates, Offices

Big Ideas

Harnessing the Data Revolution (HDR)

Research across all NSF Directorates



Educational pathways

Innovations grounded in an education-research-based framework
NASEM study: data science, the undergraduate perspective, NSF Research Traineeships

Advanced cyberinfrastructure

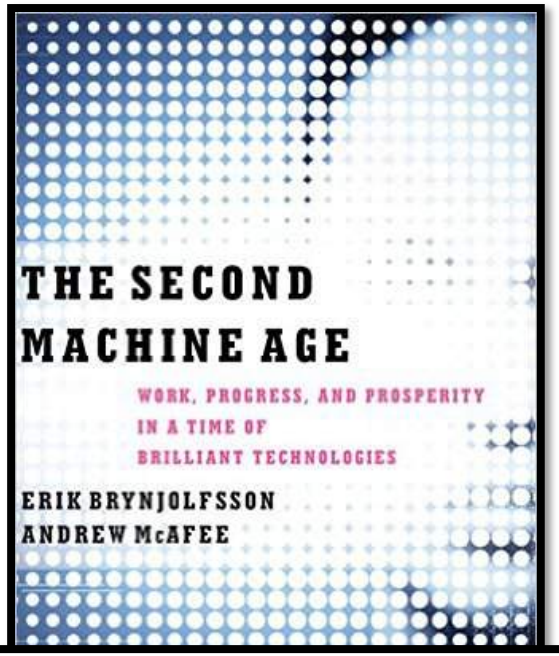
Accelerating data-intensive research.
Midscale infrastructure

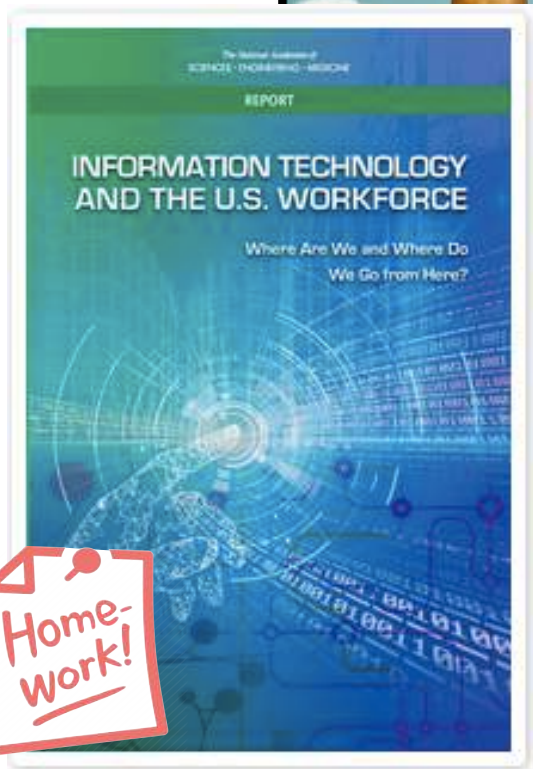
The Future of Work at the Human-Technology Frontier

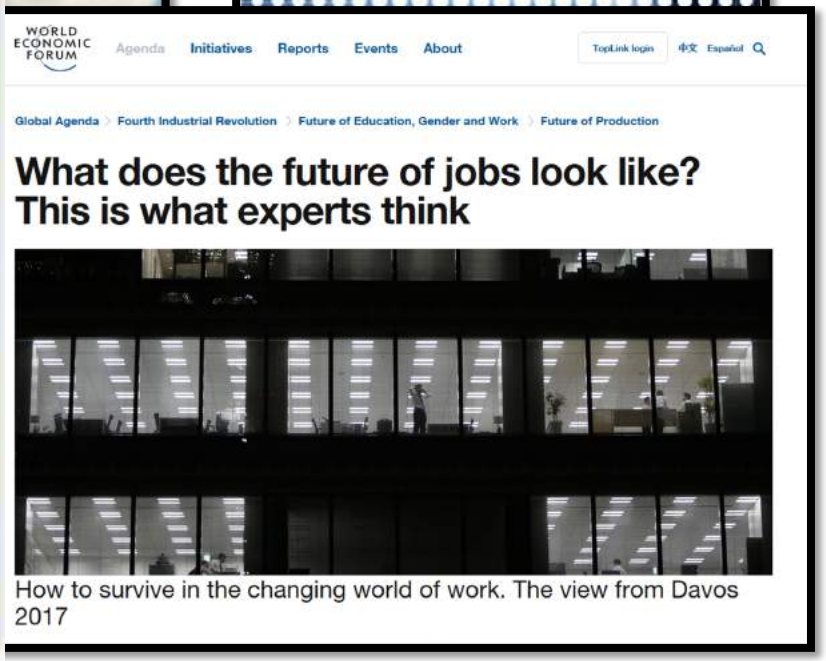
Basic Research on Humans, Society, and Technology: Shaping the Future to Increase Opportunity and Productivity

The World of Work is Changing

- On the cusp of a major transformation in work and the workplace
- Driven by combinations of
  - Artificial intelligence
  - Machine learning
  - The Internet of Things
  - Robotics
  - And more
- Toward an evolving human-technology ecosystem



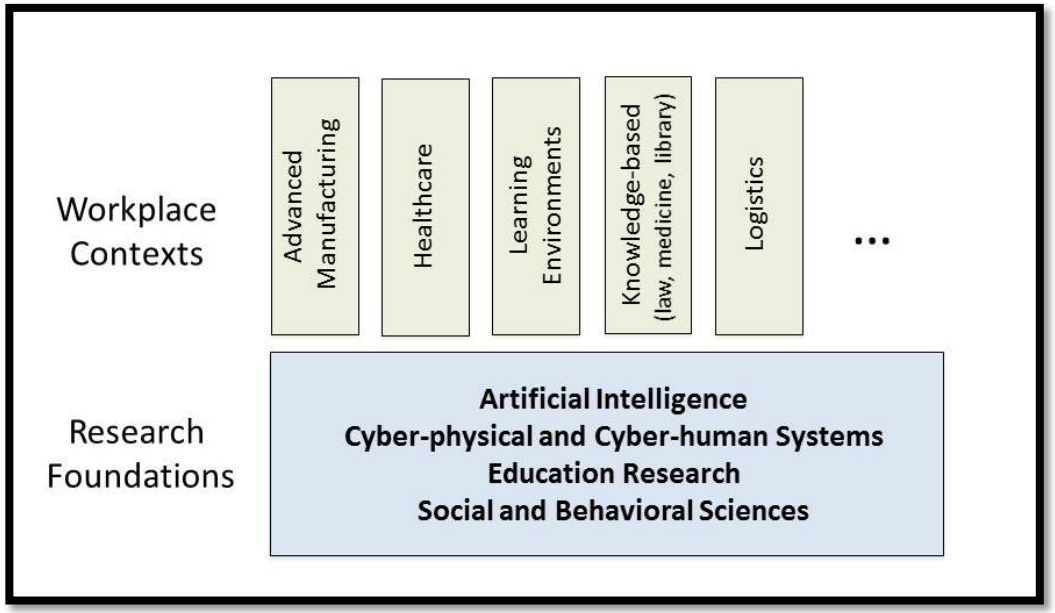




Imagine the Workplace of Tomorrow

A seamless collaboration among humans and machines and cyberspace that requires:

- understanding of reciprocal human-technology interactions;
- systems that are tailored, optimized, and continuously adapted for humans; and
- education and lifelong learning to create the requisite work force



Framework of foundational, use-inspired research in specific work contexts

The Future of Work at the Human-Technology Frontier

Research Themes

- Building the human-technology partnership
- Augmenting human performance
- Illuminating the socio-technological landscape
- Fostering lifelong learning

Looking forward

- Convergent workshops and RCNs NEW
- Cyberlearning for Work at the Human-Technology Frontier NEW
- Augmented Cognition in the Future of Work

The Future of Work at the Human-Technology Frontier

Research Themes

- Building the human-technology partnership
- Illuminating the socio-technological landscape
- Fostering lifelong learning

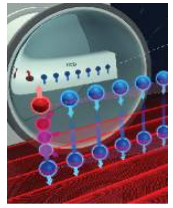
Looking forward

- Convergent workshops and RCNs

NEW

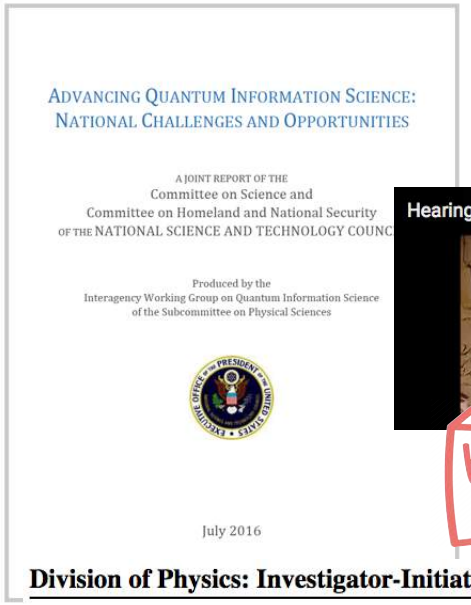
- Augmented Cognition in the Future of Work

Challenge: enabling long-term research collaboration between CS and SBE researchers



Quantum Leap: Leading the Quantum Revolution

- **Fundamentals** that advance our understanding of uniquely quantum phenomena and their interface with classical systems
- **Elements** that measure, model, control, and exploit quantum particles
- **Software systems and algorithms** that enable quantum information processing
- **Workforce**, including training a new generation of scientists, engineers


ADVANCING QUANTUM INFORMATION SCIENCE:
NATIONAL CHALLENGES AND OPPORTUNITIES

A JOINT REPORT OF THE
Committee on Science and
Committee on Homeland and National Security
OF THE NATIONAL SCIENCE AND TECHNOLOGY COUNC

Produced by the
Interagency Working Group on Quantum Information Science
of the Subcommittee on Physical Sciences

July 2016

Division of Physics: Investigator-Initiated Research Projects (PHY)

PROGRAM SOLICITATION
NSF 17-561

REPLACES DOCUMENT(S):
NSF 16-566

National Science Foundation
Directorate for Mathematical & Physical Sciences
Division of Physics

Emerging Frontiers In Research And Innovation 2017 (EFRI-2017)

1. ADVANCING COMMUNICATION QUANTUM INFORMATION RESEARCH IN ENGINEERING (ACQUIRE)

Quantum Leap: Leading the Quantum Revolution

- **Fundamentals** that advance our understanding of uniquely quantum phenomena and their interface with classical systems
- **Software systems and algorithms** that enable quantum information processing
- **Workforce**, including training a new generation of scientists, engineers

Challenge: building CS capacity for quantum research, and collaboration with MPS, ENG researchers

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American Innovation and Competitiveness Act (AICA): midscale

One Hundred Fourteenth Congress
of the
United States of America

AT THE SECOND SESSION

Begun and held at the City of Washington on Monday, the fourth day of January, two thousand and sixteen

An Act

To invest in innovation through research and development, and to improve the competitiveness of the United States.

"a gap between the established parameters of the Major Research Instrumentation and Major Research Equipment and Facilities Construction programs"

NSF 18-013

Dear Colleague Letter: Request for Information on Mid-scale Research Infrastructure

October 6, 2017

Overview

This Request for Information (RFI) is issued in response to the American Innovation and Competitiveness Act (AICA, Public Law No. 114-329), Section 109. NSF seeks information on existing and future needs for mid-scale research infrastructure projects from the US-based NSF science and engineering community.

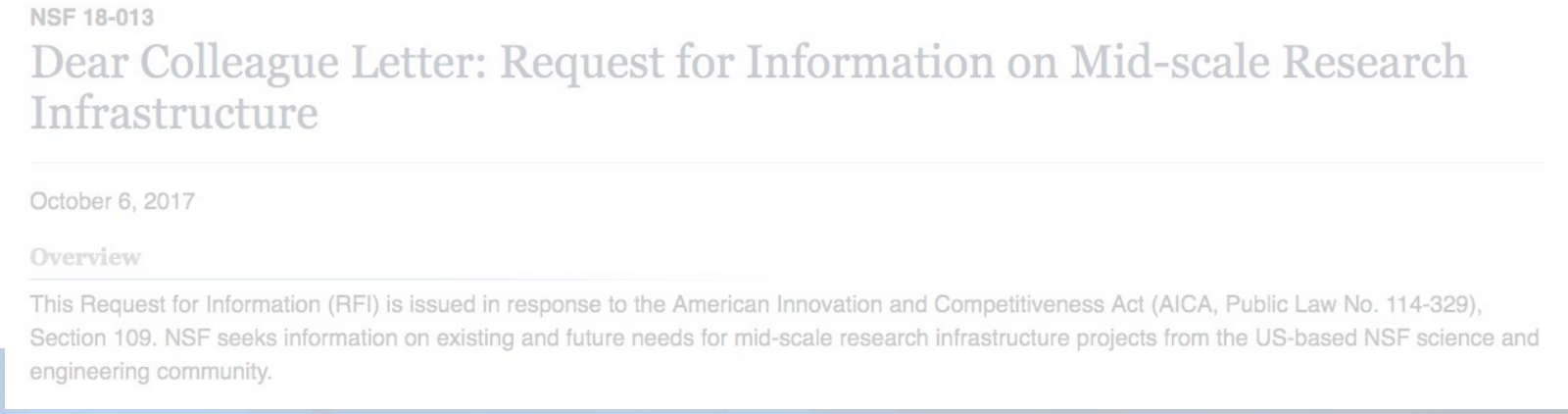
American Innovation and Competitiveness Act (AICA): midscale


One Hundred Fourteenth Congress
of the
United States of America

competitiveness of the United States.

"a gap between the established parameters of the Major Research Instrumentation and Major Research

Challenge: building CISE community capacity for midscale, MREFC CS infrastructure activities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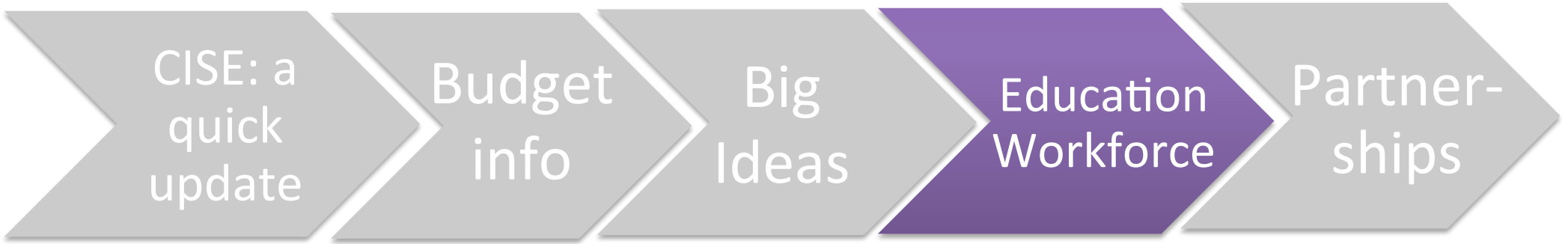
CISE: a quick update
Budget info
Big Ideas
Education Workforce
Partner-ships

CISE education, workforce: programmatics

Level	CISE Programmatics
K-12	CS For All
Undergrad	RED, CS+X
	REU, grants (2624)
	CRA-W: DREU, CREU
	Tapia, Grace Hopper
Grad	Research (6359)
	GRF (110)
	NSF Research Traineeships
	CRA Grad Cohort & Career Mentoring Workshops, CMD-IT URM Mentoring Workshop
New professors	CRII CRA Career Mentoring Workshops, CMD-IT URM Mentoring Workshop
	CAREER

CS education, workforce

Level	CISE Programmatics	STARS	CRA-W	NCWIT	ECS	IAAMCS	ECEP	ACCESSCOMPUTING	CAHSI
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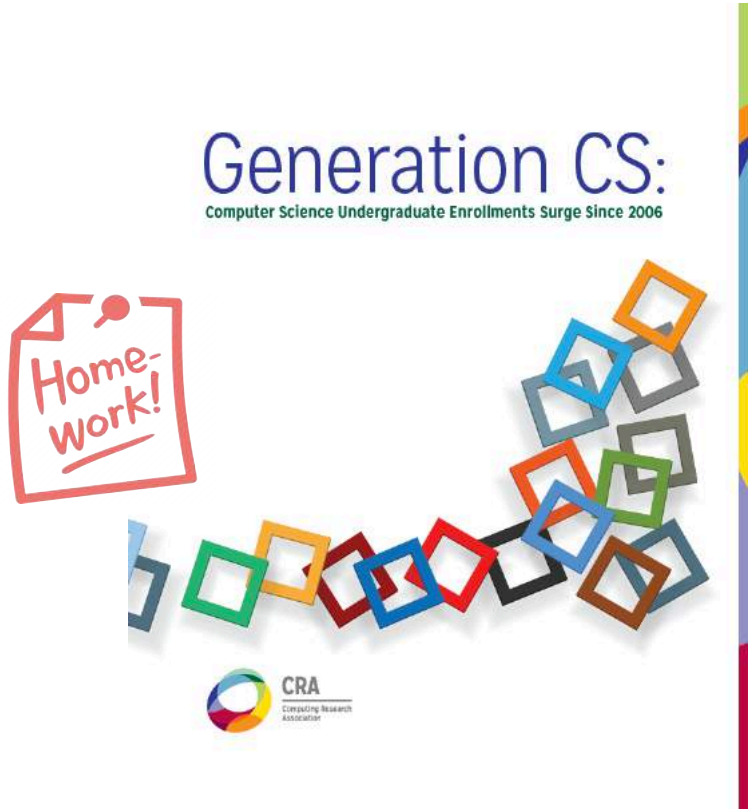
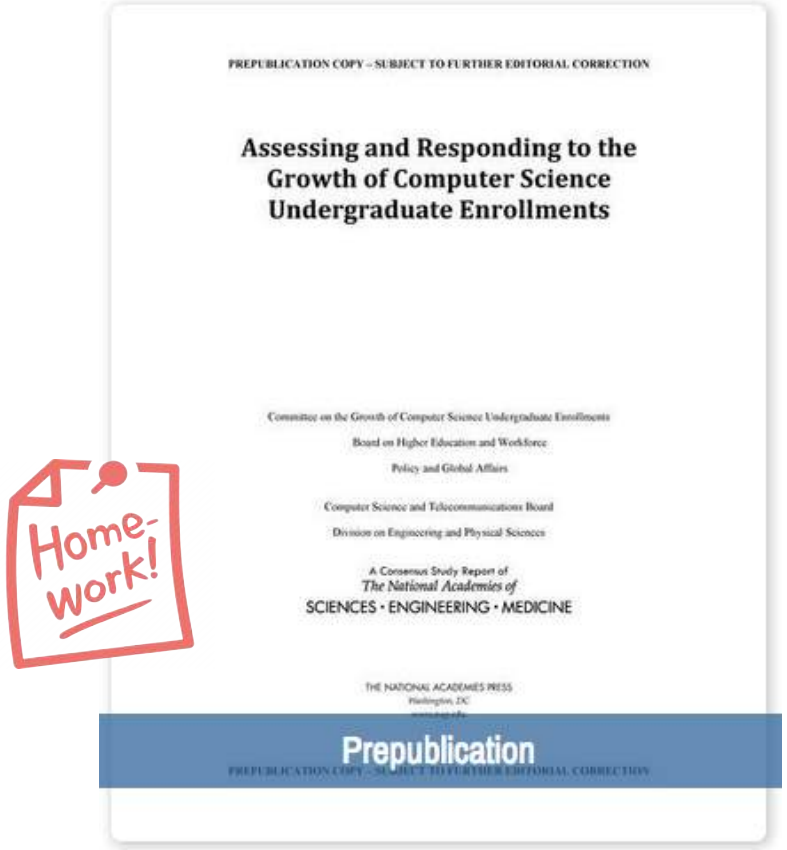
CS education, workforce: recent reports



Generation CS: Computer Science Undergraduate Enrollments Surge Since 2006, CRA, 2017



Assessing and Responding to the Growth of Computer Science Undergraduate Enrollments, National Academies Press, 2017

CS education, workforce: recent reports

RECOMMENDATION 4: The National Science Foundation (NSF) can be especially helpful in advancing undergraduate computer science education in the context of increasing enrollments, for both majors and non-majors. …

RECOMMENDATION 4.1: Use NSF's convening power to bring computer science faculty and institutional leaders together to identify best practices and innovation in computer science education in times of limited departmental resources. This should include assessment of the computer science skills and knowledge needed in non-computer science academic disciplines.

RECOMMENDATION 4.2: Support research on how best to use technology in teaching large classes. Such research should be multidisciplinary, spanning learning sciences, educational pedagogy for computer science, development and deployment of assessment instruments, and technology design.

CS education, workforce: recent reports

RECOMMENDATION 4: The National Science Foundation (NSF) can be especially helpful in advancing undergraduate computer science education in the context of increasing enrollments, for both majors and non-majors. …

Challenge: help community identify best practices and innovations in CS education, using technology in large classes, diversity in computing

resources. This should include assessment of the computer science skills and knowledge needed in non-computer science academic disciplines.

computer science, development and deployment of assessment instruments, and technology design.

CS education, workforce: recent reports

RECOMMENDATION 4: The National Science Foundation (NSF) can be especially helpful in advancing undergraduate computer science education in the context of increasing enrollments, for both majors and non-majors. …

RECOMMENDATION 4.3: Support research to advance the understanding of best practices for diversity in computing, including rigorous and longitudinal assessment of the efficacy of specific institutional practices, especially those taken or considered in times of high enrollments. This research should be multidisciplinary …

RECOMMENDATION 4.4: Create an initiative to expand instructional resources in computer science, informed by an understanding of the constraints and dynamics of the supply and demand for computer science Ph.D.s. This might include research support and doctoral fellowships for domestic computer science undergraduates, and support for incorporating teaching into computer science doctoral programs and junior faculty research.

CS education, workforce: recent reports

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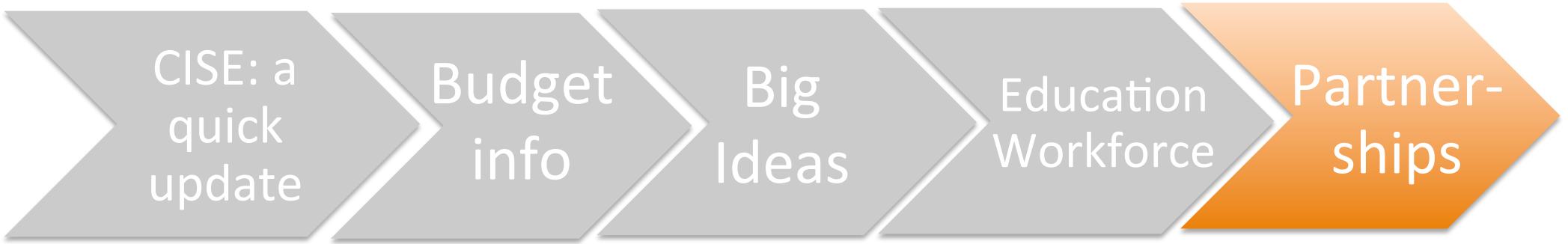
RECOMMENDATION 4.3: Support rigorous and longitudinal assessment of the efficacy of specific institutional practices, especially those taken or considered in times of high enrollments. This research should be multidisciplinary …

RECOMMENDATION 4.4: Create an initiative … demand for computer science Ph.D.s. This might include research support and doctoral fellowships for domestic computer science undergraduates, and support for incorporating teaching into computer science doctoral programs and junior faculty research.

Challenge: encourage/enable supply of high-quality faculty in computer science, related academic positions

Outline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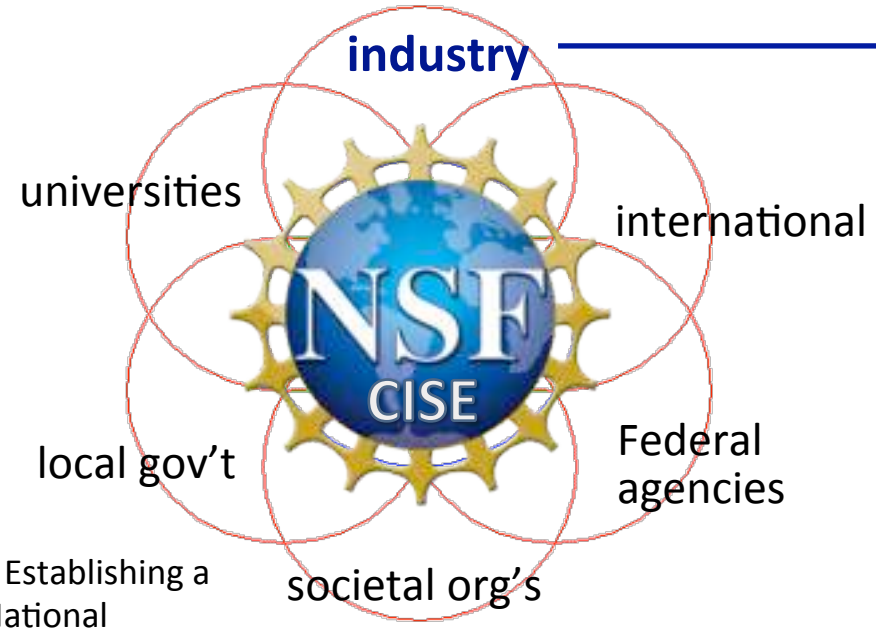
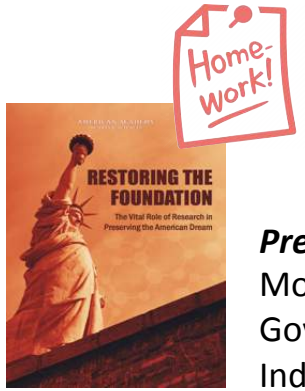
Partnerships: Many dimensions

*Partnerships **build capacity**, **leverage resources**, **increase the speed of translation** from discovery to innovation*



- **Joint NSF/industry research solicitations:** Intel (5), SRC (5), VMware (1)
- **Research infrastructure:** PAWR: Platforms for Advanced Wireless Research, cloud credits for BIGDATA (AWS, Google, Microsoft)
- **Individual project-based:** I/UCRC, InTrans, GOALI



Prescription 3: Establishing a More Robust National Government-University-Industry Research Partnership

Cyberinfrastructure, Cloud

Final Report

The Future of Cloud for Academic Research Computing

Results of an NSF-Supported Workshop, Entitled "*Cloud Forward*"
Supported by NSF ACI/CSE Award 1632037

"The emerging conversation is not about whether academic research computing will take place in the cloud as has been the case with many previous reports and meetings, but rather how best to support it."

THE CHRONICLE OF HIGHER EDUCATION

Supercomputers, a Status Symbol in Academe, Compete With the Cloud

Sean Cunningham

NSF 18-014

Dear Colleague Letter: Encouraging Participation of Cloud Computing Providers in Computer and Information Science and Engineering Research

October 11, 2017

Dear Colleagues:

Partnerships: Many dimensions

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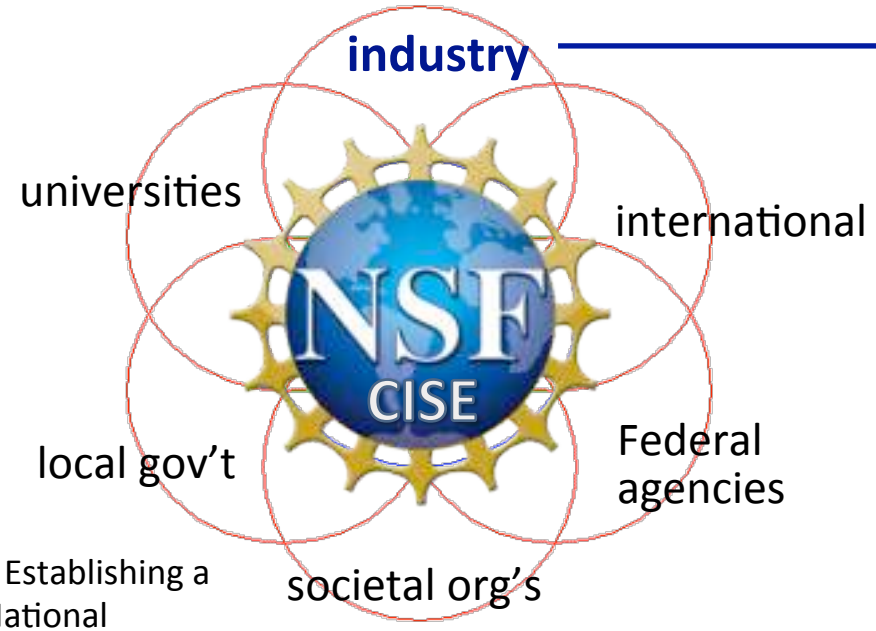

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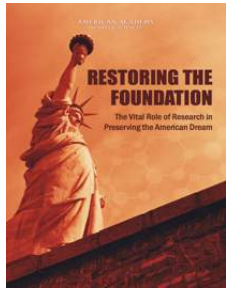

Prescription 3: Establishing a More Robust National Government-University-Industry Research Partnership

Partnerships: Many dimensions

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Challenge: building partnerships at scale (collaboration among competing companies)

Prescription 3: Establishing a More Robust National Government-University-Industry Research Partnership

An *amazing* time to be in CISE!

Ubiquity

Computing is *everywhere* – across all of science and engineering, and all of society

Engagement

Computing intertwines with many *communities*

Urgency

Computing is *rapidly expanding and evolving*. There is tremendous opportunity … *now!*

Challenges: what actions can CCC take ?

1. Flat budget (at best) and expanding CS opportunities and professoriate
   - Telling “our story” to those who will listen and can act.
2. enabling long-term research collaboration between CS and SBE researchers
3. building CS capacity for quantum research, and collaboration with MPS, ENG researchers

Challenges: what actions can CCC take ?

4. building CISE community capacity for midscale, MREFC CS infrastructure activities
5. Education/workforce:
   - take a bow for what we have accomplished
   - help community identify best practices and innovations in CS education, using technology in large classes, diversity in computing
   - encourage/enable supply of high-quality faculty in computer science, related academic positions
6. building partnerships at scale (collaboration among companies)