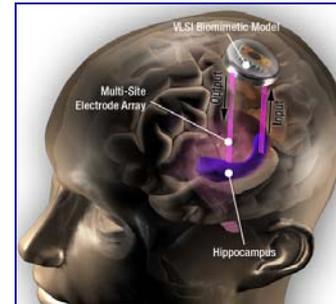
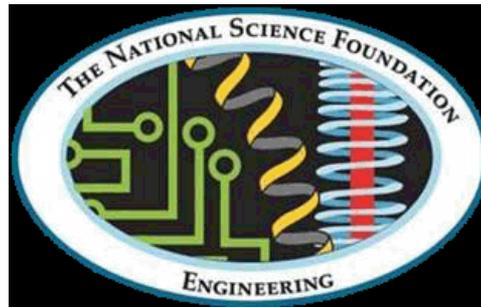




# Engineering at NSF



**Grace Wang**

*National Science Foundation*

*Directorate for Engineering*

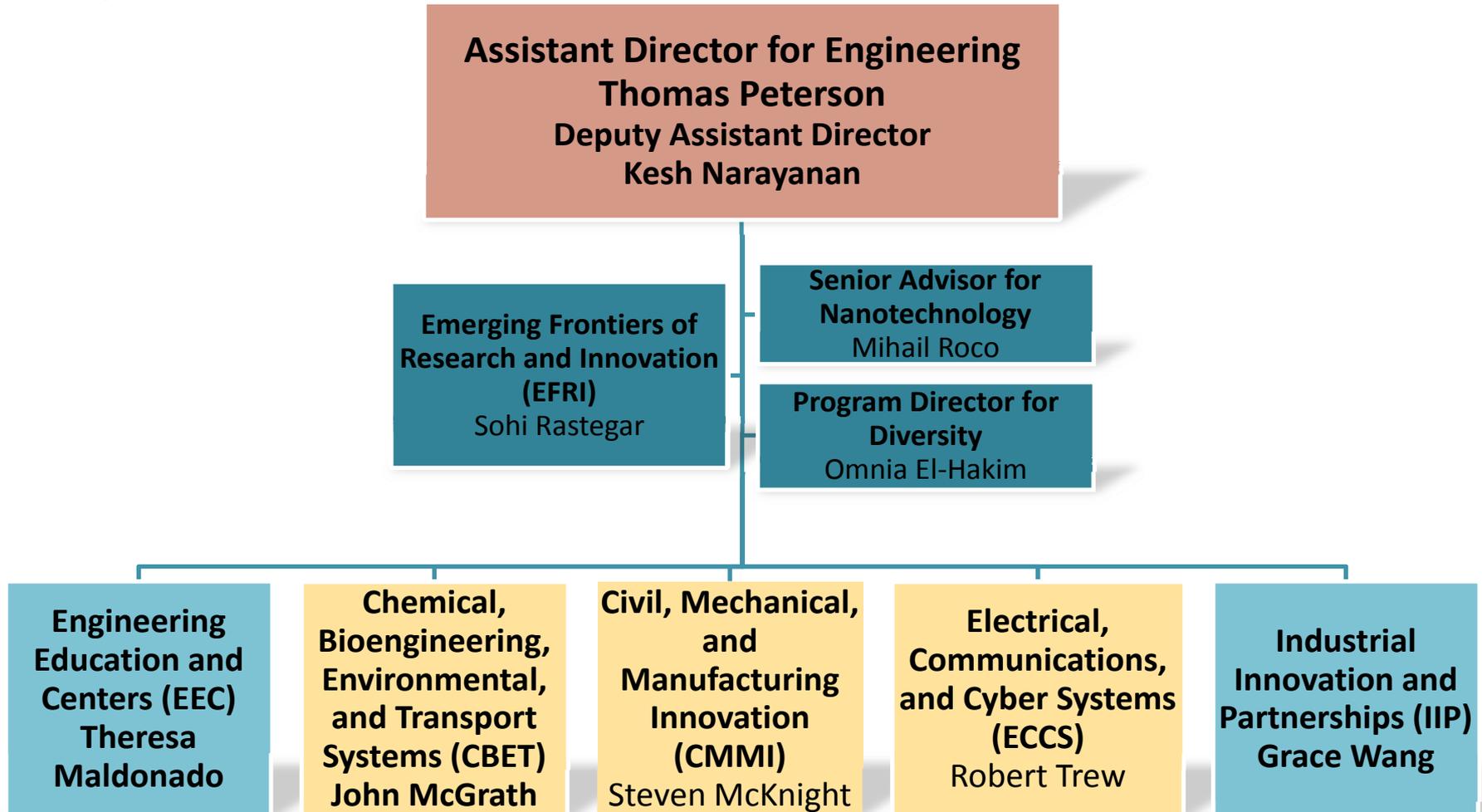


# ENG Mission

To enable the engineering and scientific communities to advance the frontiers of **engineering research, innovation, and education**, in partnership with the engineering community, and in service to society and the nation



# ENG Organization





# Outline

- **Research**
  - Core programs
  - Exploratory research
- Engineering **Education** and Centers
- **Innovation** programs
- Broadening participation
- Crosscutting and NSF-wide programs



# Chemical, Bioengineering, Environmental, and Transport Systems (CBET)

**Deputy Division Director**  
Bob Wellek

**Division Director**  
John McGrath

## Chemical, Biochemical, and Biotechnology Systems

**Catalysis and Biocatalysis**  
George Antos

**Chemical and Biological Separations**  
Rose Wesson

**Process and Reaction Engineering**  
Maria Burka

**Biotechnology, Biochemical, and Biomass Engineering**  
Theresa Good

## Biomedical Engineering and Engineering Healthcare

**General & Age-Related Disabilities Engineering**  
Ted Conway

**Biomedical Engineering**  
Semahat Demir

**Biophotonics**  
Leon Esterowitz

**Biosensing**  
Aleksandr Simonian

## Environmental Engineering and Sustainability

**Energy for Sustainability**  
Ram Gupta

**Environmental Engineering**  
Debra Reinhart

**Environmental Health and Safety of Nanotechnology**  
Barbara Karn

**Environmental Sustainability**  
Bruce Hamilton

## Transport and Thermal Fluids Phenomena

**Combustion, Fire, and Plasma Systems**  
Arvind Atreya

**Fluid Dynamics**  
Henning Winter

**Interfacial Processes and Thermodynamics**  
Bob Wellek

**Particulate and Multiphase Processes**  
Ashok Sangani

**Thermal Transport Processes**  
Sumanta Acharya

Directorate for Engineering



# CBET Areas of Interest

- **Chemical, biochemical, and biotechnology:** processing and manufacture of products by effectively utilizing chemical and renewable resources,
- **Biomedical engineering and engineering healthcare:** to integrate engineering and life science to solve biomedical problems
- **Environmental engineering and sustainability:** to reduce adverse effects of solid, liquid, and gaseous discharges into land, water, and air that result from human activity and impair the ecological value of those resources
- **Transport and thermal fluids phenomena:** thermal, mass, and momentum transport that enable new technological solutions to understand pressing issues in energy, environment, manufacturing, health care, and other fields

**ONE submission deadline per year: Sept. or Feb. , depending on the program**



# NSF/DOE Partnership in Basic Plasma Science and Engineering

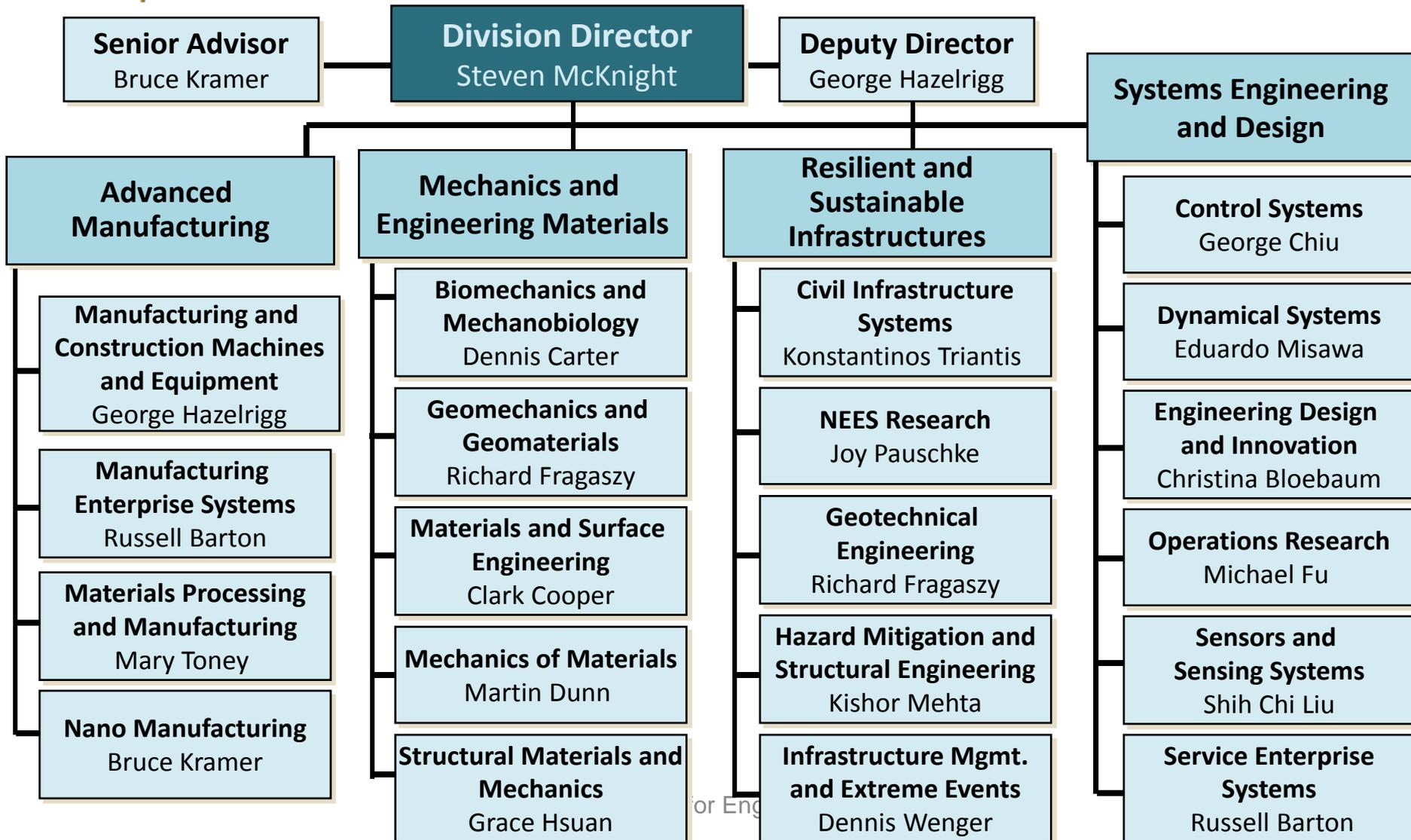
- Focuses on fundamental issues of plasma science and engineering that may impact other areas or disciplines in which improved basic understanding of the plasma state is needed
- Proposals directly related to fusion energy studies are not eligible
- ~\$15 M investment for 30–35 awards

**Full proposals due in early October through 2012**

ENG Contact  
Arvind Atreya



# Civil, Mechanical, and Manufacturing Innovation (CMMI)





# CMMI Areas of Interest

- **Advanced manufacturing:** transformative advances in manufacturing and building technologies, with emphases on efficiency, economy, and sustainability
- **Mechanics and engineering materials:** advances in the transformation and use of engineering materials efficiently, economically, and sustainably
- **Resilient and sustainable infrastructures:** to advance fundamental knowledge and innovation for resilient and sustainable civil infrastructure and distributed infrastructure networks
- **Systems engineering and design:** decision-making aspects of engineering, including design, control, and optimization

**Two submission deadlines each year: Oct. 1 and Feb. 15**



# Electrical, Communications and Cyber Systems (ECCS)

Division Director: Robert Trew

Senior Engineering Advisor: Lawrence Goldberg

## Electronics, Photonics, and Magnetic Devices (EPMD)

### Samir El-Ghazaly

- Microwave/mm-Wave/THz Devices & Circuits
- Novel & Next Generation Devices
- Vacuum Devices & Electronics Antennas
- Electromagnetic Propagation & Scattering
- Microwave Metamaterials-Based Devices
- Device /Circuit Simulation & Modeling

### Anupama Kaul

- Flexible & Printed Electronics
- Light Emitting Devices & Displays
- Molecular /Organic Electronics & Photonics
- Energy-Efficient Green Electronics
- Next Generation Memories, Memristors, & other Novel Devices

### Usha Varshney

- Bioelectronics & Biomagnetics Devices
- Science & Engineering Beyond Moore's Law
- Quantum Devices
- Magnetism, Multiferroics, & Spintronics
- Sensor Devices & Technologies

### John Zavada & Dominique Dagenais

- Optoelectronics & Photonics
- Nanophotonics
- Plasmonics & Optical Metamaterials-Based Devices
- Large-Scale Photonic Integration
- Ultrafast Photonics

## Communications, Circuits, and Sensing-Systems (CCSS)

### Zhi (Gerry) Tian

- Cyber-Physical Systems (CPS)
- Embedded Systems
- Wireless Communications Algorithms & Networking
- Integrated Sensing, Communications, & Computational Systems
- Signal Processing & Coding
- Cyber Security

### Vacant

- Sensors, Actuators, & Electronic Interfaces
- Chemical, Biological, & Physical Diagnostic Systems
- Implantable & Wearable Systems
- Environmental Sensing & Monitoring
- MEMS/NEMS Devices
- System-Level Fabrication, Packaging, & Assembly

### George Haddad

- RF/Wireless, Optical, & Hybrid Communications
- Broadband & Low Power Communications
- RF/Microwave & mm-Wave Components/Circuits
- Inter- and Intra-Chip Communications & Networking
- Submm-Wave/THz Imaging & Sensing
- Mixed Signal Circuits & Systems
- Enabling Technologies for Intelligent Communications Systems
- Interconnects & Packaging Techniques

## Energy, Power, and Adaptive Systems (EPAS)

### Kishan Baheti

- Control Theory & Hybrid Dynamical Systems
- Distributed & Mobile Networked Control
- Systems Theory in Molecular, Cellular, & Synthetic Biology/Medicine
- Estimation in Sensing & Imaging Systems
- Sensor Networks for Energy-Efficient Buildings
- Transportation Networks
- Human-Robot Interaction
- Stochastic Modeling & Applications

### George Maracas

- Energy Collection, Photovoltaics, & Thermal Devices
- Novel Energy Conversion Devices
- Renewable Energy Devices & Systems
- Power Conversion, Generators, Motors & Network Interfacing
- Energy & Power Sensing Technologies
- Energy Storage Technologies
- High Voltage, High Power Switching & Conversion Devices

### Paul Werbos

- Adaptive & Intelligent Systems
- Transmission & Distributed Systems
- Intelligent Power Grid
- Quantum Systems & Modeling
- Neural Networks
- High Performance & Multiscale Modeling
- Cognitive Optimization & Predication
- Intelligent Vehicles & Robots



# Exploratory and Urgent Research

- Early-Concept Grants for Exploratory Research (EAGER)
- Grants for Rapid Response Research (RAPID)
- Emerging Frontiers in Research and Innovation (EFRI)



# Early-Concept Grants for Exploratory Research (EAGER)

- Supports high-risk, exploratory, and potentially transformative research
- Up to \$300K over two years
- May be submitted any time; contact program officer prior to proposal submission
- Internally reviewed
- These awards are not meant to replace or supplement start up funds for new investigators.



# Grants for Rapid Response Research (RAPID)

- Supports research of great urgency with regard to data, facilities, or equipment, such as research on disasters
- RAPID proposals were sought to respond to Gulf oil spill/ Japan tsunami
- Up to \$200K over one year
- May be submitted any time; contact program officer prior to proposal submission



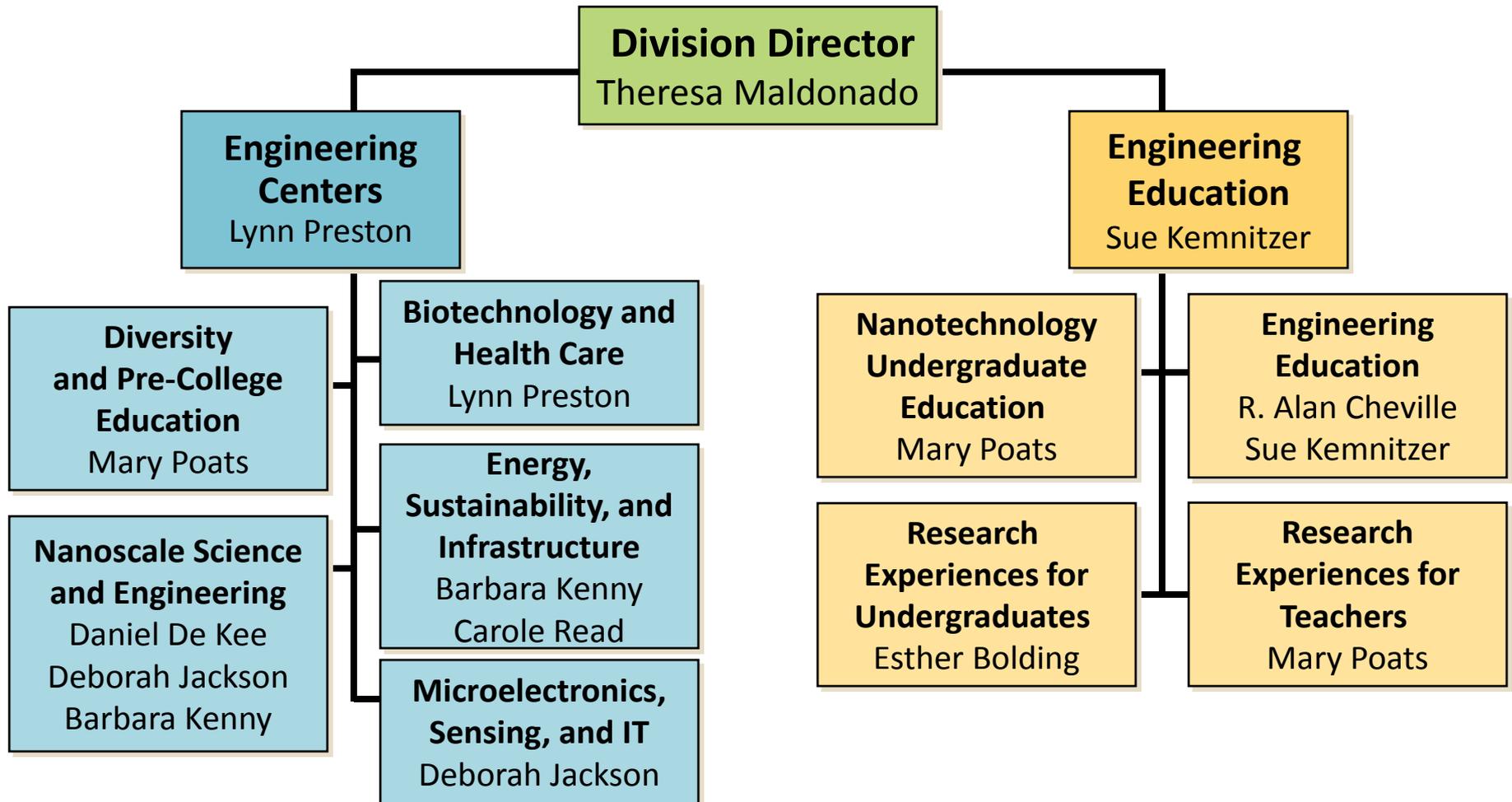
# Emerging Frontiers in Research and Innovation (EFRI)

- Supports higher-risk, higher-payoff opportunities that:
  - Are potentially transformative
  - Address a national need or grand challenge
- Topic areas for FY 2012 are:
  - Flexible Bioelectronics Systems (BioFlex)
  - Origami Design for the Integration of Self-assembling Systems for Engineering Innovation (ODISSEI)
  - Photosynthesis Biorefineries (PSBR)
- \$31M investment for 4-year awards at ~\$500K per year
- Invited full proposals due March 30, 2012

**EFRI**  
Sohi Rastegar



# Engineering Education and Centers (EEC)





# Engineering Research Centers

- Supports collaboration with industry to promote innovative research and education
- Engineering Research Centers
  - 17 in operation, including 4 new in 2011
    - Funding for 10 years
  - 2-year process from solicitation to funding
  - Competition underway for up to 3 Nanosystems ERCs to be established in FY 2012
- Nanoscale Science & Engineering Centers
  - First centers will graduate in 2011
  - 2007 solicitation established two Centers for the Environmental Implications of Nanotechnology

**ENG Contact**  
Lynn Preston



# Engineering Education Research

- Seeks to enable a system of engineering education, equally open to all members of society, that dynamically and rapidly adapts to meet changing needs. Research areas include:
  - Increasing our understanding of how engineering students learn and the capacity that supports such discovery
  - Understanding how to increase the diffusion and impact of engineering education research
  - Understanding engineering education in broader frameworks such as sustainability
  - Diversifying pathways to and through engineering degree programs

**ENG Contact**  
Sue Kemnitzer



# Research Initiation Grants in Engineering Education

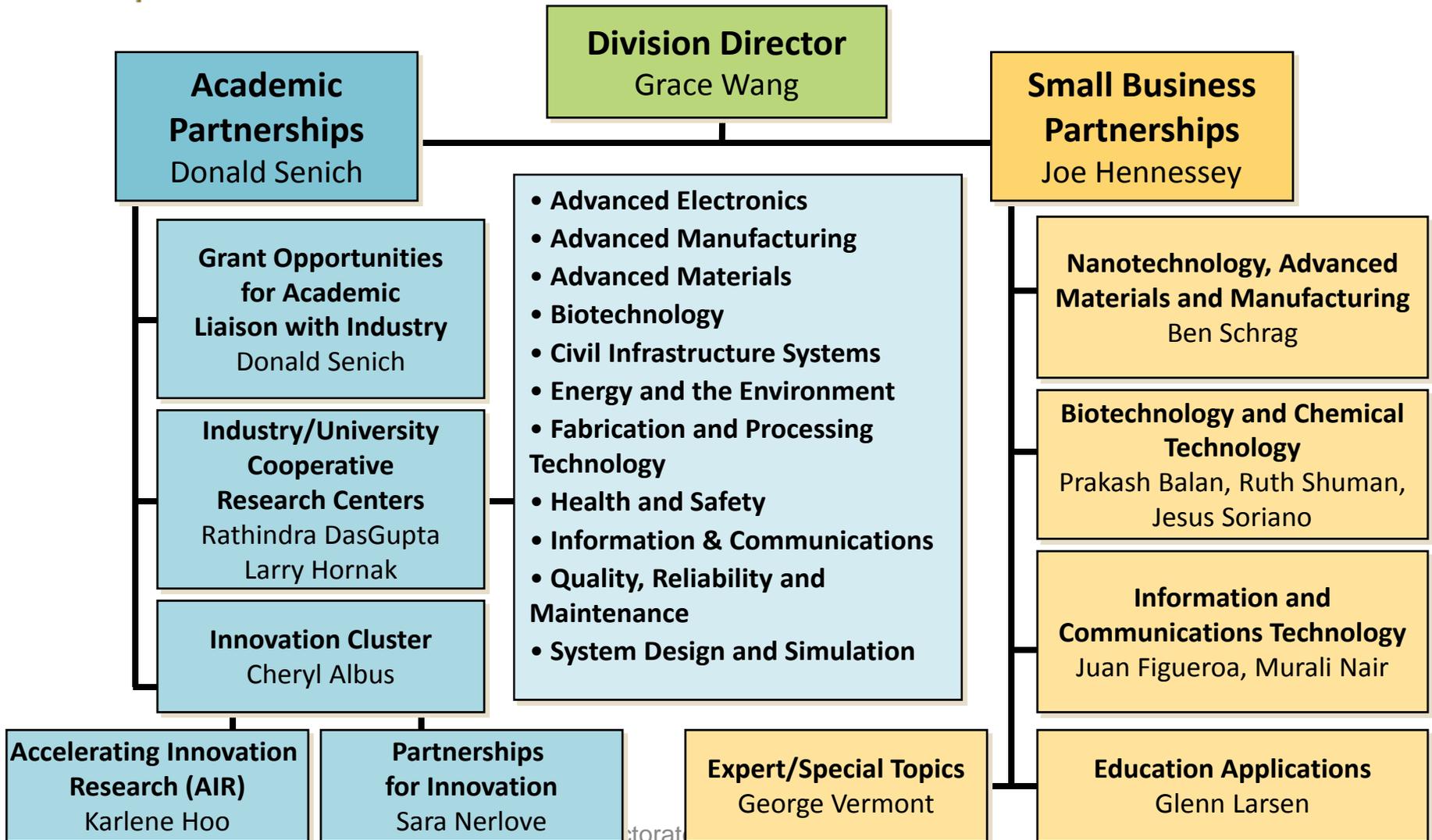
- Enables engineering faculty who are renowned for teaching, mentoring, or leading educational reform efforts to initiate collaborations with colleagues in the learning and cognitive sciences to address difficult, boundary-spanning problems in engineering education
- ~\$3M for 20 awards

**Proposals due March 29, 2012**

**ENG Contact**  
Alan Cheville



# Industrial Innovation and Partnerships (IIP)





# Grant Opportunities for Academic Liaison with Industry (GOALI)

- Effectively promotes the transfer of knowledge between academe and industry, student education, and the exchange of culture
- Supports:
  - Faculty and students in industry ( $\leq 1$  year)
  - Industry engineers/scientists in academe ( $\leq 1$  year)
  - Industry-university collaborative projects ( $\leq 3$  years)
- \$5M available for co-funding with all NSF Directorates
- Proposals accepted anytime or windows for the unsolicited proposals; ~70 awards each year

**ENG Contact**  
Don Senich



# Industry/University Cooperative Research Center (I/UCRC) Program

- Promotes long-term partnerships among industry, academe, and government
- Centers are catalyzed by a small investment from NSF and are primarily supported by industry center members during their development and evolution
- ~\$10M for 2-8 full center awards (\$55-80K/year for up to 5 years) and 4-12 planning grant awards (\$10K for 1 year)
- Two windows per year:  
Letters of Intent due in Jan. and June;  
Full proposals due in March and Sept.

**ENG Contact**  
Rathindra (Babu)  
DasGupta



## Partnerships for Innovation (PFI) **Building Innovation Capacity (BIC)**

- To stimulate the transformation and translation of knowledge into market-accepted innovations and commercial reality
- Academic lead with **a minimum of 2 small businesses participation**
- Up to \$600K per award for 2 years

**ENG Contact**  
Sally Nerlove



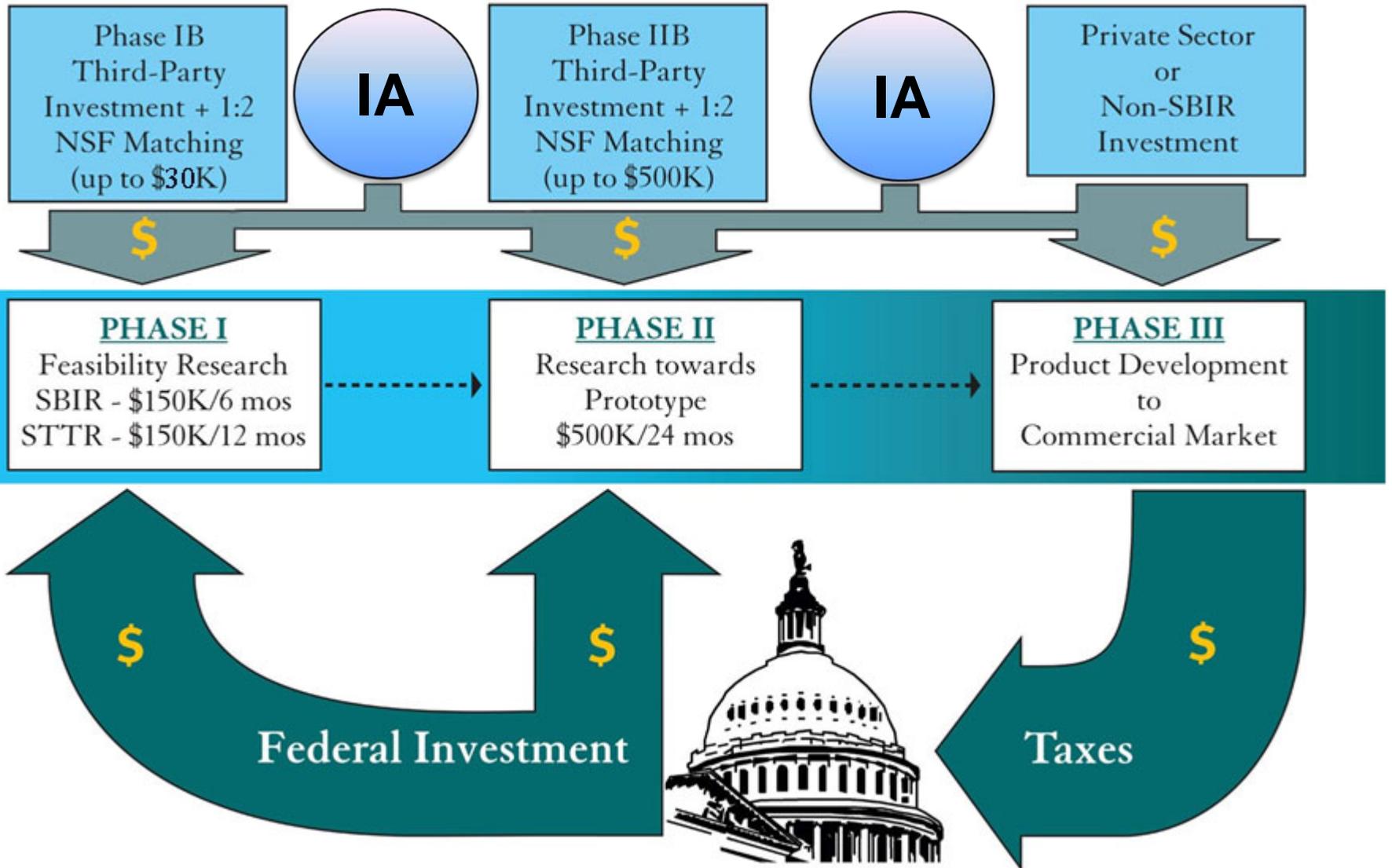
## Partnerships for Innovation (PFI)

# Accelerating Innovation Research (AIR)

- To foster connections between **NSF-funded research alliances** and other partners to spur development of discoveries into innovative technologies, thus commercialization
- Up to \$800K per award for up to 2 years
- Requires 1:1 third-party investment (**third-party investment needs to include a minimum of 75% cash**)

**ENG Contact**  
Karlene Hoo

# NSF SBIR/STTR Innovation Model



IA = Innovation Accelerator



# Faculty Early Career Development (CAREER) Program

- Supports junior faculty who exemplify the role of teacher-scholars through
  - outstanding research
  - excellent education
  - integration of education and research
- Encourages women, members of under-represented minority groups, and persons with disabilities to apply
- ENG awards are ~\$400K for 5 years

**ENG proposals due July 24, 2012**

**ENG Contact**  
Rose Wesson



# Broadening Participation Research Initiation Grants in Engineering (BRIGE)

- Funding opportunity intended to increase the diversity of researchers through research program support early in their careers
- Encourages support of under-represented groups, engineers at minority serving institutions, and persons with disabilities
- ~\$5M investment for 25–30 awards
- Up to \$175,000 over two years

**ENG Contact**  
Omnia El-Hakim



# Crosscutting and NSF-wide Opportunities

- **Cyber-Physical Systems (CPS)**
- Innovation Corps (I-Corps)
- **Major Research Instrumentation (MRI)**
- **National Robotics Initiative (NRI)**
- Partnerships for International Research and Education (PIRE)
- Research Coordination Networks
- Science, Engineering and Education for Sustainability (SEES) Fellows
- Software Infrastructure for Sustained Innovation (SI2) / Scientific Software Innovation Institutes (S2I2)
- Sustainability Research Networks
- Sustainable Energy Pathways



# Cyber-Physical Systems (CPS)

- Refers to the tight conjoining of and coordination between computational and physical resources
- Seeks proposals that address a CPA research theme:
  - **Foundations** research to develop new principles, algorithms, models, and theories
  - **Methods and Tools** research to bridge gaps between approaches to the cyber and physical elements of systems through innovations
  - **Components, Run-time Substrates, and Systems** research motivated by grand challenge applications
- ~\$30M investment for 30–40 grants for small, medium, and large projects
- Full proposals due March 10, 2011

**ENG Contact**  
Kishan Baheti



# Major Research Instrumentation (MRI) Program

- Goals of the program are to:
  - Support the acquisition or development of major state-of-the-art instrumentation
  - Improve access to and increase use of modern research and research training instrumentation
  - Enable the creation of well-equipped learning environments that integrate research with education
  - Foster the development of the next generation of instrumentation
  - Promote partnerships
- ~\$90M investment for approximately 175 awards
- Proposals due Jan. 26, 2012

**ENG Contact**  
Lawrence Goldberg



# National Robotics Initiative (NRI)

- Aims to accelerate the development and use of robots in the U.S. that work beside, or cooperatively with, people.
- Topics include knowledge representation; architectures and control mechanisms; human-robot interaction, cooperation and adaptation; multi-networked agents; mobility and manipulation; and human-connected cognitive prosthetics; and others.
- ~\$40M investment for approximately 60 awards
- Small projects: letters of intent due Oct. 1, 2011, and proposals due Nov. 3, 2011
- Large projects: letters of intent due Dec. 15, 2011, and proposals due Jan. 18, 2012

**ENG Contacts**  
Bruce Kramer  
Paul Werbos