

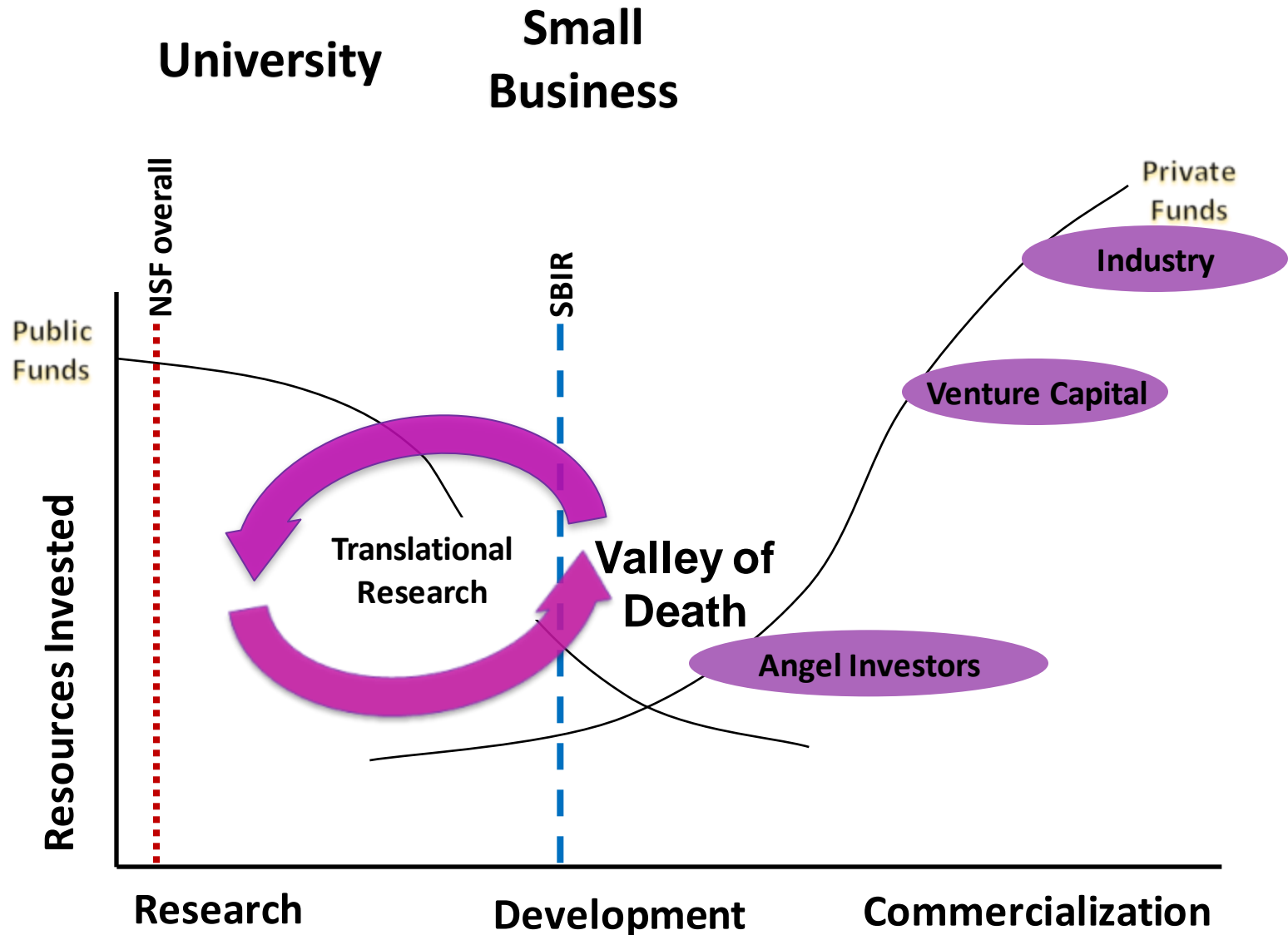
Innovation Programs at NSF

Larry Hornak
Program Director, ENG/IIP
National Science Foundation
Arlington, VA USA

Jornada Nacional de Innovacion y Competitividad
Puebla, Puebla
11 October 2012



NSF Innovation Investments

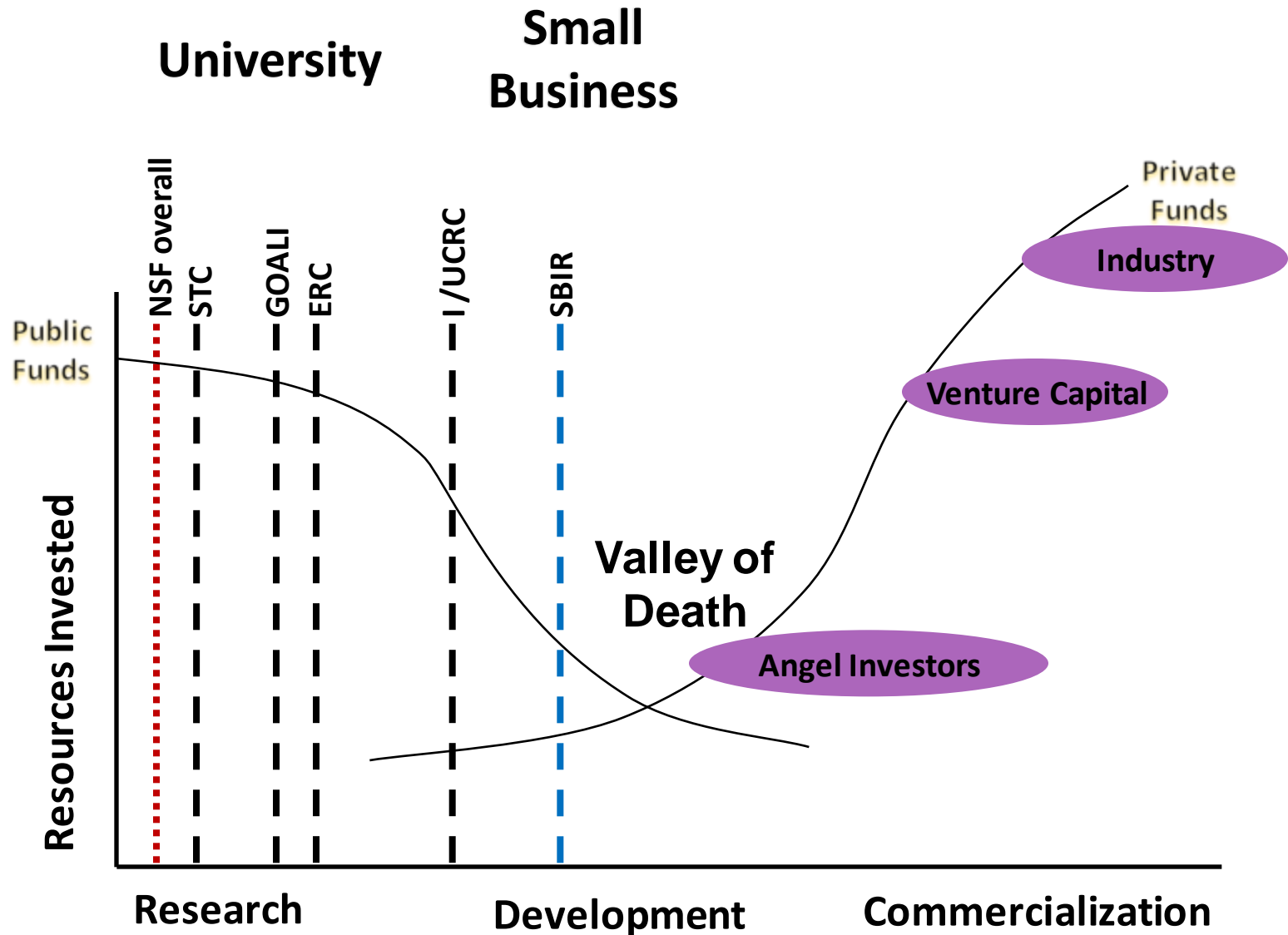


NSF Programs for Translational Research

- Science and Technology Centers (STC)
- *Grant Opportunities for Academic Liaison with Industry (GOALI)*
- *Engineering Research Centers (ERC)*
- *Industry/University Cooperative Research Centers (I/UCRC)*
- Partnerships for Innovation (PFI)
- Small Business Technology Transfer (STTR)
- Small Business Innovation Research (SBIR)
- Emerging Frontiers of Research and Innovation (EFRI)
- Other ENG programs
- *New Program: Innovation – Corps (I-Corps)*



NSF Innovation Investments

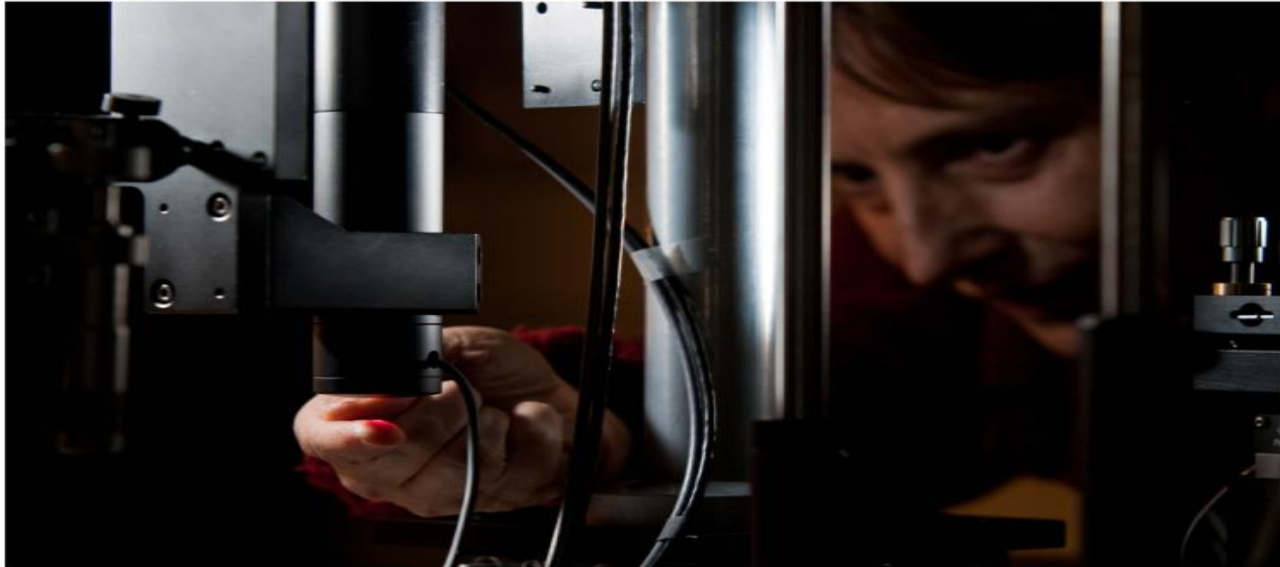


Disclaimer

- NSF doesn't claim SOLE responsibility for these successes, but
- NSF played a clear and definable role in the intellectual evolution of all these innovations.



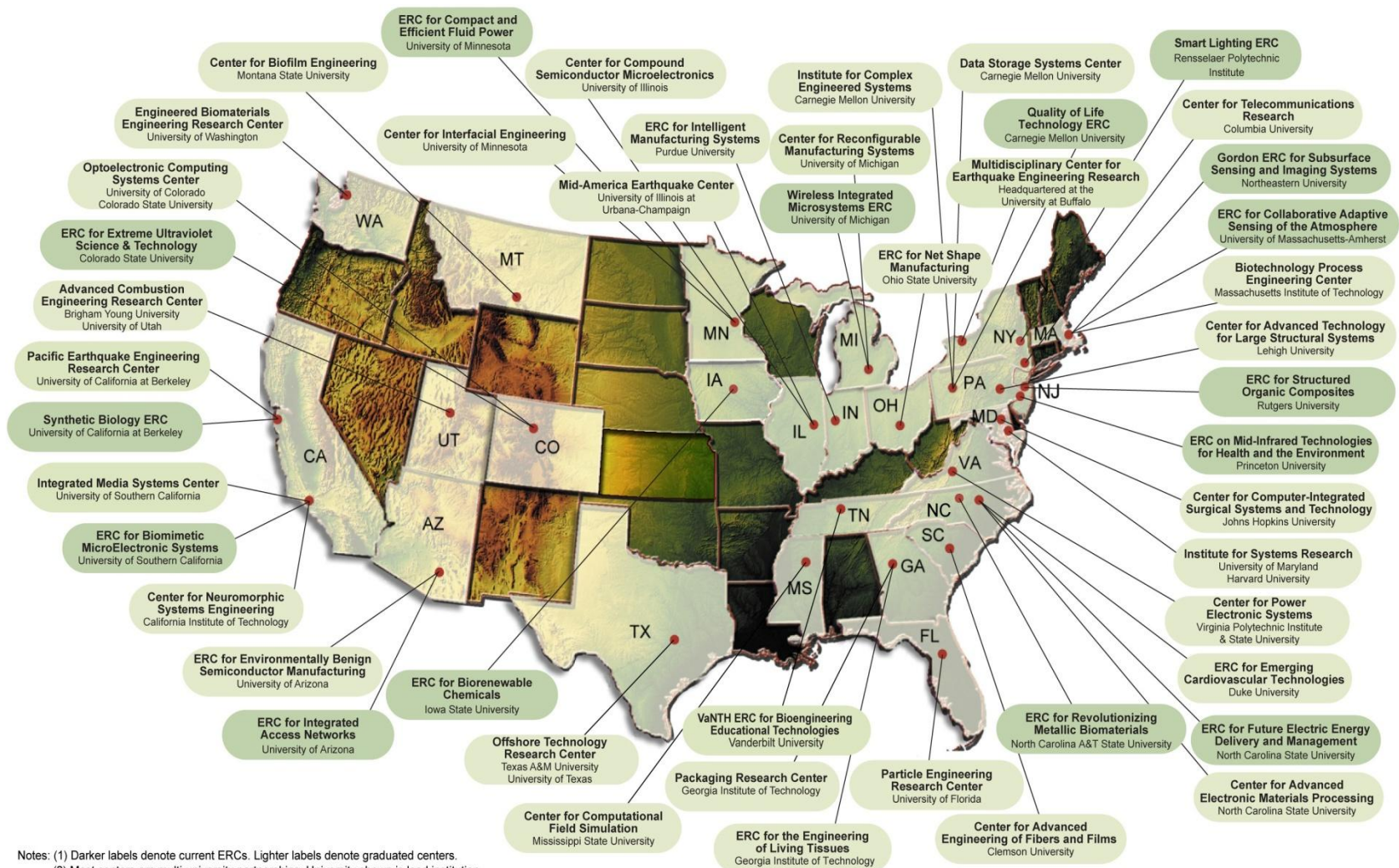
Grant Opportunity for Academic Liaison with Industry (GOALI): Freeform Optics



- Prototype device developed by University of Rochester can take high-resolution images under the skin's surface without removing the skin.
- Researchers say that in the future it may eliminate the need for many biopsies to detect skin cancer.
- In planning for a I/U Coop Res. Center

Engineering Research Centers 1985-2009

NSF Engineering Research Centers

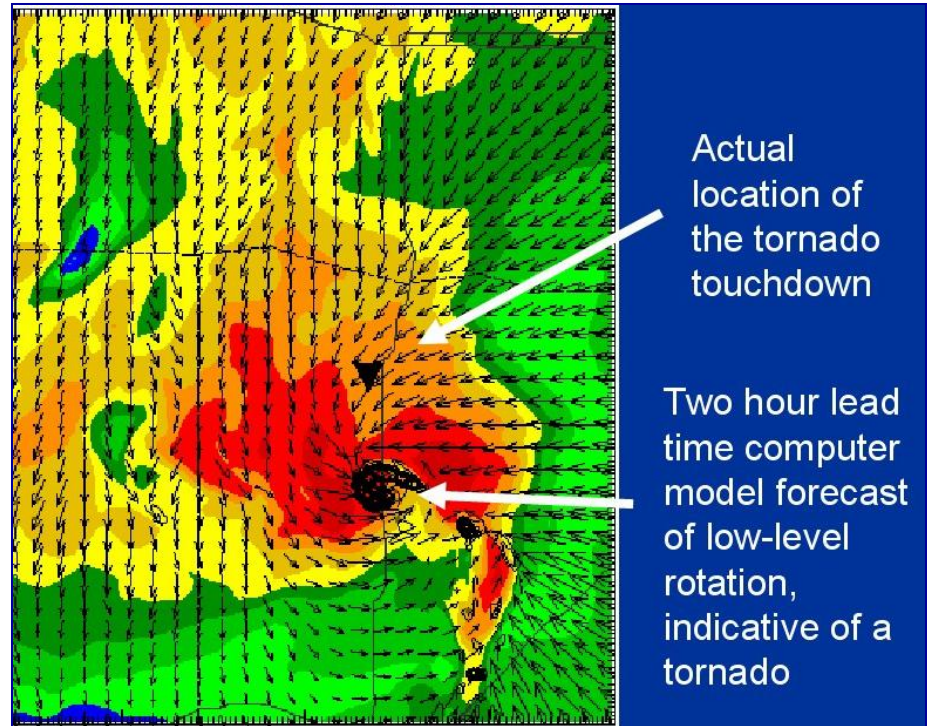


Notes: (1) Darker labels denote current ERCs. Lighter labels denote graduated centers.
 (2) Most centers are multi-university partnerships. University shown is lead institution.



ERC: Radar Network Detects Low-Altitude Weather Phenomena

- ERC for Collaborative Adaptive Sensing of the Atmosphere, Univ. of Massachusetts, Amherst
- Improves on Doppler radar and NEXRAD



The Industry/University Cooperative Research Centers (I/UCRC) Program

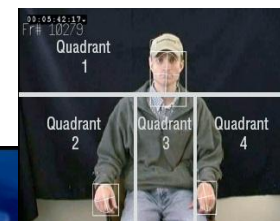
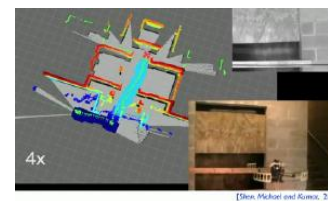
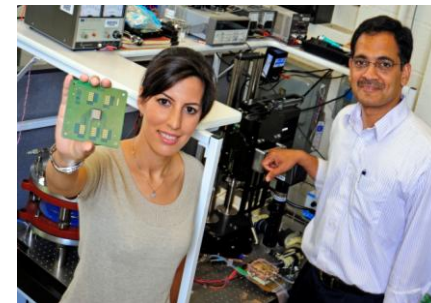
Mission:

- To contribute to the nation's research infrastructure base by **developing long-term partnerships among industry, academe and government**
- To leverage NSF funds with industry to **support graduate students performing industrially relevant research**

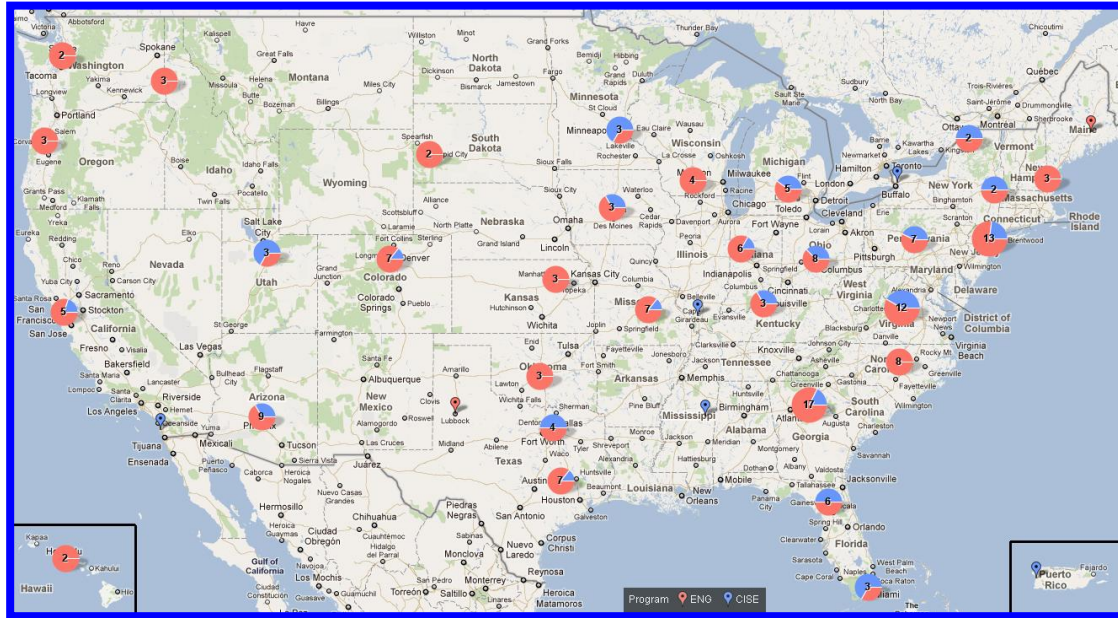
Vision:

- To **expand the innovation capacity of our nation's competitive workforce** through partnerships between industries and universities

Foster and grow long-term trusted relationships between Industry and academe based on shared value



I/UCRC Fast Facts – FY11 Snapshot



ENG – Engineering
CISE – Computer and Info. Sci and Eng.

Program Funding

- \$15M in Program Funding
- \$118M in Total Center Funding,
- **Nearly 8:1 Leveraging of NSF funds.**

Centers Nationally:

- **61 Centers with 178 Sites**
- **Over 760 Members** representing over 500 distinct organizations holding over 1000 Memberships

- 55% Large Business, 23% SB, 15% Federal Members

Students

- **600 graduated in 2010, over 30% hired by members**
- 225 PhDs, 249 MS & 128 UGs graduated in 2010, trained in Center research

Sustainability

- 44 Graduated I/UCRCs remain in operation in 2010 true to model



Industry-Spawning Applications from NSF-Funded University Technologies

Berkeley Sensor & Actuator Center BSAC (UC Berkeley & UC Davis)

100+ Industry Members spanning 25 years of Innovation Research

5 Current 20+ year members

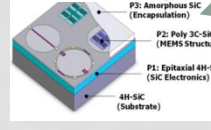
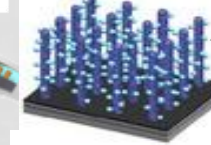
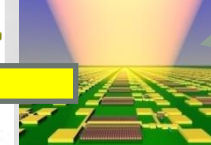
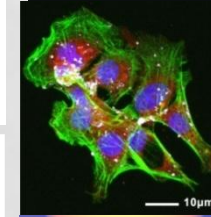
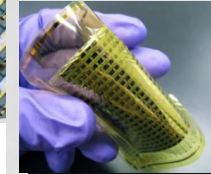
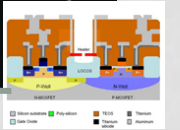
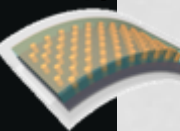
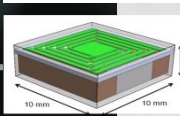
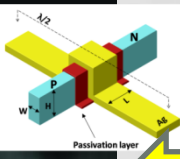
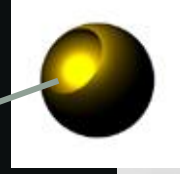
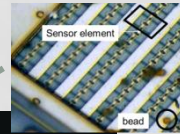
30 Start-up Companies

Multi-\$Billion Impact

Applications

- *Healthcare*
- *Plasmonics*
- *Integrated Optics*
- *Wireless Communications*
- *Energy Harvest/Monitor*
- *Conformal Electronics*
- *Processes & Packaging*

APPLICATIONS



Technologies

- *Nanotechnology*
- *BioFluidics*
- *Optophotonics*
- *Wireless*
- *MicroEnergy*
- *Sensing & Actuation*
- *Materials/Process*

TECHNOLOGIES

Center for Excellence in Logistics and Distribution (CELDi)

Project Goal: Maintain or improve in-stock performance at clubs while reducing club inventory



With the use of a custom-built simulation model of the Sam's Club supplier replenishment process, the University of Arkansas team was able to determine improved supplier reordering points to improve logistics.

Project Outcomes:

- *System wide deployment*
- *Significant inventory reduction*
- *Improved in-stock performance*
- *Estimated as a \$60M annual impact*
- *Students: 1 M.S.*



Savings Made Simple



**Collaboration between Sam's Club and CELDi
(at the University of Arkansas)**

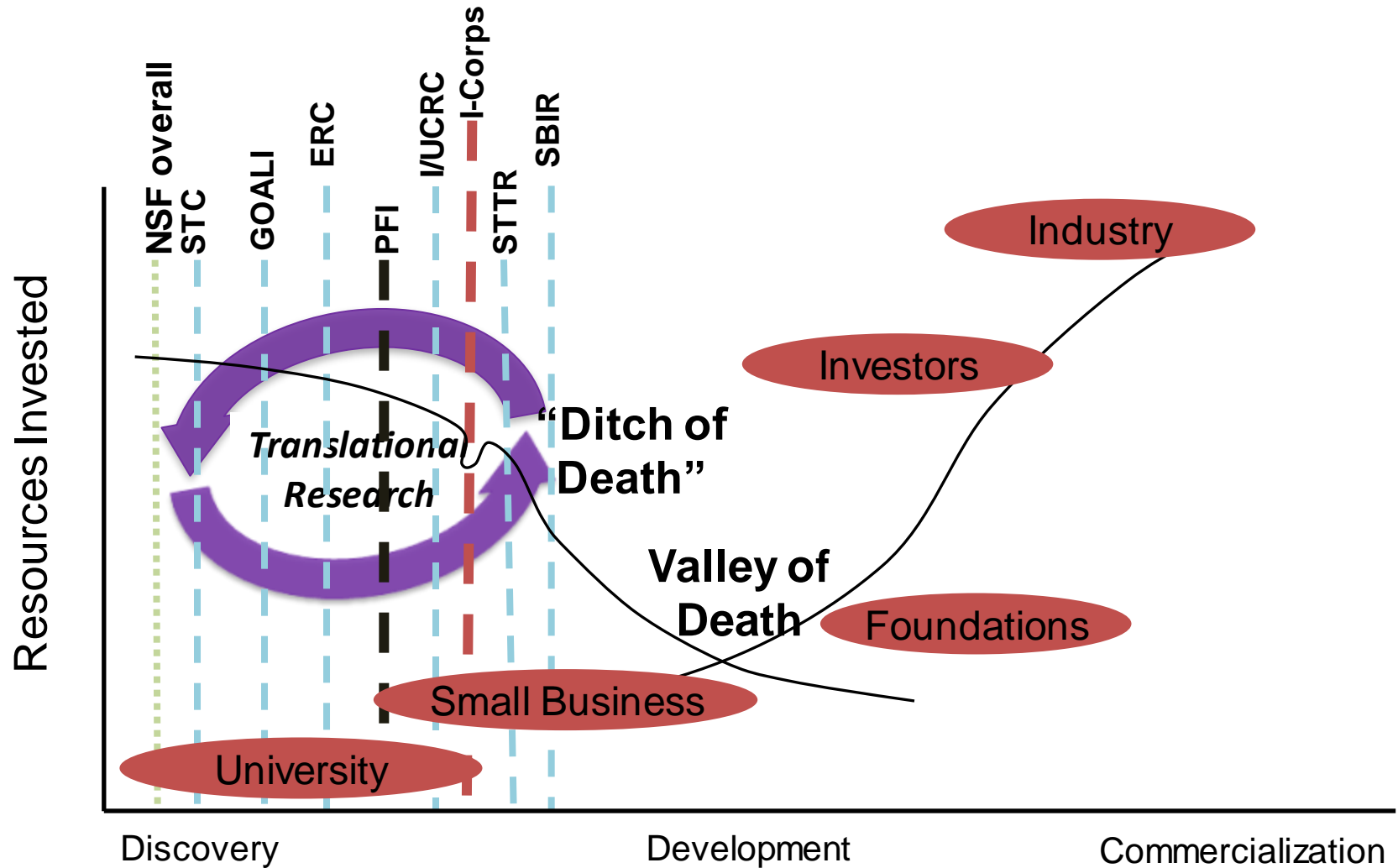


New Programs: Filling Gaps in the Innovation Ecosystem

- Spur Translation of Fundamental Research
- Encourage Collaboration between Academia and Industry
- Educate to Innovate



NSF Innovation Investments



I-Corps Approach

- Leveraging NSF-lineage of previous support
- Small grants to create a commercialization roadmap
 - Addresses the “Ditch of Death”
- Experiential, immersive learning and feedback
- Challenges teams to create their own business model canvas
- Values revision and continual improvement of business development elements
- Expects teams to be inquisitive, motivated and capable of self management



I-Corps: Replication of Laser-Generated Surface Textures



- Genesis:
 - University of Virginia
- Technology:
 - Create water repellant surface to eliminate ice build-up...by surface micro-texture
 - Low cost bondable film on a variety of surfaces
- I-Corps Impact & Lessons Learned:
 - “Learned a new language – Entrepreneurship “
 - “How to accept criticism, not all constructive “
 - “Partnering will help get us through the initial stage from the lab to manufactured solution “





Spur Translation of Fundamental Research

**Encourage Collaboration between Academia and
Industry**

Educate to Innovate

Thank You



National Science Foundation I/UCRC Contacts

Rathindra (Babu) DasGupta, I/UCRC Program Director – rdasgupt@nsf.gov

Larry Hornak, I/UCRC Program Director – lhornak@nsf.gov

Rita Rodriguez, CISE Program Director – rrodrigu@nsf.gov

Alex Schwarzkopf, Expert – aschwarz@nsf.gov

Mary Konjevoda, Program Assistant, mkonjevo@nsf.gov

for more information: <http://www.nsf.gov>
and: <http://www.nsf.gov/eng/iip/iucrc>

Program phone: (703) 292-8383

Note: The best way to contact us is via e-mail. Many are on the road frequently



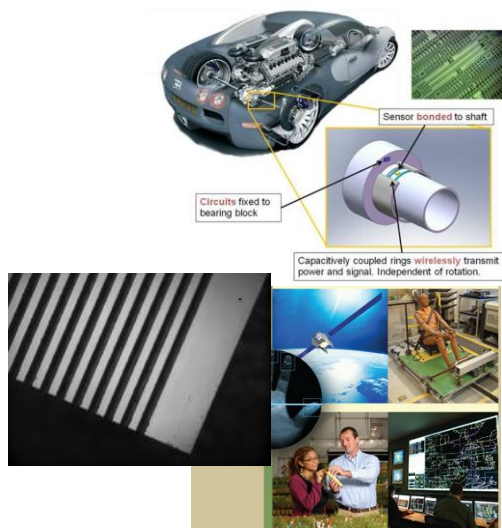
Supplementary Material



Industry/University Cooperative Research Centers

Advanced Electronics, Photonics Fabrication and Processing

Berkeley Sensor & Actuator Center – UC-Berkeley, UC-Davis
Center for Advanced Vehicle and Extreme Environment Electronics – Auburn
Center for Design of Analog Digital Integrated Circuits – WSU, OSU
Center for Electromagnetic Compatibility – MUST, Clemson, Oklahoma, Houston,
Center for Optical Wireless Apps – PSU, Georgia Tech
Cooling Technologies Research Center - Purdue



Advanced Manufacturing

Center for Friction Stir Processing – BYU, MUST, South Carolina, SDSMT, Wichita State
Center for Tire Research – Virginia Tech, U Akron
Center for Particulate and Surfactant Systems – UF, Columbia
Laser and Plasma for Advanced Manufacturing – UVa, Michigan, SMU, Illinois
Membrane Science, Engineering and Technology Center – NJIT, Colorado
Intelligent Maintenance Systems – Cincinnati, Michigan, MUST
Smart Vehicles Concepts – Ohio State, Texas A&M

Biotechnology, Health & Safety

Center for Agricultural, Biomedical, and Pharmaceutical Nanotechnology – Illinois
Center for Biophotonic Sensors and Systems – Boston University, UC-Davis
Center for Pharmaceutical Development – Georgia Tech, UK
Bio Energy Research and Development – SDSMT, Hawaii-Manoa, NCSU, Stony Brook
Center for Health Organization Transformation – Texas A&M, Northeastern, PSU, Georgia Tech
Child Injury Prevention Studies – UPenn, Ohio State



Industry/University Cooperative Research Centers

Advanced Materials

Advanced Processing and Packaging Studies
– Ohio State, UC Davis, NCSU
Center for Advanced Non-Ferrous Structural Alloys – CSM, North Texas
Center for Energy Harvesting Materials and Systems – Virginia Tech, UT-Dallas
Center for Integrative Materials Joining Science for Energy Applications – Ohio State, Lehigh, Wisconsin - Madison , CSM
Center for Metamaterials – CUNY, Western Carolina, UNCC, Clarkson
Computational Materials Design – PSU, Georgia Tech.
Center for Nondestructive Evaluation – Iowa State
Ceramics, Composites and Optical Materials Center – Clemson, Rutgers
Wood-Based Composites Center – Virginia Tech, Oregon State

Civil Infrastructure Systems

Center for Electric Vehicles - Transportation and Electricity Convergence – UT-Austin, Texas A&M
Center for the Integration of Composites into Infrastructure - WVU, Rutgers, NCSU, Miami
Grid-Connected Advanced Power Electronics - Arkansas-Fayetteville, South Carolina
Sustainable Integrated Buildings and Sites – UNCC, CMU

Energy & Environment

Center for Advanced Forestry Systems – NCSU, Georgia , Idaho , Maine , Washington, Virginia Tech , OSU, Purdue, Florida
Center for Fuel Cells (CFC) – South Carolina, Connecticut
Center for Resource Recovery and Recycling – WPI, CSM, Katholieke Universiteit Leuven
Energy-Efficient Electronic Systems Center – Binghamton, UT-Arlington, Villanova
Next Generation Photovoltaics – UT-Austin, Colorado State
Power Systems Engineering Research Center – Arizona State, UC-Berkeley , CMU, CSU, Cornell, Georgia Tech, Howard, Illinois, Iowa State, Texas A&M, Washington State, Wichita State, Wisconsin
Silicon Solar Consortium – NCSU, Georgia Tech
Water and Environmental Technology – Temple, Arizona, Arizona State
Water Equipment & Policy – Wisconsin-Milwaukee , Marquette



Industry/University Cooperative Research Centers

System Design & Simulation

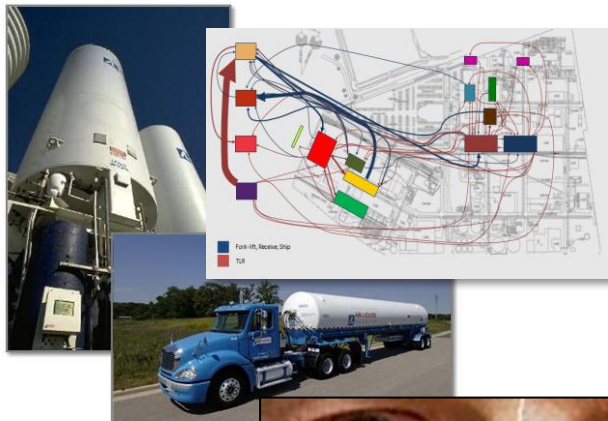
Advanced Space Technologies Research & Engineering Center – Florida , NC A&T State

Center for e-Design – Virginia Tech, Iowa State, Massachusetts-Amherst , Central Florida, CMU, SUNY Buffalo, BYU, Puerto Rico-Mayaguez , Wayne State

Center for Excellence in Logistics and Distribution – Arkansas , Oklahoma, Oklahoma State, Clemson, Missouri , Virginia Tech, Arizona State, UC-Berkeley

Center for Unmanned Aircraft Vehicles – BYU, CSU

Telecommunications (Connection One) – Arizona State, Ohio State, Hawaii, Rensselaer, Arizona



Information, Communication & Computing

Advanced Knowledge Enablement – Florida Intl, Florida Atlantic, Dubna Intl

Autonomic and Cloud Computing – Florida , Mississippi State, Arizona, Rutgers

Center for Identification Technology Research – Clarkson, Arizona, WVU

Center for Research in Intelligent Storage – Minnesota, UC-Santa Cruz,

Center for Surveillance Research – Ohio State, Wright State

Center for Data Analytics – Rutgers, SUNY Stony Brook

Embedded Systems – Arizona State, Southern Illinois-Carbondale

Experimental Research in Computer Systems – Georgia Tech, Ohio State

Hybrid Multicore Productivity Research - UMBC, UC-San Diego, Georgia Tech

Net-Centrics System and Software – North Texas , UT-Dallas , Southern Methodist, Arizona State, MUST

Center for High-Performance Reconfigurable Computing – Florida , BYU, GW, Virginia Tech

Center for Visual Decision Informatics – UL-Lafayette, Drexel

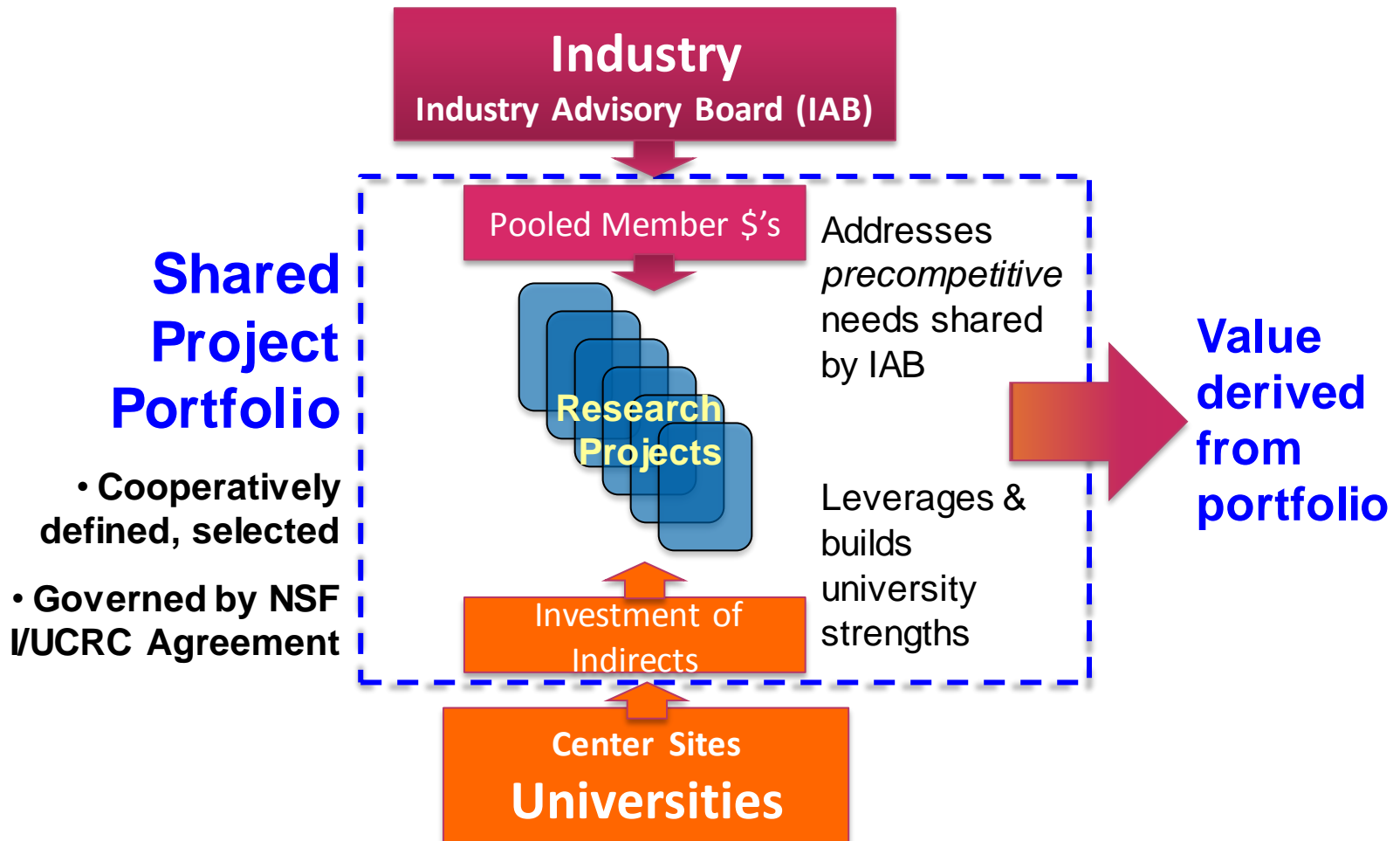
Safety, Security, Rescue Research – Minnesota, Denver, UPenn

Visual and Decision Informatics – Louisiana-Lafayette, Drexel,

Wireless Internet Center for Advanced Technology Polytechnic Inst of NYU, UVa, Virginia Tech, Auburn, UT-Austin



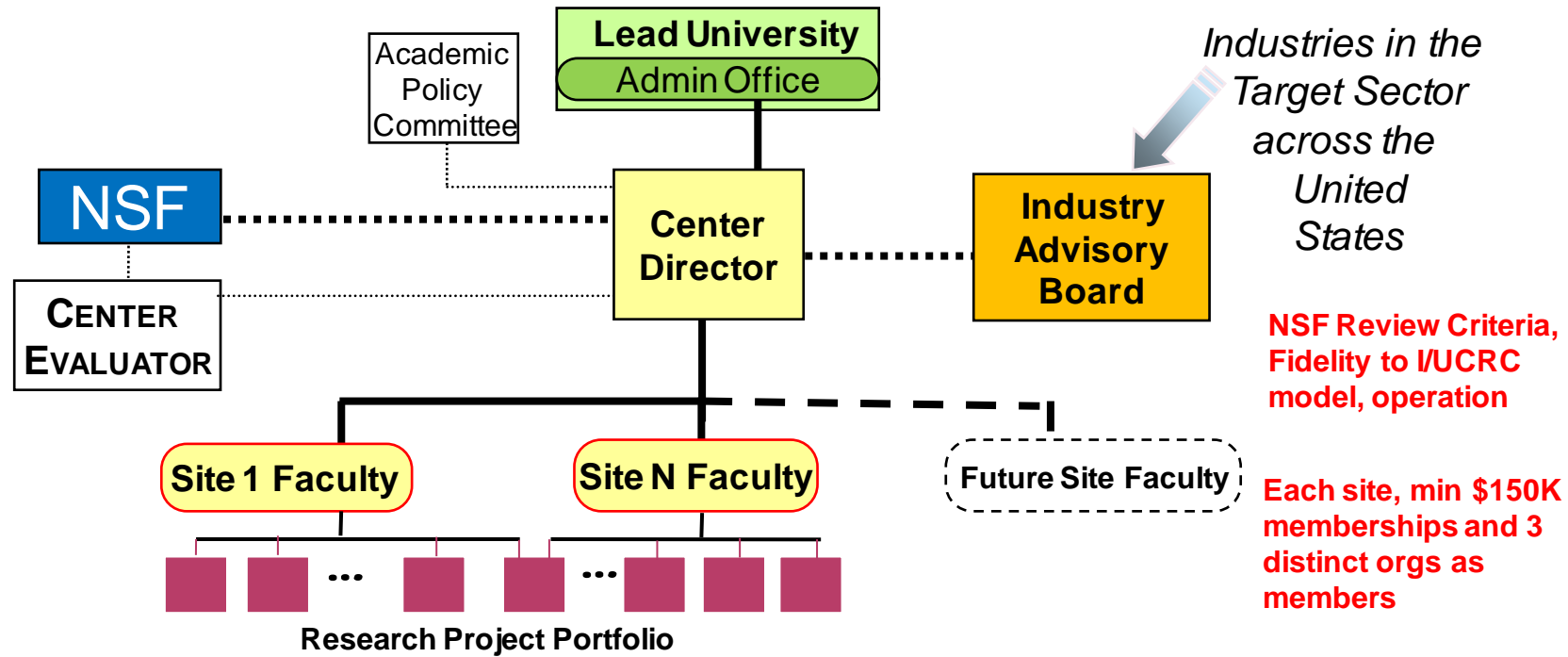
I/UCRC Nucleus: A Cooperatively Defined, Funded & Shared Research Portfolio



Requires trust be built in the model, and between all partners in the center.



Typical* I/UCRC Organization & Profile



Average Center Profile

- 3 University Sites
- \$40K Membership Fee
- \$220K in I/UCRC Program funding
- \$673K in Member Fees
- \$1.1M Total Funding (Median), \$2.1M Total (Avg)

Typical Personnel Profile

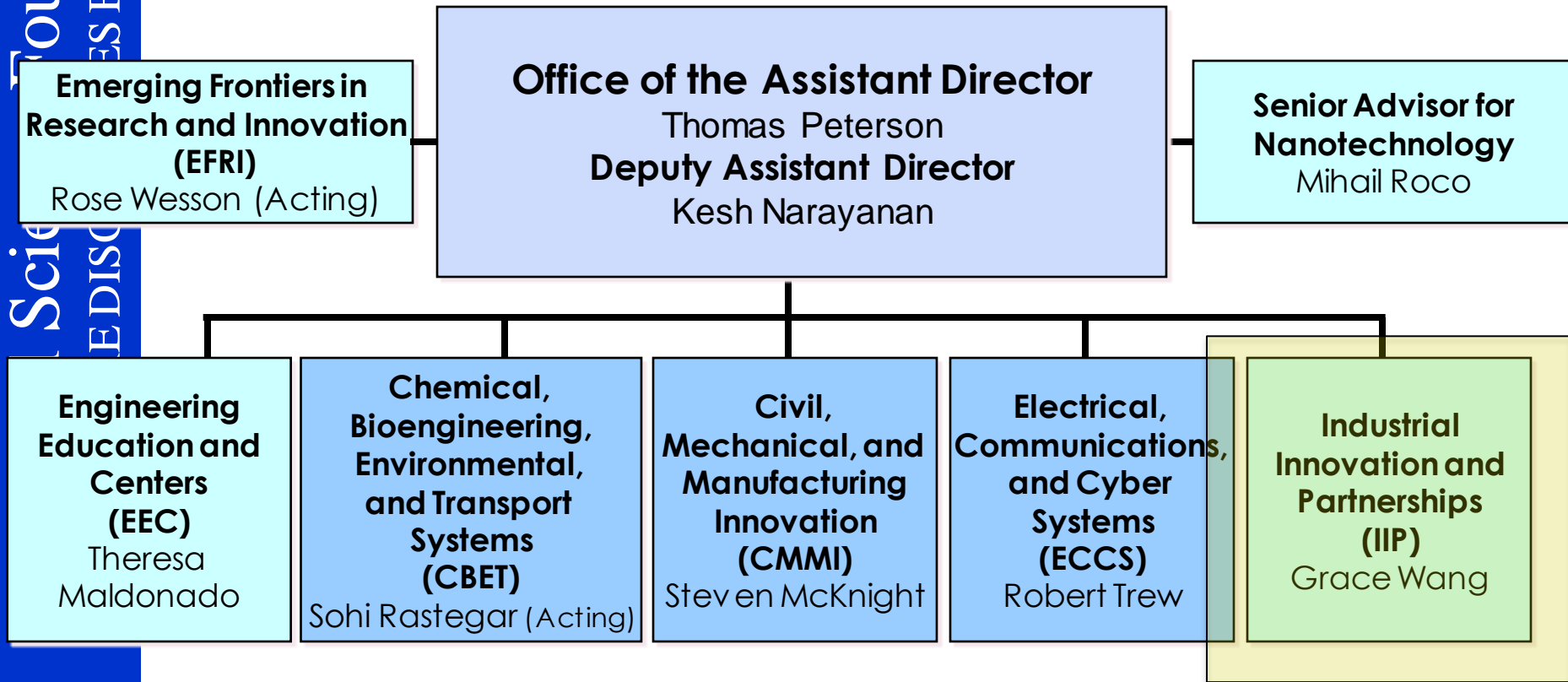
- 16 Participating Faculty, PDs
- 18 PhD, 10 MS, 3 Undergrad Students
- 2 Administrative Personnel

Average Publication Profile

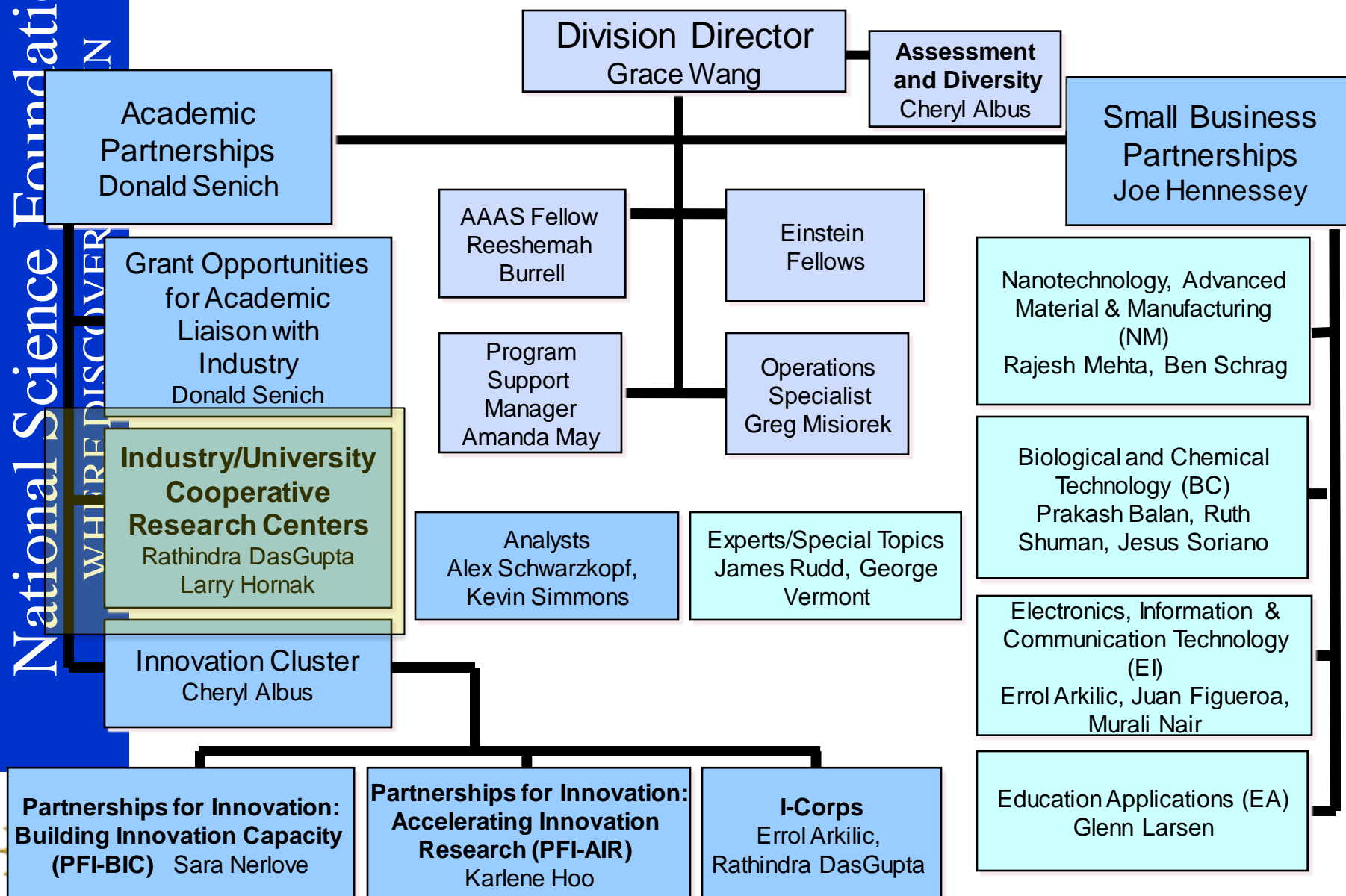
- 21 Publications annually, 3 of which are with Center Members
- 30 Presentations annually

* Based on 2010-11 Structural Data Averages

ENG Organization



Industrial Innovation and Partnerships



I/UCRCs: The NSF's Role

Facilitate a Center environment in which long-term relationships between industry and academia can thrive.

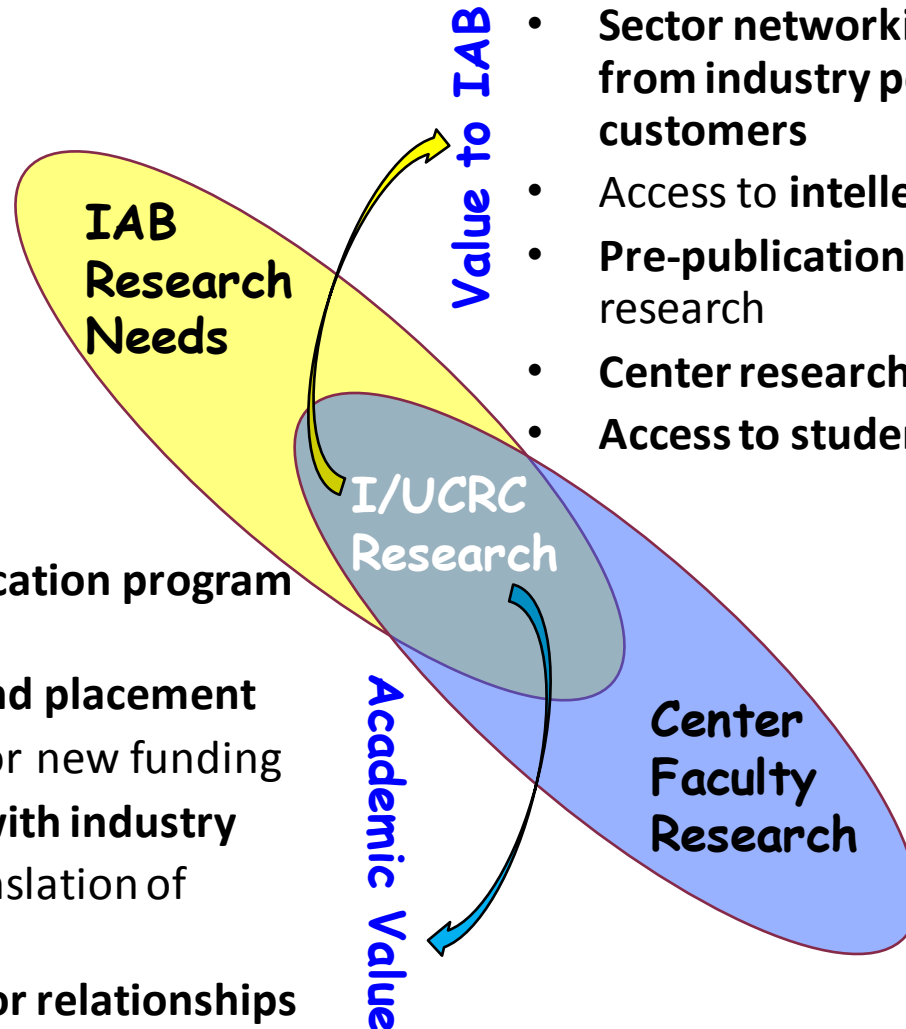
- **Cooperative Agreement & Operational Framework**
- **Franchise of centers for collaboration**
- **Best practices based on decades of evaluation**
- **NSF Award - Funding Opportunities**



What *value* does an I/UCRC offer?

Outcomes from a cooperatively defined and managed, portfolio of industry-precompetitive research.

- New research and education program dimensions
- Student recruitment and placement
- Leverage POC results for new funding
- Trusted relationships with industry
- Ready partners for translation of discoveries
- Organize industry sector relationships
- Means to achieve institutional mission.



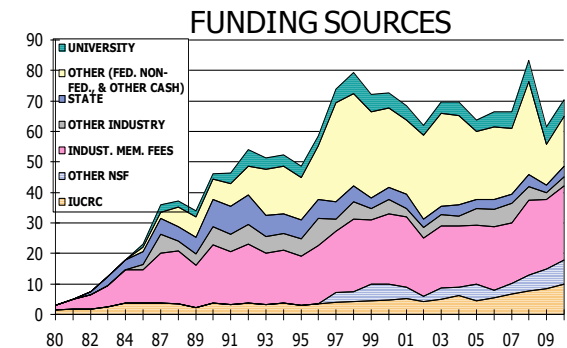
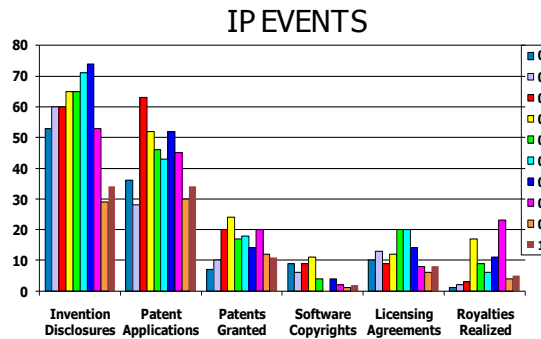
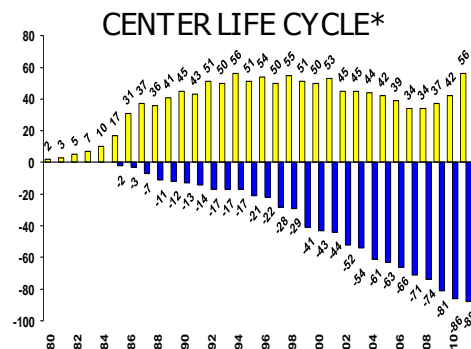
- High value research projects
- Investment leveraging
- Sector networking, learning from industry peers and customers
- Access to intellectual property
- Pre-publication access to research
- Center researchers & facilities
- Access to students



I/UCRC Evaluation & Assessment

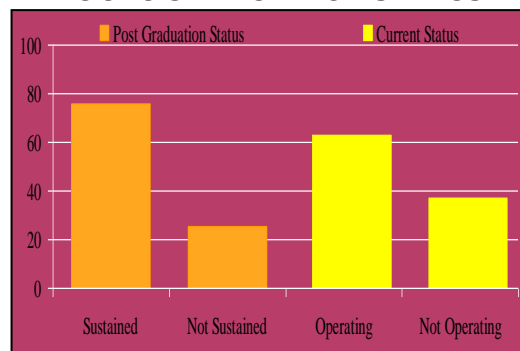
30 + year commitment to integrating evaluation with program planning, implementation and operation . *Local Evaluation – Global Assessment*

CENTER INPUTS AND OUTPUTS ASSESSMENTS

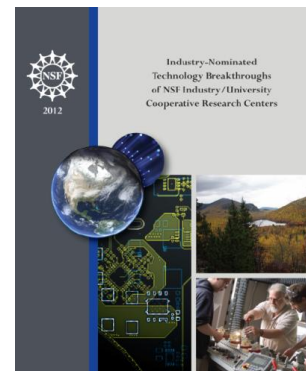


TARGETED ASSESSMENTS AND RELATED WORK PRODUCTS

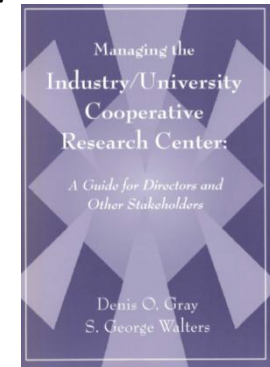
IUCRC GRADUATION STATUS



Breakthrough Compendium



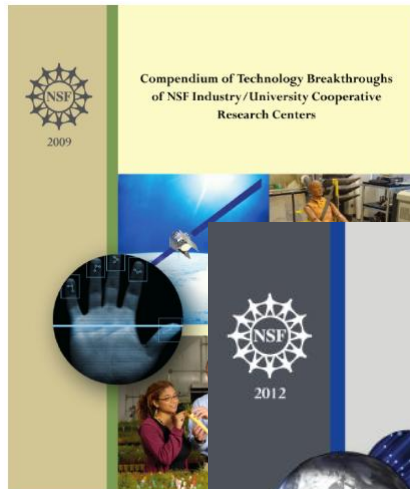
Gray & Walters Director's Guide



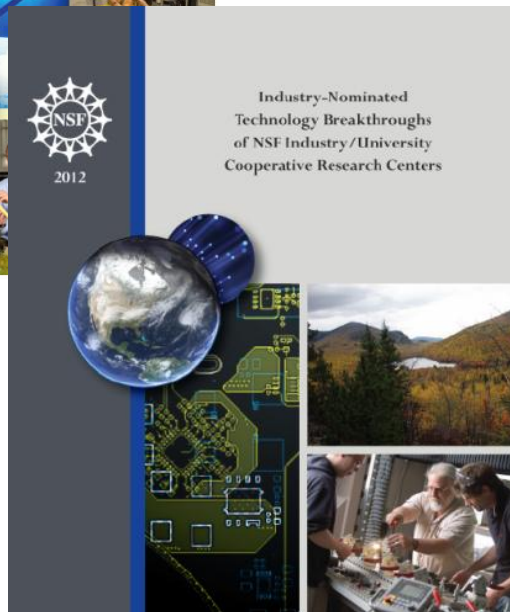
Plus publication in open literature: > 80 publications in journals, national & international conferences: *Research Policy*; *AAAS*; *Journal of Technology Transfer*; *Sc. Public Policy*; *New Directions in Evaluation*

I/UCRC Outcomes

From Trusted, Long-Term Center Relationships built on Industry-University Research

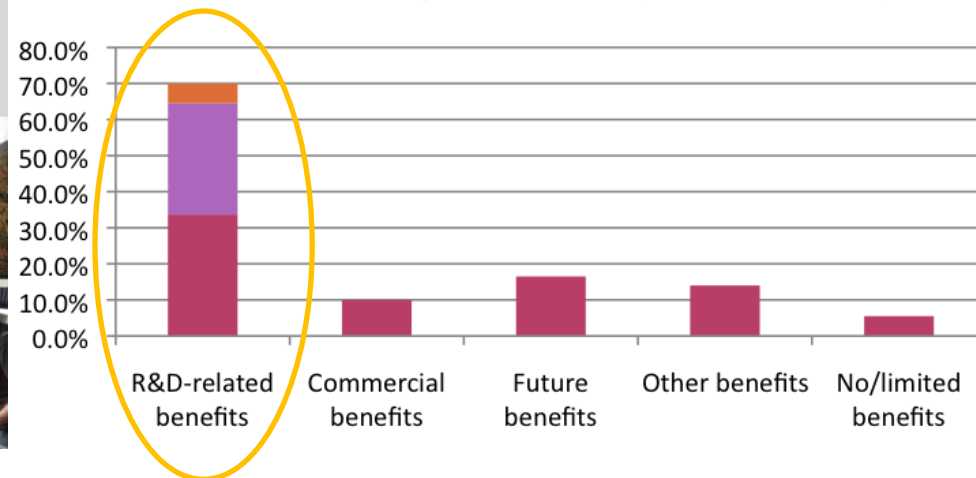


2009



2012

Percentage reporting different benefits from IUCRC participation
Process/Outcome, open comments (2008-2009, n=91)

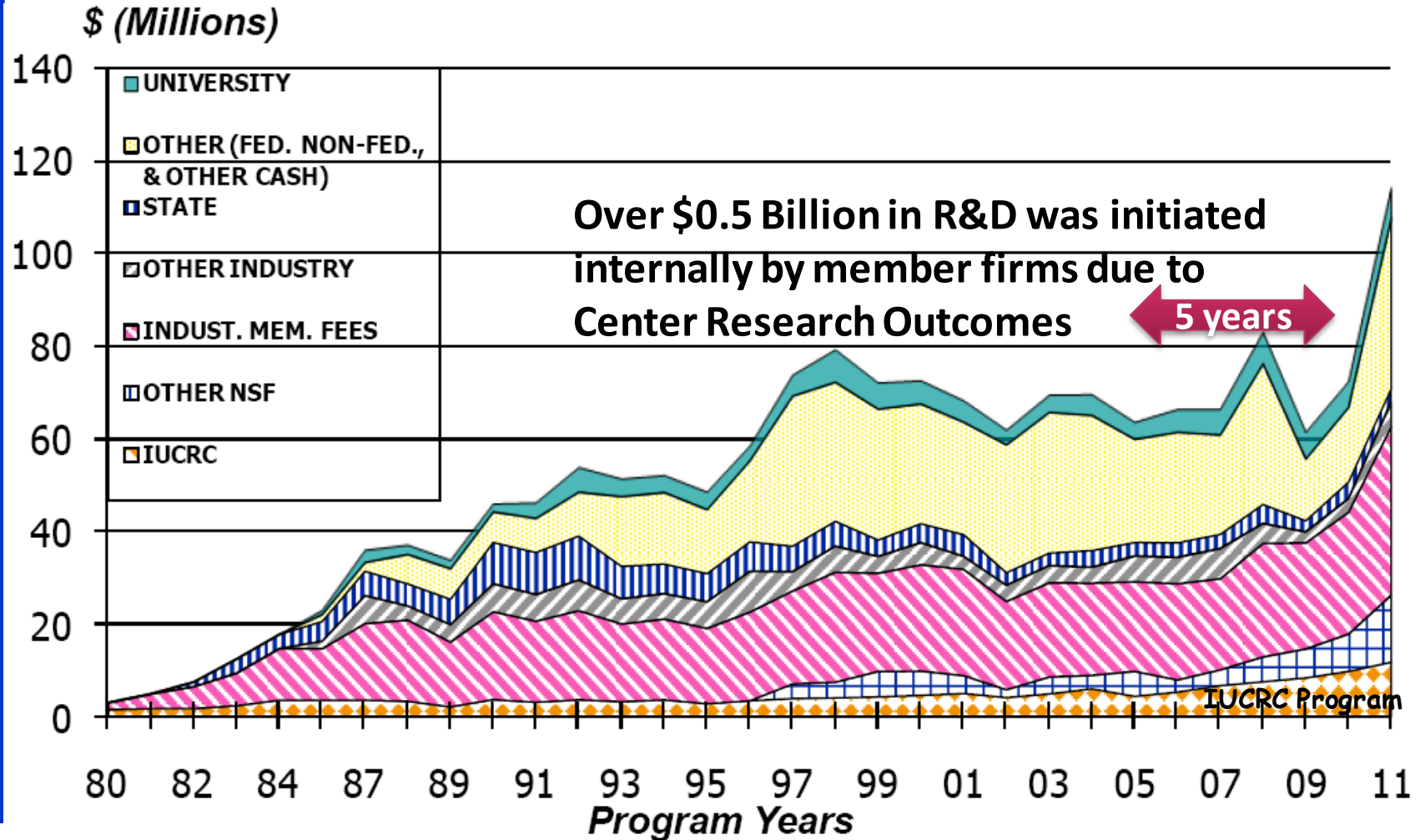


See the IUCRC Compendia at

www.nsf.gov/eng/iip/iucrc/tech_breakthroughs.jsp

Building Innovation Capacity

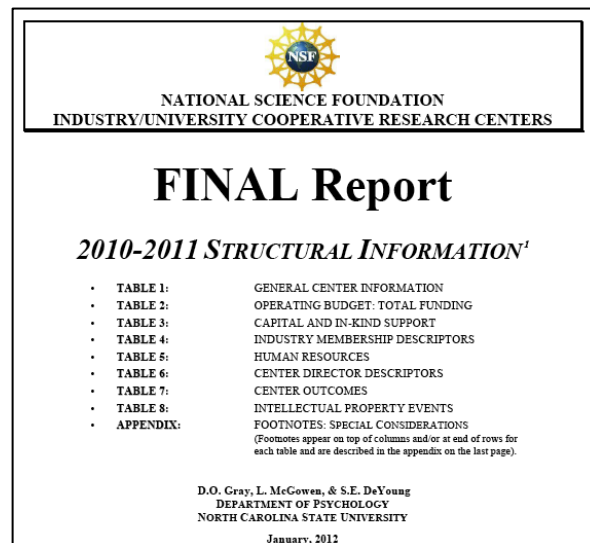
TOTAL FUNDING BY SOURCE BY YEAR IN DOLLARS



Typical* Center IAB Profile in FY11

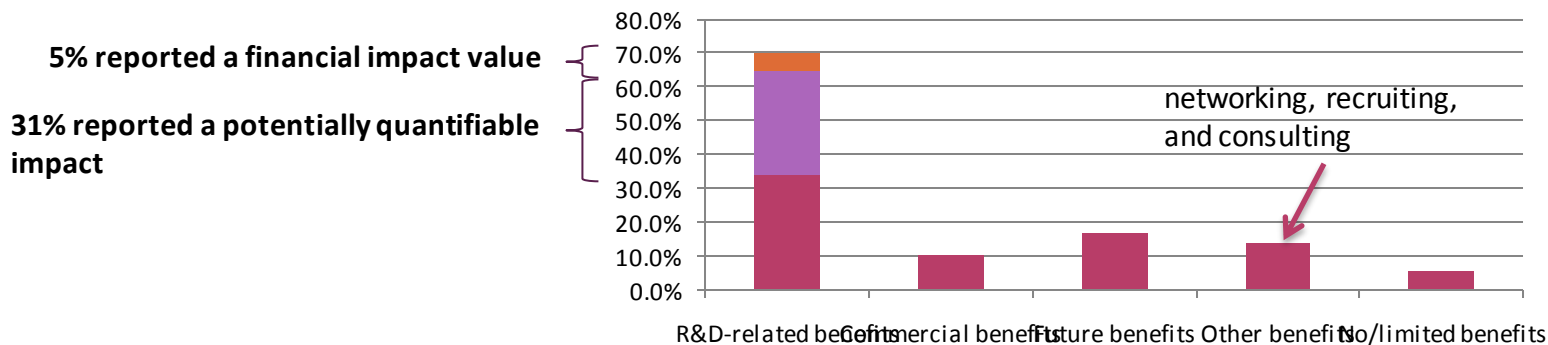
Typical Center Industry Advisory Board (IAB)

- 18 Members
- Nearly half “highly” or “very highly” value the “IAB Network”
- Each member receives 8:1 (50% Interest) to 16:1 leveraging of their membership investment
- \$1M (median) invested by IAB in internal R&D based on center research outcomes annually



Percentage reporting different benefits from IUCRC participation

Process/Outcome, open comments (2008-2009, n=91)

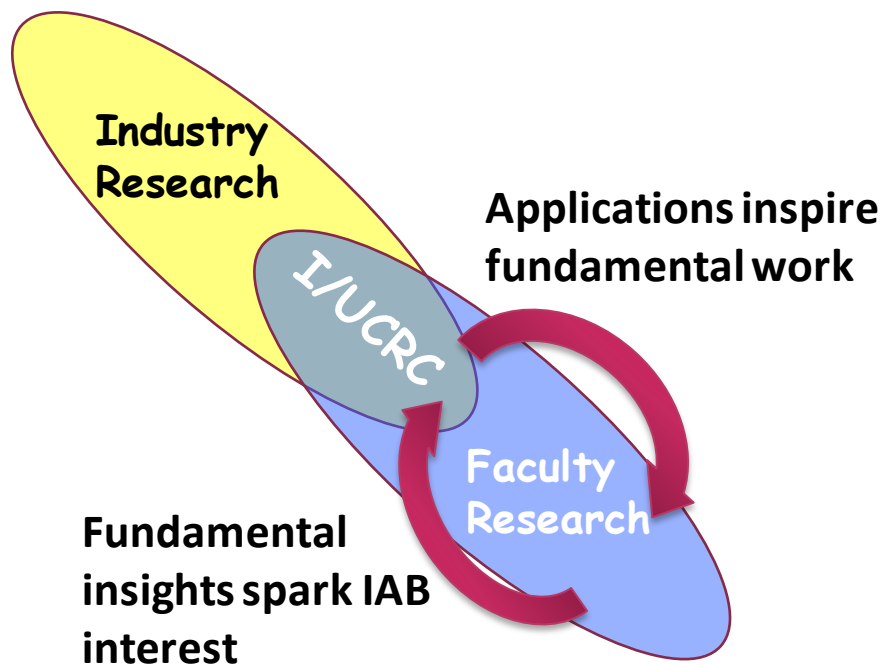


* Based on 2010-11 Structural Data Averages

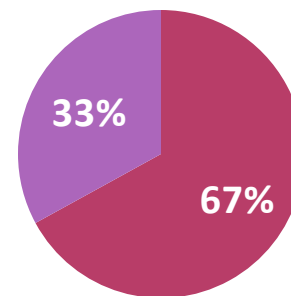
I/UCRCs: Linking Industry to University Fundamental Research

Annual evaluation results indicate that Center Faculty consistently state they are most likely to bring their best research ideas to the Center

- Over 50% of Centers receive other NSF support each year
- 67% of Centers draw on current/prior NSF support to achieve center outcomes



% of Responding Centers Receiving OR Leveraging Other NSF Support



■ Yes (N = 33)

■ No (N = 16)

I/UCRCs: Strategic Directions

- **Facilitate International Scope of Centers**
 - International Cooperative Research Projects
 - International Sites
 - Dubna University, Russia: Center for Advanced Knowledge Enablement
 - KU – Leuven, Belgium: Site of Center for Resource Recovery and Recycling
 - Dharmsinh Desai University (DDU) through the Shah-Schulman Center for Surface Science and Nanotechnology (SSCSSN) of Gujarat, India: Center for Particulates and Surfactants
- **Leverage Center Networks – Industry and Academic**
 - Cooperative Research Projects (CORBIs)
 - Complementary Center Clusters to address global S&E Challenges
 - All Center Programs, Virtual Clusters
- **Challenge: Building & maintaining strong relationships through partner cycles**



Science and Technology Center: Magnetic Resonance Imaging

- STC for Magnetic Resonance Technology for Basic Biological Research at UIUC established in 1991
- PI Paul Lauterbur discovered the possibility of creating a two-dimensional image by producing variations in a magnetic field

Lauterbur was awarded a Nobel Prize in 2003 for discoveries leading to magnetic resonance imaging.

