

***2009 NSF Nanoscale Science and Engineering Grantees Conference,
December 7-9, 2009, The Westin Arlington Gateway, Arlington, VA
Panel: NS&E Centers and Industrial Partnership***

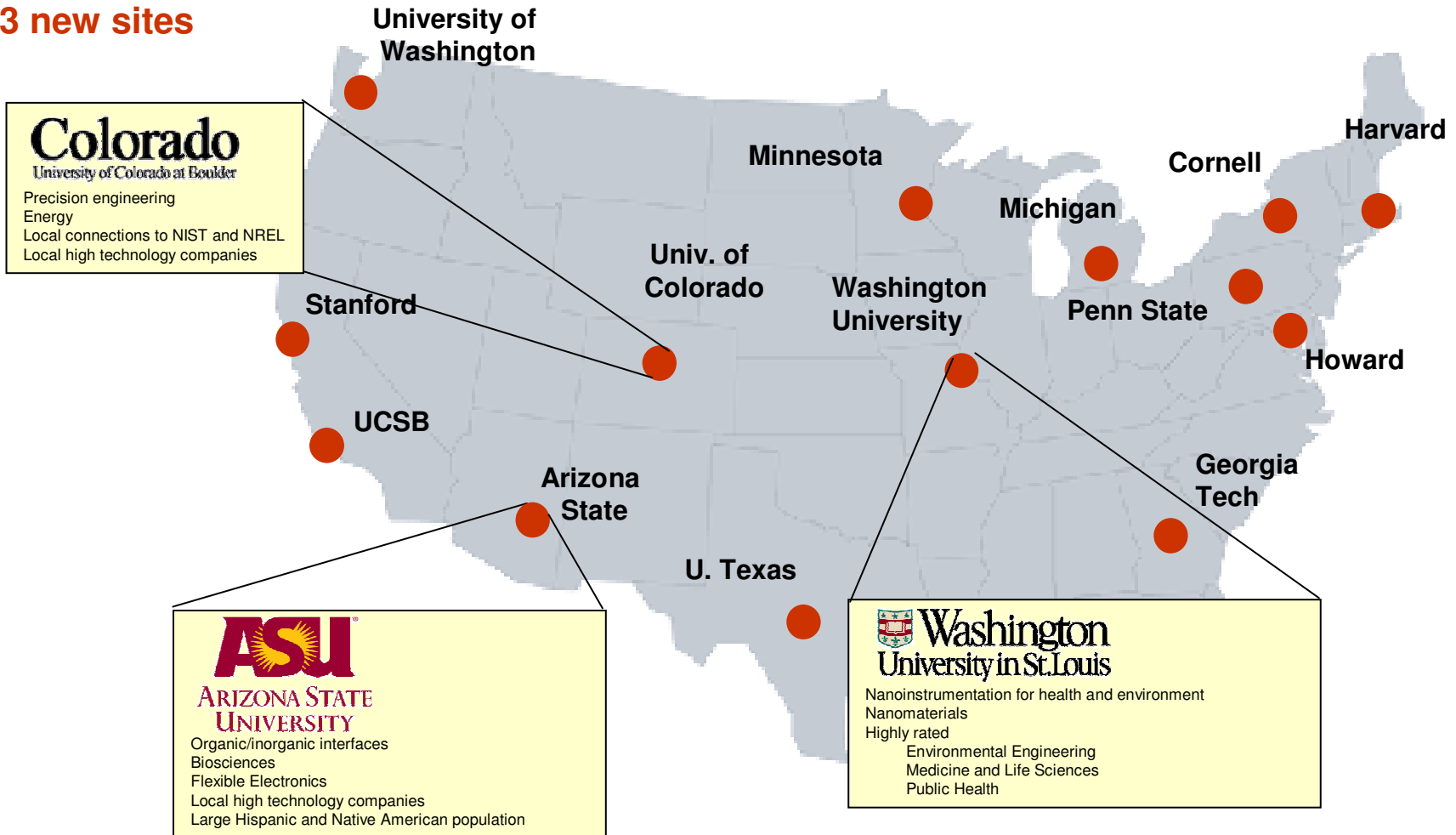
NNIN and Industrial Partnership

Yoshio Nishi

NNIN Stanford Site Director,
Professor, Electrical Engineering
Stanford University

NNIN Sites

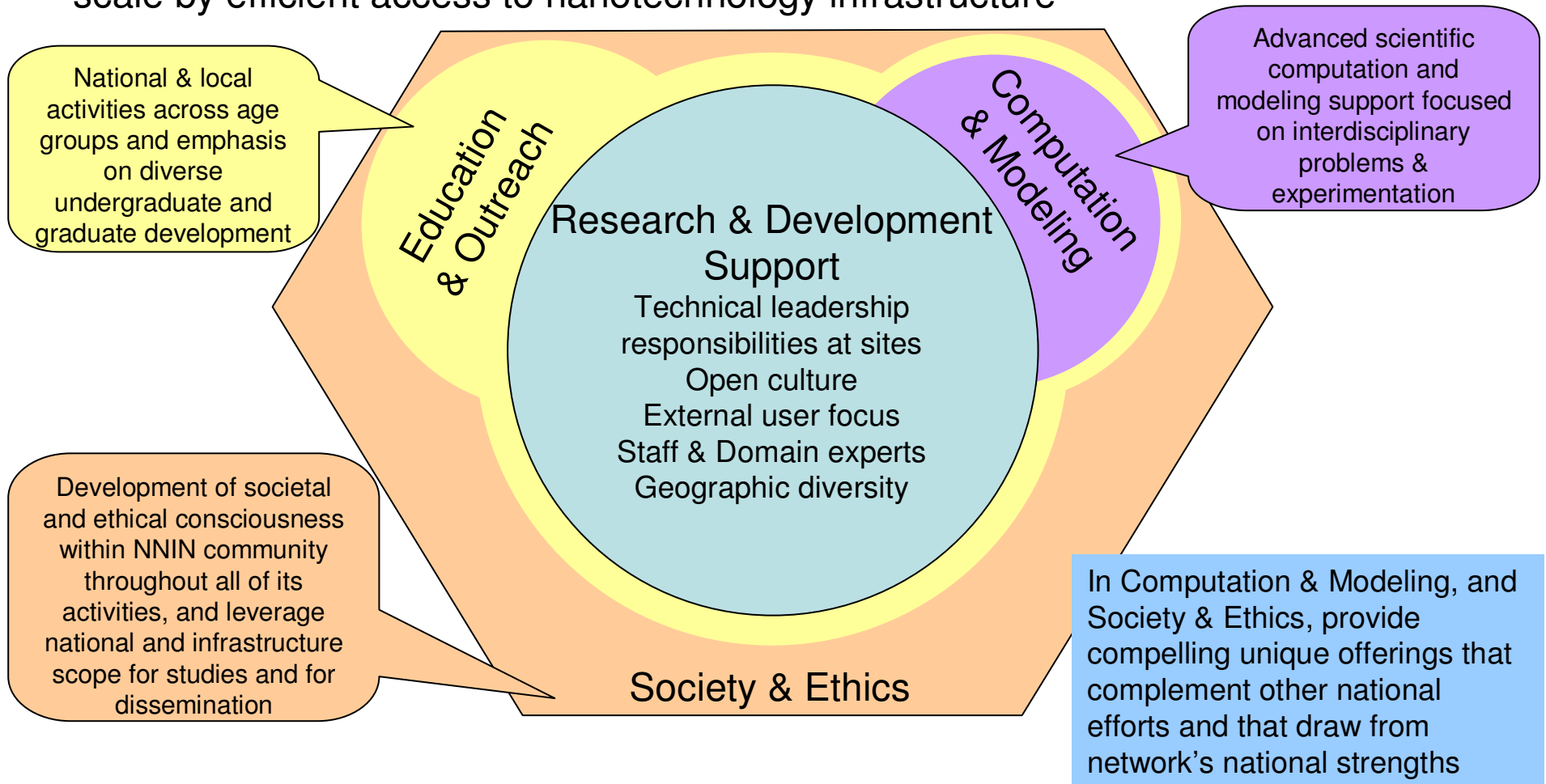
11 existing sites
3 new sites



NNIN Mission

NNIN Research Infrastructure Mission:

Enable rapid advancements in science, engineering and technology at the nano-scale by efficient access to nanotechnology infrastructure



NNIN Goals

- Advance national research and development in nanotechnology through **effective user support** to academia, industry, and others via world-leading user open R&D resource
- Develop and conduct **effective education and outreach programs** across age groups: focus on development of a diverse undergraduate and graduate student population
- **Build social and ethical consciousness** within NNIN-centered nanotechnology community throughout all of its activities, and leverage national and infrastructure strengths for related studies and for knowledge dissemination

Resources
/Effort

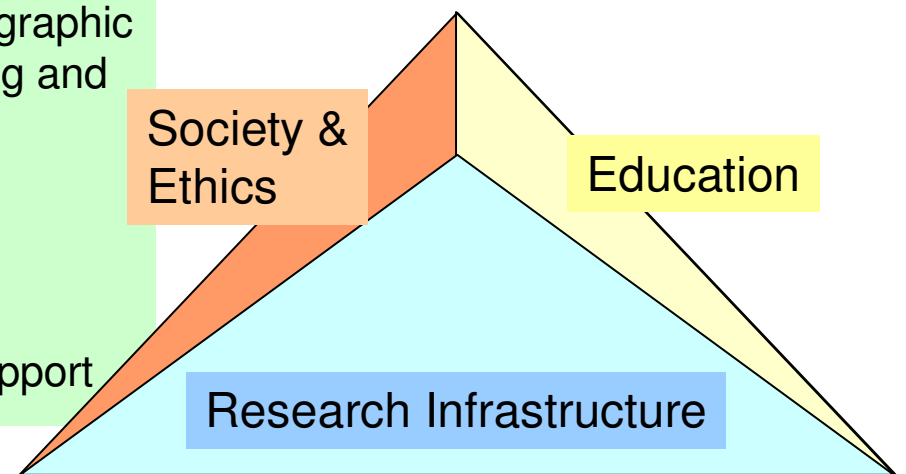
~80%

~12-15%

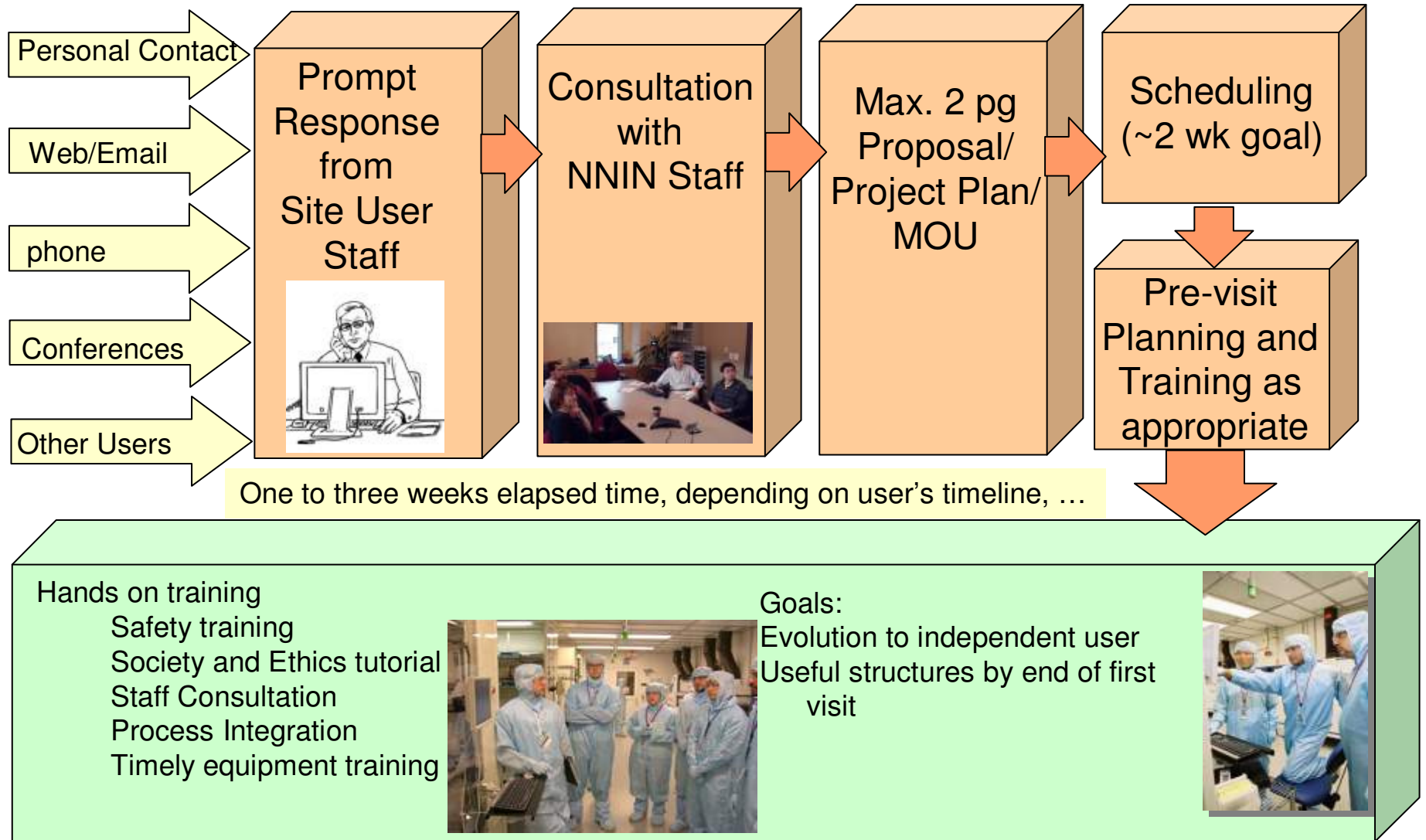
~3-5%

Synergies made possible by Technical and Geographic Diversity, Critical Mass and Cooperative Learning and Action

- Synergies within Education program
- Synergies between Education and SE
- Synergies between SE and Research Support
- Synergies between Education and Research Support



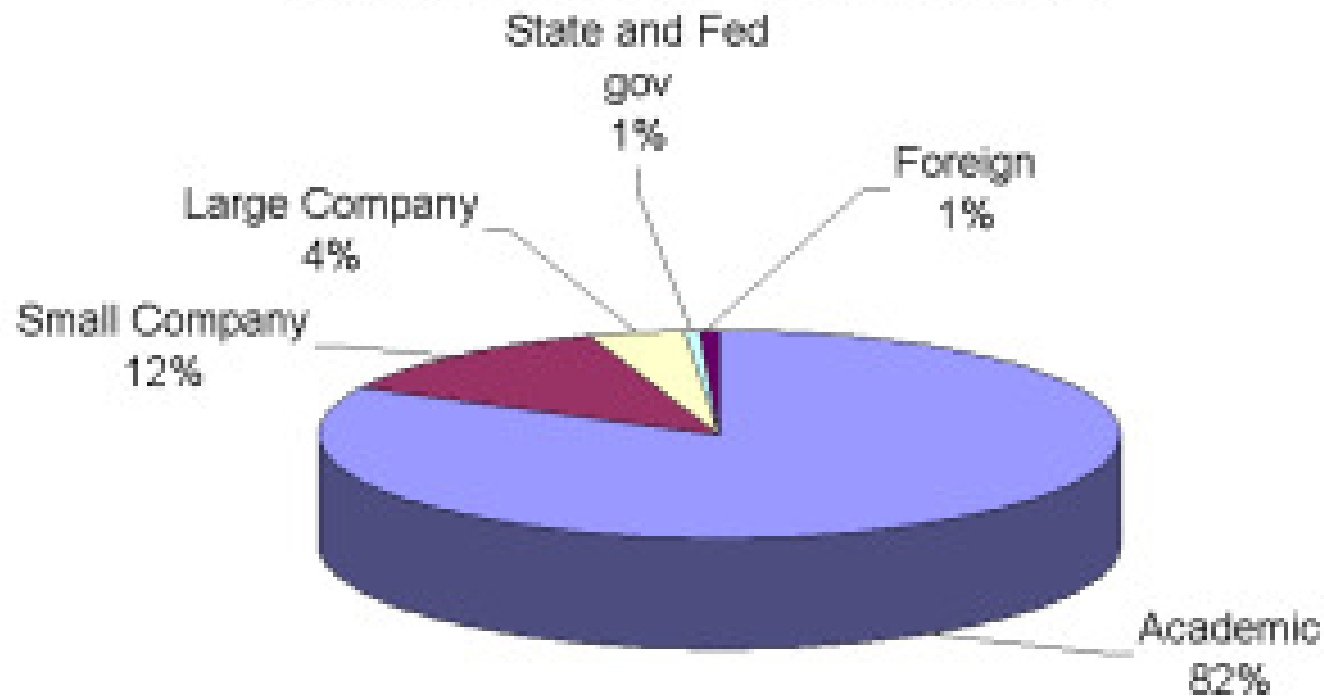
New User Process



>1800 new users trained per year on a large equipment set

NNIN Users

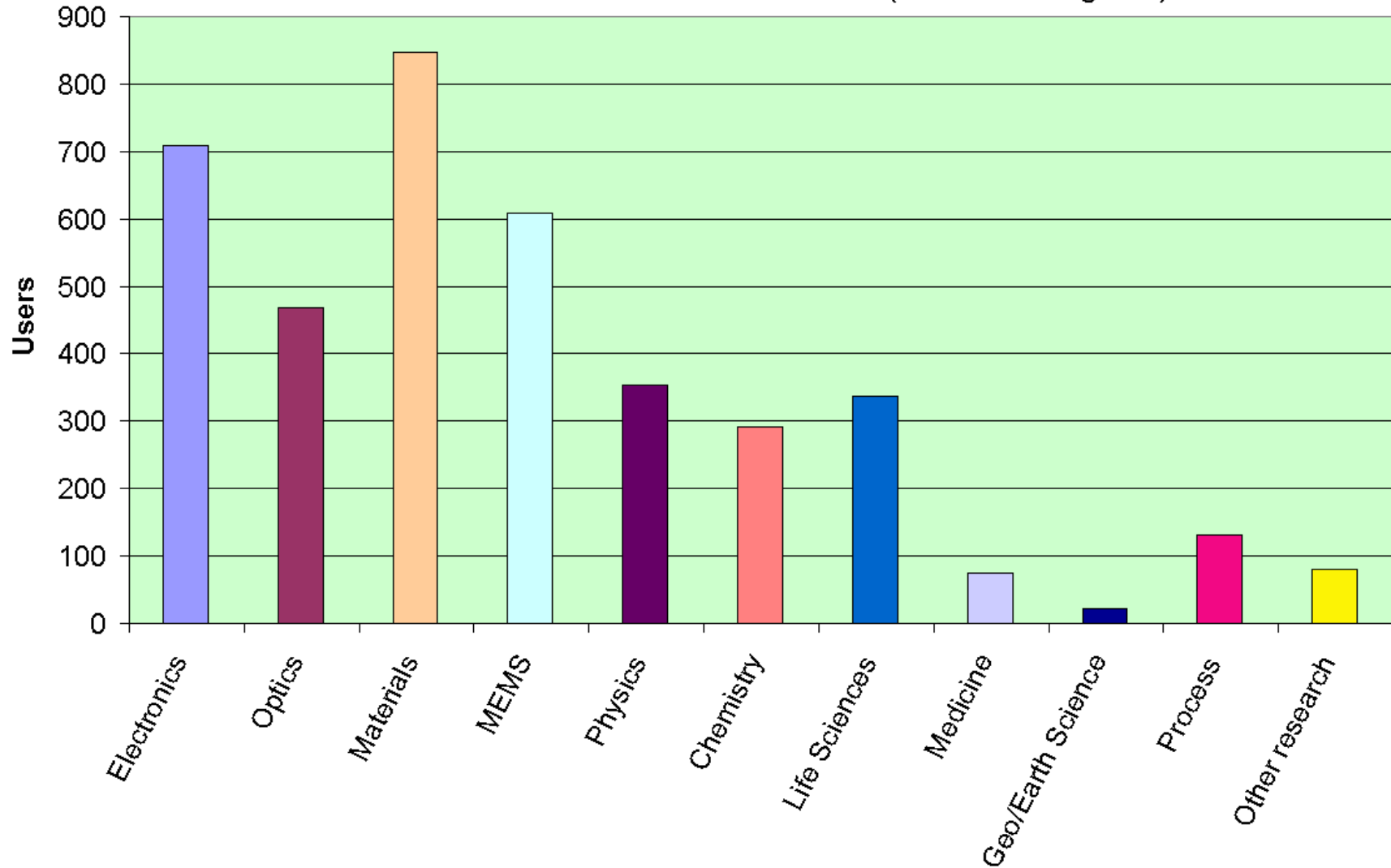
NNIN Total Users --2008 Full Year



5049 total users 12 months

User Interests

Network User Distribution 2009 6 months (March 2009-Aug 2009)

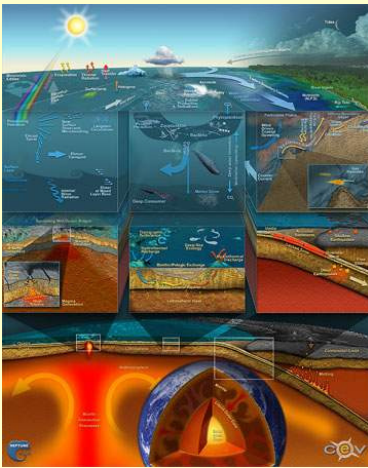


Catalyst for Change: Symposia

Major Symposia on major technical themes that bring together leaders for talks and discussions with users/participants **to define challenges of critical/emerging/changing areas and possible NNIN contributions to them**

2008

**Nanotechnology as an
Enabler for Ocean
Observatories**
Apr. 18-19, 2008
U. of Washington



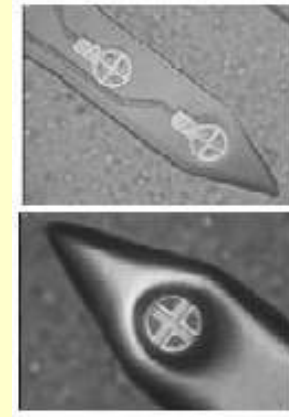
Ocean Sciences
community

**Symposium on Computing
& Complexity**
Oct. 12-14, 2008
Cornell University



EE-CS-Appl Math-
Physics-Neurosciences

**Nanotechnology as
Enabler for
Neuroscience,
Neuroengineering, and
Neural Prosthetic
Systems**
Dec. 11-12, 2008
Stanford University



Neuroscience &
Neurointerface Community

Economic Impact of NNIN

NNIN is a network of accessible nanotechnology user facilities. Its economic impact derives from

- **Facilities and Technology**
 - **Technology developed in NNIN facilities and licensed to existing or start up companies**
 - **Access for start up companies to facilities for R&D**
 - **Access for start up companies to facilities for small scale manufacturing**
 - **Access by established companies to advanced laboratory facilities for “routine” use**
- **Technology Partnerships**
 - **Companies supporting research infrastructure at NNIN**
- **Human Resources**
 - **Graduate students and Postdocs**

NNIN Economic Impact -Leverage

- **NNIN NSF direct funding**
 - \$14 M/yr (2003-2008); \$17.0M/yr (2009-2012)
- **Support of NNIN facilities by University, State, Foundation and International Sources (buildings, equipment, operations)**
 - More than \$550M over 5 years
 - Includes 6 new buildings constructed or under construction
- **Support of NNIN Facilities by Industrial Partnerships**
 - \$12M/year (most recent year) (Cash and equipment)
- **Support of NNIN Facilities by Industrial User fees**
 - \$26M industrial user fees over 5 years
 - ~\$5M per year

NNIN Economic Impact Companies Founded and Supported

- **38 small companies founded** based on technology developed by NNIN faculty in NNIN Facilities
 - ~1000 employees
- **100 small companies whose R&D is PRIMARILY done in NNIN facilities (5 years)**
- **30 companies doing small scale manufacturing in NNIN facilities (prototypes, etc.)**
- **>2300 employees at the 115 small companies that are “significantly dependent” upon NNIN (founded on NNIN technology, or conduct most R&D or Mfg functions in NNIN)**
- **Many more companies use NNIN facilities on a routine basis but would not be considered “dependent”**
- **A total of 358 companies using NNIN facilities in recent 2 years**

NNIN Users (Development & Commercialization-1)

3M Company	ATK-GASL	Crossfire Technology, Inc.	H ² Scan
454 Life Sciences	Atomate Corporation	Crystal Is, Inc.	Healio
A M Fitzgerald & Assoc.	Aveka, Inc.	Cubic Applications	Hewlett-Packard
Acorn Technologies	Baker Hughes	CV Incorporated	HP
Active Optical Networks	Battelle	CVI Laser	HP
Advanced Diamond Tech.	Becton Dickinson	Cymbet Corporation	HP
Advanced Nanostructures	BeSang Inc.	Cyoptics, Inc	HP
Advanced Optical	BF Goodrich	Cypress Semiconductor	HP
Advanced Research Corp.	BH Electronics, Inc.	CytomX	HP
Advanced Vacuum	BinOptics Corp	Delta F Corporation	HP
Advent Solar	BioArray Solutions Ltd	Diagnostic Biosensors	HP
Advion BioSciences Inc	Bioforce Nanosciences	Digital Optics	HP
AdvR Inc	BioScale	Disc Dynamics	HP
Aerius Photonics	BioVitesse, Inc	Displaytech	HP
Aerojet	Boeing	DSM Solution	HP
Agave BioSystems	Boston Applied Techn.	DuPont	HP
Agile Materials & Tech.	Boston Scientific	Eastman	HP
AgilOptics, Inc.	Brewer Science	Eaton	HP
Agiltron	Bridge Semiconductor	Eaton	HP
Agoura Technologies	BTU International	Eaton	HP
AIP Network, Inc.	C2 Biotechnologies	Eaton	HP
Air Products and Chemicals	Calient Optical Compon.	Eaton	HP
ALCES Technology	Cambridge NanoTech	Eaton	HP
Allux Medical	Cambrios	Eaton	HP
AMIA Laboratories, Inc.	Carbon Nanoprobes	Eaton	HP
Anatom	Cardiac Dimensions	Eaton	HP
Anritsu	Cardio Spectra	Eaton	HP
Apic Corporation	CardioMEMS	Eaton	HP
Apogee Technology Inc.	CardioMEMS	Eaton	HP
Applied Biosystems	CardioMEMS	Eaton	HP
Applied Nanostructures	CardioMEMS	Eaton	HP
Applied Precision, LLC	CardioMEMS	Eaton	HP
Applied Research & Photonics	CardioMEMS	Eaton	HP
Arrayed Fiberoptics	CardioMEMS	Eaton	HP
Asbury Graphite Mills Inc	CardioMEMS	Eaton	HP
Aselsan	CardioMEMS	Eaton	HP
Aspen Research	CardioMEMS	Eaton	HP
Aspex	CardioMEMS	Eaton	HP
Asylum Rese.	CardioMEMS	Eaton	HP
ATDF	CardioMEMS	Eaton	HP

Start-ups

Small & Large Companies

NNIN Users (Development & Commercialization-2)

Liquidia Technologies	Nanocrystal Corp.	Pixtronix Inc.	Siemens	Translucents USA, Inc.
Lockheed Martin	Nanofluidics	Praevium Research	Sigenics	Transfer Devices
Los Gatos Research	Nanohmics Inc	PrimeGen Biotech	SIIMPEL	Translucent
LSA, Inc	Nanomems	Primet Precision Materials, Inc.	Siimpel Corporation	Transonic Systems Inc
Lucent Technologies	Nanolambda	ProcessTek	Silicon Quest, Inc	Transparent Optical
Lumera	Nanomaterials Disc. Corp.	Proteus Biomedical	Singapore's Institute	Transphorn
Luminit	Nanomix	Protochips	Sionyx, Inc.	Trident Metrology
Luxtera	Nanosys	Qcept	Skyworks Sol	Triquent
LW Microsystems	Nano-Terra, LLC	QmagiQ	Solarity	TRS Ceramics
Lytotropic Therapeutics,.	Nantero, Inc.	Qualtre	Solid	TRS Technologies, Inc
Mag Sil Corporation	National Recovery Sys.	Quantum Logic Devices	S	True Materials
MagArray	Neah Power System Inc.	qXwave, Inc.	Systems	Tyco Electronics
Mamac Systems	Nektar Therapeutics	Qynergy	Systems	UltraClad Corporation
MedShape Solutions	NeoKismet	Radiant Technologies, Inc	Spectrum Devices	Unidym
Medtronic, Inc.	Neophotonics	Radiation Monitoring D	Spiration	Unity Semiconductor
Meggitt Endevco	Nevada Nanotech Sys.	Raymedica	SRI International	Valspar Corporations
MEMC	Ngimat (MCT)	Raytheon Infra	St. Jude Medical	Varian Semiconductor Equipment
MEMS Optical LLC	nLight	Raytheon E	Standard Microsystems	Veeco Metrology
MEMSCAP	Nonvolatile Electronics	Raytheon	Standard Steel LLC	Vesuvius Research
Meng Technology	Northrop Grumman	Re	Stanford Research	Victaulic Company
Metrosol Incorporated	NovaSpectra	Research Institute	State of the Art	Visigen
Microcess	Nup2 Incorporated	Research Corp.	Stellar Micro Devices	Visileo Corp.
Microfab Technologies Inc	NVE Corporation	Research Tech	Stion	Waters Corporation
MicroGreen Polymers, Inc.	NXTS	Research Sense	Stryker Biotech	Wavefront Research, Inc.
Microstaq	Olympic Precision	Research Sense	STS	Westover Scientific Inc.
Microsurfaces, Inc.	Olympus Micro	Research Sense	SurModics, Inc.	Wilson Tool International
Mitsubishi Chem Research	Omega Pi	Royal Institute of Technology	SVT Associates, Inc.	Winged Cat Solutions
Modumetal	Optical	RPIC Systems	Symetrix Corporation	WMR Biomedical, Inc.
Molecular Imprints	Optical	Sachem	Symyx Technologies	Wostec
Molecular Nanosystems	Optical	Sage Electrochromics, Inc.	Target Technology Company LLC	Xerox
Molex	Optical Sciences	Samsung	TelAztac	Zeno Semiconductor
MSP Corporation	Optical Sciences	Satori Pharmaceuticals	Tedyne	Zinc Matrix Power
Multispectral Imaging	Optical Sciences	Saxet Surface Science	TeraVicta	
Nano & Micro Techn	Optical Sciences	SBA Materials	The Bergquist Company	
Nano Dynamics	Optical Sciences	SCOLR Pharma	ThermoFisher Scientific	
Nano Liquid D	Optical Sciences	Scott Speciality Gases	Thorrn Micro	
Nano Surf	Optical Sciences	Seagate Technology	TIAX LLC	
NanoCool	Optical Sciences	SemiSouth Laboratories	TLC Precision Wafer Technology	
Nanocopoe	Optical Sciences	Senspex		
	Optical Sciences	Siargo		

358 start-ups and established small and large companies

Start-ups

Small & Large Companies

NNIN Representation on Major Scientific and Corporate Advisory Boards

- **Sandip Tiwari, Cornell**
 - **Defense Science Research Council, Advanced Design Consulting Anvik**
- **Yoshio Nishi, Stanford**
 - **BeSang Memories, Intermolecular Inc, DSM Semiconductors, Ultratech Inc, Soltaix Inc, Novellus Systems**
- **James Meindl, Ga. Tech**
 - **Sandisk, Zoran and US Venture Partners**
- **Sanjay Banerjee, U. Texas**
 - **DSM Semiconductors, Cambrios, Nanocoolers Inc., BeSang Memories, NanoVance, Organic ID and ITU Ventures; HSMC Foundry**
- **Steve Brueck, New Mexico**
 - **Lightpath Technologies**
- **Khalil Najafi, Michigan**
 - **Evigia, SSYS**
- **Dennis Grimmard ,Michigan**
 - **Moibus Microsystems**

Comments given by NNIN/SNF Users

- 1. By providing research infrastructure to nearby Silicon Valley nanotechnology community as well as to remote users, SNF has contributed to stimulate innovative research in nanoscience and engineering. This has resulted in a number of new finding and new ideas, some of which have created new product prototypes and opened up new markets.**
- 2. SNF capability to accommodate challenges for new nanomaterials has led large corporations to take significantly larger risk than they could do internally, which has promoted new discoveries and break-through ideas beyond their typical time horizon.**
- 3. Small start-up companies have grown to the next level after successfully spinning out from SNF toward higher volume foundries where they manufacture new products.**
- 4. SNF provides a melting pot environment for both industrial and academic researchers/engineers who can interact cross disciplinary manner for Silicon Valley style of new innovations.**
- 5. SNF provides a model for other laboratories in the US and around the world for the shared semiconductor based research and development facility.**

Summary

- **Qualitative:**
 - Fundamental understanding in life sciences & physical sciences enabled by advanced experimental resources to the national community at large
 - Major avenue for affordable development and commercialization for small companies in nascent application areas
- **Quantitative:** Publications (>3000 publications in 2008-09)
 - Economic development (> 275 small companies during 6 mo of 2009; 590 industrial users during 6 mo of 2009)
 - Academic users (~3200 PhD students in 6 mo of 2009, >1200 PhD awards/year)
 - >1800 new users trained
 - Workhorse for educational development (>750 workshop participants, >10,000 visitors to NNIN educational events & >100,000/month reached through *Nanooze*, ...)