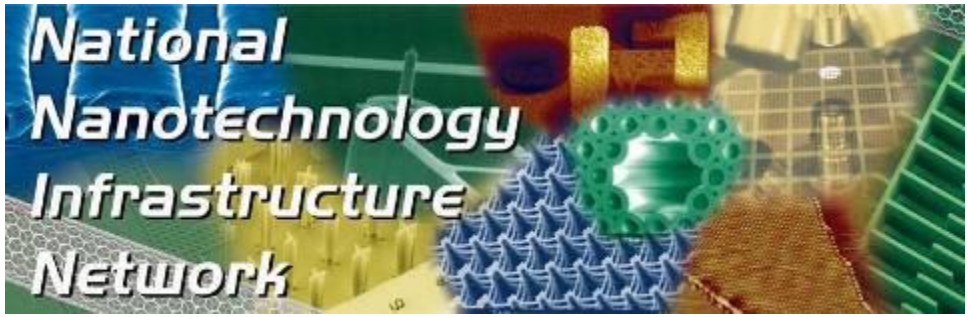
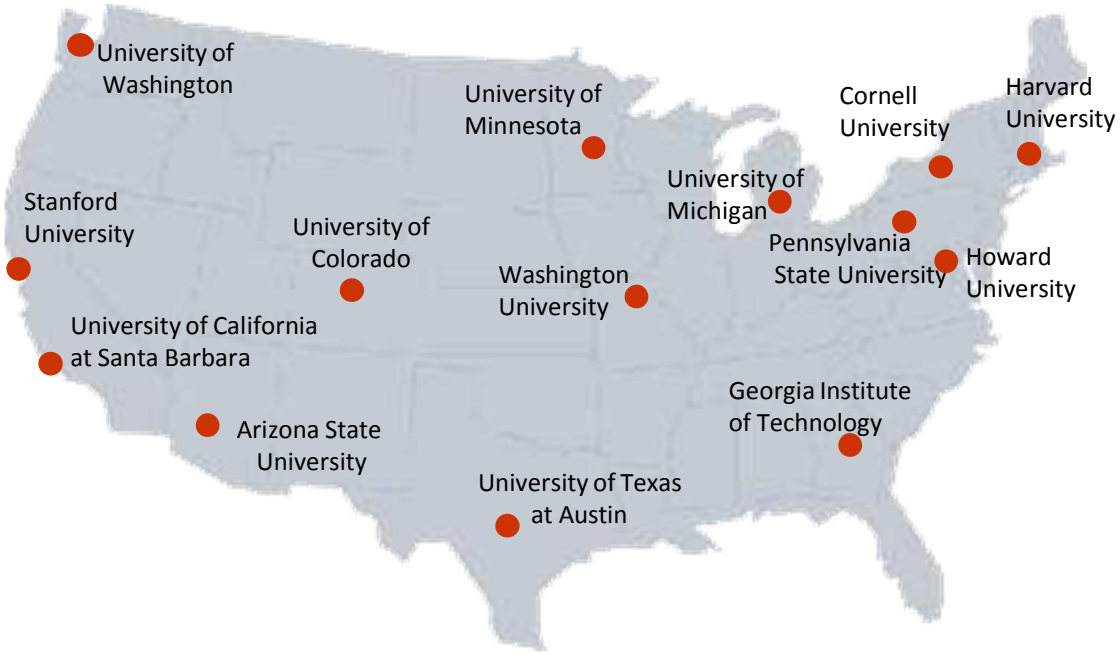
NNIN and the NNIN@Michigan Site

College of Engineering,
University of Michigan

LNF.umich.edu
nnin.org



Geographical and Technical Diversity



- Fabrication, characterization, and computational capabilities in all domains of nanoscale science, engineering and technology
- Open, shared laboratory environment
  - Readily accessible world-leading resources
  - Independent hands-on access
  - High level of staff interaction for instruction and project support
  - Extensive diverse user base
  - Efficient, synergistic and dynamic
  - Leverage but not duplicate other national activities

- Programs in education, outreach, and social and ethical issues
- Environment health & safety

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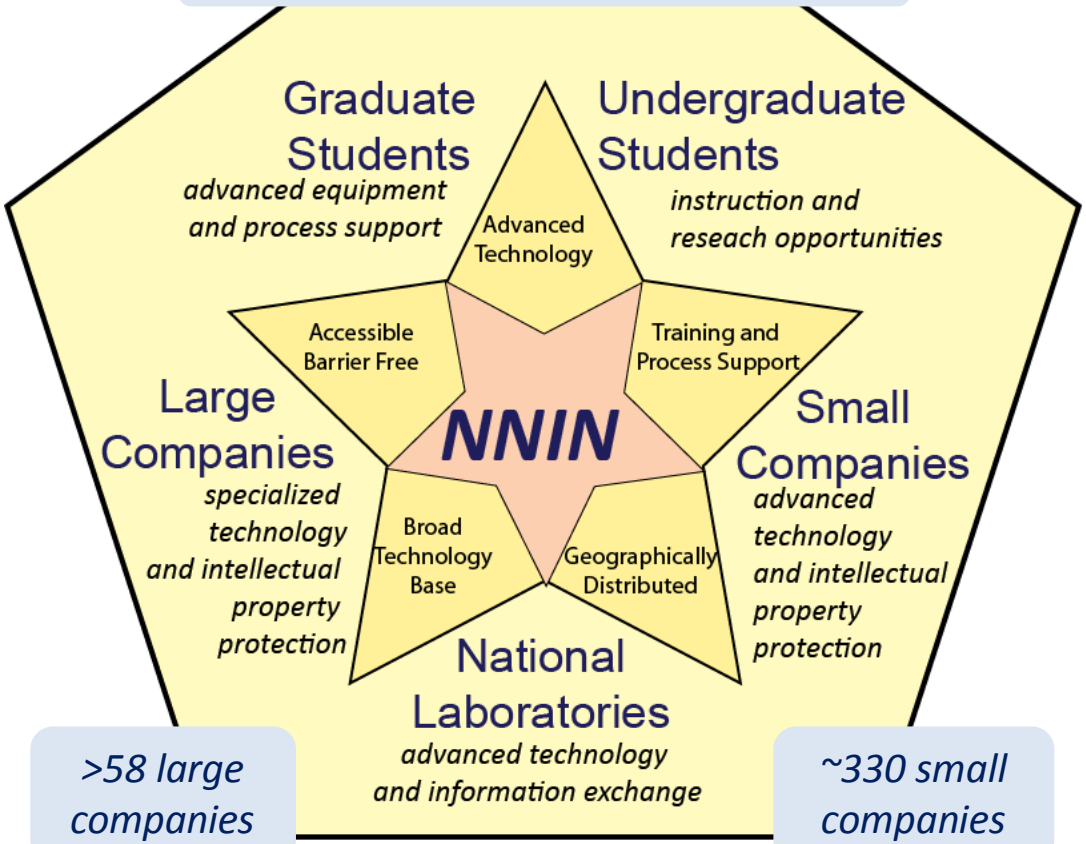
NNIN Impact (2010-11)

~5900 Unique Users

191 different academic institutions



>58 large companies

~330 small companies

>2500 Publications

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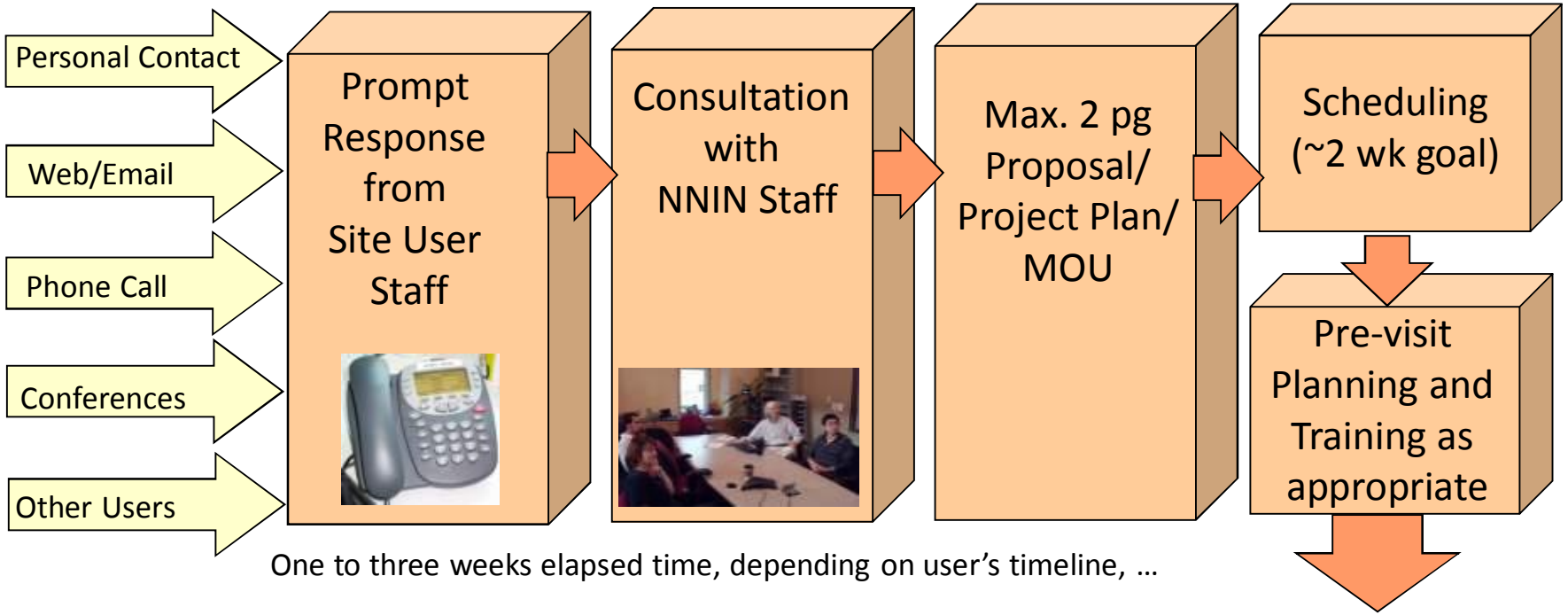
How Does a User Project Happen?



One to three weeks elapsed time, depending on user's timeline, …

Hands on training:
Safety training
Society and Ethics tutorial
Staff Consultation
Process Integration
Timely equipment training

Goals:
Evolution to independent user
Useful structures by end of first visit

>2200 new users trained per year on a large equipment set

NNIN @ Michigan:
Lurie Nanofabrication Facility (LNF)

NNIN Focus Areas

- Micro/Nanofabrication
- MEMS, BioMEMS, Microfluidics
- Computation, Micro/Nanofluidics Simulation
- Geosciences, Sensors for Ocean Sciences

Recent Facility Expansion

- $40M construction/facility
  $20M for equipment
- Dedication 2008,
  fully operational 2010
- Expanded capabilities, 6”
  wafer processing

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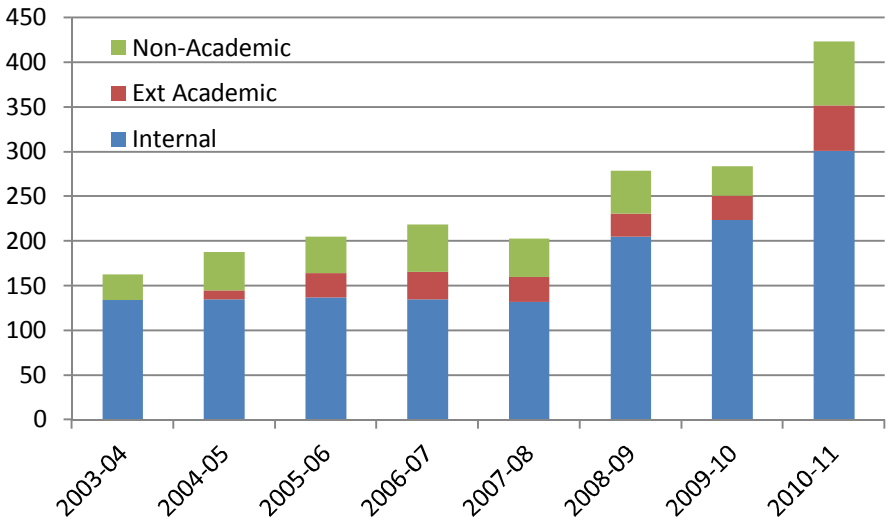
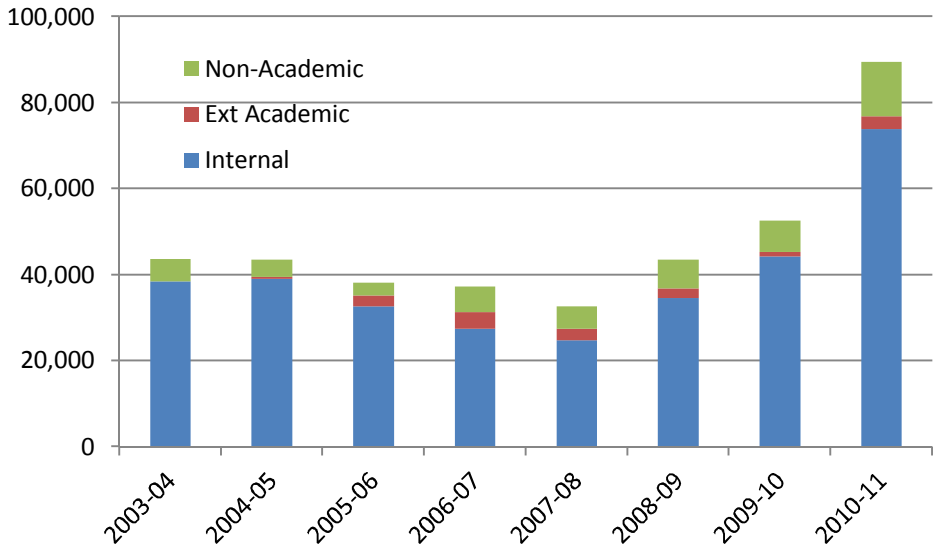
User Growth 2003 - 2011

Number of users (per year)



Lab/Tool hours (per year)



- 2004: Beginning of NNIN @ Michigan Program
- 2007-08: Initial Implementation of Per Use Cost Model
- 2008-09: Completion of LNF Expansion

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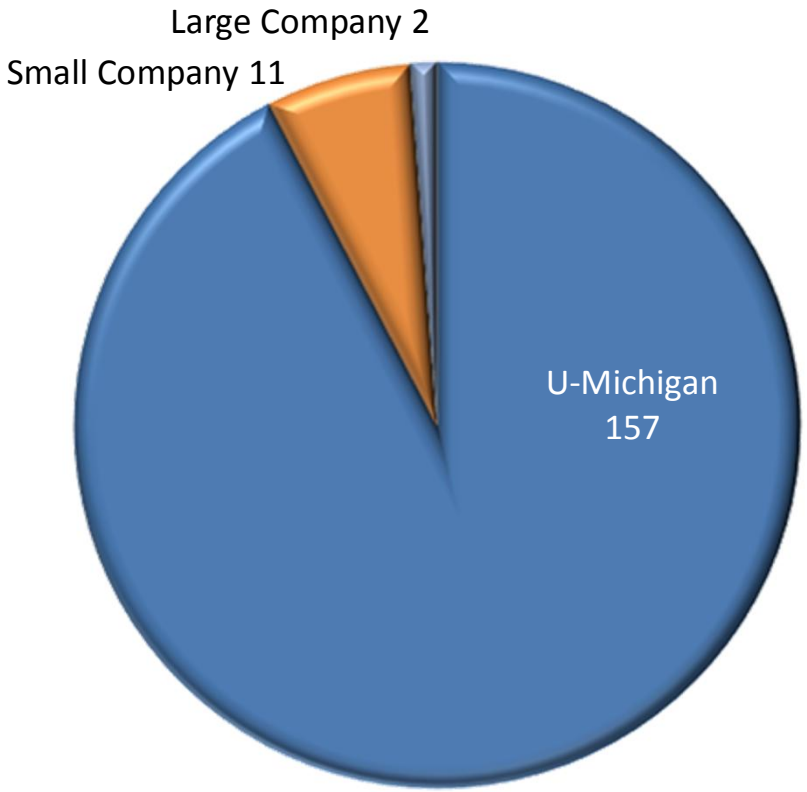
LNF User Community 2003

- Abbott
- AST
- Delphi
- Discera
- Flint Ink Corp
- HandyLab
- IMRA
- ISSYS
- Motorola
- M-Squared
- Picotronix
- Sensicore
- VA

194 users
92% internal
8% external



35 Research Groups

- Electrical Engineering
- Mechanical Engineering
- Chemical Engineering
- Nuclear Engineering
- Biomedical Engineering
- Physics
- Aerospace Engineering

- No External Academic Users

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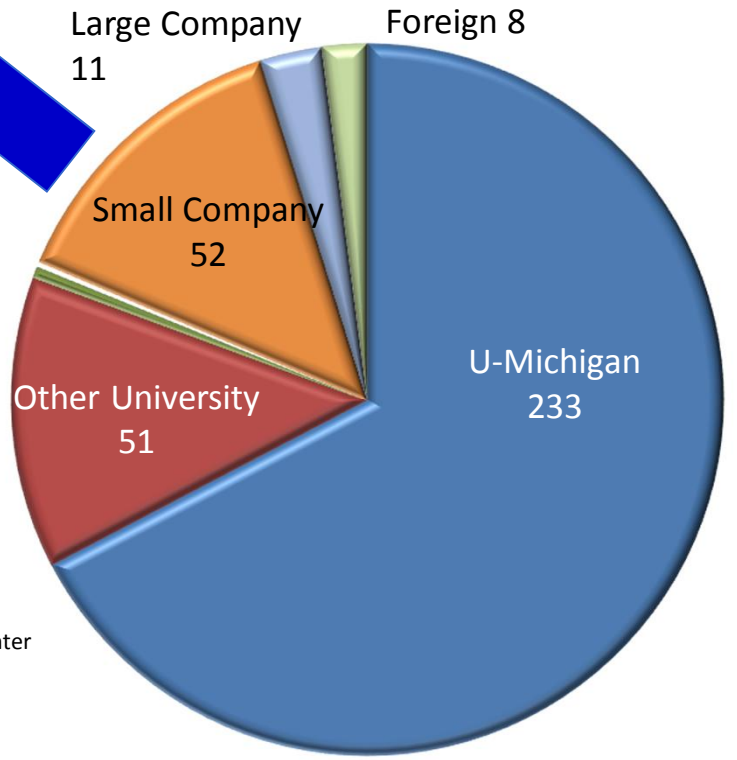
LNF User Community 2011

- Advanced Micro Fab, LLC
- Atactic Technologies
- Baker Calling
- BioArray Solutions, Inc
- DeNovo Sciences LLC
- Dexter Research Center, Inc
- ElectroDynamic Applications
- ePack
- Evigia Systems, Inc.
- EVJump Solar
- Integrated Sensing Systems
- Intellisense
- JST Manufacturing
- k-Space Associates
- LabSys, LLC
- LakeShore Cryotonics
- Lumedyne Technologies
- MEMSIC
- Midwest MicroDevices
- Nanoselect, Inc
- Nanosystems, Inc
- Neuronexus Technologies
- Ovonyx
- PicoCal, Inc.
- Picometrix
- Promerus
- Radiation Monitoring Devices, Inc
- Reliable Analysis
- Silicon Resources
- Solargystics
- Sonetics Ultrasound, Inc.
- STIgma Free
- Technova Corp
- Translume
- Visca, LLC
- Adobe Systems
- IMRA America, Inc.
- Johnson & Johnson
- PPG Industries
- Stryker Instruments
- Toyota
- Universal Display Corporation
- Watlow Electric Manufacturing

>450 users
67% internal
33% external

45

- Pacific Northwest National Lab
- Wright Patterson Air Force Base



>90 Research Groups

- Electrical Engineering
- Mechanical Engineering
- Chemical Engineering
- Civil and Env. Engineering
- Nuclear Engineering
- Biomedical Engineering
- Material Science
- Physics
- Chemistry
- Molecular, Cell and Dev Biology
- Internal Medicine
- Environmental Health Sciences
- Pharmacy
- Dentistry
- Radiology
- Geology

31

- Arizona State University
- Central Michigan University
- Cornell University
- Kent State University
- Massachusetts Institute of Technology
- Miami University
- Michigan State University
- Montana State University
- North Carolina A&T State University
- Oakland Community College
- Oakland University
- Ohio State University
- Purdue University
- Rensselaer Polytechnic Institute
- Rice University
- Stanford University
- Texas A&M University
- UCLA
- UC Irvine
- University of Minnesota
- University of Nebraska Medical Center
- University of Texas Austin
- University of Toledo
- University of Washington
- University of Wisconsin Madison
- Virginia Polytechnic Institute and State University
- Wayne State University
- Western Michigan University
- King Abdullah University of Science and Technology
- Korea Institute of Science and Technology
- Kyung Hee University

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Challenges

- How to increase user base?
  - Good support and capabilities is not enough
  - User outreach
  - Culture shift
- How to handle expanded user base and hours?
- How to integrate new programs and needs with facility operation
- Synergy between network sites

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Synergy Between Sites

- Focus Areas
  - Computation
  - Special Technical Areas (geosciences…)
  - Education and Outreach
  - Social and Ethical Issues
  - Environment Health and Safety
- Process Redundancy, Backup:
  - Synergy during tool acquisitions
  - User Support
  - Knowledge of other sites: capabilities, people
  - Referral for specific capabilities – in line with sites focus areas
  - Additional capabilities or backup as needed
- Staff Development and Interactions
  - Technical workshops
  - Best practices

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Increase User Base – Outreach

- Events
  - Onsite technical workshops
  - Seminars at other institutions
  - Technical conferences
- Communication
  - Printed material
  - Website

Increase User Base - Reduced Barrier to Entry

- User fees
  - Per usage fee schedule
  - Single academic rate
  - Discount on user fees for new users
- Online Material
  - Safety training and access
  - Documentation for operation procedures, maintenance log, characterization data…
  - Wiki under development

- Smart Start program: one day fast start to lab access
- Assistance with travel, housing
- Off-site usage

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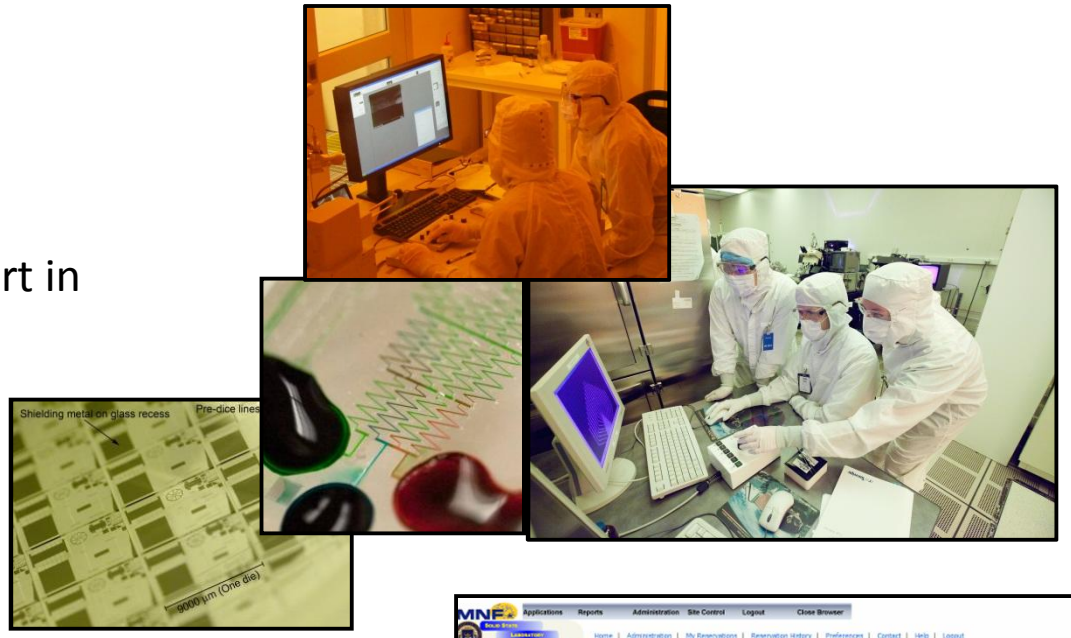
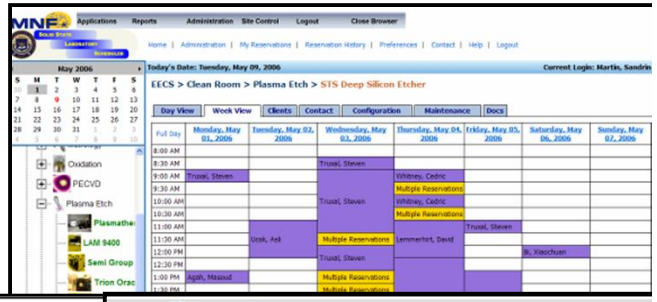
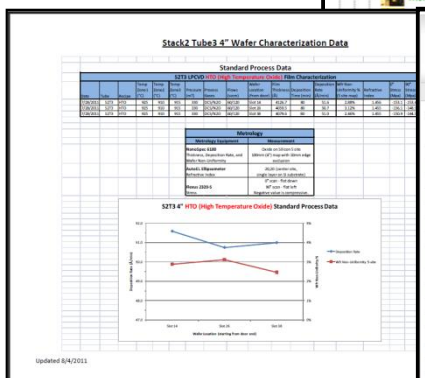
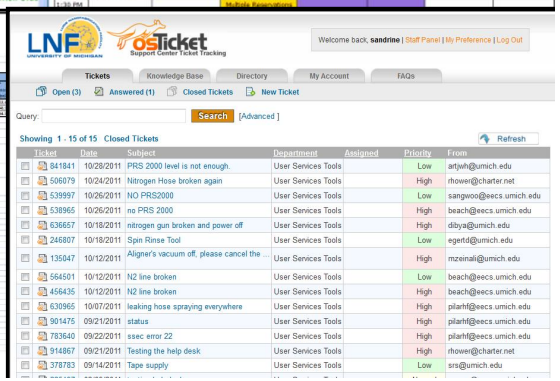
Increase User Base – Enhanced User Support

- Staff
  - Research experience
  - Dedicated to user support
  - Senior level staff for user support in specific tech area
  - On-site user support: advice, training, process support
  - Off-site usage
- Online Tools
  - Safety training and orientations
  - Tool documentation, characterization data
  - System for equipment reservations, authorizations, usage tracking, billing
  - Ticketing system for tracking user requests, equipment issues etc.









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User Growth – Consequences

- Large number of new users
- Increased diversity
  - New technical areas
    - No background in micro/nanofabrication
    - No support or history within research group
  - Light, sporadic users
  - Industrial, large research universities, small schools

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How to Handle New Users?

- Tools
  - Automation systems
    - Interlocks
    - Billing, tracking and reporting
  - Training Material and Procedures
    - Including education, and proficiency
- Culture shift – for both staff and users
  - Research Lab
    - Small tight community
    - Strong student involvement
  - Larger facility
    - Safe, professional environment
    - Increased equipment reliability
  - User centric facility

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Conclusion: Culture Shift

- **User Centric Facility**
- Staff
  - Customer service: focus on the users
  - Equipment reliability
  - Flexibility towards research needs
  - Support and collaboration between facility operation and NNIN program activities
- User community
  - Involvement of heavy users – user committee
  - Additional training and education for newer communities

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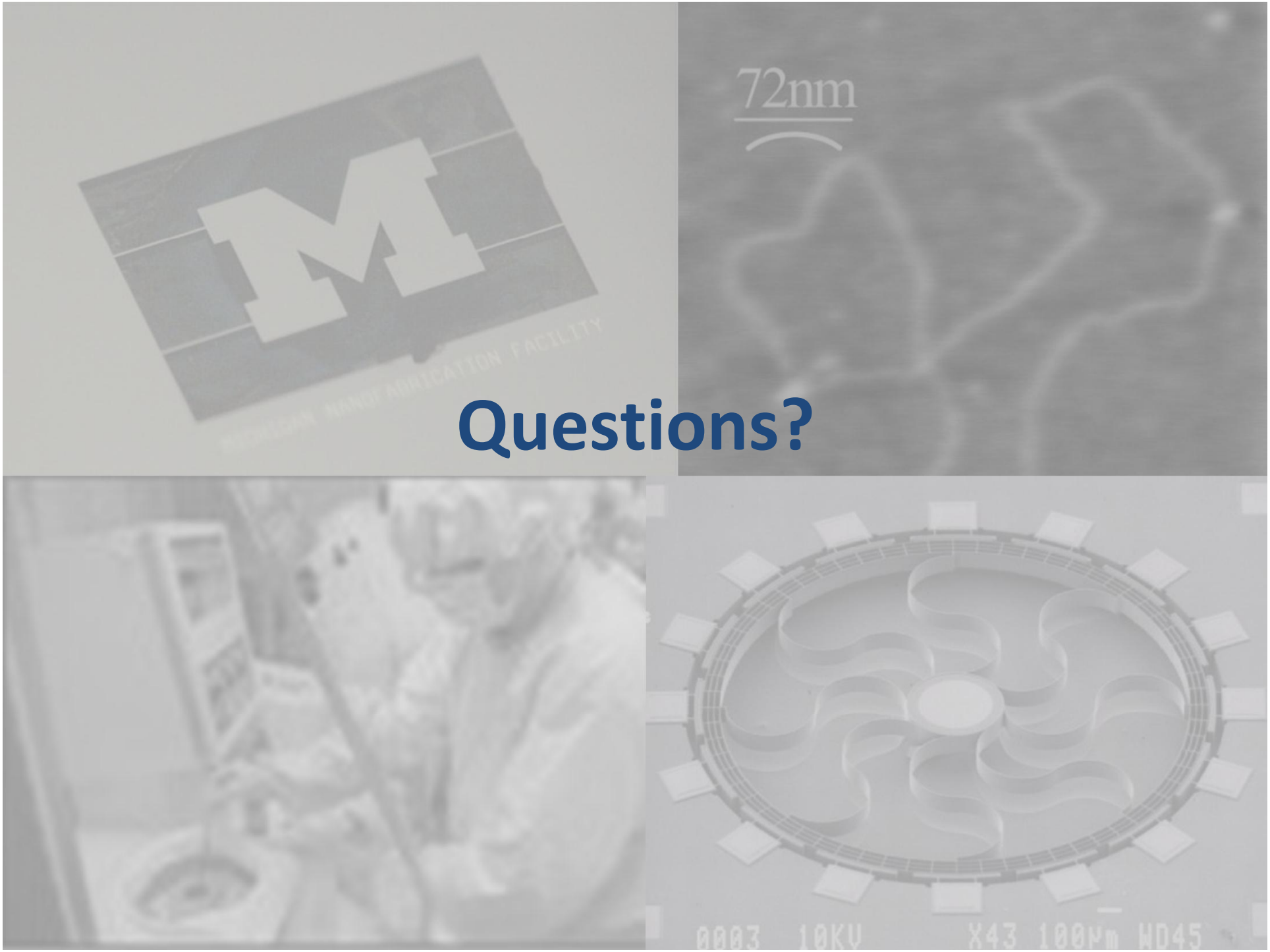
72nm
Questions?
0003 10KV X43 100µm WD45

NNIN Organizational Chart