The RTNN: Sustainable Programs

RESEARCH TRIANGLE NANOTECHNOLOGY NETWORK

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"What are examples of programs and activities developed under NNCI that will be sustainable, independent of any continued NSF renewal funding, and what strategies or sources will be used to support them?":

1. ***RTNN Kickstarter***
2. ***Early Workforce Development and Outreach***
3. ***Education Materials***
4. ***Assessment***
5. ***Ecosystems***

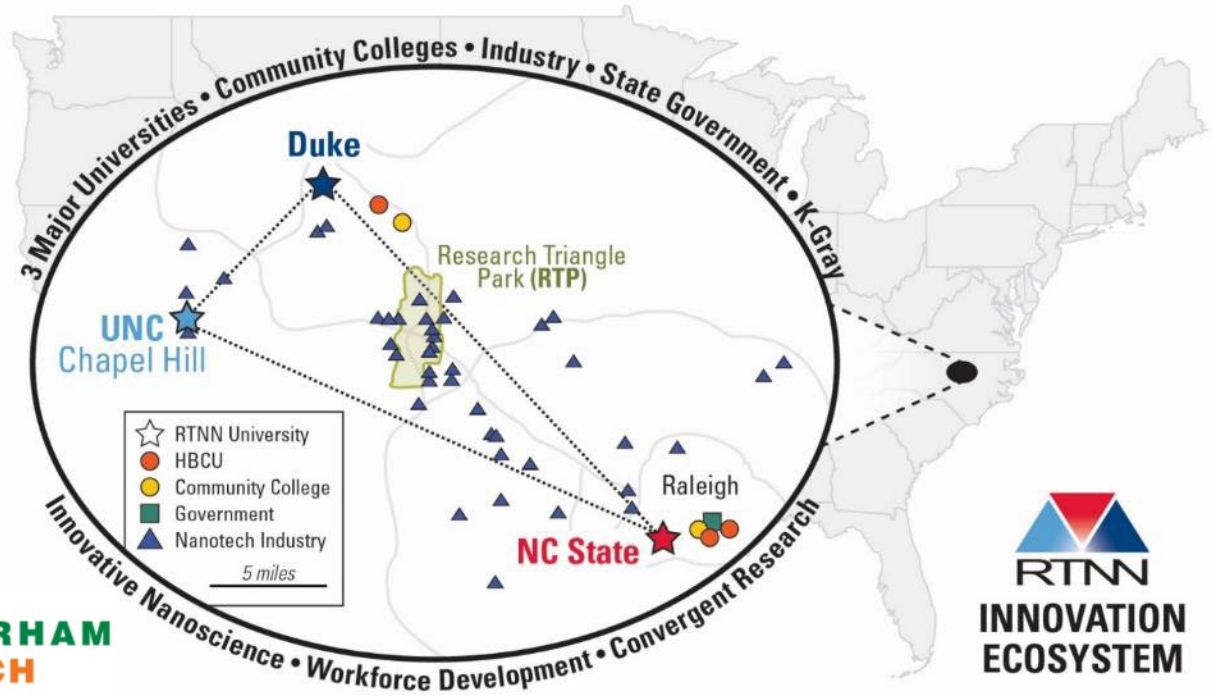
The RTNN Ecosystem

RTNN builds on an ecosystem anchored by 3 Research-1 Universities, 2 Community Colleges, and 3 HBCUs, producing large number of STEM graduates

Significant number of high-tech, nano-tech, and start-up companies

Research Triangle Park (RTP) is the largest and the most prominent research park in the U.S., currently hosting ***over 300 companies*** and institutes with ***~50,000 employees***

As a **Site that is a funded regional network**, RTNN can reach broader audiences, e.g. disciplines and industries



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1. Kickstarter Program Draws New Users and Leads to Returned Use

"Accelerator" program to overcome barriers of entry for new and non-traditional users, providing free time on tools

Up to $1,000 of use at internal rate, plus travel support

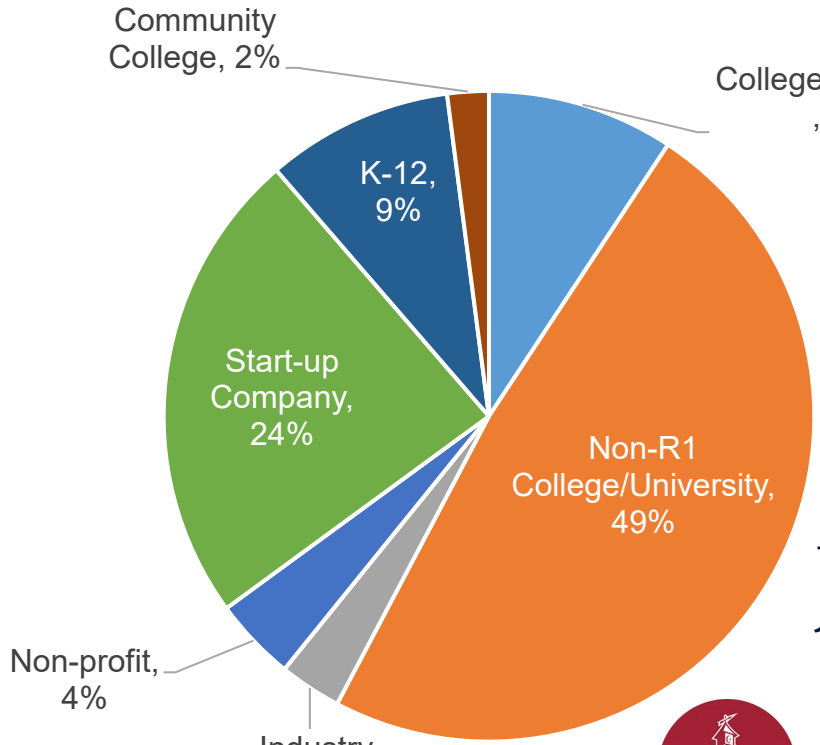
Enables first or preliminary results for follow-on proposals

105 projects since program launched in 2016 (>1,700 hours of use), 7 projects in Year 9

- >73% participation by start-up companies and non-R1 universities
- ***>40% of participants who have completed program have returned to facilities with own financial support (>$337,500 in facility fees)***

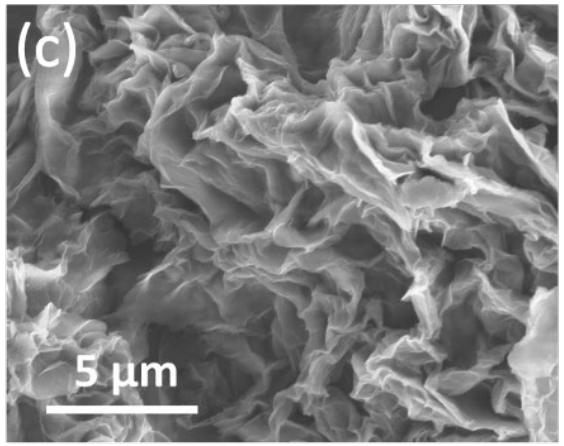
Evaluation with semi-structured interviews (n=34)

Program modeled by other NNCI Sites



We worked with Carrie Donnelly [sic] and she was most helpful. She took the time to meet with my class over Zoom, discuss the data, and talk about the instrumentation and how it works. So, 10 out of 10.

1. Kickstarter Program Draws New Users and Leads to Returned Use



Original Project Title: *Two Dimensional $Ti_3C_2T_x$ MXene-based plasmonic sensors*

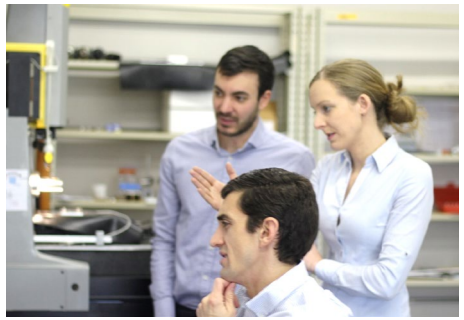
Post-doc: Tej Limbu, PI: Fei Yan

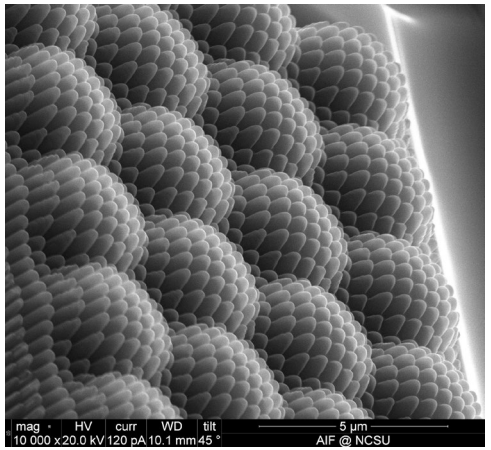
North Carolina Central University

Approved: June 2019

Returned Use: >$12k across multiple RTNN facilities

Tej Limbu, initially a postdoc at NCCU (HBCU) for first Kickstarter project, eventually became an Assistant Professor of Physics at University of Houston – Clear Lake (HSI)





Original Project Title: *Metrology of nano-indented cylinders and replicated anti-reflective films*

Stephen Furst, Smart Material Solutions

Approved: March 2016

Returned Use: >$80k across multiple RTNN facilities

Furst, initially a sole proprietor, has since added 4 full-time staff that continue to use RTNN facilities for fabrication and analysis and has since secured >$3.5M USD in SBIR/STTR funding to date

2. Sustainable Early Workforce Development and Outreach

Early Workforce Development

Distinguished from outreach, early workforce development programs go beyond exposure to concepts and includes learning or training modules over multiple interactions

Highlight: Engineering for US All (e4usa) program engages rural students in a 1-year, project-oriented engineering class that interacts with a local university (in our case, an RTNN nanotechnology facility)

Outreach

Sharing information from within academic institutions to persons who are outside of the institution, promoting exposure of concepts.

- ***>5,600 participants** individually and directly engaged with hands-on activities or facility visits with RTNN in past year (Record Year)*
- ***>13,000 attendees** at outreach events with RTNN in the past year (Record Year)*

Highlight: Waccamaw Siouan Community STEM Day on Tribal Land

***Remote and Online Content** options remain available and valuable in reaching larger audiences, especially rural communities*

NC Science Olympiad Expo
Nano-themed Activities Booth
April 15, 2024

Future Successors
Facility Visit
April 12, 2024

New Hope Elementary School
Community Science Night
April 24, 2023

Waccamaw Siouan Tribe
Community STEM Day
September 16, 2023

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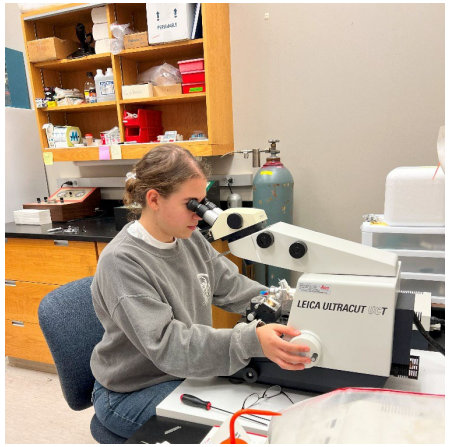
2. Workforce Development: University Education and Experiential Learning

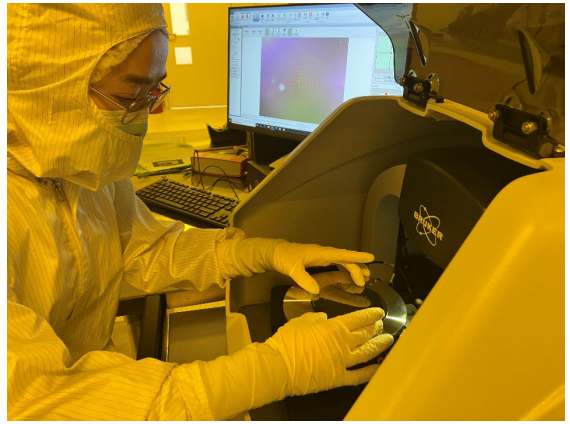
Research Experiences (REU/RET)

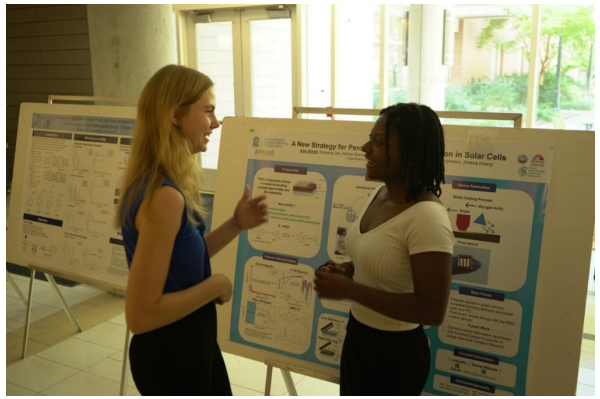
- Pilot programs initially funded by RTNN (2 students each Summer)
- Amplified by successful NSF Projects (12 students/Summer, 8 Teachers/Summer)
- Renewals currently pending

Classroom and laboratory engagement taught by RTNN personnel

- Class-based Explorations (Duke)
- Wide Bandgap Semiconductor Device Fabrication and Technology (NC State)
- Introduction to Bio-EM Techniques (NC State)
- Advanced Physics Laboratory Experiences (UNC)







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Duke UNIVERSITY

NC STATE UNIVERSITY

3. Sustainable Education Programs:
Nanotechnology: A Maker's Course

Massive Open Online Course on Coursera, providing education in nanofabrication and nano-characterization

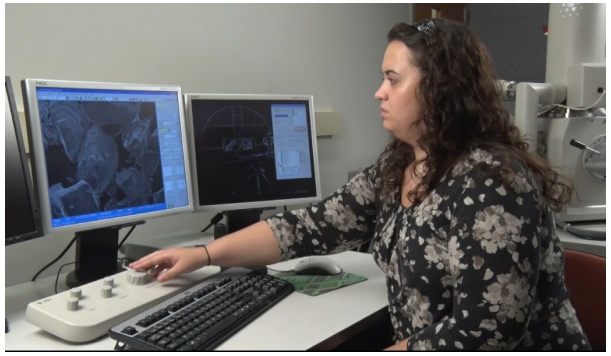
Lectures and in-lab demonstrations in RTNN labs by RTNN students, faculty, and staff from diverse backgrounds

Promotes and advances equality of opportunity through diverse teachers and lab demonstrators (primarily students)

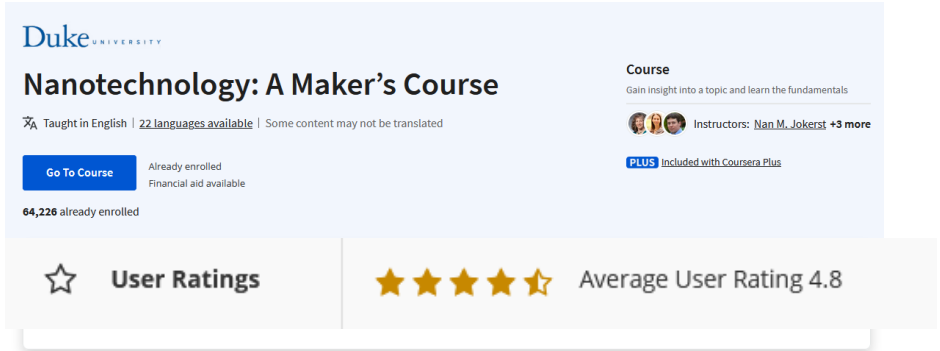
Launched September 2017

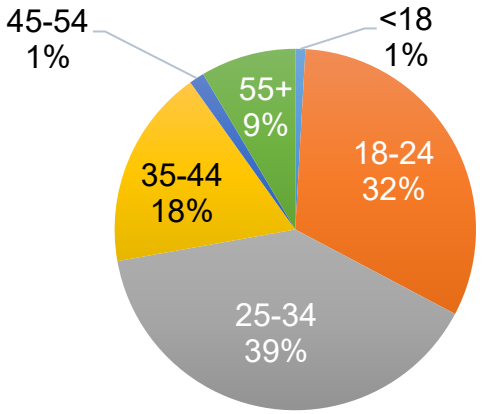
- **> 66,900 enrolled in course (Year 9: > 6,300)**
- **> 42,200 active learners (Year 9: > 4,300)**
- **> 13,300 completed course (Year 9: > 1,700)**
- **> 321,700 visitors (Year 9: > 27,000)**

High satisfaction, e.g., course content rated 6.5 on a scale with 7 being the highest (>89% "likely" or "very likely" to recommend)



"WOW, Thanks a lot for making this course, we learned a bit of the material in my class -but how the information and relationships between concepts are structured in this course are something else. Truly, thanks!"





Age of Coursera Learners

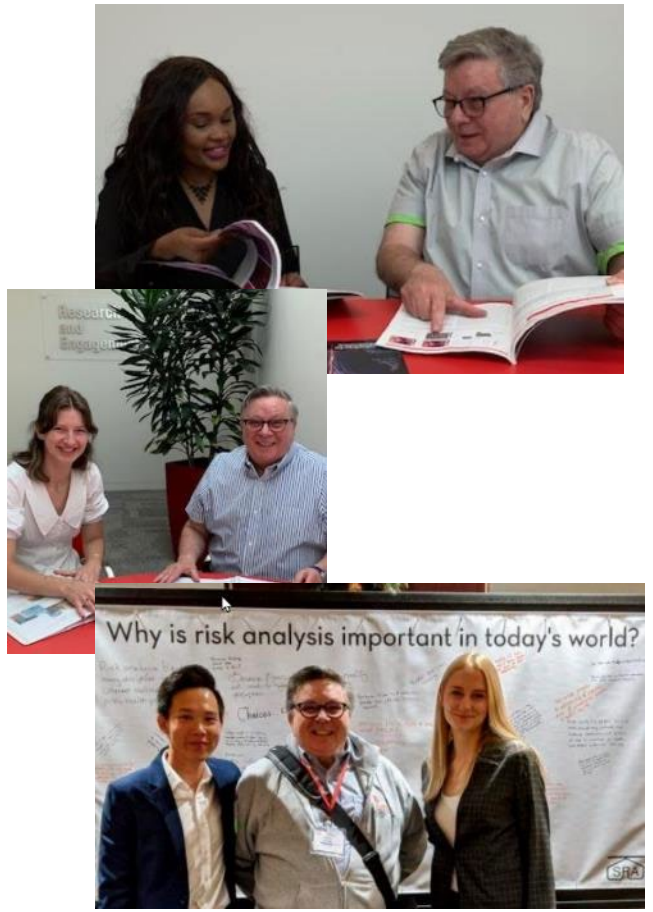
4. Assessment Protocols Established & Improved Tool Sets

Raw data and analysis from the past decade will be maintained and added to our website for continued research by others

Use of satisfaction and other variables to enhance user data has added detailed, transdisciplinary value to infrastructure assessment, soon to be published

Delphi and attribution theory on evaluating productivity variables from lab experiences will also be published

>15 PCOST/Assessment Research Assistants funded by RTNN have moved into faculty and research roles at institutions, continuing contributions to the corpus of scholarship (e.g., Rochester, Temple, Kansas, Pepperdine, Georgia, Habitat for Humanity, and USACE)



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5. RTNN Infrastructure Supports and Maintains a Growing Ecosystem

The RTNN ecosystem of individuals, facilities, and programs has fostered the creation of additional projects that, in turn, utilize RTNN facilities, e.g.:

- NSF ERC - Precision Microbiome Engineering (PreMiEr)
- DOE Energy Innovation Hub - Center for Hybrid Approaches in Solar Energy to Liquid Fuels (CHASE Center)
- NSF STC - Science and Technologies for Phosphorus Sustainability (STEPS) Center
- NSF Research Experience for Undergraduates (REU) - Elucidating the Structure and Dynamics of Hybrid Perovskite Systems
- NSF Research Experience for Teachers (RET) – Atomic Scale Design and Engineering
- DoD Commercial Leap-Ahead for Wide Bandgap Semiconductors (CLAWS) Hub in the ME Commons

PreMiEr Precision Microbiome Engineering
NSF Engineering Research Center

UNC Yale BNL CHASE Penn NCSU Emory

STEPS
Science and Technologies for Phosphorus Sustainability

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Thank You!