Partnering Opportunities with the JSNN*
Building a Lab-to-Fab Innovation Bridge Between Academia and Industry
* Gateway University Research Park

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SBTDC’s DoD SBIRSTTR Workshop, JSNN, Greensboro, NC
December 13th, 2018
JSNN Overview

- JSNN is a joint academic unit of NC A&T and UNCG
  - First nanoscience classes held in 2010
  - First nanoengineering classes held in 2011
  - $56.3 M 105K sq. ft. facility completed December 2011

- JSNN is devoted to graduate nanotechnology education and research (4 degree programs) and engagement with industry
  - ~100 M.S. and Ph.D students for Fall 2018
  - Research activities map into the industries of North Carolina
  - Focus on discovery, innovation and commercialization

- Collaboration with industry using shared infrastructure.
  - Nanomanufacturing Innovation Consortium
  - Nanobio Launchpad
  - Gateway Materials Testing Center
  - SENIC [JSNN-GaTech]
  - Sponsored Research

OAI Lithography System
Lam Research RIE Systems
Some Strategic Convergent Opportunities

Thirteen 2017 National Academy Grand Challenges

- Enhance Virtual Reality
- Reverse-Engineer the Brain
- Advance Personalized Learning
- Provide Access to Clean Water
- Advance Health Informatics
- Manage the Nitrogen Cycle
- Engineer Better Medicines
- Develop Carbon Sequestration Methods
- Secure Cyberspace
- Prevent Nuclear Terror
- Provide Energy from Fusion
- Make Solar Energy Economical

Solutions require collaborative efforts, and could come from anywhere.
Traditional Industry-Academia R&D Misalignment

Revised from: Daniel Herr, NANO Manufacturing 2014 Conference, JSNN, Greensboro, NC
Sustained economic development must be driven by innovation.

Penetrating today’s global (or even national) markets requires a very substantial resource investment to fuel innovation:

- Financial
- Intellectual
- Entrepreneurial

The challenge is even greater if the organization (or the industry) is in a “catch-up” mode.

One proven approach is to leverage resources through a cooperative association of organizations with shared visions and objectives.
One example of an SRC Compelling Reason:

193 nm optics damage studies saved members ~ $100M.

“The understanding of the mechanism and impact of 193 nm radiation on the densification of fused silica materials had a dramatic impact on the lens designs at all the major stepper suppliers. The timing of the research was ideal, as this work was presented just as the industry was developing their approaches to this new wavelength.”
The National Medal of Technology ... 

President Citation to the SRC

• “For building the world’s largest and most successful university research force to support the … semiconductor industry;
• For proving the concept of collaborative research as the first high-tech research consortium;
• And for creating the concept and methodology that evolved into the International Technology Roadmap for Semiconductors.”

Semiconductor Research Corporation Receives the 2005 NMT 

27 July 2007
# Evolution of an Emergent Technology

**Typical time-scales for breakthrough ideas to impact society**

<table>
<thead>
<tr>
<th>Technology</th>
<th>Incubation Phase (Yrs.)</th>
<th>Innovation Phase (Yrs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid State Diode</td>
<td>1874 – 1900</td>
<td>1900 - 1913</td>
</tr>
<tr>
<td>Vacuum Tube</td>
<td>1883 – 1904</td>
<td>1904 - 1919</td>
</tr>
<tr>
<td>Transistor</td>
<td>1923 – 1948</td>
<td>1948 - 1959</td>
</tr>
<tr>
<td><strong>Mean Phase Duration (Yrs.)</strong></td>
<td><strong>$22 \pm 6 (1\sigma)$</strong></td>
<td><strong>$12 \pm 3 (1\sigma)$</strong></td>
</tr>
</tbody>
</table>

Revised from D. Herr and V. Zhirnov (SRC/2003)
Design Educational Ecosystems to Achieve Desired Results

With Platform Enhanced Learning Opportunities

Convergence and Emergence

Convergence of Knowledge, Technology, and Society

Nano-Bio-Info-Cogno Convergence and Emergence

Nanomanufacturing

Strategic Educational System

Outcomes

Discovery/Understanding

Synthesis

Learning

Creation

Emergence

New Socioeconomic Capabilities

- M. Roco, NSEG Conference (2015)
Leverage colleagues who know the local environment

E.g., Bridge Industrial and Academic Cultures

Develop and share a common language and goal to uncover and develop convergent opportunities, e.g., Healthcare, communication, transportation, textiles, agriculture, etc.
JSNN Faculty Research Areas

Crosscutting-platform: Sustainability

Nanomaterials

Nanoelectronics

Textiles

Biomedical Devices

Nanomanufacturing
- Nanometrology
- Self-assembly
- Computational Nano

Biotechnology
- Pharmaceuticals
- Nano in Ag
- Toxicology

Nanoenergy
- Generation
- Harvesting

Diagnostics & Analysis

UNCG
NIC Desired Attribute Survey
February 2015

A Hands-on aptitude
B Relevant interdisciplinary education
C Research experience
D Modeling experience
E Analysis tools experience
F Environmental awareness
G Communication skills; written
H Communication skills; verbal
I Technical writing
J Collaboration/teaming skills
K Relevant internship experience
L Entrepreneurship/business skills
M System/process/product design
N System/process integration
O Design of experiments
P Equipment maintenance skills
Q Statistical process control
R Continuous improvement
S Cleanroom experience
T Process experience
U Manufacturing experience
V Reliability skills
W Effective meetings
X Sustainability
Y Ethics
Z Other: Critical Thinking Skills
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**SOFT SKILLS NEEDED IN GUILFORD COUNTY**

It’s especially hard to find workers with soft skills – those that aren’t obvious on resumes. These skills are ranked by the percentages of company responses.

<table>
<thead>
<tr>
<th>Skill</th>
<th>Percent frequency of response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical and analytical thinking</td>
<td>46%</td>
</tr>
<tr>
<td>Problem solving</td>
<td>35%</td>
</tr>
<tr>
<td>Communication</td>
<td>34%</td>
</tr>
<tr>
<td>Leadership</td>
<td>26%</td>
</tr>
<tr>
<td>Interpersonal</td>
<td>26%</td>
</tr>
<tr>
<td>Good attendance</td>
<td>23%</td>
</tr>
<tr>
<td>Customer service</td>
<td>20%</td>
</tr>
<tr>
<td>Other</td>
<td>16%</td>
</tr>
<tr>
<td>Managerial</td>
<td>15%</td>
</tr>
</tbody>
</table>

*Source: 2014 Greater Greensboro – High Point Area Workforce Development Survey by Keith G. Debbage, professor of urban geography at UNCG.*
Entrepreneurship and Translational Activities

Transdisciplinary Pivots Yield Unexpected Sustainable Technologies

From theranostic research to sustainable bait, a $6.3B market
Core Technology Molding Corporation Partners with NCAT & UNCG

**Scope:** A plastic injection molding solutions provider located next to the JSNN.

**Markets:** Aerospace, Automotive, Appliance, Biological Pharmaceutical, Heavy Truck, Medical Device and Outdoor Lawn Equipment markets.

**Location:** Relocated to Gateway University Research Park for the following reasons:

- Access to the JSNN Infrastructures
- Access to Scientists and state-of-the-art facility
- Quick turnaround with 3D printed parts capability for BMW X3 & X4 SUVs

**Selected customers:** BMW Manufacturing, Newell Rubbermaid, Husqvarna, Gaming thumbsticks for PS4, XBox1 and Nintendo consoles and Merck.

**Selected benefit:** By having access to the JSNN infrastructure, Core Tech was able to obtain contracts from BMW and Merck.
SENIC: An NNCI Partnership of GaTECH and the JSNN

Vision and Scope: Fabrication and Characterization

- **Innovation**: Strengthen and accelerate discovery in nanoscience and nanoengineering across the southeastern US
- **Commercialization**: Allow nanotechnology-based innovations to reach the market quicker
- **Education/Outreach/SEI**: Provide education, outreach and SEI programs in nanotechnology with a focus on the southeastern US
Ex.: The JSNN’s Nanobus
Initially support from Thomas Bus and Duke Power
NanoBio Launchpad

- Co-Working space w/ Wet Lab
- Month-To-Month Leases
- As needed Lab, Office, or Workstation
- Lab includes sink, benches, fume hood, safety shower, etc.
- Telephone and internet included
- Reasonable rates
NANOMANUFACTURING INNOVATION CONSORTIUM
A Program of the Joint School of Nanoscience and Nanoengineering (JSNN)
Administered by Gateway University Research Park

The Nanomanufacturing Innovation Consortium (NIC) strives to be a global leader in nanomanufacturing research. It provides access to unique state-of-the-art capabilities for product development, analytical services, materials testing, analysis, and evaluation to address the diverse needs of consortium members. NIC members gain visibility into the Joint School of Nanoscience and Nanoengineering’s (JSNN) ongoing research in nanobiology, nanomaterials, and classroom technologies, e.g., sensors, MEMS, thin films and electronic materials and devices. All consortium members will have access to JSNN facilities and have extensive networking opportunities. Memberships will be provided at three levels: Affiliate, Full Member - Nanobiology and Nanomaterials, and Full Member - Classroom.

According to a recent report released by the Project on Emerging Nanotechnologies (PEN), more than 1,200 companies, universities, government laboratories, and other organizations across all 50 U.S. states and in the District of Columbia are involved in nanotechnology research, development, and commercialization. This number is up 10 percent from just two years ago. In fact, areas of North Carolina have broken into the top rankings for the first time. The goal of the NIC is to make the Piedmont Triad region THE PLACE for Nanomanufacturing expertise.

Local Synergy
The Greensboro Economic Development Alliance (GEDA) has identified Aviation, Advanced Manufacturing & Materials, and the Life Sciences as targeted clusters for cultivating high-wage, high-growth jobs. Each of these clusters can be tapped into the activities of the NIC, making the NIC another job creation tool for our community that will help create a vibrant future for Greensboro, Guilford County, and the Piedmont Triad region.

Membership
Potential members include: companies engaged in nanomanufacturing; companies that produce nanoparticles, nanofibers, films or other nanomaterials; companies that produce machinery used for nanomanufacturing; companies that use nanomaterials in the manufacture of goods; U.S. government organizations that have an interest in nanotechnology and nanomanufacturing and organizations engaged in research, economic development or collaboration where nanotechnology is critical to their success.

• Access to Scientific Tools and Equipment
• Training Included
• Online reservation system
• Technical assistance available
• Membership based
• Reasonable rates
• Access to other amenities included
• Invitations to all research seminars at the JSNN
Gateway Materials Test Center
2901 East Gate City Blvd., Suite G300
Greensboro, North Carolina 27401

The Gateway Materials Test Center (GMTC) is a program of the Joint School of Nanoscience and Nanoengineering (JSNN) administered by Gateway University Research Park. The GMTC specializes in Polymer Matrix Fiber Reinforced Composites and Textiles. GMTC is fully equipped to serve all of your materials testing needs. Located in Research Facility One at Gateway’s South Campus in Greensboro, NC, the Gateway Materials Test Center is just minutes from the Piedmont Triad International Airport, a FedEx hub.

ISO 17025 Certified
ASTM • AATCC
Aerospace • Automotive • Textiles
Chemical, Analytical, Physical Testing
State of the Art Equipment
Research and Consulting Services
Emphasis on Quality

Full Service Materials Testing

**Mechanical (-100° F to 650°F environmental)**
- Static (Strength & Modulus)
- Fatigue
- Impact
- Environmental Conditioning
- Ultrasonic
- Fracture Toughness

**Physical**
- FTIR
- Microscopy (SEM, TEM, He Ion)
- XRD
- Mass Spectrometry
- HPLC
- Thermal Analysis
- Volume Fraction Analysis

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Thank You

“I was like a (child) playing on the sea-shore, and diverting myself now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me.”

- Isaac Newton
Development of a New Sustainable Crustacean Bait

“A Stinky Artificial Bait Could Protect Millions of Tiny Fish: Crabs and lobsters are drawn to a totally synthetic bait, which could reduce the large take of live baitfish from the sea.” Scientific American.