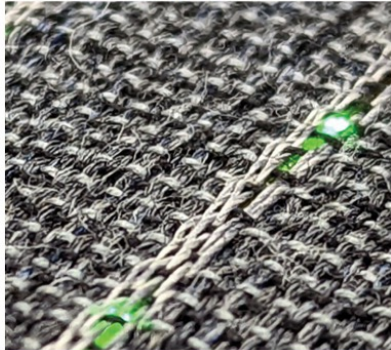




Ecosystem Impacts





FROM MANUFACTURING INNOVATION TO MISSION IMPACT

NICK MORRIS, PH.D.
DEPUTY DIRECTOR OF TECHNOLOGY
NEXTFLEX

MANUFACTURING USA NETWORK MEETING

MAY 12, 2026

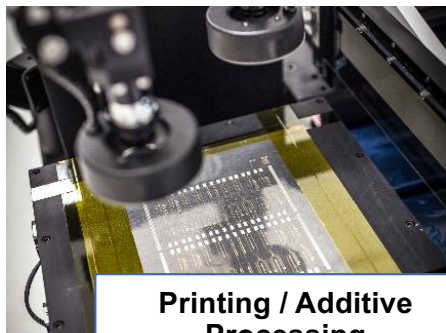
ACKNOWLEDGMENT



This material is based on research sponsored by Air Force Research Laboratory under agreement numbers FA8650-15-2-5401 and FA8650-20-2-5506. The U.S. Government is authorized to reproduce and distribute reprints for Governmental purposes notwithstanding any copyright notation thereon. The views and conclusions contained herein are those of the authors and should not be interpreted as necessarily representing the official policies or endorsements, either expressed or implied, of Air Force Research Laboratory or the U.S. Government.

WHAT ARE “HYBRID ELECTRONICS”?

Hybrid Electronics (HE) combines additive electronics manufacturing with electronics assembly, enabling a many device types and spanning electronic packaging to system integration.



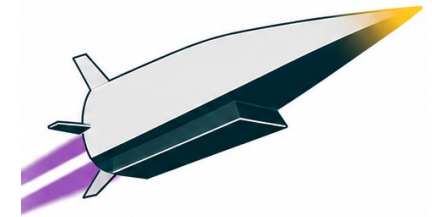
Printing / Additive Processing



Discrete Components / Thin Semiconductor Die



SWaP-C Constrained Platforms



Extreme Environments Electronics



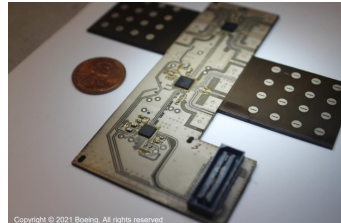
Distributed / Embedded Architectures

HE enables capabilities that conventional PCB and packaging approaches cannot.

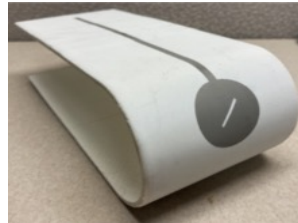
HYBRID ELECTRONICS APPLICATIONS



**Broadband
3D Antennas**



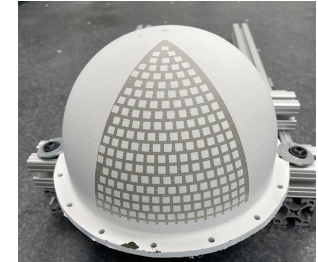
**Lightweight
Array Antennas**



**Hypersonic
Sensing and
Antennas**



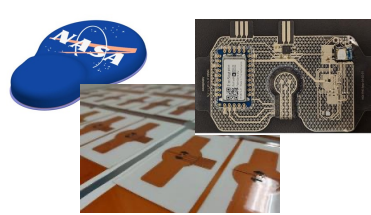
**3D Conformal
Micro**



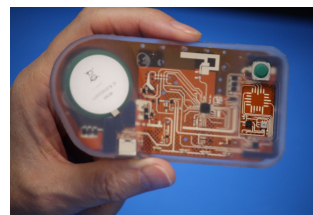
**3D Conformal
Macro**



**In-Mold
Electronics**



**In-Space
Manufacturable
Crew Monitor**



**Confined Space
Safety Monitor**



**Textile
Integration**



**Factory Asset
Monitor**

NATIONAL AND REGIONAL PARTICIPATION: NEXTFLEX MEMBERSHIP MIRRORS THE INDUSTRIAL BASE



Regional Nodes

New York Node

Division of Science, Technology & Innovation
A Division of Empire State Development

Missouri Node

Massachusetts Node

Alabama Node

Electronics Packaging Research Institute

Members

MATERIALS

EQUIPMENT

DESIGN/COMPONENT MFG

SEMICONDUCTOR

DESIGN/MANUFACTURING

INDUSTRIAL/AEROSPACE/DEFENSE

MEDICAL/WEARABLE DEVICES

RESEARCH

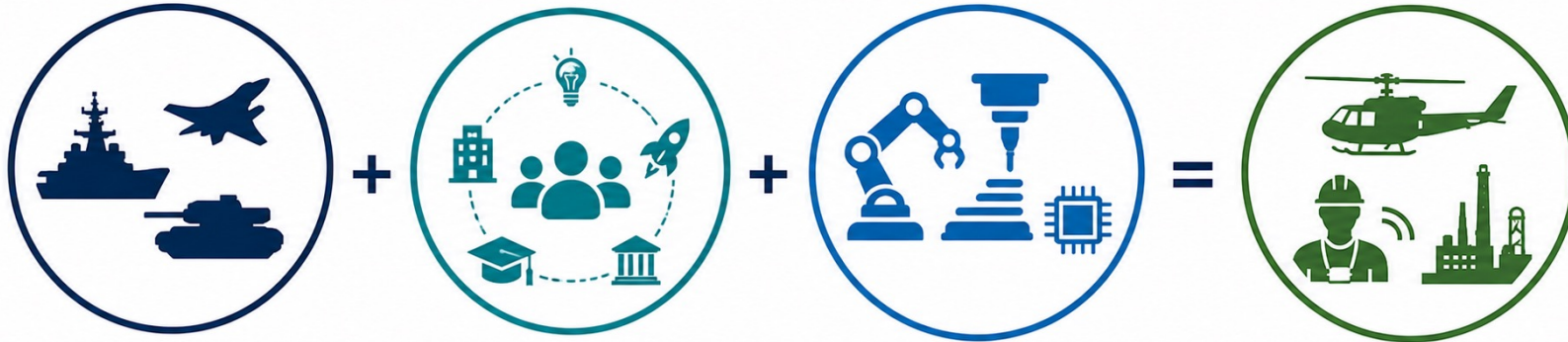
ACADE

WORKFORCE

ASSOCIATE MEMBERS

220+ MEMBERS

ROLE OF NEXTFLEX IN TECHNOLOGY MATURATION



DoW / Industry Need

Engages DoW and industry stakeholders to identify capability gaps and define mission-aligned technical requirements

NextFlex Ecosystem

Assembles and leads multi-disciplinary teams to execute targeted development programs

Adv. Mfg. & Scale Up

Leverages the Technology Hub, Nodes, and member ecosystem to design, prototype, iterate, and derisk technologies

Fielded Capabilities

De-risks and supports transition of validated capabilities into defense programs, dual-use applications, and commercial production

Case Study:



Transition into DoW Program of Record

COMPACT HIGH BANDWIDTH SPIRAL ANTENNA



Motivation: High-performance antennas are critical for SWaP-constrained defense platforms, but conventional manufacturing approaches could not realize compact 3D spiral geometries.



Lockheed Martin
Payload: >9,000 lbs
Manned Vehicle Mission Systems



Payload: a few lbs
Unmanned Vehicle Mission Systems

Technical Challenge:

- Spiral antenna architectures (*Lockheed, 2015*) provide strong RF performance; traditionally require larger geometries.
- Existing manufacturing approaches limit compact integration into tactical systems.

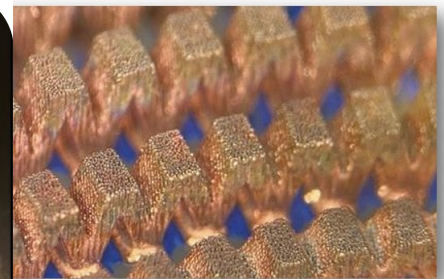
NextFlex-Enabled Solution:

- Project Call 8.0 project; leveraged several previous PCs
- Electrochemical Additive Manufacturing (ECAM) enabled fabrication of complex 3D copper spiral geometries

~60% volume reduction

3x performance improvement

Transition to POR



Picture courtesy of Fabric8 Labs

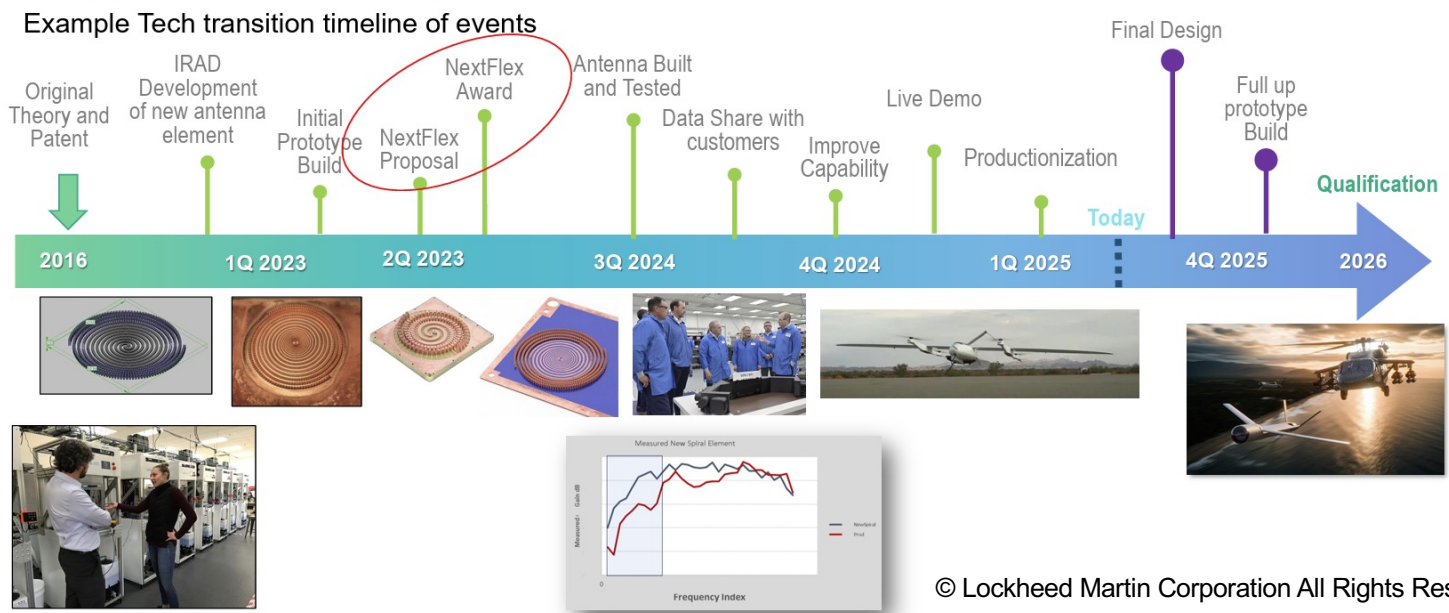
WHY THIS TRANSITION SUCCEEDED AND WHAT IS THE SUCCESS?



Integrating the correct technology in the correct application at the correct time!

LEGEND

- Complete / Deployed
- In-Progress



© Lockheed Martin Corporation All Rights Reserved

- Accelerated a promising startup
- Increased supply chain resilience
- Grew the Defense Industrial Base
- Derisked transition by proving tech and mfg

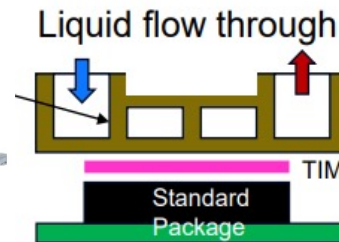
LOOKING FORWARD

Follow-on Projects

FABRIC8LABS

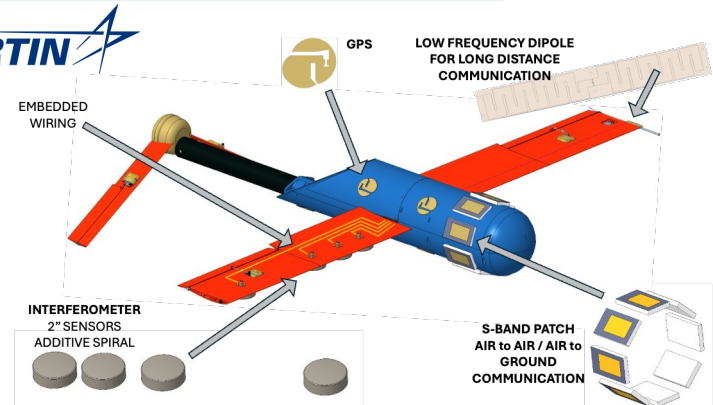


High Resolution Copper on Silicon



PC9.2: CuPID: Direct Copper Printing on Integrated Die

LOCKHEED MARTIN



PC10.3: Canister Launched High Volume Additively Manufactured Printed Antenna UAV Demonstrator (CHAMP)

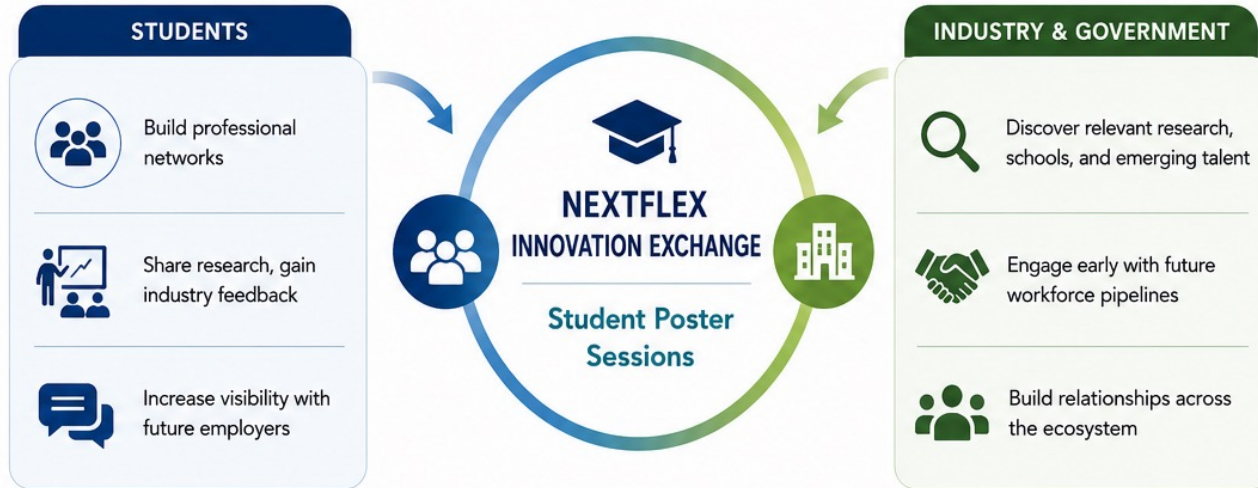
Strategic Takeaways

- Hybrid electronics enable mission capabilities conventional manufacturing cannot support.
- Transition success requires integrated manufacturing ecosystems that connect design, fabrication, scale-up, and operational transition.
- Strategic advantage depends not only on technology invention, but on the ability to transition manufacturable capability into operational systems rapidly and at scale.

NEXTFLEX INNOVATION EXCHANGE: TECHNOLOGY & EWD



A virtual student poster series that connects emerging talent with industry and government.



HOW IT WORKS

- 90-MINUTE SESSIONS**
Ten graduate students from five universities
- STUDENT INTRODUCTIONS**
Short presentations where each student shares an overview of their research
- VIRTUAL POSTER BREAKOUT ROOMS**
Attendees move between student posters, ask questions, and engage in open dialogue

Two technical areas spotlighted per session for diverse and relevant topics

EARLY IMPACT, LONG-TERM VALUE

From the first two sessions (~20 students), at least **one company has already pursued a student for an internship opportunity.**

LONG-GAME STRATEGY
Focused on cultivating and retaining talent in the hybrid electronics field over time.

STRATEGIC GOAL
Help ensure students trained in hybrid electronics remain engaged and employed in the field.

BY THE NUMBERS (TO DATE)

10 Students per session	5 Universities per session	90 Minutes of high-value engagement
-----------------------------------	--------------------------------------	---

THANK YOU



NICK MORRIS, Ph.D.

DEPUTY DIRECTOR OF TECHNOLOGY, NEXTFLEX
NMORRIS@NEXTFLEX.US

The logo for CyManII, featuring the word "CYMANII" in a bold, white, sans-serif font. A thin yellow diagonal line crosses through the letter "A".

CYMANII

the cybersecurity
manufacturing
innovation institute

CyManII Industry Use Cases

May 12th, 2026

Dr. Howard Grimes
CEO

The logo for CyManII, featuring the word "CYMANII" in a bold, white, sans-serif font. A thin yellow diagonal line crosses through the letter "A".

CYMANII
the cybersecurity
manufacturing
innovation institute

Contains trade secrets or commercial or financial information that is privileged or confidential and exempt from public disclosure.
Do not copy, cite, or distribute without permission of the author.





CyManII Industry Use Cases

CyManII initially focused on foundational topic innovation....

Cyber-Physical Passports



THE PROBLEM

A Boeing 747-8 comprises of **6 million parts.**

Manufacturers need a system that provides:

- **Provenance:** the ability to track parts across the supply chain from design to final product
- **Verification:** the ability to confirm the integrity of parts at each stage of manufacture

THE SOLUTION

Cyber-Physical Passports (CPP)

provides a framework for secure query and analysis that verifies the provenance of disparate parts.

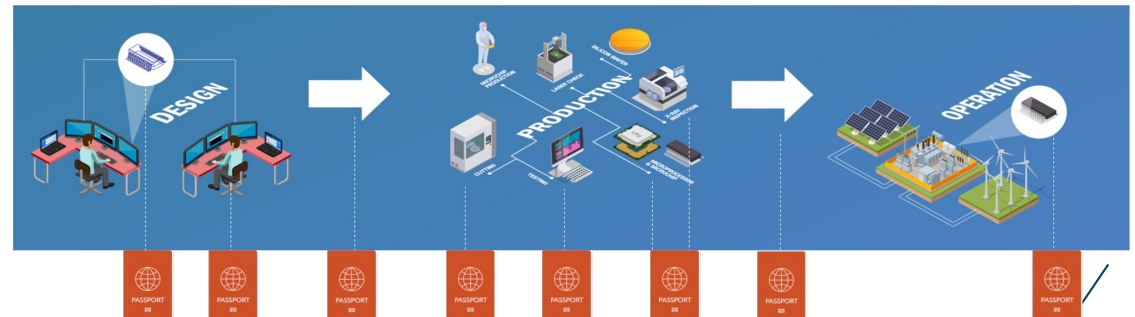
CPP BENEFITS IDENTIFIED BY INDUSTRY PARTNERS:

TRUST: verify products across suppliers

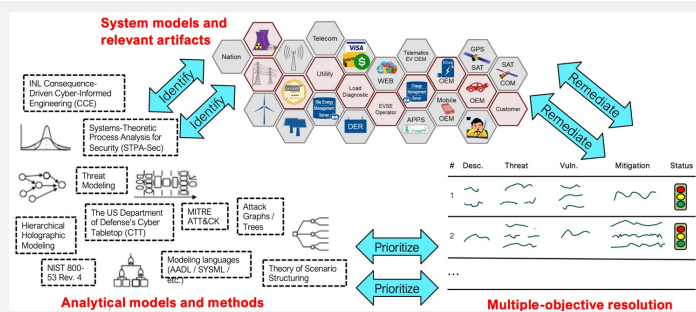
VISIBILITY: analyze and track processes/products to ensure compliance

SECURE DIGITIZATION: outperform state-of-the-art commercial quality control report generators

COLLABORATION: ability to interoperate with partners



Compositional Attack-Defense Annex (CADA)



THE PROBLEM

Threat modeling and risk analysis is **complex**.

Manufacturers need security guarantees:

- **Formal modeling:** the ability to model systems to enable automated risk analysis
- **Safety & security analyses:** the ability to conduct a formal model-based security assessment

THE SOLUTION

CADA enables the evaluation of system reliability and fault tolerance under different conditions, aligning with security threat modeling concepts such as MITRE ATT&CK and D3FEND.

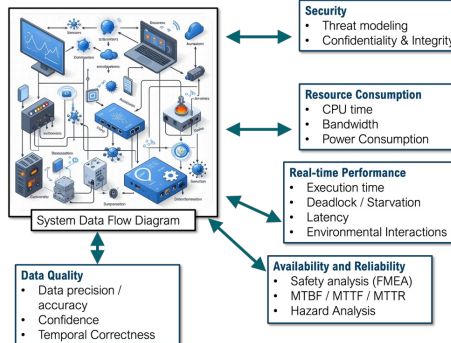


CADA BENEFITS IDENTIFIED BY INDUSTRY PARTNERS:

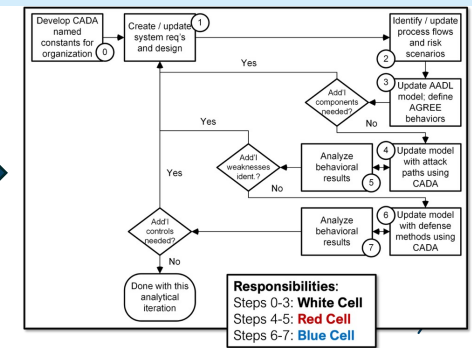
TRUST: provide link to the CPP framework

MODEL SEMI-AUTOMATION: ability to leverage LLMs to semi-automate the model generation

FLEXIBILITY: different environments from one machine to a pipeline



THREAT SCENARIO EXPLORATION: expose potential threat scenarios for industry partners





CyManII Industry Use Cases

CyManII initially focused on foundational topic innovation....

Then, CyManII focused on validating these innovations via Industry Use Cases – 10 projects with industry (we will highlight two here; one SMM (Humtown) and one OEM (GE Vernova))

Tested CPP and CADA with Industrial Partners

Small businesses...

Sector Problem: SMEs in additive manufacturing face design and product security risks and limited monitoring of critical production parameters.

Humtown, a family-owned foundry supplier, produces conventional and 3D-printed sand molds and has experienced ransomware attacks, leading it to seek support from CyManII.

CPP Provenance for 3D printer at Humtown

Normal Ops

1. Design: Passport created with design and G-code.
2. Production: Process and telemetry data captured.
3. Verification: Data validated and consolidated.
4. Outcome: End-to-end traceability and provenance.

CPP enables secure queries and analysis to verify part provenance

CADA model for 3D printer at Humtown

Demonstrated Attack Scenarios

1. G-code tampering on the HMI prior to printing.
2. Installation of unauthorized, vulnerable software on the HMI.
3. Manipulation of PLC configuration and HMI commands to force unsafe operating temperatures.



SBA 2026 National Small Business of the Year!!!!

Outcome:

Improved protection of design files and product data via:

Formal modeling of attack paths, mitigated via CPP verification and anomaly detection, demonstrating applicability in zero-downtime facilities.



“Verifying the integrity of our files and printing process through a CPP is extremely important in this age of cyber attacks... having been victims of threat actors in the past, we can validate the need to protect every facet of a business... through the use of CPPs, we can track usage and wear to be proactive with maintenance and prevent untimely machine stoppage, faulty parts, and delivery delays.”
 – The Humtown Team

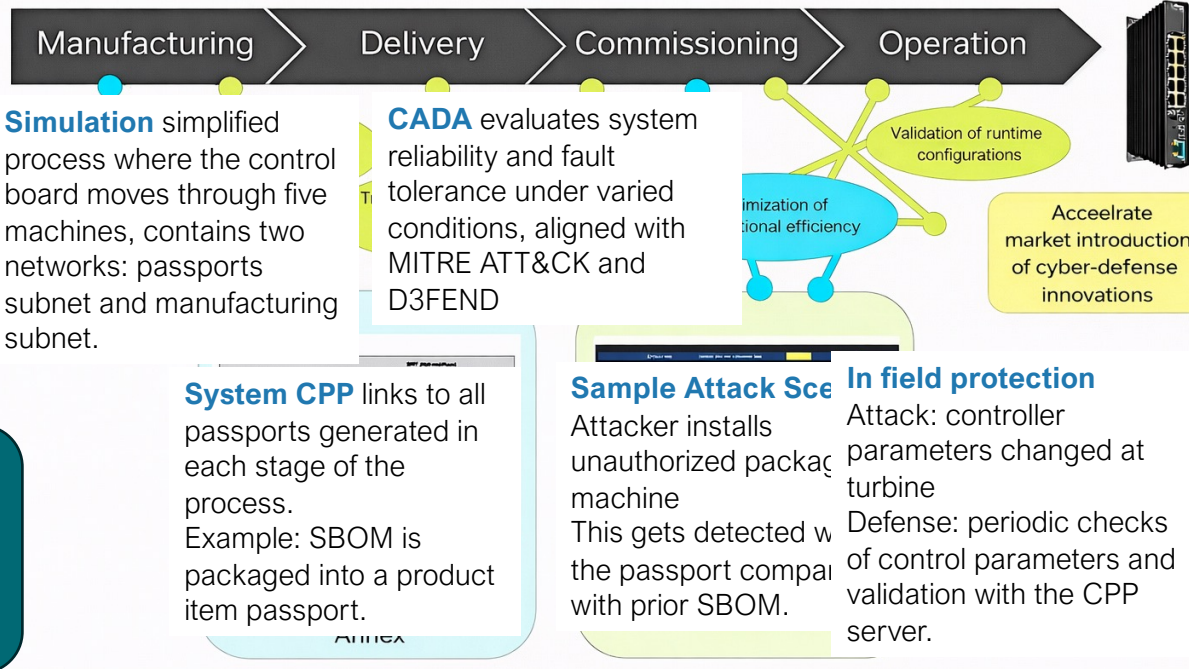
Tested CPP and CADA with Industrial Partners OEMs...



Sector Problem:

Securing the Universal Controller Standalone-E (UCSE) manufacturing process and enabling customers to verify OEM-intended integrity in operational environments critical to U.S. infrastructure.

GE Vernova needs cyber-defense innovations to prevent attacks on its controllers, which is why it collaborates with CyManII.



Outcome: End-to-end cyber hardening of ICS supply chains and operations, improving the security posture, with CPP transitioning to internal roadmap. This industry case demonstrates scalability spanning from suppliers to field operations.

“The results of this project will provide a blueprint implementation of end-to-end cyber hardening of ICS integrity across their entire lifecycle in a production environment with one of the largest OEMs worldwide who will ultimately develop a roadmap to adopt these technologies for its product line and increased affordability.” – The GE Vernova Team



What can other institutes learn from these examples?

- Create an infrastructure that enables industry to follow a consistent framework for validating ICS provenance
- Perform security verifications formally and analytically
- Provide guarantees for products manufactured and commissioned in the US

Same infrastructure can be applied to both small and large businesses

Next steps or future plans (areas where government partners could help)

- Provide seed funding for the transition of pilot to industry incorporation
- Enable mechanisms to create semi-automation and self-healing capabilities for the Secure Defensible Architecture elements of CPP and CADA via embedding AI approaches (expanding on what we are currently pursuing)
- Provide further test environments to pilot these innovations on government systems (these systems, and data, need provenance!)
- Organize workshops between industry and Institutes on topical areas (i.e. digital thread / DT cyber for automotive manufacturers)



CYMANII

the cybersecurity
manufacturing
innovation institute



Workforce Innovation

Development

NIIMBL U.S. Biopharma Workforce Partnership Conference

Building and strengthening critical cross-regional partnerships between industry and academia

John Balchunas
Workforce Director, NIIMBL
May 2026

Partnerships

Skills

Talent Acquisition

Industry

Education



Cross Regional Collaboration: A Problem Statement

- **The workforce ecosystem is busy and energized** in many regions thanks to investment by big pharma and federal/regional funding sources
- **Regional education, training, and workforce development assets are competitive** and valuable economic development resources
- **Cross regional collaboration doesn't come naturally**, and as a result, there are silos and lots of wheels being reinvented
- **There is great opportunity** for pre-competitive cross-regional collaboration



NIIMBL launched an annual workforce conference in response.

- 2024 in Boston, MA
- 2025 in Durham, NC
- 2026 in San Juan, PR



NIIMBL
LORI Wojcik
NIIMBL
SKILLS-FIRST HIRING
APPRENTICESHIPS
NETWORKING
TRIATHLON
SOURDOUGH BREAD

- **Strengthen industry-academic partnerships** that fuel talent pipelines
- **Illuminate labor market trends** and future workforce needs
- **Highlight regional workforce infrastructure** as a key factor in site selection and expansion
- **Catalyze collaboration** across sectors on shared challenges and opportunities

We approach things a little bit differently with this conference.



Dynamic Session Content

Plenary sessions focus on emerging workforce needs, partnership best practices, success stories, and metrics.



Partnering Booths/Tables

Semi-structured partnering tables provide an opportunity for all organizations to connect and collaborate.



Unconference

Participant-driven portion of the agenda where attendees drive discussion on the topics that matter to them

- Impact of AI on Biopharma Workforce
- Site Selection and Reshoring
- Regional Economic Development Strategy
- Industry-Academic Partnership Best Practices
- Brain Drain
- Metrics and Storytelling

- Attending orgs gets a **partnering table/booth** for semi-structured partnering and networking session
- Attending orgs can elect to give a “**quick pitch**” to let attendees better connect with them

- Participant-driven sessions, no A/V, no agenda
- 300+ topic ideas collected at registration, attendees vote on topics, and the top 20+ topics become sessions
- Law of Two Feet

Reception by the national community has been impressive.

200

Individuals in 2025

105

Organizations in 2025

“

I hope you and the rest of the NIIMBL team are quietly gloating and super proud of yourselves this weekend. Some conferences are super informative, but not fun. Others are fun, but logistical messes. And others are logistically on point, but the information is all blah blah blah. You guys somehow pulled off this trifecta while NOT scurrying around aloof from your participants. The result is a fun, creative, polished, smooth event that is loaded with information. But the most surprising part is the way you ALL consistently remain kind, helpful, and friendly to your attendees. Get some rest but pat yourself on the back. You guys crushed it this week.







Thank You!