NAE MEMBER-LED WORKSHOP EVENT

# QUANTUM MANUFACTURING:

## BRIDGING RESEARCH, INFRASTRUCTURE, AND SUPPLY CHAINS FOR SCALABLE QUANTUM SYSTEMS

**DATE: MAY 7TH, 2026 | TIME: 08:00 AM - 5:30 PM**

NATIONAL ACADEMY OF SCIENCES, ENGINEERING AND MEDICINE
2101 CONSTITUTION AVENUE NW, WASHINGTON, D.C. 20418.

## CO-CHAIRS


**AJAY "AJ" P. MALSHE**
MEMBER NAE | PURDUE UNIVERSITY

**SAMUEL GRAHAM JR**
UNIVERSITY OF MARYLAND


## ORGANIZING MEMBERS


**STEPHAN BILLER**
MEMBER NAE | PURDUE UNIVERSITY

**VLADIMIR M. SHALAEV**
MEMBER NAE | PURDUE UNIVERSITY

**ALEXANDRA BOLTASSEVA**
MEMBER NAI | PURDUE UNIVERSITY

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UNIVERSITY OF MARYLAND

**ANKUR SRIVASTAVA**
UNIVERSITY OF MARYLAND


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# Quantum Manufacturing: Bridging Research, Infrastructure, and Supply Chains for Scalable Quantum Systems

**Day and Date**: Thursday, May 7, 2026

**Location and Address:** National Academy of Sciences, Engineering, and Medicine (NASEM), 2101 Constitution Avenue NW, Washington, D.C. 20418.

**Morning Session: Setting the National Context**

**8:00 – 8:30 AM**
Registration and Networking Breakfast

**8:30 – 9:00 AM**
- Welcome and Workshop Overview by Workshop Co-Chairs
    - Ajay P. Malshe (Member, NAE) and Samuel Graham
- Opening remarks by Tsu-Jae Liu (Member, NAE), President, National Academy of Engineering (NAE)

**9:00 – 9:30 AM**
**Keynote Speaker-1**
- Joseph Broz, IBM

**9:30 – 10:00 AM**
**Keynote Speaker-2**
- Joel Mozer, Emeritus Chief Scientist (1st), US Space Force

**Panel 1**
**10:00 – 11:00 AM**
**Panel anchor-** Samuel Graham, University of Maryland
**Leads and Topic**: **From Lab Prototypes to Manufacturable Quantum Systems**
- Robert Visser, Applied Materials
- Nicholas Harrigan, NVIDIA
- Vladimir Shalaev (Member, NAE), Purdue University
- Francis Patrick McCluskey, University of Maryland

**Panel 2**
**11:05 AM – Noon**
**Panel anchor-** Ajay P. Malshe, Purdue University
**Leads and Topics**: **Supply Chain Fragility, Materials, and Infrastructure**
- Nick Kamin, U.S. Space Force
- Stephan Biller (Member, NAE), Purdue University
- Michael Descour, Sandia National Laboratory
- Sauli Sinisalo, Bluefors

***Noon – 1:00 PM***
***Networking Lunch***

**1:00 – 1:30 PM**
**Keynote Speaker-3**: Sridhar Tayur (Member, NAE), Carnegie Mellon University

**1:30 – 2:00 PM**
**Keynote Speaker-4**: Vimal Kamineni, PsiQuantum

**Panel 3**
**2:05 – 3:00 PM**
**Panel anchor-** Ankur Srivastava, University of Maryland
**Leads and Topics: Workforce, Skills, and the "Quantum Manufacturing Stack"**

- Alexandra Boltassava, Purdue University
- Jonathan Felbinger, QED-C
- Saikat Guha, University of Maryland

**Panel 4**
**3:05 – 4:00 PM**
**Panel anchor-** Corey Stambaugh, University of Maryland
**Leads and Topics: Standards, Interoperability, and Scaling Architectures**

- Jorge Arinez, General Motors
- Gretchen Campbell, University of Maryland

**Panel 5**
**4:05 – 5:00 PM**
**Panel anchors: Co-chairs of the Event**
**Presenters and Topic:** Findings, Trends & Drivers of Quantum Manufacturing

- Ajay P. Malshe, Purdue University
- Sam Graham, Jr., University of Maryland

**5:00 – 5:15 PM**
**Closing comments:**

- Alton D. Romig, Jr (Member, NAE), Executive Officer, National Academy of Engineering (NAE)

**A note of thanks**: Samuel Graham and Ajay P. Malshe

Note: Attendees can take bio breaks and snacks/drinks at their convenience; snacks/drinks will be available in the area.

# Appendix

**Framework of Discussion at the event to identify Trends & Drivers for Quantum Manufacturing**

**Co-Chairs:** Ajay "AJ" P. Malshe (Member, NAE), Purdue University, and Samuel Graham, Jr., University of Maryland.

**Organizing Members:**

| | |
|---|---|
| Purdue University – | Stephan Biller (Member, NAE), Alexandra Boltasseva, and Vladimir M. Shalaev (Member, NAE) |
| University of Maryland – | Francis Patrick McCluskey and Ankur Srivastava |

**Workshop on Quantum Manufacturing**:
Manufacturing and supply chain to deliver quantum systems at scale across a range of applications on Earth and in Space. In the workshop, we want to identify Trends and Drivers for Quantum Manufacturing. Top four themes for panel discussions between industries, government, and academia for quantum manufacturing and supply chain for scaling science to engineered quantum systems.

**Participants and characters of the panel theme and scope:**
The following themes are not only strategic but also force **cross-sector tension and collaboration**, where industry needs scale, academia pushes boundaries, and government shapes incentives and risk. Here are four high-impact panel themes that consistently surface in serious quantum manufacturing conversations:

<u>**Panel- 1. From Lab Prototypes to Manufacturable Quantum Systems**</u>

**Core question:** How do we transition fragile, bespoke quantum experiments into repeatable, scalable products?

**Why it matters:** Most quantum platforms (superconducting, trapped ions, photonics, spin systems) are still closer to lab artifacts than manufacturing systems.

**Discussion angles:**

- Design-for-manufacturing (DfM) in quantum hardware
- Standardization of fabrication processes (cleanroom vs. foundry models)
- Yield challenges and defect tolerance at quantum scales
- Bridging TRL gaps (Technology Readiness Levels)

**Example points to explore:**

- Academia optimizes performance; industry needs reproducibility
- Government funding often stops before manufacturability is proven

<u>**Panel- 2. Supply Chain Fragility, Materials, and Infrastructure**</u>

**Core question:** What does a resilient supply chain for quantum systems actually look like?

**Why it matters:** Quantum systems rely on **exotic materials, ultra-high purity components, and niche suppliers**, often single source.

**Discussion angles:**

- Critical materials (e.g., isotopically pure silicon, niobium, rare earths, etc.)
- Cryogenic infrastructure and specialized equipment bottlenecks
- Geographic concentration and national security implications
- Lessons from semiconductor and aerospace supply chains

**Example points to explore:**

- Open global collaboration vs. strategic autonomy
- Cost vs. resilience in early-stage markets

**Panel- 3. Workforce, Skills, and the "Quantum Manufacturing Stack"**

**Core question:** Who builds quantum systems, and how do we train them at scale?

**Why it matters:** There's a major gap between **PhD-level quantum scientists** and **technicians/operators who can run production environments**.

**Discussion angles:**

- Hybrid skill sets (quantum physics + microfabrication + systems engineering)
- Role of community colleges, apprenticeships, and upskilling programs
- Talent mobility between academia, startups, and large manufacturers
- Digital tools (AI, simulation, digital twins) in workforce augmentation

**Example points to explore:**

- Academic training pipelines vs. industry-ready skills
- Speed of workforce development vs. pace of technology evolution

**Panel- 4. Standards, Interoperability, and Scaling Architectures**

**Core question:** What standards are needed to enable a scalable quantum industry?

**Why it matters:** Without standards, every system is bespoke, making supply chains inefficient and slowing ecosystem growth.

**Discussion angles:**

- Hardware interfaces and modular architecture
- Metrology and benchmarking standards (how do we measure "quality"?)
- Software-hardware co-design and interoperability
- Role of organizations like the National Institute of Standards and Technology and international bodies

**Example points to explore:**

- Premature standardization vs. innovation freedom
- Competing technology stacks (superconducting vs. photonic vs. ion-based)