



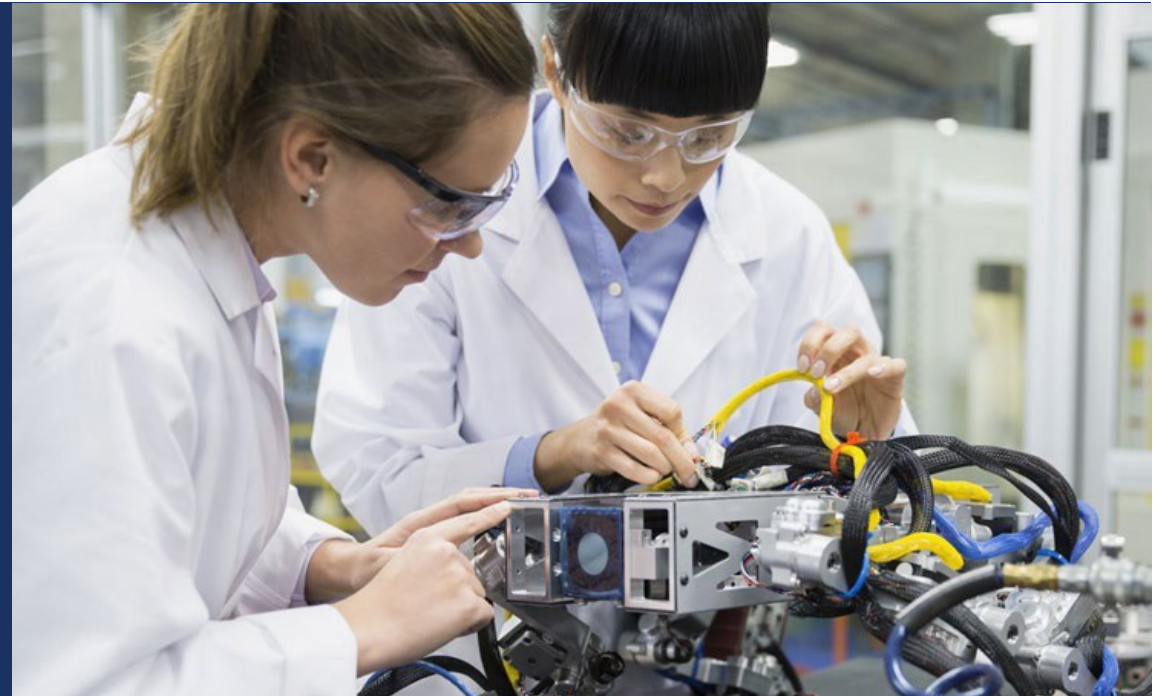
ADVANCED MANUFACTURING

JOBS OF THE FUTURE

JULY 28, 2021

DISCLAIMER

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U.S. Department of Education

Search...

Student Loans

Grants

Laws

Science, Technology, Engineering, and Math, including Computer Science

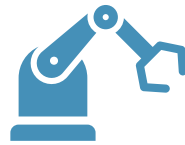
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...that our nation's youth are prepared to bring knowledge
...ate evidence to make decisions. These are
...science—disciplines
...and solve some

U.S. DEPARTMENT
OF EDUCATION
STEM RESOURCES

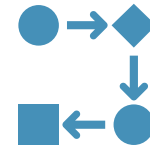
ed.gov/STEM



Technology



Workforce



Supply Chain

STRATEGY FOR AMERICAN LEADERSHIP IN ADVANCED MANUFACTURING



AMY LOYD, Ed.L.D.



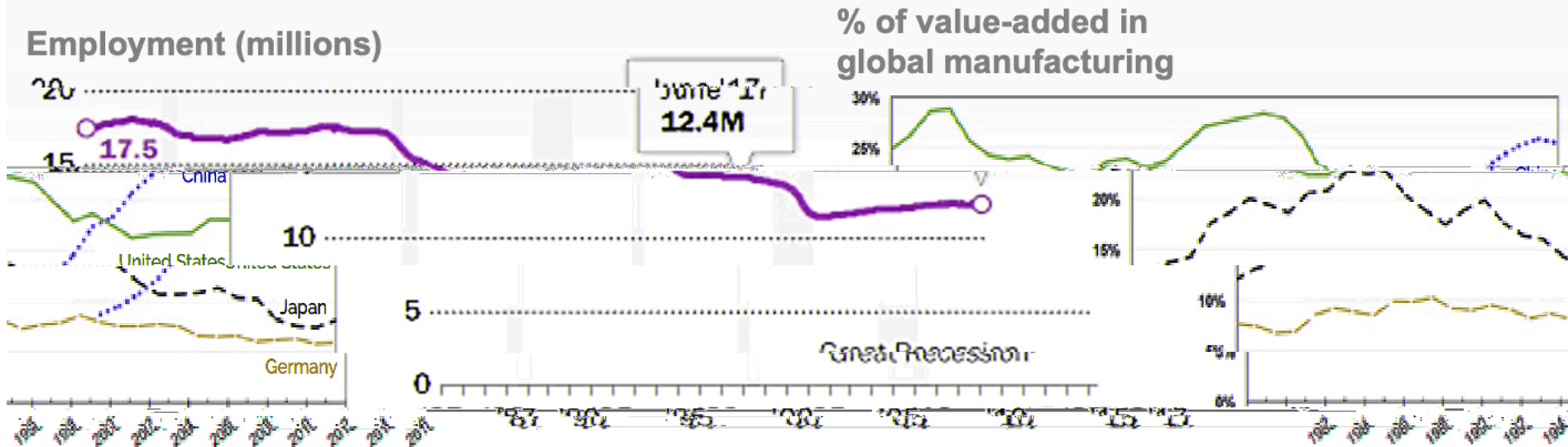


MICHAEL BRITT-CRANE



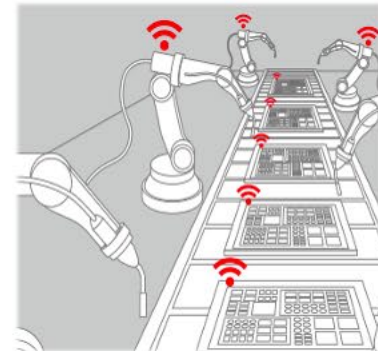
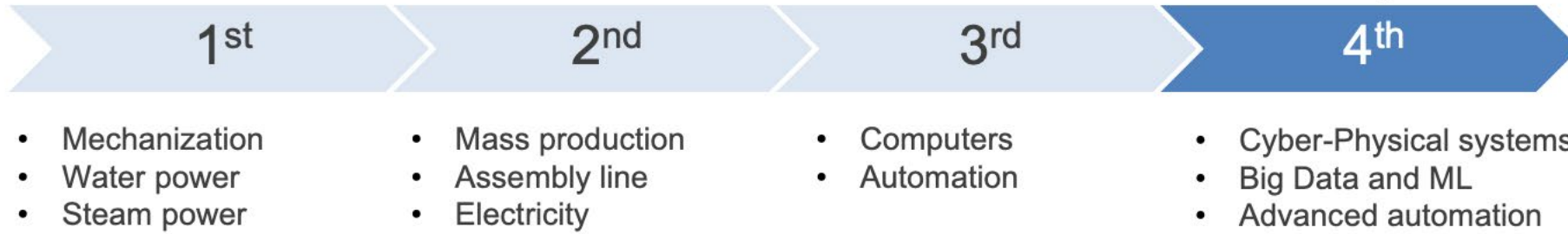
A Decline in US Manufacturing

Domestic manufacturing employment dropped nearly 30% from 2000 to 2010... ... foreign competition picked up the slack



Revitalizing domestic manufacturing is essential to national security, global competitiveness, and to a robust recovery from the COVID-19 crisis .

The world is undergoing a fourth industrial revolution



Advanced Manufacturing Technology presents an opportunity to build a technologically advanced manufacturing industry with a highly skilled, well paid workforce.



DoD Manufacturing Innovation Institutes Current Network



- Since Launching in 2012
- Committed Funding: \$1.19B+ Federal and \$1.96B+ Private/State Investments
 - 1,510+ companies, universities, and non-profit members or partners
 - DoD MII members across 49 states, Washington DC, and Puerto Rico



Flexible Hybrid Electronics
San Jose, CA



Bioindustrial Manufacturing
St. Paul, MN ★



Digital Manufacturing & Design
Chicago, IL



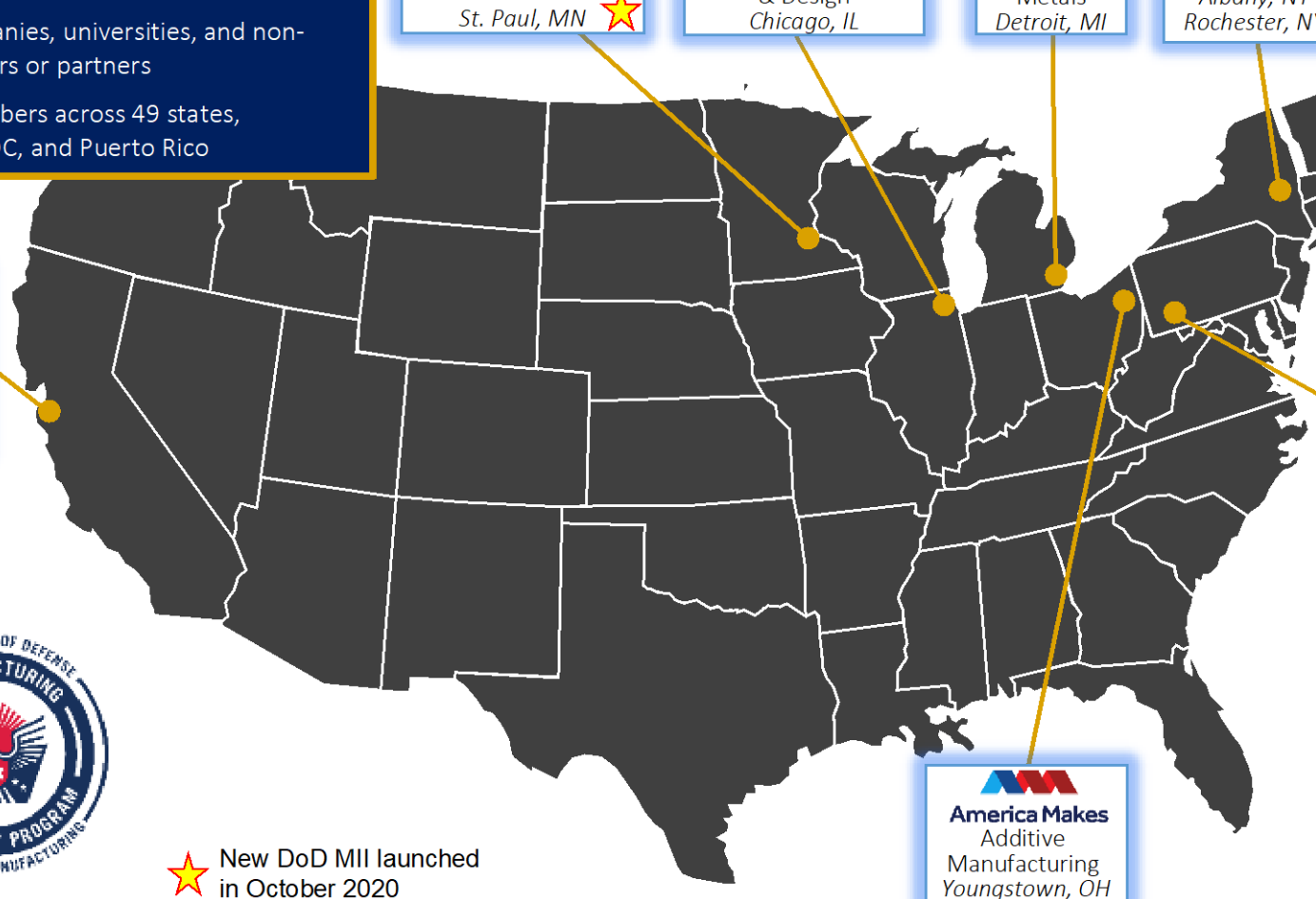
Lightweight Metals
Detroit, MI



Photonics
Albany, NY
Rochester, NY



Regenerative Manufacturing
Manchester, NH




Advanced Fibers and Textiles
Cambridge, MA



Advanced Robotics
Pittsburgh, PA



Additive Manufacturing
Youngstown, OH



★ New DoD MII launched in October 2020



The Skills Gap

Before COVID-19, manufacturing growth was constrained by a shortfall of talent, with **2.4M unfilled jobs projected by 2028.**

- Technology Transformation (Industry 4.0)
 - Skill needs for industry 4.0 \neq skills of the workforce pool
 - Labor market supply not meeting employer demand
 - Generational shift in workforce interests
- Unresponsive Education and Workforce Systems
 - Curriculum lagging rapid technology advances
 - Hybridization of skills needs across disciplines
 - Insufficient connectivity with industry
 - Industry 4.0 education inadequately resourced

IMPACTS
FELT AT
THE
REGIONAL
LEVEL

“The skills gap is upon us; it is the existential threat to our manufacturing economy.”

– Blake Moret, CEO, Rockwell Automation



Key Strategies

1. Modernize Manufacturing Education

- Develop talent & technology concurrently
- Employ disruptive innovations in learning tools, venues, and pathways in traditional education
- Model Career and Technical Education modernization and expand non traditional learning models

2. Expand the Talent Acquisition Pool

- Promote diversity, equity, inclusion, and economic mobility
- Map adjacent skills across economic sectors
- Upskill and reskill the incumbent workforce;

3. Drive Action Regionally

- Engage workforce & economic development interests

Deploy via Localized, Demand-Driven Initiatives



CINDY WATERS,
Ph.D.



The Department of Defense (DoD)'s Manufacturing Engineering Education Program (MEEP) Overview

Dr. Cindy Waters

- **Lead Coordinator, DoD MEEP Program (under the DoD STEM Program in the Office of the Under Secretary of Defense for Research and Engineering)**
- **Senior Scientific Technical Manager, Advanced Manufacturing Materials, Naval Surface Warfare Center at Carderock**

Advanced Manufacturing: Jobs of the Future
June 18, 2021



What Encompasses DoD STEM?



DoD STEM is inclusive of Department-wide efforts that address near- to mid-term (postsecondary) STEM workforce needs, and long-term (K-16 education & outreach) STEM talent development through a variety of educational and work-experiential opportunities across the K-20 continuum. The National Defense Education Program (NDEP) is one of the largest efforts under DoD STEM.



DoD STEM Strategy



VISION: A STEM talent pool with minds for innovation, diversity of thought, and technical agility to sustain the Department's competitive edge.

MISSION: Attract, inspire, and develop exceptional STEM talent across the education continuum to enrich our current and future DoD workforce to meet defense technological challenges.

- **COMMUNICATE** the value and purpose of the DoD STEM Strategy and the need for engagement.
- **INSPIRE** youth and community engagement in K-12 STEM education and outreach by encouraging participation in DoD-sponsored STEM activities.
- **CULTIVATE** the future STEM talent pool through supporting and enhancing undergraduate and graduate students served by DoD-sponsored STEM programs.
- **PROMOTE** increased participation of underserved groups in STEM
- **ENHANCE** the efficiency and effectiveness of STEM initiatives by gathering evidence using a systematic approach.



Manufacturing Engineering Education Program (MEEP)



- **Purpose:**

- Congressionally added since 2017, the MEEP program establishes new or enhances existing programs (or collections of programs) to better position the current and next-generation manufacturing workforce to produce military systems and components that assure technological superiority for the DoD;
- The goal of these efforts is to target and provide opportunities to current and future workforce acquiring manufacturing skills, which are critical to sustaining the defense innovation base;
- DoD MEEP programs include education and outreach to middle school students up to workforce retraining, including a focus on military veterans.

- **Approach:**

- DoD STEM funds MEEP initiatives through Funding Opportunity Announcements (FOAs), in coordination with the Office of Naval Research;
- Awardees establish or expand educational opportunities for Americans to acquire manufacturing skills critical to sustaining the defense innovation base.

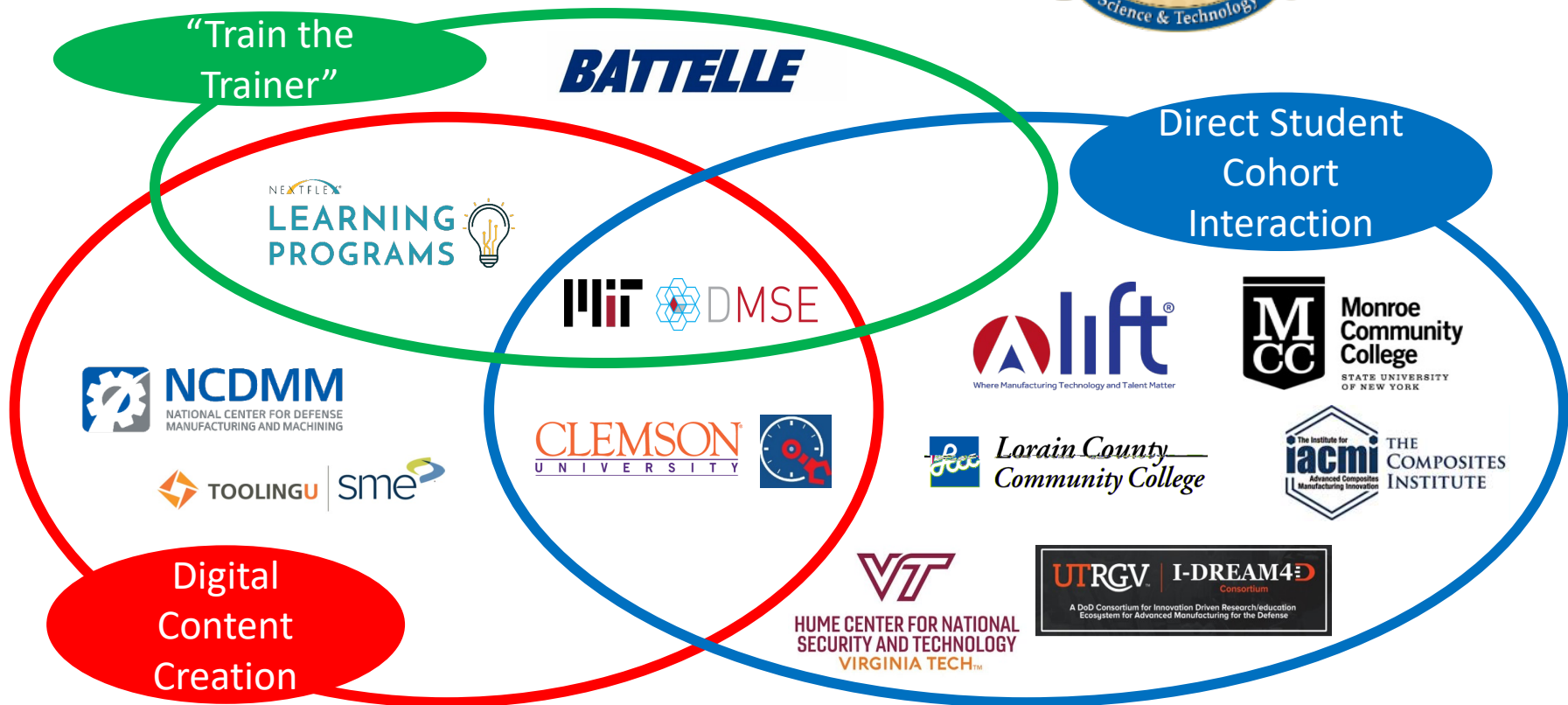


2017-2019 MEEP Grant Awards



13 awards presented to distinguished educational and industry partners totaling up to \$50M over a 3-year period

- Battelle (Columbus, OH);
- Clemson University (Clemson, SC);
- Massachusetts Institute of Technology (Cambridge, MA);
- National Center for Defense Manufacturing & Machining (Blairsville, PA);
- Institute for Advanced Composites Manufacturing Innovation (Knoxville, TN);
- Lightweight Innovations for Tomorrow (Detroit, MI);
- Monroe Community College (Rochester, NY);
- Society of Manufacturing Engineers (Cleveland, OH);
- University of Texas, Rio Grande Valley (Edinburg, TX);
- Virginia Polytechnic Institute and State University (Blacksburg, VA);
- Lorain County Community College (Elyria, OH);
- NextFlex (San Jose, CA)



“Train the Trainer”

BATTELLE

Direct Student Cohort Interaction

NEXTFLEX
LEARNING PROGRAMS

MIT DMSE

NCDMM
NATIONAL CENTER FOR DEFENSE
MANUFACTURING AND MACHINING

lift
Where Manufacturing Technology and Talent Matter

MCC
Monroe Community College
STATE UNIVERSITY OF NEW YORK

TOOLINGU | sme

CLEMSON UNIVERSITY

Lorain County Community College

The Institute for iacmi
Advanced Composites Manufacturing Innovation
THE COMPOSITES INSTITUTE

Digital Content Creation

VT
HUME CENTER FOR NATIONAL SECURITY AND TECHNOLOGY
VIRGINIA TECH

UTRGV I-DREAM4 Consortium
A DoD Consortium for Innovation Driven Research/Education Ecosystem for Advanced Manufacturing for the Defense



Various MEEP Awardees

VT | HUME CENTER FOR NATIONAL SECURITY AND TECHNOLOGY | VIRGINIA TECH

MICROWAVE ELECTROMAGNETIC MATERIALS: CONCEPTS AND CHARACTERIZATION

August 16 - August 19, 2021

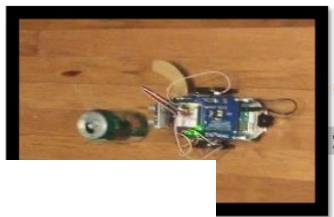
Virginia Tech Executive Briefing Center
Second Floor, Ballston Room
900 N Glebe Rd.
Arlington, VA 22203

No-Cost, In-Person Offering, Government Personnel Only
Note: Initial Offering is informal and seating is limited; continuous attendance is encouraged but not expected

Email request to be registered: emag@vt.edu

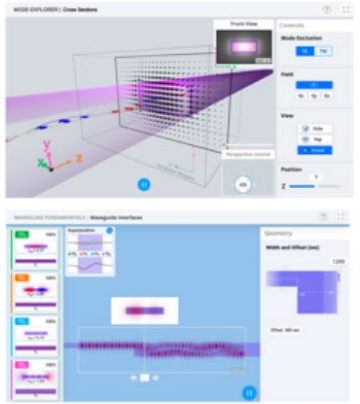
I-DREAM4D

I-DREAM4D 2020 Summer Virtual Camp

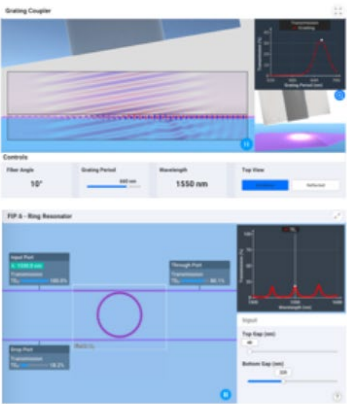


Photonics Sims Year 1 Interactive Simulation Modules

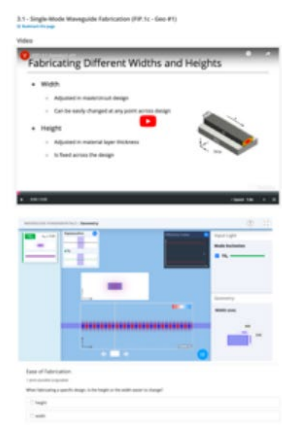
Data Visualization Tools Vector Fields and Mode Profiles



Parameter Exploration PIC-Chip Components



Intro Videos & Exercises Full Learning Modules on edX





Compiled program updates...



Educator/student opportunities

- To learn more about our MEEP partners' efforts, visit:
<https://www.cto.mil/dod-invests-42-million-to-meep/>
<https://www.defense.gov/Newsroom/Releases/Release/Article/1675281/defense-department-selects-awardees-in-the-manufacturing-engineering-education/>
<https://hume.vt.edu/research/meep.htm>
<https://www.toolingu.com/>
<https://cecas.clemson.edu/cucwd/educateworkforce/>
<https://www.nextflex.us/learning-programs/flexfactor/>
<https://iacmi.org/>
<https://www.opnextjobs.com/>
<https://lift.technology/our-work/>
<https://www.utrgv.edu/newsroom/2020/08/25-i-dream4d-summer-engineering-camp-uses-online-format-to-teach-stem-skills.htm>





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DoD STEM
DoD SMART Scholarship



cto.mil



dodstem.us

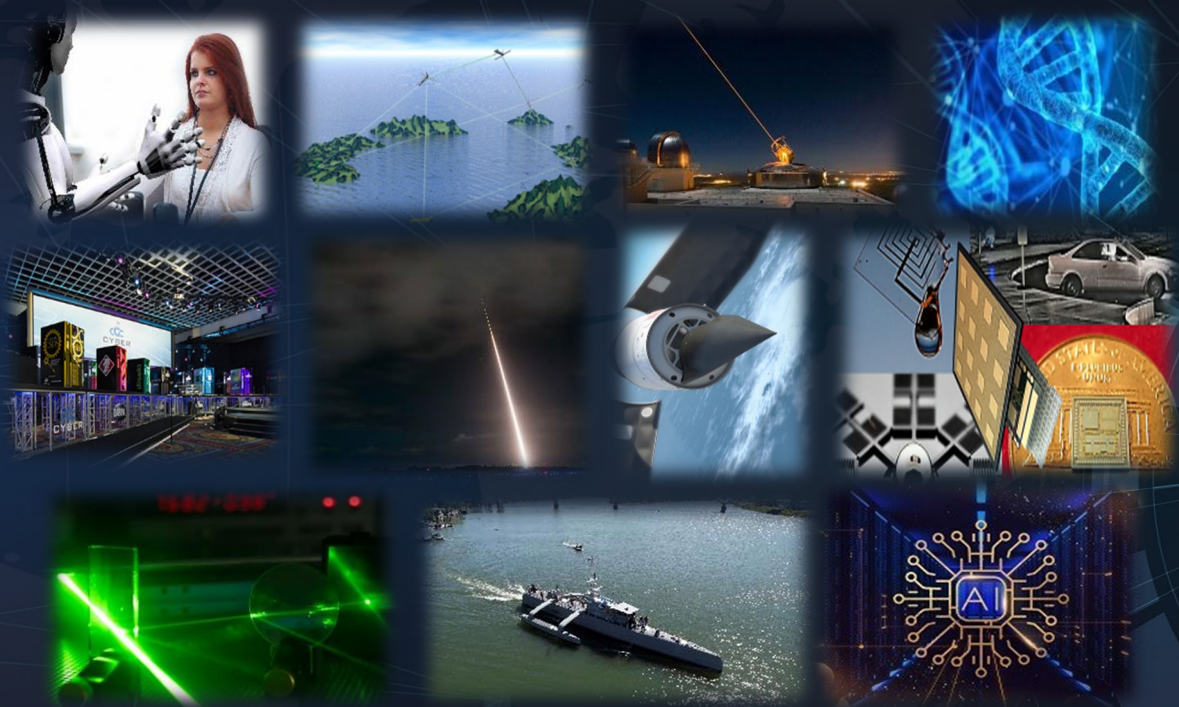


smartscholarship.org/smart



DoD Research and Engineering Enterprise

Creating the Technologies of the Future Fight



DoD Research and Engineering Enterprise
<https://www.CTO.mil/>

Twitter
@DoDCTO



EMILY McGRATH

NEXTFLEX®



NEXTFLEX LEARNING PROGRAMS

RECRUITMENT AND TRAINING FOR EMERGING TECHNOLOGIES & ADVANCED MANUFACTURING

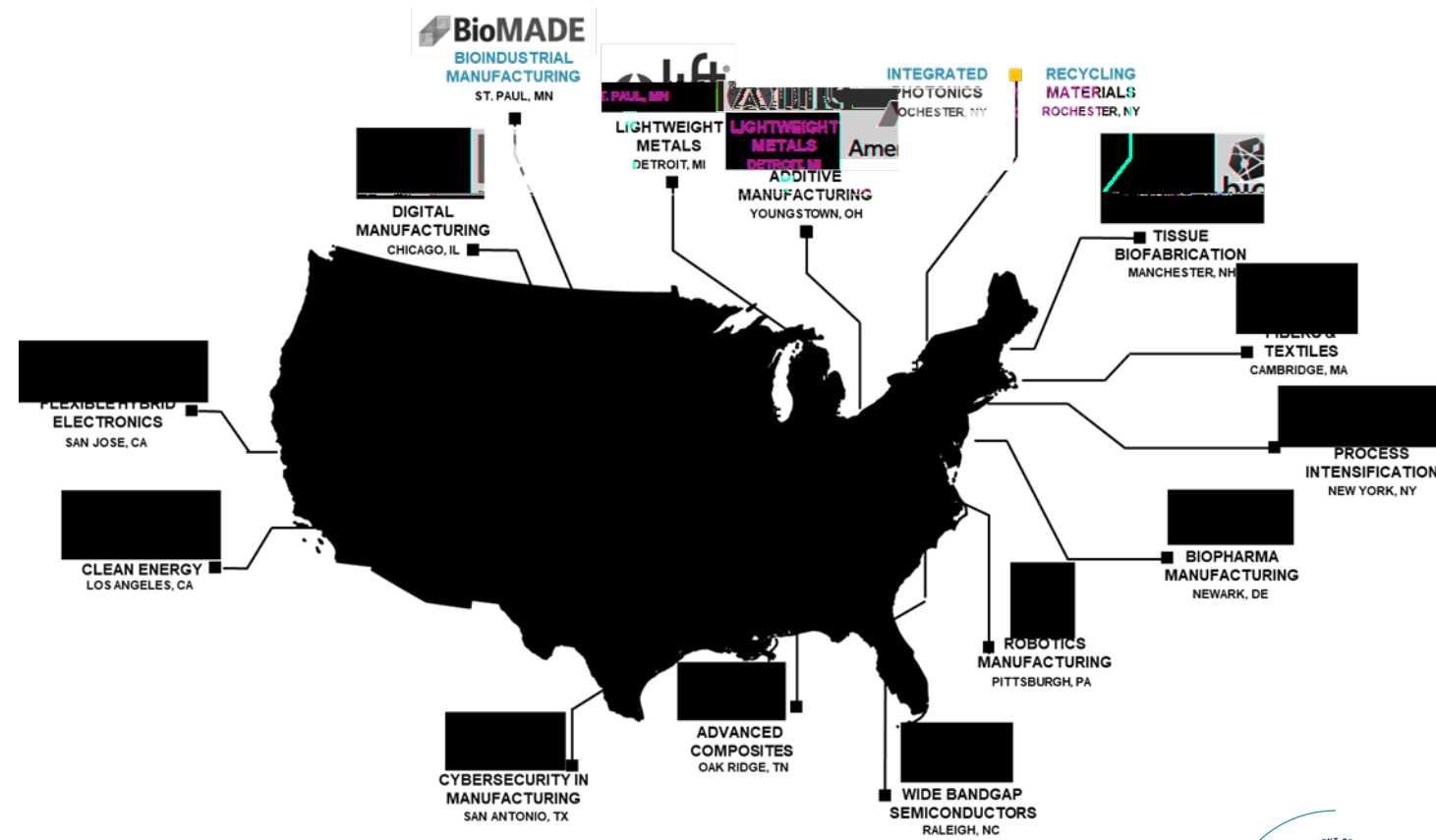
2021

NATIONAL NETWORK FOR MANUFACTURING INNOVATION



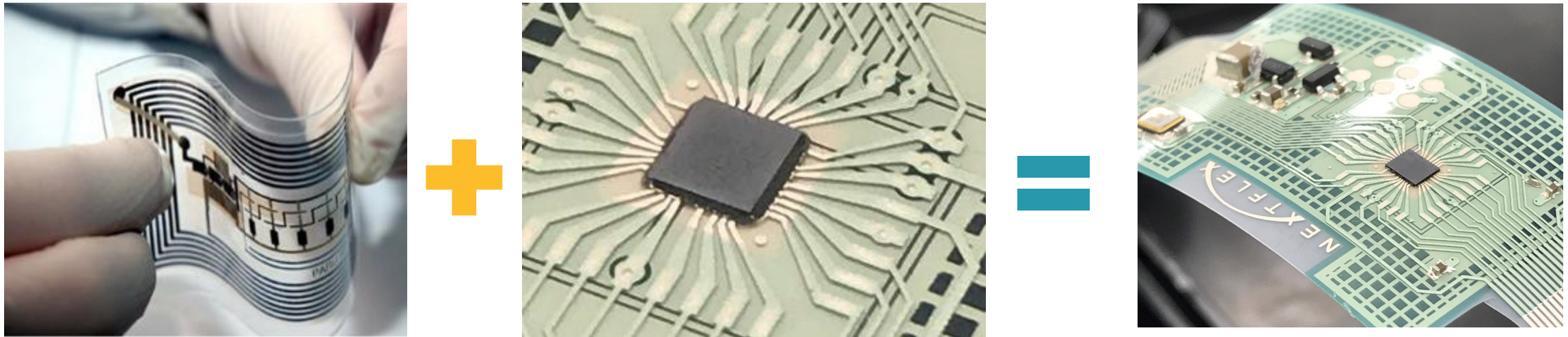
A national network of 16 Institutes, each with a specialized technology focus and three shared goals:

1. Advance the manufacturing & technology process to full scale production
2. Create a robust commercial ecosystem around the technology
3. Create the workforce needed by employers in this sector



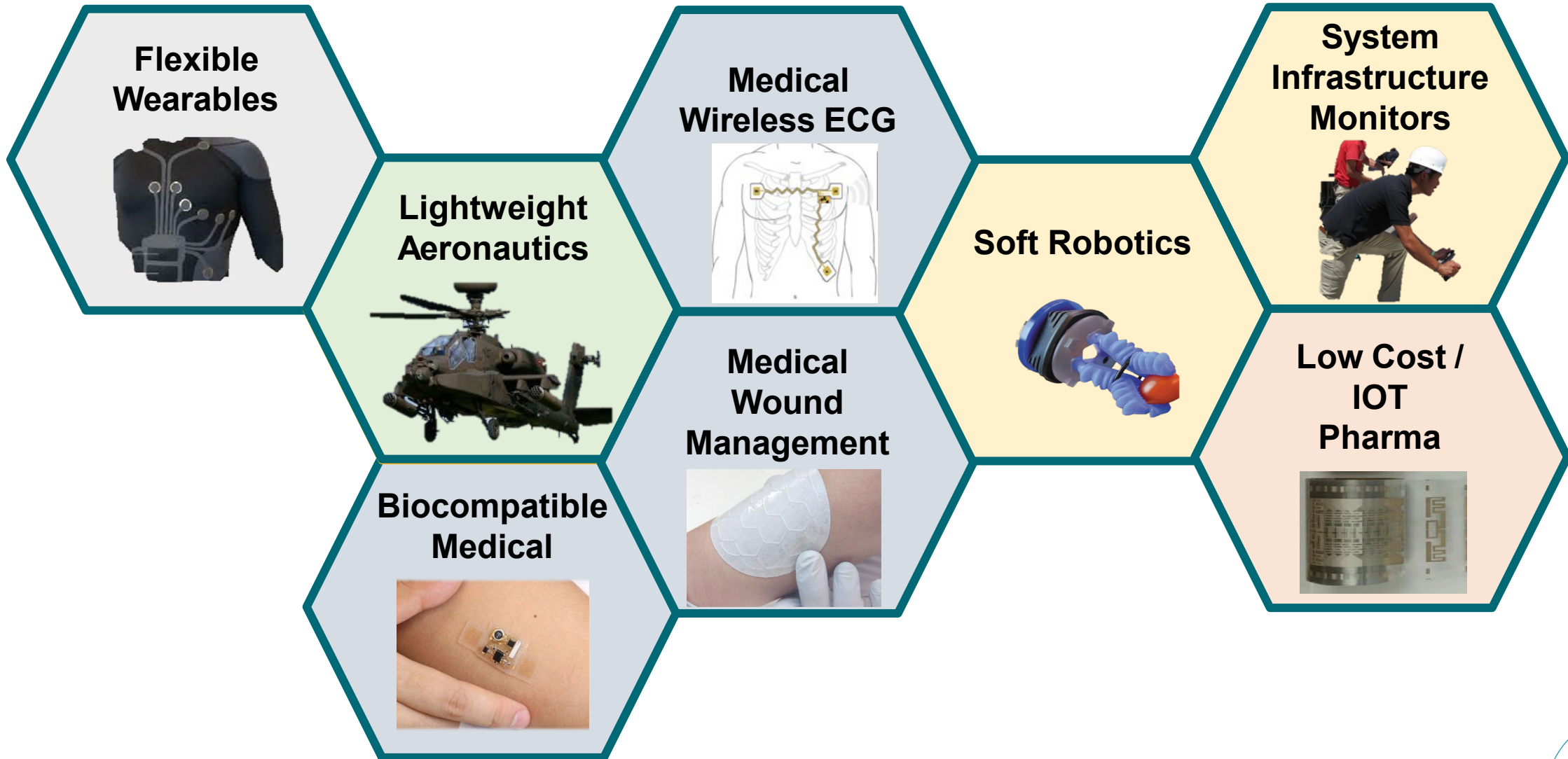
FLEXIBLE HYBRID ELECTRONICS

FHE (Flexible Hybrid Electronics) combine the flexibility and low cost of printed plastic film substrates with the performance of semiconductor devices to create a new category of electronics.



- Flexible
- Stretchable
- Conformable
- Transparent
- Biocompatible
- Lightweight

APPLICATION SPACES FOR FHE



WFD FUNDING & ENGAGEMENT STRATEGIES



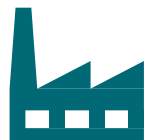
To effectively mature and commercialize a new technology, critical stakeholders including government, industry, and academia must work together to drive technology maturation and educate a skilled workforce in the necessary capabilities.



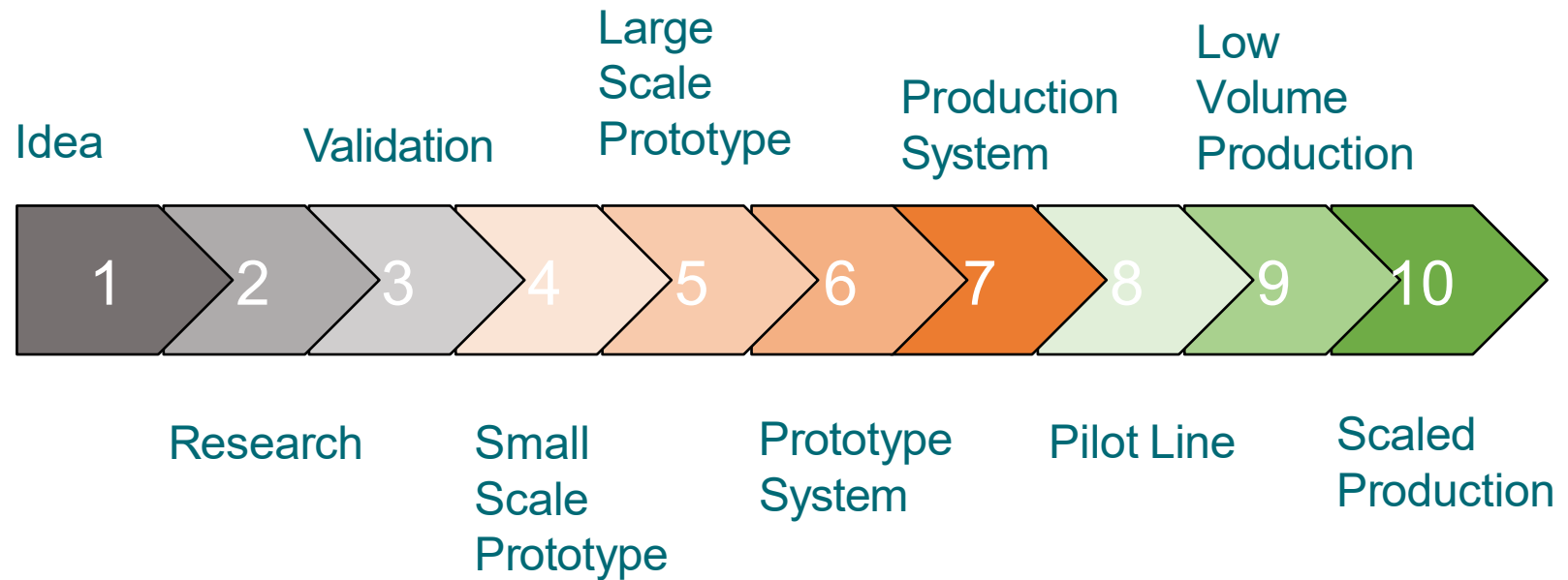
Government: Invest in fundamental research & early maturation



Academia: Provide training on new knowledge, skills, and abilities

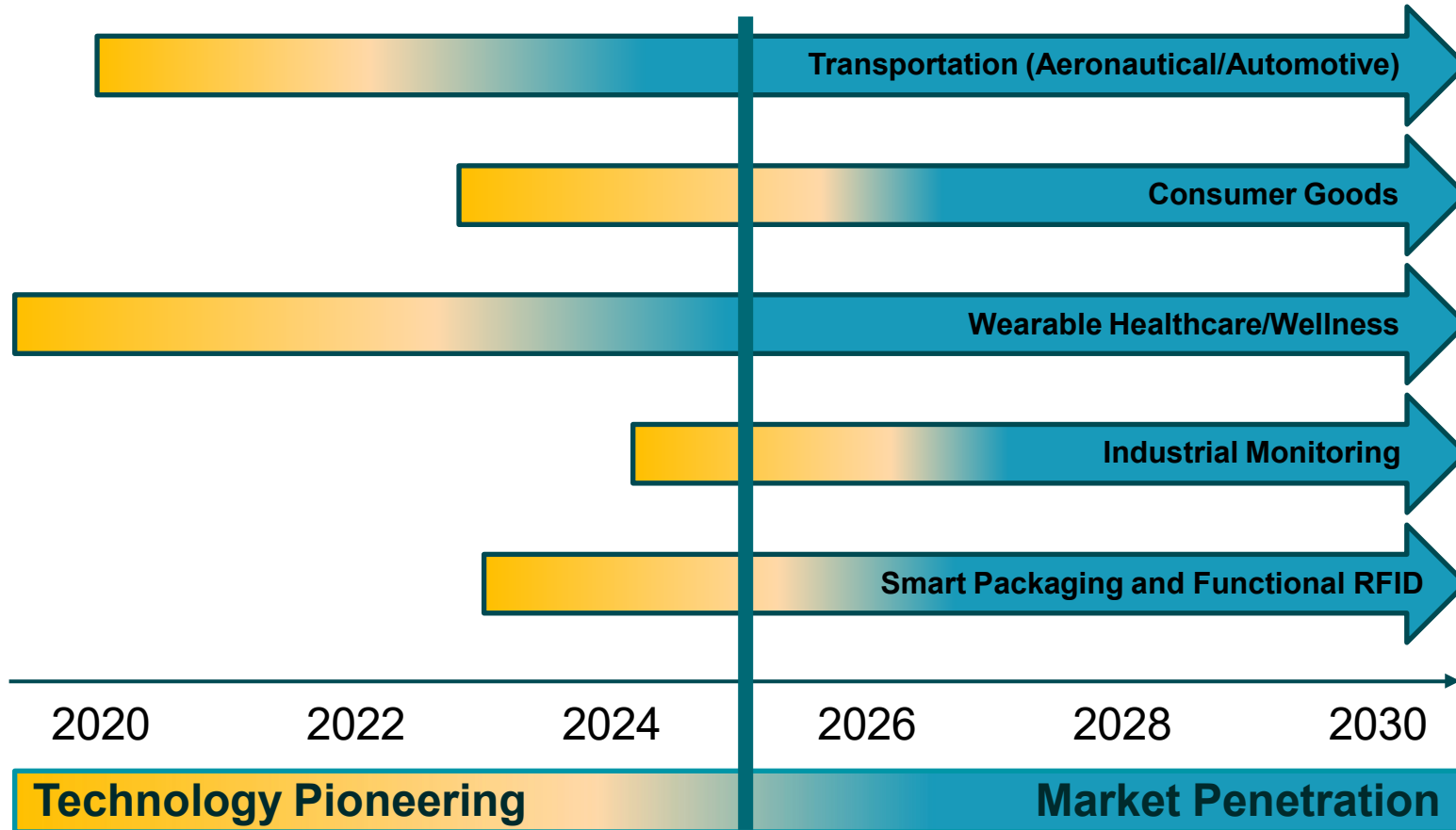


Industry: Adopt and scale new technologies



FORECAST OF FHE-ENABLED PRODUCTS

Approximate TRL 9 turning point



2025-2030: Widespread commercial adoption

Peak Market Penetration: 30% of rigid electronics may be FHE-enabled

Expect new application domains to emerge

Phase 1: Leading the proliferation of FHE through education and training

Phase 2: Meeting industry need for a trained workforce

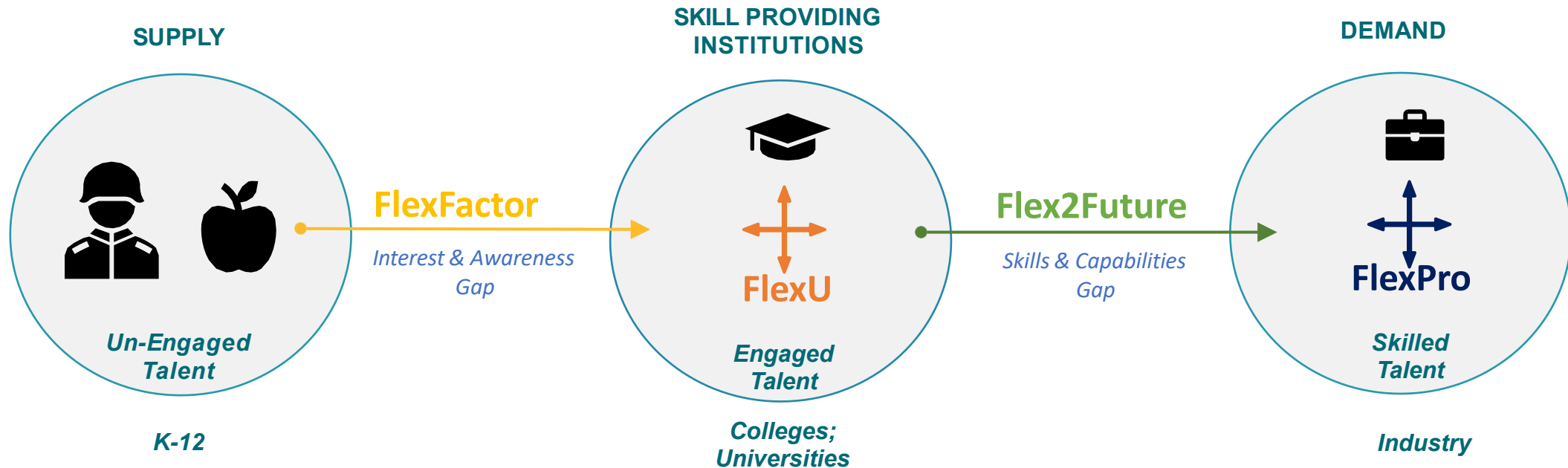
**Source: IDTechEx Flexible Hybrid Electronics 2020-2030 Report. Timelines adjusted based on NextFlex outlook & informational interviews with member SMEs*



NEXTFLEX LEARNING PROGRAMS PORTFOLIO



Mission: Create the range of talent needed by the advanced manufacturing sector and FHE community

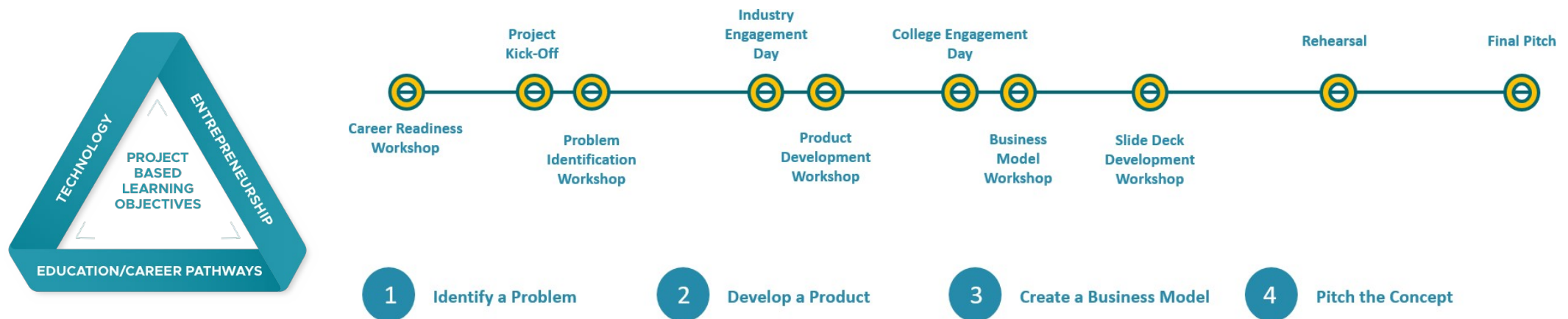


Overview

FlexFactor is a project-based learning program designed to inform, inspire, attract, and recruit the next generation workforce.

Throughout the program, small teams of students are challenged to

1. **Identify a real-world problem**
2. **Conceptualize a hardware device to address the issue**
3. **Build a business model around the product**
4. **Pitch the project to a panel of representatives including members of industry, academia, and government.**



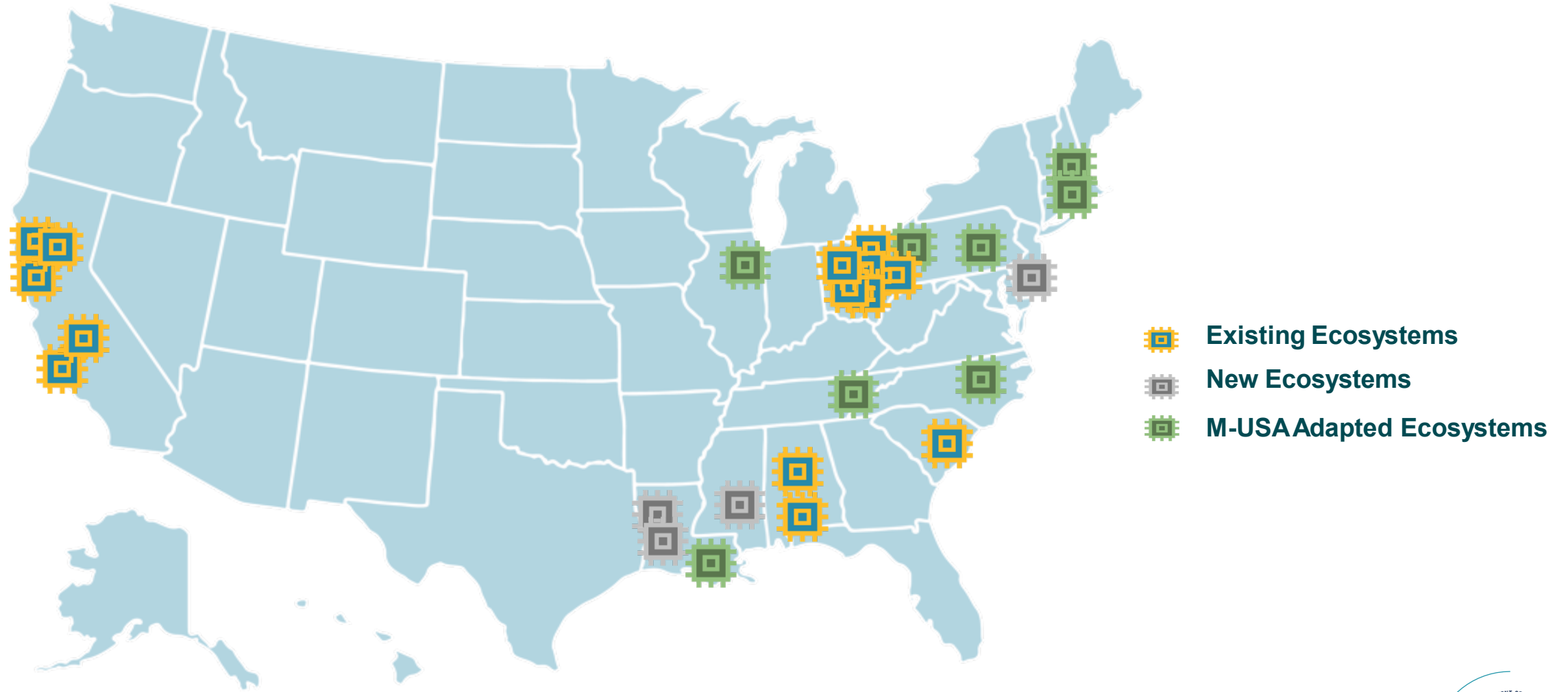
TECHNICAL TRAINING IN FHE



FHE training programs are not widely accessible due to the emerging state of the technology, but in partnership with research universities and ManTech NextFlex is creating an online, asynchronous learning program designed to build the skills and capabilities necessary to design and manufacture FHE – enabled devices. Estimated program launch is late fall 2021.



NEXTFLEX LEARNING PROGRAMS NATIONAL EXPANSION



THANK YOU



EMILY MCGRATH

DIRECTOR, WORKFORCE DEVELOPMENT

EMCGRATH@NEXTFLEX.US





ALEXIS VOGT, Ph.D.

Studying Optics at MCC: The Field of the Future

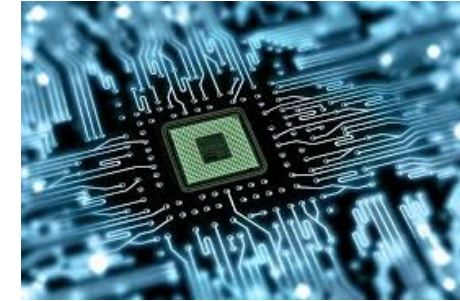
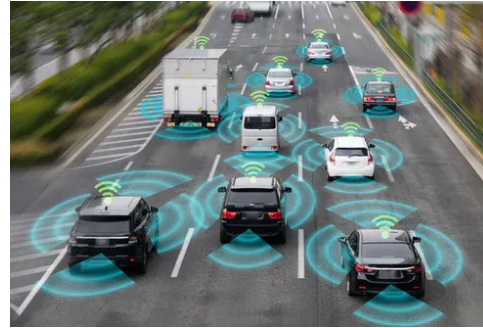


18 June 2021
US Dept. of Education STEM Webinar
Alexis Vogt, PhD

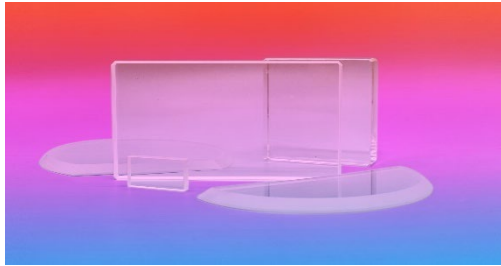
Endowed Chair & Professor, Optical Systems Technology
Monroe Community College; Rochester, NY



NETFLIX



Optics Applications in National Defense



turret windows, debris shields



missile nose cones

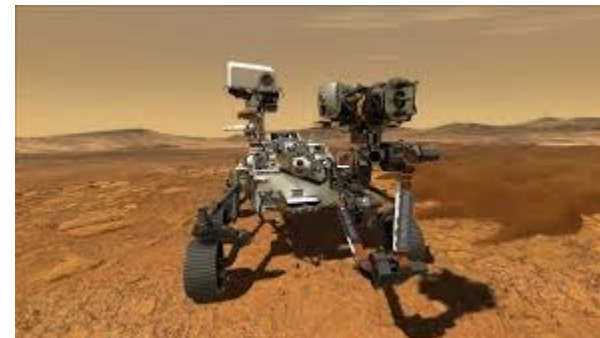
night vision goggles for military operations



remote sensing, heads-up displays,
weapon-mounted scopes



rovers

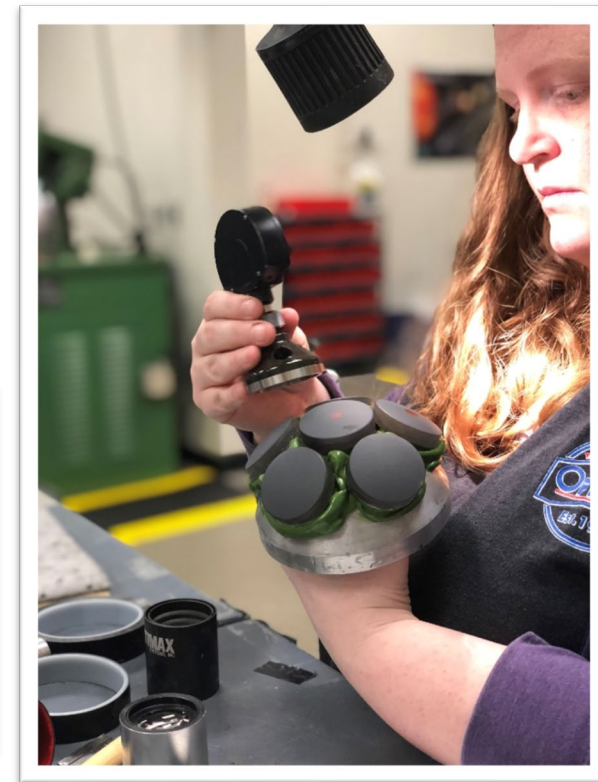
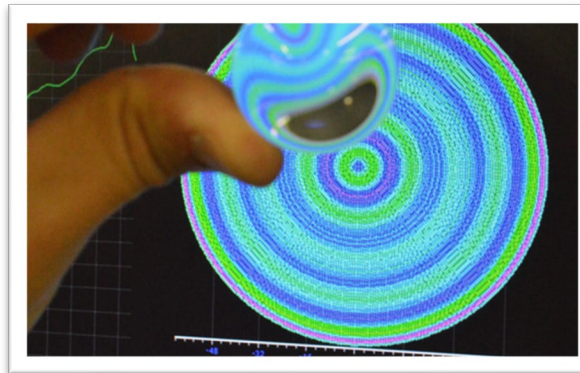
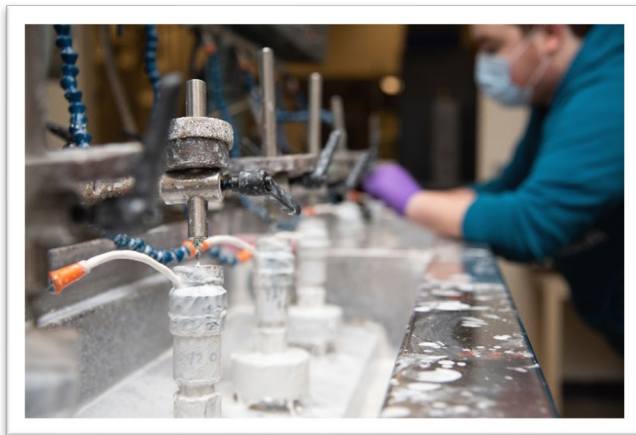


Current Marketplace Demands

Optics technicians are needed to manufacture **ALL** of these products

Who is an Optics Technician?

- Works with scientists & engineers in research, development, design, manufacturing & quality control
- Manufactures optics
- Performs testing & evaluation of optical components & systems





Current Marketplace Demands

We have a worldwide **shortage** of
optics technicians!

Current Marketplace Demands

20% of experienced technicians & engineers are approaching retirement nationwide

>550 skilled optics technician job openings go unfilled **annually** in Western NY

75% of small & medium-sized German companies report the shortage of skilled workers impairs their innovation activities

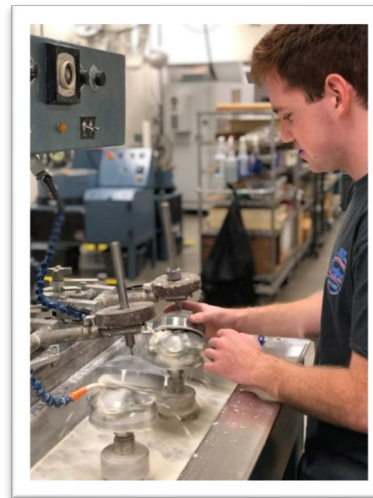


Current Marketplace Demands

Monroe Community College is the
world's **only** college
awarding associate degrees in
precision optics

Optical Systems Technology Programs

- 1-year Certificate
- 2-year Associate of Applied Science (AAS) Degree
- 2+2 transfer program:
 - University of Rochester – Institute of Optics
 - RIT – Center for Imaging Science
 - University of Arizona – College of Optical Sciences



Optical Systems Technology @ MCC

THORLABS

\$200,000



\$250,000

CORNING

\$1.26M



\$550,000



\$4.4M

Defense Engineering Education Program in Optics (DEEP OPS) Overview



Problem to be Solved:

The Department of Defense precision optical systems supply chain is facing a crisis – a workforce shortage. Monroe Community College, the nation’s only college awarding associate degrees in precision optics, does not produce enough precision optics graduates to meet the annual demand.

Program Objective and Goals:

Strengthen and expand the national precision optics workforce to ensure technological superiority for the Department of Defense.

- **Goal 1: Extensively enhance precision optics technician training with innovative approaches that meet the needs of the optics industry & students**
- **Goal 2: Increase the number and diversity of optics technicians nationwide**
- **Goal 3: Establish opportunities for student and faculty engagement with the optics industry**

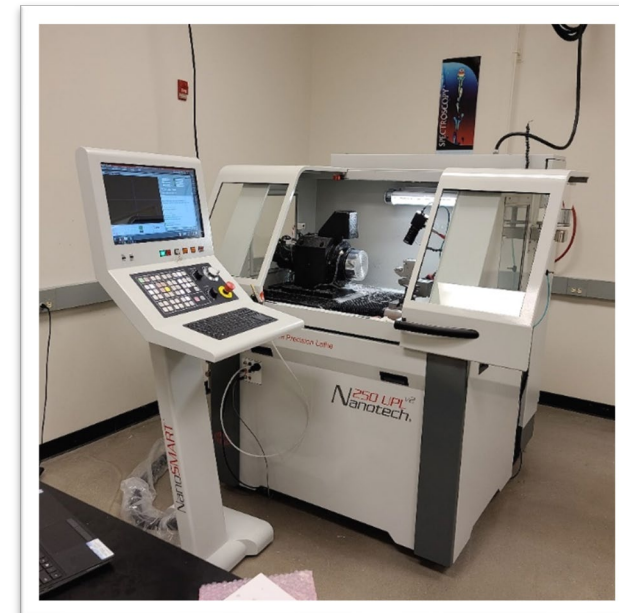
Precision Optics Manufacturing Apprenticeship

Structured earn & learn program: on the job training + related technical instruction



State-of-the-art Equipment

- New 1,400 square-foot lab
- Over \$1.5 M in new advanced manufacturing equipment installed



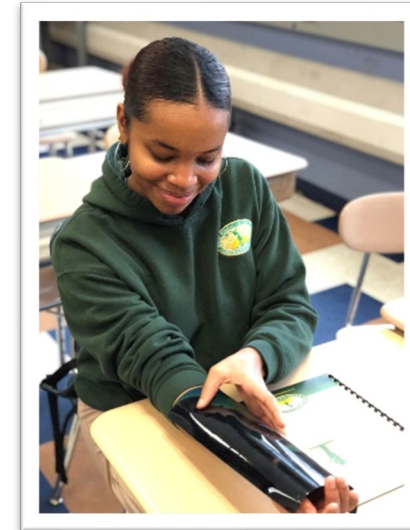
Expanding Pre-Collegiate Partnerships

Internships, Dual Enrollment & Outreach

- 13 optics dual enrollment high schools
- 1,000+ students have participated in the last 5 years
- Paid internships



CORNING



Industry Partnerships

- Optics advisory board
- Industry-validated curriculum
 - Stackable credentials and micro-credentials
- All 12 faculty/adjuncts come from the optics industry



We Need...

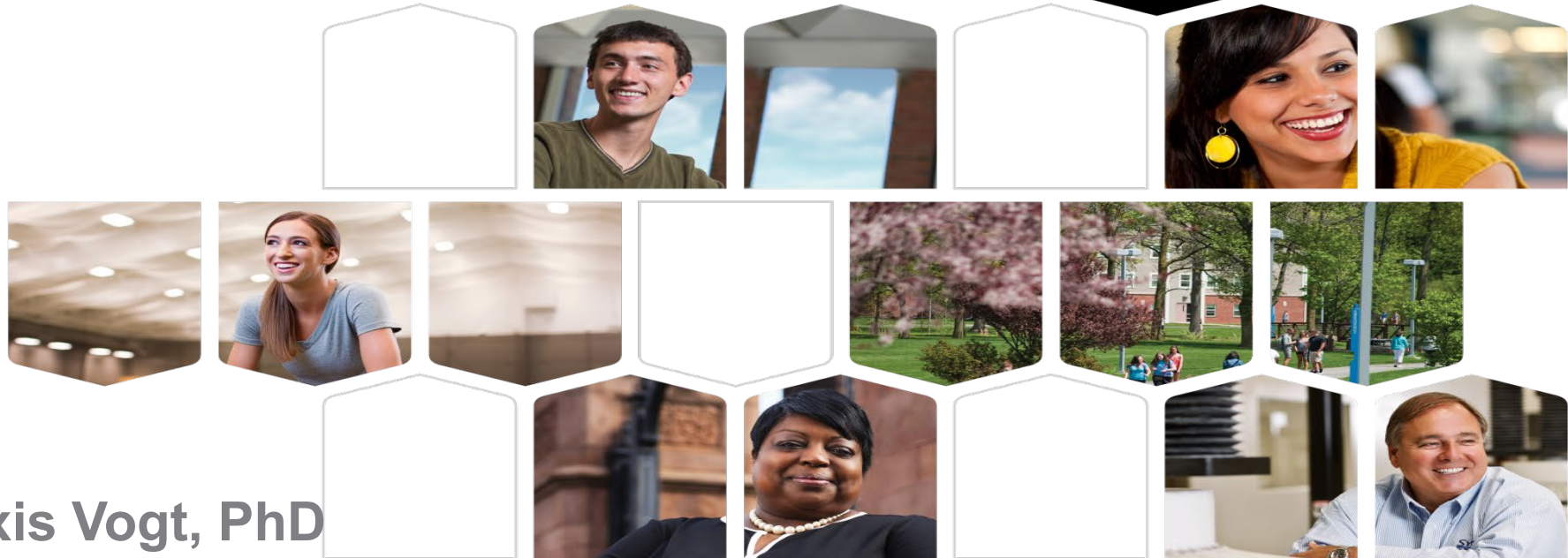


to join us at MCC!



THANK YOU

www.monroecc.edu/go/optics



Alexis Vogt, PhD
avogt4@monroecc.edu

Inspiring every day.

This material is based upon work supported by the Dept. of the Navy Office of Naval Research Award #N00014-19-1-2740. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the Office of Naval Research.



Q & A

RESOURCES

- [Manufacturing.gov](https://www.manufacturing.gov)
- [ManufacturingUSA.com](https://www.manufacturingusa.com)
- [Out of School Time Career Pathway](#)
- [AM Apprenticeships](#)
- [AM Competencies](#)