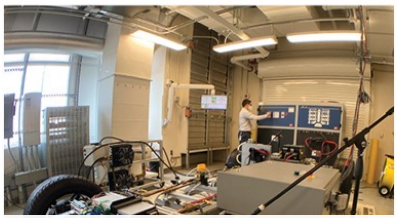
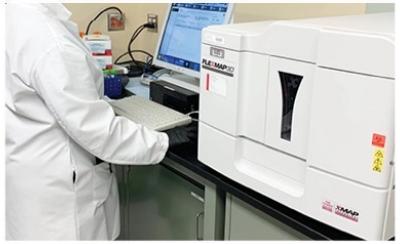
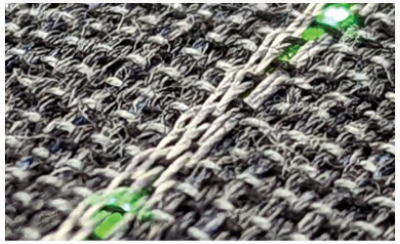







Advanced Manufacturing Occupation and Competency Framework and Network Workforce Program Updates







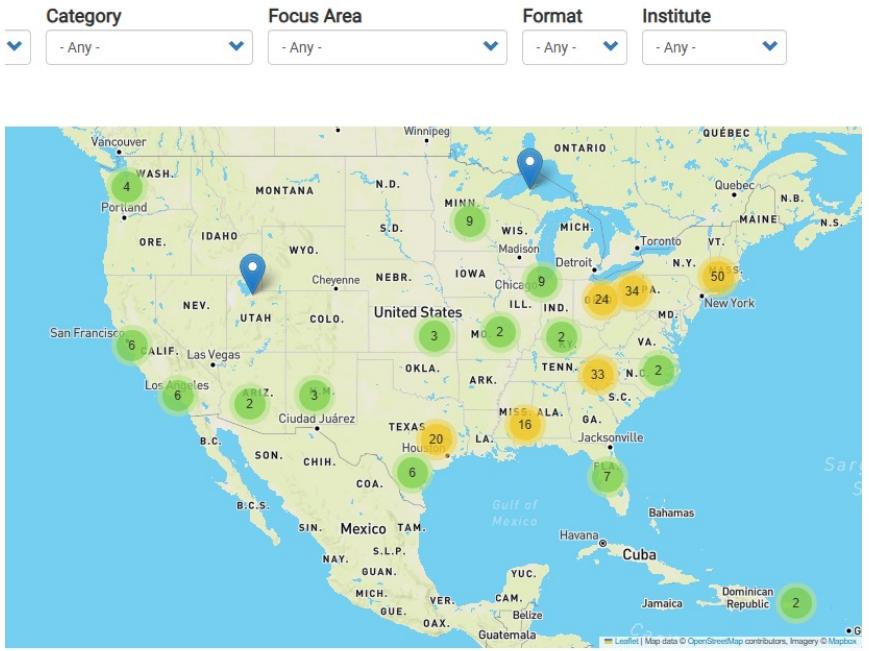
Advanced Manufacturing Occupation and Competency Framework Briefing

Brad R. Conrad PhD, Office of Advanced Manufacturing, NIST
on behalf of Manufacturing USA

Network-wide Workforce Development Efforts

In 2024, across 17 Institutes:

- **+4,100** training providers
- **+195,000** participating in institute projects or internship programs and training
- **237** separate workforce development projects
- **$54M** in funding for EWD projects and activities



EWD Connect
www.manufacturingusa.com/ewd-connect

ManufacturingUSA

Overview: MFG USA Workforce Network Efforts

1. **Establish a shared workforce agenda**
2. **Collaborate on common goals**
   - Credentials, CTE, and Apprenticeships
   - Training programs & platforms
3. **Amplify institute workforce programs**
   - Communications & outreach
   - Exhibiting
4. **Define long-term priorities**
   - Manufacturing careers portal
   - Training best practices
   - Active duty and veterans
   - Occupation and Competency Framework

Manufacturing USA Workforce Annual Meeting at MxD 2025

ManufacturingUSA

Example of Scalable Dissemination:
Wide Bandgap (WBG) Semiconductor Technology Course

Regional coordination on curriculum development:
Virtual lab & expansion strategy for course(s)

- Central Carolina Community College (CCCC)
- Western Carolina University (WCU)
- North Carolina state University (NCSU)

Target launch: Spring 2027

- Developing syllabi for institutional review and approval

CCCC: Placeholder course description to begin the state-level approval process

Developing educational pathways : CCCC → WCU → NCSU

CENTRAL CAROLINA COMMUNITY COLLEGE
Western Carolina UNIVERSITY
NC STATE

ManufacturingUSA

66

Advanced Manufacturing Occupation and Competency Framework

Closing the manufacturing talent gap foundation

This framework supports:

- Co-developing workforce skills for emerging technologies
- Scaling efforts to increase U.S. advanced manufacturing workforce
- Credentialing
- Pre-apprenticeships/Apprenticeships

Goal: Defining common Knowledge, Skills, and Abilities (KSAs) through the next 5 years

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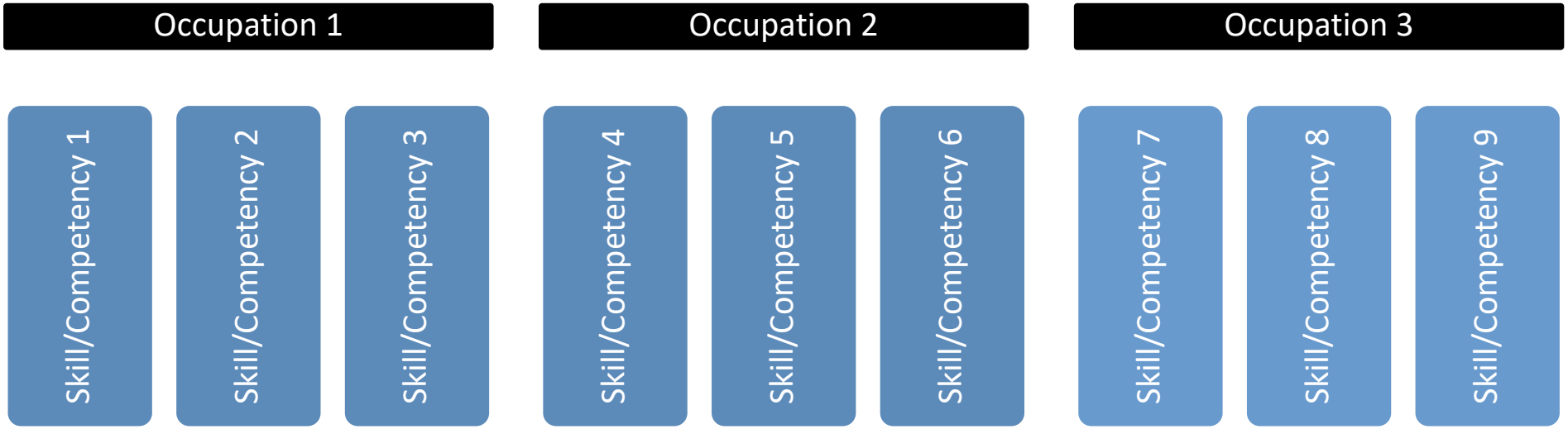
Advanced Manufacturing Occupation and Competency Framework

Each Institute



For each Institute: Identify entry level occupations over the next 5 years

- Essential competencies for each occupation
- Examine: Linkages between competencies
- Examine: Linkages between occupations

ManufacturingUSA

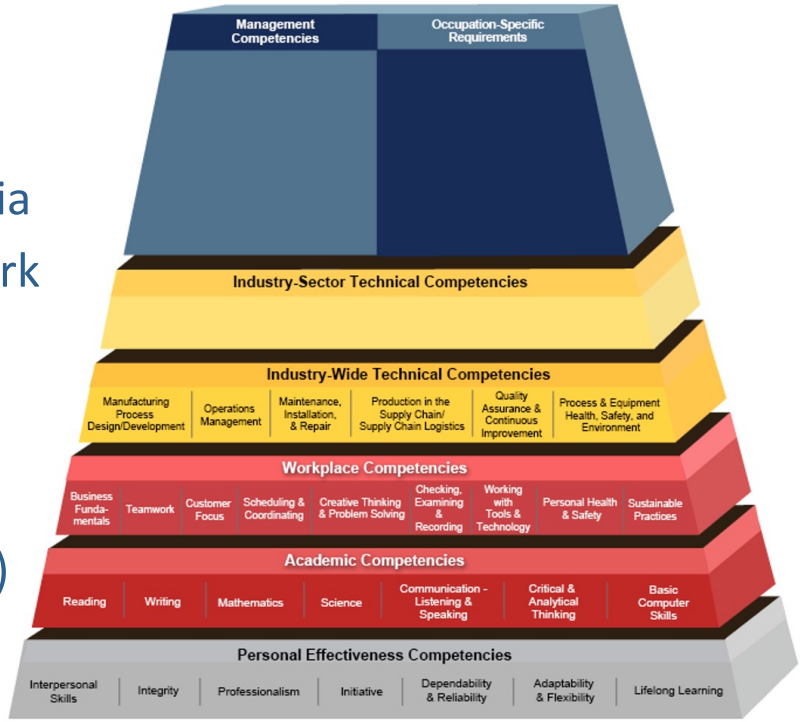
Industry and Agency Engagement

Occupation and Competency Framework Process

1. Industry-validated research
2. Develop competency model
3. Refinement of analysis with industry and academia
4. Adv. Man. Occupation and Competency Framework

   DOL's Adv. Man. Competency Collaboration

   – '25 Executive summary (Published)
   – Technology Sector Report (expected May)
   – '26 Executive Summary Update (expected June)
   – Academia Technical Report (expected July)
   – Biomanufacturing Competency Model
   – '27 Executive Summary Update (Summer 2027)



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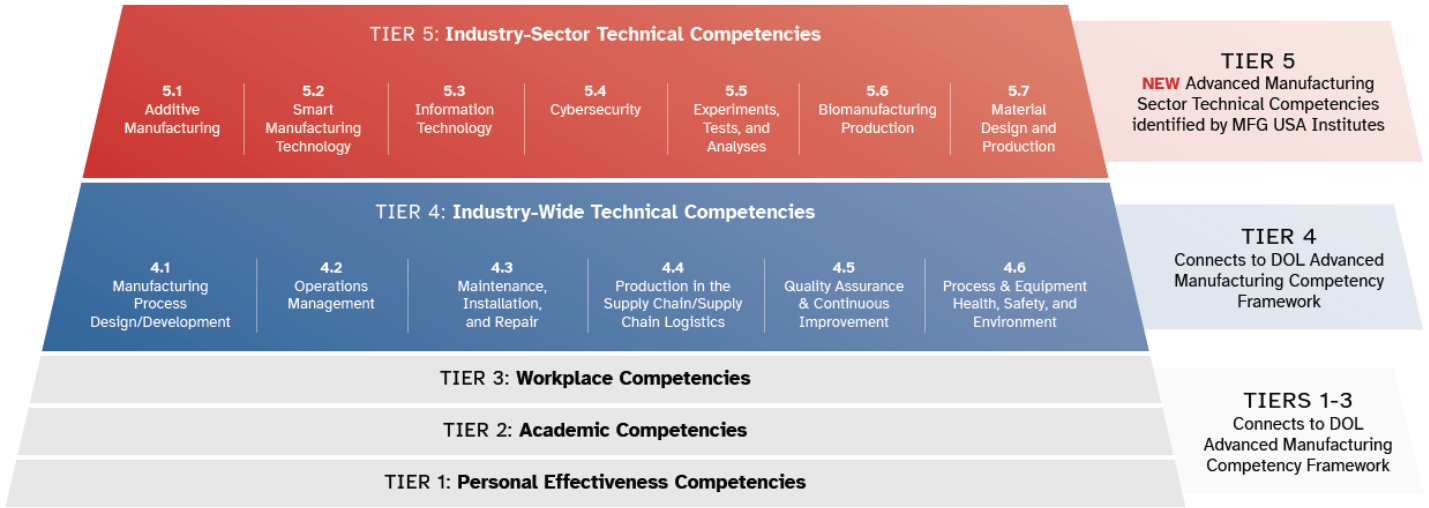
Advanced Manufacturing Occupation and Competency Framework

Key takeaways

The framework contains:

235	137	13	68	over 1,200
unique KSAs	occupations	competencies	sub-competencies	data points ("connections")



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Advanced Manufacturing Occupation and Competency Framework

Key takeaways

Network-wide KSAs:

- 33% of KSAs cross technology area lines
- 50% of KSAs are shared by 3 or more institutes
- 29% of KSAs align with 8+ occupations

Most frequently identified occupations:

- Process/Mechanical Engineers (6 institutes)
- Electrical Engineers (5 institutes)
- Materials Scientists (4 institutes)

Most Highly Selected Essential KSAs Across the Manufacturing USA Network:

A. Data collection and analysis (4.1.7)

B. Knowledge and use of computer-aided design (CAD)/computer-aided manufacturing (CAM) software (4.1.2)

C. Use basic hand tools in a safe and efficient manner to shape and form simple components (4.3.2)

D. Understand and execute test and measurement assays (4.2.11)

E. Production/process troubleshooting (4.2.11)

F. Use computers, computer-interfaced equipment, robotics or high-technology industrial applications to perform work duties (4.2.6 and 4.2.9)

G. Monitoring manufacturing operations (4.2.5)

H. Machine and equipment operations (4.2.5)

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Adv. Manufacturing Occupation & Competency Framework

Example - Robotics: Common entry-level competencies

4.2.6 Automated Systems and Control Operations

Use computers, computer-interfaced equipment, robotics or high-technology industrial applications to perform work duties

4.2.6 Automated Systems and Control Operations

Understand and use factory automation technologies

4.2.6 Automated Systems and Control Operations

Operation and control of automated systems

4.2.9 Industrial Productions

Use computers, computer-interfaced equipment, robotics, or high-technology industrial applications to perform work duties

4.2.9 Industrial Productions

Operation and control of manufacturing machinery

4.2.11 Production/Process Monitoring

Operational Technology (OT)

4.3.1 Maintenance, Installation, and Repair - Critical Work Functions

Maintenance equipment, tools, and workstations

4.3.27 Programmable Logic Controlled Equipment Maintenance, Installation, and Repair

Robotic programming

4.6.8 Safety Procedures

Understand and follow safety procedures

4.6.8 Safety Procedures

Safe material movement

5.3.1 Programming

Knowledge and use of programming skills (Python, C++)

Competency Correlation

If an occupation needs **'Knowledge and use of computer-aided design (CAD)/computer-aided manufacturing (CAM) software'** for **Technical Drawings and Schematics** as part of **Manufacturing Process Design and Development**

- Understanding of thermal, mechanical, and optical material properties
- Basic understanding of electrical and optical principles
- Mechanical engineering
- Data collection/analysis
- Work with project managers on production efforts...

Careers: Digital Engineers; Electrical Engineers; Textiles Technicians; Designers; First-Line Supervisors; Electronics Technicians; Industrial Technicians; Machinists; Mechanical Engineers; Electrical Design Engineers; Semiconductor Manufacturing Engineers; Manufacturing Engineers; Process Engineers; Fabrication Technicians; Quality Managers

Manufacturing USA Occupation & Competency Framework

Planned Development

- v1.5 for release June 2026
  - Revision of framework through 2031
- v2.0 planned for Summer 2027
  - Full re-analysis through 2032
- Connections to DOL and MyMFGCareer.org
- Build out of useful translation for:
  - Industry
  - Trainers
  - Academia
  - Hiring Managers / SMEs

MxD Learn Virtual Training Center Platform

Angela Accurso

Manufacturing USA Network Meeting

May 12, 2026

MxD Learn

Define

Develop

45
Courses

across digital manufacturing and cybersecurity

Including:
Digital Design
Data Analytics
Cybersecurity for AI
Machine Learning

CAPITAL **CyMOT**

coursera

Deliver

400,000
Learners

supported through MxD's portfolio of workforce training programs over the last 9 years

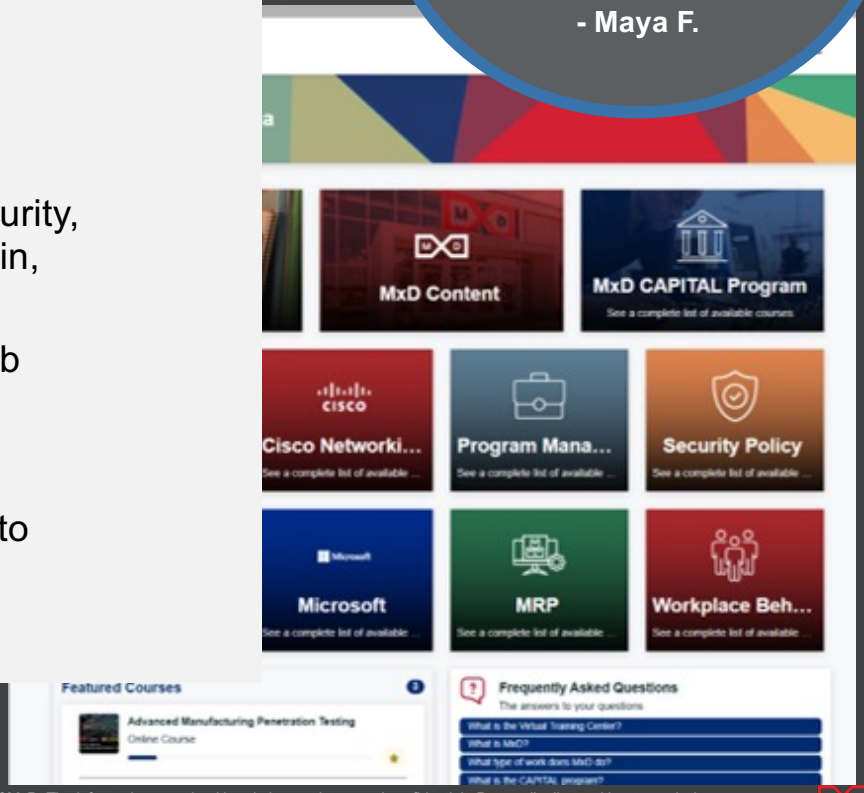
MxD Learn Virtual Training Center

All-in-one virtual platform designed to train and future-proof the manufacturing workforce

"I am taking this course to prepare for a skill-evaluation test for a data annotation job and this course made me feel much more confident."
- Maya F.

At a Glance

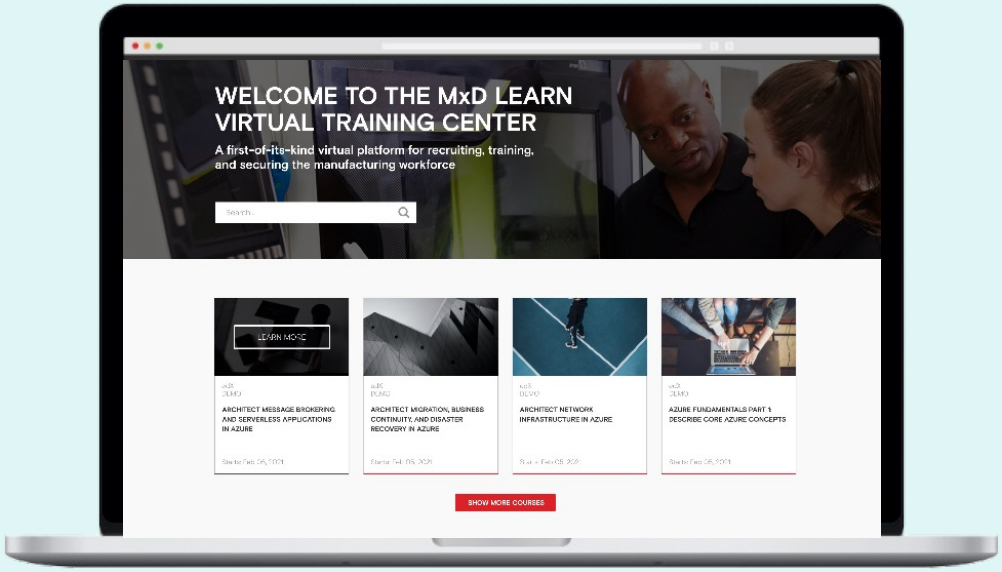
- **40,000+ enrollments** in 18 months
- More than **20,000 courses available** across cybersecurity, AI/machine learning, digital manufacturing, supply chain, operations, and more
- **Role-based trainings** preparing for success on-the-job
- Third-party certifications from the **Smart Automation Certification Alliance (SACA)**
- **Microsite capability** to rapidly deploy virtual learning to partners



MxD Learn

Virtual Training Center (VTC) Platform

Improving Access to Skills Development



Scan QR Code to Register for Free

The ARM Institute

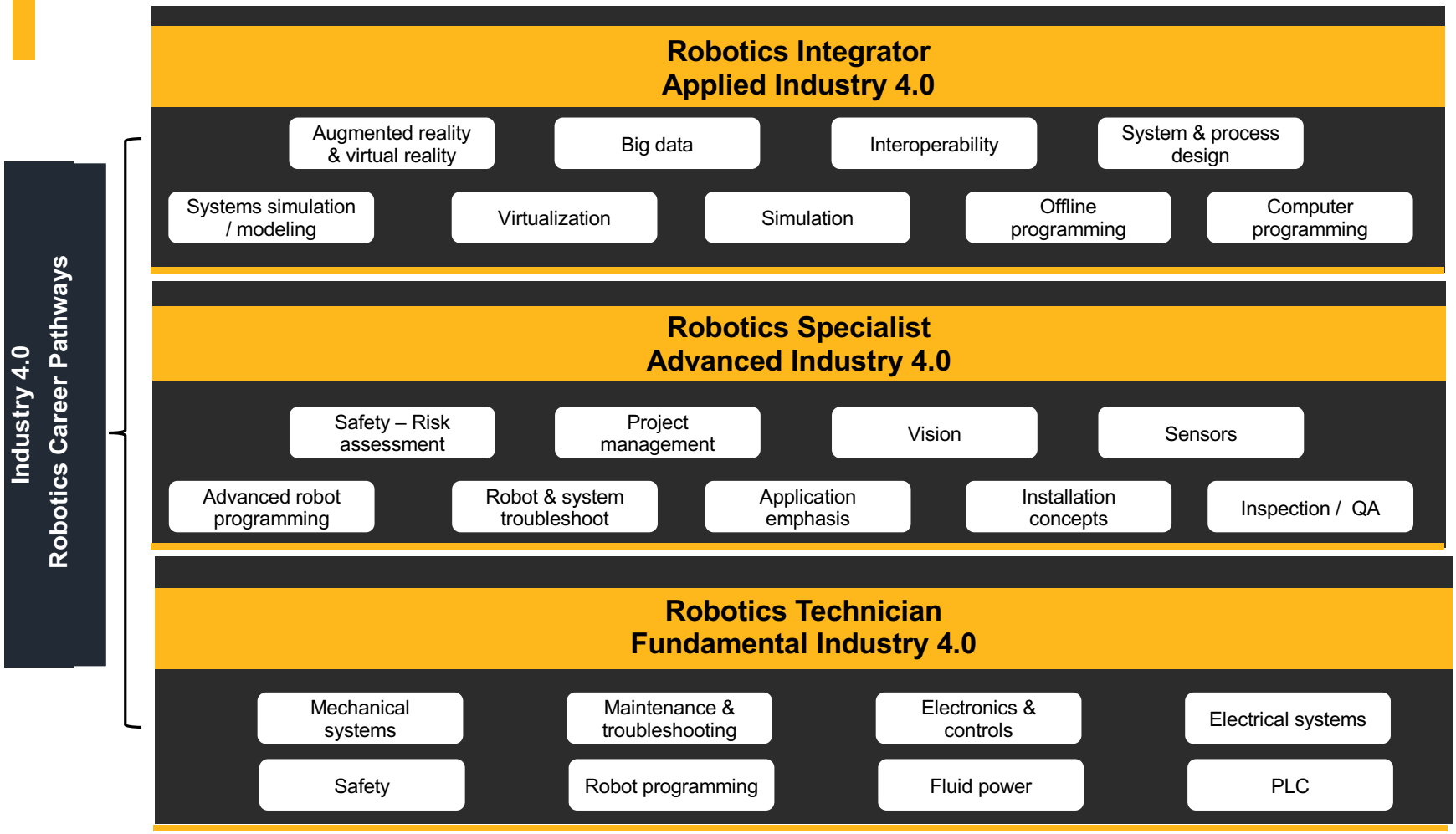
Manufacturing USA Update – May 2026

MyMfgCareer.org

How is the ARM Institute Putting Competencies Into Action…

At the core of modern manufacturing, ***worker competencies*** *bridge the gap between advanced technology and operational success*

Robotics Competency Framework



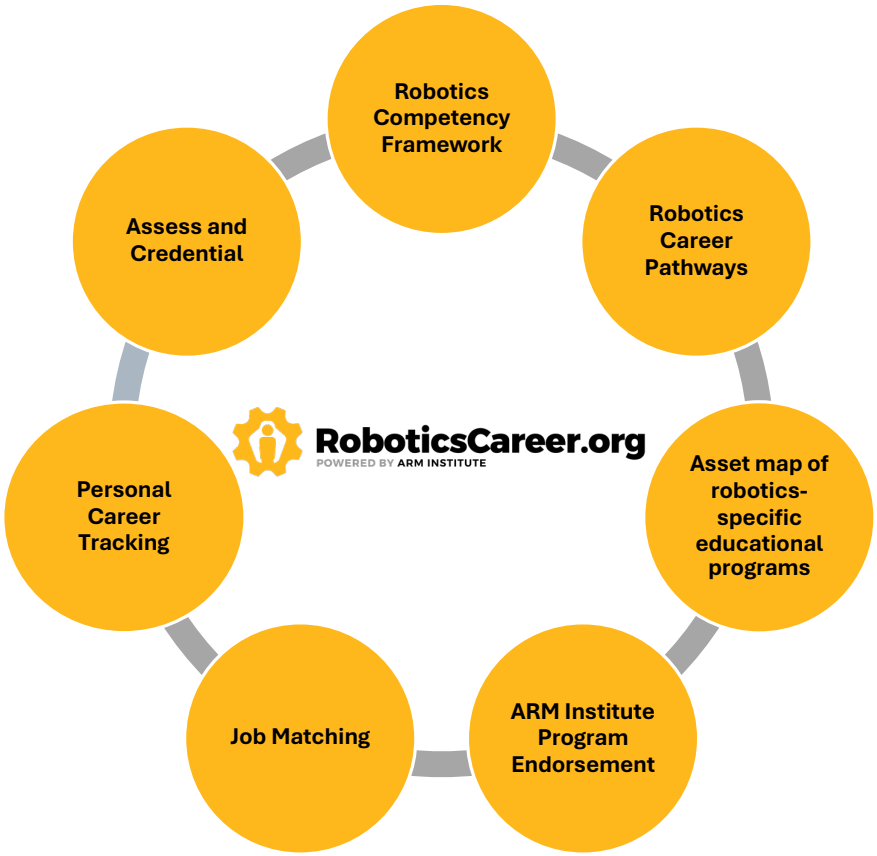
Essential Soft Skills

- Critical thinking
- Teaming
- Problem Solving
- Technology Aptitude
- Leadership
- Conflict Resolution
- Adaptability
- Attention to detail
- Technical Learning Ability
- Active Listening
- Interpersonal
- Communications
- Time Management
- Work Ethic

RoboticsCareer.org: Supporting the Nation's Robotics Workforce

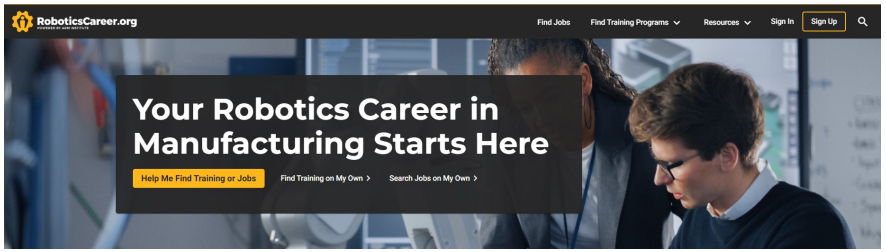
- Identify the necessary Advanced Manufacturing robotic competencies
- Understand the Advanced Manufacturing robotic career pathways
- Find the right training for the pathways
- Highlight the best training programs
- Find the right job and narrow skills gap
- Highlight career and competency progression
- Assess the skills through VR/AR

Competencies are the Key to All Components

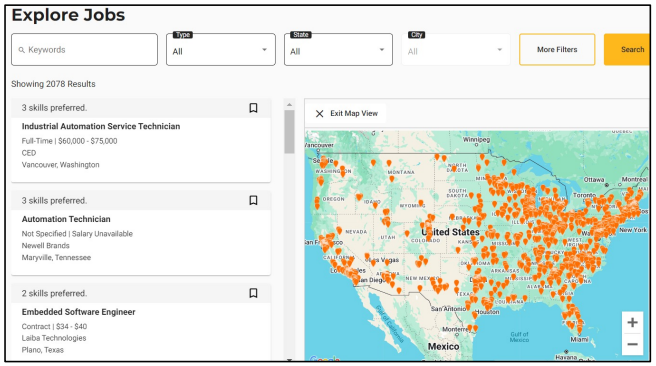


RoboticsCareer – Powered by SkillsMatch™

Track Your Career Journey and Goals



Connect to Personalized Job and Training Matches



Find the Most Effective Training Programs

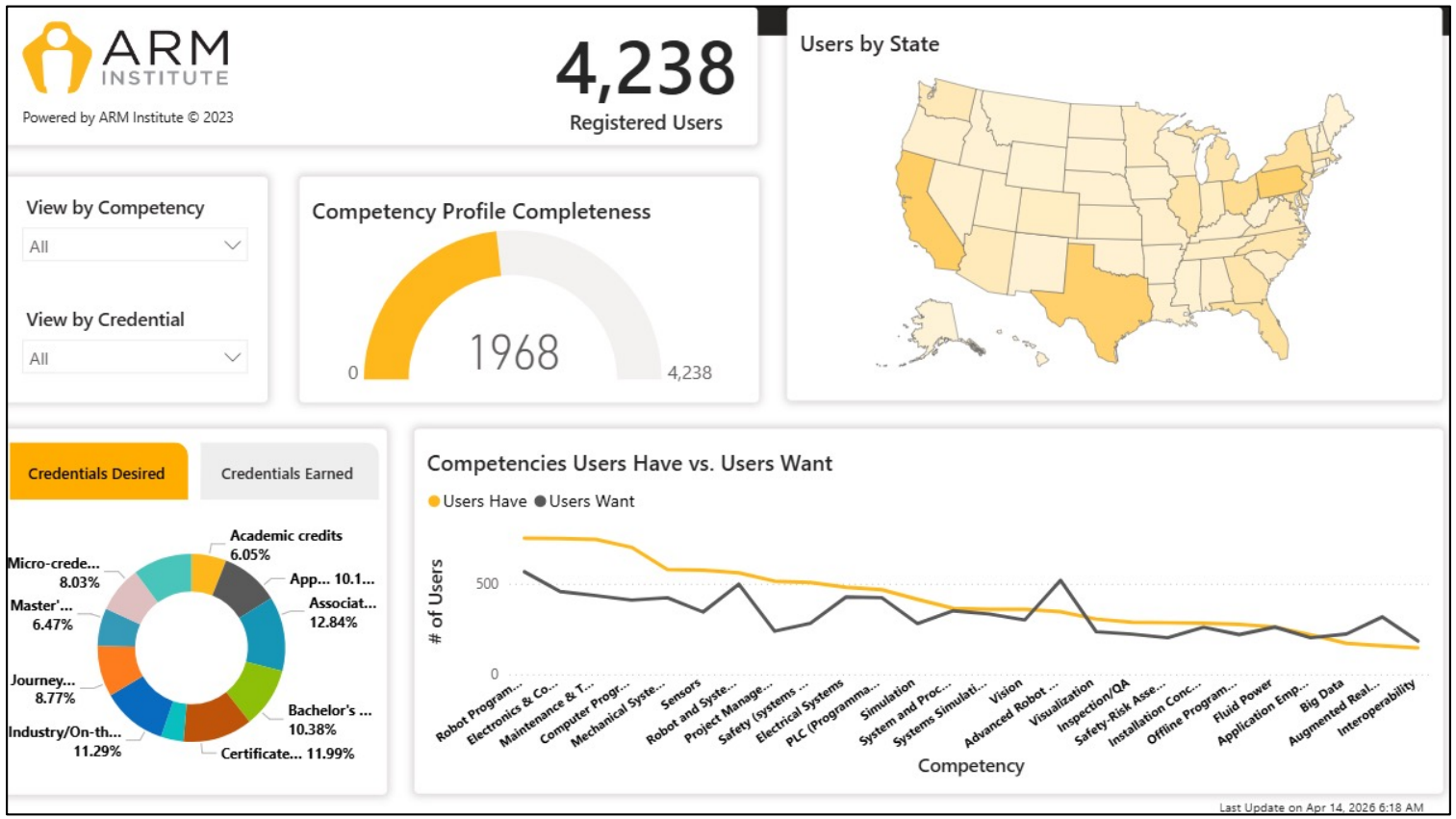
ENDORSED ARM INSTITUTE

150+
Articles

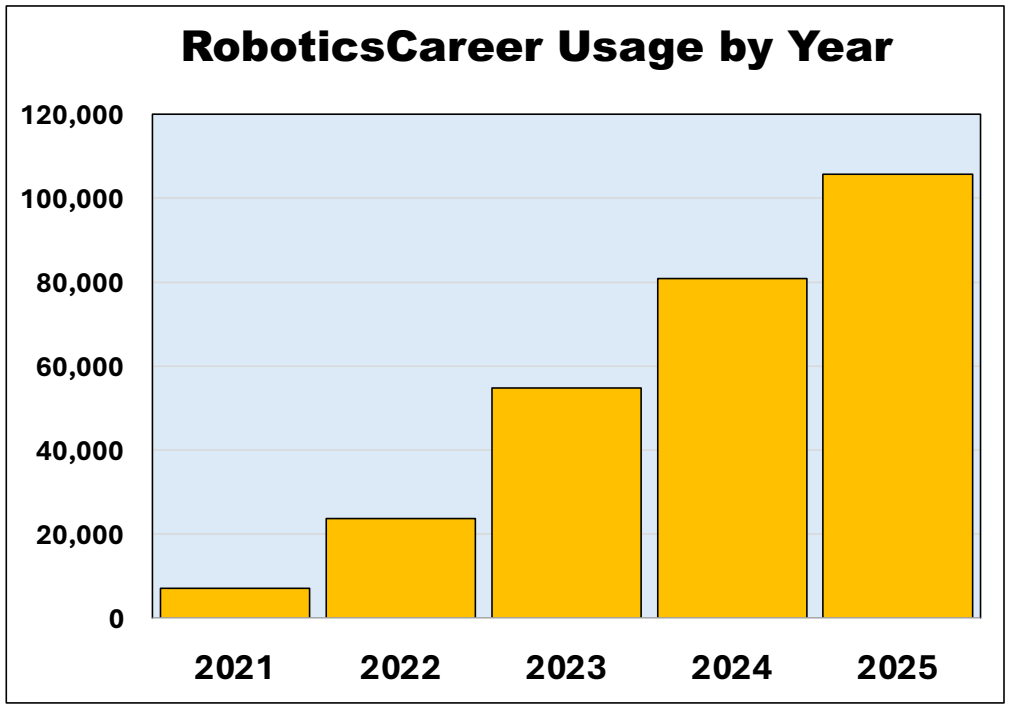
16,700+
Training Programs

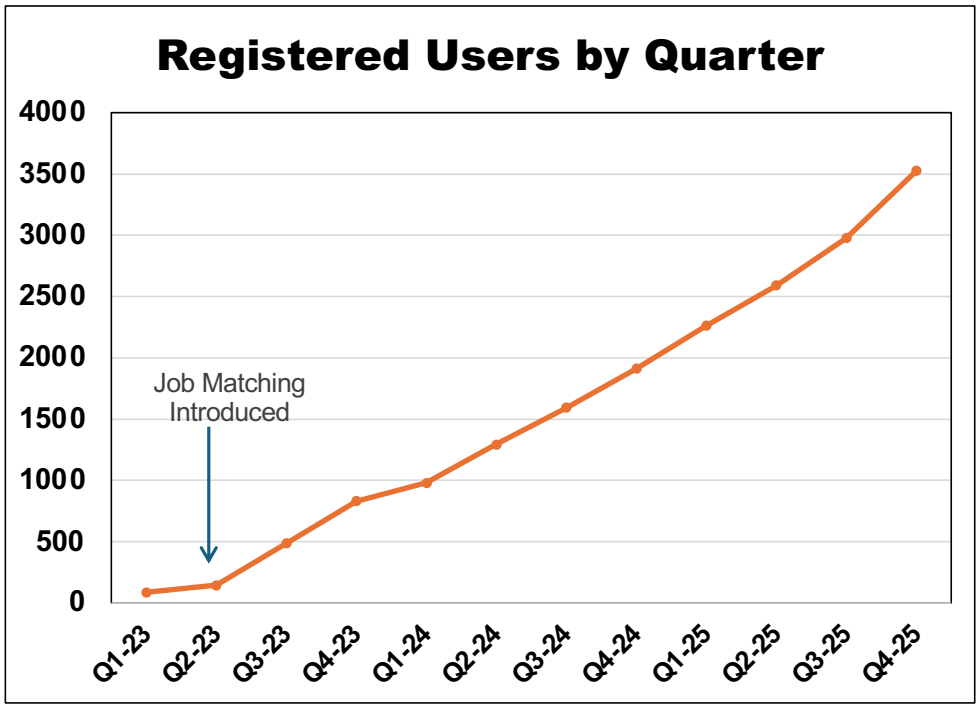
18,0000+
Active Job & Internship Postings

Data Analytics and Workforce Readiness



Growing Usage of RoboticsCareer

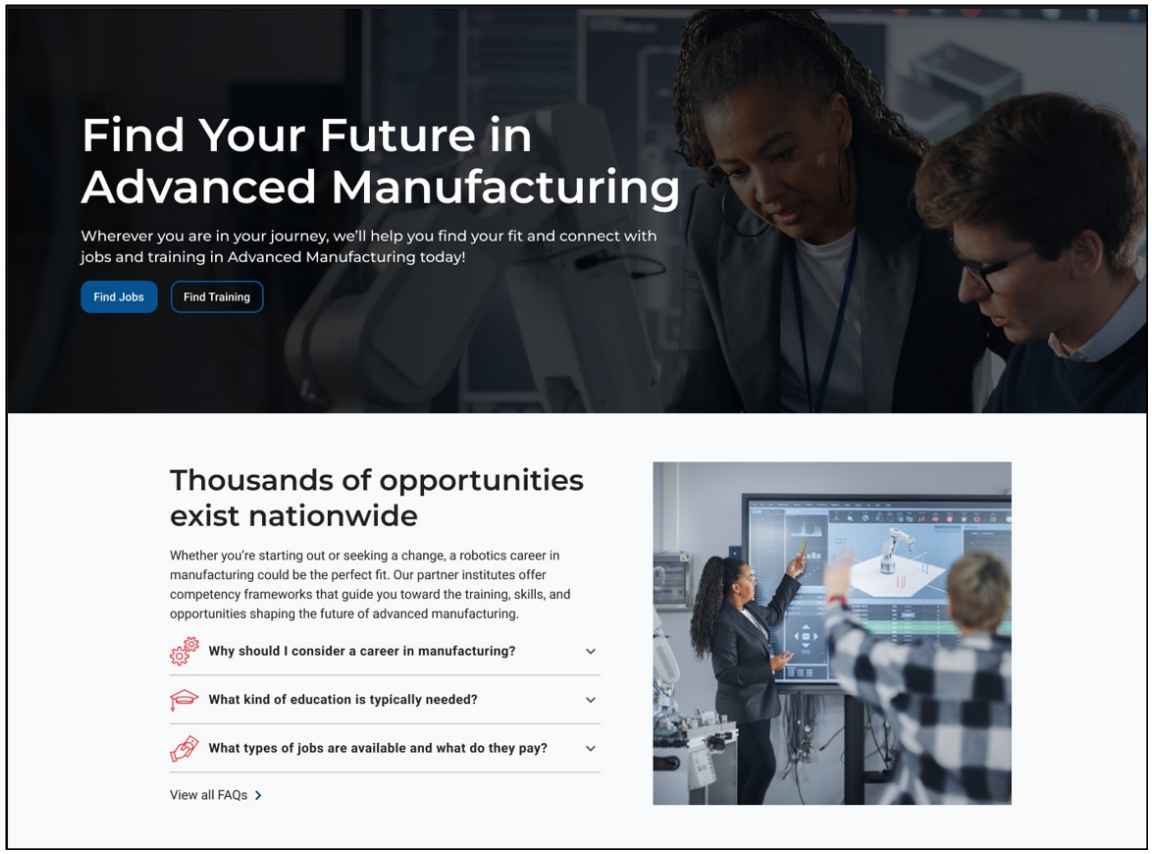




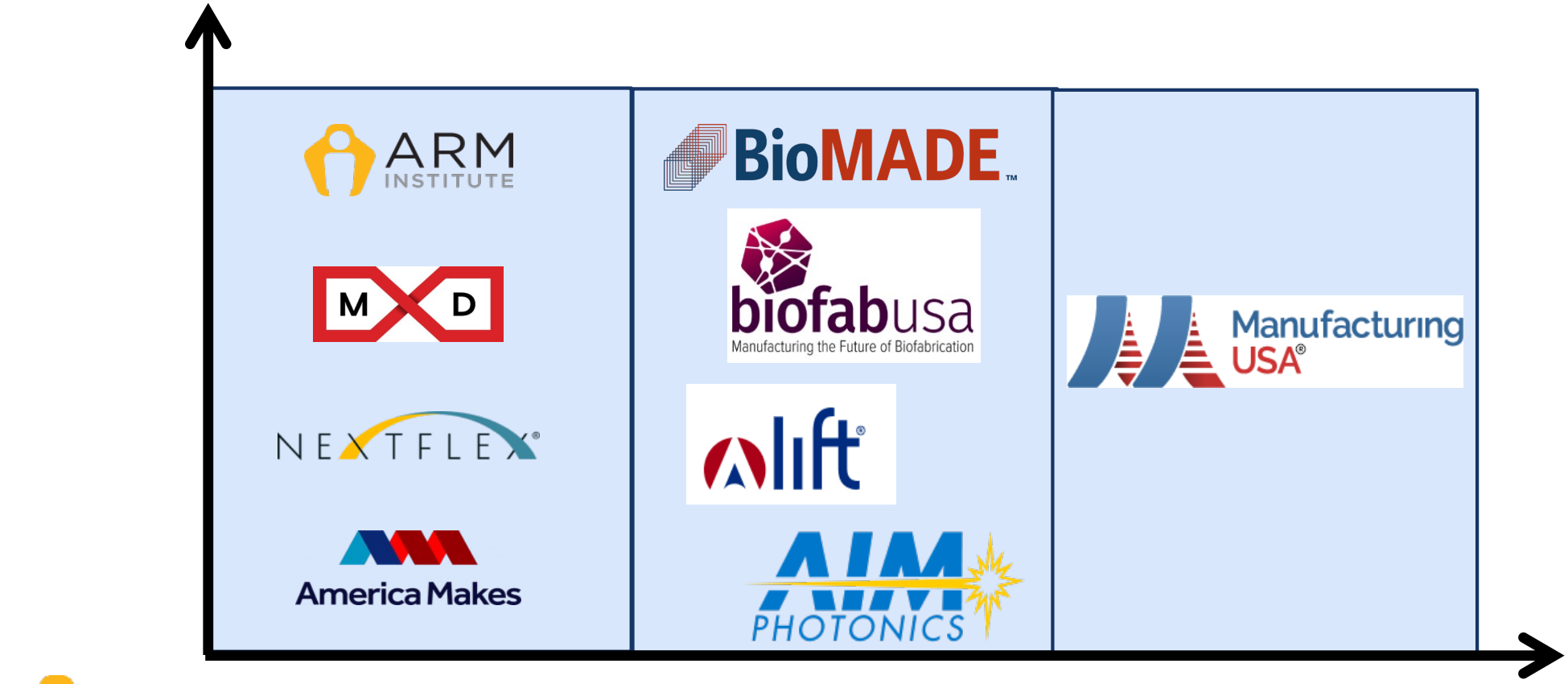
How to Expand RoboticsCareer.org to All Advanced Manufacturing Needs…

ARM INSTITUTE

MyMfgCareer.org



MyMfgCareer.org Roadmap



ARM INSTITUTE

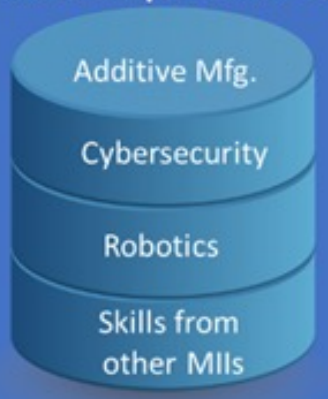
MyMfgCareer.org

Audiences Served

Job Seekers	Explore career alternatives	Match to specific job opportunities	Register and/or apply
Students	Explore career alternatives	Match to specific training opportunities	Register and/or apply
Manufacturers	Curate job opportunities	Identify and connect w/talent	Hiring Guide resources
Training Providers	Align training to industry standards	Reach boarder audience	Endorse training program
MII Contributors	Add/edit competency framework	Curate jobs and training	Add/edit resources

Business Analytics

Standardized Skills and Competencies



Outcomes

Stronger educational pipeline

Next-generation manufacturing workforce

Regional insight into talent and training needs

Thousands of opportunities exist nationwide

Whether you're starting out or seeking a change, a robotics career in manufacturing could be the perfect fit. Our partner institutes offer competency frameworks that guide you toward the training, skills, and opportunities shaping the future of advanced manufacturing.

- **Why should I consider a career in manufacturing?**
- **What kind of education is typically needed?**
- **What types of jobs are available and what do they pay?**

View all FAQs >

Explore Careers Driving the Future of Manufacturing

Each career represents a key area of innovation and connects you to related skills, training, and job paths.

Additive Manufacturing

Using advanced 3D printing technologies to design and produce innovative, high-performance parts across industries like aerospace, defense, and healthcare.

Explore Career >

AI

Centers on developing and applying intelligent systems that optimize production, enhance quality, and enable data-driven decision-making across every stage of the manufacturing process.

Explore Career >

Cyber Security

Focuses on protecting digital systems, networks, and data from threats, ensuring that advanced technologies and connected operations remain secure, resilient, and reliable across the production environment.

Explore Career >

Hybrid Electronics

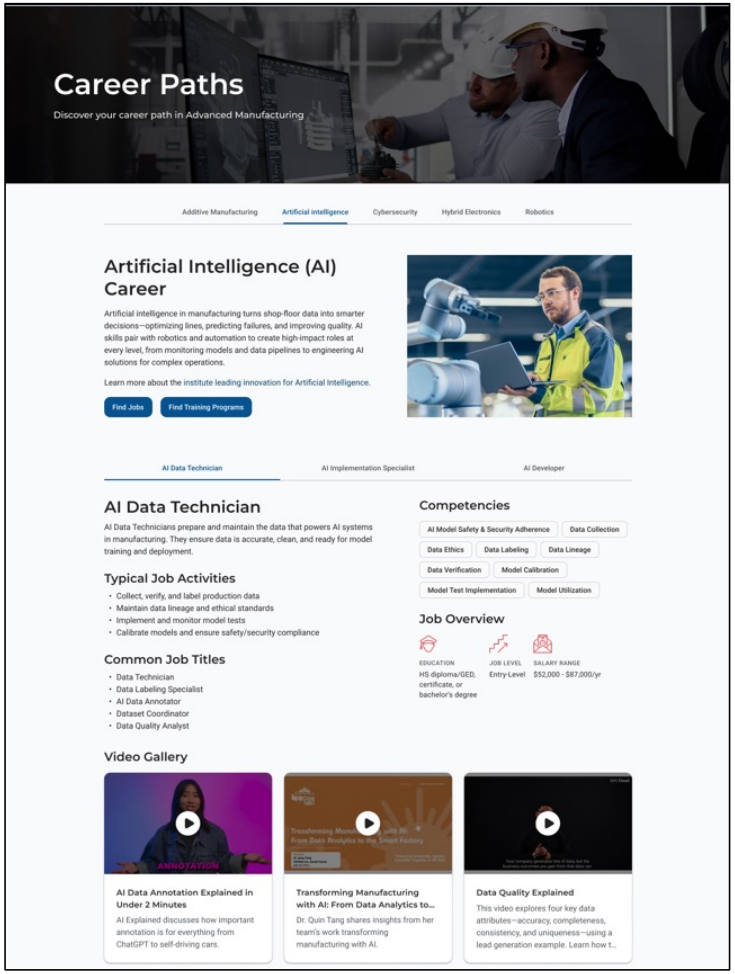
Involves designing and producing flexible, lightweight electronic systems that combine printed circuitry with traditional components to power innovations in wearables, medical devices, aerospace, and beyond.

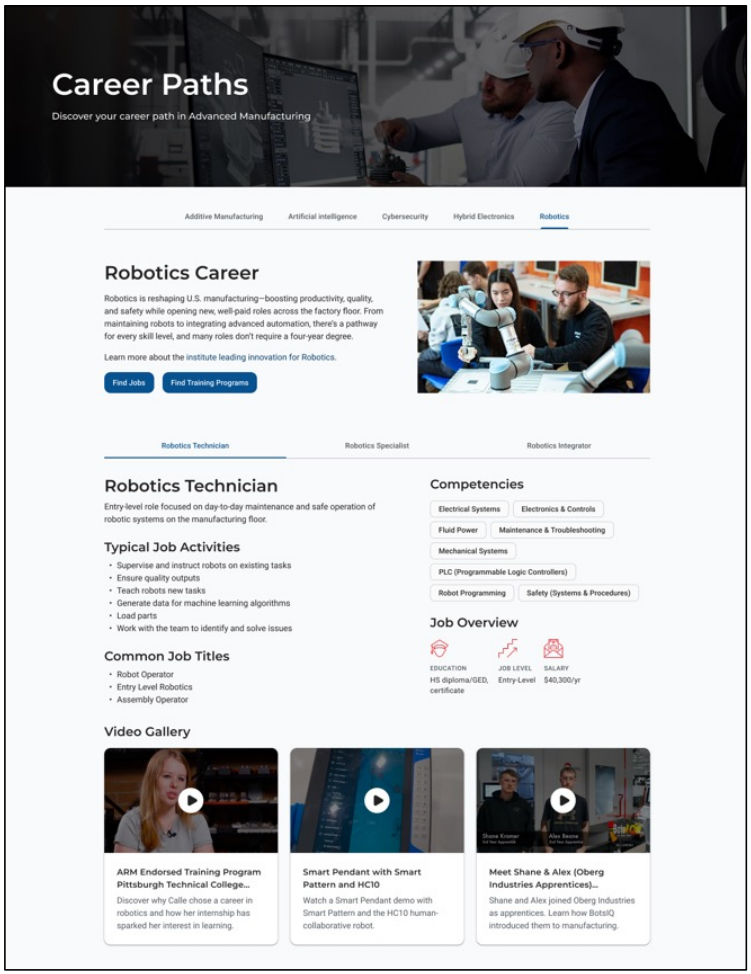
Explore Career >

Robotics

Focuses on designing, building, and maintaining automated systems that improve efficiency, precision, and safety across modern production environments.

Explore Career >


Career Paths
Discover your career path in Advanced Manufacturing
Additive Manufacturing
Artificial intelligence
Cybersecurity
Hybrid Electronics
Robotics
Artificial Intelligence (AI) Career
Artificial intelligence in manufacturing turns shop-floor data into smarter decisions—optimizing lines, predicting failures, and improving quality. AI skills pair with robotics and automation to create high-impact roles at every level, from monitoring models and data pipelines to engineering AI solutions for complex operations.
Learn more about the institute leading innovation for Artificial Intelligence.
Find Jobs
Find Training Programs
AI Data Technician
AI Implementation Specialist
AI Developer
AI Data Technician
AI Data Technicians prepare and maintain the data that powers AI systems in manufacturing. They ensure data is accurate, clean, and ready for model training and deployment.
Typical Job Activities
Collect, verify, and label production data
Maintain data lineage and ethical standards
Implement and monitor model tests
Calibrate models and ensure safety/security compliance
Common Job Titles
Data Technician
Data Labeling Specialist
AI Data Annotator
Dataset Coordinator
Data Quality Analyst
Competencies
AI Model Safety & Security Adherence
Data Collection
Data Ethics
Data Labeling
Data Lineage
Data Verification
Model Calibration
Model Test Implementation
Model Utilization
Job Overview
EDUCATION
HS diploma/GED, certificate, or bachelor's degree
JOB LEVEL
Entry-Level
SALARY RANGE
$52,000 - $87,000/yr
Video Gallery
ANNOTATION
AI Data Annotation Explained in Under 2 Minutes
AI Explained discusses how important annotation is for everything from ChatGPT to self-driving cars.
Transforming Manufacturing with AI: From Data Analytics to...
Dr. Quin Tang shares insights from her team's work transforming manufacturing with AI.
Data Quality Explained
This video explores four key data attributes—accuracy, completeness, consistency, and uniqueness—using a lead generation example. Learn how t...


Career Paths
Discover your career path in Advanced Manufacturing
Additive Manufacturing
Artificial intelligence
Cybersecurity
Hybrid Electronics
Robotics
Robotics Career
Robotics is reshaping U.S. manufacturing—boosting productivity, quality, and safety while opening new, well-paid roles across the factory floor. From maintaining robots to integrating advanced automation, there's a pathway for every skill level, and many roles don't require a four-year degree.
Learn more about the institute leading innovation for Robotics.
Find Jobs
Find Training Programs
Robotics Technician
Robotics Specialist
Robotics Integrator
Robotics Technician
Entry-level role focused on day-to-day maintenance and safe operation of robotic systems on the manufacturing floor.
Typical Job Activities
Supervise and instruct robots on existing tasks
Ensure quality outputs
Teach robots new tasks
Generate data for machine learning algorithms
Load parts
Work with the team to identify and solve issues
Common Job Titles
Robot Operator
Entry Level Robotics
Assembly Operator
Competencies
Electrical Systems
Electronics & Controls
Fluid Power
Maintenance & Troubleshooting
Mechanical Systems
PLC (Programmable Logic Controllers)
Robot Programming
Safety (Systems & Procedures)
Job Overview
EDUCATION
HS diploma/GED, certificate
JOB LEVEL
Entry-Level
SALARY
$40,300/yr
Video Gallery
ARM Endorsed Training Program Pittsburgh Technical College...
Discover why Calle chose a career in robotics and how her internship has sparked her interest in learning.
Smart Pendant with Smart Pattern and HC10
Watch a Smart Pendant demo with Smart Pattern and the HC10 human-collaborative robot.
Meet Shane & Alex (Oberg Industries Apprentices)...
Shane and Alex joined Oberg Industries as apprentices. Learn how BotsIQ introduced them to manufacturing.

MyMfgCareer

Jobs | Training Programs | Career Paths | Resources

Additive Manufacturing | Artificial Intelligence | Cybersecurity | Hybrid Electronics | Robotics

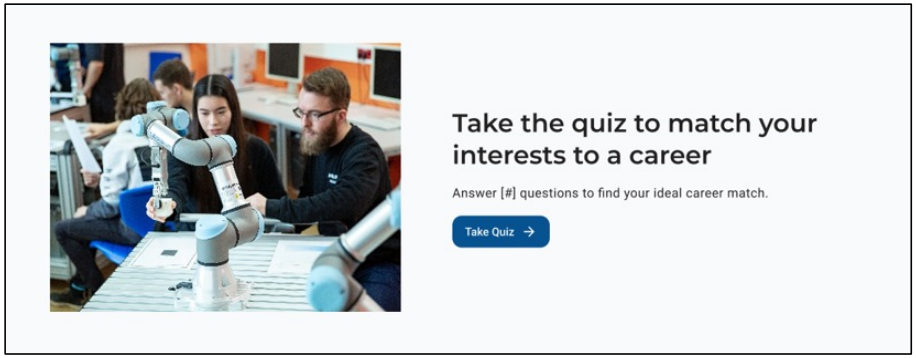
Cybersecurity Career

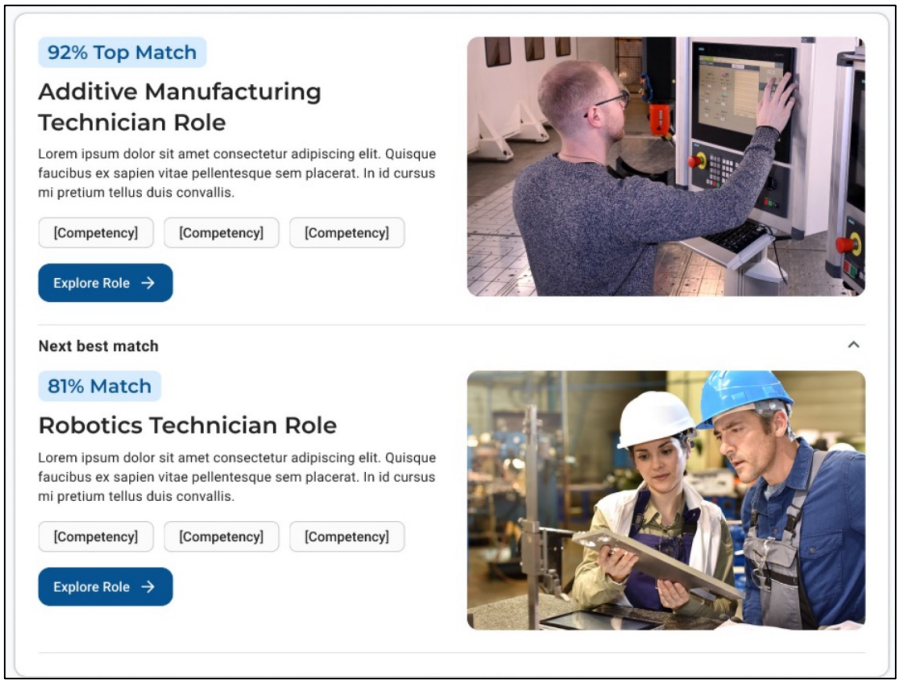
Cybersecurity is critical to modern manufacturing. As the most targeted sector for cyberattacks, manufacturers need skilled professionals to protect operations, secure data, and maintain resilience. Careers in cybersecurity offer opportunities to safeguard advanced technologies, prevent disruptions, and ensure national security. Whether you're starting out or advancing your expertise, cybersecurity roles are in high demand and provide competitive salaries.

Learn more about the institute leading innovation for Cybersecurity.

MxD Virtual Training Center | Workforce Readiness Guides

Quiz to Assess Career Pathways





Partner Institutes

Meet the institutes driving innovation and shaping tomorrow's manufacturing workforce.

America Makes

America Makes convenes government, industry, academia, the workforce, and economic development organizations to accelerate additive manufacturing (AM) adoption and support global U.S. manufacturing competitiveness.

Explore Institute >

ARM Institute

The ARM Institute leads the way to a future where people and robots work together to respond to our nation's greatest challenges and to develop and produce the world's most desired products.

Explore Institute >

MxD

MxD (Manufacturing x Digital) advances economic prosperity and national security by strengthening U.S. manufacturing competitiveness through technology innovation, workforce development, and cybersecurity preparedness.

Explore Institute >

NextFlex

NextFlex strengthens U.S. manufacturing through hybrid electronics—combining printed circuits with thin semiconductors to create flexible devices that bend and stretch.

Explore Institute >

CESMII
THE SMART MANUFACTURING INSTITUTE

Scaling Workforce Education on **Smart Manufacturing** with Micro-credentials and Training of Instructors

Conrad Leiva
VP Ecosystem and Workforce Development, CESMII

Smart Manufacturing – Competency Framework

Smart Manufacturing Skill Areas	Production Operator	Executive Leadership	"Citizen OT-IT Technologist"	Mfg/Process Engineer	OT-IT Implementer & Architect
Smart Manufacturing - Introduction, Concepts, Benefits, Examples					
SM Introduction, Strategy, Concepts, Roadmap Steps, Business Benefits, Examples. Relate and contrast with IIoT, Industry4, digital twin, digital thread initiatives.	Remember, Understand	Evaluate, Create	Apply, Analyze, Evaluate	Apply, Analyze, Evaluate	Understand, Apply
Smart Manufacturing - Capturing and Organizing Data					
SM Essentials, IIoT, OT/IT integration, Edge & Cloud Computing. IIoT sensors, wireless networking, data gateways, edge and cloud services.	Remember, Understand	Understand, Evaluate	Apply, Analyze, Evaluate	Understand, Evaluate	Evaluate, Create
Data Sources, Contextualization, Aggregation, Exchange and Storage. Interoperability, information modeling publish-subscribe vs request-response messages. Big Data, Data Lakes, Data Mesh, Blockchain.	Remember, Understand	Understand, Evaluate	Apply, Analyze, Evaluate	Apply, Analyze, Evaluate	Evaluate, Create
Smart Manufacturing - Providing Insights for Enhanced Decision Making					
Data Visualization, Manufacturing Metrics, Data-driven decision making, Big Data Analytics. Data Literacy, dashboards, SPC, value of data for the business.	Understand, Apply	Apply, Analyze, Evaluate	Apply, Analyze, Evaluate	Evaluate, Create	Evaluate, Create
Augmented Worker, Interfacing Human and Machine. Interactive AR/VR. Tablets, Wearables. Semi-autonomous systems, worker AI assistance.	Understand, Apply	Understand, Evaluate	Apply, Analyze, Evaluate	Evaluate, Create	Evaluate, Create
Smart Lean Manufacturing, Digital Lean. Information and Value Stream Analysis. Digital enhanced complex problem solving, DMAIC, root-cause analysis, continuous process improvement.	Understand, Apply	Apply, Analyze, Evaluate	Apply, Analyze, Evaluate	Evaluate, Create	Apply, Analyze, Evaluate
Digital Supply Chain and Smart Manufacturing for transparency, traceability, resiliency, and orchestration in the supply chain. Optimize inventory, trouble-shoot logistics, and assess business continuity risk .	Remember, Understand	Apply, Analyze, Evaluate		Apply, Analyze, Evaluate	Evaluate, Create
Smart Manufacturing - Connecting Data, Platforms and Systems					
Integration of Modular Applications and platforms for manufacturing operations management. Considerations for architecting SM systems and connecting apps. Leveraging edge and cloud computing.		Understand, Evaluate	Apply, Analyze, Evaluate	Apply, Analyze, Evaluate	Evaluate, Create
Methodologies towards a Digital Thread and Digital Twins. Data collection for product and process digital twin analysis. Digital thread in product lifecycle management.		Understand, Evaluate		Apply, Analyze, Evaluate	Evaluate, Create
Smart Manufacturing - Automating Flow and Control					
Automating Logic and Control, Optimization of Resources/Energy, Process Modeling, Simulation, Predictive Analysis, Machine Learning/AI. Semi-autonomous decisions, triggering workflow and human intervention for non-routine		Understand, Evaluate	Apply, Analyze, Evaluate	Evaluate, Create	Apply, Analyze, Evaluate
Cybersecurity					
Industrial Cybersecurity Risk, Policies, and Tools. Data Ethics. Tools for multiple layers of protection in the SM infrastructure. Cybersecurity framework.	Remember, Understand	Remember, Understand	Apply, Analyze, Evaluate	Apply, Analyze, Evaluate	Evaluate, Create

Skills/Competency Frameworks Inform Education

Smart Manufacturing Skill Areas	Production Operator	Executive Leadership	"Citizen OT-IT Technologist"	Mfg/Process Engineer	OT-IT Implementer & Architect
Smart Manufacturing - Introduction, Concepts, Benefits, Examples					
SM Introduction, Strategy, Concepts, Roadmap Steps, Business Benefits, Examples. Relate and contrast with IIoT, Industry4, digital twin, digital thread initiatives.	Remember, Understand	Evaluate, Create	Apply, Analyze, Evaluate	Apply, Analyze, Evaluate	Understand, Apply
Smart Manufacturing - Capturing and Organizing Data					
SM Essentials, IIoT, OT/IT integration, Edge & Cloud Computing. IIoT sensors, wireless networking, data gateways, edge and cloud services.	Remember, Understand	Understand, Evaluate	Apply, Analyze, Evaluate	Understand, Evaluate	Evaluate, Create
Data Sources, Contextualization, Aggregation, Exchange and Storage. Interoperability, information modeling publish-subscribe vs request-response messages. Big Data, Data Lakes, Data Mesh, Blockchain.	Remember, Understand	Understand, Evaluate	Apply, Analyze, Evaluate	Apply, Analyze, Evaluate	Evaluate, Create
Smart Manufacturing - Providing Insights for Enhanced Decision Making					
Data Visualization, Manufacturing Metrics, Data-driven decision making, Big Data Analytics. Data Literacy, dashboards, SPC, value of data for the business.	Understand, Apply	Apply, Analyze, Evaluate	Apply, Analyze, Evaluate	Evaluate, Create	Evaluate, Create
Augmented Worker, Interfacing Human and Machine. Interactive AR/VR. Tablets, Wearables. Semi-autonomous systems, worker AI assistance.	Understand, Apply	Understand, Evaluate	Apply, Analyze, Evaluate	Evaluate, Create	Evaluate, Create
Smart Lean Manufacturing, Digital Lean. Information and Value Stream Analysis. Digital enhanced complex problem solving, DMAIC, root-cause analysis, continuous process improvement.	Understand, Apply	Apply, Analyze, Evaluate	Apply, Analyze, Evaluate	Evaluate, Create	Apply, Analyze, Evaluate
Digital Supply Chain and Smart Manufacturing for transparency, traceability, resiliency, and orchestration in the supply chain. Optimize inventory, trouble-shoot logistics, and assess business continuity risk .	Remember, Understand	Apply, Analyze, Evaluate		Apply, Analyze, Evaluate	Evaluate, Create
Smart Manufacturing - Connecting Data, Platforms and Systems					
Integration of Modular Applications and platforms for manufacturing operations management. Considerations for architecting SM systems and connecting apps. Leveraging edge and cloud computing.		Understand, Evaluate	Apply, Analyze, Evaluate	Apply, Analyze, Evaluate	Evaluate, Create
Methodologies towards a Digital Thread and Digital Twins. Data collection for product and process digital twin analysis. Digital thread in product lifecycle management.		Understand, Evaluate		Apply, Analyze, Evaluate	Evaluate, Create
Smart Manufacturing - Automating Flow and Control					
Automating Logic and Control, Optimization of Resources/Energy, Process Modeling, Simulation, Predictive Analysis, Machine Learning/AI. Semi-autonomous decisions, triggering workflow and human intervention for non-routine		Understand, Evaluate	Apply, Analyze, Evaluate	Evaluate, Create	Apply, Analyze, Evaluate
Cybersecurity					
Industrial Cybersecurity Risk, Policies, and Tools. Data Ethics. Tools for multiple layers of protection in the SM infrastructure. Cybersecurity framework.	Remember, Understand	Remember, Understand	Apply, Analyze, Evaluate	Apply, Analyze, Evaluate	Evaluate, Create

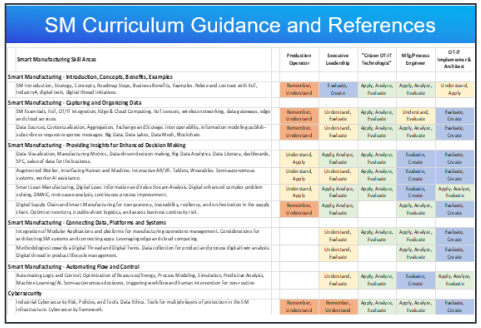
Manufacturing USA Advanced Manufacturing Competency Framework

The competency frameworks inform:

- Career Pathways
- Credentials Development
- Curriculum Development
- Employee Assessment
- Training Guidance
- Employer Job Descriptions
- Train-the-Trainer Programs
- Talent Pipeline Guidance

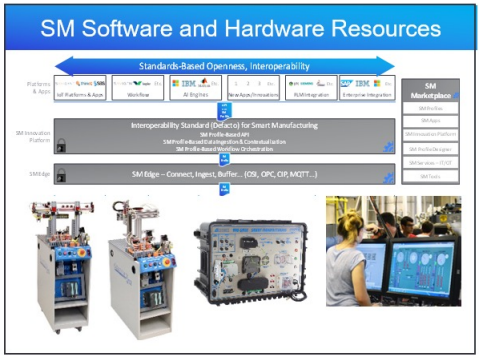
SM Education Resources → Education Ecosystem

SM Curriculum Guidance and References



Curriculum Guidance – curriculum materials, exercises, datasets

SM Software and Hardware Resources



Hardware and Software Resources for education

SM Micro-Credentials

- C-217 Smart Manufacturing Fundamentals
- C-218 Smart Manufacturing Data Acquisition
- C-219 Smart Manufacturing Visualization and Data Analytics
- C-220 Smart Manufacturing Cyber Security

SACA SM Micro-Credentials

SM Instructor Training

Smart Factory

SM Learning System

VR/digital twin

SM Instructor Academy at Texas A&M

SM Education Catalog

- Cleveland State University
- Rensselaer
- Purdue University
- FingerLakes
- PennState
- Texas A&M University
- TOOLINGU | SME
- AMATROL

CESMII-Endorsed SM Education Programs

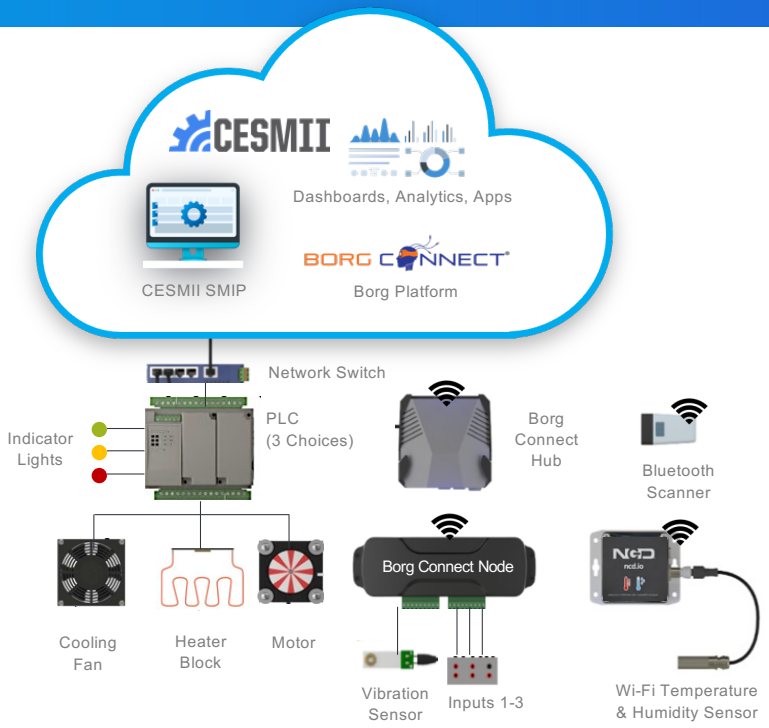
- TSTC Texas State Technical College
- Lone Star College
- Blinn College District
- Alamo Colleges District

CESMII-Amatrol SM Learning System

Wired & Wireless Sensors, PLC, HMI, Edge & Cloud Platform, Security, Analytics, Data Analysis Skills

AMATROL

SM Learning System
990-SM10CL



Exercises in the context of industrial use cases for:

- Production
- Quality
- Maintenance

Smart Manufacturing Micro-credentials

C-217 Smart Manufacturing Fundamentals

The purpose of this credential is to certify that individuals can describe the principles, technologies, and applications of Smart Manufacturing, Industry 4.0, and the Industrial Internet of Things (IIoT) and how they affect the competitive position of manufacturers. Further, individuals must be able to safely operate basic smart automation systems that use Human Machine Interface (HMI) panels, monitor system operation parameters and energy usage using HMI visualization software, and connect/test to smart devices through point-to-point Ethernet communications.

C-218 Smart Manufacturing Data Acquisition

The purpose of this credential is to certify that individuals can identify types of manufacturing data and its function, describe how smart manufacturing data is collected and stored, set up and operate a dedicated cloud-based data acquisition system, interface and test analog and discrete sensing devices, configure and test wired and wireless Ethernet communications to sensors, and view data stored in a dedicated data acquisition system.

C-219 Smart Manufacturing Visualization and Data Analytics

The purpose of this credential is to certify that individuals can organize and interpret data using a variety of visualization methods, set up and operate visualization displays using dedicated and controller-based data acquisition systems, set up programmable controllers to collect data, configure Bluetooth technology to transfer information between devices, use OPC server software to facilitate data exchange between a smart device and a database or another smart device, set up Excel Spreadsheet, and use Excel to analyze data.

C-220 Smart Manufacturing Data Transmission and Cyber Security

The purpose of this credential is to certify that individuals can assess potential cyber security threats to an industrial smart manufacturing system and data transmission methods, use best practices to protect stored and transmitted data against cyber security attacks, respond effectively to cyber security attacks, and set up secure industrial local area networks and firewalls.

C-221 Smart Manufacturing OT-IT Integration **(Coming Soon)**

The purpose of this credential is to certify that individuals can configure and operate various types of edge and cloud software including SCADA, OPC-UA server, MQTT broker, and SQL Database to enable real-time data exchange with open standards like ISA-95, OPC UA and MQTT between automation equipment and IIoT sensors (a.k.a. Operational Technology – OT), and enterprise systems like Manufacturing Execution Systems (MES) and Enterprise Asset Management (EAM) systems (considered part of the Information Technology systems – IT) . Individuals shall also demonstrate the ability to configure various types of visualizations and organization of the data for use in dashboards and analytical applications.

C-222 Smart Manufacturing OT-IT Semi-autonomous Intelligence **(Coming Soon)**

The purpose of this credential is to certify that individuals have the foundational skills for designing and working with a Unified Namespace (UNS) to organize and contextualize IIoT data from industrial systems. Individuals will demonstrate the ability to collect, model, and prepare operational data for downstream use, including analytics and AI-enabled applications. The credential emphasizes preparing high-quality, well-structured data suitable for programmatic or AI-based workflows, and includes practical experience using Python to access, transform, and analyze industrial data.

How to Leverage Micro-Credentials for Workforce Education Development

Industry 4.0 Micro-Credentials

C-201 Electrical Systems 1
C-202 Electric Motor Control Systems 1
C-203 Variable Frequency Drive Systems 1
C-204 Motor Control Troubleshooting 1
C-205 Sensor Logic Systems 1
C-206 Electrical System Installation 1
C-207 Programmable Controller Systems 1
C-208 PLC Troubleshooting 1
C-209 Pneumatic Systems 1
C-210 Mechanical Power Systems I
C-211 Industry 4.0 TPM
C-212 Ethernet Communications 1
C-213 Smart Sensor & Identification Systems 1
C-214 Smart Factory Systems 1
C-215 Robot System Operations 1
C-216 Robot Systems Integration 1
C-217 Smart Manufacturing Fundamentals
C-218 Smart Manufacturing Data Acquisition
C-219 Smart Manufacturing Visualization and Data Analytics
C-220 Smart Manufacturing Cyber Security
C-257 Process Control Systems 1
C-258 Process Control Troubleshooting 1
C-302 Laser Shaft Alignment 1
C-303 Electric Motor Troubleshooting 1
C-304 Pneumatic Troubleshooting 1
C-305 Industrial Electronic Systems 1
C-306 Industrial Electronic Systems 2
C-307 Electronic Systems Installation 1
C-311 Data Analytics 1
C-308 Variable Frequency Drive Systems 2
C-309 Programmable Controller Systems 2
C-310 Ethernet Communications 2
C-312 Robot Systems Integration 2
C-313 Smart Factory Systems 2
C-351 Predictive Maintenance 1
C-356 Process Control Systems 2
C-358 Autonomous Mobile Robot Systems 1
C-359 Programmable Controller Systems 3
C-360 Motion Control Systems 1
C-361 Programmable Conveyor Systems 1
C-362 Machine Vision Systems 1

Plus more new micro-credentials in-process…

Specialist Roles provide Pathway Options

Industrial Automation and IT Integration Specialist

C-221 Smart Manufacturing - OT-IT Semi-autonomous Intelligence [new]
C-222 Smart Manufacturing - OT-IT Integration [new]
C-220 Smart Manufacturing - Data Transmission & Cybersecurity
C-219 Smart Manufacturing - Visualization and Data Analytics
C-218 Smart Manufacturing - Data Acquisition
C-217 Smart Manufacturing - Fundamentals
C-214 Smart Factory Systems 1
C-213 Smart Sensor & Identification Systems 1
C-212 Ethernet Communications 1

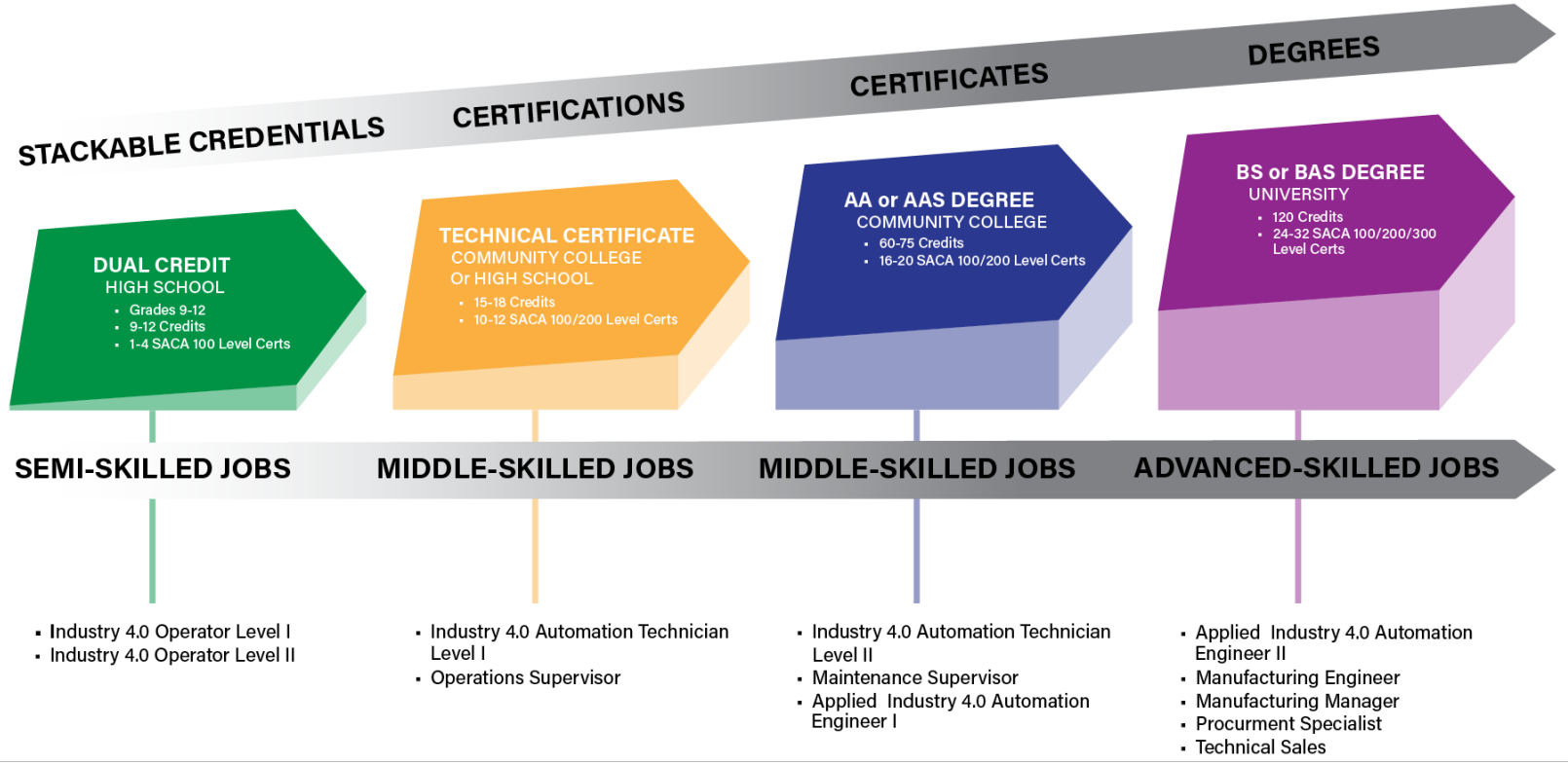
Control Systems Specialist

C-208 PLC Troubleshooting 1
C-207 Programmable Controller Systems 1
C-206 Electrical System Installation 1
C-205 Sensor Logic Systems 1
C-204 Motor Control Troubleshooting 1
C-203 Variable Frequency Drive Systems 1
C-202 Electric Motor Control Systems 1
C-201 Electrical Systems 1

Machine/Process Operator – Level 4

C-104 Associate - IIoT, Networking & Data Analytics
C-103 Associate - Robot System Operations
C-102 Associate - Advanced Operations
C-101 Associate - Basic Operations

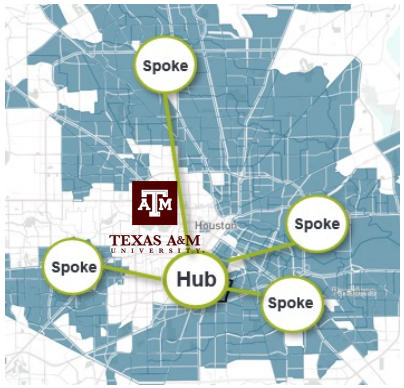
Education/Career Pathway with Micro-Credentials

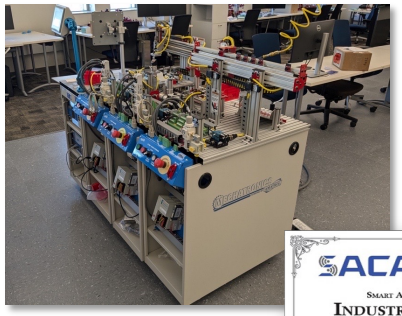


SM Instructor Academy

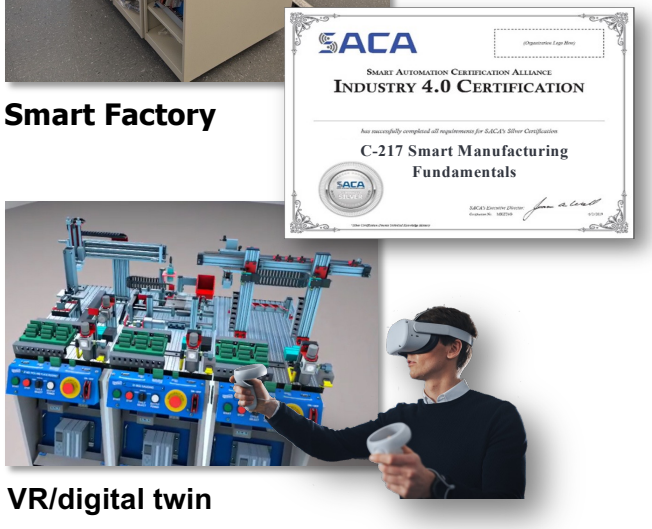
SM Credential Aligned Community College Instructor Academy

- Instructor Academy and Hub for SM Skills in the region
- SACA Certification-Based Courses
- Professors leave with curriculum and exercises
- Hybrid online and in-person
- Smart Factory, SM Learning System, and Digital Twin VR software
- Training Assessment for fast tracking worker learning





Smart Factory



VR/digital twin

Hybrid Online and Hands-On Courses

Smart Manufacturing Courses (SACA Aligned)

MX75217 - Smart Manufacturing - Fundamentals (Aligned with SACA C-217)

MX75218 - Smart Manufacturing - Data Acquisition (Aligned with SACA C218)

MX75219 - Smart Manufacturing - Visualization and Data Analytics (Aligned with SACA C-219)

The Smart Manufacturing Visualization and Data Analytics eLearning course covers data visualization and data analytics. Learners will study visualization tools, database concepts, data exchange applications, and Bluetooth data acquisition.

The Smart Manufacturing Visualization and Data Analytics course prepares learners to earn the SACA C-219 Smart Manufacturing Visualization and Data Analytic which certifies that individuals can organize and interpret data using a variety of visualization methods, set up and operate visualization displays using dedicated data acquisition systems, set up programmable controllers to collect data, configure Bluetooth technology to transfer information between devices, use OPC se facilitate data exchange between a smart device and a database or another smart device, set up Excel Spreadsheet, and use Excel to analyze data.

Learning topics include:

- Visualization Tools
- Smart Manufacturing Visualization and Data
- Database Concepts
- Data Exchange Applications
- Bluetooth Data Acquisition

SM Learning System: 990-SM10CL
+ 99-SM10B – Data Analytics Learning Kit

Hands-on Exercises:

- Identify the type of variation given a cause
- Calculate the mean and range of a data set
- Manually record process data and analyze an X-bar and R chart
- Use SPC software to create an X-bar and R chart
- Configure a visualization software dashboard and trend chart
- Configure an OPC-UA server to transfer data from a PLC to an Excel spreadsheet
- Use Excel to analyze exported data through histograms and Pareto charts
- Configure and pair a Bluetooth device barcode reader
- Use a barcode reader to transmit data to a data acquisition system

Goal is to Scale SM Education Nationwide…

CESMII-Endorsed SM Education

Education Catalog

Workforce
Training Programs

Learn More

To achieve its education mission nationwide, CESMII collaborates with various education and training organizations that share its goals and offer courses aligned with the First Principles of SM. CESMII evaluates and offers guidance to educators offering SM courses/programs seeking CESMII-Endorsed status.

Rensselaer | TOOLINGU | sme | TEXAS A&M UNIVERSITY | PennState
CLEVELAND STATE UNIVERSITY | NC STATE UNIVERSITY | AMATROL | California State University Northridge
West Virginia University | FingerLakes COMMUNITY COLLEGE | PURDUE UNIVERSITY | THE UNIVERSITY OF TEXAS AT EL PASO

CESMII
THE SMART MANUFACTURING INSTITUTE

Education Programs & Resources

Purchase a **Smart Manufacturing Learning System** & Get Your Teams Trained!

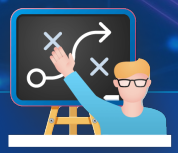
Train the workforce with our educational resources, hardware kits, software, datasets, & curated exercises.

Learn More

Use Micro-credentials to **Guide Curriculum** for SM Education Programs

SACA micro-credentials provide guidance for curriculum so students and workforce start accumulating stackable credentials.

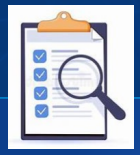
Learn More



Train and Equip Instructors to Teach SM Skills

The Instructor Academy trains instructors to teach SM skills with courses aligned to SACA micro-credentials and hands-on competency exercises using the CESMII-Amatrol SMLS.

Learn More



Verify plans for SM Education

Have CESMII subject matter experts provide review and advisory services for the development of curriculum and hands-on exercises for Smart Manufacturing education.

Learn More

Join CESMII and become a member of this great ecosystem

Work with peers that are advancing Smart Manufacturing practices in their companies and ecosystem.

Learn More

EXPANDING THE

CESMII
THE SMART MANUFACTURING INSTITUTE

Ecosystem to **Support Manufacturers**

conrad.leiva@cesmii.org

www.cesmii.org

NIIMBL Workforce Impact Assessment Framework

A tool for standardizing and aligning communication about workforce development ROI

John Balchunas
Workforce Director, NIIMBL
May 2026

Funding provided by Gates Foundation

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Measuring Workforce Impact: A Problem Statement

Current State

- EWD initiatives cannot be holistically evaluated or assessed as funders have different metrics
- Securing funding, advancing innovative ideas, and effectively demonstrating ROI is challenging
- Emerging regions lack the knowledge and best practices to design impactful solutions

Impact Assessment Framework

- Establishes a standard, consistent approach for assessing impact across key audiences
- Guides the successful development, implementation, and tracking of workforce initiatives
- Framework-informed initiatives can become a model for emerging organizations

Future State

- Consistency: Ecosystem-wide agreement on process and components of effective workforce initiatives
- Effectiveness: Industry needs are met by better designed and implemented initiatives
- Efficiency: Increased opportunities to more effectively leverage and build upon best practices

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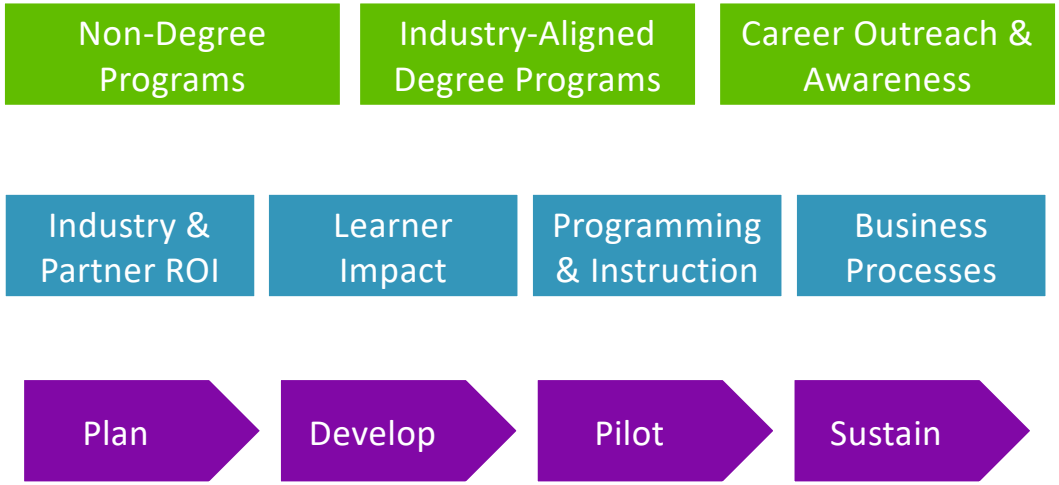
Community-Driven Socialization for Solutions

NIIMBL conducted an extensive review of existing frameworks and engaged its broader workforce community in partnership with Nexight Group to design a solution.

We realized that:

- **Workforce initiatives fall into three broad buckets**
- **Impact can be seen and felt across multiple dimensions**
- **Workforce initiatives and impact signposts vary by maturity**



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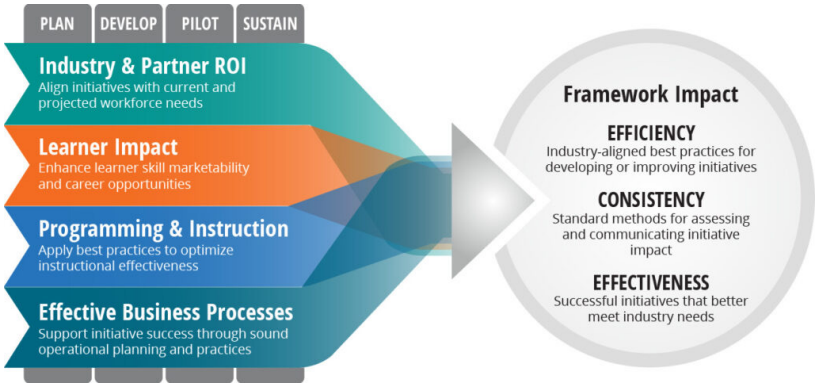
Contextualizing a Solution

Cross walking these three facets yielded an incredibly rich, meaty, and dense framework.



3 initiative types **4** dimensions of impact **4** maturity levels

200+ content pages

ManufacturingUSA

Let's look at industry and partner ROI for a mature/sustained non-degree in initiative...

ASSESSMENT QUESTION: To what extent does the initiative continue to provide return on investment to industry?

BASELINE MEASURES	EXEMPLARY MEASURES
Qualitative positive feedback (e.g., testimonials) from industry that demonstrates industry's perceived value of the initiative • Examples: reduction in unfilled positions or time to fill, more qualified candidates, reduced employee time to contribution, improved employee performance **Demonstrated implementation of data collection, management, analysis, and reporting plan**, including key stakeholders, methods, and frequency • Clearly defined key performance indicators and benchmarks	**Quantitative data from industry that demonstrates industry's sustained value from the initiative over time** • Alignment with industry market data, including occupations, current and anticipated positions to fill; demonstrated contributions to industry success and growth (e.g., regional expansion) • Data comparisons of initiative participants with similar groups who did not participate • Examples: number of initiative participants that industry interviews, hires, or promotes; reduction in unfilled positions or time to fill; reduced employee time to contribution; longitudinal improved employee performance and retention; time to promotion; skills competency scores **Multiple methods used for collecting and reporting data on initiative impact** • Collection examples: survey/feedback forms, interview, roundtable, focus group • Reporting examples: Industry case studies and testimonials that can be used in future initiative marketing and communications

2026 Impact Framework Rollout & Future Plans

- Self assessment tools will provide a user-friendly mechanism for “digesting” the treasure trove of guidance.
- Sets the stage for future institute work around “endorsement” of impactful workforce programs.
- Future plans to develop consultative capacity in applying framework to new and emerging initiatives.

ABOUT THE FRAMEWORK

To help meet the growing workforce needs of the biopharmaceutical manufacturing industry, the National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL) has rolling out a **suite of tools** to **standardize how the community can:**

- Evaluate feasibility of proposed workforce initiatives and programs
- Maximize and communicate the impact of existing workforce initiatives
- Facilitate program benchmarking and comparison through standardized metrics

Framework

Comprehensive report and “database” of activities, considerations, and measures that define industry-informed best practices for initiative development and sustainabilitv

Self-Assessment

Web-based assessment to help organizations identify initiative strengths and areas for enhancement, supplemented by guidance from NIIMBL on effectively collaborating with industry

NIIMBL Endorsement Program

Industry program endorsement based on guidance and measures outlined in the framework

Anticipated future launch

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ACE, METAL and Internships:
Scaling Successful Workforce
Programs
THE COMPOSITES
iacmi
INSTITUTE
ACE
AMERICA'S CUTTING EDGE
METAL

Scaling Workforce Impact

24,300+ Online Registrants
7,000+ Bootcamp Participants
56 Partner Sites Across **17** States

Hub-and-Spoke Workforce Model

- Central program design, standards and data systems
- IACMI provides curriculum framework, credentials and quality control
- Sites adapt delivery to local workforce needs

ACE
AMERICA'S CUTTING EDGE

METAL

Contracted Partners as Workforce Multipliers

Why Partnerships Matter

- Contracted partners bring:
  - Existing relationships with employers
  - Specialized technical and training expertise
- Diverse partner network increases resilience and adaptability

- Partners = force multipliers
- Faster deployment
- Outcome-based accountability

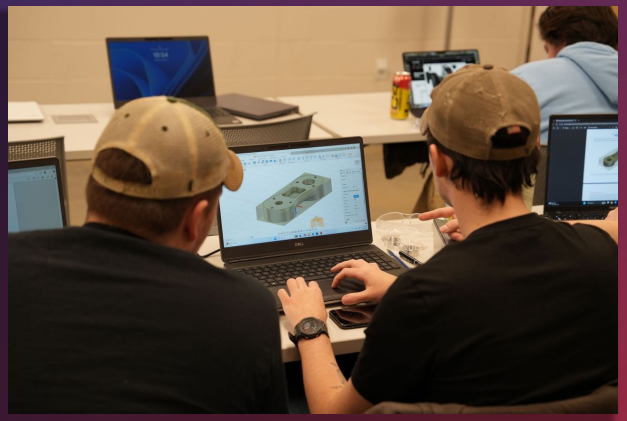
ACE
AMERICA'S CUTTING EDGE

METAL

Deliverables, Data and Industry Credibility

How ACE and METAL Built Momentum

- Clear workforce deliverables
- Standardized data collection across partners
  - Enables cross-region comparison
  - Continuous improvement
  - Stronger storytelling to funders and industry
- Industry credibility increases



Lower Cost, Higher Impact

METAL LVL 1 Casting Bootcamp

METAL Digital Technologies in Casting Bootcamp

ACE Composites Bootcamp

ACE CNC Machining Bootcamp

What Enabled Sustained Growth

- Blended funding strategy
  - Federal resources
  - State and regional workforce funds
  - Employer investment
- Co-investment aligns incentives and strengthens employer commitment
- Results improve while cost per participant declines over time

Questions?
Thank you

Andrew Pokelwaldt
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Workforce and Education
andrewp@iacmi.org

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METAL