Preparing the Future Advanced Manufacturing Workforce: Initiatives & Resources for Educators & Students

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Agenda

- Overview of National Center for Next Generation Manufacturing (NCNGM)

- Industry 4.0 in Manufacturing

- NCNGM Resources

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National Center for Next Generation Manufacturing

- Awarded in 2021– only NSF ATE National Center for manufacturing
  - Builds on four previous rounds of funding beginning in 2004 for Regional Center for Next Gen Mfg and transition to Resource Center

- Lead/Partner institutions:
  - Connecticut College of Technology, CT State Community College (CT) – Karen Wosczyna-Birch, PI
  - College of the Canyons (CA) - Tim Baber, Co-PI
  - Columbus State Community College (OH) – Chris Dennis, Co-PI
  - Central Community College (NE) - Jerry Muller, Co-PI

- Additional Partners:
  - EdAdvance (CT) – new fiduciary agent
  - Business & Industry Leadership Teams (BILT) - Dr. Ann Beheler
  - Industry
  - Comprehensive & Technical High Schools
  - Associations, Gov't Agencies, and Non-Profits
  - Manufacturing Centers & ATE Projects
  - Manufacturing USA Institutes

National Center for Next Generation Manufacturing – Goals

NCNGM goals focus on Industry 4.0 and the following at the national level:

- Develop a national manufacturing leadership network.

- Create and implement an advanced manufacturing education repository.

- Provide faculty and instructor professional development opportunities.

- Improve the image of advanced manufacturing and develop a diverse workforce.

A National Advanced Manufacturing Network

- The NCNGM utilizes a network of representatives from academia, industry, business and professional organizations, government agencies, and non-profits to gather information and resources on current and future skills needed for the advanced manufacturing workforce.

- This network includes Technology Teams and Business & Industry Leadership Teams (BILTs)

Business & Industry Leadership Team Model

The **BILT Model** is:

- **Advisory Committee 2.0** – takes employer relationships to the next level

- A **structured, repeatable process** for any technical program

- A model that puts employers in a **co-leadership/co-ownership role** that greatly increases engagement with college programs

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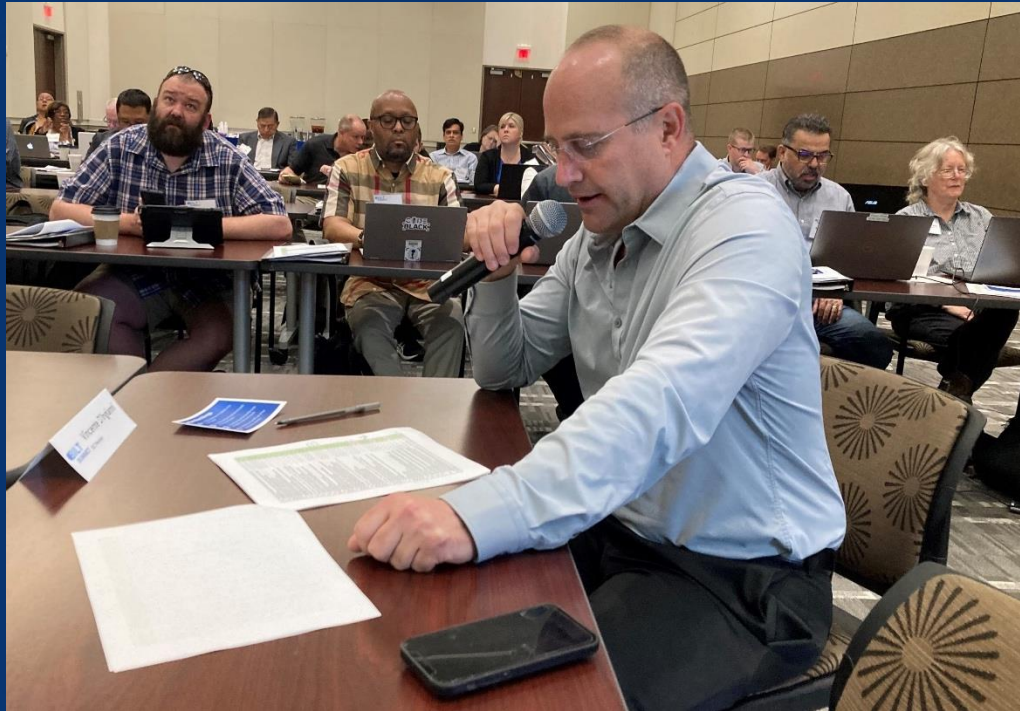
Essential Roles in BILTs

Businesses:

- Co-lead programs
- Prioritize Knowledge, Skills and Abilities (KSAs) they want graduates to have 12-36 months into the future (at a program level)
  - Structured, repeatable process
  - Synchronous discussion
  - Predict Labor Market Demand
- Share industry trends during 2-3 other meetings annually

Faculty:

- Attend KSA mtg as active listeners and questioners
- Cross reference KSAs to existing curriculum to determine gaps and coverage
- Diligently try to update curriculum to address KSAs needed by businesses
- Provide businesses feedback regarding implementation and discuss challenges
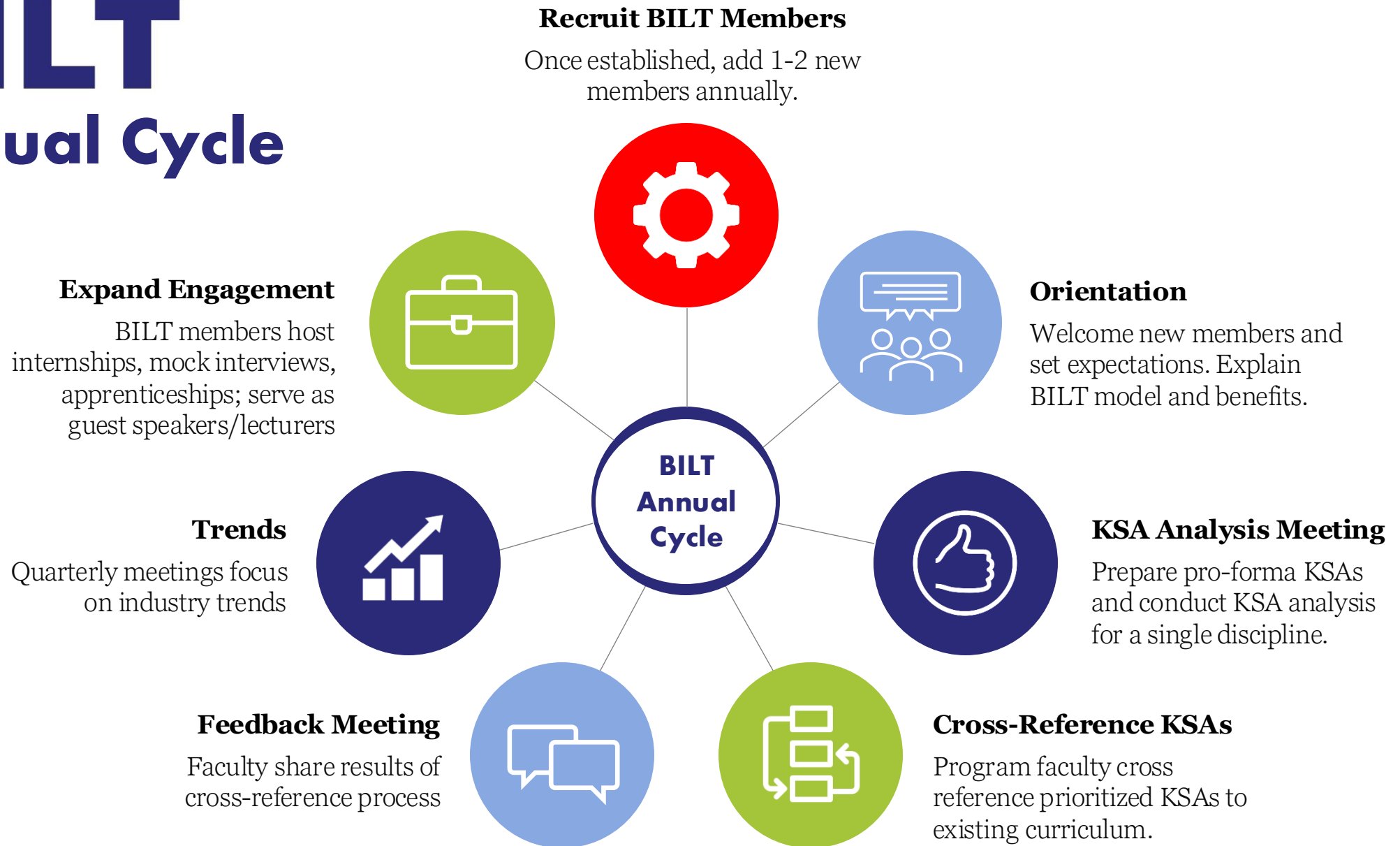
Overview of National Center for Next Generation Manufacturing – Technology Teams

National Center for Next Generation Manufacturing Technology Teams
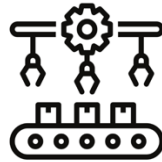
Fabrication Team		CNC Machining/Precision Machining
	Metal Forming	Welding	Assembly

Processing Team	Mechatronics/Robotics/Automation	Industrial Maintenance
	Instrumentation/Plastics	Laser & Fiber Optics	Biomanufacturing

Supply Chain, Logistics & Quality Control Team	Metrology	Process Control	Supply Chain & Logistics

- Led by NCNGM Co-PIs
- Industry 4.0 subject matter experts who consult with Technology Teams when needed.

Overview of National Center for Next Generation Manufacturing – Additional Academic & Support Resources

National Center for Next Generation Manufacturing
Additional Academic & Support Resources

Innovation & Curriculum	Open Education al Resources (OER) — Educator PD for using Educational Technologies
Education/Industry Partnerships	Entrepreneurship/Digital Badges — Recruitment of Non-NSF Centers & Industry — Business & Industry Leadership Team (BILT)
Diversity, Access, Equity, Inclusion	Diversity — Access — Equity — Inclusion — Mentoring
Public-Private Partnerships	Career Pathways — Manufacturing USA Institutes — Professional Skills — Manufacturing Extension Partnerships
National ATE Centers	All awarded NSF ATE National Centers

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Advanced Manufacturing – Industry 4.0

Industry 4.0 involves automating traditional manufacturing processes using technologies such as robotics, Internet of Things (IoT), big data analytics, artificial intelligence, and autonomous systems.

How Industry 4.0 technologies help industry:

- Optimizing processes
- Shortening cycle times
- Improving quality
- Reducing energy losses
- Shortening downtimes
- Improving overall equipment effectiveness

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Examples of How Industry 4.0 Technologies are Used in Advanced Manufacturing

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Source: National Institute of Standards and Technology's Manufacturing Extension Partnership

Nine Technologies That Are Transforming Industrial Production

Robotics and Automation:
e.g. Robots at a guitar company are used to apply polyester & urethane coatings to guitars.

Simulation:
e.g. Running simulation tests during the design phase helps a large tool manufacturer gauge the static & dynamic loads for its construction & mining earth-moving equipment.

Big Data and Artificial Intelligence:
e.g. Data from sensors on machinery like gas turbines is collected and analyzed to develop tools and improve efficiency.

Horizontal and Vertical System Integration:
e.g. Using a common set of processes & data transactions, a group of automotive OEMs & suppliers more effectively manages its packaging & parts supply chains.

Augmented Reality and Virtual Reality:
e.g. Wearable "AR" glasses can deliver repair instructions to a technician on the factory floor, who can look at diagrams while fixing equipment.

Internet of Things:
e.g. A car transmission facility uses Bluetooth-enabled devices in the production environment to easily capture data & drive it back to the operator to ensure accuracy in production.

Additive Manufacturing:
e.g. A tool manufacturer uses 3D printing of molds for casting of metal parts at radically reduced lead time and cost.

Cloud Computing:
e.g. A cloud-based analytics solution enables a paper company to analyze paper making and converting processes. Real-time feedback allows the operator to minimize risk of web breaks and optimize quality.

Cybersecurity:
e.g. Protocols & procedures are established to prevent unauthorized access to IT systems that leads to intellectual property theft.

Artificial Intelligence (AI) Skill Sets in Advanced Manufacturing

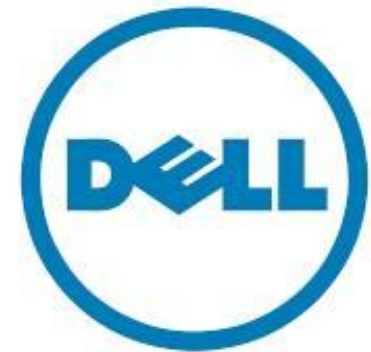**Used to Train the Manufacturing Workforce:**
1. Personalized learning experiences
2. Immersive training environments
3. Gamified learning
4. Real-time feedback and improvement
5. Adaptive learning paths
6. Simulation of complex scenarios
7. On-the-job support
8. Predictive skill gap analysis
9. Collaborative learning
10. Continuous assessment

Used in Manufacturing Operations:
1. AI Literacy and Familiarity
2. Data Analysis and Interpretation
3. Collaboration with AI Systems
4. Predictive Maintenance Skills
5. Quality Assurance with AI
6. Process Optimization
7. Adaptability and Continuous Learning
8. Problem-Solving with AI Assistance
9. Safety Skills in AI-Enhanced Environments
10. Basic Coding and AI Customization

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Source: https://www.ferolabs.com/insights/post/essential-ai-skills-and-training-for-the-modern-factory-worker

Resources Artificial Intelligence (AI)

- Intel AI for Workforce
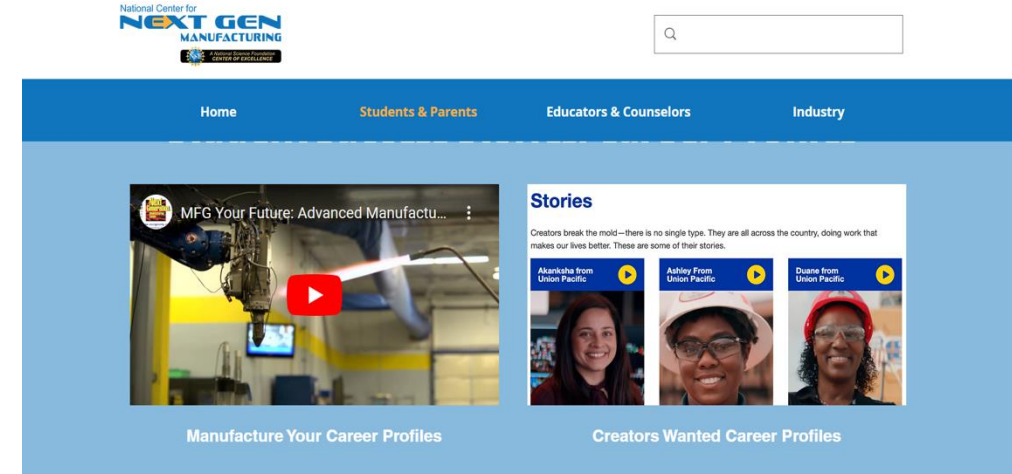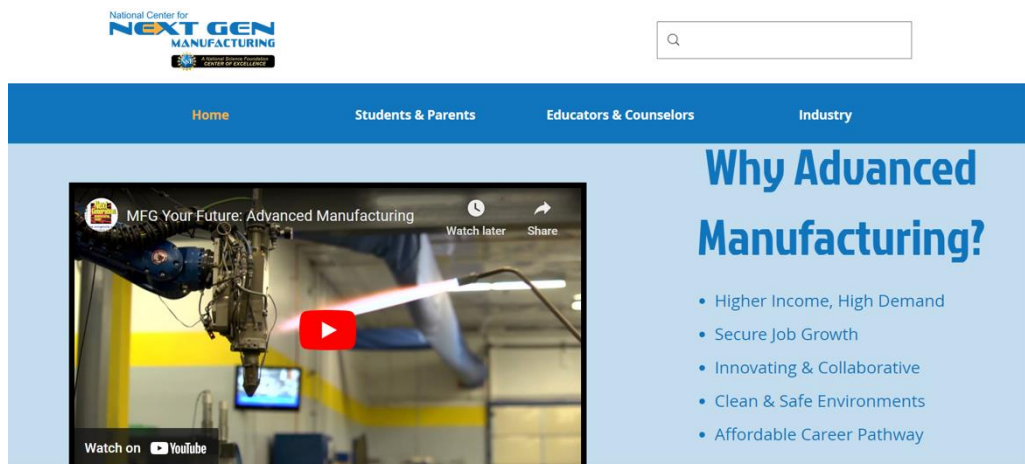
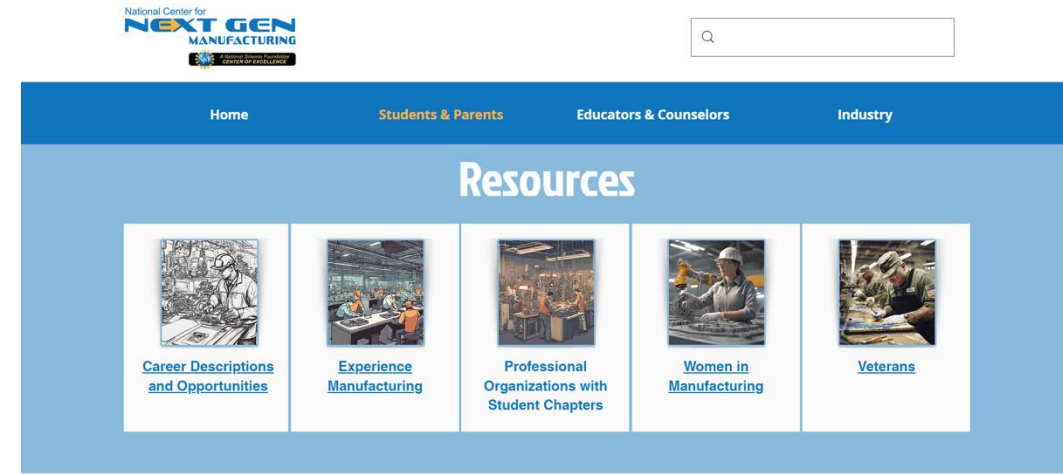- AWS (Amazon)

- IBM

- DELL

- Microsoft

NCNGM Resources

Resources for:

- Students & Parents
- Educators & Counselors
- Industry

New Website at nextgenmfg.org

Resources for Students & Parents

- Student Success Stories & Career Profiles
- Lists of Advanced Manufacturing Programs
- Scholarships
- Resources for Veterans, Women, and Underrepresented Populations in Manufacturing
- Professional Organizations
- Ways to Experience Manufacturing
- Career Descriptions & Opportunities

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Examples of
Resources for Students & Parents

Career Profile Videos

- Manufacturing career profile videos:
  - Manufacture Your Future 2.0
  - You Belong: Women in Manufacturing
  - Veterans: From Military to Manufacturing

YOU BELONG IN MFG: JESSICA; WELDER

YOU BELONG IN MFG: SHELLEY; OPERATIONS MANAGER

YOU BELONG IN MFG: MYRNA; APPLICATIONS, RESEARCH AND DEVELOPMENT ENGINEER

YOU BELONG IN MFG: A'ARIKA; MECHANICAL DESIGN ENGINEER

YOU BELONG IN MFG: LAURIE; QUALITY MANAGER

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Career Profile Videos

- [A'arika – Mechanical Engineer](#)
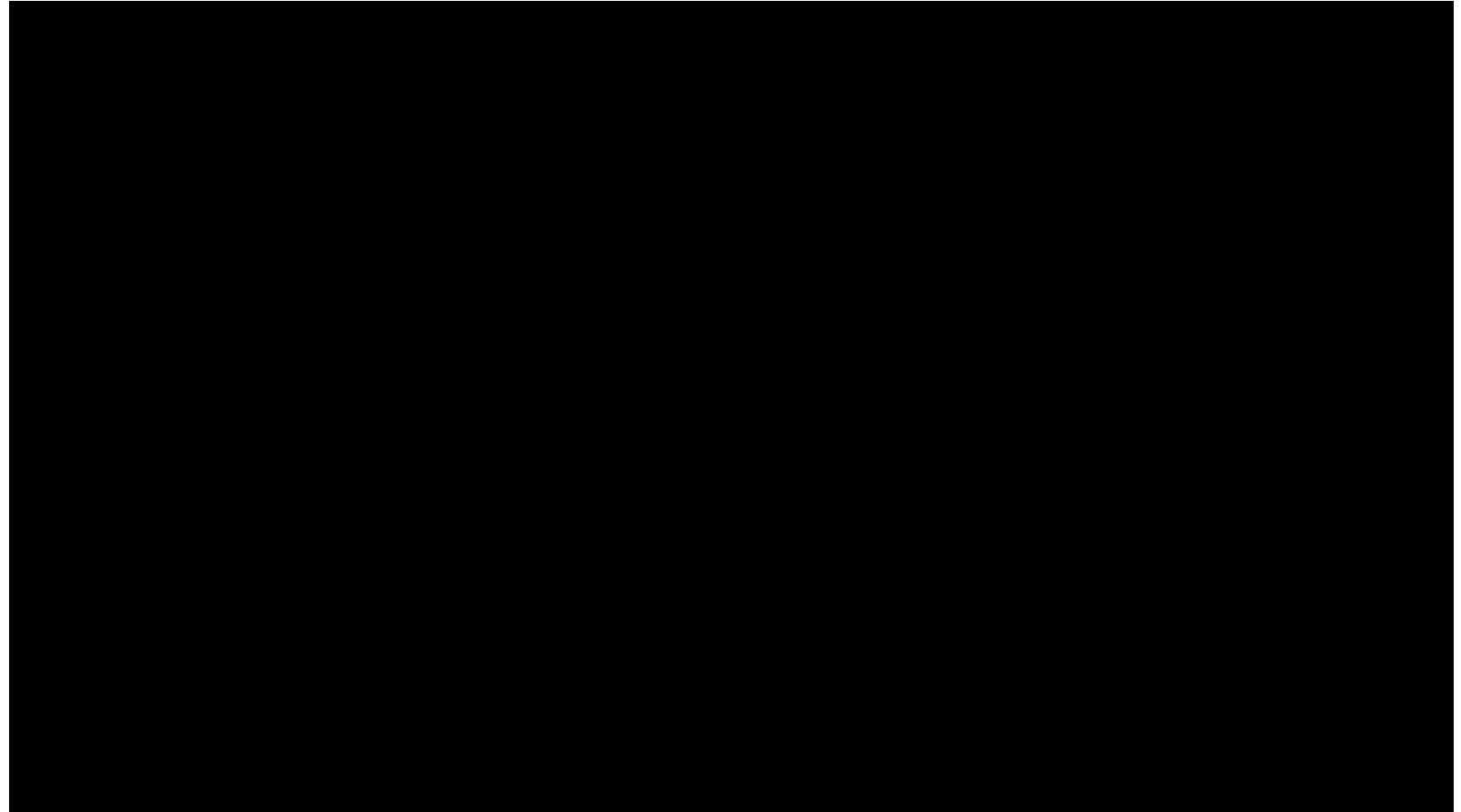
Career Profile Videos

- Stephanie - Welder

Resources for Educators & Counselors

- Professional Development Opportunities
- Instructional Resources
- Outreach Materials & Resources
- Education & Workforce Development Resources
- Additional Resources

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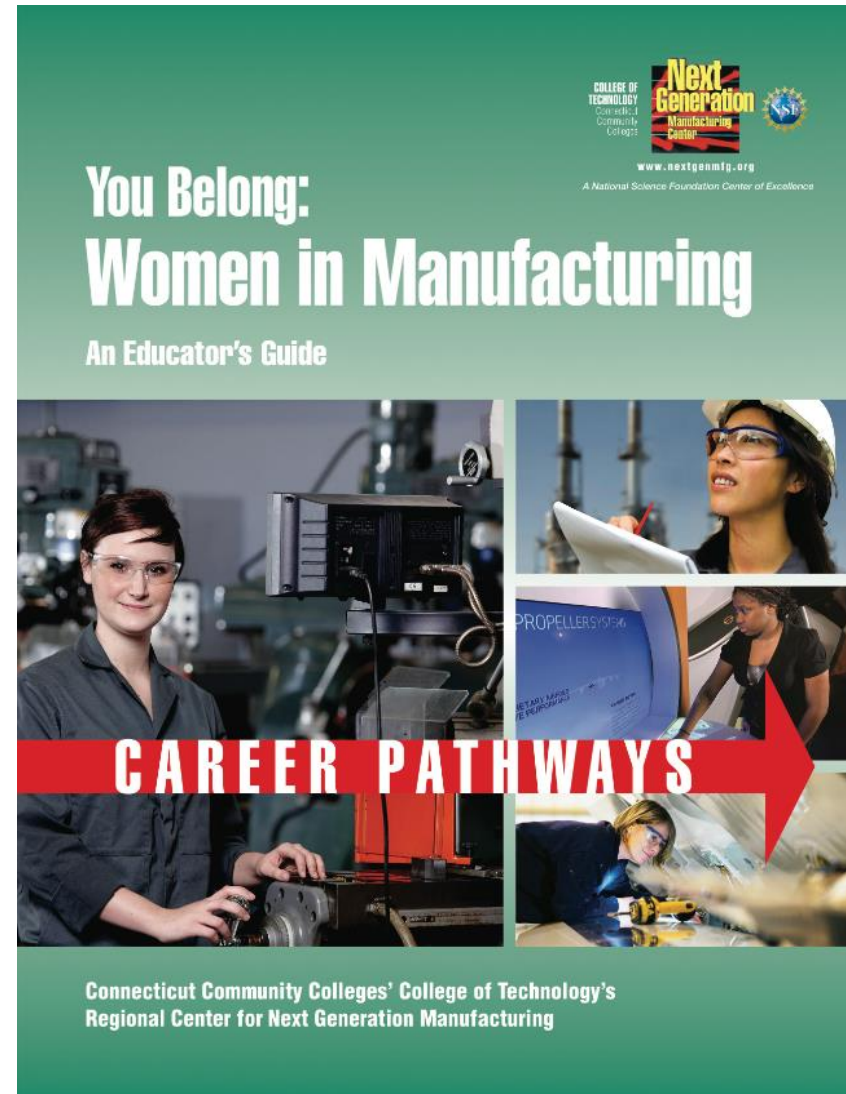**NEXT GEN MANUFACTURING**
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Examples of
Resources for Educators & Counselors

Outreach Materials

You Belong: Women in Manufacturing DVD & Educator's Guide

Resources for Industry

- How to partner with the NCNGM
- List of Industry Partners
- Business & Industry Leadership Team Info
- Employer Resources
- DEIA Resources
- Industry Conferences & Expos

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Thank you!

Questions?

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