Future of the Technician Workforce: *Industry 4.0*

- **Brief NCATC Overview**
- **What We've Been Doing**
- **What We've Discovered**
- **What Education Can Do**
- **What Industry Can Do**
- **Best Practice Examples**
- **Industry-Recognized Credentials**

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2017-2022 Strategic Focus Areas

- Industry 4.0: Smart Manufacturing / Automation
- Work-Based Learning / Training – Apprenticeships, Internships, etc.
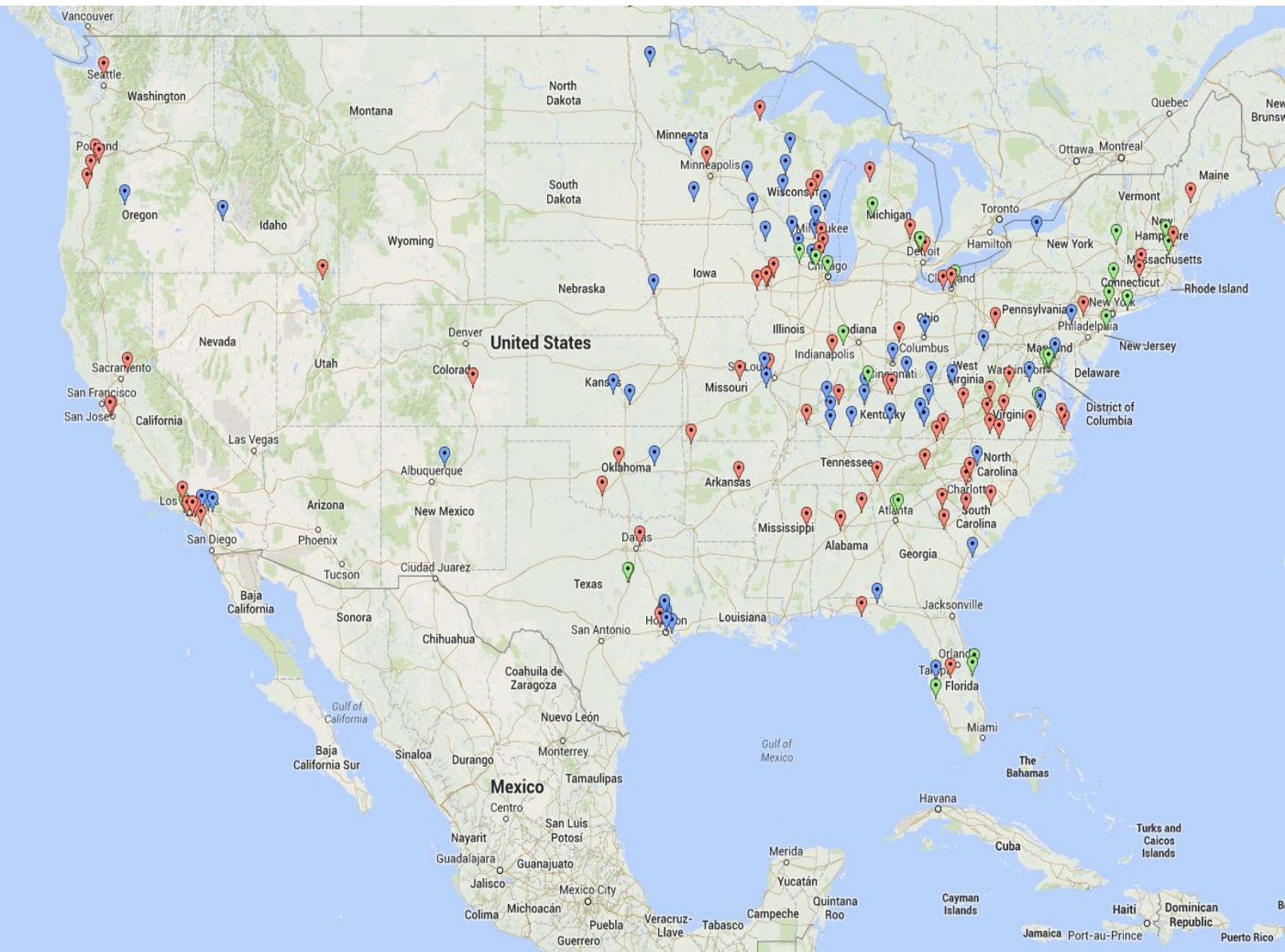- Competency-Based Education – Applied Skills & Knowledge
- Industry-Recognized Credentials / Certifications – MSSC, NIMS, AWS, NC3, SACA, etc.
- Adult Learning Opportunities – Underserved / Underrepresented Populations

- 165+ Community & Technical Colleges

- 40 Strategic Partners

Strategic Partners

ManufacturingUSA

A network of regional institutes, each with a specialized technology focus.

INTEGRATED PHOTONICS — ROCHESTER, NY

RECYCLING MATERIALS — ROCHESTER, NY

LIGHTWEIGHT METALS — DETROIT, MI

America Makes ADDITIVE MANUFACTURING — YOUNGSTOWN, OH

DIGITAL MANUFACTURING — CHICAGO, IL

TISSUE BIOFABRICATION — MANCHESTER, NH

NEXTFLEX FLEXIBLE HYBRID ELECTRONICS — SAN JOSE, CA

affoa FIBERS & TEXTILES — CAMBRIDGE, MA

RAPID PROCESS INTENSIFICATION — NEW YORK, NY

CLEAN ENERGY SMART Manufacturing — LOS ANGELES, CA

NIIMBL BIOPHARMA MANUFACTURING — NEWARK, DE

aim ROBOTICS MANUFACTURING — PITTSBURG, PA

iacmi THE COMPOSITES INSTITUTE — ADVANCED COMPOSITES — OAK RIDGE, TN

PowerAmerica WIDE BANDGAP SEMICONDUCTORS — RALEIGH, NC

Secure the future of manufacturing in the U.S. through innovation, collaboration, workforce development, and education.

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The Fourth Industrial Revolution

Digitization of production

Decentralization of processes

Networking of the working environment

Decentralization of decision-making structures

Cyber-physical systems

Intelligent factory

Mechanization
Mechanical production

Industrialization
Mass production

Automation
Electric automation

Industry 1.0 > **Industry 2.0** > **Industry 3.0** > **Industry 4.0**

"Alexa, dim the light to 10%."
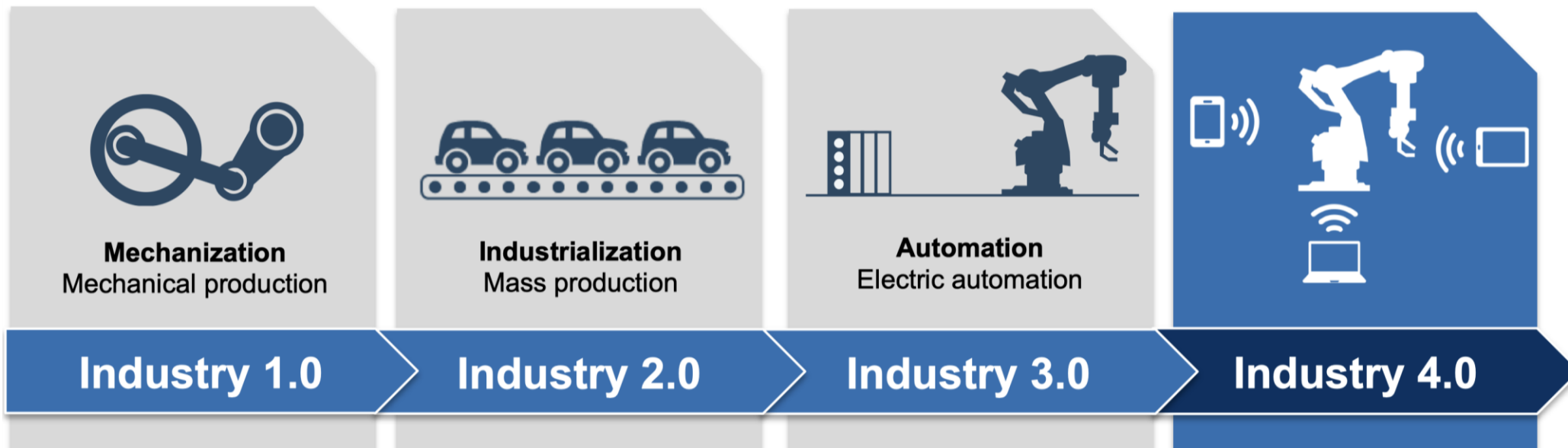
What's the Difference Between Industrial IoT and Industry 4.0?

INDUSTRY 4.0

Corporate Philosophy
- Digitalization
- New Technology
- Lean Initiatives
- Automation
- Materials

+

INDUSTRIAL IoT

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00111001
11110110

Enabling Technology
- Connected Devices
- Connected Machines
- Connected People
- Big Data and Analytics
- Predictive Maintenance

=

GLOBALLY COMPETITIVE

Positive Results
- Visibility
- Flexibility
- Efficiency
- Zero Downtime
- Maximum OEE

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The Jobs Landscape in 2022

emerging roles, global change by 2022

133 Million

Top 10 Emerging

1. Data Analysts and Scientists
2. AI and Machine Learning Specialists
3. General and Operations Managers
4. Software and Applications Developers and Analysts
5. Sales and Marketing Professionals
6. Big Data Specialists
7. Digital Transformation Specialists
8. New Technology Specialists
9. Organisational Development Specialists
10. Information Technology Services

declining roles, global change by 2022

75 Million

Top 10 Declining

1. Data Entry Clerks
2. Accounting, Bookkeeping and Payroll Clerks
3. Administrative and Executive Secretaries
4. Assembly and Factory Workers
5. Client Information and Customer Service Workers
6. Business Services and Administration Managers
7. Accountants and Auditors
8. Material-Recording and Stock-Keeping Clerks
9. General and Operations Managers
10. Postal Service Clerks

Source: Future of Jobs Report 2018, World Economic Forum
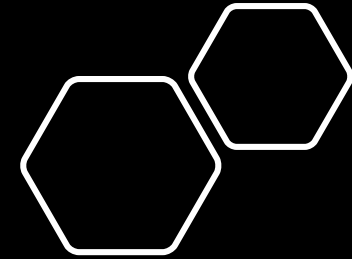
- Cuyahoga Community College, OH*
- Eastern Iowa Community Colleges, IA
- Grand Rapids Community College, MI
- Ivy Tech Community College, IN
- Lorain County Community College, OH*
- Pellissippi State Community College, TN
- Reading Area Community College, PA
- Thomas Nelson Community College, VA
- Westmoreland County Community College, PA

Industry 4.0 - Workforce Glossary

- Industry 4.0 / Smart Automation
- Industrial Internet of Things (IIoT)
- Additive Manufacturing
- Autonomous Robotics
- Big Data Analytics / Data Science
- Cloud Computing
- Systems Integration
- Simulation / Digital Twin
- Artificial Intelligence (AI)
- Augmented Reality (AR)
- Cybersecurity

INDUSTRY 4.0 Segment Strength Matrix by College – Q3-18

	Mechatronics	Autonomous Robotics	3DP/Additive Manufacturing	Industrial Internet of Things	Simulation	AI AR	Cloud Computing	BIG Data Analytics	Systems Integration	Cyber Security
EICC	1.5	1.5	2	0	1.5	0	1.5	1.5	2	1.5
GRCC	3	1	0.5	0	0.5	0	1	0	1	1
IVYTC	3	3	2.5	2.5	2.5	0.5	2	2	2.5	2.5
LCCC	3	3	1	0.5	0	0.5	0.5	0.5	3	3
PSTCC	2	3	2	0	0	0	0	1	1	3
RACC	3	2	1	0	0	0	0	2	1	1
Tri-C	3	2.5	3	0	1	0	0	0	2	2.5
TNCC	3	1	1	1	0	1	0	1	2	3
WCCC	3	2	1	1	1.5	0.5	1.5	0.5	2	3

Integrating Industry 4.0: Next Steps for Colleges

1. Reach out to employers; discuss what I 4.0 means to their changing workforce needs

2. Take an audit of what I 4.0 components are already being taught across the college and where

3. Determine which existing curricula can be leveraged or updated across departments and form interdisciplinary teams

4. Use stackable credentials and emerging certifications as tools for upskilling/reskilling/lifelong learning (cross walk and integrate into courses, programs, certificates, degrees)

NCATC Industry 4.0 Executive Toolkit

Feedback from Educators

From your perspective, what changes in technician education do you think will be prompted by FOW-driven issues?

- Entry-level jobs changing at rapid pace will require swift curriculum changes

- Interrelatedness of advanced manufacturing disciplines

- Data, cyber and IT literacy becoming foundational cross-cutting skills

- Effects of AI on "human and machine interface" for all disciplines

- Cross-disciplinary core: How to identify? How to update?

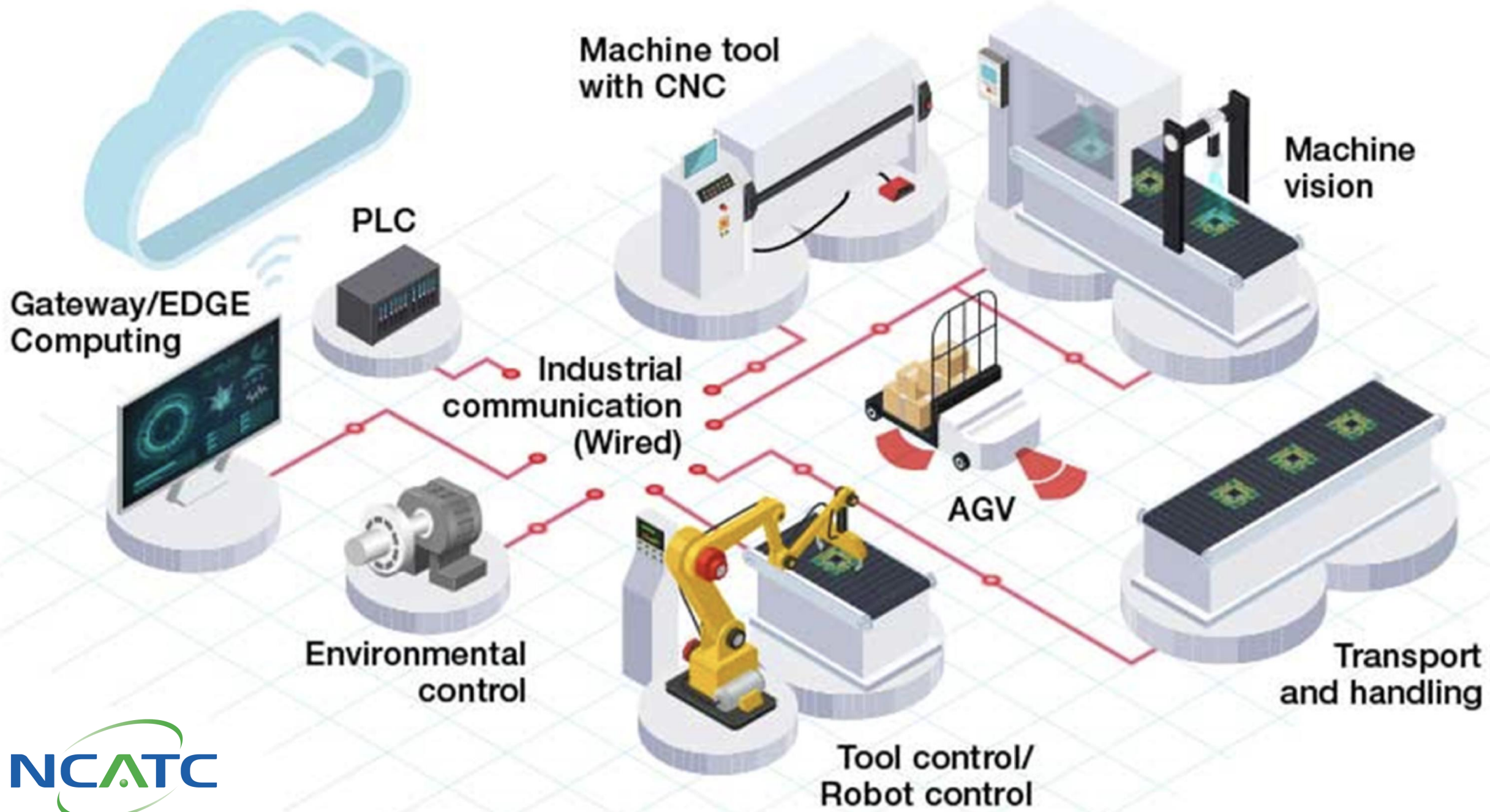- Pressure to constantly update skill sets will intensify.

Integrating Industry 4.0 for Community Colleges

What Community and Technical Colleges Need to Do:

1. Instructor training
2. Equipment procurement
3. Interdisciplinary cooperation
4. Curriculum development

Gateway/EDGE Computing

PLC

Machine tool with CNC

Machine vision

Industrial communication (Wired)

AGV

Environmental control

Tool control/ Robot control

Transport and handling

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Feedback from Industry

What challenges are facing your company?

- The challenge of the here and now

- Uncertainty about the future; the need to be agile

- Access to talent

- Profitability in an era of customization

- Zero down time; adopting Overall Equipment Effectiveness (OEE) concept

- Machines no longer standalone. Integration of local and global networks invokes a requirement for connectivity and a demand for cybersecurity.

Feedback from Industry

What implications could they have for technician education?

- Technicians need to be able to bridge virtual and live experiences in the workplace.

- Cybersecurity must be taught as a broad subject encompassing physical and virtual systems and applied across an organization.

- Embed business context in courses; use scenario learning to demonstrate "cross-the-enterprise" approach to problem solving.

- IT students must understand they are digital transformation specialists.

FOW Skill Areas for STEM Technicians

- **Skill Area 1: Advanced Digital Literacy**

- **Skill Area 2: Business Knowledge and Processes**

- **Skill Area 3: Data Knowledge and Analysis**

Skill Area 1: Advanced Digital Literacy

Digital communications and networking; cloud interface; cybersecurity; machine learning, sensors, programming

- AI software tools
- automation/robotics
- basic programming/Python
- cloud computing
- digital fluency/vocabulary
- digital twins
- edge computing

- function block programming
- human-machine interfaces
- IoT
- digital machine learning
- network architecture
- network/device communication
- security controls

Skill Area 2: Business Knowledge and Processes

General understanding of an enterprise, value chain, business practices; includes work performance skills as well as ethics surrounding use of new technologies.

- blockchain
- OEE
- business cycles
- communication
- continuous process improvement
- entrepreneurship
- customer focus

- lean processes
- market trends
- production and distribution chain
- ROI
- risk management
- supply/demand
- vertical and horizontal integration

Skill Area 3: Data Knowledge and Analysis

Interpretation and decision-making

- computational thinking
- data analysis
- data backup and restoration
- data flow from origin to end user
- data fluency/vocabulary
- data management and storage

- data modeling
- use of Excel/spreadsheets
- querying language
- SQL/databases
- statistics
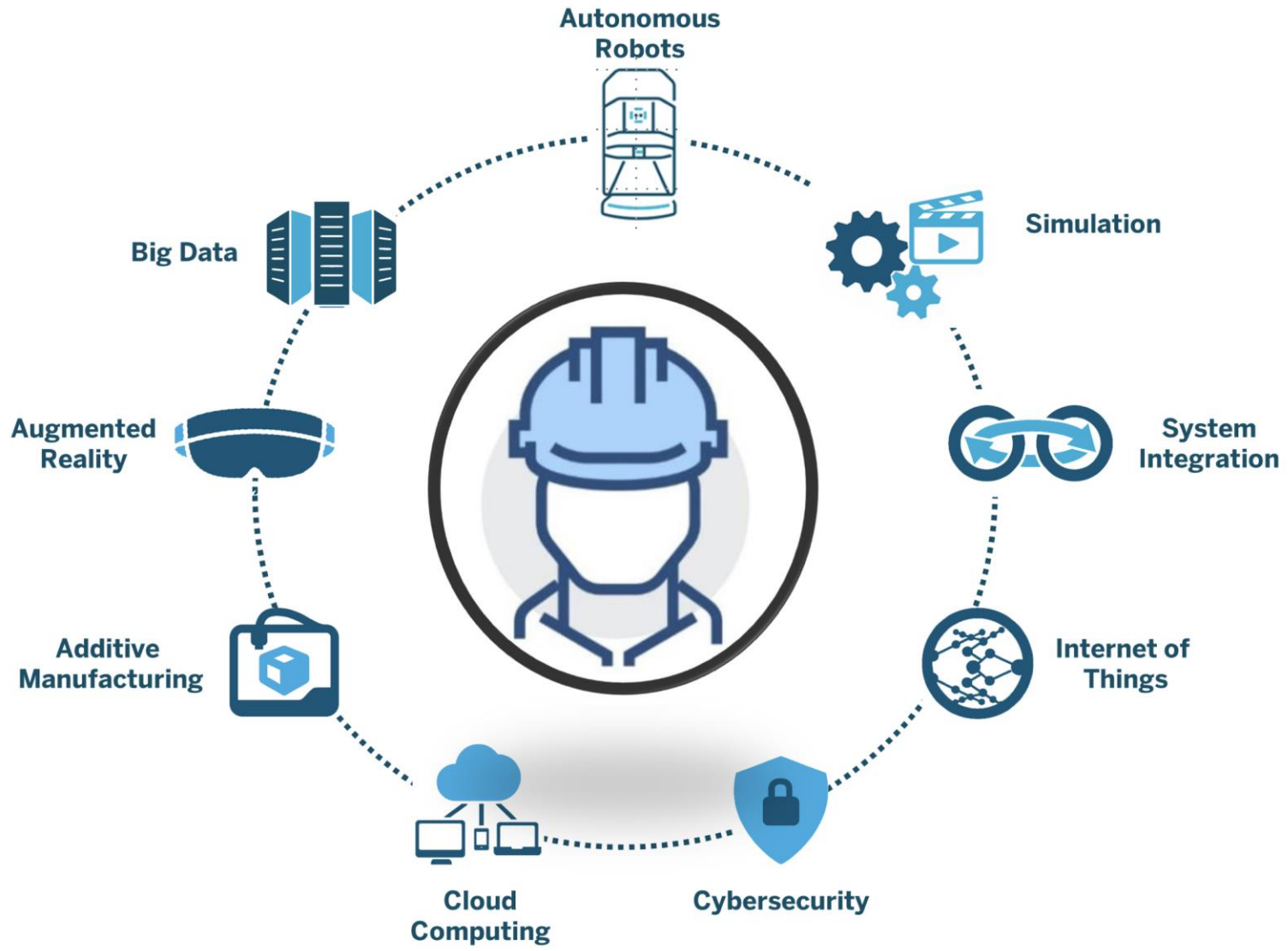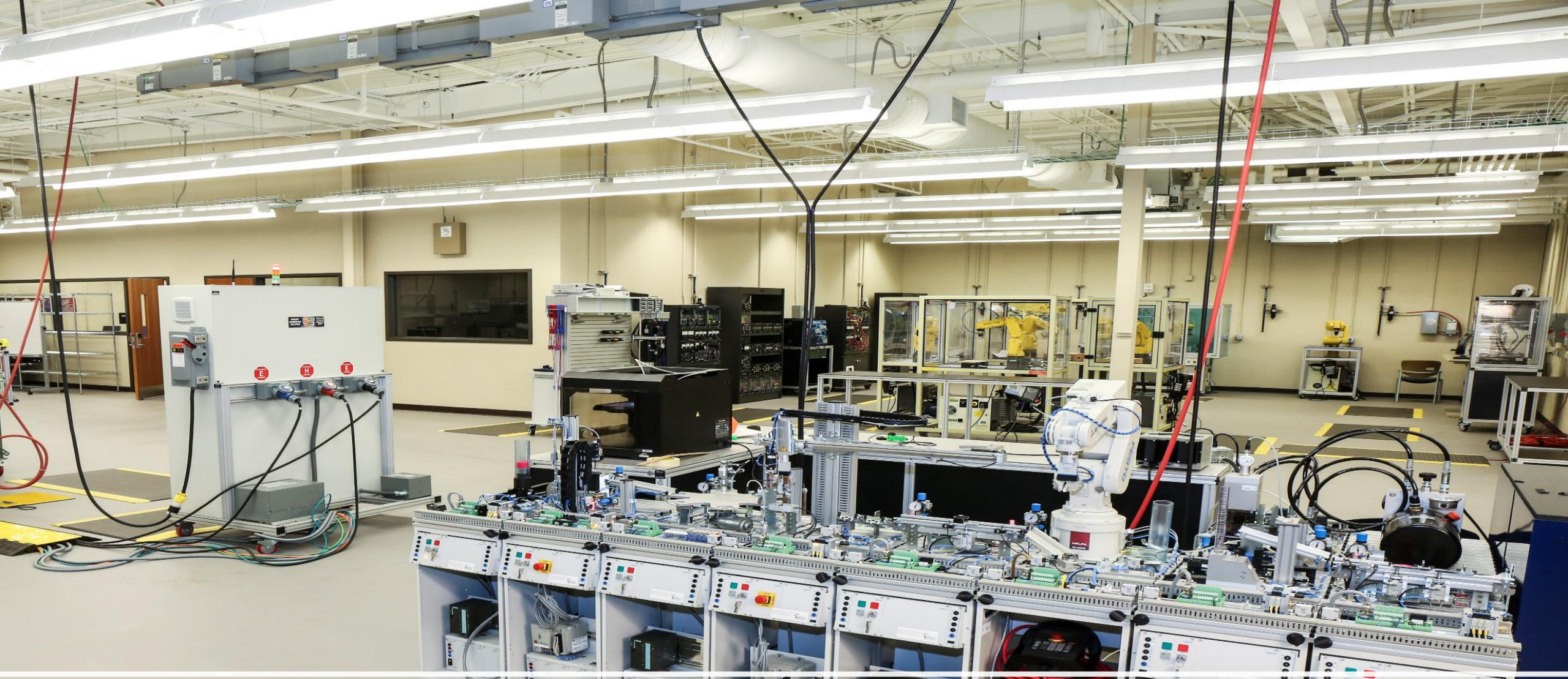- visual representation of data/business analytics software

Integrating Industry 4.0 for Community Colleges

What Industry Needs to Do:

1. Cross-sector regional engagement

2. Adopt a common nomenclature

3. Address both the "here and now" and the future of work

4. Start small to address production efficiency and security

5. Invest in workforce training with partners
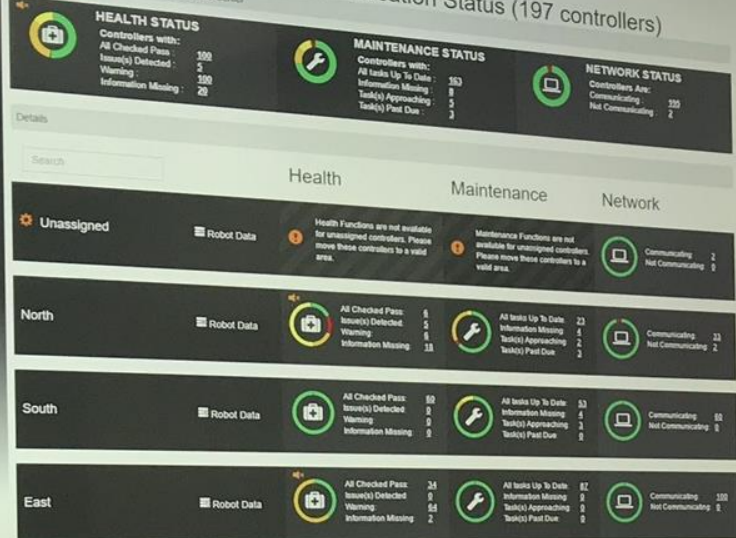
MegaLab – Pellissippi State CC (TN)

Cybersecurity Lab

Top-left screen — ZDT Portal

...ng the ZDT Portal

The ZDT portal includes the following:

Customer Experience Center - Location Status (197 controllers)

FANUC America — Customer Experience Center

FANUC Team | English-US

HEALTH STATUS
Controllers with:
All Checked Pass: 100
Issue(s) Detected: 5
Warning: 100
Information Missing: 20

MAINTENANCE STATUS
Controllers with:
All tasks Up To Date: 163
Information Missing: 8
Task(s) Approaching: 5
Task(s) Past Due: 3

NETWORK STATUS
Controllers Are:
Communicating: 335
Not Communicating: 2

Details | Search

		Health	Maintenance	Network

Unassigned — Robot Data — Health Functions are not available for unassigned controllers. Please move these controllers to a valid area. — Maintenance Functions are not available for unassigned controllers. Please move these controllers to a valid area. — Communicating 2 / Not Communicating 0

North — Robot Data — All Checked Pass 6 / Issue(s) Detected 5 / Warning 4 / Information Missing 18 — All tasks Up To Date 23 / Information Missing 4 / Task(s) Approaching 3 / Task(s) Past Due 3 — Communicating 23 / Not Communicating 0

South — Robot Data — All Checked Pass 60 / Issue(s) Detected 0 / Warning 0 / Information Missing 0 — All tasks Up To Date 53 / Information Missing 0 / Task(s) Approaching 4 / Task(s) Past Due 3 — Communicating 60 / Not Communicating 0

East — Robot Data — All Checked Pass 34 / Issue(s) Detected 0 / Warning 64 / Information Missing 2 — All tasks Up To Date 82 / Information Missing 0 / Task(s) Approaching 0 / Task(s) Past Due 0 — Communicating 100 / Not Communicating 0

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Top-right screen

Join the Next Revolution

The **Industrial Internet of Things** (IIoT) is transforming the manufacturing industry.

Devices on the factory floor are **connecting to each other, and to higher level computing platforms**, for more intelligent automation systems.

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Bottom-left screen
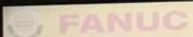
FANUC

FANUC America - Company Health Status

FANUC America

Welcome to the ZDT Demo Center. See below for the information on each of these monitors:

1 – Start by watching the video to see how ZDT works and what you can do from the ZDT Web Portal.

2 – See why you should connect your robots to ZDT.

3 – Next, check out the World Map for a live view of the number of robots communicating to the ZDT Data Center.

4 – Feel free to try out the ZDT Web Portal to see actual data from the robots here in the CEC and "mock" data from our Widget Factory.

1	2
4	3

OK, I Got It!

We've got an update for you. Windows is a service and updates are a normal part of keeping it running securely. We need your help installing this one.

Restart now | Pick a time | Snooze

Bottom-right screen — World Map

1,791
9,871
2,730
698
330
8
168
23
558
175
13
51

ZDT FANUC
MECHANICAL · SYSTEM · PROCESS
OPTIMIZE · MAINTAIN · PREDICT · ANALYZE

Austria
8 Monitored Robots

16,863
Robots Connected to ZDT

Qualification for Industry 4.0

Partnerships are Critical

> NIMS – Industry 4.0 Standards

> NC3 – Stackable/Portable Credentials

> Siemens – Mechatronics Certification

> Industry and Education Connections

ASSOCIATE CERTIFICATIONS

Certified Industry 4.0 Associate
Basic Operations

Certified Industry 4.0 Associate
Advanced Operations

Certified Industry 4.0 Associate
Robot System Operations

Certified Industry 4.0 Associate
IIoT, Networking & Data Analytics

SPECIALIST CERTIFICATIONS

Certified Industry 4.0
Automation Systems Specialist
Install, Troubleshoot Program, Maintain Factory
Automation 4.0 Systems

| Level I | Level II |

Certified Industry 4.0
Production Systems Specialist
Operate, Control, Optimize Production 4.0 Systems

| Level I | Level II |

Certified Industry 4.0
IT Operations Specialist
Install, Troubleshoot, Program IT 4.0 Systems

| Level I | Level II |

PROFESSIONAL CERTIFICATION

Certified Industry 4.0 Systems
Professional I
Design, Program, Integrate & Analyze

SMART AUTOMATION CERTIFICATIONS
INDUSTRY/OCCUPATION DRIVEN

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National Science Board
THE SKILLED TECHNICAL WORKFORCE: Crafting America's Science & Engineering Enterprise

September 2019

Recommendations for Building the Future STW:

1. Change the Message

2. Focus on the Data

3. Leverage Federal Investments

4. Build Partnerships

Leading Industry 4.0 Vendors 2019

Connected Industry Building Blocks

Hosting
Alibaba Cloud, amazon, at&t, Baidu, BOSCH, CenturyLink, Deutsche Telekom, FUJITSU, Google Cloud, Huawei, IBM, INTERNAP, Microsoft, ORACLE, QSC, Rackspace, Tencent

Industrial IoT Platforms
ADAMOS, ALTIZON, amazon, BOSCH, cisco, C3, Device Insight, EXOSITE, GE, Google, Hitachi Vantara, IBM, Microsoft, ORACLE, PLEX, ptc, relayr, SAMSUNG, SAP, Schneider Electric, SIEMENS, Software AG, TRUMPF

Analytics
amazon, Aspen, Alluvium, alteryx, arm TREASURE DATA, ARUNDO, bonsai, BOSCH, C3, Crosser edge node, databricks, ELEMENT, falkonry, FOGHORN, GREENWAVE SYSTEMS, GE, Google, Hitachi Vantara, IBM, Information Builders, integration objects, IoTium, neron, LUMENDATA, MAANA, MAPR, MathWorks, Microsoft, mnubo, pebble technologies, ORACLE, predictronics, ptc, rapidminer, relayr, RIGADO, SAP, SAS, Seeq, SIEMENS, Smart Cloud, software, sparkcognition, splunk, Striim, tableau, TIBCO, TULIP, UPTAKE

Microchips
ARM, BOSCH, Cypress, Google, Infineon, hitsilicon, intel, MARVELL, Microchip, Micron, Mediatek, nvidia, NXP, ON, Qualcomm, Ideptic Signals, RENESAS, SAMSUNG, SEMTECH, ST, Texas Instruments, tsmc

Sensors
ABB, BALLUFF, BANNER, BOSCH, CoreTigo, EMERSON, FESTO, JUMO, KEYENCE, Kionix, KISTLER, Leuze electronic, MEGGITT, MEMS, Rockwell Automation, B Schmersal, Schneider Electric, SICK, SIEMENS, Silicon Labs, TE, Texas Instruments, TOSHIBA, TURCK, VERIS, Weidotec

Connectivity Hardware
Accertek, B&R value, ABB, ADLINK, ADVANTECH, AUTOMATIONDIRECT, BECKHOFF, BELDEN, BOSCH, cisco, cradlepoint, DELL, Digi, Ennoconn, elecsys, EUROTECH, FESTO, Hewlett Packard Enterprise, hitsilicon, Huawei, inhand, IEi, KEB, kontron, LANTRONIX, libelium, LOGIC, MOXA, MULTITECH, NEXCOM, PHOENIX CONTACT, ProSoft, red lion, SEALEVEL, SIEMENS, SIERRA WIRELESS, secomea, SYSTECH, TE, Telit, u-blox, Weidmüller

Cybersecurity
ARGUS, Arilou, arm, Bastille, BAYSHORE, CLAROTY, CYBERBIT, CyberX, DEVICE AUTHORITY, endian, Indegy, Infineon, IOActive, OMC, MOCANA, NexDefense, NOZOMI, PFP, SCADAfence, SECURE RF, SECURITHINGS, SENRIO, sentryo, TEMPERED NETWORKS, Virsec, WIBU SYSTEMS, ZingBox

Systems Integrators
accenture, ACTEMIUM, ALTEN CALSOFTLABS, ARROW, Atos, Callisto, Capgemini, CGI, Agent, Cognizant, Bright Wolf, Deloitte, dimensys, GENPACT, HCL, IBM, Infosys, KALYPSO, L&T Technology Services, luxoft, ROVISYS, T-Systems, TATA, Tech Mahindra, VOLANSYS, WIPRO

Other Industry 4.0 Supporting Technologies

Additive Manufacturing
3D SYSTEMS, AddUp, AUTODESK, Arcam EBM, ARKEMA, ARBURG, BASF, BigRep, Carbon, CONCEPTLASER, DASSAULT SYSTEMES, DIGITAL MECHANICS, DESKTOP METAL, DMG MORI, eos, envisiontec, EVONIK, ExOne, FIT, formlabs, GE, German RepRap, RR, XERIX, HP, Höganäs, LehmannVossCo, Matsuura, Markforged, materialise, oerlikon, OPTOMEC, PROTOLABS, ptc, REALIZER, RENISHAW, Carbon 3D, sculpteo, SIEMENS, sisma, SLM, stratasys, TRUMPF, Ultimaker, VOXELJET, voxeljet, EXACT METAL, XJET, Xometry

Augmented and Virtual Reality
ATHEER, AUTODESK, brother, DAQRI, DASSAULT SYSTEMES, eon reality, EPSON, FUJITSU, Google, HTC, intel, iTiZZiMO, magic leap, Mevea, MSEC, Microsoft, MOTOROLA SOLUTIONS, oculus, ODG, Opconnect, ptc, realwear, RE'FLEKT, SAMSUNG, SONY, SIEMENS, Telepathy, UBIMAX, UPSKILL, VUZIX, wikitude, ZEISS

Collaborative Robots
ABB, ARTIMINDS, ASS, Aurotek, Aubo, BarrettTech, BLUE DANUBE ROBOTICS, COMAU, FANUC, FRANKA EMIKA, Kawasaki, KAWADA Robotics, KUKA, MAGAZINO, MITSUBISHI ELECTRIC, NACHi, PAL ROBOTICS, READY ROBOTICS, ROBOTIQ, SIASUN, SCHUNK, STÄUBLI, UNIVERSAL ROBOTS, vicarious, YASKAWA

Connected Machine Vision
ADLINK, Allied Vision, BANNER, BASLER, Canon, COGNEX, Edmund, FESTO, FLIR, iDS, IMPERX, KEYENCE, LMI TECHNOLOGIES, MVTec, matrox, NATIONAL INSTRUMENTS, OMRON, SICK, SONY, STEMMER IMAGING, TELEDYNE DALSA, TRUESENSE

Drone / UAVs
Altus, AiVas Systems, CYBERHAWK, Skykraft, dji, doks, DRONE SCAN, evesee, FLYABILITY, H3 Dynamics, MATTERNET, intel, kespry, PERCEPTO, PINC, PRECISION HAWK, sensefly, SKY FUTURES, SKYCATCH, TERRA DRONE

Self-Driving (Material Transport) Vehicles
AETHON, amazon robotics, BALYO, brain corp, CLEARPATH ROBOTICS, fetch robotics, GreyOrange, KNAPP, KIVNON, OMRON, STILL, SYSTEM Logistics

J. Craig McAtee
CEO & Executive Director
Cleveland, OH
PH: 440.600.7749
craig@ncatc.org

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