

Industry 4.0/Smart Manufacturing for Maine – Market Study

Report Summary

Industry 4.0/Smart Manufacturing, which is the adoption of digital technologies and connectivity throughout the manufacturing enterprise, is radically transforming the playing field. Now is the time for Maine manufacturers to gain a competitive advantage by adopting smart manufacturing techniques into their workflows. In support of this need, the Maine Technology Institute funded a market study conducted by Stone & Associates and RTI Innovation Advisors in collaboration with Roux Institute, University of Maine, and the Maine MEP to understand:

Industry 4.0/Smart Manufacturing uses advanced technologies to increase the efficiency of manufacturing processes. It combines people, technology, and self-learning production systems to create a flexible, digitalized, and automated shop floor.

- Maine manufacturers' understanding of Industry 4.0/Smart Manufacturing and where they see their company in the adoption of advanced and data-driven manufacturing,
- How to design programs to assist Maine manufacturers in navigating these rapidly changing technologies.

Key Observations from the report include:

- Need for awareness and education for company leaders to understand what smart manufacturing is,
- Desire to have an independent, unbiased assessment and recommended roadmap from a trusted resource,
- In Maine there is currently an inadequate supply of skilled labor to drive the implementation of smart manufacturing,
- Maine manufacturers will require implementation assistance from both in-house competencies and outside resources,
- Maine manufacturers face resource constraints for the investment needed to implement smart manufacturing.

Report Methodology: Interviews were conducted with 10 Maine manufacturers across seven sectors. Five external organizations specializing in helping manufacturers with the transformation to smart manufacturing. The market study was done in cooperation with Northeastern University's Roux Institute, the University of Maine Advanced Manufacturing Center, and the Maine Manufacturing Extension Partnership (Maine MEP).

For more information or questions about the report or if you are interested in participating in a Smart Manufacturing/Industry 4.0 assessment, contact contact@mainemep.org

Maine Industry 4.0 Initial Market Assessment

Final Report Summary *For Public Release*

Objective and Approach

- ❑ The objective of this project was to conduct an initial market assessment for a potential **Industry 4.0** (I4.0)** initiative in Maine
 - To gather information on Maine company needs and on successful program models in other regions to inform the design of a program in Maine.
- ❑ The approach was to first conduct interviews with a limited group of Maine manufacturers, primarily small to medium sized, that are perceived to be leaders by key stakeholders (Roux Institute, U Maine Advanced Manufacturing Center, and Maine MEP)
 - These interviews attempted to understand:
 - How leadership thinks about I4.0 for their company
 - What initiatives are driving this digital transformation
 - Where are they in this transformation today
 - What are the challenges to adoption
 - What could a state program do to help them
- ❑ And then interview a select group of organizations specializing in helping manufacturers with the transformation to I4.0, to understand:
 - Best practices, particularly for small and medium sized manufacturers (SMMs)
 - Lessons learned from their work
 - How their organizations are supported financially
 - Impact of their work
 - Recommendations for a potential state of Maine effort

****Industry 4.0 is sometimes referred to as Smart Manufacturing**

Methodology

- ❑ Obtained Maine stakeholder input (Roux, AMC and Maine MEP) through an in-person and virtual working sessions
- ❑ Interviewed 10 companies from a variety of industries
 - Note that the companies selected, during working sessions with Roux, AMC and Maine MEP, were identified as leading manufacturers in the state, and do not necessarily represent the average company.
- ❑ Interviewed 5 organizations from around the US that are assisting companies to adopt I4.0, in order to understand lessons learned
 - These organizations were informed by the group as well as past work from the consulting team
- ❑ Summarized key findings related to the current state of Industry I4.0 adoption in Maine
- ❑ Provided observations and preliminary recommendations for potential next steps to help Maine manufactures

Segments interviewed:

- Marine (1)
- Life Science (1)
- Aerospace (1)
- Machining (1)
- Composites/Specialty Textiles (3)
- Wood and Paper Products (2)
- Miscellaneous (1)

Best Practice organizations:

- ConnStep
- MMTC
- CESMII
- Digital Foundry
- Collected additional information on other MEP Centers through discussions with MEP Center Directors (gather on projects for MEP)
- HighByte

Industry I4.0 Represents the Current Phase of Digital Transformation in Manufacturing

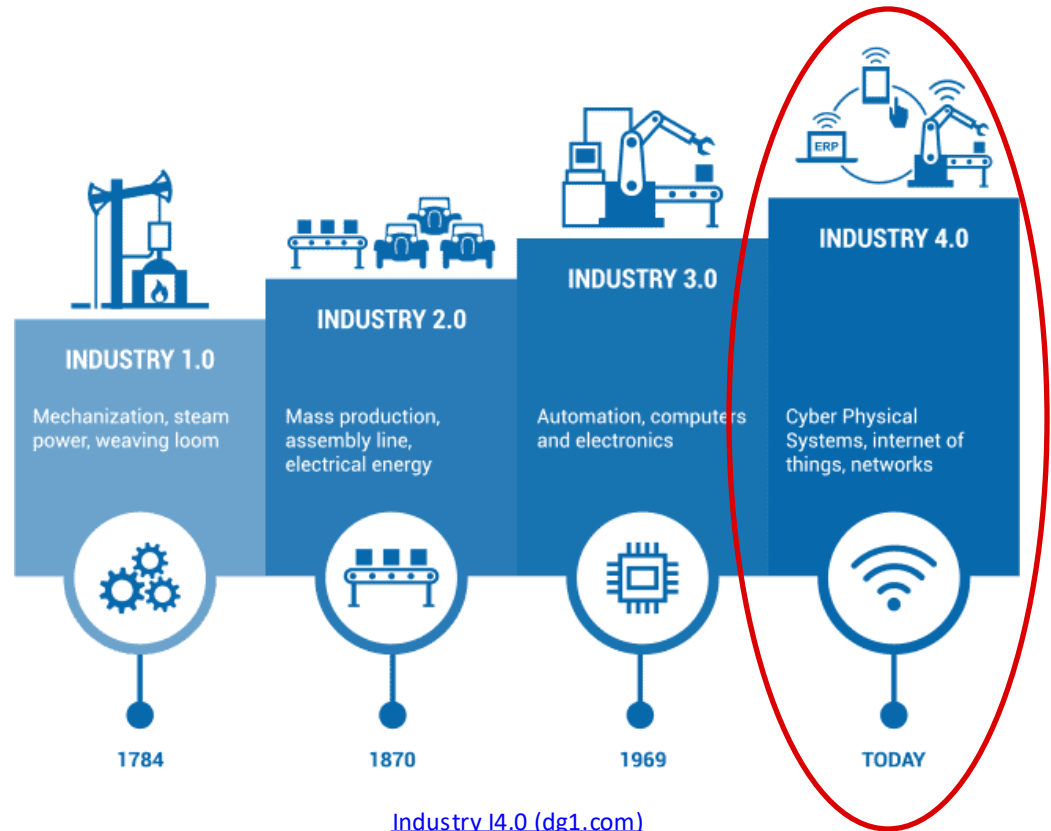
Smart Manufacturing / Digital Manufacturing / Connected Factory

Industry I4.0 description used for interviews:

Description: Industry I4.0 represents the current phase of industrialization, emphasizing the integration of digital technologies, the Internet of Things (IoT), artificial intelligence (AI), and data analytics into manufacturing. It aims to create "smart factories" with interconnected systems that can communicate, analyze data in real-time, and in some cases make automated, decentralized decisions.

Key Technologies: IoT, AI, machine learning, big data analytics, cyber-physical systems, cloud computing, additive manufacturing, augmented reality, and the integration of digital technologies for improved efficiency and flexibility.

Source: developed by the research team from a variety of sources including organizations and vendors serving the I4.0 industry.



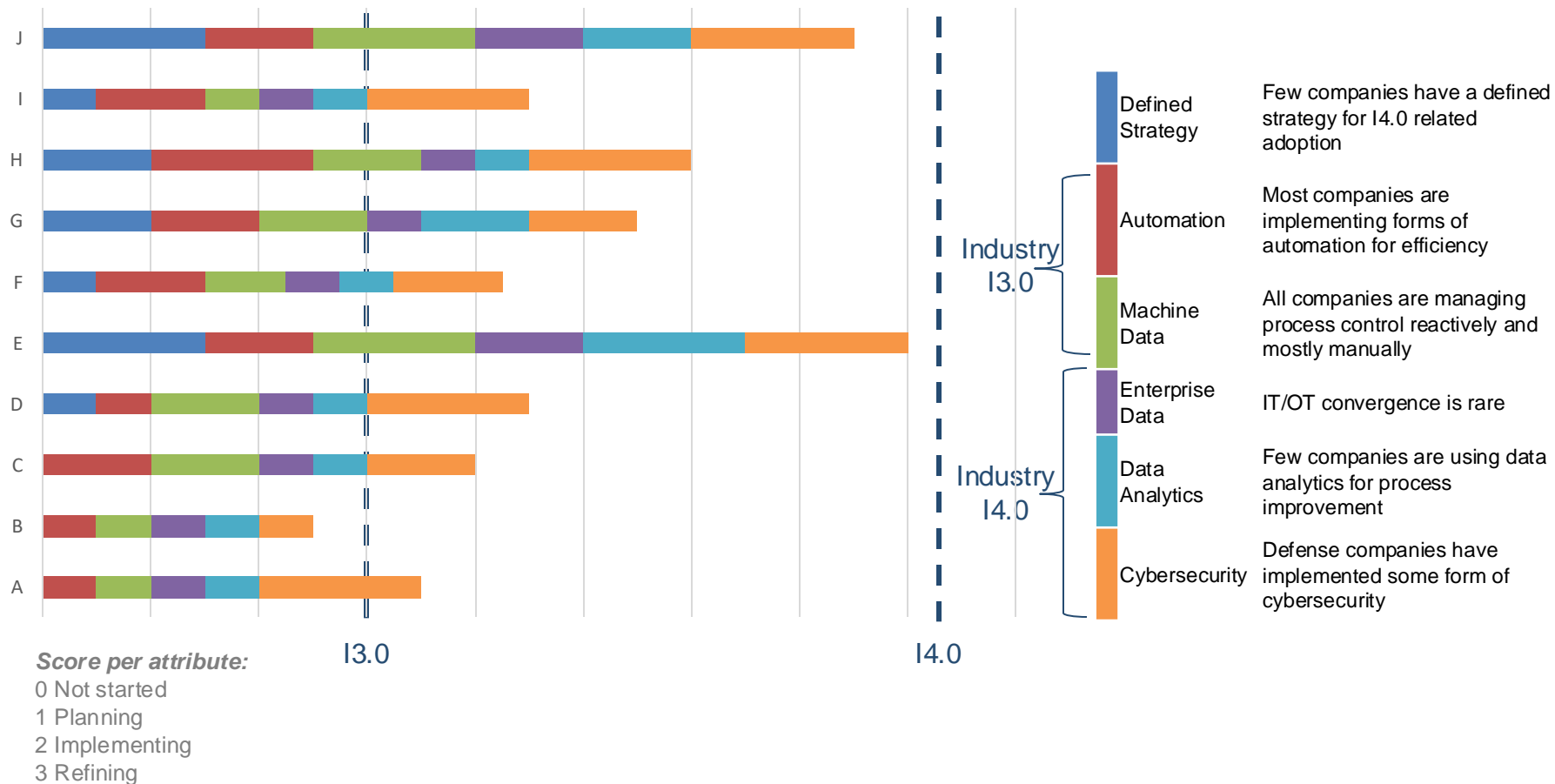
[Industry I4.0 \(dg1.com\)](http://Industry I4.0 (dg1.com))

Assessment of Maine Companies – Where We Are

- ❑ Companies are focused on automation (I3.0) and upgrading older/antiquated equipment (or they are in start-up mode)
 - Many older machines remain in use
 - Drivers: productivity and maximizing output without increasing staff, given the labor shortage
 - As well as quality, safety considerations
 - New equipment often comes with sensors, data collection and digital capabilities, but is not yet being meaningfully leveraged
- ❑ Companies are just beginning to collect and use data at the machine level – rarely is it real-time, enterprise-level analytics
 - Very early stage – sense opportunity but very limited progress in using data or integrating into processes
 - Very few have a clear understanding and vision of what data can do for their business
 - Sense opportunities without a clear roadmap or strategy

Most Companies are Just Adopting Industry I3.0 Technologies – Few Have Embraced Industry I4.0

Relative Adoption of I4.0 Characteristics

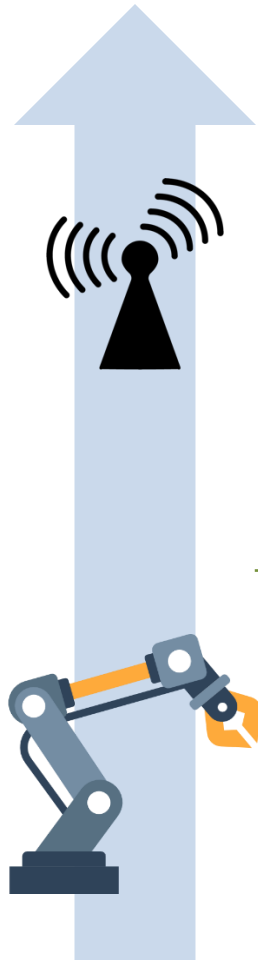


Note: This information was gathered in 1-hour interviews with one or more company leaders, and not based on in-depth onsite assessments. Companies selected are believed to be more advanced in adopting technologies than the average Maine manufacturing company.

There are Perceived Skill Gaps in the Region that are Impediments to I4.0

- ❑ Companies lack internal competencies required to leverage data, and there is perceived to be a lack of expertise in the region
 - Sense opportunities to use data to get more output with same people
 - Robotics programmers and tech support not always available
 - Need cadre of people that can layer on data/statistical and IT skills with industrial and process engineering (combining IT with OT)

Summary of Skill Gaps from Interviews



| Phase | Description | Skill Gaps |
|--|--|--|
| <p><i>Future State:</i></p> <p>Industry 14.0/ Smart Manufacturing</p> | <p>Maine companies will need to:</p> <ul style="list-style-type: none"> • Build interconnected systems that capture and share real-time data • Analyze data in real-time, using advanced analytics like ML/AI, and in some cases making automated and decentralized decisions | <ul style="list-style-type: none"> • “Data Engineering” skills for industrial environments <ul style="list-style-type: none"> • Data analytics and visualization • Machine learning/AI • Enterprise systems knowledge (ERP, MES) • People that can bridge OT and IT networks <ul style="list-style-type: none"> ○ Capturing, integrating and sharing data, sensors/IoT, networking, integration and edge computing, unified namespace/data lakes |
| <p><i>Current State:</i></p> <p>Maine Manufacturers Today/ Industry 13.0</p> | <p>Maine companies are:</p> <ul style="list-style-type: none"> • Selectively automating processes and upgrading older equipment • Obtaining new data capture and monitoring capabilities that are built into new equipment • Implementing cybersecurity for CMMC compliance (defense companies) | <ul style="list-style-type: none"> • Robotic/automation programmers and technicians |

Cybersecurity is a Major Challenge in the Transition to I4.0

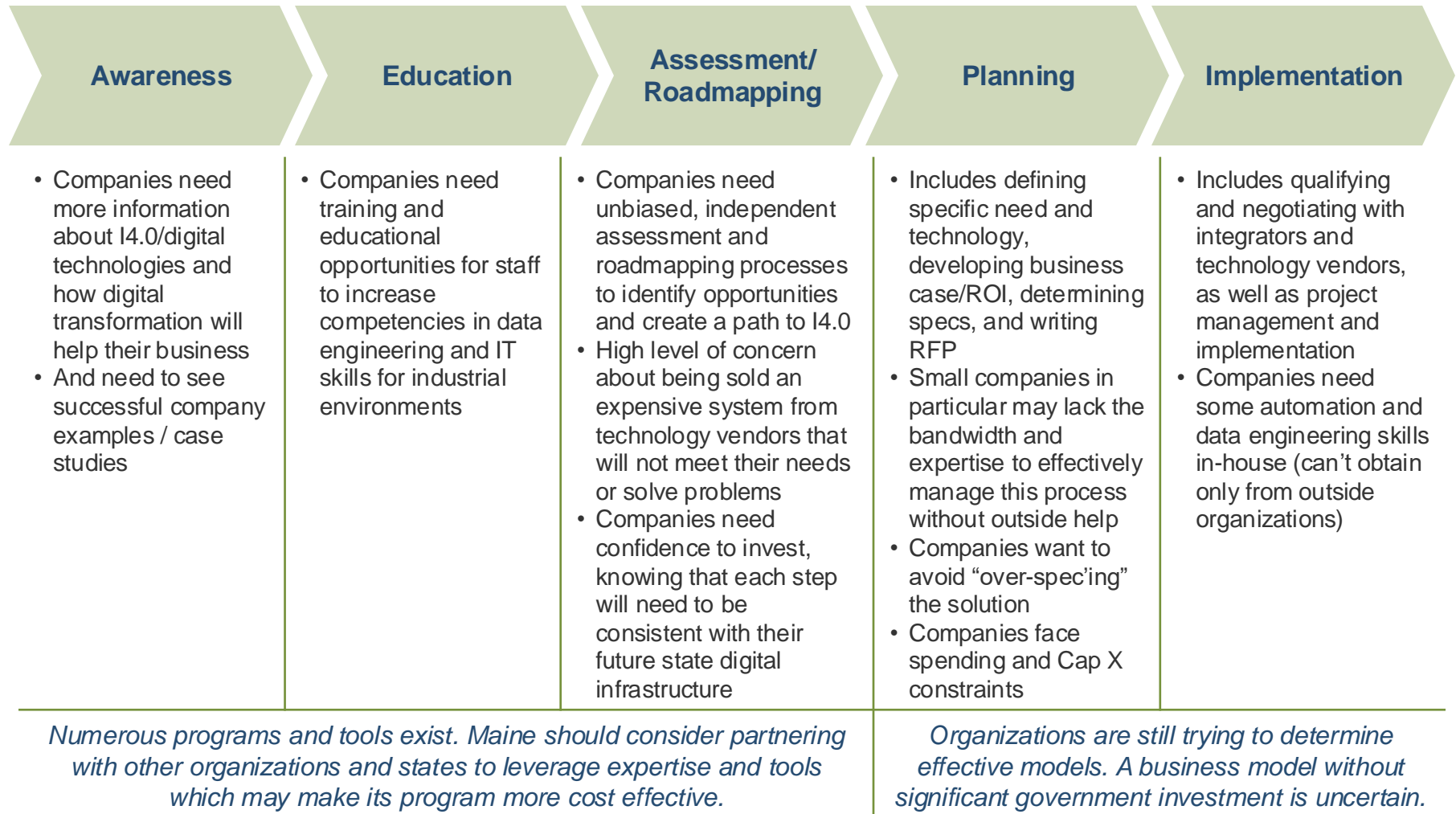
- ❑ Cybersecurity requirements are a major challenge for companies with defense business
 - Need to get CMMC done right before companies can share and use enterprise data
 - In defense environment, IT cannot have unrestricted access to OT

Assistance Needs of Companies and Implications for Potential Solutions

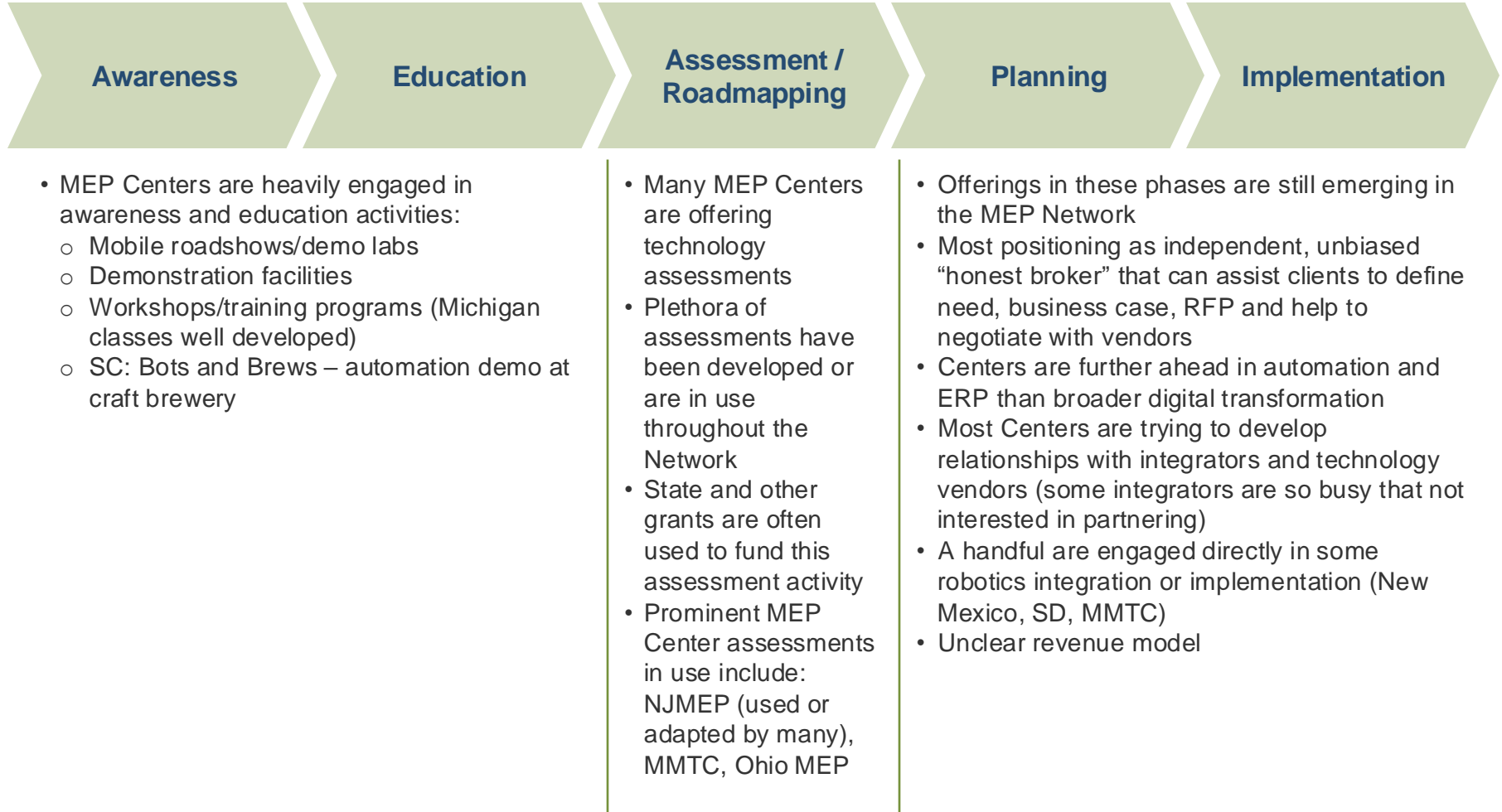
Key Observations

- ❑ Considerable awareness and education is required for company leaders to understand what I4.0 (digital transformation) can do for Maine companies
- ❑ Companies want an independent, unbiased assessment and recommended roadmap from a trusted resource
 - Want to avoid an expensive solution recommended by vendors that does not meet their needs
- ❑ Companies have spending constraints (equipment and labor) for investment in the transformation to I4.0
- ❑ There is an inadequate supply of skilled labor in the region that is important to support the transformation to I4.0 thinking and implementation
 - Data technology and analytics, robotics programmers
- ❑ Companies will need implementation assistance
 - Companies need in-house competency as well as outside resources, and shared statewide resources may make sense for some activities

Assessment by Stage of Technology Adoption and Implications for Maine I4.0 Program



Summary – MEP National Network



Other Lessons Learned from Best Practice Organizations

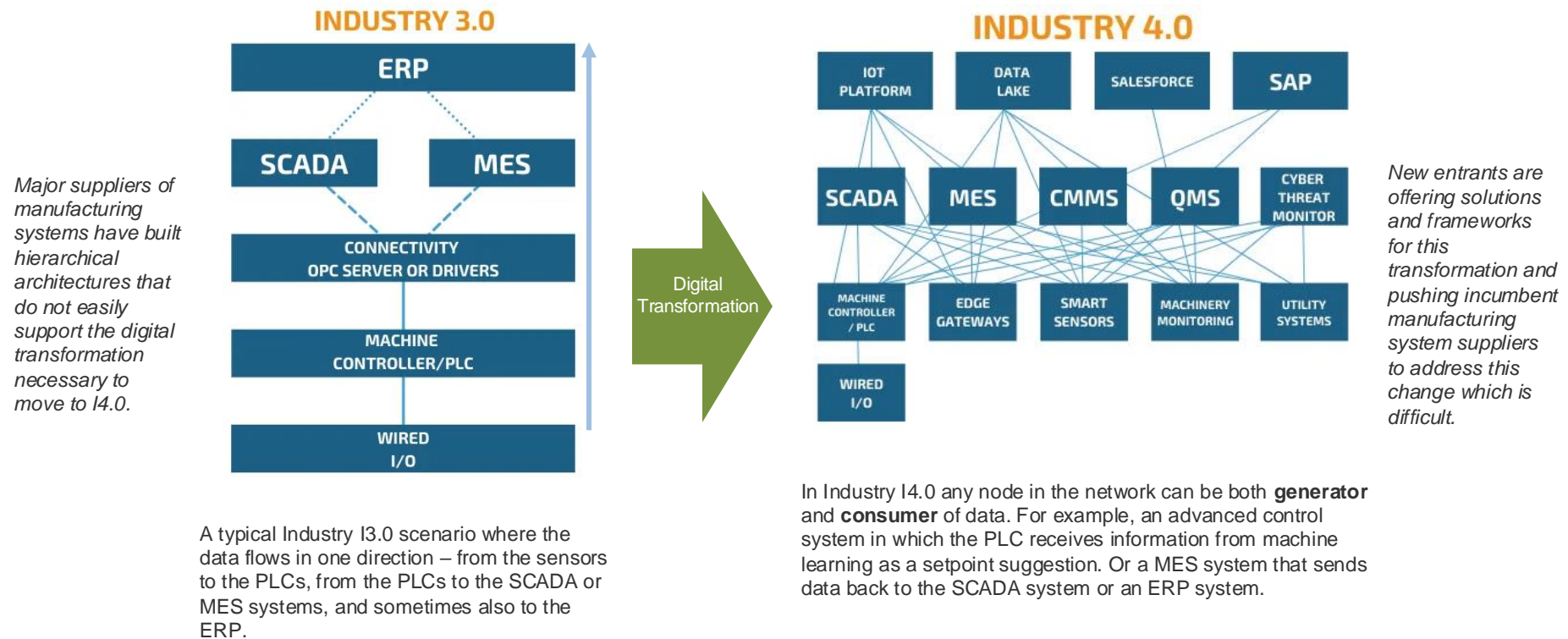
- ❑ I4.0 programs we are aware of have not yet developed a business model without government investment or grant funding
- ❑ Maine should consider leveraging existing I4.0 programs and potential partners
 - Particularly CESMII, other MEP Centers
 - Consider a regional solution, such as collaboration among northern New England or New England states
- ❑ Target market considerations for a Maine program
 - Smaller companies need the most help, but it may be difficult for them to make the required investments or have the bandwidth/skills to implement
 - It may make sense for a new Maine program to initially target larger and mid-size companies to build use cases, experience and regional momentum that eventually spreads to smaller companies

Key Challenge is Capturing Data from Legacy Equipment

- ❑ Several offerings exist to extract data from legacy machines in a cost effective way
 - CESMII/Think IQ camera/vision system to capture legacy data
 - CESMII IIOT starter packages / NCD.IO
 - MxD Sensor retrofit kit
 - Machine tool technologies retrofit/add-on (e.g. Caron Engineering)
- ❑ Recommendation: Need to explore these tools
- ❑ Note that other technologies are emerging that are primarily used by larger companies that also tap into machine sensors and legacy equipment
 - such as Maine companies Kepware and HighByte

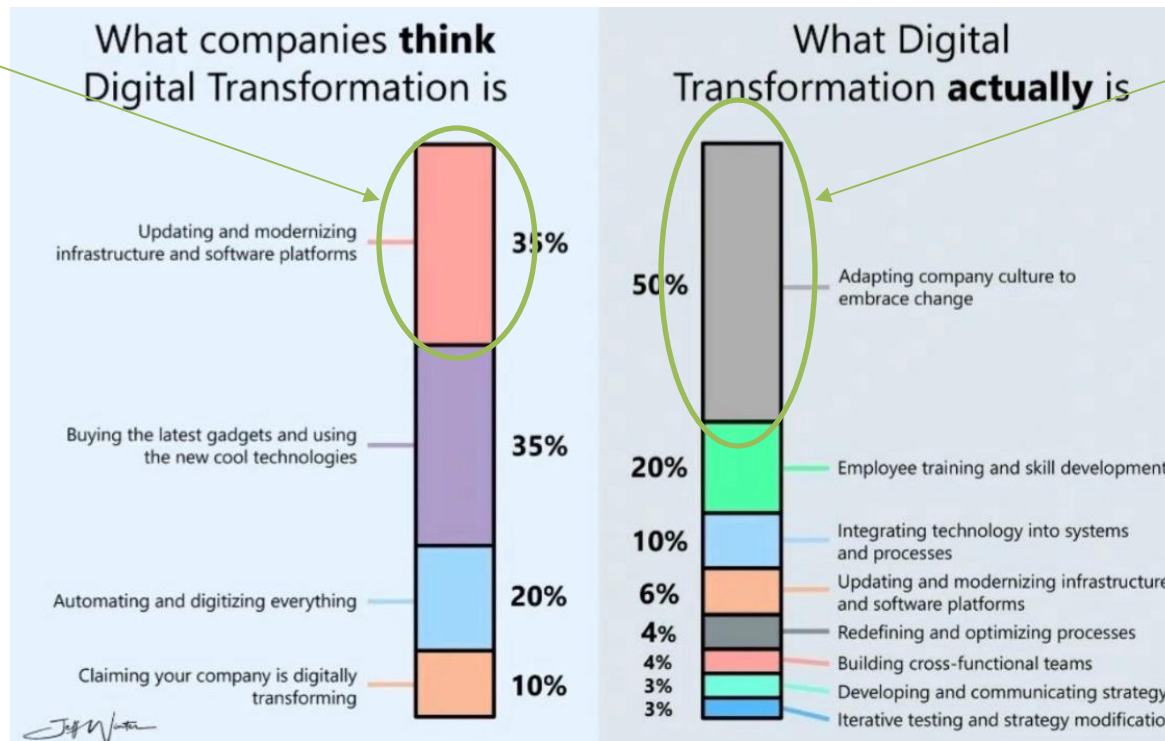
The Transition to I4.0 Requires a Fundamental Change (in Thinking) and in Digital Infrastructure

To make this change, most manufacturers need new competencies to implement the digital transformation and to achieve OT/IT convergence



Interviews Confirm the Importance of Leadership-Driven Culture Change versus Technology

Biggest technology challenge is moving from a hierarchical to distributed architecture



Biggest leadership challenge is recognizing the need to change

Source: Jeff Winter, Senior Director of Industry Strategy, Manufacturing, Hitachi Solutions America

“Digital/I4.0 transformation involves people, processes and technology. Technology is the easiest part.” -- Best Practice Interview

Addressing Maine I4.0 Skill Gaps

Skills Gap

- ❑ Companies need a combination of in-house skills and external expertise
- ❑ Companies need skills related to robotics/automation as well as data engineering skills for industrial environment
 - Data analytics and visualization
 - Machine learning/AI
 - Enterprise systems knowledge (ERP, MES)
 - People that can bridge OT and IT networks
 - Capturing, integrating and sharing data, sensors/IoT, networking, integration and edge computing, unified namespace/data lakes
- ❑ Roux, UMaine and community college programs will need to educate workers on some of these skills
- ❑ Retraining opportunities will also be needed for company staff are also needed

Company Comments

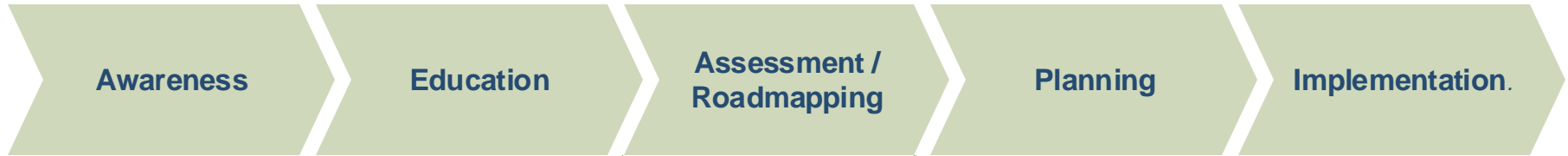
“The educational system is an issue – need to produce ‘data engineering’ people – combines applied statistics and manufacturing engineering and maybe IT...whole new skill set needed.”

“If someone had expertise in I4.0 – would hire an engineer or two – but the challenge is to find that person”...“U Maine does not have industrial engineering program...[and] only produces 10-20 computer scientists per year”

“Only one community college that has comp science degree – that is one area state can help – introduction to PLCs and sensors, how to collect data and how analyze – not prevalent skills here”

“Maine used to have scholarship to pay for civil engineers to support pulp and paper industry (believe it required work in Maine for certain number of years)...Could be done to grow I4.0 skill base in Maine. Don’t think it can be done with only 3rd party consulting. Need expertise in-house

Potential Next Steps to Consider for Maine I4.0 Assistance Program



1. Explore partnerships with CESMII, other MEP Centers, CESMII/Tooling U and other organizations to gain access to existing educational content
2. Explore shared resources with other New England states to offer demonstration facilities or mobile labs/roadshows
3. Reach out to thought leaders educating companies
 - Walker Reynolds (4.0 Solutions) offers a free IIoT training program, and is driving grass roots education and new ways of thinking about I4.0
 - Explore how they change the mindset of company leaders to understand the critical need for this transformative thinking
4. Initiate deeper evaluation of potential assessments
 - Candidates should include NJMEP, MMTC, CESMII, Automation Alley, Triple Helix
5. Maine MEP and AMC can augment assessments by applying their manufacturing experience to make sure the opportunities identified are right for the company
6. A Maine I4.0 program would need to have staff or partners with relevant technical expertise to be an independent, honest broker that can help companies plan implementation, scope projects and negotiate with vendors. Goal is to ensure projects are scoped appropriately.
7. Consider partnering with a handful of systems integrators with experience in digital transformation of manufacturing
8. Explore cost effective packages, technologies for capturing data in legacy machines – critical for rural state
9. Revenue model will probably need government support; also will generate some fees from consulting and project management
10. Connect with additional organizations assisting companies with I4.0, such as Automation Alley, Conexus (IN), additional MEP Centers, MxD, to learn about tools/capabilities and explore collaboration
11. Partnership with CESMII may offer valuable expertise and tools across all phases above. Digital Foundry is a CESMII partner (Smart Manufacturing Innovation Center). Is that a model for Maine?
12. Reach out to other new entrants that are providing relevant technologies, like Kepware, HighByte