

## Smart Manufacturing - Ohio Digital Thread Initiative III

The Smart Manufacturing Ohio Digital Thread Initiative funded through the 2019 PDAC process has been used to leverage well-established government, industry, and academia relationships across Ohio. An ARCTOS led team, partnered with the Air Force ManTech Program Office from Wright Patterson AFB has established relationships through three Ohio Community College's to address the key manufacturing skills gaps employers are facing through skilling, reskilling, and upskilling workers. The program has made significant progress against the broad objectives of the program to "...define, develop and deploy stackable fit-for-purpose training packages that reduce the barriers to adoption of I4.0 technologies." And, most importantly, successfully demonstrated that Community Colleges can work at the pace of industry. This follow-on PDAC request solidifies the role of Community College's in delivering agile training in I4.0 technologies at the speed of industry and establishes a workforce that can readily work with emerging I4.0x technologies such as Cobotics, Augmented & Virtual Reality, Machine Learning and Artificial Intelligence as they transition to the shop floor. Products from this work will flow to Ohio Community Colleges, Tech Centers and ultimately nationwide.

### Digital Threads & Digital Twins

#### Industry 4.0\* Cognitive, Interconnected Cyber Systems in a Manufacturing Environment...

- Cyber-physical systems — machine devices that are run by algorithms
- The Internet of Things (IoT) — interconnected networks of machine devices embedded with computerized sensing, scanning and monitoring capabilities
- Cloud computing — offsite network hosting and data backup
- Cognitive computing — technological platforms that employ artificial intelligence



NextGen Industry 5.Xx: Focus is on the Return of Human Hands and Minds: Cyber, Augmented Reality and Autonomy –

- A **Digital Thread** framework integrating data from up and down the product lifecycle enables **Digital Twins** of products
- Factories transform into IoT-enabled smart facilities utilizing cognitive computing and interconnect via cloud servers
- "Man and Machine Reconcile" and find ways to work together to improve the means and efficiency of production
- Combined: Humans and Computerized Machinery take manufacturing to new levels of speed and perfection

**In a Digital World.....The Most Important Element in Technology is the People!  
...Ohio "Digital First"... Leading The Nation**

\*Guide to Industry 4.0 & 5.0 By Darrian McClellan

**Funding Request:** \$15,000,000.00

The 2019 funded PDAC Ohio Digital Thread Initiative positioned Ohio to operate in an I4.0 manufacturing environment. The initiative funding to date has allowed:

- The establishment of the Air Force ManTech/ARCTOS Regional Fabrication & Certification Training Laboratories program focused on the development of new training models that enable the U.S. industrial base transition to a digital manufacturing environment rapidly and successfully.
- The establishment of a robust relationship with the Air Force Sustainment Center (AFSC) in support of their Digital Transformation Strategy, Focus Area 5: Workforce Development.
- Engagement with three Ohio community colleges who are working with industry and DoD partners to define, develop and deploy stackable fit-for-purpose training packages that reduce the barriers to adoption of I4.0 technologies.

Each Ohio Community College has a unique but complementary focus area:

- Lorain County Community College (Elyria) – Automation & Robotics;
- Sinclair Community College (Dayton) – Digital Thread;
- Clark State Community College (Springfield) – Laser Materials Processing/Photonics

Development of a strategy for I4.0 training which incorporates elements from the Stage-Gate New Product Development model; the consensus recommendations of an Ohio Manufacturers

Association Automation & Robotics Task Force; and lessons learned from ongoing workforce development efforts with the ARM Institute.

This approach enables key decision-making and assessment at each stage to assure a successful project, incorporates early validation of credentials and industry needs, and a robust technical and business case assessment of each project. The approach is grounded in the “three-legged stool” essential for training success: Education Partner + Technical Partner + Industry Partner, resulting in rapid development of workforce training packages with embedded credential and certificate opportunities, which stack within a degree pathway.

**Discussion:** Manufacturing has changed dramatically over the last 20 years. The shop floor from 1900 to today is vastly different. In the early 1900’s workers predominantly worked at the data and information or “assembly line levels”. Many are unaware that manufacturing technologies/jobs are rapidly requiring full-fledged STEM skills.

Industry 4.0 technologies are already affecting jobs globally. In the last 10 years, Chinese manufacturing has grown by 6% compared to 0.4% growth in the US. That’s being driven in part by I4.0 technology, which China is adopting much faster than the US. Adopting I4.0 technologies such as automation in the US is necessary just to keep pace with the Chinese and will be essential to bringing plants and jobs back to the US.

### ***Why should Ohioans care?***

Ohio’s key historical differentiator in manufacturing has been in precision manufacturing, which is at the very core now of an art and skill that Digital Engineering can more effectively perfect as we continue to drive from I4.0 to I4.0x capabilities.

- Manufacturing is core to Ohio’s GDP, now 4<sup>th</sup> largest manufacturing state – dropping from being the 3<sup>rd</sup> a few years ago. This initiative will allow Ohioans to stop the decline and allow us to drive towards #1 in the future through focused Digital Engineering efforts
- Digital skills moving from design and inspection bookends to the full digital thread – enabling greater throughput by existing workforce and systems
- Trained/available workforce is a huge limiting factor on regional job growth. Digital Engineering empowers workers to work at a higher knowledge level. One worker can now oversee the operation of up to 13 systems through autonomy and AI
- These are desirable, highly paid, highly rewarding jobs – a sense of accomplishment through product creation
- Historically aerospace with its high-performance demands has been the vanguard in new processes and these processes flow to medical, automotive and energy sectors enhancing the quality of life for all

The World Economic Forum, Future of Jobs Report 2018 predicts the loss of 75 million jobs by 2022, and the creation of 133 million “new” jobs by 2022. These new jobs are not the traditional blue collar or white-collar jobs of the past. These jobs are multidisciplinary in nature and will take advantage of man/machine synergies. These “NextGen” jobs require a workforce skilled in the high value tasks of reasoning and decision making. In the traditional sense of data, information, knowledge and wisdom hierarchy, manufacturing facilities were designed/operated with the

human working on redundant tasks, at the “data” level in the hierarchy. Future manufacturing facilities will utilize machines and algorithms to perform these redundant tasks at the “data” level and integrate the human into the system at a higher hierarchical “information” level. Ohio’s higher education capabilities through regional career centers, and community colleges will deliver this understanding through hands-on, real-world pilot projects to Ohioans throughout the state.

The Air Force ManTech program established an ARCTOS led consortium with the 2019 PDAC Smart Manufacturing – Ohio Digital Thread Initiative funding they received. The consortium is focused on ensuring that Ohio aerospace companies retain their leadership position in precision manufacturing of aerospace parts by working through the state community college system to skill, reskill, and upskill students and workers. Three community colleges were chosen to pilot the Digital Thread concepts with Lorrain County Community College, (LCCC), Clark State Community College, (CSCC), and Sinclair Community College, (SCC).

Progress in the first phase has been nothing short of amazing. The Air Force is fully engaged and enthusiastically supportive of the program as it is a key element of their strategy to deploy I4.0 technologies at Air Force Sustainment Center Air Logistics Complexes in GA, OK and UT.

In addition, LCCC was recently notified that they were one of five awardees under a National Defense Education Program to foster the development of Two-Year Institution/Community College STEM education consortia. *The Ohio TechNet (OTN) Defense Industrial Base (DIB) STEM Consortium* will leverage the AF ManTech/ARCTOS Regional Fabrication and Certification Training Laboratories program to develop “next generation” schools in Automation & Robotics and the Digital Thread across Ohio as well as expand Industry 4.0 training at the Air Logistics Complexes (ALC), starting with Warner-Robins ALC at Robins AFB, GA:

[DOD Awards National Defense Education Program Cooperative Agreements > U.S. Department of Defense > Release](#)

LCCC was also awarded funding to support INTEL’s workforce pipeline development for Northeast Ohio (NEO). Both awards were due to work done in Phase 1 of this program.

All three Community Colleges have said that they benefitted from the flexibility of this program. It has allowed them to take advantage of evolving opportunities and reallocate resources where required to maximize success. This has enabled them to innovate as they develop training, improving each iteration of their training. More importantly, this flexibility has allowed them to work at the pace of industry which has been critical to getting buy-in from their industry partners.

Similarly, a huge benefit of the ARCTOS program is that it has allowed the Community Colleges to purchase advanced lab equipment and software. Having the ability demonstrate state-of-the-art equipment to prospective students & industry partners has been pivotal in the success of the program. Funding to continue to add equipment for expansion of current capabilities including the addition of other emerging Industry 4.0 technologies such as Augmented Reality/Virtual Reality, Artificial Intelligence, co-bots, etc. will keep us on pace with industry.

The Smart Manufacturing – Ohio Digital Thread Initiative III builds upon its predecessor efforts focusing on developing the skills required by industry for the next generation of digital

manufacturing workforce by skilling, re-skilling, and up-skilling workers through the principles of Problem-Based Learning focused on the rapidly emerging digital thread economy. Students and workers will solve real-world digital manufacturing problems provided by industry using state of the art precision digital manufacturing equipment and are exposed to careers in the disruptive technologies of additive manufacturing, photonics, trusted systems, autonomy, and robotics as well as the significance of big data analytics to the manufacturing process.

This initiative will fund technology integration and scale-up. AFSC as well as many of our industry partners are looking for integrated technology packages to address their advanced manufacturing needs. For example, Warner-Robins Air Logistics Complex (WR-ALC) is investigating robotic sheet forming and robotic forging and is looking to add other I4.0 technologies (e.g., machine learning, digital scanning, etc.) to make metal working/forming more agile. Similarly, Unison, a Tier 1 aerospace supplier,<sup>4</sup> stated that 60% of the space in their manufacturing facility in Beavercreek, OH is used to store tooling & fixtures. They would like to use robotic material handling to replace the fixturing and integrate the welding and weld inspection operations, i.e., integrate elements of Automation & Robotics, Laser Welding, and the Digital Thread. This will require the development of integrated training packages that utilize elements of each technology focus areas and will allow us to pilot the sharing of training via Ohio TechNet (OTN), a statewide network of 23 community colleges, 7 public universities, and 12 career and technical centers for which Lorain County Community College is the lead facilitator.

We expect continued growth at an accelerated pace over the next year and foresee an expanded demand signal in all areas of focus as more manufacturers adopt I4.0 technologies and seek a trained workforce. We will continue to look for opportunities to 1) expand the pipeline of students in I4.0 pathways 2) engage with employers as a key training partner 3) share our educational models and processes with other education partners 4) incorporate new technologies into our training at the pace of industry, such as AI/ML and AR/VR.

**Summary:** The COVID-19 Pandemic has accelerated the Digitalization of Manufacturing. OEM's and lower tier suppliers are seeking skilled workers to apply Industry 4.0 capabilities in their manufacturing facilities and community colleges need to be ready to train potential employees in a new technology before industry even realizes their need for it. The Smart Manufacturing – Ohio Digital Thread Initiative III will enable the community colleges to keep pace with industry and accelerate the adoption of other emerging Industry 4.0 technologies such as Augmented Reality/Virtual Reality, Artificial Intelligence and Cobotics across Ohio. OTN will also be used to share training packages with educational institutions adjacent to the ALCs at Robins AFB, GA, Tinker AFB, OK, and Hill AFB, UT.

### ***“Ohio...from Powered Flight to Digital Manufacturing”***



**The Most Important Element in Technology is the People!**