



# TRAINING TOMORROW'S ADVANCED MANUFACTURING EMPLOYEES TODAY

BY LOGAN KOLAS  
OCTOBER 4, 2023

## Introduction

After decades of automation and technological innovation, American manufacturing firms require fewer but more talented workers—a trend likely to continue. The United States Bureau of Labor Statistics estimates the U.S. manufacturing sector will lose 113,000 jobs between 2022 and 2032.<sup>1</sup> Once a Midwest manufacturing juggernaut, Ohio suffered dwindling employment, a stagnant manufacturing sector, and a painful labor market adjustment (Figure 1). Today, U.S. manufacturing is dominated by “advanced manufacturing” subindustries. Michael Shields of Policy Matters Ohio lists 35 advanced manufacturing subindustries classified by the North American Industry Classification System.<sup>2</sup> In Ohio, only five of those subindustries added employees from 2001 to 2022, but accounting for the additional jobs and job losses, these 35 advanced manufacturing subindustries shed more than 125,000 workers or more than 40 percent of their employees.<sup>3</sup> But there is a silver lining. Even as automation and technology once reduced manufacturing workforces in Ohio and across the country, new learning technologies are poised to help train those workforces for the manufacturing jobs of tomorrow.

Corporate investments from technology manufacturing companies like Intel have revived optimism for advanced manufacturing in Ohio. But those investments also require successful training, upskilling, and education initiatives so that Ohio employers have the skilled employees needed to do the job. Ohio should follow the path charted by other states and integrate immersive learning technologies into education and worker training programs and amend its community college funding protocols to help train and send more graduates on to advanced manufacturing employers. Offering advanced manufacturers a work-ready labor force will make Ohio

---

<sup>1</sup> **Employment Projection—2022-2032**, The United States Bureau of Labor Statistics press release, September 6, 2023.

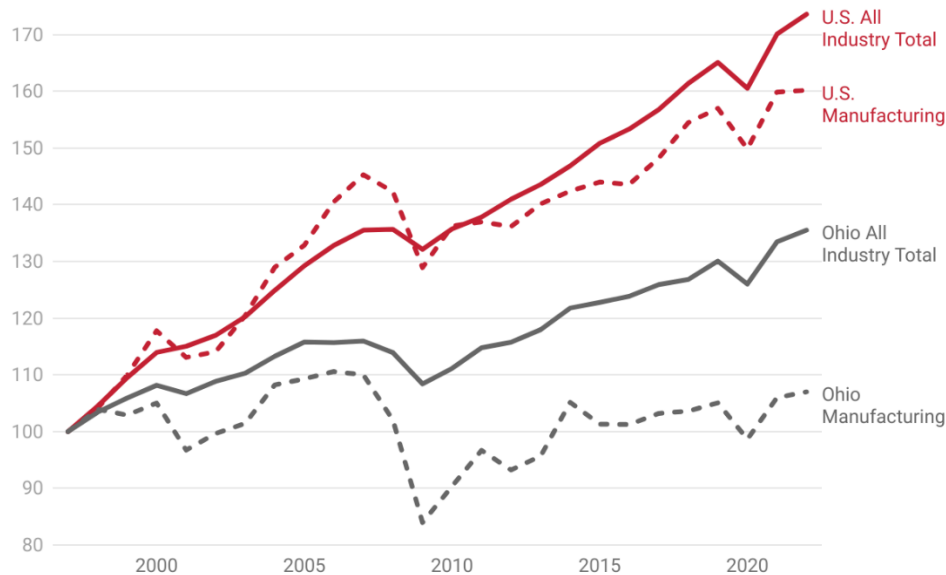
<sup>2</sup> Michael Shields, *Manufacturing a High-Wage Ohio*, The Century Foundation and Policy Matters Ohio, March 12, 2018.

<sup>3</sup> Authors calculations from Bureau of Labor Statistics, **Quarterly Census of Employment and Wages** (Last visited September 12, 2023).

more attractive to more industries and help revitalize the state's beleaguered manufacturing sector.

## Real GDP and Real Manufacturing GDP in Ohio and the United States

Indexed to 1997 Values



Created by The Buckeye Institute | [BuckeyeInstitute.org](http://BuckeyeInstitute.org)

Source: Bureau of Economic Analysis • Created with Datawrapper

## New Learning Technology Can Improve Advanced Manufacturing Training

Following waves of automation and streamlined production processes,<sup>4</sup> U.S. manufacturing now requires fewer workers, more skills, and higher employee productivity. Manufacturing in America has become advanced manufacturing,<sup>5</sup> which, as of 2017, employed 45 percent of manufacturing workers and accounted for 53 percent of the broader industry's output.<sup>6</sup> But finding workers with the requisite skills for advanced manufacturing has become a challenge. Many employers must now often hire relatively unqualified workers and teach or upskill them themselves, so they are once again turning to emergent technology—not to replace workers, but to train them. Integrating augmented reality (AR), virtual reality (VR), and mixed reality (MR) technologies into

<sup>4</sup> Michael J. Hicks and Srikant Devaraj, *The Myth and the Reality of Manufacturing in America*, Conexus Indiana, April 2017.

<sup>5</sup> Narrowly defined by economists at the San Francisco Federal Reserve as a manufacturing operation that spends more than \$450 per worker on research and development and that also require 21 percent of their workforce to have large amounts of technical knowledge; *Advanced Manufacturing Is a Key Cog in U.S. Economy*, Federal Reserve Bank of St. Louis On the Economy blog, March 29, 2018.

<sup>6</sup> *Advanced Manufacturing Is a Key Cog in U.S. Economy*, Federal Reserve Bank of St. Louis On the Economy blog, March 29, 2018.

apprenticeships and on-the-job training<sup>7</sup> helps businesses equip their workforces with the skills needed to complete advanced manufacturing tasks.

Boeing, Caterpillar, BMW, Ford, and AGL Energy have used augmented and virtual reality tools for years, cutting costs, shortening learning curves, and creating solutions that save time and money.<sup>8</sup> Ford, for example, has used VR technologies to convert designs into virtual vehicles that engineers and technicians can inspect before ever building a prototype, saving Ford time and money.<sup>9</sup> Similarly, Connecticut-based energy company Avangrid is using VR to train wind turbine maintenance technicians remotely and less expensively.<sup>10</sup> Lifeliqe's Manufacturing Technician Level 1 (MT1) certification program has introduced trainees future-oriented skills such as “CAD [computer-aided design] proficiency, computer-controlled machine programming, precise measurement abilities, process and machine troubleshooting, problem-solving, machine maintenance, and adept use of diagnostic and statistical tools.”<sup>11</sup> The Purdue University-National Science Foundation has partnered with Indiana-based manufacturing companies such as Wabash National, Kirby Risk, and Gaylor Electric to test immersive learning prototypes and experiment with best practices on the factory floor.<sup>12</sup> By combining virtual objects with physical, hands-on activities, virtual advanced manufacturing factories present an opportunity for students to learn safely and in an engaging way.<sup>13</sup>

Some states, like Massachusetts, have already begun using immersive learning platforms to introduce students to aviation maintenance, automotive repair, hospitality, and healthcare.<sup>14</sup> Immersive learning technologies help students and employees “learn by doing.” For many students, traditional learning methods fail, but immersive learning technology can simulate real world scenarios and bring boring textbook materials to life with curated databases of interactive, standardized, on-demand learning materials. By creating a catalogue of interactive, instructional material accessible through the internet, AR/VR technologies provide valuable tools for remote instruction and easily accessing archived material online.

Immersive learning tools can also improve some difficult-to-teach but in-demand “soft skills” in the post-pandemic workforce.<sup>15</sup> American Enterprise Institute scholar Brent Orrell explains that

---

<sup>7</sup> Eric Adelson and N. Kirkpatrick, **Virtual Reality Has Expanded into a New Field: Job Training**, *The Washington Post*, August 10, 2023.

<sup>8</sup> Anurag Choudhry and Anshu Premchad, “**Digital Transformation Using Immersive Technologies in Manufacturing and Utilities**,” *Innovations in Electrical and Electronic Engineering*, Volume 661 (July 26, 2020)

p. 433

<sup>9</sup> *Ibid.*

<sup>10</sup> Patrick Sisson, **How VR Training in the Workplace Is Transforming Learning on the Job**, Redshift Autodesk, March 29, 2021.

<sup>11</sup> **Discover Advanced Manufacturing Career Pathway with New Modules**, Lifeliqe.com, August 14, 2023.

<sup>12</sup> Jared Pike, **Augmented Reality to Provide New Skills for Manufacturing Workforce Education**, Purdue University, 2020.

<sup>13</sup> Faisal Aqlan, Richard Zhao, Hui Yang, and Sreekanth Ramakrishnan, **A Virtual Learning Factory for Advanced Manufacturing**, Proceedings of the 2020 Winter Simulation Conference.

<sup>14</sup> Courtney Cole, “**Very enlightening,**” **Virtual Reality Headsets Allow Massachusetts Students to Learn New Trades**, CBSNews.com, September 5, 2023.

<sup>15</sup> David Capranos and Andrew J. Magda, Ed.D, **Closing the Skills Gap 2023: Employer Perspectives on Educating the Post-pandemic Workforce**, Wiley Inc., January 2023.

AI-enabled, chat-driven, soft-skill coaches can help close the gap between needed soft skills and gainful employment.<sup>16</sup> And, as Jeanne C. Meister argues in the Harvard Business Review, virtual reality applications for soft skill development are growing in popularity due to remote work arrangements, and may one day “become the desired platform for many soft skills training programs, from senior leadership development to new hire onboarding.”<sup>17</sup>

The manufacturing jobs of tomorrow are going to require a mix of on-the-job training, apprenticeships, and associate and bachelor’s degrees. Most manufacturing jobs used to only require a high school diploma, but as manufacturing has become more advanced and skill-dependent, those manufacturing employers are now seeking further education—and Ohio is lagging the nation once again. A recent RAND Corporation report explains that Ohio manufacturing workers are “significantly less likely than manufacturing workers in other states to have a four-year college degree,” which may reflect a need for more upskilling and reskilling or a “preference among Ohio employers for experience and industry credentials over college credentials.”<sup>18</sup> Some changes are in order to help prepare tomorrow’s workforce and implement immersive learning technologies in Ohio’s post-secondary schools.

State policymakers should rethink state metrics and funding rules for community colleges and public universities to make sure taxpayer dollars flow to where they are most useful. Ideally, higher education institutions would compete to attract taxpayer dollars. But state funding should at least be competitive with taxpayer dollars conditioned on results-oriented metrics like loan repayment rates, debt as a percentage of earnings, postgraduation employment, and degree completion. Currently, community colleges are disadvantaged by Ohio’s “Pell-First” policy, which denies funding when a Pell grant covers anything beyond tuition.<sup>19</sup> This financial disadvantage makes it harder for community colleges to afford immersive learning technologies. Without micromanaging school administrators, Ohio policymakers should clarify that higher education institutions may spend Super RAPIDS (Regionally Aligned Priorities in Delivering Skills) funding for equipment purchases on immersive learning technology as needed.<sup>20</sup> Other states have already shown a willingness to incorporate AR and VR into their community college and university environments. Northern Virginia Community College, for example, used the Higher Education Emergency Relief Fund to include VR into its cancer radiation education curriculum.<sup>21</sup> And Ohio schools are exploring similar uses and advantages. A Cuyahoga Community College study found AR was an “effective and engaging tool” to learn class material,<sup>22</sup> and Lorain County Community

---

<sup>16</sup> Brent Orrell, **An Unexpected Role for AI in the Workplace**, The Bulwark, May 23, 2023.

<sup>17</sup> Jeanne C. Meister, **How Companies are Using VR to Develop Employees’ Soft Skills**, *Harvard Business Review*, January 11, 2021.

<sup>18</sup> Lisa Abraham, Christine Mulhern, and Lucas Greer, **Strengthening the Manufacturing Workforce in Ohio**, RAND Corporation, 2023.

<sup>19</sup> Rea S. Hederman Jr, Logan Kolas, and Greg R. Lawson, **Budget Priorities for a More Prosperous Ohio**, The Buckeye Institute, January 26, 2023.

<sup>20</sup> **Governor DeWine, Lt. Governor Husted Announce Super RAPIDS Application Period**, Ohio Department of Higher Education press release, September 5, 2023.

<sup>21</sup> **Higher Education Emergency Relief Fund** (Last visited September 12, 2023).

<sup>22</sup> Elizabeth A. Duncan-Vaidya and Erica L. Stevenson, **“The Effectiveness of Augmented Reality Head-Mounted Display in Learning Skull Anatomy at Community College,”** *Anatomical Sciences Education*,

College will experiment with a completely virtual immersive learning environment in the 2023 fall semester.<sup>23</sup> At the university level, researchers from The Ohio State University are working to simulate real classroom environments that support multiple users at once.<sup>24</sup> Manufacturing light-based technologies is crucial for high-speed wireless networks, and researchers from MIT and Clemson are using immersive learning technology to make this complex and difficult manufacturing task easier to learn and more accessible.<sup>25</sup> From on-the-job training and apprenticeships to associate's and bachelor's degrees, immersive learning technology is changing the nature of manufacturing, and Ohio policy should change along with it.

## **Conclusion**

For decades, traditional manual manufacturing firms automated tasks and displaced workers. But advanced manufacturers that need skilled employees have reinvented the industry. Ohio must embrace the new manufacturing opportunities of an increasingly tech-centric sector. Instead of retrenching yesterday's manufacturing jobs, state policymakers, employers, and educators should equip workers with the training and skills needed for the jobs of tomorrow. Emergent technologies like immersive learning tools can help educate, reskill, and upskill Ohio students and workers. By prioritizing flexible workforce environments, embracing technological tools, and promoting a flexible jobs market, Ohio can help employers and employees take the next step toward a stronger, more advanced manufacturing future.

---

Volume 14, Issue 2 (June 24, 2020); and **How Will VR and AR Affect the Future of Work?** Verizon Wireless (Last visited September 12, 2023).

<sup>23</sup> Lauren Hoffman, **Lorain County Community College to Become a 'Metaversity,'** *The Morning Journal*, March 19, 2023.

<sup>24</sup> Mariah Chuprinski, **A Giant Leap for Immersive Learning: Creating a Virtual Reality Classroom,** PSU.edu, February 22, 2022.

<sup>25</sup> College of Engineering, Computing and Applied Sciences, **Massachusetts Institute of Technology and Clemson University Team Up to Close the Education Gap in Manufacturing Light-based Technologies,** Clemson News, December 11, 2019.

### **About the Author**

Logan Kolas is an economic policy analyst with the Economic Research Center at The Buckeye Institute where he researches and writes about the impact of state and federal policies on peoples' lives and on the economy. He is a native of Cincinnati and throughout his career has focused on researching Ohio-related policies. He holds a Master of Science in applied economics from the University of Maryland.



**THE BUCKEYE INSTITUTE**

88 East Broad Street, Suite 1300

Columbus, Ohio 43215

(614) 224-4422

[BuckeyeInstitute.org](http://BuckeyeInstitute.org)

*Training Tomorrow's Advanced Manufacturing Employees Today*

Copyright © 2023 The Buckeye Institute. All rights reserved.

Portions of this work may be reproduced and/or translated for non-commercial purposes provided The Buckeye Institute is acknowledged as the source of the material.