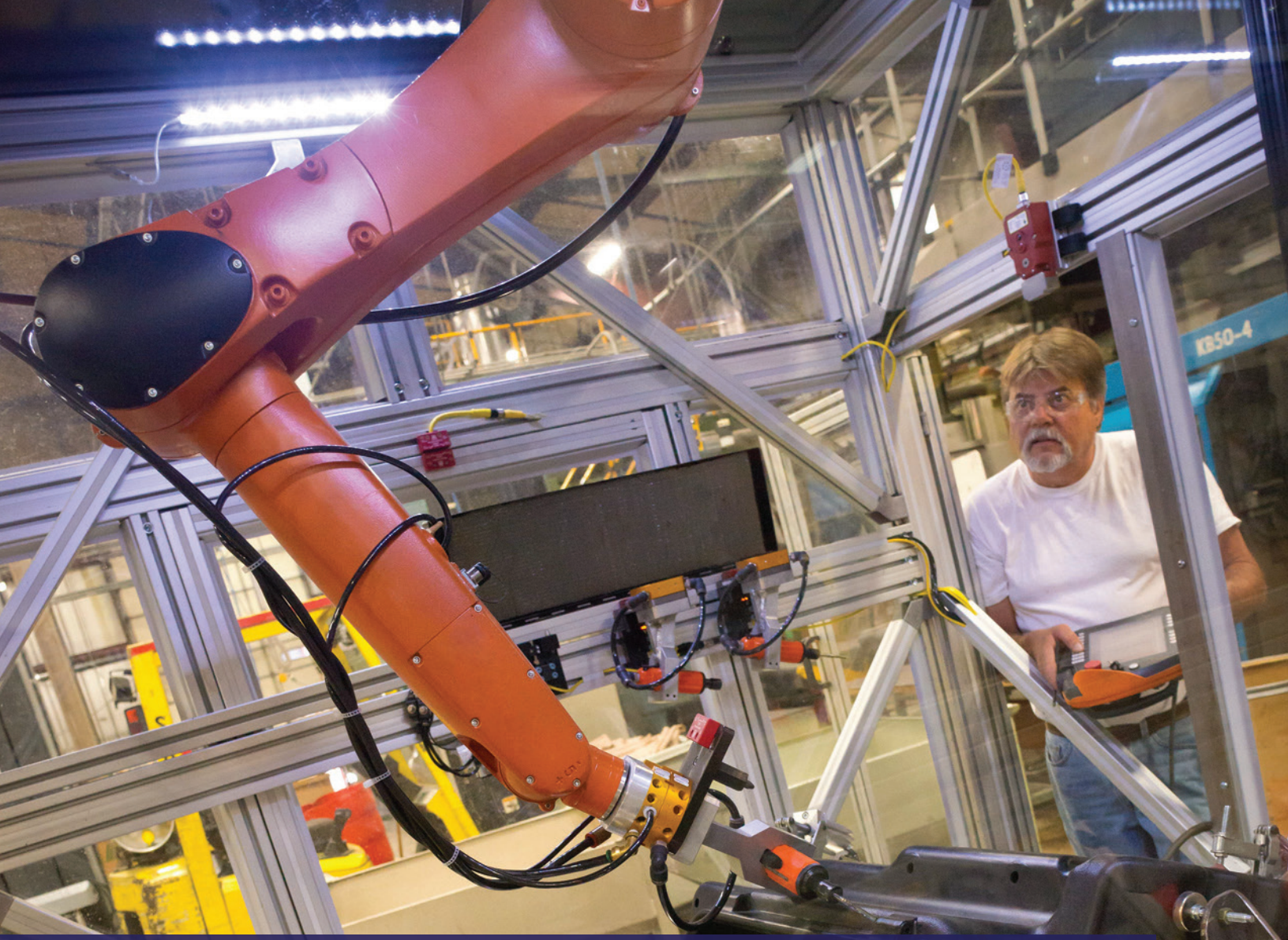


SEIZING THE MANUFACTURING 4.0 OPPORTUNITY:

A STRATEGIC PLAN FOR IOWA'S MANUFACTURING INDUSTRY

EXECUTIVE SUMMARY

PREPARED FOR:
Iowa Economic Development Authority

PREPARED BY:
TEConomy Partners, LLC

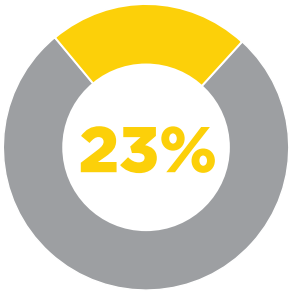
JANUARY 2021

POSITIONING IOWA MANUFACTURERS FOR A TECHNOLOGY REVOLUTION

Iowa has a proud history and impressive legacy in manufacturing. Just as the state has long fed this nation as a leading agricultural producer, its manufacturers have supplied global markets with value-added food products, farm and construction machinery and equipment, advanced materials, chemical products, aerospace electronics, medical devices and more. Iowa has remained competitive by moving toward advanced manufacturing products and processes that incorporate innovative technologies. Because this sector represents a major pillar of Iowa's economy, it is critical for the state to examine the present and look toward the future to ensure it remains a globally competitive manufacturing leader.

Manufacturing faces a technology revolution that emphasizes automation and smart technology. This fourth Industrial Revolution, known as Industry 4.0, will usher in advances and disruptions to manufacturing on a similar scale as those brought over time by water and steam power, mass assembly and computing and robotics. Industry 4.0 includes the Internet of Things, additive manufacturing, advanced robotics, augmented reality and cybersecurity. Digital technologies may not replace jobs, but they will transform how work is performed – how products are designed, fabricated, used and serviced.

Iowa's ability to compete globally will hinge on its successful transition to new operating models, especially for small-to-medium sized manufacturers who will face mounting pressure from the larger manufacturers they supply.



NEARLY **ONE-QUARTER** OF CURRENT WORK HOURS WILL BE AUTOMATED BY 2030

AUTOMATION IS EXPECTED TO CREATE AN ADDITIONAL **15 MILLION JOBS**

EVERY COUNTY IN IOWA HAS BETWEEN **50% AND 61%** OF JOBS WITH POTENTIAL FOR AUTOMATION

SOURCES: McKinsey, Ball State University Center for Business and Economic Research

Photo courtesy of Pella Corporation

Photo courtesy of Ag Leader

ABOUT THIS PLAN

While Iowa is a manufacturing powerhouse, state and industry leaders have long understood the need to set the stage for future growth in this critical industry – Iowa's largest.

Iowa formed an industry-led Manufacturing 4.0 initiative in 2020 with the goal of creating a strategic plan to take on the Industry 4.0 challenges of adopting technology, increasing productivity, competing for talent and ongoing globalization. The initiative built on previous statewide efforts to grow Iowa's manufacturing Gross Domestic Product (GDP).

The Advanced Manufacturing Work Group, a subgroup of the Iowa Economic Development Authority's (IEDA) Iowa Innovation Council (IIC), led the Manufacturing 4.0 initiative with support from TEConomy Partners, manufacturing leaders across the state and IEDA. Leaders gathered extensive input from stakeholders through focus groups, regional forums and one-on-one interviews. Overall, more than 100 individuals contributed to the development of the Manufacturing 4.0 plan.

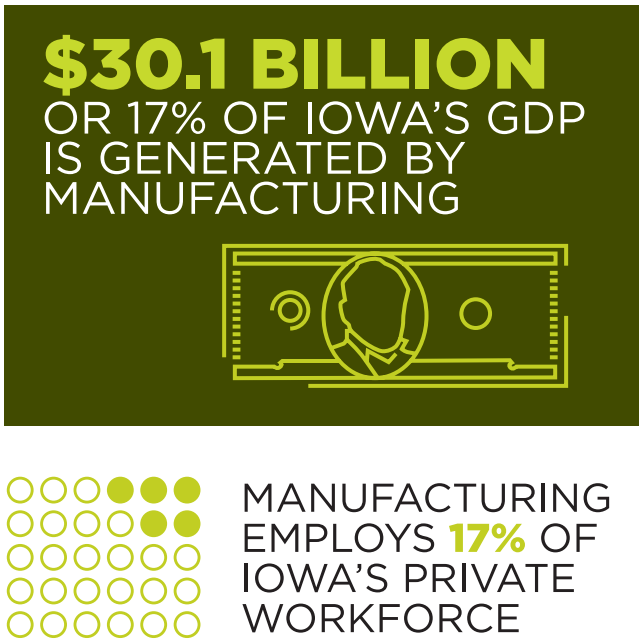
This plan includes clear strategies and actions for all manufacturing stakeholders, from small- to medium-sized enterprises (SMEs) and large original equipment manufacturers (OEMs) to state leaders, resource providers, higher education institutions, state workforce programs, economic developers and entrepreneurs.

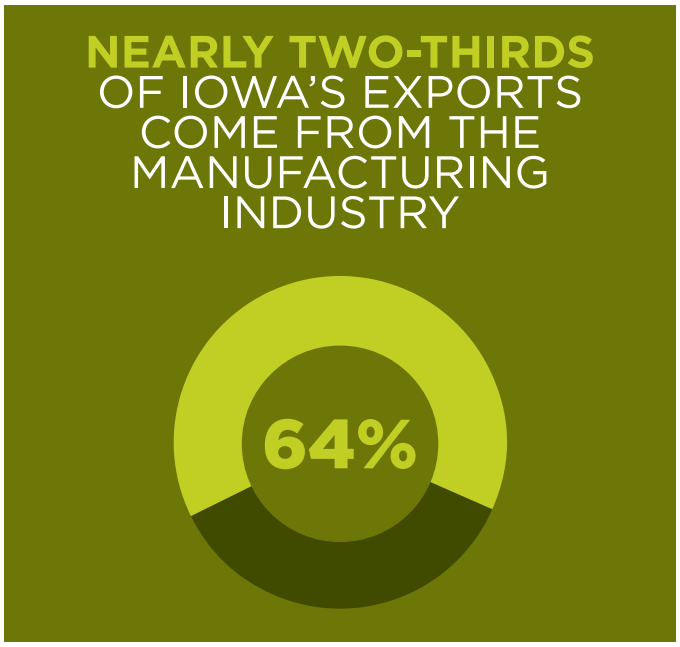
> ***"Manufacturing drives Iowa's economy. Our primary goal is to help Iowa manufacturers maintain a competitive advanced manufacturing sector and ensure its future growth and resiliency."***
>
> **Kevin Gaul**, Director of Operations, Pella Corporation
> **Hank Norem**, President and CEO, Ramco Innovations
> Co-chairs, Advanced Manufacturing Work Group

MANUFACTURING DRIVES IOWA'S ECONOMY

The manufacturing industry's significance in Iowa cannot be overstated. Today, 226,000 Iowans work in more than 4,100 manufacturing establishments across the state, leveraging their skills, education, and training across a wide range of corporate, innovation and production roles. These thousands of workers and the products they manufacture contribute $30 billion to Iowa's Gross Domestic Product (GDP). Beyond pure economic size, manufacturing delivers an unmatched combination of employment, wages and geographical distribution, with more than half of Iowa's manufacturing workers in rural counties.

While there is no doubt the COVID-19 pandemic and resulting global economic shutdowns have negatively impacted the industry, Iowa's manufacturers were in a strong position heading into the pandemic-induced health and economic challenges of 2020.





SOURCES: Bureau of Economic Analysis, Brookings Institution

IOWA'S MANUFACTURING CHALLENGES

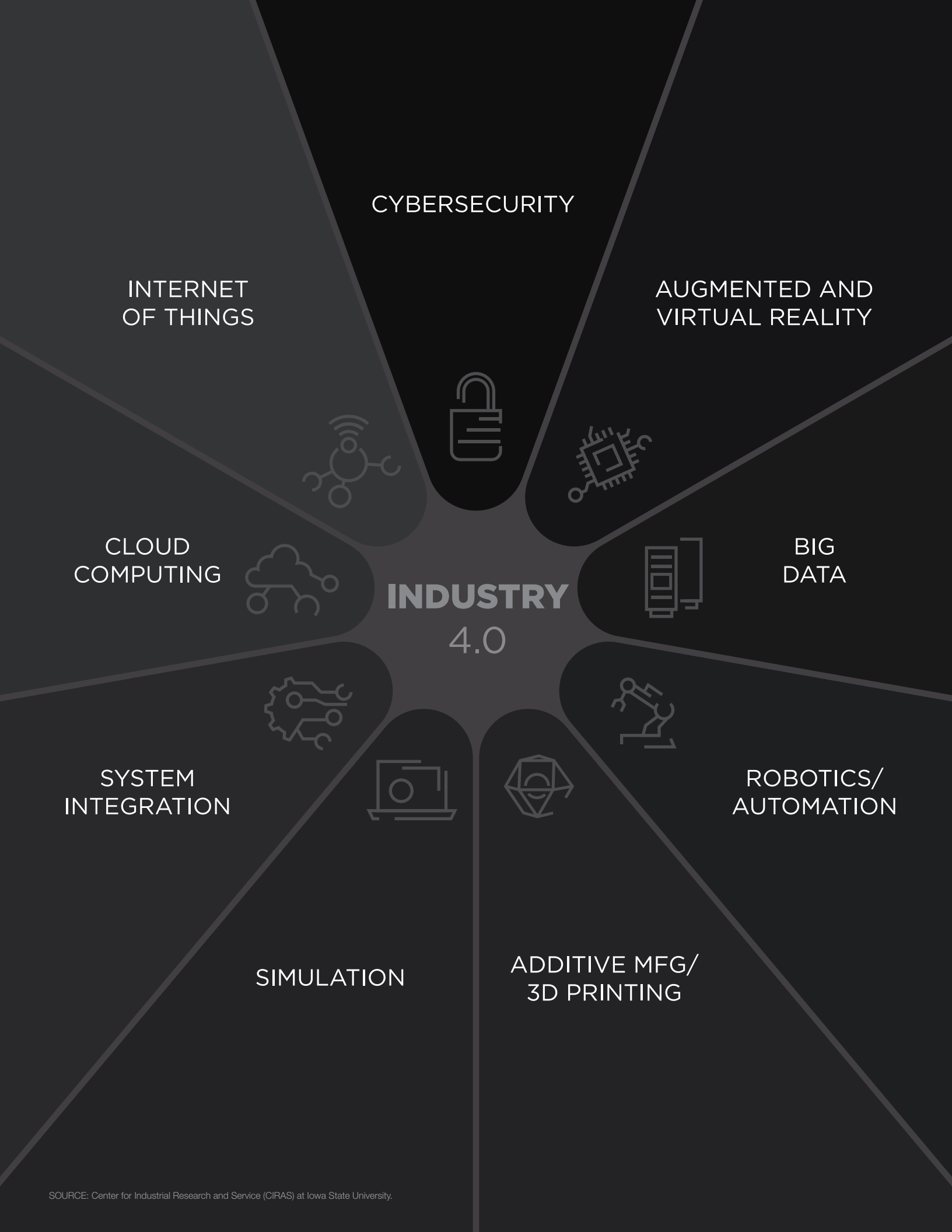
While manufacturing makes up a larger economic footprint in Iowa than the national average, the state faces challenges in remaining competitive. Iowa lags just behind the national averages in overall measures of manufacturing productivity — measured as value-added (GDP) per worker — and this plays out across many of the industry's major subsectors. GDP growth also has been slower in Iowa compared with U.S. averages during the lengthy economic expansion of the 2010s.

While many factors influence manufacturing productivity, workforce constraints undoubtedly hinder Iowa's industry. Iowa manufacturers have operated under acute, well-documented workforce shortages as the state's labor supply has strained under the weight of a lengthy economic expansion and less than 3% unemployment rates in recent years, combined with slow population growth.

A limited talent pool places an emphasis on increasing and enhancing production capacity through technology investments. Iowa companies are embracing and adopting industrial automation, but investments and deployment of new technologies are often discrete and limited to individual machines or systems (for example, a welding robot or 3D printing capability).

While these represent important steps forward for the state's manufacturers, particularly its SMEs, investments are not yet occurring in a holistic, fully integrated manner required to realize the full benefits of Industry 4.0. And while its skilled workforce is absolutely vital, Iowa manufacturers must look to strategic technology investments to realize continued growth and remain competitive.

SOURCES: TEConomy Partners' analysis of Bureau of Economic Analysis, real GSP trends (chained 2012 dollars); estimated GSP data per Employee (Productivity) from EMSI (EMSI Release 2020.2)



SOURCE: Center for Industrial Research and Service (CIRAS) at Iowa State University.

THE DIGITAL PRESENT AND FUTURE OF MANUFACTURING

Industry 4.0 is transforming the modern global manufacturing sector, with major implications for industry competitiveness. Digital technologies are driving bottom-line outcomes for manufacturers in terms of increased productivity and efficiencies, faster and more flexible production, and ultimately higher-quality goods at lower costs. While manufacturers have long used digital technologies and automation, technology development has progressed – a number of formerly disparate tools and applications are now commercially available and able to interconnect in a "smart" manufacturing environment.

As one would expect from such transformational technology, Industry 4.0 has significant implications for all facets of the manufacturing ecosystem including innovation, supply chains, infrastructure, the workforce and even customer engagement—implications that will have tremendous impacts on state and regional competitiveness within advanced manufacturing clusters.

While the Industry 4.0 concept includes an expansive portfolio of new technologies, capabilities and services, there are several key goals that industry leaders seek to realize in transitioning manufacturing operations to Industry 4.0 models:

- Interconnectivity: generation of Big Data, machine to machine/machine to human communication
- Decision support: use of analytics for predictive action and autonomous decision making
- Customization and flexibility: ability to create highly tailored production runs with minimal downtime and waste
- Decentralization: outsource low-level tasks and decision making to machines and increase modular capabilities of production assets

As a result of integrating new technologies that achieve these goals, companies hope to achieve further optimization of production processes (reducing costs and energy usage), improving operational efficiency and worker safety, and greatly improving customization and flexibility in meeting customer demand.

TRANSITIONING TO INDUSTRY 4.0 MODELS

For many manufacturers, transitioning to Industry 4.0 models has become a question of "how" rather than "if," based on rising investments in digital technologies by competitors both locally and globally. PwC's recent Global Industry 4.0 Survey found that U.S. companies planned to commit $907 billion annually to digital technologies.

Growing Pains for Manufacturers

Survey findings also reinforce the challenge of finding skilled talent to operate within this increasingly digital environment, an important reminder that fully integrated cyber-physical environments also require significant investments in training and workforce development.

It is becoming increasingly clear that those slow to adopt, or left behind in a Manufacturing 4.0 environment, risk losing their competitive edge.

The strength and competitiveness of a state's manufacturing industry is never guaranteed, and the disruptive nature of Manufacturing 4.0 technologies and the high rates of investment and adoption globally should give pause to industry leaders and stakeholders. To remain competitive, Iowa manufacturers must embrace and adopt new technologies. Adopting the suite of digital technologies described herein poses significant challenges, particularly for small- and mid-sized manufacturers facing costly technology purchases, planning for integration in ongoing operations, seeing limited digital expertise in their current workforce, and phasing out or reconfiguring legacy IT systems to prepare for new interoperability requirements. These are just some of the hurdles manufacturers face in the Industry 4.0 journey.

To boost and ease this transition to increasingly digital operations and functionality, Iowa must leverage and coordinate its manufacturing expertise, assets and institutional know-how. The state also must re-visit its existing economic development incentives, considering ways in which to direct strategically targeted resources to this vital segment of the state economy.

Iowa has a Breadth of Manufacturing-Related Assets and Expertise to Leverage in Advancing Manufacturing 4.0 Technologies

Iowa has significant organizational and infrastructure assets for industry to draw from and partner with on Manufacturing 4.0 development. Some highlights include:

- **Iowa's research universities** are active and growing in both education and R&D activities related to Manufacturing 4.0:
  - **Iowa State University (ISU)** stands out in its engineering and computer science strengths and infrastructure, including: Cybersecurity, Materials Testing, Virtual Reality applications and Machine Learning/AI Research.
  - **University of Iowa (UI)** stands out with unique manufacturing assets and capabilities, including: UI Pharmaceuticals, Center for Biocatalysis and Bioprocessing and Rapid Prototyping capabilities.
  - **University of Northern Iowa (UNI)** stands out in its focused education mission in Industrial Technology — placing 90% of graduates in Iowa's high-demand technical roles — as well as its world-class Metal Casting Center and the new and growing Additive Manufacturing Center at TechWorks.

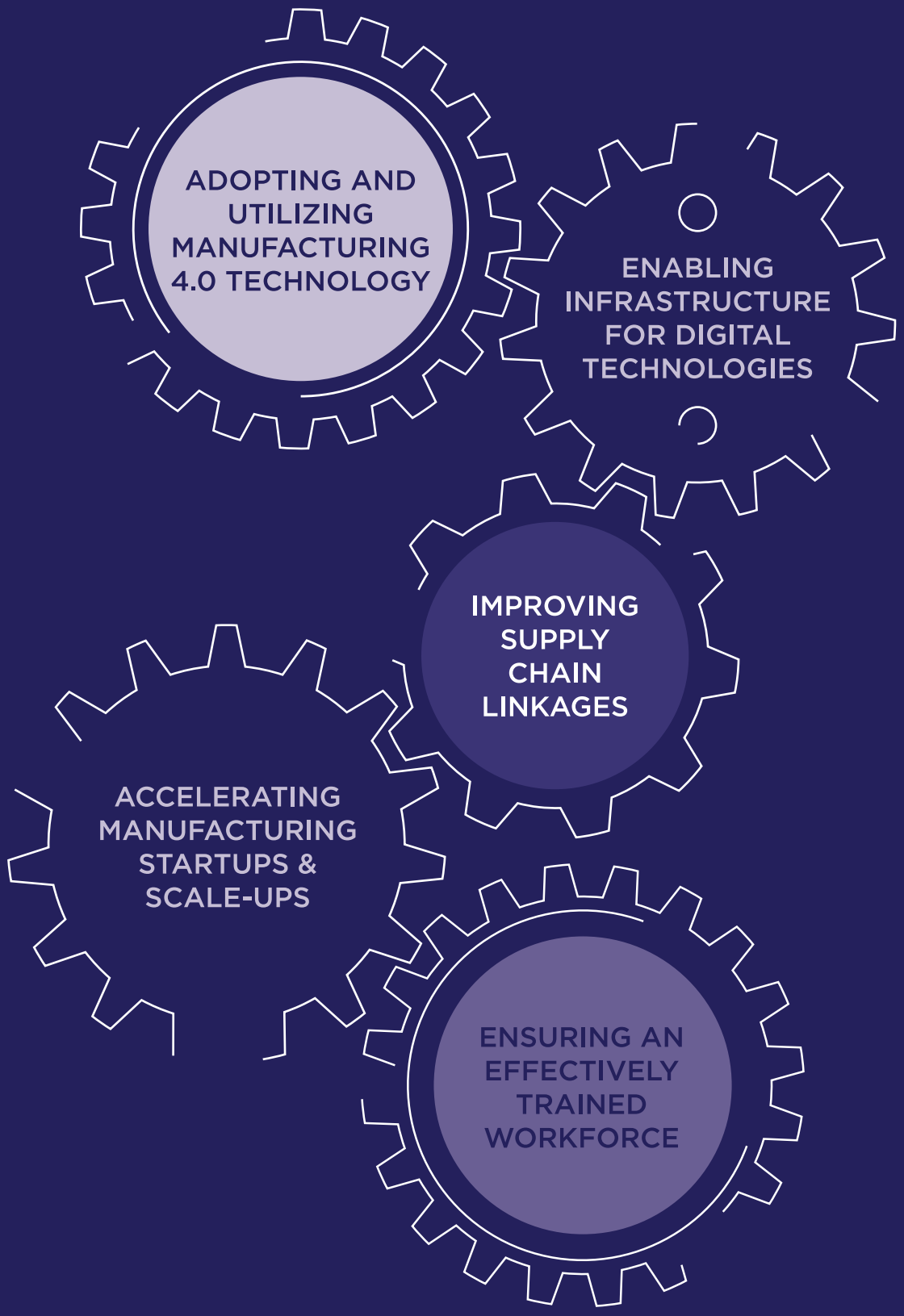
- **Iowa's Community Colleges** are actively involved in education and workforce training activities across each of the Industry 4.0 technology areas, with each of the 15 colleges engaged in academic programming in at least one 4.0 area.

- **CIRAS at ISU** is seen as a key partner, serving vital need for assisting manufacturers and hosting companies and demonstrating Manufacturing 4.0 technologies in its new Digital Manufacturing Lab.
  - CIRAS leads numerous outreach programs, including: Manufacturing Extension Partnership, Technology Assistance Program, Procurement Technical Assistance Program, Iowa Lean Consortium and the Economic Development Administration (EDA) University Center Program.
  - CIRAS further provides key Industry 4.0 resources, services and programs, including digital manufacturing/Industry 4.0 assessments.

- **TechWorks** is a 30-acre advanced manufacturing, R&D, innovation, education, commercial and manufacturing campus in Waterloo. It plays a unique role as a center of gravity/connectivity for industry-academic collaborations on industry-relevant equipment. UNI and the Metal Casting Center have invested heavily in a fast-growing presence at TechWorks with its industry- and customer-focused Additive Manufacturing Center and Design Lab (AMC).

- **Quad Cities Innovation Hub** represents a multifaceted organization providing operational, technical, and business resources and events to the Quad Cities region's manufacturers. It represents a valuable (free) resource for regional, primarily DoD-focused companies along their Industry 4.0 journey, providing technology "playbooks," a supply chain mapping tool and more.

MANUFACTURING 4.0's FIVE STRATEGIC PRIORITIES



STRATEGIES AND ACTIONS

The goal of this Manufacturing 4.0 plan is to help Iowa become a high-adoption state in Manufacturing 4.0 technologies across its diverse manufacturing base – with respect to both size of firm and industry sector. While this strategic plan is primarily focused on advancing and integrating technology adoption and utilization among Iowa's manufacturers, especially SMEs, it further addresses enhancements in some key elements of the broader manufacturing ecosystem.

STRATEGY #1

Rationale: Most Iowa manufacturers demonstrate a strong awareness of Industry 4.0 technologies and the specific technologies that may apply to enhance their competitiveness by increasing productivity and addressing acute workforce shortages. Yet, among all sizes of manufacturers, and especially among the state's SMEs, significant barriers to acquiring and integrating these technologies remain.

At the core of this first Manufacturing 4.0 strategy is addressing how to "de-risk" significant technology investments and where the public sector and public-private partnerships have roles to play.

Manufacturing 4.0 Tech Adoption and Utilization

Action 1.1	Implement state economic development incentives for Manufacturing 4.0 technology investments and adoption by Iowa manufacturers, including digital investments, allocating a sizable portion of incentives to SMEs.
Action 1.2	Accelerate depreciation schedules to support the integration of Manufacturing 4.0 technology investments.
Action 1.3	Increase usage and availability of CIRAS' Industry 4.0 Assessment tools, counseling, and implementation planning as a key starting point for Iowa manufacturers developing actionable technology adoption plans specific to their company.
Action 1.4	Advance the knowledge base, expertise and collaboration among Iowa's economic development professionals and other business support professionals and organizations around the importance of Industry 4.0 and key technologies.
Action 1.5	Monitor and track Iowa's Manufacturing 4.0 adoption rates regularly via CIRAS surveys and forums, segmented by size of company and industry.

Strategy #2

Rationale: Just as reliable and well-maintained roads, railways, airports and bridges have been foundational to advanced economies, a modern digital infrastructure is fundamental to advancing a competitive Industry 4.0 economy with high rates of technology adoption. As manufacturers adopt Industry 4.0 technologies, increased bandwidth, latency requirements, and ability to manage Big Data and associated advanced analytics will be essential.

Enabling Infrastructure for Digital Technologies

Action 2.1	Prioritize investments in rural fiber and broadband infrastructure for Iowa's rural manufacturers, aligned with ongoing state investments and initiatives.
Action 2.2	Support cross-industry and industry-university collaborations and implement company-specific assessments to address critical manufacturing-specific cybersecurity challenges.
Action 2.3	Provide resources to Iowa manufacturing SMEs to help address interoperability challenges in a dynamic Industry 4.0 operating environment.

Strategy #3

Rationale: Industry 4.0 technology adoption is often advanced through the requirements and directives of larger manufacturers or OEMs pushed down to SMEs through supply chain relationships. Ensuring Iowa's SMEs understand and are able to meet and integrate key technology requirements is important for maintaining a vibrant manufacturing sector into the future.

Improved Supply Chain Linkages

Action 3.1	Form an Iowa OEM Advisory Council to advise, counsel and support supply chain SMEs in adopting Manufacturing 4.0 technologies.
Action 3.2	Incent and enhance in-state supply chain connectivity between Iowa's larger manufacturers and OEMs and SMEs.
Action 3.3	Update and leverage existing supply chain mapping tools to better understand and promote the strength of Iowa's supply chain network and identify opportunities to enhance connectivity.

Strategy #4

Rationale: Iowa's robust manufacturing industry cluster is characterized not only by innovation and growth among existing manufacturers, but also the ability to generate new startups and to enable them to scale. Iowa has been intentional about investments in the startup ecosystem, with resources and a suite of innovation and support programming for emerging companies. Manufacturing, however, brings unique challenges in the barriers to starting a new physical products company.

Accelerating Manufacturing Startups and Scale-Ups

Action 4.1	Develop and maintain a virtual Manufacturing Start-up, Support and Information Source.
Action 4.2	Consider personal and potentially corporate incentives (e.g., tax incentives, matching funds, dedicated fund of funds) to generate manufacturing-specific angel or venture investments in new, physical product-based, manufacturing companies located in Iowa.

Strategy #5

Rationale: Manufacturing 4.0 technologies are profoundly changing the nature of work and job functions in the modern "smart" factory. How quickly and efficiently training and upskilling can occur is a significant factor in how Iowa competes into the future. Through its Future Ready Iowa initiative, Iowa has in place a suite of key workforce training programs. This strategy is not designed to replace these existing programs, but rather seeks to target resources to the unique workforce re-training and upskilling needs of a robust Manufacturing 4.0 environment.

Ensuring an Effectively Trained Manufacturing 4.0 Workforce

Action 5.1	Restructure funding models for workforce re-training and upskilling program(s) for Iowa's existing manufacturing workforce that are not tied to new job creation.
Action 5.2	Develop and implement Manufacturing 4.0-specific "micro-credentialing," certificate programs, and otherwise applied, "stackable" credentials at Iowa 2- and 4-year institutions to upskill and re-train the incumbent workforce, particularly targeted toward the SME technician workforce and in digital skills and data analytics.
Action 5.3	Enhance cross-disciplinary undergraduate and graduate level curriculum and programming for "hybrid" Manufacturing 4.0 talent demands across engineering, information technology and data sciences at Iowa's colleges and universities.
Action 5.4	Target Manufacturing 4.0-related occupations for increased participation in Registered Apprenticeships and Industry Recognized Apprenticeship programs and invest to lower existing barriers specific to manufacturing.
Action 5.5	Align and consolidate state support for achieving the necessary scale in Manufacturing 4.0 training/re-training.

A CALL TO ACTION

This plan is a call to action for Iowa's manufacturers, state leaders, resource providers, economic developers and state agencies to support Iowa's manufacturers through this transition and maintain a vibrant manufacturing base through strategies that will drive competitiveness in the state's manufacturing sector.

As Iowa looks to implement these strategies, it will continue to rely on the Advanced Manufacturing Work Group, the IIC and manufacturing leaders to ensure the implementation of these strategies are industry-driven and supported by continuous collaboration among all partners.

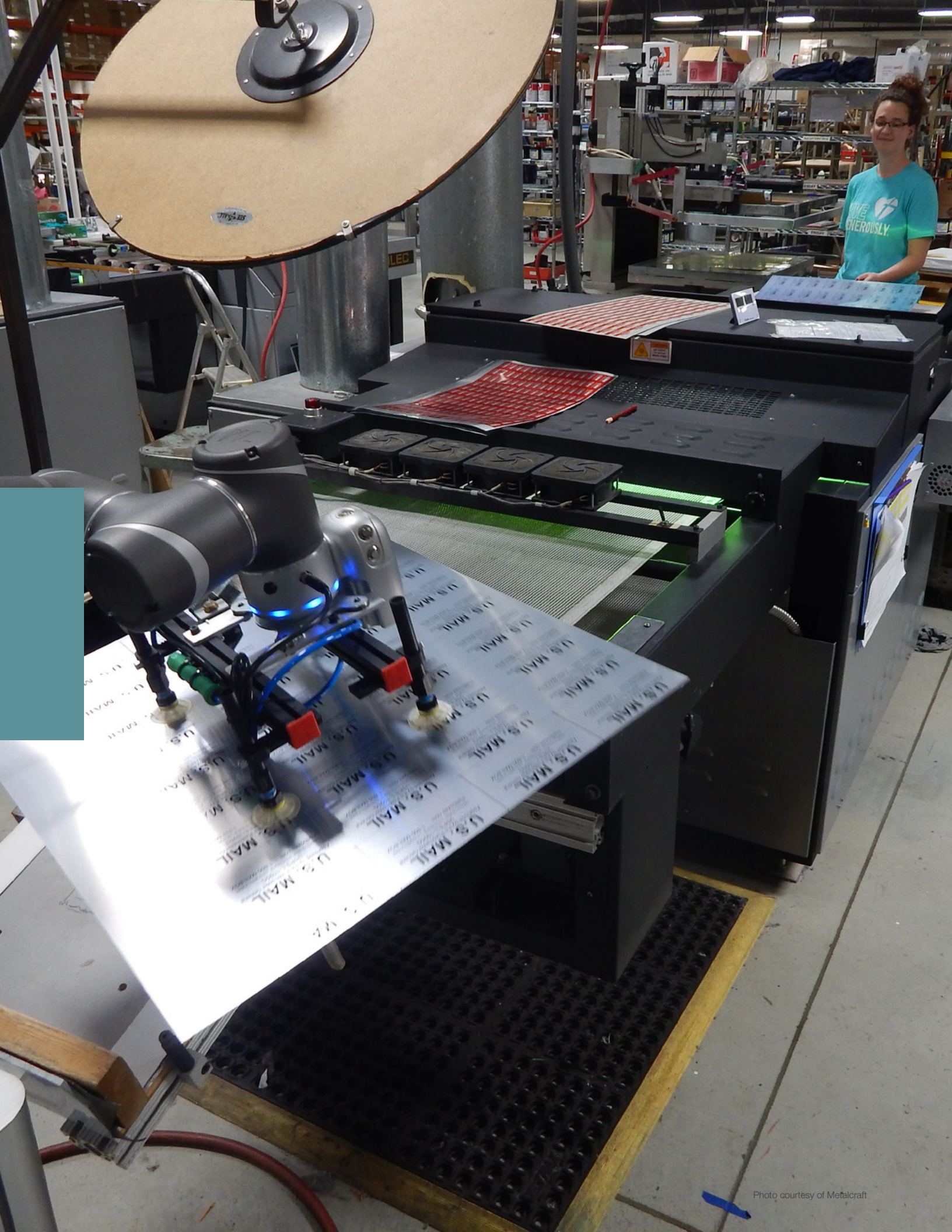


Photo courtesy of Metalcraft

Photo courtesy of Deere & Company

IOWA INNOVATION COUNCIL

The Iowa Innovation Council is a business-led group that develops strategies and long-term plans to make sure Iowa stays competitive in the global business economy. As an advisory council to IEDA, the IIC develops recommendations on programs, services and policies needed to support existing businesses and increase the chance for success for entrepreneurs. IEDA and TEConomy Partners, LLC extend their thanks to the following individuals who participated in the IIC Advanced Manufacturing Workgroup for this project.

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The full report, Seizing the Manufacturing 4.0 Opportunity: A Strategic Plan for Iowa's Manufacturing Industry, can be found at: **https://www.iowaeda.com/our-agency/reports/**

TECONOMY
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TEConomy Partners, LLC is a global leader in research, analysis and strategy for innovation-based economic development. Today, we're helping nations, states, regions, universities and industries blueprint their future and translate knowledge into prosperity.

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