

Manufacturers Make Strides on AI Adoption to Enhance Production Capabilities



AI in Manufacturing: 2023

May 2024

Executive Summary

In September 2023, Conexus Indiana partnered with its parent organization, Central Indiana Corporate Partnership (CICP), and its branded initiatives (AgriNovus Indiana, Ascend Indiana, BioCrossroads and TechPoint) to field a statewide survey focused specifically on AI across Indiana's key industry clusters. More than 170 responses were gathered, with more than 50% coming from Indiana's manufacturing sector.

Conexus analyzed the survey responses that were specifically from those that identified as manufacturers to develop its own whitepaper on Artificial Intelligence (AI) in manufacturing, called "Manufacturers Make Strides on AI Adoption to Enhance Production Capabilities."

The key findings for Indiana's manufacturers are as follows:

Key Finding 1: AI Adoption

45% of manufacturing survey respondents have implemented AI in one or more business units (see Figure 4). This result lags the overall survey population, which include also includes the professional services and information technology (IT) sectors.

Key Finding 2: AI Capabilities

Of survey respondents that have adopted AI in at least one or more business units, most have implemented computer vision systems or physical robotics (see Figure 5). These are AI capabilities that directly and immediately impact a manufacturers' shopfloor production efficiency and productivity.

Key Finding 3: AI Risks

Most manufacturers selected cybersecurity as the most relevant AI risk (see Figure 6). The potential for data breaches and sharing of sensitive information or intellectual property is widely understood by the manufacturing ecosystem but can be both expensive and complex to resolve, particularly for small- to mid-sized firms.

Key Finding 4: Real-World AI Adoption Continues to Grow Through State-Funded Programs

Several Indiana manufacturers have leveraged the [Manufacturing Readiness Grants](#) program to help fund AI and machine learning projects and more implementations are likely to occur in the coming. These include Photon Automation, POLARIS Laboratories, Mach Medical and Pike Lumber Company. To learn more about their AI adoption projects, read more [here](#).



Introduction: A Look into AI Adoption by Indiana Manufacturers

From 2020 to 2022, Conexus Indiana has studied Industry 4.0 technology adoption trends among Indiana manufacturers. Data from the three surveys, fielded between 2020 and 2022, showed many Indiana manufacturers are steadily increasing adoption of Industry 4.0 technologies with a focus on efficiency and productivity gains in their production facilities. Since the completion of the last survey in early 2022, the development and use of Artificial Intelligence (AI) has rapidly evolved, particularly with the launch of OpenAI's ChatGPT platform. Consequently, AI has progressively been at the forefront of national media and public policy discussions.

With this national significance in mind, Conexus Indiana joined its parent organization, Central Indiana Corporate Partnership, to survey Indiana's key industry clusters (advanced manufacturing and logistics, agbiosciences, life sciences and technology) to better understand AI adoption and its role in Indiana's economy. This whitepaper provides a retrospective analysis of AI adoption by Indiana manufacturers with additional insights from [CICP's AI in Indiana: 2023](#).

Section 1: Prior Industry 4.0 Technology Adoption Surveys Show AI Lags Other Technologies

For the last several years, Conexus Indiana has partnered with Indiana University’s Kelley School of Business Center for Excellence in Manufacturing to survey Indiana manufacturing companies on Industry 4.0 technology adoption. Over three years, survey results showed a steady increase in the number of Indiana manufacturers adopting Industry 4.0 technologies. By 2022, 32% of survey respondents said they have successfully implemented one or more Industry 4.0 technologies and another 26% said a pilot project is underway.¹

The most recent report, “A Glimpse into Indiana’s Factory of the Future,” analyzed input from nearly 200 manufacturers in 2022 from a wide cross-section of Indiana’s industrial landscape, touching nearly two dozen subsectors, including automotive, fabricated metal products, industrial equipment and aerospace and defense. A mix of small, medium and large enterprises—based on both revenue and employment—were also well represented. Most of the respondents said they were in executive management (63%) or manufacturing operations/production roles (16%).

While three-year data showed adoption of specific technologies—such as additive manufacturing cobots and machine vision—continued to lead among manufacturers, AI implementation rates remained low year-over-year. Of the companies that have adopted one or more Industry 4.0 technologies, only 8% said they implemented AI in 2022 (**Figure 1**).

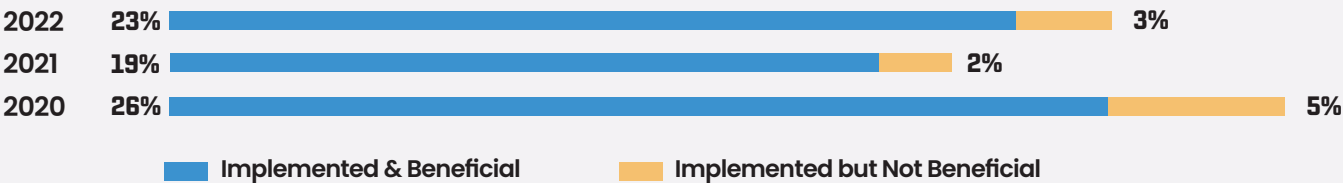
Figure 1: AI Implementation Rates Among Manufacturers, 2020–2022



¹ “A Glimpse into Indiana’s Factory of the Future: Companies Scale-up Industry 4.0 Technology Investments to Enhance Efficiency and Optimize Productivity. 2022 Industry 4.0 Technology Adoption Report,” Conexus Indiana, 2022. (<https://www.conexusindiana.com/wp-content/uploads/2022/12/2022-Conexus-Tech-Adoption-Report.pdf>). Accessed 12/20/2023.

Though AI implementations lag, adoption of big data and analytics saw year-over-year progress. Data from the 2022 report confirmed that many companies are collecting data from machines and other industrial sources, but not capturing its full value through analytics. The implementation rates among manufacturers rose from 21% in 2021 to 26% in 2022, highlighting an increasing demand for data-driven insights from the factory floor **(Figure 2)**.

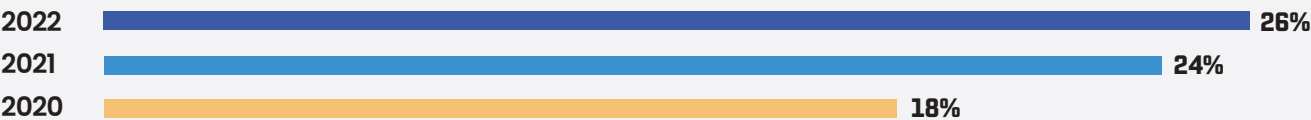
Figure 2: Big Data and Analytics Implementation Rates Among Manufacturers, 2020–2022



While there has been an uptick in the percentage of manufacturers adopting big data and analytics, developing digital infrastructure for the shop floor continues to be a challenge. The 2022 survey revealed that companies face several barriers to big data and analytics adoption, which is often considered to be a precursor to more sophisticated AI and machine learning (ML) implementations. The barriers included lack of internal knowledge, complexity of integration with legacy systems, data collection from machines and turning data into insights. The upshot is moving from data collection to real-time visualizations and analytics is a highly complex step in a production setting, particularly for small- and mid-sized companies.

The Conexis surveys also revealed growing expectations among Indiana manufacturers for future AI implementations. Manufacturers have steadily increased expectations for AI implementations within the next five years **(Figure 3)**. The data suggest about 1 in 4 companies may deploy AI tools in the next five years. Examples of AI capabilities within the manufacturing sector include demand forecasting, quality inspection, inventory control and production scheduling, anomaly detection and predictive maintenance. Most of these tasks are currently performed manually by a human worker and present an opportunity for automation.

Figure 3: Expected AI Implementations Among Manufacturers in the Next 5 Years, 2020–2022

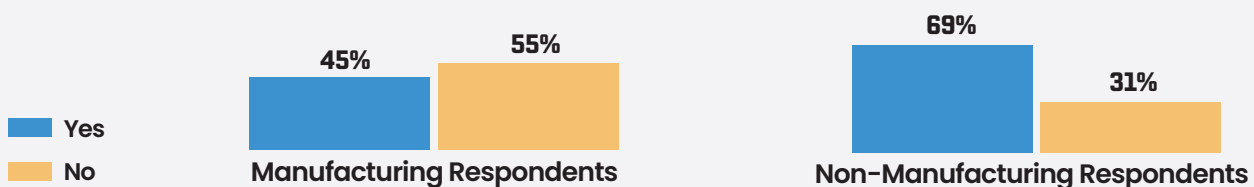


Section 2: New Data from CICP's AI in Indiana: 2023 Survey Shows Increased AI Adoption

In September 2023, Conexus Indiana partnered with its parent organization, Central Indiana Corporate Partnership (CICP), and its branded initiatives (AgriNovus Indiana, Ascend Indiana, BioCrossroads and TechPoint) to field a statewide survey focused specifically on AI across Indiana's advanced industry sectors. More than 170 responses were gathered, with more than 50% coming from Indiana's manufacturing sector. The new data will help establish statewide benchmarks to support CICP and its branded initiatives to better understand how AI adoption can drive Indiana's economic growth. The survey questions were inspired by McKinsey & Company's [Global Survey on AI](#).

Of the manufacturing respondents in CICP's AI survey, 45% said that they have implemented AI in one or more business units (**Figure 4**). This slightly lags the overall survey population, which also includes companies in the professional services and information technology (IT) sectors. It is no surprise that non-manufacturing respondents are more likely to adopt AI. As evident in "A Glimpse into Indiana's Factory of the Future," manufacturing companies must make investments in sophisticated digital infrastructure (i.e., 5G networks, IoT, cloud computing and big data and analytics), systems integration and highly specialized talent to deploy AI. Many manufacturing companies have yet to make these capital investments and have not hired AI professionals with experience in a production environment.

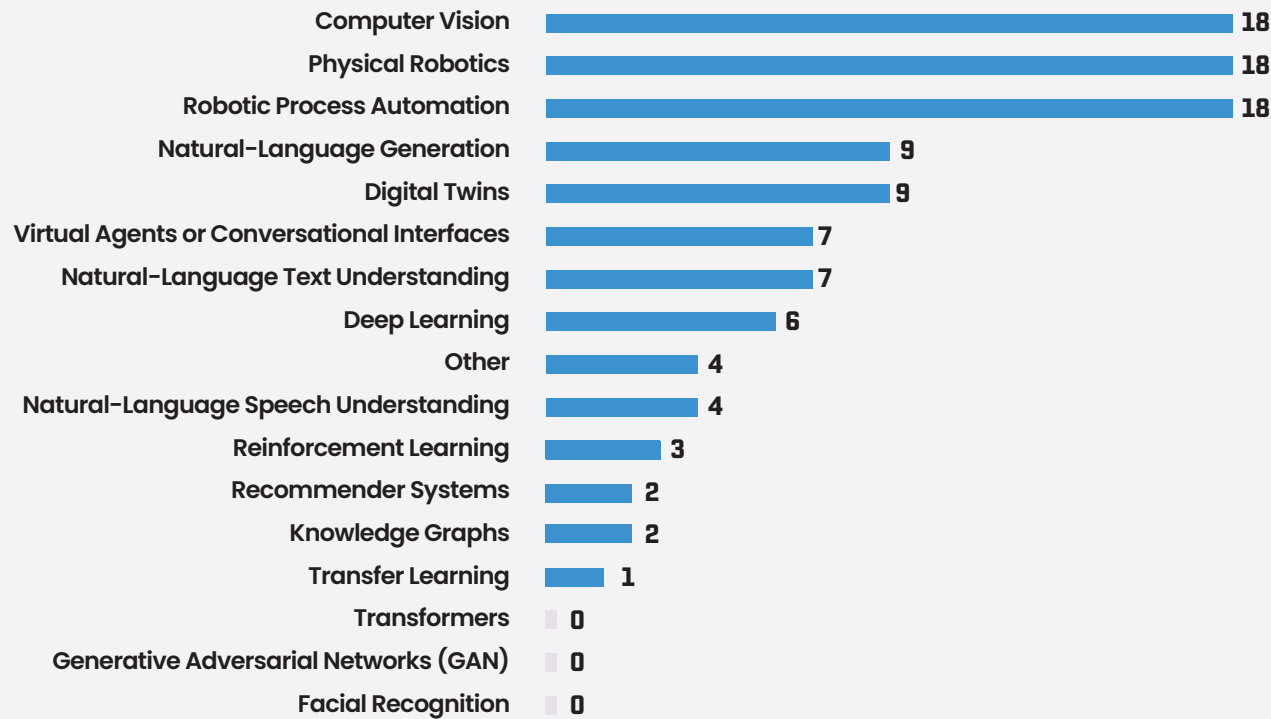
Figure 4: Adopted AI in One or More Business Units—Manufacturing vs. Non-Manufacturing



Surprisingly, AI in Indiana: 2023 shows a significant uptick in AI adoption among manufacturers when compared to Conexus' prior technology adoption surveys. While 8% of respondents in Conexus' last survey indicated that they have adopted AI, the AI in Indiana: 2023 survey found that 44% of manufacturing respondents have adopted AI in one or more business units. This marked difference could be due to a different universe of respondents. It could also be that the many newsworthy developments in AI, like the launch of ChatGPT, have accelerated the adoption curve. Looking back to Figure 3 from prior Conexus' surveys, the findings illustrate a steady increase in AI adoption plans in future years.

Of manufacturers that have adopted AI in at least one or more business units, 18 of 42 respondents have implemented computer vision systems and 18 have also implemented physical robotics (Figure 5). Even with the high number of respondents in finance and strategy roles, AI capabilities that directly impact a manufacturers' shopfloor production efficiency and productivity rose to the top of the list. Physical robotics and computer vision appear to be the areas where manufacturing companies are making the most progress on the Industry 4.0 technology adoption curve.

Figure 5: AI Capabilities—Manufacturing Respondents (n=42 responses)

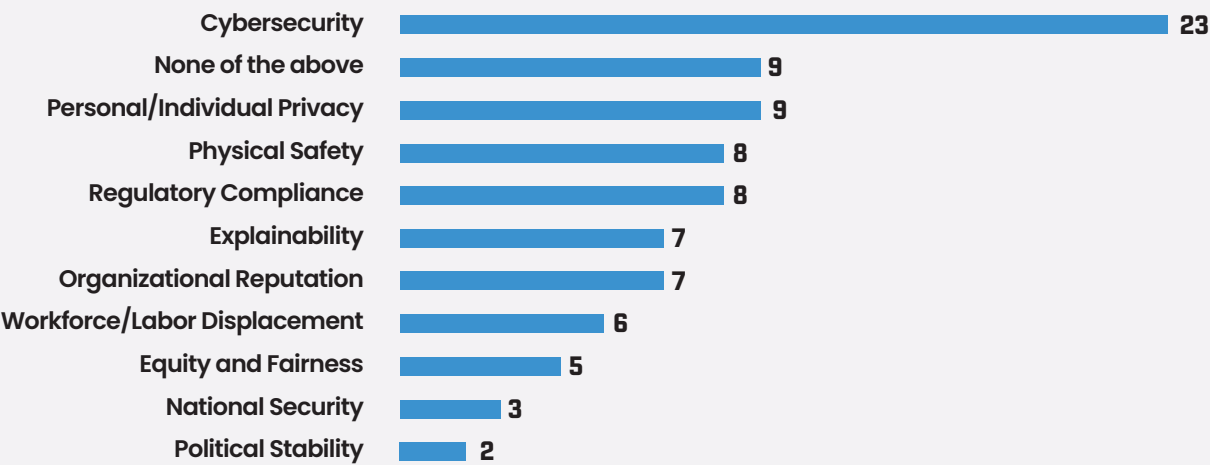


Survey respondents continue to heavily favor commercial-ready technologies that immediately impact production capabilities, augment the labor supply and increase capacity while reducing operating costs. These types of capabilities tend to include robotics, machine vision, advanced modeling, advanced sensors and additive manufacturing (3D printing). While these technologies can be AI-enabled, the software is usually included as part of the overall equipment package.

Robotic process automation (RPA) is also a top three capability identified by manufacturers. It is important to note, however, that this finding may be a result of manufacturers misinterpreting the term RPA to include conventional physical robotics (e.g., welding, drilling, or material handling). In the AI survey, RPA refers to software solutions that use automation to perform business process activities such as extracting data to autofill forms (e.g., invoices), not physical robotics.

Pure AI software-as-a-service (SaaS) solutions, not packaged as features within hardware-based systems, appear to be slower to enter the tech stack at many organizations. Natural-language generation and digital twins are the fourth most common capabilities among manufacturers, possibly due to the increased use of tools like ChatGPT in the workplace. While it is difficult to determine exactly how generative AI (genAI) is being utilized by manufacturers, contact-center automation, service operations optimization and customer service analytics were among use cases selected by survey respondents.

Figure 6: AI Risks—Manufacturing Respondents (n=39 responses)



As seen in **Figure 6**, 23 of 39 manufacturers selected cybersecurity as the most relevant AI risk. While this finding is somewhat unsurprising due to the potential for data breaches and sharing of sensitive information or intellectual property, it is likely an expensive obstacle for small- to mid-sized companies to overcome. Deployment of AI technologies may compel manufacturers to not only make investments in AI software products but also to progressively incorporate it into all facets of their cybersecurity infrastructure.

Section 3: Real-world AI Implementations

Case Studies at Indiana Manufacturers

While AI remains an emerging Industry 4.0 technology throughout Indiana’s manufacturing sector, some companies are already reaping the gains of successful deployments. For example, through the State of Indiana’s Manufacturing Readiness Grants (MRG) program, Mach Medical, POLARIS Laboratories and Photon Automation have implemented AI-enabled solutions to enhance production capabilities and provide new services to customers.

The MRG program is run by the Indiana Economic Development Corporation (IEDC), in partnership with Conexus Indiana. Since the program’s inception, a total of 526 grants totaling \$56.9 million have been awarded to 465 unique companies in 79 counties with a leverage ratio of 13 industry dollars to one grant dollar invested. Matching industry investments of over \$800 million have been incentivized to accelerate the adoption and implementation of Industry 4.0 technologies to improve productivity and modernize the state’s manufacturing sector.

A significant portion of these investments are being made in small businesses (72% of projects are supporting businesses with fewer than 100 employees), rural operations (28% of projects are in rural communities), and long-standing operations (79% are businesses more than 10 years old). The AI adoption examples highlighted on the next three pages are short summaries from case studies on the Conexus Indiana website.



Mach Medical

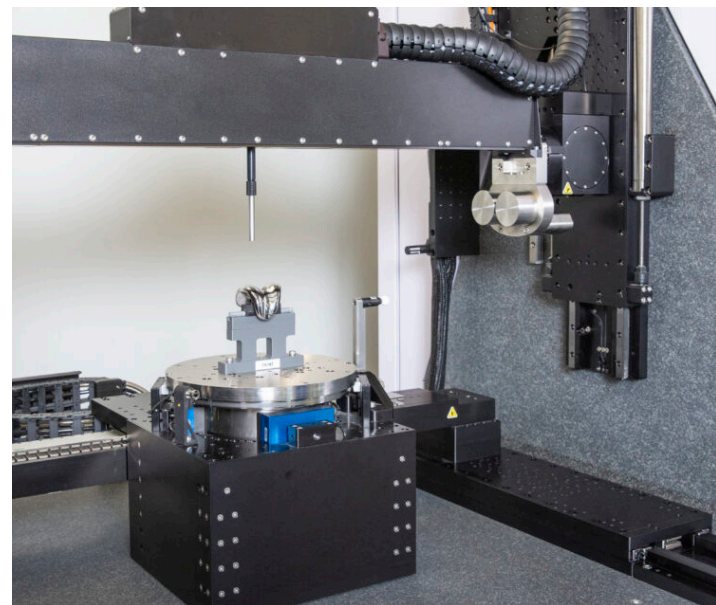
Whitley County, IN

Tech Deployment: Digital Twin for Medical Implants Production

Mach Medical developed a digital twin solution for high velocity single-piece flow manufacturing. This technology deployment directly impacts production automation. A key challenge in the orthopedic implant market is the length of time it takes to translate new product designs into an efficient manufacturing process. To manufacture a specific medical implant family requires the same tooling, inspection and

manufacturing process for each part in a family, but it needs to be scaled appropriately across all the sizes in the product line. Each implant size traditionally requires significant engineering resources and time to execute even after the first size is completed. Mach Medical's answer to this challenge was through developing a comprehensive "digital twin" of the manufacturing process tied to a standardized manufacturing platform, which significantly reduces the engineering time and resources it takes to translate the product design specifications to executable manufacturing. The digital twin solution is built on Mach's comprehensive manufacturing process data.

[For more information, see the full case study here.](#)



POLARIS Laboratories®

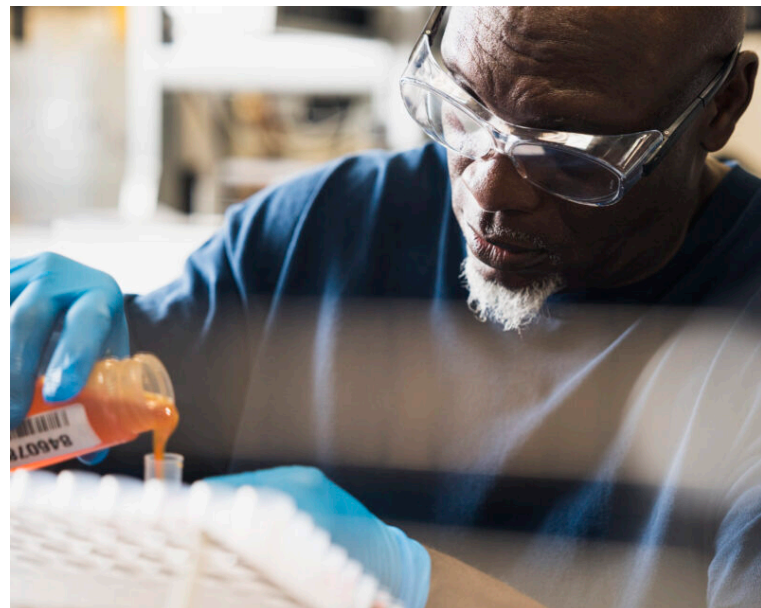
Marion County, IN

Tech Deployment: Predictive Maintenance Analytics for Industrial Equipment

POLARIS Laboratories® has invested in proprietary AI/ML software to provide predictive maintenance and analytics for its global manufacturing customers. The firm has recently developed machine learning software to analyze its dataset of historical machine and equipment performance. Over the course of almost 25 years of operation, POLARIS Laboratories has built a

massive database incorporating information from fluids, OEM machines and other manufacturing equipment. Today, their customers test fluids to understand if any conditions exist that indicate the need for maintenance. But in addition to identifying existing problems with fluid analysis, POLARIS Laboratories has begun providing AI/ML-driven recommendations to its industrial customers on how far they can extend the maintenance intervals to maximize use of the lubricants while keeping the components healthy. The software development project brings POLARIS Laboratories' existing software platforms and big data together with AI and ML for predictive maintenance of industrial machinery to extend its service offerings.

[For more information, see the full case study here.](#)



Photon Automation

Hancock County, IN

Tech Deployment: A Proprietary Fiber Laser Welding System for Assembly of High Energy-density Batteries

Photon Automation recently deployed an automated laser welding system that provides flexibility for both assembly of different battery sizes and materials as well as for low-volume contract manufacturing. Originally, Photon's project was designed to help develop new battery products. But when it expanded in scope with the addition of low-volume contract manufacturing capabilities, they applied to the

Manufacturing Readiness Grants program. The technology adoption project grew in complexity to include not only the tools for producing a part, but new equipment and machines for use in low-volume contract manufacturing of Photon's customers' prototypes and battery products. The technology adoption project goes far beyond industry standards for battery manufacturing by integrating robotics, software, machine vision and proprietary AI/ML algorithms to precisely control the weld profile. A sophisticated laser welding system is a must-have in the world of manufacturing batteries and electric vehicles (EVs), and Photon continues to build capacity to assemble and test high-capacity batteries for these industries of the future here in Indiana.

[For more information, see the full case study here.](#)



Section 4: Actions for Accelerating AI Adoption in Manufacturing

1. Support the Development of Customized AI Solutions for Manufacturing

Conexus Indiana will continue to support Indiana manufacturers' engagement with AI initiatives, such as AnalytiXIN and Energy INsights. Through expertise and talent at Indiana's research universities—Indiana University, Purdue University and the University of Notre Dame—AI solutions can be tailored to meet the specific needs of manufacturing companies. And manufacturers are invited to participate in Communities of Practice events facilitated by [AnalytiXIN](#).

2. Bridge the Gap Between AI Adoption + Talent Development

Conexus and its academic partners will work collaboratively on bridging the AI talent gap at manufacturing companies. This may include the development of new education programs and curriculums for AI skills and providing training programs for existing employees to enhance their understanding of AI technologies. Any work must also include cybersecurity education and resources to promote best practices and risk mitigation among manufacturers.

3. Increase Collaboration Between Manufacturing Companies and Indiana's Technology Integrators

Conexus will increase collaboration between Indiana's technology integrators and manufacturers to accelerate adoption of AI technologies into production processes. An important factor of technology adoption is partnering with the right technology integrator or solution provider. Manufacturing companies often use a network of certified technology partners that provide project management, integration and workforce training to ensure successful deployment of a new technology. Companies of all sizes rely heavily on this outsourced expertise, but it is especially critical for small-to mid-sized companies.