Institute for Furthering AI and Computing in Manufacturing (IFACM)

University of Wisconsin–Milwaukee (UWM) on behalf of a consortium of participants

(1) Introduction

Artificial Intelligence (AI) and advanced computing hold the potential to unlock untold efficiencies in manufacturing and supply chains if facilitating infrastructure removes barriers for its adoption. This is critical for large-scale manufacturers and more so for small and medium manufacturers (SMM) across the U.S. SMMs represent 70% of the manufacturing workforce and an estimated 40% of the business outcome of this sector for the resilience and independence of U.S. industries and the economy. Rapid adoption, risk management, definition, and a standardized way to judge, evaluate, and design AI solutions is critical to achieve the full potential of AI. The Institute for Furthering AI and Computing in Manufacturing (IFACM) aims to do this by establishing standards for AI technology that serve to remove barriers and aid adoption.

During the late 20th century, manufacturers grappled with a critical gap in automated systems. While networked controls yielded efficiency gains, safety-critical applications lagged, relying on costly and inflexible hardwired connections due to concerns over network determinism and therefore reliability and safety. Addressing this challenge demanded a standardized approach to assessing and mitigating risks in networked safety systems.

After 13 years of collaborative effort, the manufacturing community adopted International Electrotechnical Commission (IEC) 61508, marking a turning point for industry and introducing functional safety. This groundbreaking standard provided a framework for designing, deploying, and maintaining safety systems, enabling quantification of risk based on specific configurations.

IEC 61508 fueled the emergence of independent certification bodies and empowered automation vendors to develop safety-compliant solutions. Manufacturers, backed by their risk departments, embraced these systems with newfound confidence. A competitive marketplace emerged, driven by trust in universally recognized safety metrics. Today, industries beyond traditional manufacturing embrace the standard. The U.S. entertainment industry routinely specifies Safety Integrity Level (SIL) 3[1] for equipment controlling amusement park rides, assured that they know what level of dependability is delivered by a properly certified and installed system.

AI represents a parallel challenge today. It is a new set of technologies that offer significant benefits in productivity, flexibility, and overall resilience, but its failure modes are complex and challenging to predict, limiting broad adoption. The critical difference with AI is the speed and iterative nature of its development. Various AI systems—whether random forest, neural networks, genetic algorithms, fuzzy logic, etc.—have different failure mechanisms. Industry cannot afford 13 years of debate each time a new AI technique is introduced. This is compounded when factoring in new forms of computing—such as neuromorphic and quantum—further delaying the benefits for U.S. manufacturing. Something must be done to accelerate the standards, assurance, and application process.

These developments need to be piloted, verified, and implemented in the field. Wisconsin is a second-to-none domain because of its deep manufacturer base with 19% of the State's GDP, 570,000 jobs in the sector, and more than 9,000 small manufacturing facilities. Furthermore, Wisconsin makes tools, technology, software, industrial controls, and more that are core to manufacturing across the nation. As such, this ecosystem, embedded into a U.S.-wide manufacturing partnership network, offers a perfect pilot and verification ground for the AI technologies that will be developed.

[1]This equates to risk of ~1 dangerous failure in 1,140 years of continuous operation; e.g., one incident from 2024 to the year 3164.

*Challenge: Manufacturers **make things**, to a **specification**, on a **schedule**, for a **profit**, in a **safe** and compliant manner. AI solutions that hallucinate, can mislead the manufacturer **risking one or many of these goals**. This is unacceptable, and if left unsolved for U.S. industry, we will not sustain and grow our global competitiveness.*

1.1 Manufacturing and Supply Chain Resilience Through the Lens of Dependability

This proposal is based on the team's experience implementing industrial processes at scale in applications where unintended operation can lead to significant costs—and sometimes loss of life or limb. Delivering resiliency in this context requires the implementation of systems that are dependable and safe (termed together as "dependable" in this submission). A technical definition of dependability is "the ability of [the] system to deliver the intended service and the ability of a system to not cause damage under a fault."

While AI solutions can claim to make a system more resilient by introducing flexibility through higher-level decision-making or other means (e.g., autonomous operations), this approach is ineffective if the technology is not implemented and assessed with dependability at its core. Fundamentally, *all* AI systems exhibit some form of confusion matrix, see Figure 1. They will provide users with false positives and false negatives. **AI providers cannot deliver and manufacturers cannot achieve resilient manufacturing without robust ways to measure and implement dependability for AI-based solutions.** This represents a critical need that, until addressed, will delay the effective implementation of AI in U.S. manufacturing. Achieving scaled dependability will allow the implementation of AI for resilient manufacturing.

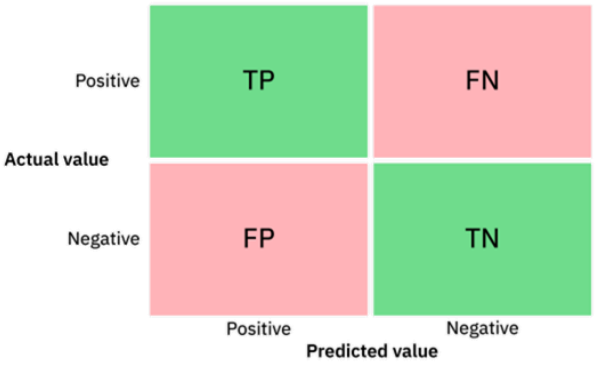

Figure 1 - A typical confusion matrix. TP is a true positive, FN a false negative, FP a false positive, and TN a true negative.

(2) Fulfilling a National Need

2.1 Proposed Mission

IFACM is focused on solving a critical problem facing every plant manager and supply chain operator in the U.S. These individuals are responsible for "getting it done." Decisions they make regarding the processes and technology they utilize are directly measurable. For instance, the average automotive manufacturer loses $22,000 per minute of unplanned downtime. Faced with these real-world consequences, plant managers demand concrete evidence before embracing new technological solutions.

The assurances necessary for scaled implication of new technologies in this space come in the form of proven examples and trusted processes. Industry has done this before. The development and implication of robust standards, trusted conformity assessments, and workforce development/implementation tools facilitated the successful implementation of Functional Safety. AI demands the same, except that AI is iterative in nature, with each new form introducing unique failure mechanisms.

This time U.S. industry requires a catalyst to accelerate the process, from developing dependability strategies to implementing standards, performing conformity assessments, and ensuring the development and distribution of quality workforce development materials. Waiting 13 years is not an option. This is the basis for IFACM's proposed mission:

*Mission: Enable **safe**, **efficient**, and **responsible** adoption of AI in U.S. manufacturing through a collaborative, non-biased approach designed to complement existing market participants, ensuring resilient and growing domestic manufacturing, supply chain, and associated services accelerating the advanced manufacturing future of the U.S.*

2.2 Technical Scope

Innovative ideas progress from academic curiosity to practical application through a reasonably predictable path. Communicated through scales such as the National Aeronautics and Space Administration's (NASA) Technology Readiness Levels (TRLs), and the closely related Manufacturing Readiness Levels (MRLs), concepts evolve through iterative cycles, gradually becoming more concrete and approaching realization as a tangible product or service. Finally, real-world prototypes are developed, tested, and prepared for full-scale production and deployment.

As discussed in Section 2.1, 'scaling up' solutions in the high-integrity, high-risk manufacturing sector—particularly segments involving high volumes, critical infrastructure, public safety, and regulated products—is challenging. This community prioritizes safety and reliability, demanding confidence that solutions will perform as anticipated.

As such, decision-makers in this area prioritize solutions developed according to established specifications and verified by trusted third parties. Furthermore, before successful implementation, manufacturing leadership must understand the economic implications, technical execution, and workforce training requirements associated with the technology. This complex value chain is depicted in Figure 2.

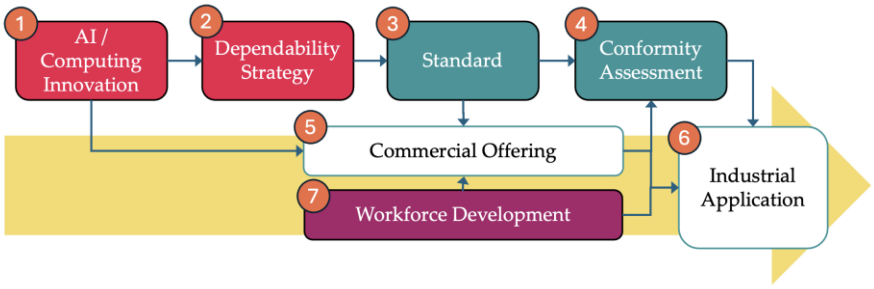

Figure 2 - Schematic of the manufacturing-focused AI value chain.

2.2.1 Accelerating the Ecosystem: Due to the iterative nature of AI, traditional processes to developing technology and associated dependability-related standards will not keep pace (see Section 1). IFACM's technical scope is focused on the needs of various communities in the ecosystem. Figure 2 describes the manufacturing AI value chain. Following with the numeric labels:

- AI/Computing Innovation: Item 1, IFACM will empower both commercial and non-commercial entities developing AI for manufacturing. This support includes (a) industry-validated use cases, bridging the gap between TRL 2-4 research and tangible applications, (b) curated datasets, freeing researchers to concentrate on AI development rather than data acquisition, and (c) Verification & Validation (V&V) services on dedicated testbeds, facilitating direct comparisons with established solutions.
- Dependability: Item 2, standards development currently relies on voluntary contributions from market participants. While effective, this process is inherently time-consuming. Acceleration is crucial to timely, effective, and scaled delivery of value to U.S. industry. IFACM will (a) provide grants to academic research and technology (R&T) organizations conducting dependability-focused AI research for manufacturing, (b) perform train, consult, and convene activities for commercial organizations aiming to utilize standards and conformity processes for enhanced market access, and (c) collaborate with the National Institute of Standards and Technology (NIST) for measurement sciences to support dependability research.
- Standards: Item 3, as new forms of AI evolve, the standards development process must adapt at pace. To accelerate this task, IFACM will (a) provide grants to academics, enabling their participation in the standards development process and removing barriers to entry, and (b) convene and coordinate with

key standards bodies, especially American National Standards Institute (ANSI) and American Society for Quality (ASQ) to ensure alignment between dependability initiatives, evolving AI technologies, and real-world industrial use cases.

- Conformity Assessment: Item 4, manufacturers require assurance that AI solutions will function reliably as designed. IFACM will support conformity assessment by (a) establishing communities of practice to foster knowledge-sharing and collaboration on the topic, (b) implementing coordinated workforce development programs to equip manufacturers with an understanding of conformity principles and their application to AI in their field, and (c) developing internal capacity for conformity testing if deemed necessary or strategically advantageous for U.S. competitiveness.
- Commercial Offering: Item 5, IFACM accelerates the journey to market for organizations developing AI solutions, fostering greater confidence along the way. Our support encompasses (a) provision of high-quality data sets for robust model training, (b) access to licensable testbeds for V&V and proprietary datasets development, (c) industry-validated use cases connected to real-world needs and, (d) comprehensive economic, technical, and workforce-related application guide frameworks to streamline implementation.
- Industrial Application: Item 6, value is only generated when AI solutions transition from concept to operational reality within the manufacturing environment. IFACM facilitates this transformation through (a) dependability, standardization, and conformity processes that progress in tandem with AI advancements, ensuring seamless integration, (b) comprehensive application guides explaining the economic, technical, and workforce implications of deploying AI tools for specific manufacturing applications, (c) a knowledgeable services sector (e.g., consultants) to support transitions, and (d) robust workforce development materials helping companies embrace and utilize new AI concepts.
- Workforce Development: Item 7, realizing the full potential of AI requires a skilled workforce capable of implementing and leveraging new AI-driven tools and processes. Recognizing this imperative, IFACM will (a) harness its expertise in dependable AI to craft targeted training programs and workforce development resources, and (b) disseminate these assets through a comprehensive network of national delivery partners. Equipping the workforce with essential skills empowers widespread adoption of AI across manufacturing, unlocking substantial economic and productivity gains.

IFACM's technical scope is designed to accelerate the development and deployment of dependable AI in manufacturing, rapidly moving technologies to MRL 7 and beyond. IFACM addresses key challenges across the innovation lifecycle, from funding fundamental research in dependability and shaping robust standards to empowering a skilled workforce and streamlining the path to market-ready solutions.

2.2.2 A Community of Complimentary Institutes: IFACM, with its focus on dependable AI for manufacturing, occupies a unique space within the Manufacturing USA institute ecosystem. While most institutes concentrate on specific domains—such as lightweight materials, biopharmaceutical manufacturing, or additive manufacturing—AI transcends individual sectors, permeating the entirety of manufacturing. By addressing the pillars of dependability, data management, application support, and workforce development tailored specifically to AI, IFACM facilitates advancements across discrete, process, and mixed-mode (e.g., hybrid) manufacturing. Consequently, IFACM is strategically positioned to augment other Manufacturing USA institutes by leveraging its scalable resilience and data frameworks to bolster AI deployment across their respective manufacturing focus areas. Preliminary collaborative discussions with leadership teams at the Clean Energy Smart Manufacturing Innovation Institute (CESMII), Advanced Regenerative Manufacturing Institute (ARMI), and Manufacturing x Digital (MxD) have already identified promising synergies to expand IFACM's data-driven approach while integrating with specialized manufacturing processes. For instance, conversations with ARMI revealed the potential for AI to optimize biomanufacturing parameters, such as refining nutrient delivery to cells and enabling real-time

anomaly detection. These collaborations amplify the collective impact of the Manufacturing USA Institute network by broadening the reach and applicability of AI solutions.

2.2.3 Synergy with other Federal Funding: IFACM complements other federally funded AI initiatives by focusing specifically on driving dependable (e.g., resilient, see Section 1.1) AI adoption in domestic manufacturing, aligning with national AI strategies and collaborating with broader federal AI programs. These initiatives span diverse sectors such as healthcare, pharmaceuticals, finance, retail/e-commerce, automotive, and energy/utilities. IFACM, however, concentrates solely on manufacturing and its specific requirements.

IFACM's business model is uniquely designed to amplify the effectiveness of the existing manufacturing ecosystem, including federal investments. By strategically connecting with and complementing ongoing initiatives, IFACM doesn't merely supplement these activities—it accelerates progress exponentially. For example, in Wisconsin, IFACM's collaboration with Energy+Water Resiliency[2] through The Water Council promises to yield both more resilient, optimized manufacturing energy/water infrastructure *and* a more resilient and capable supply chain to support it. This synergy will be replicated with other federal investments—including BioHealth Tech Hub and Workforce Hub—and their counterparts nationwide.

Furthermore, IFACM pairs well with the federal laboratory system. For example, concurrent with this proposal, the National Science Foundation (NSF) released a "dear colleague" letter describing a planning grant to create AI-ready testbeds. Leveraging this opportunity, IFACM's principal investigators intend to collaborate with Argonne National Laboratories (ANL) to propose planning grant activities that inform testbed creation for classified and unclassified applications. ANL is well positioned to build and manage these sensitive assets from which feedback on safety and national security requirements for AI applications will flow into IFACM to inform standards development and workforce programs.

A crucial aspect of the Manufacturing USA network lies in each institute having distinct yet complementary missions, collectively forming part of a strong foundation for U.S. industrial competitiveness. IFACM's mission, focused on fostering resilient AI in manufacturing, aligns well with this concept.

Collaboration: For example, recognizing the potential of AI in biomanufacturing, IFACM engaged with the ARMI. Discussions revealed that AI offers significant opportunities to improve monitoring and controlling complex biomanufacturing parameters, such as optimizing nutrient delivery to cells and detecting anomalies in real time. IFACM is uniquely positioned to contribute due to its expertise in AI-related dataset collection and management, coupled with its focus on dependability techniques. As such, ***IFACM and ARMI plan to collaborate*** *in this promising area, unlocking new possibilities for personalized medicine.*

IFACM's cross-cutting scope is most closely aligned with MxD and CESMII. IFACM is spearheading coordination with both institutes to ensure missions are aligned. Specifically, IFACM will work with MxD on the industrial cyber security for AI and with CESMII and data interoperability, advocating for standard and secure formats. Details of planned collaborations will be included in the full proposal.

2.2.4 Institute Goals and Alignment: IFACM's goals are aligned directly with NIST's objectives as described in the Notice of Funding Opportunity. Specific goals for IFACM include:

- Accelerated Market Transition: IFACM's focus on catalyzing the existing ecosystem is designed to shorten the time and reduce the risk of developing and applying AI in domestic manufacturing. (e.g., time-to-market). IFACM ensures R&T engagement in the standards process, driving U.S. leadership and reducing the time from AI innovation to qualified standard for dependability.

[2] https://thewatercouncil.com/weforward/

- Trusted Manufacturing Testbeds and Data Commons: A key resource restraining the development of AI for manufacturing is the availability of high-fidelity datasets for applicable use cases. IFACM fills this need with testbeds and validated, internally consistent datasets. This will result in a vibrant ecosystem of new and innovative solutions coming to market.
- AI-Ready Manufacturing Workforce: The development and curation of robust workforce development materials and IFACM's other activities will result in job creation, job preservation, and widespread successful upskilling of the existing workforce
- Non-Federal Investment in AI for Manufacturing/Institute Sustainability: IFACM's business model is designed to provide value critical to the AI in manufacturing ecosystem. Institute operations will generate a virtuous loop of investment in the technology area, as well as IFACM itself.
- Engagement of SMMs Across National Ecosystem: The Institute's development and maintenance of application guides covering the economics, technical, and workforce implications of AI unleash adoption in SMMs across the U.S.

2.3 National Impacts and Broad-Based Benefits

Considering the proposed creation of IFACM to accelerate the future of advanced manufacturing in the U.S., focus is set on clear, measurable outcomes for job creation, competitiveness, and scalability to evaluate broader impact of the Institute. IFACM will publish outcomes from a mix of quantitative (employment records, output improvements) and qualitative (surveys, case studies, and input for net promoter score) assessments to demonstrate impact of IFACM members and partners (in relation to the broader market) and highlight continual improvement opportunities. Data collection will be streamlined through a centralized platform, ensuring real-time tracking and transparency for NIST. IFACM leverages these approaches to demonstrate commitment to measurable success and scalable growth.

2.3.1 Creation or Preservation of High-Quality Jobs: From the U.S. Bureau of Labor Statistics, there are currently 11.7 million individuals employed in manufacturing in our country. Reports from the International Monetary Fund indicate that as many as 60% of jobs in the U.S. could be impacted by AI by the year 2030, with related reports predicting that as many as 16% of U.S. jobs could be replaced by AI in the coming year. With these data points, of the 11.7 million individuals employed in manufacturing in the U.S., nearly 1.9 million jobs could be at risk in the coming year and upwards of 7 million could change significantly by 2030 due to AI adoption. Similarly, Deloitte and the Manufacturing Institute report that 2.5 million jobs in the manufacturing space will be sufficiently changed by 2030 requiring an upskilling evolution that keeps pace with AI advancement in manufacturing.

Driven by workforce programs and collaboration with other Manufacturing USA Institutes, IFACM will ensure the existing workforce has access to the AI upskilling needed as new standards are taken on. This will help the nearly 2.5 million individuals in manufacturing jobs likely to change by 2030 stay relevant as their jobs evolve. Of specific example, IFACM will work with MxD to help avoid destructive disruption of individuals in surviving manufacturing roles by training them on a foundation of knowledge and career pathways that can take them from redundant roles into *new* more resilient roles driven by the acceleration of AI use in manufacturing.

To *preserve* the nearly 1.9 million jobs at risk, IFACM will work in conjunction with the other institutes to fast-track net-new talent into the AI in Manufacturing space. Inclusive IFACM workforce efforts, AI skills training and learning tied to AI application in specific manufacturing disciplines across varying career demographics will enable a cross-Manufacturing USA Institute effort to preserve 1.9 million manufacturing jobs across the U.S. These approaches are detailed in Section 3.2, Integrated Education and Workforce Development.

2.3.2 Advance Economic Competitiveness: Within Wisconsin, feedback from the Wisconsin Economic Development Corporation indicates that AI adoption leads to improved brand reputation and customer satisfaction, which are critical qualitative measures of competitiveness. The IFACM approach to drive reliable adoption of AI in manufacturing will amplify competitiveness in manufacturing through gains in productivity and workforce development. Using Wisconsin as a proxy to demonstrate nationwide economic competitiveness impact of IFACM, integrating AI technologies in manufacturing is projected to enhance competitiveness across the sector, with specific goals aimed at improving productivity by 10% to 15% in at least 50% of participating Wisconsin companies within three years. Massachusetts Institute of Technology (MIT) research indicates that AI-driven process optimizations can lead to productivity improvements ranging from 8% to 15% in manufacturing settings, aligning with the proposed IFACM targets. These advancements will streamline operations, reduce manufacturing cycle times, and minimize machine downtime, allowing manufacturers to respond more quickly to market demands and customer needs. Datasets and services from IFACM will enable rapid advances in AI for predictive maintenance and quality control, elevating maintained output levels and product quality, directly impacting their competitive positioning in the market.

Cost reductions of 5% to 10% are anticipated across greater than 60% of participating companies, driven by enhanced supply chain management and operational efficiencies. The ability to lower production costs while improving product quality and customization can help manufacturers retain existing customers and attract new ones—a measure of resiliency in both domestic and international markets. Ultimately, these improvements in competitiveness are expected to translate into increased market share and export growth, with projected increases of 5% to 8% in exports by Year 5, a $13B–$21B national impact, reinforcing the transformative potential of AI in revitalizing the U.S. manufacturing landscape.

2.3.3 Increase in Non-Federal Investment in Advanced Manufacturing: Through the IFACM services model, manufacturers will realize practical business case solutions and accelerated return on investment (ROI) horizons with use of datasets and testbeds for V&V. Additionally, as IFACM expands across industries and regions via its core business model, it will foster extended public-private partnerships and collaboration with state governments, universities, economic organizations, and other Manufacturing USA Institutes, further stimulating innovation and creating a self-reinforcing cycle of investment and economic development in advanced manufacturing across the U.S. Scaled impact from IFACM will continue to drive non-federal investment by showcasing the tangible benefits of AI integration in manufacturing, such as system resiliency, productivity gains, cost efficiencies, and enhanced competitiveness. Further, as AI tools are implemented across an increasing number of manufacturing companies, the Institute will provide additional real-world examples of cost savings and job creation, making a compelling case for private companies, venture capitalists, and industry consortia to invest in similar technologies. In Rough Order of Magnitude (ROM) budget, IFACM conservatively estimates a minimum of $72M investment from non-federal investments over the five-year planning horizon. The success stories will reduce perceived risks of AI-driven manufacturing solutions, leading to sustained and scalable investment.

2.3.4 Engagement with SMMs: As a landing point for IFACM, the Wisconsin economy contains nearly 9,000 SMMs, representing approximately 98% of the manufacturing base in the state. These manufacturers play a key role in sustaining state and regional manufacturing sector growth and span various industries, including machinery, food processing, paper products, and metal fabrication, making them critical to the supply chain and manufacturing base in Wisconsin and surrounding regions. Supporting these SMMs in their adoption of relevant technologies are the Wisconsin Manufacturing Extension Partnership (WMEP), Center for Manufacturing & Productivity (Wisconsin's MEP), the University of Wisconsin-Stout—Wisconsin's polytechnic institute—and numerous tech schools and regional economic development agencies. IFACM will strengthen this foundation for support of SMMs within the State of Wisconsin and,

by way of the expected network and node model of the Institute, will scale the support network for SMM adoption of AI technologies across the U.S.

Within Wisconsin, there is an emerging core group of SMM leaders eager to invest in right-sized AI technologies to improve their businesses (e.g., Pindel Precision, Waukesha Metal Products, and GenMet Corp.). By way of the IFACM membership structure, we envision creation of an Application and Use-Case Advisory Council (reference Section 3.1.2) that leverages the industry, academic, and WMEP network connections in Wisconsin as a model to scale the impact of IFACM across nationwide SMMs.

2.3.5 Position as U.S. Knowledge Broker across Stakeholder Groups: Core objectives for IFACM include delivery of scalable resiliency, datasets and testbeds, technology deployment playbooks, and aligned workforce programs for manufacturers across the U.S. Inherent in its efforts to accomplish these objectives, the IFACM business model intentionally shares knowledge across and between stakeholders, including users, manufacturers, industry associations, labor organizations, professional societies, economic development entities, MEP networks, and partnering Manufacturing USA Institutes. As discussed in Sections 2.3.1 and 2.3.2, outcomes from IFACM work include productivity improvements and an upskilled workforce. These outcomes are generated from the specific capabilities (datasets and services), equipment (testbeds), and personnel (workforce programs) that IFACM will build as part of its core business model.

2.3.6 Promotion of Technology Transfer: Outcomes from IFACM partnership model will accelerate the commercialization of AI-enabled manufacturing technologies, promoting technology transfer from R&T labs to industry. Through funded research programs and exclusive service agreements with Institute members, the Institute will facilitate the development of market-ready solutions, supporting industry partners in converting innovative AI-driven manufacturing processes into commercial solutions. This will drive an increase in patents filed and received across the Manufacturing USA network as the Institute focuses on securing intellectual property that can be licensed to U.S. manufacturers. Inherent to the network and node model within which IFACM will operate, innovation ecosystems for AI in manufacturing will evolve, enabling creation of start-up companies that specialize in AI-based manufacturing tools and solutions, thereby stimulating entrepreneurship and economic growth within the sector. Regional presence of the Microsoft AI Co-Innovation Lab for Manufacturing at the University of Wisconsin--Milwaukee (UWM) Connected Systems Institute (CSI), in partnership with Venture Firm TitletownTech, will create a support system to fund and launch new start-ups focused on AI in manufacturing. Per recent data, the Manufacturing USA network has facilitated more than 400 patents and license agreements and advanced over 270 technologies toward commercialization; given the acceleration of AI in manufacturing, IFACM stands to disproportionately increase this technology transfer impact.

Several case studies from Manufacturing USA institutes demonstrate the impact of their efforts in technology transfer and commercialization. For example, IFACM partner MxD focuses on equipping U.S. manufacturers with digital tools and cybersecurity capabilities, collaborating with over 300 partners. Work at MxD has led to measurable increases in productivity, along with the creation of intellectual property such as patents, licensed technologies, and spin-off companies.

2.4 Leadership and Engagement

The creation of the IFACM has been driven by a consortium of over thirty manufacturers, ten education partners, and five community organizations, many of whom have been actively involved in creation of concept, scope, and vision of IFACM from the initial stages of Notice of Intent from NIST. This concept paper reflects the collaborative and inclusive input from academic, industry, and community stakeholders, ensuring a comprehensive approach. This collective effort highlights the magnitude and adequacy of the leadership assembled, illustrating the commitment of diverse teammates toward the IFACM success.

The consortium's efforts are further evidenced by the completion of uniquely moderated academic and industry workshops that have shaped the Institute's research priorities and initial business plan, with focus on testbeds, data, and services. The involvement of more than six academic institutions has helped define key research areas, while the participation of six manufacturers has identified core manufacturing processes critical to the initial testbed buildout. Moreover, the active engagement of workforce partners and economic development organizations, including the Milwaukee TechHub Coalition, Wisconsin Economic Development Corporation (WEDC), Wisconsin Manufacturing Extension Partnership, and the Metropolitan Milwaukee Association of Commerce, underscores a strong value proposition, reinforcing the Institute's potential to secure broader industry partnership commitments.

- Academic Workshop: Led by the Associate Dean for Research Innovation in the College of Engineering at the University of Wisconsin—Madison (UW), and hosted at the Waukesha County Technical College (WCTC), an academic workshop was completed to create focus on initial research thrust areas related to the IFACM scope. The workshop was attended by 37 registered faculty, with participants from UW, UWM, Milwaukee School of Engineering (MSOE), Marquette University, Argonne National Laboratory, Madison Area Technical College, Waukesha Area Technical College, UW—Eae Claire, and UW—Stout. From this effort, technology themes of AI Computing/Innovation and Dependability Strategy emerged as top candidates for high-TRL use-case inspired research.
- Industry Workshop: Led by the Executive Director of the CSI with participants from six local manufacturers (Milwaukee Tool, Husco, Brady Corp, Regal Rexnord, Plexus, and Rockwell Automation), an industry-centric ideation workshop was held to converge on common manufacturing processes to represent in preliminary IFACM testbeds that will generate seed data sets pursuant to the Institute concept. The team agreed on the following data-rich manufacturing processes to represent in initial testbeds: material forming and assembly operation, a vision-enabled quality checking process, and a plant-level production planning process.
- Workforce Initiatives: Led by CEO of the MKE Tech Hub Coalition, a group of educational and workforce professions from technical colleges, private colleges, industry certification organizations, employers, and a manufacturing apprenticeship intermediary collaborated to create a holistic approach to addressing the workforce requirements of manufacturing employers. Each participant contributed both their expertise and their networks to develop the data-driven, scalable, and standardized approach to solving the national workforce shortage. Their practical experience ranged from collaboration with other Manufacturing Institutes, to consulting experience helping employers prepare for the era of AI, to expertise in earn/learn programs.

(3) The Proposed Manufacturing USA Institute

3.1 Business Plan

IFACM's design is based on core needs in the U.S. market to accelerate AI in manufacturing. Given NIST's stated intent for the institute to be self-sustaining, the proposers took an entrepreneurial-driven approach to organizational design. The value chain was mapped, Figure 2, and participant needs were identified.

3.1.1 Institute Concept: As described in Sections 2.1 and 2.2, IFACM is *based on a business plan* leveraging federal investment as *seed funding* to launch a sustainable not-for-profit. IFACM will focus on:

- Datasets and Testbeds: Addressing the scarcity of high fidelity, non-proprietary manufacturing datasets for AI development; deploying highly instrumented testbeds (digital and physical) representing key manufacturing processes; and generating datasets accessible to members with a subset released publicly.
- Scalable Resiliency: Convening AI experts and partnering with the R&T community to develop tools/techniques for measuring and assessing the risks of AI in manufacturing; developing strategies

to achieve resiliency through the framework of dependability; and demonstrating these concepts for validated use cases on testbeds and representative non-proprietary datasets, paving the way for construction of industry standards, best practices, and easy adoption at scale.

- Technology Deployment Playbooks: Accelerating adoption of AI at SMMs through application guides and off-the-shelf solutions, accounting for economic, technical, and workforce implications applied to specific use cases.
- Aligned Workforce Programs: The starting point on workforce development, which will be manufacturer-engaged research to define future skills by role type. Partnerships with academic institutions and technical colleges, and curricula and training materials across all education levels will be built and regularly updated. For the most in-demand roles, IFACM will partner with certification organizations to ensure transferable skills between manufacturers. Training materials will be deployed through existing networks, including online courses and work-based environments. Focus will be on designing, deploying, measuring, and maintaining AI systems.

These assertions are *based on market research* with large industrials, SMMs, AI makers, IT companies, service providers, NIST MEPs, and others.

Expanding on this, IFACM will facilitate manufacturing use cases ranging from near-term, incremental improvements to disruptive concepts that—when realized—will deliver radical increases in productivity, quality, etc. Looking forward, IFACM envisions use cases including incremental plant-level predictive maintenance and real-time quality control to long-range applications such as AI-enabled regional manufacturing networks that can detect supply chain bottlenecks in real time, predict potential problems in advance, and enable proactive planning to mitigate macro-level supply chain disruptions.

3.1.2 Structure, Management and Governance: IFACM will operate through an independent Wisconsin 501(c)(3) established by Foley & Lardner, LLP, for this purpose. The Institute's proposed structure is shown in Figure 3. As is typical, the entity was established with the board operating in an oversight role, ensuring efficient and proper application of various bylaws, including those addressing whistleblower protection and conflicts of interest. In parallel, NIST's program office will serve in a key oversight function for grant-related activities. Reporting to both the board and NIST is IFACM's executive leadership. This office will eventually include the executive director, controller, and legal counsel. Activities in the support division, including the membership office, will report to appropriate members of the executive leadership team.

The operations division is broken into two groups. The technology group is led by the chief scientist. This individual is responsible for testbeds, datasets, and dependability R&T. The applications group is led by the operations director, who will manage workforce development and engagement with the standards/conformity community. The chief scientist and operations director report to the executive director and are principal investigators of the grant.

Three steering committees, comprising members and representatives from NIST, guide IFACM's operations division:

- Technology Steering Committee: Focusing on the R&T community, this team is responsible for identifying and prioritizing emerging trends in AI and helping IFACM focus on high-impact areas. This team will work closely with the Use Case Steering Committee to ensure aligned priorities.
- Application/Use Case Steering Committee: Focusing on commercial participants, particularly SMMs, this Committee helps IFACM identify and prioritize use cases on which to base testbeds. They also validate the usefulness and effectiveness of dataset generation. Their results will be closely coordinated with the technology steering committee.

- Workforce Development Steering Committee: Focusing on industry (career and talent), educational institutions, and service providers, this team will provide guidance and prioritization on the development and implementation of IFACM's workforce development program.

IFACM's board of directors serves as the executive steering committee for the Institute as a whole.

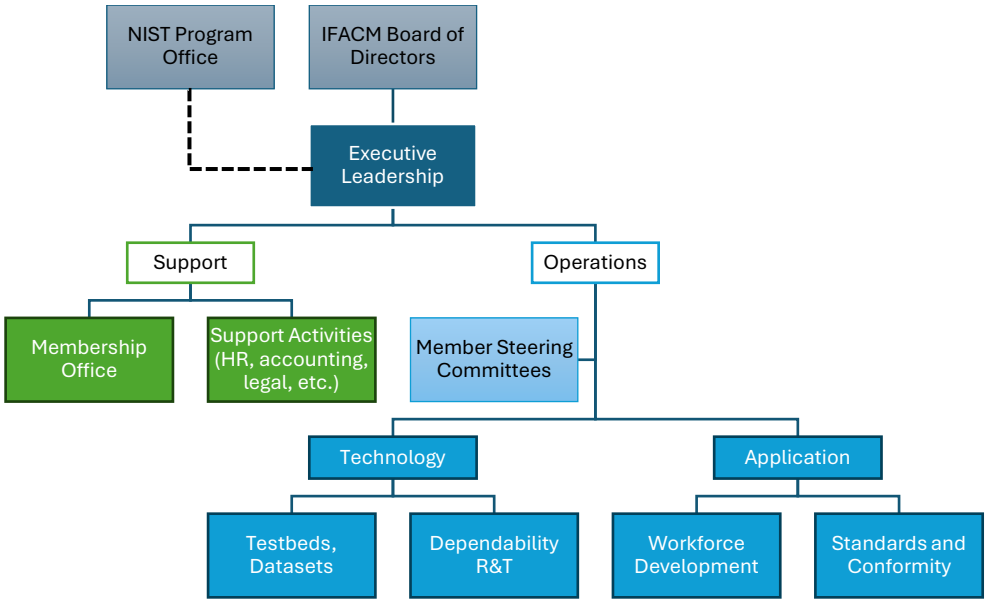

Figure 3 – Proposed organizational structure of IFACM.

3.1.3 Revenue Model: IFACM will initially rely on NIST, local government, and founding member funds as a foundational seed investment. As IFACM builds infrastructure, its stand-alone value proposition will create a "virtuous loop," attracting new members and generating revenue that fuels further growth and innovation. IFACM offers benefits tailored to members' needs as they execute the development and deployment of dependable AI in U.S. manufacturing and associated supply chains. Specific non-government sources of revenue include:

- Memberships: Members will include both industrial and non-industrial entities. Industrial members are categorized by size and desired service level. Those with fewer than 500 employees are designated as small companies and offered significantly reduced rates. Non-industrial entities, encompassing universities, industry groups, nonprofits, and relevant government organizations, utilize a tiered membership structure without size-based distinctions. Costs for each membership tier reflect best practices established within the broader Manufacturing USA network.
- Licensing: IFACM provides licenses for two primary assets: testbed data and workforce development materials. Fees are structured based on membership level and intended use, recognizing the diverse needs of different stakeholders. For example, data utilized for training AI models will be licensed under distinct terms for small companies compared to large companies. **To maintain its neutral, unbiased position in the market, IFACM *will not* enter into exclusive licensing agreements for data or workforce materials developed with Institute funding.**
- Training: Integrated into higher-level membership benefits or available à la carte, IFACM offers courses and economic, technical, and workforce impact guides to members. A particular emphasis is placed on supporting SMM service providers, such as local automation integrators, empowering them to harness IFACM resources and contribute to these critical ecosystem partners.
- Services: IFACM will operate a wide variety of physical and digital testbeds simulating real-world manufacturing processes, such as assembly lines, quality control inspections, and logistics chains.

These will be made accessible to members as a service, enabling them to develop proprietary datasets or conduct V&V of proposed solutions. This service benefits both AI developers seeking unique data or to validate solution effectiveness and manufacturers aiming to evaluate alternatives without disrupting production or exposing confidential information.

- Consulting: Although not its primary focus, IFACM leverages its extensive experience in developing, testing, implementing, and maintaining advanced AI systems and workforce development materials to offer limited consulting services on an ad hoc basis. Positioned to provide on-demand expert advice, IFACM will offer tailored support to clients needing specialized insights and guidance. IFACM envisions performing second-tier consulting, available to members from the services industry for specific engagements.
- Conformity Assessment: Recognizing the growing need for trusted third-party evaluators of AI for high-integrity manufacturing applications, IFACM envisions establishing and providing AI conformity assessment services for the manufacturing sector. These assessments could encompass factors such as algorithmic bias mitigation, data privacy protection, explainability, and robustness against adversarial attacks. By offering independent and credible certifications, IFACM would foster trust and confidence in dependable AI for manufacturing, accelerating its adoption and responsible integration. *This revenue stream is not included in initial budgets.* IFACM will partner with Deloitte during the scale-up phase of IFACM to assess the feasibility of this initiative.

Ultimately, IFACM's diversified revenue streams will fuel continued expansion of its capabilities, amplifying its positive impact on U.S. competitiveness and technological leadership in the global marketplace.

3.1.4 Intellectual Property Management: Designed to empower existing market participants rather than compete with them, IFACM utilizes intellectual property (IP) protection—including patents, know-how, copyrights, and other relevant mechanisms—to guarantee impartial, non-bias access to IFACM resources for U.S. industry while maintaining the Institute's ability to generate self-sustaining revenue.

- Institute Materials and Data: IFACM's testbeds, combined with donated datasets, will constitute a significant asset. All such materials will be considered Institute property and licensed to members through membership agreements or on an à la carte basis. Workforce development materials will follow similar guidelines, with base materials owned by the Institute and available for licensing. Testbed designs will be licensable to U.S. commercial entities for a fee and to U.S.-based nonprofits free of charge. Designs remain the property of IFACM and cannot be shared further.
- Open Source: Recognizing the importance of collaboration, IFACM embraces open-source principles wherever possible. Our dependability processes, developed in partnership with R&T organizations and standards bodies, are inherently open. Grants in this area focus on progressing the science and application of dependable AI for manufacturing; as such, they will be open source as much as practical to enable their widespread use.
- *Services: Data, findings, V&V results, or other materials generated using IFACM infrastructure at a member's sole expense (e.g., through as-a-service arrangements) will be* ***exclusively owned*** *by that member. This crucial feature empowers members to leverage IFACM's infrastructure on a not-to-interfere with IFACM operations basis to advance their own research and development goals while simultaneously contributing to IFACM's operational sustainability.*

3.1.5 Managing the Risk of AI: As detailed in Section 1.1 and throughout Section 2, mitigating the risks inherent in deploying AI within U.S. manufacturing and supply chains lies at the very core of IFACM's design. Leveraging established, trustworthy processes, the Institute serves as the focal point to accelerate the identification, development, and implementation of scalable, standards-based processes to ensure dependable and safe AI for manufacturing applications. Furthermore, IFACM's investment in workforce

development materials cultivates a skilled talent pool equipped to confidently and safely implement the evolving landscape of AI implementation in manufacturing processes. The Institute will design all activities with NIST's Artificial Intelligence Risk Management Framework (AI RMF 1.0) as foundational guidance.

3.1.6 Facilities and Infrastructure: Utilizing a network and node model, IFACM will coordinate a set of nationwide partnerships through a central group of networks located in Wisconsin. Regional nodes allow the Institute to deliver localized workforce development, conduct R&T, and operate dedicated testbeds specialized to the focus of various regions and taking advantage of existing infrastructure, creating synergy with other federal/non-federal investment as available. Key connections have already been established and will be followed up with more.

IFACM will reach SMMs through the NIST MEP network, starting with the Wisconsin Center for Manufacturing & Productivity and other delivery partners such as Penn State New Kensington's Digital Foundry[3]. This decentralized yet interconnected structure fosters broad engagement, leverages focused expertise, and facilitates efficient resource allocation.

Workforce engagement will also leverage national networks from K-12 education (GPS Education and Science center network) to certification organizations (SACA, ASQ), and from national training providers (Manpower, MxD) to national apprenticeship standards with the Department of Labor. Additional partnership networks will continue to be built as the work progresses.

Initial IFACM operations will leverage UWM's CSI as an interim headquarters due to the facility having access to a Microsoft AI-in-manufacturing Co-Innovation Lab and a robust $4.3M manufacturing testbed from Rockwell Automation.

3.1.6.1 Why Wisconsin as IFACM's Hub: Wisconsin stands as a key player in U.S. industry, with manufacturing contributing almost 19% to the state's gross domestic product. Ranked second nationally in per-capita manufacturing jobs, Figure 4 underscores Wisconsin's—and the Midwest's—prominence in manufacturing. In its diverse portfolio of manufacturing sectors, including defense, machinery, food processing, paper products, and advanced materials, Wisconsin possesses a rich industrial heritage. This robust base—coupled with a highly skilled workforce, a supportive business environment, manufacturing-savvy educational institutions, and a burgeoning AI ecosystem—positions Wisconsin as the ideal setting for IFACM's main hub. By leveraging these strengths and executing its meticulously crafted network and node strategy, the Institute will drive innovation, enhance competitiveness, and elevate Wisconsin, the region, and the nation as leaders in AI-driven manufacturing.

Wisconsin's well-established manufacturing infrastructure, with its network of suppliers, logistics, and skilled labor, provides a solid foundation for piloting the integration of AI technologies in the manufacturing context. IFACM will collaborate with this vibrant ecosystem and partner with organizations such as the National MEP national network to accelerate the testing and scaling of AI solutions across the industry. Wisconsin is also a "near neighbor" to MxD and the Chicago Quantum Exchange (CQE), among others. Linked by the Lake Michigan corridor, IFACM, MxD, CQE, and others will have tremendous synergy, and their footprint will help us accelerate scale and adoption across the other Institutes through their membership and partner ecosystems.

Furthermore, leading technical colleges and universities in the state, such as the UW, UWM, MSOE, Marquette University, WCTC, Milwaukee Area Technical College, and many others, offer programs in engineering, computer science, and data analytics, ensuring a constant influx of talent for the AI and manufacturing sectors. Notably, Wisconsin is also home to the University of Wisconsin-Stout, a strong

[3] https://www.digitalfoundrynk.com/

polytechnic institution committed to hands-on learning and close industry partnerships. Its curriculum evolves in tandem with industry needs, providing graduates equipped with real-world skills. Wisconsin's educational institutions actively engage in cutting-edge research in AI, robotics, and advanced manufacturing. These collaborations, along with engagements with other universities as IFACM matures, will fuel innovation and provide essential research support for the institute.

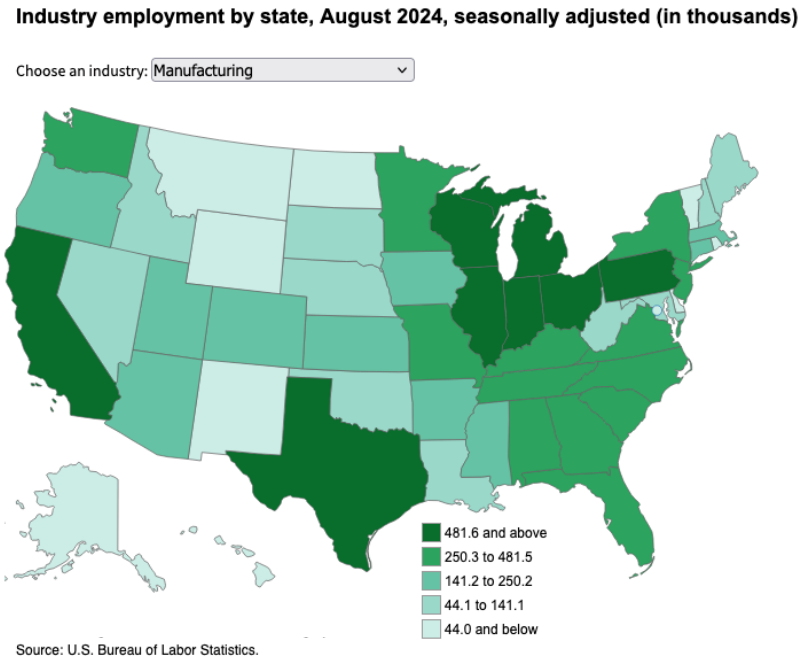

Figure 4 - U.S. Bureau of Labor Statistics industrial employment by state for manufacturing (August 2024).

3.1.7 Startup to Operation: The IFACM program will consist of two distinct phases. The first year of the award will focus on establishing operations and building a foundation for future actions. Year 2 and beyond will be mission oriented, delivering results based on the Institute's charter.

IFACM has partnered with Deloitte to serve has its startup phase partner. Upon award, IFACM and Deloitte will launch a 30–60–90-day plan to implement industry best-practice human resources, cost accounting, legal, and other business processes. Deloitte is well situated to provide these services with their worldwide consulting and business advisory role and as operating the largest professional services network by revenue and number of employees in the world.

3.2 Integrated Education and Workforce Development

The context for U.S. manufacturing today is primarily defined by two challenges: (a) a shortage of rightly skilled workers and (b) stagnant and declining productivity. Investments in both infrastructure and technology are up significantly, with federal spending for manufacturing construction at a 143% increase since 2019[4] and geared toward stimulating both growth and productivity. However, without rightly skilled workers, the competitive edge of the U.S. will continue to erode. ManpowerGroup has shared that many of their manufacturing clients, from large-scale multinationals to SMMs, understand they face a workforce challenge. They are unclear on how to align their workforce strategies with their technological adoption plans. A shared challenge for all manufacturers is the projection that by 2030, the U.S. will be short 1.5–2.5 million workers, according to studies by National Association of Manufacturers Deloitte and McKinsey.

[4] https://www.census.gov/construction/c30/current/index.html#:~:text=The%20latest%20estimate%20of%20construction

This projected gap is further complicated because the talent we will need must operate in the new technological environment with different/evolved skills on an unclear timeline.

The Institute plans to address this "double squeeze" in two ways. First, IFACM will define the new requirements for AI-enabled roles and create the training and distribution methods to develop the requisite skills. Second, IFACM will build career pathways to move individuals from the sidelines into these good jobs through career pathways that recognize the need for earn/learn programs.

Within the steering committee structure illustrated in Figure 3, IFACM will convene employers, certification bodies, educational partners, re-skillers, economic/social justice organizations, and workforce development partners to form an AI Workforce Steering Committee that will confirm skill changes, timing, and gap closure recommendations. The existing infrastructure of the Manufacturing USA Institutes will prove critical to accelerate the process. For example, MxD's network of partnerships will be invaluable in convening, aligning, accelerating, and scaling the process. The Committee will have inclusive representatives, including current and potential manufacturing employees to ensure worker voice is included in recommendations for strategic workforce initiatives such as barrier remediation and solutions, adaptable skilling opportunities, and equitable career pathway design.

IFACM recognizes the need for a holistic approach to transforming the workforce and will focus on the following six areas to accelerate our transition to an AI-enabled workforce in manufacturing:

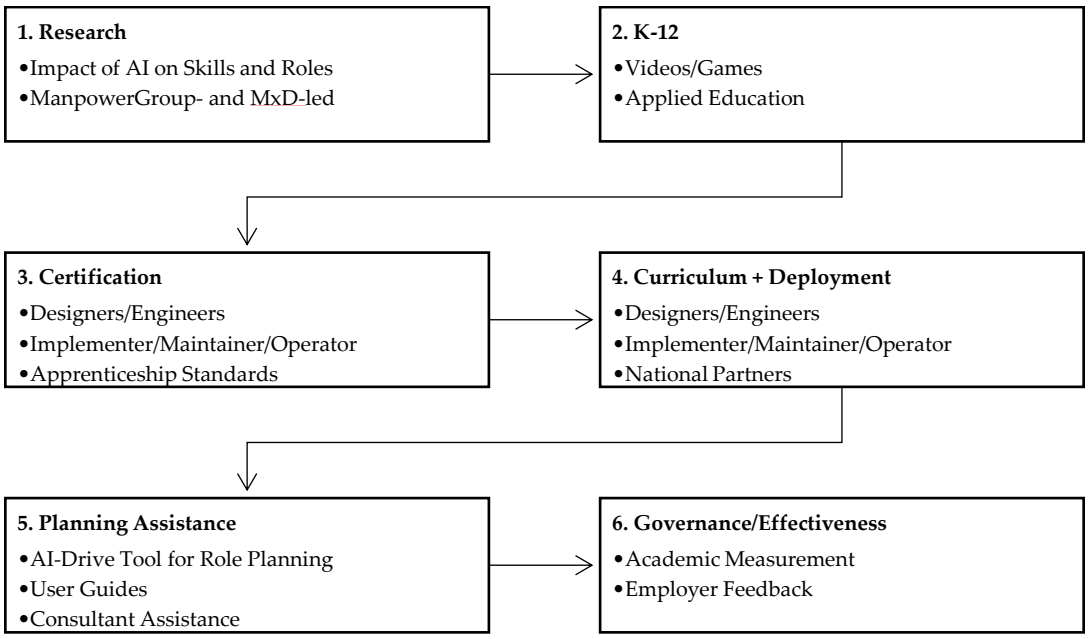

Figure 5 – Six areas to accelerate an AI-enabled workforce in manufacturing.

3.2.1 Employer-Engaged Research on Impact of AI on Skills/Roles: Research is critical to understand the impact of AI on manufacturing job roles. IFACM will partner with both MxD and ManpowerGroup to develop this with a proven approach on role and skill evolution in digital manufacturing (mxdusa.org/taxonomy) and cybersecurity in manufacturing (mxdusa.org/hiringguide) to develop an AI hiring guide. This research will be conducted by ManpowerGroup, joined by collaborative academic partners and validated through the Workforce Steering Committee. The benchmark for this effort will be roles where over 25% of the role's tasks will be automated or evolved through AI to determine the net impact on existing roles and new roles that will be created, including:

- Tasks that would be automated

- Average percentage impact of automated tasks on the role
- New tasks and skills that will be required in AI-manufacturing
- New roles that will need to be created

An overview of this research will be available to the public and will provide a clear from/to perspective on how the manufacturing workforce will evolve and how the gap will be closed. Details on skills requirements will be transferable and scalable nationally through partners and stakeholders. This research will also become the basis for other elements of this plan, including certification, workforce planning automation tools, and implementation guides that will be made available to members of the IFACM.

3.2.2 K-12 Educational Opportunities: Manufacturing will continue to rapidly evolve with the implementation of AI, making it an attractive career pathway for youth. To inspire students to pursue these pathways, IFACM will develop scalable resources and best practices for partner delivery. First, IFACM will commission the development of short educational videos to be released on social media, partnering with existing effective science communicators. Also, an interactive game will be created that will model AI-enabled manufacturing. These resources will be piloted with partners, including Discovery World—a world-class, highly interactive destination science laboratory that will serve as an excellent proof-of-concept for early education models. IFACM will then package and deploy the materials in libraries, science centers, exhibits, makerspaces, and schools. Second, IFACM will provide an "educational playbook" demonstrating how AI can be integrated into existing co-curricular opportunities (e.g., FIRST Robotics). Finally, an applied learning curriculum will be developed in partnership with GPSed[5], where hands-on activities and real-world work is integrated into students' education. GPSed provides an integrated continuum of work-based learning that involves meaningful interactions with employers to prepare them for manufacturing careers. The distribution of these educational elements will accelerate nationally through participating schools in GPSed's network. IFACM will grow this network of national partners.

3.2.3 Certification Development for Designers/Engineers, Implementers/Maintainers, and Operators: Manufacturing leverages certification to ensure key roles have the necessary skills for success and as milestones for employee development. Common examples include Certified Manufacturing Engineer (CMfgE); Certified Six Sigma Green Belt (CSSGB); Certified Production Technician (CPT); Certified Logistics Technician (CLT); Project Management Professional; Certified Professional in Supply Management (CPSM); Certified in Production and Inventory Management (CPIM); Certified Reliability Engineer (CRE); Certified Quality Engineer (CQE); and SACA.

Utilizing an International Organization for Standardization (ISO) 17024-compliant process, prior research, and in partnership with an independent assessment body, including SACA and ASQ, IFACM would convene technical and validation workgroups to define stackable credentials and standards, establish robust and unbiased assessments, and advocate for adoption by employers and other stakeholders. IFACM anticipates certifications for designers/engineers through four-year degrees; implementers/maintainers through technical colleges; and operators through apprenticeship models. These stackable credentials standards would be the basis for the scalable education approach.

3.2.4 Curriculum Development with Scalable Deployment: IFACM will focus on the centralized development of educational materials, including applied project work, to meet certification requirements for scaled deployment through existing education providers. This approach creates the ability to update the materials at least every six months to reflect the rapid advancements in technology.

To develop these materials, IFACM will leverage a coalition of education and workforce development partners, including the Wisconsin Technical College System (WTCS), the Universities of Wisconsin,

[5] https://gpsed.org/

private universities like MSOE, and non-profits focused on workforce readiness. These partners have strong national networks for scaling adoption.

Curriculum materials and applied project guidelines for the designers/engineers will be developed by national leaders in applied AI-enabled manufacturing, including MxD, which has significant experience in both curriculum development and a platform for deployment. Another collaborator within our ecosystem, the MSOE, is one of the first institutions in the nation to develop an undergraduate computer science degree with a singular focus on AI. MSOE has since developed post-baccalaureate certificates in applied machine learning, machine learning engineering, and a master's program in machine learning. Their supercomputer, "ROSIE", provides students with a hands-on learning opportunity. The UWM recently launched the connected systems engineering master's program that focuses on the Industrial Internet of Things, factory automation, and the implementation of Industry 4.0 solutions. By way of the Research, Innovation and Scholarly Excellence Initiative (RISE-AI), the UW is focusing on the field by investing in faculty, researchers, and research infrastructure that will accelerate the growth of AI innovators. Included in this curriculum would be critical skills in dependability analysis (functional safety, security, availability, etc.), training data development, measurement sciences, model development, and technology road-mapping.

For implementation and ongoing maintenance of manufacturing AI, our certification curriculum, including online delivery and local implementation guide, will be developed by a coalition of technical colleges, led by WCTC. WCTC has the first AI certificate and AI two-year degree program in the U.S. WCTC's AI programs were specifically designed to be stackable with their manufacturing curriculum. The implementer/maintainer certification will be obtained through a combination of online educational modules and applied exercises through IFACM-member institutions. The curriculum will prepare individuals to implement and maintain AI standards to increase reliability, security, and fidelity.

Our apprenticeship readiness partner, Wisconsin Regional Training Partnership (WRTP) Building Industry Group Skilled Trades Employment Program (WRTP | BIG STEP), a workforce intermediary and Department of Labor Apprenticeship Ambassador, will integrate the educational assets into designated curricular points of their Certified Pre-Apprenticeship to assist youth and adults in understanding AI-related concepts in entry-level manufacturing settings. WRTP | BIG STEP's nationally recognized model ensures traditionally underrepresented communities have equitable career pathways to high-road manufacturing careers through extensive outreach, barrier solutioning, training, and placement assistance. Additionally, they will develop and scale updated manufacturing apprenticeship standards that integrate an optional AI module through the Department of Labor and in the State of Wisconsin Department of Workforce Development. These standards would then be executed in manufacturing Certified Pre-Apprenticeship and Apprenticeship to ensure a diverse and skilled talent pipeline. A best practices guide would also be developed to assist with adoption in other states.

Finally, to address four incumbent workforce audiences most likely to experience significant and near-term evolution (developers, implementers, maintainers, and operators), online certifications will be delivered electronically through large skilling providers, standards bodies, and professional associations. This will provide a common foundation of knowledge on the standards for AI in manufacturing. SACA and ASQ are committed deployment partners. IFACM also plans to utilize MxD's Virtual Training Center (VTC) to expand the reach of our planned online certification program, especially in view of their planned reach to SMMs. The VTC is an online, virtual platform for training and securing the manufacturing workforce. The VTC provides access to content and tools remotely and instantaneously for rapid evolution and development of a skilled workforce. Within the VTC, MxD will create a 'microsite' that hosts a unique library of AI and related content. ManpowerGroup, which employs 100,000 individuals in industrial roles (from operator to engineering), has also committed to collaborate with IFACM to make this training

available to their associates. IFACM looks forward to also partnering with other organizations, such as the American Society of Mechanical Engineers (ASME), the Institute of Electrical and Electronics Engineers (IEEE), and the Association for Manufacturing Excellence (AME).

3.2.5 Manufacturer Planning Assistance: IFACM will assist in planning and implementing the workforce changes required to adopt AI "at scale" in manufacturing environments. Many elements of the plan are common and will be shared with partner Manufacturing Institutes and MEP networks, including communities of practice, events, and conferences, to share best practices.

Unique to IFACM members will be an AI-driven tool that helps manufacturers identify the project return on investment and develop plans for workforce transformation. Based on prior research on future-focused roles, the tool would evaluate the manufacturer's current workforce and create recommendations for the future workforce, including the actions required to evolve to an AI-enabled workforce. Included in this tool will be future role definition, upskilling pathways from existing roles, and recommended adjacent roles for those who may be displaced due to automation. To create scale, the IFACM team will also train and provide second-level support to member workforce service providers and MEP networks as they leverage the tool to assist manufacturers. The IFACM team members and service providers who leverage the AI-driven tool will be asked to provide workforce changes after deployment to refine the model based on experience.

Given its research basis, the tool could also assist in large-scale implications of AI in manufacturing, which could be leveraged by labor unions, policy-makers, and philanthropic organizations. As a newly designated Workforce Hub by the White House, the Milwaukee region is poised to showcase how the tool can be leveraged for regional workforce ecosystem planning. The outcome will be recommendations that can be leveraged by other regions and integrated into the Talent Pipeline Management (TPM) framework.

3.2.6 Governance and Effectiveness Check: The AI Workforce Advisory Committee will meet semi-annually to review the current state of implementation, assess progress against metrics, ensure continuous collaboration, and recommend any changes based on these assessments and feedback from participating organizations. The Committee is also dedicated to benchmarking progress in developing direct pathways for unemployed and underemployed people seeking family-sustaining careers in manufacturing as well as examining the equitable outreach, training and skilling opportunities for all people.

(4) Resources, Qualification, and Experience:

4.1 Rough Order of Magnitude (ROM) Budget

Details of IFACM's ROM budget outlining projected expenses and revenue streams are provided in a stand-alone appendix to this submission. As a general note, IFACM planners took a conservative cash-basis only approach to its ROM financial plan. The authors assumed modest membership and a steady scale-up as the Institute establishes its infrastructure. In addition to visionary members aligned with IFACM's vision, non-federal funding is driven by business case-driven members seeking access to testbeds, AI training data, and workforce development materials in out years. As with any business plan focused on launching a new initiative, developing these resources will require time.

Looking ahead, future iterations of the budget *will incorporate in-kind offsets* from members. Examples of contributions currently under discussion include a headquarters facility, partner facility and equipment use, supercomputer time, cloud-computing credits, legal services, accounting, foundation models, an enterprise management system, automation equipment, simulation software, and much more. These contributions will enhance the Institute's financial stability and dramatically expand its mission capability.

4.2 Cost-Share/Matching

IFACM has a *robust path to greatly exceed the minimum 1:1 cost share* required by the Notice of Funding Opportunity. This is demonstrated by 41 existing Letters of Interest from a variety of key contributors. In line with IFACM's "sustainable business model first" approach, the Institute focused initial effort on securing support from AI, industrial, consulting, and delivery organizations. These cornerstone partners, representing (at this point) a founding team of 10 organizations, inspire peer engagement, attract additional members, and provide crucial first-year matching funds to the Institute. This support comes from large companies across the ecosystem, from AI producers and IT companies to major industrials and consultants. These are complemented by SMMs in multiple industries that will drive use case selection and workforce implementation planning. IFACM matched its industrial ecosystem with execution partners critical to achieving the core mission. These include standards/quality organizations to facilitate the scale-up of dependability concepts, workforce development partners to implement change, state economic development groups, and a wide variety of academic partners to perform R&T and deliver workforce products. Specific matching and in-kind opportunities currently in discussion include:

- Membership of 30+ commercial organizations and counting.
- World-class facilities at UW, UWM, UW–Stout, Penn State–New Kensington's Digital Foundry, MSOE, WCTC, Milwaukee Area Technical College, Rockwell Automation, Discovery World, ManpowerGroup, Lab Midwest, the CQE, and many others.
- Access to computing resources through MSOE, the CQE, Microsoft, NVIDIA, IBM, and others.
- Datasets from IBM, Modine, Regal Rexnord, Brady Corporation, Rockwell Automation, and others.
- Support through matched legal services, human resources, contracting support, IT services, an Enterprise Resource Planning (ERP)/Quality Management System (QMS)/ Supply Chain Planning (SCP) system, and others from various parties. This includes access to consulting from Deloitte.
- Equipment and software support from various members, including access to advanced industrial control equipment from Rockwell Automation.
- The State of Wisconsin's commitment of $7M in funding as part of the upcoming budget.

Together, these represent a subset match and in-kind of approximately $108M. Additional match and in-kind opportunities continue to emerge as further partnerships and engagement are pursued.

4.3 Qualifications and Experience:

IFACM's planning team of over 55 is spread across the U.S. and in various sectors; a subset includes:

4.3.1 Leadership in Innovation and Technology:

Dr. Joe Hamann, Executive Director of CSI, combines an MBA and a Ph.D. in Materials Science with extensive experience leading engineering teams and overseeing industrial research. He is passionate about mentorship and STEM outreach, exemplified by his founding of Rexnord's Technical Excellence Program.

*Kyle Crum***,** Director of Advanced Technology at Rockwell Automation, drives technology roadmaps, manages Advanced Technology and Global Product Standards, and leads engagements with CSI and ARMI. His holds engineering degrees from Grove City College and the University of Pittsburgh and a technology management certificate from MIT.

Matt Kirchner, a fierce advocate for technical education, champions securing the American Dream for future STEM talent. Through his podcast *TechEd Podcast™*, authorship, and presidency of a resource distribution company, his work is backed by 25 years of experience as CEO and COO in manufacturing.

Buckley Brinkman, Executive Director/CEO of WCMP since 2011, specializes in transforming manufacturing organizations. He holds a business degree from the University of Wisconsin and an MBA from Harvard Business School.

4.3.2 Research and Academia Leadership:

Dr. Oliver Schmitz, Associate Dean for Research Innovation in the College of Engineering and Director of the Grainger Institute of Engineering at UW, is a leading researcher in plasma physics. He investigates the behavior of plasmas in fusion reactors and their interaction with materials. He plays a crucial role in the AWAKE accelerator at CERN. He is committed to educating K-12 students about plasma physics. He earned an MS in physics from the University of Bonn and a Ph.D. and Habilitation in Plasma Physics from Heinrich-Heine University Duesseldorf.

Dr. Eric T. Baumgartner, Executive Vice President of Academics at MSOE, guides the institution's academic endeavors. He previously served as Dean of Engineering at ONU and spent a decade at NASA's Jet Propulsion Laboratory; his contributions include the Mars Exploration Rover project. His has received NASA's Exceptional Achievement Medal and the IEEE Robotics and Automation Award. He holds a bachelor's degree in aerospace engineering from the University of Notre Dame, a master's degree in aerospace engineering from the University of Cincinnati, a Ph.D. in mechanical engineering from the University of Notre Dame, and a certificate from the Institute for Educational Management at the Harvard Graduate School of Education.

Dr. Xuedong David Ding, Associate Dean of the College of STEM and Director of the School of Engineering at UW–Stout, brings over 30 years of industry and academia experience. He specializes in digital transformation, manufacturing automation, AI, and data analytics, and has contributed to the State of Wisconsin Governor's Task Force on Workforce and Artificial Intelligence. He earned his Ph.D. in Industrial and Management System Engineering from the University of Nebraska.

Mike Shiels, Dean of the School of Applied Technology at Waukesha County Technical College since 2011, leading over 150 faculty and developing industry-aligned programs in advanced manufacturing, architecture, and engineering. He emphasizes data-driven decision-making and industry collaboration.

4.3.3 Economic and Workforce Development:

Kathy Henrich, CEO of the MKE Tech Hub Coalition, leads a non-profit focused on fostering inclusive tech growth in Milwaukee. She draws upon her experience managing $500M+ businesses at IBM and guiding clients through transformations at Accenture. Kathy has her Master of Workforce Development from LSU, with a specialization on the impact of AI on the future of work.

Rebekah Kowalski is Global Head of Strategic Workforce Partnerships at ManpowerGroup. She has launched specialized staffing solutions, spearheaded research initiatives, explored technological impact on jobs, and collaborated with industry leaders to define future workforce needs. Rebekah is expert at guiding organizations in navigating complex talent challenges and adapting to the evolving labor market.

Dr. Jeff Bannink, Vice President at the Metropolitan Milwaukee Association of Commerce, leverages over 25 years of global experience to drive regional economic development. Having worked with companies such as Nike, Caterpillar, and Moderna, he has expertise in diverse manufacturing sectors.

Jason Schuetz, Vice President of Global Operations and Advanced Manufacturing at Husco, oversees worldwide operations and the Advanced Manufacturing Group, which develops innovative manufacturing solutions. His experience encompasses quality management, operations, supplier relations, and automation.

Bill Berrien, CEO of Pindel Global Precision and Liberty Precision Manufacturing, providing components to industrial and defense OEMs. He leads Forwardskilling, an innovative workforce development program that upskills the incumbent workforce to meet future industry needs. He holds a BA from Princeton and an MBA from Harvard.