NSF-ATE AMTEC Institute for Industry 4.0 Innovation (AI3)

Jason Simon, AMTEC

Jason Simon is a nationally recognized leader in advanced manufacturing education and workforce development. As Director of the Advanced Manufacturing Technical Education Collaborative (AMTEC) at Owensboro Community & Technical College, Jason drives a bold vision to modernize technical education through innovation, industry alignment, and scalable strategy.

With more than 20 years of experience spanning instructional design, systems integration, and multimedia development, Jason has led transformative initiatives that position AMTEC at the forefront of Industry 4.0 training. He is a two-time Principal Investigator for National Science Foundation Advanced Technological Education (NSF ATE) grants, having spearheaded the creation of immersive virtual reality training systems and nationwide educator development programs.

Under Jason's leadership, AMTEC has established high-impact partnerships with industry giants such as Boeing, Toyota, and zSpace, launching programs that blend IoT, automation, and robotics into dynamic curricula. His thought leadership is regularly featured at national conferences, where he advocates for integrating emerging technologies into technical education to meet future workforce demands.

Jason's strategic contributions to Owensboro Community & Technical College include the development of scalable safety training systems and multi-state eLearning platforms. His career began with distinguished service as Production Manager for the 1st Marine Division Combat Camera in the United States Marine Corps, laying the foundation for a career defined by mission-driven innovation.

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NSF-ATE AMTEC Institute for Industry 4.0 Innovation (AI3): Impact of Hybrid Professional Development Opportunities on Manufacturing Instructors

Introduction

The Advanced Manufacturing Technical Education Collaborative (AMTEC) is a former National Science Foundation (NSF) Center that has been sustained to provide resources and a partnership network for manufacturers and educators [1]. In 2021, AMTEC and Owensboro Community and Technical College were awarded a NSF Advanced Technological Education (ATE) grant, Strengthening the Industry 4.0 Workforce through Virtual Reality Training (DUE 2142868), that provided the opportunity to establish the Industry 4.0 skills standard for maintenance technicians [2], [3]. AMTEC worked with Nocti Business Solutions to facilitate the Develop A CUrriculuM (DACUM) and Delphi process with subject matter experts from Boeing, Interactive Training Systems, Toyota, Toyotetsu, and Kentucky Community and Technical College System to define the duty areas of knowledge [3].

Building upon this work, the AMTEC Institute for Industry 4.0 Innovation (AI3) was funded by the NSF ATE program (DUE 2350012) in August 2024 and utilized the Industry 4.0 skills standard to create a professional development program for advanced manufacturing, engineering, and related instructors [4]. As indicated in several studies and reports [5], [6], [7] there is a skills gap manufacturers are facing that is negatively impacting their workforce both in hiring and retaining employees. The AI3 program intends to address this workforce issue by equipping instructors with training that can, in turn, be provided to their students to better prepare them for the workforce [4]. In spring 2025, the same subject matter experts completed a survey ranking the importance of the skills identified in the skills standard and had the option to share additional comments about new technologies. The survey responses were used to finalize the agenda for the AI3 program. There are three objectives for the award. Objectives one and two are to increase the knowledge of 50 secondary and 50 postsecondary instructors "from across the nation in Industry 4.0 concepts and related promising practices through providing professional development and follow-up community-of-practice offerings [4]." Objective three is to have 70% of instructors who participate in the training incorporate Industry 4.0 concepts into the curriculum and classroom [4]. The project will continue through July 2027, but based on current data, AMTEC has promising findings after hosting five of the ten planned training sessions. Early evidence indicates that a deliberately hybrid, industry validated professional development model accompanied by follow-up guidance can move instructors from awareness to early implementation.

Methodology

AI3 utilized a hybrid professional development approach to equip career and technical instructors with tools to address the workforce crisis in the manufacturing industry. Instructors attended a two-day in-person training to complete exercises on Industry 4.0 laboratory equipment with Multi-Skill Training Services, nationally recognized industrial maintenance trainers, who facilitated labs on electrical control theory and variable frequency drives. In addition, instructors experienced virtual/augmented reality technologies to explore digital twins and 3-D applications with partners from nationally recognized educational provider, zSpace, who shared these innovative impacts on student success. Complementing these hands-on opportunities, instructors also attended presentations on Competency-Based Education (CBE) and potential funding resources such as grants and corporate sponsorships. In the October and November 2025 sessions, presentations on artificial intelligence were also added to ensure program relevancy.

Travel assistance and stipends were provided to instructors that attended and completed training. After training completion, the instructors could access an online portal that housed the lab exercises, a CBE primer, and additional CBE templates. Monthly, virtual Community-of-Practice (CoP) sessions provided continued support to instructors, so we could offer additional resources and concepts versus only exposing them to information one time. Six CoP sessions were held in 2025 and topics included: industry partnerships, CBE, ATE Central/STEMLink resources, FIRST robotics programs, artificial intelligence tools, and tips for building Industry 4.0 equipment and creating lab exercises.

Results

Five in-person AI3 sessions were held in 2025 with 54 instructors attending, representing administrations and classrooms at high schools, two year technical and community colleges, and universities from Alabama, Colorado, Illinois, Indiana, Kentucky, Massachusetts, Michigan, Nevada, North Carolina, North Dakota, Ohio, Tennessee, Texas, Virginia, and Washington. Table I shares the breakdown of instructors from secondary and postsecondary institutions during each of the five cohorts [8].

TABLE I

Secondary and Postsecondary Attendance Breakdown at Training Sessions

Training Dates	**Secondary Attended**	**Postsecondary Attended**	**Total Attended**
May 20-21,2025	3	9	12
June 10-11,2025	11	2	13
July 10-11,2025	5	4	9
October 7-8, 2025	6	4	10
November 18-19, 2025	9	1	10

All data discussed are aggregated responses from 2025 surveys. A survey was provided to each instructor on the final day of the in-person training with 87% of participants completing the survey [9]. Instructors were asked to rank a list, using a Likert scale, of Industry 4.0 skills (aforementioned skills standard) to indicate if their knowledge did not increase, increased to basic understanding, increased to intermediate understanding, or increased to advanced understanding of the concepts [10]. Instructors ranked 20 skill areas as provided in Table II [10].

Of the respondents, 94.6% indicated a knowledge increase in one or more skills to either basic, intermediate, or advanced understanding [9]. When reviewing the same respondent data, but focusing on the intermediate and advanced understanding levels, 65.8% of respondents indicated one of these higher knowledge levels when answering the survey question [9]. Since instructors attended from both secondary and postsecondary institutions, responses were reviewed separately for each group as well. When reviewing these segments, 97.7% of secondary respondents indicated an increase to either basic, intermediate, or advanced understanding compared to 89.7% of postsecondary respondents [9]. Comparing the same segmented data and focusing on intermediate and advanced skill level responses, there is a more consistent response rate between secondary and postsecondary instructors of 66.1% and 65.2%, respectively. Despite institutional differences, these rates suggest the training model functions consistently across education levels.

TABLE II

Aggregated Numbers of Participant Responses Indicating Knowledge Level After Training

Industry 4.0 Duty Area	**No Increase in Understanding**	**Increased to Basic Understanding**	**Increased to Intermediate Understanding**	**Increased to Advanced Understanding**
Identify Industry 4.0 Fundamentals, Internet of Things and Industry Internet of Things, Big Data and Analytics	3	12	26	6
Introduction to Electrical Control Panels	3	9	23	11
Power Distribution in Industrial Systems	4	14	24	4
Transformers, Fuses, Power Supplies, Relays and Contractors	2	12	23	9
Basic Rules for Reading and	4	10	21	11

Interpreting Electrical Diagrams				
Control Circuits and Logic Functions	3	12	18	13
Practical Wiring Exercises	3	6	21	16
Motor Control Circuits	3	11	20	12
Safety in Electrical Control Systems; Machine Guarding and Safety Components	1	10	20	15
Safety Relays and their Applications	1	7	24	13
Troubleshooting Safety Circuits	1	13	21	11
Practical Application of Safety Relays	1	12	20	13
Identify Virtual and Augmented Reality	3	13	19	11
Introduction to Variable Frequency Drives (VFDs)	1	17	19	9
Common Wiring Connections for VFDs	1	16	19	10
Parameter Programming Basics	2	15	20	9
Digital Inputs and Outputs in VFDs	2	18	17	9
Advanced VFD Control Wiring and Parameter Adjustments	4	18	16	8
Modifying VFD Relay Functions	4	19	15	8
Diagnosing and Troubleshooting VFD Faults	4	21	13	8
Total Responses for Each Knowledge Level	**50**	**265**	**399**	**206**

Another section of the survey included a question that asked instructors to share how they planned to incorporate the information or experiences from the training into their classroom [10]. When reviewing this data, 96% of respondents indicated a response that positively reacted to the training or indicated activities to implement information received from the training [9]. When comparing secondary and postsecondary responses once again, 100% of secondary instructors provided a positive response related to implementation whereas postsecondary instructors provided a positive response rate of 88.9%. Positive responses from instructors included comments such as:

- "I am excited to add wiring safety relays and machine interlocks into our program [10]."
- "I plan to incorporate more Competency-Based Education into my classes. I also will bring my knowledge of electrical controls and VFDs into my industrial maintenance instruction [10]."

When reviewing attendee data versus respondent data, 80.5% of the attending instructors indicated their knowledge of Industry 4.0 increased in one or more skills [10], and 83.3% of the attending instructors indicated that they planned to incorporate what they learned or experienced into their own classrooms in a variety of ways, including through new equipment and technologies [9]. The project is on track to meet the goal of 70% of instructors incorporating what they learn into the classroom.

After each virtual CoP session, instructors, which primarily include those that have attended the in-person AI3 training, were also asked to complete another survey. This survey asked them to describe the usefulness of the information shared in the session and how they plan to incorporate the information into their classroom [11]. Response rates for these sessions averaged 58.7% of attendees [12]. When reviewing this aggregated 2025 session data, 89% of respondents indicated a response that positively reacted to the training or indicated activities to implement information received from the training. The remaining 11% of responses either did not provide a response or indicated a session was not applicable.

Conclusion

The aggregated data indicates this professional development model effectively supports instructors in acquiring Industry 4.0 knowledge and preparing for curricular integration. Utilizing in person and virtual sessions along with a combination of presentations and hands-on experiences creates a resourceful program [9]. Anecdotal observations of instructors indicated there may be varying timelines for actual implementation based on circumstances and resources. For example, two instructors from Colorado reacted positively to the training and are pending completion of a new pathway at their high school. A group of participating community college instructors built their own equipment and created labs based on skills learned. Six months later, these same instructors shared tips and experiences in the November 2025 CoP Session to assist their peers in incorporating Industry 4.0 into additional classrooms. During the program, many instructors commented on how the sessions were some of the best professional development opportunities they had attended. Due to these positive responses and the aforementioned data, the program will address the skills gap faced by manufacturers as relevant programming is used to better prepare students for the workforce.

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