SIGHT: SAFETY IMMERSION AND GAMIFIED HAZARD TRAINING FOR INDUSTRY 5.0 WORKERS

WSIC26-250206-009

PROJECT MANAGEMENT PLAN

Dr. Fadel Megahed

Miami University

Version 1.2

09/24/2025

This project is funded wholly by a grant awarded by the Ohio Bureau of Workers' Compensation, Workforce Safety Innovation Center®.

VERSION HISTORY

Version #	Implemented By	Revision Date	Approved By	Approval Date	Reason
1.0	Arthur Carvalho, Jay Shan, Mohammad Mayyas, Reza Abrisham Baf, Ibrahim Yousif, Mo Farrag, and Fadel Megahed	08/29/2025	Fadel M. Megahed	08/29/2025	First version
1.1	Arthur Carvalho, Jay Shan, Mohammad Mayyas, Reza Abrisham Baf, Ibrahim Yousif, Mo Farrag, and Fadel Megahed	09/11/2025	Fadel M. Megahed	09/11/2025	Corrections proposed by BWC
1.2	Arthur Carvalho, Jay Shan, Mohammad Mayyas, Reza Abrisham Baf, Ibrahim Yousif, Mo Farrag, and Fadel Megahed	09/24/2025	Fadel M. Megahed	09/24/2025	Corrections proposed by BWC (certifications)

TABLE OF CONTENTS

1. INTRODUCTION

1.1 EXECUTIVE SUMMARY OF PROJECT PROPOSAL

SIGHT (Safety Immersion and Gamified Hazard Training for Industry 5.0 Workers) is an initiative led by Miami University to modernize hazard-recognition training for Ohio manufacturers. The project integrates web-based virtual reality (VR), on-the-job augmented reality (AR), Industrial Internet of Things (IIoT) sensors, and generative Artificial Intelligence (AI) to move beyond static, one-size-fits-all safety modules. In particular, the project aims are:

Aim 1: VR-Based Hazard Recognition Training: Develop an interactive, web-based VR training system that provides scenario-driven learning tailored to real-world industrial hazards.

Aim 2: AR-Based Cyber-Physical Training System: Implement an AR-based, real-time hazard coaching system that utilizes AI and IIoT data to deliver intuitive safety interventions

Together, these solutions support an Industry 5.0 vision by targeting high-priority manufacturing hazards, such as cuts/lacerations, piercing injuries, and caught/crush/pinch incidents, identified on target equipment, including a manual milling machine and an electric forklift material handling vehicle, a CNC machine, and universal collaborative robots. Development will progress through structured work on data curation, core AI engine development using retrieval-augmented generation (RAG) and computer vision, gamified scripting and analytics, VR/AR proof-of-concepts, and testing and validation.

The project is led by Principal Investigator (PI) Dr. Fadel Megahed. Co-PIs Dr. Arthur Carvalho and Dr. Jay Shan provide expertise on database and AI development. Co-PI Dr. Mohammad Mayyas leads the integration of manufacturing systems. Senior Personnel Dr. Reza Abrishambaf directs IIoT integration and digital transformation. Postdoctoral researcher Dr. Ibrahim Yousif supports the development and integration of AI work. Graduate Research Assistant Michael Wise supports on-site data collection, equipment operations, and IIoT integration at the AM Hub. Additional student research assistants, approved by the Ohio Bureau of Workers' Compensation (BWC), will support software development, analytics, and validation. Project Manager (PM) Dr. Mohamed Farrag oversees administration and reporting. Independent evaluation is provided by Miami University's Discovery Center, spearheaded by Dr. Yue Li. Finally, Dr. Lora Cavuoto, Professor at the University at Buffalo, serves as a safety consultant.

Industry collaboration is central to the project's success and is supported by two industry partners: MaxByte Technologies, Inc., the primary Ohio partner, and MeetKai, Inc. MaxByte leads IIoT integration, edge computing, and AR commercialization. Its scope includes standardizing sensor kits, integrating the AI coaching layer, and enabling scale-up through its Ohio network. Meanwhile, MeetKai delivers a browser-based VR platform that integrates AI for adaptive, scenario-driven training, which works without specialized hardware. Future industry partners will provide facilities and access to their workforce to validate the usability and measure the impact of both solutions in real-world manufacturing contexts, ensuring continuous feedback from safety teams and frontline technicians.

The project will deliver two complementary training solutions: (1) an open source, publicly accessible, web-based VR hazard-recognition training platform usable by any professional, and (2) an on-site AR safety guidance solution requiring AR-enabled hardware for real-time, context-aware coaching. Both tools will be evaluated for measurable improvements in hazard identification rates, knowledge retention, and overall safety culture across Ohio's manufacturing sector, establishing a scalable model for Industry 5.0 workforce safety transformation.

1.2 Purpose of Project Management Plan

The SIGHT Project Management Plan (PMP) outlines the approach for executing, monitoring, and controlling the project throughout its duration. It serves as a comprehensive document to guide project stakeholders, including the BWC, the Project Manager (Dr. Mohamed Farrag), the PI (Dr. Fadel Megahed), and the Co-PIs (Dr. Arthur Carvalho, Dr. Jay Shan, and Dr. Mohammad Mayyas), in understanding their roles and responsibilities. The PMP ensures alignment with approved organizational objectives and deliverables. It supports effective decision-making and helps mitigate and eliminate risks to ensure the successful delivery of the project.

2. Scope Management

The scope of the project encompasses the full development, testing, and deployment of an adaptive VR hazard-recognition training platform and an AR-based on-the-job safety coaching system, both of which are underpinned by AI and IIoT integration. All activities are directed toward meeting the approved aims of building publicly accessible VR training modules, deploying AR coaching at the Miami University Advanced Manufacturing Hub, and validating these technologies through industry partnerships. Work is bounded by a defined set of deliverables, including AI models for hazard recognition and adaptive feedback, immersive VR and AR environments, and performance evaluation reports. Efforts outside of these objectives, such as expansion into unrelated training domains or unapproved commercial ventures during the project period, fall outside the scope of the project.

The project execution is governed by structured internal processes designed to maintain alignment with the approved plan. The PI leads a coordinated management approach involving Co-PIs, senior personnel, the project manager, and the external evaluator. Review meetings are held twice a month to monitor progress, validate milestones, and track expenditures against the budget. Detailed task assignments, milestone-based tracking, and centralized documentation, utilizing modern project management tools, ensure accountability and facilitate the early detection of deviations. For example, the following web page demonstrates our live system for tracking tasks and projects using the Notion software: https://modern-carrot-878.notion.site/Projects-Tasks-23cd922af54380e6a8fbd034562fabbb. Budget adherence is reinforced through Miami University's established grant management systems, which provide financial reporting and expenditure verification through the Workday platform.

To prevent, control, or mitigate unauthorized or unexpected project changes, the team employs a formal change control process. In particular, any proposed modifications to objectives, scope, or budget require internal review by the PI and Co-PIs and, where necessary, approval from the funding agency before implementation. Change control processes are further detailed in Section 2.3. Risks such as technology integration delays or partner availability issues are mitigated through phased work plans, overlapping development and testing cycles, and the use of alternative partners drawn from companies represented on advisory boards across multiple departments at Miami University, as well as from the broader industry networks of the PI and Co-PIs.

2.1 Assumptions & Constraints

As we elaborate upon next, the project operates under certain assumptions that underpin its technical and financial feasibility, technological maturity, cyber-physical infrastructure connectivity, software compatibility, hardware connectivity, integration capabilities, and successful implementation of the proposed VR/AR safety training platform.

More generally, we assume that end-users will demonstrate positive adoption rates for VR/AR training technologies, thereby overcoming potential cultural resistance to digital transformation initiatives. We also assume that immersive, gamified training methodologies can produce measurable improvements in hazard identification capabilities, knowledge retention rates, and overall safety culture compared to traditional classroom-based or computer-based training modules.

Regarding partnerships, the project assumes commitment and active participation from industry partners, throughout the development, testing, and validation phases. Specifically, the assumption encompasses MaxByte Technologies' continued engagement in IIoT integration and AR solution development, MeetKai's ongoing support for browser-based VR solution development and AI integration, and future industry partners' provision of facility access and workforce participation for usability testing. We further assume our partners will authorize interviews and surveys across organizational tiers (management, operations, and engineering) to generate actionable insights for requirements, user interface/experience, and deployment constraints.

Regarding the AI system, we assume that a RAG architecture, integrated with computer vision capabilities, can deliver the required accuracy and reliability for both machine and hazard recognition. This assumption also relies on the availability and performance of third-party LLM application programming interfaces (API) operating with low latency and consistently producing accurate results.

For the VR system, we assume that the web browser technologies used by end-users possess sufficient computational capabilities and standardized web API support to deliver immersive mixed reality experiences without requiring specialized hardware installations.

Regarding the AR system, the expectation is that the target manufacturing facilities maintain adequate network infrastructure, including sufficient bandwidth and low-latency connectivity, to support real-time data transmission between IIoT sensors and augmented reality coaching systems. Furthermore, we assume that IIoT sensor networks deployed in manufacturing environments will provide consistent, accurate, and timely data streams, which are necessary for contextual AR guidance. This assumption encompasses sensor reliability, data integrity, and the ability of edge computing systems to process sensor inputs with minimal latency.

Moving from assumptions to constraints, when it comes to technical constraints, the lack of standardized data streaming capabilities presents a significant barrier, as getting different machines and systems to share data seamlessly remains challenging. This occurs because industrial equipment often operates in isolation, utilizing proprietary communication protocols and legacy interfaces. The absence of general frameworks for comprehensive manufacturing process monitoring compounds this challenge, as there is no universally applicable solution to monitor diverse manufacturing processes. Furthermore, the AR system requires specialized hardware, specifically AR glasses and supporting computational infrastructure, which creates immediate constraints on deployment scope and user accessibility. Similarly, the VR system must operate within the computational and rendering limitations of standard web browsers across various device specifications. Finally, the integration of IIoT sensor networks introduces additional technical constraints, including data processing latency, sensor accuracy limitations, and communication protocol compatibility. In particular, existing manufacturing equipment may impose constraints on sensor placement, data collection frequency, and integration approaches, requiring our developed systems to adapt to legacy infrastructure rather than implementing optimal sensing configurations.

Regarding governance constraints, the project faces a fixed budget over its two-year performance period, which must cover all personnel, software, hardware, travel, and evaluation costs. This budgetary structure leaves little room to absorb unexpected price increases, particularly in materials, due to inflation, supply chain disruptions, or ongoing tariff disputes affecting imported hardware components. Any such increases could require scaling back on non-essential features or adjusting procurement timelines to stay within the approved financial plan. Additionally, all material purchases must comply with Miami University's procurement protocols. While these procedures ensure transparency and accountability, they can also introduce delays that compress development and testing schedules. Along similar lines, all project expenditures must align with approved budget categories, and any significant deviations may require agency approval, thereby enhancing transparency and accountability, but potentially slowing down project adjustments.

2.2 Work Breakdown Structure (WBS)

To design, develop, test, and deploy AI-enhanced VR and AR coaching systems for Ohio's manufacturing sector, we will undertake the following tasks. As detailed in the table below, our work begins with obtaining Institutional Review Board (IRB) approvals, hiring and training personnel, and assessing and integrating the machine. In Phase 1, we collect and organize data to deliver a supporting core database. In Phase 2, we build and deploy the core AI technology. Phase 3 creates gamified training and delivers the integrated AI analytics layer. In Phase 4, we develop AR/VR proof-of-concepts. Lastly, we conduct final tests before fully deploying all systems in Phase 5.

Table 1. Work breakdown structure.

Phase	Tasks/Activities	Connected Aim	Key Deliverable
Project Initiation	0.1 IRB approval 0.2 Hiring and training 0.3 Machine assessment, integration, and setup	Aim 1 (VR) Aim 2 (AR)	Requirements and design specification
Phase 1: Data Collection & Organization	1.1 Compile machine manuals	Aim 1 (VR)	Database creation
	1.2 Create image database		
	1.3 Detailed metadata tagging		
Phase 2: Core AI Development	2.1 Develop RAG model	Aim 1 (VR) Aim 2 (AR)	AI system deployment
	2.2 Develop image classification tools		
Phase 3: Gamified Training	3.1 Create gamified training modules	Aim 1 (VR)	AI and analytics layer integration
	3.2 Implement gamification engine	Aim 2 (AR)	
	3.3 Develop analytics framework	Aim 1 (VR)	

Phase 4: AR/VR Proof-of-Concept Development	4.1 Construct digital twin environment	Aim 2 (AR)	XR prototypes
	4.2 Develop 3D equipment renders	Aim 1 (VR) Aim 2 (AR)	
	4.3 Implement real-time speech-to-speech AI integration		
	4.4 Deploy Integrated VR and AR Training System		
Phase 5: Testing & Fine-Tuning	5.1 Conduct pilot testing 5.2 Refine XR systems 5.3 Deployment & commercialization roadmap	Aim 1 (VR) Aim 2 (AR)	Final application online

2.3 Change Control Management

The project utilizes a formal change control management system to ensure that any modification affecting scope, budget, schedule, or deliverables is carefully reviewed, documented, and approved prior to implementation. The live change control management system is available at https://modern-carrot-878.notion.site/24fd922af54380fab9a9d66dbd39adfc?v=24fd922af5438029b84e000c647c061d&pvs=74. The baseline, established in the funded proposal and initial project plan, serves as the reference point for measuring progress and identifying variances. Monitoring for potential changes is a shared responsibility of the PI, Co-PIs, and the PM, who work closely with team members and industry partners to detect early signs of scope creep, budget overruns, or schedule slippage. These leaders also provide ongoing mentoring to the development and evaluation teams, ensuring that any adjustments are aligned with project objectives and compliance requirements.

When a change is proposed, whether by internal staff or an industry partner, it must be submitted in writing to the PM, who must log the request into the project's change control register. The request must include, but is not limited to, a description of the proposed change, its rationale, and, if necessary, an impact assessment covering cost, schedule, scope, risks, and dependencies. The PM coordinates with the PI and Co-PIs to review the request, verify its necessity, and determine whether it falls within allowable adjustment tolerance or requires sponsor approval. If the change significantly impacts the approved budget categories, timeline, or deliverables, the PI and PM will prepare and submit a formal change request to BWC prior to implementation, in accordance with its requirements.

2.4 Commercialization Approach

The project's commercialization and deployment strategy ensures broad societal impact through the utilization of our two-tiered approach. The web-based VR platform will be offered at no cost to all Ohio manufacturers, democratizing access to high-quality safety training, enabling even small and medium-sized manufacturers to benefit from advanced tools without financial barriers. On the other hand, Miami University will retain ownership of the AR solution, with licensing opportunities for technology partners, such as MaxByte, to integrate it into broader industrial safety solutions and facilitate scaled deployment.

3. Time Management

Using modern project management tools, the PM, PI, and Co-PIs will regularly maintain and update our internal tracking and control system with the latest information to ensure accurate progress tracking and alignment with project milestones. Task durations are estimated by breaking work into smaller activities and applying expert input from the PI, Co-PIs, and industry partners to establish realistic timeframes. Milestones are then set as key checkpoints within our timeline, and progress is tracked against them. As needed, we adjust resources, priorities, or scope to maintain alignment and ensure on-time delivery.

3.1 Milestones

The table below outlines the key milestones of the project's lifecycle, the expected completion dates, and the associated aims.

Table 2. Key milestones.

Milestones	Estimated Completion Timeframe	Connected Aims
Requirements and design specification	Sep. 2025	Aim 1 (VR) Aim 2 (AR)
Database creation	Oct. 2025	Aim 1 (VR)
AI system deployment	Dec. 2025	Aim 1 (VR) Aim 2 (AR)
AI and analytics layer integration	Mar. 2026	Aim 1 (VR) Aim 2 (AR)
Mixed reality (XR) prototypes	Dec. 2026	Aim 1 (VR) Aim 2 (AR)
Final application deployment	Jun. 2027	Aim 1 (VR) Aim 2 (AR)

3.2 Project Schedule

This timeline reflects all major milestones and tasks in our project. As planned in the proposal, *start dates correspond to the first business and end dates correspond to the last business day of a given month*.

Table 3. Project Schedule

Phase/Task	Start Date	End Date	Dependencies (Internal & External)
Project Initiation			
0.1 IRB approval	Jul. 2025	Sep. 2025	Dependent on IRB review cycle and availability of board members; must be approved before any human subject testing begins.

Phase/Task	Start Date	End Date	Dependencies (Internal & External)
0.2 Hiring and training	Jul. 2025	Sep. 2025	Internal HR recruitment timelines; potential delays due to summer academic break and the beginning of the academic semester.
0.3 Machine assessment, integration, and setup	Jul. 2025	Sep. 2025	Availability of AM Hub facilities; equipment readiness; scheduling around lab maintenance and university facility access.
Milestone: Requirements and design specification	Jul. 2025	Sep. 2025	Requires IRB approval and personnel onboarded.
Phase 1: Data Collection & Organization			
1.1 Compile machine manuals	Oct. 2025	Oct. 2025	Access to manufacturer manuals; availability of the safety consultant.
1.2 Create image database	Oct. 2025	Oct. 2025	Facility/lab access for photography; equipment operational readiness.
1.3 Detailed metadata tagging	Oct. 2025	Oct. 2025	Consultant review of OSHA/BWC/NIOSH documentation.
Milestone: Database creation	Oct. 2025	Oct. 2025	Dependent on timely completion of 1.1–1.3 and student availability during the fall semester.
Phase 2: Core AI Development			
2.1 Develop RAG model	Nov. 2025	Dec. 2025	Availability of curated dataset from Phase 1; access to stable LLM APIs.
2.2 Develop image classification tools	Nov. 2025	Dec. 2025	Requires finalized image database and GPU/compute resources.
Milestone: AI system deployment	Nov. 2025	Dec. 2025	Dependent on successful Phase 1 completion and functioning compute infrastructure.
Phase 3: Gamified Training			
3.1 Create gamified training modules	Jan. 2026	Jan. 2026	Stakeholder input sessions.
3.2 Implement gamification engine	Jan. 2026	Feb 2026	Requires completion of training scripts; coordination with VR development partner MeetKai.

Phase/Task	Start Date	End Date	Dependencies (Internal & External)
3.3 Develop analytics framework	Mar. 2026	Mar. 2026	Dependent on integration with VR modules; cloud/edge infrastructure availability.
Milestone: AI and analytics layer integration	Jan. 2026	Mar. 2026	Requires alignment between internal developers and MeetKai deliverables.
Phase 4: AR/VR Proof-of-Concept Development			
4.1 Construct digital twin environment	Jan. 2026	Jun. 2026	Access to AM Hub floor space and equipment.
4.2 Develop 3D equipment renders	Jan. 2026	Mar. 2026	Dependent on equipment imaging from Phase 1; availability of MeetKai 3D artists.
4.3 Implement real-time speech-to-speech AI integration	Jul. 2026	Dec. 2026	Requires access to external speech-to-speech APIs; testing time scheduled around fall semester workload.
4.4 Deploy Integrated VR and AR Training System	Jan. 2026	Dec. 2026	Dependent on MaxByte AR development timelines; availability of AM Hub lab facilities.
Milestone: Mixed reality (XR) prototypes	Jan. 2026	Dec. 2026	Hinges on aligned development schedules of MeetKai (VR) and MaxByte (AR) partners
Phase 5: Testing & Fine-Tuning			
5.1 Conduct pilot testing	Jan. 2027	Apr. 2027	IRB approval already in place; participant recruitment aligned with academic calendar.
5.2 Refine XR systems	Jan. 2027	Jun. 2027	Dependent on pilot testing results, developer availability, and partner feedback schedules.
5.3 Deployment & commercialization roadmap	May 2027	Jun. 2027	Requires collaboration with MaxByte for licensing strategy; University summer break may affect dissemination.
Milestone: Final application deployment	Jan. 2027	Jun. 2027	Dependent on pilot testing completion and refinement.

4. Quality Management

Quality management for this project is embedded across all phases, from data collection to XR proof-of-concept deployment and final testing. The approach integrates continuous measurement, quality control, and quality assurance practices to ensure all activities and deliverables meet the required standards of accuracy, reliability, and safety. In particular, each project phase incorporates measurable performance indicators that are directly tied to milestones. Data quality, AI system accuracy, usability performance, and compliance with specifications will be tracked through both automated logging systems and structured expert reviews. Interim progress will be benchmarked against predefined thresholds, defined in "Exhibit D Post Application Supplemental Documents_WSIC26-250206-009 MU Megahed" (p. 24 of the PDF document). Deviations from these thresholds will trigger corrective actions before progression to subsequent phases. The following covers our plan regarding quality control measures.

- Phase 1 (Data Collection & Organization): All operational and safety documentation will undergo dual review by the research team and safety consultant to ensure standardization and completeness. The image database will be validated using automated metadata validation scripts and manual audits to confirm accuracy, coverage, and consistency.
- Phase 2 (Core AI Development): AI outputs will be evaluated against holdout datasets and validated by the research team. Accuracy rates will be continuously measured and logged. Failed classifications or inconsistent responses will be analyzed, and the training data will be adjusted accordingly.
- Phase 3 (Gamified Training Script & Analytics Layer): Our team will stress-test the analytics framework. Randomized test scenarios will be executed to verify system responsiveness and reliability.
- Phase 4 (XR Proof-of-Concept): VR/AR prototypes will undergo structured usability tests with predefined setup and operation tasks. Completion times and error rates will be recorded. Integration of AI subsystems will be validated through regression testing to confirm consistency after each iteration.
- Phase 5 (Testing and Fine-Tuning): Participant data resulting from experiments will be continuously monitored for completeness, with recruitment quotas and balance checks verified prior to final testing. Scenario evaluation forms will undergo statistical analysis to ensure the reliability of participant feedback.

Our quality assurance processes emphasize reliability, safety, and compliance. For example, all AI models and XR systems will be version-controlled using versioning software such as GitHub, with audit trails maintained for datasets, code revisions, and configuration changes. Test results will be independently verified by the safety consultant. From a safety and compliance perspective, compliance with machine-specific operational safety standards (OSHA and industry guidelines) will be ensured by cross-referencing training content and XR overlays with official documentation and consulting with our safety consultant.

Regarding roles and responsibilities, the PI will hold overall accountability for quality management and regulatory compliance. The Co-PIs will be responsible for quality control and assurance reviews, oversight of corrective actions, and documentation of compliance activities. Finally, the safety consultant will independently verify compliance with safety standards and regulations.

4.1 Innovation Testing and Certification Standards

We will reference ISO 45001:2018 practices during the development and pilot phases to support effective hazard identification, risk assessment, worker participation, and continuous improvement in health and safety management. In addition, ANSI Z490.1 criteria will inform the design, delivery, and evaluation of AR/VR safety training programs, helping ensure training methods are consistent, effective, and aligned with accepted practices. For technical safety, both ISO 13849 and IEC 61508 will be considered when developing machinery simulations and control system representations in AR/VR environments, with the goal of reflecting safety-related requirements and functional reliability. To further address immersive technology risks, UL 8400 standards will be used as a reference for the safety of VR/AR/MR devices and applications. Finally, ISO/IEC 23894 will guide risk management for AI-driven VR/AR training systems, including considerations for data integrity, bias, and ethical deployment. The following table summarizes the standards relevant to our project.

Table 4. Testing & Certification Standards

Standard/Requirement	Description	Applicability
ISO 45001:2018	International standard for occupational health and safety management systems	References practices for hazard identification, risk assessment, worker involvement, and continuous safety improvement in AR/VR training environments.
ANSI Z490.1	Criteria for accepted practices in safety, health, and environmental training	Informs the development, delivery, and evaluation of AR/VR safety training programs to support effectiveness and alignment with accepted practices.
ISO 13849	Standard for the safety of machinery, focusing on safety-related parts of control systems	Provides guidance to help AR/VR modules realistically simulate machinery controls and reflect safety interlocks in training scenarios.
IEC 61508	International standard for functional safety of electrical/electronic/programmable electronic safety-related systems	Serves as a reference for representing control system behaviors in VR/AR simulations, including safe states and potential failure modes.
UL 8400	Standard for safety of VR, AR, and MR technologies	Offers requirements that can be referenced when addressing safety considerations in the design, testing, and deployment of VR/AR headsets and applications.
ISO/IEC 23894	Guidance on risk management for artificial intelligence in information technology	Provides a framework for managing risks in AI-driven VR/AR training platforms, including data quality, bias, and ethical considerations.

5. Resource Management

The team organizes resource management into three domains: Human Resources, Materials, and Financial. This section is organized accordingly. Human Resource management specifies roles, skills, time commitments, and reporting lines. Materials management encompasses material custody, procurement process configuration, and inventory management. Financial management encompasses budget baseline development, milestone allocations, cash flow tracking, variance management, and sponsor reporting.

5.1 Human Resource Management

The SIGHT project is structured for clear responsibility, accountability, and collaboration. Figure 1 shows key personnel and reporting relationships. Solid blocks denote individual roles and areas of expertise; dashed group blocks indicate pooled roles or teams. The direction of the arrows indicates formal reporting. At the top, the PI, Dr. Fadel Megahed, leads the project and serves as the sponsor interface. Reporting to the PI, the PM, Dr. Mohamed Farrag, manages administration, tracks deliverables and schedules, and coordinates communications. Co-PI Dr. Arthur Carvalho and Co-PI Dr. Jay Shan lead database architecture pipelines and provide expertise in AI and predictive analytics. Co-PI Dr. Mohammad Mayyas leads AM Hub operations, ensures equipment readiness and maintainability, and provides expertise in Industry 4.0 and smart manufacturing. Supporting them, Senior Personnel Dr. Reza Abrishambaf and Postdoctoral Researcher Dr. Ibrahim Yousif jointly lead automation and digital-transformation activities at the AM Hub and contribute expertise in IIoT integration and digital-twin development. Student researchers are supervised by the postdoctoral researcher and faculty leads; their work supports research, development, and system implementation based on role and expertise. The hiring request for the postdoctoral researcher, graduate research assistant, and hourly student assistant roles, prepared in accordance with BWC criteria and including each candidate's qualifications, resume, and start date, was submitted to BWC on August 24, 2025, and the approval notice was received on August 25, 2025.

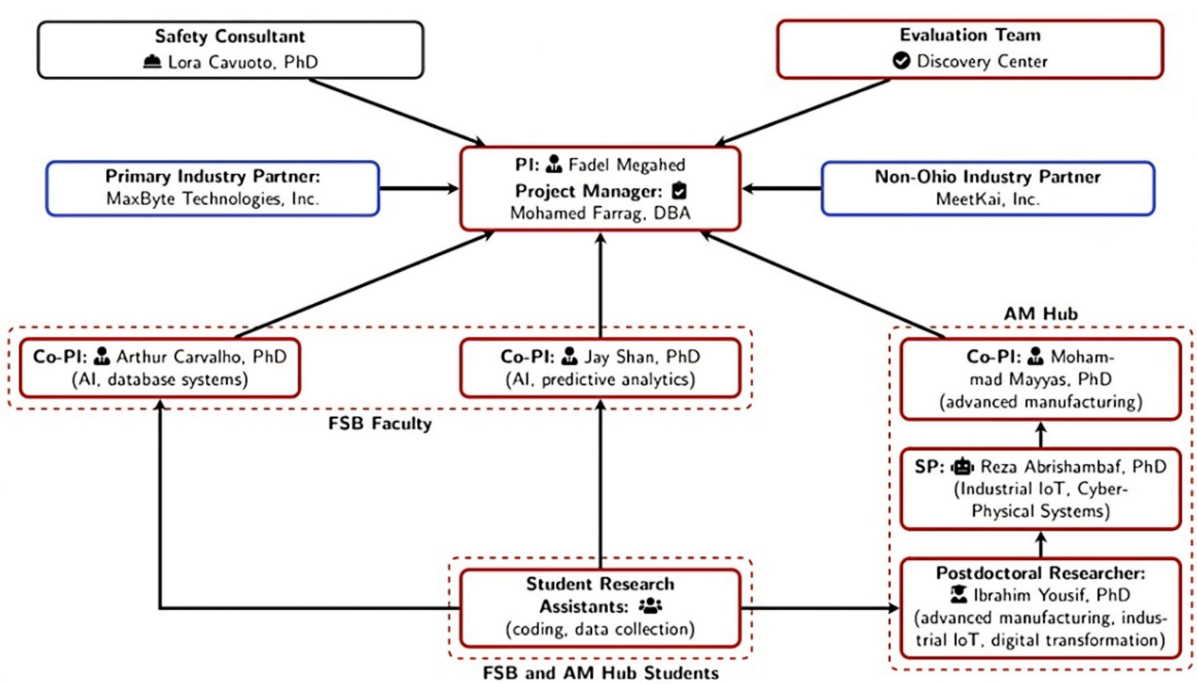

Figure 1: Project organizational and reporting structure.

Industry partners MaxByte Technologies, Inc., responsible for AR and IIoT integration, and MeetKai, Inc., responsible for the browser-based VR platform development, collaborate closely with the research team. They coordinate day-to-day with Drs. Yousif and Abrishambaf and report milestone progress to the PI and

PM. The Discovery Center at Miami University, led by evaluator Dr. Yue Li, assesses project outcomes and conducts independent evaluation. Dr. Lora Cavuoto, professor at the University at Buffalo, serves as a safety consultant, advising on safety best practices and hazard assessment. Detailed role information is provided in Table 5 and Table 6 for internal personnel and industry partners, respectively.

Table 5: Internal personnel: Roles and responsibilities.

Name	Role	Main Responsibilities
Dr. Fadel Megahed	Principal Investigator Miami University	— Overall leadership and success accountability for scope, budget, and compliance — Primary sponsor interface and milestone approvals
Dr. Arthur Carvalho	Co-Principal Investigator Miami University	— Co-leads AI system architecture and model development — Leads speech-to-speech AI integration within XR systems — Supervises students — Defines data-governance practices
Dr. Jay Shan	Co-Principal Investigator Miami University	— Co-leads AI development, database management, and edge AI implementation — Oversees SIGHT deployment and data pipeline reliability — Provides expertise in AI and predictive analytics — Supervises students — Tracks model performance metrics
Dr. Mohammad Mayyas	Co-Principal Investigator Miami University	— Leads AM Hub activities and advanced manufacturing integration — Co-mentors the postdoctoral researcher — Oversees IIoT integration (Cobot, CNC, manual milling, automated forklift) — Provides advanced manufacturing expertise and guidance
Dr. Reza Abrishambaf	Senior Personnel Miami University	— Manages automation and digital transformation initiatives at the AM Hub — Co-develops IIoT/AR integration and control interfaces — Supports research, development, and system implementation — Co-mentors postdoctoral researcher and student researchers — Ensures site and systems readiness
Dr. Mohamed Farrag	Project Manager Miami University	— Leads comprehensive administrative task management — Budget tracking, reporting, and grant compliance

		— Ensures research activities and deliverables meet schedules — Maintains risk/issue/change logs — Compiles project progress and financial reports — Coordinates teams, contractors, and vendors meetings — Tracks deliverables
Dr. Lora Cavuoto	Safety Consultant University at Buffalo	— Coordinates training content design and development — Advises on safety best practices and hazard assessment — Co-designs training content and validation criteria — Reviews ergonomics — Approves safety gates before pilots — Ensures compliance with safety protocols and standards
Dr. Yue Li, (Discovery Center)	Associate Director Discovery Center Miami University	— Serves as liaison between research team and Discovery Center — Designs and conducts independent evaluation and assessment of project outcomes — Defines metrics — Analyzes outcomes and provides feedback — Reports evaluation findings to PI — Aligns with IRB requirements
Dr. Ibrahim Yousif	Postdoctoral Researcher Miami University	— Drives applied research across AI/AR/IIoT integration — Supports computer-vision and AI layer development — Develops digital-twin simulation — Coordinates integration and on-site validation with industry partners — Writes academic report (articles) — Mentors student researchers
Michael Wise	Graduate Research Assistant Miami University	— Leads hands-on data collection at the Hamilton AM Hub — Operates CNCs, mills, and robotic arms safely — Maintains equipment readiness, experiment logs, and documentation — Assist with experiments
Amanda L. White	Undergraduate Research Assistant (Hourly Student Worker) Miami University	— Implements Python-based RAG knowledge engine — Builds ingestion, indexing, retrieval, and evaluation scripts

		— Integrates knowledge services with VR/AR training content
Austin A. Hamilton	Undergraduate Research Assistant (Hourly Student Worker) Miami University	— Develops interactive VR/AR modules in Unity — Implements device interfaces and scene logic — Optimizes runtime performance — Connects AI outputs to XR interactions and UI
Ryan Singh	Graduate Hourly Worker Miami University	— Builds analytics layer and KPI dashboards — Designs telemetry pipelines for evaluation

Table 6: Industry Partners: PoC, Roles, and Responsibilities

Name	Role	Main Responsibilities
Ramshankar CS	Organizational Senior Collaborator MaxByte	— Allocates and manages MaxByte resources and personnel for AR and IIoT integration — Delivers AR/IIoT modules — Ensures on-time, on-budget deliverables — Supports pilots — Reports progress to PI, PM, and collaborates with AM Hub team
James Kaplan	Organizational Senior Collaborator MeetKai	— Allocates and manages MeetKai resources and capabilities — Leads web-based Virtual Reality (VR) platform development — Delivers VR modules/APIs, coordinates with AM Hub researchers — Ensures deliverables meet schedule and budget constraints — Meets security and uptime commitments — Reports progress to PI, PM, and collaborates with research team

The RACI matrix (Responsible, Accountable, Consulted, and Informed) in Table 7 clarifies roles and responsibilities for activities and deliverables within our project.

Table 7. RACI matrix.

PROJECT RACI CHART - SIGHT Platform Development

LEGEND: **R = Responsible** | **A = Accountable** | **C = Consulted** | **I = Informed**

Activity/Deliverable	Fadel (PI)	Arthur (Co-PI)	Jay (Co-PI)	Mayyas (Co-PI)	Reza (SP)	Farrag (PM)	Lora (Safety Consultant)	Yue (Evaluator)	Ibrahim (Postdoc)	Michael (GRA)	Amanda (URA)	Austin (URA)	Ryan (GRA)	Ramshankar (MaxByte)	James (MeetKai)	Industry Partners
Overall Project Leadership & Governance	A	C	C	C	I	R	I	I	I	I	I	I	I	I	I	I
Budget Tracking & Financial Reporting	A	I	I	I	I	R	I	I	I	I	I	I	I	I	I	I
Grant Compliance & Reporting	A	C	C	C	C	R	C	C	C	I	I	I	I	I	I	I
Risk Mitigation Plan, Risk Log, & Change control	A	C	C	C	C	R	C	I	C	I	I	I	I	C	C	I
Milestone Approvals, Reviews, & BWC	R	C	C	C	I	A	I	I	I	I	I	I	I	I	I	I
Define KPIs & acceptance criteria; analytics/telemetry	R	C	C	A	C	I	C	R	I	I	I	I	I	C	C	I
AI System Architecture & Model Development	C	A	R	C	C	I	I	I	R	C	C	C	C	I	I	I
Speech-to-Speech AI Integration	R	R	A	I	I	I	I	I	C	I	I	C	I	I	I	I
Database Management & SIGHT Deployment	I	C	A	I	C	I	I	I	R	I	R	I	C	I	I	I
AI Model Roadmap & Training Pipeline	C	C	R	I	C	I	I	I	A	C	C	I	C	I	I	I
MLOps & Data Governance	I	A	R	I	C	I	I	I	R	C	C	I	C	I	I	I
Edge AI Implementation	I	C	A	C	R	I	I	I	R	C	I	I	C	I	I	I
AM Hub Activities & Operations	I	I	I	A	R	C	C	I	C	R	I	I	I	C	I	I
IIoT Integration (Cobot, CNC, Lathe, Forklift)	I	I	I	A	R	C	C	I	R	R	I	I	I	R	I	I
Automation & Digital Transformation	I	I	I	C	A	I	I	I	R	C	I	I	C	C	I	I
Equipment Setup & Maintenance	I	I	I	C	A	I	C	I	C	R	I	I	I	C	I	I
Applied Research (AI/AR/IIoT Integration)	I	C	C	A	C	I	I	I	R	C	C	C	C	C	C	I
Computer Vision & AI Layer Development	I	C	A	C	C	I	I	I	R	I	C	I	I	I	I	I
Digital Twin Emulation Development	C	C	C	A	C	I	I	I	R	C	I	I	C	I	I	I
Data Collection & Ground-Truthing; Analytics dashboards & telemetry	I	I	C	C	C	I	I	C	A	R	C	R	R	I	I	I
Publications & Research Outputs	R	R	R	R	R	I	R	I	A	C	C	C	C	I	I	I
AR/IIoT Module Development	I	I	I	C	A	C	I	I	C	I	I	I	C	R	C	I
VR Platform Development	I	I	I	I	A	C	I	I	C	I	I	C	I	C	R	I
Knowledge Engine Services (RAG) Development	R	A	C	C	I	I	C	I	C	I	C	C	C	I	I	I
Interactive VR/AR Training Modules	I	C	I	I	I	I	C	I	C	I	C	A	C	R	R	I
XR System Integration	I	A	C	I	C	I	I	I	C	I	C	R	I	R	C	I
Safety Training Content Design & gate approvals	A	I	I	I	I	I	R	I	C	C	I	C	I	I	I	I
IRB & Data governance & Approvals/Controls	A	C	C	I	I	I	R	I	C	C	C	I	C	I	I	C
Safety Protocols & Standards Compliance	A	I	I	C	C	C	R	I	R	C	I	I	I	C	C	C
Hazard Assessment, Risk Log & Management	C	I	I	C	C	C	A	I	R	C	I	I	I	C	C	C
PPE/Ergonomics Reviews	I	I	I	A	C	I	R	I	R	R	I	I	I	I	I	I
Independent Project Evaluation	C	I	I	I	I	I	I	A	I	I	I	I	I	I	I	I
Metrics Definition & Outcome Analysis	C	I	C	I	I	C	I	A	C	I	I	I	R	I	I	I
IRB Compliance & Reporting	A	I	I	I	I	C	C	R	I	I	I	I	I	I	I	I
Performance Assessment	C	I	C	I	I	C	I	A	C	I	I	I	R	I	I	C
Data Curation & Management	I	C	A	I	C	I	I	I	R	C	C	I	R	I	I	I
Analytics Layer & KPI Dashboards	I	I	C	I	I	C	I	C	C	I	I	R	A	I	I	I
Telemetry Pipelines	I	I	C	C	C	I	I	C	C	C	R	I	A	I	I	I
Student Researcher Supervision	A	R	R	R	R	I	I	I	R	I	I	I	I	I	I	I
Postdoctoral Researcher Mentoring	I	I	I	A	R	I	I	I	I	I	I	I	I	I	I	I
Training & Development Activities	I	C	C	A	R	I	C	I	C	C	C	C	C	I	I	I
Industry Partner Coordination	A	I	I	C	C	R	I	I	R	I	I	I	I	C	C	I
Contractor Management	A	I	I	C	C	R	I	I	C	I	I	I	I	I	I	I
Team Meetings & Communications	C	C	C	C	C	A	C	C	C	C	C	C	C	C	C	I
Progress Reporting	A	C	C	C	C	R	C	C	C	I	I	I	I	C	C	I

The project spans 24 months. To quantify individual effort, we calculate each team member's commitment as a percentage: (Total Months Committed ÷ Total Project Duration) × 100, rounded to the nearest whole percent. For example, Dr. Fadel Megahed contributes 5.10 full-time months (≈21%), while Drs. Mayyas, Shan, and Carvalho each contribute 5.16 months of work (≈22%). Figure 2 shows these time commitments. Any revisions to effort commitments will follow the project's change-control procedure and will be promptly reported by the PI and PM to Miami University's Grants Administration and the Ohio BWC, with prior sponsor approval obtained when required.

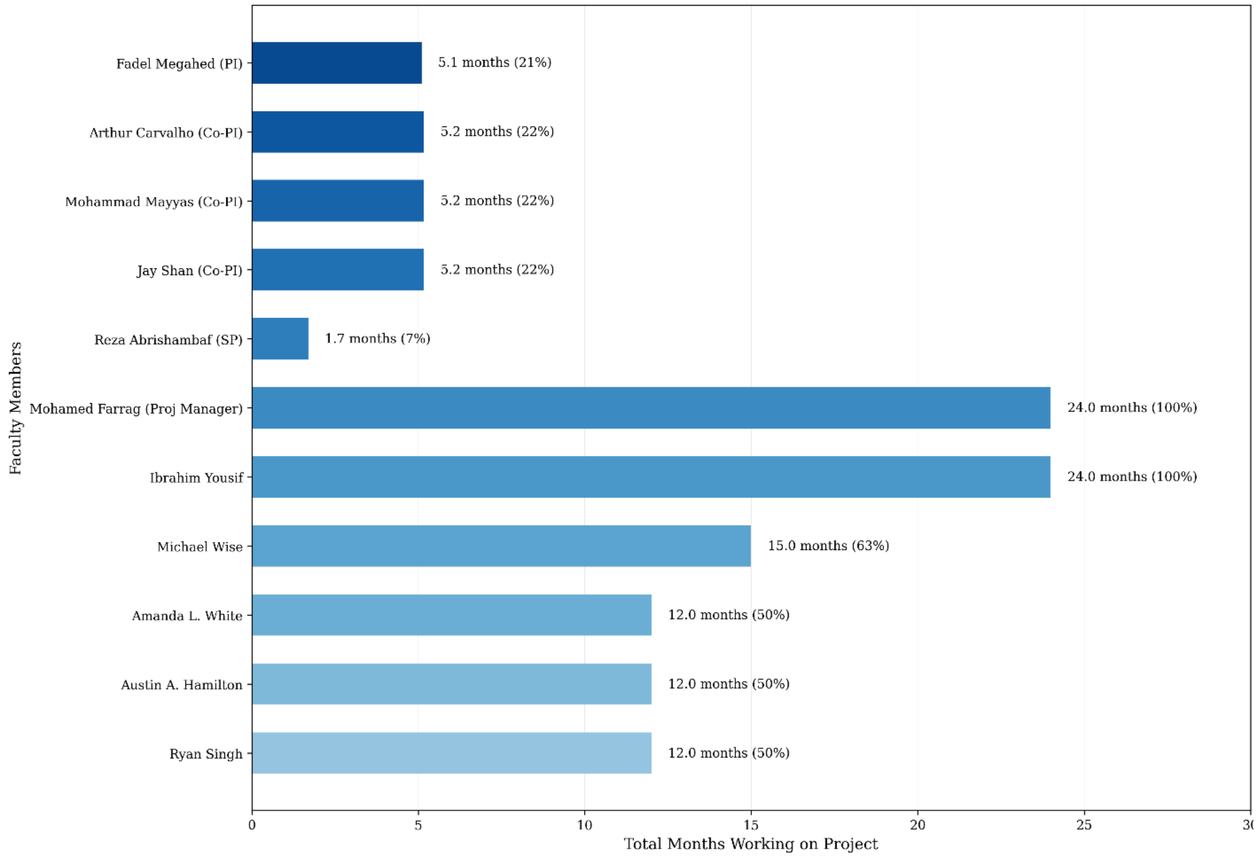

Figure 2. Faculty and students' project commitment: Duration and time allocation.

5.2 Material Resource/Procurement Management

All project purchasing activities will adhere to Miami University's established procurement guidelines, as detailed in the Purchasing Policy[1] and Purchasing Handbook[2]. Whenever possible, items will be acquired through Miami University's approved supplier catalogs to ensure access to negotiated pricing and streamlined approval processes. Our to-be-procured materials are significantly under the $10,000 (internal limit for equipment classification), and thus, we suspect that all our purchases will be made using departmental purchasing cards. The PI and Co-PIs will oversee purchasing decisions, ensuring (whenever possible) that the purchases are consistent with our approved budget. The PM will be responsible for maintaining accurate records and managing them effectively.

[1] https://miamioh.edu/finance-business/strategic-procurement/purchasing/purchasing-policy.html
[2] https://miamioh.edu/finance-business/strategic-procurement/purchasing/purchasing-handbook.html

5.3 Financial Resource Management

All expenditures must align with the approved budget categories. Any deviations requiring rebudgeting (budget revisions and redirections) will be processed through the formal change-control procedure. Supporting documentation, including purchase orders, invoices, receipts, and payroll certifications, will be maintained in Miami University's Workday financial system to ensure a complete and auditable transaction record.

Roles and Responsibilities

- **PI:** The PI holds overall accountability for budget stewardship and compliance.
- **Co-PIs**: Oversee spending within their respective technical workstreams and allocated budgets.
- **PM:** Responsible for day-to-day budget tracking, processing contractor invoices (e.g., MaxByte and MeetKai), maintaining expenditure documentation, and monthly monitoring of all project-related transactions in Workday. Any significant budget variances will be escalated to the PI for corrective action.

Quarterly Financial Reporting and Invoicing

The Grants & Contracts (G&C) department at Miami University will prepare and submit all outgoing quarterly invoices and financial reports to the Ohio BWC in accordance with the approved project schedule.

Quarterly Review Process:

- After the month-end close (typically within five business days), the PM and PIs will review a summary of actual expenditures by budget category to ensure all expected expenses are posted and accounted for.
- The project team may be asked to provide additional documentation or clarification for specific expenses, as needed.
- Once reviewed and confirmed, the assigned G&C accountant will complete the quarterly invoice and financial report, which will then go through internal reviews and secure the required authorized signature.

Reporting Timeline

- **Start Date:** September 30, 2025 (first reporting period ends)
- **End Date:** June 30, 2027 (final project closeout)
- **Submission Deadlines:**
    - <u>Quarterly expenditure report and invoices:</u> Due ~30 days after the end of each quarter per the Table in P.27 of the WSIC Grant Application Guide.
    - <u>Final expenditure report and invoices:</u> Due on July 30, 2027

Budget Revisions and Redirections

We will follow the detailed guidelines provided in the WSIC Budget Revision document. Formal budget revisions and redirections will follow the five-step process outlined in the WSIC Budget Revision Instructions document. Given that WSIC provides two periods for such requests: Q4, and Q7, with the stipulation that "requests must be submitted at the beginning of the applicable quarter", we plan to submit the budget revision request letter and the updated project budget/expenditure report Excel file to WSIC at approximately 15 business days from the start of that specific quarter (i.e., 10 days after the PM and PIs meet to discuss the expenses). This time will be used to document all the changes and align with the requirements set forward in the WSIC instructions.

6. Communications Management

The Miami University project team, Maxbyte, MeetKai Inc., and other project partners will serve as the primary internal communication channels. The PM will oversee the creation and ongoing maintenance of the communication plan. A crucial point of such a plan is that an in-person or virtual project team will meet every two weeks to discuss issues, evaluate progress, and reach important decisions. All relevant materials, including agendas, meeting minutes, training materials, data, and other pertinent files, are securely stored on Google Drive and shared with all project members (MU project personnel, industry partners, the safety consultant, and project evaluators from the Discovery Center).

For external stakeholders, including the Ohio BWC and future industry partners providing testing grounds, progress will be communicated primarily through stakeholder reports prepared by the PI, Co-PIs, and PM, milestone review sessions, and/or scheduled partner update calls. These communications will summarize technical progress and address evolving requirements or risks. Furthermore, the

Beyond the core stakeholders, the project will also engage academic and public audiences through multiple communication channels. Academic outreach will include submitting manuscripts for peer-reviewed publications and/or presenting at professional conferences, such as the ASSE Safety Conference. Public engagement will be supported by Miami University's media channels, including press releases (e.g., see MU Press Release[3]), feature stories, project website[4] updates, and/or social media posts (e.g., Summer Progress LinkedIn Post[5]). Media outputs may include short demonstration videos of VR hazard scenarios, infographics showing Industry 5.0 safety benefits, and testimonials from trainees and industry partners. Together, these efforts will ensure that project results are communicated effectively, widely disseminated, and accessible to all relevant audiences.

7. Risk Management

The PM will be responsible for the development and ongoing maintenance of a comprehensive project risk mitigation plan. Working in close coordination with the PI and Co-PIs, the PM will implement established risk management practices to systematically identify, evaluate, monitor, and mitigate potential risks. A centralized risk management log, maintained in Notion[6], will serve as the authoritative record and will be reviewed and updated by the PM no less than twice per month. Each log entry will include detailed information on the probability of occurrence, anticipated impact, composite risk score, designated owner, and corresponding mitigation strategies and plans. Consistent with the data management procedures described in the preceding section, all project documentation, including risk-related materials, will be

[3] https://miamioh.edu/news/2025/07/miami-university-receives-1.5m-grant-for-ai-powered-manufacturing-safety-training-project.html
[4] https://sites.miamioh.edu/sight/
[5] https://www.linkedin.com/feed/update/urn:li:activity:7363268088248623105/
[6] The following link displays our live risk management log system using the Notion software: https://modern-carrot-878.notion.site/25ed922af5438011897fd3ce814c6bf2?v=25ed922af5438085b1d2000cc9e10e49&source=copy_link

securely stored on Google Drive and made accessible to all project personnel. Hyperlinks to these files will be embedded within the Notion risk log to ensure seamless integration and ease of access.

To reduce, control, and mitigate risks affecting the project, we will employ a proactive, multi-layered strategy grounded in continuous monitoring, structured mitigation planning, and adaptive response, which we will thoroughly elaborate on in our project risk mitigation plan. Risks will be prioritized based on their probability and potential impact, with high-priority risks assigned clear ownership and tracked in the centralized risk log (see Footnote 6), which all stakeholders have access to remotely. Preventive measures include phased development schedules (see Figure 1) with extra safeguards and built-in slack to keep progress on track even if challenges arise. In addition, we will rely on overlapping validation cycles to identify issues early, allowing us to test and review deliverables at multiple points in time (see Table 2), often before a phase is fully complete. Finally, as discussed in Section 2, we have proactively planned for backup industry partners to safeguard against resource and/or availability disruptions.

Where risks cannot be fully prevented, contingency plans will be implemented, including predefined fallback approaches for technology integration, alternative vendor arrangements, and reallocation of internal resources to sustain progress. The PM will update the risk log for periodic reporting, and regular bi-weekly project review meetings will serve as checkpoints to reassess risks, validate the effectiveness of mitigation measures, and adjust strategies as necessary. Our overarching goal is that such a structured approach will ensure that risks are systematically identified, transparently documented, and proactively managed to safeguard project deliverables and timelines.

8. Compliance Related Planning

The following table outlines common compliance-related laws, regulations, and policies, and specifies their applicability to this project.

Table 8. Compliance requirements, description, and applicability.

Compliance Requirement	Description	Applicability / Notes
SOC 2	Security, availability, processing integrity, confidentiality, and privacy requirements for data safety.	Included in project requirements definition to ensure data safety is prioritized.
ISO 45001:2018	International standard for occupational health and safety management systems.	Provides guidance for system development with a focus on health and safety.
OSHA Regulations	U.S. federal requirements for workplace safety management.	Provides regulatory guidance for system development related to safety compliance.
ADA (Americans with Disabilities Act)	Accessibility requirements for commercialization, including functionality testing.	**To be determined:** As a Track 2 (Proof of Concept) Project, we are aware that this would be applicable if we are

		successful and graduate to a Track 3 Project. However, we will consider ADA implications in our design choices for both the AR and VR environments, utilizing the human factors engineering expertise of our consultant.
Miami University Procurement Policy	All procurement must go through authorized processes. Unauthorized commitments do not bind the University. "No PO, No Pay" policies apply.	Ensures all purchases follow university procedures; compliance with Strategic Procurement policies is required.
Miami University Effort Reporting	Uniform Guidance §200.430 requires effort certification for federally funded projects.	**Not Applicable:** This is a state-funded project, not federal, so effort certification requirements do not apply; however, we will follow the university's effort reporting guidance whenever possible.
Miami University Equipment Policy	Equipment (≥$10,000, >1-year life) purchased with external funds must be tracked and inventoried.	**Not Applicable:** No equipment purchases are anticipated for this project.
Miami University IRB / Research Compliance	Human subjects research must be submitted to IRB 4–6 weeks before implementation; CITI and orientation training are required. Projects involving animals require IACUC protocol. Biosafety review applies to recombinant DNA, infectious agents, or hazardous materials.	Compliance with IRB/IACUC/IBC oversight and training is mandatory. All research team members working with human subjects will be CITI Trained, and we have already begun the IRB approval process. We will submit our approved IRB acceptance notification within 10 days per the BWC/WSIC Policy.
WSIC / BWC Grant Administration (GAPP Manual)	Recipients must follow the WSIC GAPP Manual, state fiscal rules, and grant terms. This includes procurement standards,	Applies to all WSIC-funded projects. Non-compliance may result in disallowance, enforcement action, or termination. We will consult

	allowable/unallowable costs, reporting requirements, monitoring, and records retention.	and abide by the GAPP Manual in our grant decisions.
WSIC Budget Revisions	Budget revisions are allowed only in Q4 and Q7. They require a Budget Revision Request Letter, updated Project Budget/Expenditure Report, and WSIC approval before changes take effect.	We will follow the WSIC quarterly schedule and approval process.
WSIC Invoicing	Invoices must match approved WSIC budget categories exactly; invoices and expenditure reports must be submitted quarterly via OIA.	Required for reimbursement. Incorrect or incomplete invoices may delay payment.

9. Performance Measures

This section outlines the metrics that will be used to measure the success of the SIGHT project. These metrics will be reported in both interim and final reports to ensure alignment with project goals and objectives.

9.1 Success Metrics

Table 9. Success metrics.

Metric	Description	Target Value	Measurement Method	Reporting Frequency
Metric 1	Compile 100% standardized operational and safety documentation for the three selected target machines (Bridgeport Manual Mill, TL-1 CNC, Universal Cobot)	100% compilation	Completeness of documentation (an expert assessment of the compiled documents and whether they capture the operation/safety procedures for our targeted machines)	Once (Upon Completion of Phase I; October 2025)
Metric 2	Create a comprehensive image database containing a minimum of 60 high-quality,	60 images per machine	Count of images stored (manually or using a computer program)	Once (Upon Completion of Phase I; October 2025)

Metric	Description	Target Value	Measurement Method	Reporting Frequency
	metadata-tagged images per machine for the three target machines, covering multiple angles and operational scenarios			
Metric 3	Achieve at least 80% response accuracy for safety-critical information queries with the RAG system, validated through expert review and user testing	80% response accuracy	Expert evaluation via qualitative assessment following approaches in the literature, e.g., that of Megahed et al. (2024), on the use of ChatGPT for statistical quality control	Once (Upon Completion of Phase II; December 2025)
Metric 4	The AI image classification system will achieve at least 80% classification accuracy on a holdout dataset under standard lighting and at least 75% accuracy under varying environmental conditions	80% classification accuracy under standard lighting conditions; 75% under varying environmental conditions	Classification accuracy is defined as the total number of correct images divided by the total number of images in the test/holdout set (which can be computed using Python or our programming language of choice)	Once (Upon Completion of Phase II; December 2025)
Metric 5	A framework for tracking user interactions that successfully captures data from at least 90% of training interactions within 5 seconds per interaction	Capturing 90% of training interactions with 5-second latency	Automated logging on the WebVR via tracking software	With each interaction in our training data (To be reported with Phase III; March 2026)
Metric 6	Have functional VR and AR proof-of-concept prototypes that successfully integrate AI systems (RAG, image classification, speech-to-speech), display 3D renders/AR overlays for target equipment, and connect to the analytics backend	1 functional VR and 1 functional AR proof-of-concept prototypes	Preliminary user testing by the project team, which will be documented manually and likely recorded on video	Once (Upon Completion of Phase IV; Dec 2026)

Metric	Description	Target Value	Measurement Method	Reporting Frequency
Metric 7	Ensure XR prototypes achieve initial usability, demonstrated by first-time users (research team/safety consultant) completing setup and initiating use of both VR and AR systems in under 30 minutes each	Completing the setup and using the system within 30 minutes of first interaction with the devices	Usability testing via surveys and/or qualitative interviews	Once (Upon Completion of Phase IV; Dec 2026)
Metric 8	Successfully recruit participants balanced across student trainees and industry professionals. Ensure that at least 36 participants complete and evaluate all required scenarios in both VR and AR testing sessions	Having 36 participants who completed both VR and AR testing sessions	Session completion logs/data, including manual sheets, which can either be filled by hand or computer-based	Once (Upon Completion of Phase V; June 2027)
Metric 9	Deploy the refined web-based VR application for public access via the project website, with the link provided in the final report	A public link that can be accessed by the public	A working public web link, which is easily verifiable by examining access and data loading	Once (Upon Completion of Phase V; June 2027)

9.2 Process for Monitoring and Reporting

Data Collection: Data for each success metric will be collected through a combination of automated tracking systems, manual logs, and/or direct assessments. We listed the specific data collection approach for each metric in parentheses under the "Measurement Method Column" in Table 7.

Analysis: The research team (PI, Co-PIs, senior personnel, post-doctoral student, and/or student assistants) will perform initial analyses on the collected data. Our analyses will be verified and/or supplemented by those of the evaluation team to ensure that the project goals are met.

Reporting: The metrics will be reported to our research team, industrial partners, and safety consultant in our regular scheduled meetings, which happen twice a month. Our reporting will include both work-in-progress updates and comprehensive evaluations. Furthermore, we will use the quarterly, interim, and final reports as well as the final presentation to present our results to the Ohio BWC/WSIC. Additionally, reporting may be included in our conference presentations, journal paper submissions, provisional patent submissions, and/or social media announcements.

9.3 Continuous Improvement

As an AI-enabled and data-driven research team, we operate in a constantly evolving and continually improving technology landscape. In our project proposal, we alluded to the impact of new AI technologies (e.g., image-to-3D models) on improving the generalizability of our proposed XR solution through the stretch goal of creating XR overlays on the fly. As such, our approach to improving our project's outcomes involves three complementary approaches:

- *Adoption of and experimentation with novel AI technologies*: We understand that new, state-of-the-art AI models will be released throughout our project. Our research team is encouraged to examine whether any of these models can further improve the performance of our SIGHT platform. If initial experimentations show an improvement in performance (e.g., generation quality, computational complexity, accuracy, or latency), we will incorporate such technologies in our solution. We will document any such changes in accordance with our change management procedure, as defined in Section 2.3.
- *UI/UX Feedback:* Through our analytics layer and initial experimentation with the XR proof-of-concept prototype, we are capturing quantitative and qualitative data regarding the users' interactions with our SIGHT platform and perceived usefulness/ease-of-use of the platform. This information will be incorporated to refine our SIGHT platform prior to the expanded user testing in Phase 5 (see Figure 1).
- *Metric and milestone-driven performance reviews:* A formal evaluation of each of our nine metrics in Table 7 will be performed. If any of the metrics are not achieved, the team, in collaboration with our industry partners and safety consultant, will examine additional alternative strategies to improve performance, including, but not limited to, those mentioned in our project proposal.

Continuous improvement is not limited to our technical work. We also plan to utilize the lessons learned throughout the project, as well as the feedback from the BWC/WSIC on our administrative deliverables, to improve our submitted items. For example, we experimented with three approaches for attendance verification (Zoom, Google Forms, and manual sign-in sheets). Based on our experience, we have found that the automated Zoom recording is the most suitable approach; therefore, we plan to use it for all our future meetings.

10. Project Closeout

As the SIGHT project approaches its completion date of June 30, 2027, the team will conduct a structured closeout process that fulfills sponsor requirements while also ensuring long-term impact and knowledge transfer. The process will begin with the preparation of a comprehensive final report that documents all research activities, outputs, evaluation findings, and outcomes relative to the success metrics outlined in Section 9.1. A final financial and expense report will accompany this submission, providing full documentation of all expenditures in accordance with BWC/WSIC requirements and ensuring accountability. In parallel, the project team will deliver a final presentation and live demonstration of the VR hazard-recognition platform, the AR safety coaching modules, and their supporting analytics to BWC/WSIC representatives and industry partners.

Beyond compliance, the closeout phase will include a structured post-project review led by the Discovery Center. This review will capture lessons learned in three domains: technical feasibility, including (1) the integration of AI and IIoT systems; (2) workforce usability, focusing on adoption, training effectiveness, and user experience; and (3) industry partner feedback, addressing deployment readiness, scalability, and commercialization potential. The Discovery Center's evaluation will be compiled into a formal report to ensure that insights are systematically documented and shared with all relevant stakeholders. More formally, the project closeout will follow a root cause analysis framework to systematically investigate underlying factors behind both successes and challenges. This analysis will examine five critical dimensions:

1. What worked well: identifying successful practices, tools, and approaches that should be replicated and scaled.
2. What could be improved: analyzing challenges and enhancement opportunities for commercialization.
3. What would we do differently: proposing alternative approaches based on proof-of-concept experience.
4. What should be standardized: recommending practices for organizational adoption and prototype development.
5. What requires further investigation: identifying areas needing additional research before market deployment.

The closeout process will also prioritize sustainability and knowledge transfer. All project documentation, datasets, and source code will be archived in secure and accessible repositories to facilitate future use. Project outcomes may be disseminated through peer-reviewed publications, national safety and manufacturing conferences, and industry-focused workshops and webinars, ensuring that results extend beyond the immediate sponsor and partners.

Overall, these closeout activities will serve as a bridge to the next phase of development. The results from Track 2, including validated XR prototypes, usability data from industry partners such as MaxByte's Ohio-based clients, and a refined commercialization strategy, will form the foundation of the planned Track 3 Prototype Development proposal, which is scheduled for submission in February 2027. By aligning closeout activities with future project planning, the SIGHT team will ensure that lessons learned are translated into practical improvements and that the outcomes of Track 2 provide a strong platform for sustained innovation and scalability.

APPENDIX A: PROJECT MANAGEMENT PLAN APPROVAL

The undersigned acknowledge they have reviewed the SIGHT Project Management Plan and agree with the approach it presents. Changes to this Project Management Plan will be coordinated with and approved by the undersigned or their designated representatives.

Signature: Date: 08/29/2025

Print Name: Fadel M. Megahed

Title: Raymond E. Gloss Professor in Business

Role: PI

Signature: Date: 08/29/2025

Print Name: Arthur Carvalho

Title: Associate Professor

Role: Co-PI

Signature: Date: 08/29/2025

Print Name: Jay Shan

Title: Associate Professor

Role: Co-PI

Signature: Date: 08/29/2025

Print Name: Mohammad Mayyas

Title: Professor and Chair of Engineering Tech

Role: Co-PI

Signature: Date: 08/29/2025

Print Name: Mohamed Farrag

Title: Visiting Assistant Professor

Role: Project Manager

APPENDIX B: REFERENCES

The table below summarizes the key reference documents for the Project Management Plan.

Table 10. Referenced documents.

Document Name and Version	Description	Location
Projects and Task Real-Time Tracking: Notion Page	Real-time tracking of the subprojects and tasks for our SIGHT project	https://modern-carrot-878.notion.site/Projects-Tasks-23cd922af54380e6a8fbd034562fabbb
Live Change Control Management System: Notion Page	A Notion Page to track our changes for the project, with their requestor and their approvers	https://modern-carrot-878.notion.site/24fd922af54380fab9a9d66dbd39adfc?v=24fd922af5438029b84e000c647c061d&pvs=74
MU Purchasing Policy	Miami University's Purchasing Policy	https://miamioh.edu/finance-business/strategic-procurement/purchasing/purchasing-policy.html
MU Purchasing Handbook	Miami University's Purchasing Handbook	https://miamioh.edu/finance-business/strategic-procurement/purchasing/purchasing-handbook.html
MU Press Release for the Initiation of the SIGHT Project	Press release for the SIGHT Project initiation and funding	https://miamioh.edu/news/2025/07/miami-university-receives-1.5m-grant-for-ai-powered-manufacturing-safety-training-project.html
SIGHT Project Website	A site for the SIGHT Project News	https://sites.miamioh.edu/sight/
Arthur Carvalho's LinkedIn Post for Summer 2025 Activities	A LinkedIn post by Arthur Carvalho, capturing our activities in the MU Hamilton Campus over Summer 2025	https://www.linkedin.com/feed/update/urn:li:activity:7363268088248623105/
Risk Management Log: Notion Page	A Notion Page to log discovered risks and mitigation strategies	https://modern-carrot-878.notion.site/25ed922af5438011897fd3ce814c6bf2?v=25ed922af5438085b1d2000cc9e10e49&source=copy_link
Megahed et al. (2024)	Academic paper serving as the guideline for expert evaluation of AI models	https://arxiv.org/pdf/2302.10916

APPENDIX C: KEY TERMS

The table below provides definitions for terms relevant to this Project Management Plan.

Table 11. Key terms.

Term	Definition
SIGHT	*Abbreviation for our project's name: SAFETY IMMERSION AND GAMIFIED HAZARD TRAINING FOR INDUSTRY 5.0 WORKERS*
AR	*Augmented reality*
VR	*Virtual reality, web-based*
XR	*Mixed reality, a combination of AR and VR*
IIoT	*Industrial Internet of Things, i.e., sensors connected to the internet*
AM Hub	*Advanced Manufacturing Hub, located in Miami University Hamilton*
RAG	*Retrieval augmented generation, where large language models are grounded using one or more prespecified documents*
API	*An application programming interface, the standard way of importing/exporting data on the web*