

MassTech Pathmaker Core Competency Checklist

Core competencies establish the minimum content for a Pathmaker-approved training program. The MassTech Core Competency Checklist identifies the areas that must be addressed. Examples shown in italics illustrate focus areas that may satisfy each requirement.

General Competencies for either Manufacturing or AI/Robotics

- ☐ **Career track options:** entry-level occupations, employer information, wages and benefits, job expectations, career pathways, advancement opportunities
- ☐ **Basic professional skills:** workplace readiness, attendance, punctuality, dependability, accountability, initiative, communication, teamwork, problem-solving, responding to feedback, time management, computer literacy, resume/interview preparation, employer attendance and scheduling expectations
- ☐ **Digital and AI literacy:** digital communication and documentation, responsible use of AI in the workplace, data privacy and cybersecurity awareness, evaluating technology-generated information for accuracy

Manufacturing & Defense Competency Framework

This track prepares participants for entry-level careers in manufacturing and defense-related manufacturing operations. Programs combine foundational workplace capabilities with hands-on technical training aligned with documented employer hiring needs. Career examples include manufacturing technician, CNC operator, assembler, and quality inspector.

Role Specific Competencies

- ☐ **Good Documentation Practices:** reading and following standard operating procedures, work instructions, technical drawings, and workplace documentation; recording technical activities and results; documenting and escalating issues
- ☐ **Tools, Equipment, and Safety:** selecting and safely preparing tools and equipment, following technical instructions, validating equipment readiness, using measuring and inspection tools, maintaining an organized and safe work area
- ☐ **Quality and Process Control:** quality standards, inspection and testing, quality-control tools, process monitoring, corrective action, documenting and escalating quality concerns
- ☐ **Manufacturing Processes and Technology:** production workflows, materials, technical drawings, sensors, computer-controlled equipment, automation, robotics, and basic mechanical, electrical, or electromechanical systems
- ☐ **Troubleshooting and Maintenance:** defining a problem, collecting relevant information, identifying root causes, implementing and validating solutions, basic maintenance, continuous improvement

Optional Company-Specific

Examples include: CNC machining, blueprint reading, geometric dimensioning and tolerancing, metrology and inspection, assembly, welding and fabrication, additive manufacturing, robotics, semiconductor or microelectronics processes, cleanroom practices, employer-required certifications, or other skills identified by a partner employer.

Robotics AI Competency Framework

This track prepares participants for entry-level and applied careers in AI-enabled robotics — roles that combine perception, autonomy, and human-robot collaboration with foundational workplace capabilities. Initial Role Specific competency work is based on the National AI Competency Framework, with initial input from key stakeholders including the MA Business Roundtable, AI Coalition, MA AI Hub, EOLWD, and CommCorp.

Role Specific Category 1: AI Literacy

Target: Applied | Sector-specific application: Perception systems, autonomy levels, and AI decision-making in physical systems

Model Fundamentals

- **Model inputs:** Understand how sensor data (LiDAR, cameras, IMU, force/torque) and simulation-generated data shape perception and control model performance
- **Model behavior:** Understand how perception and planning models generate probabilistic outputs — object detection confidence, trajectory predictions — under real-world sensor noise
- **Model outputs:** Understand the forms of robot AI outputs — classifications, pose estimates, motion plans, control commands — and their reliability limits

AI Systems Understanding

- **System components:** Distinguish the roles of the perception, planning, and control stack — sensors, models, and actuators — within a robotic system
- **System integration:** Understand sensor fusion, real-time inference pipelines, and the tradeoffs between edge and cloud compute in a control loop
- **System deployment:** Understand how autonomy level (from teleoperated to fully autonomous) and on-device vs. networked control affect accountability and safety

Workplace Context

- **Tool landscape:** Recognize the robot operating systems (e.g., ROS), vision libraries, and simulation platforms in use on the floor or in the lab
- **Work impact:** Recognize how autonomous systems reshape task allocation, human-robot work cells, and staffing needs

Role Specific Category 2: AI Usage

Target: Proficient | Sector-specific application: Simulation platforms, computer vision frameworks, AI-powered robot programming tools

Identify & Assess AI Use-Cases

- **Opportunity recognition:** Identify robotics tasks suited to AI-driven perception or autonomy — pick-and-place, inspection, navigation
- **Suitability assessment:** Evaluate whether a vision-based or autonomous approach fits task variability, throughput, and safety constraints
- **Use-case piloting:** Run simulation or testbed trials to validate an approach before physical deployment

Direct AI Effectively

- **Tool selection:** Select the vision framework, simulation platform, or robot programming tool appropriate to the task

- **Context & data preparation:** Prepare training data — annotated images, CAD models, sensor logs — in a form usable for robot learning
- **Instruction & direction:** Program and parameterize robot behaviors; define task goals, constraints, and success criteria
- **Iteration & refinement:** Tune models and behaviors through simulation-to-real (sim2real) testing cycles
- **Workflow adaptation:** Redesign cell layout and task sequencing around AI-enabled robot capabilities — the cluster most often missing from robotics training programs

Role Specific Category 3: AI Oversight & Governance

Target: Applied | Sector-specific application: Safety in autonomous systems; liability and accountability; ISO and OSHA standards

Evaluate AI Output

- **Evidence verification:** Verify perception and detection outputs against ground truth via sensor cross-checks
- **Reasoning & consistency:** Assess whether robot decision logic behaves predictably and safely across varying conditions
- **Purpose fit:** Determine whether the autonomy level in use is reliable enough for the task and environment

Use AI Responsibly

- **Fairness & bias mitigation:** Address vision model performance gaps across lighting, materials, and environmental conditions
- **Value alignment:** Ensure automation decisions align with organizational safety priorities and workforce values
- **Safety & misuse prevention:** Prevent unsafe autonomous behavior and unauthorized system overrides

Apply Policy Compliance

- **Regulatory adherence:** Apply ISO 10218 / ISO 15066, ANSI/RIA, and OSHA robotics safety standards
- **Data privacy & protection:** Secure sensor and video data; restrict access to control systems

Exercise Human Oversight

- **System calibration:** Set the appropriate autonomy level and human-in-the-loop checkpoints for a given task
- **Escalation & intervention:** Recognize when to e-stop, override, or hand control back to a human operator
- **Explanation & transparency:** Communicate clearly to workers and operators how and when the robot is acting autonomously

Role Specific Category 4: AI Build & Engineering

Target: Proficient | Sector-specific application: The highest Build requirement of any sector — this workforce builds the systems rather than using them

Plan & Prepare Data

- **Solution & architecture design:** Design perception, planning, and control system architecture for a physical task

- **Data engineering & preparation:** Build sensor data pipelines; simulate and label training data for robot learning

Build & Develop Models

- **Model & algorithm design:** Design perception, SLAM, motion planning, and reinforcement learning policies
- **Training & optimization:** Train and tune models under real-time, embedded compute constraints
- **Agent & workflow engineering:** Build autonomous decision-making and task-orchestration logic
- **Retrieval & context engineering:** Integrate maps and world models to ground planning and navigation
- **System integration:** Connect trained models to actuators, controllers, and hardware I/O

Verify, Deploy & Operate

- **Model & system validation:** Test safety and robustness in simulation and physical trials before deployment
- **Serving & release engineering:** Package and deploy models to embedded or edge robot hardware
- **Operations & lifecycle oversight:** Monitor fleet performance; maintain, update, and retire deployed systems

Role Specific Category 5: Human Capabilities (Professional Skills)

Target: Applied | Sector-specific application: Designing human–robot collaborative work is a requirements and translation problem as much as an engineering one

Exercise Domain Judgment

- **Expertise application:** Apply floor or process expertise where AI has no reliable coverage — novel parts, edge cases
- **Judgment under uncertainty:** Make safe operational calls when sensor data is ambiguous or conflicting
- **Accountability for outcomes:** Own the outcomes of human-robot collaborative decisions, not just the process

Solve Novel Problems

- **Problem framing:** Frame ambiguous physical-world tasks so that robotic/AI assistance becomes productive
- **Domain synthesis:** Combine AI output with tacit process knowledge to solve physical-world problems
- **Experimentation & iteration:** Change approach when a robotic solution fails to perform in practice

Translate & Collaborate

- **Technical translation:** Translate between robotics engineers and operations, clinical, or production stakeholders
- **Requirements definition:** Write specifications precise enough for robot behavior and task design
- **Opportunity identification:** Surface cross-functional robotics opportunities no single team can see alone

Lead Through Change

- **Change leadership:** Guide teams through the role and workflow change driven by robotics/automation adoption

- **Learning culture:** Create conditions where experimentation with new robotic tools is safe and expected
- **Investment & workforce prioritization:** Decide where robotics investment goes, what tasks to automate, and how role composition should change