Smart Factory Trainer for Industry 4.0
Bridging the Gap Between Classroom and Industry

Industry 4.0 is not simply a buzzword. The technological and conceptual changes in manufacturing are changing the face of industry. Educational institutions need to change the perspective of what and how they teach to prepare graduates for this new paradigm.

NEW SKILLS/NEW ROLES

■ INTEGRATION
As more complex manufacturing systems are deployed, smart factory or Industry 4.0 environments are centered around system level integration.

■ CONNECTIVITY
Interconnectivity enables real-time data collection and analysis from equipment on the factory floor and is the cornerstone of production efficiency and predictive/preventative maintenance.

■ SIMULATION
Visualization or offline testing of system solutions enables viability testing, enhanced planning and ensures safety before deployment.

To address these new skills, employees in a modern factory require strong interdisciplinary skills in automation, integration, systems, communications, and networking.

Intelitek offers an integrated program including curriculum that encompasses design, hands-on experience, project-based learning, and theory to deliver job ready graduates for industry.

The flexible solution, with mix and match training modules, skill-sets and hardware, creates a comprehensive manufacturing program culminating with a capstone project using the Electro-Mechanical Manufacturing Cell.

Flexible solution for educating and training students in the principles and technologies of advanced manufacturing
Building Expertise in Industry 4.0 Technologies

THREE TIERED INDUSTRY 4.0 TRAINING PROGRAM:

1. **EMMC-1000** Base Platform for Level 1 Technician Skills Training

   Students, build, interconnect, configure, troubleshoot and operate the cell.

2. **I4MC-1000** Industry 4.0 Platform for Level 1 and Level 2 Training

   Upgraded cell includes automation, machine vision, networking for more advanced technical or specialist level training and certifications.

3. **I4MC-1200** Multi-faceted and Flexible Industry 4.0 Integration Trainer

   Flexible platform focused on integration, connectivity, and information processing to enable technicians, specialist and integrators to learn, implement and get certified for industry jobs.

Tiered Training Platform for Multi-level Industry 4.0 Certification Aligned with ARM CRSS Certification Blueprint

**Interdisciplinary Training for Industry 4.0**

- Manufacturing Fundamentals
  - Safety
  - Tools
  - Measurement and QC
  - Maintenance
  - Manufacturing Processes
- Electrical for Industry
  - Basic Power Electricity
  - Electrical Control Systems
  - Industrial Power Electronics
- Mechanical Systems
- Sensors
- Machine Vision and Quality Control
- Pneumatics
- Hydraulics
- Automation and PLCs
- Robotics and Materials Handling
- Networking and Cybersecurity
- Data Collection and Analysis
- Simulation and Planning
- Process Management

**Prerequisite Skills Training**

Intelitek offers over 300 online, interactive and practical lab based training programs used to deliver industry designed and skills mapped training on core skills and manufacturing specific education to students of all levels. Starting with fundamental and progressing to advanced courses, training programs include:

- Electrical
- Mechanical
- Fluid Power
- PLC/Automation
- Machining
- Robotics
- and more...

**Hands-on Project**

Programs uses the EMMC-1000, I4MC-1000 or I4MC-1200 cells to implement hands on, self driven capstone projects where students must complete skill drills and work orders just like they will see in real work environments. The work orders test the students knowledge as they implement all they have learned in a real-world scenario with life-size actual industrial components. Students are given tasks and exercises specific to their program and certification level.

**Certification Testing**

Certified Robotics Solutions Specialist (CRSS)

Certification exams aligned to competency maps developed with industry and ARM (Advanced Robotics for Manufacturing) are required to complete the CRSS Certification.

**Tiered Training Platform**

- **Level 1 - Technician**
  - **Tier 1** EMMC-1000 Maintenance Cell
  - **Tier 2** I4MC-1000 Ind. 4.0 Mfg. Cell

- **Level 2 - Specialist**
  - **Tier 3** I4MC-1200 Adv. Ind. 4.0 Mfg. Cell

- **Level 3 - Integrator**

**Hardware Platforms**

**Tech Learning**

- Creative Thinking
- Career Skills
Electro-Mechanical Maintenance Cell (EMMC-1000)

The JobMaster® EMMC-1000 Electromechanical Maintenance Cell simulates the automated manufacturing operation of an industrial plant. This platform, used as a teaching program or a capstone project by CTE and manufacturing programs worldwide delivers relevant and practical training in the installation, operation, troubleshooting and maintenance of industrial processes and equipment.

The construction of the cell can be performed entirely by the trainees. Using industry-standard work orders, standard operating procedures, schematic diagrams and manufacturers technical manuals as resources, students assemble the system, install the electrical wiring, configure the pneumatic subcomponents, and learn to operate the add-on components. Built around validated industry skills, trainees develop troubleshooting skills in a relevant, engaging manner. Each task includes measurable criteria for assessing students’ performance.

The JobMaster® EMMC-1000 Electromechanical Maintenance Cell is the ultimate capstone to any industrial maintenance/mechatronics program.

Once operational, faults, skills exercises and integration projects can be introduced by the instructor to expand the knowledge of the students.

Training Documentation and Operating Instructions

- Supplied for each task in standard industry format
- Work orders and operating procedures
- Electrical schematics and mechanical drawings
- Observable and measurable performance standards
- Maintenance supervisor signoff/assessment

EMMC-1000 Cell Features

In a footprint of just 20 square feet and on wheels to make it mobile, the base cell includes electrical power distribution and controls, wire, conduit and equipment housings, and lighting fixtures. Students will engage in mechanical systems, pneumatics systems and automation leading to more advanced learning of industrial systems. Students gain enhanced understanding of industrial processes by installing, operating and troubleshooting sub-systems onto the cell including:

- Industrial Electrical Systems
- Conveyor drive and control
- Part manipulator and controls with paint, bake & cool process simulation
- Pneumatic system and controls
- Motors, Motor Controls and Drives
- Automation and PLC Control
- Networking
- Troubleshooting and predictive maintenance

The construction of the cell can be performed entirely by the trainees.

EMMC-1000 Specifications

<table>
<thead>
<tr>
<th>System Requirements</th>
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<tbody>
<tr>
<td>Power: 15A Single or Three Phase AC Power</td>
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<tr>
<td>Freq: 50Hz-60Hz</td>
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<tr>
<td>Compressed Air: 50Psi @ 1CFM</td>
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<tr>
<td>Tools: Metric and Imperial Socket Set, Wrenches and Allen Keys, Hacksaw, EMT Bender, Utility Knife, Screwdriver set</td>
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</table>

**Specifications**

| Dimensions | 76.5” × 36” × 60” LxWxH (1945mm × 915mm × 1525mm) |
| Weight     | 500lbs (227kg) Assembled                          |
| Material   | Extruded Aluminum Frame 1.5” × 1.5” Painted Steel Enclosures |

**Components**

| Frame        | 28 pcs of 1.5” x 15” Extruded Aluminum |
|             | 170pcs of Misc. Fasteners              |
|             | 4 Wheels                               |
| Electrical Enclosures | 5x Steel UL Listed Enclosures |
|             | 40pcs Misc. Fasteners                  |
| Electrical Conduit | 10ft 3/4” EMT |
|             | 25ft 1/2” Flexible PVC Conduit         |
|             | 25ft 1/2” armored Flex Conduit         |
| Motor Controller | Single/Three Phase Variable Frequency Drive w/Modbus Support |
| Conveyor Motor | Three Phase 60v Gear Motor              |
| Conveyor Belt | 59” × 8” conveyor belt w/Stainless Steel Frame |
| Pneumatic Parts Feeder | Acrylic Parts Feeder w/Sensor to feed 2in × 3in × 1/2” stock |
| Paint, Bake, Cool Process | Simulation of industrial manufacturing process installed on conveyor belt |
| PLC          | 24v PLC with 8 Inputs and 8 Outputs, Serial, Ethernet w/Software |
| Wiring       | 4 x 100ft 18AWG THHN Stranded Wire      |
|             | 1 x 100ft 20AWG 2C Stranded             |
| Transformer  | 500VA - 220v to 110v step down           |
| Station Lighting | LED Lighting               |
The JobMaster I4MC-1000 cell is a fully configured emulation of an Industry 4.0 industrial plant with a comprehensive range of mechanical, electrical, pneumatic and automation components for students to construct, operate and troubleshoot. The cell is a learning environment for a school, where students can become practiced in manufacturing processes and expand their skill-set to advanced Industry 4.0 operations.

In addition to all the components and skills covered in the EMMC-1000 platform, the I4MC system adds advanced skills like networking and communications, advanced automation with PLCs, sensors and integration, upgrading the experience to be compatible with Industry 4.0 manufacturing settings. The I4MC-1000 platform can not only be used to train Industry 4.0 Level 1 maintenance technicians, but also has the skills and components to certify Level 2 Specialists aligned to the ARM blueprint for Industry 4.0 Certification.

Whether constructed from scratch by students as a capstone project or used as an on-going learning project, the I4MC-1000 introduces students to standard operating procedures via work orders, schematic diagrams and maintenance orders. Once operational, faults can be introduced, skills can be tested and integration projects can be introduced by the instructor to expand the knowledge of the students.

### Industry 4.0 Maintenance Cell (I4MC-1000)

Using the same frame and footprint as the EMMC-1000 of just 20 square feet, this upgraded mobile trainer adds elements specific to Industry 4.0 to enhance your program to 21st century manufacturing skills. Students will be introduced to networking and communications of the smart factory and advanced automation through PLCs and sensors, all elements found commonly in updated manufacturing facilities and essential to all levels of maintenance, predictive maintenance, operation, monitoring, control and optimized design of Industry 4.0 environments.

The core elements of Industry 4.0 monitoring (sensors) and data collection and analysis can be integrated with MES and ERP software to control, monitor and troubleshoot the process to introduce students to the latest techniques in predictive maintenance and system integration.

#### EMMC-1000 Skills & Training Exercises

**Manufacturing Cell Frame Assembly**
- Work Order: Assemble the Base
- Work Order: Assemble and Install the Conveyor Mount
- Work Order: Install Crossbars and Top Members
- Work Order: Inspect & Align Completed Frame

**Electrical and Control Enclosures**
- Work Order: Install Pull Boxes
- Work Order: Install Equipment Enclosures
- Work Order: Install Fuse Box and Station Transformer

**Conduit & Fittings Installation**
- Work Order: Cut and Ream Conduit
- Work Order: Wire & Connect Main Power Panel
- Work Order: Install & Connect Circuit Breakers
- Work Order: Install Equipment Grounds
- Work Order: Perform Megohmmeter Tests

**Conveyor, Conveyor Drive & Controls**
- Work Order: Install Conveyor
- Work Order: Install Conveyor Drive Components
- Work Order: Install and Align Conveyor Drive Chain
- Work Order: Install Conveyor Drive Safety Guard
- Work Order: Install and Connect Conveyor Drive

**Wiring of Conveyor drive Motor Control Circuit**
- Work Order: Install Emergency Stop Circuits
- Work Order: Perform Circuit Continuity Tests
- Work Order: Megger Test Conveyor Drive
- Work Order: Test and Troubleshoot Conveyor Drive

**Preventive Maintenance**
- Work Order: Lubricate Conveyor Drive
- Work Order: Verify Conveyor Alignment
- Work Order: Verify Drive Chain Alignment
- Work Order: Obtain Vibration Profiles

#### Part Manipulation
- Work Order: Install Part Stacker and Feeder Tray
- Work Order: Install Part Kicker
- Work Order: Install Stacker Part Sensor
- Work Order: Install and connect pneumatic lines

#### Paint, Bake and Cool Process Simulation
- Work Order: Install Tunnel
- Work Order: Install Paint Nozzles
- Work Order: Install Paint Bake Heaters
- Work Order: Install Part Count Sensor
- Work Order: Install Paint Process Status Indicators

#### Programmable Logic Controller (PLC)
- Work Order: Install the PLC
- Work Order: Rough-In PLC Power
- Work Order: Load Program to PLC
- Work Order: Connect PLC Input Sensor Circuits
- Work Order: Connect PLC Output Sensor Circuits
- Work Order: Test and Troubleshoot Paint, Bake & Cool System

#### Variable Frequency Drive
- Work Order: Install Drive
- Work Order: Rough-In Drive Wiring
- Work Order: Megger Test VFD Wires
- Work Order: Program and Test Drive

#### Safety Function Operations
- Work Order: Interconnect safety cutoffs
- Work Order: Test Lock out/tag out
- Work Order: Install and test safety stack lite

#### Industrial Lighting Circuits
- Work Order: Install LED Lighting
- Work Order: Rough-In Lighting Circuits
- Work Order: Megger Test Lighting Circuits

### I4MC-1000 Cell Features

- Using the same frame and footprint as the EMMC-1000 of just 20 square feet, this upgraded mobile trainer adds elements specific to Industry 4.0 to enhance your program to 21st century manufacturing skills.
- Students will be introduced to networking and communications of the smart factory and advanced automation through PLCs and sensors, all elements found commonly in updated manufacturing facilities and essential to all levels of maintenance, predictive maintenance, operation, monitoring, control and optimized design of Industry 4.0 environments.
- The core elements of Industry 4.0 monitoring (sensors) and data collection and analysis can be integrated with MES and ERP software to control, monitor and troubleshoot the process to introduce students to the latest techniques in predictive maintenance and system integration.
### I4MC-1000 Skills & Training Exercises

In addition to the skills of the EMMC-1000:

#### Networking
- Work Order: Install and configure network router
- Work Order: Perform Ethernet Cable Termination
- Work Order: Install network cabling
- Work Order: Configure IP addressing
- Work Order: Perform connectivity tests

#### Communication
- Work Order: Install and configure Remote IO Hub
- Work Order: Wire RS-485 Network
- Work Order: Connect VFD drive to RS-485 network
- Work Order: Connect Sensors to RS-485 Network
- Work Order: Connect and configure Remote IO hub network (Ethernet)
- Work Order: Configure Remote IO Hub device security
- Work Order: Test remote IO using built-in Web page

#### Programmable Logic Controller (PLC)
- Work Order: Install the PLC
- Work Order: Rough-In PLC Power
- Work Order: Connect and configure PLC network (Ethernet)
- Work Order: Configure PLC device security
- Work Order: Upload and Program PLC Ladder Logic Programs
- Work Order: Install HMI Panel with PLC
- Work Order: Connect and configure HMI network (Ethernet)
- Work Order: Configure HMI device security
- Work Order: Upload and Program HMI Applications
- Work Order: Edit/Customize HMI operation, results, graphs and notifications
- Work Order: Connect PLC Input Sensor Circuits
- Work Order: Connect PLC Output Sensor Circuits
- Work Order: Test and Troubleshoot Paint, Bake & Cool System

#### Sensors
- Vision Sensor
  - Work Order: Install the Cognex Vision Sensor
  - Work Order: Wire power and network to sensor
  - Work Order: Configure Vision Sensor Network (Ethernet)
  - Work Order: Install and test Vision Sensor with Insight software
- Vibration Sensor
  - Work Order: Install the Motor Vibration Sensor
  - Work Order: Wire power and network to sensor
  - Work Order: Install and test Vibration Sensor software

#### Integration
- Remote Control and Monitoring Dashboard
  - Work Order: Set up a virtual computer and install virtual machine image
  - Work Order: Configure and test virtual computer access to network devices
  - Work Order: Install and test dashboard on virtual computer
  - Work Order: Configure remote access
  - Work Order: Integrate and test all dashboard functionality

### I4MC-1000 Specifications

<table>
<thead>
<tr>
<th>System Specification</th>
<th>PLC</th>
<th>Allen Bradley Micro820 PLC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensors</td>
<td>HMI</td>
<td>Allen Bradley Panel View 800 7” HMI</td>
</tr>
<tr>
<td>Remote IO</td>
<td>2 x Moxa Remote IO with Ethernet</td>
<td></td>
</tr>
<tr>
<td>Software</td>
<td>Virtual machine image</td>
<td></td>
</tr>
<tr>
<td>Wiring</td>
<td>All required additional electrical, network or IO cables</td>
<td></td>
</tr>
</tbody>
</table>

### I4MC-1000 Sensors for Industry 4.0

One of the primary enhancements of Industry 4.0 factories is the use of sensors, IIoT and data collection and analysis applications for predictive maintenance, advanced system control and flexible manufacturing optimization.

The I4MC-1000 introduces a series of advanced sensors to enable the learning and experimentation of students to fully understand the installation, calibration, connectivity and maintenance of advanced sensor systems. These include:

- Vision sensor (Cognex)
- Vibration sensors
- Touch Sensors
- Proximity sensors
- Temperature sensors
- RFID sensors
Industry 4.0 Maintenance & Manufacturing Cell (I4MC-1200)

The JobMaster I4MC-1200 cell is a flexible solution that expands the functionality of the EMMC-1000 and I4MC 1000 further by including additional manufacturing components like industrial robotics. This is a solution that can be augmented with additional components and can be added to other manufacturing training configurations like the Intelitek FMS or Intelitek CIM systems.

The system can be further enhanced with options for data collections and analysis, IIoT, control and cloud and analysis software. In addition to building and operating system, students will delve into development and interpretation of data for the purposes of predictive maintenance, advanced monitoring and control and system design an optimization.

Industry 4.0 Curriculum and Training

The Intelitek program is enhanced with a series of advanced curriculum specifically focused on Industry 4.0 topics.

Introduction to Industry 4.0
- Definitions and background
- What is Industry 4.0? Why Now?
- Key Technologies that drive Industry 4.0
- The Journey to Industry 4.0
- Horizontal Integration & Vertical Integration

The 4 Industrial Revolutions - Background

Industry 3.0 to Industry 4.0 - The Gaps

Key elements of Industry 4.0
- Industrial Internet, Ethernet
- IoT, IIoT
- Connectivity basics (CPS - cyber physical systems)
- Wireless Sensor Networks (WSN)
- Low-power wide area networks (LP-WAN)
- Sensors + IIOT, lab

Introduction to Maintenance 4.0

Use cases of Industry 4.0

Additional curriculum for more advanced Industry 4.0 Level 2 and Industry 4.0 Level 3 topics is available.