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

TECH LEARNING
CREATIVE THINKING
CAREER SKILLS

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Building Expertise in Industry 4.0 Technologies

Employability
- Project Management
- Critical Thinking
- Planning
- Problem Solving
- Time Management
- Adaptability
- Attention to Detail
- Techical Learning Ability
- Interpersonal
- Communications
- Technology Aptitude
- Teaming
- Safety

Level 3 — *Integrator*

Level 2 — *Specialist*

Level 1 — *Technician*

Industry 4.0
Integration
Connectivity

- Industry 4.0 Integrator
- Systems Designer
- Process Engineer
- Integration Specialist
- Operations/Maintenance Super

Advanced
Processes
Programming
Interoperability

- Mechatronics Specialist
- Automation Specialist
- Robotics Specialist
- Applications Engineer
- Systems Operator

Fundamentals
Technical Expertise
Micro-certifications

- Electromechanical Technician
- Production Technician
- Industrial Maintenance Technic
- Operator

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 Platfrom for Level 1 and Level 2 Training

Upgraded cell includes automation, machine vision, networking for more advanced techinicial 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.

Industry 4.0 for Education

Curriulum Levels

- Level 3 - Integrator
- Level 2 - Specialist
- Level 1 - Technician

Tier 1
EMMC-1000
Maintenance Cell

Tier 2
I4MC-1000
Ind. 4.0
Mfg. Cell

Tier 3
I4MC-1200
Adv. Ind. 4.0
Mfg. Cell

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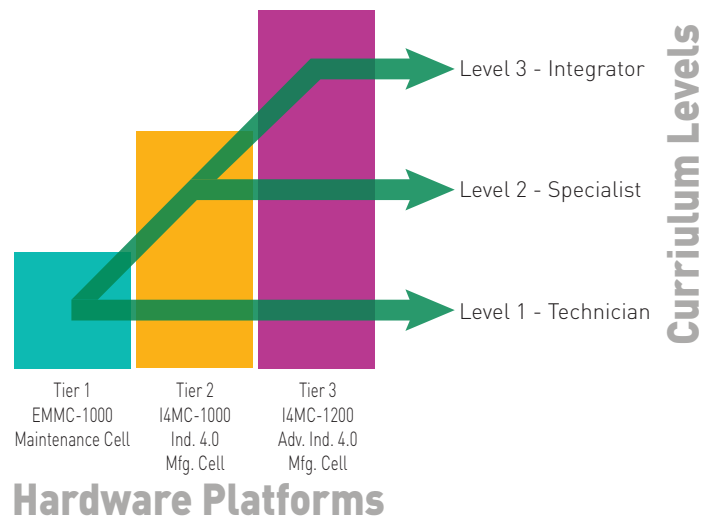
Tiered Training Platform for Multi-level Industry 4.0 Certification Aligned with ARM CRSS Certification Blueprint

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.

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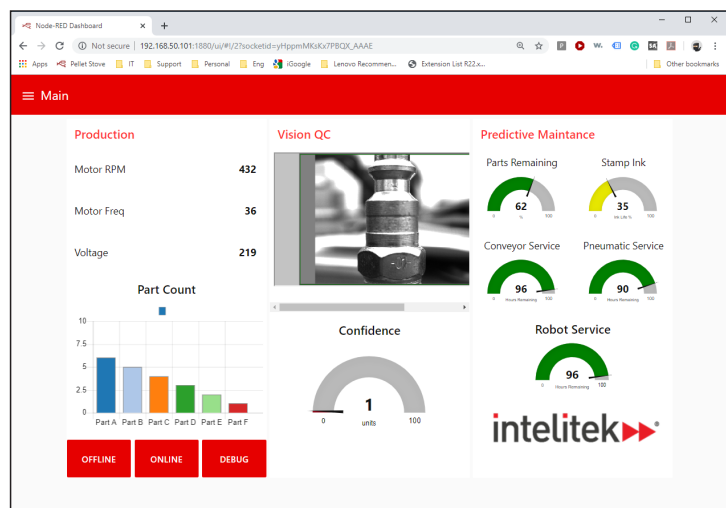
Electro-Mechanical Maintenance Cell (EMMC-1000)

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

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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

System Requirements	
Power:	15A Single or Three Phase AC Power Voltage: 208v-240v Freq: 50Hz-60Hz
Compressed Air:	50Psi @ 1CFM
Tools:	Metric and Imperial Socket Set, Wrenches and Allen Keys, Hacksaw, EMT Bender, Utility Knife, Screwdriver set
Specifications	
Dimensions	76.5" x 36" x 60" LxWxH (1945mm x 915mm x 1525mm)
Weight	500lbs (227kg) Assembled
Material	Extruded Aluminum Frame 1.5" x 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 60w Gear Motor
Conveyor Belt	59" x 8" conveyor belt w/Stainless Steel Frame
Pneumatic Parts Feeder	Acrylic Parts Feeder w/Sensor to feed 2in x 3in x 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

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

Industry 4.0 Maintenance Cell (I4MC-1000)

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.

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 introduces 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, predicitive 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 student to the latest techniques in predictive maintenance and system integration.
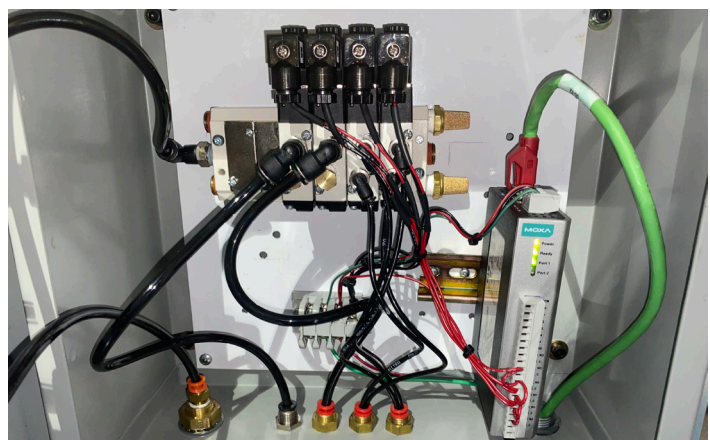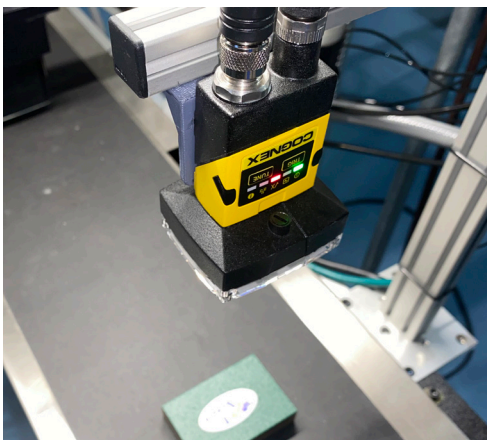
I4MC-1000 Skills & Training Exercises

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

System specification are the same as the EMMC-1000:	
Additional Components	
PLC	Allen Bradley Micro820 PLC
HMI	Allen Bradley Panel View 800 7˝ HMI
Sensors	Motor Vibration Sensor with RS-485 Insight 2000 Vision Sensor from Cognex
Remote IO	2 x Moxa Remote IO with Ethernet
Software	Virtual machine image
Wiring	All required additional electrical, network or IO cables

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 colloection and analysis applications for predicitive 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 predicitive 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.

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