



Scalable Smart Manufacturing Workforce Development Community Model



- Dr. Amarnath Banerjee, Director at TEES Manufacturing Institute



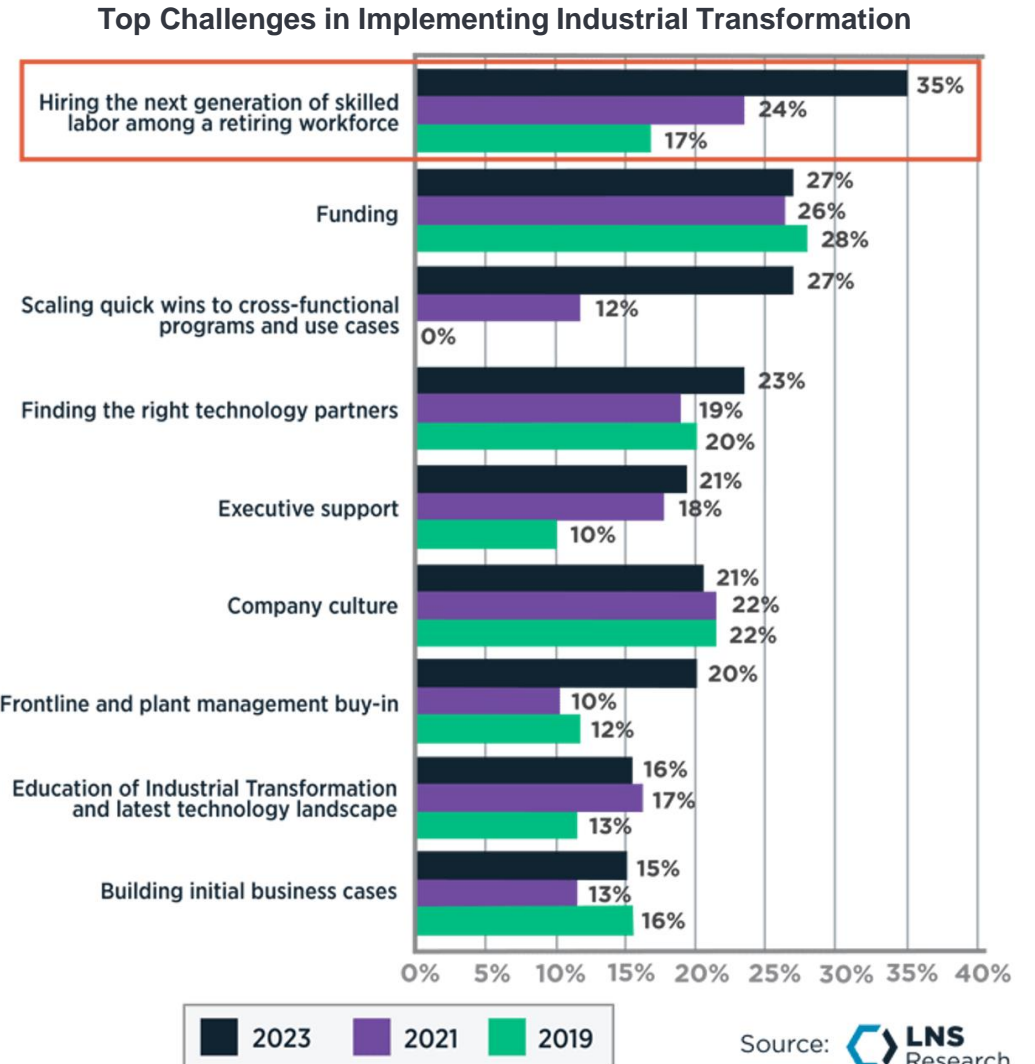
- Paul Perkins, President, Amatrol



- Conrad Leiva, VP Ecosystem and Workforce, CESMII

The Problem

The most significant barrier to industrial transformation and Smart Manufacturing is the **lack of a trained workforce.**



Contributing Challenges

- **High retirement rate** of experienced workers
- **Lack of SM education** in college programs
- **Lack of short-term SM courses** for incumbent workers
- **Lack of low-cost industrial teaching tools** to make hands-on learning experience affordable
- **Lack of instructors** with skills to teach SM



Solutions Strategy

- **Low-cost industrial teaching tools** to make hands-on learning experience affordable
- **Industry vetted micro-credentials** provide guidance for modular curriculum and basis for competency-based assessments
- **Instructor Academy** with modular courses based on micro-credentials

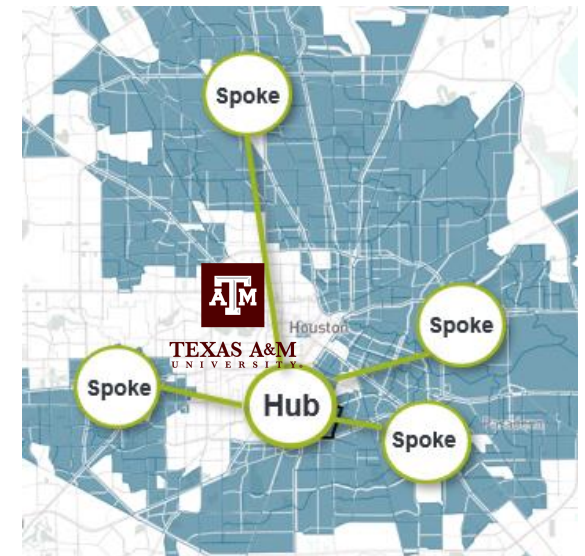


SM Learning System used to teach IIoT and SM skills



TEXAS A&M
UNIVERSITY.

Instructor Academy
becomes a hub
for SM Skills in the region



CESMII Project

Scalable SM Workforce Development Community Model



Dr. Amarnath Banerjee
Director of
TEES Institute for
Manufacturing Systems



Conrad Leiva
Vice President of CESMII



Paul Perkins
President of Amatrol, Inc.

Project Elements

- Regional College & Industry Network
- Smart Manufacturing Workforce Center at TAMU
- SACA Industry 4.0 Courses
- Accelerated Assessments
- Virtual Reality Software
- Teacher Training Academy at TAMU



Regional Smart Manufacturing Network

- 5 College Systems/1 Campuses
- 20 Industry Partners
- Steering Committee



Industry Needs Verified

Conducted Industry Survey of key competencies needed in Industry 4.0 with 52 Local Companies

Q: What Industry 4.0-Related Occupations Currently Exist?

• Top Occupations

- Production Operator
- Maintenance Technician
- Quality/Continuous Improvement Technician
- Manufacturing/Process Engineer
- Automation Controls-IT Technologist
- Robot/Collaborative Robot Technician

Q: What Industry 4.0-Related Occupations Are Emerging?

- Industrial Data Analyst
- Production Mobile App Developer
- Virtual Reality/Augmented Reality Developer



Industry Needs Verified

Conducted Industry Survey of key competencies needed in Industry 4.0 with 52 Local Companies

Q: What Industry 4.0 Skills Sets are Most Needed for Operations?

- **Top Skill Needs**
 - Level 1 Industry 4.0 Operations
 - Monitor Dashboards
 - Operate Computer-Controlled processes
 - Use mobile devices
 - Operate robots
 - Level 2 Industry 4.0 Operations
 - Interpreting Metrics
 - Use Networks
 - Analyze Production Data
- **Emerging Skill Needs**
 - Cyber Security

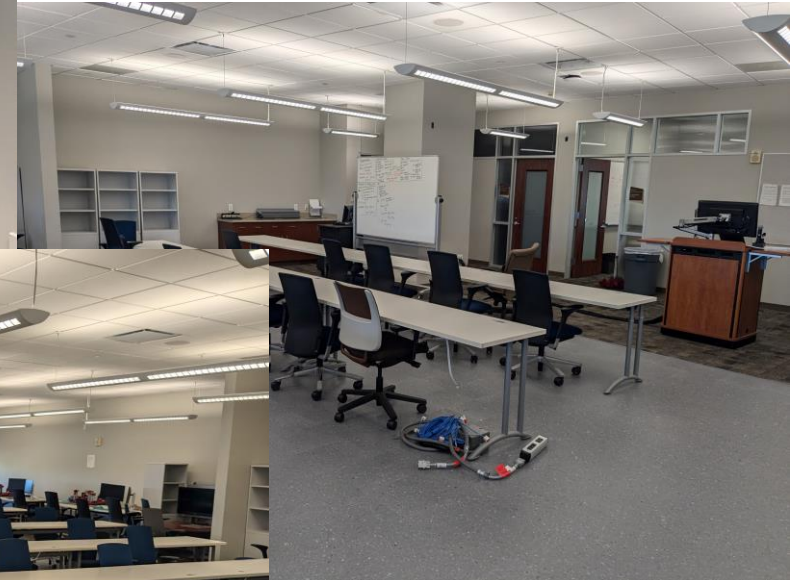
Q: What Industry 4.0 Skills Sets are Most Needed for Maintenance?

- **Top Skill Needs**
 - Electrical/Electronic Systems
 - Programmable Controllers
 - Process Control
 - Robotics
- **Emerging Skill Needs**
 - IIoT and Smart Devices
 - Industrial Networks
 - Data Acquisition



Smart Manufacturing Center at Texas A&M

- Ongoing Development Testbed
- Instructor Academy



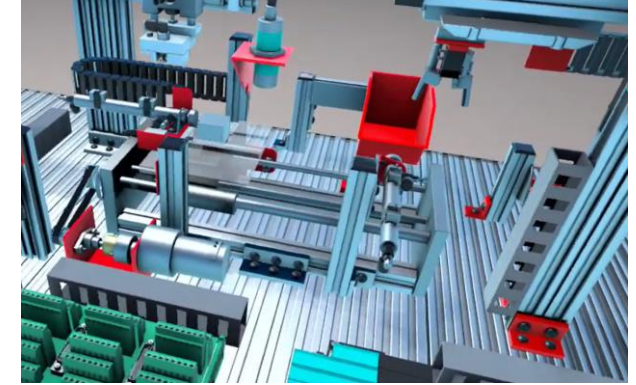
Smart Manufacturing Center at Texas A&M

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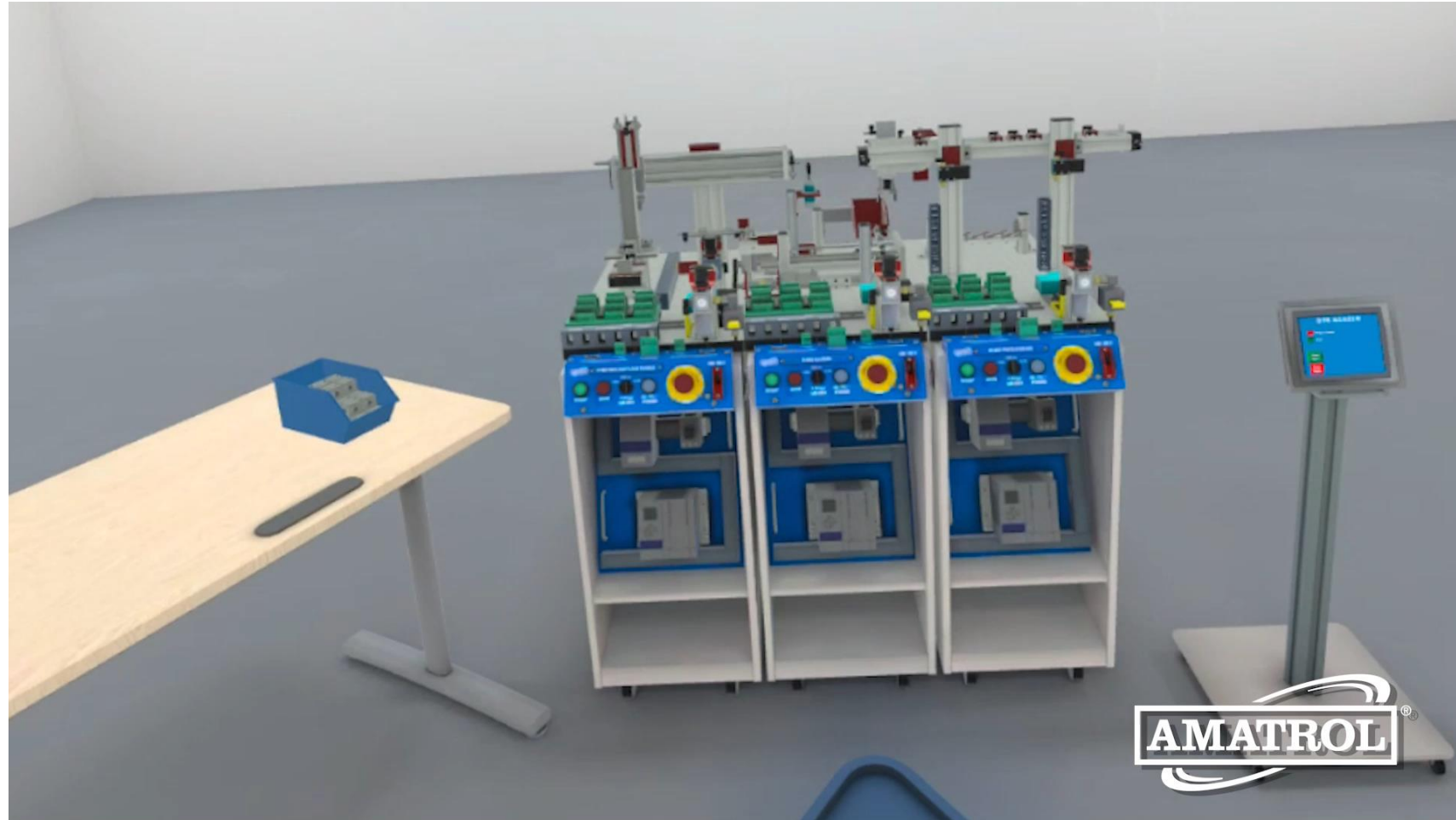


Virtual Reality Software

- Reduces lab costs
- Enables practice anytime/anywhere
- Expands student hands-on

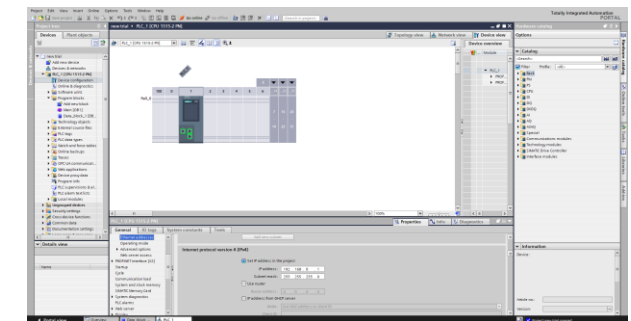
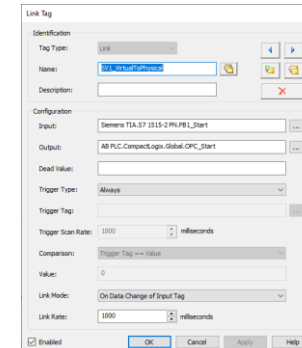
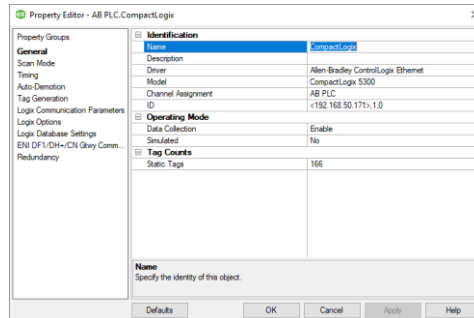
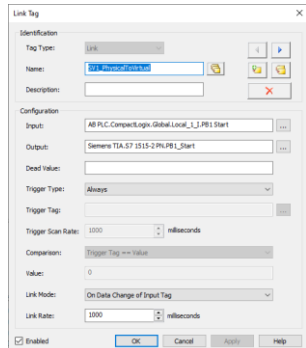
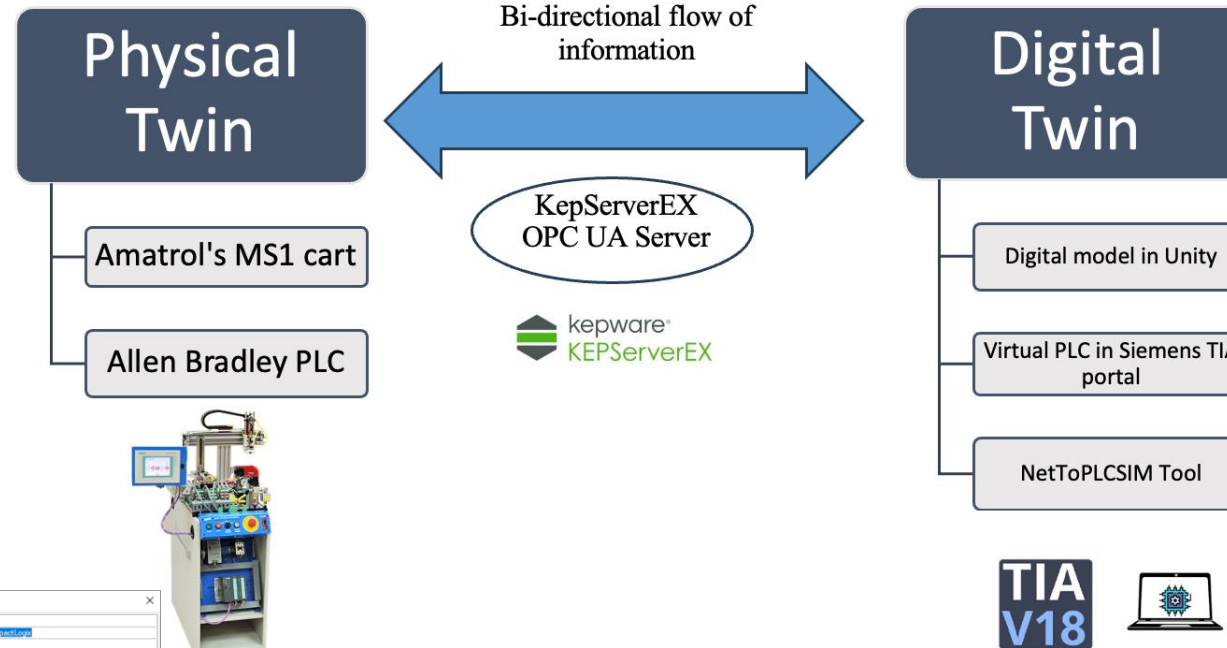


Virtual Reality Software Demo



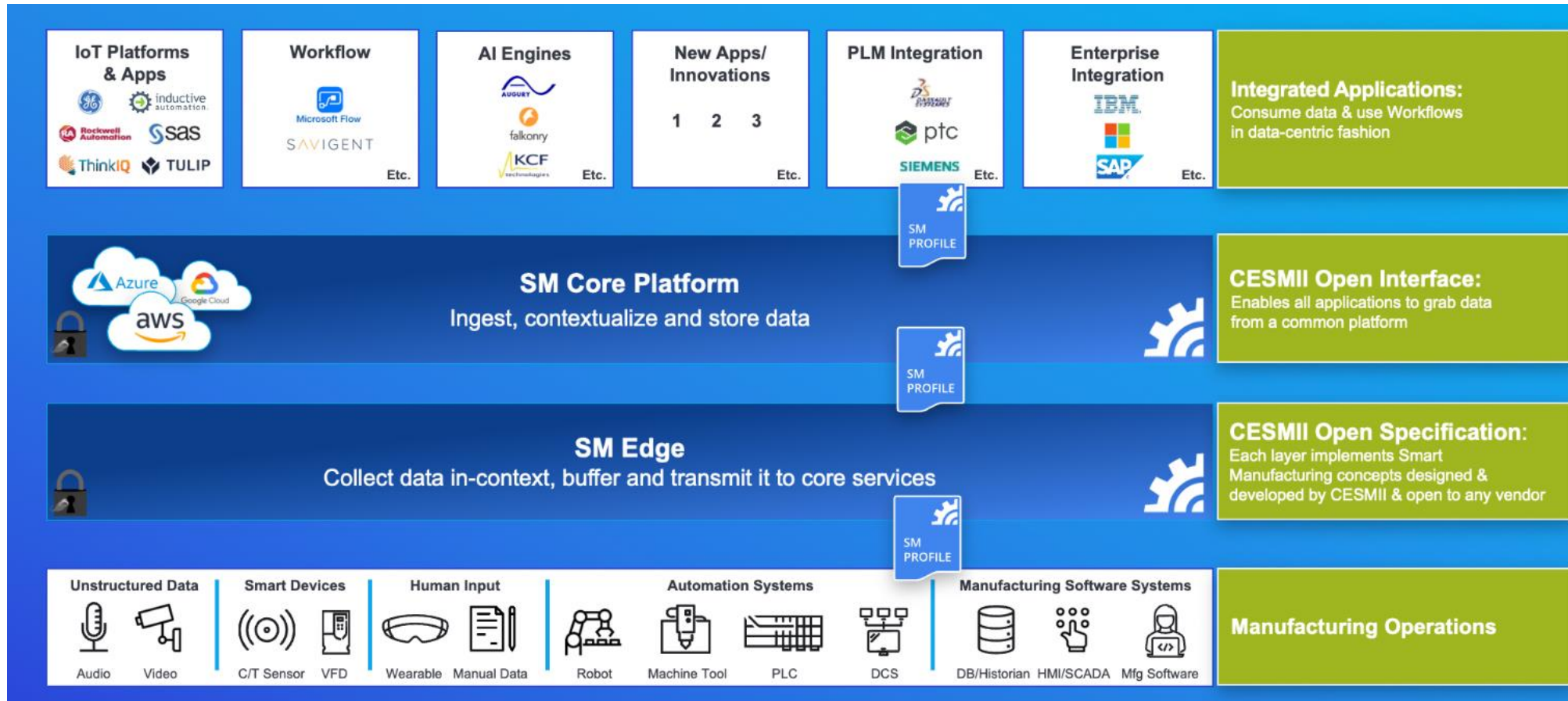
Digital Twin with SMIP Link

- True Digital Twin
- Enables data analysis “what if”
- Demonstrates interoperability



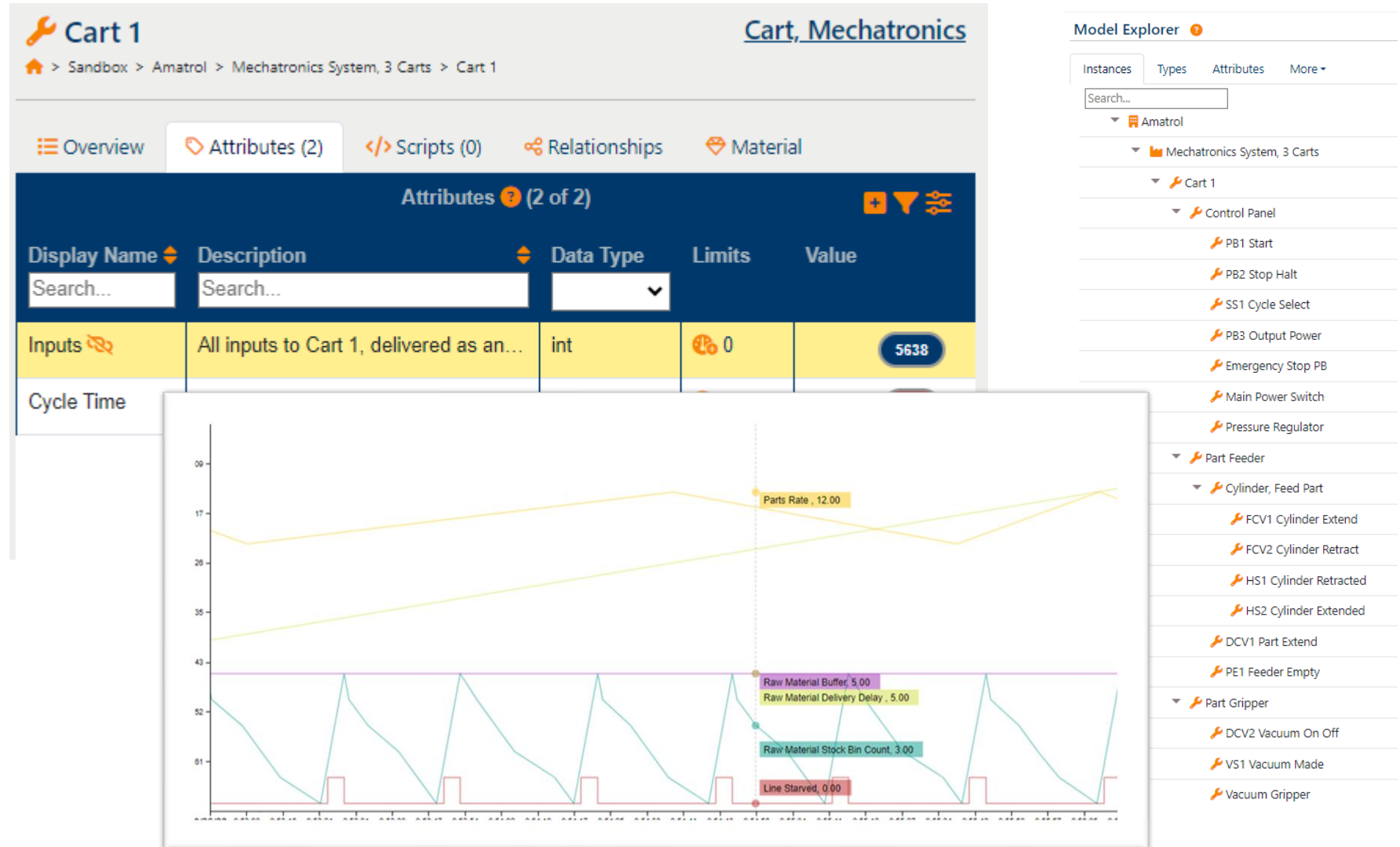
The SM Interoperability Platform

Teaching use of IIoT connectivity, cloud platforms, and information models for interoperability




Digital Twin with SMIP Link

- True Digital Twin
- Enables data analysis “what if”
- Demonstrates interoperability



Training & Assessment Alignment

- Industry 4.0 SACA online short courses aligned with local industry needs survey
 - Online multimedia courses from Amatrol
 - Competency-Based
 - Meet SACA Silver and Gold Credentials
 - Embedded Hands-On Exercises
 - Interactive with simulation



Smart Pressure Sensors

Objective 1: Describe the Function of a Smart Sensor

Smart Sensors Benefits

Smart sensors ensure better accuracy by processing and digitizing signals and then transmitting them as data. The data transmitted through a network is also checked, which further ensures accuracy.

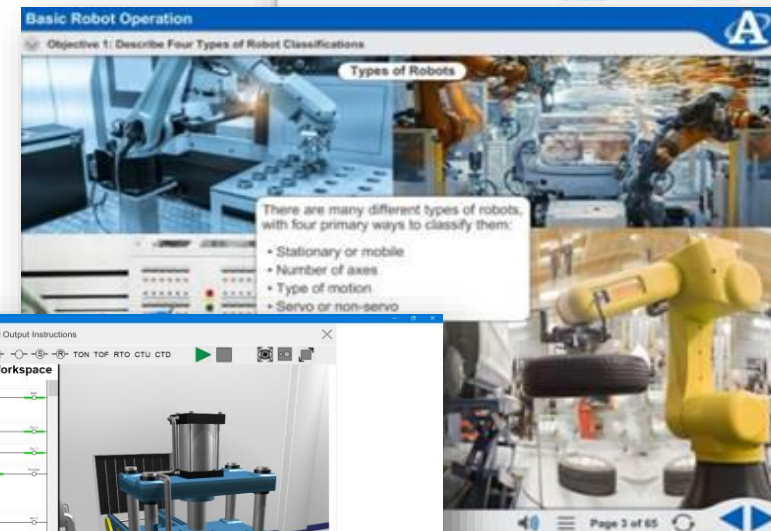
Smart sensors provide a number of benefits over standard sensors. Some of the most notable include:

- Self-Diagnostics
- Simplified Wiring
- Self-Calibration
- Programmable

Move your mouse over each benefit for a description.

This page is interactive. Click anywhere to hide the instructions.

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Basic Robot Operation

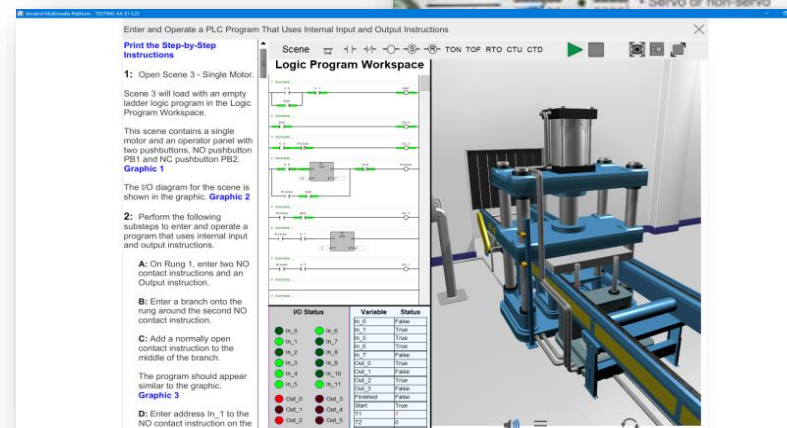
Objective 1: Describe Four Types of Robot Classifications

Types of Robots

There are many different types of robots, with four primary ways to classify them:

- Stationary or mobile
- Number of axes
- Type of motion
- Servo or non-servo

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Enter and Operate a PLC Program That Uses Internal Input and Output Instructions

Print the Step-by-Step Instructions

1: Open Scene 3 - Single Motor

Scene 3 will load with an empty ladder logic program in the Logic Program Workspace.

This scene contains a single motor and an operator panel with two pushbuttons, NO pushbutton PB1 and NO pushbutton PB2.

Graphic 1

The I/O diagram for the scene is shown in the graphic. Graphic 2

2: Perform the following substeps to enter and operate a program that uses internal input and output instructions.

A: On Rung 1, enter two NO contact instructions and an Output instruction.

B: Enter a branch onto the rung around the second NO contact instruction.

C: Add a normally open contact instruction to the middle of the branch.

The program should appear similar to the graphic. Graphic 3

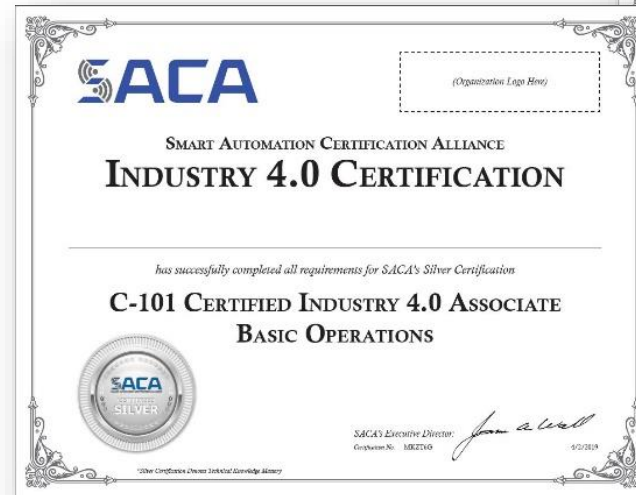
D: Enter address In_1 to the NO contact instruction on the

Logic Program Workspace

IO Status	Variable	Status
●	IL_0	True
●	IL_1	True
●	IL_2	True
●	IL_3	True
●	IL_4	True
●	IL_5	True
●	IL_6	True
●	IL_7	True
●	IL_8	True
●	IL_9	True
●	IL_10	True
●	IL_11	True
●	IL_12	True
●	IL_13	True
●	IL_14	True
●	IL_15	True
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●	IL_97	True
●	IL_98	True
●	IL_99	True
●	IL_100	True

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Industry 4.0 Micro-Credentials

- C-201 Electrical Systems 1
- C-202 Electric Motor Control Systems 1
- C-203 Variable Frequency Drive Systems 1
- C-204 Motor Control Troubleshooting 1
- C-205 Sensor Logic Systems 1
- C-206 Electrical System Installation 1
- C-207 Programmable Controller Systems 1
- C-208 PLC Troubleshooting 1
- C-209 Pneumatic Systems 1
- C-210 Mechanical Power Systems I
- C-211 Industry 4.0 TPM
- C-212 Ethernet Communications 1
- C-213 Smart Sensor & Identification Systems 1
- C-214 Smart Factory Systems 1
- C-215 Robot System Operations 1
- C-216 Robot Systems Integration 1
- C-217 Smart Manufacturing Fundamentals
- C-218 Smart Manufacturing Data Acquisition
- C-219 Smart Manufacturing Visualization and Data Analytics
- C-220 Smart Manufacturing Cyber Security
- C-257 Process Control Systems 1
- C-258 Process Control Troubleshooting 1
- C-302 Laser Shaft Alignment 1
- C-303 Electric Motor Troubleshooting 1
- C-304 Pneumatic Troubleshooting 1
- C-305 Industrial Electronic Systems 1
- C-306 Industrial Electronic Systems 2
- C-307 Electronic Systems Installation 1
- C-311 Data Analytics 1
- C-308 Variable Frequency Drive Systems 2
- C-309 Programmable Controller Systems 2
- C-310 Ethernet Communications 2
- C-312 Robot Systems Integration 2
- C-313 Smart Factory Systems 2
- C-351 Predictive Maintenance 1
- C-356 Process Control Systems 2
- C-358 Autonomous Mobile Robot Systems 1
- C-359 Programmable Controller Systems 3
- C-360 Motion Control Systems 1
- C-361 Programmable Conveyor Systems 1
- C-362 Machine Vision Systems 1



Training & Assessment Alignment

- Online assessments for accelerated learning in SACA credentials
 - Aligned with online multimedia SACA courses
 - Custom Prescriptions for filling training gaps

ConAgra Foods
Food you love

ConAgra Foods Technician Development Program
Welcome KENT POWELL

Platform: Snack Foods | Plant: Rensselaer | Shift/Crew: [Select Shift/Crew] << Back

Check to group by Shift/Crew:

Level of Detail: Assessment Module Objective

Showing Rensselaer Users, Grouped by Shift/Crew

Assessment Name	Assessment Category	Number Assigned	Number Taken	Average Score	Average Time to Complete
AC/DC Electrical Systems	Electrical	4	3	56%	37:58 minutes
W-VTB707-AC-01 Virtual Trainer - Basic Electrical Circuits				92%	
W-VTB707-AC-02 Virtual Trainer - Electrical Measurement				69%	
W-VTB707-AC-03 Virtual Trainer - Circuit Analysis				55%	
W-VTB708-AC-01 Inductance and Capacitance				52%	
W-VTB708-AC-02 Combination Circuits				44%	
W-VTB708-AC-03 Transformers				20%	
Electrical Relay Control	Electrical	4	3	55%	21:47 minutes
W-VTB703-XB-01 Virtual Trainer - Control Logic				38%	
W-VTB703-XB-02 Virtual Trainer - Sequencing Control				76%	
W-VTB703-XB-03 Virtual Trainer - Timers and Advanced Systems				51%	
		4	2	27%	21:41 minutes

Amatrol LMS - Mozilla Firefox

Amatrol LMS

www.learnamatrol.com/common/reporting.php

Customer Demo Site

Welcome JOHN DOE - ADMIN

Reporting

User: Doe - Student, Jane | Course: showAll | Content: showAll | Activation Code Tags: | Show Archived Users: | Show Users With No Activity: | Export to Excel

Searching by User

User	Course Number	Course Title	Content Name	Content Title	Date Started	Last Accessed	Pre-Quiz	Quiz	Skill Tracking
Jane Doe - Student	VB227-AC00XEN	AC / DC Electrical	W-VTB227-AC-01	Basic Electrical Circuits	2011-12-05 15:04:05	2012-01-04 08:12:38	25%		3.7 (7.7)
Jane Doe - Student	VB227-AC00XEN	AC / DC Electrical	W-VTB227-AC-02	Electrical Measurement	2012-01-02 15:04:14	2012-01-02 15:04:14	0%		NS
Jane Doe - Student	VB227-AC00XEN	AC / DC Electrical	W-VTB227-AC-03	Circuit Analysis	2012-01-04 08:12:59	2012-01-04 08:12:59	NS		NS
Jane Doe - Student	VB227-AC00XEN	AC / DC Electrical	W-VTB227-AC-04	Inductance and Capacitance	2012-01-04 10:12:31	2012-01-04 10:12:31	0%		NS
Jane Doe - Student	VB831-XA00XEN	Basic Hydraulics	VB831-XA01XEN	Hydraulic Power Systems	2011-06-08 11:44:57	2011-10-31 11:39:29	0%		3.4 (7.7)
Jane Doe - Student	VB831-XA00XEN	Basic Hydraulics	VB831-XA02XEN	Basic Hydraulic Circuits	2011-06-08	2011-06-08	10%		3.4 (7.7)

SM Instructor Training Academy

- **Site Location**

- Texas A&M University

- **12 Courses**

- Courses 1-5 Process
- Courses 6-12 Smart Technology

- **Hybrid Option**

- Courses 1-5
 - 4 Hr. Virtual Synchronous
- Courses 6-12
 - 4 Hr. Virtual Synchronous
 - 15 Hrs. Online Self-Paced
 - 4-20 Hrs. Hands-On

Course 1: SACA Silver Certifications

Course 2: Introduction to the SACA Certification Library

Course 3: E-Learning Courses for SACA Silver Certification

Course 4: SACA Pre-Assessment for Accelerated Learning

Course 5: SACA Gold Certifications

Course 6: SACA C-212 Ethernet Communications for Smart Manufacturing

Course 7: SACA C-212 Ethernet Networking for Smart Manufacturing

Course 8: SACA C-213 Smart Sensor and Identification Sys. 1

Course 9: SACA C-214 Smart Factory Operation 1

Course 10: SACA C-214 Smart Factory Virtual Reality Learning

Course 11: SACA C-214 Smart Factory Integration

Course 12: SACA C-214 Smart Automation Data Dashboards



Instructor Training Academy

- Conducted 13 Workshops
- 25 instructors Participated
- Piloting with Students



Re-Usable Project Outcomes

- **Virtual Reality Software** available nationwide
 - Future goal: certification testing.
- **Texas A&M University Smart Manufacturing Center**
 - Ongoing research and support for community college/high school instructors
- **National Instructor Academy at Texas A&M**
 - On-site and hybrid training access or replication in other communities.
- **Online Smart Manufacturing SACA Certification Courses** available nationwide
 - With VR digital twin
- **Computer-Based Assessments** available nationwide
 - Accelerate incumbent workers with prior knowledge.
- **Smart Manufacturing Community Model Playbook** available nationwide
 - to assist communities in replicating the Texas A&M model.

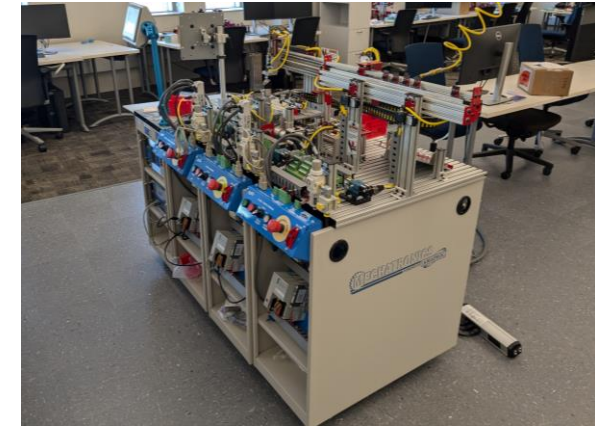
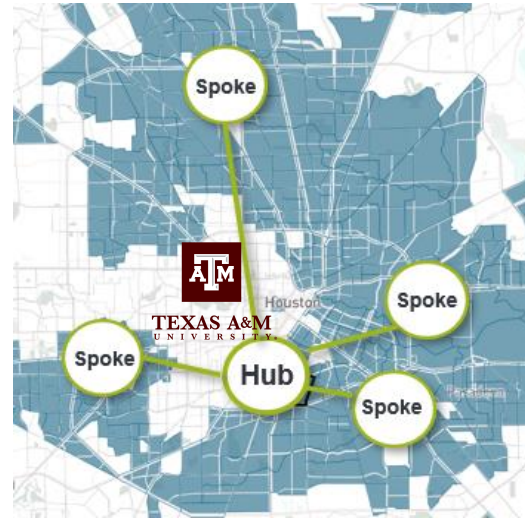


CESMII Project – Next Phase

SM Credential Aligned College Instructor Academy

Instructor Training Academy

- SACA Certification-based Courses
- Collaborative community network
- Hybrid online and in-person
- Hands-on options on Smart Factory, SM Learning System, and Digital Twin VR software
- Training Assessment can fast track worker learning



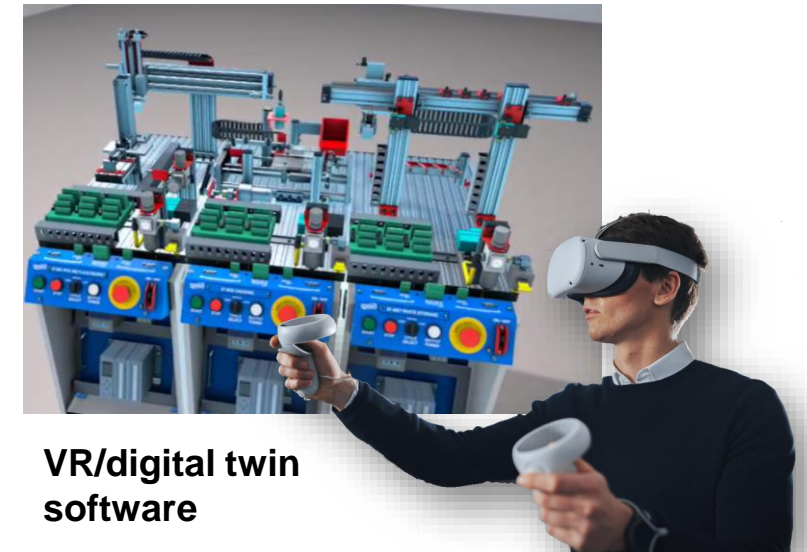
Smart Factory



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SM Learning System



VR/digital twin software





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- Conrad Leiva, VP Ecosystem and Workforce, CESMII, conrad.leiva@cesmii.org, www.cesmii.org

