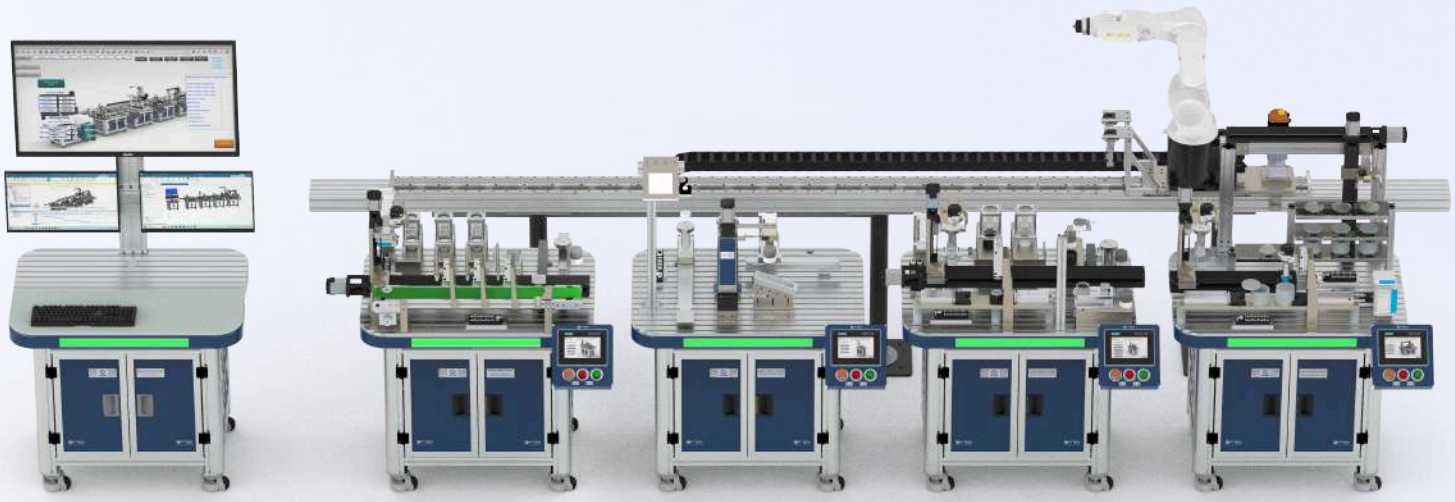
HYTECH DIDACTIC

ROBOTICS

Smart Factory

ROBOTIC Smart Factory with Digital Twin and Remote Commissioning



- PLC and HMI Programming & Integration
- Robot Programming
- Integrated 7 Axes Robot with Tool Changer
- SCADA Design and Integration
- I/O Link
- Sensors and Servo Motors
- VFD integration
- RFID Based programming
- Digital Twin Integration for Robot (Siemens Tecnomatix)
- Digital Twin Integration for PLC (Siemens Mechatronic Concept Designer)
- AR and VR Based Training
- Learning Management System
- IIOT Based Operation
- Dashboard design for IIOT

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Key Features of the Robotic Smart Factory

1. Seamless Industrial Integration

- Fully integrated with **PLC, HMI, SCADA, and IIoT Edge** technologies for an immersive Industry 4.0 training experience.
- Incorporates **IO-Link-based master modules**, enabling real-time device-level communication and modular system expansion.
- Supports **RFID tracking, sensor data logging,** and **real-time decision-making** across all stations.

2. Advanced Station-Specific Functionalities

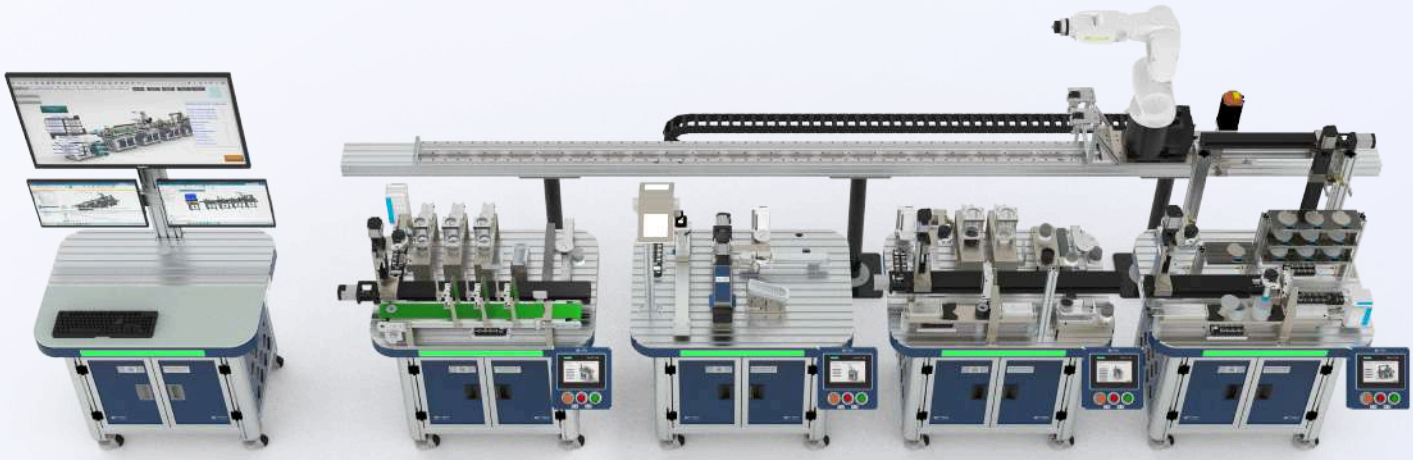
- Each station is designed for distinct automation tasks using real-world components:
  - **Station 1:** Pneumatic gauging with high-accuracy diameter classification and automated rejection.
  - **Station 2:** Vision-based inspection with classification, defect detection, and sorting via smart camera.
  - **Station 3:** Assembly with integrated weight measurement, color sensing, and level detection.
  - **Station 4:** ASRS-based material handling with vacuum-based capping and rotary pick-and-place.
- Encourages learners to explore complete industrial workflows—from part identification to final packaging.

3. Gantry-Mounted 7th Axis Robot with Automatic Tool Changer

- High-precision **robot mounted on a gantry** system enables inter-station part handling over extended travel ranges.
- Equipped with a **smart tool changer**, enabling automatic switching between grippers and tools based on process needs.

4. Immersive Digital Twin Integration

- Fully integrated with **digital twin software**, enabling:
  - Real-time simulation of all robotic and material handling operations.
  - Safe virtual testing of logic and sequences before deployment.
  - Parallel training of multiple users for collaborative learning environments.



Key Features of the Robotic Smart Factory

5. Virtual Programming & Simulation Tools

- Includes **offline programming utilities** for robot path planning and PLC/HMI logic validation.
- Minimizes risk of hardware damage and optimizes commissioning time by detecting errors in the virtual phase.

6. Rugged and Modular Hardware Design

- Framework constructed using **industrial-grade aluminum extrusions** for longevity and easy configuration.
- Each module includes:
  - **Transparent polycarbonate enclosures** ensuring 360° visibility and enhanced safety.
  - **Anti-static industrial work surfaces** and high-durability component mounting.
  - **Lockable castor wheels** for mobility and stability in lab environments.

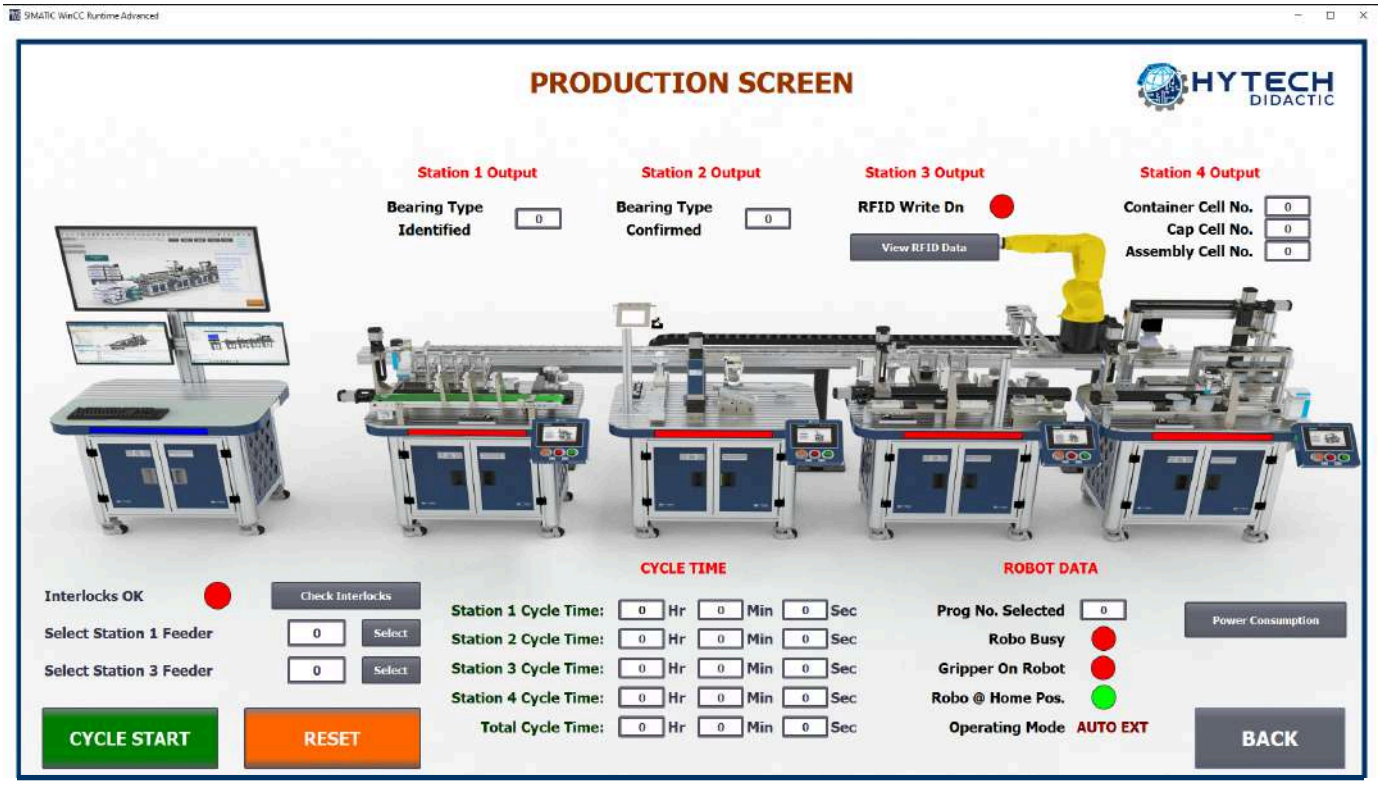
7. Centralized Intelligent Control System

- Features a **dedicated control panel** equipped with:
  - Industrial PLC (e.g., Siemens/Mitsubishi) for automation control.
  - Touch-based HMI interface for operator-friendly interaction.
  - SCADA-enabled monitoring and diagnostics for real-time system insights.

8. Centralized Intelligent Control System

- Delivered with a **pre-installed software suite** for:
  - Digital twin operations and visualization.
  - Offline robot and PLC programming.
  - Real-time HMI/SCADA interaction and process monitoring.

SCADA

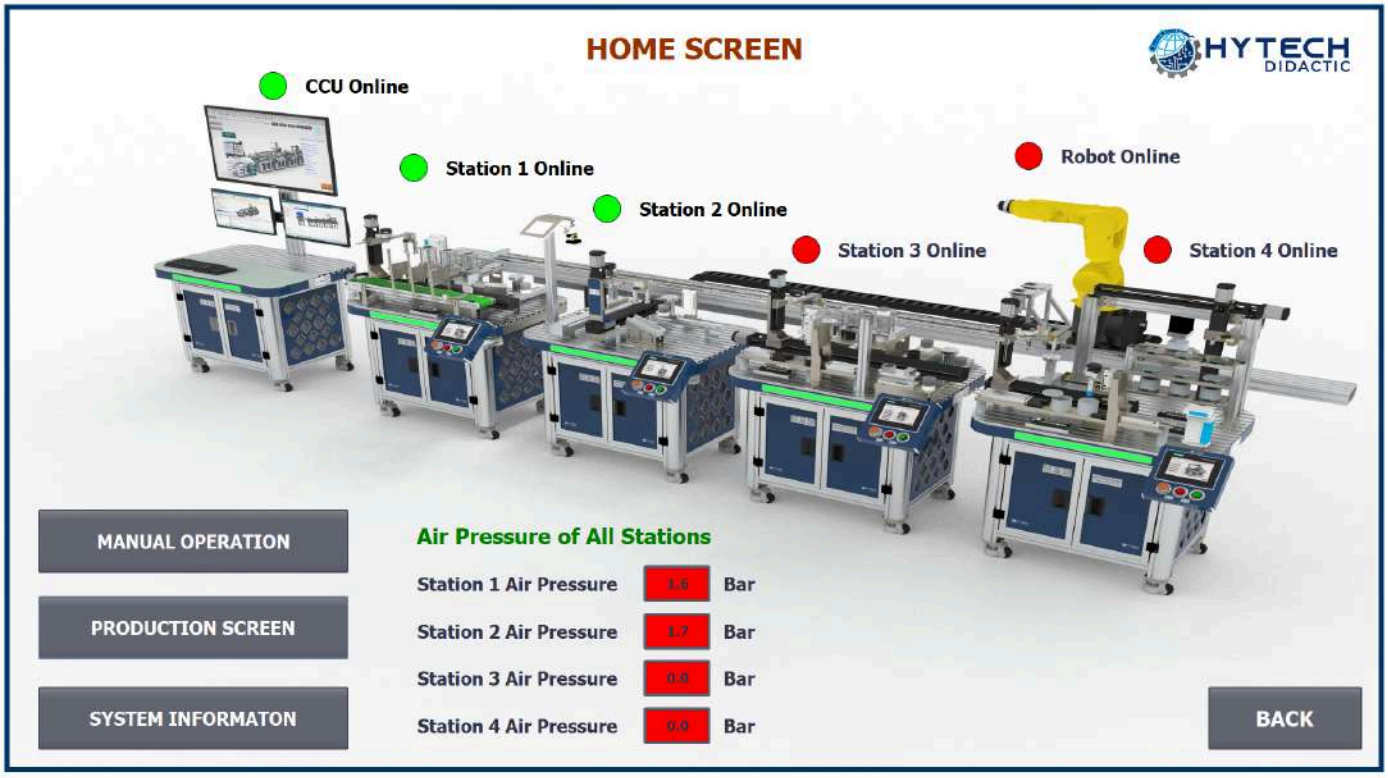


The **SCADA (Supervisory Control and Data Acquisition)** system is a powerful integration of **hardware and software components** that enables **real-time supervision, control, and data acquisition** across the entire automation environment. SCADA ensures seamless interaction between operators and field-level devices, both **locally and remotely,** via a centralized control interface.

Features:

- **Centralized Monitoring:** SCADA collects operational data from PLCs across all stations, aggregating it at the Central Control Unit (CCU).
- **Real-Time Data Processing:** Data from sensors, actuators, motors, vision systems, and conveyors is acquired, examined, and visualized in real time.
- **Human-Machine Interface (HMI):** Integrated HMI software enables intuitive user interaction with field.
- **Event Response & Control:** Operators can monitor system events and issue control commands directly through the SCADA interface, ensuring timely responses to anomalies or process variations.
- **Data Logging:** Historical data storage capabilities allow for trend analysis, diagnostics, traceability, and system optimization.

SCADA



Communication Architecture:

- Communication data from field-level PLCs is routed to the SCADA system using i**ndustrial Ethernet** and **PROFINET protocols**.
- The SCADA system **interprets, visualizes, and logs** this data, enabling in-depth analysis of process health and system performance.

Real-World SCADA Integration:

The SCADA used in the Hytech Smart Factory is a **true-to-industry system**, mirroring those implemented in advanced manufacturing setups worldwide. It provides:

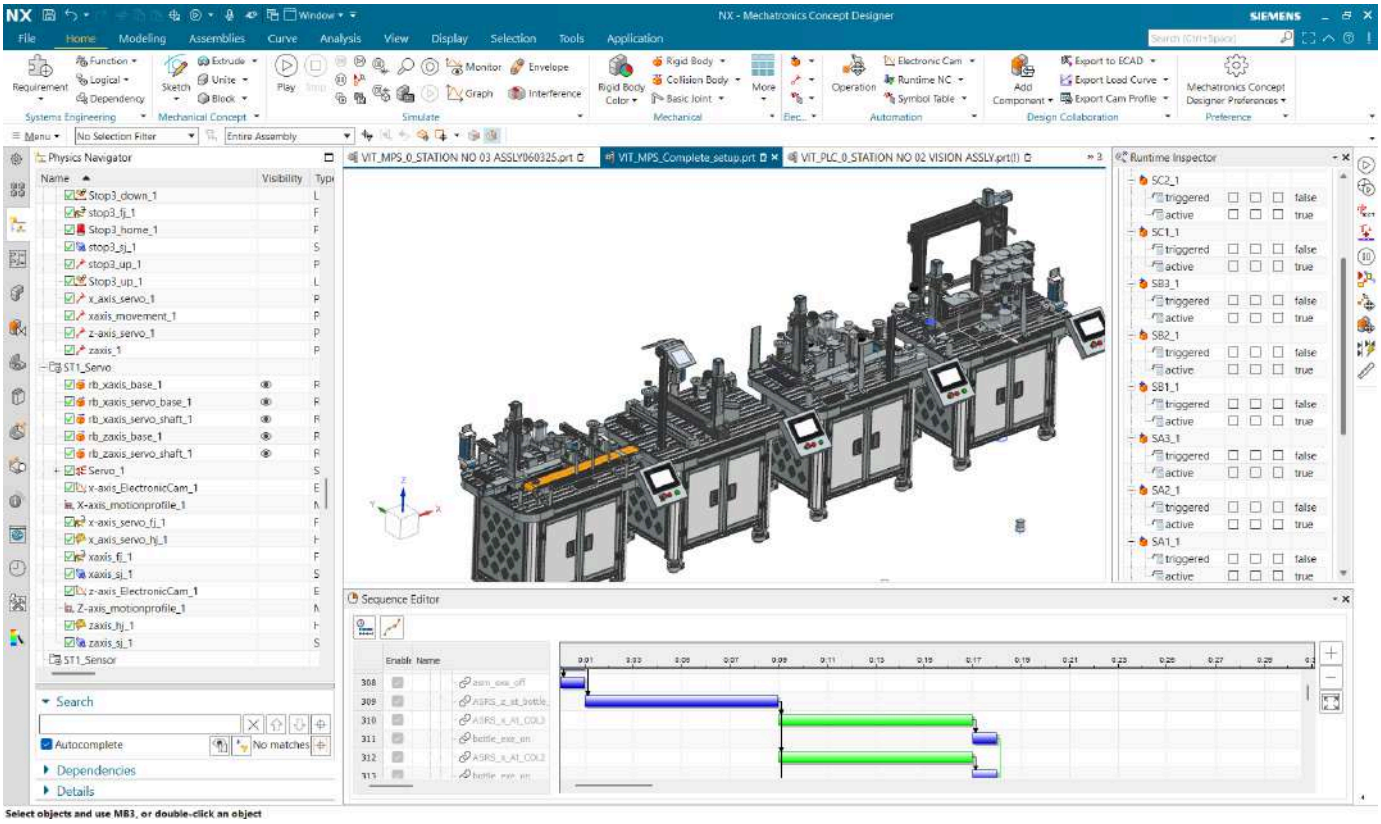
- **Hands-on experience** with widely adopted SCADA technologies.
- Exposure to the **integration of multi-station processes** under a unified supervisory system.
- Practical skills in **monitoring, diagnostics, and decision-making** through live system data.

Real-World SCADA Integration:

SCADA plays a pivotal role in **Industry 4.0** by enabling the **smart integration of automation, IoT, and data analytics:**

- Facilitates **end-to-end visibility** across the production line.
- Enables **remote and predictive maintenance** using real-time data insights.
- Acts as the **central nervous system** of the smart factory, bridging **physical operations** with **digital intelligence.**

Mechatronics Concept Designer (MCD)

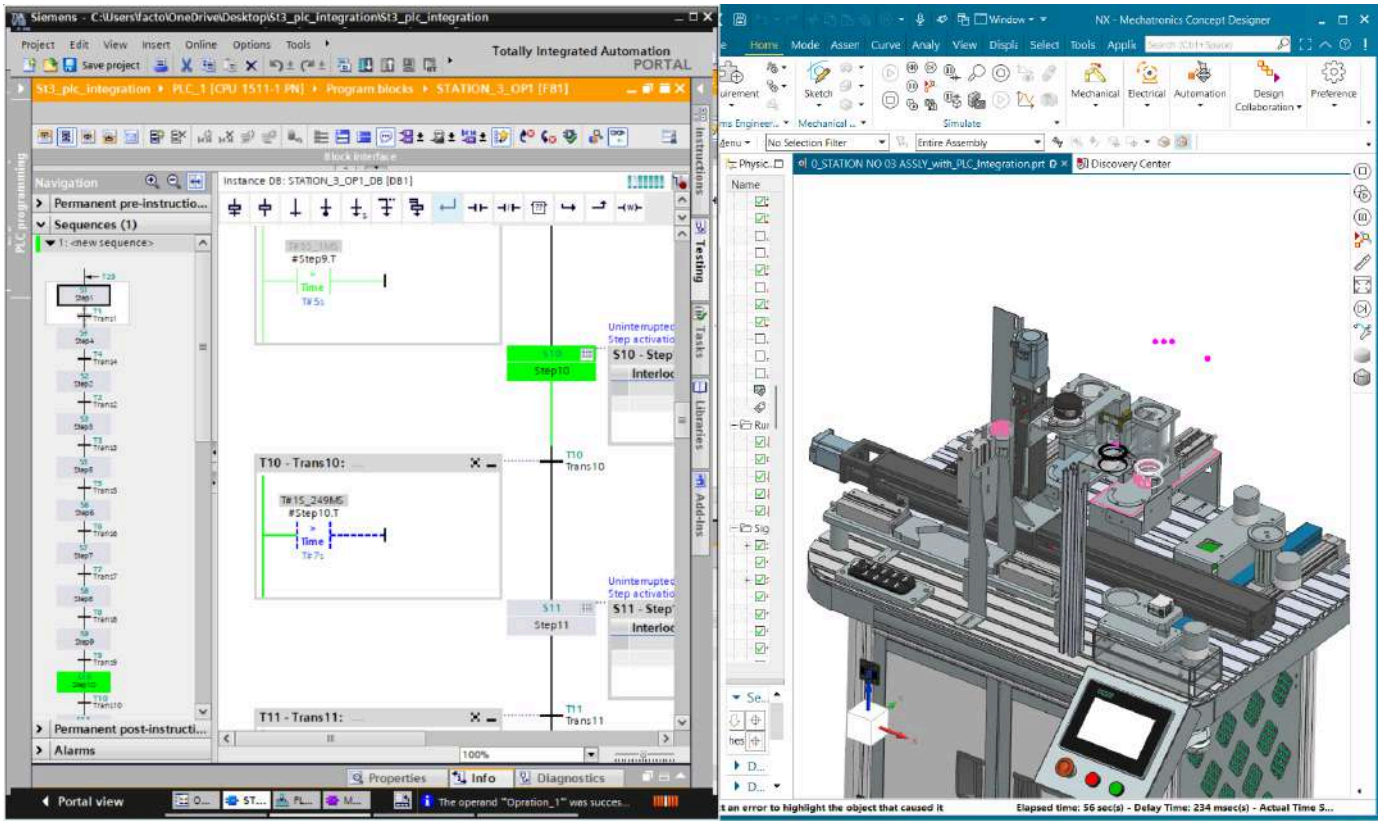


Mechatronics Concept Designer (MCD) is an innovative and integrated solution for the early-stage **conceptual design of mechatronic systems**. It enables engineers to create, simulate, and validate machine concepts in a **3D virtual environment** using **multi-body physics, sensor-actuator logic**, and **automation behaviors**—all within a unified platform.

Core Capabilities:

- **3D Modeling & Simulation:** Build and simulate mechanical structures, joints, and motion sequences in real-time with multi-body physics.
- **Functional Behavior Modeling:** Define how machines should react using both time-based and event-based control logic.
- **Automation Simulation:** Integrate automation behaviors early using PLC-like logic blocks to mimic real machine operation.
- **Interdisciplinary Collaboration:** Bridge gaps between mechanical, electrical, and automation/software engineering from concept to deployment.

Mechatronics Concept Designer (MCD)



Integrated Engineering Workflow:

MCD acts as a collaborative platform that connects upstream and downstream processes by integrating:

- **Requirements Management**
- **Mechanical Design (3D CAD & Kinematics)**
- **Electrical Design (Sensor/Actuator Placement)**
- **Software/Automation Engineering (Logic Behavior Modeling)**

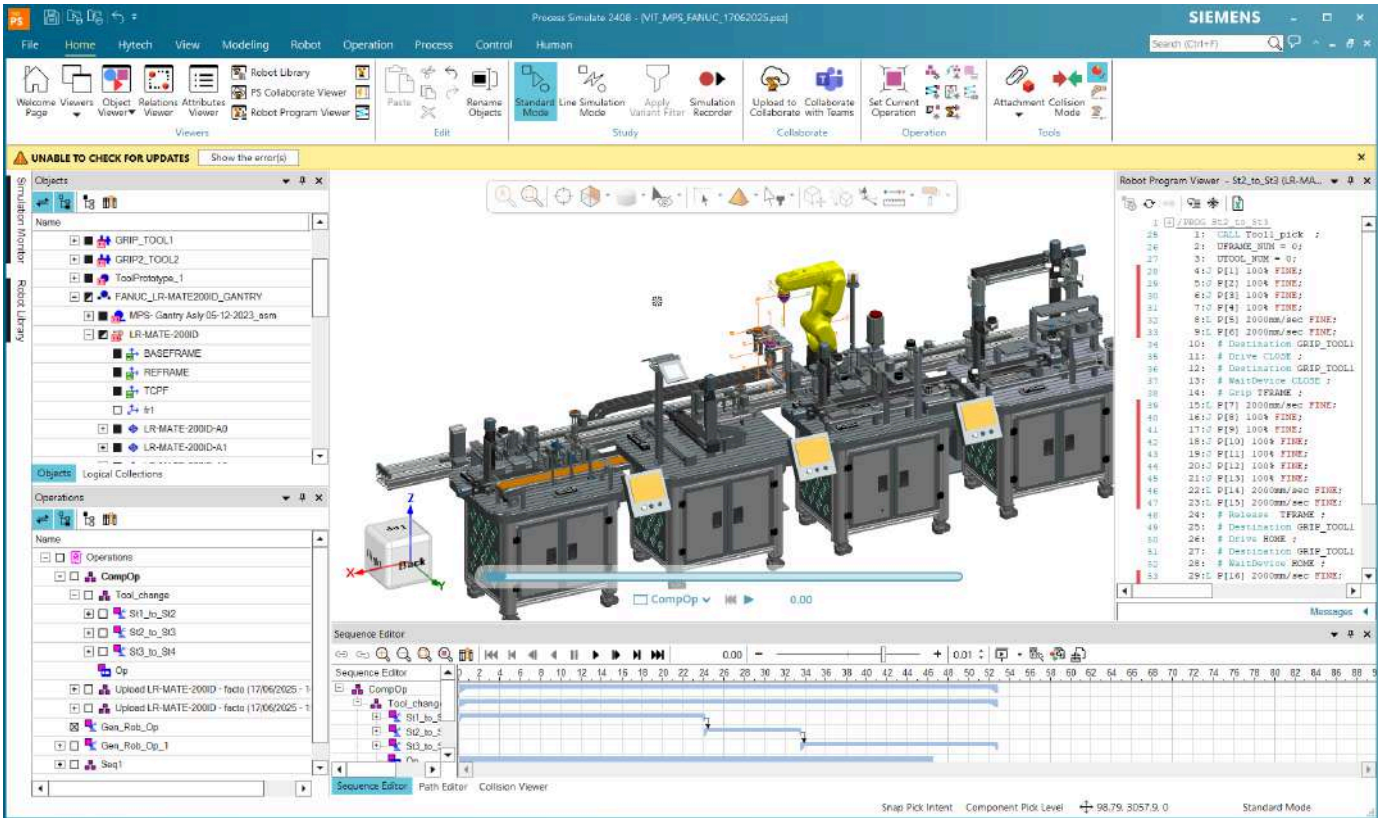
This ensures a functional design approach where machine behavior is defined and validated from the earliest stages of development.

Discipline-Specific Roles:

MCD supports parallel collaboration between multiple engineering domains:

- **Mechanical Engineers**
  - Create 3D machine structures
  - Define rigid bodies, joints, constraints, and motion paths
- **Electrical Engineers**
  - Assign and place sensors, actuators, and interfaces
  - Link logical behavior to physical devices
- **Electrical Engineers**
  - Model behavior using state charts, flow diagrams, and event triggers.
  - Simulate machine responses based on real-time inputs and events.

Process Simulate – Virtual Manufacturing & Robotics Simulation



Process Simulate is a cutting-edge **digital manufacturing solution** that enables comprehensive **process verification in a virtual 3D environment**. It significantly accelerates time-to-market by allowing manufacturers to simulate, validate, and optimize production processes early in the product lifecycle—before any physical resources are committed.

By leveraging 3D product and resource data, Process Simulate helps cross-functional teams validate complex operations, leading to **faster product launches, reduced commissioning risks,** and **higher production quality.**

Core Capabilities:

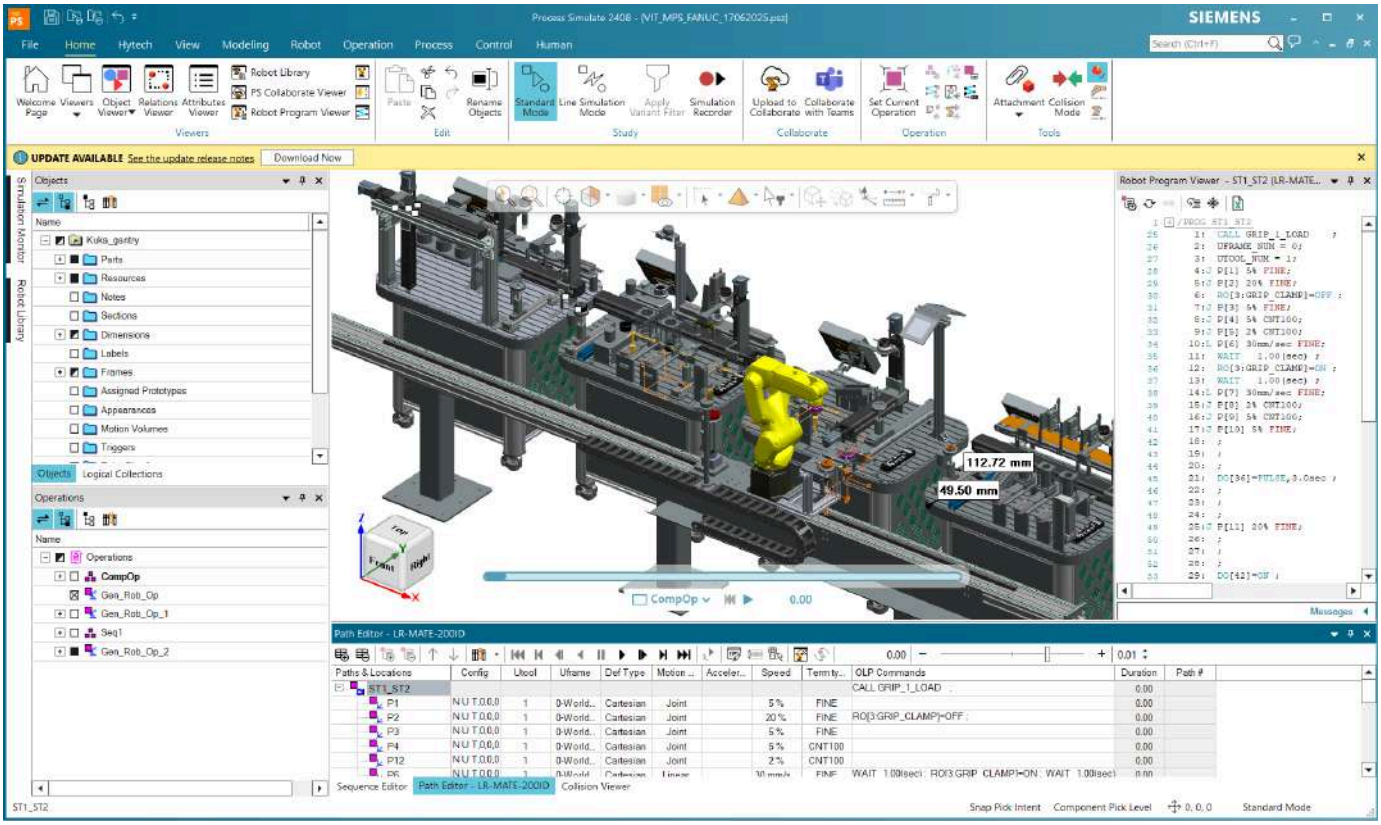
1. Robotic Motion Planning & Simulation:

- Design, simulate, and validate complex robotic motion paths using advanced kinematic models.
- Support for both discrete event simulation and continuous robotic operation.
- Emulates real-world behavior of robots, end-effectors, tools, and auxiliary devices.
- Optimize reachability, collision avoidance, and cycle times using automated path planning tools.

2. Virtual Commissioning

- Integrate mechanical, electrical, and control systems on a common digital platform.

Process Simulate – Virtual Manufacturing & Robotics Simulation



- Simulate real PLC code, robot programs, and sensor logic in a hardware-in-the-loop (HIL) environment.
- Detect and resolve integration issues prior to physical deployment, reducing costly delays and rework.
- Ensure full system functionality is validated before transitioning to the shop floor.

3. 3D Manufacturing Process Validation

- Validate end-to-end manufacturing workflows in a graphical 3D environment.
- Perform task sequencing, workstation validation, and tooling interference checks.
- Evaluate ergonomics, safety, and efficiency through human simulation and time analysis.

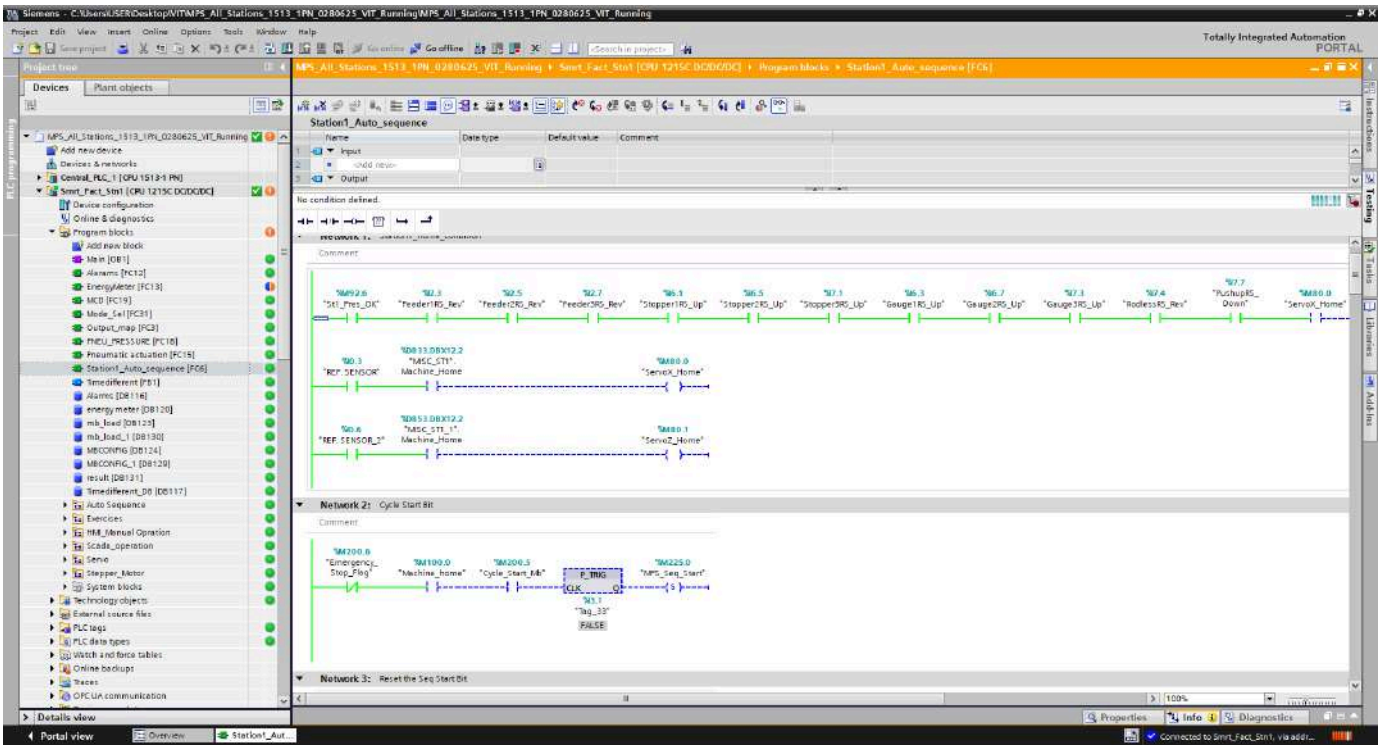
Relevance to Modern Manufacturing

Process Simulate plays a pivotal role in digital transformation initiatives by:

- Enabling collaborative development across mechanical, electrical, and automation teams.
- Reducing physical prototyping costs and shortening product development cycles.
- Improving production quality by verifying control logic, process flows, and machine interactions virtually.

It supports a seamless digital thread from concept design to real-world execution, aligning with Industry 4.0 principles and smart factory implementation.

Programmable Logic Controller (PLC)



The Brain of Industrial Automation

A **Programmable Logic Controller (PLC)** is an industrial digital computer specifically designed for the control and automation of manufacturing processes. In smart factories, PLCs play a crucial role in managing and coordinating machines, sensors, and actuators in real-time.

Key Features:

- **Robust And Reliable:** Designed to operate in harsh industrial environments with high accuracy.
- **Flexible Programming:** Supports multiple languages like Ladder Logic, Structured Text, and Function Block Diagrams.
- **Real-Time Control:** Enables instant decision-making for critical operations.
- **Modular Design:** Easily scalable to adapt to future expansions.
- **Seamless Communication:** Integrates with HMI, SCADA, sensors, and IIoT systems using protocols like PROFINET, MODBUS, and IO-Link.

Benefits in Smart Factory Applications:

- Enables automated decision-making and error detection.
- Facilitates remote monitoring, diagnostics, and data logging.
- Enhances process consistency, efficiency, and safety.
- Plays a vital role in Industry 4.0 transformation through connectivity and intelligence.

Human-Machine Interface (HMI)

The Visual Bridge Between Operator and Machine

A **Human-Machine Interface (HMI)** is a user interface that connects an operator to the industrial control system, typically a PLC. It displays real-time data, allows control commands, and provides status alerts—making it a vital component of any automation system.

Key Features:

- **Intuitive Touchscreen Interface:** User-friendly graphical displays for seamless interaction.
- **Real-Time Monitoring:** Visualizes data from machines and sensors instantly.
- **Alarm & Notification System:** Provides immediate alerts for faults or system errors.
- **Customizable Screens:** Allows design of process-specific layouts and dashboards.
- **Connectivity:** Communicates with PLCs and SCADA via industrial protocols such as MODBUS, PROFINET, or OPC-UA.

Benefits in Smart Factory Applications:

- Enhances operator efficiency through simplified control and diagnostics.
- Reduces downtime with quick fault identification and resolution.
- Enables centralized control of complex systems with minimal training.
- Supports data logging for performance tracking and analysis.

Industrial Robot With Automatic Tool Changer

Flexible Automation for Multi-Tasking Operations

The **Industrial Robot with Tool Changer** is a high-performance robotic solution designed to perform multiple operations by automatically switching between different tools. This setup enhances flexibility, efficiency, and adaptability in manufacturing environments.

Key Features:

- **Automatic Tool Changing System:** Enables seamless switching between tools (e.g., grippers, screwdrivers, welders) without manual intervention.
- **Multi-Axis Robotic Arm:** High-precision, repeatable motion for handling complex tasks.
- **Compact Tool Storage Rack:** Secure placement of various end-effectors for quick access.
- **Integrated With PLC & HMI:** Ensures smooth coordination and real-time monitoring.
- **Smart Sensors & Safety Features:** Equipped with position sensors, interlocks, and safety controls for reliable operation.

Station 1: Bearing Dispensing And Pneumatic Gauging Station

Station 1 is equipped with a pneumatic gauging system that sorts three different types of bearings with the same outer diameter but varying inner diameters. Any bearing other than the three predefined types will be rejected at Station 1.

Learning outcomes:

- PLC and HMI Integration
- Integration of Reed switches with PLC
- Integration of Sensor with PLC
- Sequential Operations of PLC
- Gauging Operation with Reed Switch Feedback
- PLC integration with Servo system
- Quality-based sorting and decision-making logic
- Operation of Pneumatic Solenoid Valves (Profinet Communication) in integration
- PLC and HMI
- PLC and SCADA robot integration.

Station 1: Technical Specifications

Station Structure	Structure made in Aluminum profiles with minimum work surface dimensions of 720mm x 1000mm. Worksurface made in aluminimum extrusions.
	4 Castor wheels with brakes
	Glass Door with door latching switch
	LED Based process indication on the station
PLC - HMI And FA	Basic PLC - Siemens S7 1200 Series or Mitsubishi FX 5 Series
	Perpetual licensed software for Basic PLC
	Basic HMI - Siemens Unified 7 inch HMI or Mitsubishi GOT 7 inch HMI
	Perpetual licensed software for Basic HMI
	I/O Link Master with 8 ports
	I/O Link Hub with 8 ports (16 inputs / outputs)
	5 Port Unmanaged Switch
	Complete Electrical Panel with necessary safety devices
Pneumatics	13 Station pneumatic valve bank with I/O Link connectivity / Profinet Connectivity
	5/2 Way Double acting solenoid valves as per station requirements (Mounted on Valve Bank)
	4mm PU Tube with necessary fittings as per station requirements
Linear Servo Slide / Single Axis Robot (Horizontal Transfer)	Frictionless Slide with minimum travel length of 700mm
	Ball Screw with Ball Nut
	400 Watt Servo Motor with Servo Drive
	Inductive Proximity Sensor for Servo Motor Referencing
Linear Servo Slide / Single Axis Robot (Vertical Transfer)	Frictionless Slide with minimum travel length of 200mm
	Ball Screw with Ball Nut
	400 Watt Servo Motor with Servo Drive
	Inductive Proximity Sensor for Servo Motor Referencing
Pneumatically Actuated Rotary Pick And Place Module	Pneumatic Parallel Gripper
	Pneumatic Vane Motor with 180 degree rotation
	One Way Flow Controller (Qty: 02)

Station 1: Technical Specifications

Pneumatic Gauging Module 1,2,3	Guided Cylinder with minimum stroke of 50mm (Qty: 03)
	Magnetic Reed Switch (Qty: 06)
	One Way Flow Controller (Qty: 06)
	Pencil cylinder with minimum stroke of 40mm and pneumatic gauging attachment to detect bearing type 1
	Magnetic Reed Switch (Qty: 06)
	One Way Flow Controller (Qty: 06)
Robot Pick Up / Drop Module	Pneumatic Double Acting Rodless Cylinder with minimum stroke of 200mm
	Magnetic Reed Switch (Qty: 02)
	One Way Flow Controller (Qty: 02)
	Pneumatic Double Acting Square Cylinder with minimum stroke of 50mm
	Magnetic Reed Switch (Qty: 02)
	One Way Flow Controller (Qty: 02)
	Pallet for holding the Bearing
	Three colour tower lamp
Bearing Dispensing Module 1,2,3	Guided Cylinder with minimum stroke of 75mm
	Magnetic Reed Switch (Qty: 02)
	One Way Flow Controller (Qty: 02)
	Storing Module for Type 1,2,3 Bearing
Conveyor Module	Conveyor with minimum width of 65mm and travel length of 800mm
	Step Servo Motor with Gearbox for conveyor operation
	Drive with suitable capacity for Step Servo Motor
	Retroreflective photosensor with reflector to detect the job at the end position on conveyor
Retroreflective Photosensor	Retroreflective photosensor with sensing distance of minimum 1000mm to detect the presence of bearing at the pick up position of auto feeders
Rejection Slide	Rejection slide made in Aluminium mounted on mild steel structure

Station 2: Vision Inspection Station

Station 2 is equipped with a vision inspection system. The vision camera inspects each bearing based on predefined teaching parameters. If a bearing does not meet these parameters, it will be rejected. The system sorts three types of bearings, while rejected items are placed in a designated bin.

Learning outcomes:

- PLC and HMI Integration
- Sequential Operations of PLC
- PLC Integration with vision sensor
- Vision camera Teaching
- Application and operation of Rodless cylinder
- Operation of Pneumatic Solenoid Valves (Profinet Communication) in integration with PLC and HMI.
- PLC integration with Servo system
- Pneumatic rotary operation
- Servo positions- Absolute, Relative and homing of position.
- Robot integration with PLC and SCADA

Station 2: Technical Specifications

Station Structure	Structure made in Aluminum profiles with minimum work surface dimensions of 720mm x 1000mm. Worksurface made in aluminimum extrusions.
	4 Castor wheels with brakes
	Glass Door with door latching switch
	LED Based process indication on the station
PLC - HMI And FA	Basic PLC - Siemens S7 1200 Series or Mitsubishi FX 5 Series
	Perpetual licensed software for Basic PLC
	Basic HMI - Siemens Unified 7 inch HMI or Mitsubishi GOT 7 inch HMI
	Perpetual licensed software for Basic HMI
	I/O Link Master with 8 ports
	5 Port Unmanaged Switch
	Complete Electrical Panel with necessary safety devices
Pneumatics	6 Station pneumatic valve bank with I/O Link connectivity / Profinet Connectivity
	5/2 Way Double acting solenoid valves as per station requirements (Mounted on Valve Bank)
	4mm PU Tube with necessary fittings as per station requirements
Linear Servo Slide / Single Axis Robot (Horizontal Transfer)	Frictionless Slide with minimum travel length of 500mm
	Ball Screw with Ball Nut
	400 Watt Servo Motor with Servo Drive
	Inductive Proximity Sensor for Servo Motor Referencing
Rejection Slide	Rejection slide made in Aluminium mounted on mild steel structure

Station 2: Technical Specifications

Robot Transfer (Inwards) Module	Pneumatic Double Acting Rodless Cylinder with minimum stroke of 300mm
	Magnetic Reed Switch (Qty: 02)
	One Way Flow Controller (Qty: 02)
	Pneumatic Double Acting Square Cylinder with minimum stroke of 50mm
	Magnetic Reed Switch (Qty: 02)
	One Way Flow Controller (Qty: 02)
	Pallet for holding the Bearing
Robot Transfer (Outwards) Module	Pneumatic Double Acting Rodless Cylinder with minimum stroke of 200mm
	Magnetic Reed Switch (Qty: 02)
	One Way Flow Controller (Qty: 02)
	Pneumatic Double Acting Square Cylinder with minimum stroke of 50mm
	Magnetic Reed Switch (Qty: 02)
	One Way Flow Controller (Qty: 02)
	Pallet for holding the Bearing
	Three colour tower lamp
Pneumatically Actuated Rotary Pick And Place Module	Pneumatic Parallel Gripper
	Pneumatic Vane Motor with 180 degree rotation
	One Way Flow Controller (Qty: 02)
Linear Servo Slide / Single Axis Robot (Vertical Transfer)	Frictionless Slide with minimum travel length of 200mm
	Ball Screw with Ball Nut
	400 Watt Servo Motor with Servo Drive
	Inductive Proximity Sensor for Servo Motor Referencing

Station 3: Assembly And Gauging Station

In this station, the bearing housing is dispensed from the bearing dispensing module and positioned on the sensing modules, where its weight is measured both before and after assembly. A color sensor identifies the bearing housing's color and level sensor measures its depth. The bearing housing is then assembled with the bearing, and the assembled product is transferred to the RFID module. In the RFID module, the system detects the tag attached to the bearing housing, and the PLC records its weight, color, and level. Finally, the bearing housing is transferred to the storing and packaging station.

Learning outcomes:

- Understand basic PLC hardware components
- PLC and HMI Integration
- Principle and operation of Color Sensor
- Application of color sensor in automation system
- Principle and operation of Weight Sensor
- Application of Weight Sensor in automation system
- Principle and operation of Level Sensor
- Application of Level Sensor in automation system
- Integration of Weight Sensor with plc
- Integration of Level Sensor with plc
- Functions and applications of RFID Sensor
- Integration of RFID sensor with PLC
- RFID system for real-time data write and Read
- PLC and SCADA robot integration

Station 3: Technical Specifications

Station Structure	Structure made in Aluminum profiles with minimum work surface dimensions of 720mm x 1000mm. Worksurface made in aluminimum extrusions.
	4 Castor wheels with brakes
	Glass Door with door latching switch
	LED Based process indication on the station
PLC - HMI And FA	Basic PLC - Siemens S7 1200 Series or Mitsubishi FX 5 Series
	Perpetual licensed software for Basic PLC
	Basic HMI - Siemens Unified 7 inch HMI or Mitsubishi GOT 7 inch HMI
	Perpetual licensed software for Basic HMI
	I/O Link Master with 8 ports
	I/O Link Hub with 8 ports (16 inputs / outputs)
	5 Port Unmanaged Switch
	Complete Electrical Panel with necessary safety devices
Pneumatics	11 Station pneumatic valve bank with I/O Link connectivity / Profinet Connectivity
	5/2 Way Double acting solenoid valves as per station requirements (Mounted on Valve Bank)
	4mm PU Tube with necessary fittings as per station requirements
Linear Servo Slide / Single Axis Robot (Horizontal Transfer)	Frictionless Slide with minimum travel length of 700mm
	Ball Screw with Ball Nut
	400 Watt Servo Motor with Servo Drive
	Inductive Proximity Sensor for Servo Motor Referencing
Linear Servo Slide / Single Axis Robot (Vertical Transfer)	Frictionless Slide with minimum travel length of 200mm
	Ball Screw with Ball Nut
	400 Watt Servo Motor with Servo Drive
	Inductive Proximity Sensor for Servo Motor Referencing
Pneumatically Actuated Rotary Pick And Place Module	Pneumatic Parallel Gripper
	Pneumatic Vane Motor with 180 degree rotation
	One Way Flow Controller (Qty: 02)

Station 3: Technical Specifications

Bearing Housing Dispensing Module 1,2	Guided Cylinder with minimum stroke of 75mm
	Magnetic Reed Switch (Qty: 02)
	One Way Flow Controller (Qty: 02)
	Storing Module for Type 1 Bearing Housing
RFID Module	I/O Link based RFID Reader and Writer
	Three colour tower lamp
	RFID Tags which can be mounted on the bearing housings (Qty: 09)
Load Cell Module	Load Cell with resolution of 10 Gram
	Load Cell Amplifier with Analog Output
	Load Cell Pallet
Level Gauging Module	I/O Link based laser distance sensor to gauge depth of housing
	Three colour tower lamp
Colour Sensing Module	I/O Link based colour sensor to gauge colour of housing
	Three colour tower lamp
Bearing Press Assembly Module	2 Qty Guided cylinder for holding housing
	Magnetic Reed Switch (Qty: 04)
	One Way Flow Controller (Qty: 04)
	Guided Cylinder with minimum stroke of 40mm
	Magnetic Reed Switch (Qty: 02)
	One Way Flow Controller (Qty: 02)
Robot Transfer (Inwards/ Outwards) Module	Pneumatic Double Acting Rodless Cylinder with minimum stroke of 150mm
	Magnetic Reed Switch (Qty: 04)
	One Way Flow Controller (Qty: 04)
	Pneumatic Double Acting Square Cylinder with minimum stroke of 50mm
	Magnetic Reed Switch (Qty: 04)
	One Way Flow Controller (Qty: 04)
	Pallet for holding the Bearing
	Three colour tower lamp (outwards)

Station 4: Packaging And Storage Station

The ASRS Cartesian robot retrieves a container and cap from the ASRS storage rack. The servo motor-based rotary pick-and-place module picks up the container and cap from the ASRS storage rack and transfers them to the Capping Module. In the Capping Module, the container cap is securely fixed onto the container using a vacuum-based suction mechanism. After capping, the system transfers the capped container back to the ASRS storage rack.

Learning outcomes:

- PLC and HMI Integration
- Understand basic PLC hardware components
- Operation of Pneumatic Solenoid Valves (Profinet Communication) in integration with PLC and HMI.
- PLC integration with Servo system
- Pneumatic rotary and gripper operation
- Servo positions and teaching
- ASRS operation and applications

Station 4: Technical Specifications

Station Structure	Structure made in Aluminum profiles with minimum work surface dimensions of 720mm x 1000mm. Worksurface made in aluminimum extrusions.
	4 Castor wheels with brakes
	Glass Door with door latching switch
	LED Based process indication on the station
PLC - HMI And FA	Basic PLC - Siemens S7 1200 Series or Mitsubishi FX 5 Series
	Perpetual licensed software for Basic PLC
	Basic HMI - Siemens Unified 7 inch HMI or Mitsubishi GOT 7 inch HMI
	Perpetual licensed software for Basic HMI
	I/O Link Master with 8 ports
	I/O Link Hub with 8 ports (16 inputs / outputs), Qty: 02
	5 Port Unmanaged Switch
	Complete Electrical Panel with necessary safety devices
Pneumatics	11 Station pneumatic valve bank with I/O Link connectivity / Profinet Connectivity
	5/2 Way Double acting solenoid valves as per station requirements (Mounted on Valve Bank)
	4mm PU Tube with necessary fittings as per station requirements
Linear Servo Slide / Single Axis Robot (Horizontal Transfer)	Frictionless Slide with minimum travel length of 300mm
	Ball Screw with Ball Nut
	400 Watt Servo Motor with Servo Drive
	Inductive Proximity Sensor for Servo Motor Referencing
Linear Servo Slide / Single Axis Robot (Vertical Transfer)	Frictionless Slide with minimum travel length of 200mm
	Ball Screw with Ball Nut
	400 Watt Servo Motor with Servo Drive
	Inductive Proximity Sensor for Servo Motor Referencing
Pneumatically Actuated Rotary Pick And Place Module	Pneumatic Parallel Gripper
	Pneumatic Vane Motor with 180 degree rotation
	One Way Flow Controller (Qty: 02)

Station 4: Technical Specifications

Automatic Storage And Retrieval Module	Frictionless Slide with minimum travel length of 400mm (Horizontal Travel)
	Ball Screw with Ball Nut
	400 Watt Servo Motor with Servo Drive
	Inductive Proximity Sensor for Servo Motor Referencing
	Frictionless Slide with minimum travel length of 300mm (Vertical Travel)
	Ball Screw with Ball Nut
	400 Watt Servo Motor with Servo Drive
	Inductive Proximity Sensor for Servo Motor Referencing
	Pneumatic Guided Cylinder with minimum stroke of 100mm
	Magnetic Reed Switch (Qty: 02)
	One Way Flow Controller (Qty: 02)
	Pneumatic Parallel Gripper
	Three colour tower lamp
	Pallet to store 3 Qty Bottles
	Pallet to store 3 Qty Lids
	Pallet to store 3 Qty Bottle Assemblies
	Diffused Photosensor (Miniature) with minimum sensing distance of 25mm (Qty: 10)
Bottle And Cap Thread Assembly Module	2 Qty Guided cylinder for holding Bottle
	Magnetic Reed Switch (Qty: 04)
	One Way Flow Controller (Qty: 04)
	Guided Cylinder with minimum stroke of 150mm
	Magnetic Reed Switch (Qty: 02)
	One Way Flow Controller (Qty: 02)
	Pneumatic Vane Motor with 180 degree rotation
	One Way Flow Controller (Qty: 02)
	Pneumatic Vacuum Generator
	Flexible Bellow (Pneumatically actuated)
Robot Transfer (Inwards) Module	Pneumatic Double Acting Rodless Cylinder with minimum stroke of 150mm
	Magnetic Reed Switch (Qty: 02)
	One Way Flow Controller (Qty: 02)
	Pneumatic Double Acting Square Cylinder with minimum stroke of 50mm
	Magnetic Reed Switch (Qty: 02)
	One Way Flow Controller (Qty: 02)
	Pallet for holding the Bearing

Gantry-Mounted Robot System With Tool Changer

Flexible Material Handling Across Smart Factory Stations

High-Precision Gantry Integration

- Features a **robot mounted on a linear gantry (7th axis)** that enables extended reach and mobility across multiple factory stations.
- The gantry is constructed using **rigid aluminum extrusions** and equipped with high-accuracy **servo-driven linear motion**, ensuring smooth and precise transfer of components between processes.

Automatic Tool Changer

- The robot is equipped with a **pneumatic or servo-driven tool changer**, enabling **automatic switching between end-effectors** based on task requirements.
- Supports multiple tools such as:
  - **Pneumatic grippers** for bearing and component handling
  - **Vacuum suction cups** for container and cap pickup
  - **Custom end tools** for assembly and inspection tasks
- Enhances operational flexibility and reduces cycle time by **eliminating manual tool change interventions.**

PLC and HMI Controlled Operation

- Fully controlled via **central PLC and HMI,** allowing dynamic programming of robot tasks and tool paths.
- Users can monitor gantry positions, tool status, and part flow in **real-time** using integrated **HMI/SCADA interfaces.**

Central Control With PLC – HMI And IIOT

Learning outcomes:

- Understand the Role of CCU
- Integration and Control of RTU (7th Axis of Robot)
- SCADA Design and Implementation
- Digital Twin Integration via OPC UA
- Comprehensive Smart Factory Operation

1. Centralized Control with PLC and HMI Integration

- The robotic training cells feature a separate Central Control Unit comprising a PLC (Programmable Logic Controller) and HMI (Human-Machine Interface).
- Robots are seamlessly integrated with the PLC and HMI, enabling trainees to operate complete robotic cycles within an industrial automation context.
- This setup provides comprehensive exposure to industrial robotic architecture and hands-on experience with state-of-the-art robotics.

2. Customization and Experimentation

- Users can design and implement various PLC programs and develop custom HMI screens for controlling robot operations.
- Trainees can experiment with diverse industrial automation components, such as:
  - RFID Reader/Writer: For tracking and automation applications.
  - Color Sensors: For detecting and responding to color variations in automated workflows.
  - IO-Link Sensors: Such as color, distance, and proximity sensors for high-resolution part tracking and condition-based control.
  - Servo & Pneumatic Actuators: For movement control in dispensing, assembly, and robotic handling tasks.
- These components are integrated with the robot via the PLC-HMI framework, providing real-world automation scenarios.

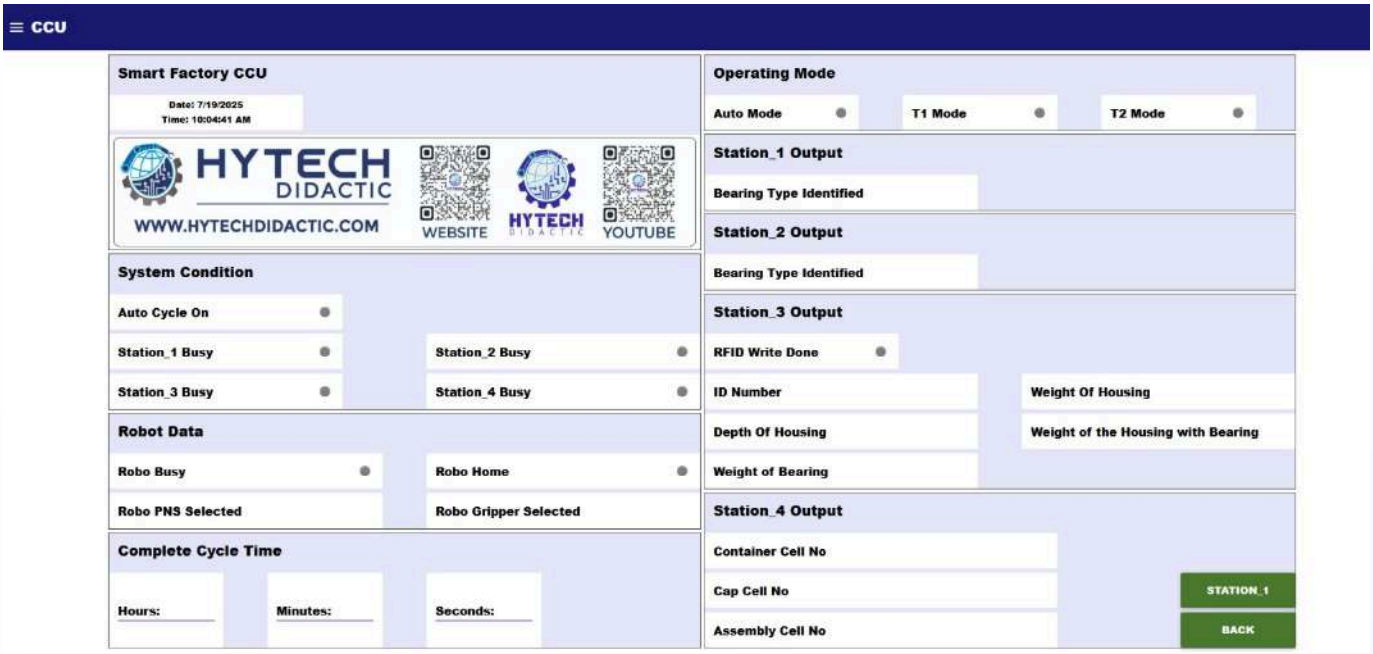
3. Industrial IoT (IIoT) Integration

- Siemens Industrial Edge technology is incorporated to offer advanced IIoT capabilities.
- Trainees gain essential skills in data collection, analysis, and remote monitoring—key aspects of modern industrial environments.

4. Comprehensive Licensing

- All required software licenses for PLC, HMI, and Industrial Edge are pre-installed and fully operational.
- The workstation included with the setup ensures a seamless and efficient training experience.

Industrial IoT (IIoT) Integration



Connecting Machines to Intelligence

Our smart factory integrates Siemens Industrial Edge technology to enable real-time connectivity, data-driven insights, and intelligent automation. This IIoT-enabled environment equips trainees with cutting-edge skills in digital manufacturing and connected industry solutions.

Key Features:

- **Siemens Industrial Edge:** Bridges OT and IT by processing data directly at the machine level for faster decision-making.
- **Real-Time Data Acquisition:** Captures operational data from sensors, PLCs, and machines.
- **Edge-To-Cloud Connectivity:** Securely transfers relevant data to cloud platforms for deeper analytics.
- **Dashboard & Analytics Tools:** Enables visualization of trends, performance metrics, and predictive insights.

Training Highlights:

- Learn to **collect, process, and analyze industrial data** from real-time sources.
- Understand **remote monitoring**, condition-based maintenance, and production optimization.
- Work with **IIoT protocols** such as MQTT, OPC UA, and edge computing concepts.
- Prepare for **Industry 4.0** roles in smart manufacturing environments.

Industrial Vision Systems

In a modern smart factory ecosystem, **Industrial Vision Systems** are crucial for enabling automated decision-making, precision control, and adaptive manufacturing processes. When integrated with **PLC, HMI, and Robotics**, vision systems elevate the scope of industrial training by offering a comprehensive and realistic learning environment.

A smart factory training setup that includes **hands-on experience with Industrial Vision Systems** prepares students for real-world challenges in advanced manufacturing. The integration of **vision with PLC, HMI, and Robotics** ensures learners develop a deep understanding of intelligent automation, quality assurance, and smart decision-making — skills that are essential in today's Industry 4.0 era.

- **Real-Time Inspection & Quality Control**
  Trainees learn to configure vision systems for automated inspection tasks such as dimensional checks, surface defect detection, orientation, and presence/absence verification using tools like edge detection and pattern matching.
- **PLC & HMI Integration**
  Vision outputs are integrated with PLCs to trigger automated actions like rejection or sorting. HMIs display real-time inspection results, helping learners understand end-to-end process control.
- **Vision-Guided Robotics**
  Students program robots to perform dynamic tasks like pick-and-place using real-time visual feedback, object recognition, and camera-robot calibration—replicating real industrial applications.
- **Hands-On With Industrial Vision Systems**
  Using industrial systems like Cognex, trainees gain hands-on experience in camera setup, image processing, inspection programming, and communication protocols. They also perform exercises in barcode reading, defect detection, and alignment.
- **Industry 4.0 & Data Analytics**
  Vision systems act as data sources for process monitoring and analytics. Trainees learn to log, analyze, and utilize inspection data—building skills for predictive maintenance and digital twin-based environments.

Robotic Smart factory Training cell (Learning Management System)

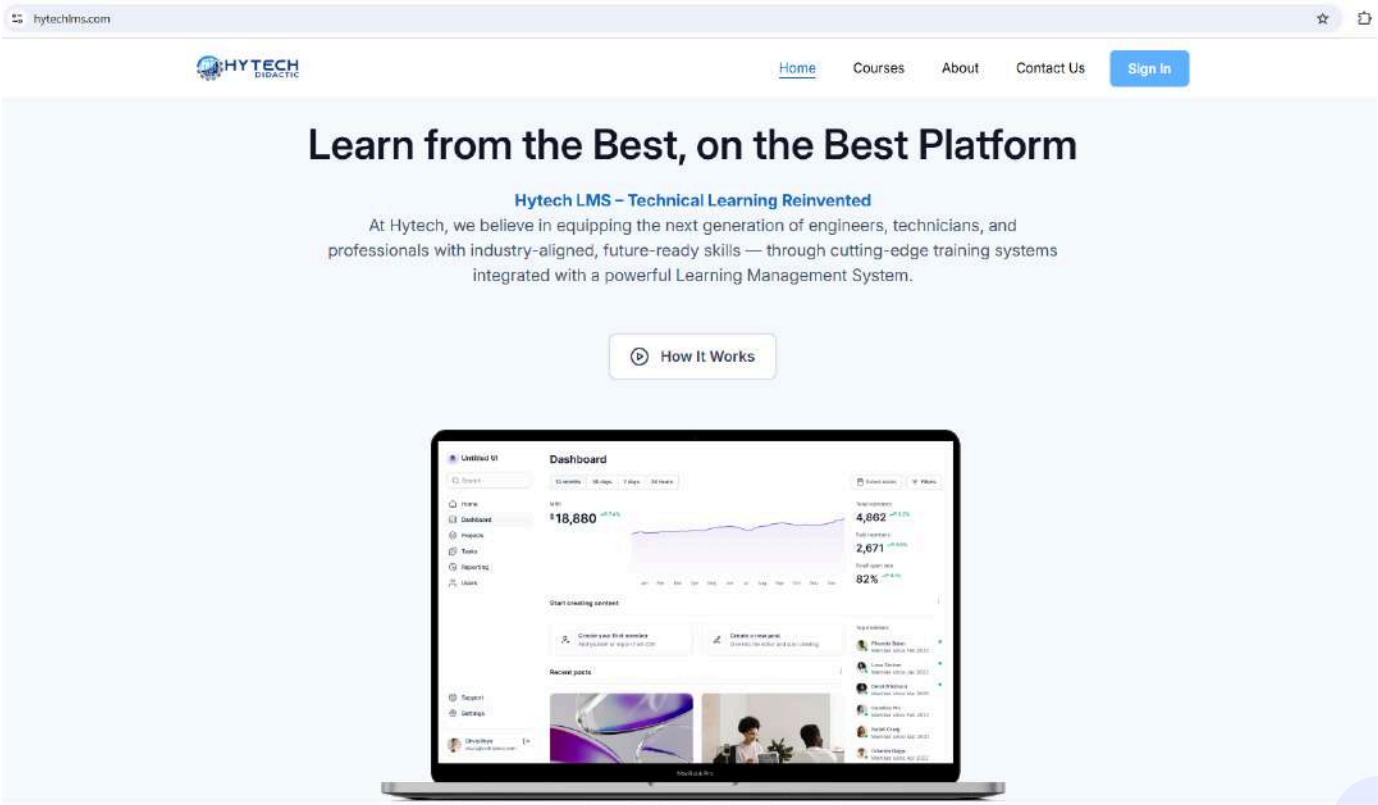
Robotics **Smart factory** technology is an advanced and continuously evolving field. Training of trainers plays a pivotal role in equipping them to impart effective training to students. Hytech Robotics **Smart factory** training cells come equipped with a comprehensive Learning Management System (LMS) designed to enhance the learning experience.

Key Features Of The Hytech LMS:

- **Step-By-Step Guidance:** Trainers receive a structured, step-by-step guide to understand various robotic technologies.
- **Up-To-Date Training Content:** Courses within the LMS are continually upgraded to align with the latest advancements in robotics technology.
- **Customizable Content:** Trainers can create their own training modules, conduct examinations, and issue certifications directly through the LMS.
- **Support For Management:** The LMS is an invaluable tool for addressing trainer attrition and ensuring consistent training and handholding for trainers.

Robotic Smart Factory Courses In The LMS:

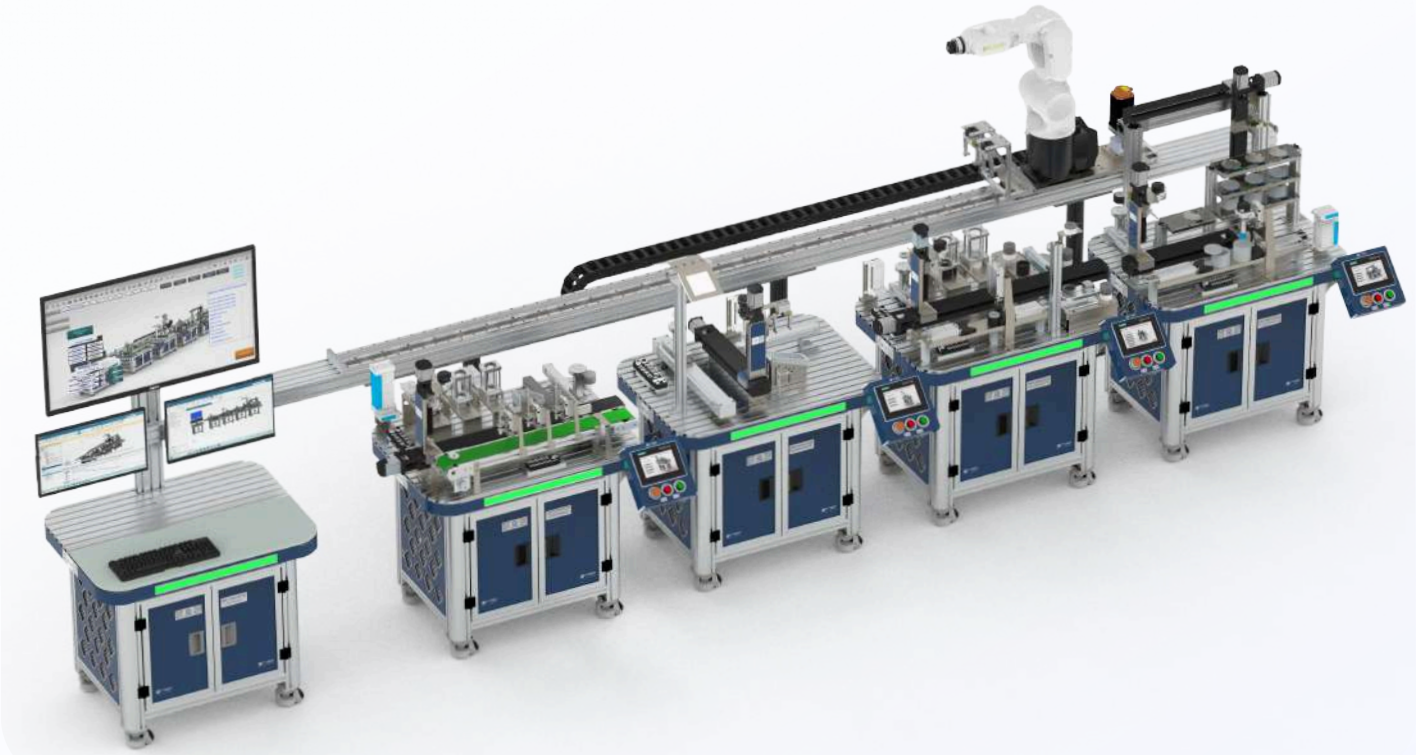
The Hytech LMS offers courses that focus on both theoretical knowledge and practical applications in **Robotic Smart Factory**. These courses are designed to build a strong foundation and enhance hands-on skills for trainers and students alike.
Contact us today for a free demonstration of the Hytech LMS and explore how it can transform **Robotic Smart Factory** training at your institution.



Detailed Training Module Mapping for Smart Factory Setup:

Station Details and TrainingModule Mapping Details		Station 1	Station 2	Station 3	Station 4	Robotics	CCU
		Feeding & Pneumatic Gauging Station	Vision Inspection & Sorting Station	Pneumatic Assembly & Colour Sensing Module	Packaging & Storage Station	7 Axes Robot with Gantry	Central Control Unit
Training Module 1	Basic Electrical Wiring	■	■	■	■		
Training Module 2	PLC Programming	■	■	■	■		
Training Module 3	HMI Design	■	■	■	■		
Training Module 4	PLC - HMI Integration	■	■	■	■		
Training Module 5	I/O Link Master Integration with PLC & HMI	■	■	■	■		
Training Module 6	Sensors	■	■	■	■		
Training Module 7	Servo Motor	■	■	■	■		
Training Module 8	Load Cell			■			
Training Module 9	Colour Sensing			■			
Training Module 10	Pneumatics	■	■	■	■		
Training Module 11	Level Gauge Sensor			■			
Training Module 12	Vision Camera/Sensor		■				
Training Module 13	RFID Writer			■			
Training Module 14	RFID Reader			■			
Training Module 15	Robot Operations					■	
Training Module 16	Robot Integration with PLC					■	■
Training Module 17	SCADA Design & Integration (PLC-HMI)						■
Training Module 18	SCADA & Robotics Integration						■
Training Module 19	SCADA Runtime Design						■
Training Module 20	MCD - Remote Commissioning						■
Training Module 21	IIOT Based Operation						■

ROBOTIC Smart Factory with Digital Twin and Remote Commissioning



Smart Factory is a robotic setup with connected machines. It can also be called as a Modular Production System (MPS) with IIOT Integration.

Smart Factory is designed to provide students with hands on experience on industrial automation techniques which are currently used in the industry.

Unlike other similar setups, Hytech Didactic Robotic Smart Factory offers students with few of the most important training aspects such as:

- PLC Ladder Programming
- HMI Design
- SCADA Design and Integration
- SCADA Runtime design and Operation (MES)
- Robot Integration with PLC – HMI – SCADA
- Remote Commissioning with OPC UA Communication (Siemens Mechatronics Concept Designer)
- Robot Digital Twin (With Dynamic Programming)
- IIOT Based Data Collection and dashboard design

In Hytech Didactic, Learning Management System focuses not only on training modules but also on operation training which includes PLC and SCADA based system design and operation. This training system provides holistic experience in actual industrial automation processes including robotics.

Users are also trained on Industrial Robotics with a 7 axes industrial robot and industrial robot tool changer.

Detailed Training Module Mapping for Smart Factory Setup:

FANUC / KUKA Robot with 7 Axes Robotic Tool Changer Attachment Gantry Axis Controlled from TP

Complete Integration with SCADA LM Rails and Rack Based Gantry

Siemens S7 1200 Siemens MTP 700 Siemens TIA Siemens WINCC - Runtime	Siemens S7 1200 Siemens MTP 700 Siemens TIA Siemens WINCC - Runtime COGNEX Vision Temperature Pressure and Humidity	Siemens S7 1200 Siemens MTP 700 Siemens TIA Siemens WINCC - Runtime Assembly Level Sensing Load Based Sensing Colour Sensing	Siemens S7 1200 Siemens MTP 700 Siemens TIA Siemens WINCC - Runtime Capping RFID Reading & Writing AC Motor & VFD	Siemens S7 1200 Siemens MTP 700 Siemens TIA Siemens WINCC - Runtime Siemens WINCC - Developer Industrial PC Robot OLP Siemens MCD - Virtual Commissioning

7 Axes Robot with Gantry Axis and Robotic Tool Changer

Bearing Dispensing & Pneuamtic Gauging Station	Vision Inspection Station	Assembly & Gauging Station	Packaging & Delivery Station	Central Control Unit
Different types of bearing are automatically dispensed in this station. Pneumatic gauging of the bearing is carried out & type of the bearing is recorded in the SCADA.	Vision Inspection of the bearing is carried out in this station. Temperature, Pressure and Humidity data is recorded at this station.	Assembly of Bearing and respective shaft is carried out in this station. Level of the shaft before assembly is recorded with level sensor. Colour of the shaft is recorded with i/o link bsed colour sensor. Weight of the assembly is recorded in load cell.	Assembled product is packed in a container in this station. Capping (Thread Based) is carried out on the container after placing the assembled product inside. Important parameters decided by the user along with URN are recorded in the RFID tag from RFID Reader / Writer.	Complete process in controlled through SCADA along with Robot integration from CCU. Remote commissioning with digital twin (Siemens Mechatronics Concept Designer) is also carried out from CCU. IIOT Integration with remote operation facility from Industrial PC is also provided with CCU.

7 Axes Robot is mounted on a gantry which has a reach from one end of the setup to other end ot the setup. Robot is equipped with a dual tool changer. Entire robot (Along with 7th Gantry Axis) can be programmed from a Teach Pendant. Robot is utilised to transfer jobs from one station to another. User needs to integrate robot with SCADA to transfer signals from Station PLC to Robot Controller. Tool of the robot needs to be changed depending on the job to be handled.

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