COMPUTER INTEGRATED MANUFACTURING SYSTEM

Computer Integrated manufacturing System from Hytech Automation is a completely integrated industrial automation based system with actual manufacturing processes such as turning and milling. CIM system consists of various industrial automation stations which are integrated with industrial SCADA system and a central PLC. Entire system is coupled with industrial MES as well as industrial digital twin software. User can operate each station / equipment in the entire system in individual mode as well as in integrated mode.

CIM System consists of actual machining processes such as CNC Turning and CNC Milling. Each station except the robot module and CNC Machines of the system is equipped with Siemens S7 1200 PLC and Siemens KTP 700 HMI. This allows user to program each station in individual mode and integrate it with the central control system through Siemens SCADA. Complete system is integrated with IIOT. This allows users to commission as well as operate the system remotely. Users can also collect various data points for AI and ML integrations.

Hytech Automation CIM System is also provided with complete fencing arrangement along with door latching switches as well as laser based security sensors providing complete industrial experience to users. Industrial components such as smart vision system, magnetic scales with analog feedback, i/o link communication with i/o link sensors are also provided with CIM system. Integration of this system with Augmented reality to create various process simulations provides users with additional skillset. With Process simulation software, users can create various case studies and simulate them as per industrial standards.

Various Machines / Stations in Computer Integrated Manufacturing System:

1. CNC Turning Machine
2. CNC Milling Machine
3. Automated Storage and Retrieval System
4. Industrial Articulated Robot with Gantry Axis and Robot Tool Changer
5. Pneumatic Press Assembly Station with PLC and HMI
6. Vision Inspection Station with PLC and HMI
7. Automatic Bolt Assembly Station with Automatic bolt feeder and DC Nut Runner
8. Central Control Station with Siemens S7 1500 PLC and Siemens KTP 900 HMI (Integrated System)

Various Software Integrated with Computer Integrated Manufacturing System:

1. Siemens SCADA
2. Siemens MES
3. Digital Twin – Siemens Technomatix
4. Unity – Augmented Reality
5. Remote Commissioning Software (PLC Based Digital Twin) – Siemens Mechatronics Concept Designer
6. Siemens TIA for PLC and HMI programming

Various Training Modules in Computer Integrated Manufacturing System:

1. CNC Training
2. Robotics Training
3. PLC and HMI Training (Industrial Automation and Mechatronics)
4. Smart Vision Training Module (Industrial Automation and Mechatronics)
5. Process Simulation with Digital Twin Integration
6. SCADA Training Module
7. MES Training and Integration
8. IIOT Module
9. Augmented Reality Training Module

Training Module Mapping:

Equipment Details / Training Modules	CNC Turning	CNC Milling	Automated Storage and Retrieval	Gantry with 7 Axes Robot	Press Assembly Station	Bolt Assembly Station	Vision Inspection Station
CNC Training							
CNC Integration with SCADA							
Robotics Training							
Robot Integration							
Pneumatics							
PLC							
HMI							
SCADA Integration							
Vision							
PLC and SCADA Integration							
MES							
Digital Twin							

CNC Turning Machine:

CNC Machine in Computer Integrated Manufacturing System is an industrial CNC Turning machine equipped with industrial automatic turret and capable of machining mild steel. CNC Turning Machine is equipped with Siemens 828D Controller. Automatic door and Hydraulic chuck provide necessary automation required for complete automation of the process. CNC Turning machine is connected with the central control station through profinet communication. In integration mode, all control pints of the CNC Turning machine can be monitored as well as controlled from a central control station.

Major Specifications:

- Chuck: 135mm Hydraulic Chuck with Hydraulic powerpack
- Turret: 8 Station Industrial Automatic Turret
- Bed Type: 45 degree Slant Bed
- Z Axis Travel: 300mm
- X Axis Travel: 120mm
- Controller: Siemens 828D
- Coolant and Lubrication: Automatic
- Motion Type: Linear Motion Guideways with Ball Screws

Major Exercises:

- Operation of CNC Turning Machine with Siemens 828D Controller
- CAD and CAM based program generation and execution using Siemens NX Software
- Integration with CNC Turning Machine with SCADA
- Integration with CNC Turning Machine with Industrial Robot
- CNC Operation from Central Control
- CNC Turning Data Acquisition and storage in cloud

CNC Milling Machine:

CNC Milling Machine in Computer Integrated Manufacturing System is an industrial CNC Milling machine equipped with 12 station industrial automatic tool changer and capable of machining mild steel. CNC Milling Machine is equipped with Siemens 828D Controller. Automatic door and pneumatic vice provide necessary automation required for complete automation of the process. CNC Milling machine is connected with the central control station through profinet communication. In integration mode, all control pints of the CNC Milling machine can be monitored as well as controlled from a central control station.

Major Specifications:

- X Axis: 300mm
- Y Axis: 225mm
- Z Axis: 250mm
- Bed Size: 650mm x 250mm
- Spindle: 4000 RPM (3.7 KW)
- Vice: Pneumatically operated
- Controller: Siemens 828D
- Coolant and Lubrication: Automatic
- Motion Type: Linear Motion Guideways with Ball Screws

Major Exercises:

- Operation of CNC Milling Machine with Siemens 828D Controller
- CAD and CAM based program generation and execution using Siemens NX Software
- Integration with CNC Milling Machine with SCADA
- Integration with CNC Milling Machine with Industrial Robot
- CNC Operation from Central Control
- CNC Milling Data Acquisition and storage in cloud

Automated Storage and Retrieval System:

Automated Storage and Retrieval System (ASRS) in Hytech Automation Computer Integrated Manufacturing System is an automated station for storage and Retrieval of jobs commanded from the central control station. ASRS is equipped with Siemens S7 1200 PLC and Siemens KTP 700 HMI for individual operation. ASRS can be operated in individual mode and can also be integrated with the complete automated process. User is expected to program the ASRS in individual mode for pick up and drop and then integrate it with the MES as well as central control station.

All three axes of ASRS are coupled with magnetic scales which cross check the exact position of pick up arm and avoid any accidents. Users can program and feed the coordinates for each cell in X, Y and Z Axis. Two conveyors on each side of the ASRS are provided for each of job pick up. Job from ASRS fixture can either picked up by a Robot or the same can be transferred on AMR with the help of conveyor.

Major Exercises:

- Servo Motor Operation from PLC and SCADA
- Interpolated Servo Motor Operation (X, Y and Z Axes) for ASRS Operation from PLC
- PLC and HMI Integration for ASRS Operation
- PLC and HMI (ASRS) integration with SCADA
- Complete ASRS Operation in integration with PLC - HMI - Pneumatic Gripper - Servo Motors - AC Motor powered Conveyors
- Complete ASRS Operation in integration with CIM SCADA

Automated Storage and Retrieval System:

Automatic storage and Retrieval System		
	Description	**Specifications**
Structure	No of Cells	36
	No of Rows	6
	No of Columns	6
	Cell Size	200mm x 200mm x 200mm
	Accuracy	0.010mm
	Repetability	0.015mm
	X Axis Travel: 2,000mm	2000mm active travel
	Linear Motion Rails for X Axis, Qty: 02	25mm size, 3 meter x 2
	Linear Motion Blocks for X Axis, Qty: 04	25mm size x 4
	Servo Motor for X Axis	750 Watt - 2.39 Nm
	Y Axis Travel: 800mm	800mm active travel
	Linear Motion Rails for Y Axis, Qty: 02	25mm size, 1.5 meter x 2
	Linear Motion Blocks for Y Axis, Qty: 04	25mm size x 4
	Servo Motor for Y Axis	750 Watt - 2.39 Nm
	Z Axis Travel: 1,500mm	1500mm active travel
	Linear Motion Rails for Z Axis, Qty: 02	25mm size, 1.8 meter x 2
	Linear Motion Blocks for Z Axis, Qty: 04	25mm size x 4
	Servo Motor for Z Axis	750 Watt - 2.39 Nm with Brake
	Overall Dimensions	2360 x 1585 x 2200 mm
Gripper	Pneumatic Gripper for ASRS	32mm Cylinder with 10 KG holding capacity at 7 Bar air pressure
	Pneumatic FRL Unit	1/4 inch
	Pneumatic Air Gun	1/4 inch
Transfer Station	No of transfer stations	2
	Length of each transfer station	500mm
	Width of each transfer station	250mm
	Transfer station operation control	Through ASRS PLC
PLC	Siemens S7 1200 PLC	
HMI	Siemens KTP 700 Basic HMI	
I/O Link Junction Box	Profinet based junction box with minimum 8 Ports - M12	
Smart Light	Smart Light to indicate the process status - I/O Link based	

Industrial Articulated Robot with Gantry Axis and Robot Tool Changer:

Industrial Robot Unit is designed for the job transfer between various station of Computer Integrated Manufacturing System along with machine tending application for CNC Turning Machine and CNC Milling Machine.

The Robot provided has a minimum reach of 2,000mm in radius and a minimum payload capacity of 8 KG.

Robot has a 7th axis which is a linear axis and the same can be controlled directly from the robot teach pendant. This makes it feasible for operators to control the Robot in absolute position in integrated as well as in individual mode.

The Robot is equipped with an electrical gripper. Robot tool changer is also provided where the tools for the robot gripper can be changed automatically. The tools are designed in such a way that the robot can clamp round jobs of various specified sizes with one tool and rectangular jobs of various sizes with another tool. Robot tool changer is provided with a profinet communication which communicates directly with the Central Control Unit of CIM system.

Robot is mounted on a Robot Transfer Unit which has a linear travel of 4 meter. This makes an effective linear reach of the robot as 8 meter considering the reach of robot and reach of RTU in linear direction.

Robot is mounted on a Robot Transfer Unit which has a linear travel of 4 meter. This makes an effective linear reach of the robot as 8 meter considering the reach of robot and reach of RTU in linear direction. The layout is designed in such a way that the Robot can pick up the jobs directly from Automatic Storage and Retrieval System (ASRS) and load them in desired station in CIM. Depending on the job to be picked up, tool of the robot will be changed accordingly.

Each station in CIM is provided with Robot integration fixture where the jobs are placed as well as picked up by the Robot.

Robot Unit is provided with Smart light with IO Link connectivity which can demonstrate the status of various processes.

Automatic Robotic Tool Changer:

Automatic exchange of the end effector increases the flexibility of robot.

The quick-change system consists of a quick-change master and a quick-change adapter.

The quick-change master is mounted onto the robot, and couples the quick-change adapter mounted onto tool. User can add multiple tools by adding quick change adapter in future for additional requirements.

A pneumatically driven locking piston, with its patented design, ensures that the connection is secure. After coupling, pneumatic and electric feed-throughs automatically supply your robot tool.

User can control this complete mechanism from the CCU of a CIM system as well as remotely by making use of IIOT based technology.

In Hytech CIM System, Robot is equipped with two tools which can be automatically picked up depending on user requirement.

Automatic Tool Changer requires precise Robot programming along with Robot - PLC and SCADA Integration.

Major Exercises:

Operate and precisely position Robot on all 7 axes with the help of teach pendant

Operate Robot in integration with Tool changer from teach pendant

Operate Robot in integration with PLC and HMI

Operate Robot in integration with PLC and SCADA

Carry out Pick n Place Operation with Robot in integration with PLC and SCADA

Carry out Pick n Place Operation of two different jobs using Robotic Tool changer in integration with PLC - HMI and SCADA

Pneumatic Press Assembly Station with PLC and HMI:

Hytech Didactic Assembly Station is a mechatronics based training system designed to carry out automated assembly of 4 different parts with pneumatically and electrically actuated process. Automated bearing dispensing station is also provided in the system. Entire station is programmed and operated with SIEMENS PLC and HMI.

Users can have hands on experience on the remote commissioning as well through Siemens Mechatronics Concept Designer Software. Assembly station is an individual station which can be integrated with Hytech Computer Integrated Manufacturing System. When integrated with Computer Integrated Manufacturing system, raw jobs are loaded in the assembly station by gantry mounted robot whereas in an individual system, these raw jobs are loaded manually.

User can change the process as well as the PLC ladder and HMI screens depending on training requirements. This station is designed to provide students with real time industrial automation process and integration of various automation components such as PLC, HMI, Servo motors, Auto feeders, pneumatic press process etc

Assembly Station Experiments:

Assembly Station can be used individually as well as in integration with the entire CIM Setup. Assembly Station is equipped with PLC as well as HMI and relevant software necessary for the PLC and HMI programming.

Even in integration setup with CIM, Assembly cell will initiate the process once it receives the signal from Central Control Unit. It will complete entire task of assembly and pass on the signal of process completion to CCU (Master PLC) for further process.

For experimentation, user is expected to carry out all process cycles or experiments on assembly station in individual mode. In ideal scenario, assembly station is programmed individually and then integrated with the CIM setup.

There are 3 jobs which are to be assembled together on assembly station along with bearing assembly. Bearings are fed into the assembly station automatically. Three manufactured jobs which are to be assembled in assembly station are as follows:

1. Mill Job 1 – Pocket Job
2. Mill Job 2 – Male Job
3. Turning job – Shaft

All three jobs are to be placed on the assembly pallet for experimentation to start.

Vision Inspection Station with PLC and HMI:

Hytech Didactic Vision Inspection Station is a Mechatronics based training system designed to provide training on PLC HMI integrated Vision Inspection System. This station is equipped with Smart Vision system mounted on a single axis robot which can travel at least 500mm in linear axis making the total focal envelope of the vision system of at least 900 x 200mm.

User is expected to carry out vision inspection of test jobs by programming PLC, HMI, Servo Motor based liner slide and smart vision system. Vision Inspection Station is an individual station which can be integrated with Hytech Computer Integrated Manufacturing System. When integrated with Computer Integrated Manufacturing system, test jobs are loaded in the Vision Inspection Station by gantry mounted robot whereas in an individual system, these test jobs are loaded manually.

User can change the process as well as the PLC ladder and HMI screens depending on training requirements. This station is designed to provide students with real time industrial automation process and integration of various automation components such as PLC, HMI, Servo motors, Smart Vision Inspection System etc

Vision Inspection Station Experiments:

Vision Inspection Station can be used individually as well as in integration with the entire CIM Setup. Vision Inspection Station is equipped with PLC as well as HMI and relevant software necessary for the PLC and HMI programming. Even in integration setup with CIM, Vision Inspection Station will initiate the process once it receives the signal from Central Control Unit. It will complete entire task of Vision Inspection and pass on the signal of process completion to CCU (Master PLC) for further process.

For experimentation, user is expected to carry out all process cycles or experiments on Vision Inspection station in individual mode. In ideal scenario, Vision Inspection station is programmed individually and then integrated with the CIM setup.

There are 3 jobs which are to be inspected in Vision Inspection Station before they are assembled together.

1. Mill Job 1 – Pocket Job
2. Mill Job 2 – Male Job
3. Turning job – Shaft

Automatic Bolt Assembly Station with Automatic bolt feeder and DC Nut Runner:

Hytech Didactic Automated Bolt Assembly Station can be used individually or in integration with the Computer Integrated Manufacturing Setup.

This station is used to carry out bolt assembly application automatically with integration of servo slide and DC Nut Runner. Entire station is controlled and programmed with Siemens S7 1200 PLC and Siemens KTP 700 HMI.

Actual bolt feeding and assembly application is carried out on this station in integration with PLC, HMI, Digital AC Servo Motor and Pneumatically actuated systems.

User is expected to carry out entire ladder programming to achieve desired results.

Basic technical requirement of this station is to assemble bolts using DC Nut runner. DC Nut runner is mounted on the servo slide powered by Digital AC Servo Motor controlled from PLC. There are three servo slides each powered by digital AC Servo motor. User can carry out interpolated motion and conclude the bolt assembly process. Users are expected to carry out the complete programming utilizing the Servo motor operation techniques in integration with PLC and HMI.

Pneumatic guided cylinder is provided on the Y axis Servo Slide to clamp the job for carrying out bolt assembly process.

Bolt Feeder station is also equipped with vibratory bowl feeder which can feed bolts of M5 x 25mm to the system. Vibratory bowl feeder operation is also actuated from the PLC and HMI of Bolt feeder station.

In integrated CIM (Computer Integrated Manufacturing) System, bolt feeder station is the last process from where the assembled job is stored back in the ASRS.

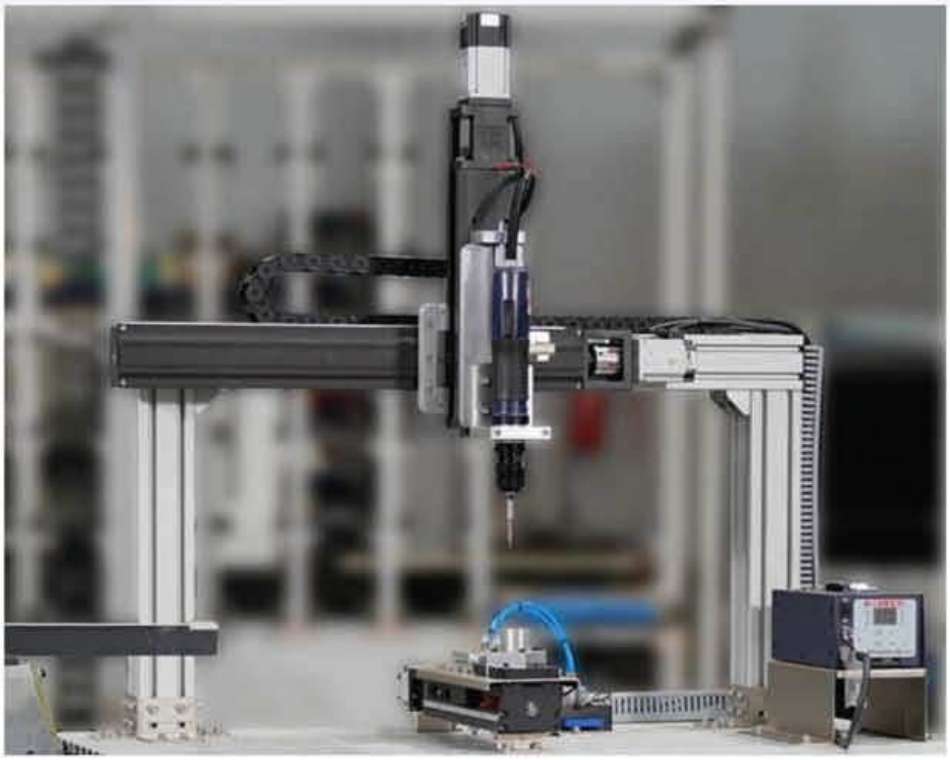
In integrated CIM mode, Jobs are loaded on the Y Axis Pneumatic module by Articulated Robot. In Individual mode operation, user has to manually load the job on the pneumatic module.

In CIM mode, bolt feeder station will be integrated with SCADA and MES and eventually be controlled by the Central Control Unit.

Automated Bolt Assembly Station is completely integrated with Siemens MCD – Mechatronics Concept Designer software which acts as a digital twin software with remote commissioning facility.

IIOT with Siemens Nano box can also be integrated with this station.

Automatic Bolt Assembly Station with Automatic bolt feeder and DC Nut Runner:



Bolt Feeder Station Experiments:

Bolt Feeder Station can be used individually as well as in integration with the entire CIM Setup. Bolt Feeder Station is equipped with PLC as well as HMI and relevant software necessary for the PLC and HMI programming.

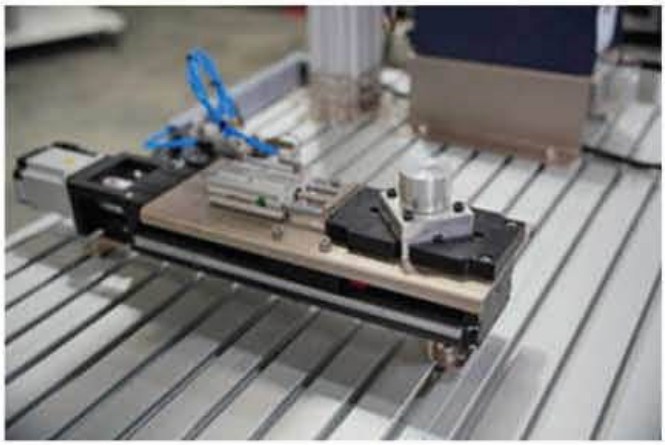
Even in integration setup with CIM, Bolt Feeder cell will initiate the process once it receives the signal from Central Control Unit. It will complete entire task of bolt assembly and pass on the signal of process completion to CCU (Master PLC) for further process.

For experimentation, user is expected to carry out all process cycles or experiments on Bolt Feeder station in individual mode. In ideal scenario, Bolt Feeder station is programmed individually and then integrated with the CIM setup.

There are 3 jobs which are to be assembled together on Bolt Feeder station. Three manufactured jobs which are to be assembled in assembly station are as follows:

1. Mill Job 1 – Pocket Job
2. Mill Job 2 – Male Job
3. Turning job – Shaft

All three jobs are assembled together (Press Assembly) and placed in the pneumatic module for experimentation to start.



Central Control Unit:

Central Control unit is equipped with workstation as well as central PLC (Siemens S7 1512C) which controls the complete smart factory.

7th axis of robot also known as RTU is also controlled from Central Control Unit (CCU).

CCU is provided with operational interface for complete smart factory operation. Digital twin software is interfaced with CCU workstation with the help of OPC UA. SCADA screen as per user requirement can be designed on CCU.

RTU Referencing can be carried out from CCU. All software which are required for Smart factory operation are installed in CCU Workstation.

List of FA Software Installed in CCU Workstation:

- Siemens Win CC for S7 1512 PLC and Siemens KTP 900 Operation
- Siemens WinCC Advance User and Developer License (SCADA)
- Digital Twin – Siemens Technomatix
- Virtual Commissioning – Siemens MCD

List of Major Components in CCU:

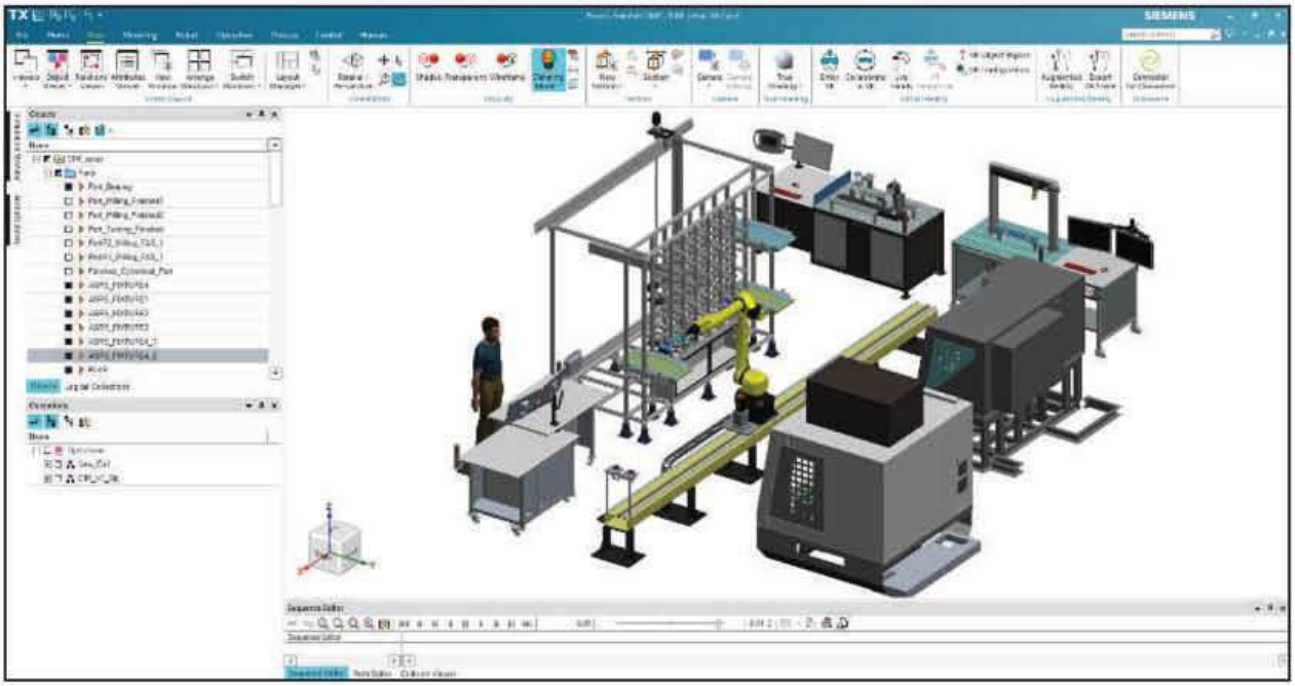
Workstation with Windows 10 Professional Licensed Software

Operation Panel (Hardware)

Dual monitors with mounting stands

Siemens S7 1500 – 1512C PLC

Tecnomatix



A digital manufacturing solution for manufacturing process verification in a virtual 3D environment, Process Simulate is a major enabler of speed-to-market. It accomplishes this by helping manufacturing organizations to validate their manufacturing concepts from the outset and throughout the lifecycles of new products they introduce. The takeaways here are faster launches and higher production quality as the 3D data produced for products and resources help groups to validate, optimize, and commission complex manufacturing processes.

Relevance

Plan and simulate robotic motion

Create, examine and verify complex robotic motion paths and processes with a complete set of manual and automated robotics simulation software tools. Facilitate the most realistic discrete and continuous simulation of various manufacturing processes and mechanical procedures for robots, tools and devices, as well as the control logic used to drive them in production. Facilitate the most realistic discrete and continuous simulation of various manufacturing processes and mechanical procedures for robots, tools and devices, as well as the control logic used to drive them in production.

Commission production systems virtually

Streamline the flow of data from conceptual design to the shop floor. Leverage a common integration platform for the mechanical and electrical disciplines participating in commissioning of automated production systems. Simulate real controller code and robot programs combined with actual hardware in a realistic virtual commissioning environment to verify complete system function before starting production.

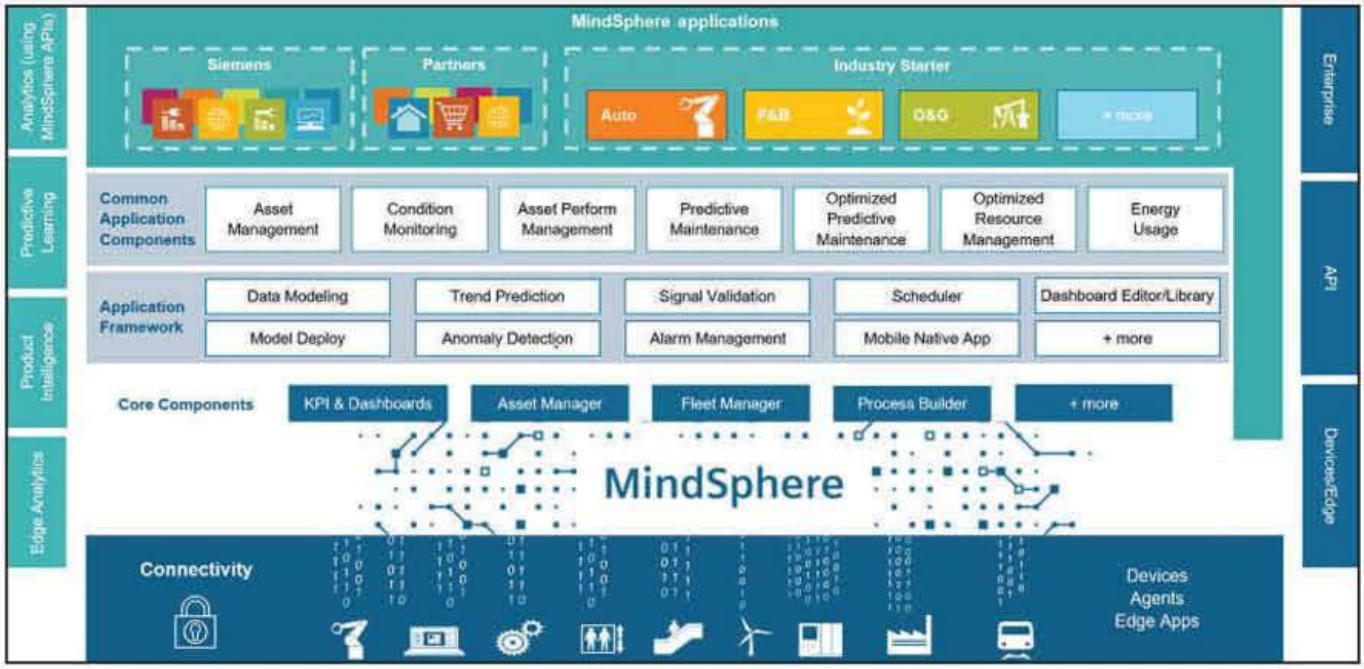
Case Studies

Use Tecnomatix to check various material handling processes as well as various other automation components from library to optimise the cycle time of Smart Factory Setup

Courses

- Design complete kinematic workcells
- Plan and simulate robotic motion
- Program robots completely offline
- Commission production sys tems virtually
- Factory Simulation
- Tecnomatix as a Digital Twin

Mindsphere



MindSphere, the industrial IoT as a service solution from Siemens, enables industries worldwide to link their machines and physical infrastructure to the digital world easily, quickly and economically. Harnessing data from virtually any number of connected intelligent devices, enterprise systems and federated sources allows for analysis of real-time operational data. This analysis then leads to optimized processes, resource and productivity gains, the development of new business models and the reduction of operations and maintenance costs. Companies leveraging MindSphere boost performance, sharpen their competitive advantage and realize much more profitability.

Relevance

With MindSphere, users are able to leverage Siemens' deep knowledge and domain expertise in automation and digital services. In fact, Siemens is a leading automation provider, delivering critical operation and automation technology through global deployments of:

- 30 million automation systems
- 75 million contracted smart meters
- 1 million-plus connected products in the field

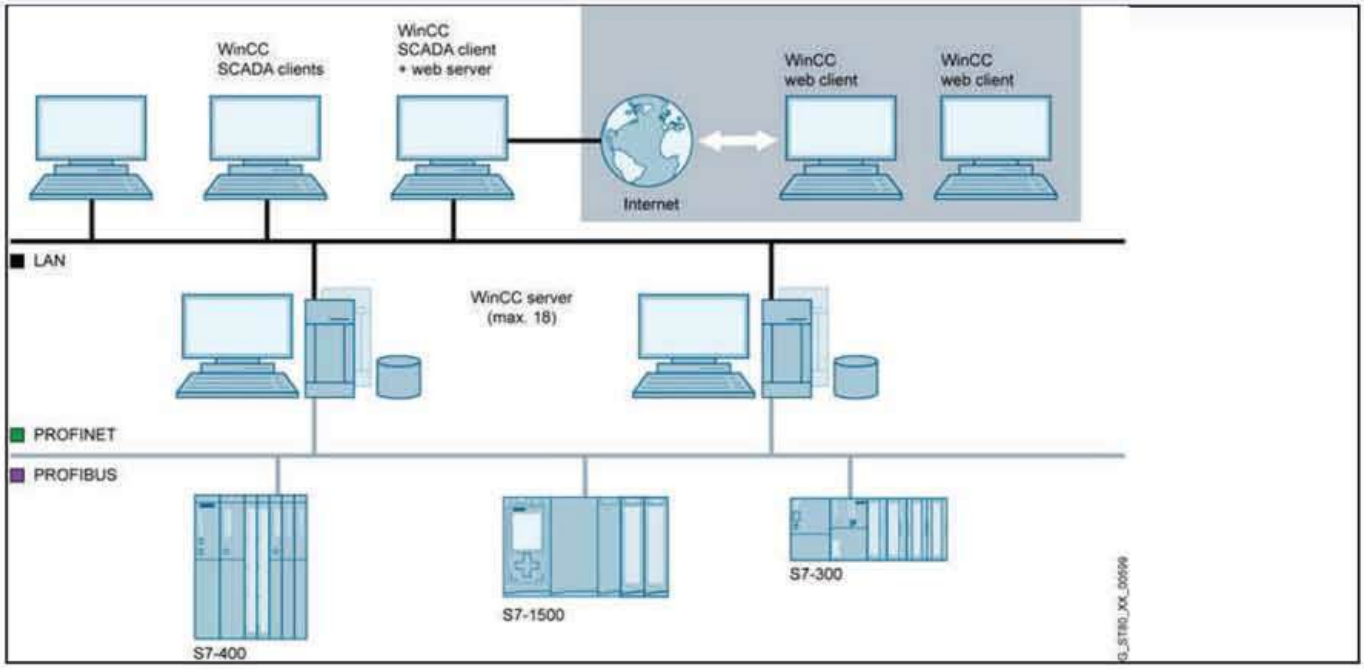
Siemens business units have developed IoT solutions for their industries and are building additional ones, contributing to the continuing growth of MindSphere applications and capabilities.

Users can make use of Siemens Mindsphere to devise various applications suitable for SMart Factory Applications. Various screens as well as dashboards can be prepared for different types of datapoints

Courses

- MindSphere architecture
- Mindsphere Applications
- Industrial IoT as a service
- Mindsphere Connectivity
- How MindConnect works - Protocols
- How MindConnect works - Data security
- MindConnect Integration with Cyber Physical Systems

SCADA (Developer and Runtime):



The SCADA acronym stands for Supervisory Control and Data Acquisition.

A SCADA system is a collection of both software and hardware components that allow supervision and control of plants, both locally and remotely. In Hytech Smart Factory, SCADA collects data from PLCs of each station and allows the user to supervise the data centrally from CCU. The SCADA also examines, collects, and processes data in real time. Human Machine Interface (HMI) software facilitates interaction with field devices such as conveyors, valves, motors, sensors, vision camera, etc. Also within the SCADA software is the ability to log data for historical purposes.

That communication data is routed from the processors to the SCADA computers, where the software interprets and displays the data allowing for operators to analyze and react to system events.

SCADA used in Hytech Smart factory is a real world SCADA system which is used for the integration of entire manufacturing process providing users with hands on experience on the one of the most commonly used technology in automation industry.

Relevance

Industry 4.0 represents a breakthrough in the integration of technological innovations in production and operations using smart technologies.

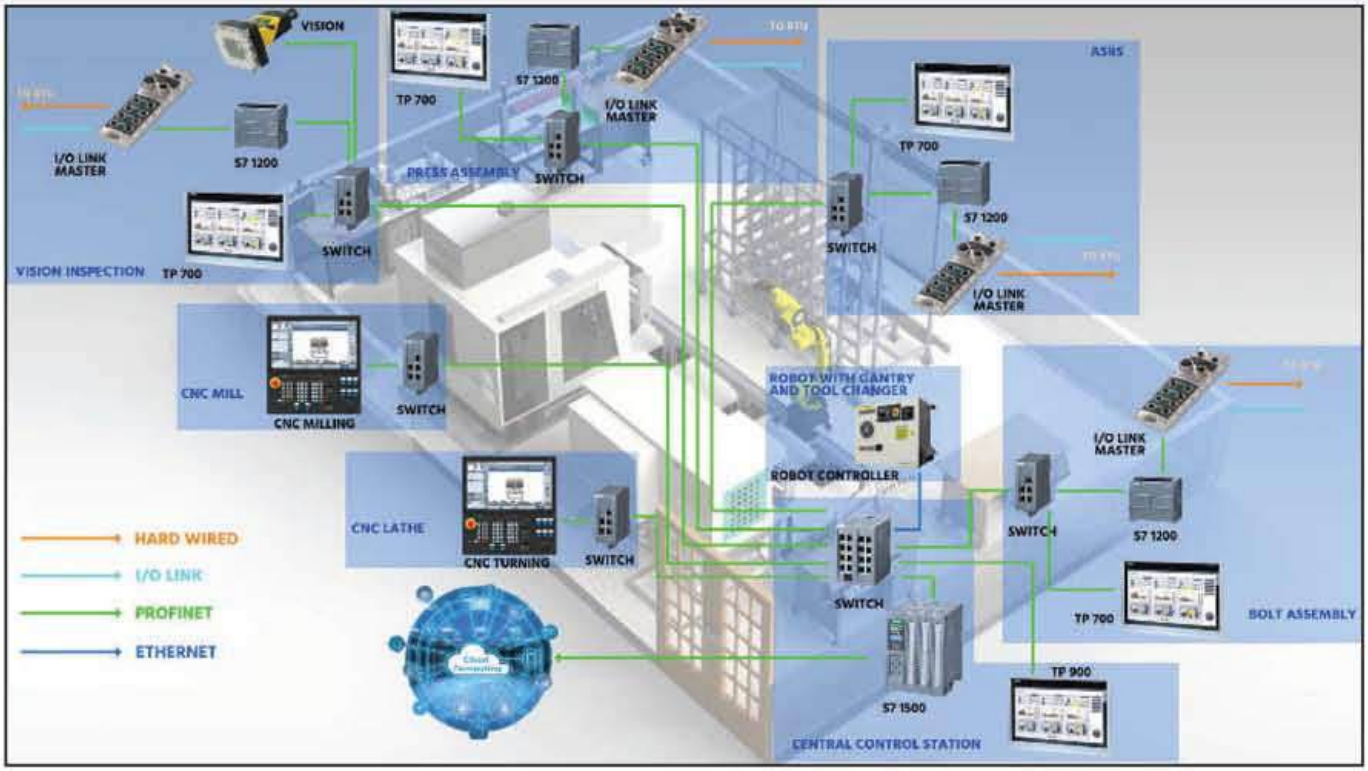
It is a field data collection system that has sensors connected to a master station in a factory, plant or other remote location, and then sends this data to a central computer and this process is carried out in real time.

SCADA (Supervisory Control and Data Acquisition) is used to monitor and control industrial equipment in virtually any industry at various stages of the development, production or manufacturing process.

Courses

- SCADA and PLC HMI Integration
- Developing SCADA Runtime
- Smart Factory Operation using SCADA from Central Control Unit
- Industry 4.0 / IIOT Based remote SCADA operation and data acquisition
- SCADA and Digital Twin Integration

CIM Communication Infrastructure:



Stations in CIM are provided with I/O Link masters as well as individual PLCs and HMIs which enables them to be programmed and operated individually. User can integrate these stations with central SCADA system as well as central PLC in CCU.

I/o link connectivity enables future expansion as well as ease of connectivity for any additional RTUs (Remote Transfer Units) which can be additionally incorporated in each station.

Profinet as well as Ethernet based communication reduces the wiring complexities as well as makes the entire system easy to maintain and service.

Each Station in CIM is completely integrated with Central Control Station as well as SCADA, digital twin, MES and Cloud.

Use of indurtial cloud systems such as Mindsphere makes it easier for users to store as well as access the data in realtime applications. User can also remotely operate thye entire system through IIOT applications.

Use of industrial components such as wireless solenoid valve banks and smart sensors along with smart lights provides hands on experience on latest industrial technologies.

Digital twin as well as process simulation software enables students and users to simulate the entire process in real time.

Open architecture along with licensed softwares for programming of PLCs, HMIs and SCADA provides real time industrial automation and integration experience to students.

User can not only program individual stations, they can also integrate entire system in SCADA (Developer as well as Runtime).


HYTECH
SPM 300

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