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#75, Electronics Estate, Perungudi, Chennai, Tamilnadu, India - 600 096.
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# Industry 4.0 & Digital Twin: DCS - PLC- IOT2050 Based Implementation for 6 Plants with VR, AR and AI Integration

## Using a college campus facility like

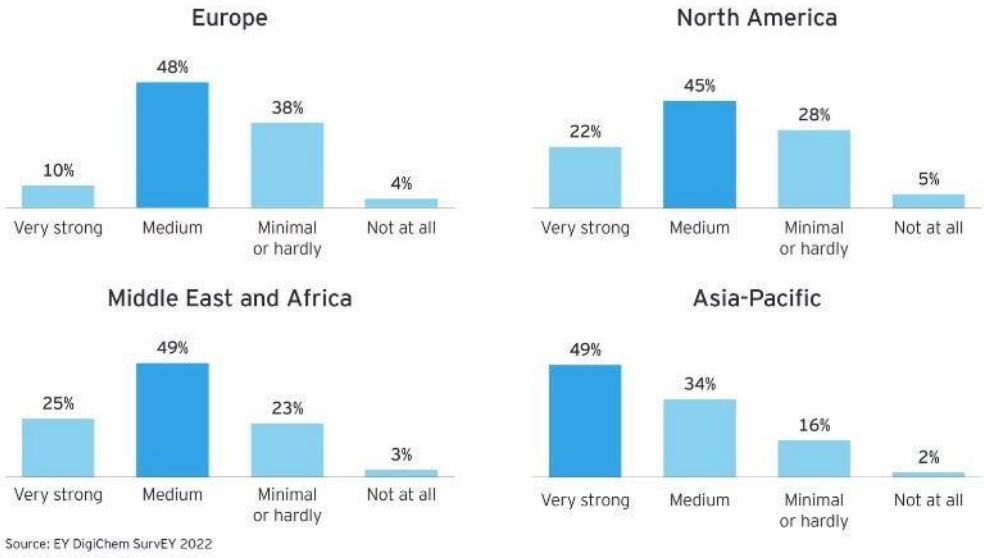
1. S7-1200 & IOT2050 Gateway based Smart Water Distribution Management at Small Factory.
2. AS410 PCS7-IOT2050 Gateway based Smart Water Distribution Management at Big Campus at NSTI, Hyderabad
3. ADVANCED PROCESS CONTROL PLANT (four tank system)
4. Venturi-Orifice Meters Character Study Trainer

## Using Fabricated Mini Plants

5. AS410 PCS7-IOT2050 based Mini Paint Industry.
6. AS410 PCS7-IOT2050 Based Mini Paddy Processing Plant.

## • Digitalization for sustainability — the way forward

- Chemical and other manufacturing players are already leveraging technologies such as digital twin, Internet of Things (IoT) and automation to reduce resource and energy consumption. This, in turn, needs to be supported by an infrastructure for data collection and machinery for production and emission control.
- Without a doubt, digitalization and sustainability are key priorities for companies, and hence, the CEO of many Industries are driving digitalization for faster implementation of sustainability goals.
- The following Data shows Asia-Pacific industries has 49% Very Strong opportunity to implement Digital Twin, IOT and Automation (PLC, DCS) which results in strong requirement for well-trained students.




**Government is focusing Digitisation of all Industries, due to its great Benefits. An Example – Digitization of Land records.**

100-DAY AGENDA

# Digitisation of Land Records Among Key Reforms of New Govt

## Govt may allocate ₹1,035 cr for proposed plan

Anuradha. Shukla
@timesgroup.com

**New Delhi:** The Centre is working on digitisation of land records as one of the priority reforms for the incoming administration. The government may allocate ₹1,035 crore for the proposed plan that seeks to complete the digitisation of all land records by the end of 2026, helping streamline the land acquisition process and speed up projects, **ET** has learnt.

The move may be announced when the full budget is presented. "Land reforms are one of the top agenda items for the government and if it comes back to power, these will be aggressively pushed starting with the digitization of land records," a senior official said.

The proposed plan is also a part of the next government's 100-day economic agenda that was discussed last week.

It includes rejigging land-use policies for urban, forest and agricultural land, which will speed up the key infrastructure projects which are often stuck or delayed due to land acquisition and litigation. The meeting, chaired by the cabinet secretary last week to take stock of the 100-day agenda, also discussed how other flagship reforms were stuck due to lack of digital land records, for instance land-monetization, agricultural reforms.

"The target is to complete the digitisation of land records by the end of 2026 and as per the initial estimate, ₹1,035 crore be dedicated for the plan and an announcement may be made when the full budget is presented," the official added.

There is already a Unique Land Parcel Identification Number (ULPIN) going on, which gives unique identity toland parcels. This is a 14 digit unique ID for each land parcel based on Geo-coordinates in sync with international standards. The centre will add ownership, usage, and risk also to the database.

"This reform will have a multiplier effect, once the land record is digitized, it will also reduce land disputes, will give exact ownership and usage patterns with


https://youtu.be/wpAE0syjU7k?si=kuyc0-HSPa7_2Tuq

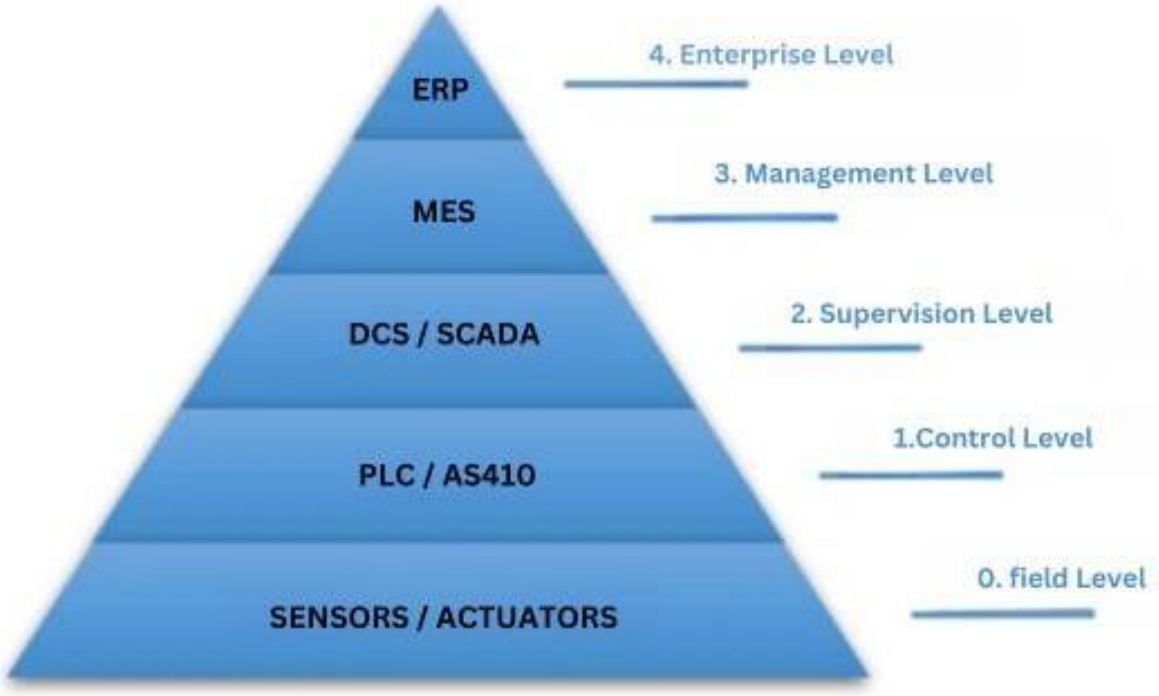
**Then it is coupled with Finance (Income Tax & Bank), Agri Department, Urban Land, Disaster Management, Court, Registration Office, GIS, USGS, Money Laundering, etc.**

# Digital Twin & Industry 4.0 Implementation

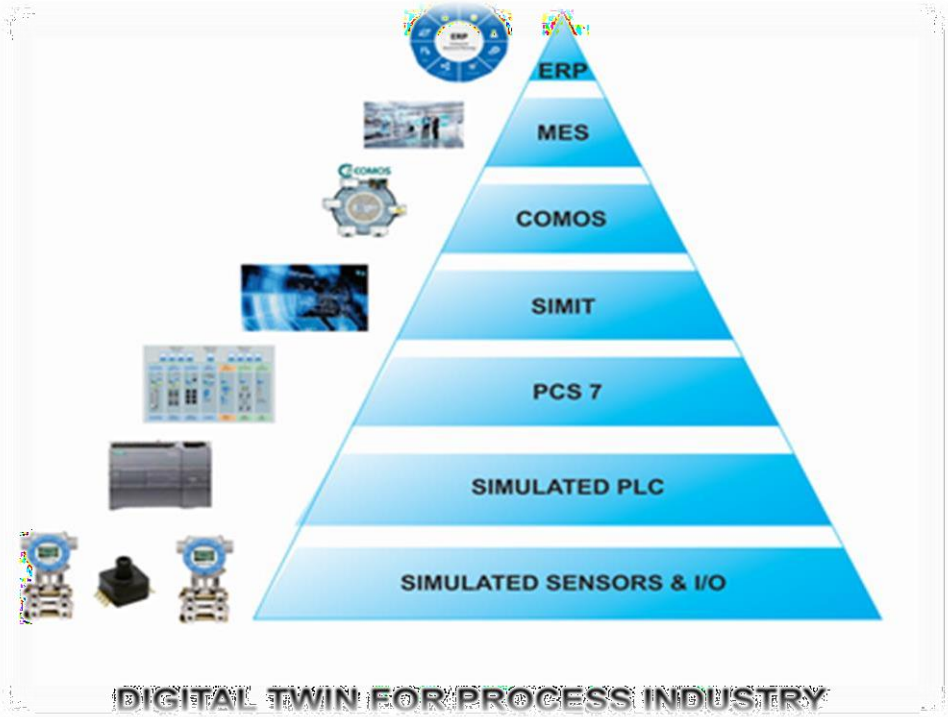
Industry 4.0 integrates advanced technologies like IoT, AI, and Automation to create smart, Interconnected manufacturing systems. A digital twin in this context is a virtual model of a physical asset, updated in real-time with data from sensors and IoT devices. This allows companies to monitor, simulate, and optimize processes and equipment performance.

Digital twins improve decision-making, enable predictive maintenance, and allow for virtual testing of changes before applying them physically, leading to better efficiency, reduced downtime, and enhanced lifecycle management across industries.

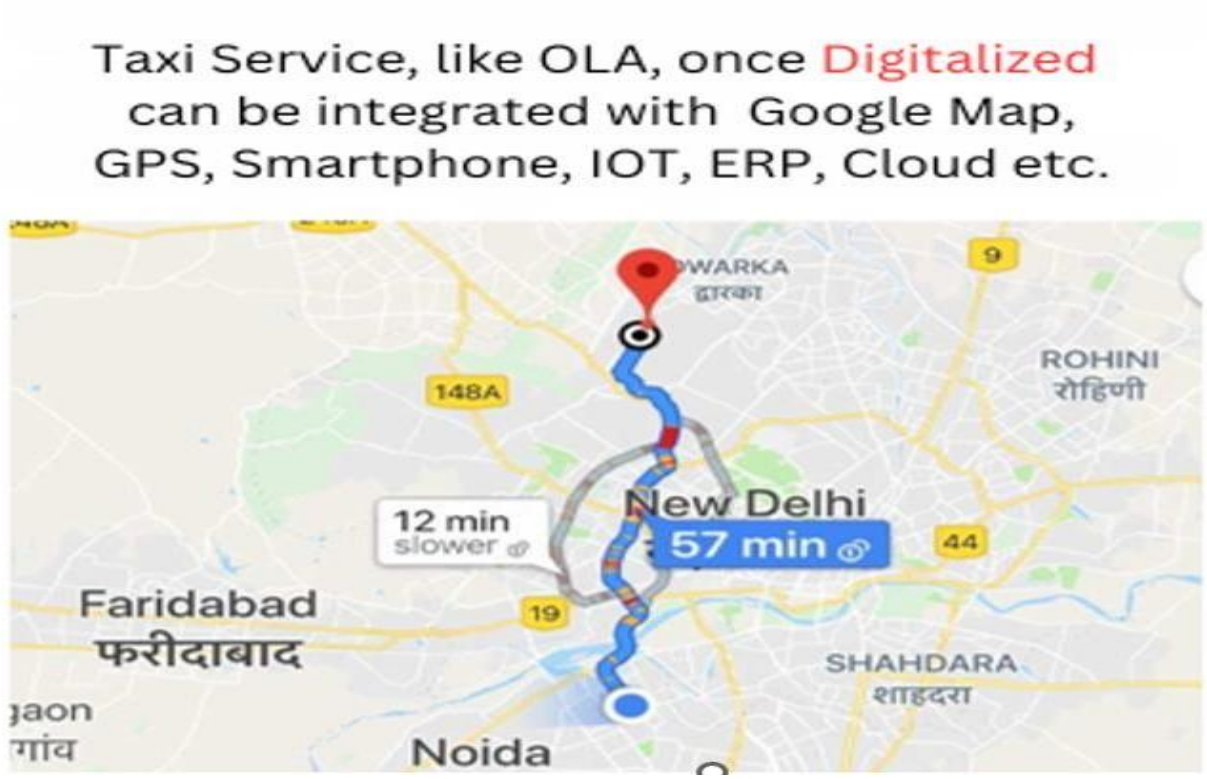
# INDUSTRY 4.0 IMPLEMENTATION:



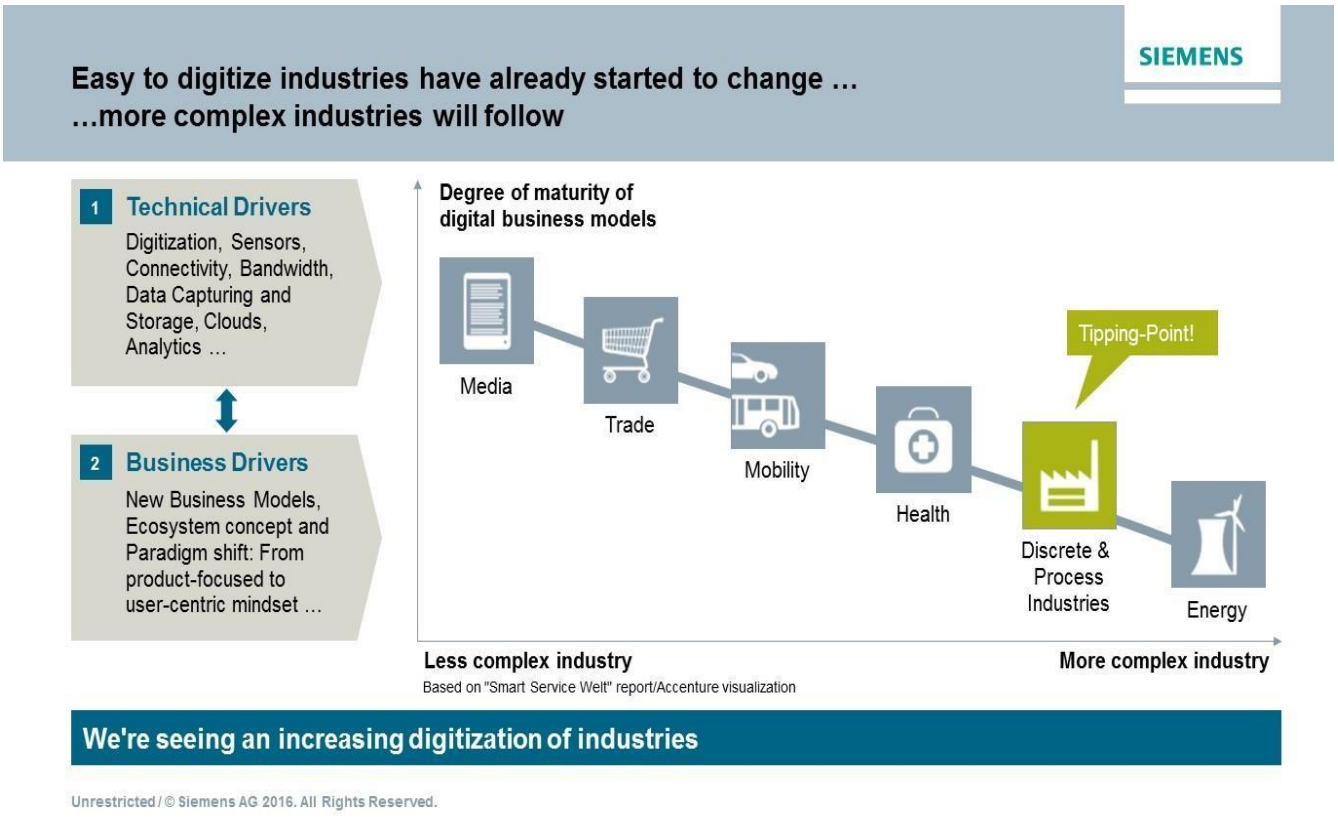
# DIGITAL TWIN IMPLEMENTATION:



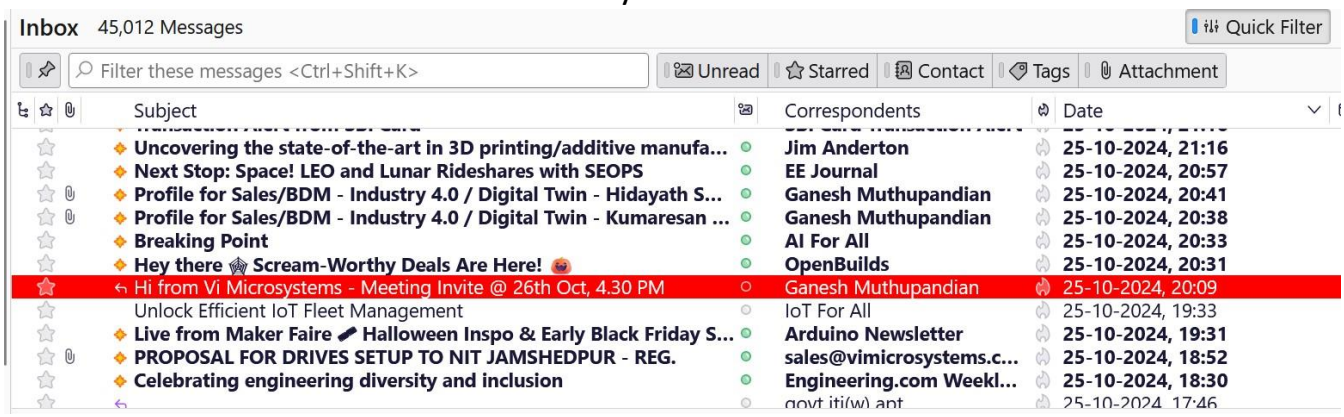

## Digitalization in Many Industries & Coupling with Software




Complex Industries will follow.

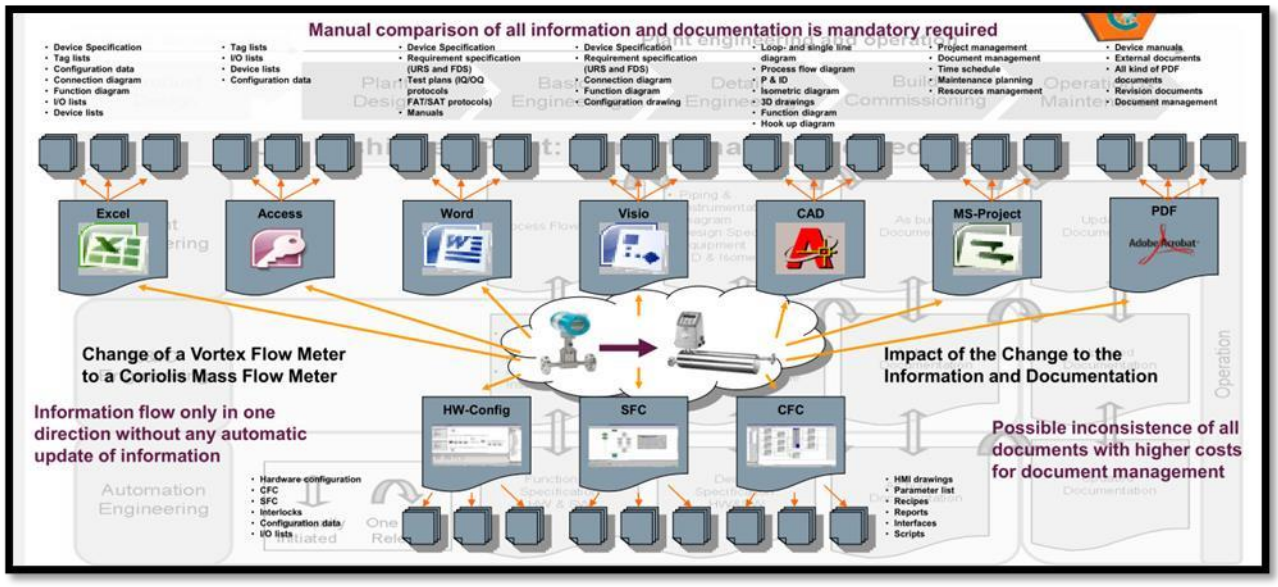


Email is DIGITIZED and TAG feature is very useful.




The following Diagram shows the unstructured way of storing all Data of a Plant, like manual creation of Data of each Department in Word, Excel, and AutoCAD etc. This will lot of money and very low efficiency in Data handling

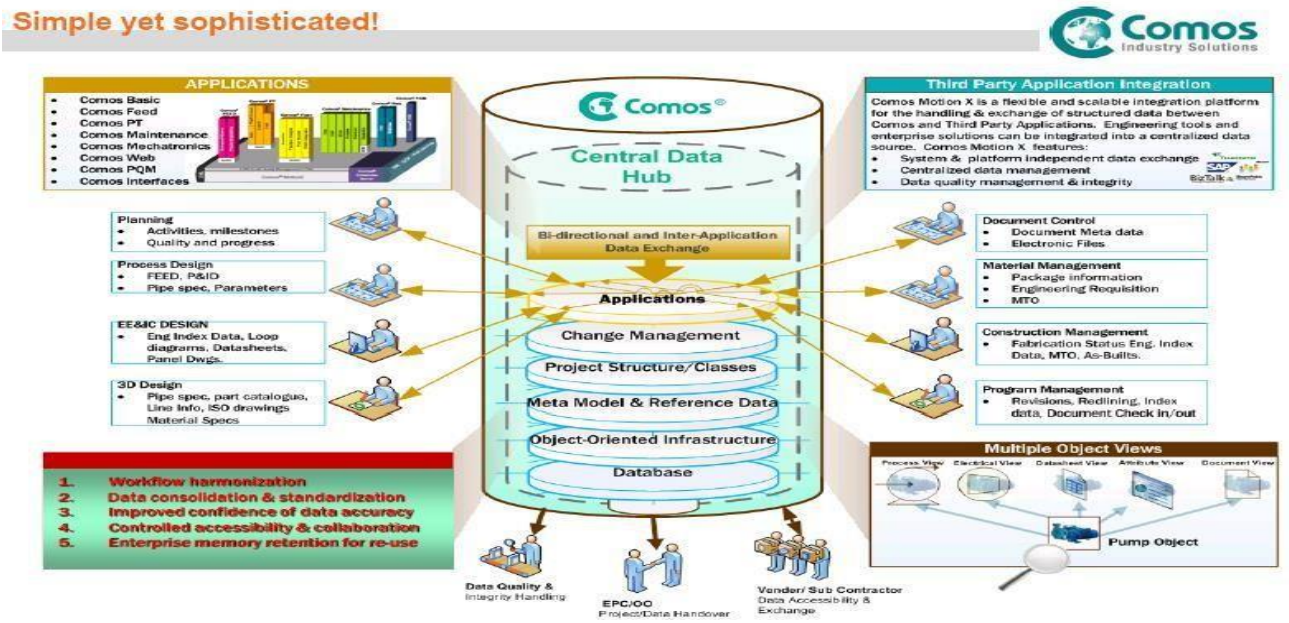
## Data are stored in different software and not Bidirectional.




cost

COMOS offers a centralized object-oriented intelligent Data storage and making the Data to work for Dairy Engineers. COMOS digitized all Data, once Digitized it can be coupled with many software.

## COMOS offers a centralized object-oriented intelligent Data Storage and DIGILIZATION Using P&ID




COMOS can be made responsible for all activities from design, procurement, construction, to commissioning and handover the deliverables to the management, the Operator Training and Dismantling the Factory.

With COMOS, there are many Unique following features, advantages for students

1. Students can learn about the Piping and Instrumentation diagram of the entire plant
2. Students can learn about the Piping Diagrams & PFD used in the industries
3. Conversion of PFDs into Piping and Instrumentation Diagrams (P&IDs) without data loss
4. The entire data management platform is divided into four families: process, automation, operations and lifecycle.
5. Each of which are divided into more specified sections governed by licenses.
6. Figure represents the structure of COMOS, displaying the main components and their subsections
7. COMOS consists of COMOS PLATFORM, COMOS PROCESS, COMOS AUTOMATION, and COMOS OPERATIONS. All these are integrated together and the only software in the Process Industries
8. Data base related to Piping and Instrumentation diagrams, Electrical diagrams and many more like Automation Hardware database such as CPU of PLC, DCS and Communication Protocols like PROFINET, PROFIBUS provided in COMOS
9. Piping Diagrams can be exported as PDF format
10. Data of each equipment, for example data sheet of the pump, will be created as Object.
11. In COMOS, complete plant information is saved in a central database
12. COMOS can be interfaced with PCS7 software (DCS Software)
13. COMOS can be interfaced with SIMIT (Simulation Software)
14. Both COMOS and SIMIT can be interfaced with PCS7 without any real time hardware
15. Digitalization is the concept of a digital twin and COMOS is used to realize the digital twin
16. COMOS EI&C facilitates both 2D and 3D views of the control cabinet
17. Integration with MES and ERP software for Industry 4.0 Implementation.
18. Virtual Reality training and simulation

As Engineering has become multidisciplinary, the Computer Science and other branch student have to study VR, AR, AI & Digitization, applied to real time Engineering Implementation. Digitalization happens everywhere like Land Record, Ola Taxi Booking, Google Map, and Railway-Airlines-Redbus Ticket Booking. Hence it should happen in more complex Industries like Power Plant, Pharmaceutical, Oil & Gas etc. Here, the Experimental platform will be based on 6 PLANTS, as mentioned above.

The whole piping, pumps, controllers etc. will be digitized by the engineering tool (COMOS). Once Digitized, this can be coupled with many software tools like 3DWalkinside (VR), Mobile worker (AR), SIMIT, PCS7 etc., to Experiment VR, AR & AI.

This tool has to be customized for this water distribution application, through Visual Studio Script and XML, hence CSE & IT Students can play good role in this.

Generically, many try to use the General Purpose "UNITY "Software, which is not the Engineering Tool. Hence this solution would be an Ideal to study and experiment VR, AR & AI.

Also, the Maintenance Operator & the Students can be assigned a series of tasks of Procedures to maintain the pipe erosion, leakage, pumps working conditions etc. As COMOS generates various Maintenance Reports, the Monitoring Engineers & the Students can maintain the Installation & Maintenance very easily. The students also can be given these experiments for gaining good knowledge in IOT based Smart Agriculture and Industries.

This Experimental set up consists of i. Siemens COMOS Software ii. COMOS Virtual Reality 3D Walk Inside. iii. Automation Components

Many tanks with pumps, Pipes, Controllers etc., are provided to set up these Use Cases. These set up are Digitized by the P&ID of COMOS Software and many experiments can be conducted like Navigating from P&ID Diagram to particular Pump/Tank for details study of VR, AR by the student.

The 3D Model of valves, instruments like Level Transmitter, PH indicators, Colour sensors, conductivity sensors, Limit switches, Control Valve are provided and Digitized by the COMOS Software.

# Digitalisation:

# All data in Excel can be imported in COMOS

# All Datasheet of each Component can be stored in P&ID.

# Lab Manuals/Operator manual for each equipment can be stored in P&ID

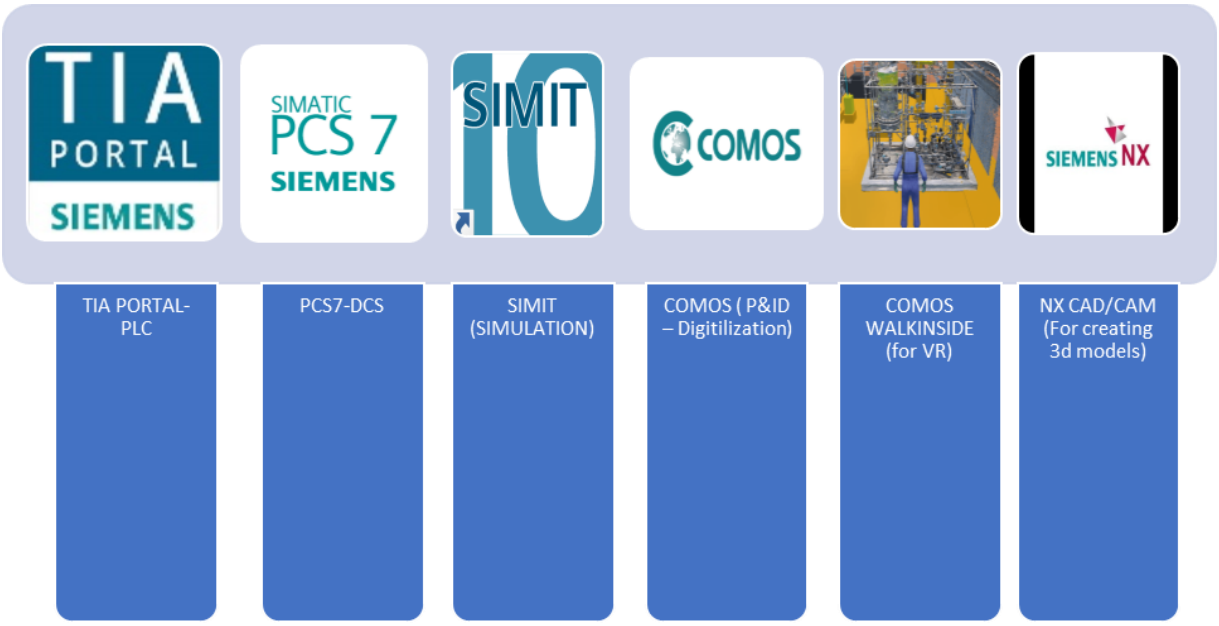
# Work order/ work permit can be stored in P&ID during maintenance operation.

# All these documents can be viewed in VR walk inside and COMOS

- The water Distribution & Mini Plants will be digitalized by using COMOS
- The Pumps, Pipes, Control Valves, Solenoid Valves, Controller will be Digitalized as P&ID Diagram
- The Power Distribution Panel with PLC will be digitized by COMOS.
- The student can Navigate from P&ID to Virtual Reality and identify each component virtually

- The student can read the Datasheet of Particular Component like Pump in VR.
- The student can tour all Pipe Layout Distribution in VR.
- The student can read the Parameter of each Component like Pump's Pressure, delivery, size, length etc. in VR.
- The student can get work order/ work permit from the Training Officer in P&ID while maintenance operation. (Since any maintenance operation has to be synchronized with theproduction team).
- The student training can be given as task of procedures in VR. Sequence of operations for training can be provided like i. open the valve ii. Power on the pump, power off the MCCB etc.
- The Students Experiment like Follow the sequence of operation in case of Fire.
- All the Objects (Created in COMOS) can be TAGED for further Digital Transformation, like the emails shown above TAGGED for sorting – by color, Copy to various folder etc.

## SOFTWARES USED FOR DIGITIZATION:



# Hardwares Software used in building Industry 4.0 & Digital Twin.

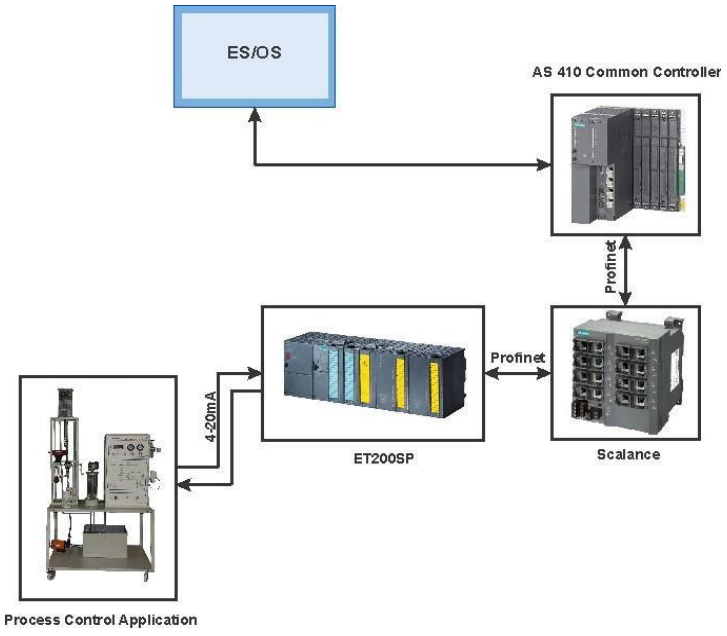
## PLC CONTROLLER:

A programmable logic controller (PLC) or programmable controller is an industrial digital computer which has been ruggedized and adapted for the control of manufacturing processes, such as assembly lines, or robotic devices, or any activity that requires high reliability control and ease of programming.

A PLC is an example of a real time system.


## AS410 – DCS Controller.

**AUTOMATION of a Plant Using DCS**



## TIA PORTAL:


- Write and load program in the PLC
- Siemens is adding all its new developments and future
- Gives you unrestricted access to the complete range of digitalization automation service, from digital planning to integrated engineering & transparent operation.
- constantly acquiring new functions and is enhanced with exciting technologies

## PCS7:

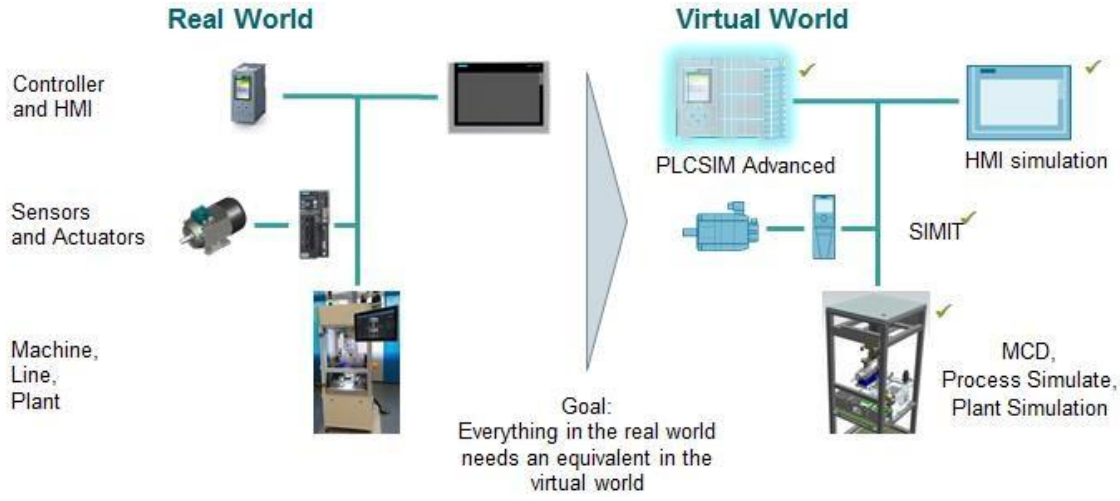
PCS7 is Siemens' Distributed Control System (DCS) for process automation, offering advanced control, monitoring, and optimization of industrial processes. It integrates seamlessly with COMOS, a comprehensive software for engineering, asset management, and lifecycle management of plant systems, providing consistent data across disciplines.


- Specifically for process control applications
- System-integrated tools for engineering tasks
- Graphic User Interface
- Integration of the field level, including drives, switchgear, etc.
- Integrated functions, e.g.
- batch process automation
- route control
- Process safety energy management etc.,

# SIMIT (SIMUALTION SOFTWARE):

SIMIT is Siemens' simulation platform for virtual commissioning and operator training. It enables real-time simulation of processes and control systems, creating a digital twin of the plant to validate and test automation systems before deployment, and ensuring operational reliability.

- Simple linkage between simulation and automation environments
- The linkage can be established using the real hard ware of the automation systems (hardware-in-the loop)
- As well as using the integrated virtual controller or SIMATIC S7-PLCSIM Advanced (software-in-the-loop).



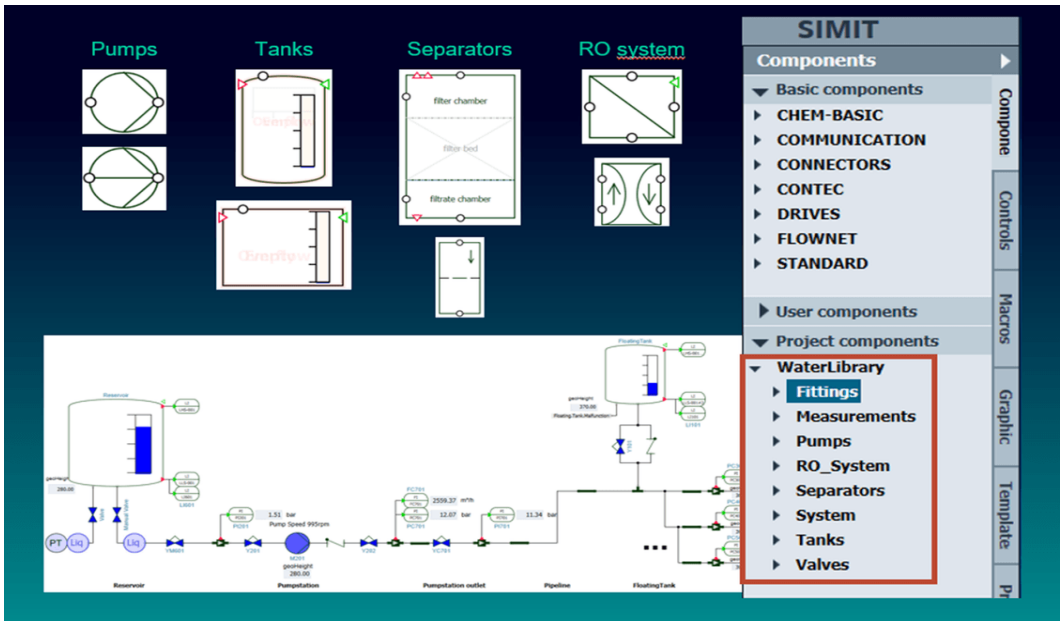

## The entire plant is simulated in SIMIT Simulation Software.

- **Piping and Instrumentation Diagrams (P&IDs) Simulation**:
  - Students can learn to create P&IDs for the plant and simulating the entire plant's piping layout, valves, pumps, and instruments in SIMIT.

- **Process Flow Diagrams (PFDs)**:
  - Allows conversion of PFDs into P&IDs without data loss, giving students real-world experience.

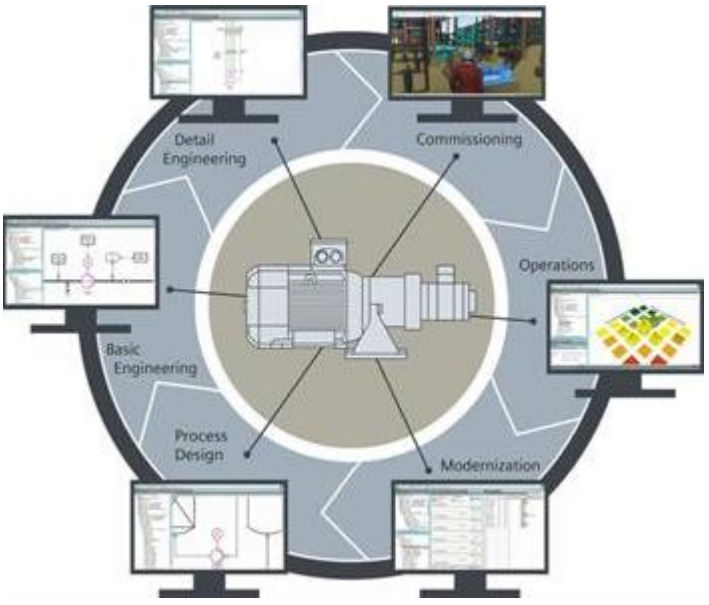
- **Integrated Data Management**:
    - The simulation covers process, automation, operations, and lifecycle management for water systems, divided into sections governed by licenses for focused learning.
- **COMOS Integration**:
    - COMOS enables centralized plant data management for plant, including piping diagrams, electrical layouts, and automation hardware databases (like PLCs and communication protocols like PROFINET, PROFIBUS).
- **PDF Export of Diagrams**:
    - Piping diagrams can be exported as PDFs for documentation and study purposes, enabling practical learning.
- **Object-Based Equipment Data**:
    - Equipment like pumps can have detailed datasheets saved as objects, useful for simulating maintenance and operation planning for plant.
- **Centralized Data Storage**:
    - COMOS stores complete plant information, ensuring that management data is organized and accessible from a central location.
- **PLC and SIMIT Integration**:
    - Simulated systems in SIMIT can interface with PLC software, allowing students to control and monitor processes.
- **Digital Twin for Water Systems**:
    - COMOS supports the concept of a digital twin, simulating a virtual version of the water system for design, testing, and optimization.
- **Virtual Reality (VR) Training**:
    - SIMIT can be used in combination with VR for immersive training , giving students a hands-on experience with simulated Plant

# COMPONENTS IN SIMIT SOFTWARE:



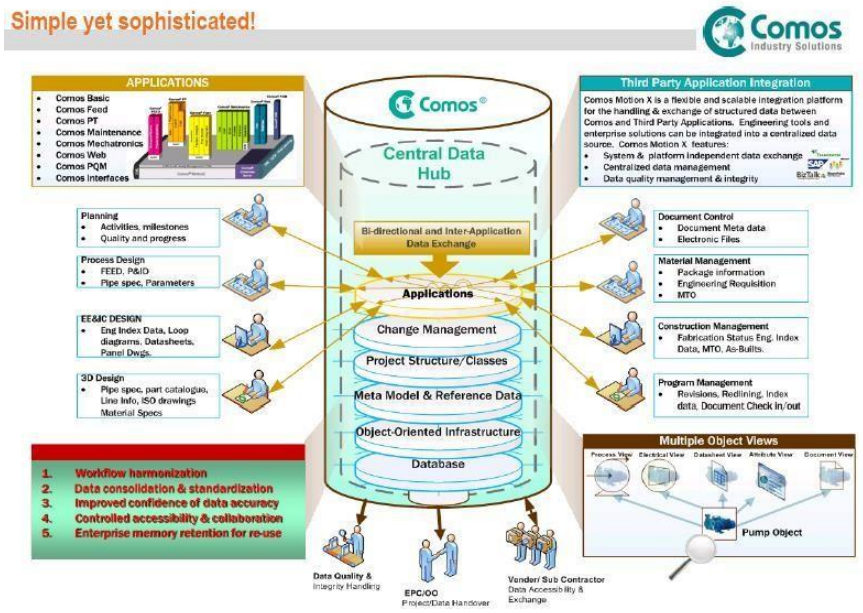

# COMOS (P&ID-DIGITALIZATION):

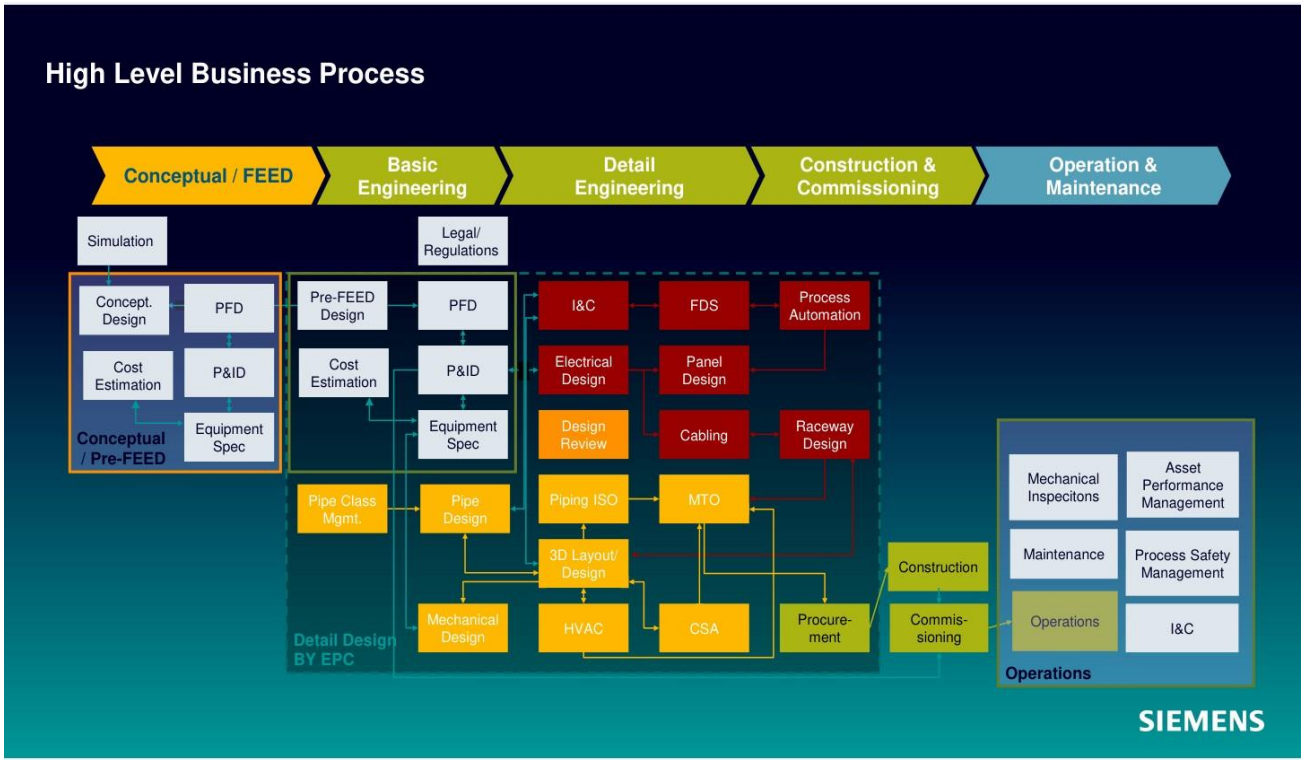
- COMOS is a plant engineering software from Siemens.
- The applications for this software are in the process industries for the engineering, operation, and maintenance of process plants as well as their asset management.
- COMOS = **Com**ponent **O**bject **S**erver
- COMOS was developed as an integrated CAE system for engineering in plant construction
- Plant Engineering provides strategic manufacturing knowledge to help the plant manager operate his business efficiently, effectively and safely.
- Information on automation, electrical systems, mechanical operations and maintenance gives the plant manager and plant engineer the knowledge he needs to do his job in a modern manufacturing plant

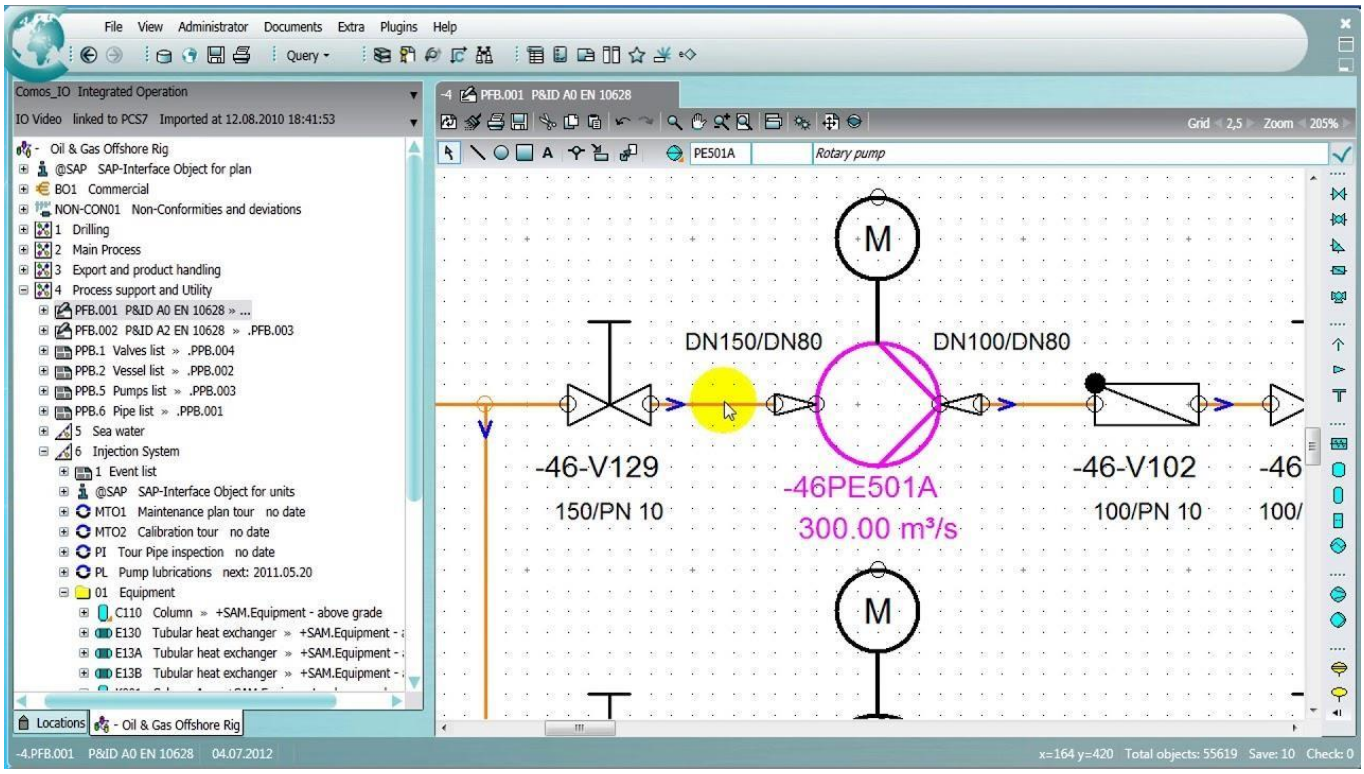


The Plant Engineering and Data Management Software COMOS for Process Industry is used here for creating the DIGITAL TWIN

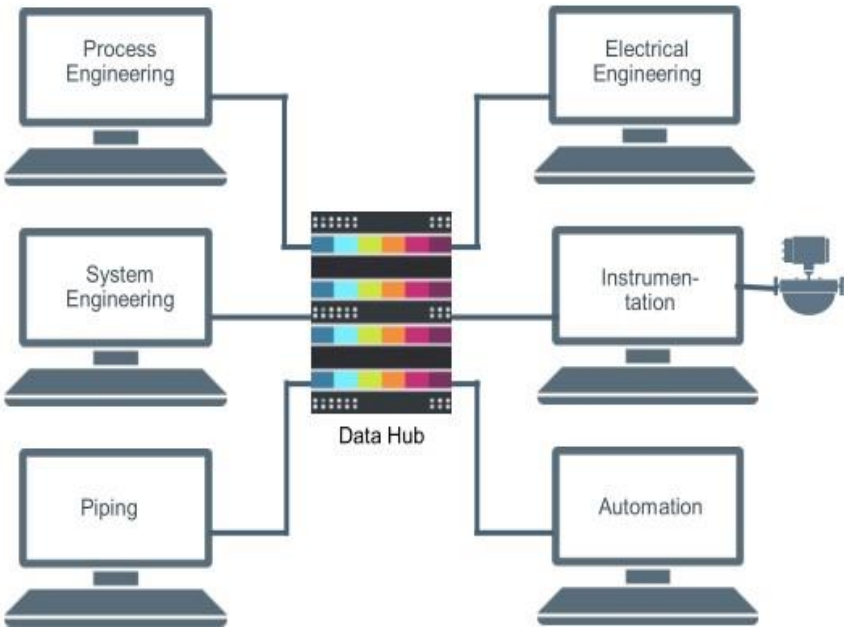
## COMOS – Plant Engineering Software



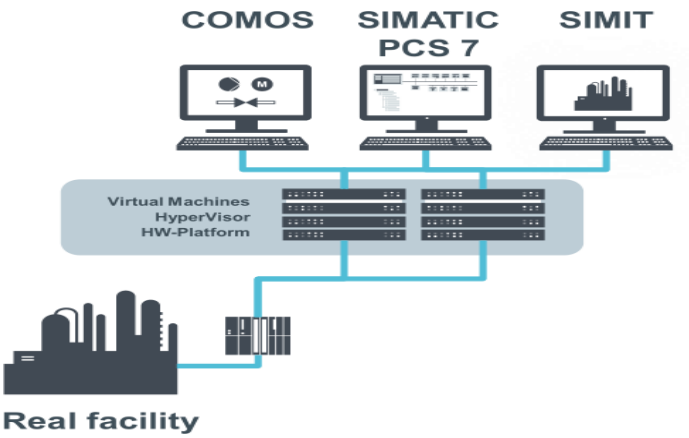



One data hub that completely integrates all disciplines into a globally consistent database …



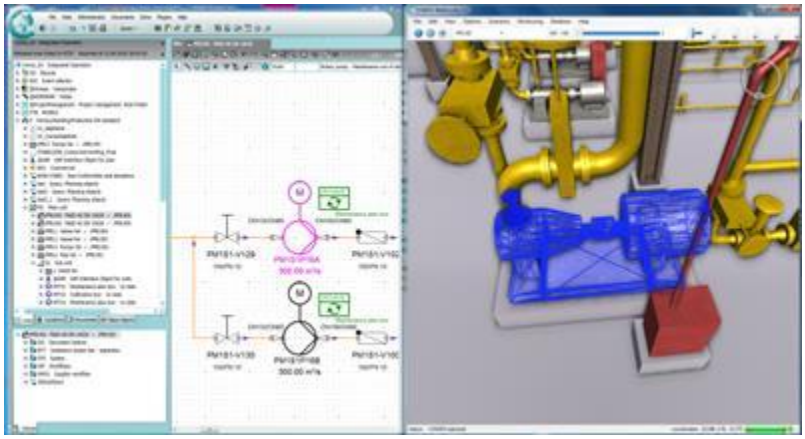
# Digitization using COMOS & Coupling with many Software

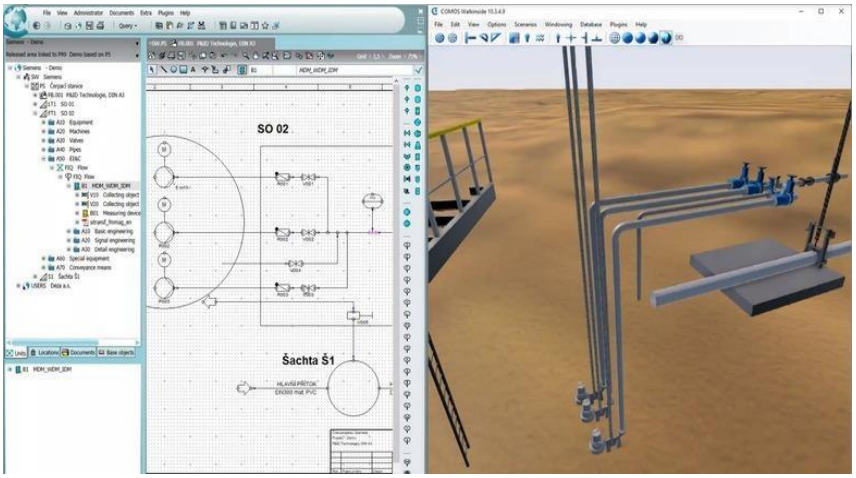
- The more complex Process industry like Power Plant, Chemical Plant, Refineries etc. are digitized through COMOS Software, then, it can be integrated or Coupled with many powerful Software Like,
    - SIMIT – simulation software
    - PCS 7 - DCS Software
    - NX – CAD, CAM, MCD Software
    - ASPEN, gPROM Simulation Software
    - **MATLAB-SIMULINK** & many more




## COMOS 3D WALKINSIDE:

**COMOS Walk inside** is a 3D visualization and virtual reality tool within COMOS, allowing users to navigate and interact with 3D plant models for better understands



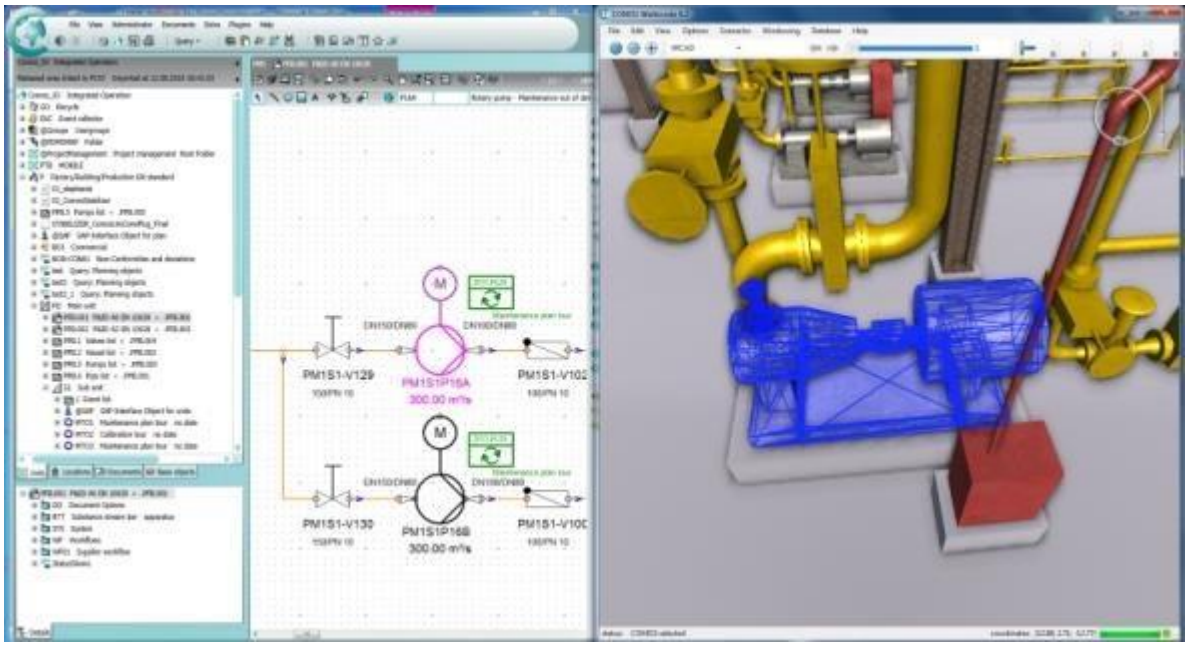

**3D simulation training for oil field operators**
Realistic training environment

SIEMENS

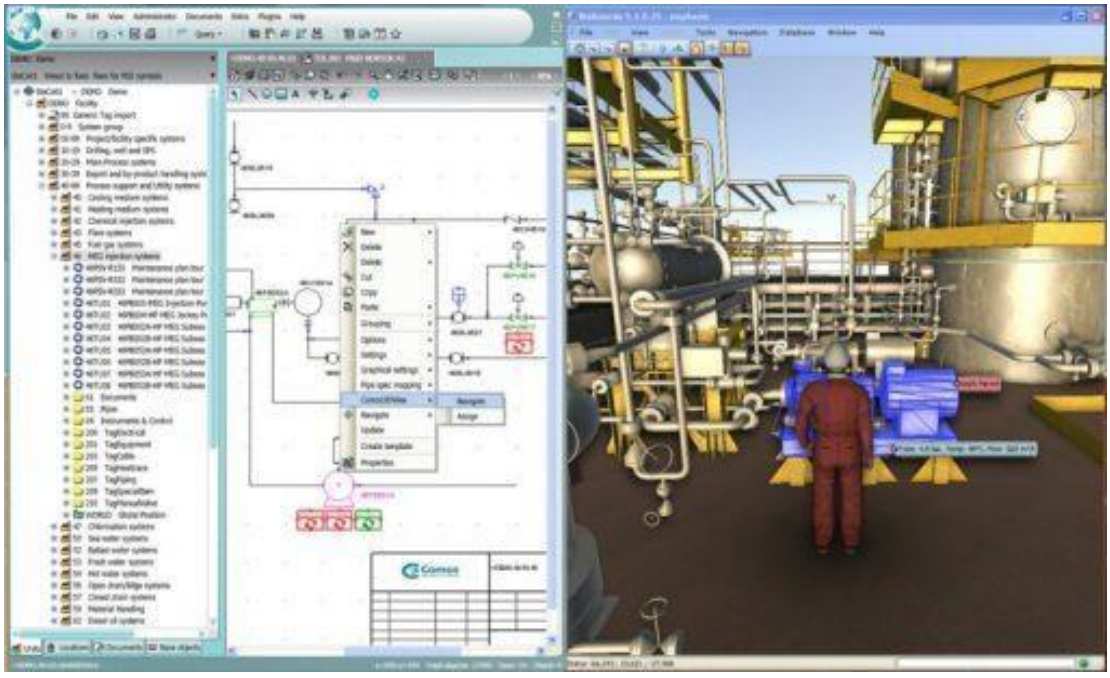
**Benefits of COMOS Walkinside**


- Support of massive 3D models
- Easy-to-use: game-like navigation
- Integration with 3rd party asset management and real-time systems (PI, OPC)
- Software Development Kit (SDK) for 3rd party interfaces

The fresh graduates can Navigate from P&ID to 3D Walkinside



**Navigating for an equipment in P&ID to 3D of the Plant. The Students can families all the components used to build this plant.**

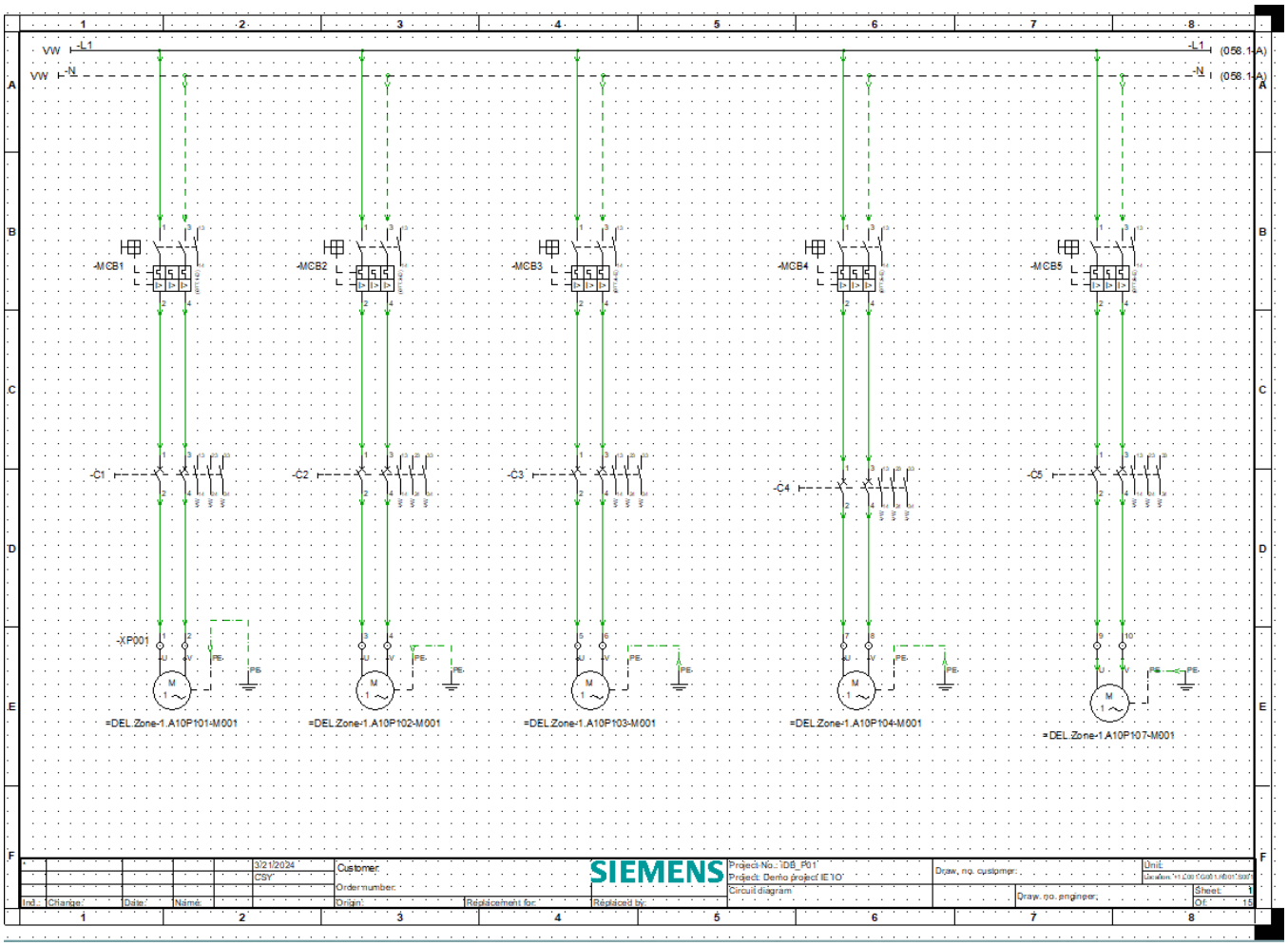


Student & Operator training can be done very efficiently


Calculation of Power of Motors used in an Industry

## Load and Power Estimation

The consumption of individual devices or entire networks can be defined and saved in COMOS in the form of a detailed load and power estimation. Any time the maximum power limit is exceeded, it’s visually indicated in a clear manner. As a result, the required power supply or energy consumption can be easily determined.


-MCB1
-MCB2
-MCB3
-MCB4
-MCB5
-C1
-C2
-C3
-C4
-C5
-XP001
=DEL Zone-1.A10P101-M001
=DEL Zone-1.A10P102-M001
=DEL Zone-1.A10P103-M001
=DEL Zone-1.A10P104-M001
=DEL Zone-1.A10P107-M001
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Customer:
Order number:
Project-No.: IDB_P01
Project: Demo project IE IO
Circuit diagram
Draw. no. engineer:
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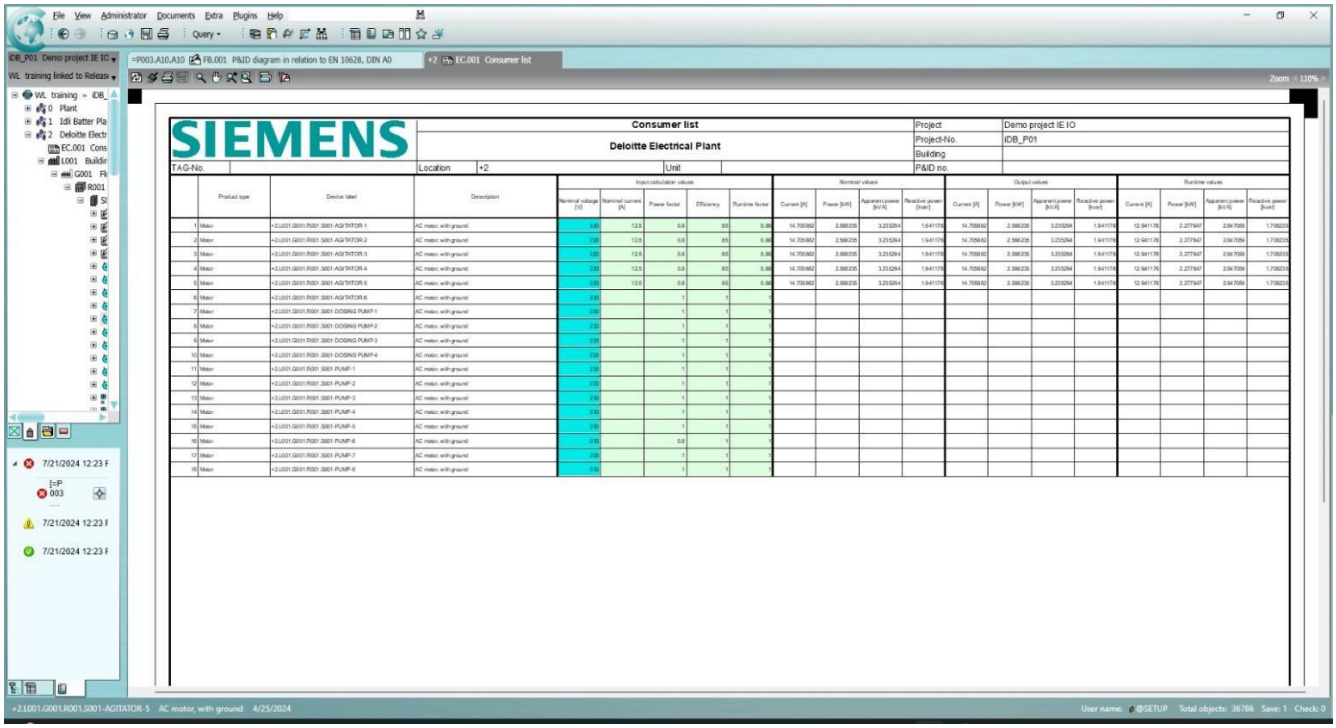
SIEMENS
Consumer list
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Project
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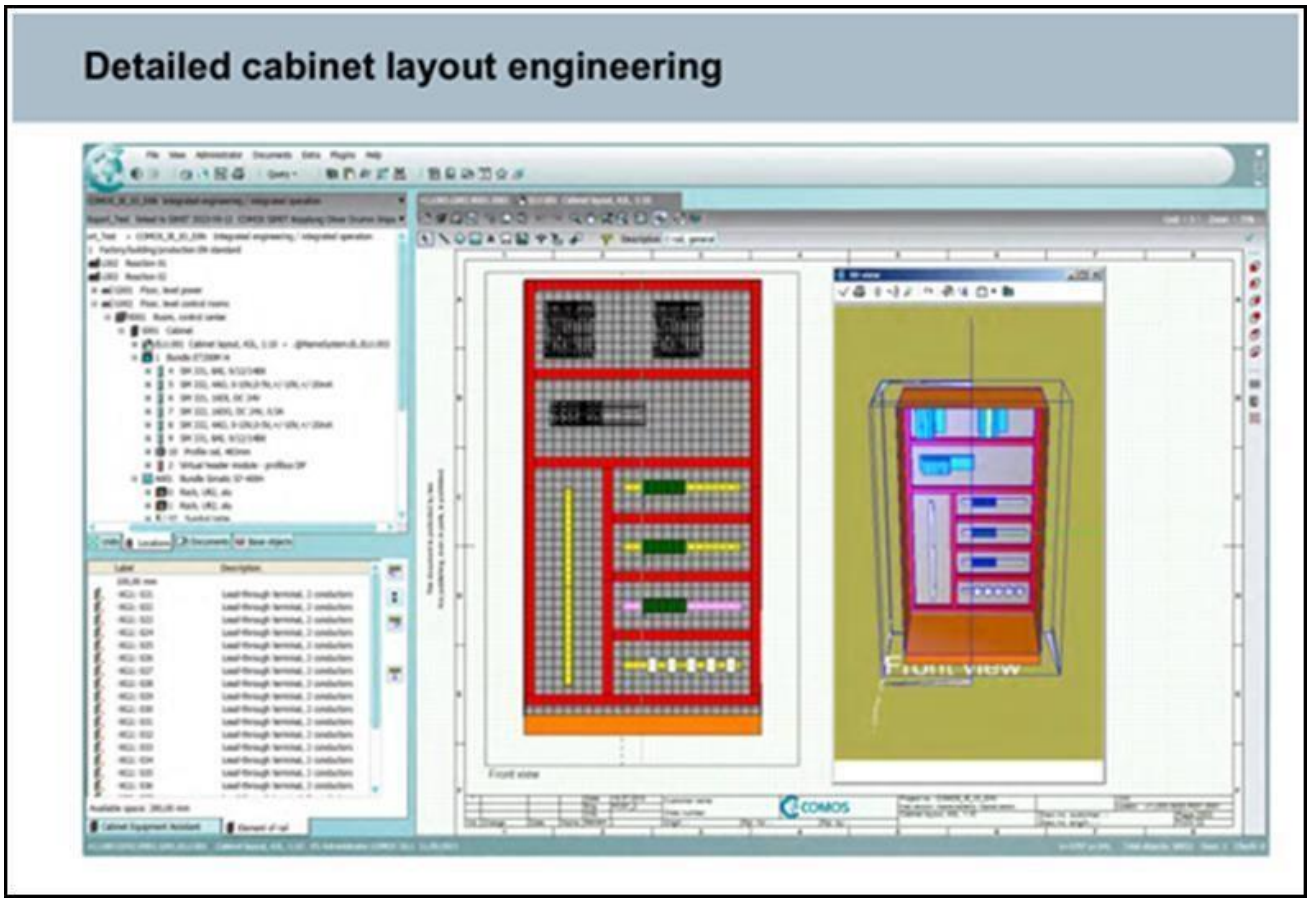
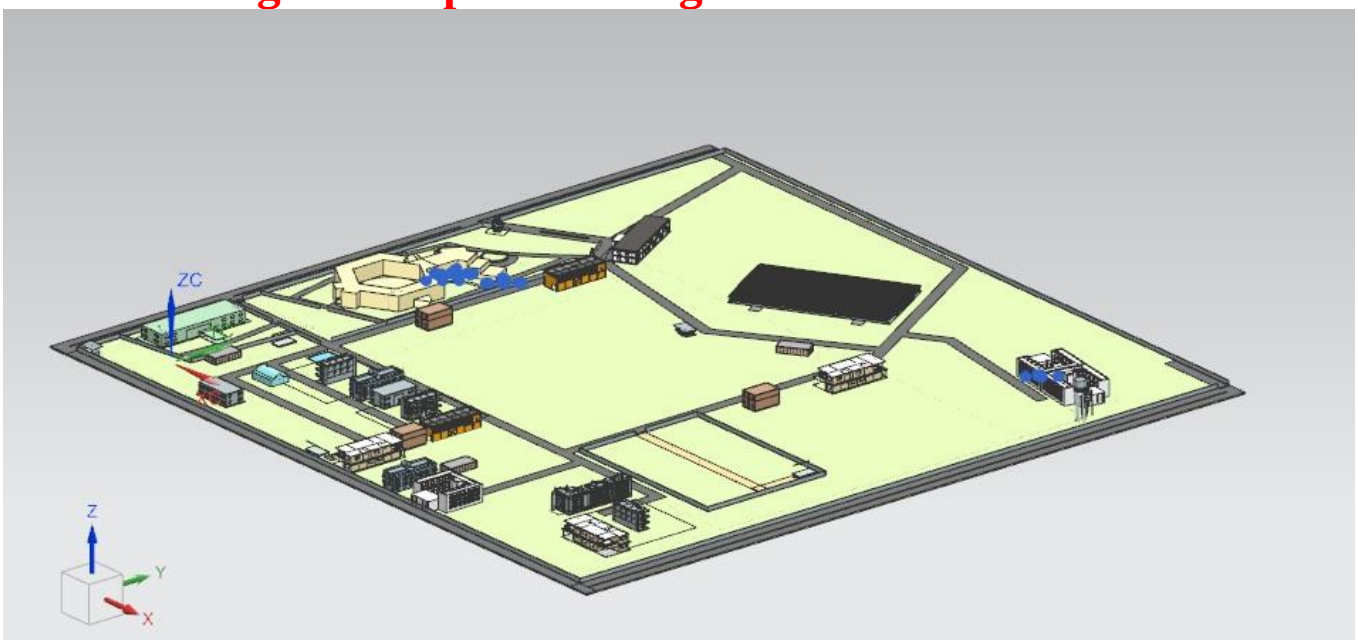


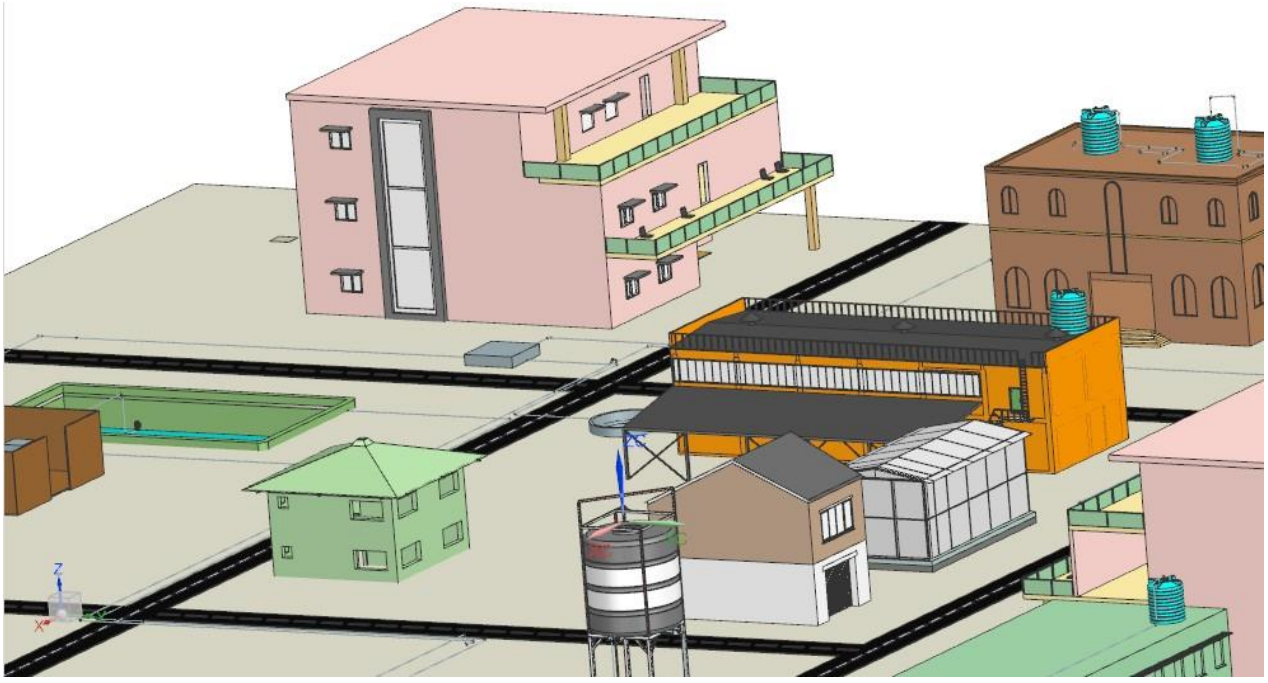

## NX (cad/cam/mcd) Plant 3D Tool Set for Rendering of Pumps, Pipes, valves.

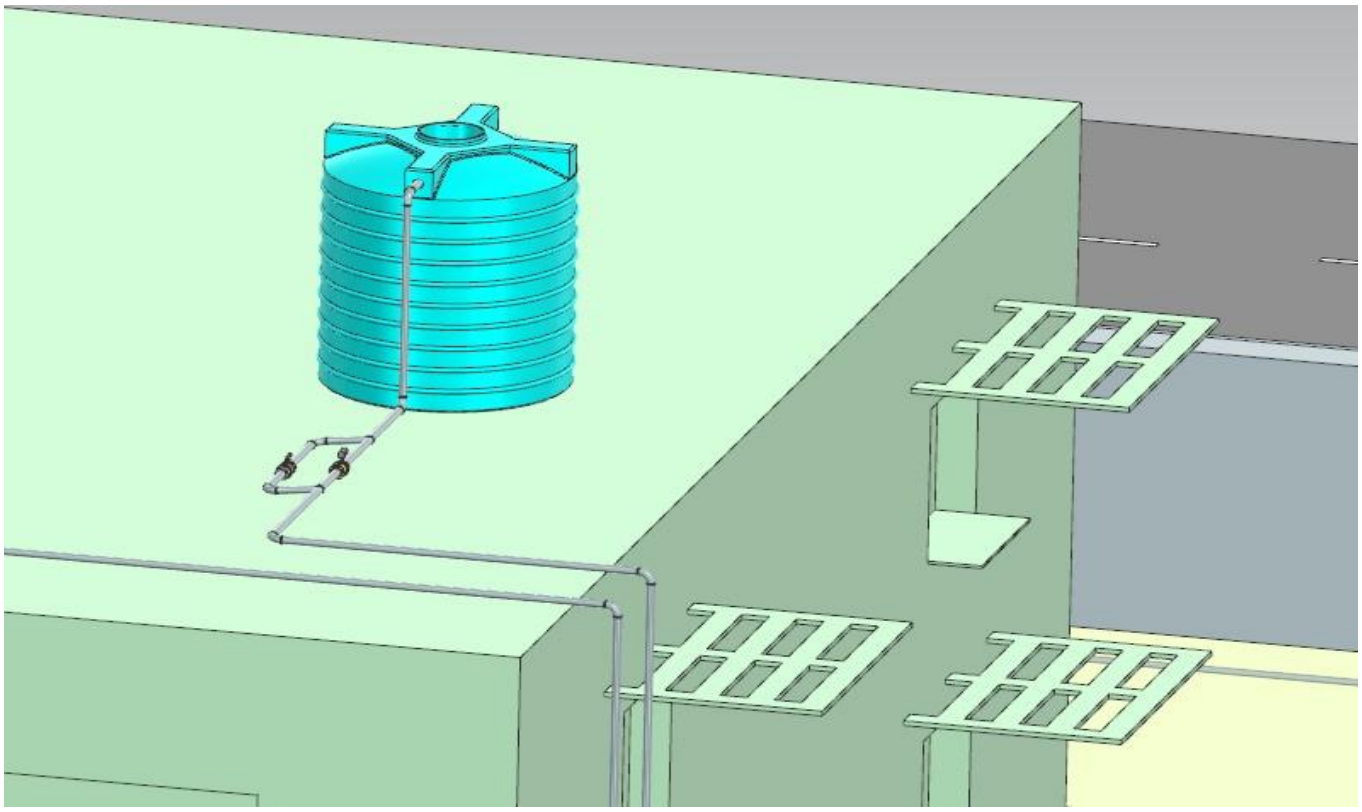
**NX CAD (Computer-Aided Design)**: Siemens NX provides advanced tools for designing complex 3D models, including parametric, direct, and surface modeling. It's widely used in industries such as automotive, aerospace, and machinery for designing parts, assemblies, and detailed engineering drawings.

# 3D Modelling of Campus Building




# The 3D Modelling of College Campus Watering.

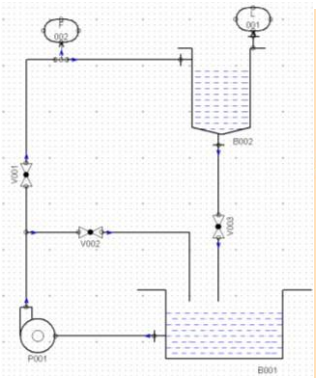




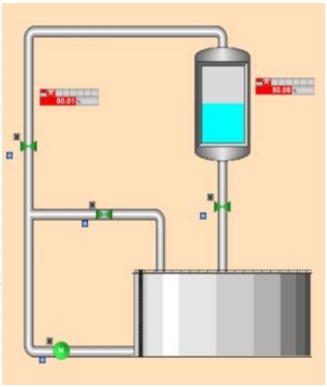

YC

Integration of PCS7/SIMIT/COMOS

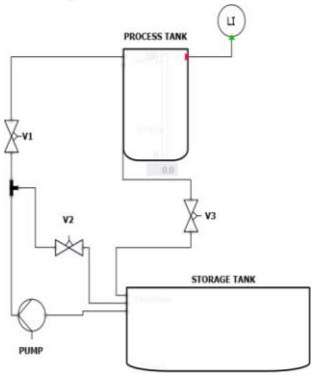
COMOS




PCS7



SIMIT



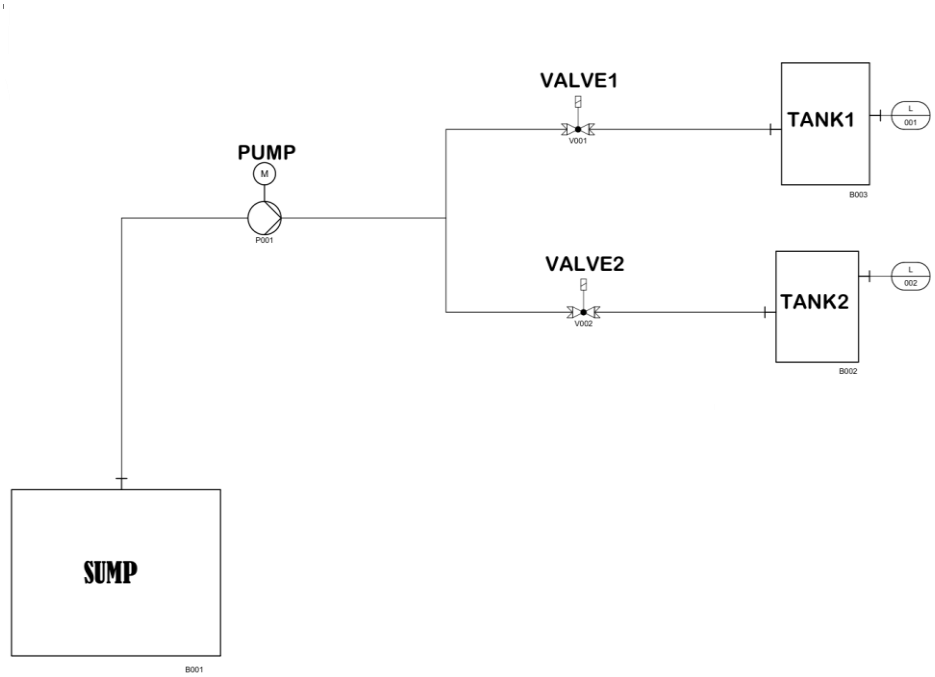
# USE CASES

## PLANT 1 - SMALL FACTORY WATER DISTRIBUTION

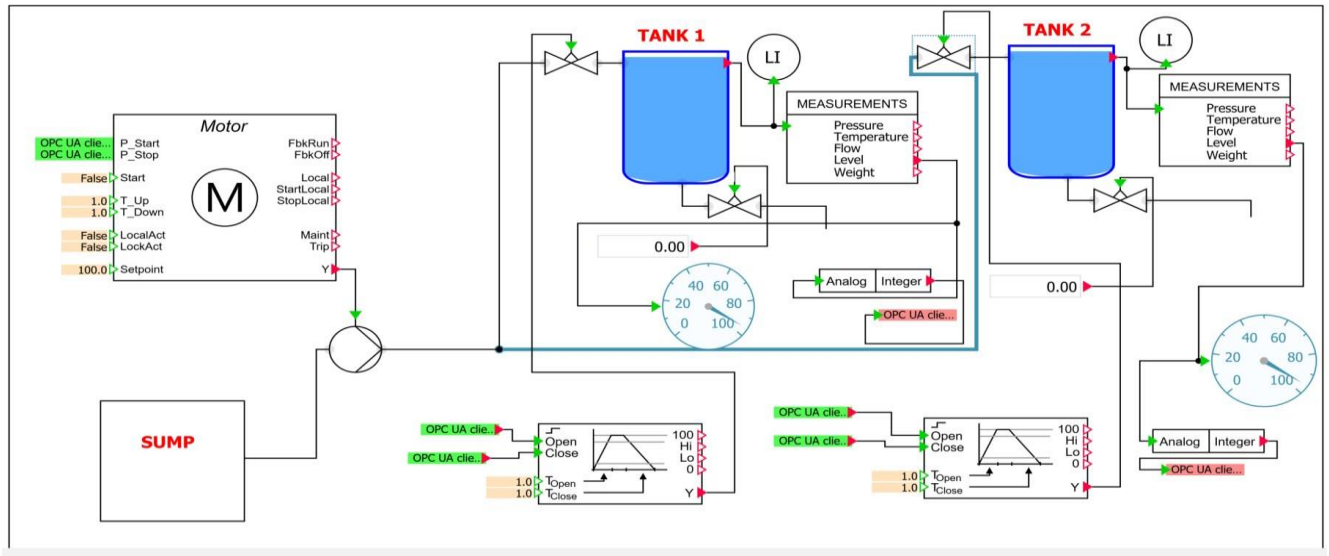
## REAL PLANT

- In this plant, we are going to automate the water distribution there are one Sump, two overhead tanks,one pump and two valve is used to make a digitization.
- When the water level of the tank is low the pump automatically fill the water.

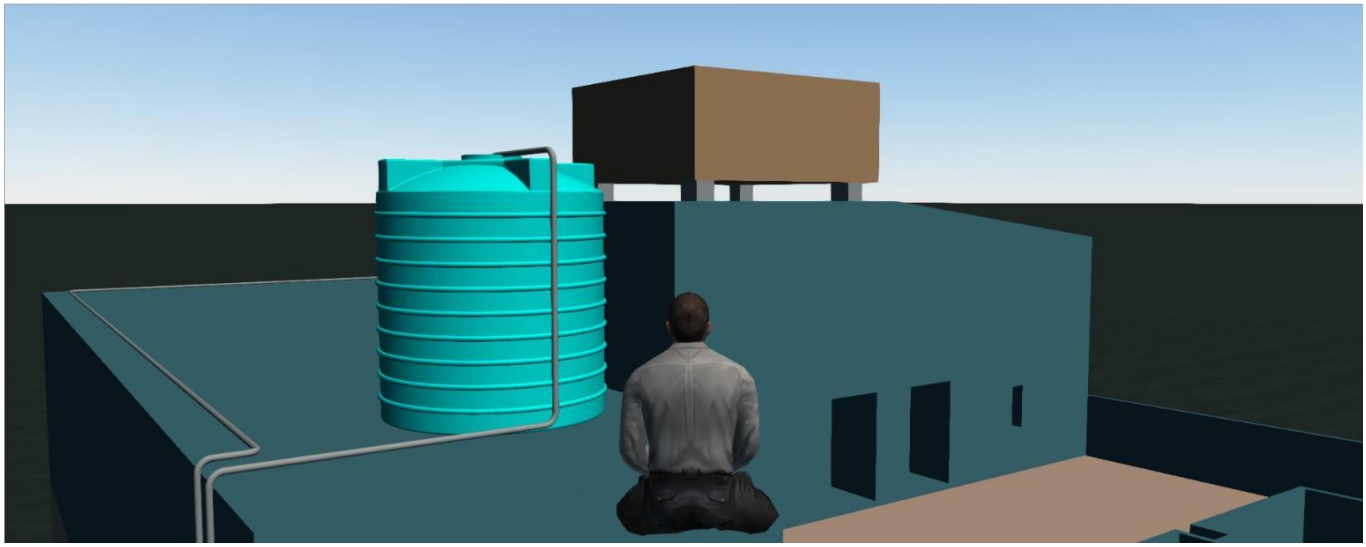
## COMOS P&ID:



# SIMIT SIMULATION:




# 3D VIEW USING COMOS WALKINSIDE:



The below link is for “DIGITAL TWIN FOR SMART WATER DISTRIBUTION MANAGEMENT SYSTEM” in office.

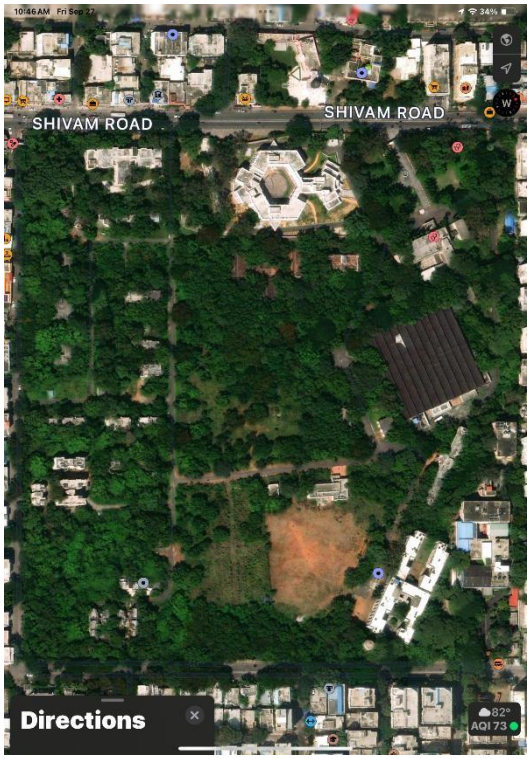
To watch this video **Press ctrl + click below link**

**https://drive.google.com/file/d/1XSG3Y196_HAlFniEhz2MhTJ-DKglSfM1/view?usp=sharing**

This link will show - how digital twin works in smart water distribution management system.

# PLANT 2- NSTI –SMART WATER MANAGEMENT SYSTEM

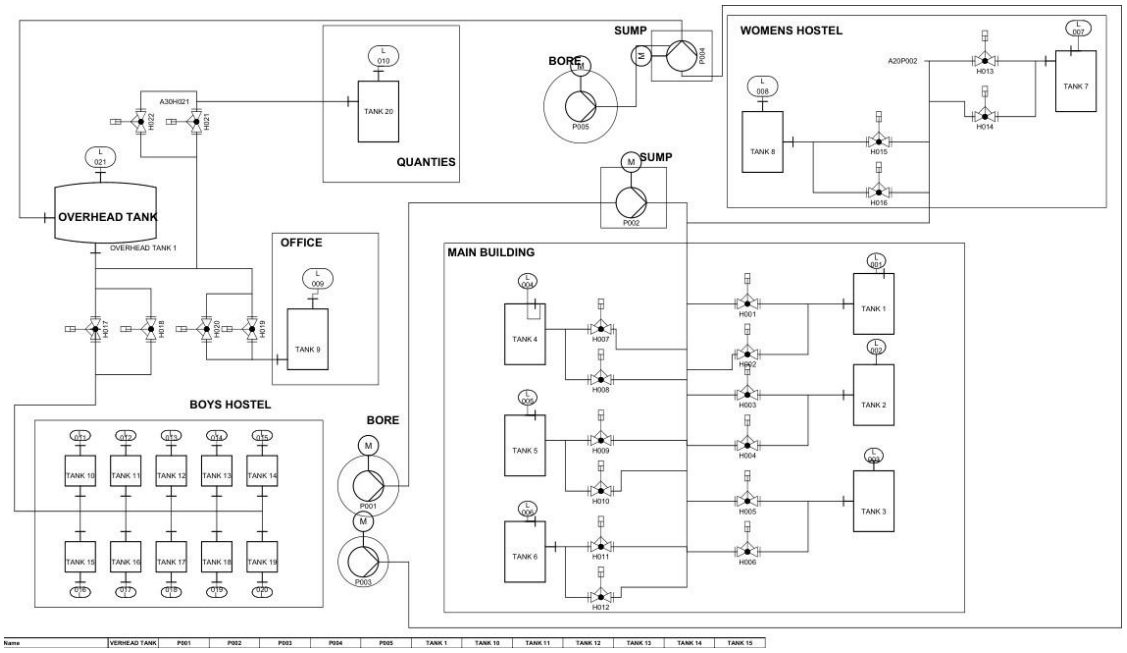
## REAL PLANT:



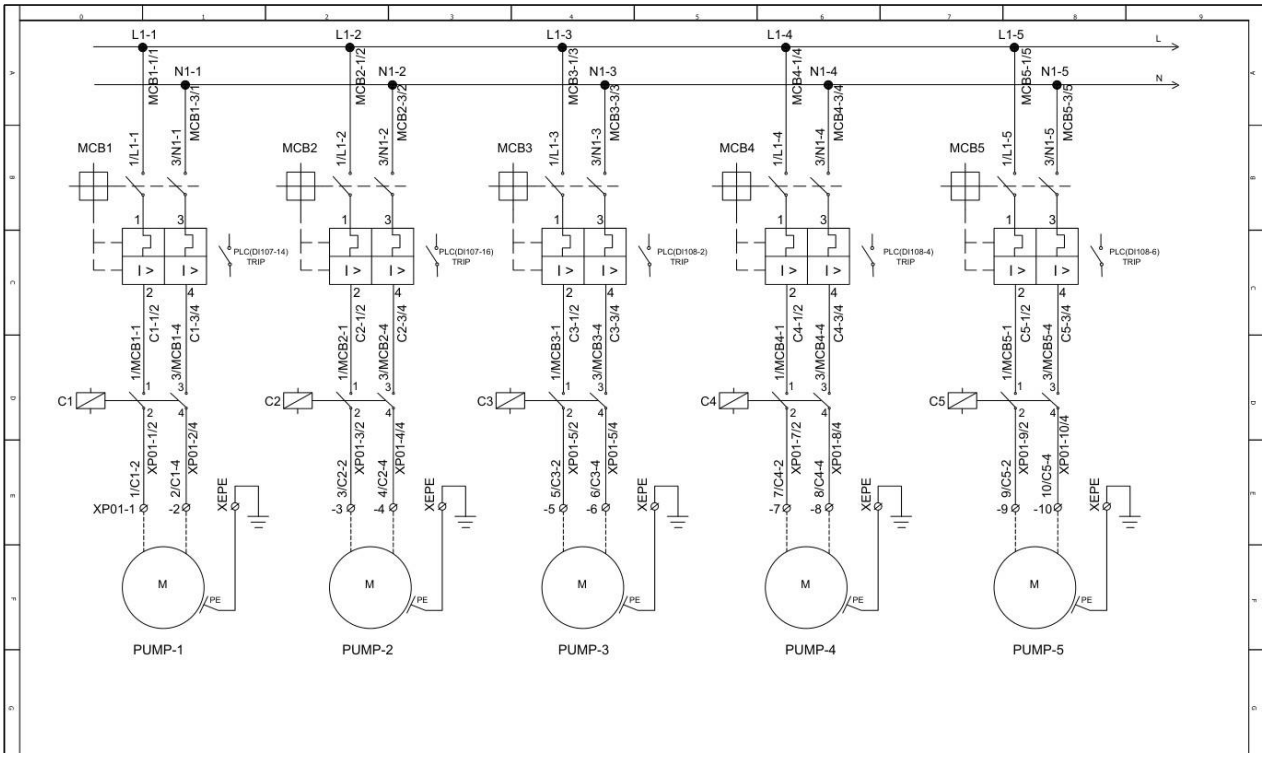

## SATILITE VIEW:

In this plant, we automate the whole college campus water distribution system using the above software tools.

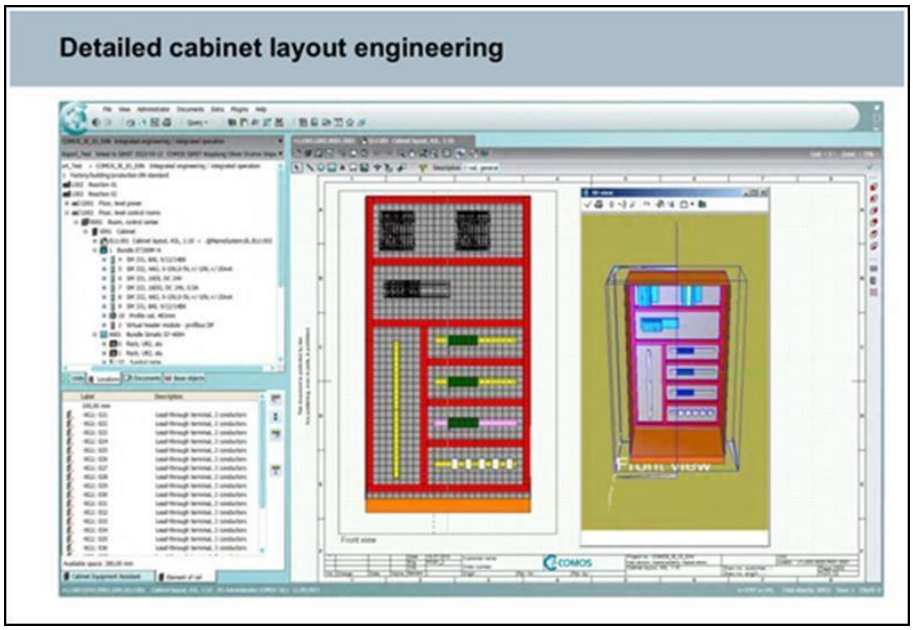
## COMOS P&ID:



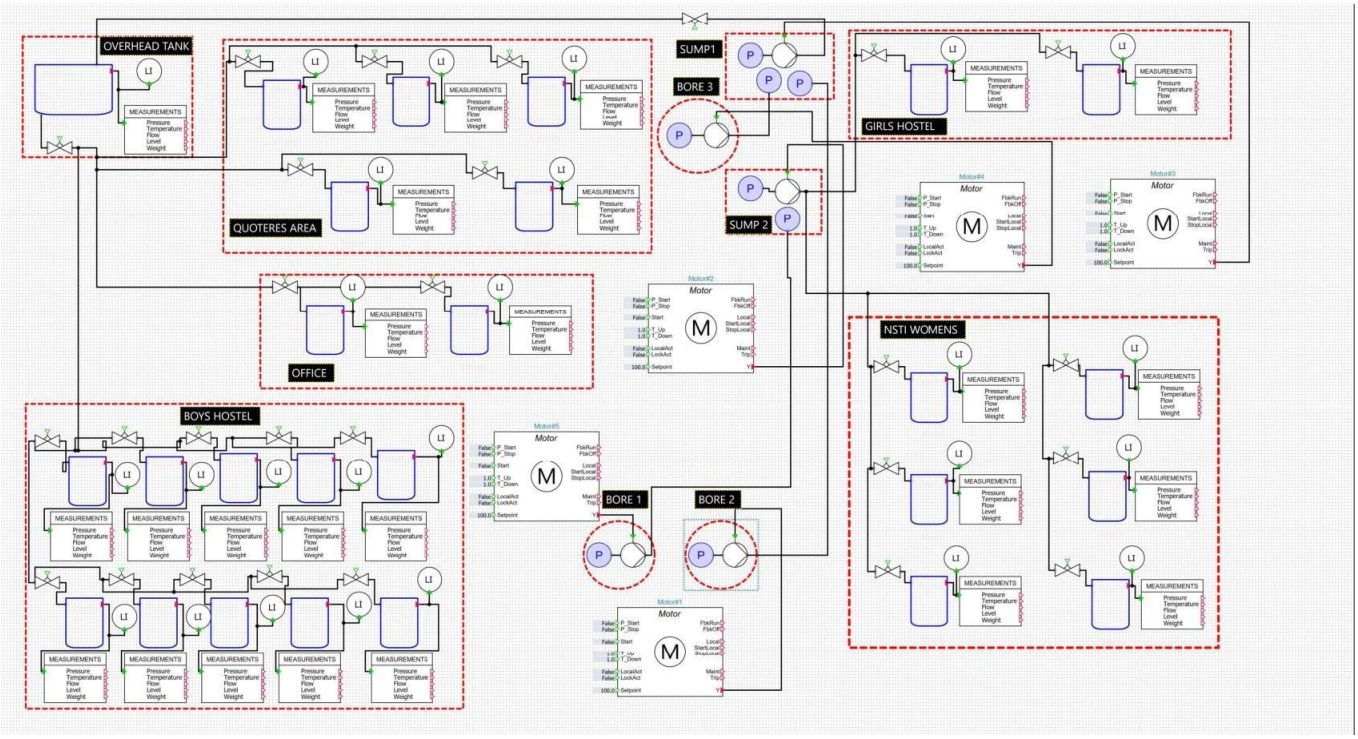
The following Figure shows Electrical Drawing set up for this water Management System and Digitized by the COMOS Software.




Power Distribution component wiring & Cabinet Digitalization.

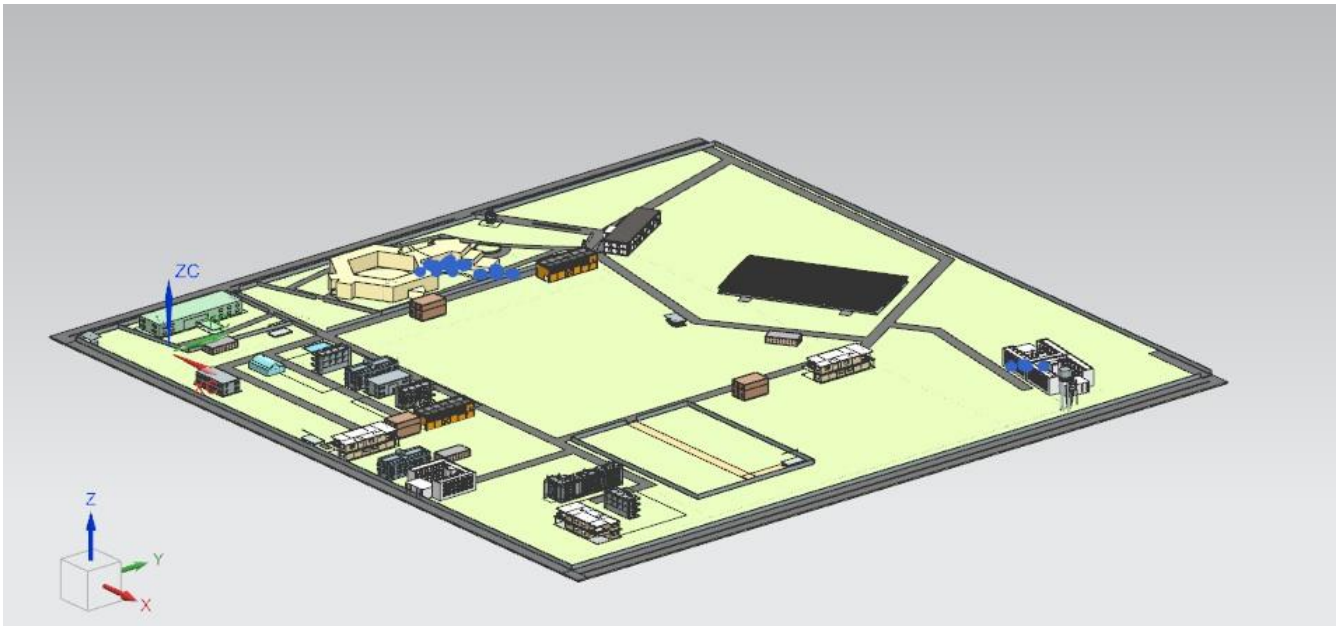


# SIMIT SIMUALATION:

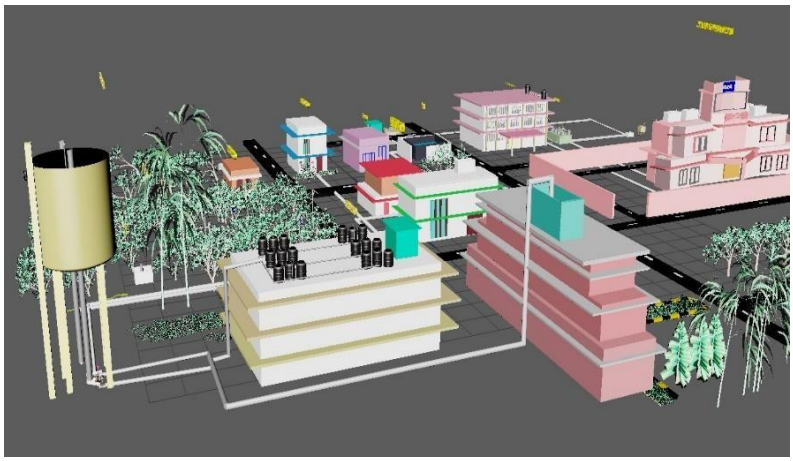


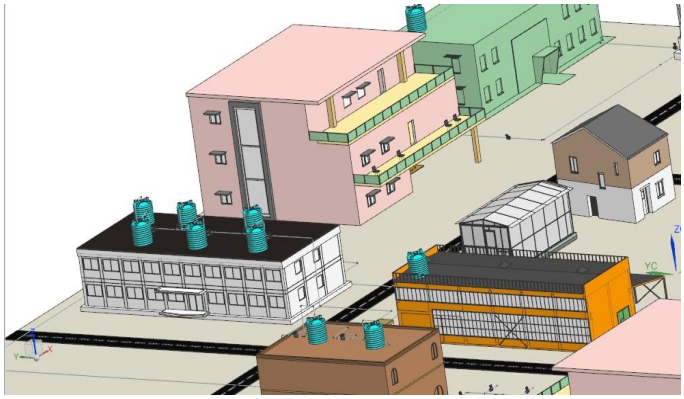

# 3D MODELLING USING NX CAD/CAM:

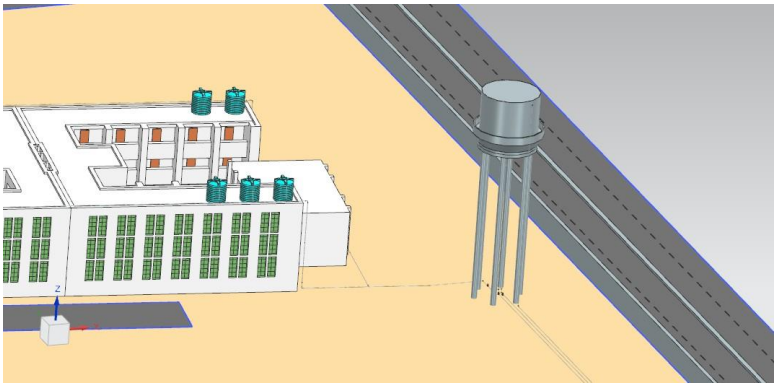
3D Modelling of Water Distributions system of the entire college campus.



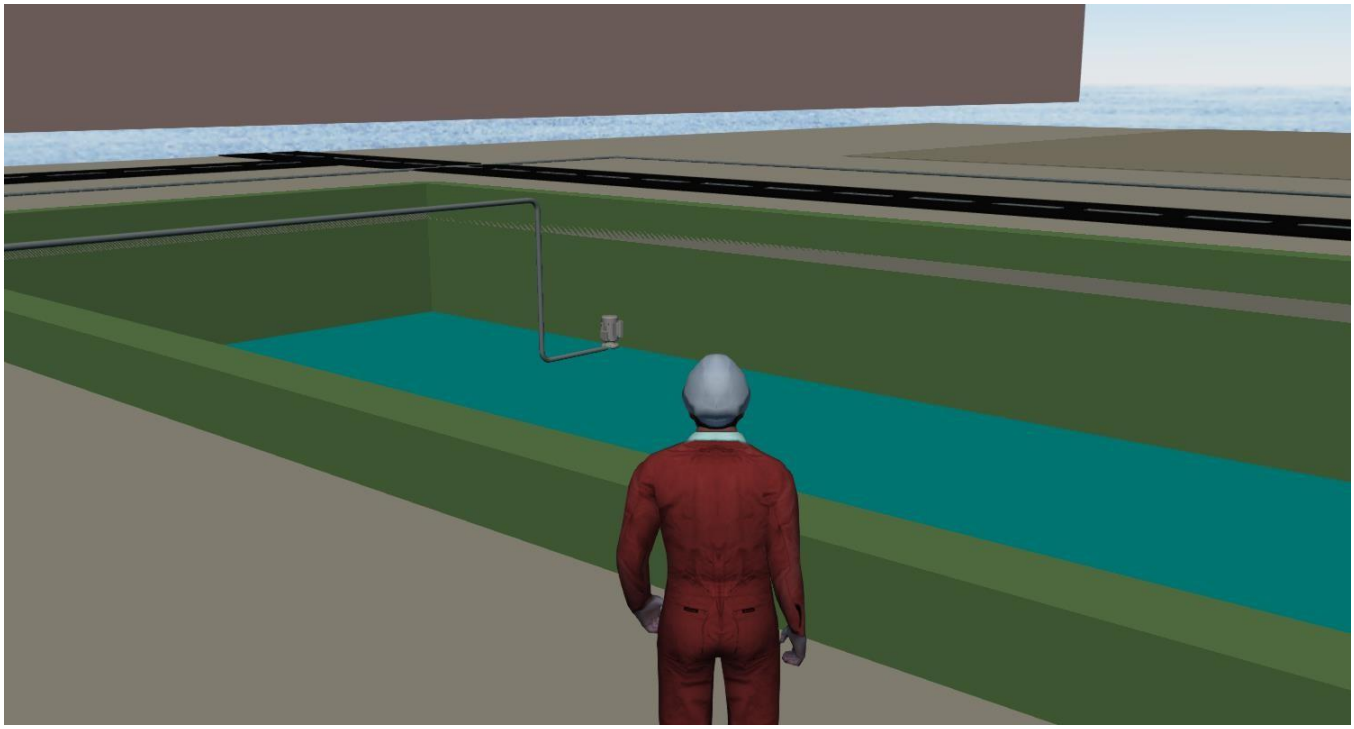
# 3D VIEW USING NX



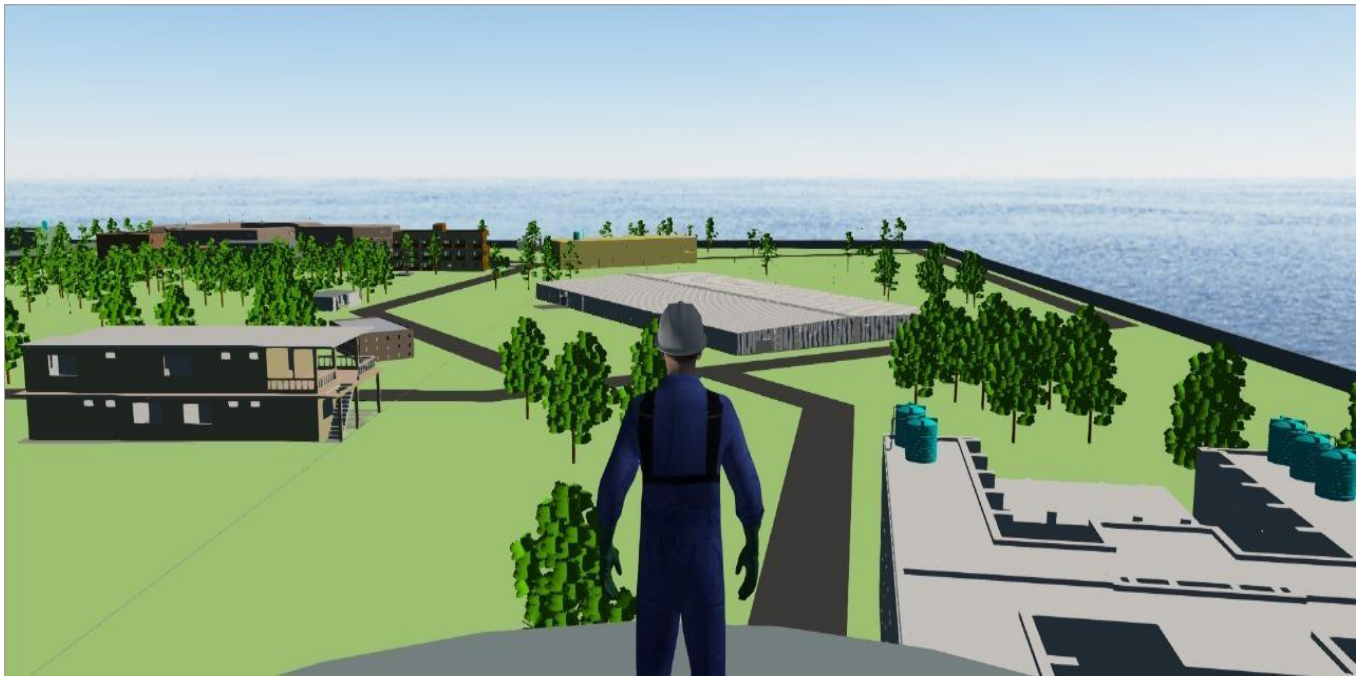




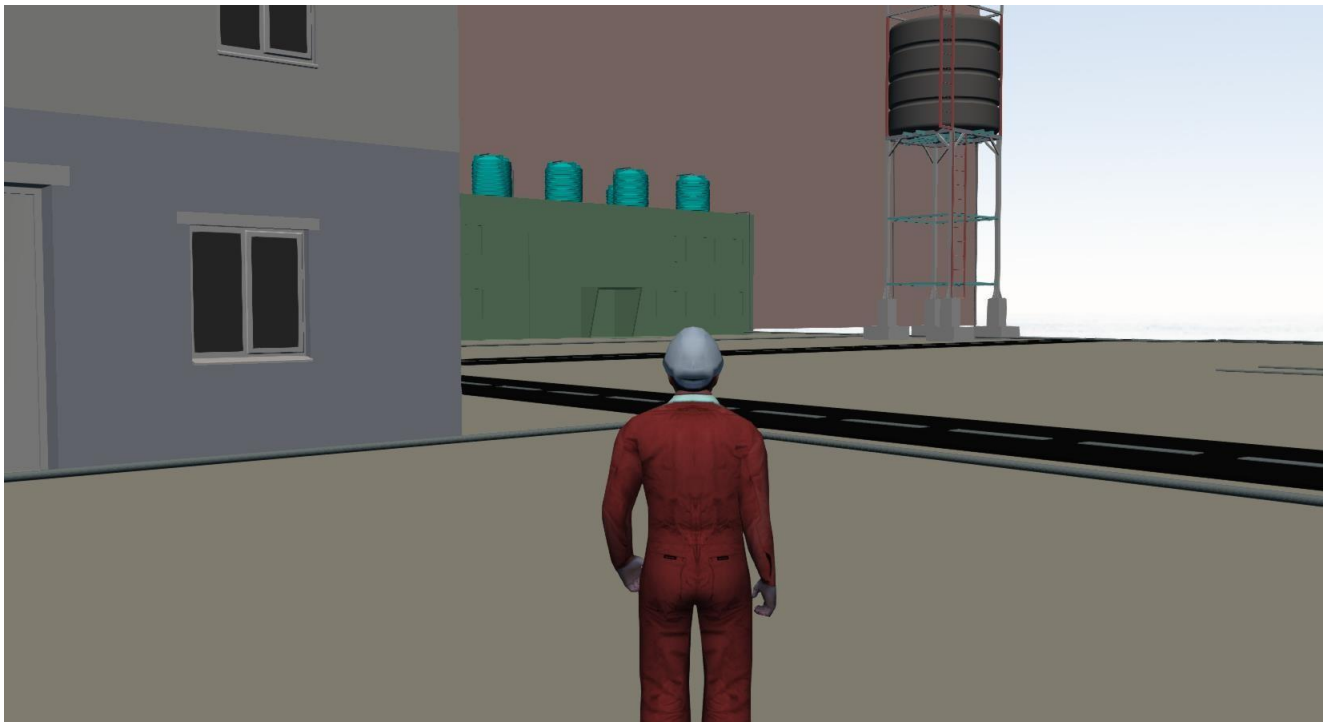
## SUMP VIEW USING COMOS WALKINSIDE:



## CAMPUS VIEW:



## OVER HEAD STORAGE TANK VIEW BY VR



The below link is for “DIGITAL TWIN FOR SMART WATER DISTRIBUTION MANAGEMENT SYSTEM” in a college campus.

To watch this video **Press ctrl + click below link**

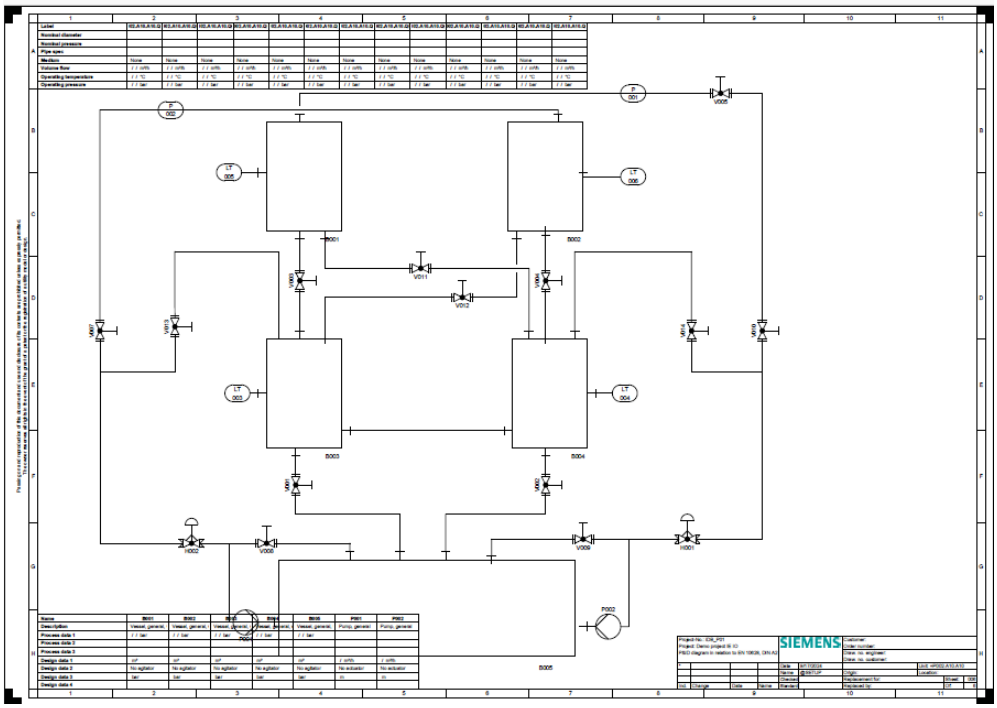
https://drive.google.com/file/d/1Ic4NiZlMMt9wixGq1eR7KkVczkA5UFPr/view?usp=drive_link

This link will shows the how digital twin works in smart water distribution management system.

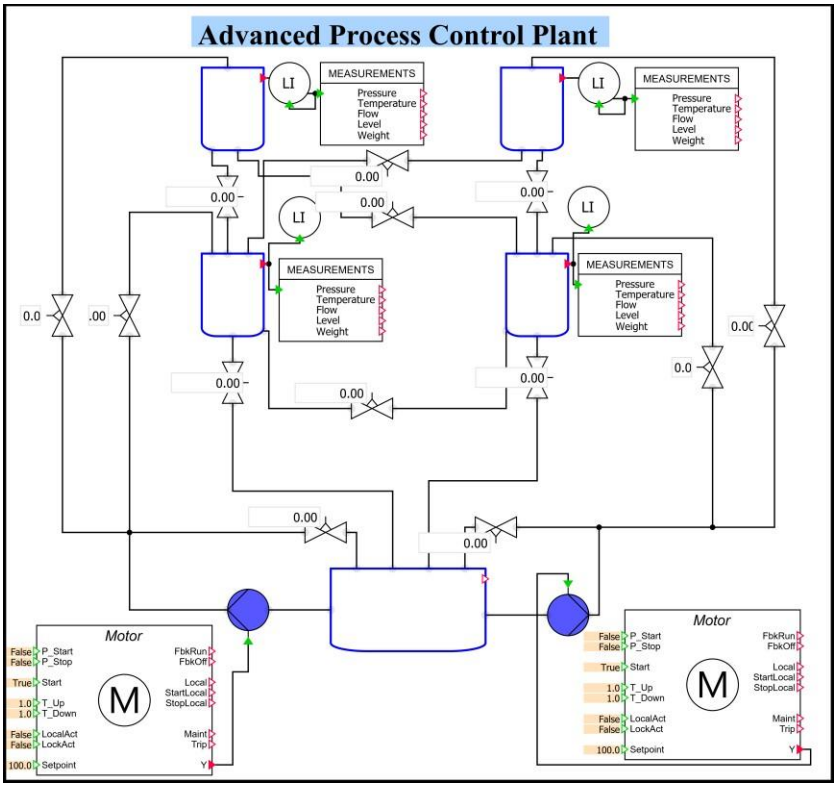
# PLANT3-**ADVANCED PROCESS CONTROL PLANT (four tank System)**

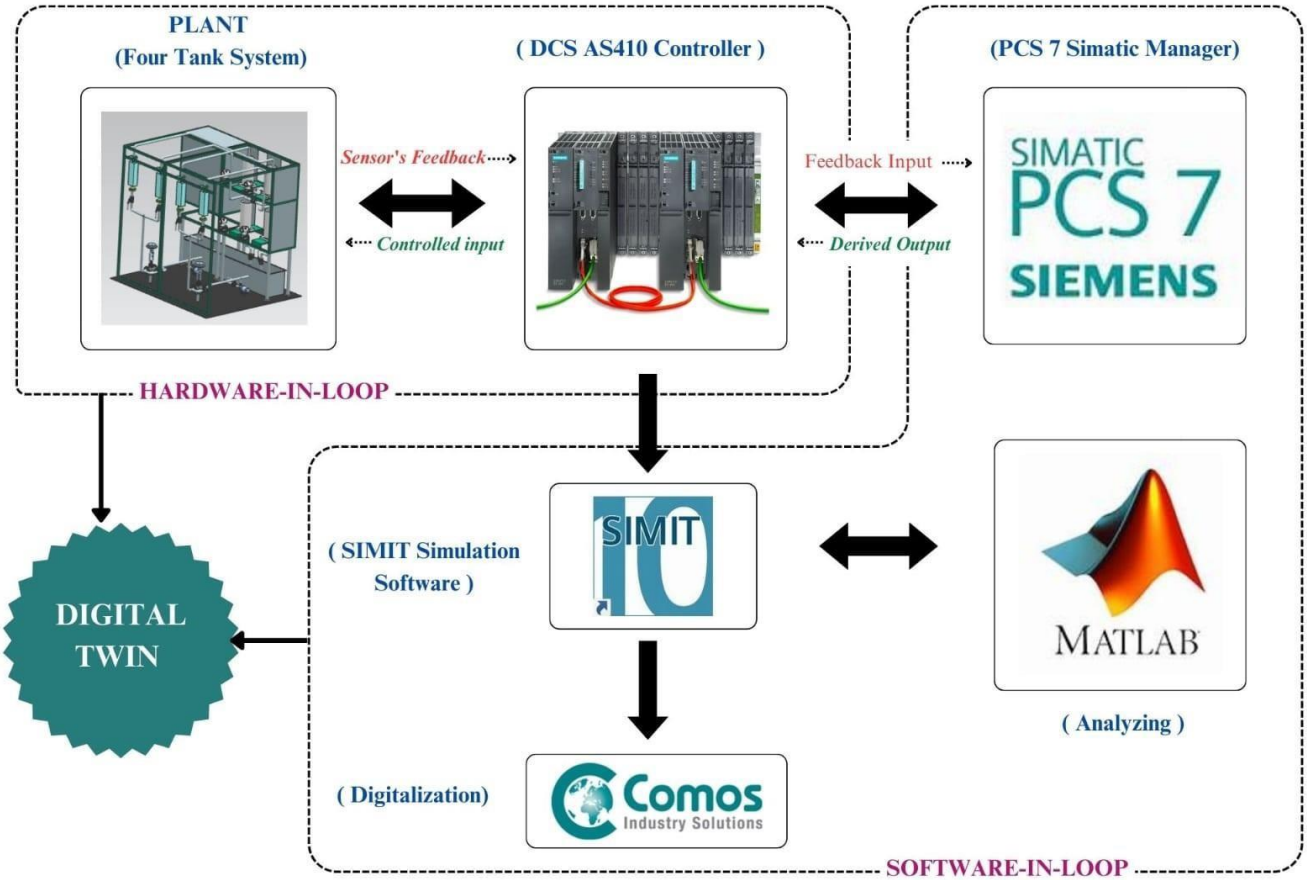
## REAL PLANT

# COMOS P&ID FO 4 TANK SYSYTEM:

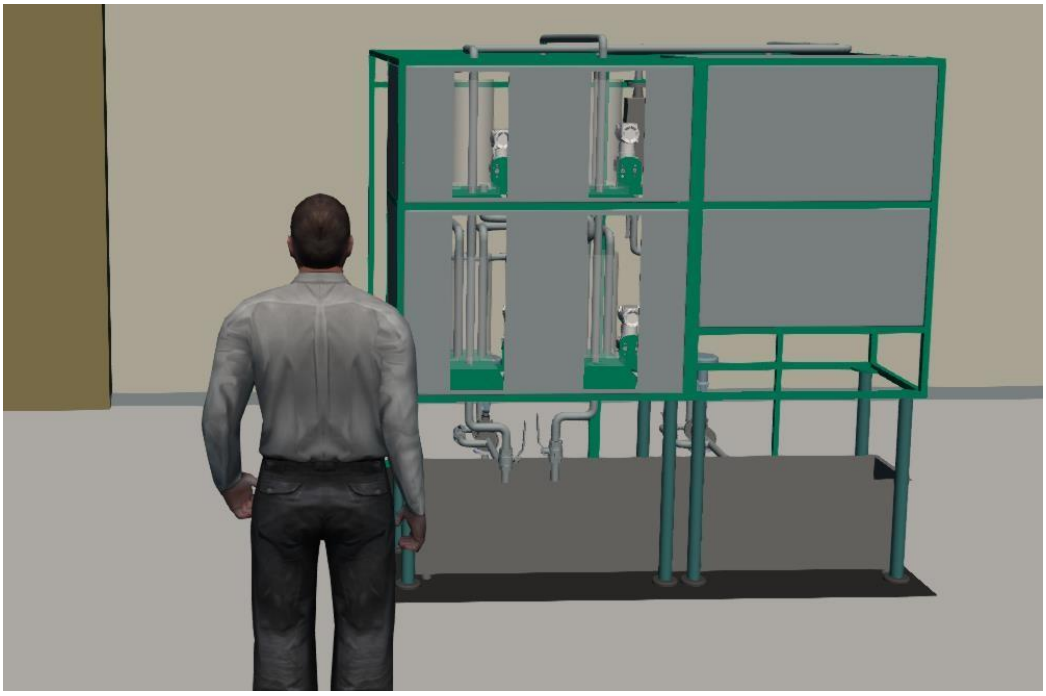


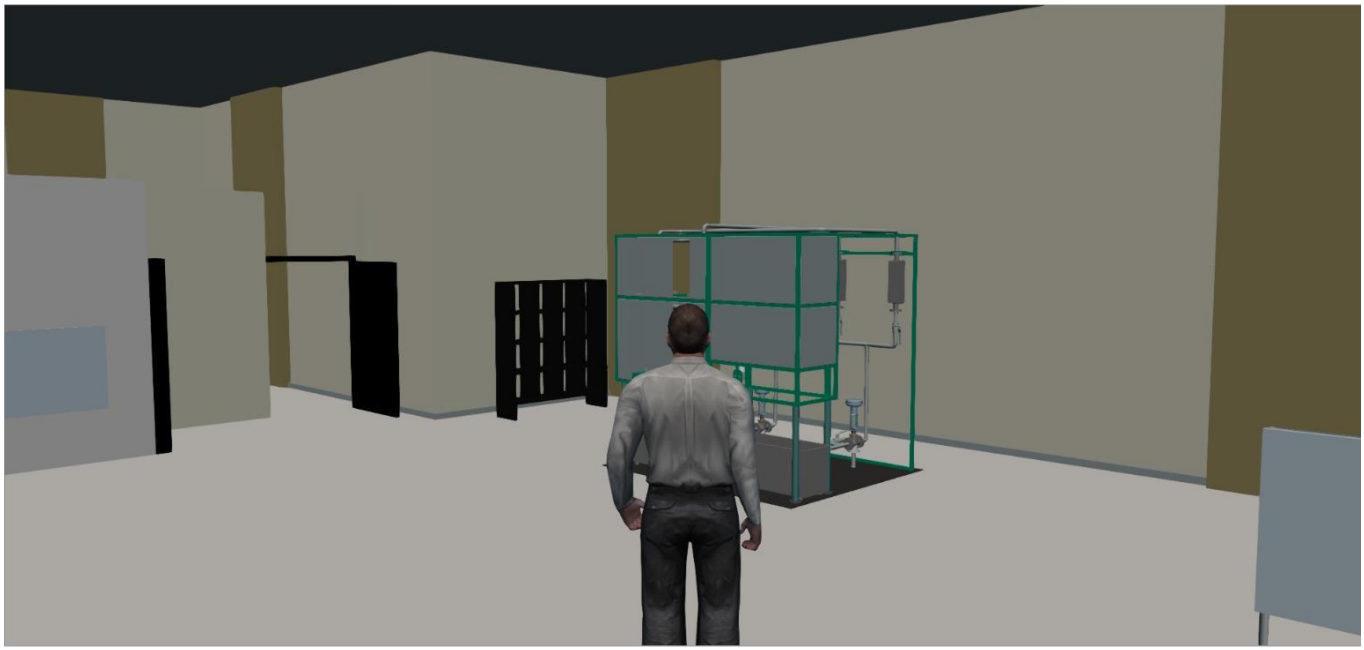
# SIMIT SIMULATION FOR 4 TANK SYSTEM:






# 3D VIEW USING COMOS WALKINSIDE:





The below link is for “DIGITAL TWIN FOR 4 TANK SYSTEM”.

To watch this video **Press ctrl + click below link**

**https://drive.google.com/drive/folders/1UOw4aC51dRiG6E5PrXdtM3LAFRAppmHt?usp=drive_link**

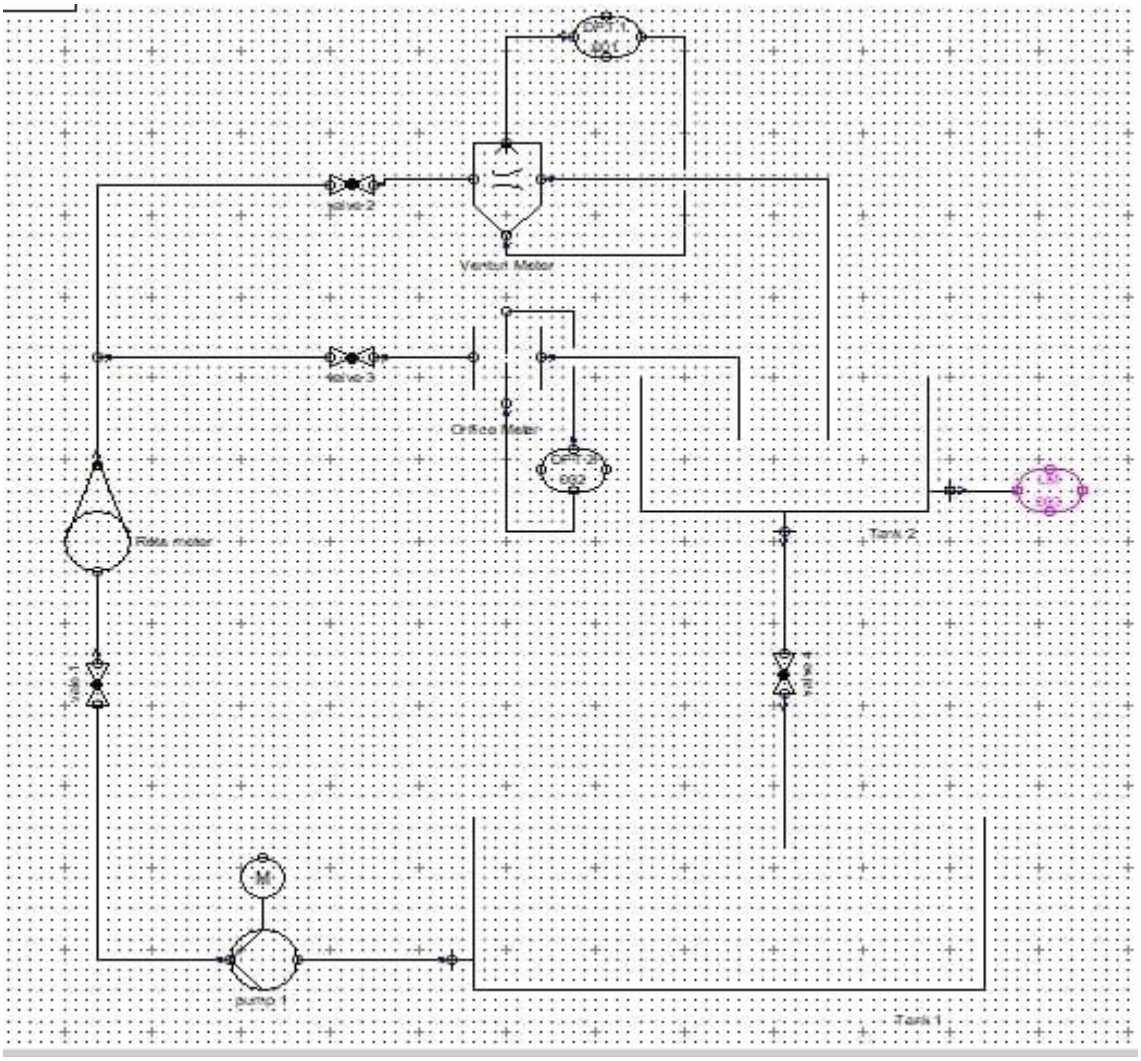
This link will shows the how digital twin works in 4 TANK SYSTEM.

# PLANT4: VENTURI-ORIFICE CHARACTER STUDY TRAINER REAL PLANT

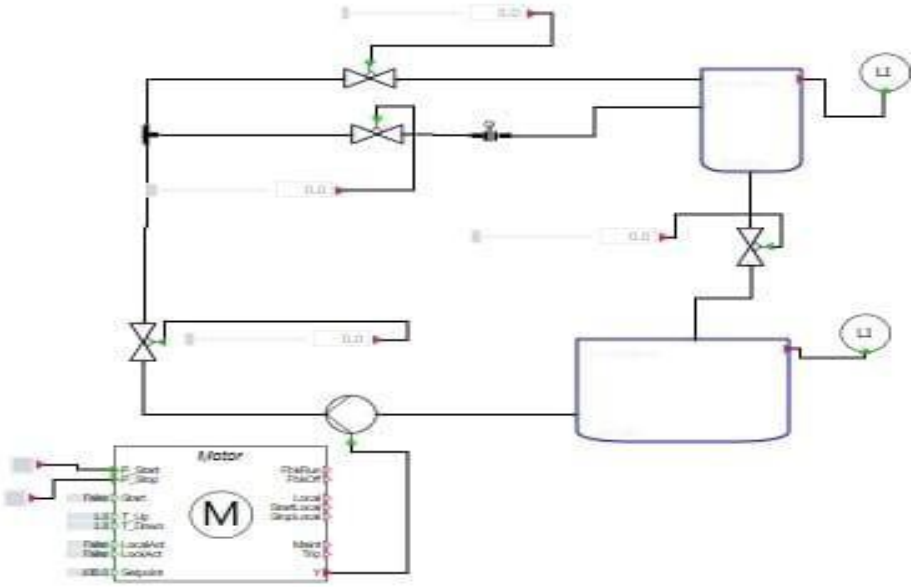
## Automation Hardwares:

- S7-1200 PLC,
- VDF for the Pump,
- DPT for Flow Measurement,
- MEMS Flow Sensors for Venturi & Orifice Meters.

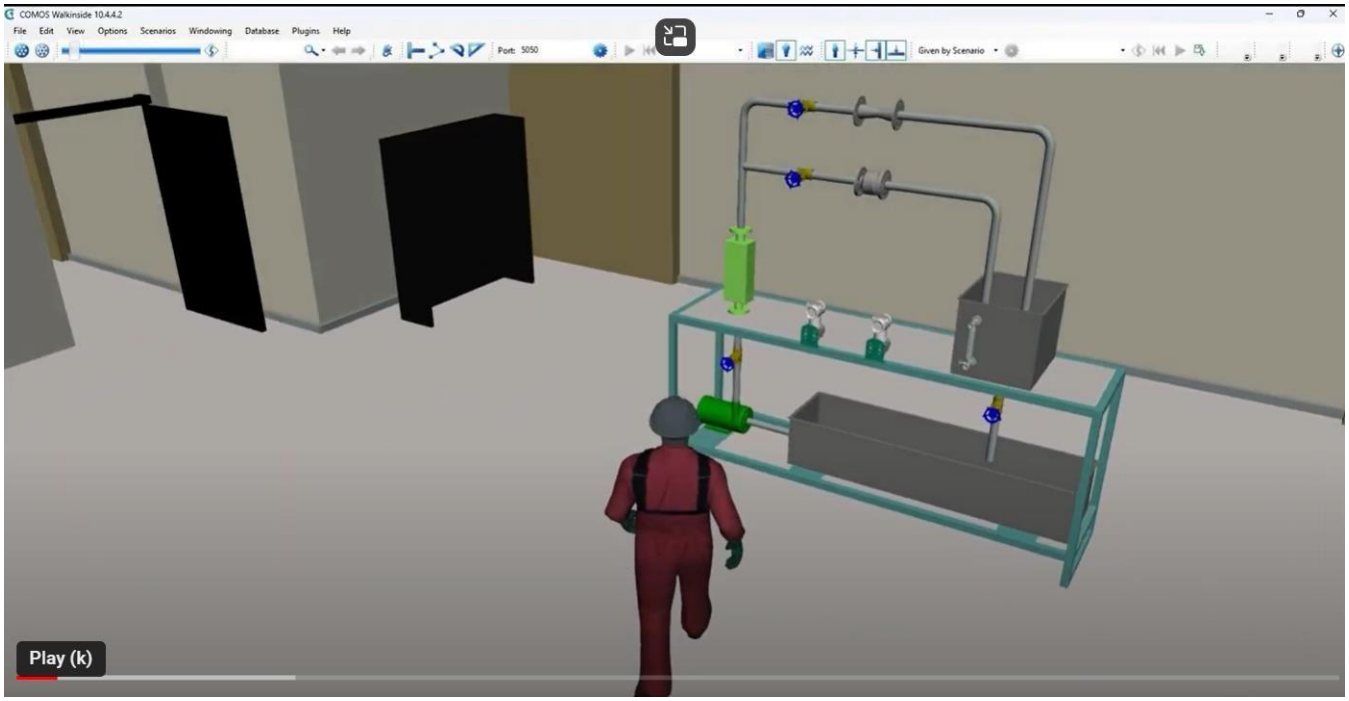
COMOS P&ID FOR VENTURI-ORIFICE CHARACTER STUDY TRAINER:

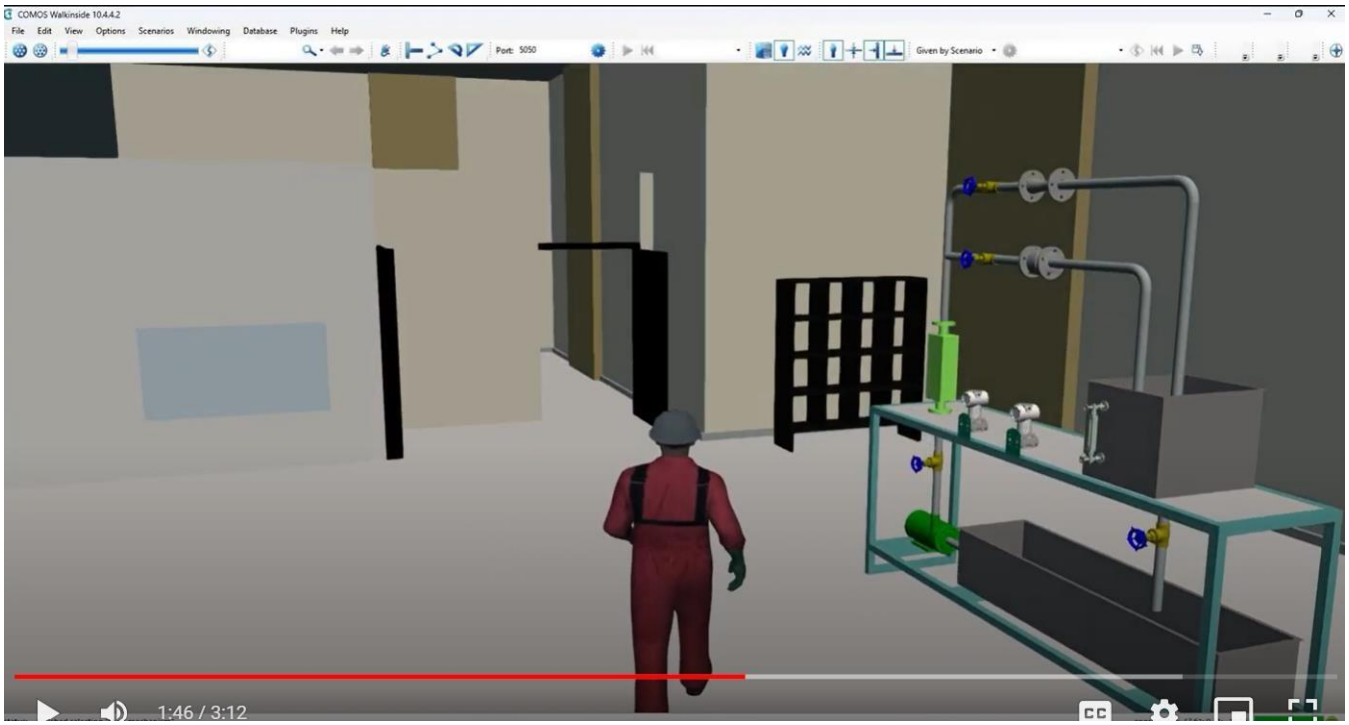


# SIMIT FOR VENTURI-ORIFICE CHARACTER STUDY TRAINER:




# 3D VIEW USING COMOS WALKINSIDE:






The below link is for " Venturi-Orifice Meters Character Study Trainer "

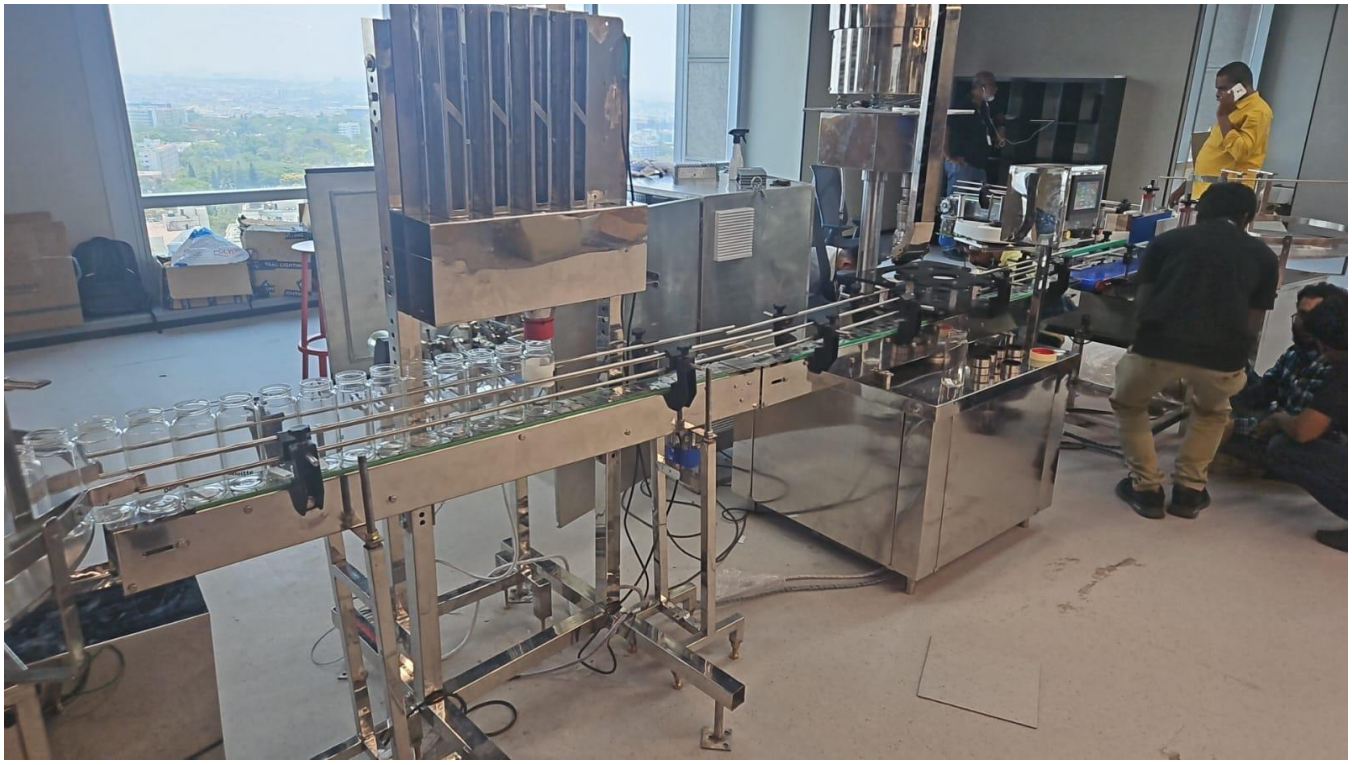
To watch this video **Press ctrl + click below link**

**https://drive.google.com/file/d/1Vu_xW6q06wtaCxFQD_G60v1BedRJwWY7/view?usp=sharing**

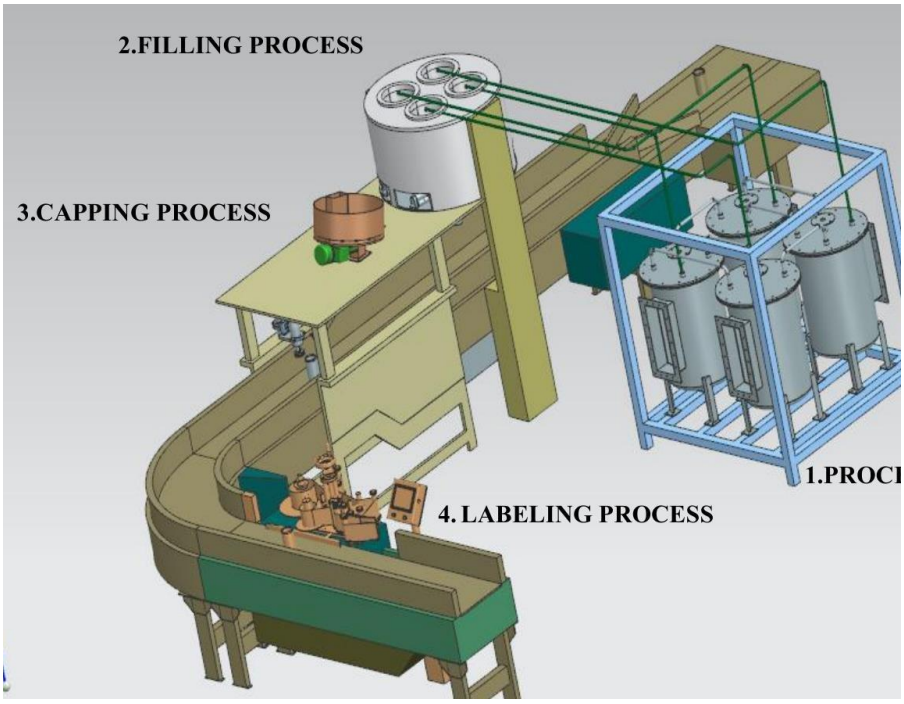
This link will shows the how digital twin works in this industry.

# PLANT 5-PAINT PROCESS INDUSTRY

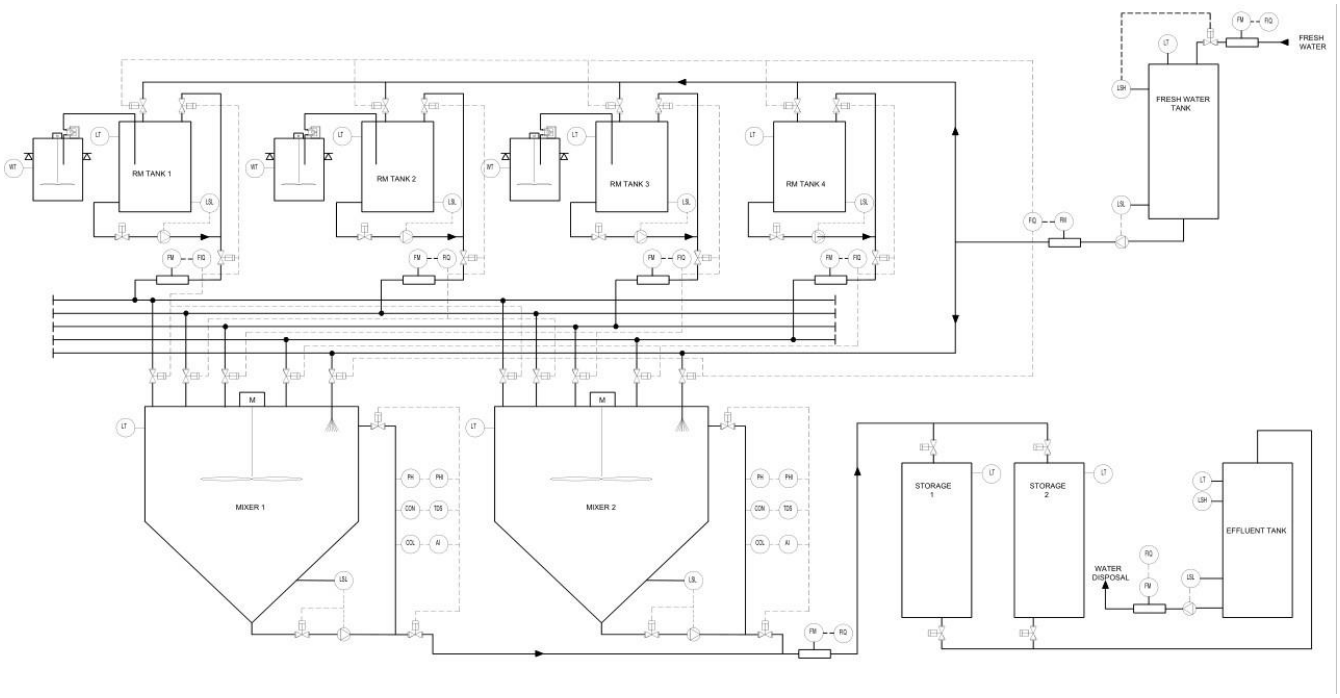
## REAL PLANT



## 3D MODEL OF PLANT

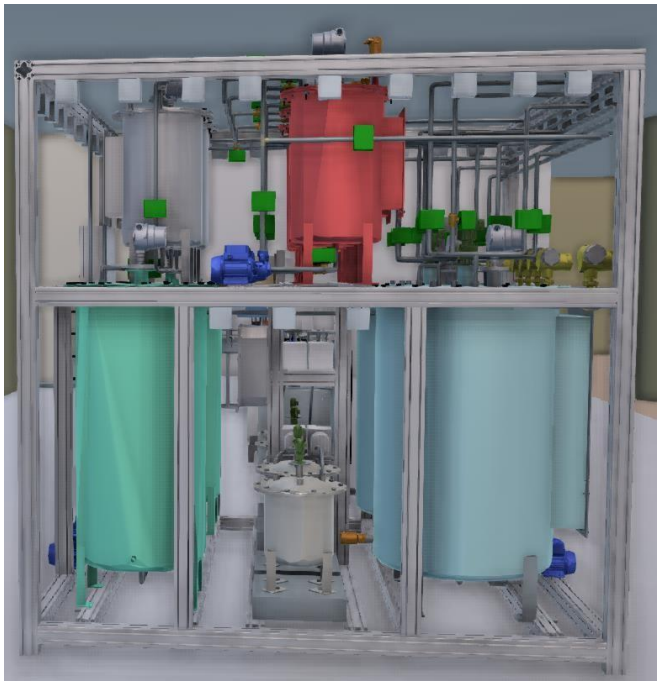


# COMOS P&ID:




Our Digital Twin Project Of Paint Industry At Deloitte Experience Centre, Bangalore

REAL HARDWARE



DIGITAL TWIN

# 3D VIEW USING COMOS WALKINSIDE:



The below link is for "DIGITAL TWIN FOR PAINT INDUSTRY".

To watch this video **Press ctrl + click below link**

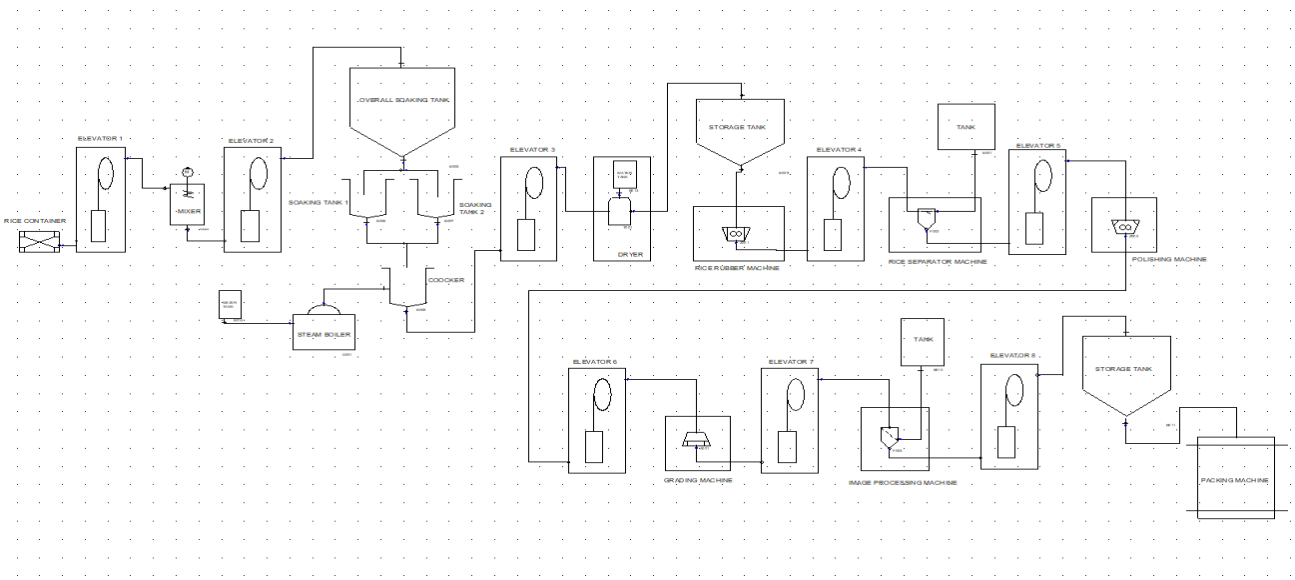
🎥 https://drive.google.com/drive/folders/1yWclN-cuHdt6XyynIIFKOMQhyHxsYYac?usp=drive_link

This link will shows the how digital twin works in Paint industry.

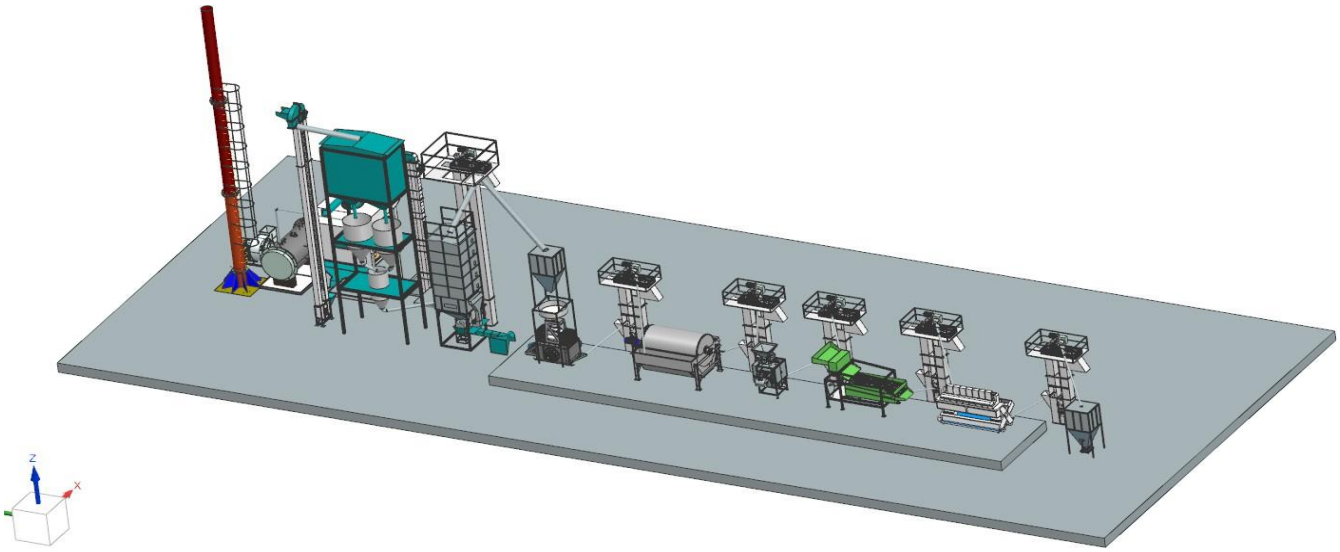
# PLANT 6- Mini Paddy Process Plant
# REAL PLANT

**Mini Paddy Processing Plant**

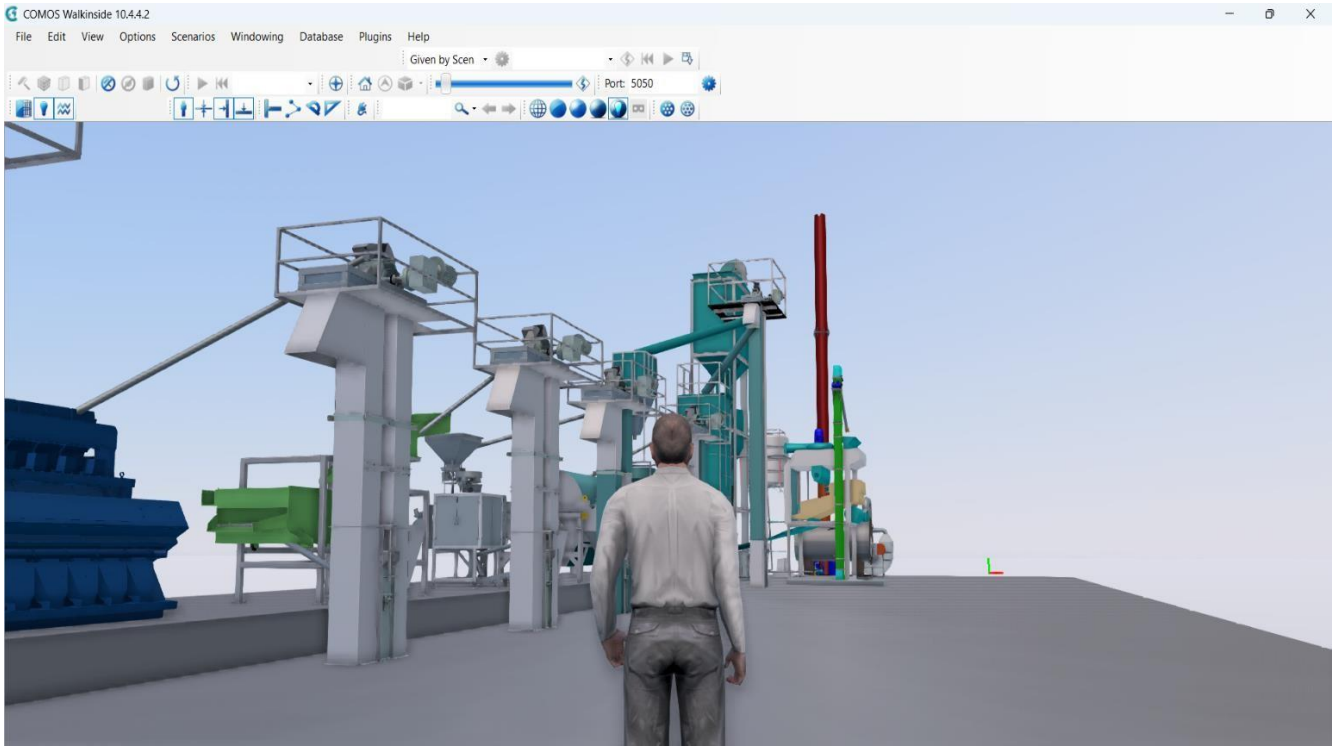
## COMOS P&ID:

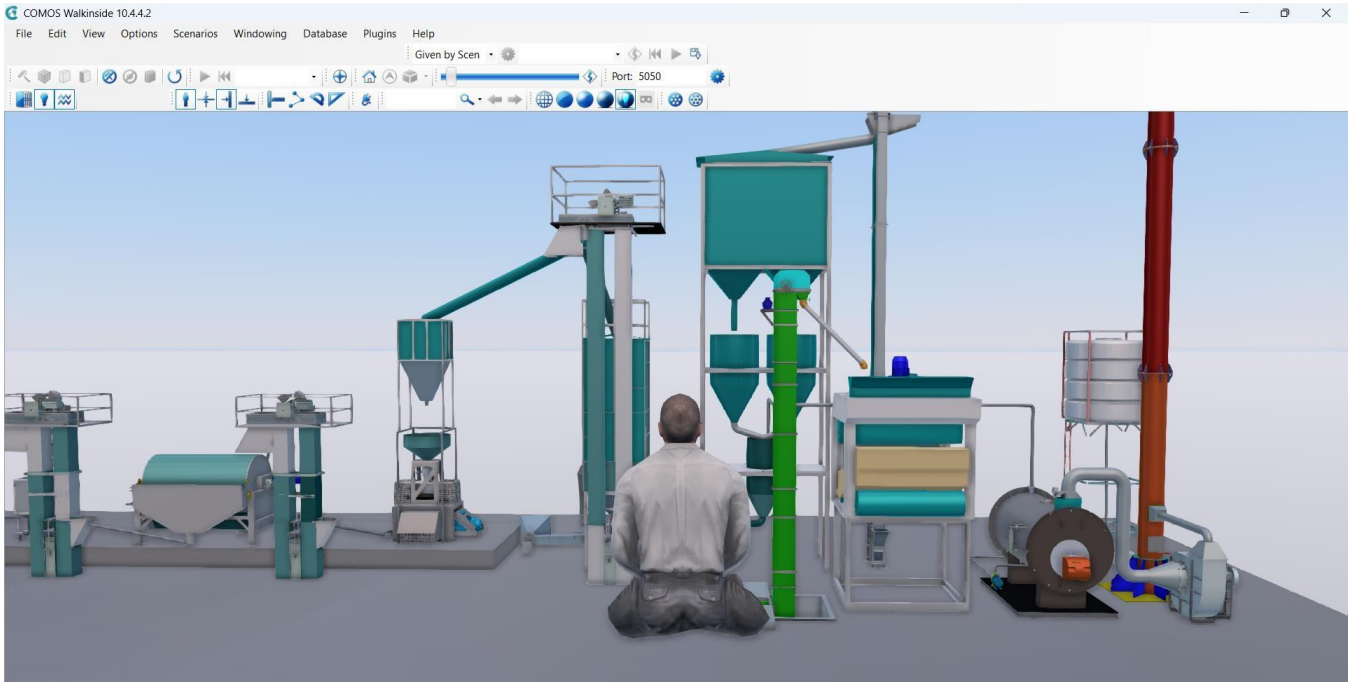


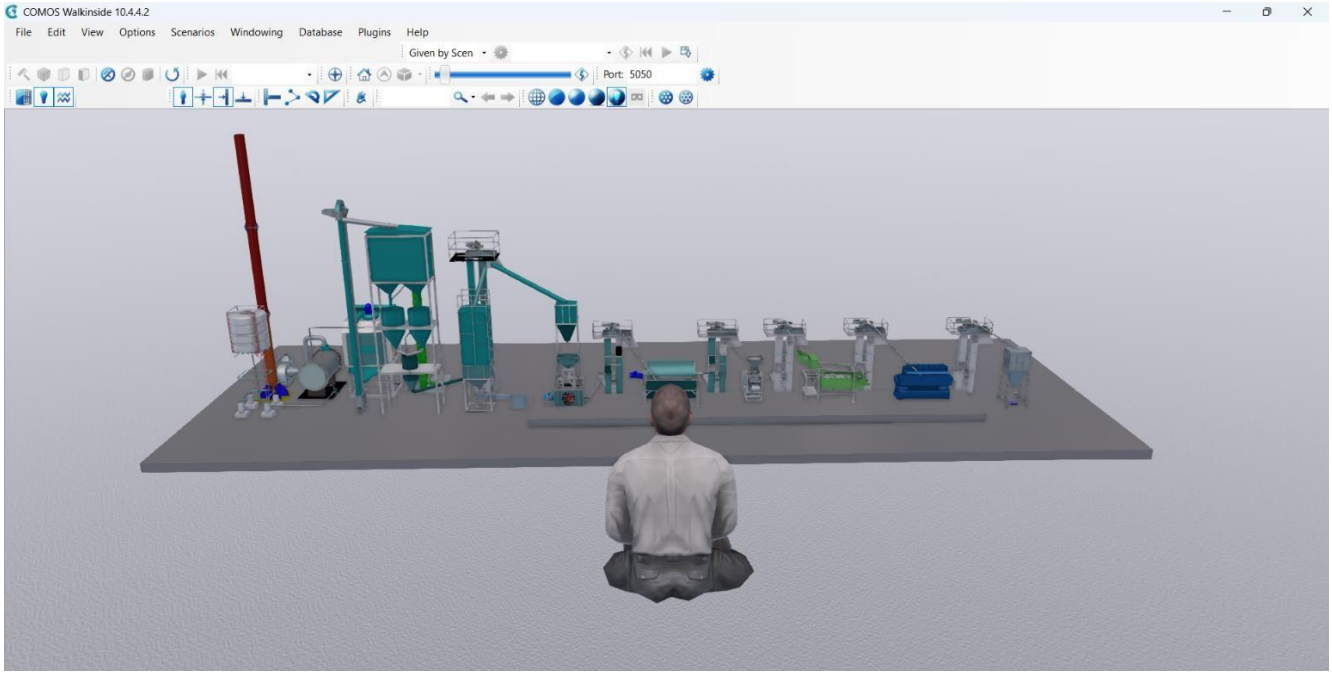
# 3D MODELING USING NX CAD/CAM:



# 3D VIEW USING COMOS WAKINSIDE:




COMOS Walkinside 10.4.4.2
File Edit View Options Scenarios Windowing Database Plugins Help
Given by Scen
Port: 5050


COMOS Walkinside 10.4.4.2
File Edit View Options Scenarios Windowing Database Plugins Help
Given by Scen
Port: 5050

IOT2050 Gateway Integration