16th STS-AIChE Southwest Process Technology Conference

- Regarding process automation modernizations with AI and real-time edge optimization

---

- Iiro Olavi Esko

- Siemens Industry, Inc.

REACH OUT FOR LINKS AND VIDEOS!

Sept 22-23, 2025, University of Houston

16th STS-AIChE Southwest Process Technology Conference

Speaker Bio:

Iiro is a chemical engineer with 15+ years of process industries experience with a focus on digitalization and the application of digital twins across chemical industry value chains.

He has spent the last six years working and studying in Houston, TX – graduating with a University of Houston MBA from C.T. Bauer College of Business class of 2025.

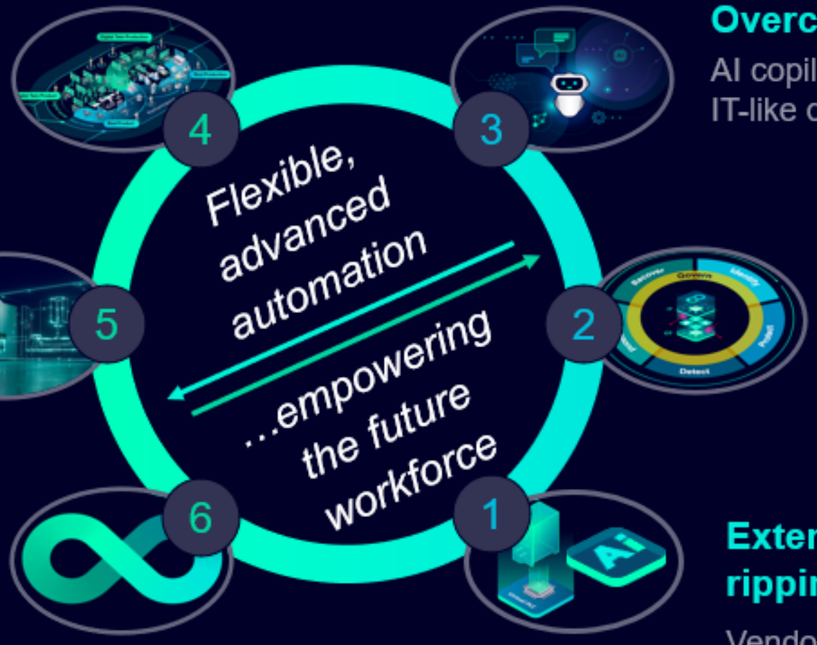
Before Texas, Iiro lived and worked a decade in Brazil. Originally from Finland, he holds a bachelor of engineering degree with a focus on pulp and paper technologies from his native country.

Sept 22-23, 2025, University of Houston

So, what are we talking about?

Become adaptive
Dynamic scheduling
Lot size one
Self organizing production workflows

Overcome the workforce gap
AI copilots
IT-like deployment paradigm



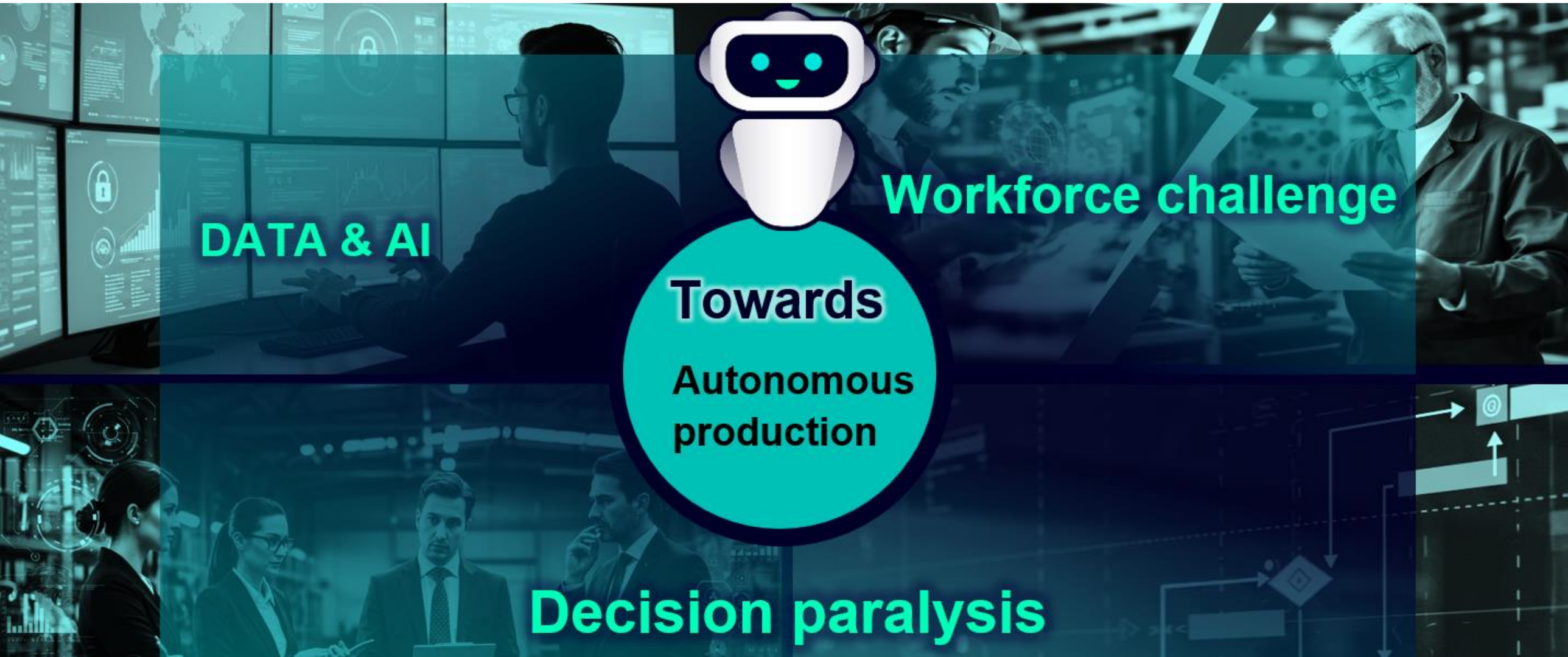
Validate virtually
Full fidelity physics
Full fidelity rendering
Integrated data from R&D through production

Secure the OT ecosystem
IT-like discovery and management of OT assets
Dynamic & adaptive cybersecurity paradigm

Engineer better and faster
DevOps for automation
AI copilots
Move the controller, not the code

Extend and scale automation w/o ripping and replacing
Vendor agnostic edge data collection
Contextualize and combine data sets
Run advanced apps to get more from existing OT

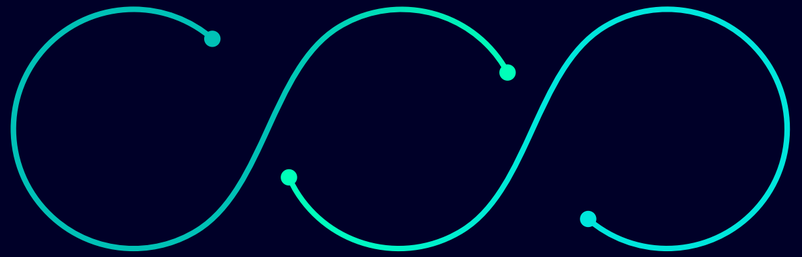
What's the backdrop today?



What is the angle of approach? And why?

IT layer
-Dashboarding, Engineering, Business Workflows

Industrial AI orchestration layer
-aggregation
-integration
-contextualization
-structuring



OT layer
-Process, SCADA, DCS, PLCs, BCS, EMS
-Machine vision, sound processing, edge GPU

AI?

Multiple AI Agents?

Operator Override?

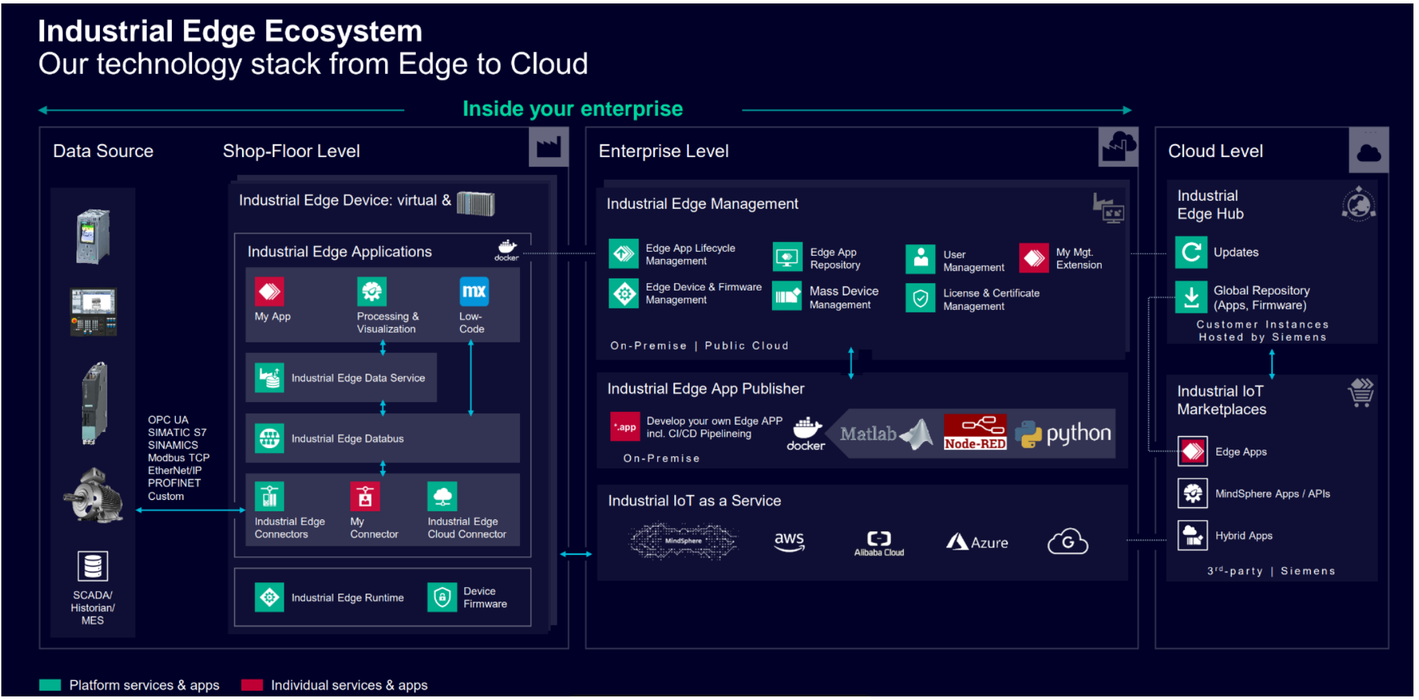
Machine Vision Processing?

Central Deployment & Programming?

Device, App, and/or Modelling Updates?

How to prove out new(er) technologies?

Regarding a technology stack bridging operations and analytics



Docker containers

Linux machines*

Hardened platform – standard IT user deletion

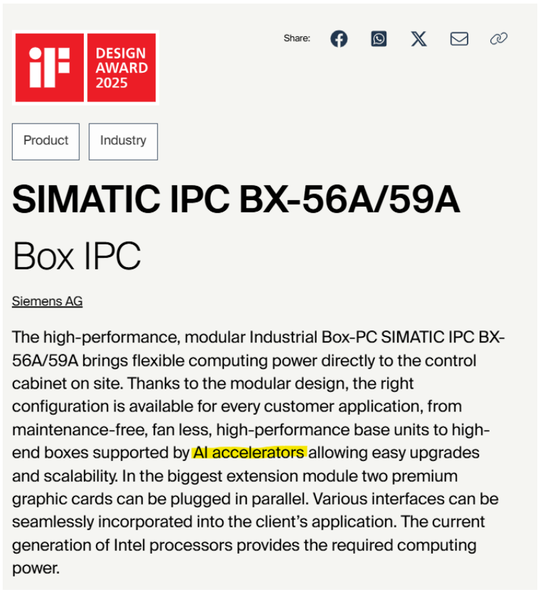
Extends across the enterprise, divisions, and plant sites

Running locally on OT – Think Autopilot and Full Self-Driving

Industrial Edge Management is done in a centralized way

Think 3 or 4 people in the admin team for 10k edge devices

*What's not on Linux machines: Stuxnet, Colonial Pipeline, Equifax, NotPetya, WannaCry



Comparison around edge and traditional on-premise

Edge computing enables **modular, cloud-like control** of local resources using **containers** and **orchestration platforms**, while traditional systems rely on **manual management** of VMs or hardware. This shift supports **real-time analytics**, **AI deployment**, and **Unified Namespace architectures**

Feature	**Edge Computing**	**Traditional On-Premise**
Management	Centralized, cloud-like	Manual, device-by-device
Scalability	Dynamic, app-based	Static, hardware-bound
Updates	Remote, automated	Local, manual
Integration	API-driven, containerized	Often custom or vendor-specific
Delivery Method	Containers/Helm Charts	Virtual Machines/Physical Machines

OCI = Open Container Initiative

What is MQTT? Why is this ‘trendy’ today in OT?

MQTT (Message Queuing Telemetry Transport) is a lightweight, publish/subscribe messaging protocol designed for low-bandwidth, high-latency, or unreliable networks.

Key Features:
Developed by IBM and Arlen Nipper in 1999 for oil pipeline telemetry.
Open standard (OASIS) since 2014.
Popular for industrial IoT and edge computing.

Why It Matters for OT:
Simple to implement.
Pretty Trendy Right Now.
Minimal resource usage (such as network resources).
Insanely Scalable.
Time to Value.

MQTT

For reference: Compare to Zenoh (gaming, autonomous vehicles pub/sub), Ethernet/IP, OPC UA (manufacturing)

16th STS-AIChE Southwest Process Technology Conference

Sept 22-23, 2025, University of Houston

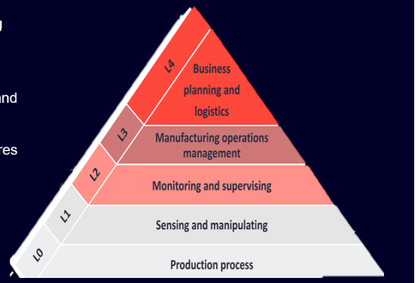
Let’s not get into too much detail… I’d rather pull in an expert off-line

What is ISA-95

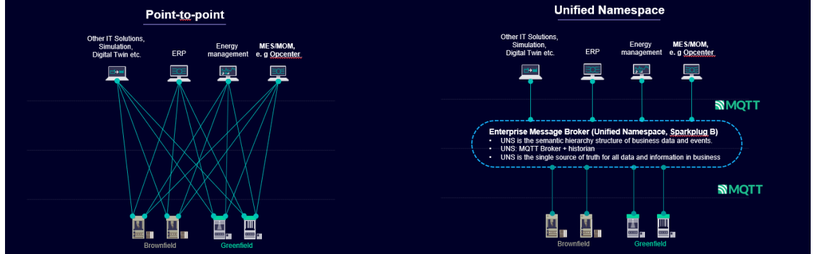
Definition:
ISA-95 (also known as ANSI/ISA-95 or IEC 62264) is an international standard for **integrating enterprise systems (ERP)** with **manufacturing control systems (MES, SCADA, PLCs)**.

Purpose:
Define a common language between business and production systems
Reduce integration cost, risk, and complexity
Enable scalable, modular automation architectures

Scope:
Applies to discrete, batch, and continuous manufacturing
Used across industries including pharma, automotive, and food & beverage.



Unified Namespace (UNS) is a naming convention and architecture that enables a single source of truth for all data (generally) based on MQTT



- Unified Namespace data architecture concept integrates different data sources and systems across an organization into a single, cohesive framework, enabling IT and OT data exchange and interoperability.
- It orchestrates the data exchange, creating a unified dataset that simplifies complex infrastructures and enhances data accessibility for advanced technologies like AI etc.

What is MQTT Sparkplug B?

Sparkplug B is an open-source **MQTT-based messaging protocol** designed specifically for industrial automation. It standardizes how devices and applications **publish and subscribe** to data in a **Unified Namespace (UNS)**.

Key Features
- **Stateful Messaging**: Tracks device connection status and data freshness.
- **Payload Standardization**: Uses a consistent format for tags, metrics, and metadata.
- **Birth/Death Certificates**: Devices send a “birth” message when they connect and a “death” message when they disconnect.
- **Edge-Driven Architecture**: Devices push data directly to the broker—no polling required.

Why It Matters for OT
- Enables **plug-and-play interoperability** between PLCs, SCADA, MES, and cloud systems.
- Reduces integration complexity by enforcing a **common data model**.
- Ideal for **real-time monitoring**, **alarm handling**, and **analytics** in distributed environments.

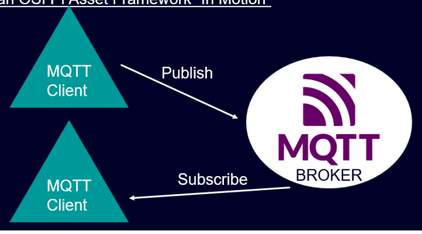
Common Stack
- **MQTT Broker** (e.g., HiveMQ, EMQX)
- **Sparkplug B Clients** (e.g., PLCs, Edge Gateways, SCADA)
- **Unified Namespace** for organizing topics like Site/Area/Line/Device/Metric

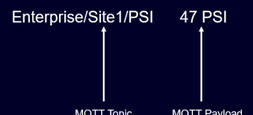
Sparkplug™
MQTT Topic & Payload Definition

What Is In a Unified Namespace?

Core Elements:
MQTT Broker (e.g., HiveMQ, EMQX): Central message hub
Topic Tree: Hierarchical structure for organizing data
Edge Devices: Publish machine data (e.g., via Industrial Edge)
Consumers: MES, ERP, SCADA, dashboards, AI agents

Think of it as an OSI PI Asset Framework “In Motion”



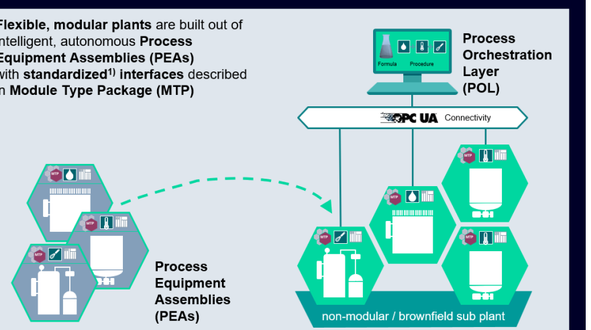


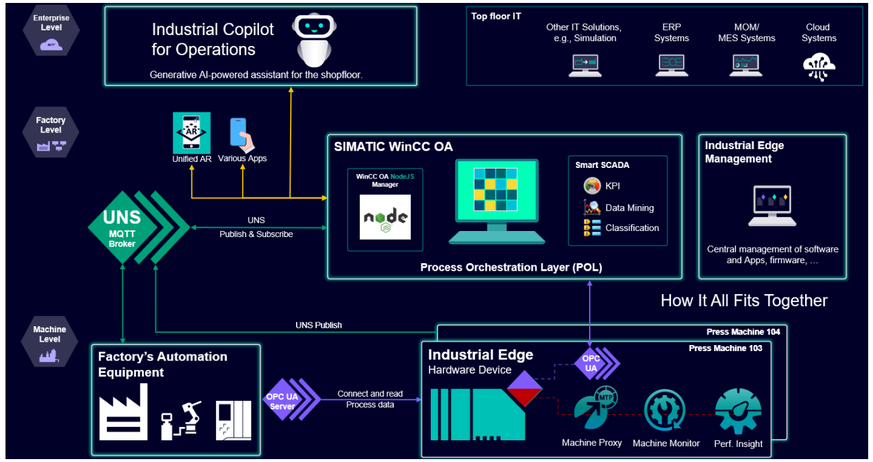
MTP as driver for **flexible production** and **package unit integration**
Core concepts: Standardized interfaces and application-level description

Module Type Package (MTP)

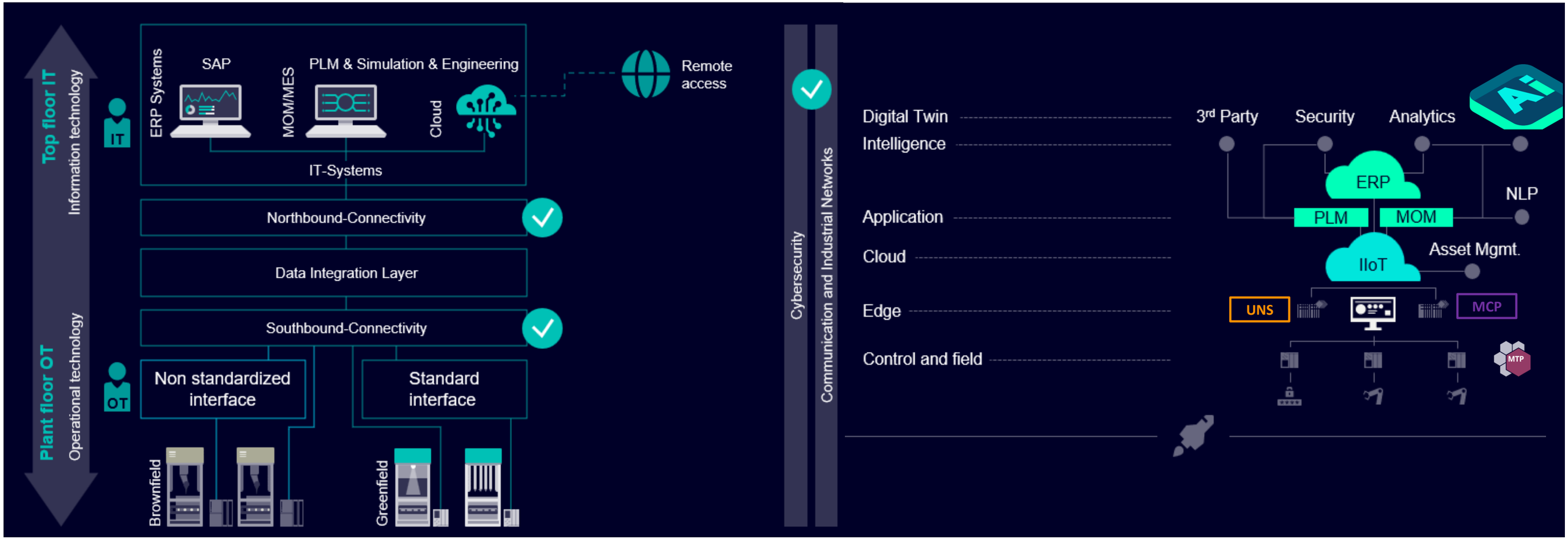
MTP is a standardized, non-proprietary, vendor neutral application-level description of autonomous equipment assemblies

Flexible, modular plants are built out of intelligent, autonomous **Process Equipment Assemblies (PEAs)** with **standardized[1] interfaces** described in **Module Type Package (MTP)**





Regarding a more modern architecture (+UNS, MQTT, MTP, OPC UA, MCP)

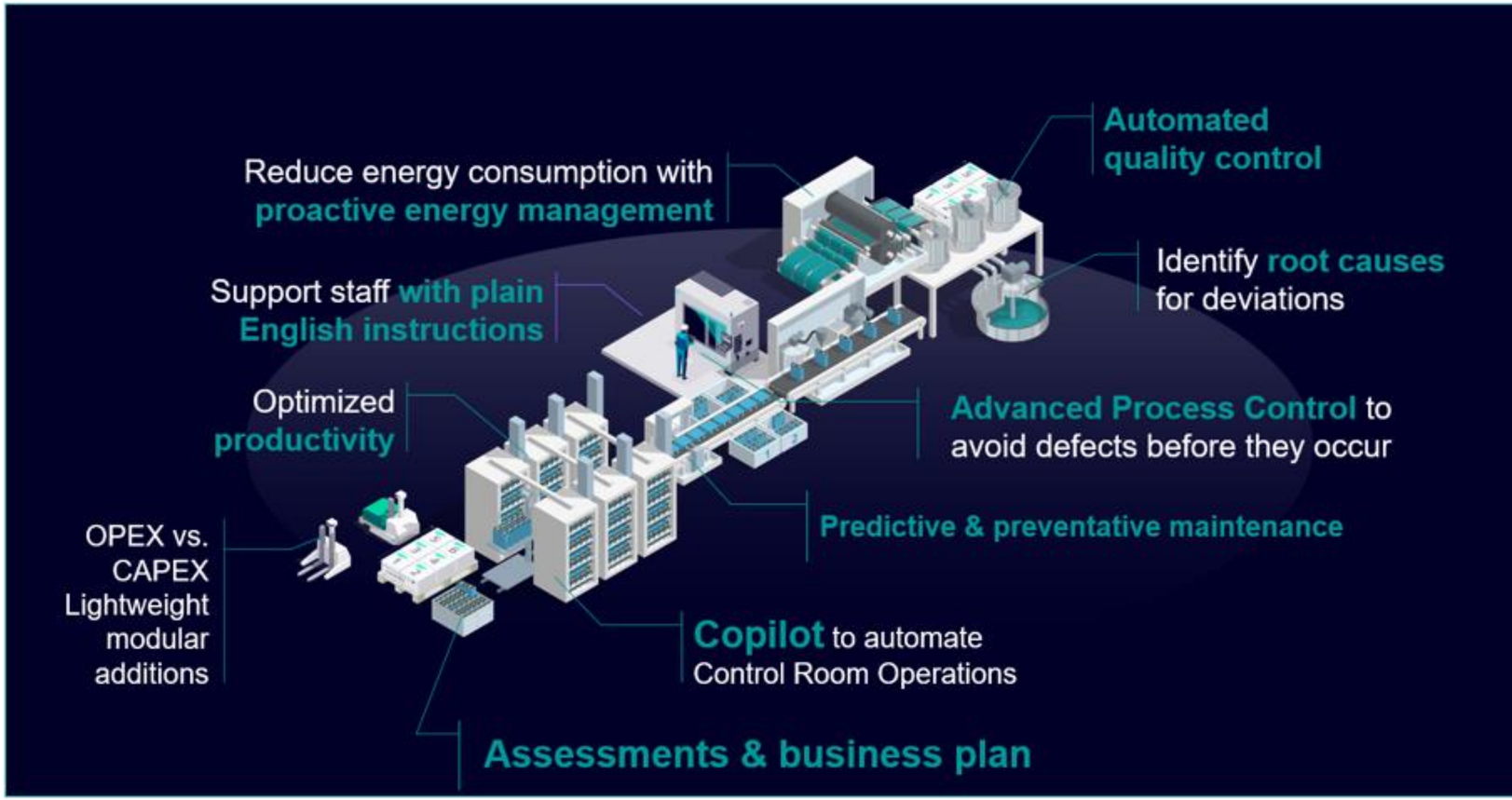


*MCP = Model Context Protocol

A couple of examples

What to deploy:

- Data connectors
- Virtual software controllers de-coupled from PLC hardware
- Physics-based executable digital twins (BASF on next slide)
- AI machine vision solutions
- Full closed-loop control
- Front-line worker support
- Solutions to unsolved problems
- AI Copilots for OT environments

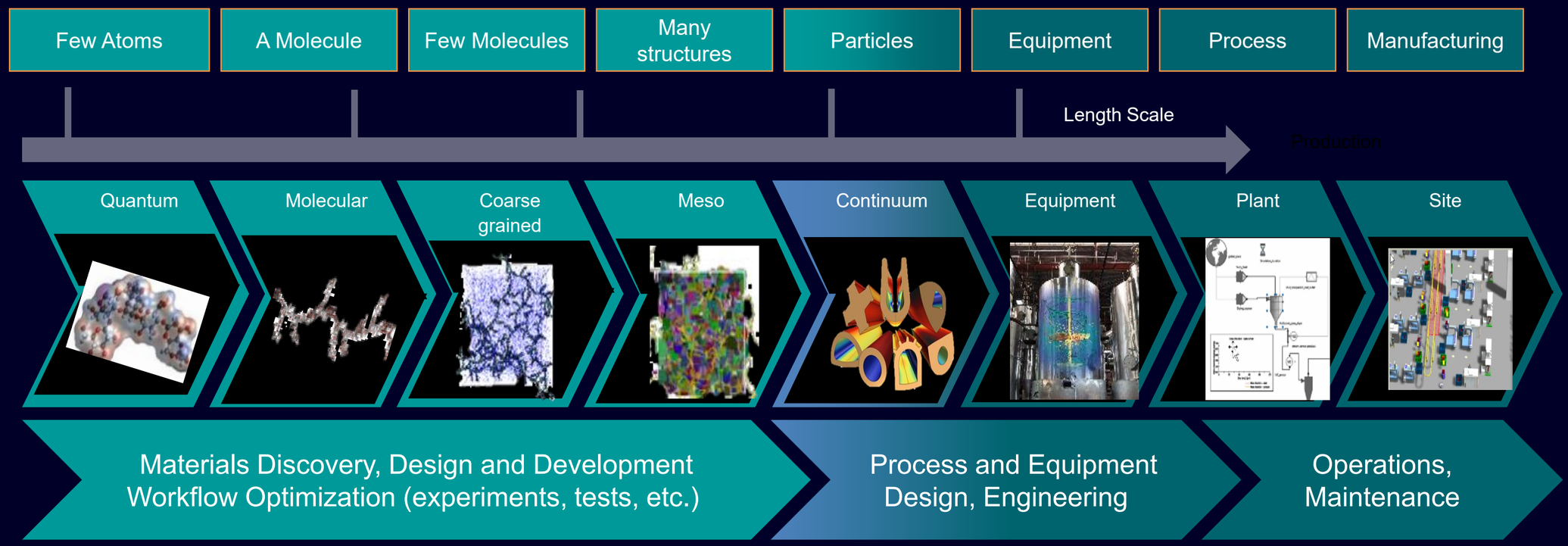


16th STS-AIChE Southwest Process Technology Conference

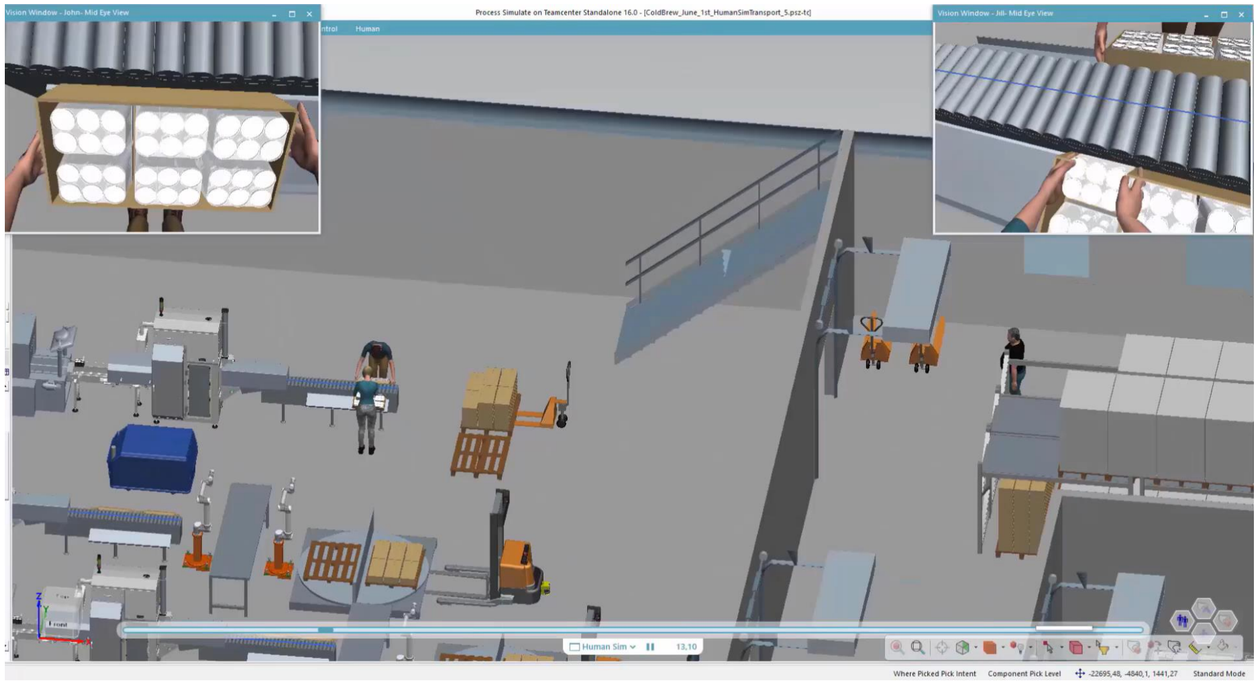
Sept 22-23, 2025, University of Houston

Organized by the South Texas Section of AIChE®

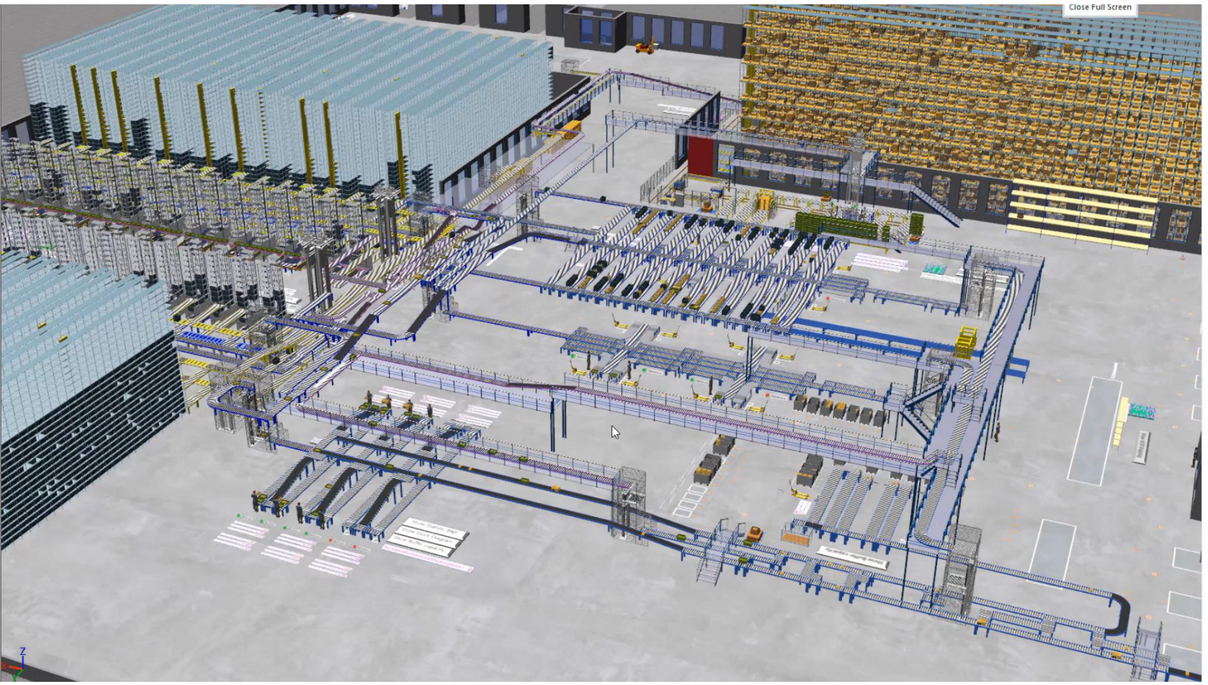
Regarding scale



Keep it simple and understandable



Some more visuals and videos

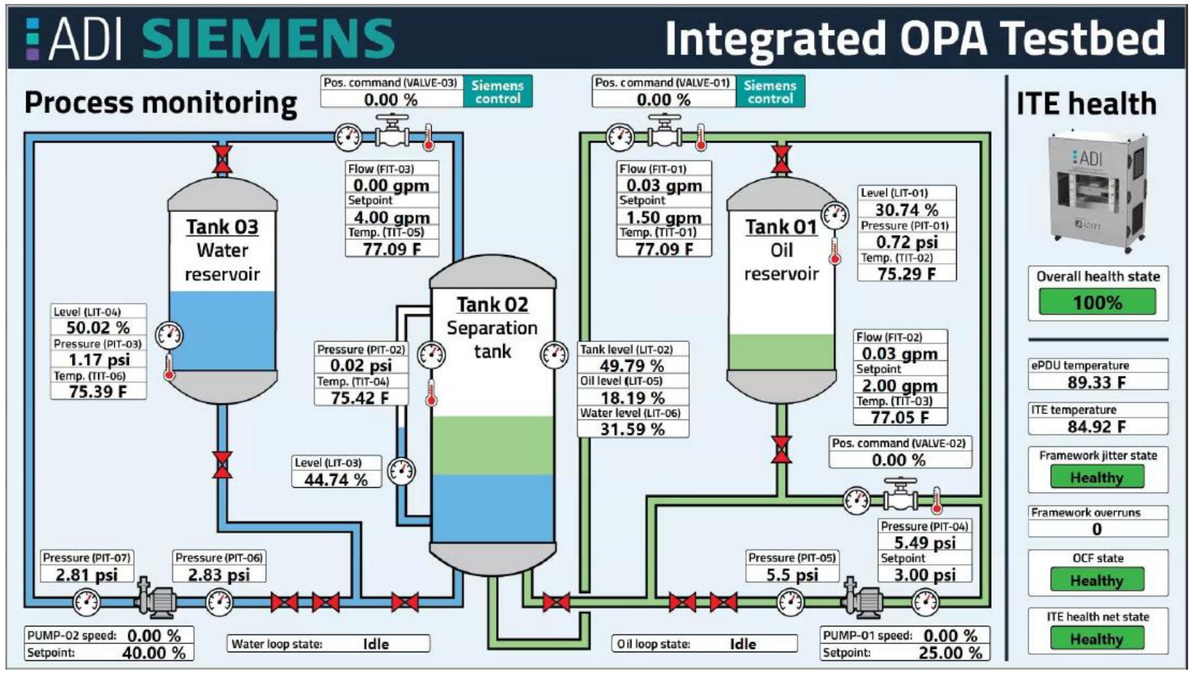


Regarding Open Process Automation DCS testbed @ MxD, Chicago, IL

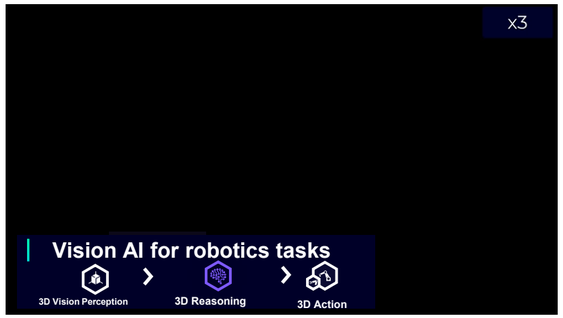
Use Cases:

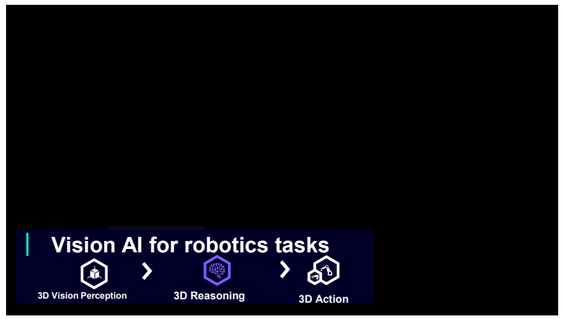
- OPA-F Testbed
- Process Monitoring
- Communication Monitoring
- Anomaly Detection
- Fault Prediction
- MTP, OPC UA, POL

Process Monitoring



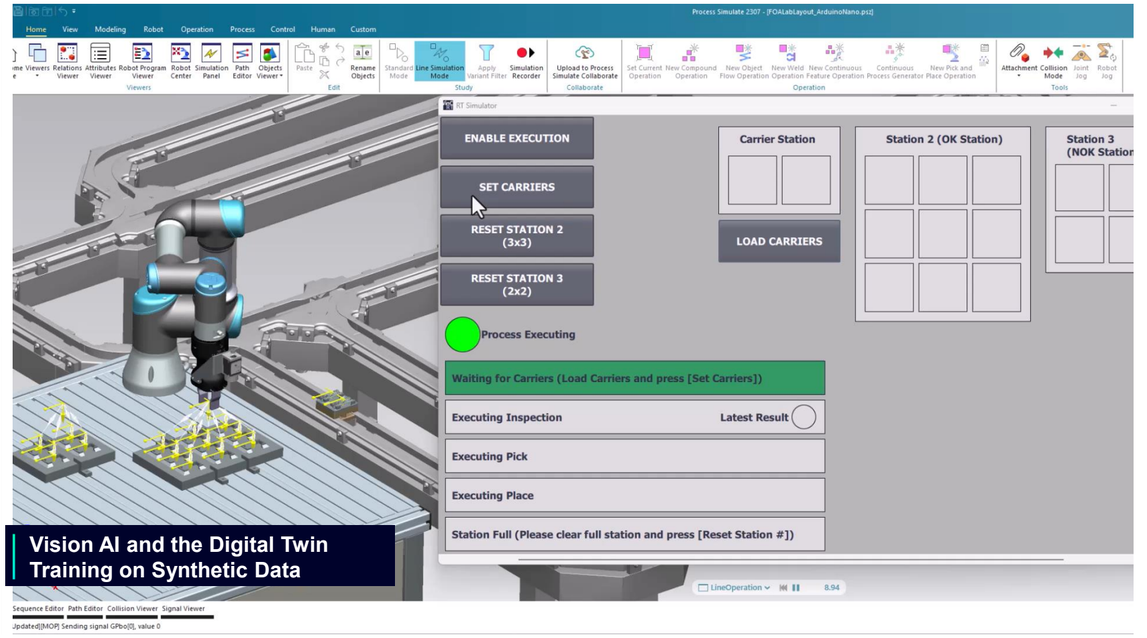
Machine vision & synthetic data examples





Where to deploy:

- Process-level
- Plant-level
- Asset-level

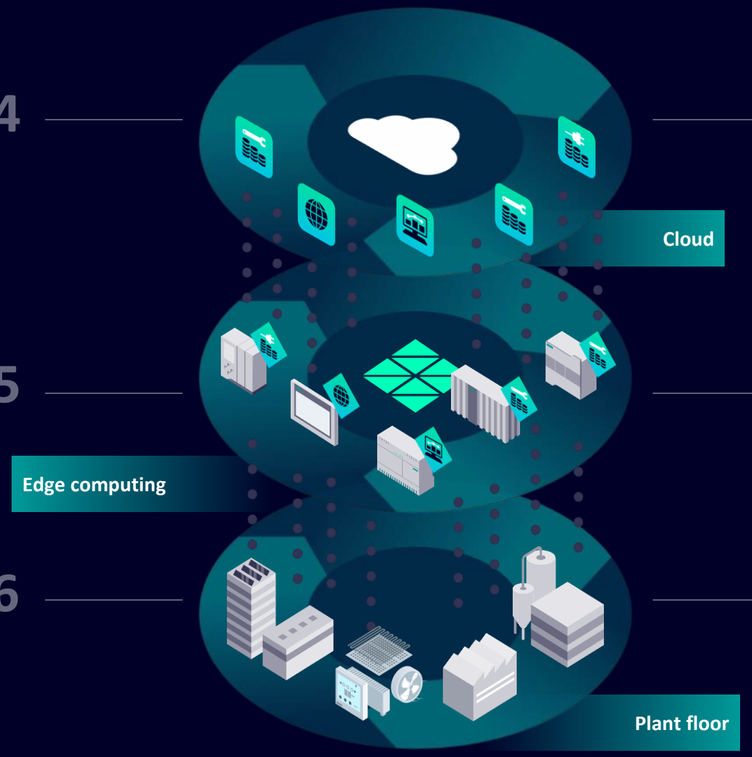


Moving on to cybersecurity considerations

04 Adapt your production to your batches

05 Ideate & implement faster, establish trust

06 Efficiently deploy, manage & test the identical asset

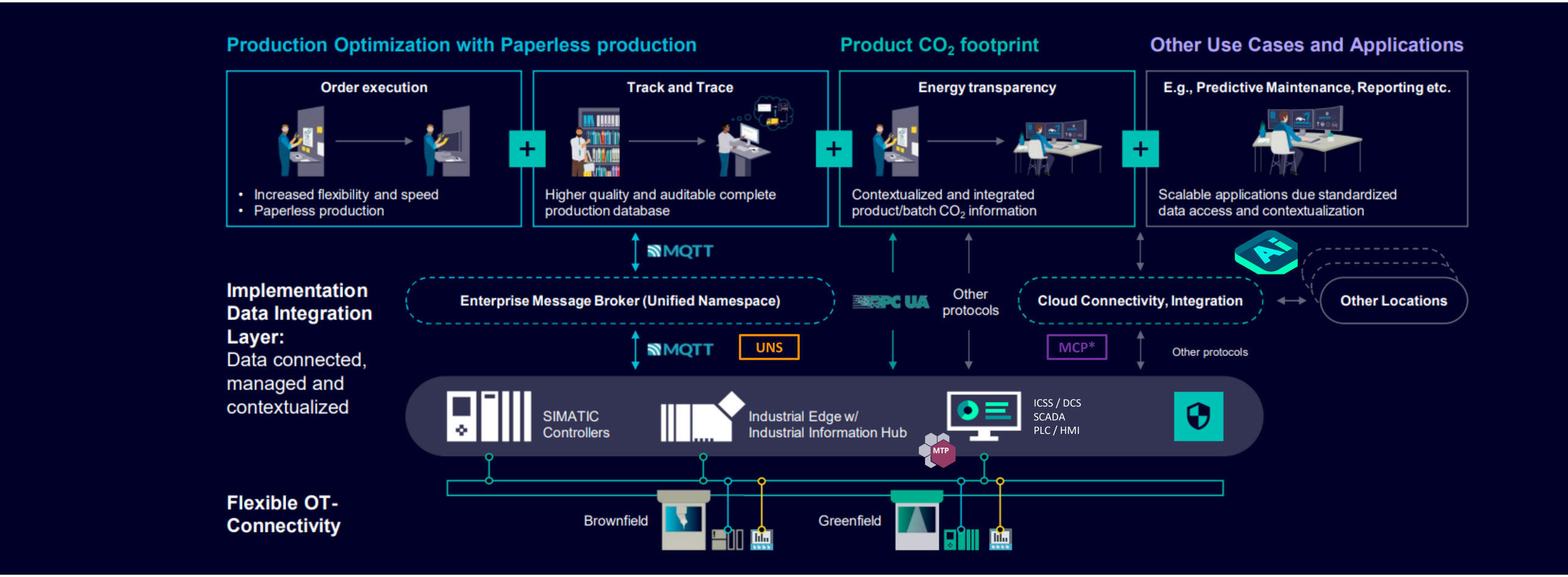


03 Drive resource efficiency in operations

02 Take control of & secure your assets

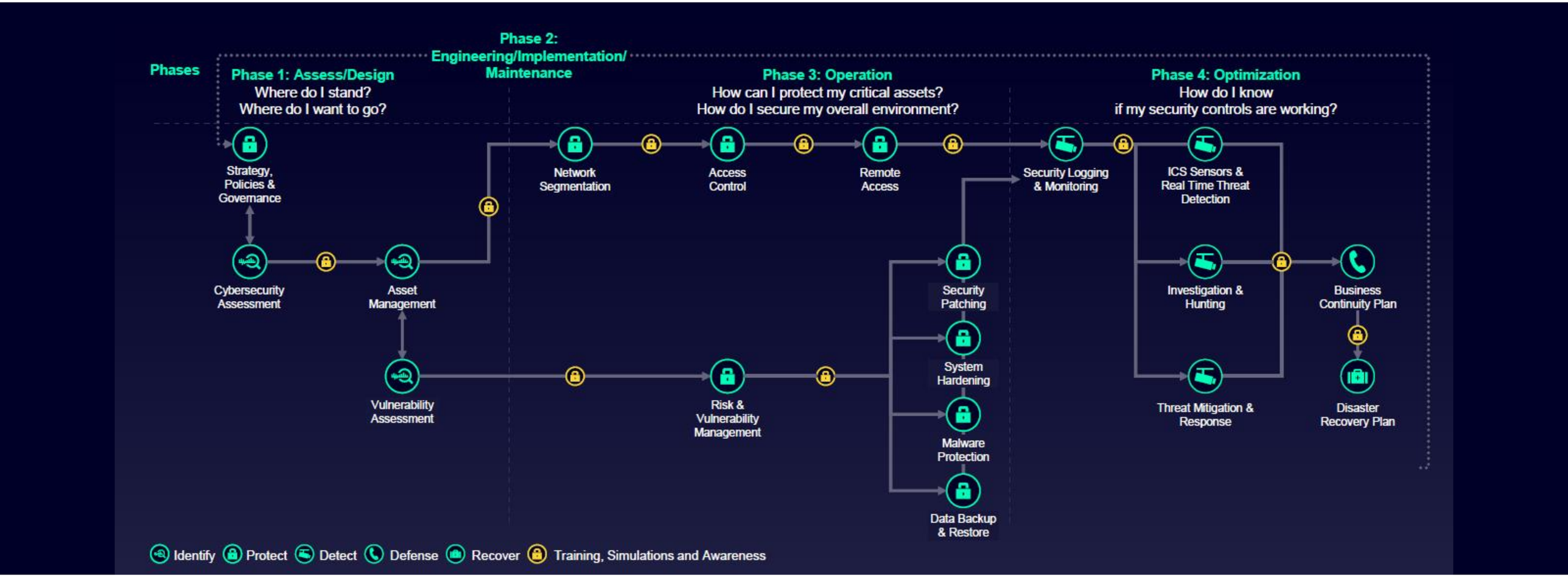
01 Make your Brownfield adaptive while ensuring robustness

Matching use cases with adequate security measures

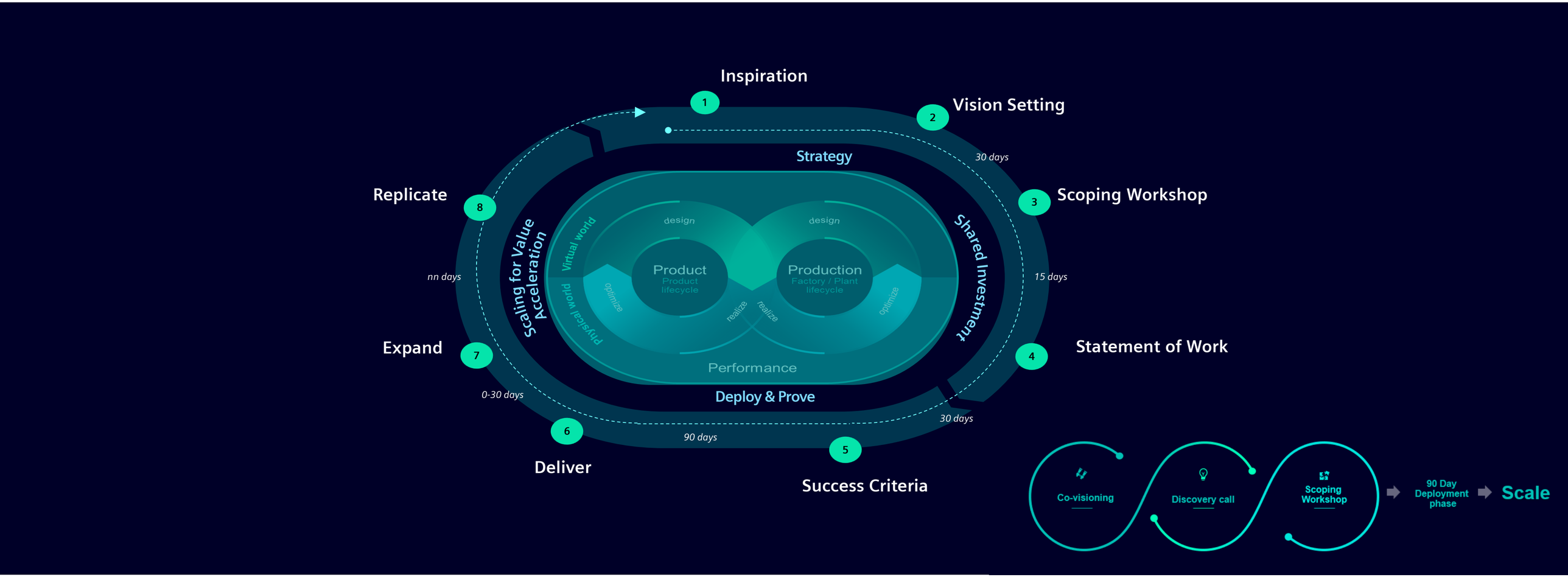


*MCP = Model Context Protocol

Holistic cybersecurity approach example



Racetrack approach and continuous improvement



16th STS-AIChE Southwest Process Technology Conference

Sept 22-23, 2025, University of Houston

REACH OUT FOR LINKS AND VIDEOS!

Thank you, contact, Q&A

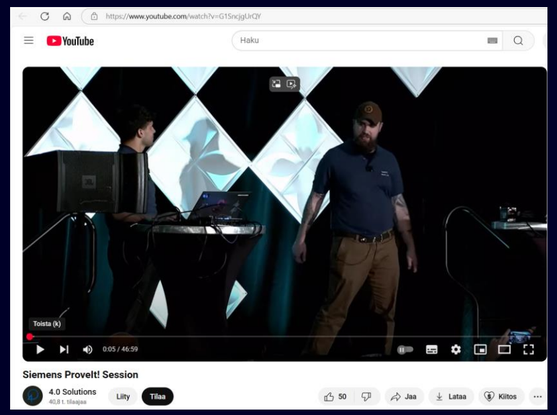
https://www.linkedin.com/in/iiro-esko-mba

Q&A

Thank You!

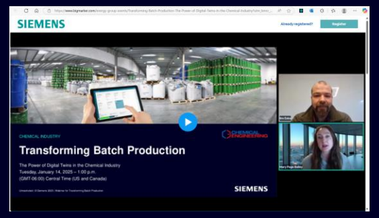
- Iiro Olavi Esko
- iiro.esko@siemens.com
- (281) 640-4039

Hear what is being done with Edge, UNS, MQTT*, IIoT



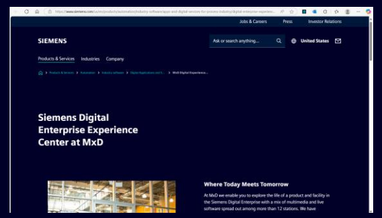
Siemens Chief Key Expert at Siemens ProveIt! Session - YouTube

Learn Enterprise Recipe Management



Siemens at Chemical Engineering webinar

See these technologies in action in Chicago:



Siemens at Manufacturing USA Innovation Center MxD

Siemens and OPA https://www.mxdusa.org/projects/23-02-01/

*with Walker Reynolds