

Smart Plant Automation Modernization – Improving Operations and Maintenance for Reduced Cost

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Smart Plant

SAFER

**SUSTAIN
ABLE**

**LESS
MAINTENANCE**

**LESS
MANUAL**

Plant Modernization and Operations Transformation

Add Missing Automation: 'Digital' Transformation

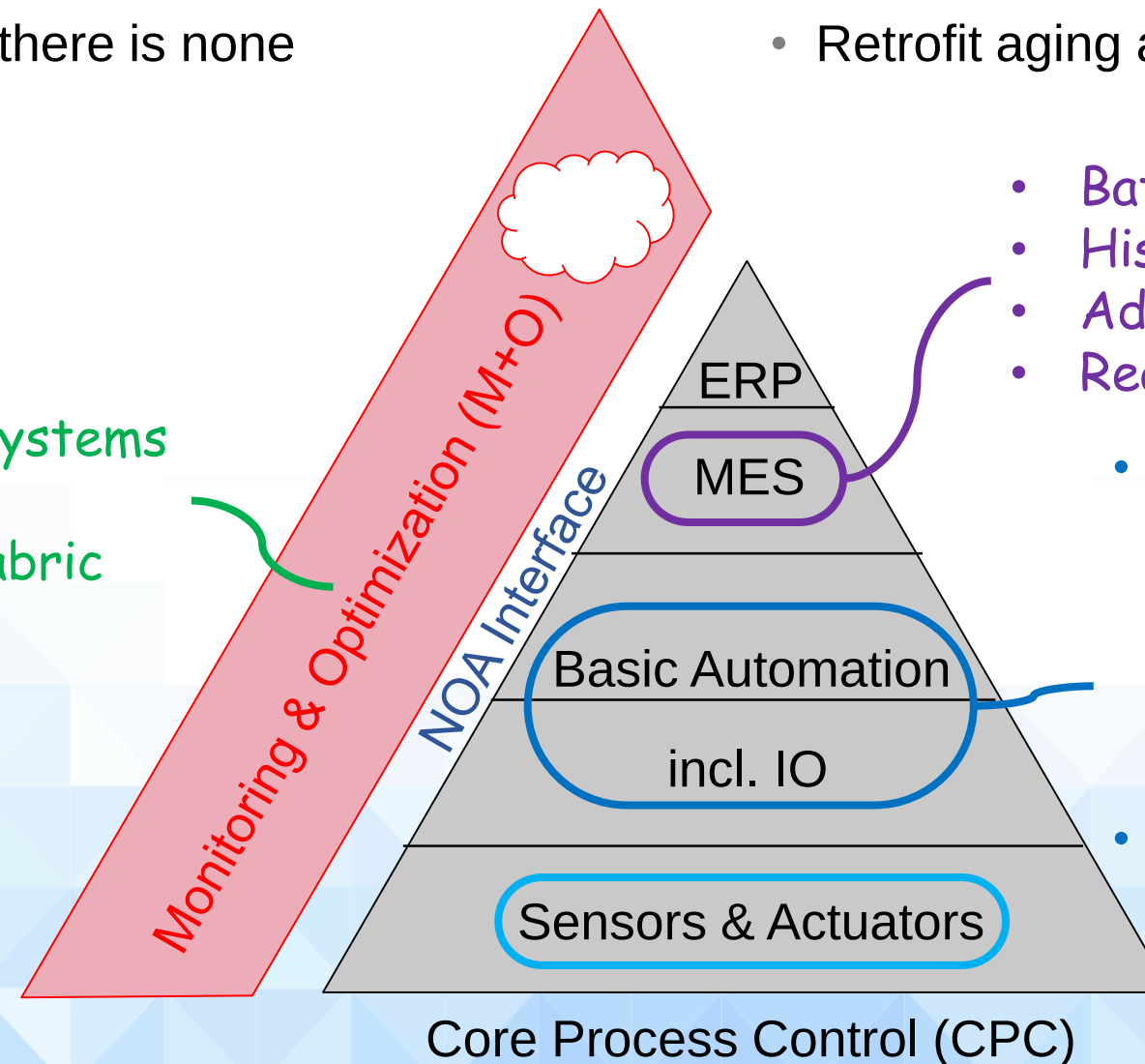
- Deploy automation where there is none

Asset Performance Management (APM) systems

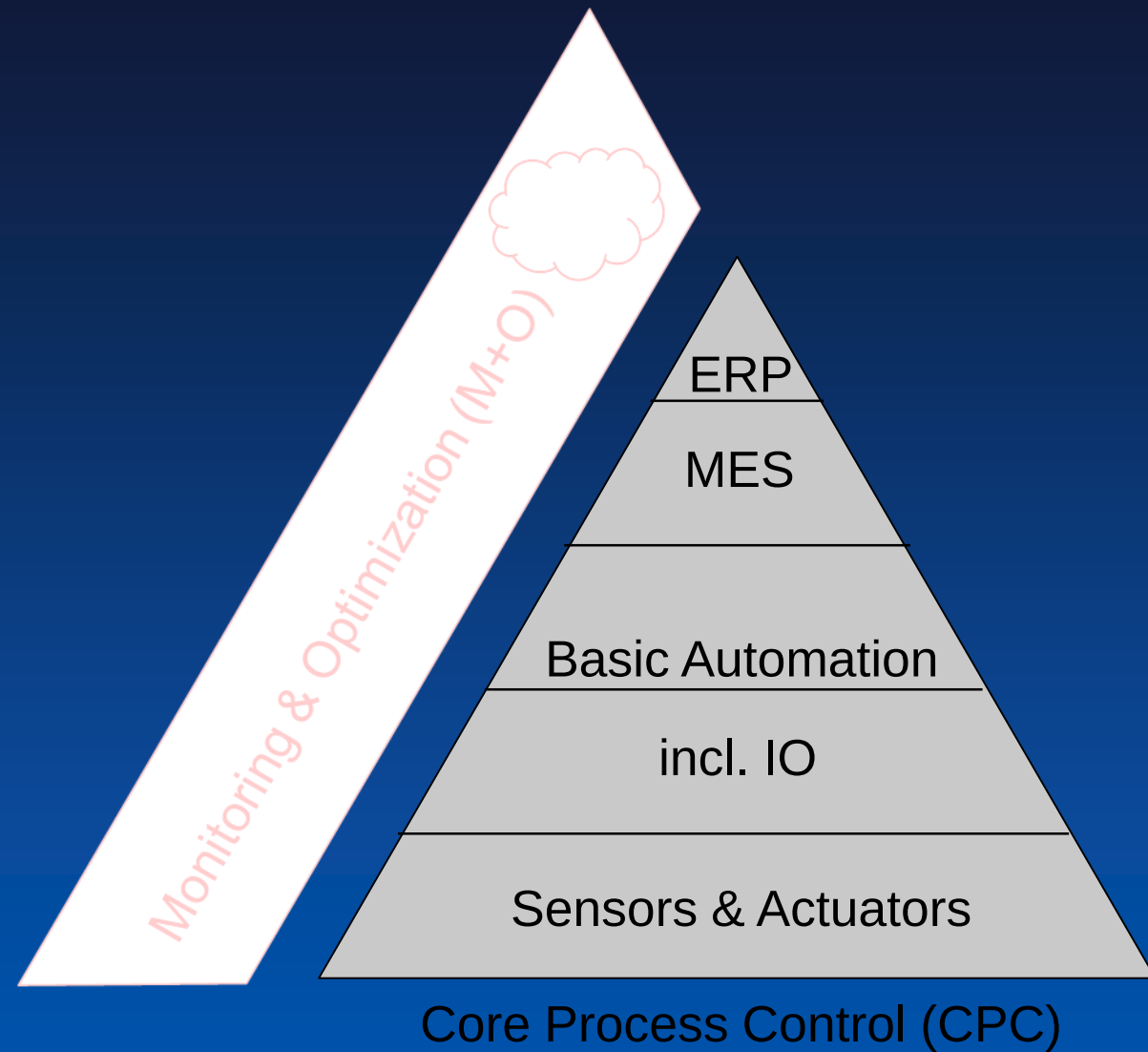
- Sensors
- Industrial Data Fabric
- Industrial AI

Retrofit Aging Automation: Smart Plant Automation Modernization

- Retrofit aging automation



- Batch
- Historian
- Advanced Process Control (APC)
- Real Time Optimization (RTO)
- Integrated control and safety system (ICSS):
 - Distributed Control System (DCS)
 - Safety Instrumented System (SIS)
- Machinery protection system (MPS)



Smart Plant Automation Modernization

- Retrofitting aging automation



Legacy Automation – Manual Intervention and Limits Operations

MECHANICAL



ANALOG



HAND-OPERATED



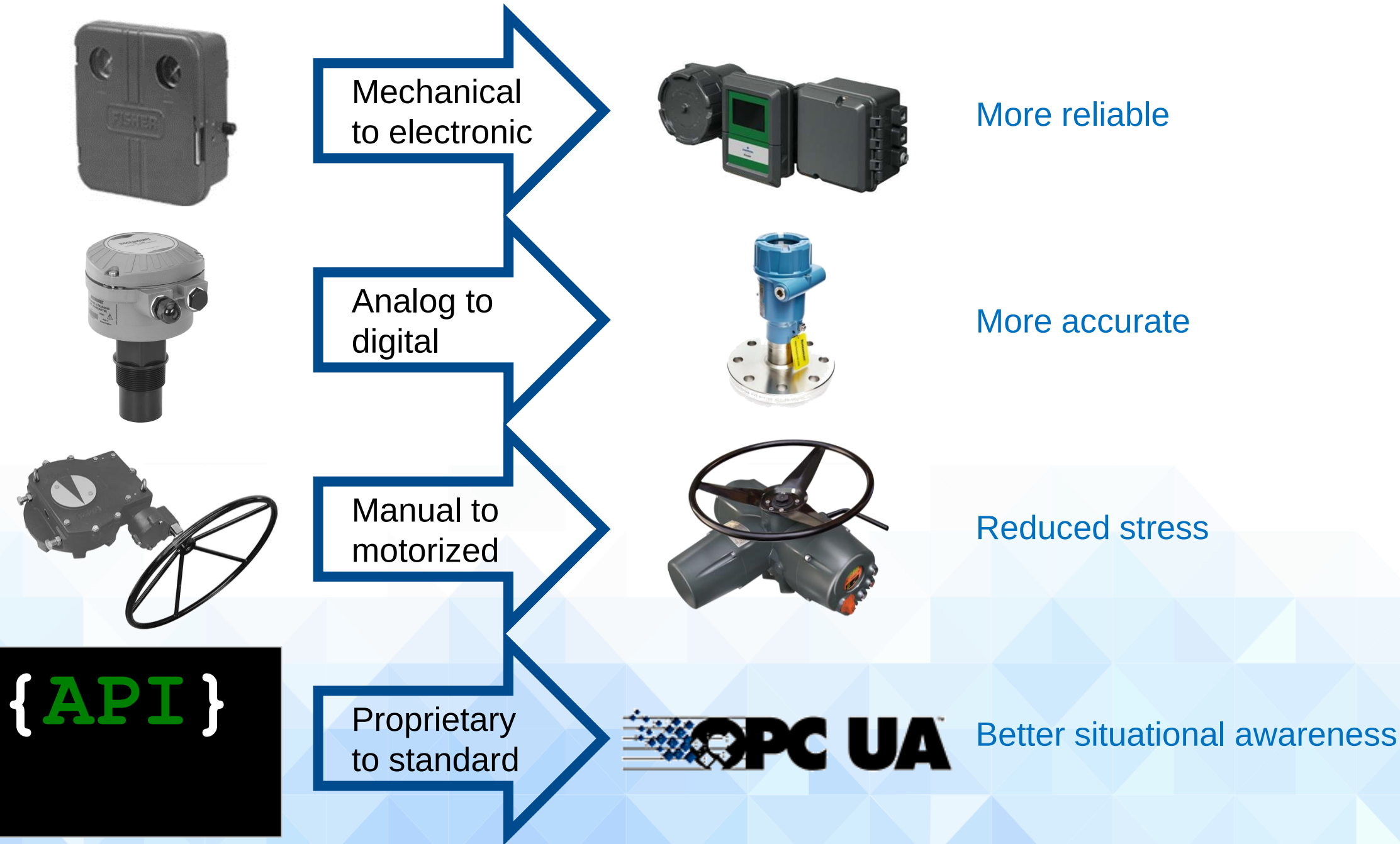
PROPRIETARY



- Manual data transfer and workflows
- Go to field to check, test, and operate
- Operate loops in manual
- Pull instruments and valves

Poor Plant Performance and Manual Intervention

Smart Plant Automation Modernization – You Can’t Replace Failed Components with The Same Model



End-to-End Control Loop Modernization



Measurement

- Analog temperature 'pucks'
- Displacer density
- Direct temperature sensors
- Analog displacer interface level
- DP flow meters
- Float level switches
- Flow registers
- Lab chromatography
- Analog pH electrodes
- Pressure switches
- [Remote seals](#)
- Servo level gauges
- Float & tape level gauges
- Turbine flow meters
- PD flow meters
- [Ultrasonic level](#)
- [DP level](#)
- Lab viscosity

Control

- [PLC](#)
- HMI/SCADA
- Heritage DCS

Actuation

- Pneumatic controllers
- Manual valves (small w handle)
- [Manual valves \(large w hand-operator\)](#)
- Hardwired MOVs
- Proprietary protocol MOVs
- [Analog electro-pneumatic positioners](#)
- Valves without noise attenuation
- Analog position sensors
- 'Dumb' ESD valves
- Natural gas actuated valves

Optimization

- [Basic PID control](#)
- [Historian](#)
- Manually supervised APC

SEE

DECIDE

ACT

OPTIMIZE

Challenge: Process Level Transmitter Inaccuracy and Non-compliance

Challenge	Solution	Result
■ Ultrasonic level: – Affected by temperature and pressure – Sensitive to foam, turbulence, wind – Dust/dirt build-up spiderweb ■ DP level – Affected by changes in density and temperature – Build-up – Ambient effect on impulse lines and capillaries – Challenging calibration – Empty tank to service ■ Operators set setpoints with 'comfort margins' to not cross limits – Quality giveaway – High energy consumption	• Non-contacting 26 GHz or 80 GHz FMCW radar • Overfill prevention • Liquids or solids • Independent of ambient conditions • Higher accuracy • Low failure rate and high diagnostic coverage • Proof test 	✓ Reduced production cost ✓ Greater sustainability ✓ Greater safety (SIL) No wiring change

Challenge: Pressure Transmitter (Remote Seal) Inaccuracy and Non-compliance

Challenge	Solution	Result
- Remote seal capillaries - Temperature drift - Heat tracing or insulation may be required - Slow response time - Capillaries hard to install - Right length capillary required - Easily damaged - Challenging calibration - Operators set setpoints with 'comfort margins' to not cross limits - Quality giveaway <i>Exception: for small spans DP transmitter with remote seals is still the better option.</i>	- Electronic Remote Sensors (ERS) system - Cable instead of capillary - Cut to length - Digital - Higher accuracy - No heat tracing or insulation required - Easy installation - Easy handling - Easy maintenance - Low failure rate and high diagnostic coverage 	✓ Reduced production cost ✓ Greater sustainability ✓ Greater safety (SIL) ✓ Faster response time No wiring change

Challenge: PLC Operations Limitations

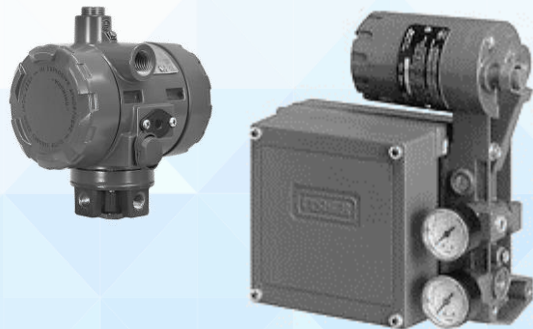
PLC Limitation	Operations Challenge	DCS Solution	Operations Result
Singly IO cards	Production downtime	IO card redundancy	Reduced downtime
Ring topology network		Parallel redundancy network	Reduced downtime
Ladder and text code	No continuous improvement	Function block and SFC	Continuous improvement
Single controller cycle	Process variability	Individually set loop cycle	Reduced off-spec product
No peer-to-peer comms		Peer-to-peer communication	
No online code changes	No continuous improvement	Online configuration change	Continuous improvement (Quality, sustainability, throughput, agility...)
No online download		Online download	
Multiple databases		System-wide database	
No HART pass-through IO	Undetected device failures	HART pass-through IO	Reduced downtime
No online firmware updates	Cybersecurity risk	Online firmware updates	Greater cybersecurity
No network security		Edge gateway environment	
Multiple diagnostics apps	Slow troubleshooting	System-wide diagnostics	Reduced downtime
No recipe management	Hard to create new recipes	Native recipe management	Time to market
No campaign management	Hard to manage campaigns	Campaign management	Faster batch switching
No alarm management	Alarm flooding	Alarm management	Greater safety
No APC	Process variability	Advanced Process Control	Reduced off-spec product
No OTS	Deskilling	Operator Training Simulator	Greater safety

- Multiple disconnected PLC packages added over the years – migrate into single DCS
- Heritage DCS have some of the same issues



Challenge: Control Valve Positioner Failure

Challenge	Solution	Result
▪ Mechanical position feedback linkage ▪ I/P converters ▪ Production downtime ▪ High maintenance cost	• No moving parts • Non-contact position sensor • Advanced valve diagnostics – Accessible locally	✓ Greater reliability ✓ Reduced production downtime ✓ Reduced maintenance cost



No wiring
change

Challenge: Hand-Operated Valves

Challenge

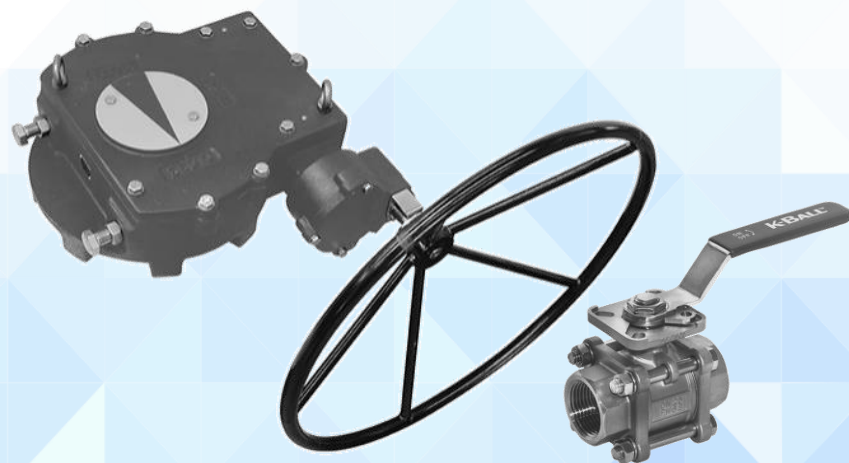
- Cannot control from operator console
- Must dispatch person to the field
- High stress and workload
- Especially in bad weather
- High levels of stress lead to errors
- Acceptable in the past, not anymore

Solution

- Valve remote control
- Valve actuator
- Operated directly from the operator console
- Shared digital networking of multiple valves

Result

- ✓ Reduced workload and stress
 - Fewer mistakes
- ✓ Reduced off-spec product



Requires
control signal
wiring and
pneumatic /
electric supply

Challenge: Multiple Interacting Loops, Multiple Constraints, and Difficult Process Dynamics

Challenge

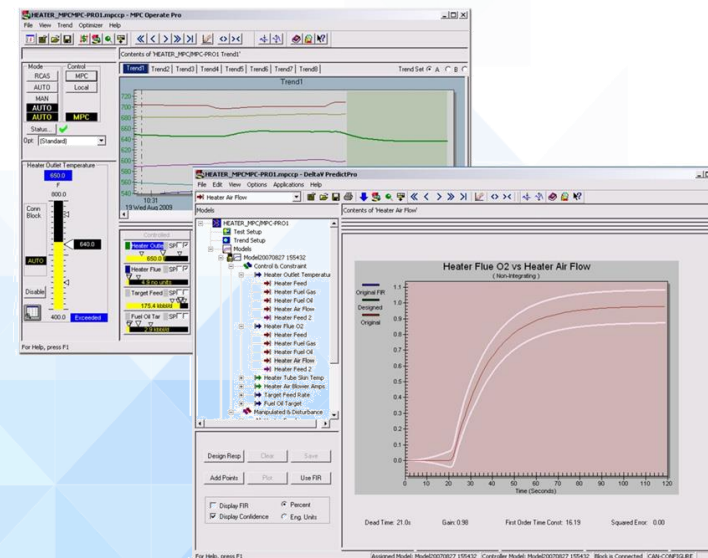
- Simple PID does not handle multiple interacting loops, multiple constraints, and difficult process dynamics
 - Long deadtime
 - Long time constants
 - Inverse response
- Operators must make manual make PID setpoint adjustments
 - Operator stress, mistakes
 - Off-spec product
 - High energy consumption
 - Low throughput
- Example:
 - Combustion

Solution

- DCS with Advanced Process Control (APC) Model Predictive Control (MPC) software based or dynamic matrix control (DMC)
- Multiple inputs, outputs, and constraints
- Reduced process variability
- Stay within constraints

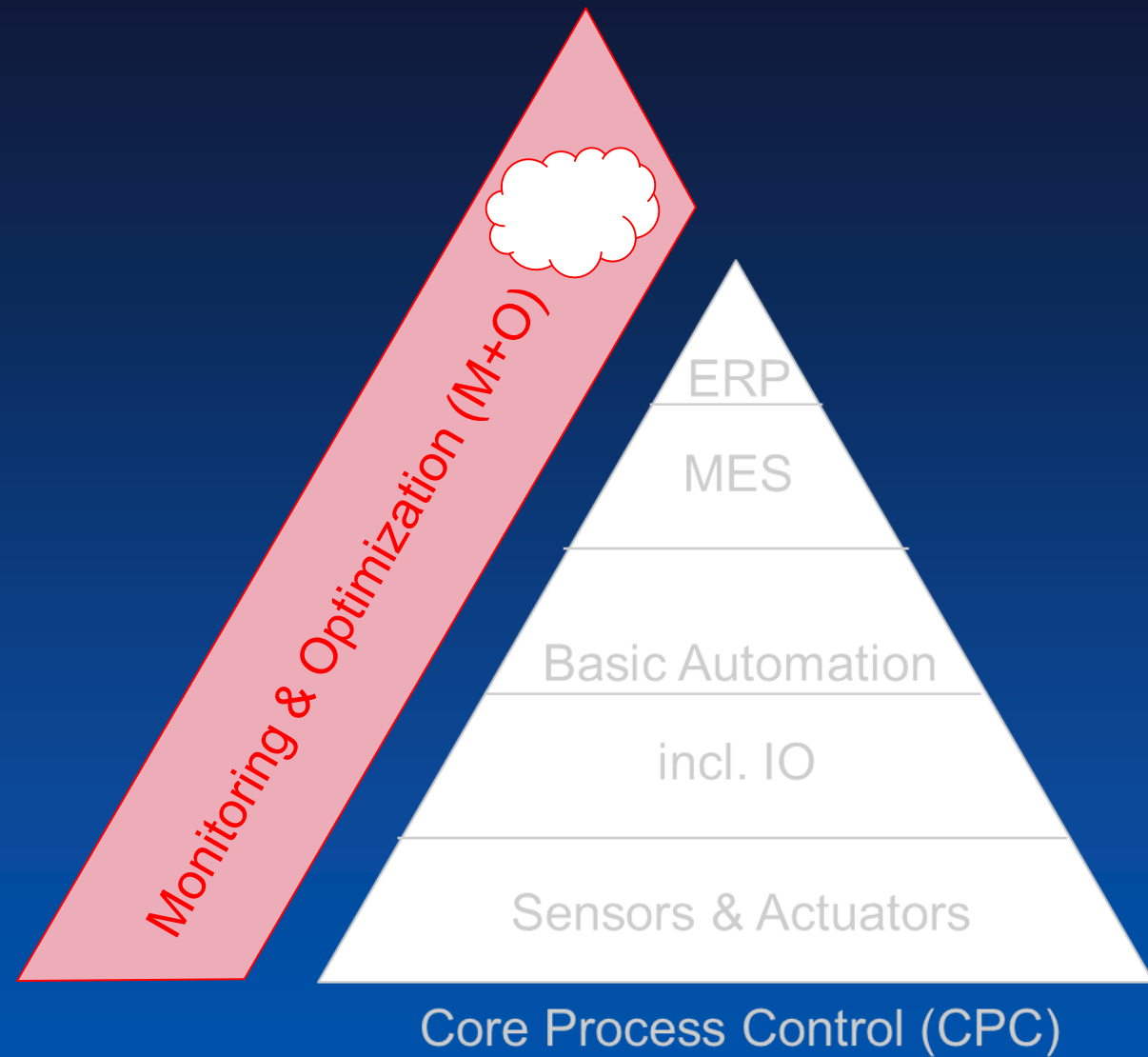
Result

- ✓ Reduced energy cost
- ✓ Greater sustainability
- ✓ Increased throughput
- ✓ Reduced stress
- ✓ Reduced off-spec product



Challenge: Limited Subsystem Integration into Historian

Challenge	Solution	Result
- Proprietary ‘data connectors’ - Historian bundled with the DCS - Data from underlying systems does not get integrated - Package units (PLC) - Safety system (SIS) - Machinery protection system (MPS) - Flow computers (RTU) - Custom coded API - Integration of data from sub-systems is very costly	- Industrial data fabric with OPC-UA - Easily integrate subsystems - Including contextual metadata - Freely add industrial software apps App App App Industrial Data Fabric Sub-system Sub-system Sub-system	✓ Improvements in all operational areas depending on the new apps ultimately installed: - Greater safety - Greater sustainability - Greater reliability - Greater throughput - Lower energy cost - Lower maintenance cost - Reduced off-spec product 



‘Digital’ Transformation “2.0”

- Operations transformation: Deploying automation where there is none



1st: Wireless and Non-Intrusive Monitoring & Optimization (M+O) Industrial Internet of Things (IIoT) Sensors

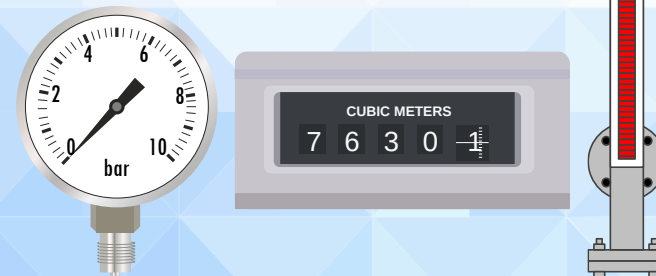
Portable Testers

- ✓ Corrosion (UT)
- ✓ Erosion (UT)
- ✓ Vibration
- ✓ Equipment temperature
- ✓ Acoustic noise (leak)
- ✓ Gas concentration
- ✓ Quad temperature (for ΔT)
- ✓ Illuminance and motion



Mechanical Gauges

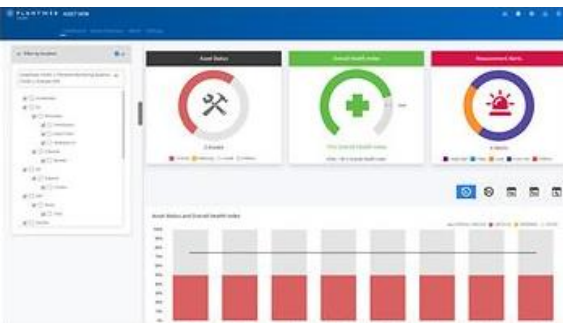
- ✓ Pressure
- ✓ Process temperature
- ✓ DP level
- ✓ Radar level
- ✓ DP flow
- ✓ Turbine flow
- ✓ Position
- ✓ Discrete
- ✓ Interface level
- ✓ Differential pressure (DP)
- ✓ Pressure + DP
- ✓ Pressure gauge
- ✓ Level switch
- ✓ Immersion level



2nd: Specialized Industrial AI Apps – Easy Causal AI and Depth of Functionality

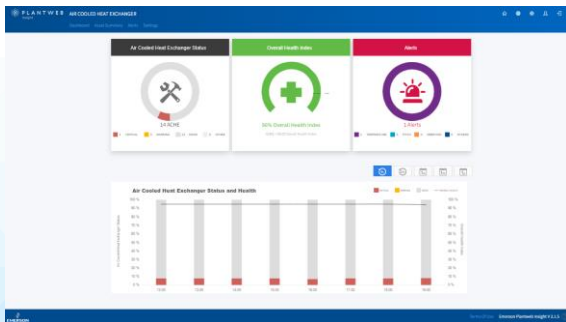
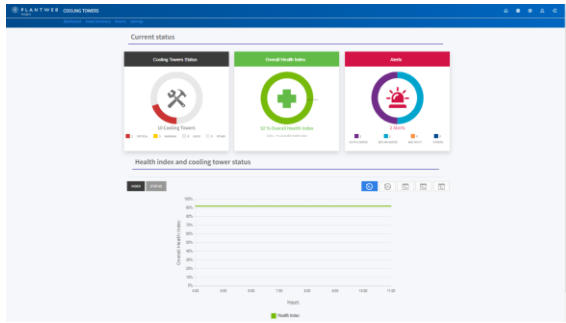
Safety

Situational awareness



Sustainability

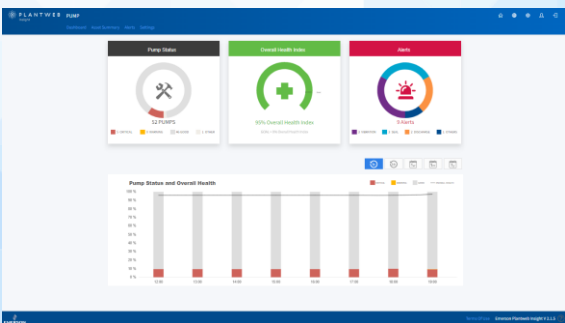
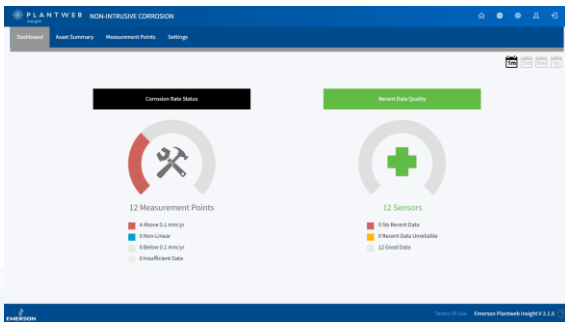
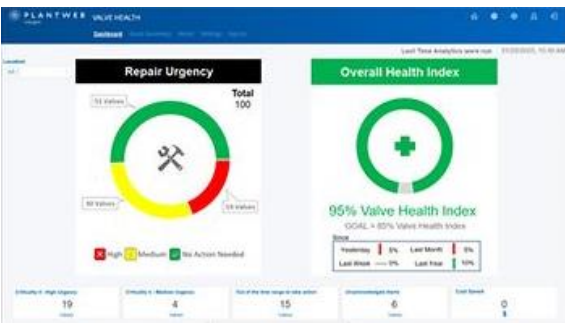
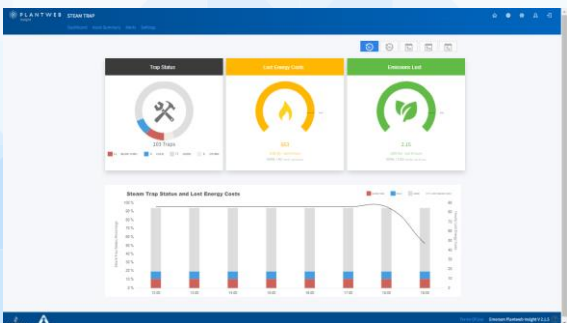
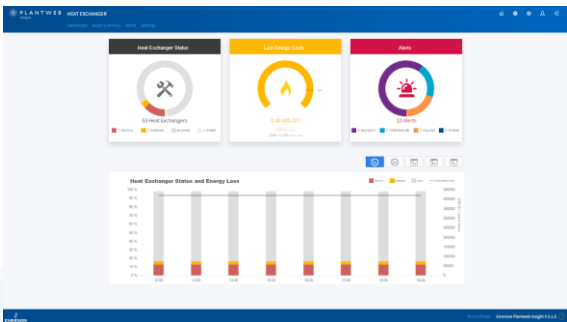
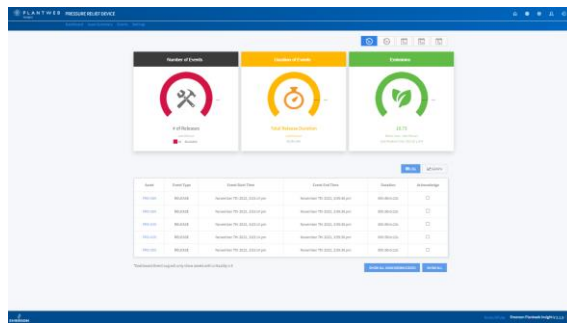
Pinpoint inefficiencies



Reliability

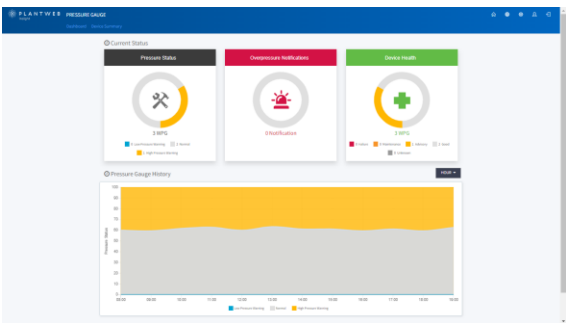
Reliability

Predict failures

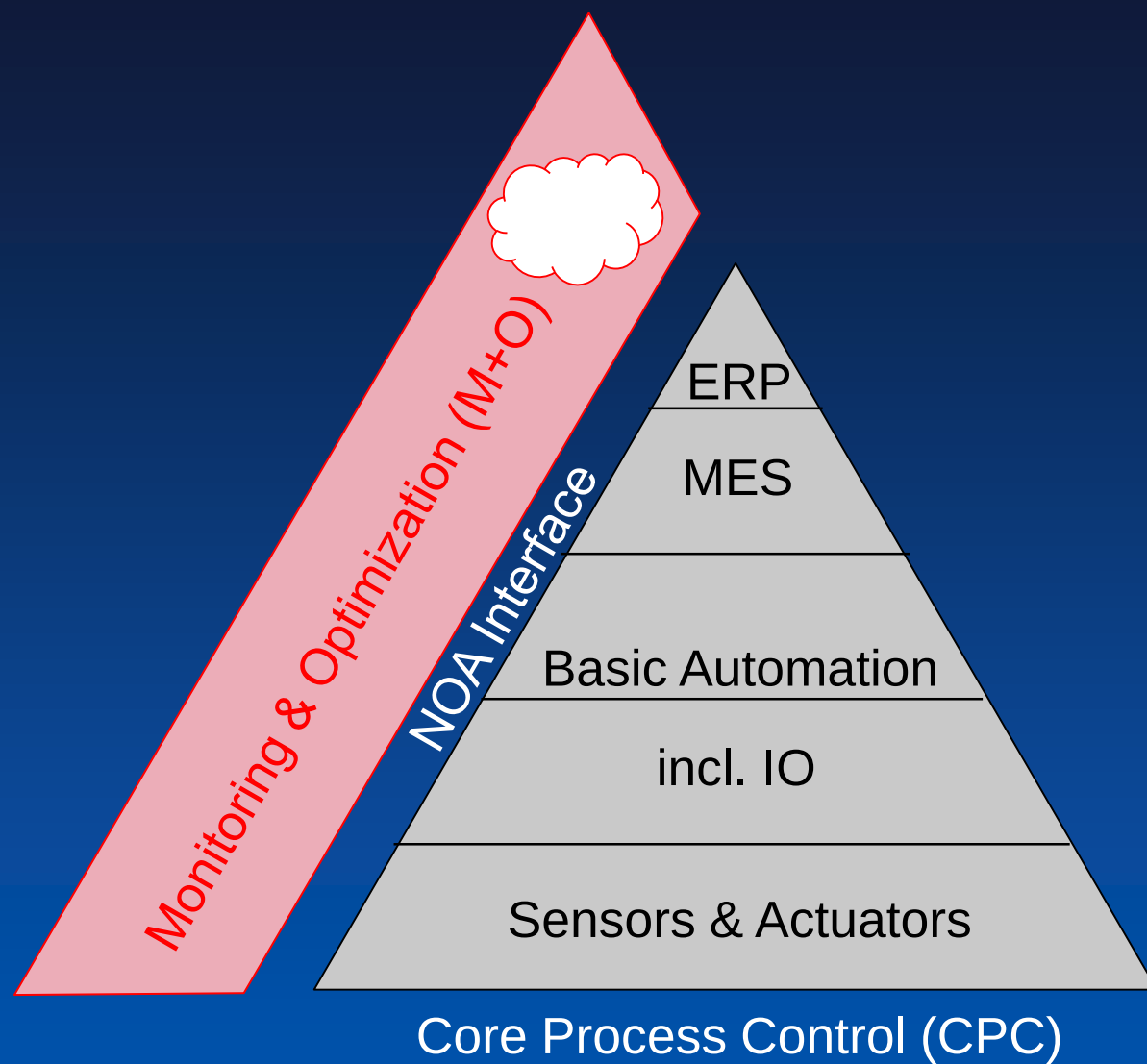


Production

Situational awareness



The New Automation



Smart Plant

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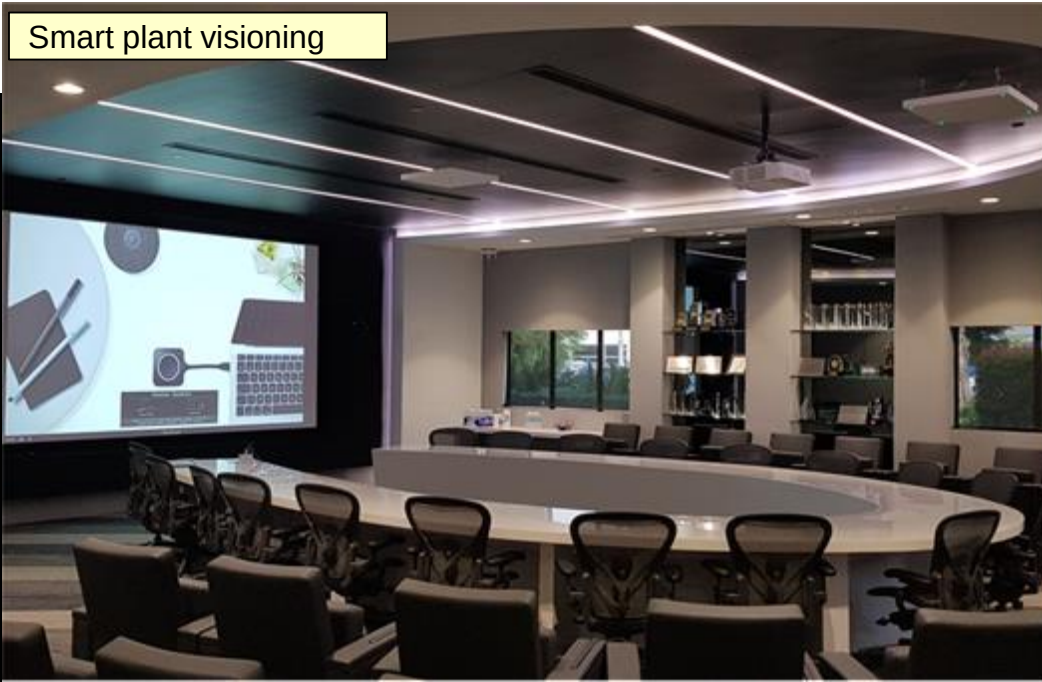
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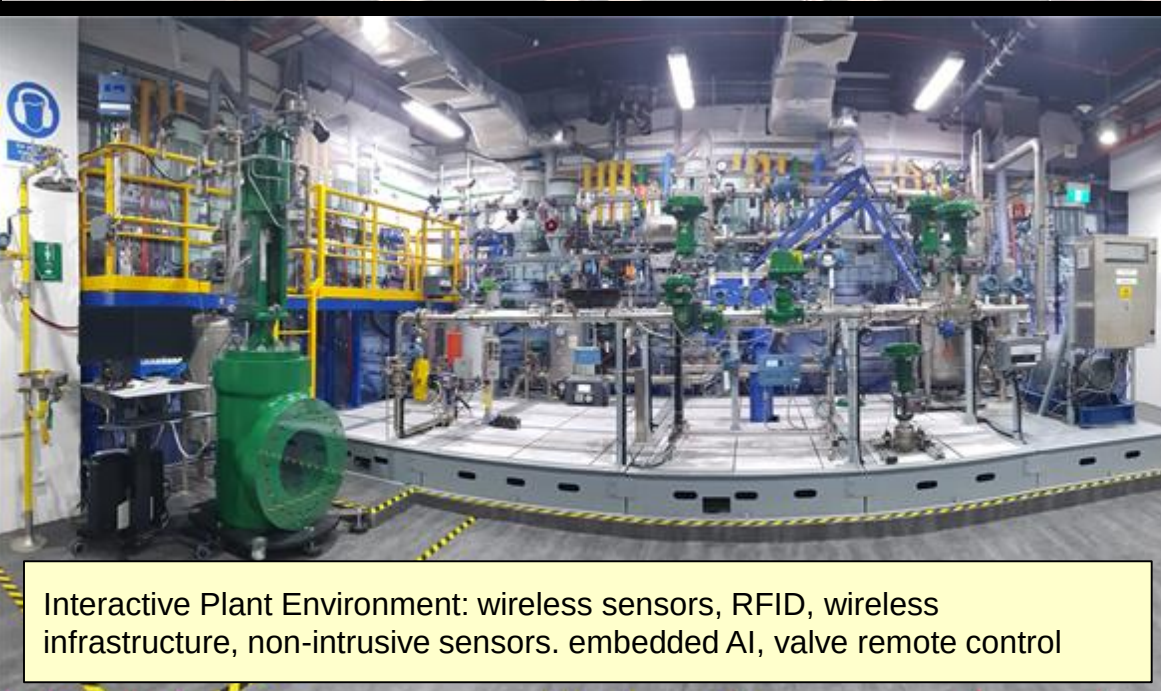
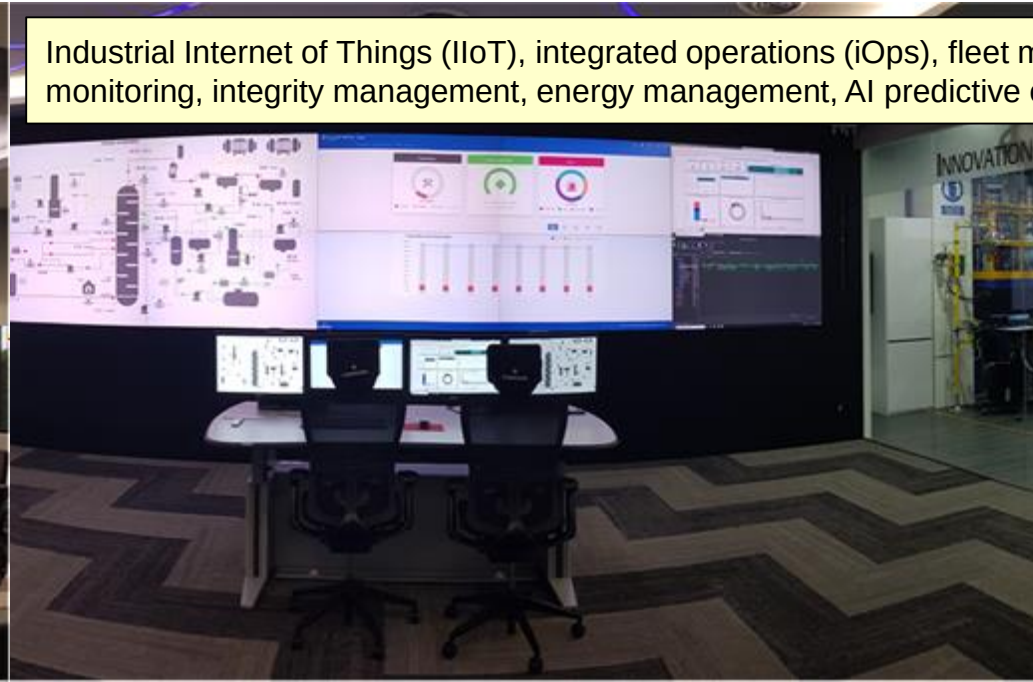
**LESS
MANUAL**

The Most Realistic Smart Plant Experience - The Emerson Solutions Center in Singapore

Smart plant visioning



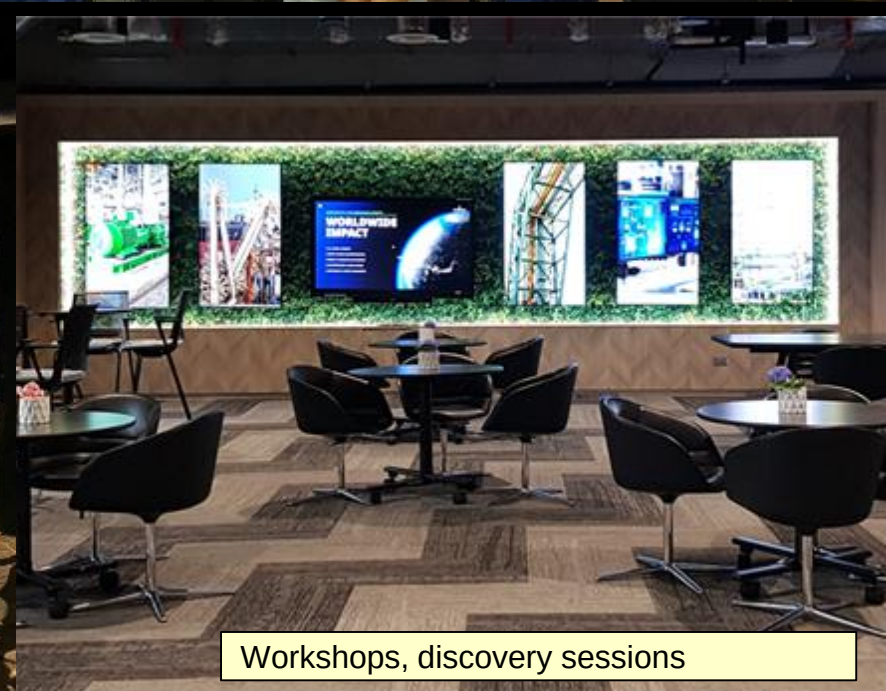
Industrial Internet of Things (IIoT), integrated operations (iOps), fleet management, expert support, cloud, AI equipment performance monitoring, integrity management, energy management, AI predictive equipment condition monitoring



Interactive Plant Environment: wireless sensors, RFID, wireless infrastructure, non-intrusive sensors, embedded AI, valve remote control



Digital twin, Virtual Reality (VR)



Workshops, discovery sessions

I'm Listening...

- Jonas Berge

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Booth V8

