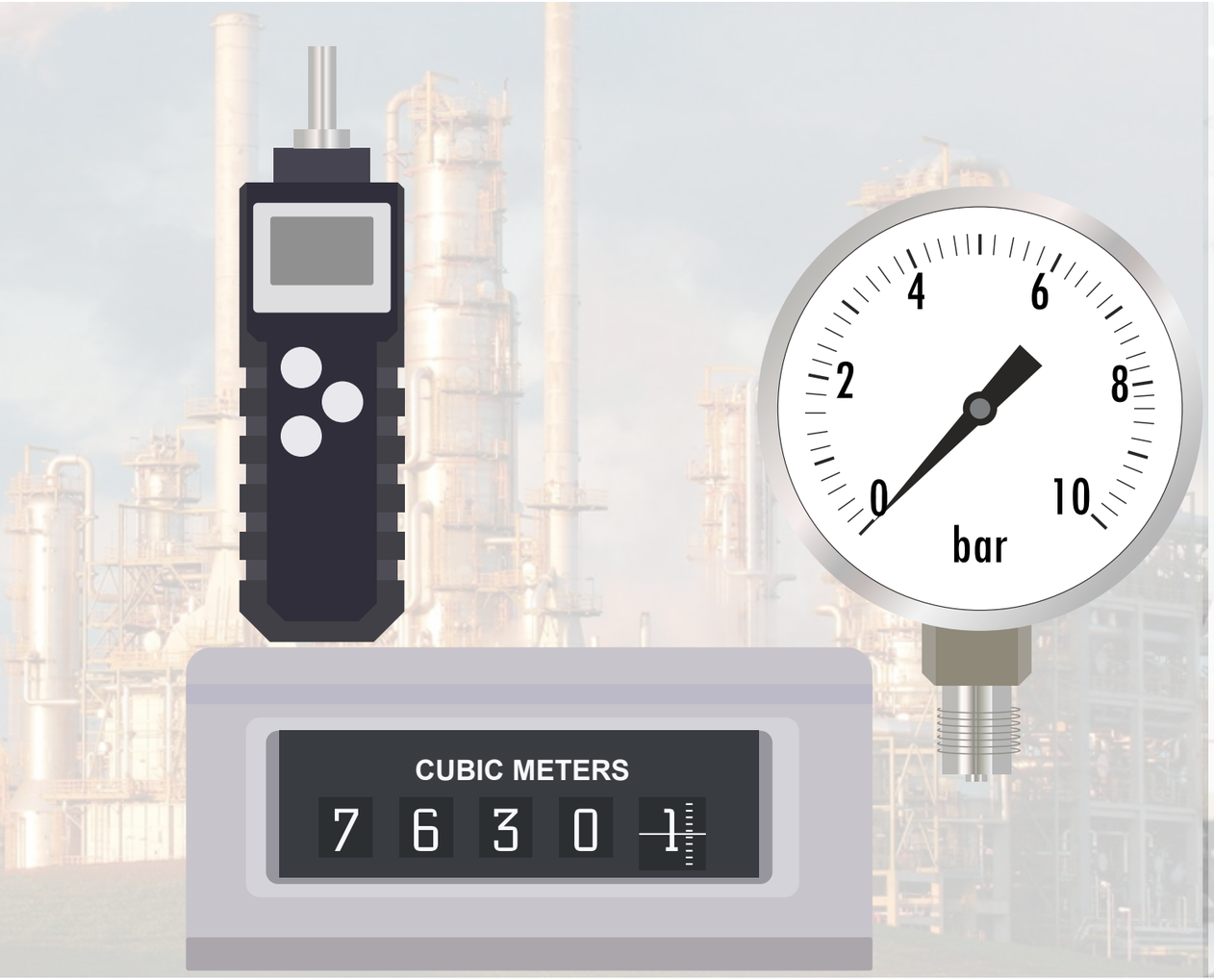
Digital Transformation for Sustainability, Safety, and More

Jonas Berge, Emerson

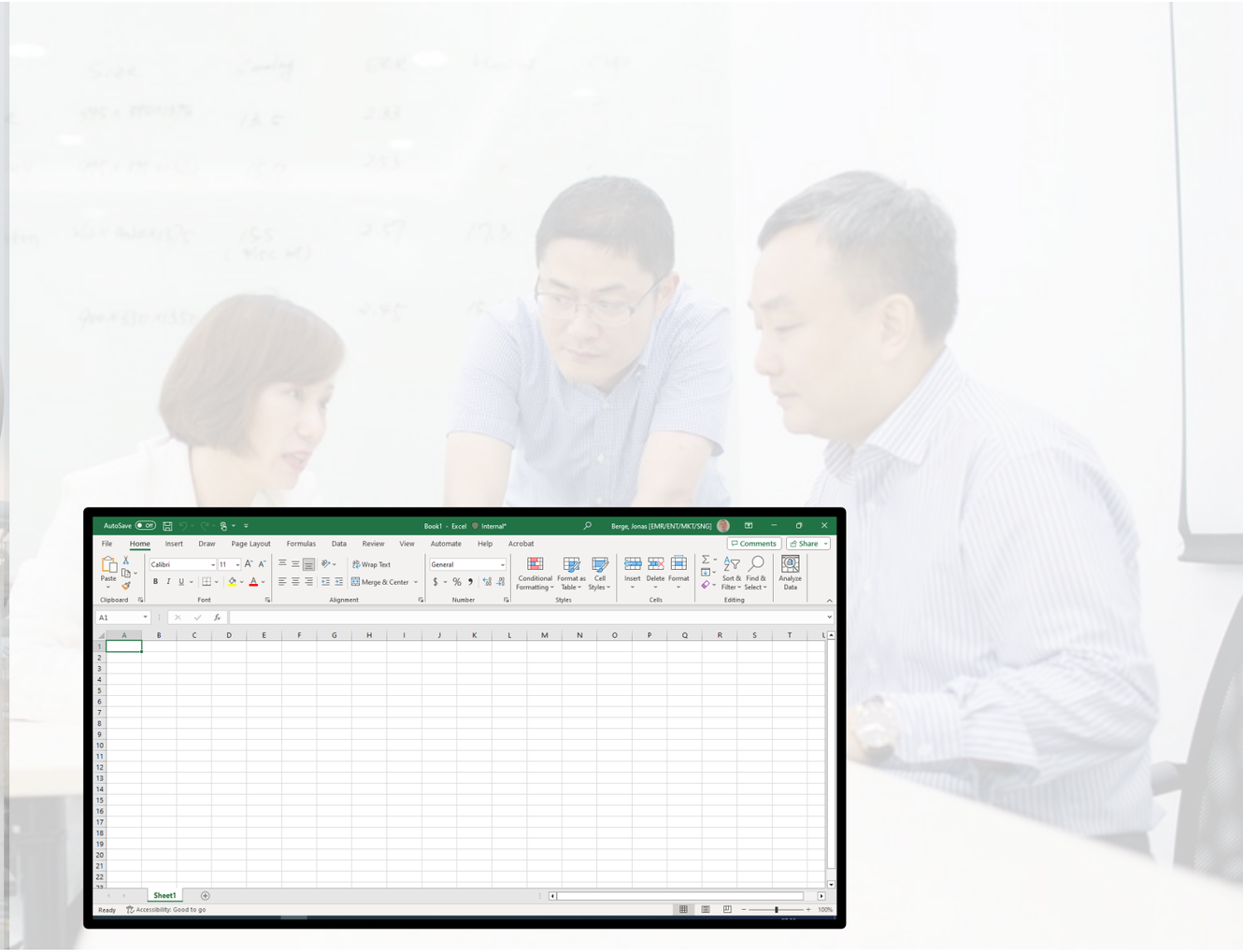
Intelligent Plant
Sustainability
No undetected loss or flaring
No hidden equipment fouling
Safety
No surprise loss of containment
No undetected leaks
No manual valves in wrong position
Reliability
No manual data collection
No surprise equipment failure
Production
No non-uniform temperature profiles

Familiar Plant Challenges in Every Operational Area – Manual Work

MANUAL DATA COLLECTION

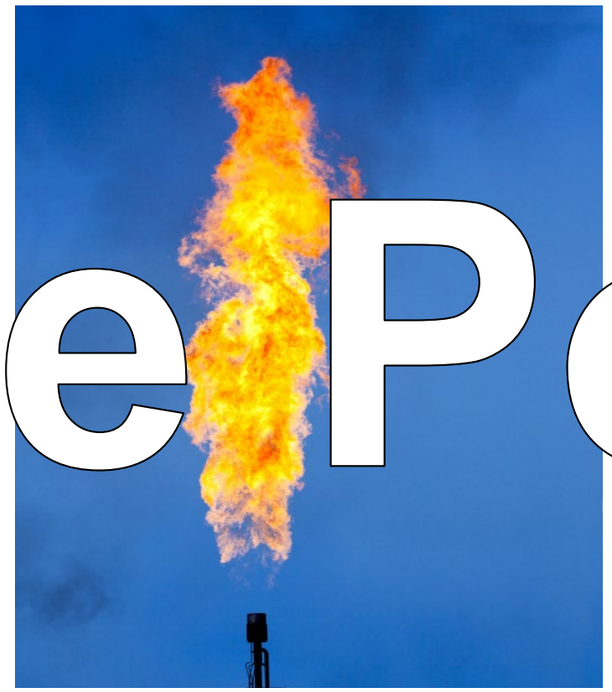


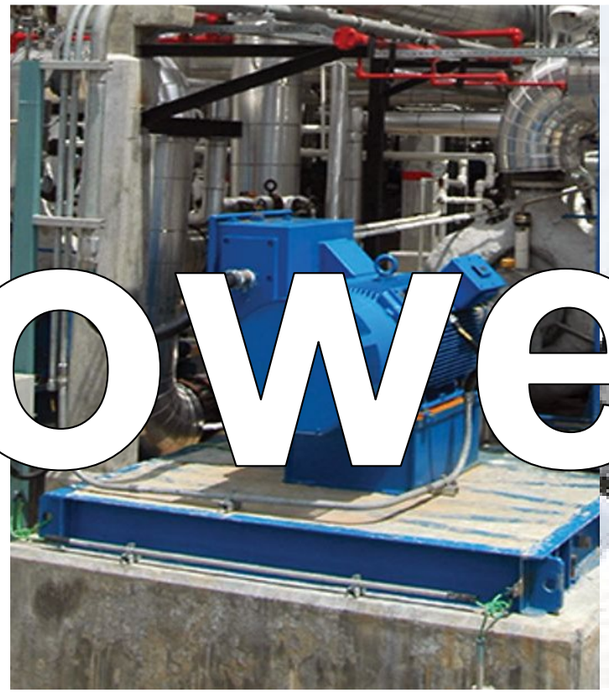
MANUAL DATA INTERPRETATION



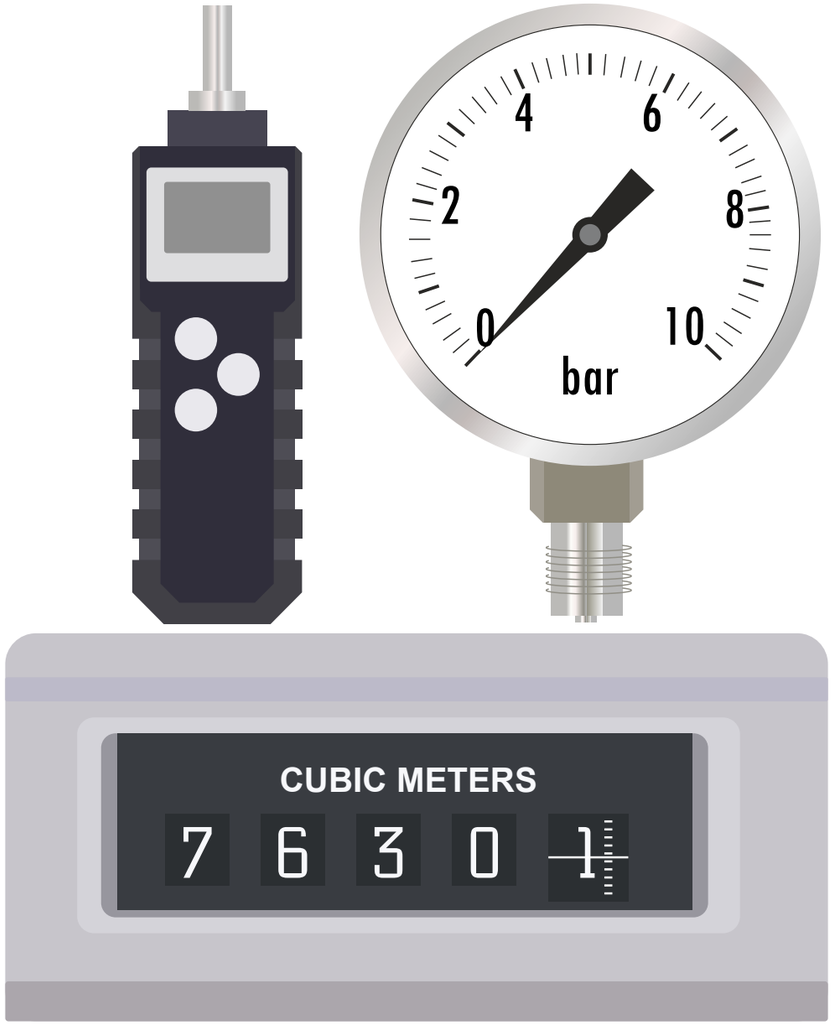
The Power of Zero

Safety	Sustainability	Reliability	Production
Situationally aware	Responsive	Predictive	Productive
“Zero incidents”	“Zero emissions”	“Zero downtime”	“Zero off-spec”
Threat monitoring	Performance monitoring	Condition monitoring	Balance process monitoring



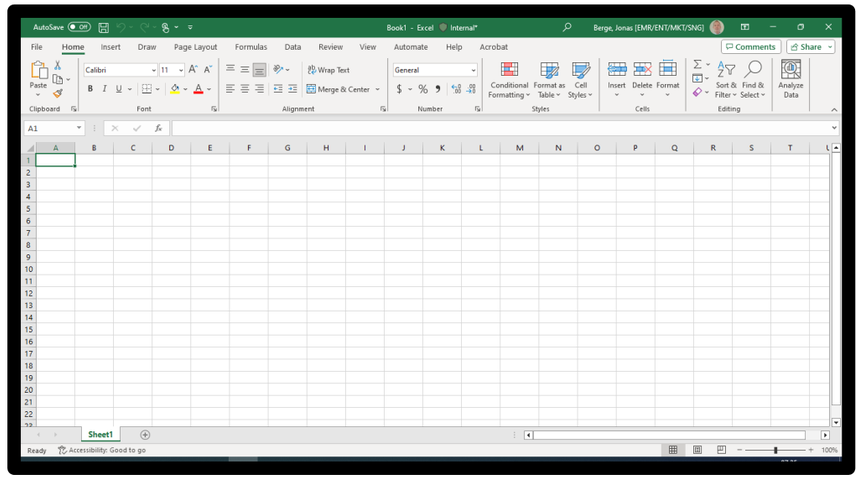


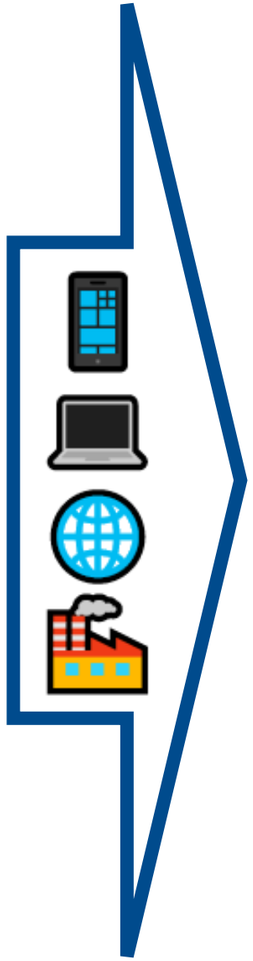
Transformation Starts with Automatic Data Collection – Sensors Everywhere

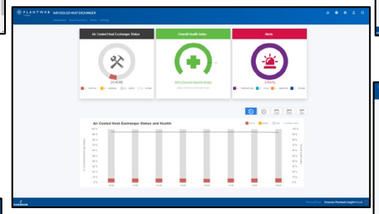


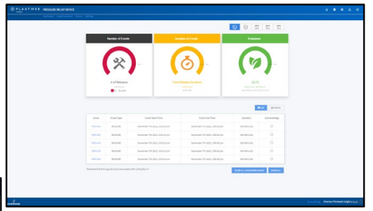
- ✓ Corrosion
- ✓ Erosion
- ✓ Vibration
- ✓ Position
- ✓ Level
- ✓ Discrete
- ✓ Flow
- ✓ Pressure
- ✓ Temperature
- ✓ Acoustic noise
- ✓ Gas concentration
- ✓ Differential pressure
- ✓ Multi-temperature
- ✓ Motion
- ✓ Illuminance

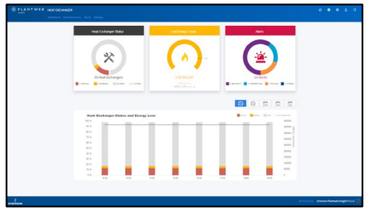
Next: Data Interpretation with Specialized Analytics

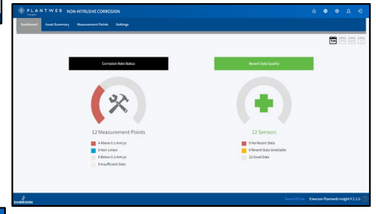


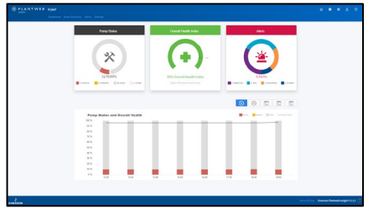


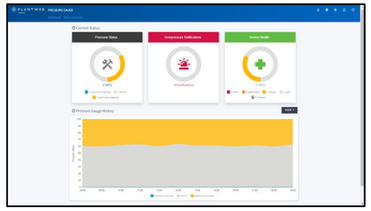












Easy Modular App Examples

- ✓ Steam traps
- ✓ Pumps
- ✓ Heat exchangers
- ✓ Air-cooled heat exchangers
- ✓ Pressure relief valves
- ✓ Cooling towers
- ✓ Corrosion/Erosion
- ✓ Safety showers
- ✓ Inspection
- ✓ Industrial lighting
- ✓ Control valves

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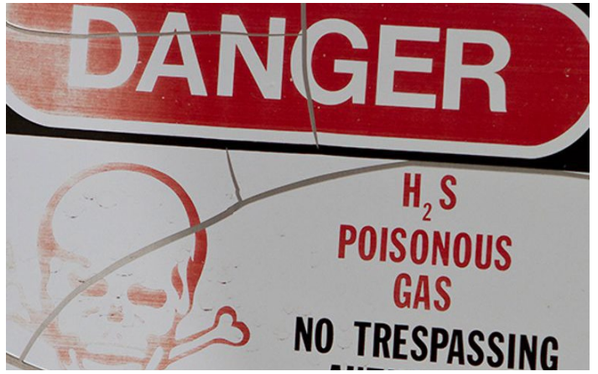
Example Occupational Health, Safety, and Environment Use-Cases with Readymade Solutions

Emergency safety shower activated	Manual valves in wrong position	Flammable gas leak	Toxic gas leak
			

Tank overfill	Breather valve and blanketing	Pipe corrosion and erosion	People out of harm's way

Example Sustainability Use-Cases with Readymade Solutions

Steam trap leak or blockage	Pressure relief valve release and passing	Air-cooled heat exchanger fouling	Cooling tower fouling
Heat exchanger fouling	**Other over-consumption and loss**	**Methane leaks**	**Lighting power consumption**

Example Maintenance, Reliability, and Integrity Use-Cases with Readymade Solutions

Pump failure	Air-cooled heat exchanger fan failure	Cooling tower gearbox failure	Pipe corrosion and erosion

Inspection rounds: autonomous	Control valve underperformance	Heat trace failure	Breather Valve Failure

Example Production and Quality Use-Cases with Readymade Solutions

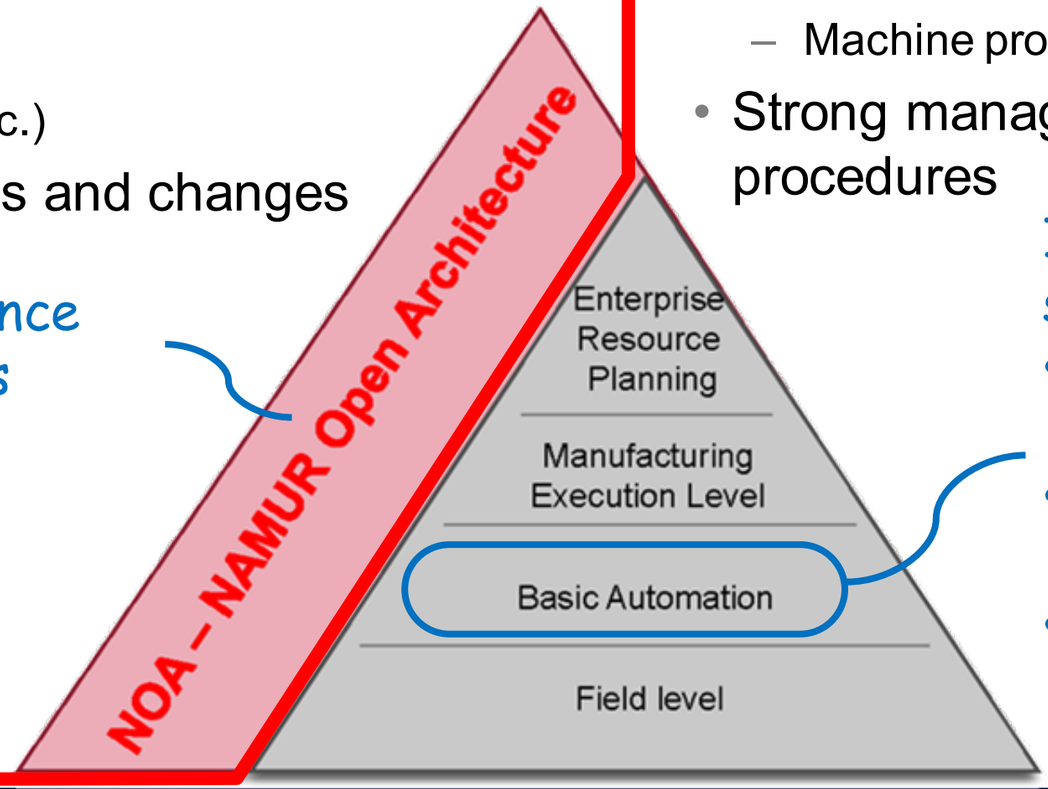
Field operator rounds: autonomous	Offsite tank farm storage tanks	Wellhead and control panel	Temperature profile
Local control panels	**Offsite standby pumps**	**Consumables inventory**	**Manual valves**

‘Digital’ Transformation

Monitoring & Optimization (M+O) Applications

- Transform manual tasks
  - Safety (occupational)
  - Sustainability
  - Reliability
  - Production (quality etc.)
- Freely make additions and changes

New Asset Performance Management systems



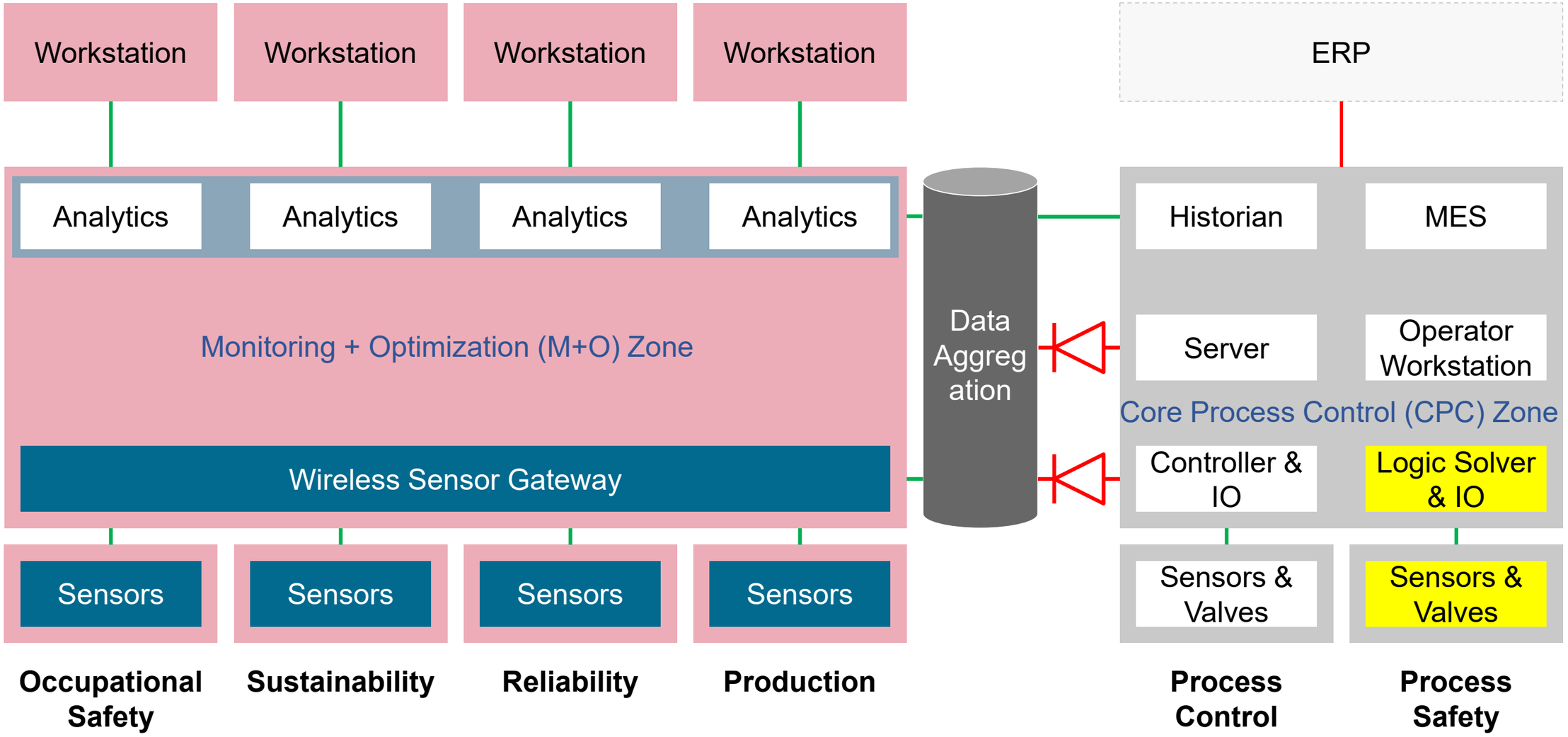
Core Process Control (CPC) Applications

- Improve existing automation functions
  - Process control
  - Process safety
  - Machine protection
- Strong management of change (MoC) procedures

Integrated control and safety system (ICSS)

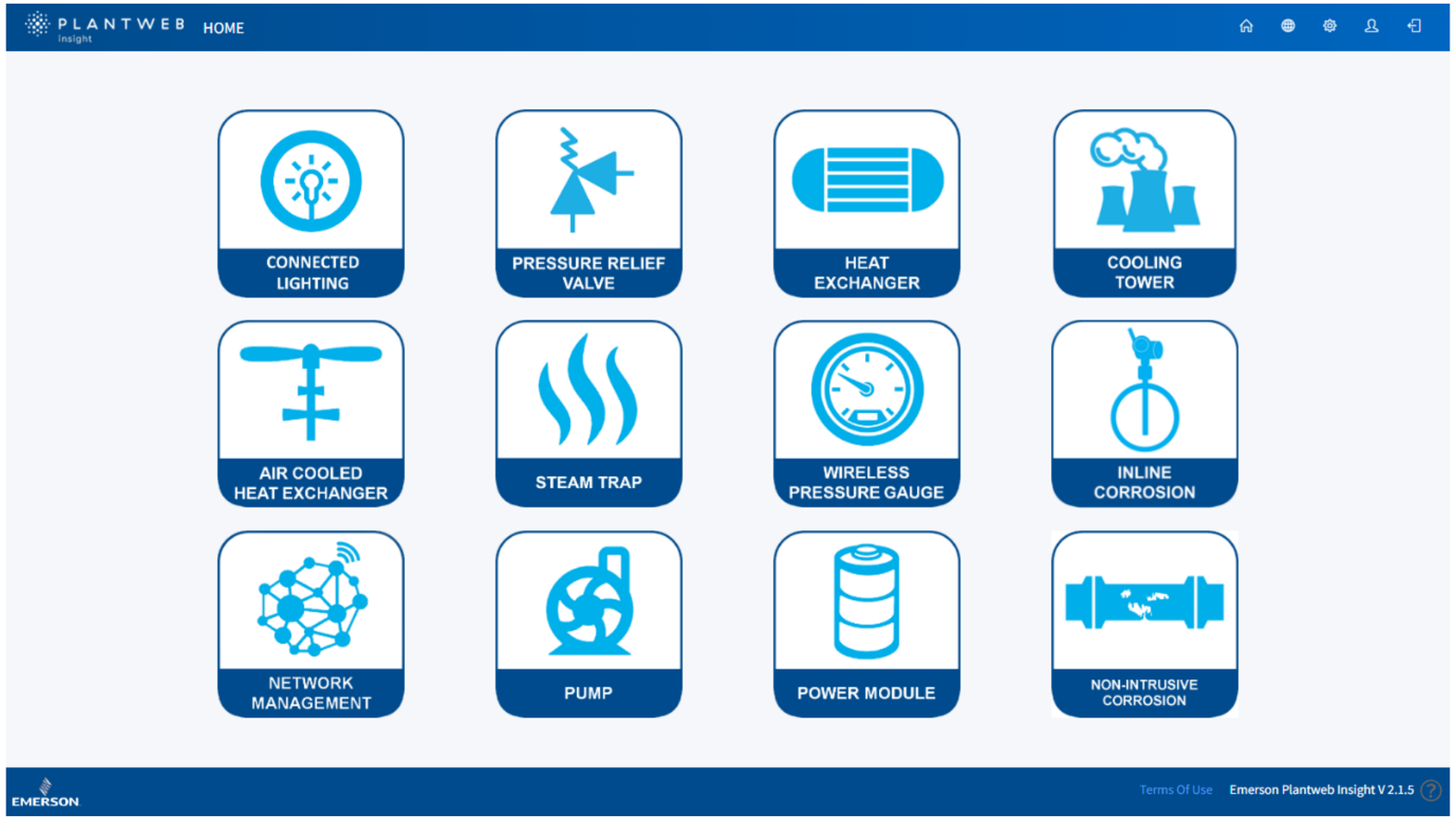
- Distributed Control System (DCS)
- Safety Instrumented System (SIS)
- Machinery protection system (MPS)

The Unifying Architecture Delivering the Vision



Readymade Apps – Rapid, Capable, and Low Cost

- No coding, no testing, no development cost, no delay, no pilot PoC
- Proven track record
- Rich feature set



- Predict failures
- Pinpoint inefficiencies

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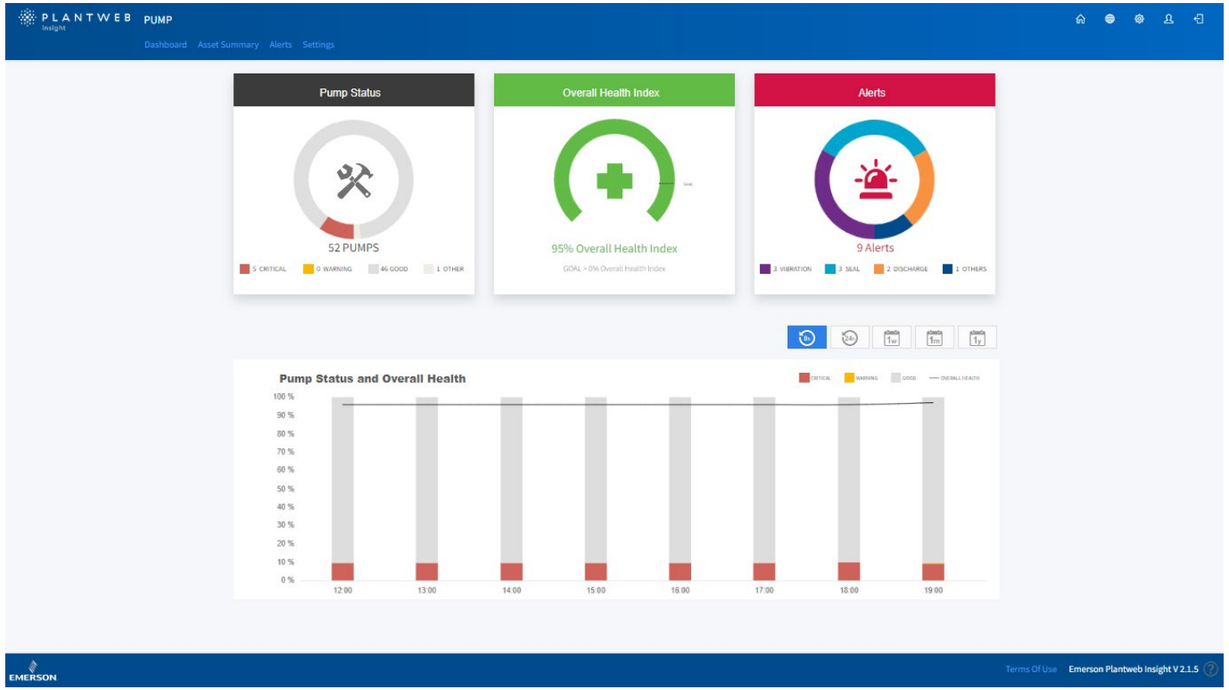
Analytics Without Data Science – Easy; Critical to Broad Adoption

- Existing maintenance and reliability engineers can use it
  - No data science: no historical data import, data cleansing, no algorithm selection, no algorithm training runs and testing iterations, no unfamiliar terminology
  - Minimal upkeep
  - This is vital as talent is hard to come by



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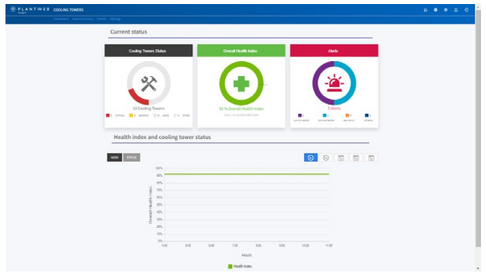
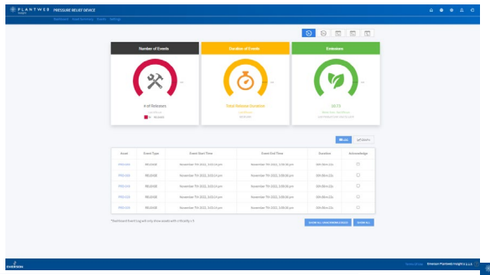
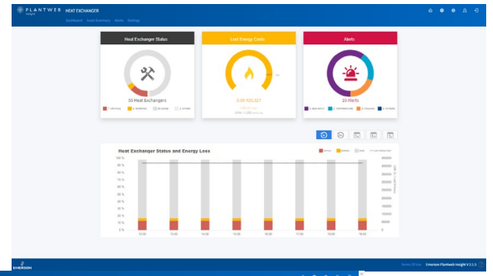
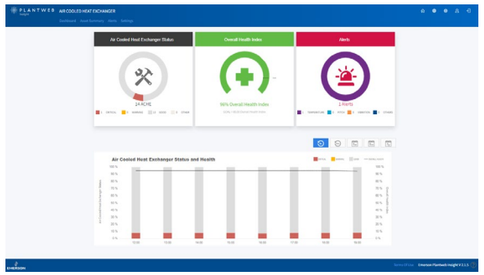
Specialized Apps – Easy

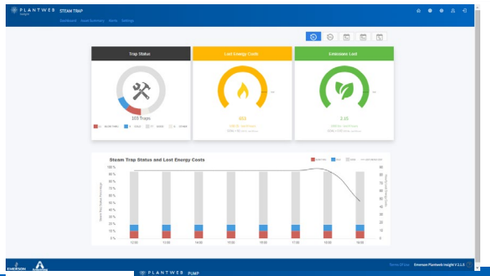
- Specialized for process plant use-cases
- Domain-specific features
  - Relevant dashboards, detail visualization capabilities, and terminology

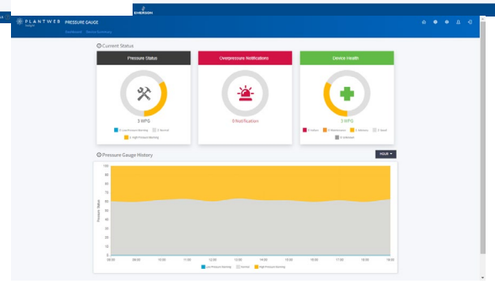


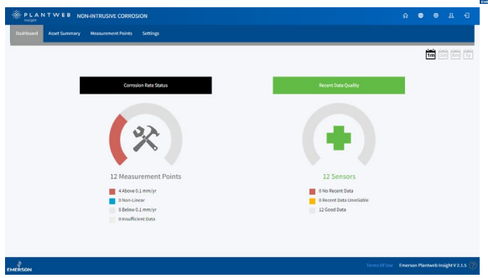


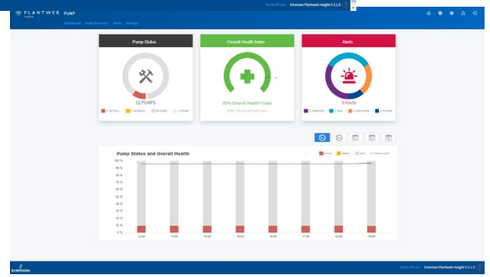












Operational Domains (Teams)

- ✓ Maintenance
- ✓ Reliability/Inspection
- ✓ Integrity/Corrosion
- ✓ Sustainability/Energy
- ✓ Process
- ✓ Health, Safety, and Environment
- ✓ Production
- ✓ Quality

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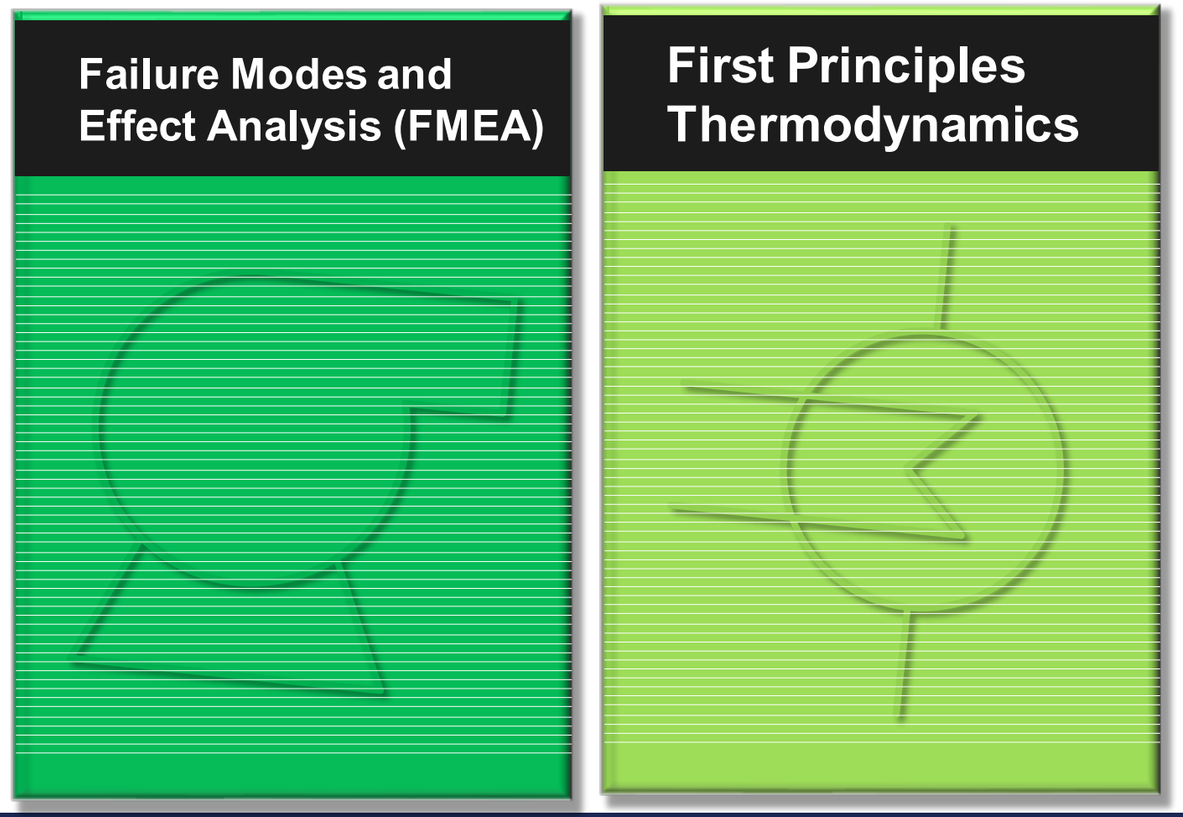
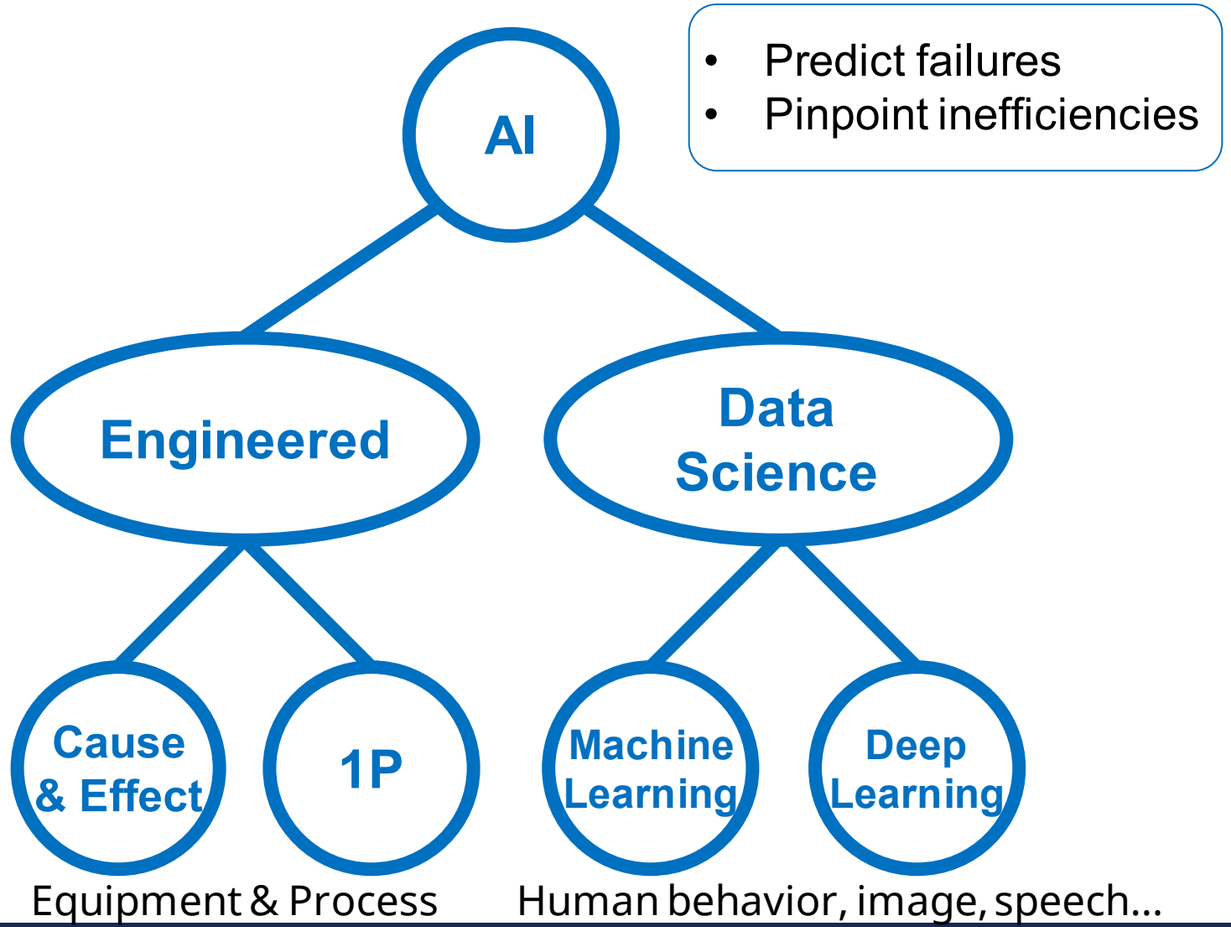
- Predict failures
- Pinpoint inefficiencies

Engineered Analytics – Early and Reliable Predictions

- Mechanistic AI for equipment and processes with well-known cause & effect and first principles (1P)
- Deterministic: robust, verifiable





Pervasive Sensing “IIoT Sensors” / “M+O Sensors” – Early and Reliable Predictions

- All prediction are based on early symptoms
- All diagnosis (distinguish problems) is based on symptoms
- Automate data collection
- Sense every part of the plant
- Keeps personnel out of harm’s way

- ✓ Corrosion
- ✓ Erosion
- ✓ Vibration
- ✓ Position
- ✓ Level
- ✓ Discrete
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- ✓ Illuminance

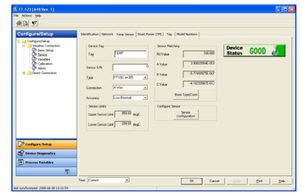
Advanced Sensors – Low Total Installed Cost

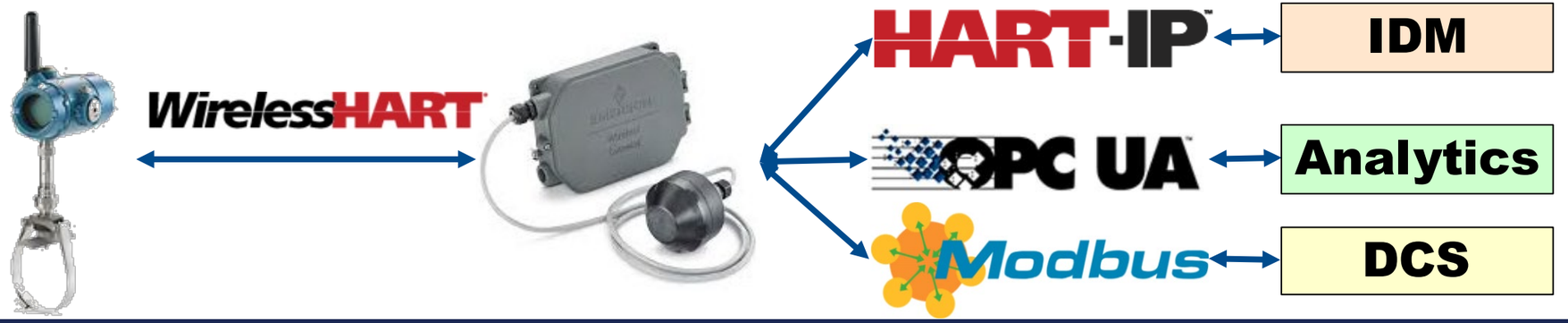
- Wireless
  - No power cord, no signal wires
- Non-intrusive
  - No cutting, drilling, or welding
- Edge analytics
  - Peak acceleration
- ‘Cheap sensors’ do not provide comparable results

Bolt-on	Clamp-on	Slip-in	Reuse Connection
• Position • Discrete • Gas concentration • Vibration	• Corrosion • Erosion • Temperature • Acoustic	• DP flow	• Level • Pressure • Corrosivity

Industrial Wireless Sensor Network – Rapid, Capable, and Low Cost

- IEC62591 (WirelessHART)
- Data conversion to OPC-UA, HART-IP, Modbus, EtherNet/IP without coding or scripting
  - Easy integration of data to all kinds of third-party software
- No data left behind
- Centralized sensor management
  - Centralized configuration of remote sensors
  - Single app for diagnostics of all sensors





Think Big, Start Small, Scale Fast – Rapid and Low Cost

- Start with a workshop
- Select technologies, architecture, and components that solve multiple problems across the entire plant
- Deploy use-case solutions one at a time
- Quickly spread across all plants

Safety, Health, and Environment

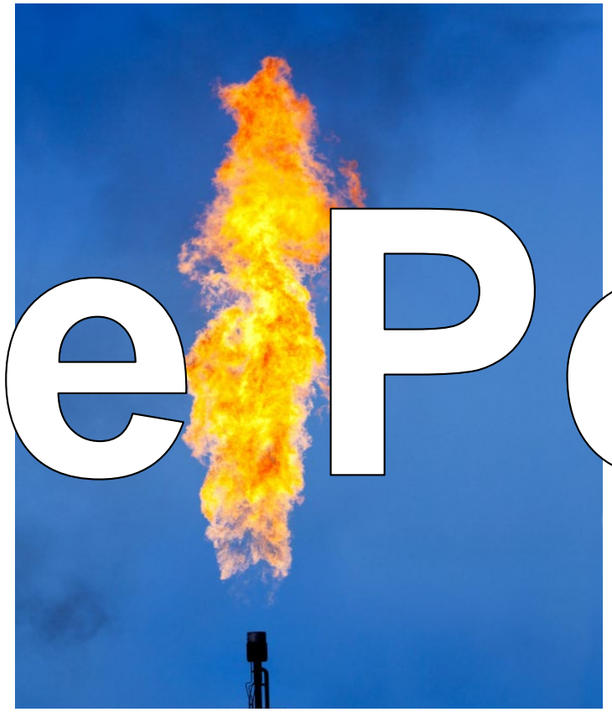
Sustainability and Energy

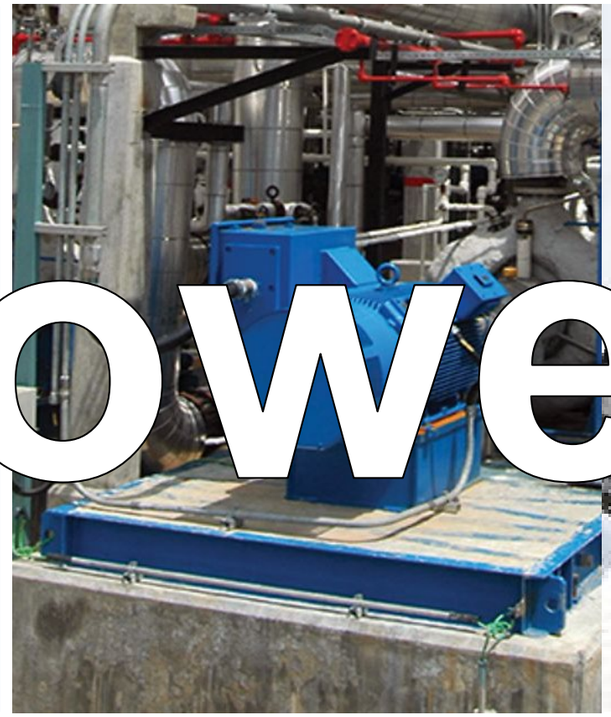
Reliability, Maintenance, and Integrity

Production and Quality

Operational Results of Work Transformation

Safer	Greener	Longer	Faster
• Fewer injuries • Fewer incidents • Reduced clean-up cost • Reduced fines	• Reduced energy consumption and loss • Reduced energy cost • Reduced emissions	• Reduced downtime • Reduced loss of containment • Lower maintenance cost	• Reduced off-spec product • Greater throughput • Improved yield • Fewer site visits

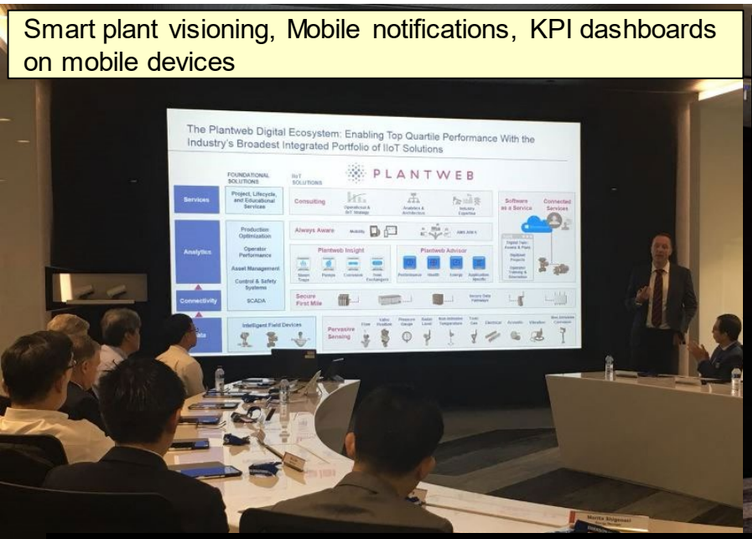




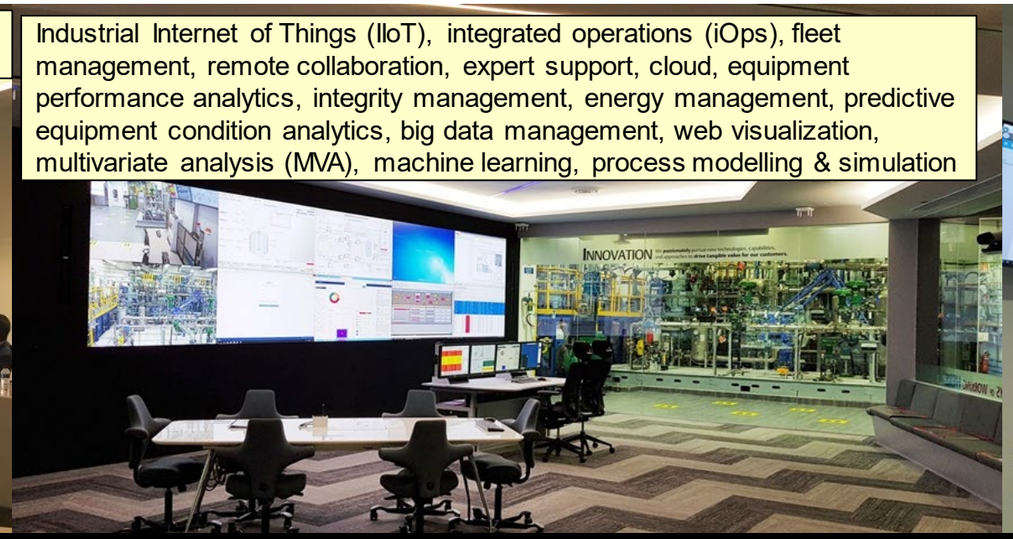
The Power

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

Smart plant visioning, Mobile notifications, KPI dashboards on mobile devices

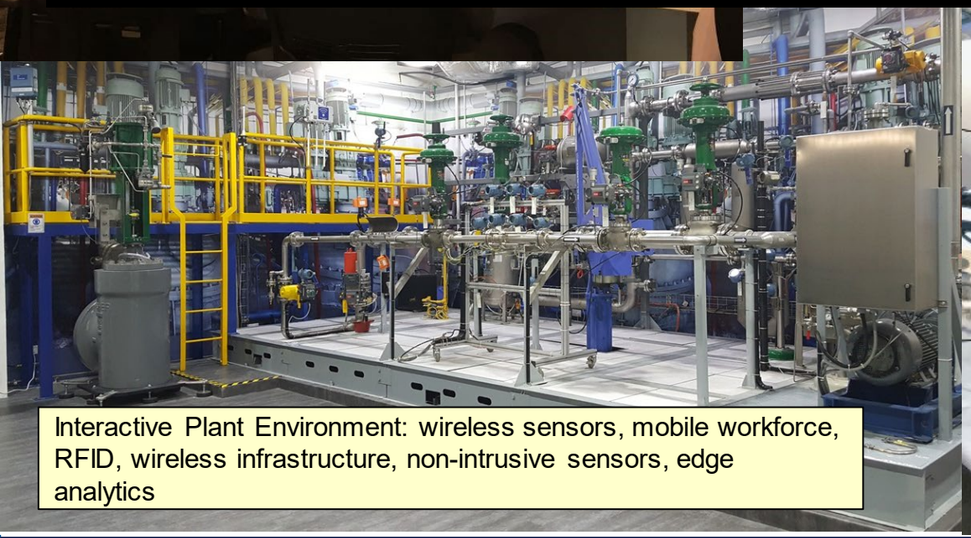


Industrial Internet of Things (IIoT), integrated operations (iOps), fleet management, remote collaboration, expert support, cloud, equipment performance analytics, integrity management, energy management, predictive equipment condition analytics, big data management, web visualization, multivariate analysis (MVA), machine learning, process modelling & simulation



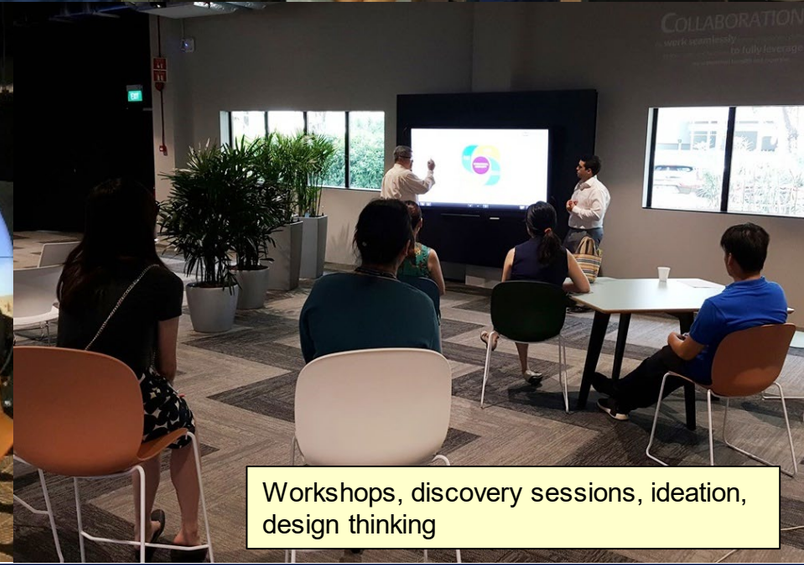
Digital twin, batch analytics

https://www.youtube.com/watch?v=Boy0fuNEgZQ



Interactive Plant Environment: wireless sensors, mobile workforce, RFID, wireless infrastructure, non-intrusive sensors, edge analytics

Digital twin, Virtual Reality (VR) upskilling



Workshops, discovery sessions, ideation, design thinking

I’m Listening…

- Jonas Berge

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