Capturing Refinery Operational Value Through IIOT – The Industrial Internet of Things

Douglas White
Emerson Process Management

Speaker

Doug White Principal Consultant

Systems and Solutions Group

Emerson Automation Solutions

Many years experience designing, justifying, installing and commissioning advanced real time computer/ automation applications in the process industries.

Email: doug.white@emerson.com

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Consumer Use of Internet of Things (IOT)

Data Example: Edyn- Smart Gardens

- Sensor - Monitors soil moisture and nutrition (conductivity), sunlight hours, humidity
- Connects to app on smart phone that accesses local weather forecasts to determine how much water is needed for garden
- Smart phone app connects via wifi to smart valve that controls water to garden based on current and forecast conditions – if rain is forecast it defers watering
- Can manually control watering remotely via your smart phone
- Provides recommendation on soil nutrition based on specific plants in garden
- Solar rechargeable batteries in sensor and valve

Source: https://edyn.com/

What if You Didn't Have to Take Your Car In For Service?

Car

- Must periodically be sent for service
- Critical components inspected
- You can't use it
- What happens between inspections?

BMW 7 Series (with ConnectDrive)

- Continuously monitored with car data and analysis sent to the dealer of your choice
- Early warning of problem with critical components
- Dealer contacts you if maintenance required on critical item
- Less disruptive
- Greater availability and performance

Topics Covered

- What is IIoT
- Why should you care ? - IIoT benefits
- Who is benefitting today? - IIoT examples
- What is the architecture of IIOT?
- What about Security?
- How To Get Started

What is it? - Industrial Internet of Things (IIoT)

Internet of Things (IOT)

Internet of People

Human interfaces

- Computers
- Tablets
- Smart phones

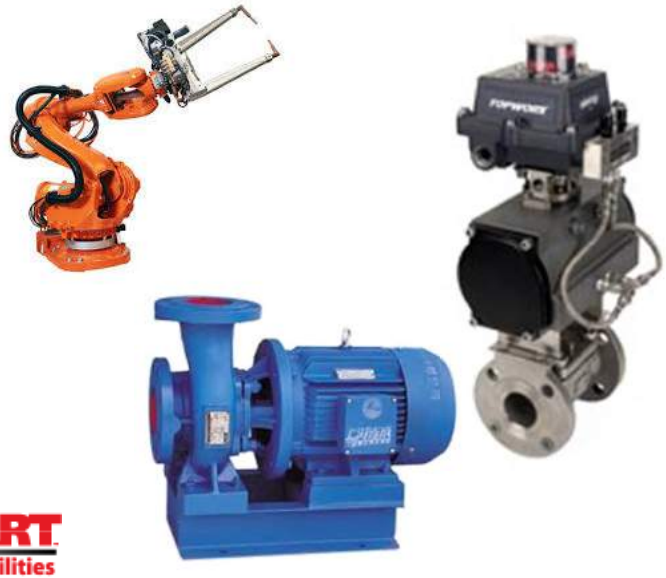
Internet of Things

Networked autonomous devices

- Refrigerator
- Car
- Aircon

Industrial Internet of Things (IIoT)

- Industrial things
  - Industrial equipment
    - Smart pump
    - Robot
    - Smart valve
  - Can also be instrument itself
- Using industrial protocols
  - WirelessHART
  - Fieldbus
  - PROFIBUS
- Unique identifier
  - IPv6 address
  - MAC address
  - Any other kind of unique ID



WirelessHART
Expanding the Possibilities

PROFIBUS

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Internet Enables Remote Monitoring of Equipment

- **Enterprise level**
  - **Global technology center of excellence**
- **By equipment manufacturer**
  - **Pump, valve, ACHX, CT, etc.**
- **By third-party plant services provider**

IIoT is a group of enabling technologies

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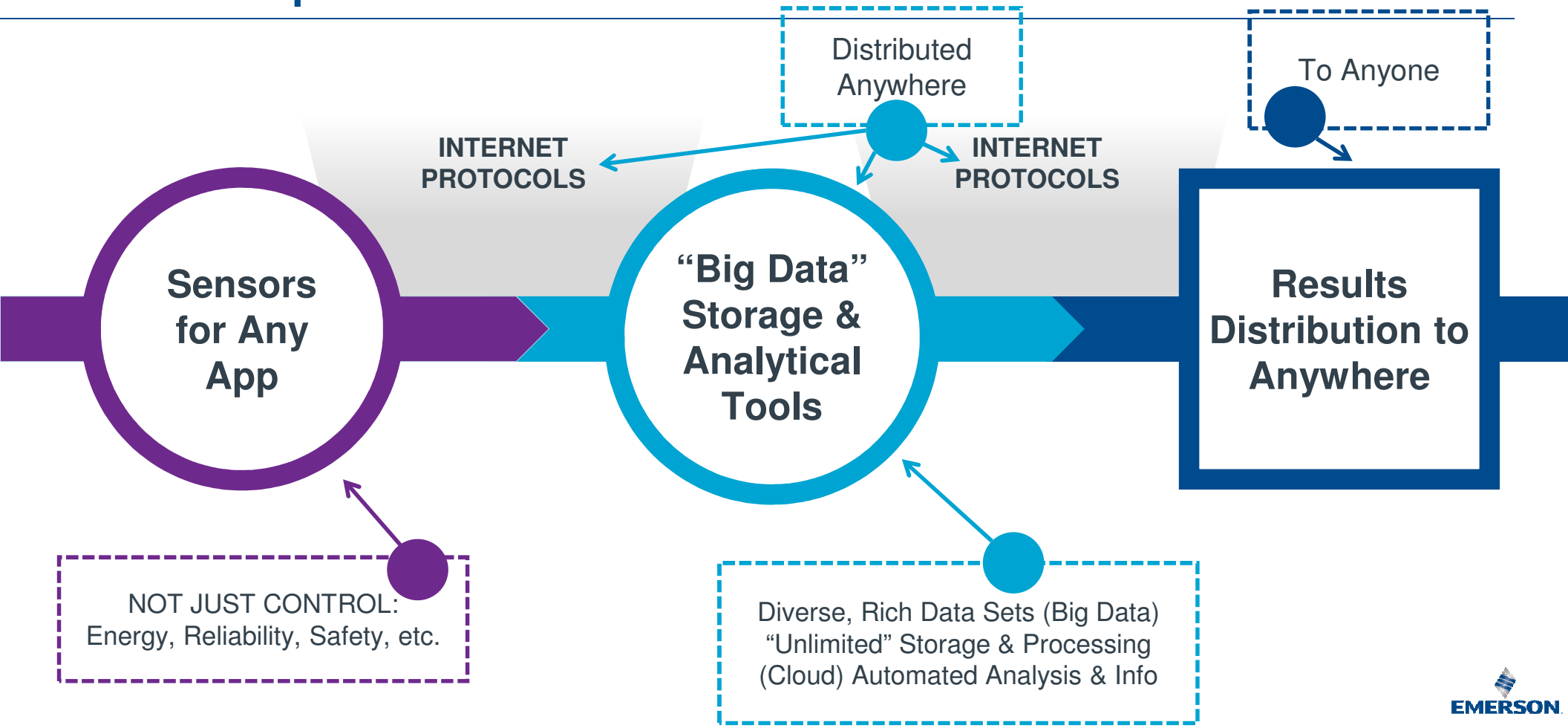
IIoT Concept



Automation and the Industrial Internet of Things

Why is everyone talking about it?

Improved sensing technologies

Cost-effective connectivity

Advanced computing and analytical methods

Why should you care? - IIoT Benefits

Plant Operational Excellence - The Four Zero's

- ***Safety*** **– the goal is zero serious safety incidents**
- ***Sustainability*** **– the goal is zero significant environmental incidents, excess energy use and excess waste**
- ***Availability/ Reliability*** **– the goal is zero unscheduled downtime**
- ***Financial*** **- the goal is zero lost profit opportunities**

How can IIOT support these objectives?

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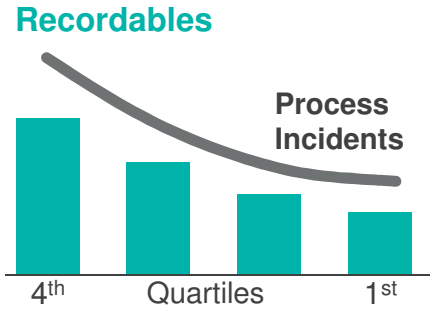
Industry Benchmarks Reveal Significant Business Improvement Opportunities from Average to Top Quartile Performers

Safety

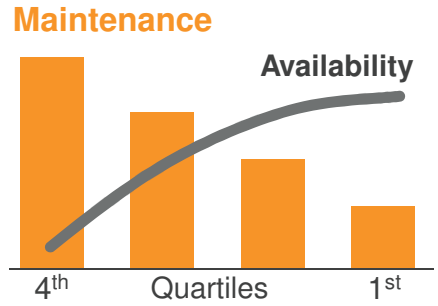
3X fewer recordables and process incidents



Availability/ Reliability

4% higher availability

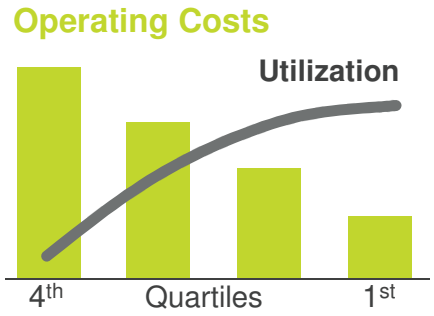
Half the maintenance costs



Financial/ Production/ Optimization

20% lower operating costs

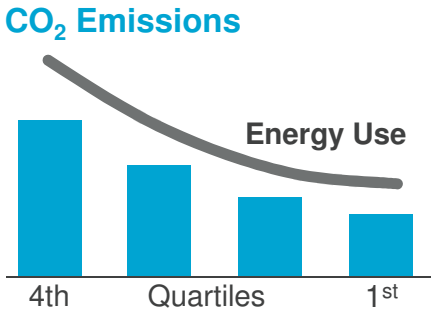
10% higher Utilization Rate



Sustainability/ Energy/ Emissions

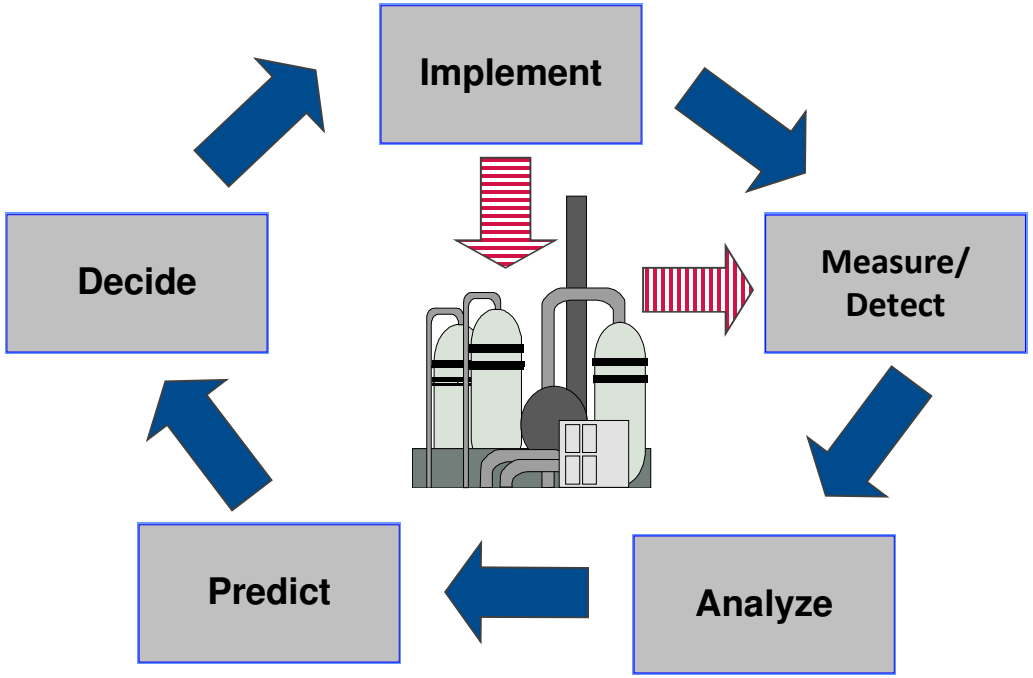
30% lower emissions

30% less energy use



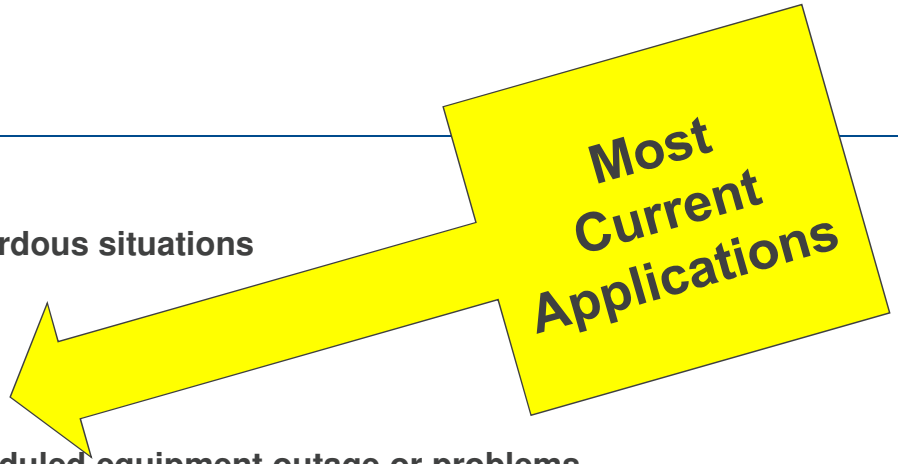
Sources: Refining and Petrochemical Benchmarks, API, Solomon, OSHA, IHS Market and Company Reports

How can IIOT Impact These Metrics? – Plant Decision Cycles



To have a financial impact IIOT has to improve the plant decision cycle – reduce delays, reduce uncertainty, etc.! Data driven decisions!

What Impact Can IIOT Have?



- **Safety**
  - Avoiding incidents through early detection of potential hazardous situations
  - Monitoring safety equipment use for detection of events
  - Monitoring staff location relative to safety events
- **Availability/ Reliability**
  - Increasing availability
  - Anomaly detection – identifying precursor events to unscheduled equipment outage or problems
  - Performance monitoring – detecting loss of process/ equipment performance before it impacts production capacity
- **Sustainability**
  - Reducing per barrel energy usage
  - Comparing current usage of resources such as energy to its expected usage under current conditions and determining possible causes of variation
  - Energy supply/ demand optimization
- **Financial Optimization**
  - Increasing yields of most valuable products
  - Detecting and dissecting complex interacting constraints on production
  - Determining reasons for product quality/ yield issues
  - Understanding patterns and relationships – developing statistical models that explain them

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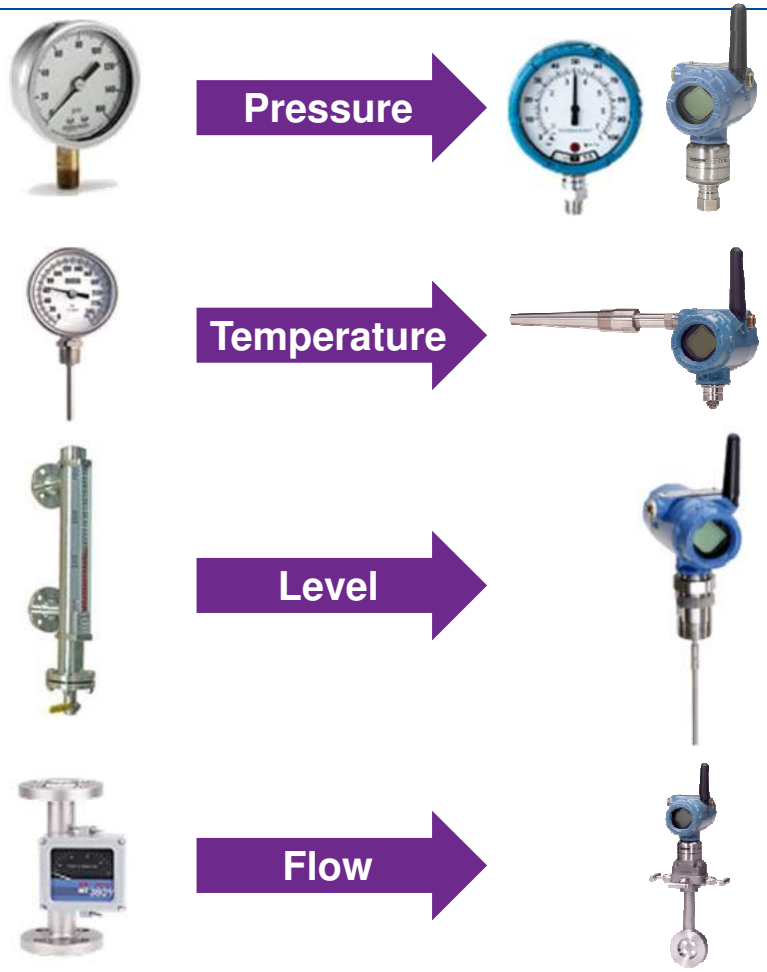
Infrequent, Manual Data ⟶ Reliable, Real-Time Digital Data

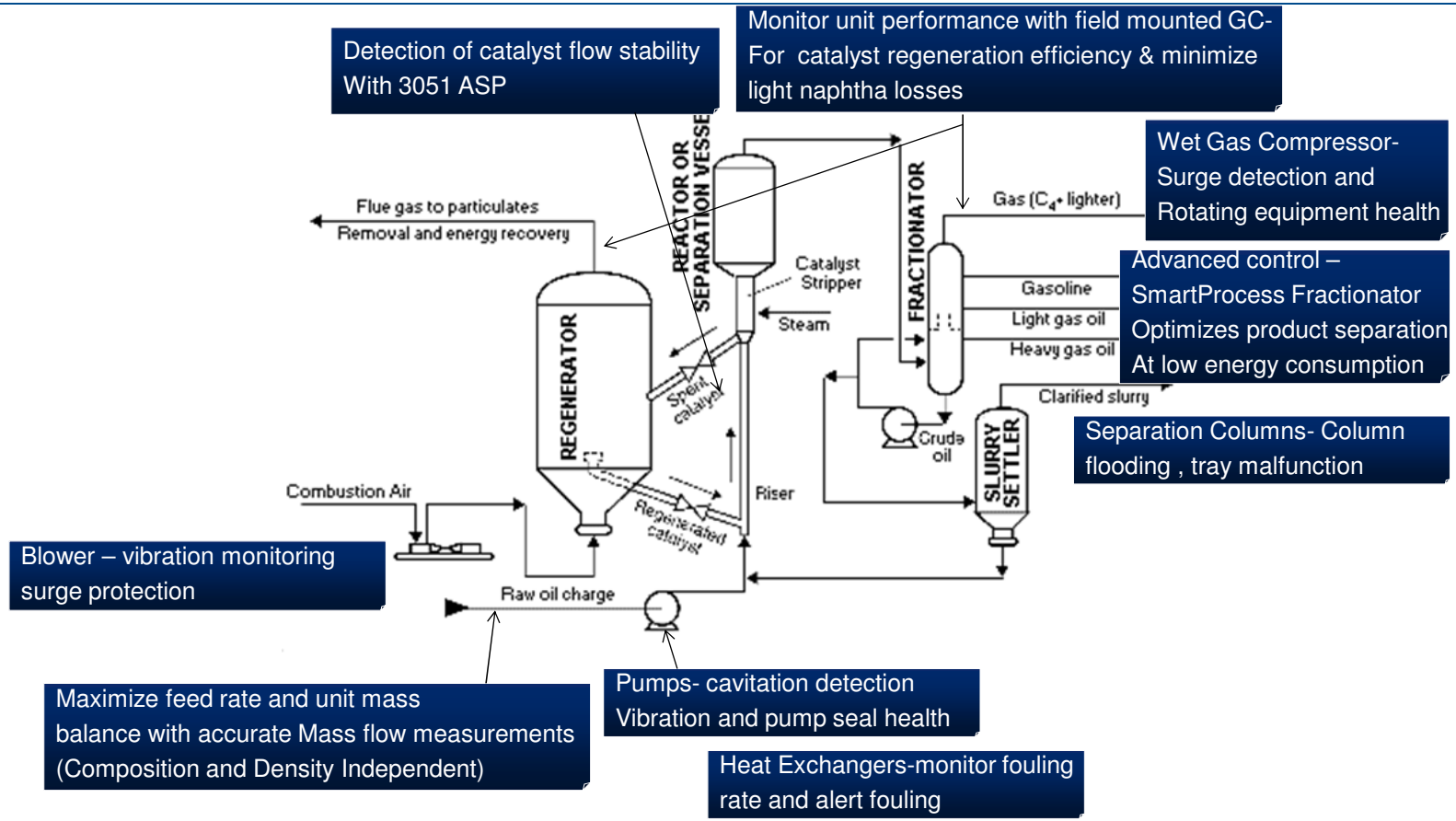
- Reduce Field Manual Readings
  - Dial Gauges
  - Sight Glasses
  - Dip Sticks
  - Corrosion Checks
  - Vibration Checks
- Results
  - Fewer Field Operator Rounds
    - Less Exposure to Hazardous or Unpleasant Plant Areas
    - Accurate Readings in Bad Weather
  - Early Indication of Potential Problems



IIoT Examples

Some plants are already benefitting from IIoT

IIOT Examples - FCC



IIOT – Refinery Cooling Tower

- **Problem Description:**
  - Cooling Tower instrumentation was old and most of it was out of service.
  - Local operators spend a lot of time to get process information.
  - The Cooling Tower efficiency couldn't be measured accurately.
- **Challenges:**
  - Implement a low installation and maintenance cost solution.
  - Improve cooling tower operator safety; measurements are taken in-place, manually.
  - Increase cooling tower reliability and efficiency.
- **Solution:**
  - Instrumentation of critical process variables, including: Rosemount wireless pressure transmitters , Rosemount wireless temperature transmitters, Rosemount wireless discrete input transmitters, Rosemount Analytical wireless pH transmitters, CSI wireless vibration transmitters and Smart Wireless Gateway.
- **Results:**
  - Smart Wireless technology reduced turnaround time and improved operator safety.
  - Improved Cooling Tower efficiency through accurate information from on-line measurements.

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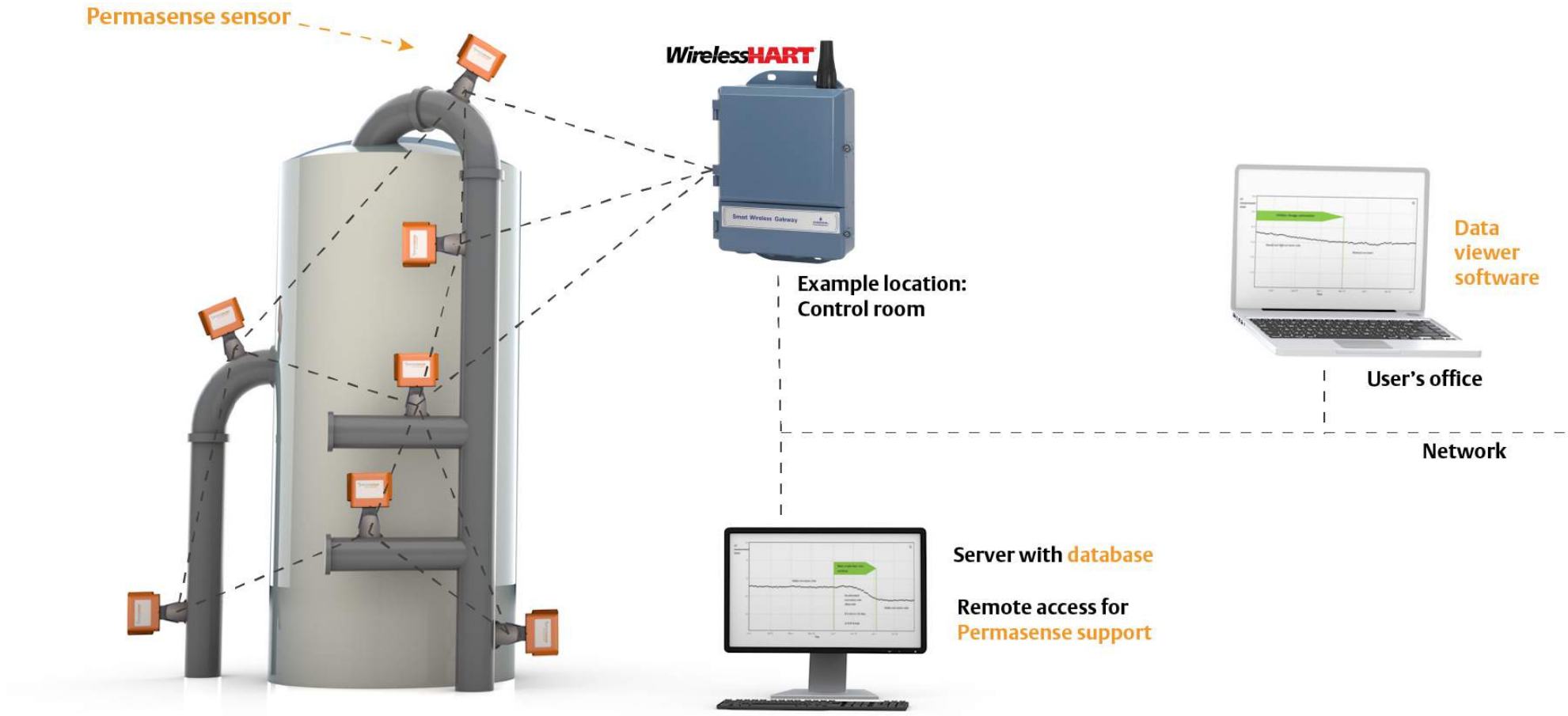
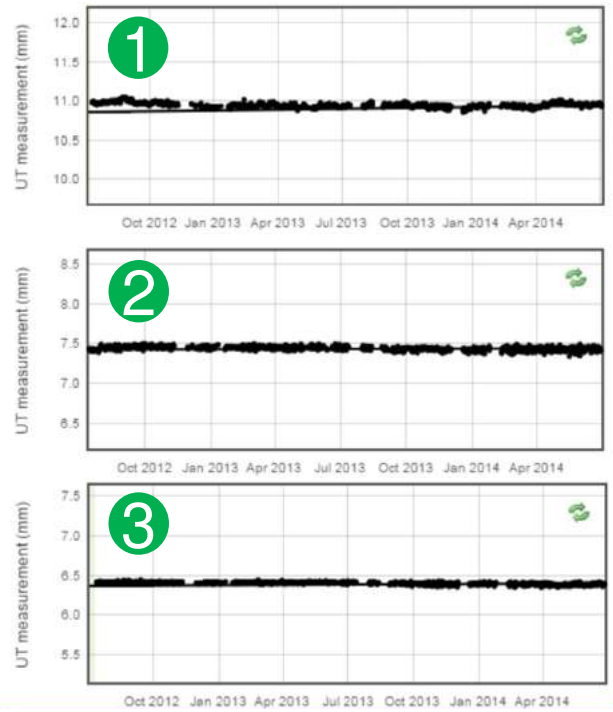
IIOT – Corrosion Monitoring



IIOT – Sulfur Handling – Corrosion Monitoring

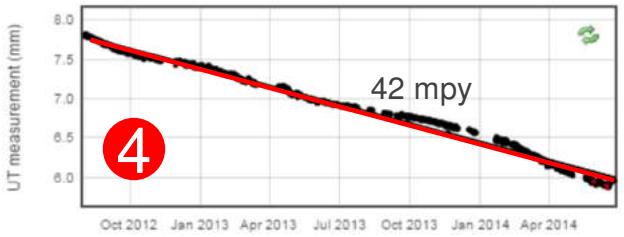
- **Refinery with four amine absorber / regeneration trains**
- **All similarly configured, all stainless steel – corrosion NOT expected**



- Much faster and **unexpected** corrosion in train 4
  - 1 year to retirement even in stainless !
- High CO2 content feed due to preferential routing of FCC off-gas to this train
- Carbonic acid attack mechanism

Results From IIOT Corrosion Monitoring

- Feeds redistributed to dilute effect of CO2 corrosion across trains and extend run length



IIOT Service Example: Control Valve Condition Monitoring

Submitted abstract for 2017 Emerson Exchange

Major Chemical Company Freeport, TX

CHALLENGE

- Connectivity to control valve diagnostic capabilities
- PM activities were not data-driven and were very expensive

SOLUTION

- Installed WirelessHART THUMS on Fisher DVCs
- Used WirelessHART connectivity to provide a Control Valve Condition Monitoring service

RESULTS

- Identified a potential failure on a critical valve that would have caused a **plant shutdown** for 2-3 days resulting in millions of pounds of lost product.
- Improved maintenance **work process** on control valves (data-driven)

"We would not have caught this condition ourselves. We would have run this valve to failure and it would have shut the train down for at least 2 days. This would have also affected a downstream plant that relies on this plant for product." - *Associate Reliability Manager*

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IIOT Architecture

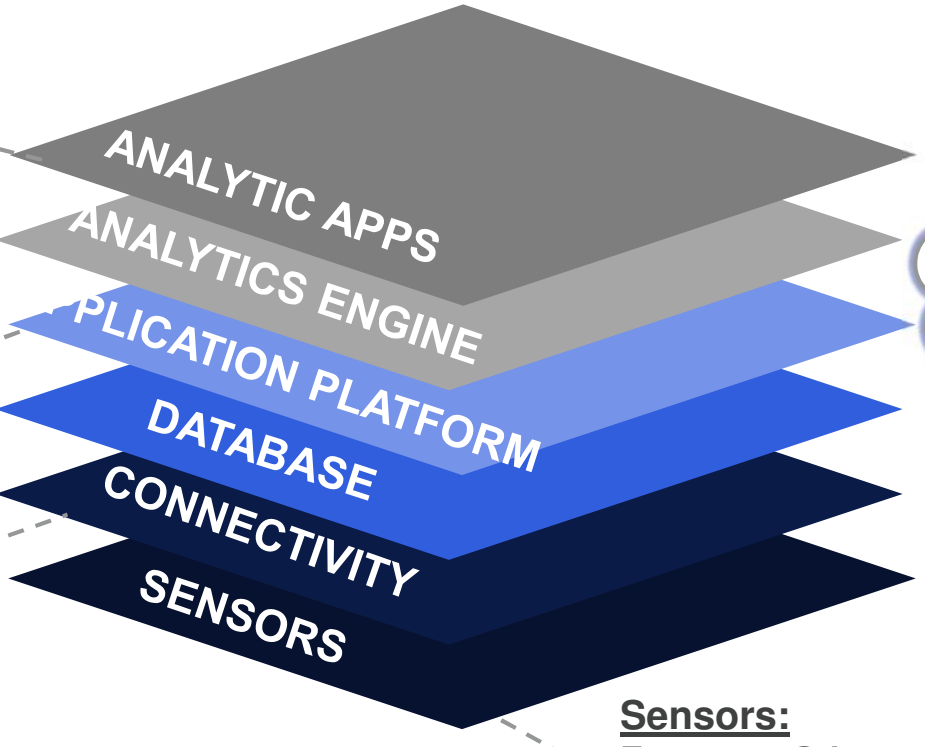
IIOT Architecture – Many Options

Analytic Apps:
Diagnose / predict anything you can imagine!

BI / Analytics Engine:
SAS, Tableau, Seeq, Azure ML, Batch Analytics

Platform & Programming:
PI, Hadoop, SQL, DocumentDB, MongoDB, Cassandra, Java, Python

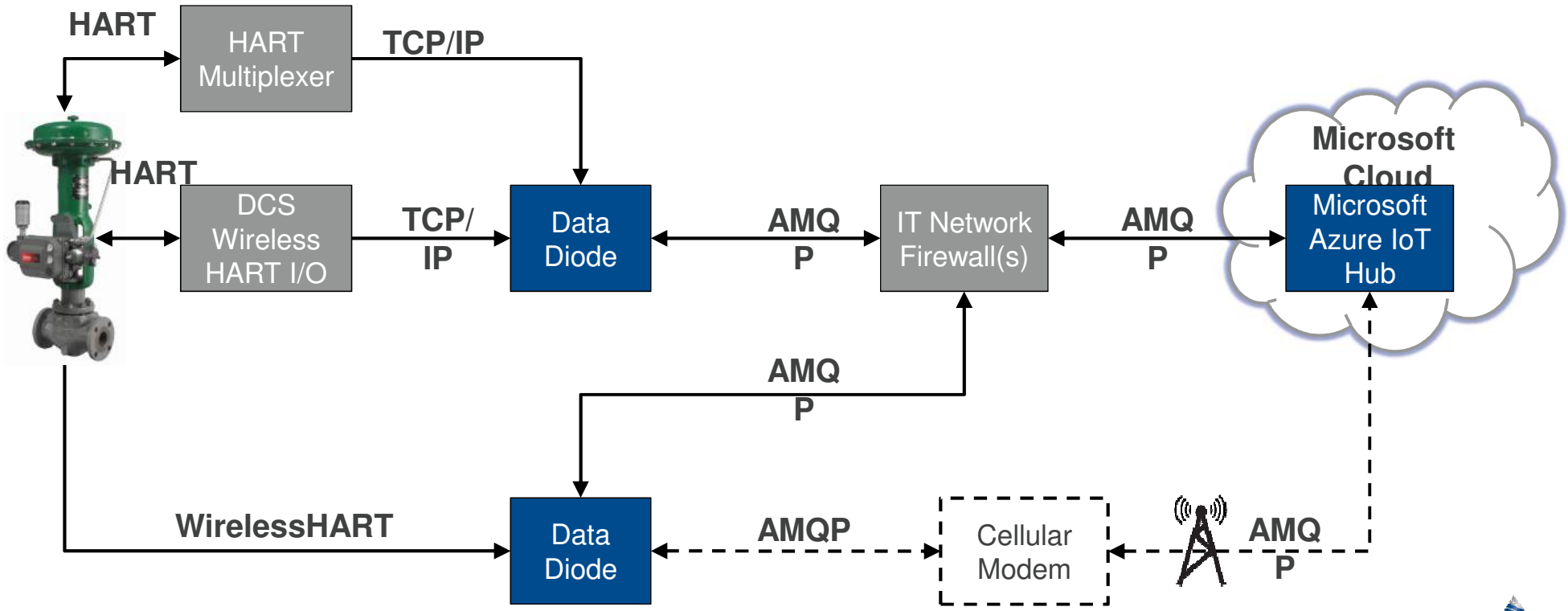
Connectivity:
HART, FF, OPC, Profibus, EthernetIP, MQTT, AMQP, DDS



Cloud Environments:
- Azure
- Predix
- Bluemix

Sensors:
Emerson, Others

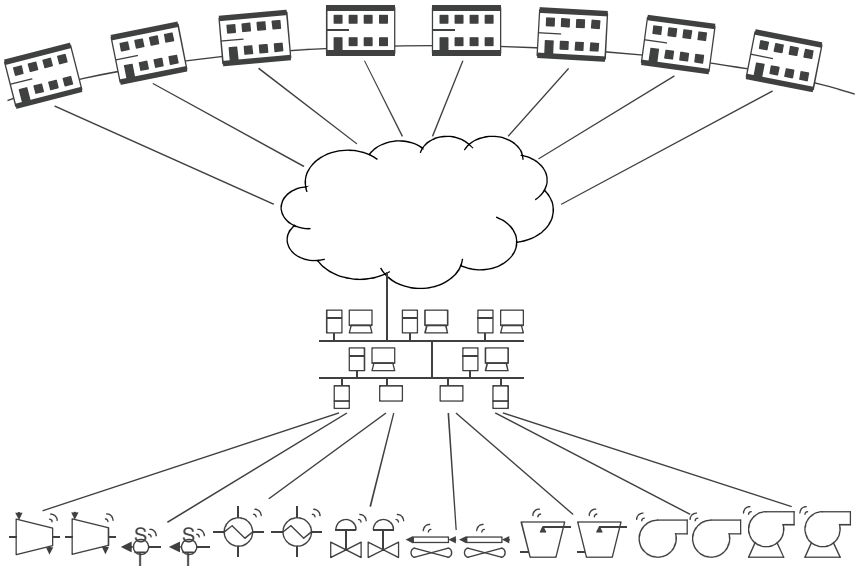
Prototype Plant Architecture For IIoT Service



What About Security?

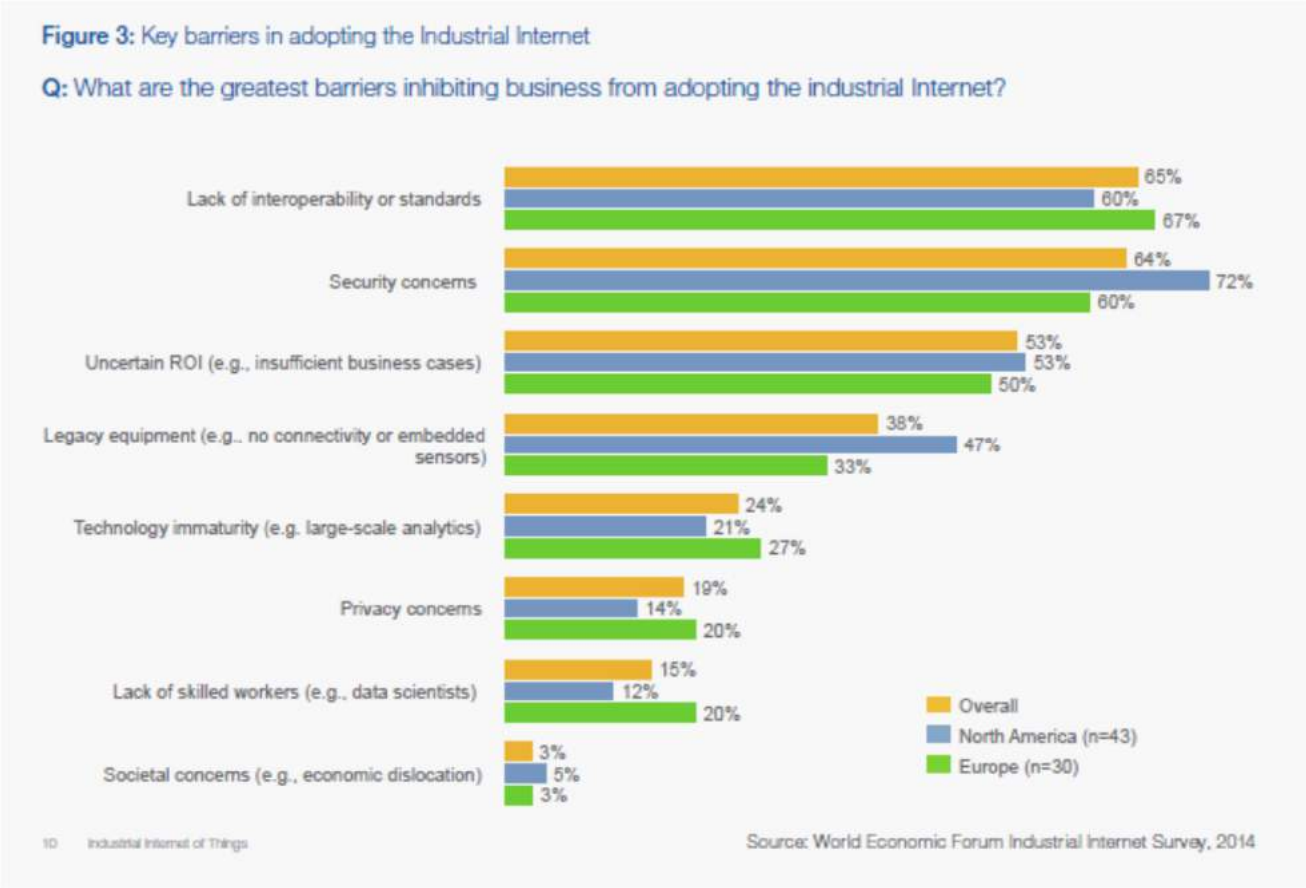
Multi-Vendor Cyber Security

- Multiple vendors may need access
  - Many asset classes
  - Many equipment manufacturers
- Proper access rights for each vendor
- Note – Read-Only Monitoring (No remote equipment changes)
- Such solutions already exist

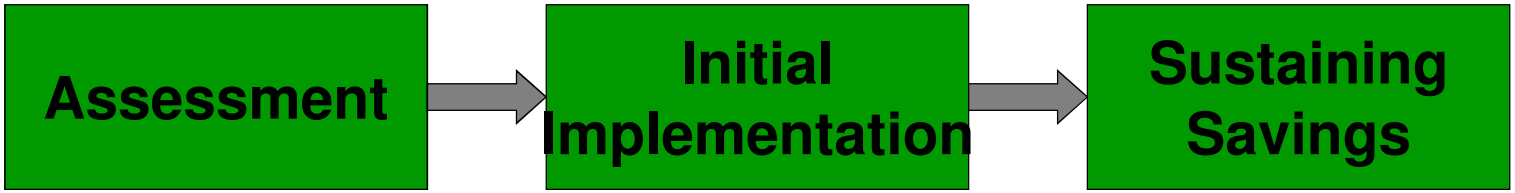


How To Get Started

Barriers To IIOT



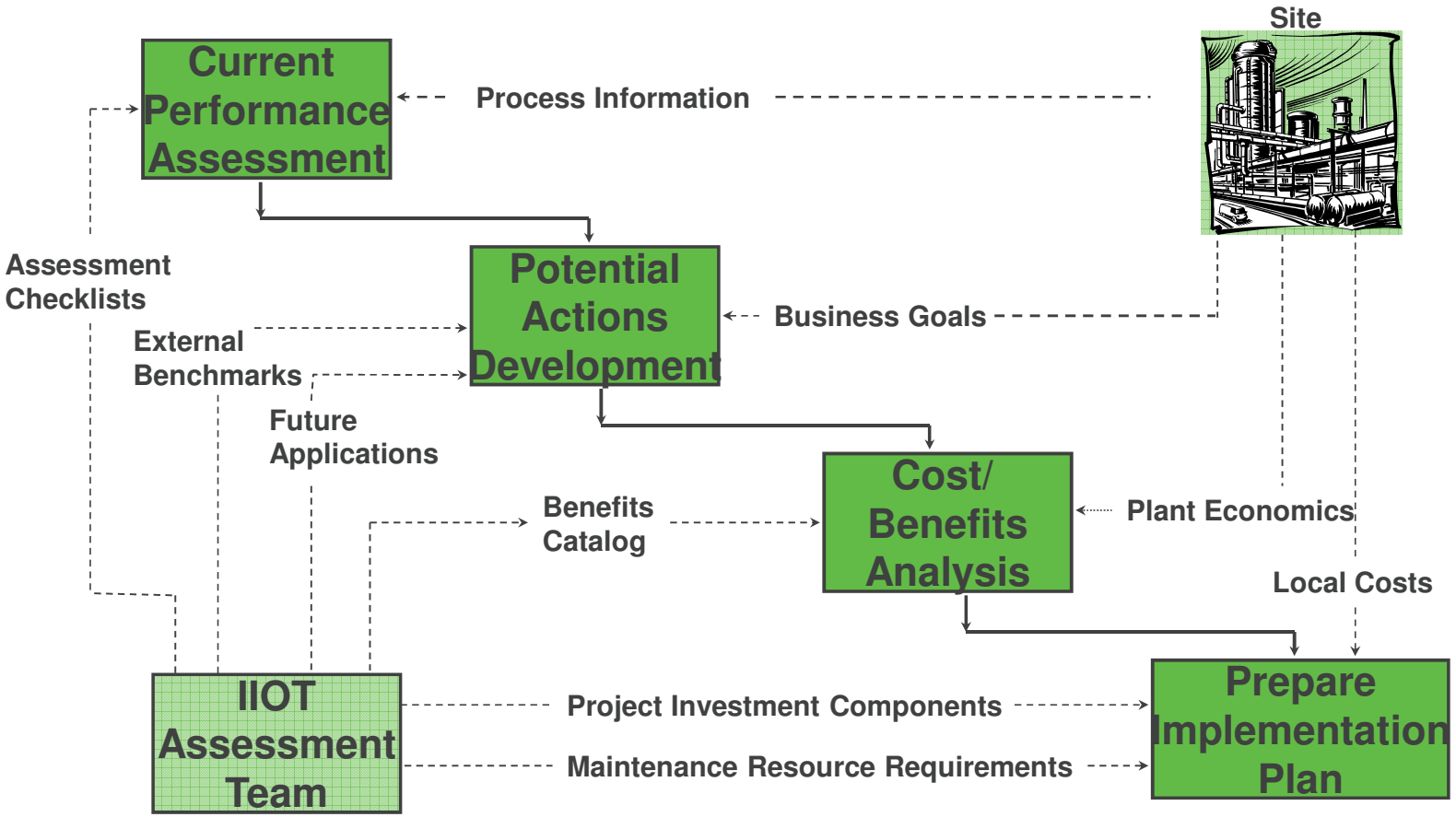
IIOT Program



Assessment Steps

- Get Organized
- Management Sponsor
- Find The Pain
- Pick The Low Hanging Fruit
- Estimate The Costs And Benefits
- Get Funding

Assessment Methodology



Prioritize Business Challenges

- **Can I increase throughput?**
- **Am I looking at the correct leading indicators?**
- **Are my plans on target?**
- **How do I find sources of fluctuations?**
- **Is my equipment performing correctly?**
- **How I detect future events before they happen?**
- **Will my equipment make it to the next turnaround?**

Technology with a Purpose
- Not technology for technology's sake

- Conduct a plant modernization audit...
- Collect needs from each department in the plant
- Pervasive use of sensors
- Each and every sensor has a purpose

Availability/ Reliability	Maintenance	Integrity	Energy	HS&E	Operations
•Manual data collection •Bearing failure •Mechanical seal failure •Corrosion	•Manual data collection •Heat exchanger fouling •Fouling in cooling towers •Cooling tower fouling •Fluid levels •Steam trap failure	•Manual data collection •Inhibitor injection	•Steam balance •Water balance •Flare and vent reduction •Compressed air balance •Pipe and flange leaks	•Safety showers •Manual valves •Hydrocarbon leaks	•Manual data collection

Sustaining The Program

Keys To Long Term Program Success

- **Accountability – Need To Have A Specific Individual Or Group Responsible**
  - **Need Top Management Sponsor And Support**
- **Visibility – Need Regular Reporting Of Results And Trends To Plant Management ($/ Yr Savings)**
- **Monitoring – Need Automated Calculation Of Equipment, Unit, And Site KPI's**

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Summary

- IIoT transforms how plant is run and maintained
  - More proactive
  - Less reactive
- IIoT transform how personnel work
  - Less time spent collecting data
  - More time to act on the new information
- The standards and technologies are already in place
  - You can start today
  - Some plants have already taken the first few steps

Thank You!