Harnessing the Power of Industrial IoT for Upstream Oil & Gas Production

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Jonas has over thirty years of experience in I&C and is responsible for helping plants adopt new technologies.
He is a subject matter expert in fieldbus, wireless, and IIoT.
Sits on the ISA104 and ISA108 standards committees and steering committee of the FieldComm Group in AP.
Author of two books, contributed to several others, and frequently featured in articles.
Editor of the IEC 61804-6 standard. Holds patents in safety communications.
Occasionally acts as adjunct lecturer.

Jonas Berge
Emerson Process Management

Topics Covered

- Case for Change: High performance to reduce cost and increase revenue
- Digital transformation of operation and maintenance work practices
- Digital ecosystem and IIoT-based connected services

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CASE FOR CHANGE: HIGHER PERFORMANCE TO REDUCE COST AND INCREASE REVENUE

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Addressing the Long-Term Business Needs of Operating Companies

Safety & Compliance

Fewer

Faster

Production

Greater

Reduced

Reliability & Maintenance

Reduced

Lower

Longer

Energy & Emissions

Reduced

Lower
Energy consumption

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It is Time to Modernize - Spend CapEx to Save OpEx

- CapEx deferred since oil price dropped
- Cannot defer CapEx indefinitely
- Spend CapEx now to reduce OpEx

- Cost of modernization solutions is low thanks to new technology:
  - Fieldbus
  - Wireless
  - Cloud
- Connected services have no CapEx outlay

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DIGITAL TRANSFORMATION OF OPERATION AND MAINTENANCE WORK PRACTICES

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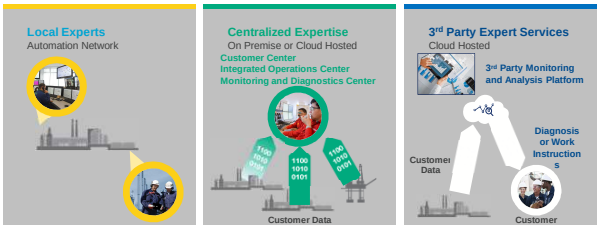
Evolving Deployment Methods for Operational Improvement



- Connecting the Data to Expertise Unlocks the Value of Industrial IoT

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Predictive Production Equipment Analytics

- Condition monitoring of production equipment
- Detect developing equipment problems early
  - Servicing while it is still simple, fast and at low cost
  - Before outright failure causes shutdowns and expensive repairs

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Offshore Platform: Minimum Intervention - Reduced offshore travel

- The platform is connected via a 512-kb/sec satellite link
- All essential offshore functions can be operated from onshore
- A fully functional asset management system enables remote instrument calibration, diagnostics and troubleshooting of Fieldbus devices

http://www.mb.com.ph/malampaya-natural-gas-field-to-remain-highly-productive/

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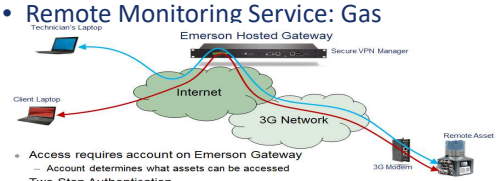
Coal Seam Gas Fields: Minimum Intervention

- Save 3 Days and $6K/trip, $100K/day in Mis-Measurement

- Remote Monitoring Service: Gas



- Access requires account on Emerson Gateway
  - Account determines what assets can be accessed
- Two Step Authentication
  - 1 - Username and Password Login
  - 2 - Random PIN code sent to Mobile phone for each login attempt
- Gateway generates a new VPN for each connection

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Second Layer of Automation for Digital Methodology

- Cost reduction from new digital work practices have been shared

Integrity: Corrosion and Sand Management
- Corrosion monitoring
- Erosion monitoring
- **Fewer incidents, longer life**

Reliability: Maintenance and Inspection
- Automatic data collection for maintenance and reliability
- Predictive diagnostics on Production equipment
- From preventive to predictive (condition-based) maintenance
- Prevent failures that lead to shutdown
- Connected services for monitoring equipment after-sales
- **Reduced downtime, longer life**

Production: De-Manning, Enhanced Oil Recovery
- Automate production and wellhead monitoring (no mechanical instruments)
- De-manning platforms
- **Reduced cost of operation**
- Gas lift and injection automation
- **Increased production**

Energy: Flare Reduction
- PRV monitoring to detect passing
- PRV monitoring to correlate releases with production and equipment condition
- **Reduced losses**

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DIGITAL ECOSYSTEM AND IIOT-BASED CONNECTED SERVICES

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Vision to Reality: 3-5 Year Deployment Roadmap for IIoT

Digital Field Networks → Instrument Assets → On-premise Analytics Software → Review Work Processes → IntRAnet of Things → IntERnet of Things

- Step 1 Plant-wide Digital Field Networks
- Step 2 Instrumenting Assets
- Step 3 Deploy Predictive Analytics Software On-premise
- Step 4 Review Work Processes
- Step 5 Enable Private IntRAnet of Things
- Step 6 IntERnet of Things Business Models

Technical White Paper Available

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Step 1 Plant-wide Digital Field Networks - Pervasive Networking

- Digital networking from the first meter
  - Low cost
  - Proven
- Covering measurements left out in the original design
  - Energy management
  - Reliability and maintenance management
- Sensors can easily be added to existing fieldbus networks
- Fieldbus sites also deploy wireless sensor networks

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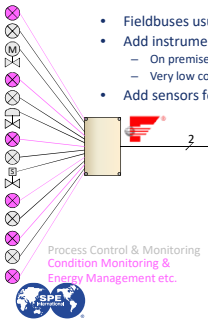
FOUNDATION Fieldbus for IIoT - Build on the Fieldbus You've Got



- Fieldbuses usually not fully populated
- Add instruments for equipment condition and performance monitoring
  - On premise or IIoT
  - Very low cost
- Add sensors for energy management

Control System
Condition Monitoring System & Energy Management System etc.

Process Control & Monitoring
Condition Monitoring & Energy Management etc.

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Step 2 Instrumenting Assets

- Today maintenance data and some operations data is collected manually
  - Not enough data for condition monitoring
  - Not enough data for ISO 50001 energy management
  - Many other blind spots
- Hardwiring additional 4-20 mA and on-off sensors for all this would be impractical:
  - Very costly
  - Risk of damaging existing installation

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Operational Certainty Discovery Session

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- No site walk down required
- Domains reviewed
  - Production
  - Reliability & Maintenance
  - Health, Safety, & Environmental (HS&E)
  - Energy Efficiency & Loss Control
- Report

• How many operator round pressure, temperature, choke position, etc. points should be automated?
• How many separators should be monitored?
• How many storage tanks should be monitored?
• How many pumps are critical and should be monitored? • Are mechanical seals monitored as per API standard 682, edition 2014 (using transmitters)?
• How many pipe lines experience corrosion and should be monitored?
• How many maintenance round (portable) vibration, temperature, steam trap, valve leak, and corrosion test points should be automated?

Description Available

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Mexico: Wellhead Control Panel (WCP) - Centralized monitoring or remote WCP status

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Operational Benefits

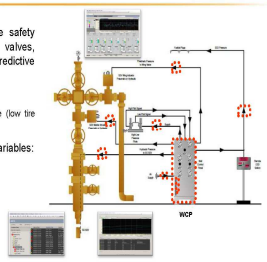
•Monitoring failure indicator for sub-surface safety valves, master, wing, choke and gas lift valves, providing information to perform predictive maintenance and avoid mistakes such as:

- ✓ Lost pressure in pneumatic and hydraulic actuators
- ✓ Fire detection system using a pneumatic plug fuse (low tire pressure plug each has a selected area system)

▪ Predictive monitoring of main operational variables:

- ✓ low pressure air supply
- ✓ low pressure hydraulic supply
- ✓ low hydraulic fluid
- ✓ total emergency well closure (front panel control well)
- ✓ state drive station emergency closing.
- ✓ leak in the hydraulic and / or pneumatic main circuit.
- ✓ health trends of the well control board.

▪ Information about Platform shutdown.



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INSPIRING INGENUITY

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USA: Piping / Flow line - Detect sand and Wax Buildup Issues

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Wireless Benefits in Upstream Flowline Monitoring

- Determine flowline and well head issues
  - Provide additional data on existing facility with minimal cost
  - Diagnose sand/wax buildup issues in piping

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ELEVATE EVERY EXPERIENCE

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USA: Separators – Flare Reduction

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Small Well Pads

- Three Phase Separator

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← Pressure Transmitter for vessel gas pressure

→ High Level Switch for system shutdown to avoid fluid to combustor or flare

→ Temperature Transmitter to measure fluid temperature to optimize oil separation

INSPIRING INGENUITY

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USA: Tank Farm - Tank overfill prevention

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Central Tank Battery

- Tank Farm

- Guided Wave Radar Level Transmitters

Give level and interface readings to monitor tank levels in water and oil tanks. Interface level can be used for recycling of tanks back into separators.

Level readings help reduce the amount of times an operator has to climb on top of the tanks, reducing exposure to possible H2S

- High Level Switch

Used for system shut down to avoid and liquid spills

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USA: Energy Efficiency & Loss Control - PRV Monitoring for Flare Reduction

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Wireless Acoustic Transmitter Installation

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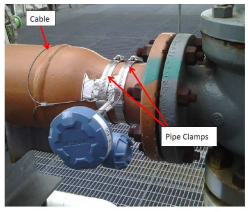

ELEVATE YOUR EXPERIENCE

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Brazil: Reliability - Pump Condition Monitoring

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Problems and challenges

- Problems:
  - 12 critical motor-pumps sets (10 Oil Export and 2 Cooling water system)
  - Problems related to vibration; mostly in bases and bearings, ex. mechanical seal failure and bearing replacement
  - Installed vibration monitoring system is not working properly
  - Off-line vibration analysis haven't been effective and requires periodical assistance each 2 months.
  - Repair components is expensive and require complicated logistic
  - Disturbance in the process is confused with misalignment



Build on Your Knowledge.

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Brunei: Safety - ESD Valve Status and Performance Monitoring

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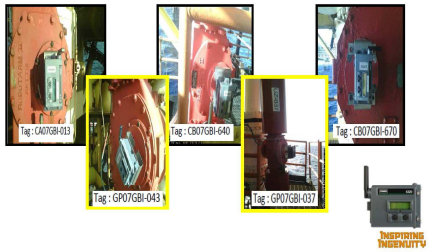
The Solution – Pilot Site



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Step 3 Deploy Predictive Analytics Software On-premise

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- Analytics software:
  - Equipment condition monitoring
  - Equipment performance monitoring
  - Energy management
  - Valve condition monitoring
  - Corrosion monitoring
  - Sand monitoring
  - Vibration monitoring
  - Steam trap monitoring
- Most automation software use OPC to access the data
- Specialized applications may use FF-HSE and HART-IP

Vibration alone is not sufficient for condition monitoring

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Smart Connected Equipment

- Sensors and software turn dumb equipment into smart connected equipment

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Analytics Software

- The software can run on a server at site; on-premise
  - Cloud is not a must
- Low cost solution: readymade analytics applications as opposed to "roll-your-own" general purpose analytics

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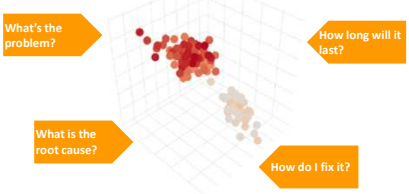
"Hide" Complexity of Data Science from End-Users

- Reliability and maintenance engineers do not know data analytics
- General purpose analytics software does not solve the maintenance challenge



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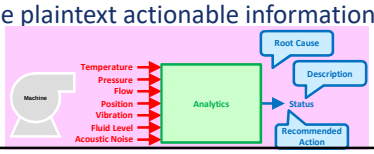
Easy Apps

- Analytics apps detect and diagnose these early signs of trouble
- Software predictively notify reliability and maintenance personnel at the sign of trouble
- Analytics is "hidden" from user
- Simple plaintext actionable information



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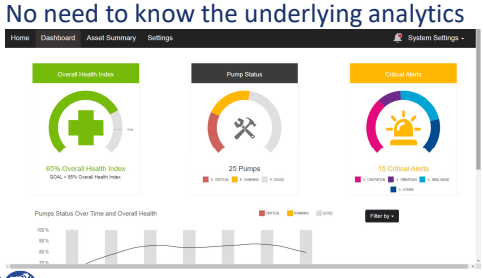
Production Equipment Health Dashboard

- No need to know the underlying analytics



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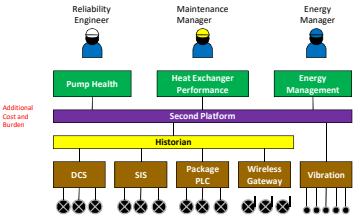
Duplicating Existing Platform - Duplicating Cost and Work



- Duplication
  - Complexity
  - License cost
  - Software maintenance cost
  - Administration burden:
    - User accounts
    - Software updates
    - Patches
    - Security
- Who support the additional system layer?
  - IT department
  - I&C department
  - Collaborative effort

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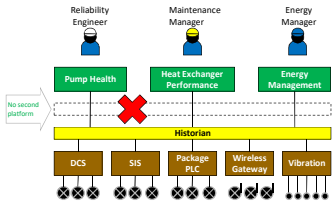
Simpler Architecture - Lower CapEx, Lower OpEx



- Use existing historian
  - Reduced complexity
  - Lower investment cost
  - Lower ongoing support cost
- No second platform system layer
- Analytics apps plug directly into the historian

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Step 4: Review Work Processes - Check the Software First Mindset

- Modify the Standard Operating Procedures (SOPs)
  - Include the new data and information
- Incentivize personnel to follow the new data-driven workflow
- Train staff to use the new data, software, and information

Example
If heat exchanger is not performing, the first course of action should not be to walk to the equipment, but to check the software first

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Step 5: Private IntRAnet Connection

- Manage equipment at all the company's sites around the world from the same office
  - Onshore, offshore, and downstream
- Analysis, decision making, and planning
  - Maintenance, reliability, and integrity
  - Energy efficiency
- Shared pool of experts
  - Vibration monitoring, control valves, steam traps, etc.
- De-manning offshore installations
  - Personnel working from onshore offices

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Step 6: IntERnet of Things Enabling New Business Models

- Access by selected external service providers anywhere
- IIoT enables a digital transformation of outsourced business models
- No access to production operations
- New business models; connected services
  - Including underlying instrumentation and infrastructure at site
  - No CapEx, no assets on the books, service fee is OpEx

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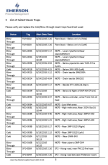
Connected Services: Data (Reports) not Devices

Exception Report

- Tag, fault, date, location, recommended action etc.



Monthly Savings Report

- Production loss, financial loss, CO2 emission, equipment failure rates etc.

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Connected Services: New Business Model

Traditional Purchase

- Plant buys the devices
- Investment (CapEx)
- Plant personnel interpret data
- Plant personnel support the system
  - Transmitters
  - Sensor network
  - Server
  - Software

Connected Services

- Provider owns the devices
- Subscription fee (OpEx)
- Provider generates reports
- Provider supports the system

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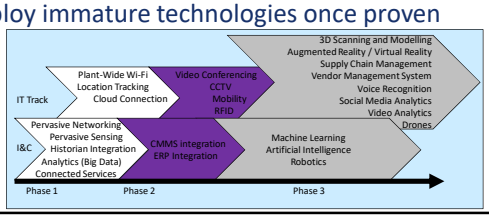
Phased Digital Transformation - Proven Technologies in Phase 1 and 2: Low Risk

- Many exciting digital technologies available
- IIoT requires just a few of these technologies
- Start with proven technologies
- Deploy immature technologies once proven

Spend capital wisely



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CONCLUSION

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Summary

- Case for Change: High performance to reduce cost and increase revenue
- Digital transformation of operation and maintenance work practices
- Digital ecosystem and IIoT-based connected services

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I'm Listening...

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