Asset Management and CBM+

Chris Crosby, Principal - US Federal

April 16th, 2015

OSIsoft.

Asset Management - ISO 55000, 55001 and 55002

Early last year (January 2014), the International Organization for Standardization released a set of three standards (ISO 55000, 55001 and 55002) addressing the terms, definitions, requirements and guidance involved with implementing "asset management systems." These standards acknowledge that "asset management is data intensive and new tools and processes are often necessary to collect, assemble, manage, analyze and use asset data."

CBM+ DOD Definition

At its core, CBM+ is maintenance performed based on evidence of need, integrating RCM analysis with those enabling processes, technologies, and capabilities that enhance the readiness and maintenance effectiveness of DoD systems and components. CBM+ uses a systems engineering approach to collect data, enable analysis, and support the decision-making processes for system acquisition, modernization, sustainment, and operations." CBM+ can be thought of simply as connecting maintenance and logistics and once again, proper data management that emphasizes actionable data is a key success factor."

Why Are We Here Today?

The CBM+ strategy was originally promulgated as DoD policy in a memorandum signed by the Deputy Under Secretary of Defense (Logistics and Materiel Readiness) in November of 2002. This memorandum directs that CBM+ be "implemented to improve maintenance agility and responsiveness, increase operational availability, and reduce life cycle total ownership costs."

Why Are We Here Today?

"DoD activities should establish a CBM+ environment for the maintenance and support of weapon systems by establishing appropriate processes, procedures, technological capabilities, information systems, and logistics concepts. For example, this environment will include the following: integrated maintenance and logistics/supply chain, configuration management, and financial information systems.

This integration is made more difficult because the data in each of these areas traditionally has been kept in different information systems. Implementation of the CBM+ data warehouse concept may help alleviate this issue. Business rules should require use of the full range of monitoring capabilities to ensure full accuracy and timeliness of condition monitoring results.

This means that as the ability improves to collect and store greater amounts of more accurate condition data, the analytical software algorithms can deliver increasingly more accurate predictions of failure and related information.

To achieve greater integration, CBM+ suggests tying together various data sources, or at the very least, interfacing data sources and analytical systems using common standard protocols. Modern CBM+ analytic software should offer integrated condition monitoring and analysis capability, which permits the effective integration of different forms of analysis and other condition data into combined management information reports." DOD CBM+ Guidebook

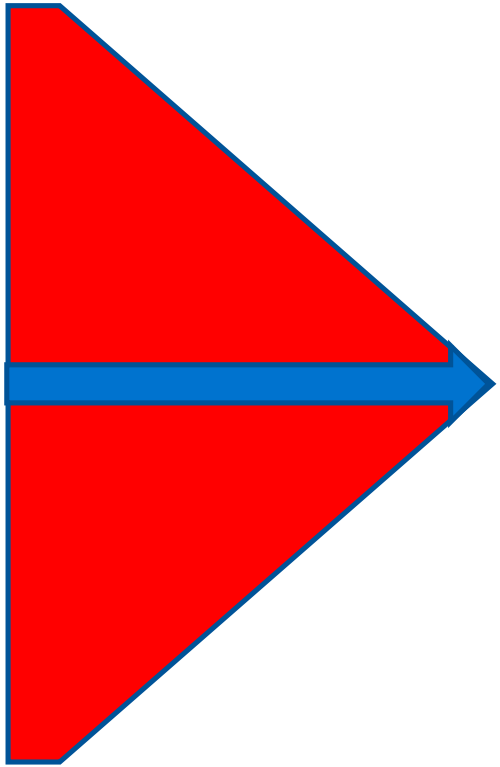
Why Are We Here Today?

"Together we can provide the warfighter with the very best commercial practices and technologies that United States industry has to offer." Dean G. Popps, Acting Assistant Secretary of the Army, Acquisition, Logistics and Technology. Given such a noble and straightforward objective, what do we still need to do to make it happen?

"I don't know what the hell this logistics is that (General) Marshall is talking about, but I want some of it!" Admiral Ernest J. King, Chief of Naval Operations

Technology Trends Enabling Improved Equipment Reliability

- Digitalization increasing
- Sensor costs dropping
- Secure, wireless use increasing
- Historian evolution
  - Asset perspective
  - Complex event streaming
  - Multiple data types
  - Thick and thin client visualization tools
- Interfacing made easy
- OT to IT to SI (Security Information) integration
- Internet of Things/Everything
- Predictive analytics/advanced pattern recognition/big data in-memory analytics



Lower cost & time saving methods to improve equipment reliability!

OSIsoft CBM Montage

Remote Condition Based Monitoring and Proactive Asset Management for Caterpillar

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Governmental/Defense

- Whether it is standard products, modification of existing products, or entirely new products, **Caterpillar Defense & Federal Products** is committed to all branches of the military and to U.S. federal civilian agencies.
- As part of a U.S. federal civilian agency working in rural America or as part of a military unit stationed domestically or deployed overseas, you have a unique set of requirements to work with when purchasing machines that many other businesses may not deal with such as:
  - Making sure your equipment has **minimal downtime** regardless if you are plowing emergency routes or are on military missions around the world

Machine Applications - Modified and Newly Designed Machines

US Army Programs

- Bulldozers – Cat D6K and D7R-II track-type tractors
- Wheel Loaders – Cat 924G and 966H wheel loaders
- Motor Graders – Cat 120M motor graders with joystick controls
- Airborne Scraper and Water Distributor System (ASWDS) – Scrapers and water distributors modified to be helicopter airlifted and Low Velocity Airdropped (LVAD) from a C130 aircraft for the US Army and USMC
- CS-433C and CS563D Vibratory Rollers – Air-deployable rollers modified to meet military specifications
- Mine clearing/Armor Protection (MCAP) – Kits to protect operators and sensitive machine components on Cat D7G
- Wheel Tractor-Scrapers - Cat 621G Scrapers

Other Major DOD Programs

- US Air Force 10K All Terrain ForkLift (ATFL) – Cat 930K wheel loader with military modifications
- USMC/US Army 277C MTL – Cat 277C Multi Terrain Loader is a rubber belted skid steer machine with military modifications for sling loading, and removable cab with crew protection kit
- USMC/USN/USAF BHL – Cat 420 backhoe loaders modified to meet military specifications
- US Navy Machines – Recent US Navy programs include the following models: D6K, D6T, D7R-II, and D8T bulldozers, 924H and 966H wheel loaders, 963D track loader, 120M motor grader, 730 and 770 trucks, 613C-II and 621G scrapers and 621G water distributor, CS-56, PS150 and 815F-II compactors, 420E backhoe loader and AP655D paver.

A History of Progress

CATERPILLAR®

1925: Holt & Best companies merge into Caterpillar Tractor Co.

1960-1970: Rapid global expansion

2001: Joined World Business Council for Sustainable Development

1925	1930	1940	1950	1960	1970	1980*	1990	2000	2010	2011
$13.8 Million	$45.4 Million	$73.1 Million	$337.3 Million	$716 Million	$2.1 Billion	$8.6 Billion	$11.4 Billion	$20.2 Billion	$42.5 Billion	$60.1 Billion

1931: First diesel track-type tractor

1942: Cat machines serve in World War II

1986: Factory modernization

2011: Acquired Bucyrus International, Inc.

* In 1978, the company began reporting Sales & Revenues

A Global Reach

- Global reach and presence is unmatched in the industry
- Serve customers in more than 180 countries around the globe
- More than half of our sales are outside the United States
- Manufacturing, marketing, logistics, service, R&D and related facilities along with our dealer locations total more than 500 locations worldwide

Dealers

- 188 worldwide with more than 126,000 employees
- Independent, locally owned
- Key competitive advantage

A Broad Range of Products and Industries

Cat equipment – more than 3 million pieces globally – is at work for our customers on highways, rail lines, oceans and rivers, in forests, quarries, mine sites and oil fields.

The Next Great Chapter in Mining

Mining Equipment Management

Availability + Component Life + Rebuild Cost = Cost / Hr Cost / Ton

Maintenance & Repair Process

- Preventative Maintenance
- Condition Monitoring
- Planning & Scheduling
- Repair Mgmt
- Component Mgmt
- Backlog Mgmt
- Parts Mgmt
- Training
- Performance Evaluation
- Continuous Improvement

Application Changeable Non-Changeable

- Mine Location
- Pit Design
- Haul Road Conditions
- Truck Loading

Component Life Management

- Component History Mgmt
- Component Database Mgmt
- Component Performance Rpt
  - Product Groups
  - Regions / Dealers
- Unique Component Identifier
- Statistical Life Projection
- Assist CPI Find-it prioritization

Component Renewal

- Repair Management
- Rebuild Mgmt (CRC)
- Salvage Mgmt (Shop)

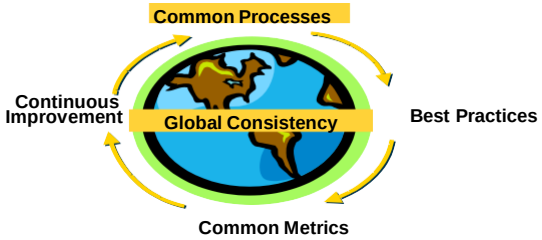
Product Quality & Reliability

- Designed Life
- CPI Issues Fix
- Serviceability
- Parts Commonality
- Failure Reporting

MARC Management

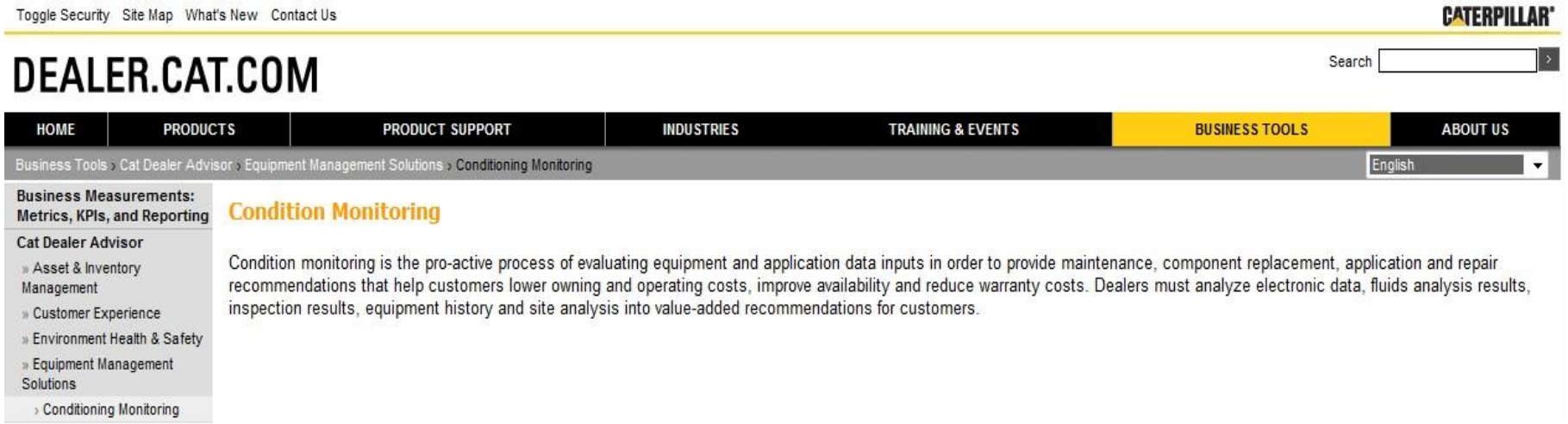
- Market Strategy
- Rate Development
- Risk Analysis & Quantification
- Strategy Development & Implementation
- Financial Management

WHEREVER THERE'S MINING



CAT®

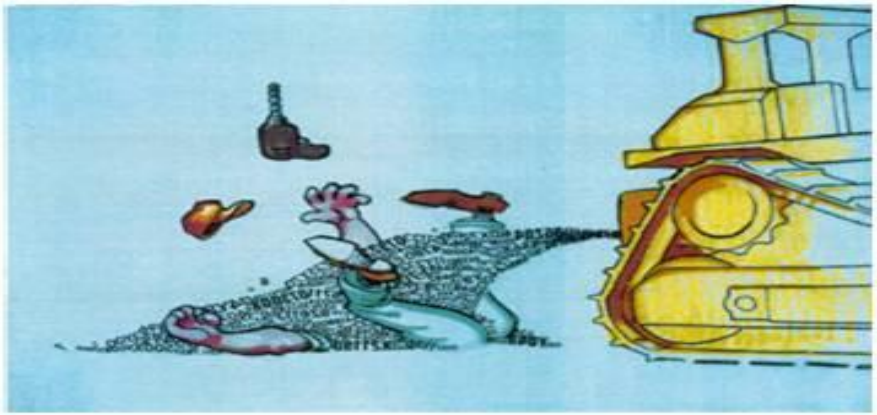
Common Definition

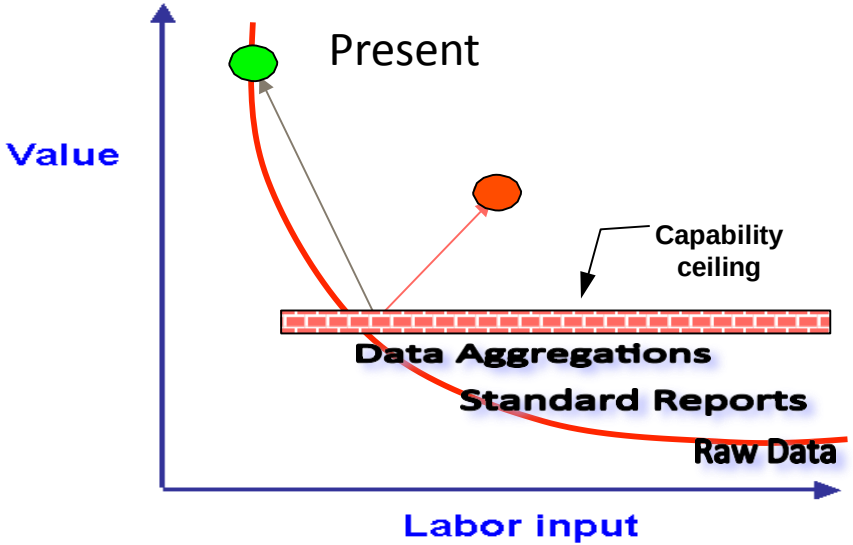


… the proactive process of evaluating equipment and application date inputs in order to provide maintenance, component replacement, application and repair recommendations that help customers lower owning and operating costs, improve availability and reduce warranty costs. Dealers must analyze electronic data, fluid analysis results, inspection results, equipment history and site analysis into value-added recommendations for customers.

Condition Monitoring

Past

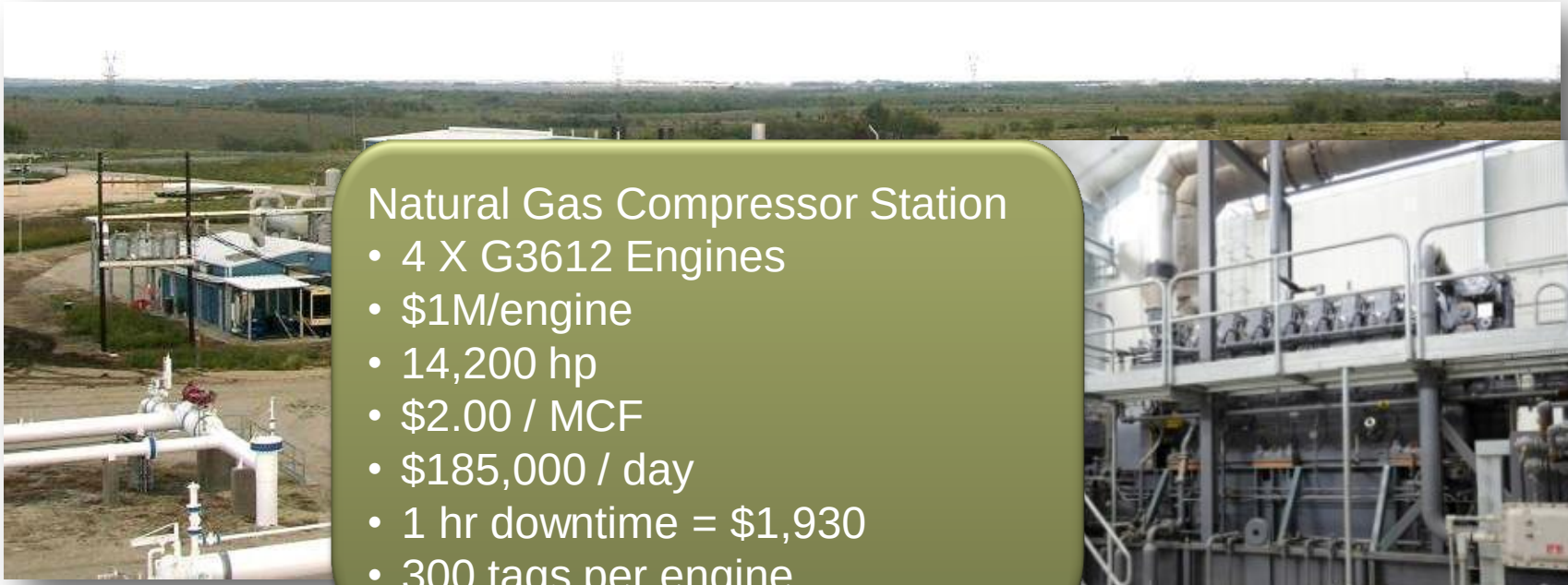




From information overload…….

……to actionable intelligence

Power for Natural Gas Compression

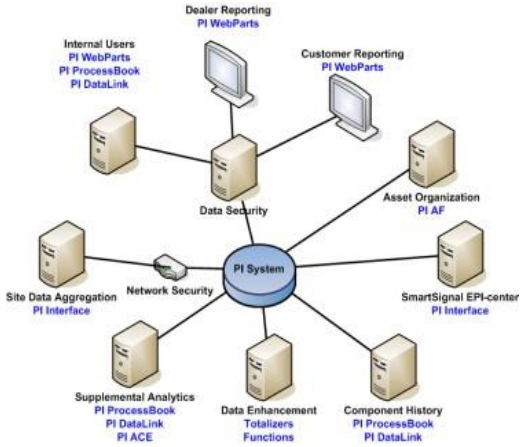


Natural Gas Compressor Station

- 4 X G3612 Engines
- $1M/engine
- 14,200 hp
- $2.00 / MCF
- $185,000 / day
- 1 hr downtime = $1,930
- 300 tags per engine

Why the PI System?

- Proof of Concept Identified Gaps
  - Aggregate Data from Various Industrial Controls, not just engines
  - Visualization to Facilitate Root Cause Determination
  - Data Archiving for “cradle-to-grave” Analysis
  - Additional Analytics
  - Platform for Information Distribution
- Core Competency
  - Manufacturing Highly Durable and Reliable Machines
  - Not Data Management Software
- Time and Cost to Market
- Common Platform to Customers Using the PI System



5 Key Processes to Making Data Actionable

Aggregating Data

Data Types
- Analog
- Derived
- States
- Faults

- Once per Second
- PI Interfaces
- Cat & non-Cat Products

5 Key Processes to Making Data Actionable

Transmitting Data

- Cell
- Satellite
- DSL
- Customer Network
- PI-to-PI Interface
- Other Historian to PI System

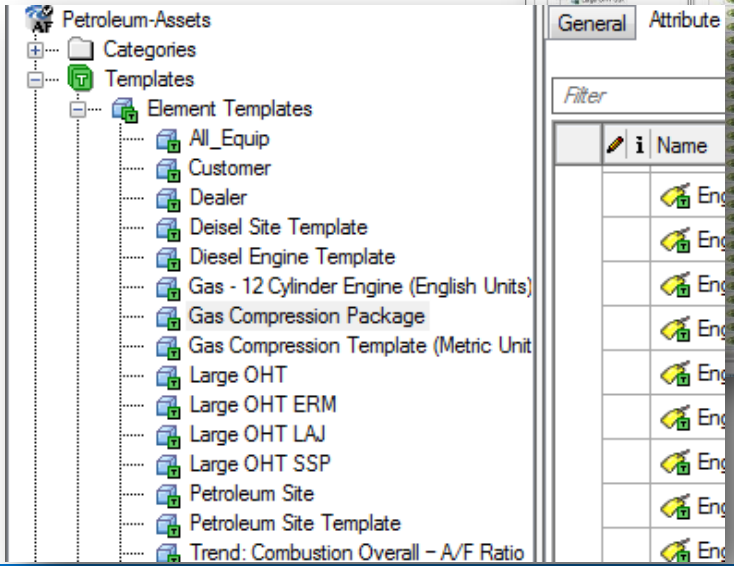
5 Key Processes to Making Data Actionable

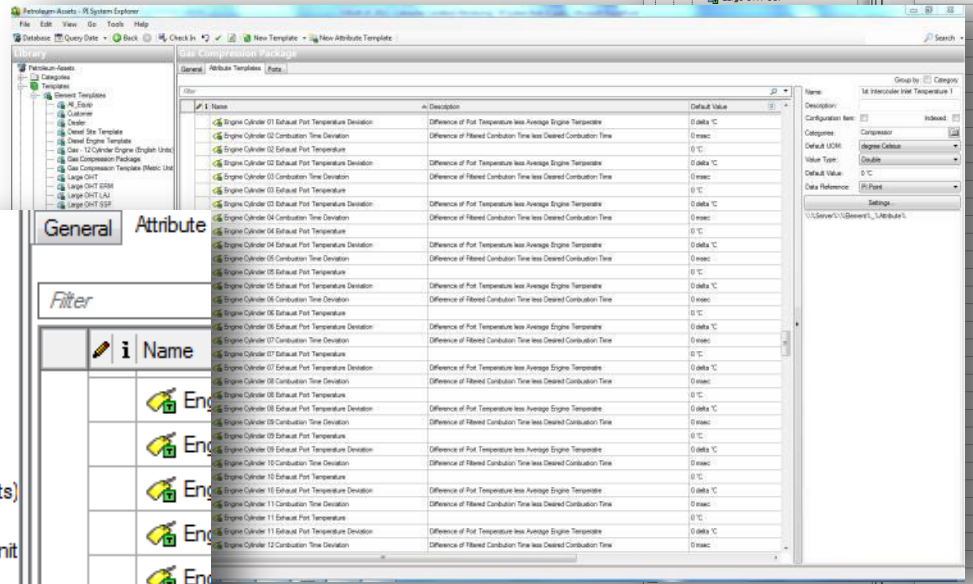
Finding Exceptions
GE SmartSignal EpiCenter
Non-parametric, Multivariate Data Analysis

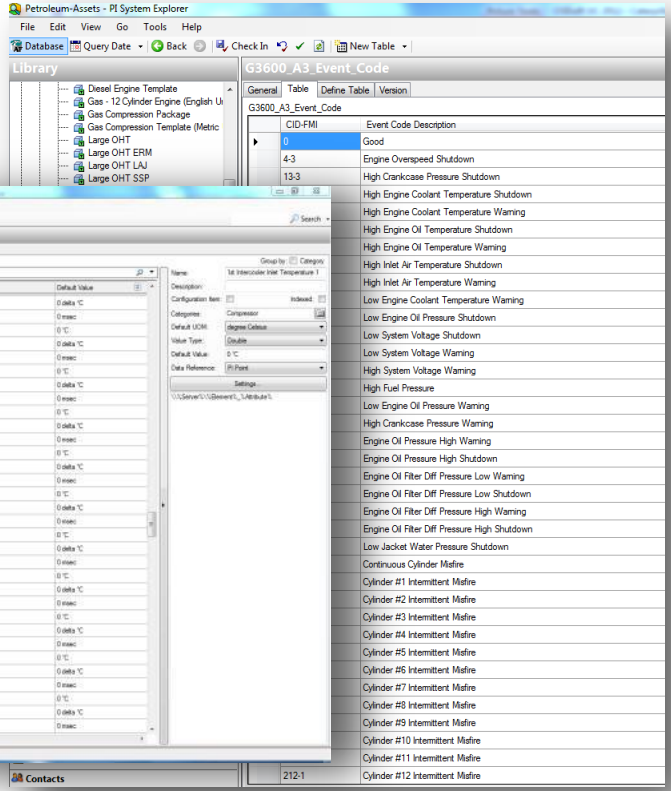
5 Key Processes to Making Data Actionable

PI AF

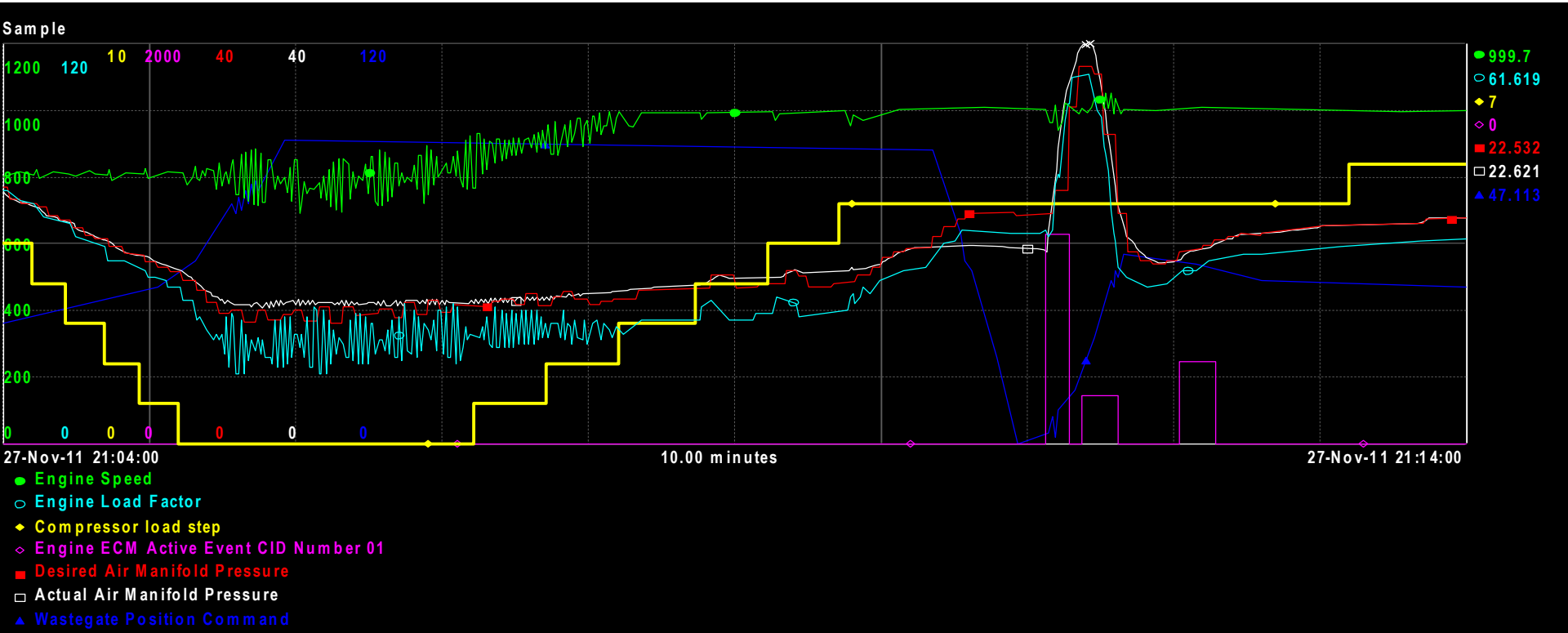
- Security
  - Network
  - Data
- Scalability





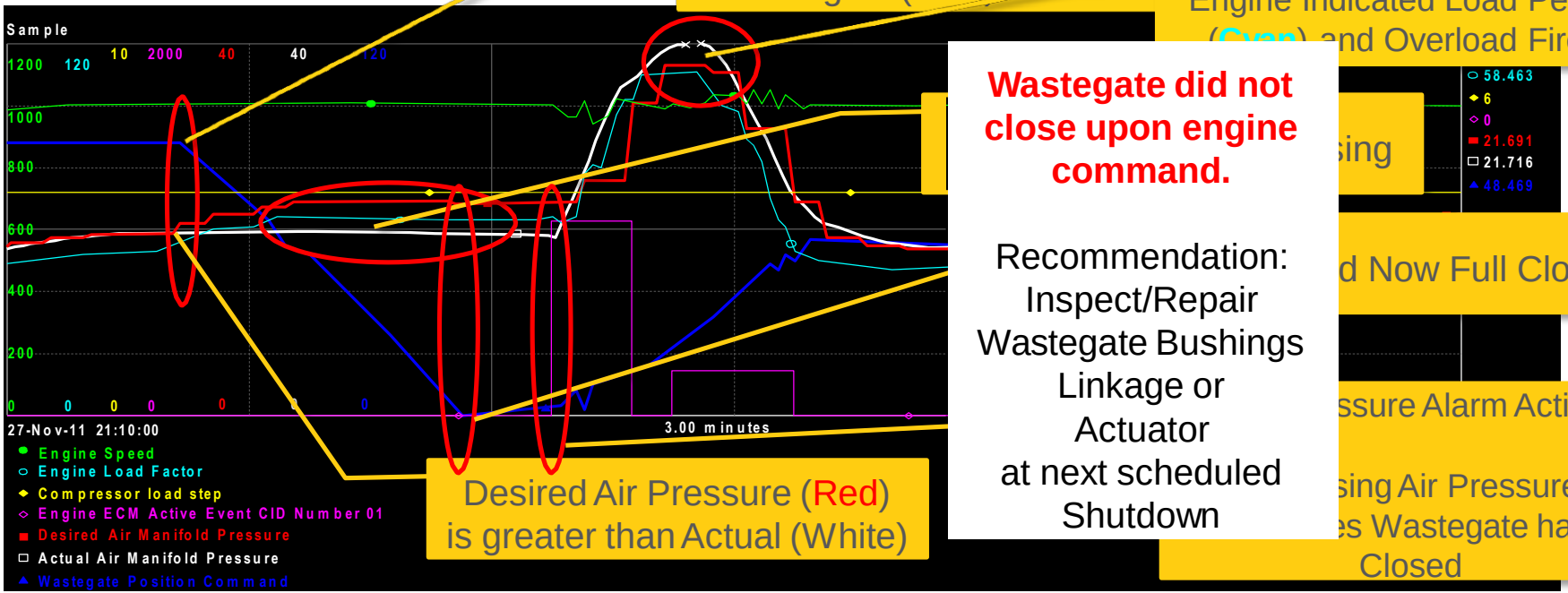


High Fidelity Data



High Fidelity Data

- **Event begins and ends in 3 minutes!**

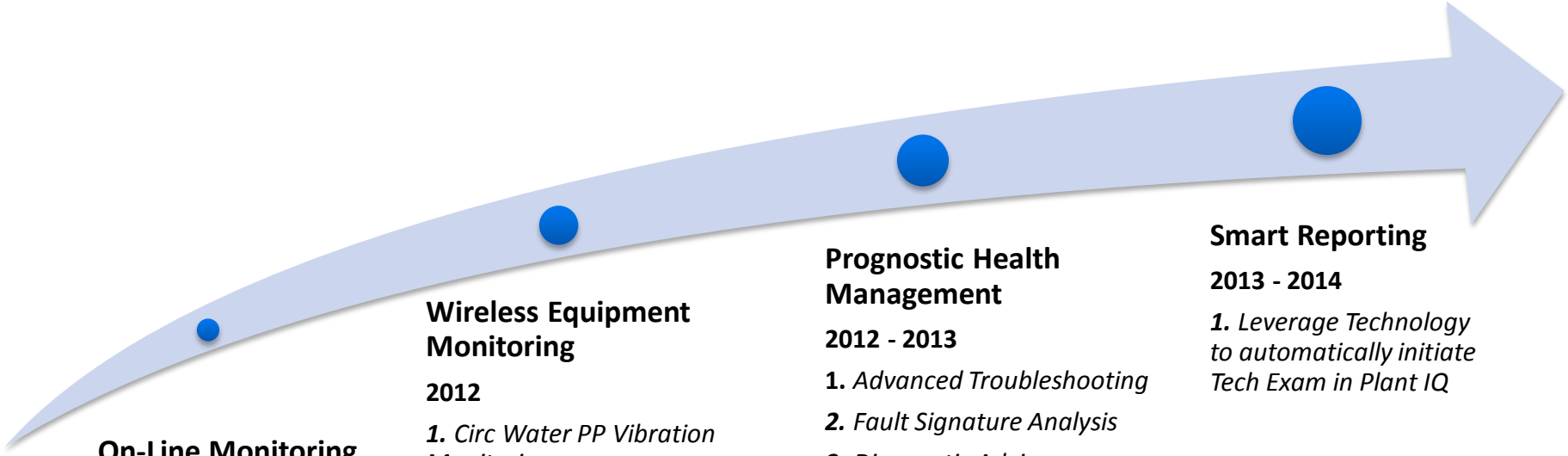


David Krenek's (CAT Engines and Compressors) Condition Monitoring Summary

- The power of visualization – a tool so powerful, yet often overlooked
- Get all the data together, regardless of source and fidelity
- Take data off sites (site personnel don't have time nor expertise)
- OEM/equipment experts can look at data and identify issue in milliseconds
- Analyst job is to strike the right balance of catches vs. false positives
- Have analytical tools identify exceptions
- Have experts identify issues, root cause and offer recommended actions (potential to automate by comparing to fault library)
- Need information from equipment (event codes, alarms, diagnostics)
- To make decisions about remaining life, need information on current condition
- May need different analytical tools to catch anomalies or failures with short durations (i.e., PI) and with longer durations, i.e., pattern recognition, in-memory predictive
- Must establish efficient and effective two-way communications between sites and monitoring center…to request additional data from the site or to provide recommendations to the site

AUTOMATE collection, AUTOMATE analysis, AUTOMATE diagnostics, AUTOMATE prognosis

Exelon Nuclear Advanced Condition Monitoring - History



On-Line Monitoring

2010 - 2011

1. *~16,000 Computer Points in the program*

2. Over *1,500 assets being monitored*

Wireless Equipment Monitoring

2012

1. *Circ Water PP Vibration Monitoring*

2. *Service Water Pumps Vibration Monitoring*

2. *Cooling Towers Level Monitoring*

3. *Cycle Isolation Valves Temp Monitoring*

Prognostic Health Management

2012 - 2013

1. *Advanced Troubleshooting*

2. *Fault Signature Analysis*

3. *Diagnostic Advisor*

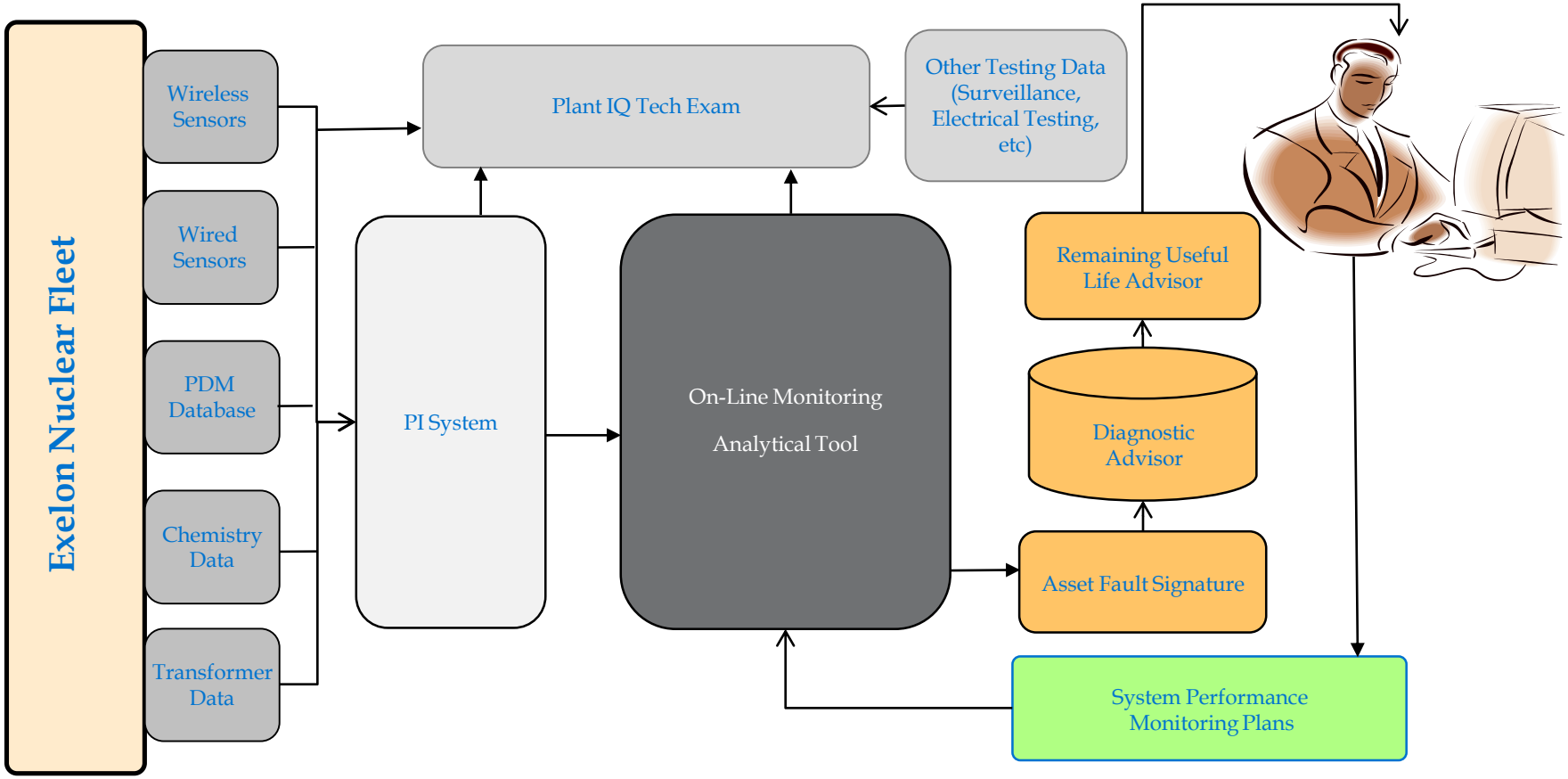
4. *Remaining Useful Life Advisor*

Smart Reporting

2013 - 2014

1. *Leverage Technology to automatically initiate Tech Exam in Plant IQ*

Exelon Nuclear Advanced Condition Monitoring - Overview



Exelon Nuclear Advanced Condition Monitoring - Purpose

- ✓ Build Advanced Monitoring infrastructure capable of significant advancement in system **monitoring**, **diagnostics** and **prognostics** capabilities
- ✓ Leverage technology for system and component monitoring and obtain critical plant data in OSIsoft PI data historian
- ✓ Improve plant safety by quickly identifying plant anomalies and initiate corrective or mitigative actions
- ✓ Improve plant reliability and maximize availability of safety systems in operator hands
- ✓ Utilize critical plant resources for data analysis and diagnostics rather than data collection
- ✓ Utilize wireless infrastructure to enhance equipment monitoring and switch limited Time Based PMs to Condition Based PMs
- ✓ Optimize Exelon preventive maintenance (PM) strategy
- ✓ Operate nuclear plants sustainably protecting public safety and gain public trust

Exelon Nuclear Advanced Condition Monitoring - Benefit

✓Engineering

- *~10% system engineer's work load reduction* by transferring engineering monitoring and trending function to On-Line Monitoring
- *~30% of unexplained equipment failure* can be better understood due to improved wireless equipment monitoring capabilities

✓Operations

- *~10% Ops rounds optimization* by aligning local panel data to data historians
- *Dose reduction* by remotely monitoring local data and reducing entry into high dose areas

✓Maintenance

- *~50% of vibration specialist efficiency improvement* due to on-line vibration data through wireless equipment monitoring
- *Better vibration analysis* since the expert will spent more time in diagnostics and less in data collection
- *~20% PM reduction* by switching Time Based PM to Condition Based PM

OSIsoft and PI System Security

OSIsoft is NOT a compliance consulting or security solutions company, but we do "GET" security…both software security and cybersecurity

- *In collaboration* with
  - Department of Homeland Security
  - Department of Energy Labs – Idaho National Lab (INL)
  - Microsoft (Security Development Lifecycle (SDL) and Security ACE team)
  - Many large, experienced customers
  - Infrastructure partners
- *Infrastructure partners* include
  - Intel/McAfee/Nitrosecurity (SIEM)
  - Waterfall Solutions (unidirectional gateways)
  - Owl (data diodes)
  - FoxIT (data diodes)
  - BEA (data diodes; Industrial Protect)

- Knowledgeable of security controls in the following practice domains representing most cyber security compliance regimes
  - Mission Assurance - DOD DIACAP, RMF
  - Information Security - NIST 800 Series
  - Infrastructure Protection - DHS, NRC, NERC

Questions

Please wait for the microphone before asking your questions

State your
name & company