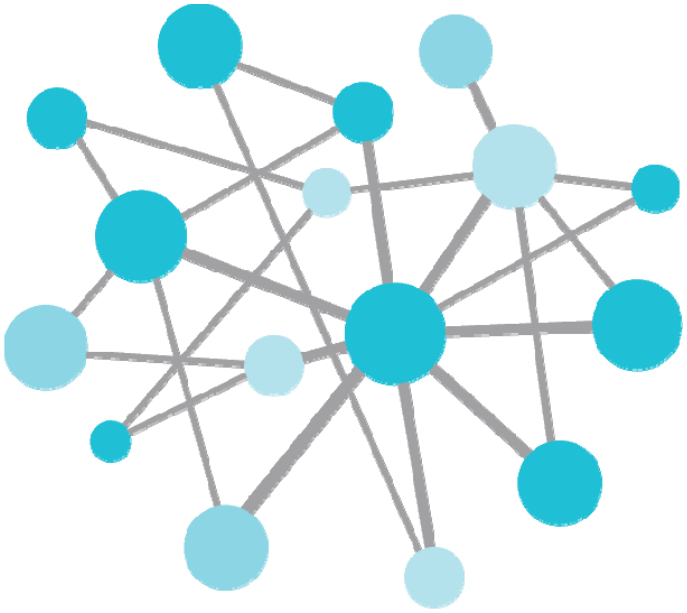


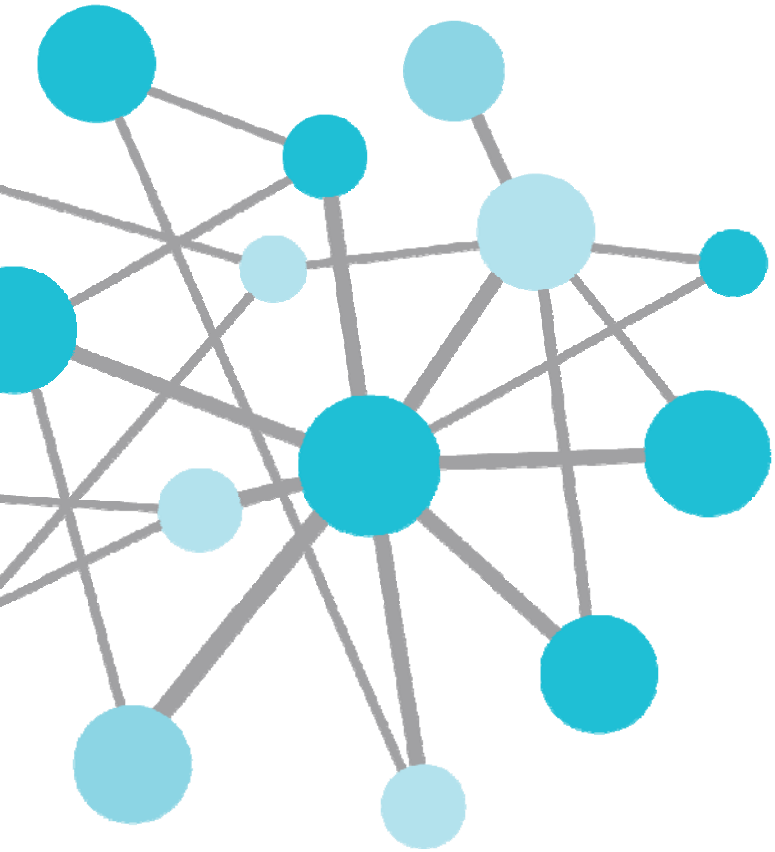
OSIsoft.

PI SYSTEM ROADSHOW 2014

The Power of Data

DECISION READY IN REAL-TIME

OCEANIA



The PI System

The Foundation for Enterprise Analytics, Visualization, & Collaboration in Context

Business to Operations Value

Presented by **Craig Harclerode**

Industry Principal –in O&G and Petrochemicals

My Journey with Technology….What an Experience!

What I use

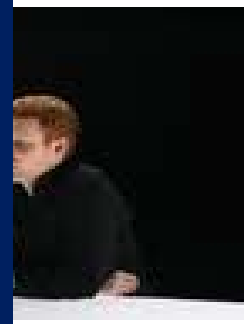
The Power of Real-Time Data in the 21st Century

Data as a Strategic Asset – Needs to be Managed as Such!

Need A Strategic Data Infrastructure

I moved up to an HP Calculator by the time I graduated..

My First Job out of College..



In the not to distant future…

Agenda

- Business to Operations Data Value Requisites:
  - Data Consistency and Context
  - Organizational Alignment
  - Applications/Solutions Simplicity
  - Data Transformation Methodology
- “Future Proofing” of the Data Infrastructure
- Resulting Value in O&G
- Closing Comments

Agenda

- Business to Operations Data Value Requisites:
  - Data Consistency and Context
  - Organizational Alignment
  - Applications/Solutions Simplicity
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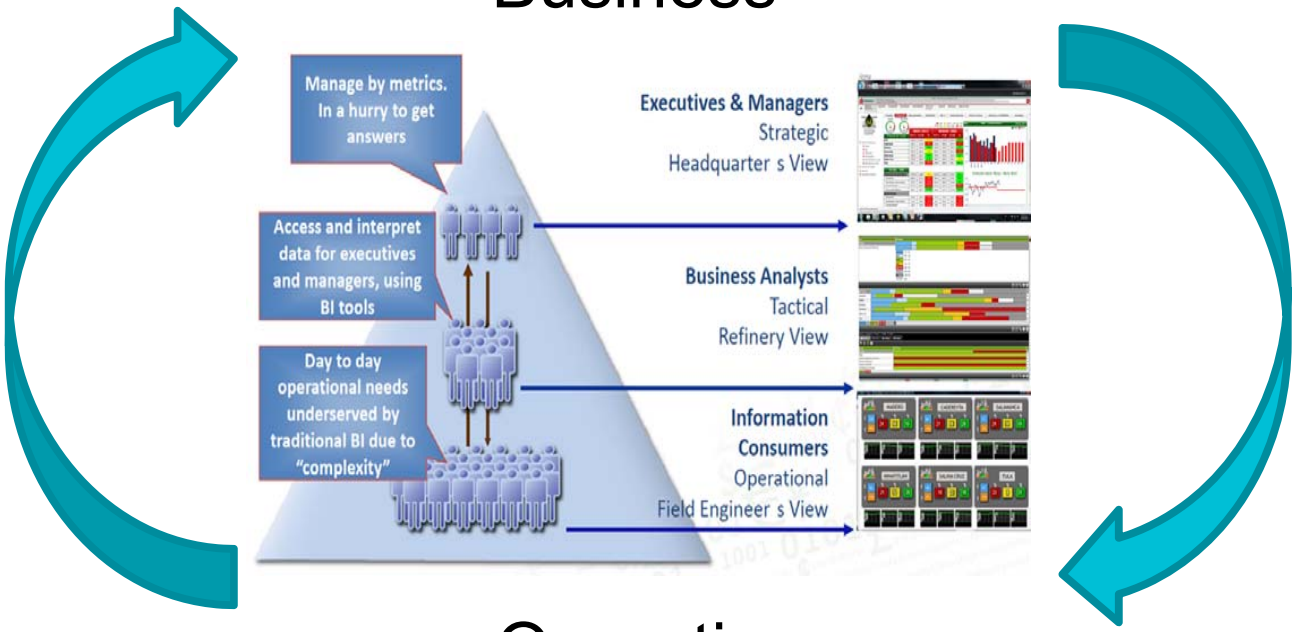
- Closing Comments

The Need for a Data Information Infrastructure

Consistency

Alignment

Business

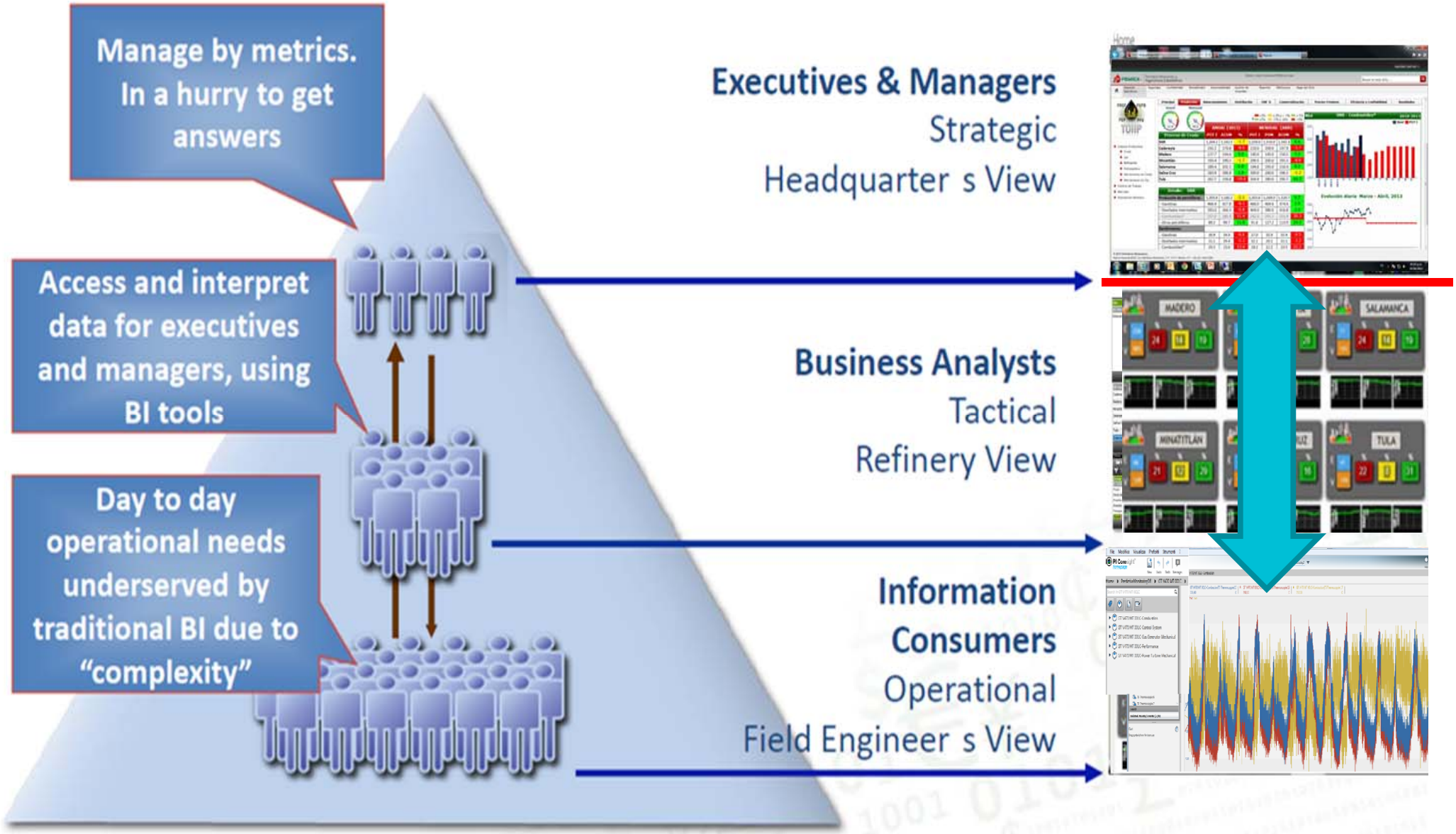


Operations

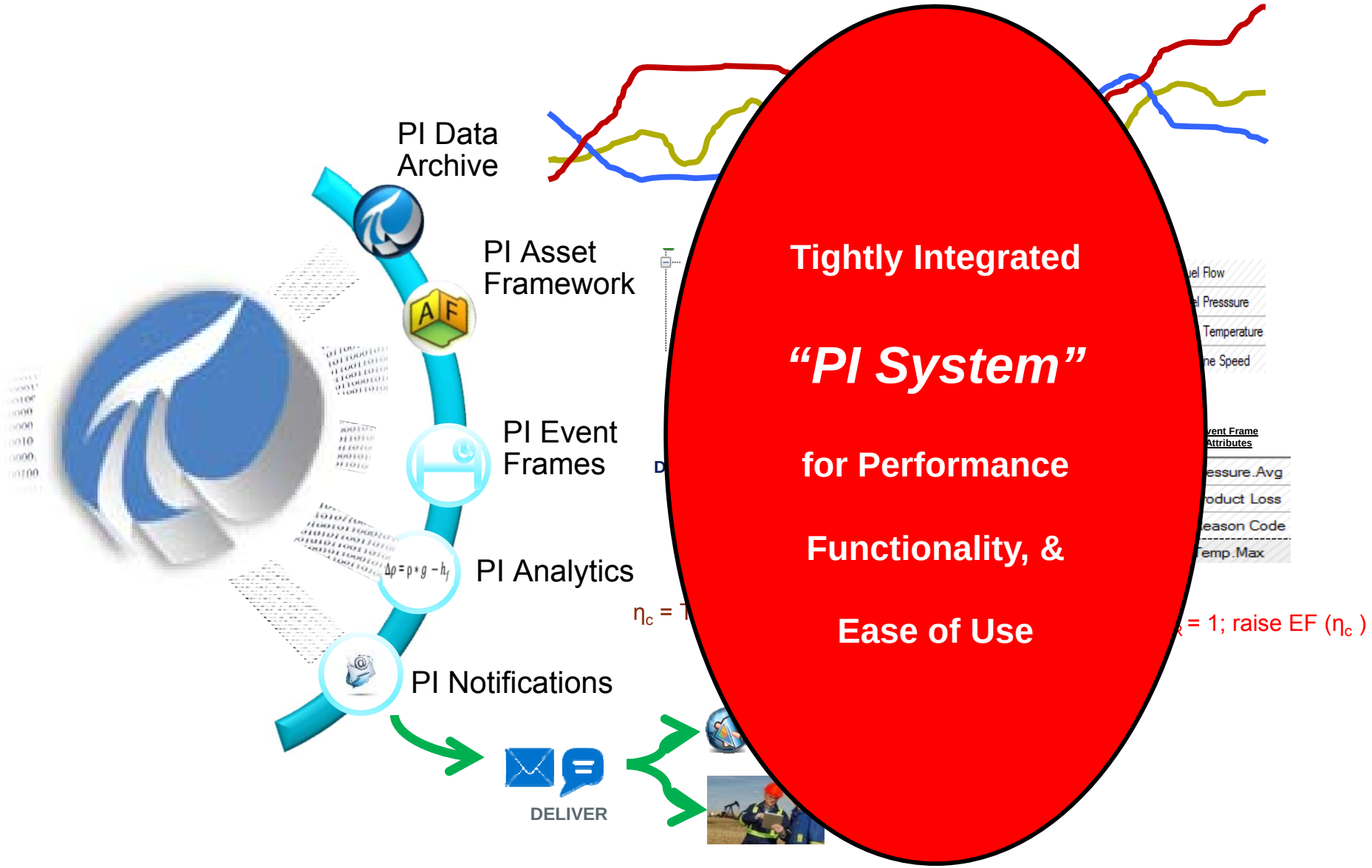
Transformations

Simplicity

Data and Information in Context with Integrated High Fidelity Drill Down – “Don’t Let Sexy override Functionality”



The Foundation for Enterprise consistency, alignment, simplification, and data transformation



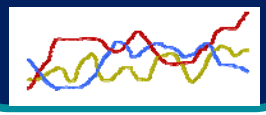
Enterprise Consistency, Alignment, Simplification & Data Transformation

PI System Based Applications & Integration of "Best of Breed Models & Solutions"

Business & "Big Data" Systems, & Cloud

PI System Based Analytics, Visualization & Integration of "Best of Breed" Alternatives

Streaming Data and Events

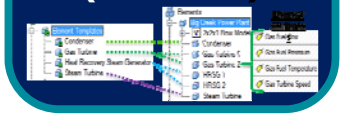


PI System Used as a Data Store

PI System Used as a Data Store

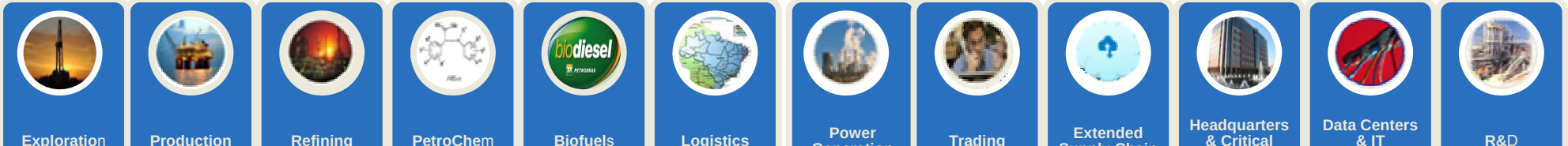
PI SYSTEM

Asset Structure (Context)



Across Value Chain & Extended Value Chain

Across the Infrastructure



DCS

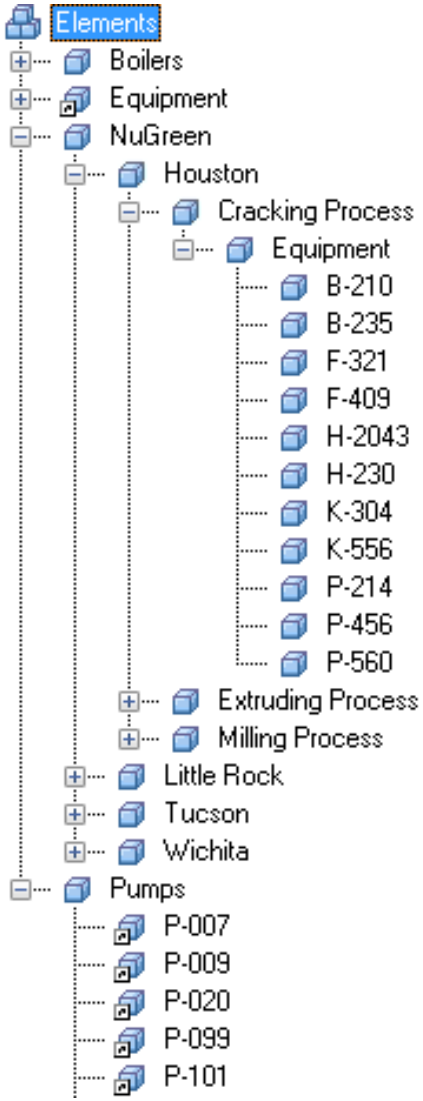
SCADA

Other Control

Other Data

PI Asset Framework (PI AF)

The Foundation for Business to Operations Value



Analyses
- Efficiency analysis
- Key Performance Indicators (KPI)

Time-series
- In-Flow
- Pressure
- Vibration data

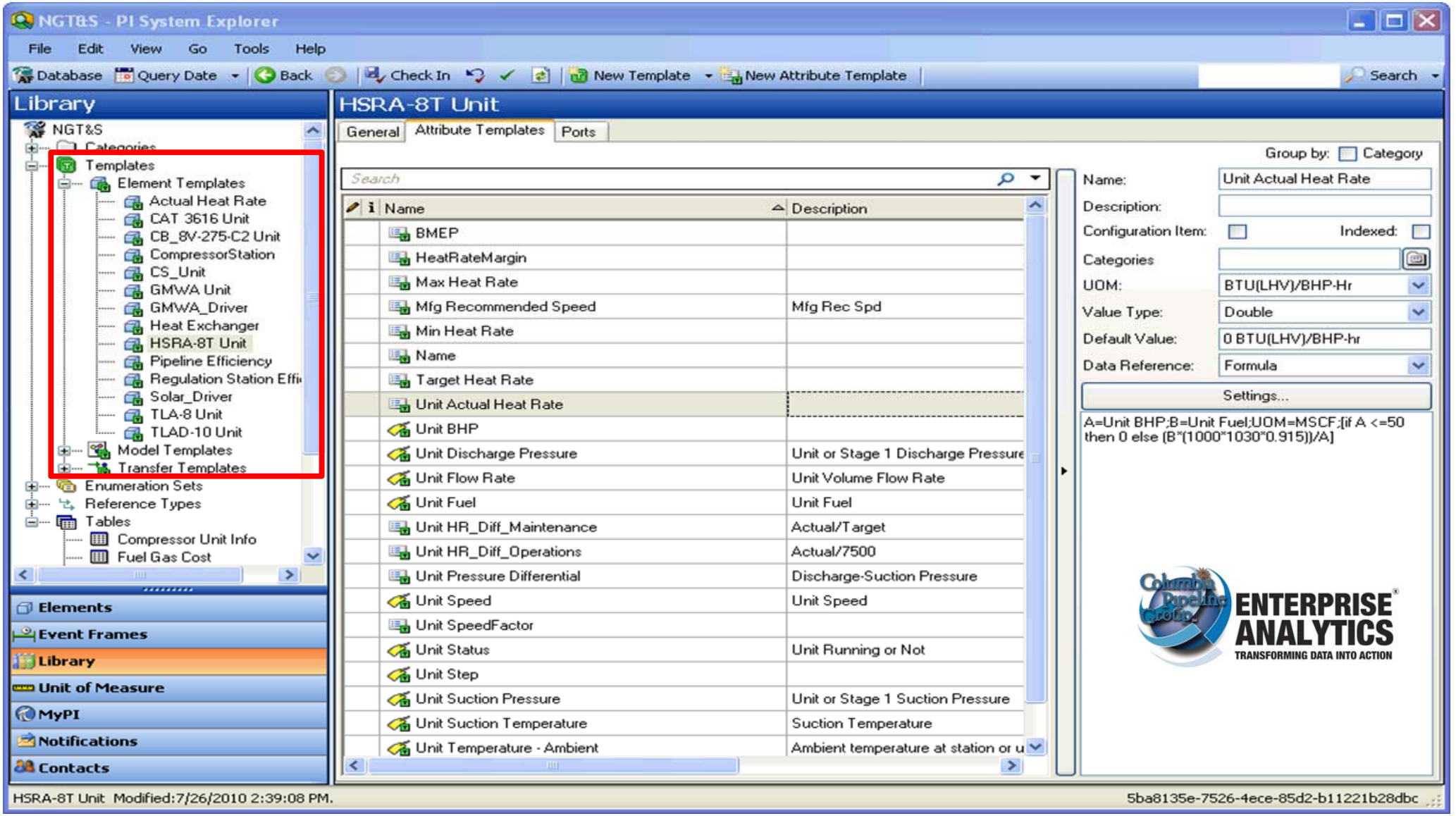
Events
- Downtime
- Startup
- Failure

Asset details
- Name
- Model
- Manufacturer

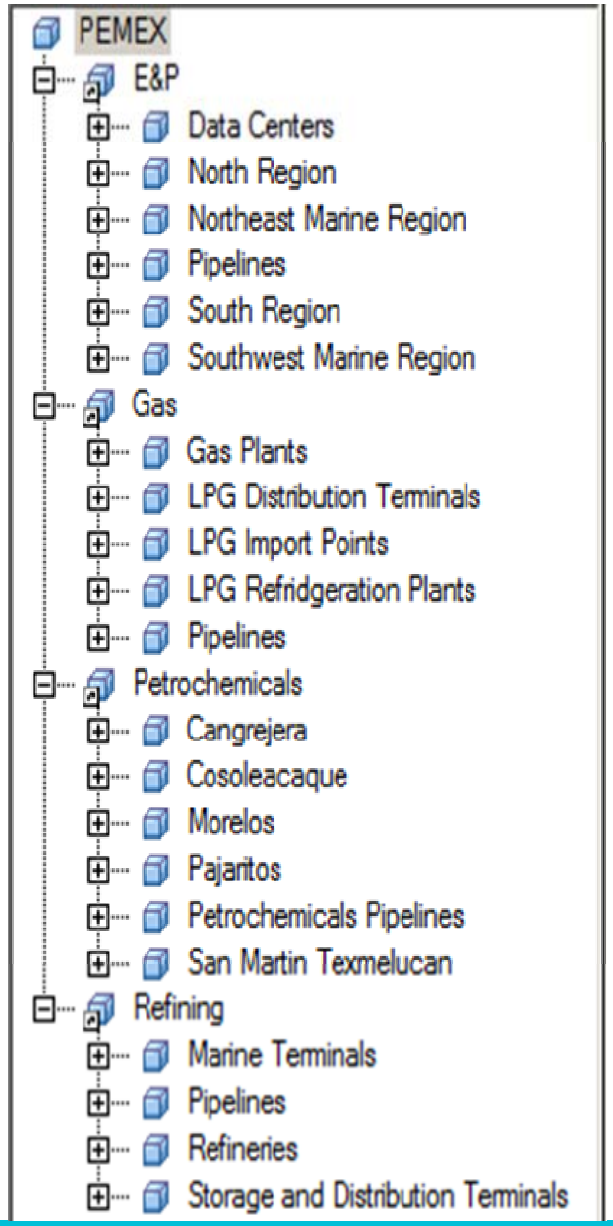
Notifications
- High speed
- Rotor failure
- Low pressure

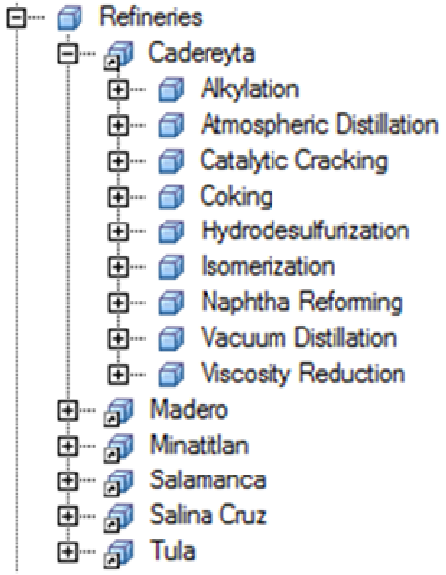
External data
- Performance curves
- Last maintenance date
- Design documents
- Best operating procedures

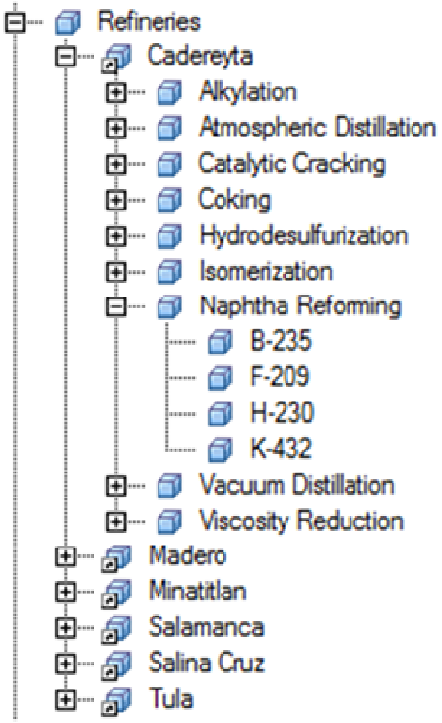
Example of PI-AF Templates – Scalability/ Governance
Calculation of Compressor Heat Rate

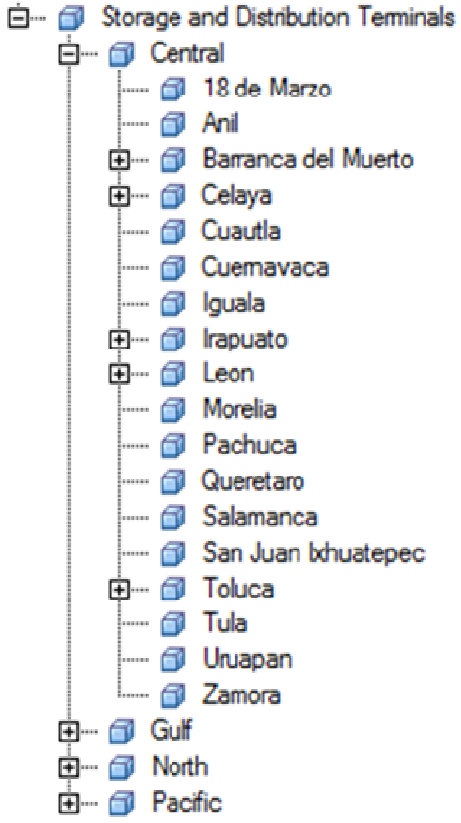


PI – AF - The Underpinning of Analytics & Visualization
A Journey – started small, evolved over time…scalable







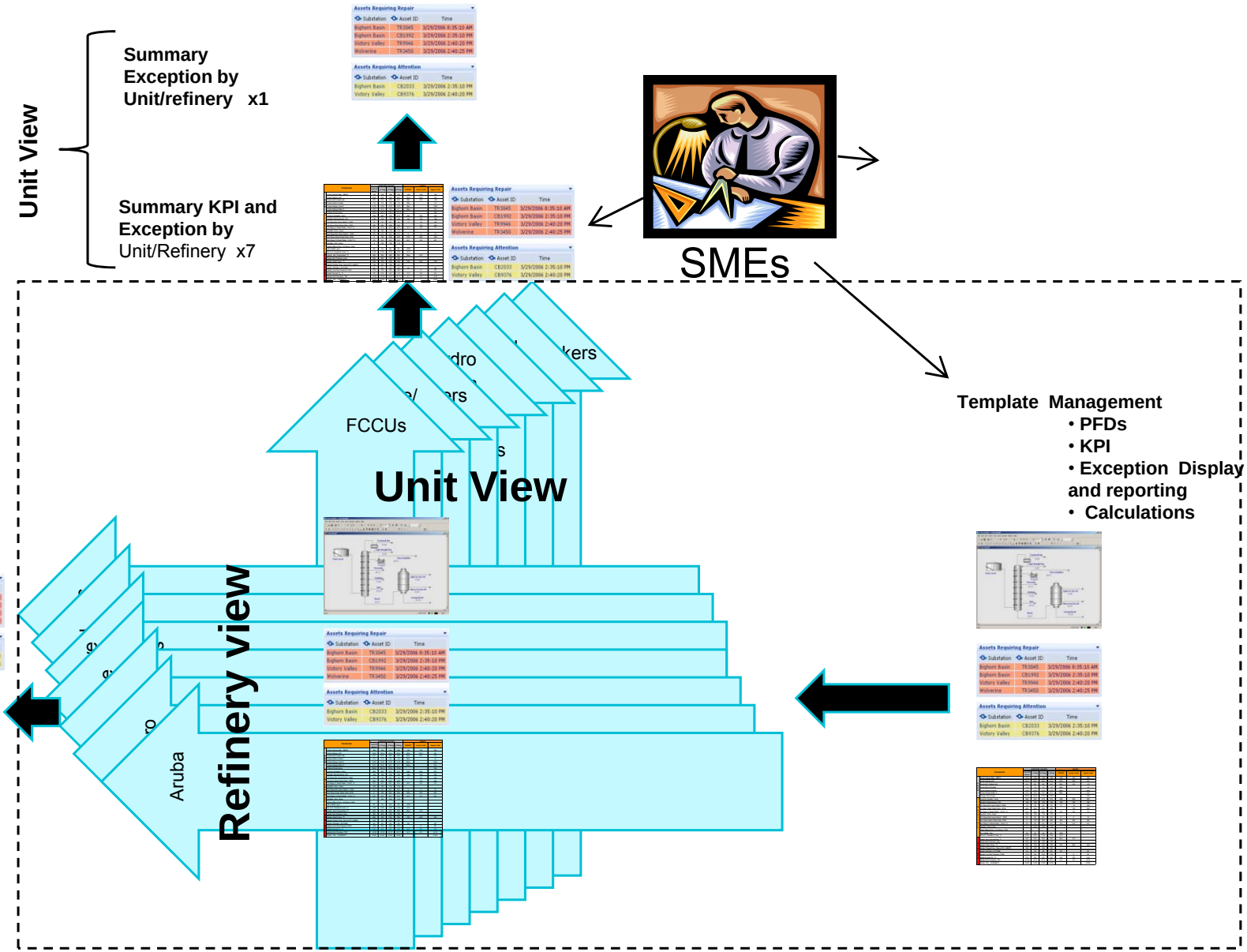


Enterprise Object Model &
Data Abstraction Layer
Views for Context

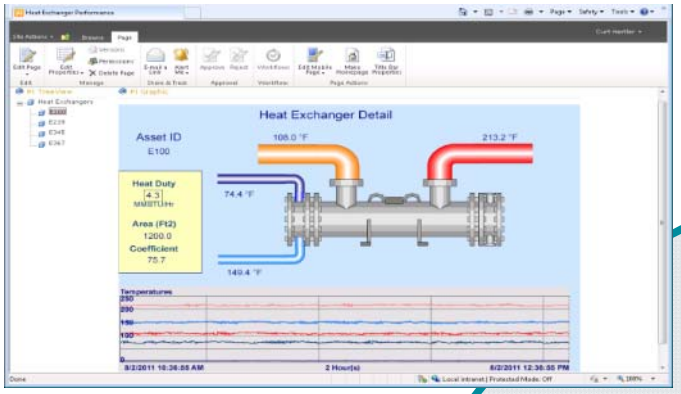
PI AF Views to Pivot the AF Structure – Consistency, Alignment, Simple, & Data Transformation

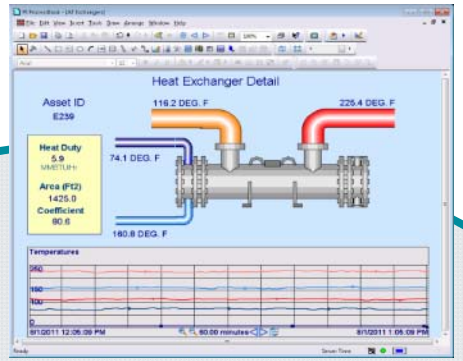
Critical Success factors:

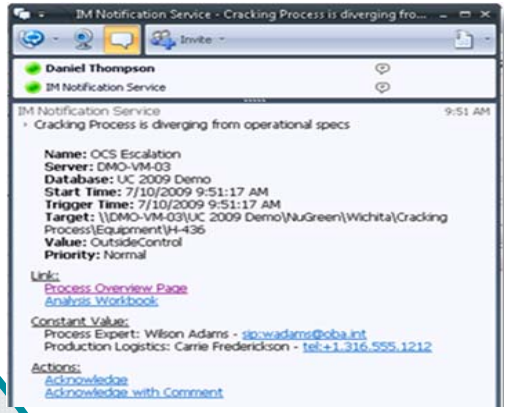
1. Scalability
2. Ease of Use
3. Organization
4. Flexibility
5. Interoperability
6. Simplicity
7. Self Sufficiency

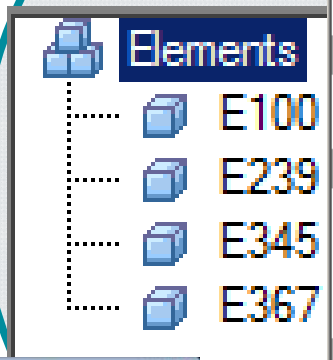


PI AF – Consistency, Simplicity, Scalability, Alignment, and Data Transformation

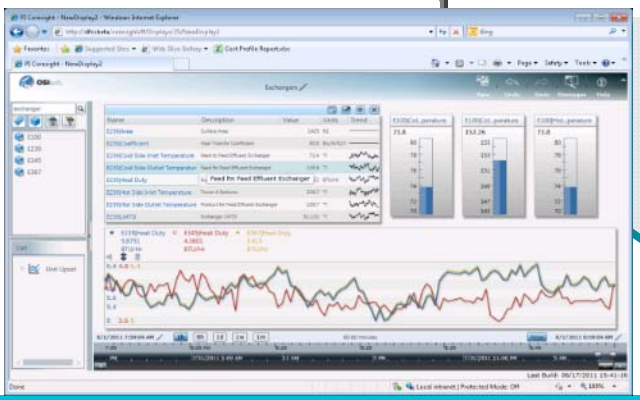


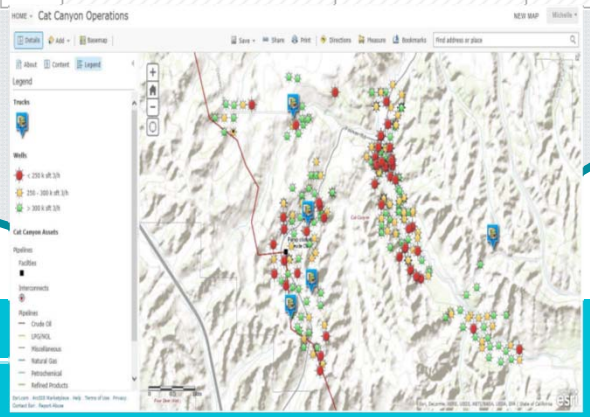


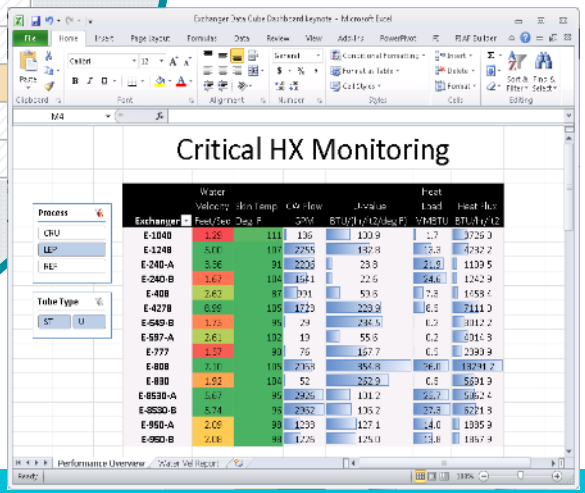




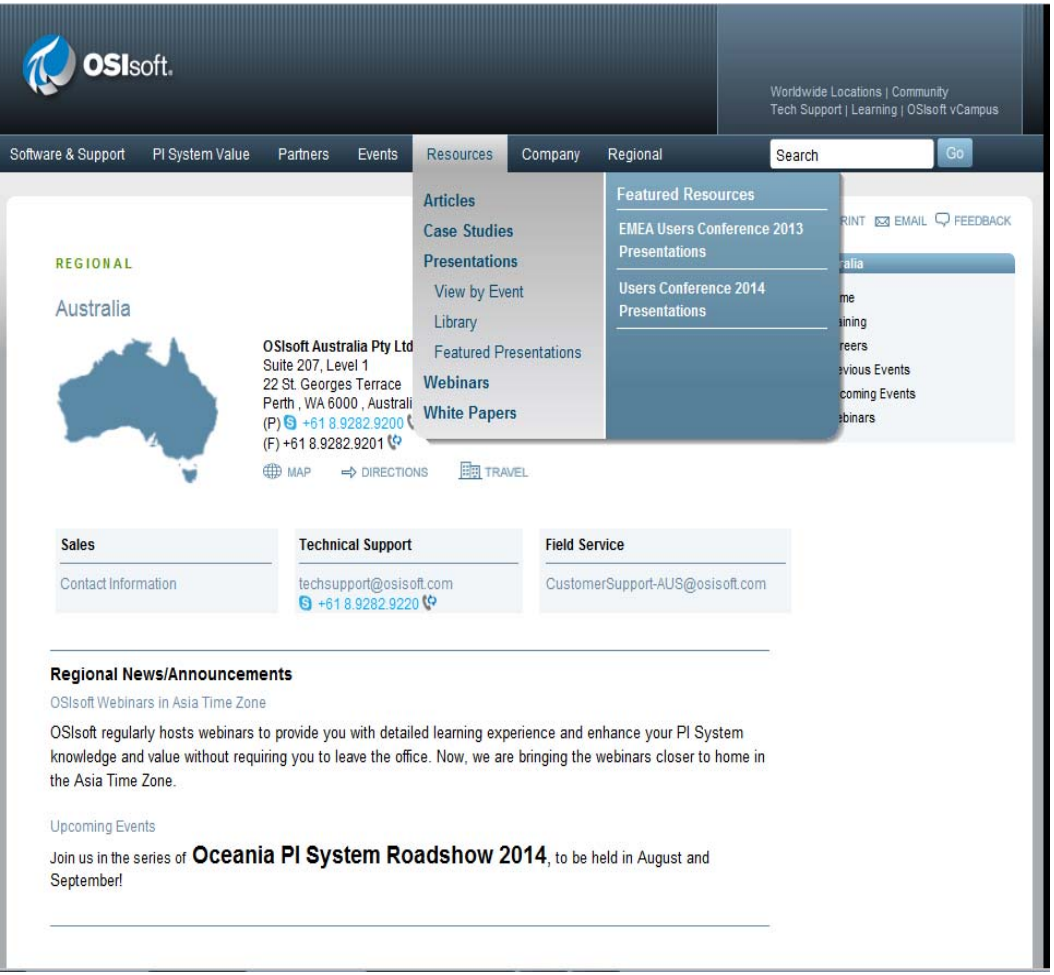
Calculation		
Heat Duty	4.52496386846314 B...	BTU per hour
LMTD	49.8387949209527 °F	degree Fahrenheit
Performance Limits		
High Heat Duty Limit	6 BTU/Hr	BTU per hour
Low Heqat Duty Limit	4 BTU/Hr	BTU per hour
PI Data		
Cold Side Inlet Temperature	70.0089721679688 °F	degree Fahrenheit
Cold Side Outlet Temperature	147.653396606445 °F	degree Fahrenheit
Hot Side Inlet Temperature	211.52458190918 °F	degree Fahrenheit
Hot Side Outlet Temperature	108.038589477539 °F	degree Fahrenheit
Specifications		
Area	1200 ft2	square foot
Coefficient	75.66 BTU per F ft2 Hr	BTU per F ft2 Hr

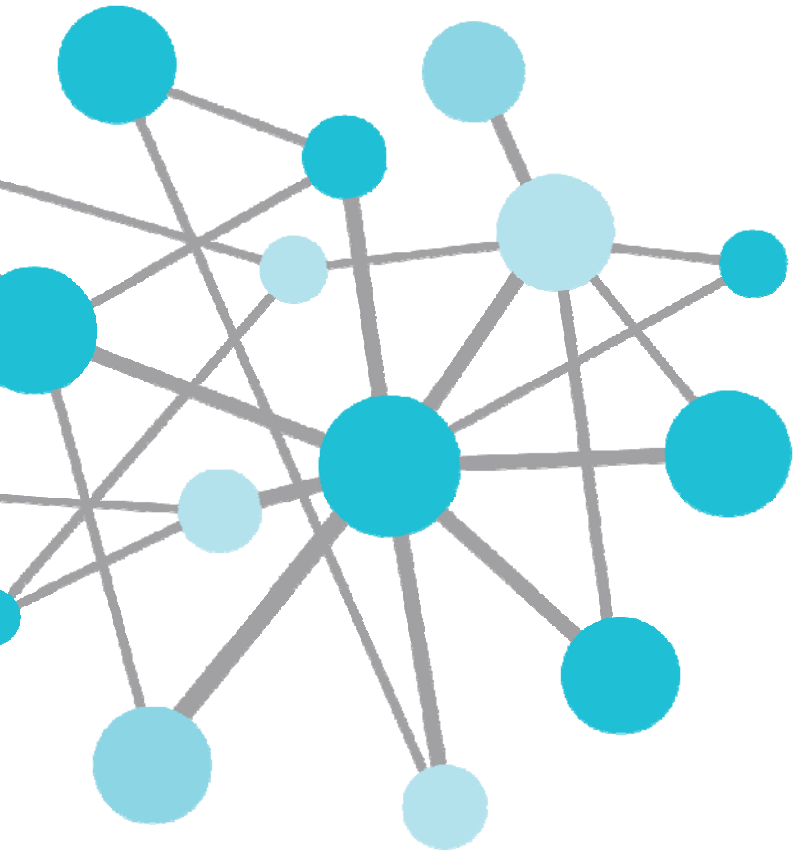






Case Studies on the OSIsoft Website



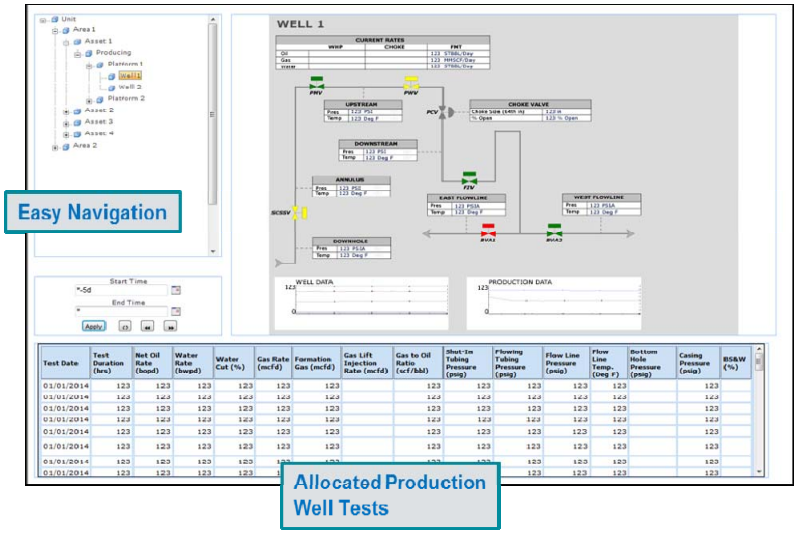


Illustrative Case Study – Chevron GOM

Data Consistency and Context
Organizational Alignment
Applications/Solutions Simplicity
Data Transformation Methodology

Data Consistency and Context

"The PI System infrastructure is fundamental to our E&P data governance and workflow. The PI System and in particular PI AF, underpins our analytics and visualization by providing asset based, normalized, and structured operational data including associated meta-data. The PI System as an enterprise data infrastructure "future proofs" our investment in our applications & solutions"



UC2014

E&P Automation Analyst

Business Challenge

- Data issues from E&P assets
- Legacy custom applications not scalable or maintainable
- No std tagging across E&P
- Data issues from DCS/SCADA
- No infrastructure for FOF vision

Solution

- Evolve and expand PI System leveraging unlimited access
- **Used PI AF to normalize and structure E&P data & information**
- Developed new E&P workflow, analytics, and visualization

Results and Benefits

- **Asset based** access and propagation of E&P data and information
- Enabled a **"best of breed"** approach to analytics and visualization tools
- **Significantly improved analytics, visualization, collaboration & Integration**

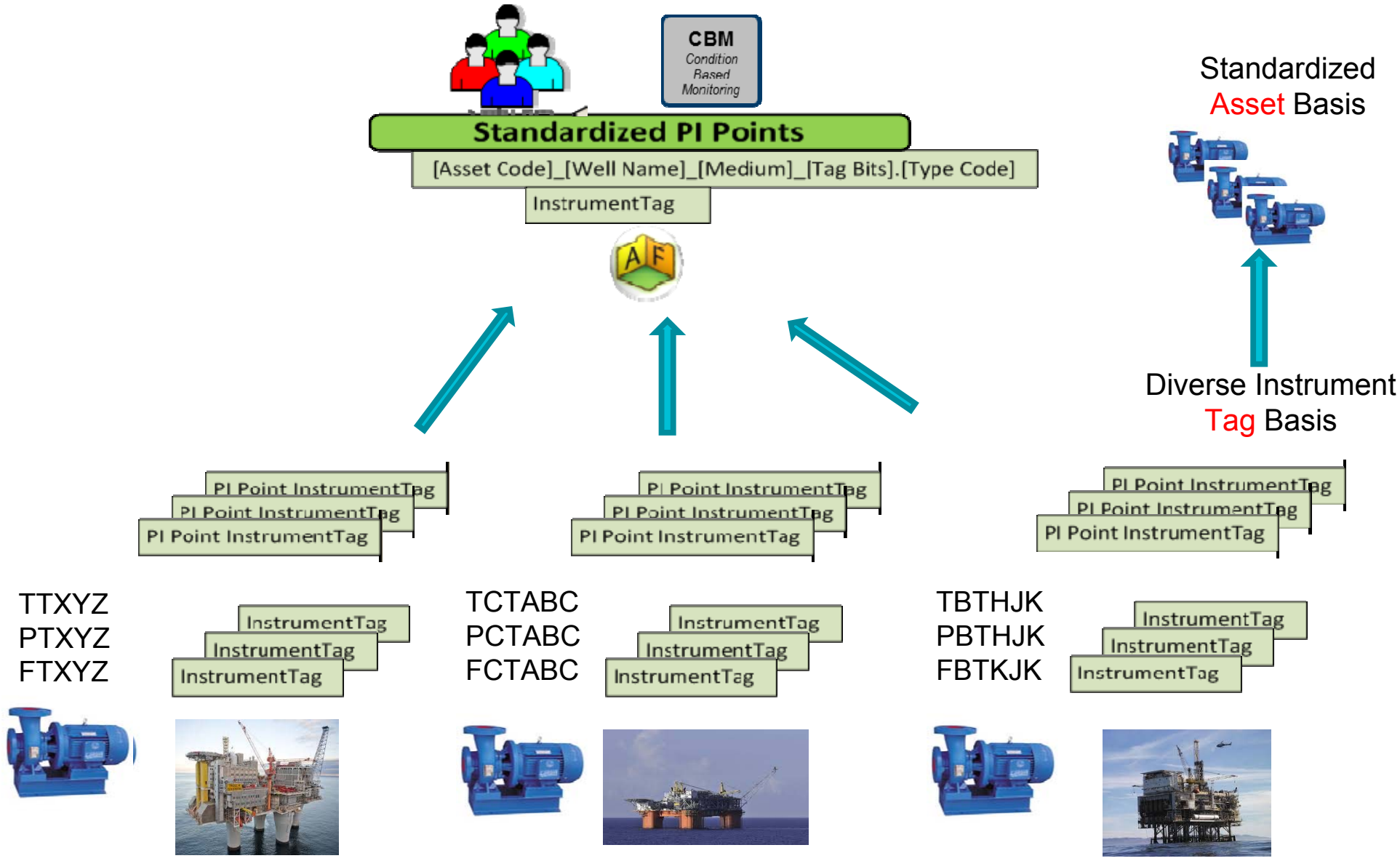
Gulf of Mexico Business Unit (GOM) Who we are…

- **Overview**
  - Largest leaseholder in the Gulf of Mexico
  - Over 500 structures
  - Onshore facilities in Louisiana and Alabama
  - Main headquarters in Covington, LA
  - 6 shore bases

- **Process Control Network Overview**
  - Over 600 PCN servers, workstations & support machines
  - Over 650 Control Systems
  - Over 30 PCN Applications and 170 Utilities
  - 25 historical databases
  - 7 Firewalls, 150 routers and switches, 220 wireless radios

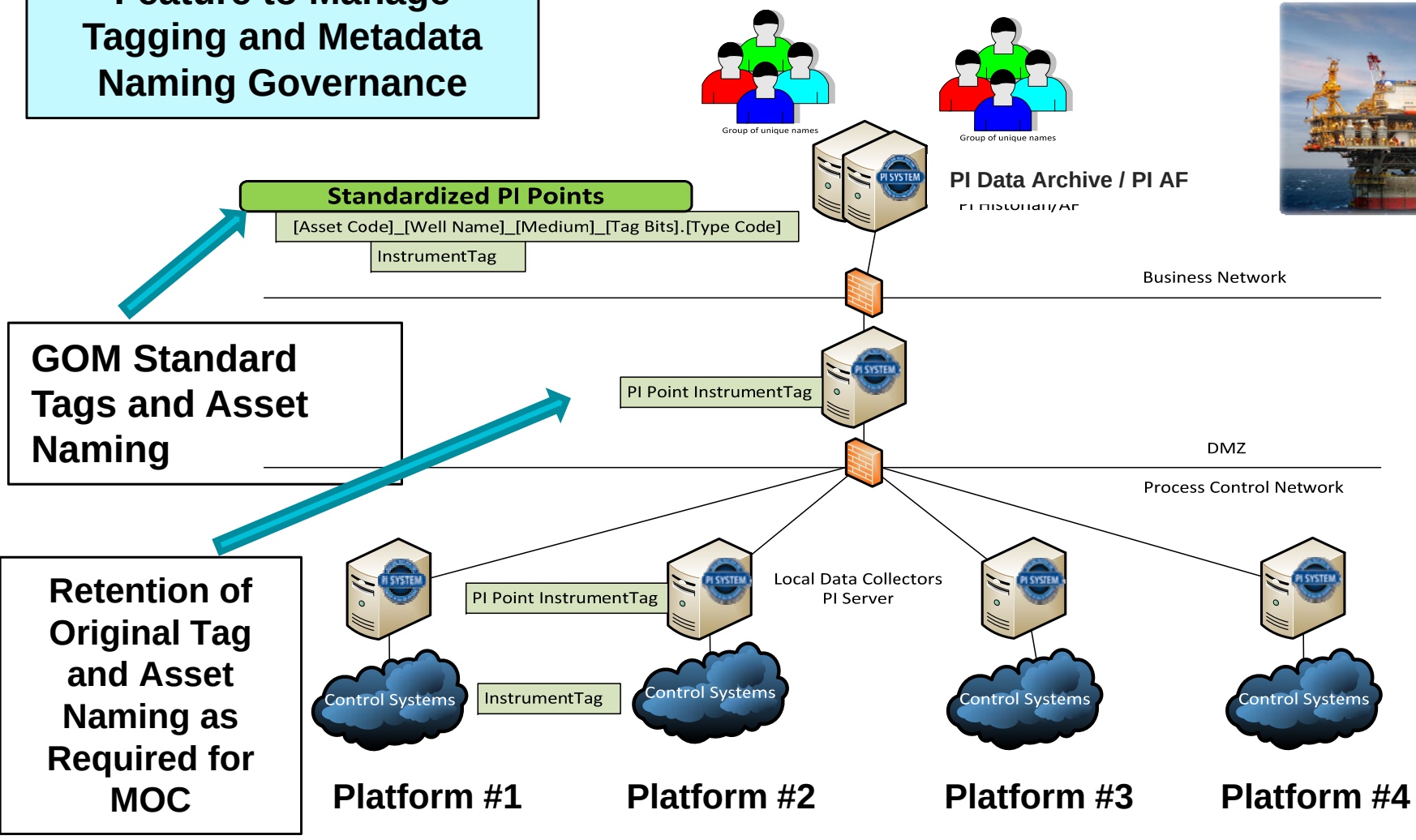
Abstracting the Tag/Naming with PI AF

Diversity in Tag Names to Standardized Asset Naming



Chevron GOM PI System Infrastructure

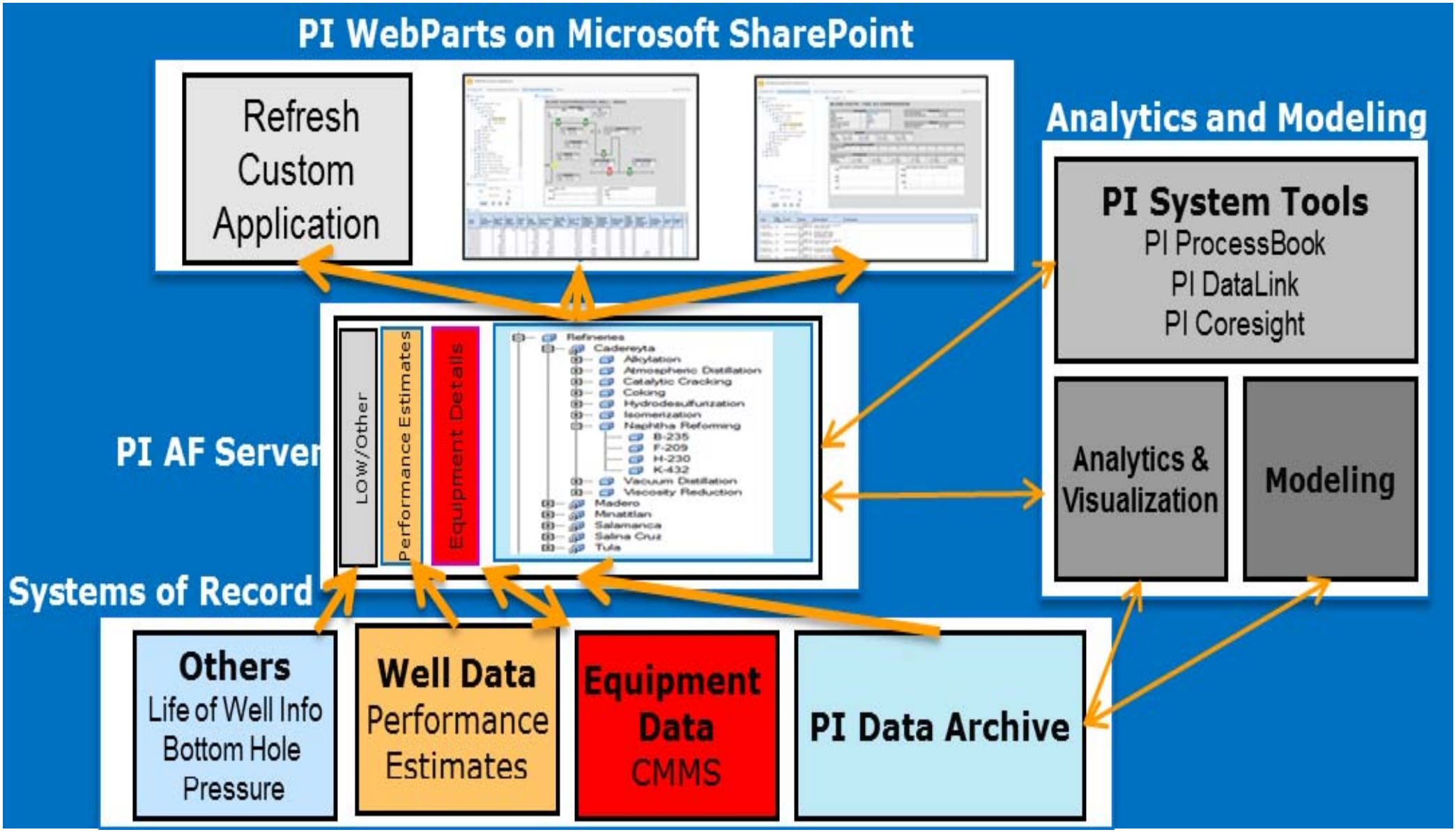
Using PI AF as a Data Abstraction Layer & Alias Feature to Manage Tagging and Metadata Naming Governance



GOM Standard Tags and Asset Naming

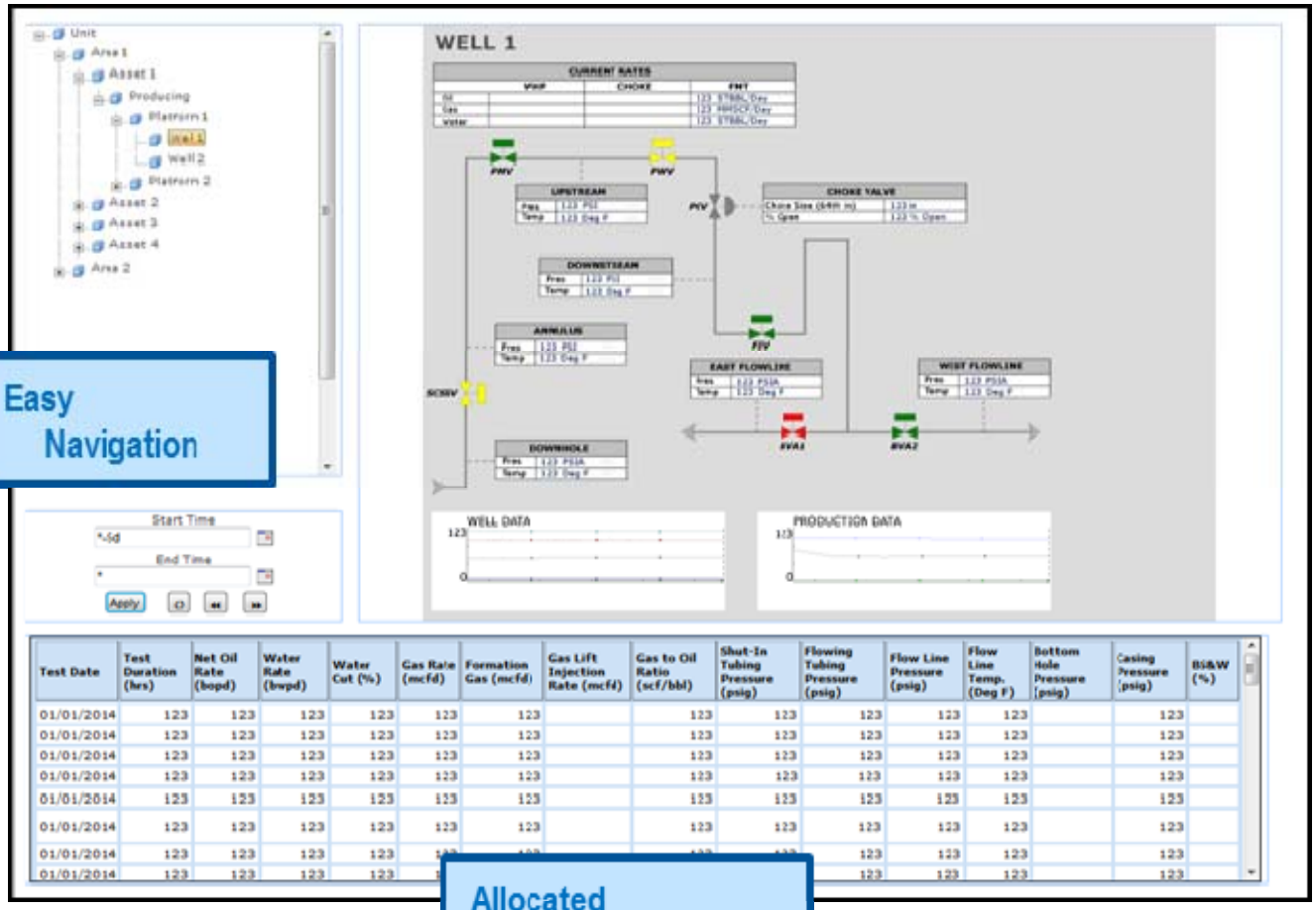
Retention of Original Tag and Asset Naming as Required for MOC

Chevron – GOM PI System Data Infrastructure



Chevron – Gulf of Mexico Business Unit

Integrating Key Well Data with the PI System



Easy Navigation

Allocated Production Well Tests

Project Benefits

- Consistent, Reliable Real-time Data
- Standard Tags
- **Graphic Templates**
- Easy Navigation
- Allocated Production
- **Well Tests**
- Sustainable Support Model

Deployed Well Statistics

- **Over 700 Wells**

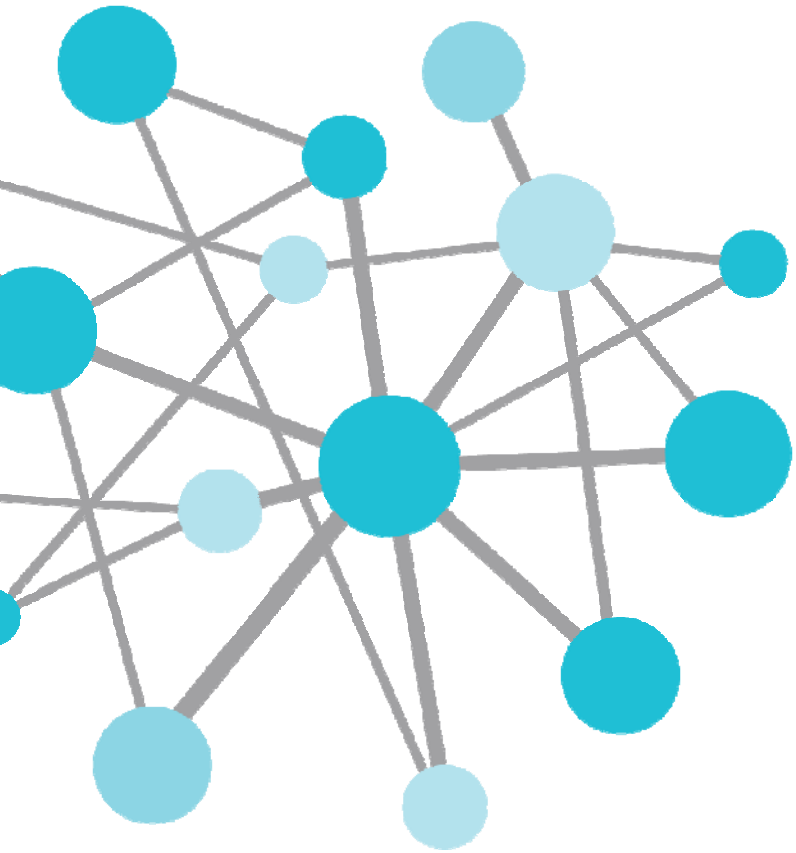
Chevron – Gulf of Mexico Business Unit
Integrating Key Equipment with the PI System

Project Benefits

Consistent, Reliable
Real-time Data
Standard Tags
Std. Graphic Templates
Std. Calculations/Analytics
Easy Navigation
Equipment Master Data
Open Work Orders
Sustainable Support Model

Deployed Equipment Statistics

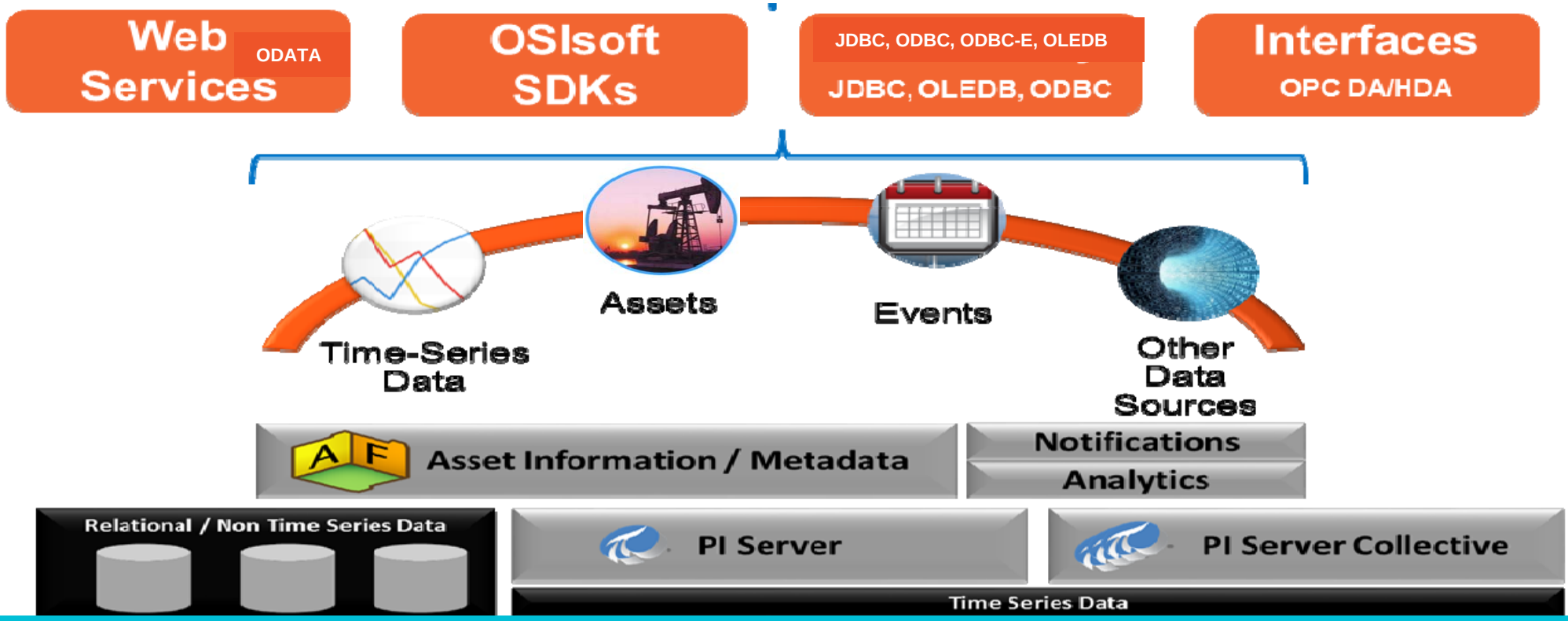
- **Over 180 Compressors, Pumps, Generators**



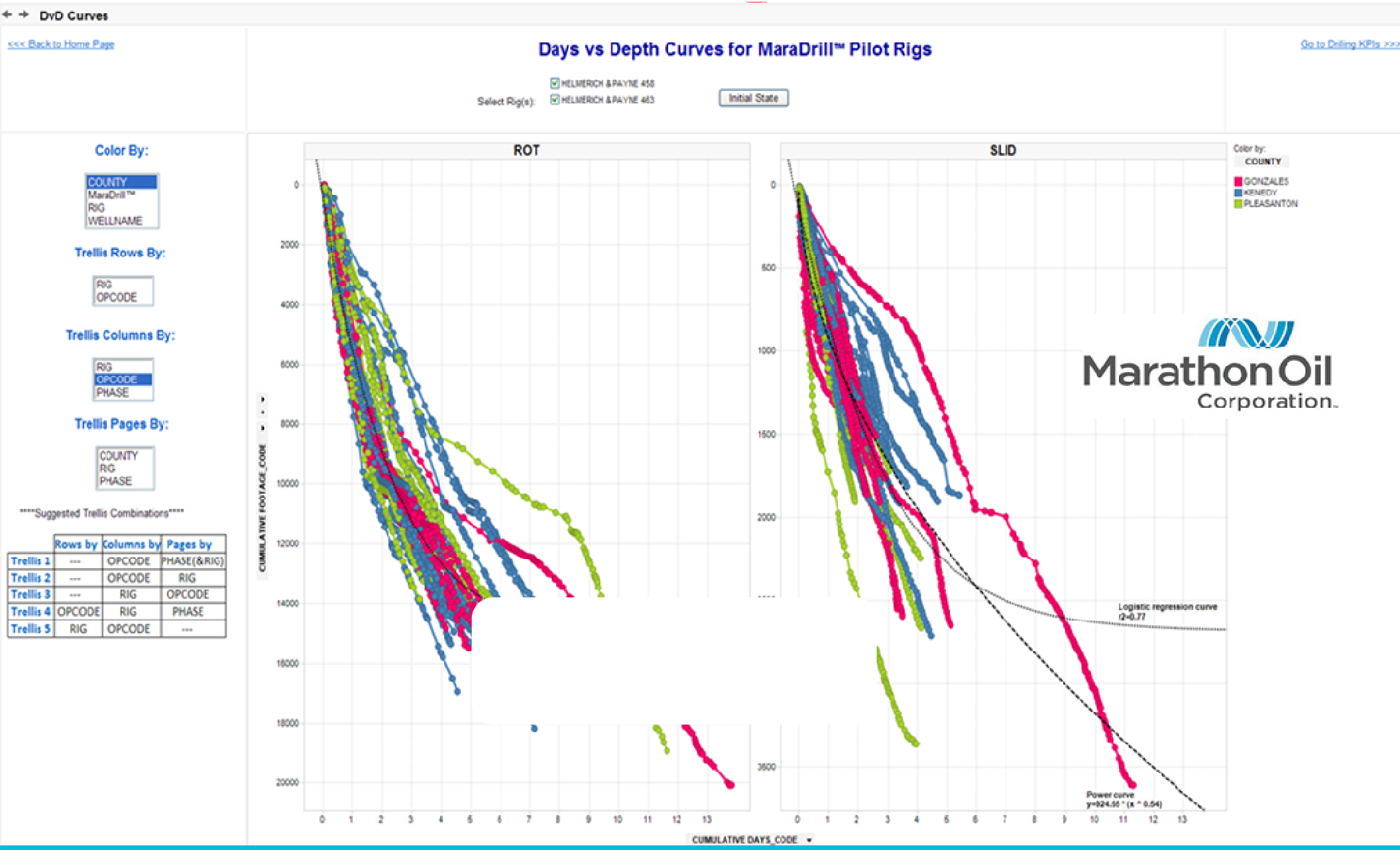
Illustrative Case Study – Marathon Oil

Data Consistency and Context
Organizational Alignment
Applications/Solutions Simplicity
Data Transformation Methodology

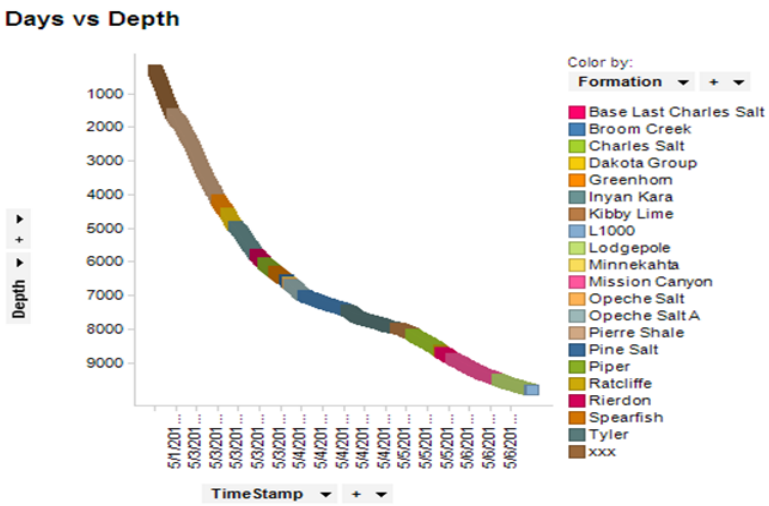
Integration of 3rd Party Analytics and Visualization Capability – Infrastructure Enabled "Best of Breed"

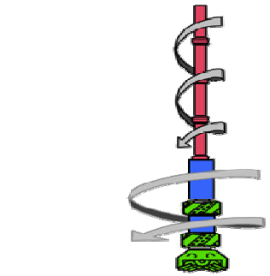


PI System/PI AF - The Foundation for Dashboards and Workflow Integration and Business to Operations Value

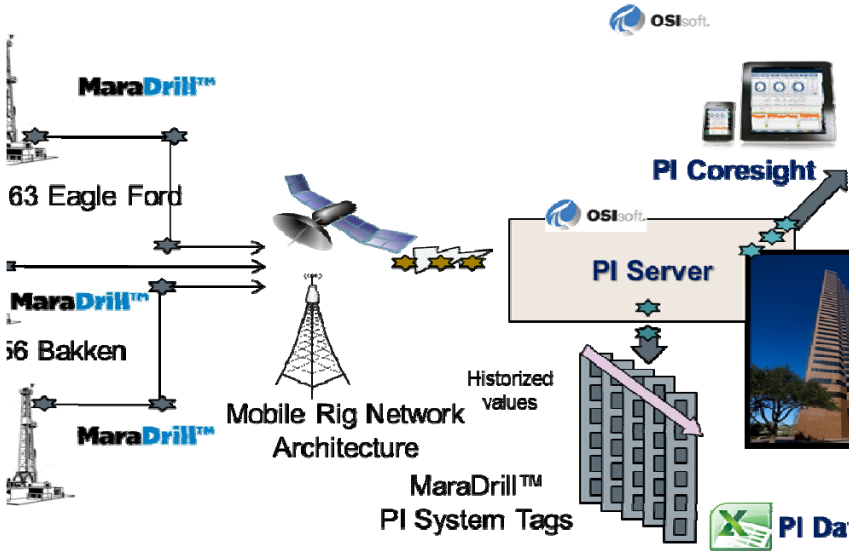


Real-Time Drilling Optimization Reduces Drilling Time and Associated Resources Usage





Marathon Oil



Business Challenge

- Drilling time and capital well cost savings including reduction in resources
- Reduced vibration and damage to downhole tools
- Continuous optimization onsite & retrospective post-well analysis

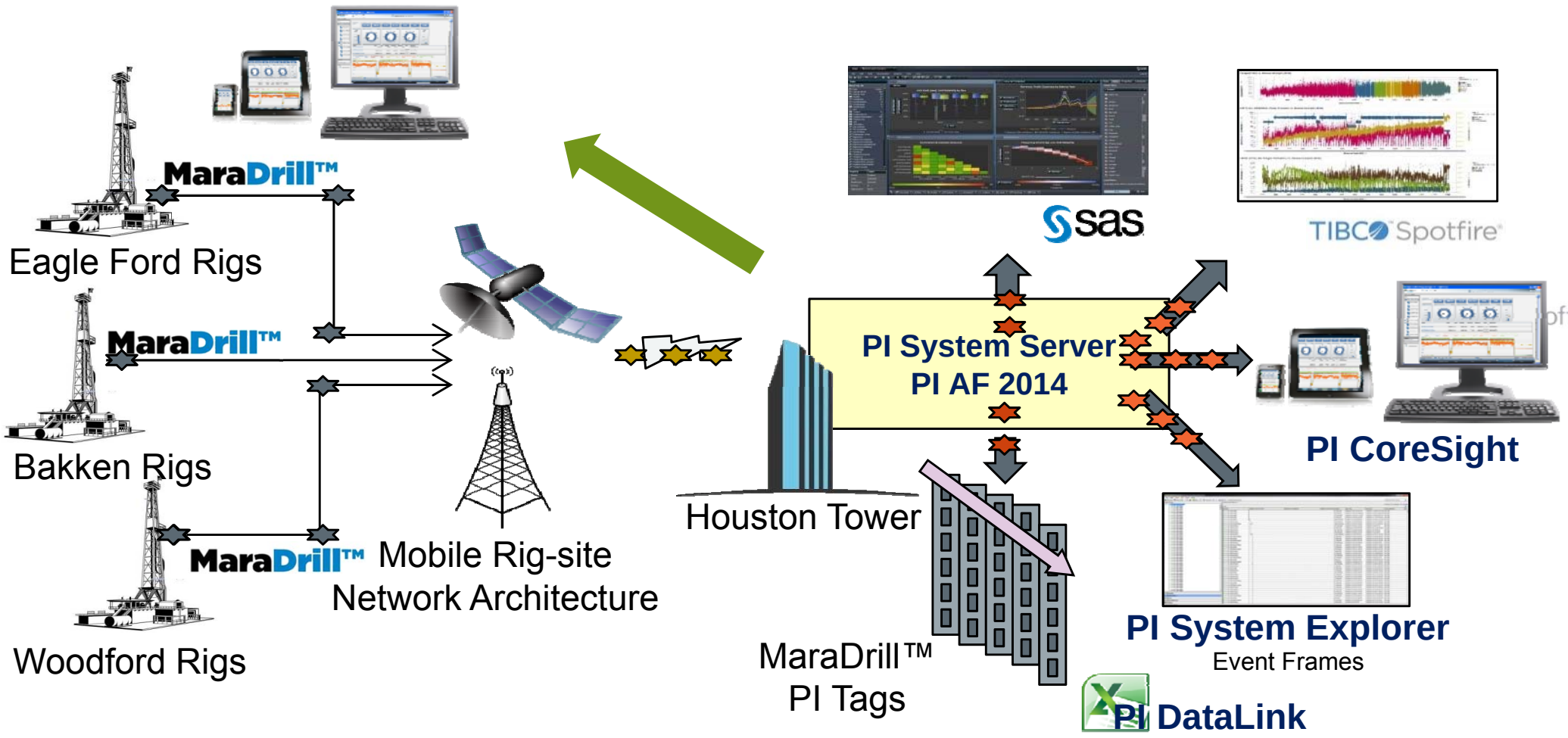
Solution

- Installation of the PI System real-time integration and applications infrastructure
- Creation of drilling process high fidelity real-time analytics and visualization capabilities at the drill site

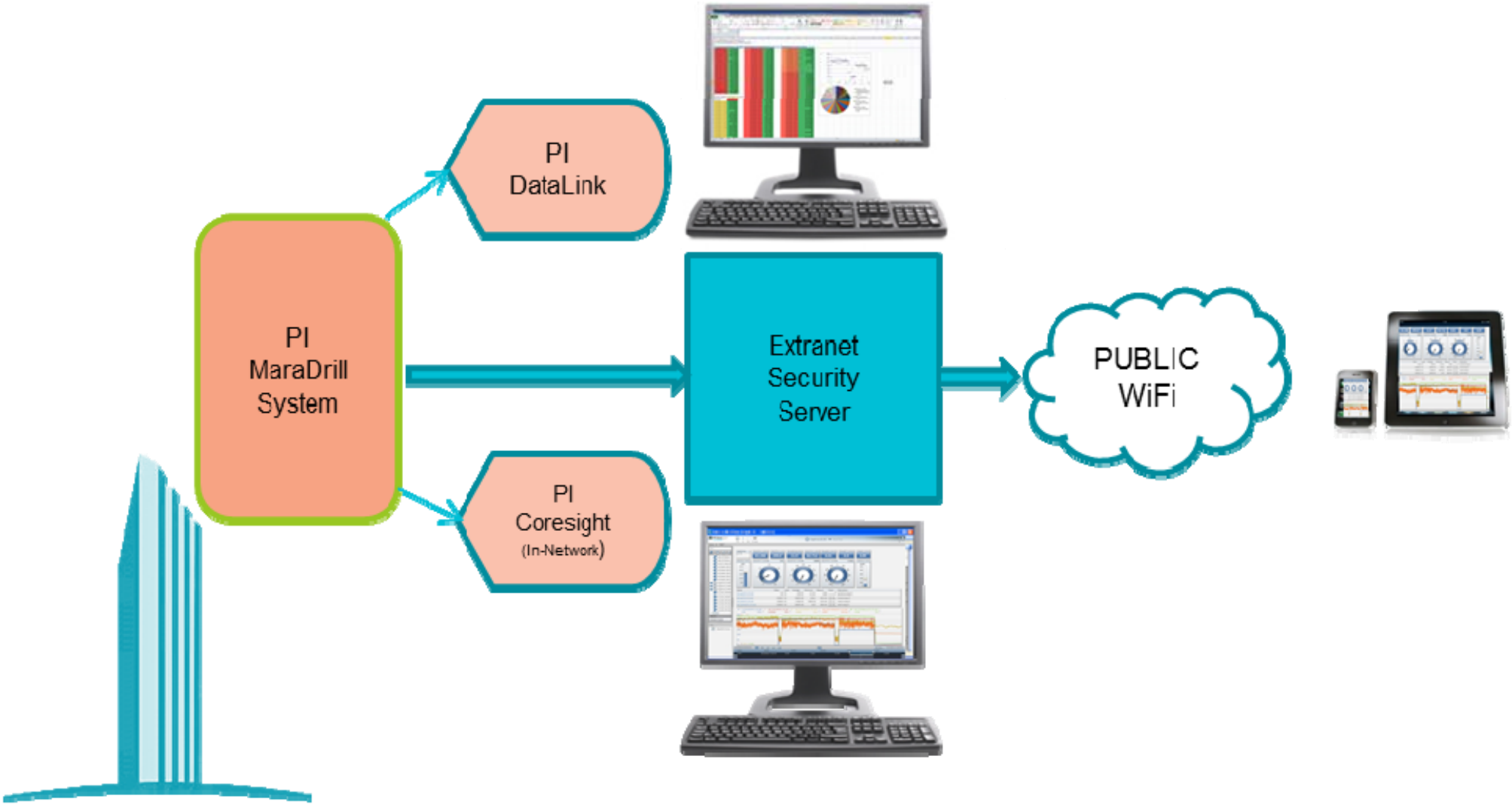
Results and Benefits

- Drilling time and capital well cost savings including reduction in resources
- Reduced vibration and damage to downhole tools
- Continuous optimization onsite and retrospective post-well analysis

Business to Operations Value – real-time Drill Site Guidance



PI System Visualization- Consistency



PI Coresight – Stick-Slip Identification- Eagle Ford Rig

Eagle Ford Rig

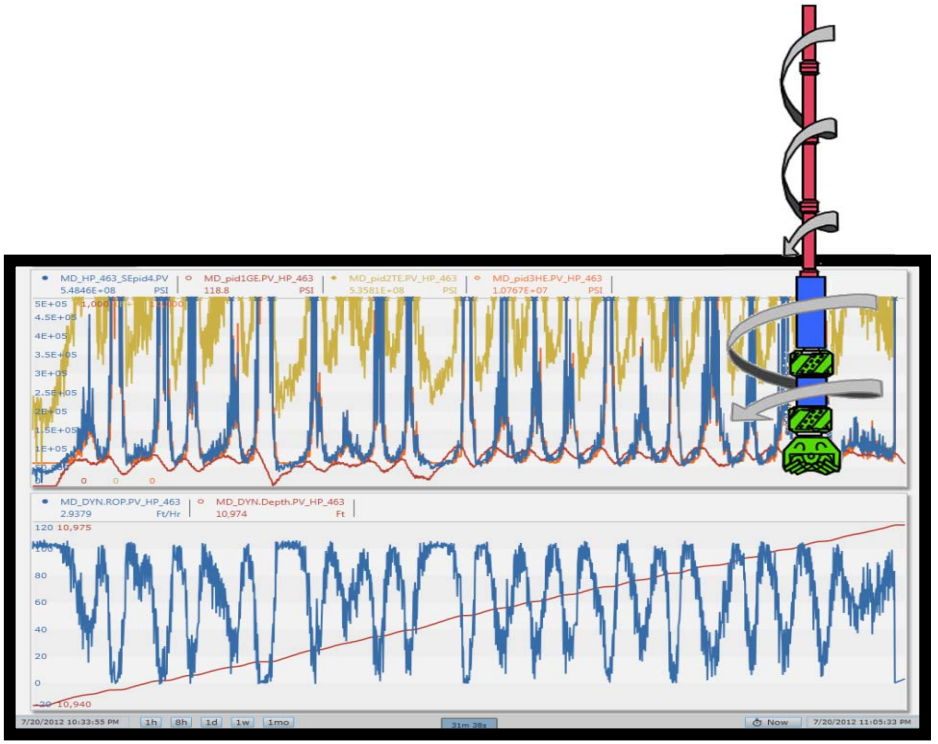
"Perfect" drilling

Stick-slip: Non-uniform rotation of the bit/BHA

Sticking phase → bit stops

Slipping phase → bit "breaks" free

Drillstring torsional oscillations



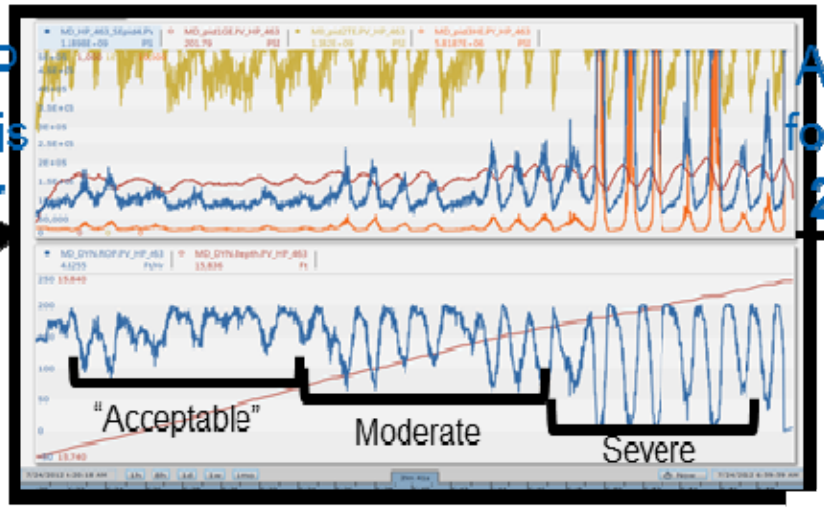
Stick-slip

Real-Time Optimization PI Coresight

Stick-Slip Identification ...few stands later... Stick-Slip Mitigation

40% Sustained Increase in Rate of Penetration

Avg. ROP for stand is 144 ft/hr



Avg. ROP for stand is 201 ft/hr

Marathon Oil

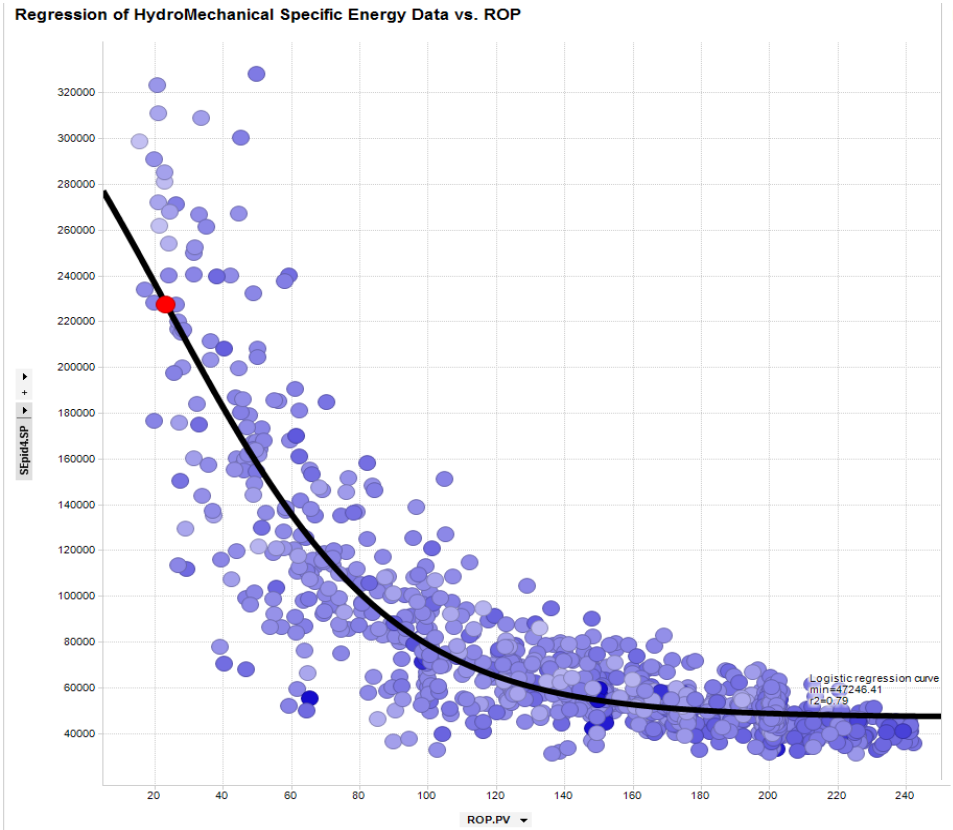
PI Coresight View with XML Data Export

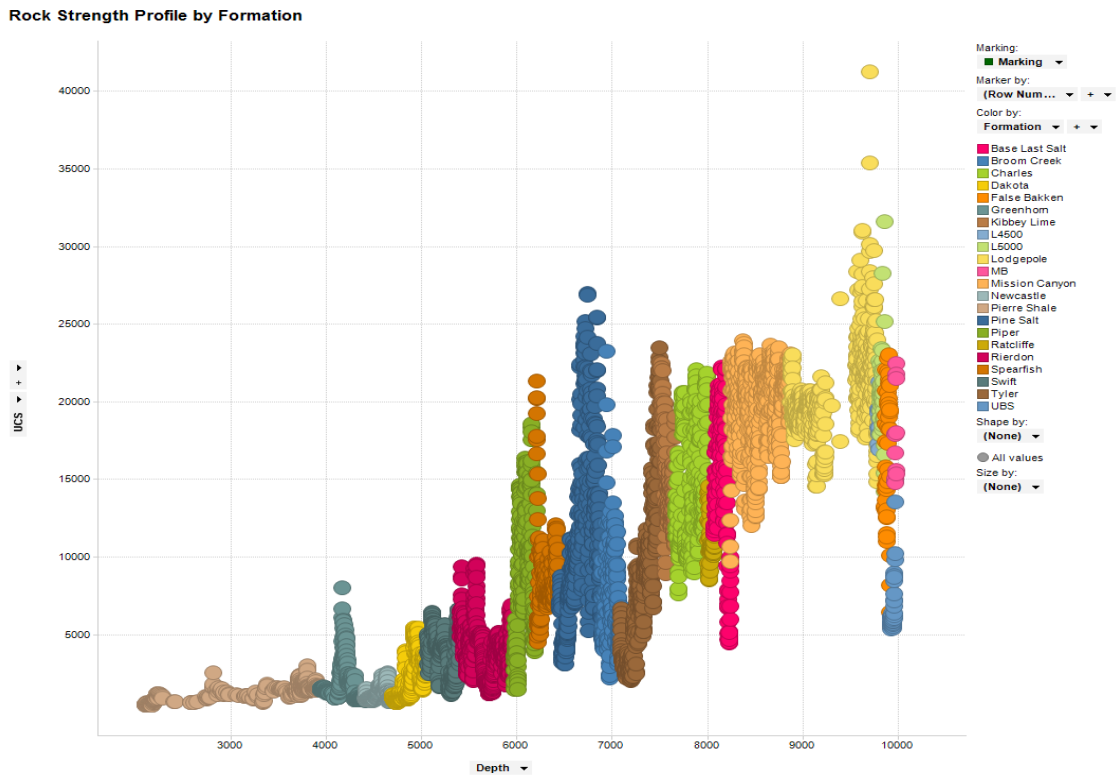
Enables Integration with WellView data

Enables Integration with Spotfire visualization

Post-Well Science Using MaraDrill™ Data in SpotFire

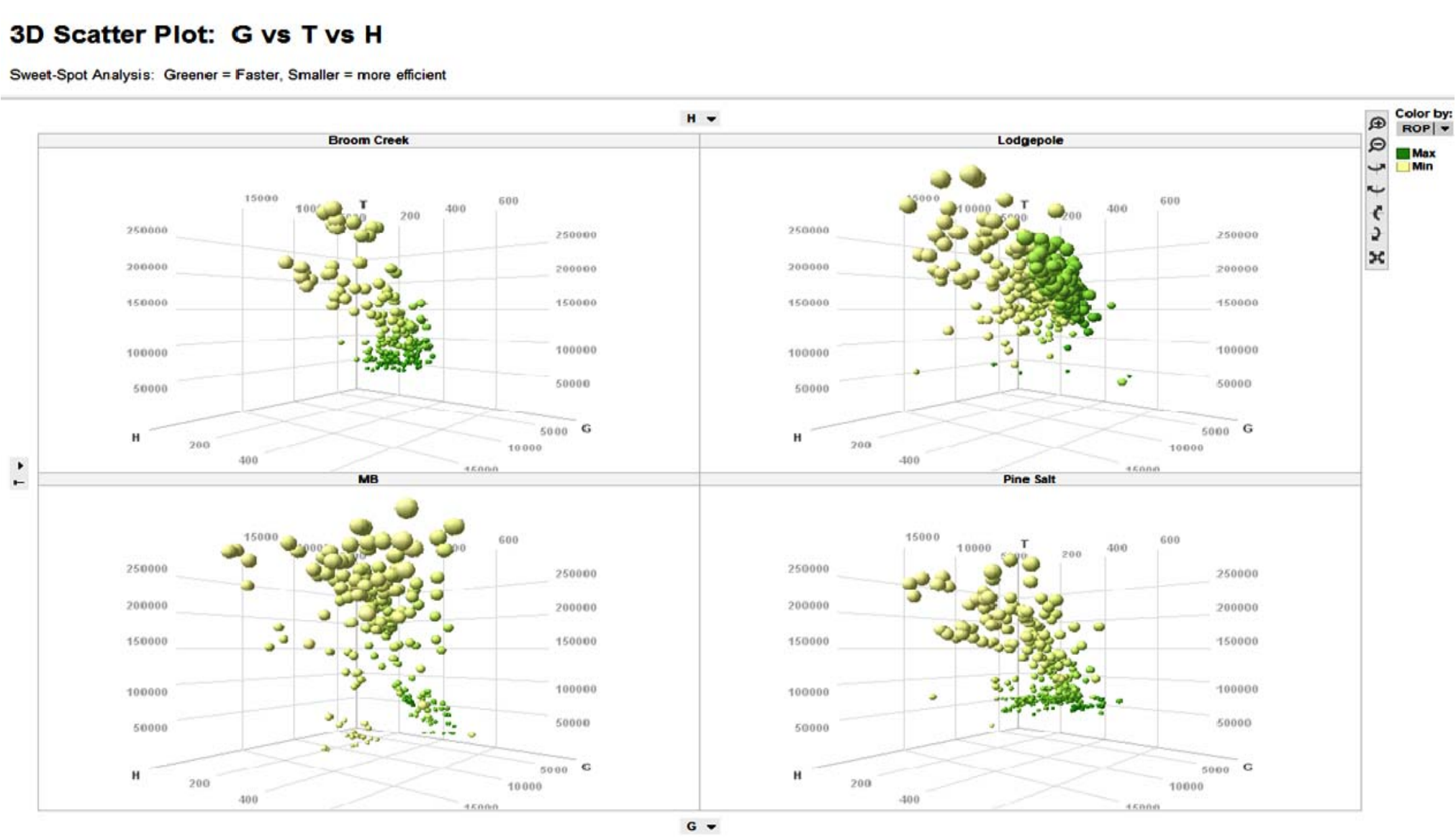
Modeling the rock strength & predicting ROP's on subsequent wells in the area to improve logistics and planning





Post-Well Science Using MaraDrill™ Data

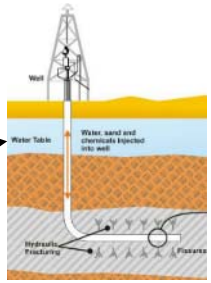
Formation Sweet-Spot Analysis



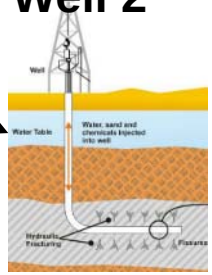
Extending to PI AF and PI EF to Completions

Drilling Rig 1

Well 1



Well 2



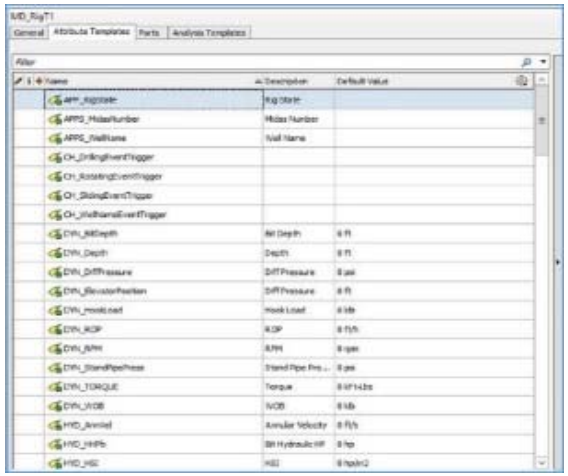
Event Frames

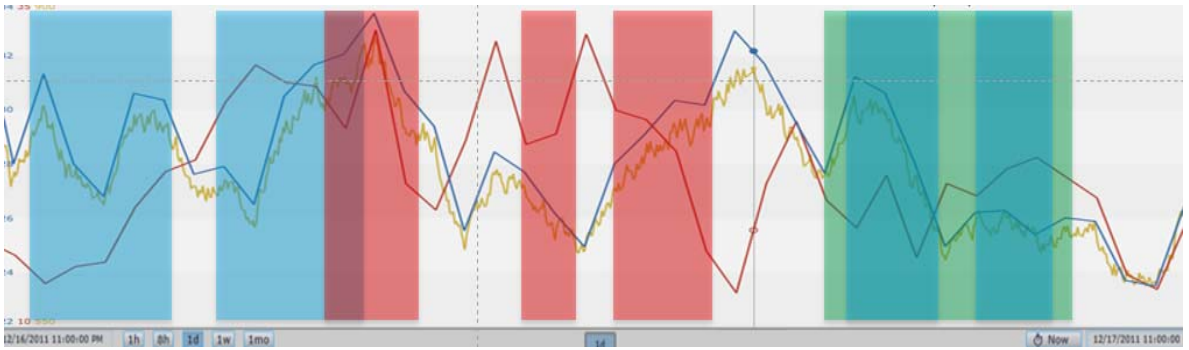
Well 1	24:11:41:12	4/1/2014 2:00:00 AM	4/25/2014 1:41:12 PM
Sliding	0:19:00	4/1/2014 2:40:00 PM	4/1/2014 2:59:00 PM
Rotary ...	4:40:38	4/1/2014 3:33:45 PM	4/1/2014 8:14:23 PM
Sliding	0:28:30	4/1/2014 5:23:04 PM	4/1/2014 5:51:34 PM
Stick-Slip	0:03:30	4/2/2014 5:59:00 AM	4/2/2014 6:02:30 AM
Sliding	0:20:33	4/3/2014 3:42:00 AM	4/3/2014 4:02:33 AM
Rotary ...	8:10:26	4/4/2014 1:33:23 AM	4/4/2014 9:43:49 AM
Stick-Slip	0:00:51	4/5/2014 3:33:45 PM	4/5/2014 3:34:36 PM
Sliding	0:22:01	4/12/2014 10:41:10 AM	4/12/2014 11:03:11 AM

Event Frames

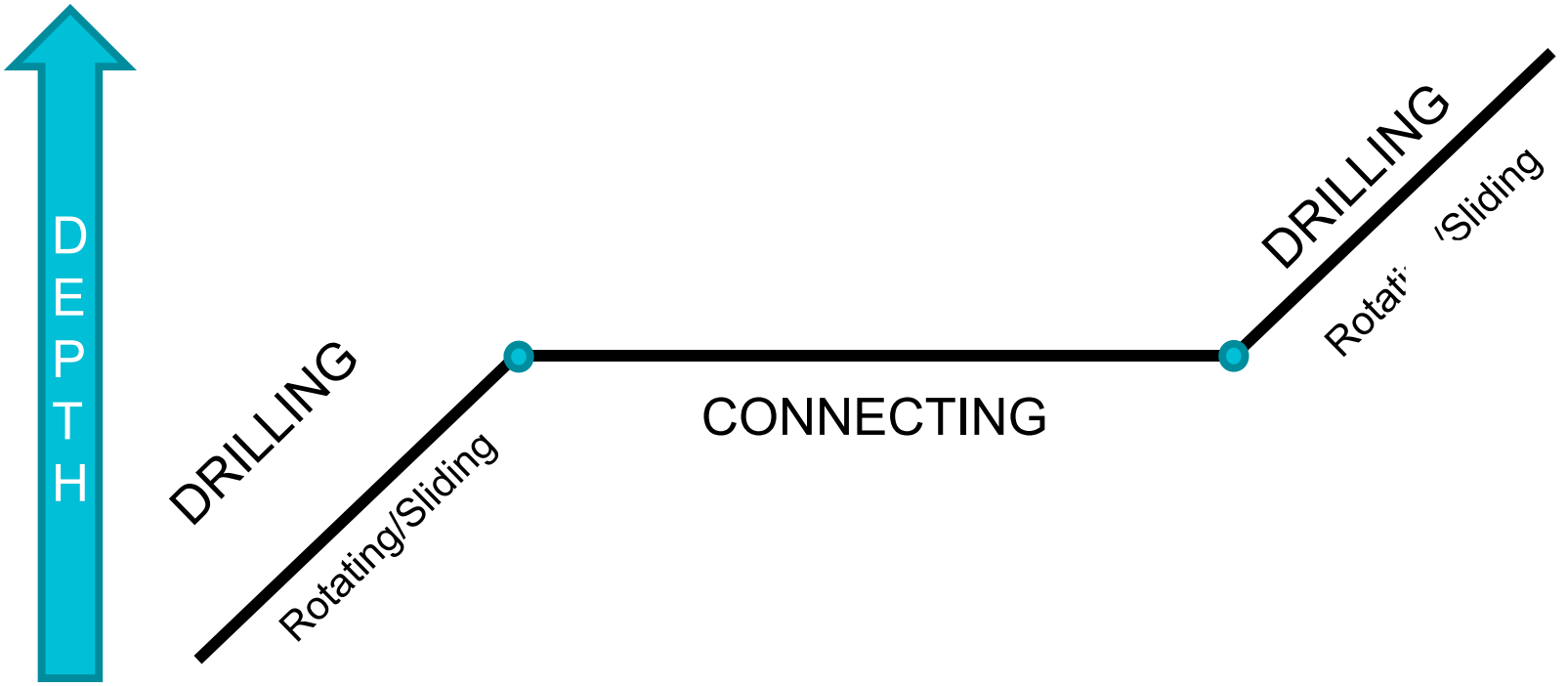
Well 2	24:0:00:33	4/27/2014 1:42:00 PM	5/21/2014 1:42:33 PM
Sliding	0:18:50	4/28/2014 2:40:10 PM	4/28/2014 2:59:00 PM
Rotary ...	7:40:38	4/29/2014 3:33:45 PM	4/29/2014 11:14:23 PM
Sliding	1:11:30	5/1/2014 3:23:04 PM	5/1/2014 4:34:34 PM
Stick-Slip	1:23:35	5/2/2014 5:39:00 AM	5/2/2014 7:02:35 AM
Sliding	0:23:00	5/3/2014 5:32:30 AM	5/3/2014 5:55:30 AM
Rotary ...	8:49:59	5/4/2014 1:33:23 AM	5/4/2014 10:23:22 AM
Stick-Slip	0:11:29	5/5/2014 4:43:45 PM	5/5/2014 4:55:14 PM
Sliding	10:41:00	5/6/2014 10:41:10 AM	5/6/2014 9:22:10 PM
Sliding	0:35:04	5/7/2014 8:40:20 AM	5/7/2014 9:15:24 AM

AF Element

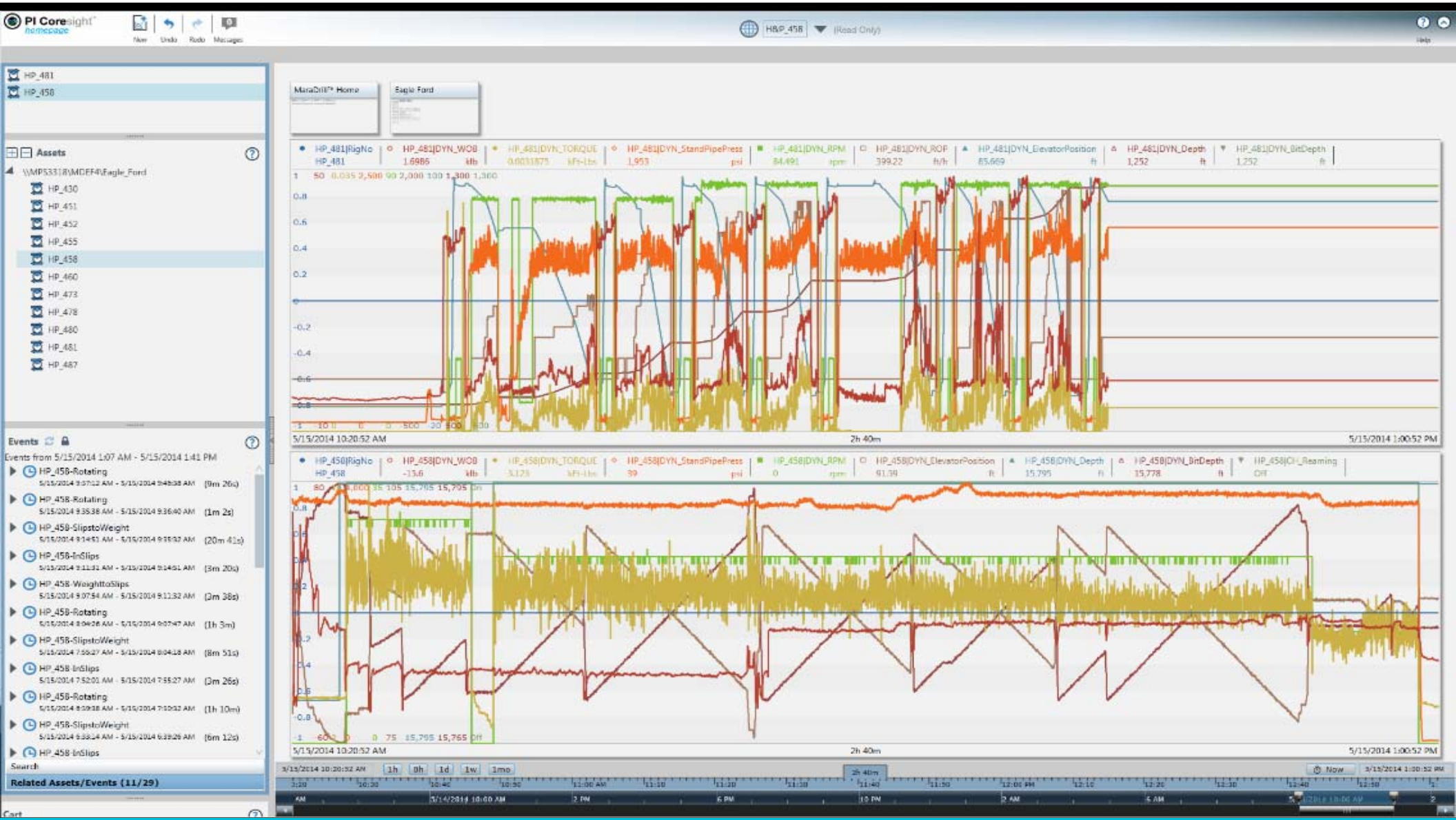




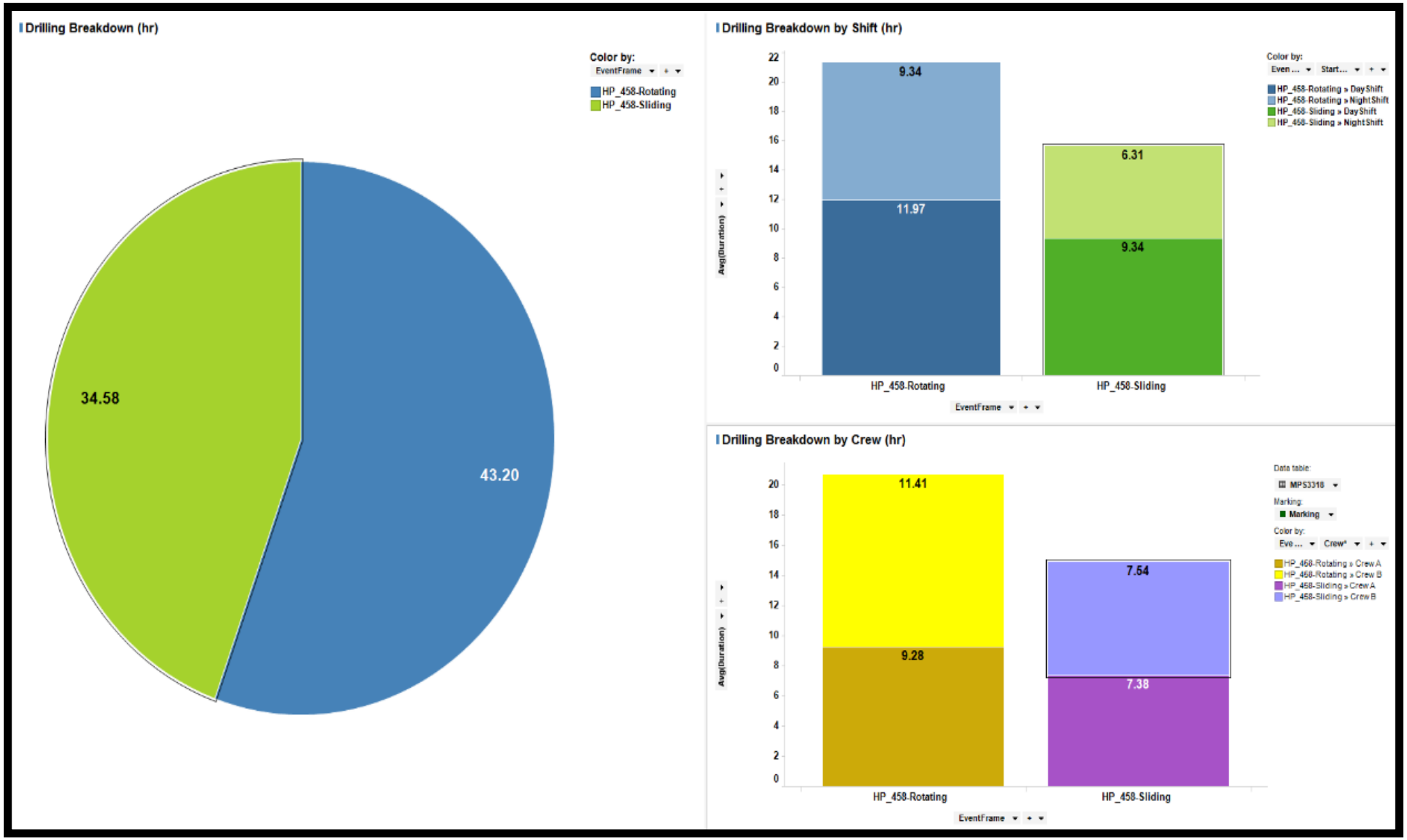
Major Drilling Events
– Looking for Sources of Idle Time

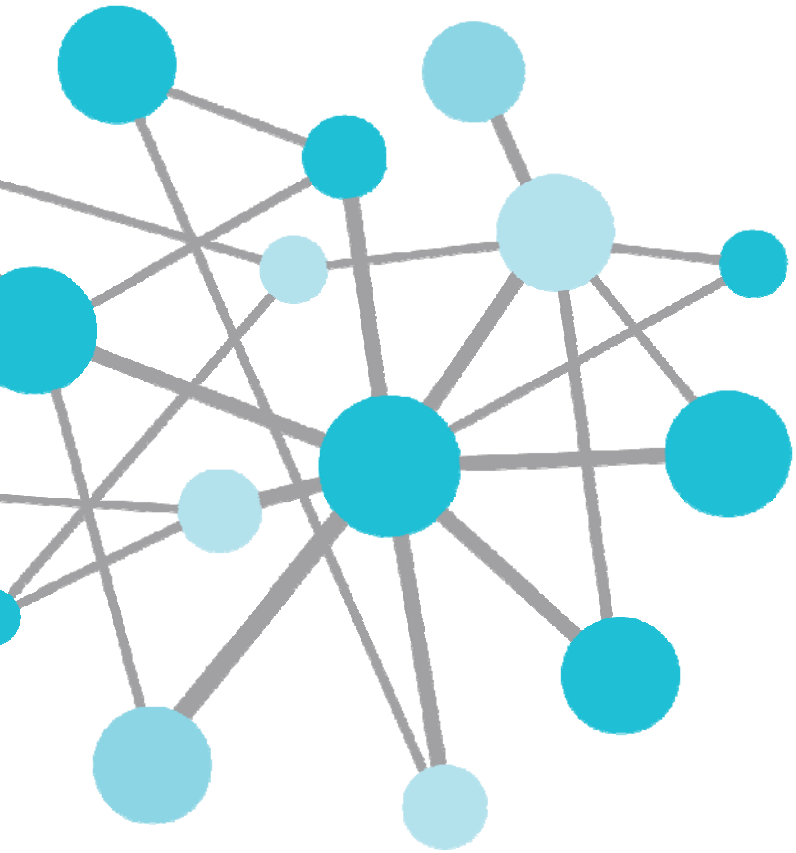


Self Serve Analytics & Visualization, Mobility…..Consistency, Alignment, Simplicity, and in Context – Drilling Events



Microsoft Power BI for Advanced Analytics

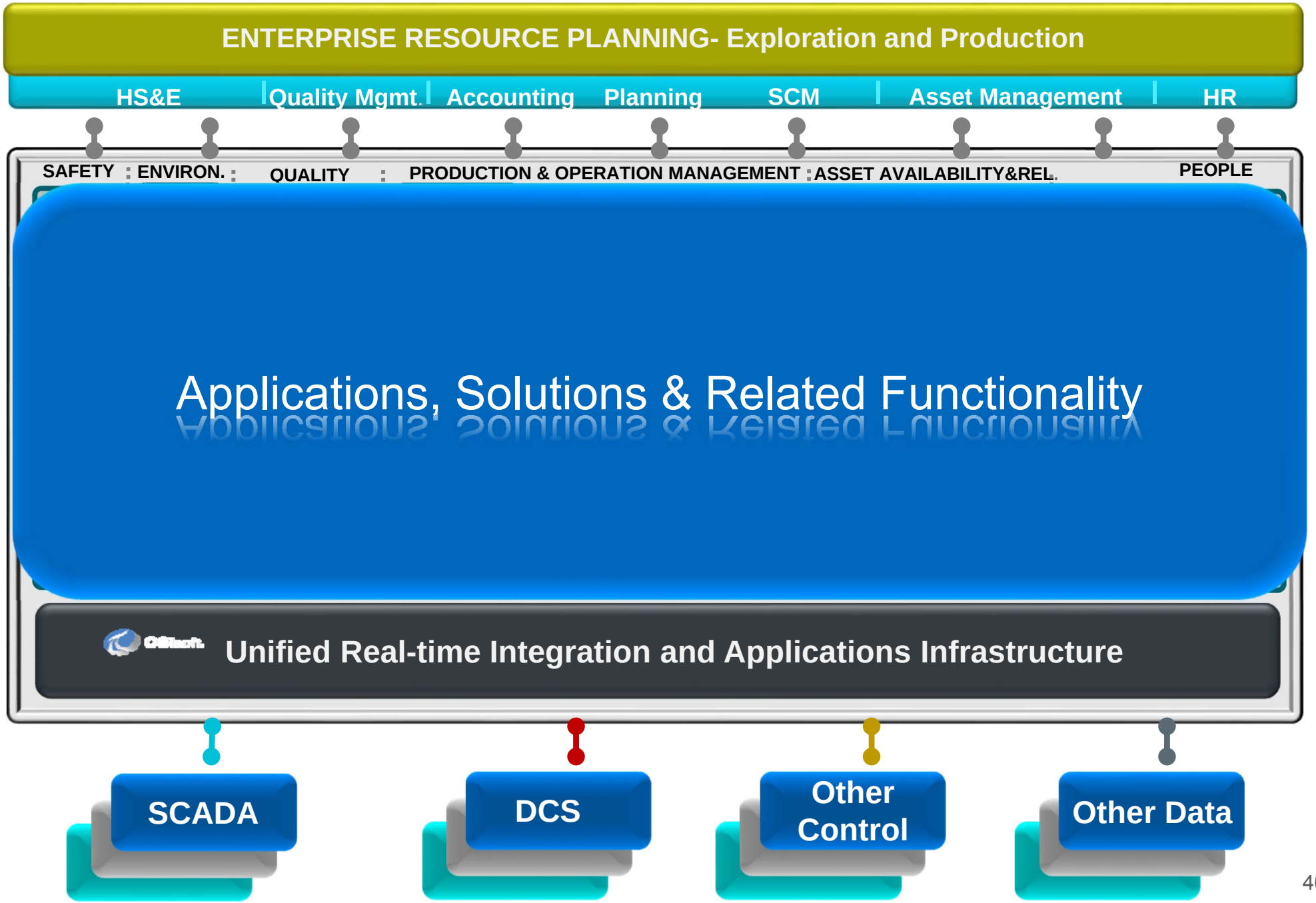




Illustrative Case Study – Talisman Energy

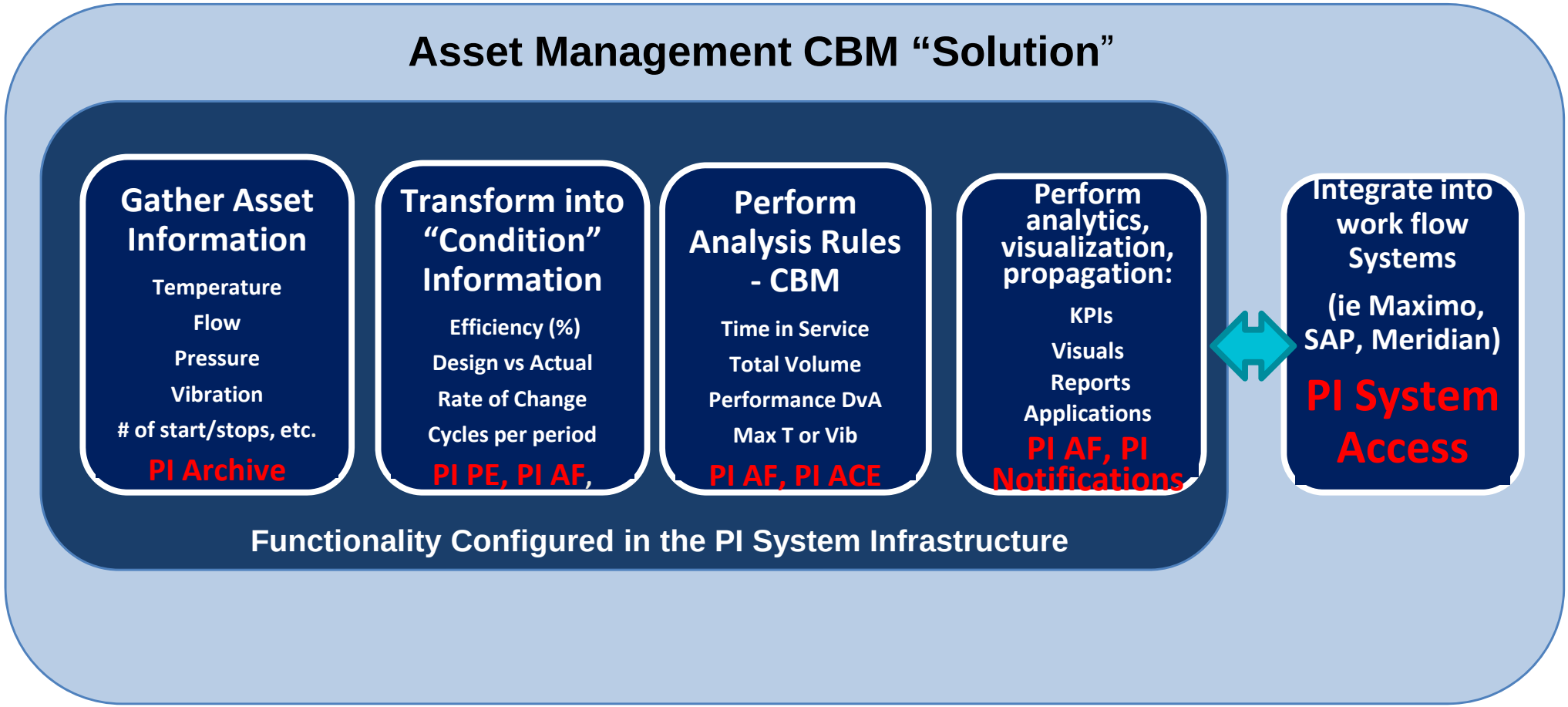
Data Consistency and Context
Organizational Alignment
Applications/Solutions Simplicity
Data Transformation Methodology

Moving Applications to & Integrating Solutions with the Data Infrastructure – Simplification & Standardization

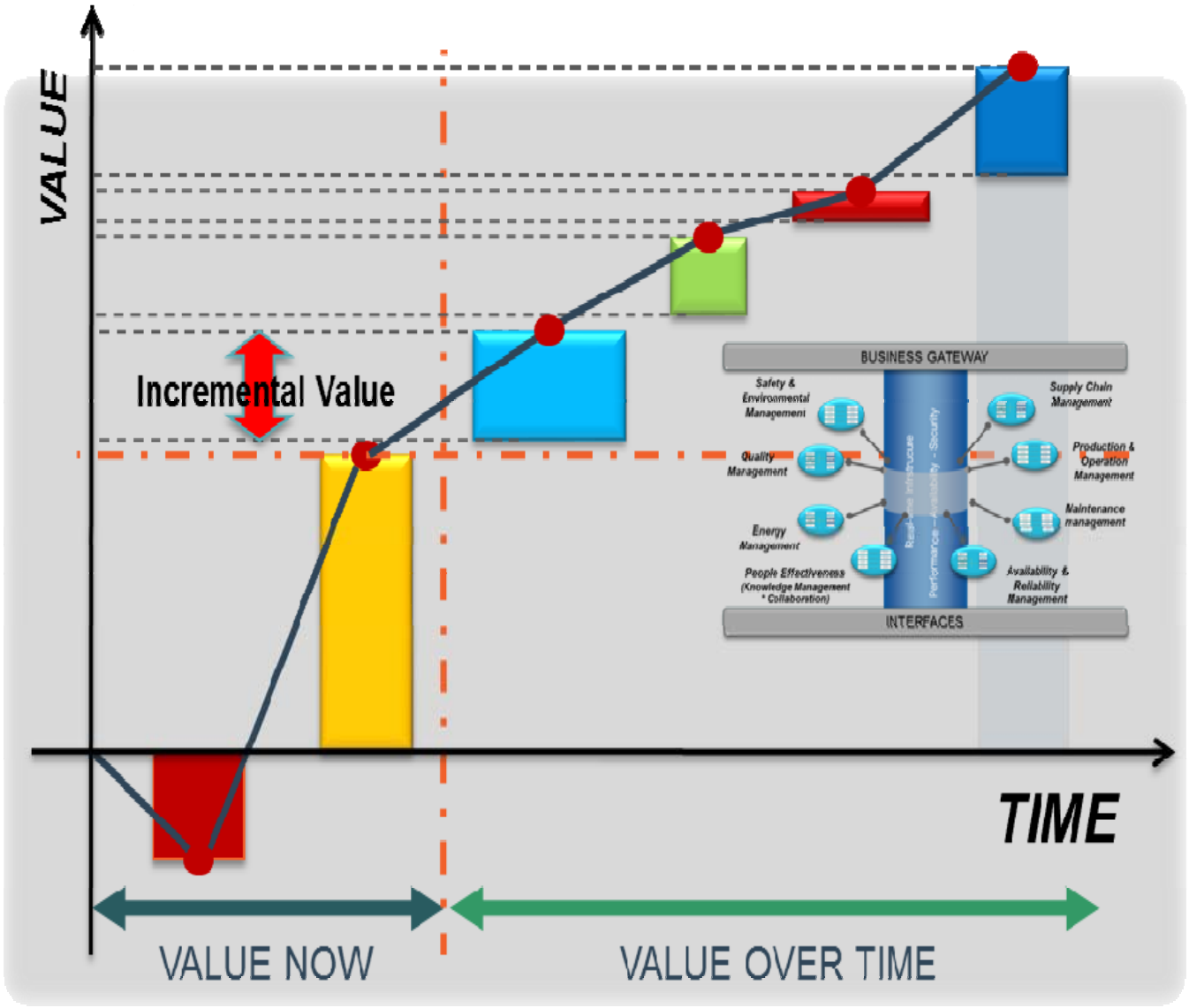


Decomposition of Typical "CBM Solution"

(note: concept can be applied to a majority of solutions)



An Infrastructure Approach



Performance Management

Environmental Reporting

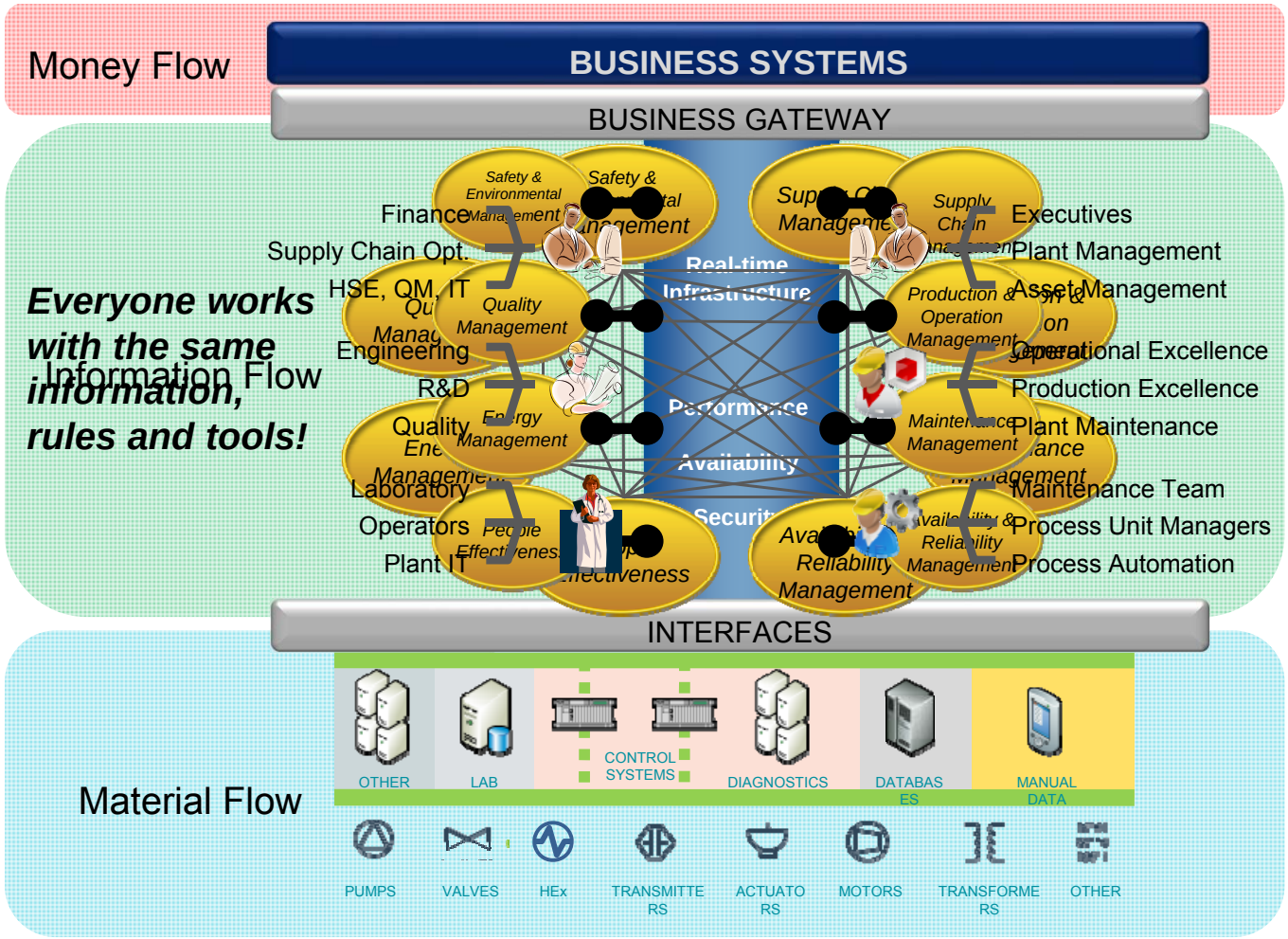
Equipment Health Mgmt.

Operations Management

Initial Infrastructure Value

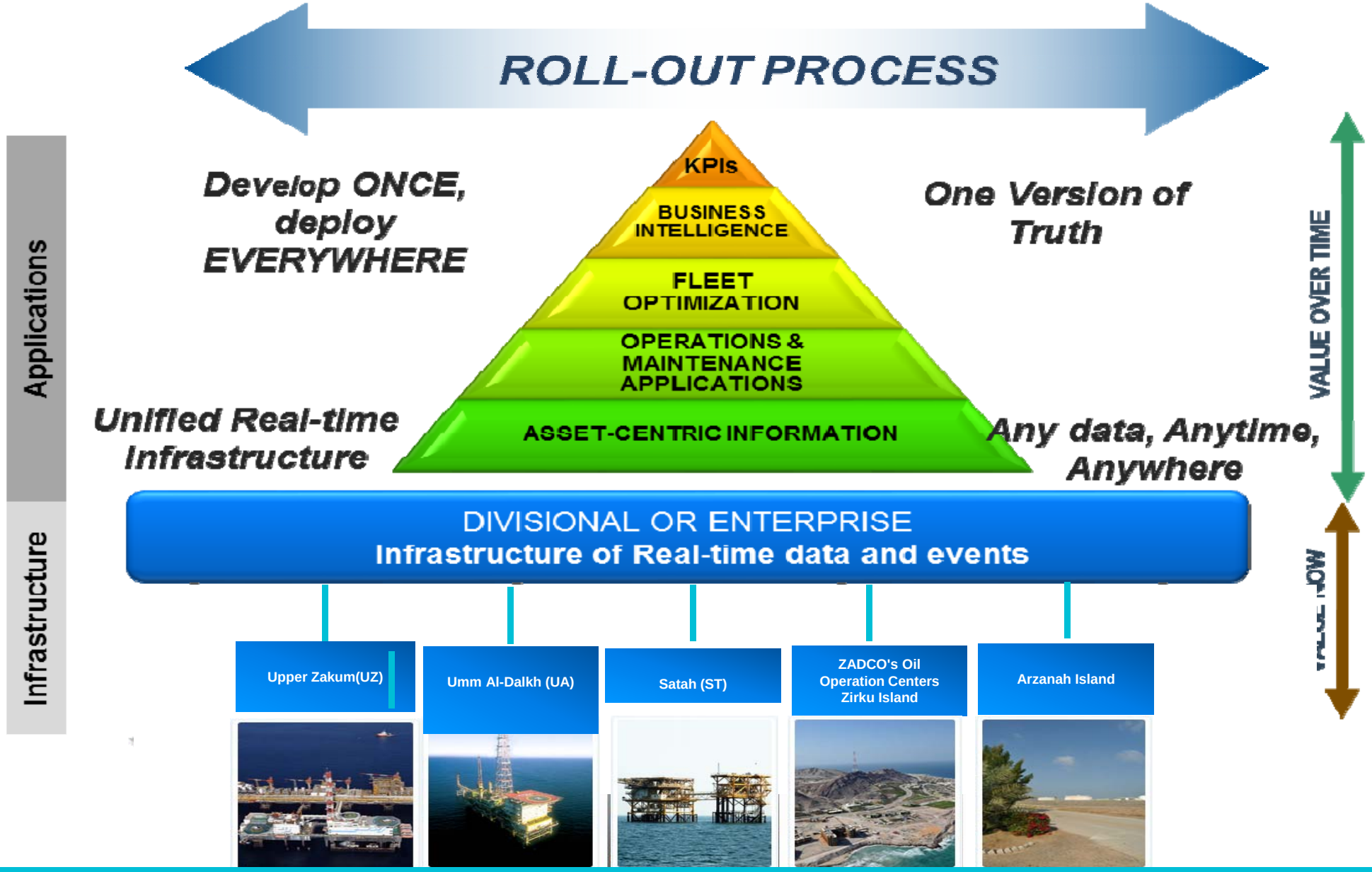
Infrastructure Initial Investment

Enablement of Business to Operations Value

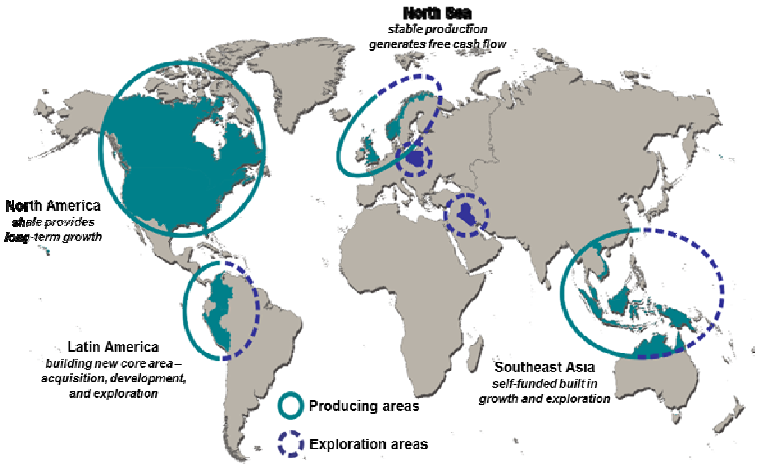


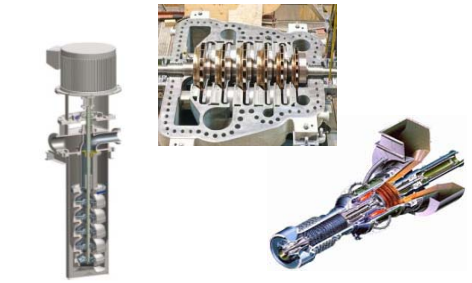
Infrastructure, to harness the Power of Data

Implementing Strategic Initiatives on Enterprise Scale

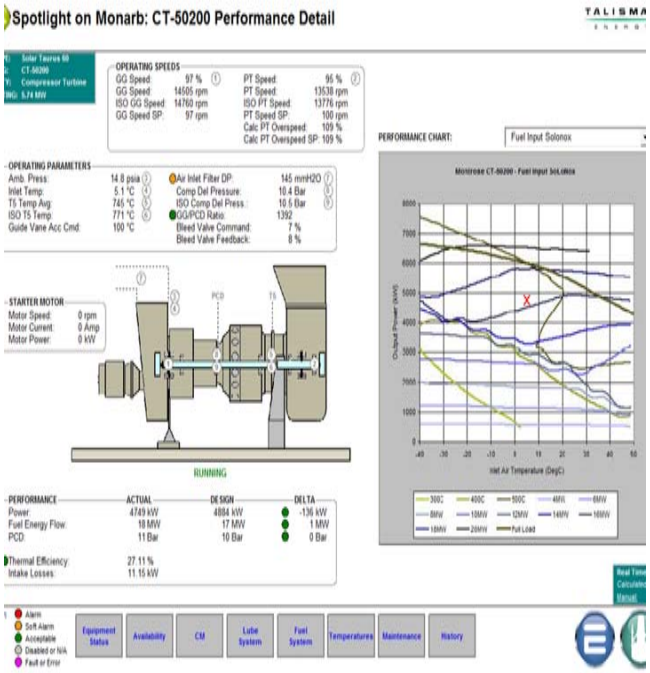


Real-Time Monitoring of 2,900 Safety, Production, and Water Critical Pieces of Rotating Equipment





TALISMAN ENERGY



Business Challenge

- Consistency in displays, calculations, process points, and operating points
- Continuous monitoring of live and derived values against alarm limits and thresholds
- Improved overall production by reducing critical rotating equipment failures

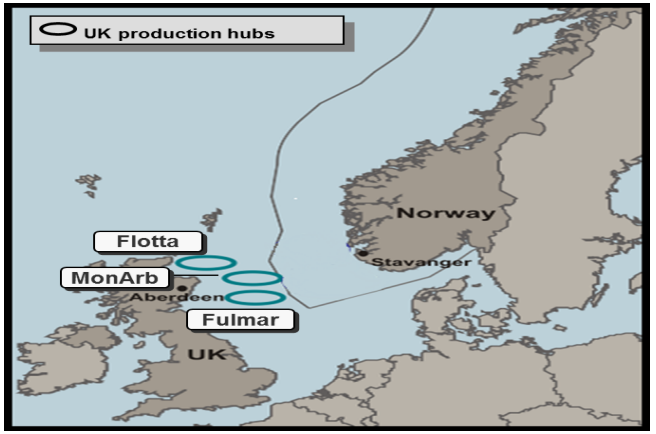
Solution

- Creation of a PI System based solution – SPOTLIGHT to monitor 2900 critical pieces of equipment – in 6 months
- Goals:
- Improve reliability Reduce production losses from rotating equipment
- Improve rotating equipment integrity

Results and Benefits

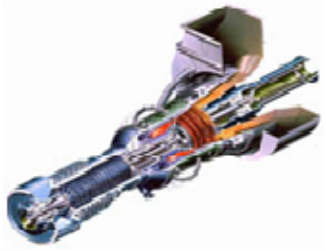
- Globally consistent, aligned, and simplified application
- Ability to scale and replicate to other assets
- Saved 220K BPD of lost production from avoidance of incident in first 6 months

Business Challenge
Offshore – 8 Production Platforms



Safety Critical Equipment

- 39 Diesel Drive Fire Pumps
- 6 Electric Drive Fire Pumps
- 8 Hydraulic drive fire pumps
- 15 Emergency Power Generation Packages
- 26 Bilge / Ballast Pumps
- 53 Other Safety Critical Pumps

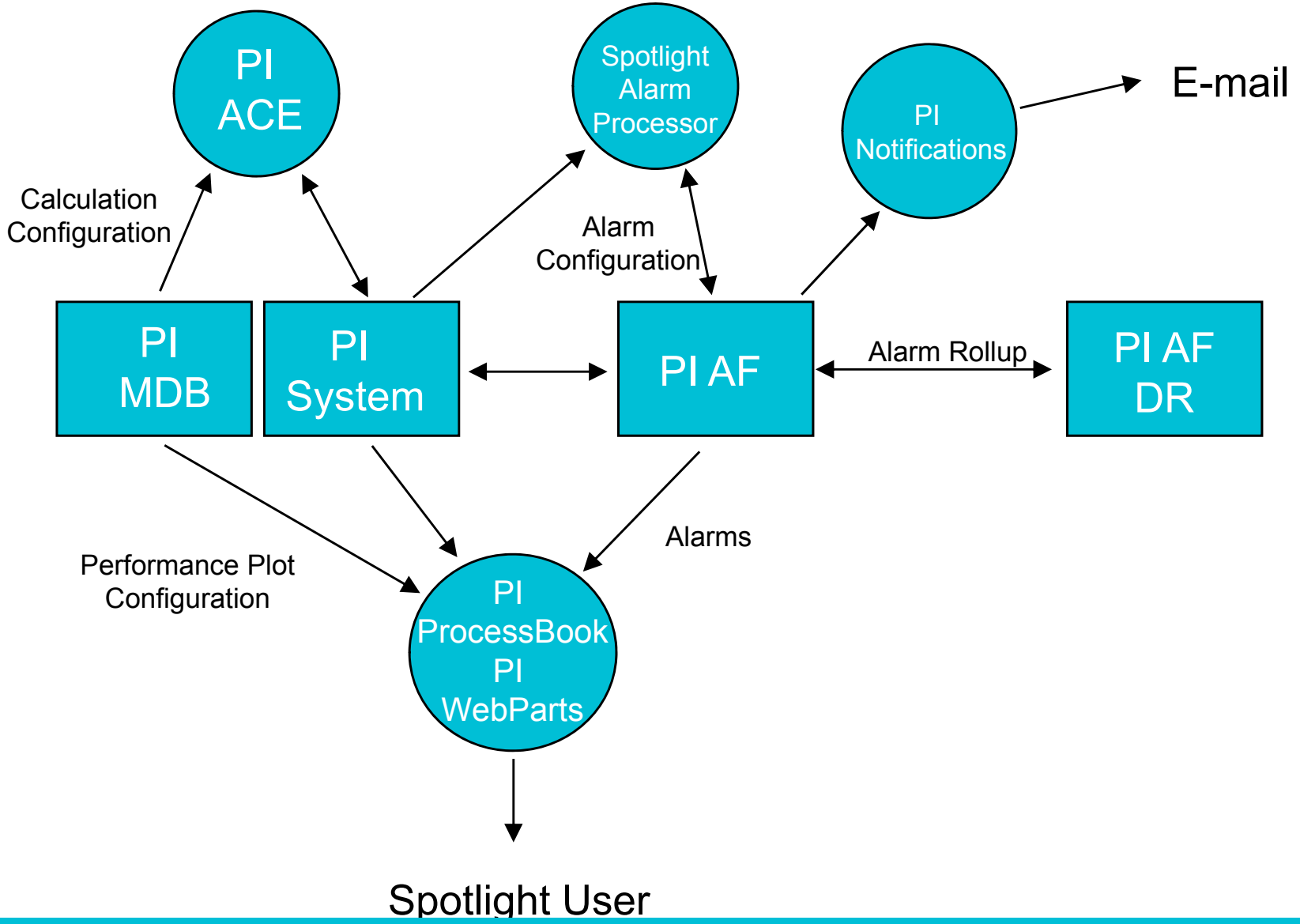


Production Critical Equipment

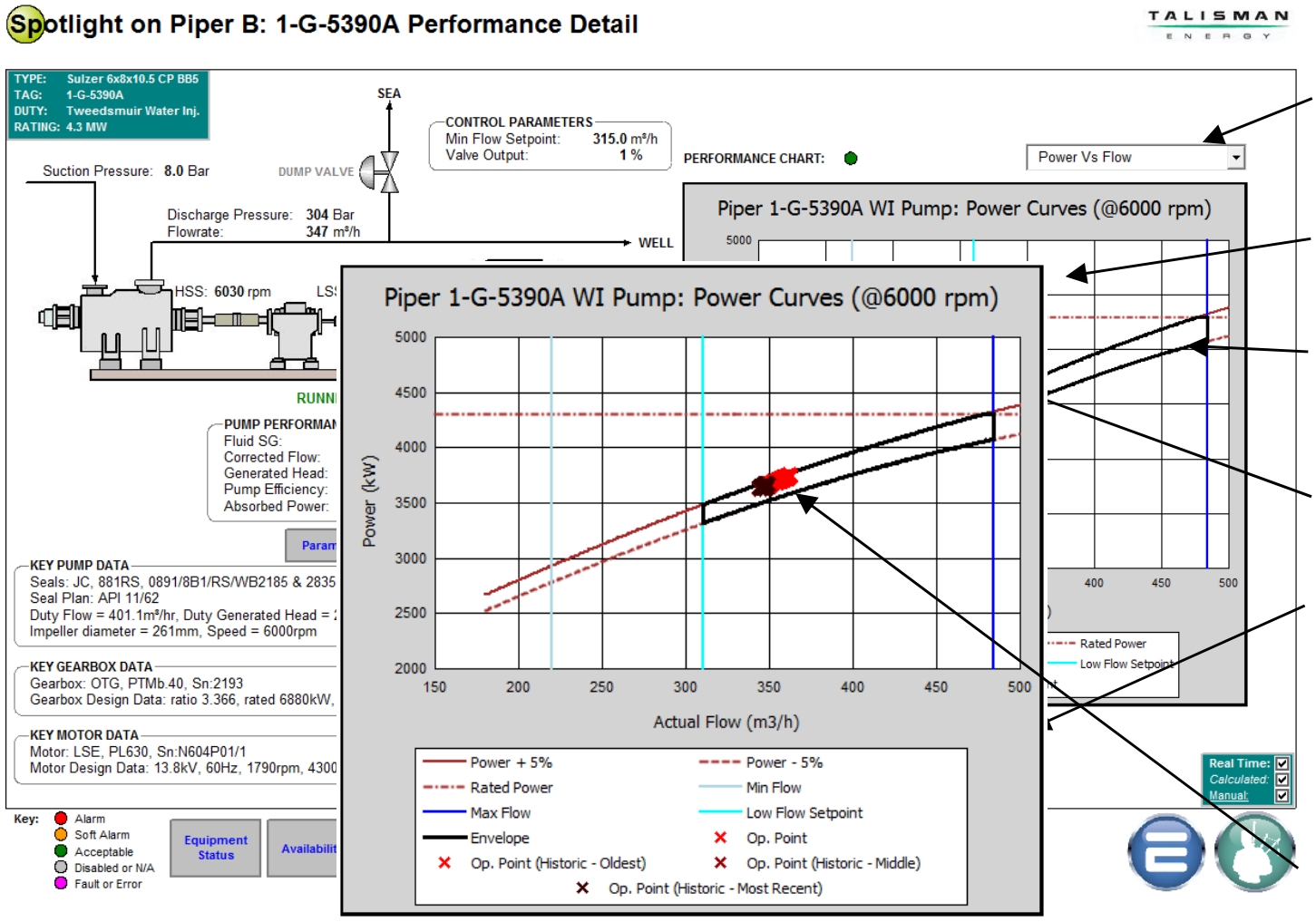
- 56 Gas Turbines
- 40 Gas Compressors
- 9 Diesel Engines for Main Power Generation
- 27 Main Water Injection, P.W. & Artificial Lift Pumps
- 35 Main Oil Line Pumps
- Circa 2711 Operational Pumps

A total of 2831 pieces of Major Rotating Equipment

Spotlight Architecture



Spotlight Display - Performance



User can select different charts associated with this item

Chart showing performance constraints

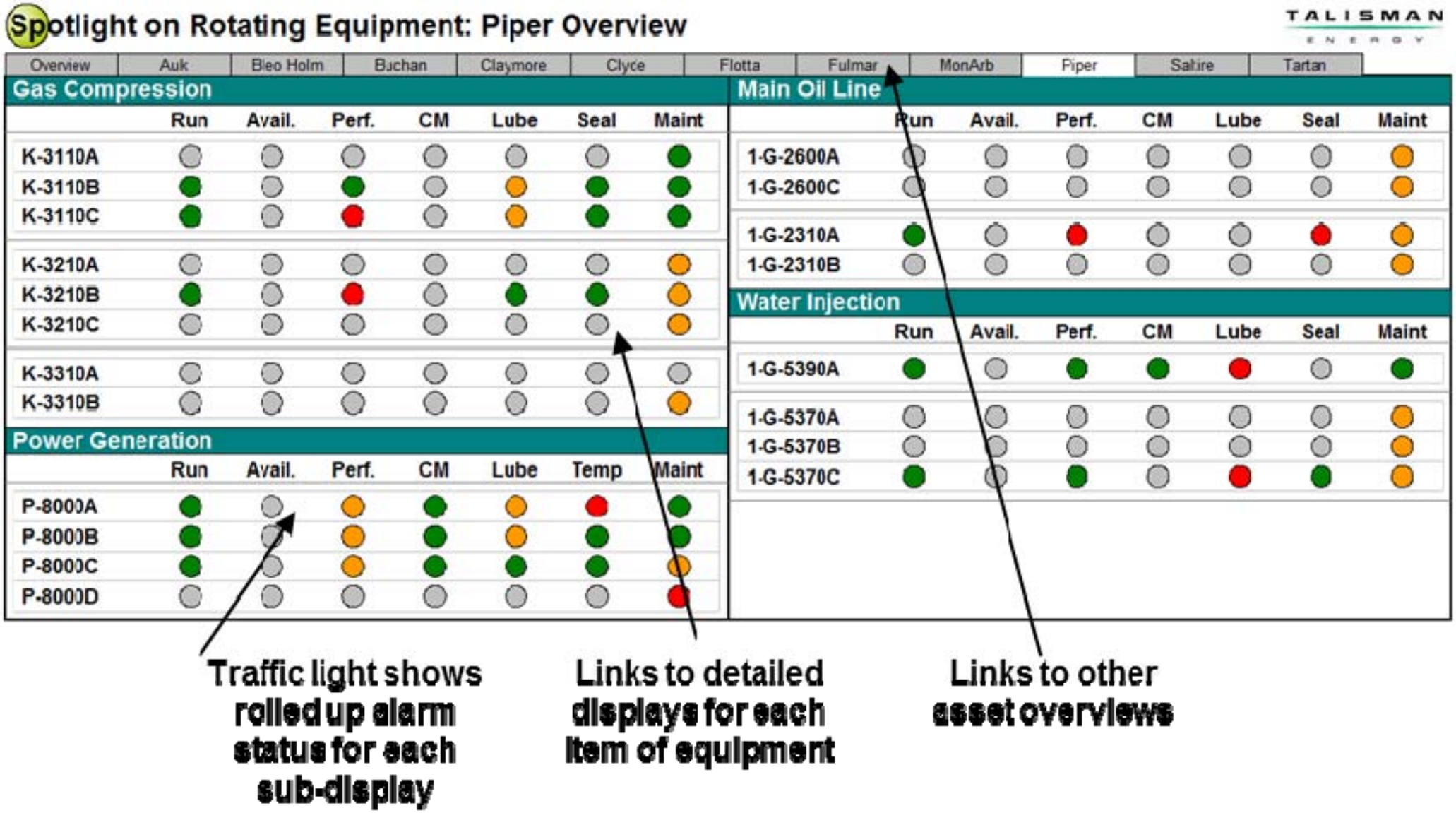
Operating Envelope

Current operating point

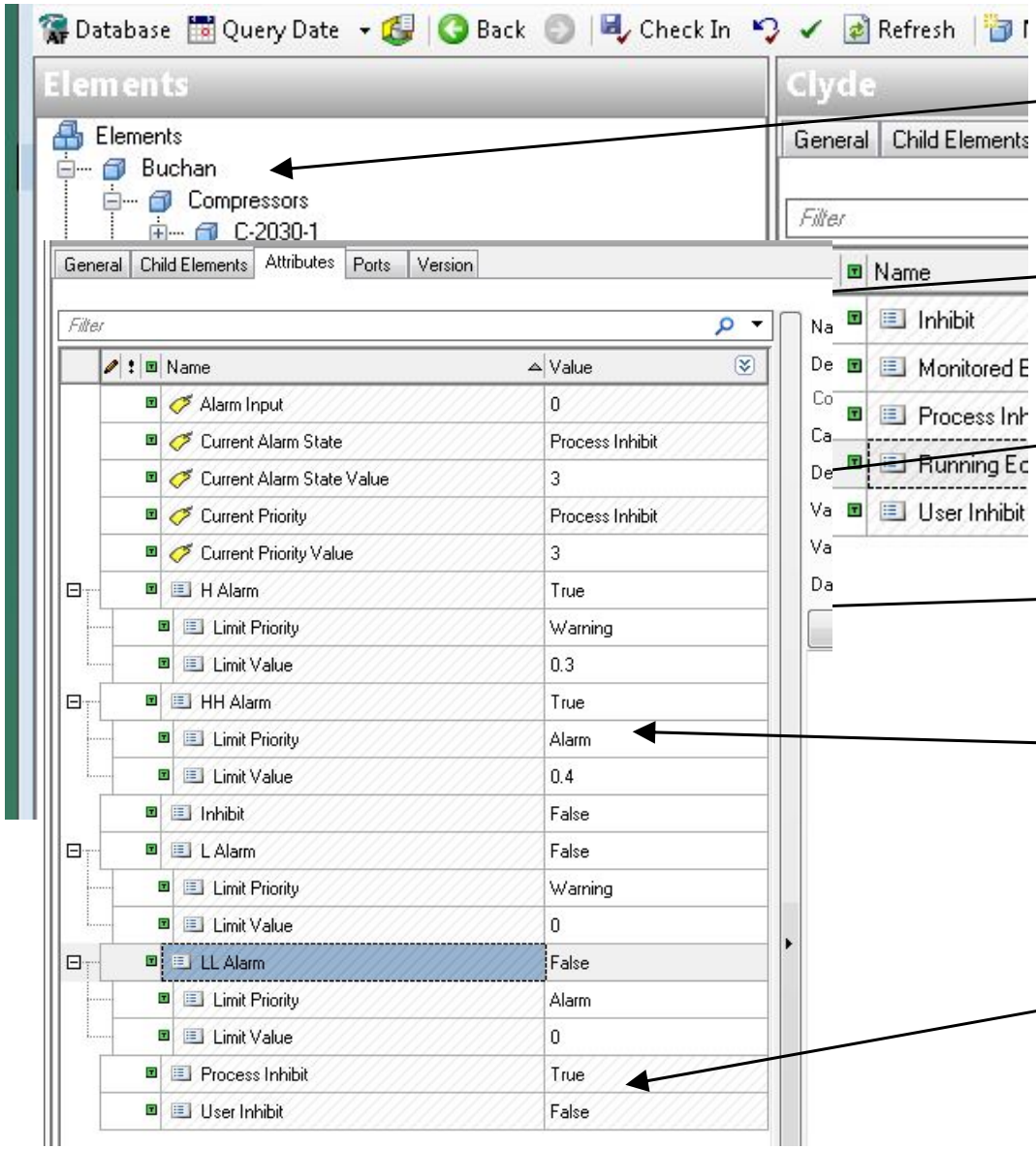
View operating point history over varying time periods

Operating point “cloud” shows history

KPIs with High Fidelity "Live" Drill Down



Consistency in KPIs, Alarms, & Transformations



Asset/Equipment Tree Structure

Individual Equipment (run indicators, etc.)

Displays (alarm rollup for summary)

Individual Alarms (allows more than one alarm type per measurement)

Alarm limits configuration

Process inhibit (run state)
User inhibit (cascaded down)

Agenda

- Business to Operations Data Value Requisites:
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  - Organizational Alignment
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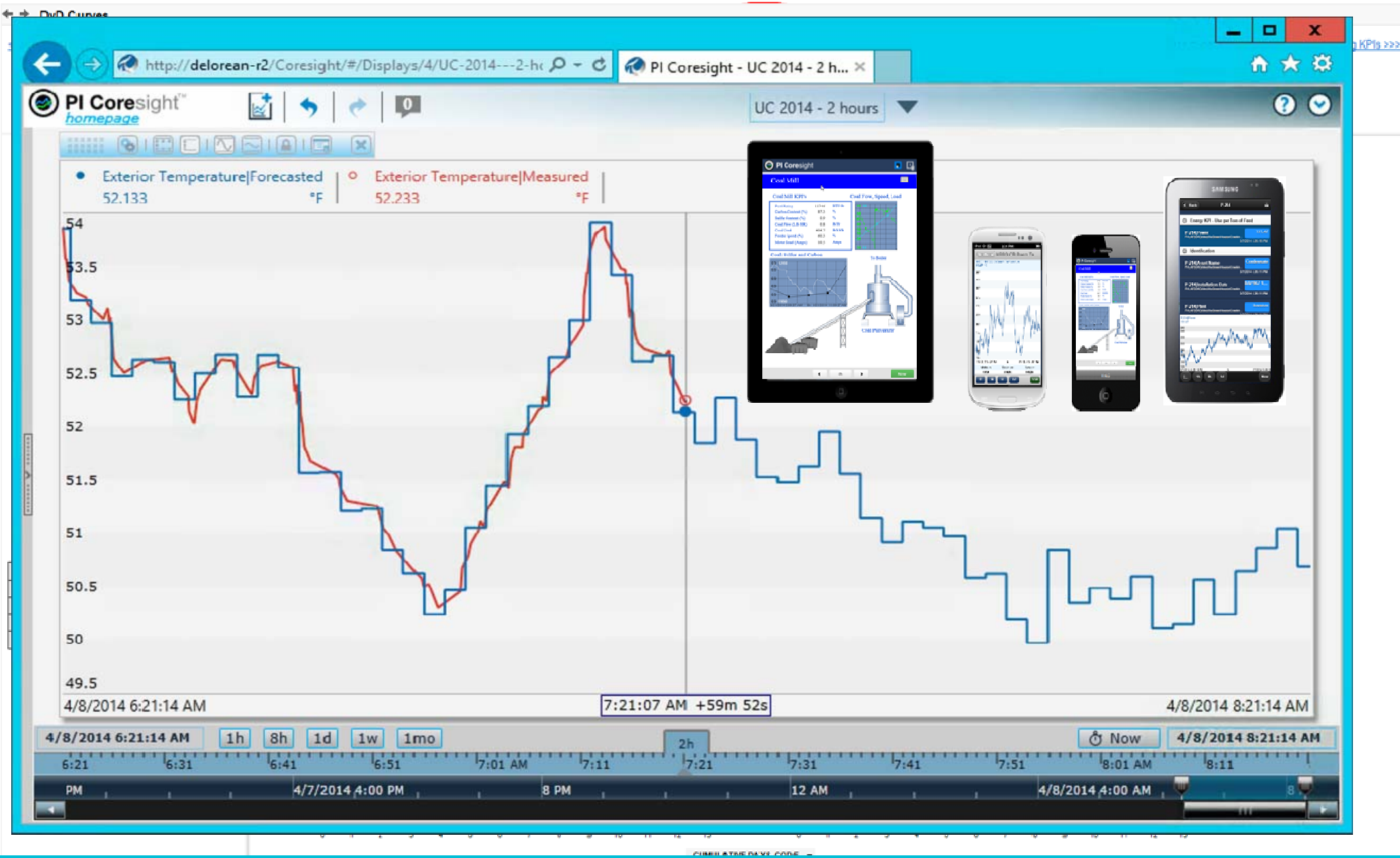
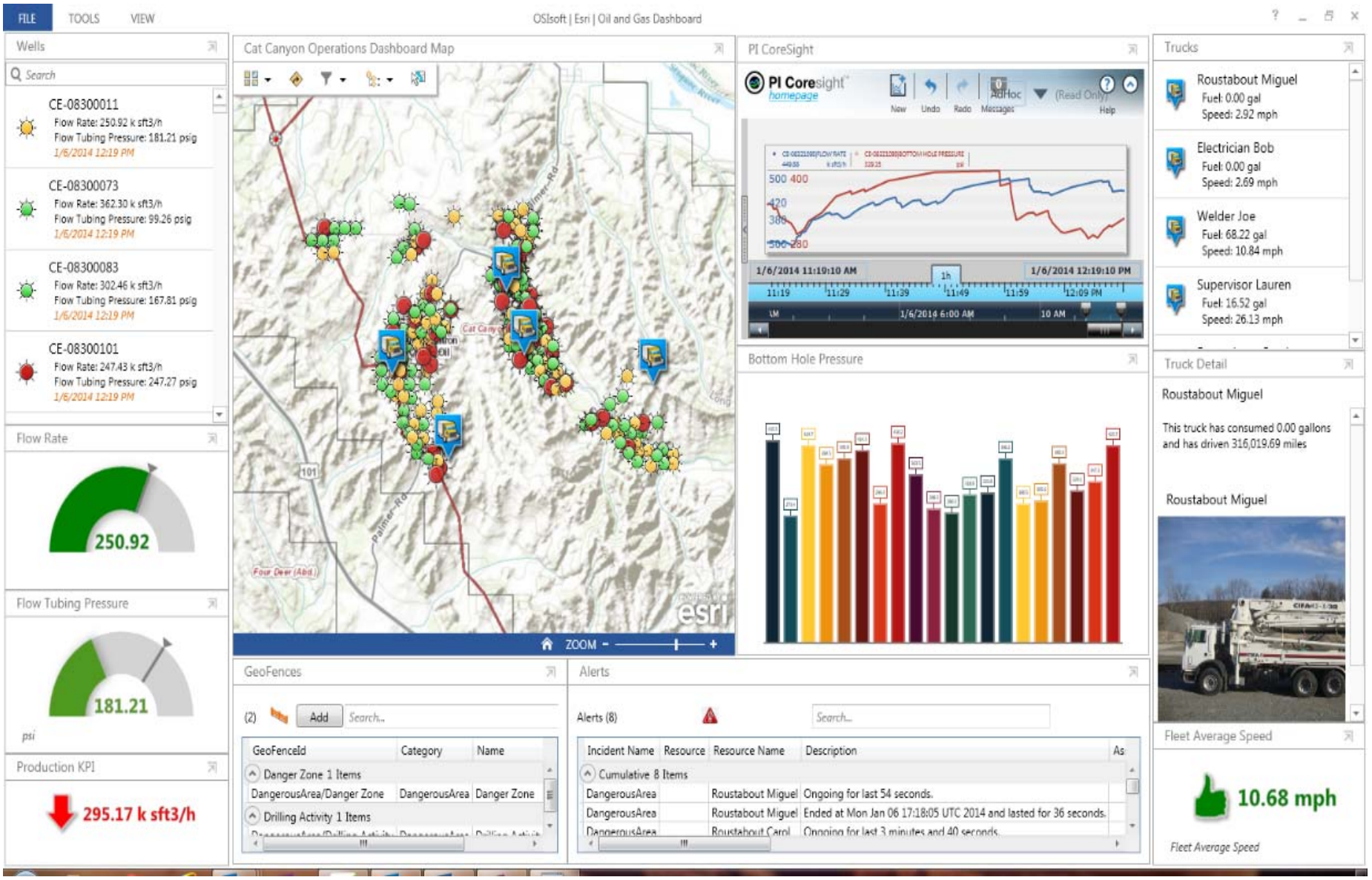
- "Future Proofing" of the Data Infrastructure
- Resulting Value in O&G
- Closing Comments

Future Data – Operational Performance and Model Acuracy



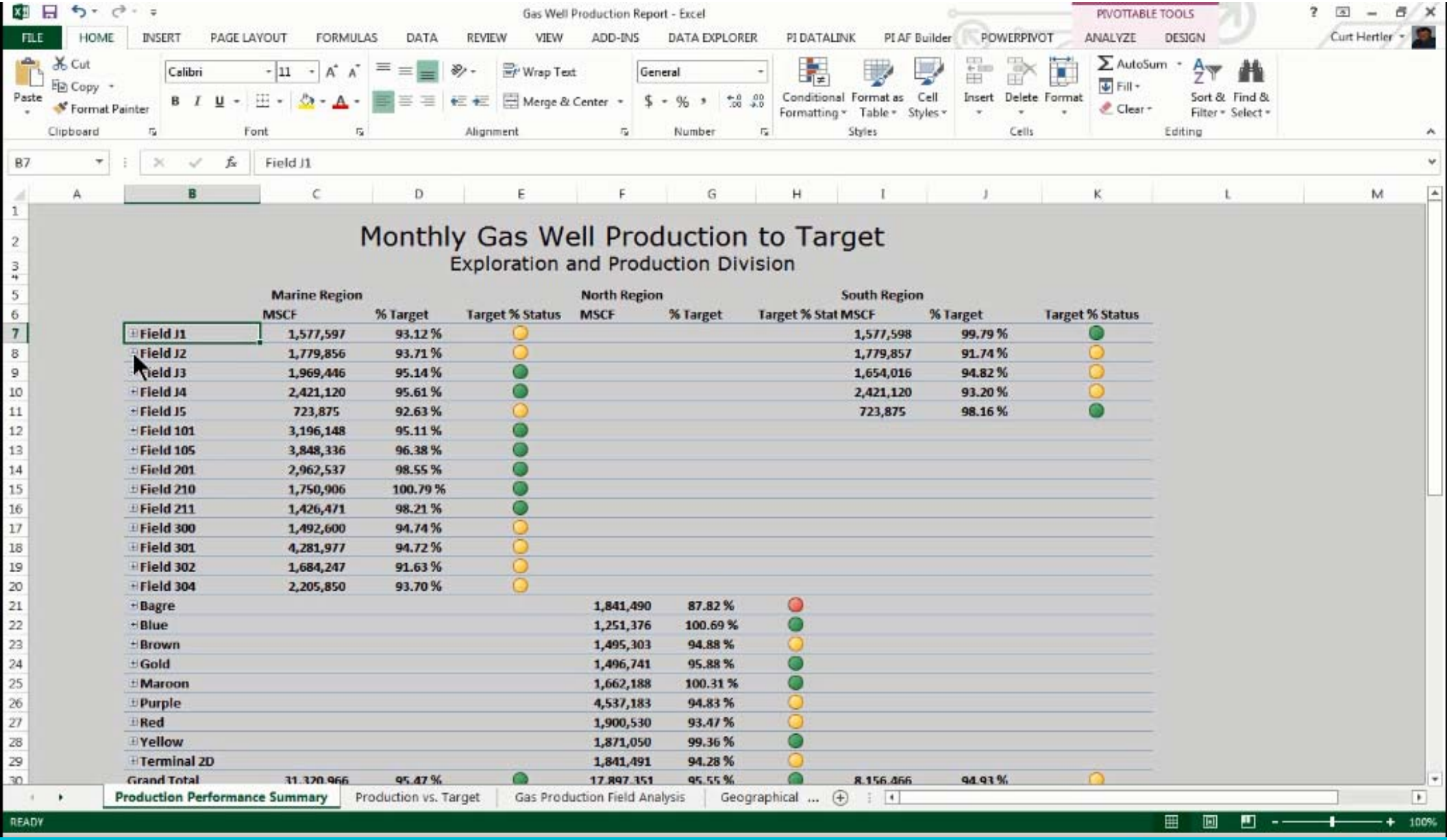
PI Integrator for Esri ArcGIS

Jump

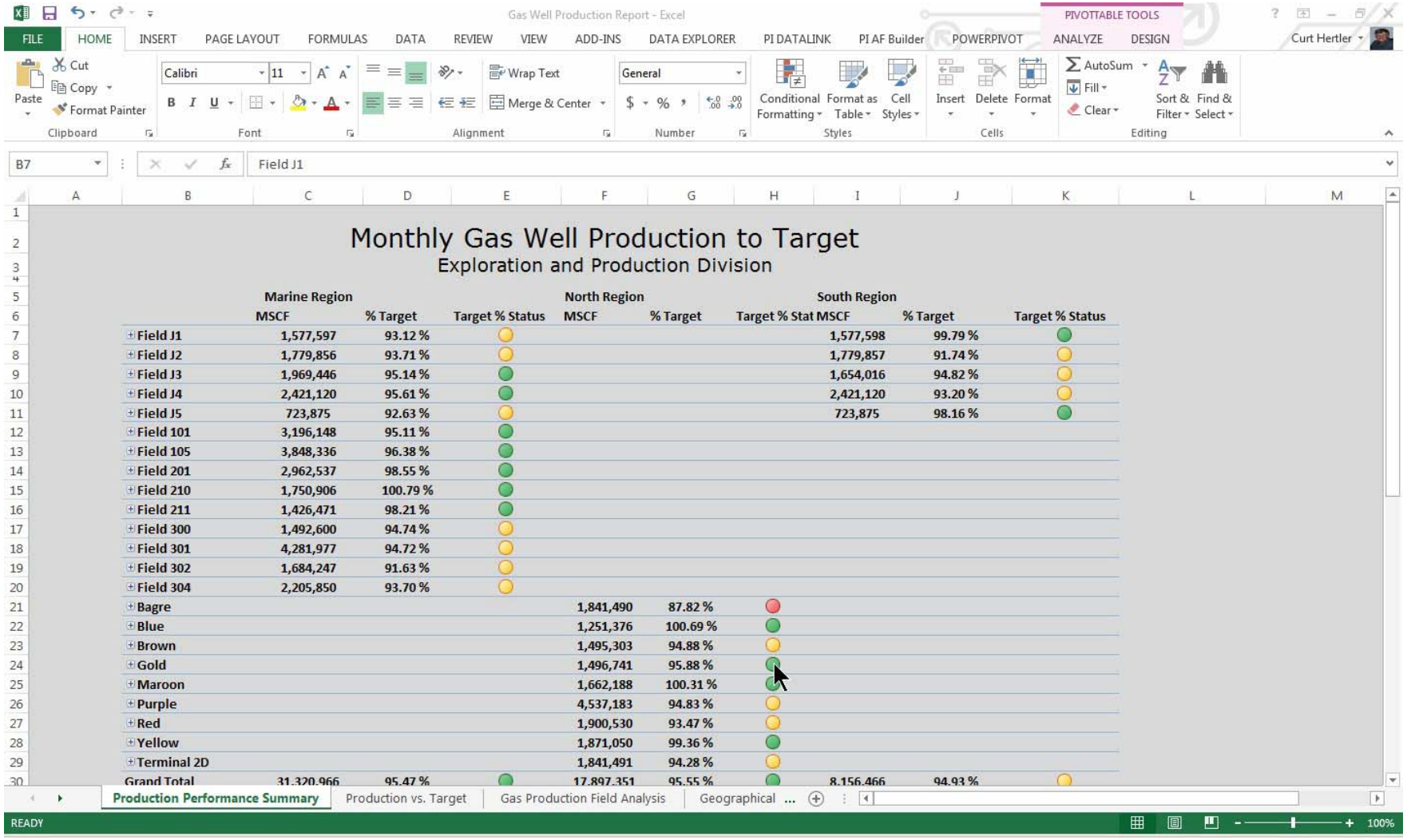


Microsoft BI and the PI System

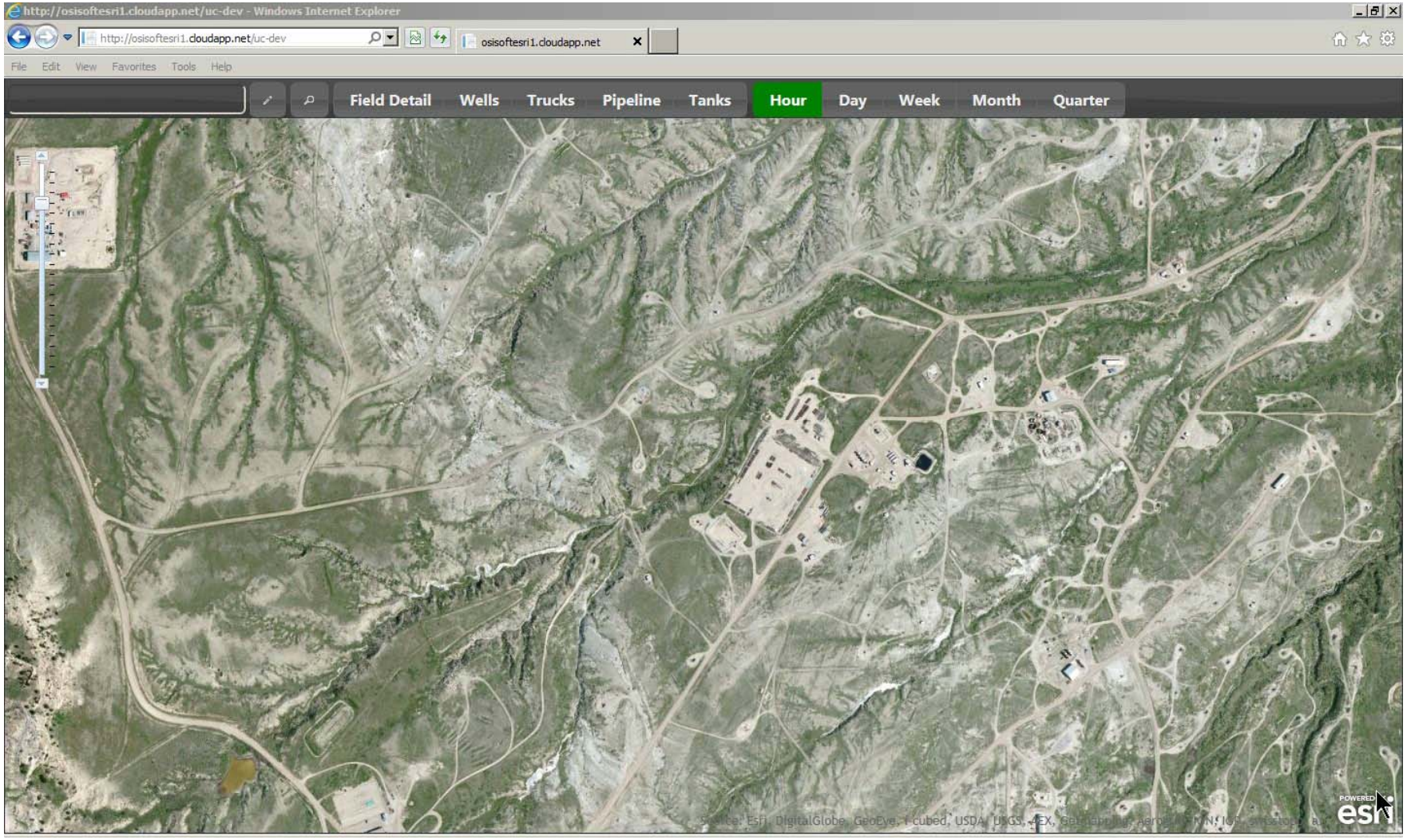
Extending Analytics and Visualization to the Enterprise



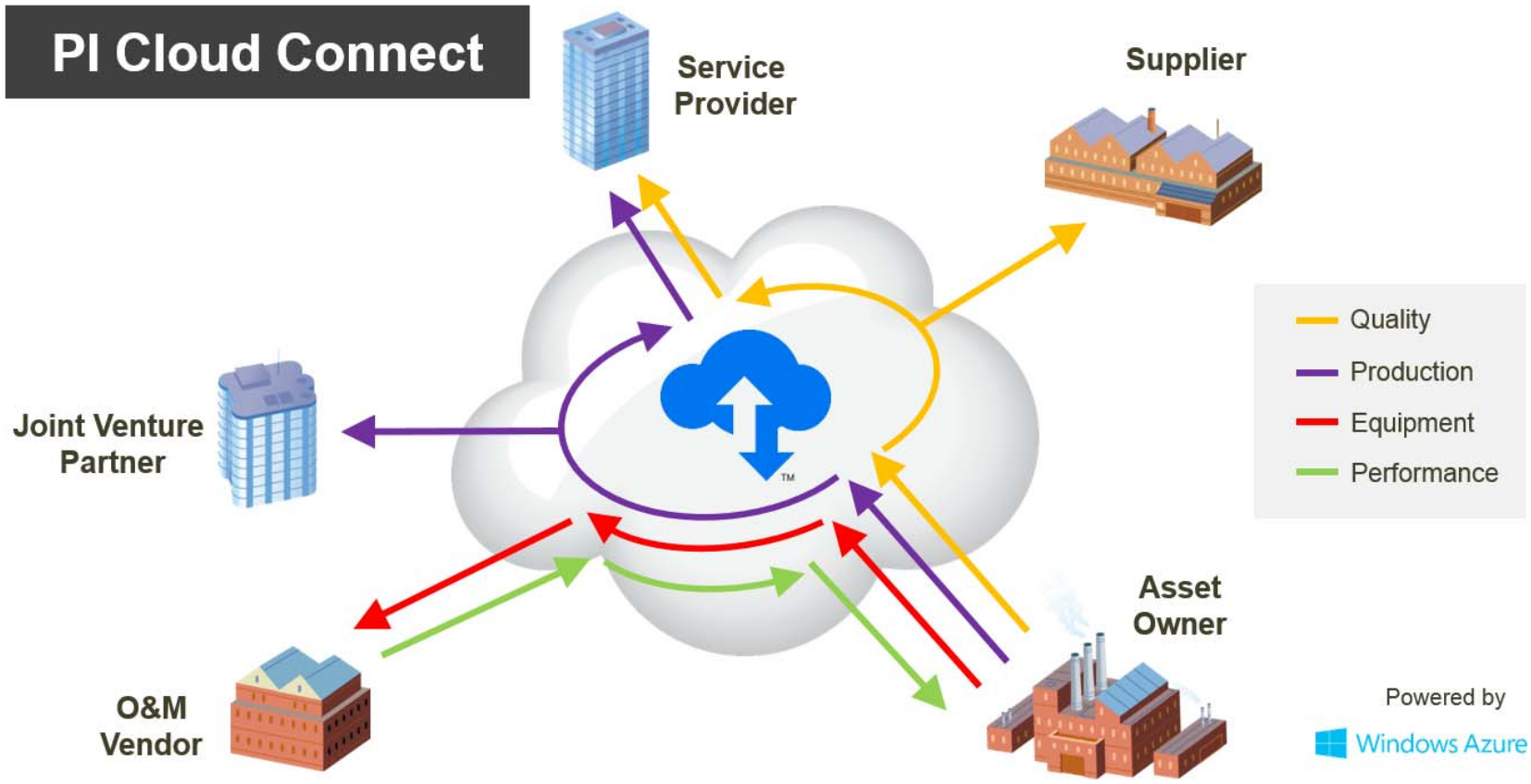
“High Fidelity” Business Intelligence (BI) With Microsoft



Geospatial Integration with “High Fidelity” BI



Cloud Services



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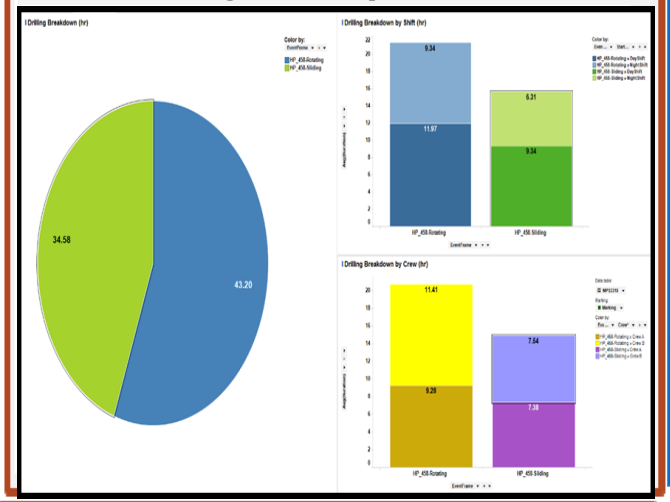
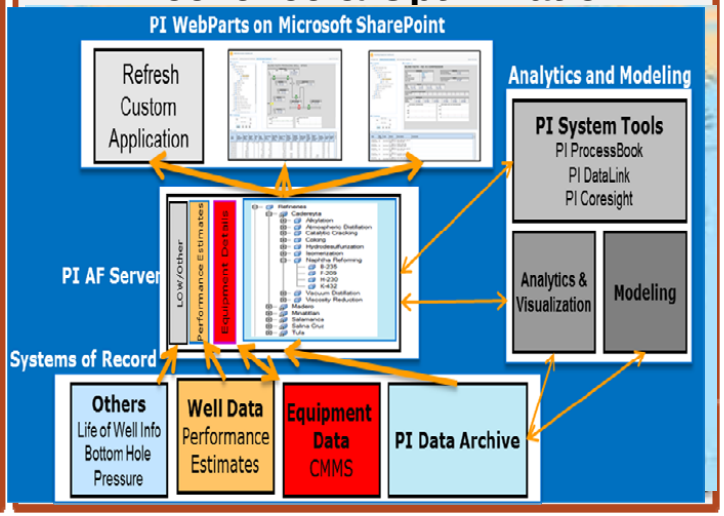
Enabling Op Ex in All Areas of E&P/Logistics

Asset Performance, Reliability, & Portfolio Management

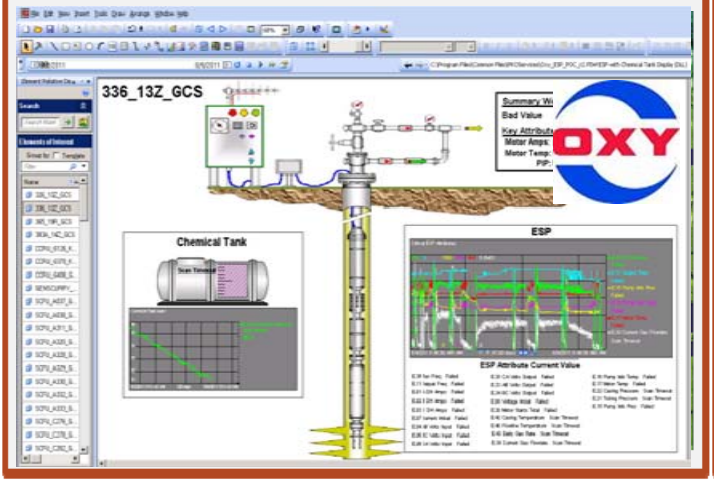
Drilling and Completion Oversight & Optimization



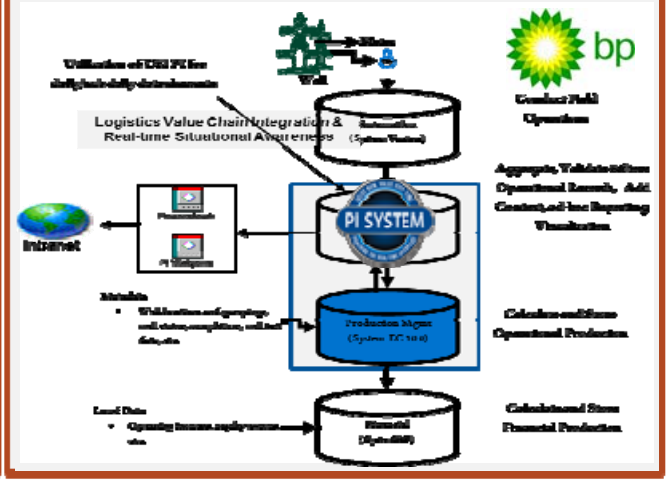
Production Operational Excellence & Optimization



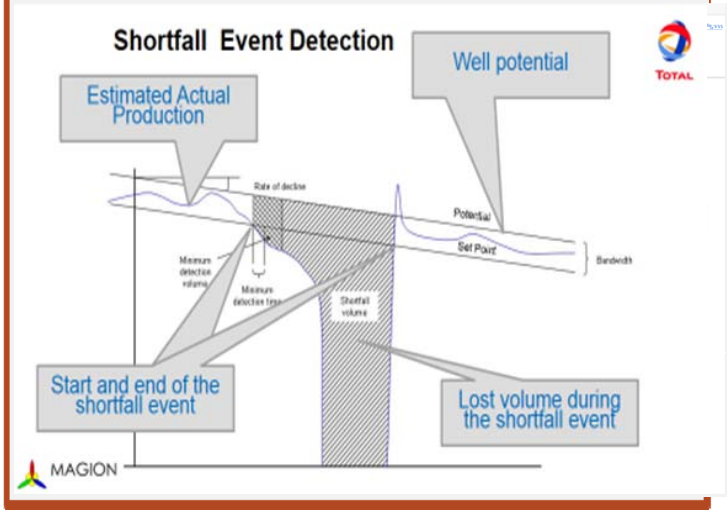
Artificial Lift Reliability and Optimization



Augmentation of "Best of Breed" Solutions

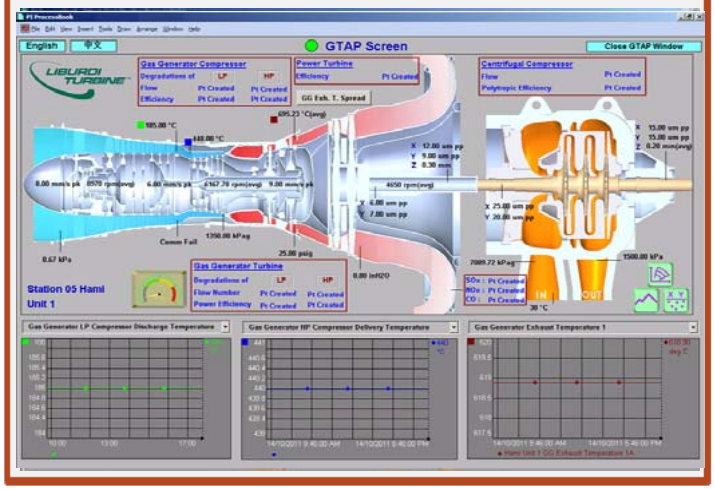


Integration with E&P Analytics & Visualization/Post Well Science



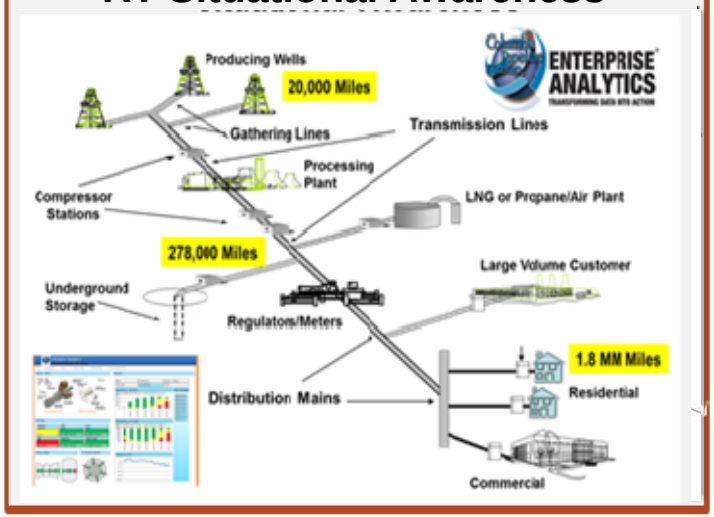
Enabling Op Ex in All Areas in O&G Logistics

Asset Performance, Reliability, & Portfolio Management

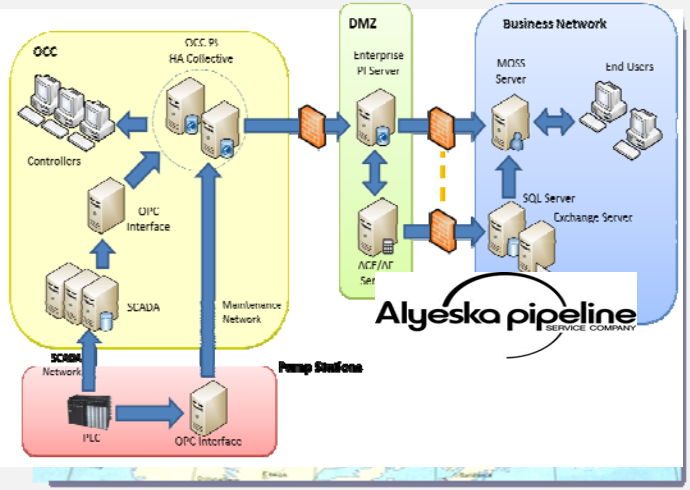


Geospatial Integration "Real-Time & Space"

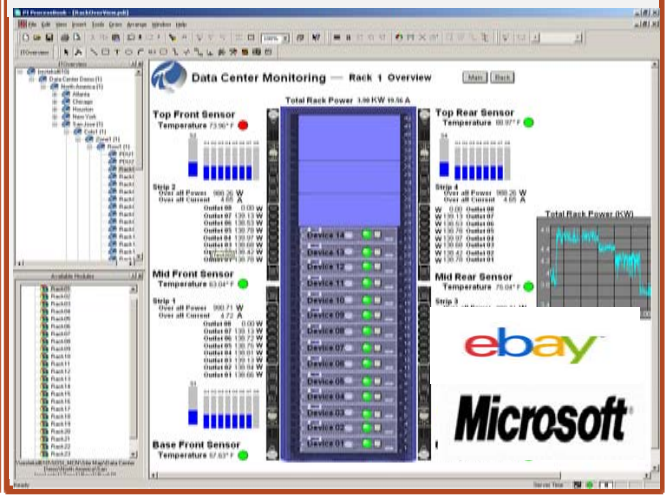
Gas Value Chain Integration & RT Situational Awareness



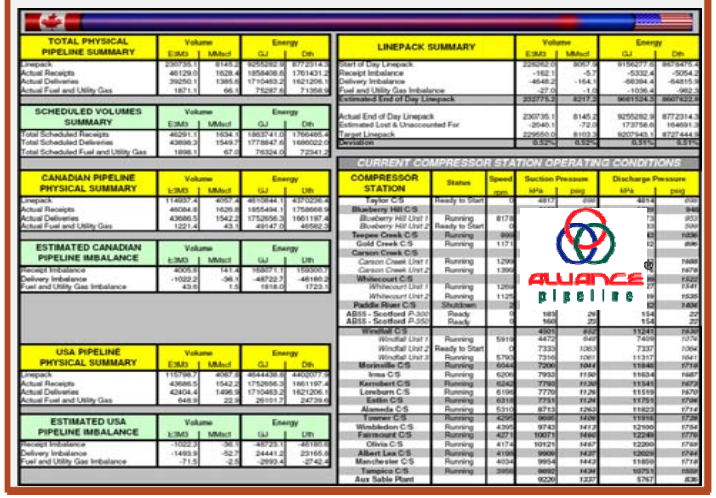
SCADA/DCS Augmentation



IT/SCADA Infrastructure Energy & Reliability Mgmnt

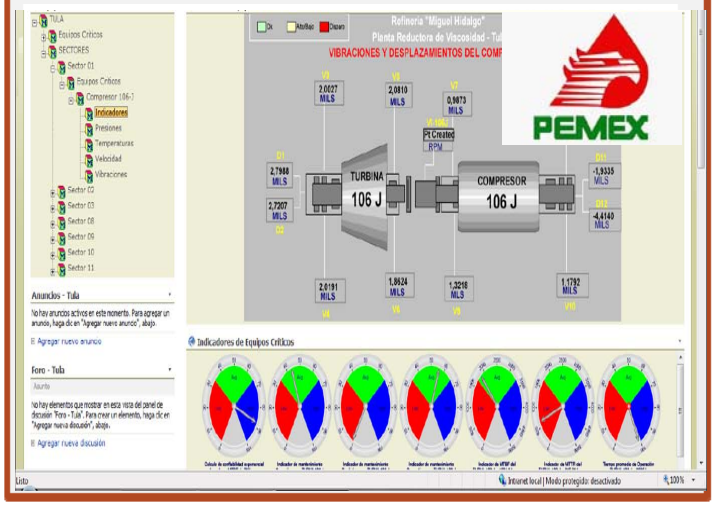


Compliance Reporting, Environmental & Energy Mgmt.

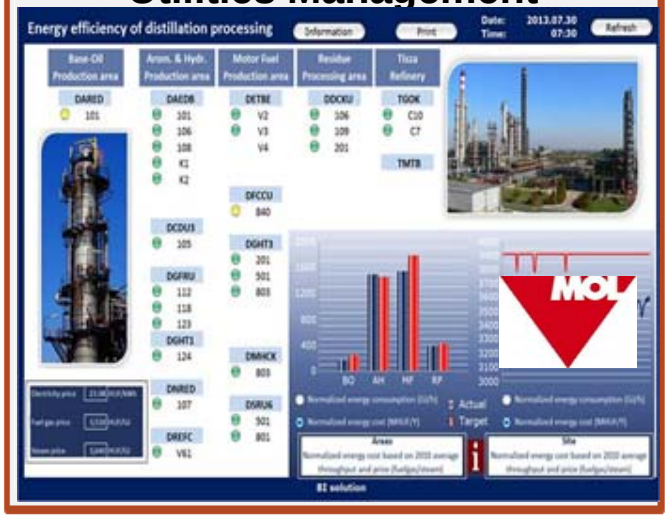


Enabling Operational Excellence in Hydrocarbon Processing

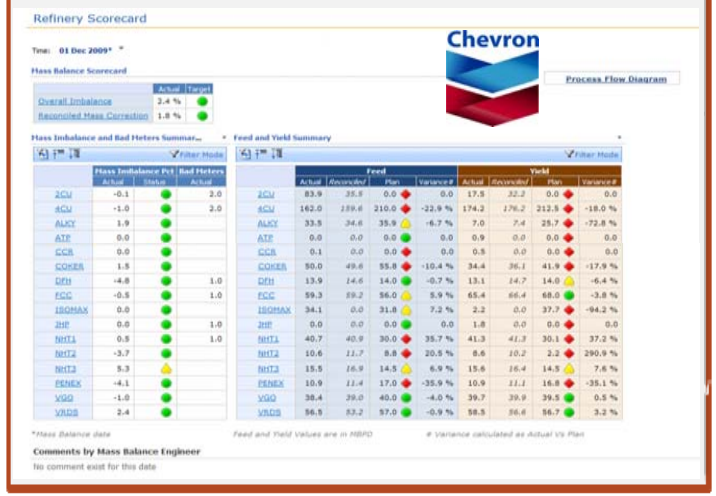
Asset Performance, Reliability, & Portfolio Management - CBM



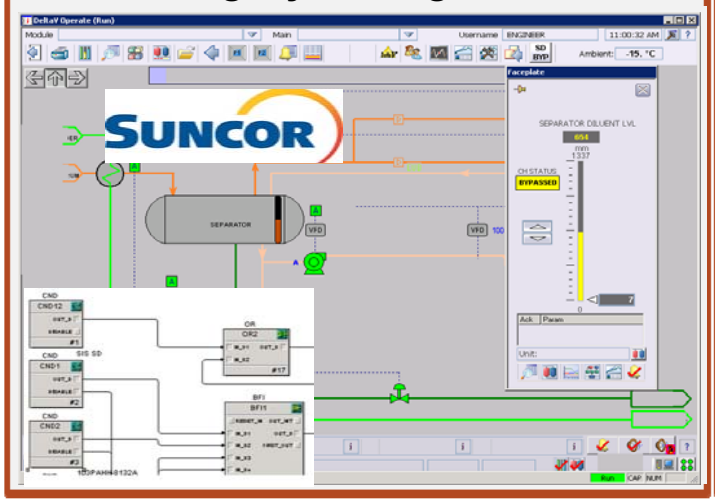
Environmental, Energy & Utilities Management



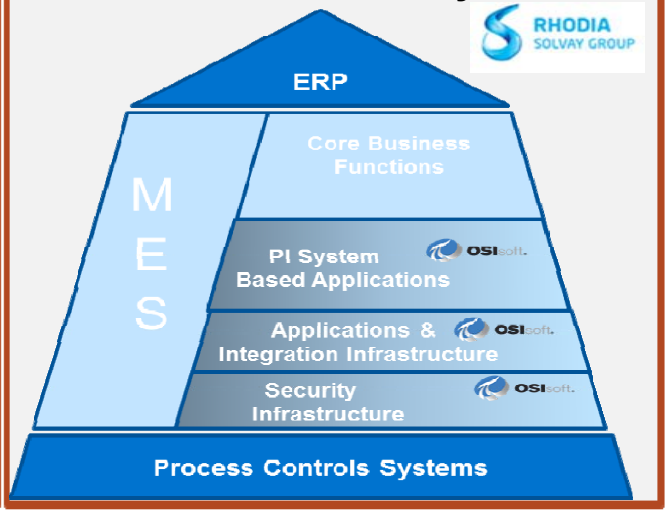
Ops Visibility, Reporting & Analytics, YA, "live" KPIs, & Model Based PvA



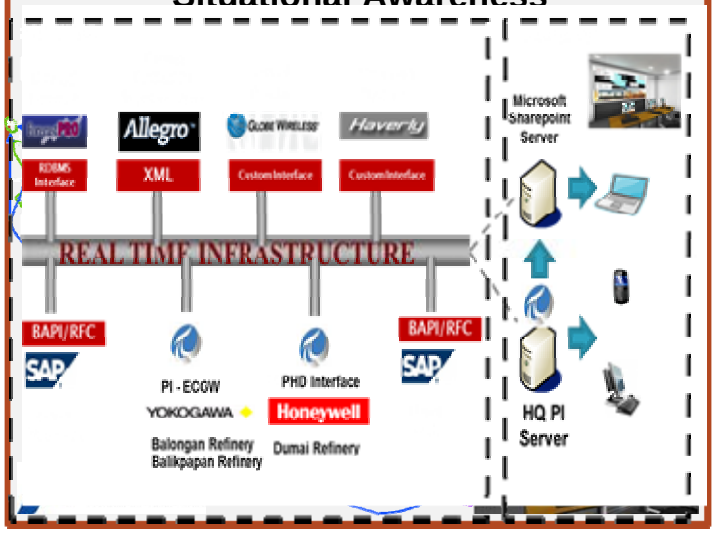
Safety & Reactive/Proactive Integrity Management



Infrastructure for MES MES AND The PI System



Value Chain Integration & Real-time Situational Awareness



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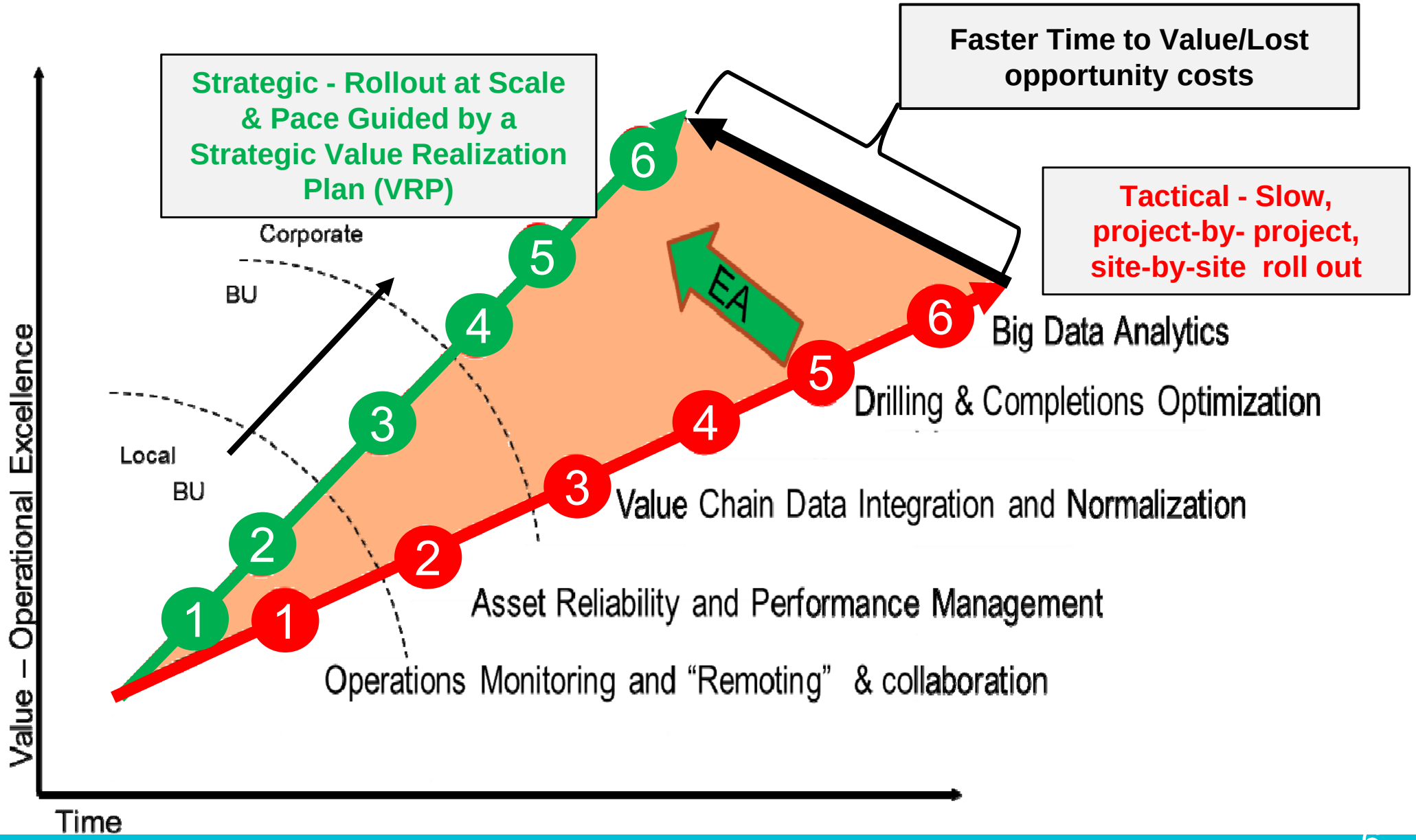
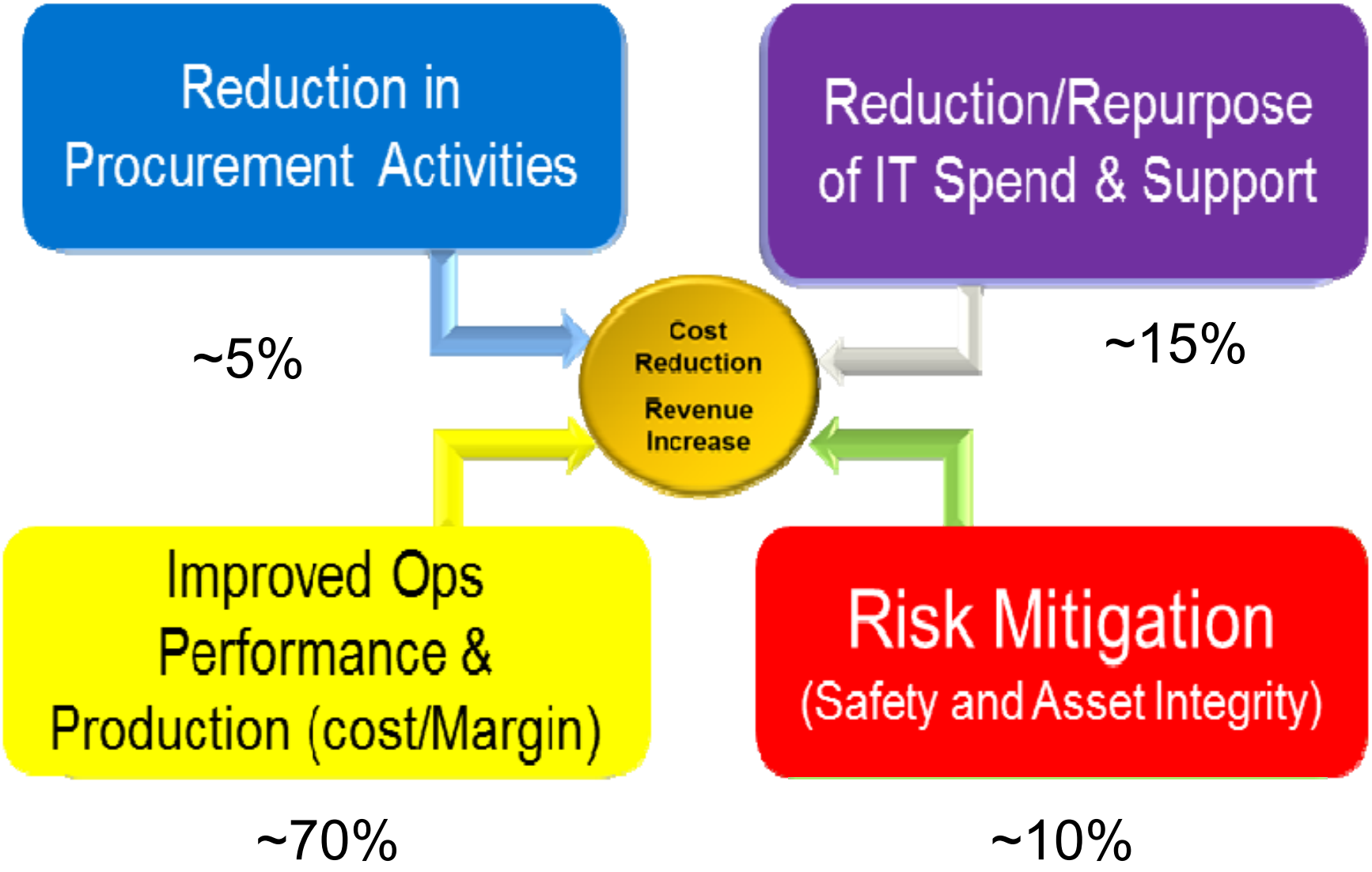
Accelerating the Benefits of Operational Excellence



Possible Business Case Framework for an EA

% of total EA benefits



Note: Estimate from the 1,100 case studies that can be found on the web.. Your results may differ

Key Takeaways….

- The key to Business to Operations Value is data :
  - Consistency
  - Alignment
  - Simplicity
  - Transformation in the infrastructure vs applications, solutions, and business systems where possible
- Infrastructure vs Custom applications & Solution approach
- PI AF can be and is a strategic enabler
- The PI System Future Proofs the data infrastructure
- The EA is a way to accelerate the benefits from your PI System

Craig Harclerode

charclerode@osisoft.com

Industry Principal

OSIsoft

THANK YOU

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