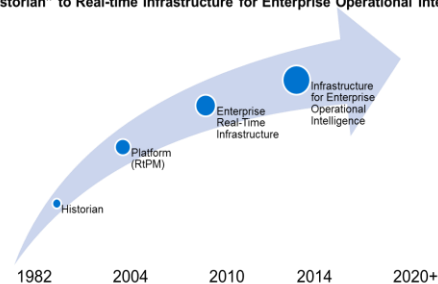


**The Continuing Evolution of the PI System**  
From "Historian" to Real-time Infrastructure for Enterprise Operational Intelligence



# Topics in O&G and Petrochemicals

## “The Evolution Continues”

Moderated by: **Craig Harclerode**  
**O&G Industry Principal**

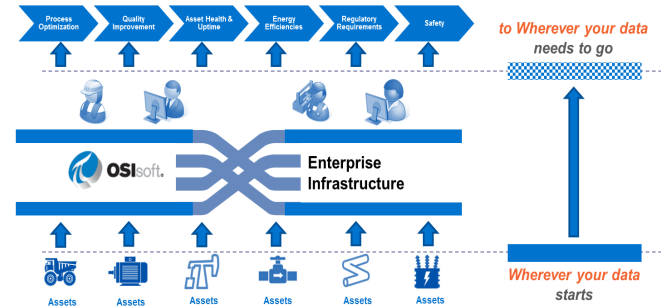
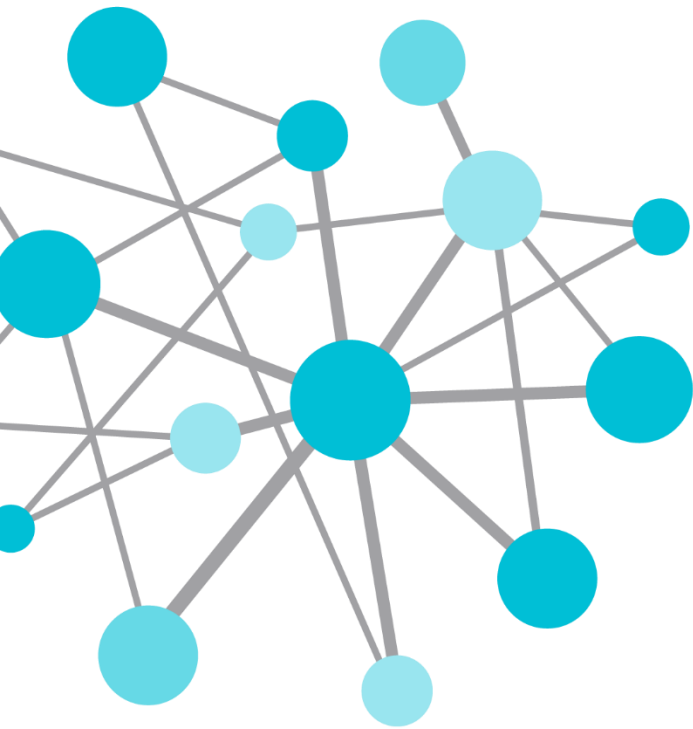




# Segment Overview

- Introduction and Context
- The Integrated Value Chain
- Update on Key E&P Interfaces & Connectors
- Advanced Analytics and Visualization
- Concluding Remarks and Q&A

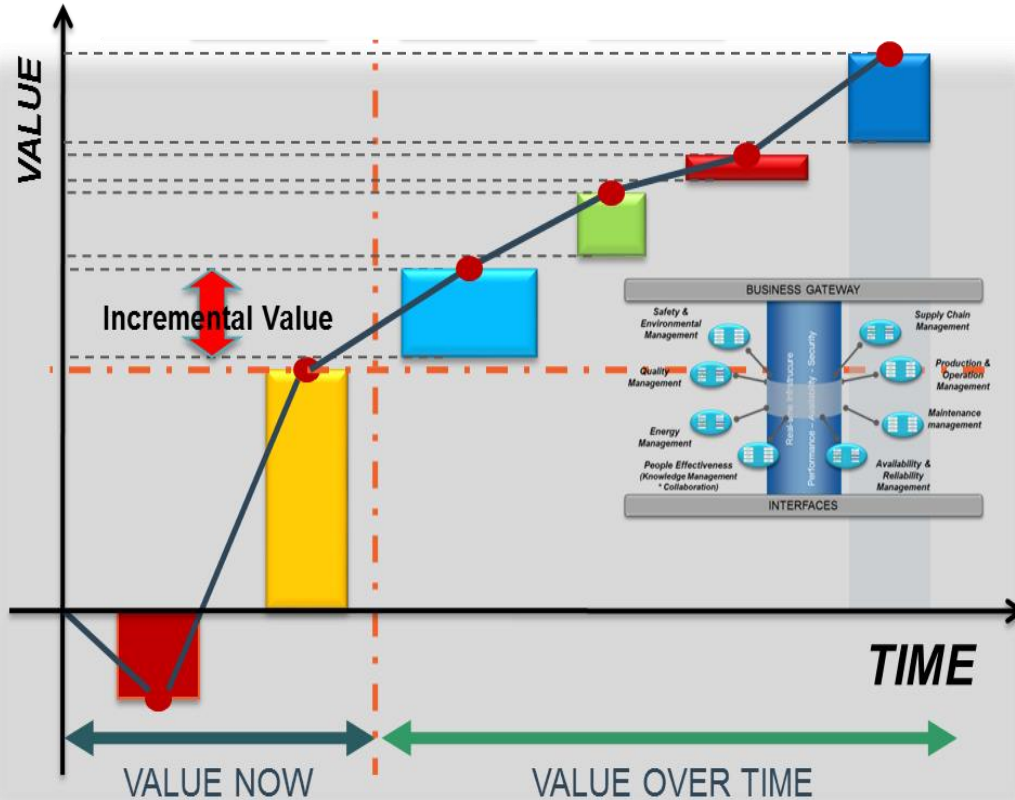




# The Big Picture



# An “Infrastructure vs Solutions Approach

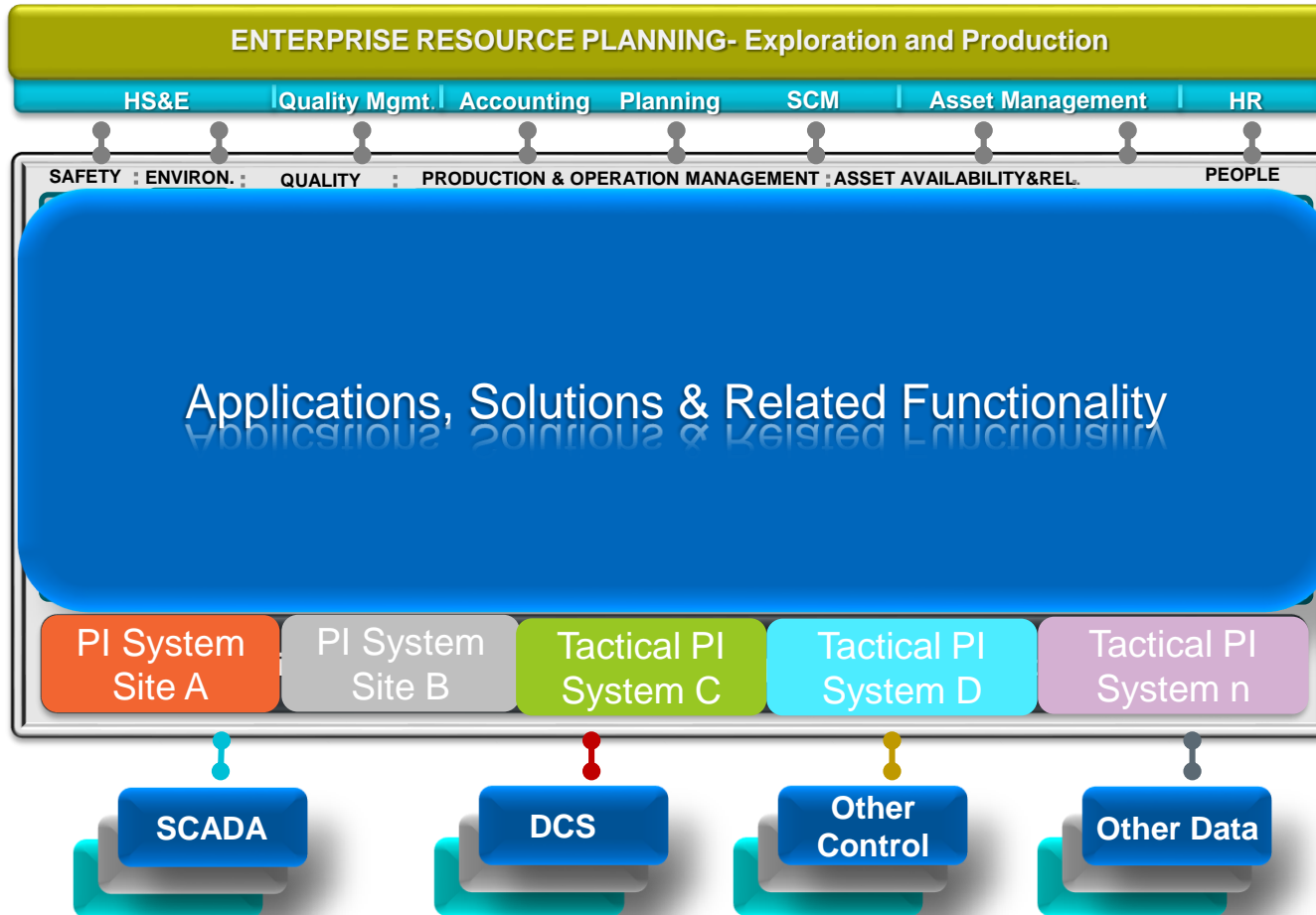


Initial Infrastructure Value

Infrastructure Initial Investment

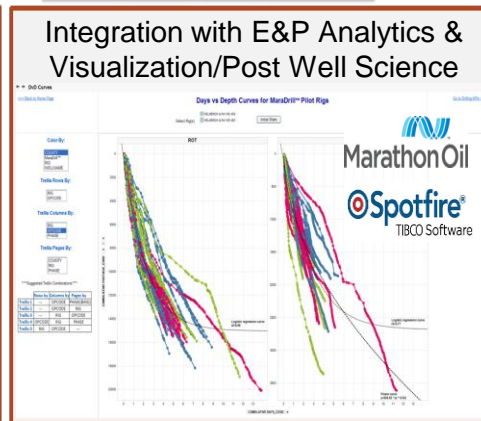
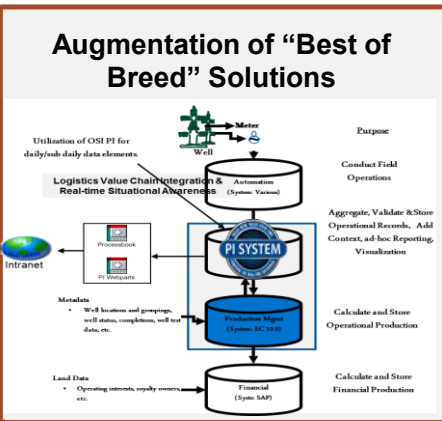
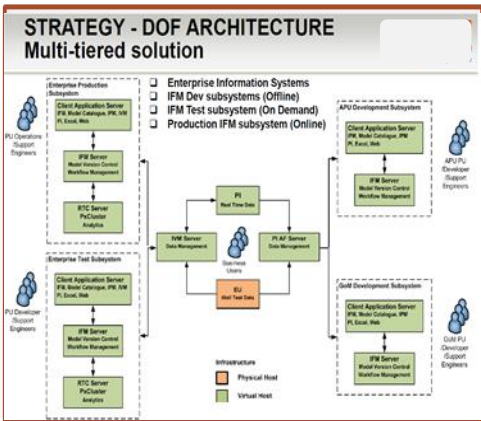
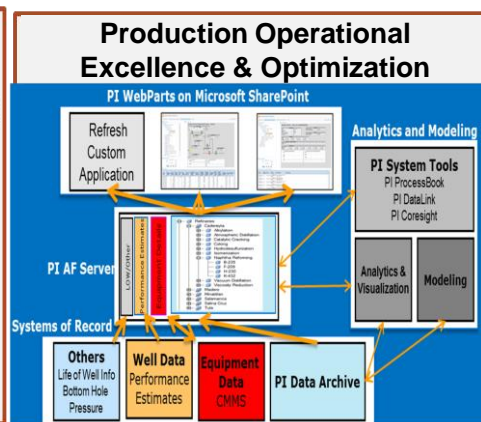
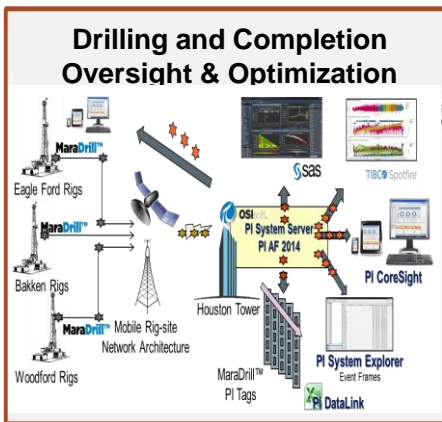
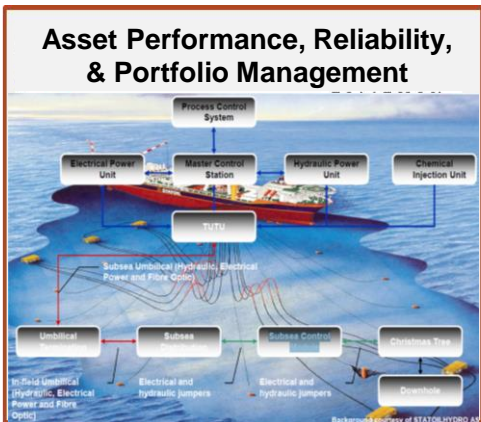


# Moving Applications to & Integrating Solutions with the Data Infrastructure – Simplification & Standardization



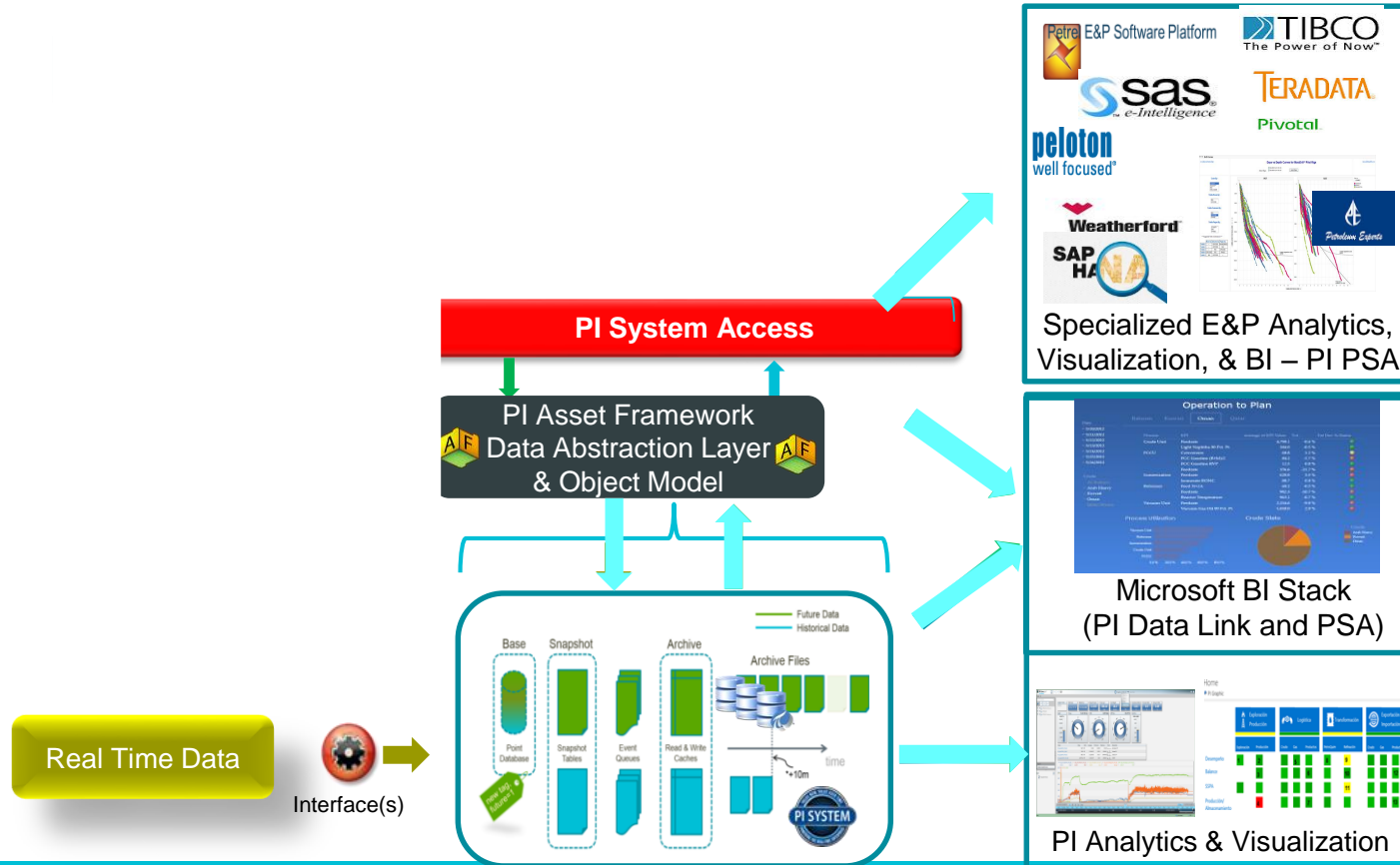


## Enabling Op Ex in All Areas of E&P





# OSIsoft PI System Analytics and Visualization - The Foundation for E&P Dashboards and Workflow Integration





[illegible][illegible]

The diagram illustrates the network architecture for the Alyeska pipeline, showing the flow of data between the Operations Control Center (OCC), the DMZ (Demilitarized Zone), and the Business Network.

**OCC (Operations Control Center):**

- Controllers (represented by computer icons) are connected to the OCC PI HA Collective.
- The OCC PI HA Collective is connected to the DMZ Enterprise PI Server.
- The OCC PI HA Collective is connected to the OPC Interface.
- The OPC Interface is connected to the SCADA Network.
- The SCADA Network is connected to the PLC (Programmable Logic Controller).
- The PLC is connected to the OPC Interface.
- The OPC Interface is connected to the DMZ Enterprise PI Server.
- The DMZ Enterprise PI Server is connected to the DMZ ACE/ADU Unit.
- The DMZ ACE/ADU Unit is connected to the DMZ Enterprise PI Server.
- The DMZ Enterprise PI Server is connected to the Business Network MOSS Server.
- The Business Network MOSS Server is connected to the Business Network SQL Server.
- The Business Network SQL Server is connected to the Business Network Exchange Server.
- The Business Network Exchange Server is connected to the Business Network End Users.

**DMZ (Demilitarized Zone):**

- Enterprise PI Server
- ACE/ADU Unit

**Business Network:**

- MOSS Server
- SQL Server
- Exchange Server
- End Users

**Other Labels:**

- Pump Stations
- Alyeska pipeline
- DMZ
- OCC
- Business Network
- Enterprise PI Server
- MOSS Server
- SQL Server
- Exchange Server
- End Users
- Controllers
- OCC PI HA Collective
- OPC Interface
- SCADA Network
- PLC
- ACE/ADU Unit

The screenshot shows the 'Data Center Monitoring - Rack 1 Overview' application. It provides a comprehensive view of the hardware health in Rack 1. The interface is organized into several panels:
 

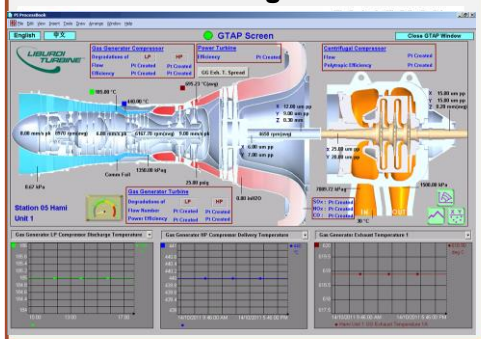
- Top Front Sensor:** Shows a temperature of 13.0°C and bar charts for four fans (Fan 1, Fan 2, Fan 3, Fan 4).
- Top Rear Sensor:** Shows a temperature of 40.0°C and bar charts for four fans.
- Mid Front Sensor:** Shows a temperature of 13.0°C and bar charts for four fans.
- Mid Rear Sensor:** Shows a temperature of 40.0°C and bar charts for four fans.
- Base Front Sensor:** Shows a temperature of 13.0°C and bar charts for four fans.
- Central Rack View:** A large vertical panel displaying 16 server slots. Each slot has a status indicator (green for OK, yellow for Warning, red for Error) and a label (e.g., 'Server 1', 'Server 2', etc.).
- Power Monitoring:** A 'Total Rack Power (kW)' meter and a corresponding line graph are located on the right side.
- Log and Alerts:** A 'Log' window on the left lists various events, and an 'Alerts' window at the bottom right shows active warnings.
- Branding:** The eBay and Microsoft logos are prominently displayed in the bottom right corner.

[illegible]



# Enabling Op Ex in Hydrocarbon Processing

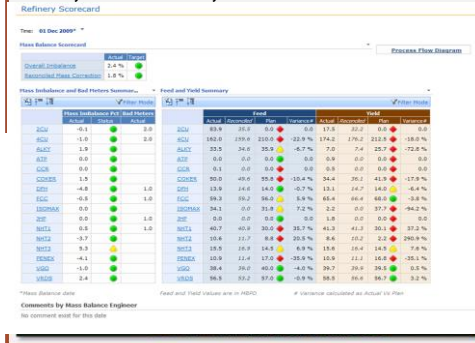
## Asset Performance, Reliability, & Portfolio Management - CBM



## Environmental, Energy & Utilities Management



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



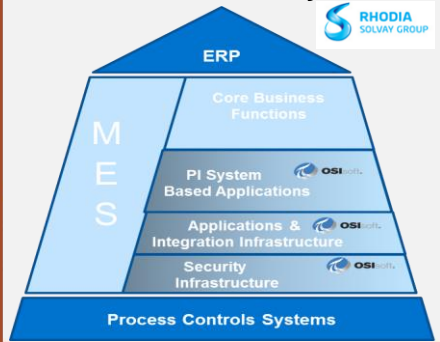
## Safety & Reactive/Proactive Integrity Management

Controlling safety via PI System tools

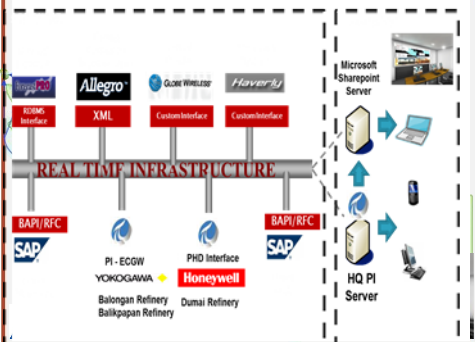


## Infrastructure for MES

MES AND The PI System



## Value Chain Integration & Real-time Situational Awareness







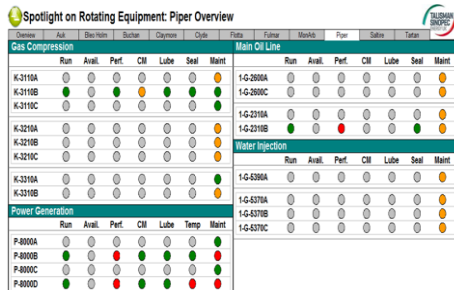
# Case Study — Talisman Sinopec

**Leveraging PI AF for Critical  
Equipment Reliability Improvement on  
a Fleet of Remote Assets**

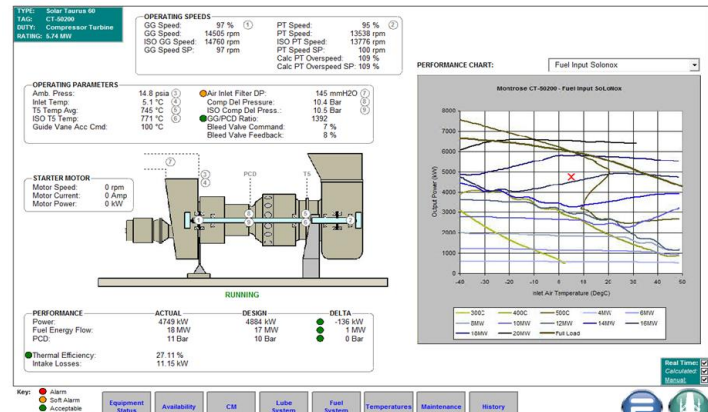


# Real-Time Monitoring of Rotating Equipment

Talisman Sinopec



UC2013  
UC2014



## CHALLENGES

**Globally diverse** critical rotating equipment environment

Issues with **integrity, reliability,** and related **production losses**

Inability to **capture** and leverage **knowledge** of subject matter experts

**Inconsistency** in analytics, visualization/KPIs, and reporting

## SOLUTION

Implemented the Strategic Rotating Equipment **Excellence Program**

PI System based solution **SPOTLIGHT** to monitor 2,900 safety, production, and water critical pieces of rotating equipment

### Goals:

- Improve reliability
- Improve equipment integrity
- Reduce production losses

## RESULTS

**Standardization and Consistency** in displays, calculations, and points

Continuous **monitoring** of values against alarm limits

**Reduced** the amount of critical rotating equipment **failures**, saved about 220K BOE in 6 months

Improved **visibility** of water related systems



# Business Challenge

## Increase Reliability on 8 offshore 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

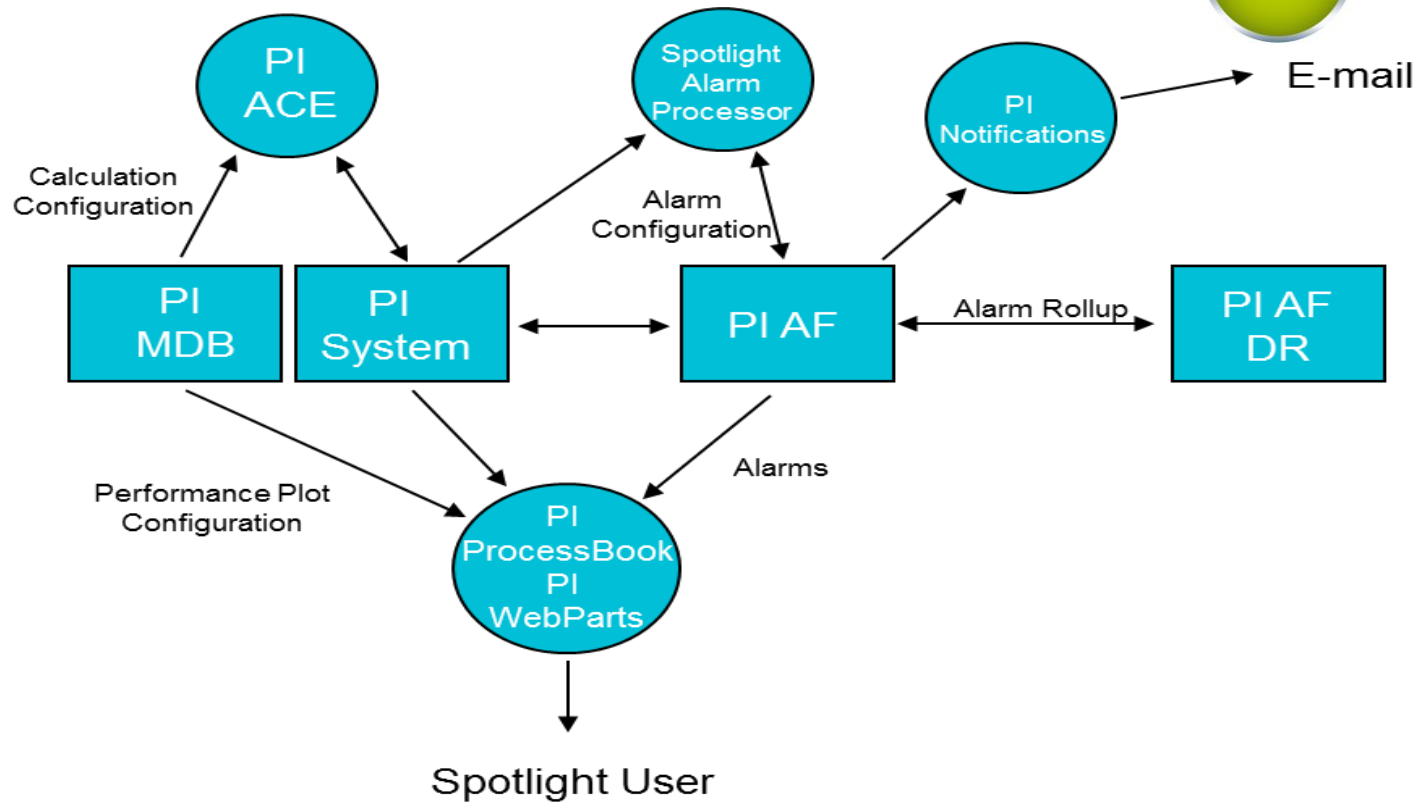
- 56 Gas Turbines
- 40 Gas Compressors
- 9 Diesel Engines for Main Power Generation
- 27 Main Water Injection, P.W. & Artificial Lift Pumps
- 35 Main Oil Line Pumps
- Circa 2711 Operational Pumps



A total of 2831 pieces of Major Rotating Equipment



# Spotlight Architecture





# PI AF Is the Foundation

The screenshot displays the OSIsoft PI AF software interface. On the left, the 'Elements' tree shows a hierarchy starting with 'Buchan'. The 'General' tab is selected, showing a list of elements with columns for 'Name' and 'Value'. The 'Clyde' equipment details are shown on the right, with the 'General' tab selected. The 'Filter' section shows a list of elements with columns for 'Name' and 'Value'. The 'Process Inhibit' (run state) and 'User Inhibit' (cascaded down) are highlighted in the 'Filter' section.

Name	Value
Alarm Input	0
Current Alarm State	Process Inhibit
Current Alarm State Value	3
Current Priority	Process Inhibit
Current Priority Value	3
H Alarm	True
Limit Priority	Warning
Limit Value	0.3
HH Alarm	True
Limit Priority	Alarm
Limit Value	0.4
Inhibit	False
L Alarm	False
Limit Priority	Warning
Limit Value	0
LL Alarm	False
Limit Priority	Alarm
Limit Value	0
Process Inhibit	True
User Inhibit	False

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)



# Displays – KPI with High Fidelity Drill Down



## Spotlight on Rotating Equipment: Piper Overview

TALISMAN  
ENERGY

Overview	Auk	Bleo Holm	Buchan	Claymore	Clyde	Flotta	Fulmar	MonArb	Piper	Saltire	Tartan				
Gas Compression								Main Oil Line							
	Run	Avail.	Perf.	CM	Lube	Seal	Maint		Run	Avail.	Perf.	CM	Lube	Seal	Maint
K-3110A								1-G-2600A							
K-3110B								1-G-2600C							
K-3110C								1-G-2310A							
K-3210A								1-G-2310B							
K-3210B								Water Injection							
K-3210C									Run	Avail.	Perf.	CM	Lube	Seal	Maint
K-3310A								1-G-5390A							
K-3310B								1-G-5370A							
Power Generation								1-G-5370B							
	Run	Avail.	Perf.	CM	Lube	Temp	Maint	1-G-5370C							
P-8000A															
P-8000B															
P-8000C															
P-8000D															

Traffic light shows  
rolled up alarm  
status for each  
sub-display

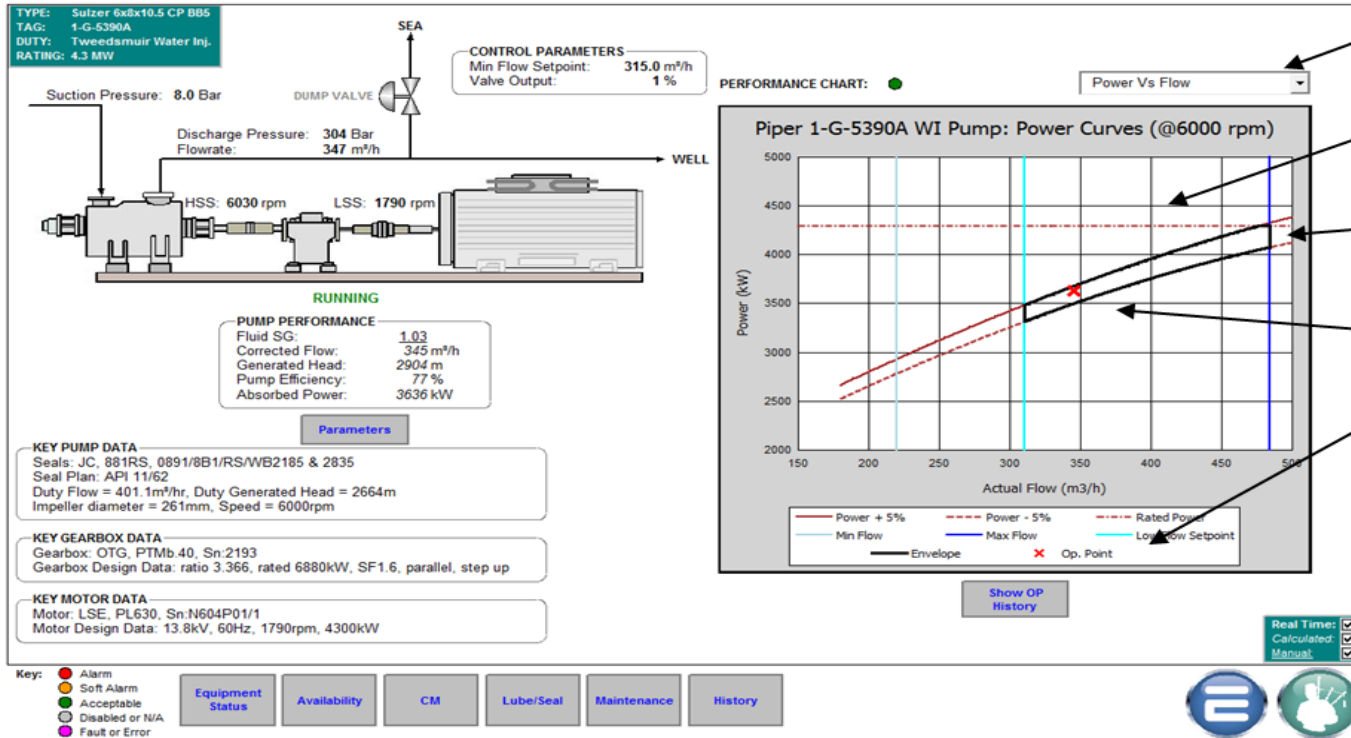
Links to detailed  
displays for each  
item of equipment

Links to other  
asset overviews



# Improving Critical Rotating Equipment Reliability and Performance

## Spotlight on Piper B: 1-G-5390A Performance Detail



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



[illegible]

# Case Study – Anglo American

# Dynamic KPIs with End User Governance and Business Intelligence Capabilities Leveraging PI AF



# Going BI with KPIs

*“KPI building and maintenance was a nightmare, creating a lot of frustration due to long lead times. New KPI Applications standardizes, simplifies, and gives users ability to create and manage their own KPIs with ability to perform business intelligence and analytics”*



Date	2014-03-05	
Site	(Multiple Items)	
KPI Type	All	Apply Formatti
Process Cell	(Multiple Items)	

		Values						
Process Unit	KPI Name	Design	StdDev Design	Daily	Variance	StdDev	Condition	StdDev Condition
WSML FD2 HGG	Bed Temperature			890.1		38.46	1.00	1.00
Gas Cleaning	CM-120 Circulation	65.00		90.25	25.23	0.645	5.00	1.00
	CM-120 Outlet Temperature	60.00		46.06	-13.94	1.33	5.00	1.00
	DC-160 Voltage	30.00		35.37	5.32	1.88	5.00	1.00
	DC-161 Voltage	30.00		50.01	-29.98	0.006	3.00	1.00
	DC-162 Voltage	30.00		34.50	4.56	1.91	5.00	1.00
Gas Cooling	VT-140 Circulation	450.0		529.3	79.27	2.17	5.00	1.00
	CM-170 Outlet Temperature	27.50		29.25	1.79	4.69	5.00	1.00
	DC-190 Voltage	20.00		9.49	-10.52	2.00	3.00	1.00
	DC-191 Voltage	20.00		27.52	7.92	0.757	5.00	1.00
Tower Plant flows	CM-300 Flow 535FIT590	150.0					3.00	1.00
	CM-310 Flow 535FIT610	150.0					3.00	1.00
	CM-330 Flow 535FIT630	300.0					3.00	1.00
	CM-350 Flow 535FIT651	450.0					3.00	1.00
	CM-400 Flow 535FIT675	450.0					3.00	1.00

## Business Challenge

- KPIs were onerous to create and troubleshoot
- Configuration was complex
- KPIs were growing
- More plants wanted KPI reports
- KPIs were inflexible

## Solution

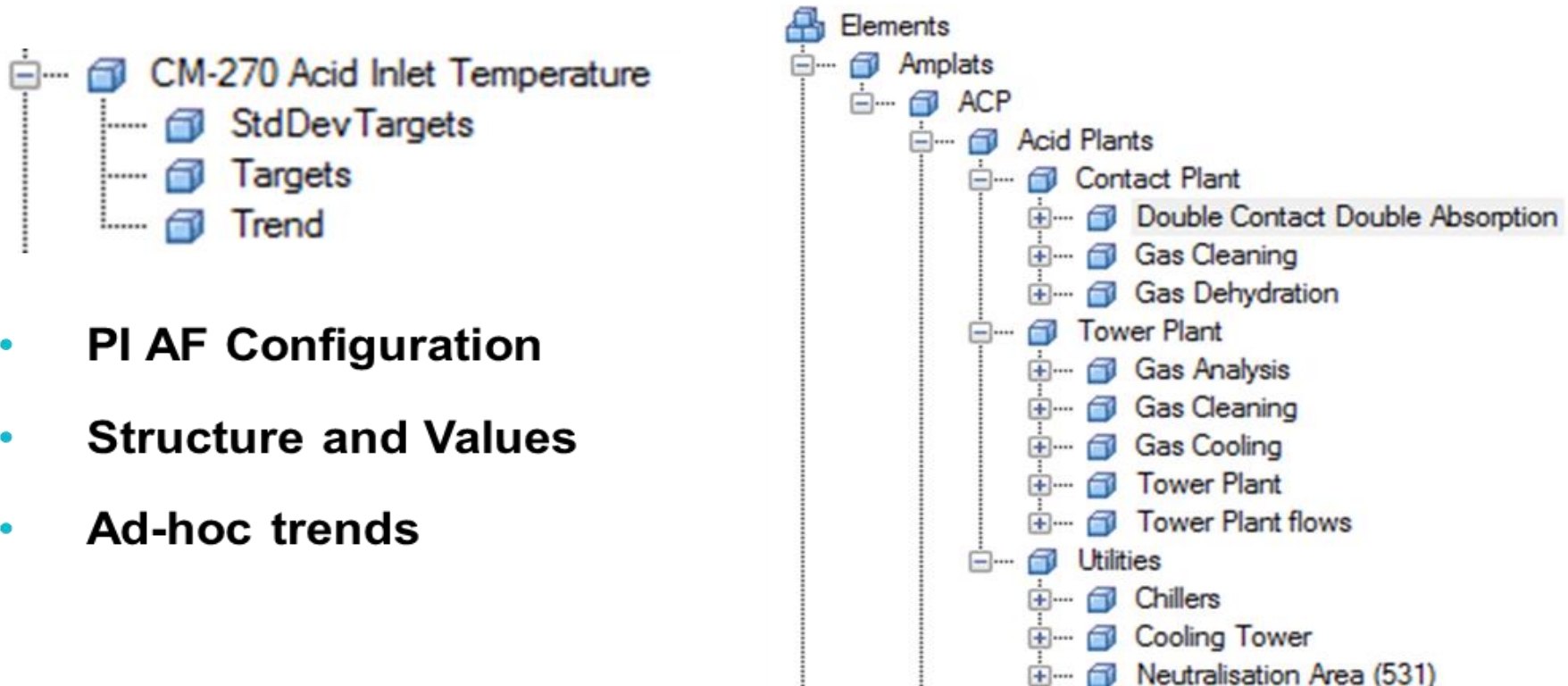
- **PI System for daily/ shift totals**
- **PI Asset Framework for KPIs and hierarchy configuration and data extraction**
- **Microsoft Analysis Service tabular model to aggregate up**
- **Excel Pivot table for reporting**

## Results and Benefits

- **KPI creation from 6 to 3 steps**
- **One report**
- **Quick rollout (30min)**
- **More user control**
- **Flexible reporting**
- **Enterprise Alignment**



# Standardized PI AF Structure for the Enterprise



- **PI AF Configuration**
- **Structure and Values**
- **Ad-hoc trends**



# Use Configurable KPI Capability

- 39 Attributes
- 14 are user configurable

CM-280 Acid Inlet Temperature

General Child Elements Attributes Ports Analyses Version

Filter

Name	Value
Plant	WACP
SQC_Status	not used
StdDevTargets	Range
TargetID	485
Targets	Range
Design	75
Hi	80
HiHi	85
Lo	70
LoLo	65
Month	NaN
TargetURL	http://acpweb.angloilt.net/ReportingUIBunker/AFServer=a

Group by: ☒ Category ☐ Template

Name: Targets

Description: Specifies Target type, Monthly

Configuration Item: ☐

Categories:

Default UOM: <None>

Value Type: String

Value: Range

Data Reference: AP String Concat

Settings...

.Targets|TargetType

CM-280 Acid Inlet Temperature

General Child Elements Attributes Ports Analyses Version

Filter

Name	Value
Category: <None>	
AFPath	\\acpmes\WACPsite\Amplants\WACP\Acid Plants\Contact Plant\Do...
errString	calc
Format	0.0
FullTagName	\\acppi.angloilt.net\534TT522/PV.V
Plant	WACP
SQC_Status	not used
StdDevTargets	Range
TargetID	485
Targets	Range
TargetURL	http://acpweb.angloilt.net/ReportingUIBunker/AFServer=acp...
ValueFixURL	http://acpweb.angloilt.net/FixValue/Vacppi.angloilt.net\534TT...
ValueURL	http://acpweb.angloilt.net/RD/Displays/AdHoc?StartTime="*-30...
Category: User Configuration	
Aggregation	Average
ControlStatus	PI Point not found '\\acppi.angloilt.net\CM-280 Acid Inlet Temp...
DataAggregationPeriod	Daily
Display Name	CM-280 Acid Inlet Temperature
DisplayOrder	148
DV_perGood	PI Point not found '\\acppi.angloilt.net\CM-280 Acid Inlet Temp...
DV_Quality	PI Point not found '\\acppi.angloilt.net\CM-280 Acid Inlet Temp...
Ignore	False
Instrument Category	
PV	60.84488
Standard Deviation	0.7333928
UOM	°C
Value	61.3514977
WeightingValue	3.59786033630371 h



# Demonstration – PI AF configuration

The screenshot shows the PI System Explorer (Administrator) window. The left pane displays the 'Elements' tree with 'Amplats' selected. The main pane shows the 'Amplats' configuration for the 'Display Order' element. The 'General' tab is active, showing a table of elements. The right pane shows the configuration details for the selected element, including 'Name', 'Description', 'Configuration Item', 'Categories', 'Default UOM', 'Value Type', 'Value', and 'Data Reference'.

**Amplats Configuration Table:**

Name	Value	Time Stamp	Description
Category: <None>			
Display Order	0	1970/01/01 00:00:00	
Category: OPM Configuration			
Active	True	1970/01/01 00:00:00	Indicate the status of the element
Category: Run			
Run	True	1970/01/01 00:00:00	Equipment Run Status
Category: Run Expression			
Run	True	1970/01/01 00:00:00	Equipment Run Status

**Configuration Details (Right Pane):**

- Name: Display Order
- Description:
- Configuration Item: ☐
- Categories:
- Default UOM: <None>
- Value Type: Double
- Value: 0
- Data Reference: <None>
- Settings...



# Demonstration – Report

Site

ACP

USML

WSML

Unallocated

Process Area

ACP Converter

Acid Plants

WSML Charge-Prep

USML Charge-Prep

Charge-Prep

WSML Hot Metals

Process Cell

Converter Top Common

Phase A Top

Contact Plant

Tower Plant

Phase A Low Pressure Co...

Utilities

Phase B Top

Phase B Low Pressure Co...

Time Selector

Morning Shift for 8h / 12h shift

Afternoon Shift for 8h shift

Process Unit

Neutralisation Area (531)

RMH

Matte tap hole 1

Matte pots

High Pressure Cooling

Gas Cleaning

Tap Blocks

Gas Dehydration

Date

2014-07-28

Site

ACP

KPI Type

All

Process Cell

All

Apply

Format

Process Unit	KPI Name	Design	Values										YTD		
			StdDev Design	Daily	Variance	StdDev	Condition	StdDev Condition	Weekly Variance	StdDev Condition Weekly	MTD	Variance MTD		StdDev Condition MTD	
Neutralisation Area (531)	TK-001 Flow	20.00		12.81	-7.17	5.50	3.00	1.00	12.81	-7.39	1.00	14.90	-5.10	1.00	14.25
	TK-001 pH (AIT-013)	7.00		7.71	0.710	0.667	5.00	1.00	7.49	0.487	1.00	8.05	1.05	1.00	8.30
	TK-003 Flow	20.00		9.41	-10.57	1.48	3.00	1.00	9.58	-10.42	1.00	8.81	-10.19	1.00	10.56
RMH	TK-003 pH (AIT-018)	7.00		8.64	1.64	0.706	5.00	1.00	8.63	1.63	1.00	8.58	1.58	1.00	8.46
	Baghouse fan	66.00	7.00	69.37	3.37	0.672	5.00	5.00	69.72	3.72	5.00	69.32	3.32	5.00	66.99
	Baghouse fan current (FA-001)	74.00	5.00	79.61	5.61	25.68	6.00	7.00	77.48	3.48	7.00	77.99	3.99	7.00	77.14
	Baghouse pressure differential	3.00	4.00	5.91	2.91	8.91	5.00	7.00	8.62	5.62	7.00	9.25	6.25	7.00	8.56
	Baghouse temp	51.00	17.00	44.27	-6.73	14.38	5.00	5.00	48.84	-2.16	5.00	48.65	-2.35	5.00	47.53
	Blower burner current (FA-002)	62.00	8.00	73.05	11.05	6.06	6.00	5.00	73.74	11.74	5.00	72.33	10.33	5.00	73.36
	Blower flow PV	10154	1366	5471	-4682	5806	3.00	7.00	7195	-2961	7.00	7704	-2450	7.00	7702
	Burner outlet temp (TT-007)	240.0	160.0	176.0	-63.98	160.3	5.00	5.00	230.5	-9.47	5.00	227.9	-12.10	5.00	217.8
	Bursting disc pressure			-1.11		0.271	1.00	1.00	-0.726		1.00	-0.859		1.00	-0.554
	Chiller fan current (FA-007)	81.00	7.00	76.55	-4.45	1.43	5.00	5.00	76.95	-4.05	5.00	76.72	-4.28	5.00	76.39
	Chiller Lubrication pump (ZM-021)	73.00	2.00	73.35	0.350	3.01	5.00	6.00	76.60	3.60	6.00	74.15	1.15	5.00	73.76
	Chiller outlet temp cooling water (TT-002)	15.00	7.00	16.27	1.27	2.63	5.00	5.00	16.24	1.24	5.00	15.89	0.891	5.00	17.40
	Chiller pump current (PP-001)	69.00	17.00	53.31	-15.69	1.79	5.00	5.00	53.65	-15.35	5.00	53.27	-15.73	5.00	53.47
	CO analyser 1	26.00	9.00	12.92	-13.08	1.59	5.00	5.00	16.59	-9.41	5.00	6.77	-19.23	5.00	7.69
	CO analyser 2	27.00	11.00	12.75	-14.25	1.59	5.00	5.00	16.68	-10.32	5.00	6.77	-20.23	5.00	7.87
CO analyser A	27.00	14.00	12.72	-14.28	1.60	5.00	5.00	16.27	-10.73	5.00	4.25	-22.75	5.00	6.60	
CO analyser B	26.00	12.00	12.92	-13.08	1.65	5.00	5.00	16.37	-9.63	5.00	4.27	-21.73	5.00	6.62	
Coal baghouse fan current	50.00	3.00	56.28	6.28	2.03	7.00	5.00	59.90	6.90	5.00	57.04	7.02	5.00	57.21	
Coal Roofbin LIT13 - Ave	35.00	12.00	52.48	17.48	7.18	5.00	5.00	55.76	20.76	5.00	58.72	23.72	5.00	60.91	

KPIs / Sheet1





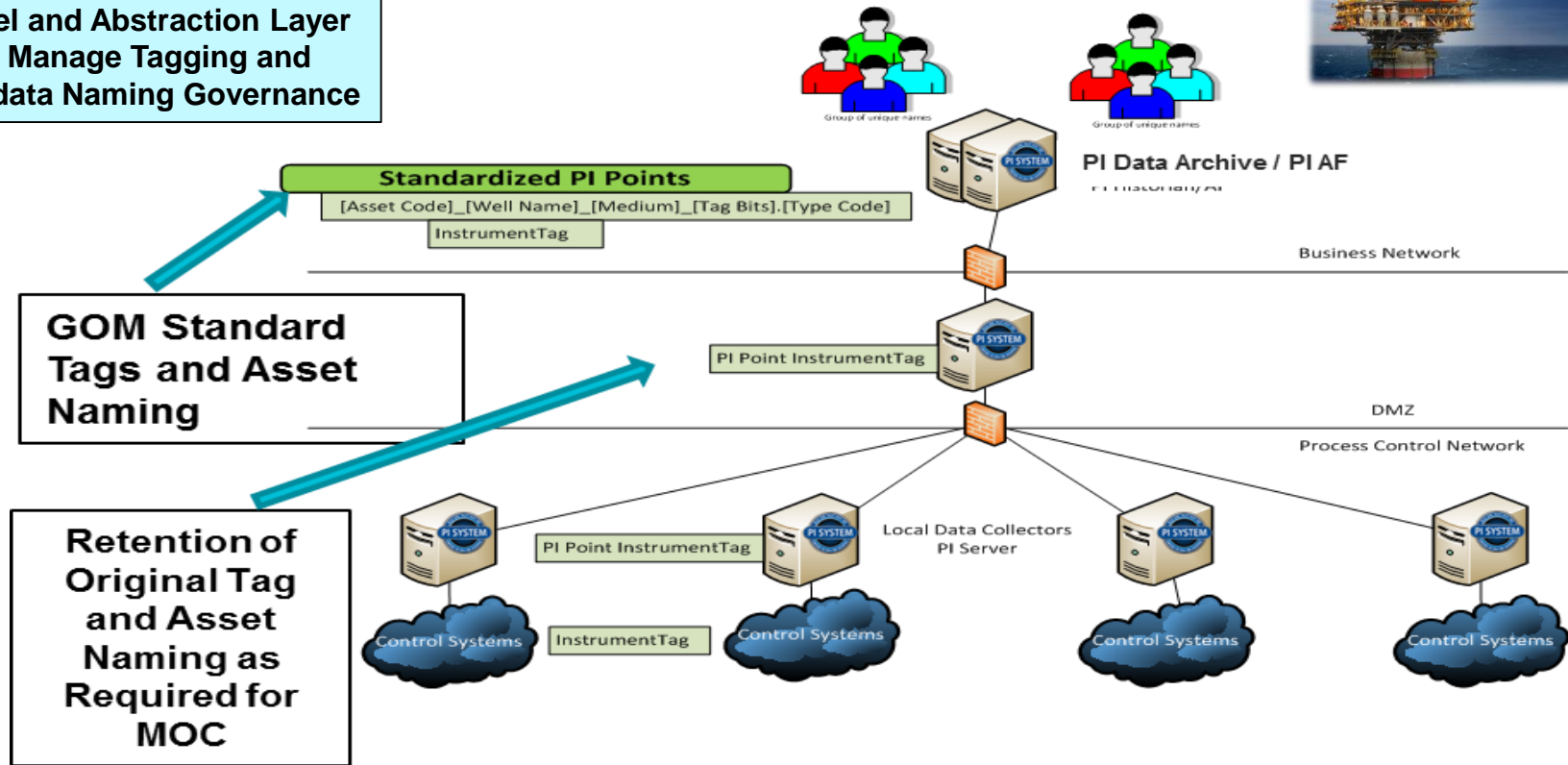
# Case Study —

**Leveraging PI AF as a Data Object Model  
and Abstraction Layer for Migrating from  
Diverse Tags to Normalized Asset Naming**



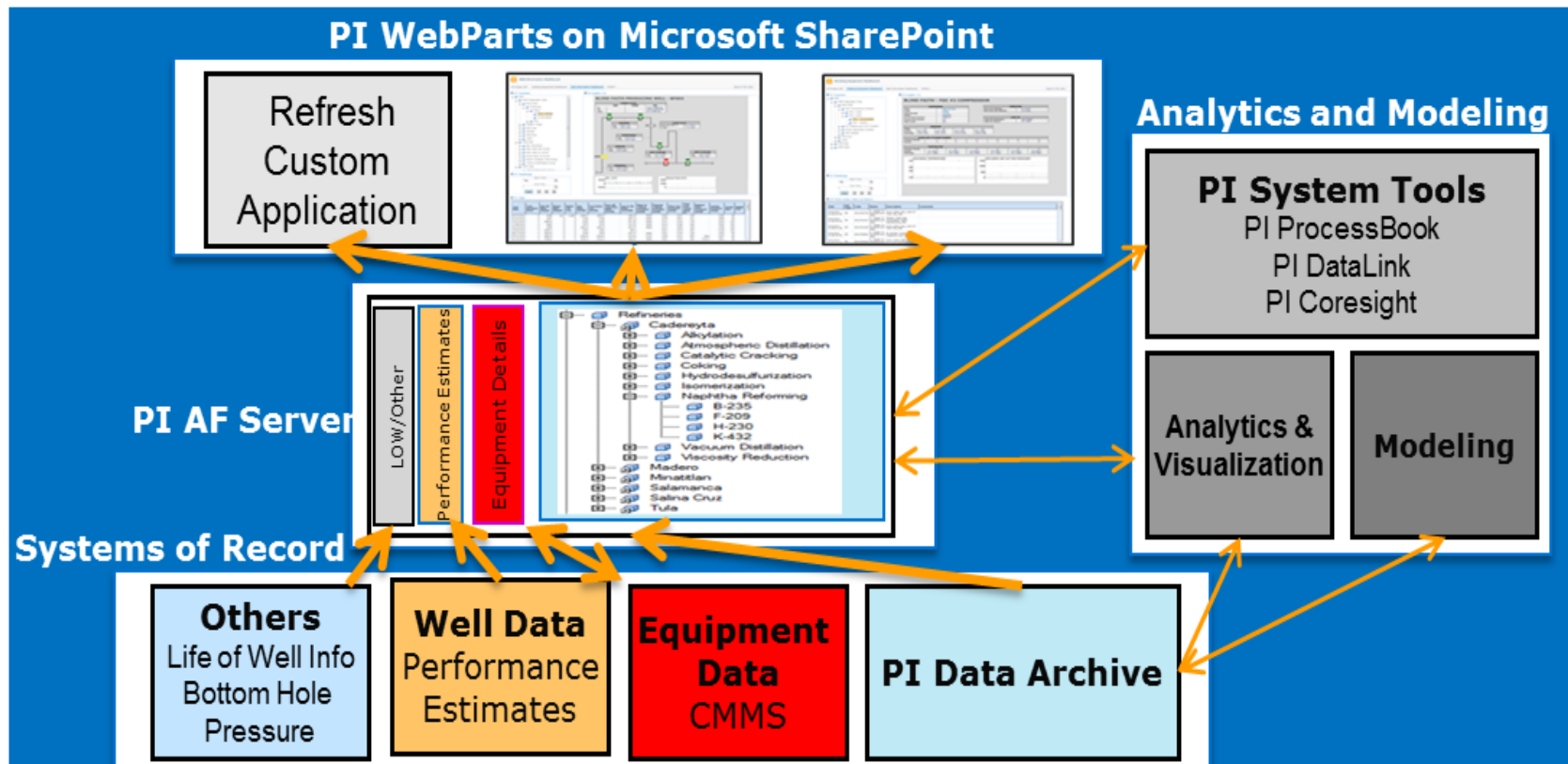
# GOM PI System Infrastructure

Using PI AF as a Data Object Model and Abstraction Layer to Manage Tagging and Metadata Naming Governance



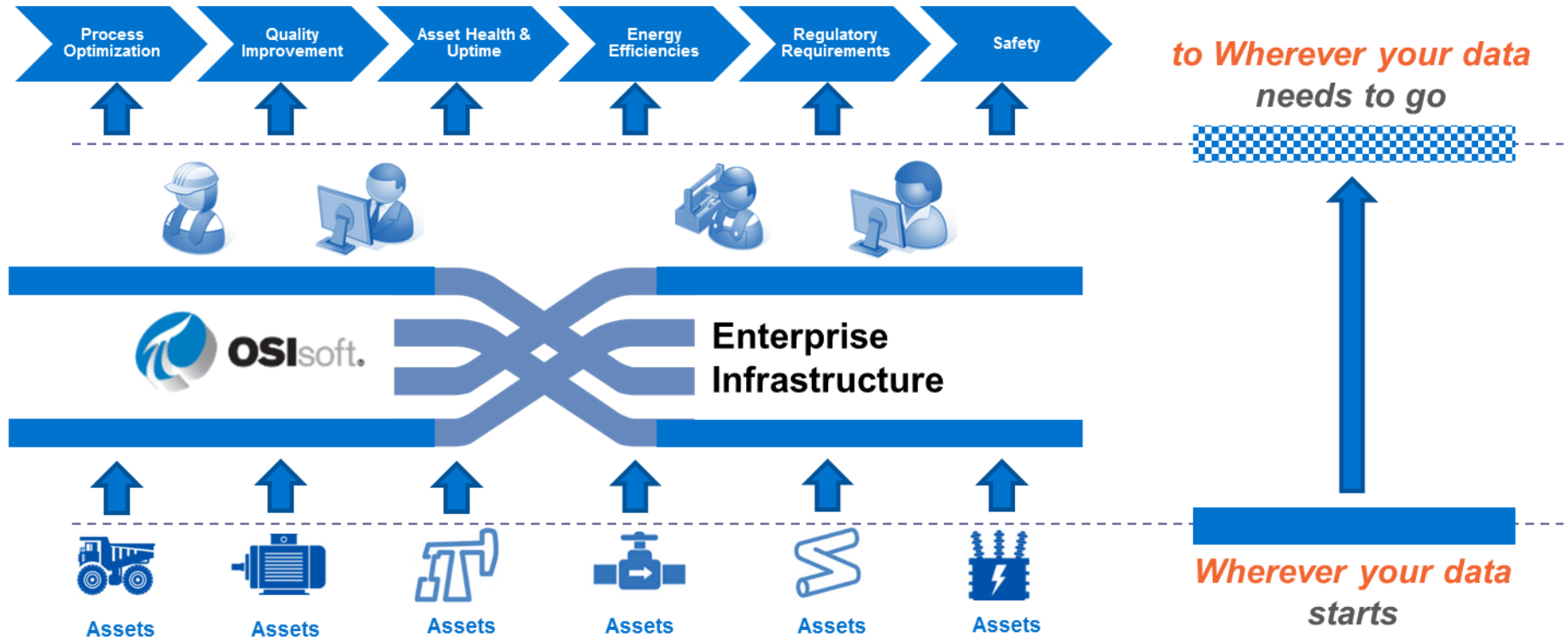


# GOM PI System Solution

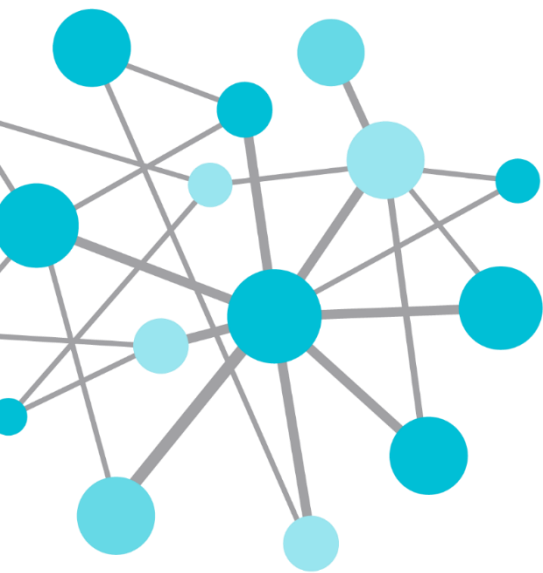




# An Enterprise Real Time Data Infrastructure







# Marine Fleet Condition Based Monitoring at Marathon Petroleum Company

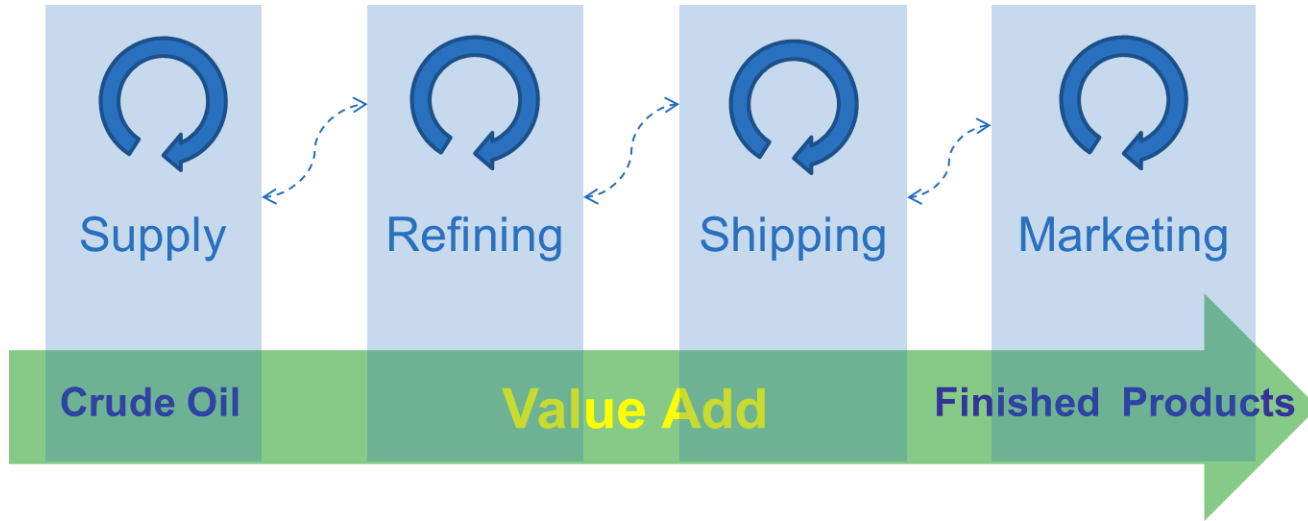
Presented by **Joshua Schaublin**



**Marathon  
Petroleum Company LP**



# Fuels Value Chain Integration







**Marathon  
Petroleum Company LP**

# Condition Based Monitoring

Josh Schaublin  
Adv IT Systems Integrator





# Agenda

- Marathon Petroleum Overview
- Marathon and PI
- MPC Marine - Condition Based Monitoring
- PI System
- Business use of The PI System
- Results and Benefits
- Dashboards
- Conclusion



# Marathon Petroleum Statistics at a Glance

- Fortune 25 company
- Established in 1887
- Fourth largest U.S. refiner
  - Largest in Midwest
- 2013 Revenues and other income:  
\$100.3 billion
- 2013 Net income attributable to MPC:  
\$2.11 billion
- Employees: ~30,000
- Headquartered in Findlay, Ohio
- Approximately 2,740 Speedway convenience stores
- Approximately 5,300 Marathon Brand retail outlets





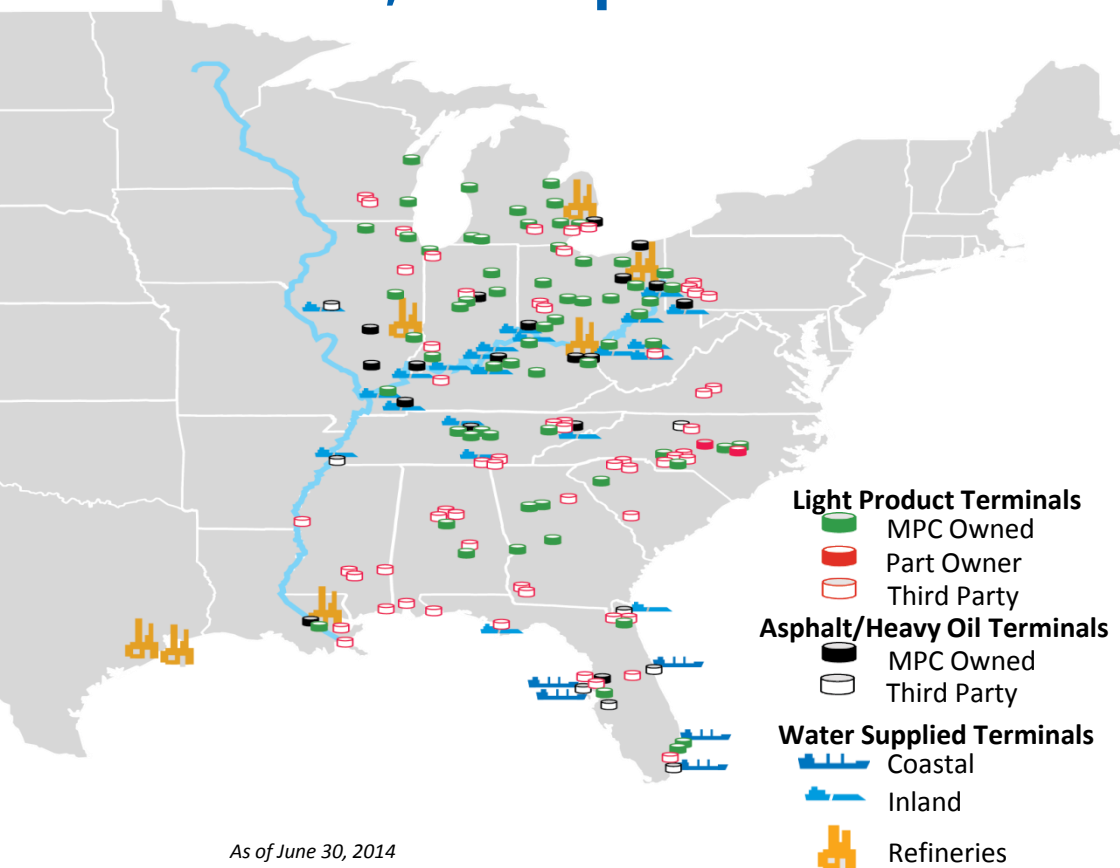
# Marathon Petroleum Corporation and PI



- PI System License since mid 80's
  - 2<sup>nd</sup> ever Production PI server in Cattlesburg
- Current Usage
  - 7 Refineries
  - Terminal Visualization
  - Terminal of the Future
  - Marine Vessels
- 1.1 million PI Tags
  - Refinery ~715,000
  - Terminals ~200,000
  - EA&S ~140,000
  - SD&P ~35,000
  - Marine ~15,000



# Terminals, Transport and Rail



As of June 30, 2014



- 63 owned and operated, two part-owned and non-operated and approximately 60 third-party light product terminals (gasoline, diesel, kerosene, jet fuel)
- 18 owned and operated and eight third-party asphalt terminals
- 170 owned transport trucks and 262 transport loading lanes
- 2,165 owned or leased railcars



# Marine

- Large private inland petroleum products barge fleet
- Operations include 18 owned/leased inland waterway towboats and 184 owned and 16 leased barges
- Charters additional equipment for brown and blue water movements
- Transports crude, light products, ethanol, feedstocks, and other specialty chemicals





# Business Challenge / Project Overview

## ■ Condition Based Monitoring:

- This effort is expected to reduce extended downtime of equipment due to equipment failure, reduce costs for failure by having better information available, increase mechanical availability, enable a safer working environment, and improve efficiency of the Marine work force.

## ■ Project Scope

- Marine vessels
  - Engines
  - Gears
  - Generators
  - Steering
  - Ship Service
  - Tank Alarms
- Marine Repair Facility
  - Waste Water Treatment Plant
  - Thermal Oxidizer
  - Maintenance Float
  - Tank Farm
  - Boiler house



# Project Progress

## ■ Marine Repair Facility

- Cleaning Dock
- Tank Farm
- Waste Water Treatment Plant
- Boiler house
- Thermal Oxidizer

## ■ Currently nine vessels implemented (~400 data points per vessel)

- |                      |                  |
|----------------------|------------------|
| — M/V Speedway       | — M/V Detroit    |
| — M/V Cincinnati     | — M/V Kentucky   |
| — M/V Ohio Valley    | — M/V Marathon   |
| — M/V Nashville      | — M/V Map Runner |
| — M/V Paul G. Blazer |                  |



# The PI System Architecture Overview

- PI Interface for Modbus Ethernet
  - Leveraging the buffering capability
- PI ProcessBook for viewing graphical representations
- PI DataLink for data analysis
- PI Notifications to identify system outages
- PI Coresight for future mobile analysis
- PI AF for future analytics



# MPC Marine Use of the PI System

- Preventative maintenance potential
- Updates existing alarm panels
- Fuel burn metrics
- Historical data for incident investigation and trouble shooting
- Move workforce from data capturing to data analysis

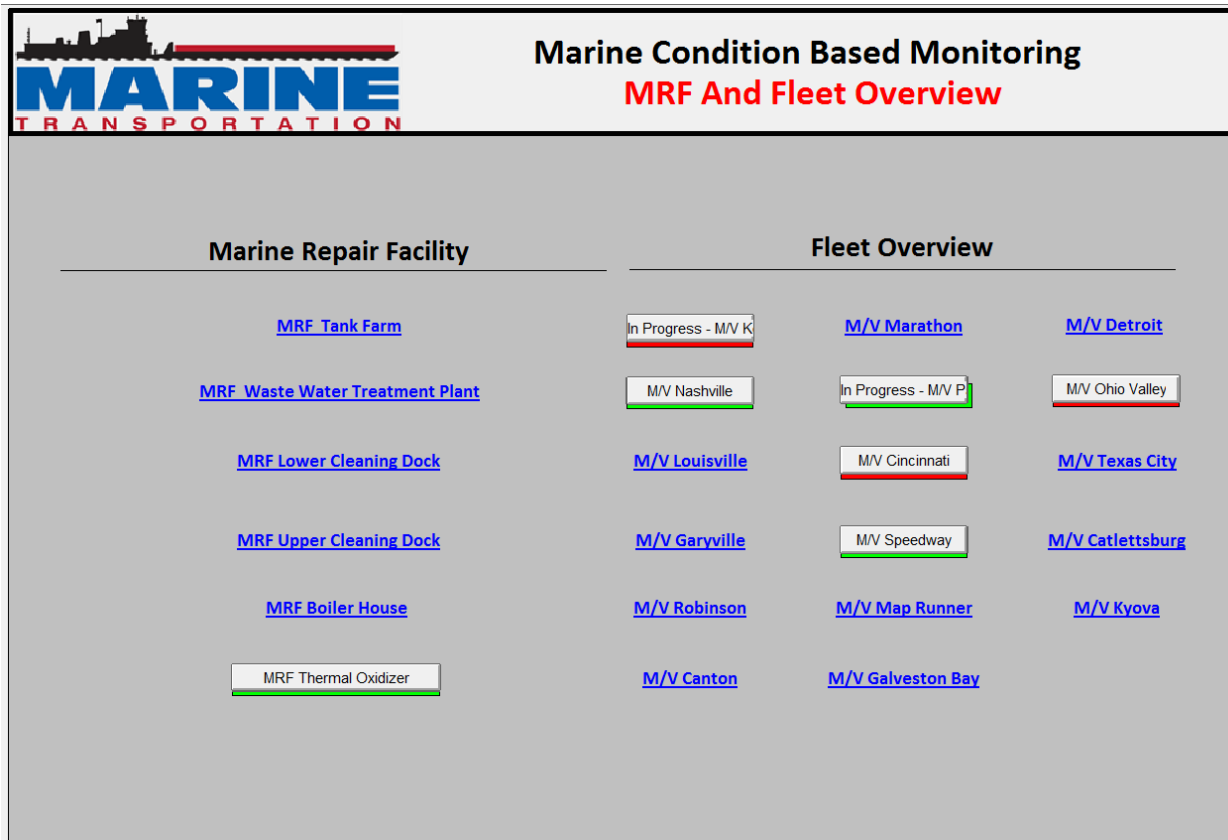


## Results / Benefits

- Leverage previous initiatives to provide network access to the Marine Fleet
- On average 7% of the CDM data being pulled over the network was being lost when vessels traveled during bad weather, under bridges or through locks. This issue has been mitigated by placing the PI Interface for Modbus Ethernet on the vessels to buffer data that would be otherwise lost.
- Reduced downtime and increased mechanical availability through better understanding of equipment performance
- Enable safer working environment by reducing unnecessary equipment maintenance
- Overall efficiency improvement with the workforce

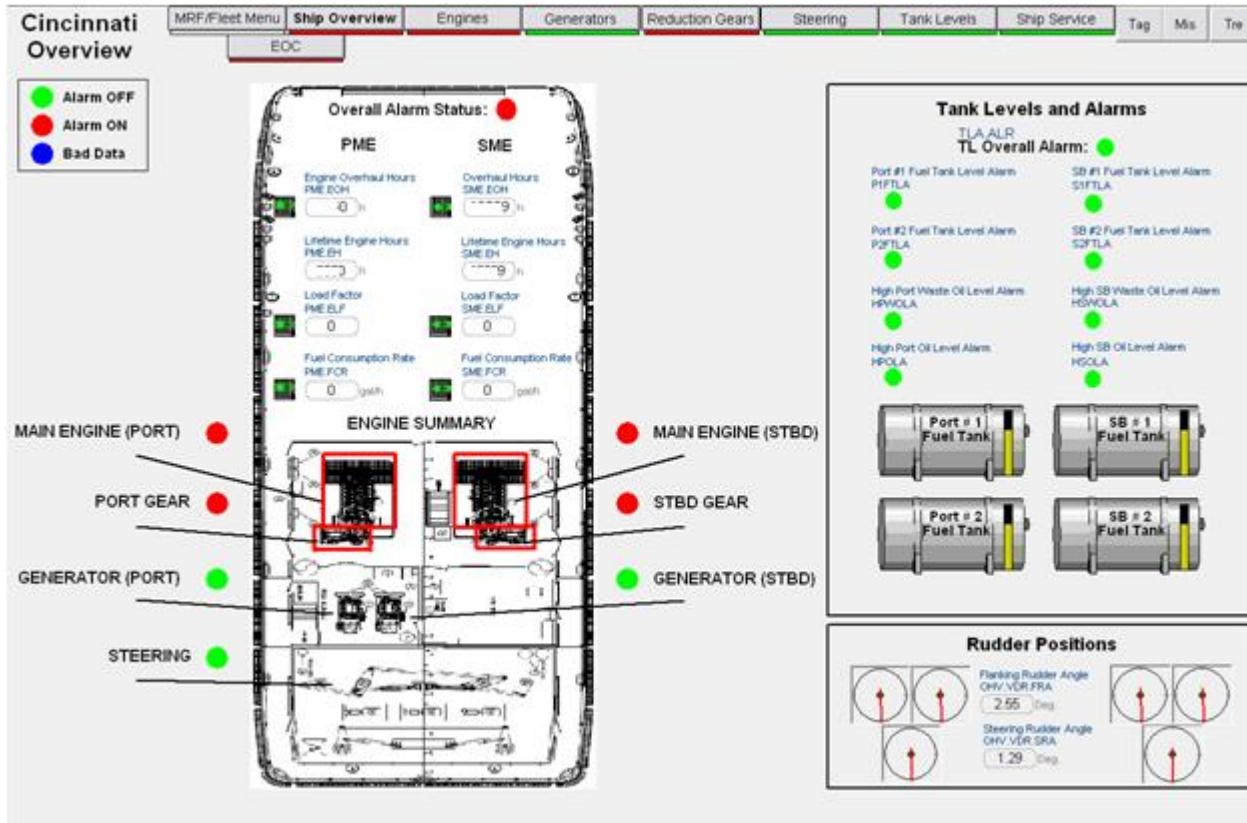


# Dashboards – Marine Overview





# Dashboards – Vessel Overview

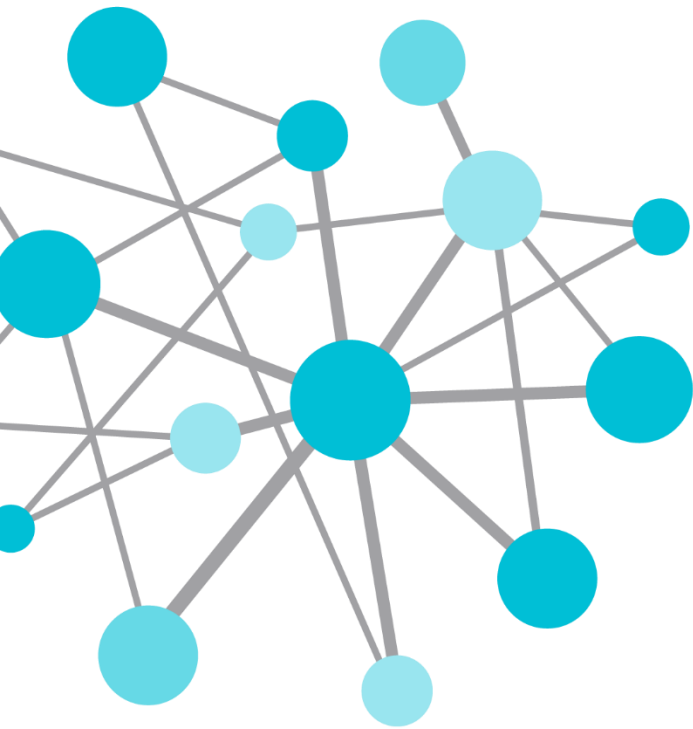




# Summary

- Innovative method of connecting real-time business data to end-users and de-silo business systems to a single platform.
- Leveraging past expertise within Marathon Petroleum and the industry to benefit the Marine organization
- Continuing to learn, adapt and utilize new technology





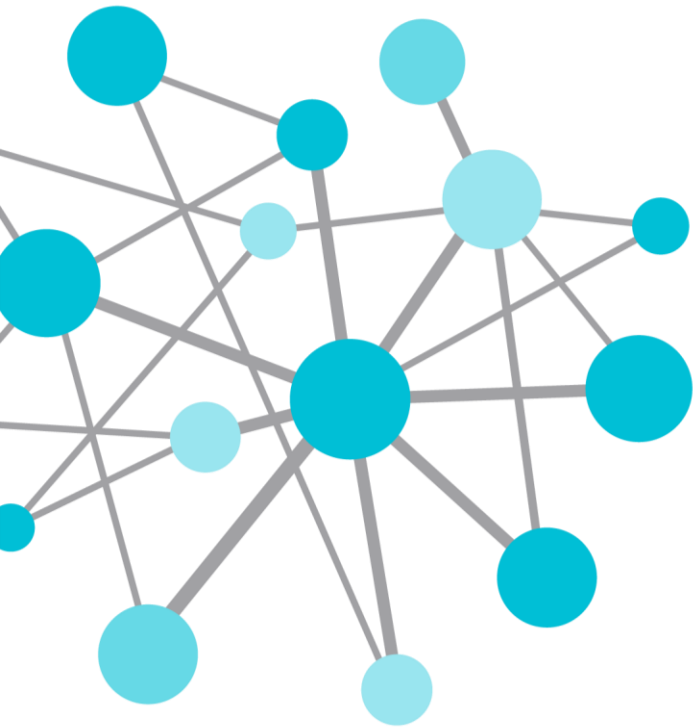
# Questions

**Please wait for the  
microphone** before  
asking your question



**Please state your name  
and your company**





THANK  
YOU

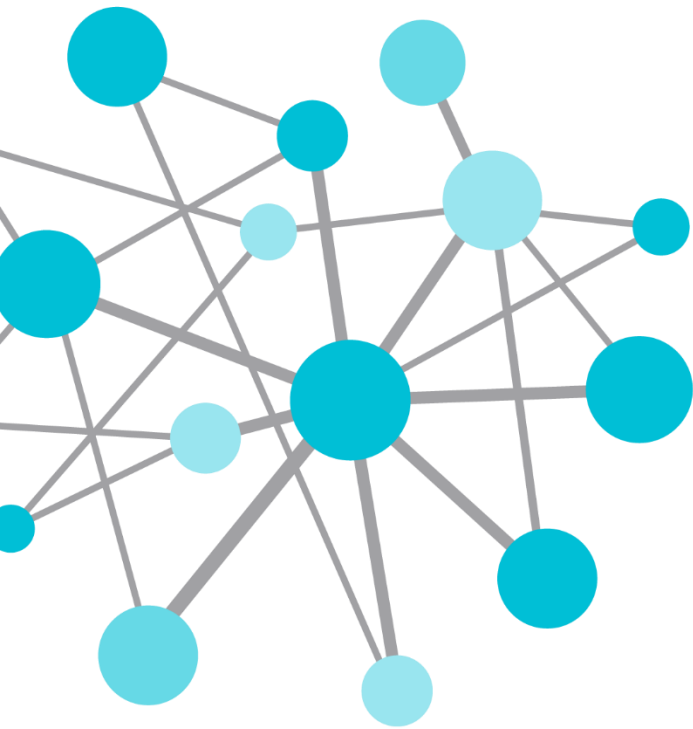
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# Joshua Schaublin

- [OJSchaublin@MarathonPetroleum.com](mailto:OJSchaublin@MarathonPetroleum.com)
- Advanced IT System Integrator
- Marathon Petroleum Company LP





## **The WITSML Service For Devon Energy**

**A WITSML Compliant  
Real-Time Drill Data  
Management System**



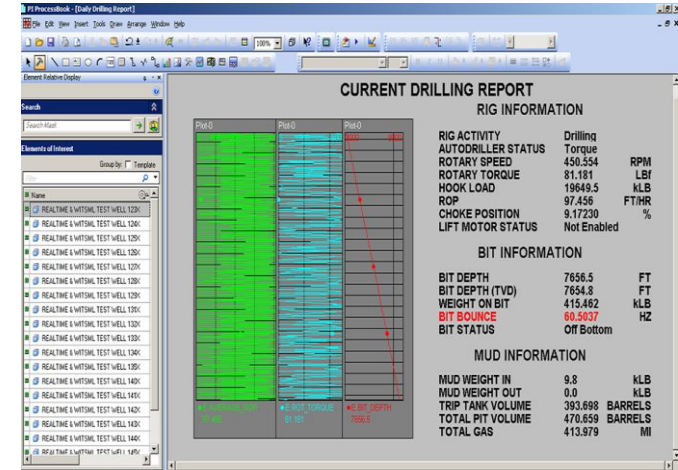
Presented by **Rick Howell, Devon Energy**  
**Shaun Wright, Industrial Evolution**





# Agenda

- About Devon Energy
- Challenge – Problem(s) to Solve
- PI System based WITSM Solution
- Progress and Future Plans
- Illustrations
- Case Study Summary





# About Devon Energy



- One of North America's leading independent producers of oil and natural gas
- Engaged in exploration and production
- Corporate headquarters in Oklahoma City
- More than 5,000 employees
- Member of the S&P 500
- On Fortune magazine's 100 Best Companies to Work For list each year since 2008.

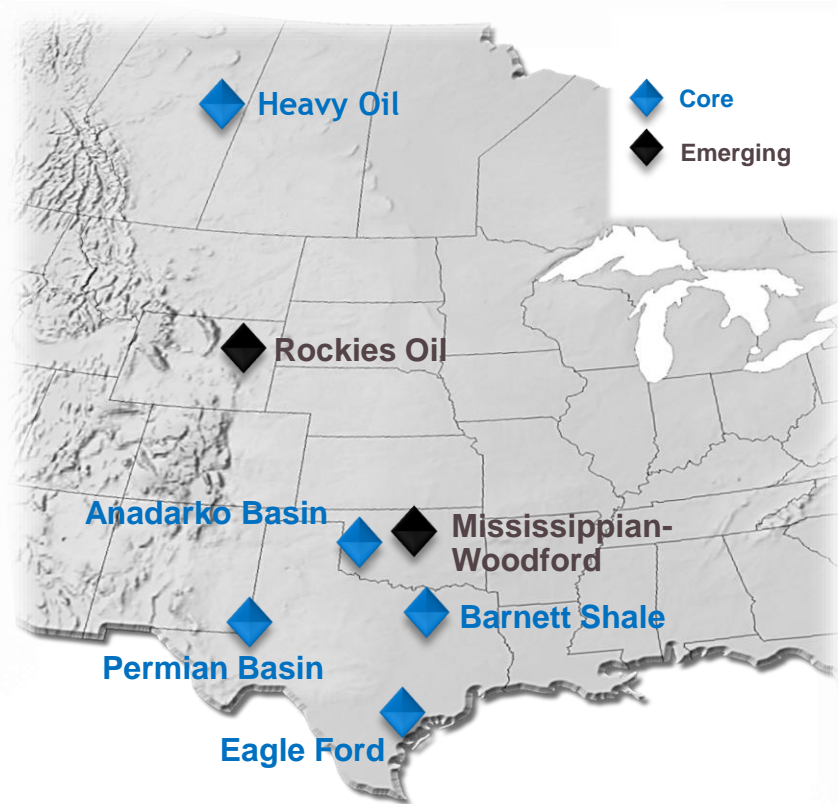


# Devon Today

- Q3 2014 net production: 640 MBOED<sup>(1)</sup>
- Deep inventory of oil opportunities
  - Top-tier Eagle Ford development
  - Strong Permian Basin position
  - World-class heavy oil projects
  - Upside potential in emerging plays
- Strong liquids-rich gas optionality
- EnLink ownership valued at ≈\$8 billion
  - Additional midstream value in Access and Victoria Express pipelines

(1) Excludes non-core divestiture assets.

## Devon's Core & Emerging Assets





[illegible]

- OSIsoft® REGIONAL SEMINARS



# Challenges – Decrease Time to First Oil, Safety, & Costs

## Capture “high fidelity” Data for Complete Well Data Set

- **Drill Phases**

- Plan new well
- Set-up and commence drill operations
- Sustain and manage drilling until full completion
- Change status to cap or produce

- **Challenges**

- Vast amounts and types of data from and to different systems
- Missing information
- Out of date information
- Information in many different locations
- Lots of manual work that needs to be digitized
- Difficult to follow life-of-well cycle
- Need to search and report on time stamped dynamic and static data (eg time and depth)

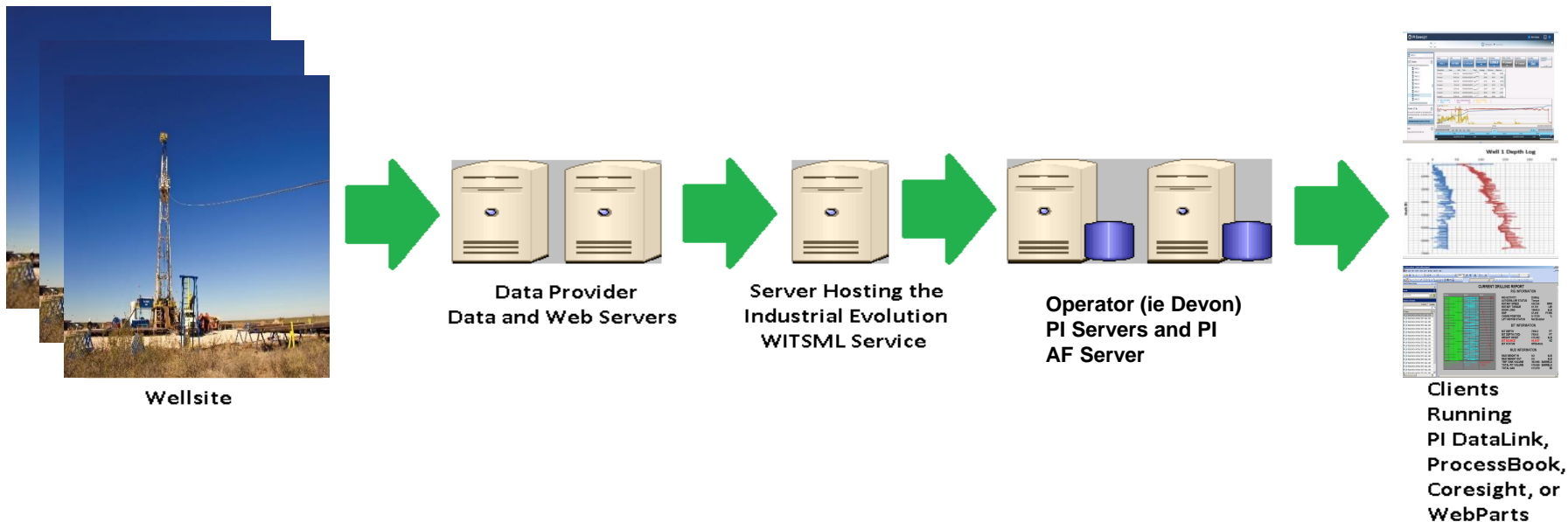


# PI System Based WITSML Solution

- Use PI System to gather, validate, normalize and manage real-time data
- Use PI AF to establish system over-arching integration framework:
  - Integration with mud, surveys and BHA data through WellView
  - WITSML data is available through the PI AF elements
  - Data from other sources, such as SQL and Oracle databases are also made available through PI AF elements
- Make extensive use of PI AF templates, particularly well templates
- Automate as much data management as possible, eg. WITSML provider selection, addition of new wells, tags and even mnemonics not in template
- Use CoreSight and EventFrames to manage data availability and reporting
- Maintain WITSML compliancy



# Data Flow





# Example - Element in PI Asset Framework

DAEDTESTPIE-WITSML Test - PI System Explorer (Administrator)

base Query Date Back Refresh New Element New Attribute Search Elements

to  
Entities  
Wells

- REALTIME & WITSML TEST WELL 123X
- REALTIME & WITSML TEST WELL 124X
- REALTIME & WITSML TEST WELL 125X
- REALTIME & WITSML TEST WELL 126X
- REALTIME & WITSML TEST WELL 127X
- REALTIME & WITSML TEST WELL 128X
- REALTIME & WITSML TEST WELL 129X
- REALTIME & WITSML TEST WELL 131X
- REALTIME & WITSML TEST WELL 132X
- REALTIME & WITSML TEST WELL 133X
- REALTIME & WITSML TEST WELL 134X
- REALTIME & WITSML TEST WELL 135X
- REALTIME & WITSML TEST WELL 140X
- REALTIME & WITSML TEST WELL 141X
- REALTIME & WITSML TEST WELL 142X
- REALTIME & WITSML TEST WELL 143X
- REALTIME & WITSML TEST WELL 144X
- REALTIME & WITSML TEST WELL 145X
- REALTIME & WITSML TEST WELL 146X
- REALTIME & WITSML TEST WELL 147X

rank Searches

REALTIME & WITSML TEST WELL 123X

General Child Elements Attributes Ports Analysis Version

Filter

	Value	Description
ACC_DRILL_STKS	1280230 stroke	Stroke - Acc Drill
ACC_FILL_STKS	1279127 stroke	Stroke - Acc Fill
ACCIN_TRIP_IN	1280670 bbl	Accum Trip In
ACCIN_TRIP_OUT	1281374 bbl	Accum Trip Out
AD_ROP	Pt Created	Ad ROP
ALKALINITY	Pt Created	Alkalinity
ALT_GRAVITY_TOOLFACE	Pt Created	Toolface Thrash
ANN_TEMP	Pt Created	Ann Temp
ANN_PRESSURE	177.605 psi	Ann Pressure
AVERAGE_ROP	450.0166 R/h	
ANG_ROP_FT_HR	0 R/h	ROP - Average
ANG_ROP_MIN_FT	0	
BASE_FLUID_VOL_ADDED	Pt Created	Base Fluid Volume Added
BIT_BOUNCE	60.5037 ft	
BIT_COMMENT	Pt Created	Comment
BIT_DATETIME_OUT	Pt Created	Datetime Out
BIT_DEPTH	8025.568 ft	Bit Position
BIT_DPT_MD	8025.303 ft	Bit TVD
BIT_NOZZLES	Pt Created	Nozzles
BIT_NUMBER	Pt Created	Bit Number

Group by: Category

Name: ACC\_DRILL\_STKS

Description: Stroke - Acc Drill

Configuration Items

Categories: Well Nomenclature

Default UOM: stroke

Value Type: Double

Value: 1280230 stroke

Data Reference: PI Point

Settings...

YDENPIRG.WITSML: REALTIME & WITSML TEST WELL 123X ACC\_DRILL\_STKS

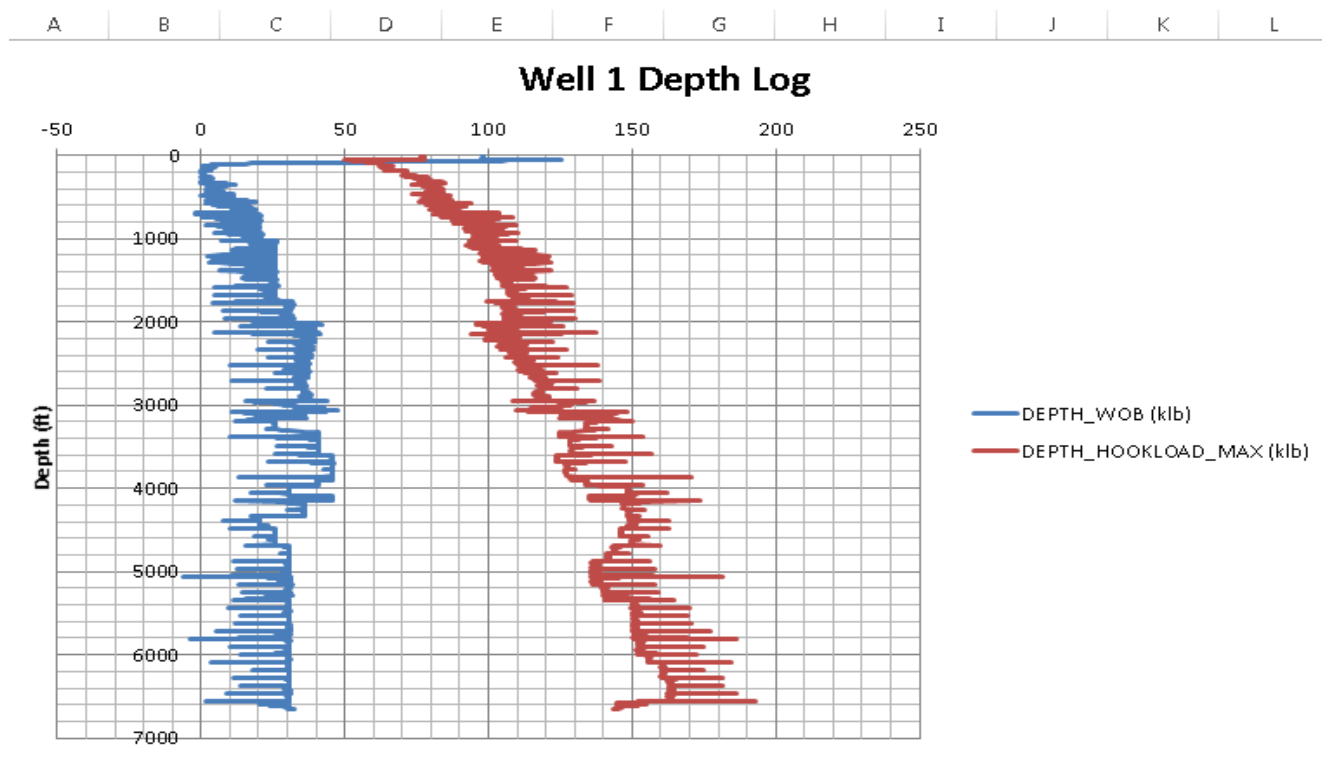


# Progress and Plans

- **Progress and plans for the future**
  - System is in production at Devon Energy
  - Currently interfaced to 30+ rigs and 2 distinct vendors, NOV and Pason
  - Automatically creates PI AF elements, PI AF attributes and PI tags
  - Automatically creates PI AF attributes and PI tags for new mnemonics
  - Integrating PI Event Frames to organize data
  - WITSML output interface
- **Demonstration and Discussion**
  - Slide 1 utilizes PI DataLink Microsoft Excel spreadsheet
  - Slide 2 utilizes an element relative PI Coresight graphic accessing PI AF
  - Slide 3 utilizes an element relative PI ProcessBook graphic accessing PI AF



# Example - Depth Log



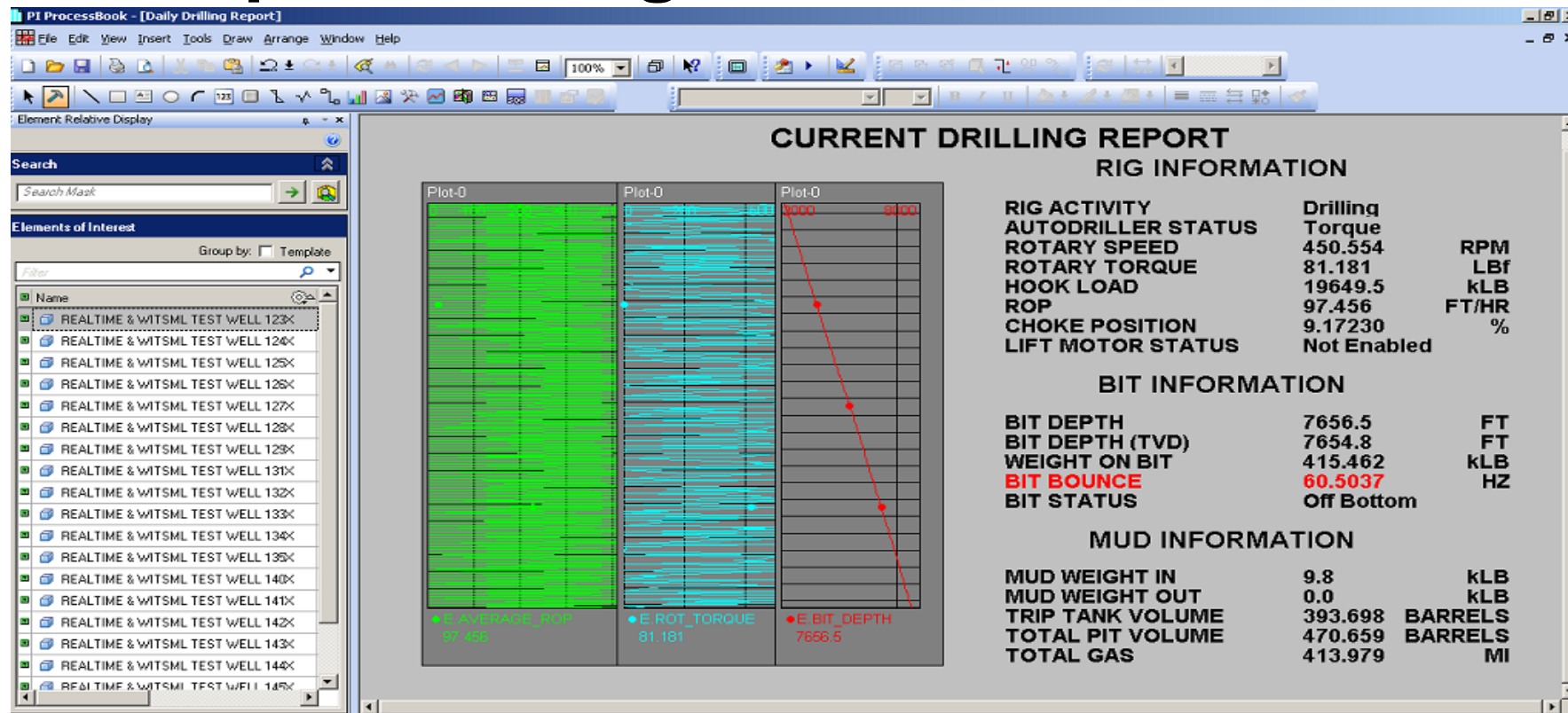


# Example - Drilling Data in Coresight





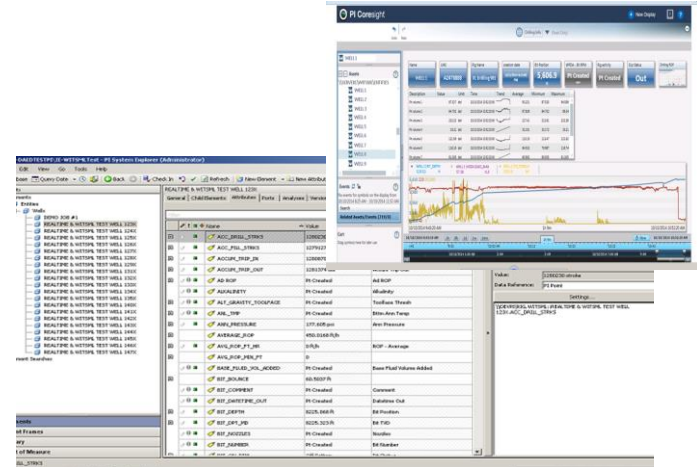
# Example - Drilling Data in ProcessBook





# PI System WITSM Integration Improves Drilling Performance

The PI System and in particular PI AF provided a foundation to enable integration of real-time drill site data including WITSML sources. The resulting solution is enabling vastly improved drilling analytics, visualization, and collaboration resulting in improved drill fleet optimization, costs, ROP, safety, and reduced time to first oil.



## Business Challenge

- Develop infrastructure for acquiring one second drilling data to improve analytics and visualization
- Diverse data sources, many using “WITSML” which is not standard between providers
- Desire to have a complete real-time data set for wells from drilling, completions, to production

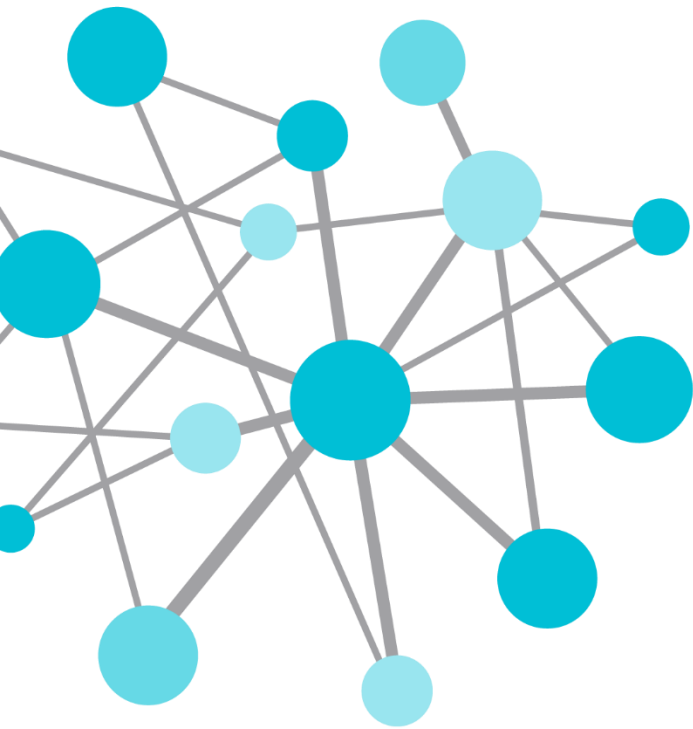
## Solution

- Used the PI System as an integration & applications infrastructure and the EA
- Developed a WITSM client interface for PI System (by IE)
- Developed PI AF model with heavy use of well templates
- Used PI PSA for WellView integration

## Results and Benefits

- System is operational on 30+ rigs, expanding to drilling fleet
- Real-time drilling visibility of current depth vs planned
- Engineering access to real-time data with improved SME collaboration
- Optimized drilling schedule





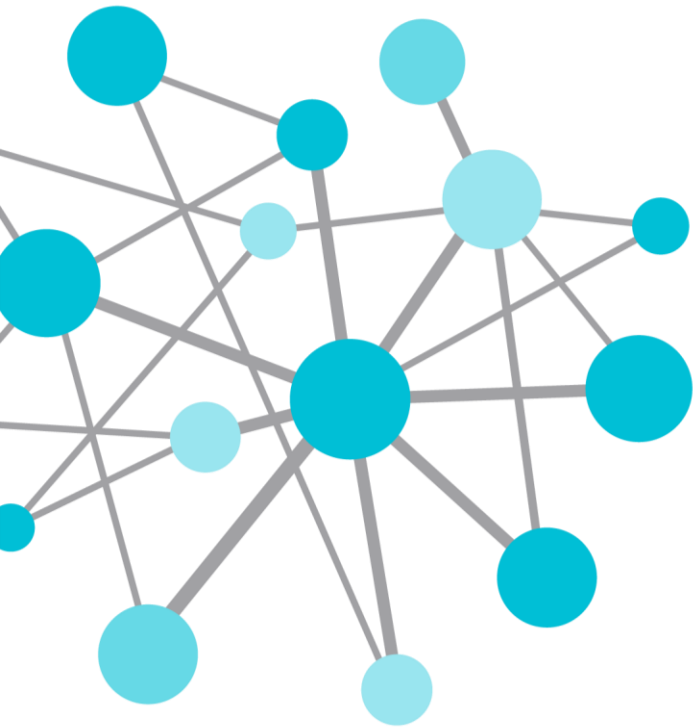
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**Please wait for the  
microphone** before  
asking your question



**Please state your name  
and your company**





THANK  
YOU

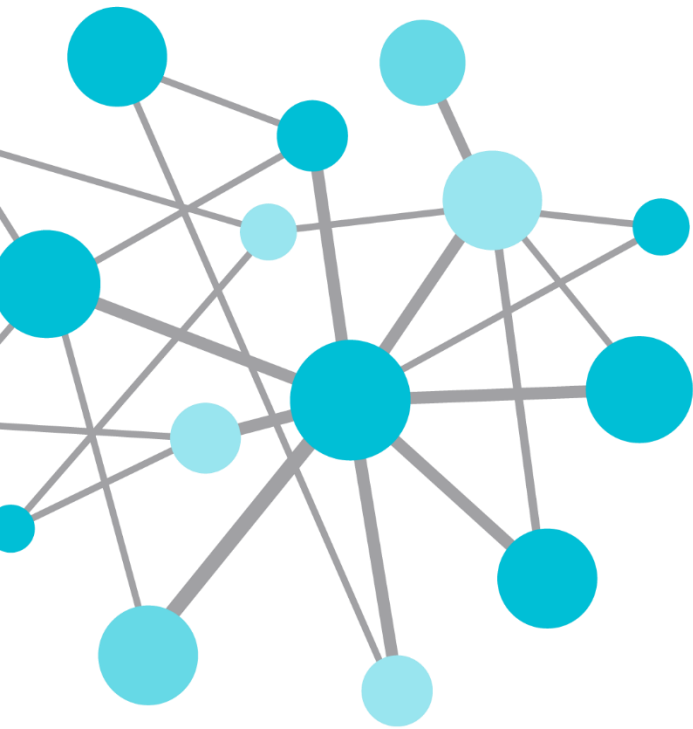
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# Firstname Lastname

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- Devon Energy
- [Shaun.Wright@industrialevolution.com](mailto:Shaun.Wright@industrialevolution.com)
- VP Business Development, Oil and Gas
- Industrial Evolution





# PI Connector for CygNet

Presented by **John Miller** **CSE** ICON  
**John.Miller@cse-icon.com**





# Background



CygNet is a powerful enterprise class SCADA system which collects operations data, including numerous types of attributes for each data point.

Many companies would like to bring their CygNet data into their PI Systems and PI AF for enhanced storage, archiving, analysis, and reporting.



CSE Icon is the largest CygNet SCADA Integrator in the US.

CSE Icon has been integral with OSIsoft to create the smart connector from CygNet to the PI System.

CSE Icon worked together with OSIsoft to create requirements and beta test the PI Connector for CygNet on our CygNet and PI System development servers



# Why the Need for a PI Connector for CygNet?

## Existing Interface Choice

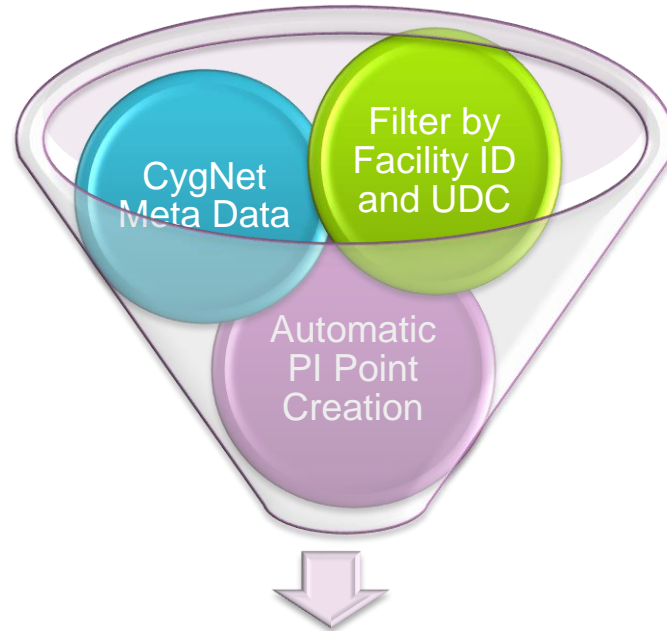
- Only offers collection of current point value
- Previous OPC methods were problematic
- Has issues with scalability and performance
- All PI System points must be manually created
- Meta data must then be manually exported
- Both these processes are incredibly time consuming in terms of both schedule and budget
- Inability to perform advanced analytics, visualization, and reporting on Cygnet Data





# Simplifying Integration and Data Structures

## PI Connector for CygNet



**Automatic PI AF Structure Creation  
and Synchronization**



# CygNet Connector Advantages

---

- Collects Point State (High Alarm, Unreliable, etc.)
- Collects Base Status (If customer wants to export tag status)
- Collects CygNet Facility Attributes (Meter Descriptions, Routes, Field, etc.)
- Collects CygNet Point Attributes (Data Descriptions, Alarm Settings, etc.)
  
- Filtering CygNet points by Facility ID and UDC
- Automatic PI Point Creation
- Automatic PI AF structure Creation
  
- Can run from CygNet server, PI Server, or independent server
- Data travels over a static port and communication is firewall friendly
  
- Opens up the CygNet SCADA to the “Power of the PI System” and PI AF for enhanced analytics, visualization, and reporting



# CygNet Data Structure = PI AF Structure

Properties for UON\_MAR.OPCIS:MN001-1H\_M1

General

Facility: UON\_MAR.OPCIS:MN001-1H\_M1 Category: GENFAC

Description: Dangel 1H Mtr

Type: Meter Run ACS Appl.

Facility Link: UON\_MAR.OPCIS:MN001-1H

Description:

Filter Attributes: <All> ☒ Active

Attribute	Description	Value
facility_table9	Analyzer Type	
facility_table11	Owner	
facility_table15	PAD	Dangel Pad
facility_table16	Reservoir	
facility_table17	Operator/Forman	Drilling Appellation Company
facility_table18	Property	
facility_table19	Route	Ohio Route
facility_attr10	Feature ID	
facility_attr11	GQ Source	
facility_attr12	Contract #/ID	
facility_attr13	Tank Farm	
facility_attr14	Pad ID Desc	MN001 - Dangel
facility_attr15	Tank Height (ft)	
facility_attr19	Company	Statoil
facility_attr20	System/Division	Appalachian
facility_attr21	Area	Marcellus
facility_attr22	Lateral	
facility_attr23	Span	

Updated 10/9/2014 21:56:48 UON-SLR-MAR-CYG\Administrator

References: Devices Points

Audit History Previous Next Close

\\BNPDC-OSIPISA3D\Demo OPCIS\_DB - PI System Explorer (Administrator)

File Edit View Go Tools Help

Database Query Date Back Check In Refresh New Element New Attribute

Elements

- UON\_MAR.OPCIS:HA002-1H\_M1
- UON\_MAR.OPCIS:HA002-2H
- UON\_MAR.OPCIS:HA002-2H\_M1
- UON\_MAR.OPCIS:HA002-2H\_T5
- UON\_MAR.OPCIS:HA002-2H\_T6
- UON\_MAR.OPCIS:HA002-3H
- UON\_MAR.OPCIS:HA002-3H\_M1
- UON\_MAR.OPCIS:HA003\_M1
- UON\_MAR.OPCIS:HA004\_M1
- UON\_MAR.OPCIS:MN001\_M1
- UON\_MAR.OPCIS:MN001\_M2
- UON\_MAR.OPCIS:MN001-1H
- UON\_MAR.OPCIS:MN001-1H\_M1**
  - MN001-1H\_M1\_PRDIFXIN
  - MN001-1H\_M1\_PRSTAXIN
  - MN001-1H\_M1\_QTGASDCR
  - MN001-1H\_M1\_QTGASDPV
  - MN001-1H\_M1\_RTGASDIN
  - MN001-1H\_M1\_TPGASXIN
  - MN001-1H\_M1\_YTBATXIN
- UON\_MAR.OPCIS:MN001-2H
- UON\_MAR.OPCIS:MN001-2H\_M1
- UON\_MAR.OPCIS:MN001-3H
- UON\_MAR.OPCIS:MN001-3H\_M1
- UON\_MAR.OPCIS:MN001-4H
- UON\_MAR.OPCIS:MN001-4H\_M1
- UON\_MAR.OPCIS:MN001-5H
- UON\_MAR.OPCIS:MN001-5H\_M1
- UON\_MAR.OPCIS:MN001-6H
- UON\_MAR.OPCIS:MN001-6H\_M1
- UON\_MAR.OPCIS:MN001-7H

UON\_MAR.OPCIS:MN001-1H\_M1

General Child Elements Attributes Ports Analyses Version

Group by: Category Template

Name	Value
Attr6	
Attr7	
Attr8	
Attr9	Williams/Dangel CRP
Attr10	
Attr11	
Attr12	
Attr13	
Attr14	MN001 - Dangel
Attr15	
Attr16	
Attr17	
Attr18	
Attr19	
Attr20	Appalachian
Attr21	Marcellus
Attr22	
Attr23	
Attr24	
Attr25	

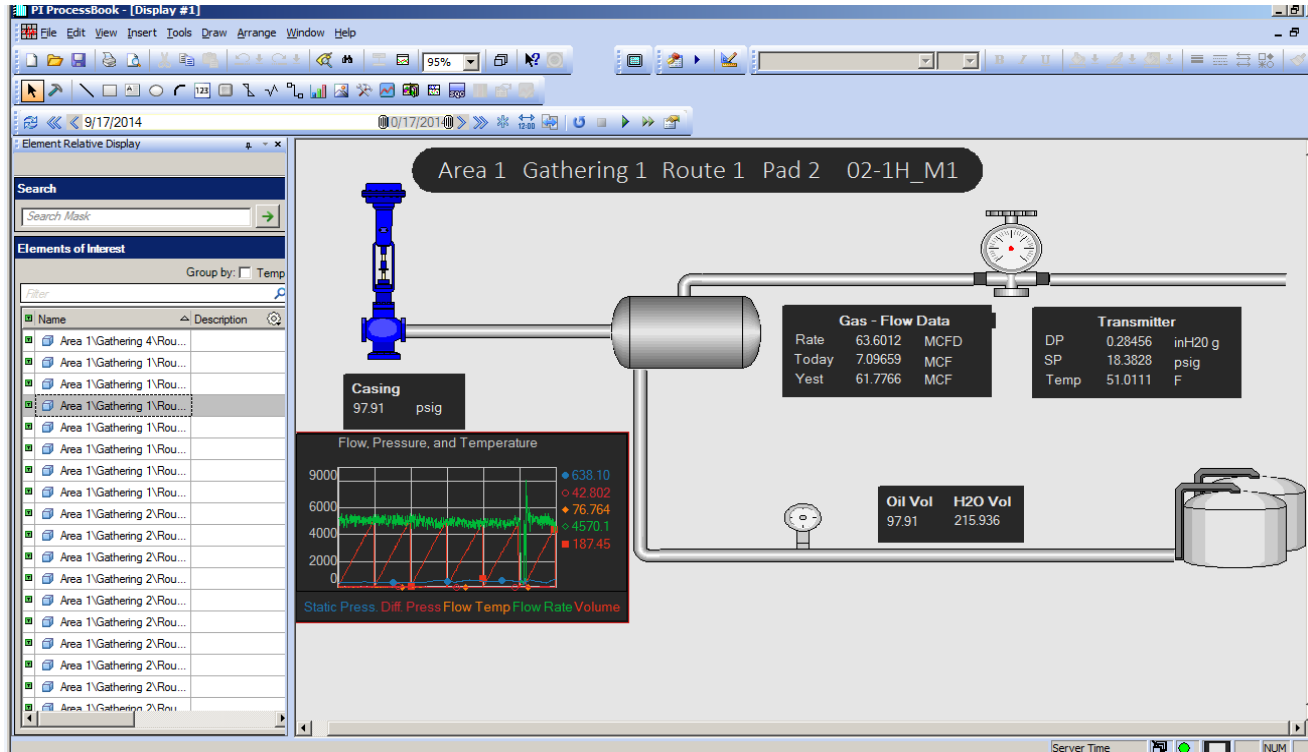
Elements

- Event Frames
- Library
- Unit of Measure
- Analyses

UON\_MAR.OPCIS:MN001-1H\_M1 Modified:11/4/2014 11:38:39 AM, Version: 1/1/1970 12:00:00 AM, Revision 1



# Leveraging PI AF Asset Based Analytics & Aggregation to Provide Flexible Analytics & Visualization





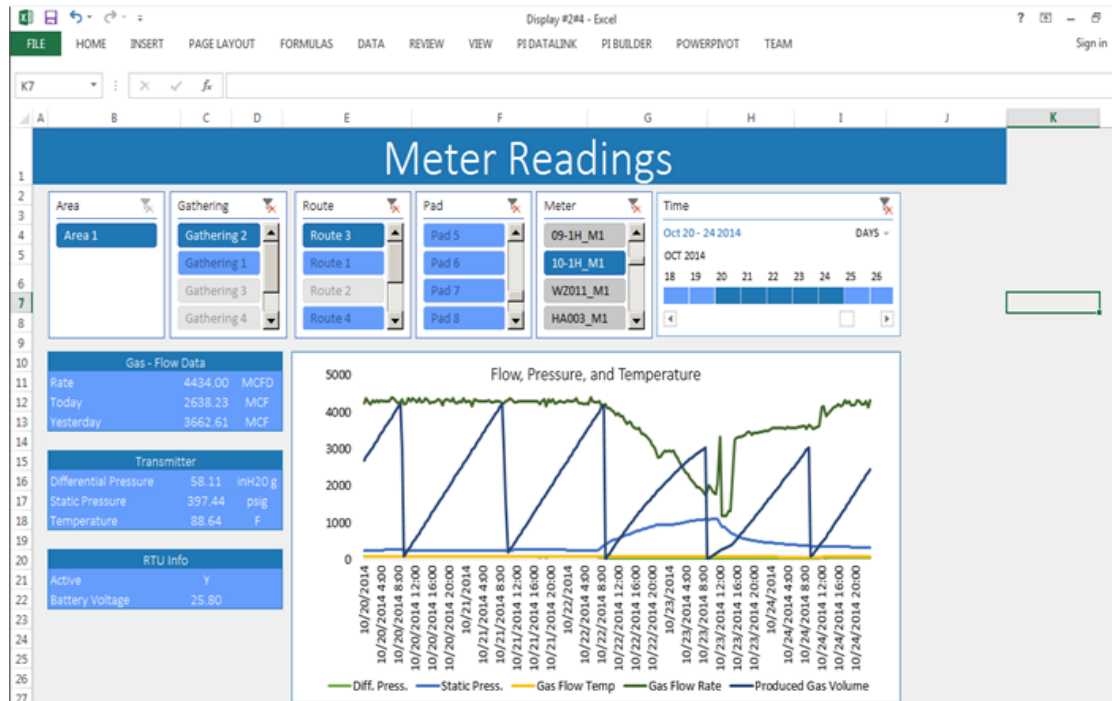
# CygNet Alarms Analytics, Visualization, & Reporting in the PI System

## Alarm and Event Status

Gathering 1									
Asset	Gathering 1 *	Start time	Duration	Area	Well	Meter	PAD	Route	Status
StartTime	10/10/2014	10-Oct-14 00:07:51	0 0:03:00	Area 1		02-1H_M1	Pad 2	Route 1	High Flow Rate
EndTime	11/5/2014	10-Oct-14 00:07:51	0 0:03:00	Area 1		02-3H_M1	Pad 2	Route 1	High Flow Rate
Duration	50s	10-Oct-14 00:56:48	0 0:01:59	Area 1		10-1H_M1	Pad 13	Route 3	High Flow Rate
		10-Oct-14 01:22:52	0 0:02:59	Area 1		02-1H_M1	Pad 2	Route 1	High Flow Rate
		10-Oct-14 02:14:51	0 0:02:09	Area 1	WZ010-1H		Pad 13	Route 3	Low Casing Pressure
		10-Oct-14 02:25:33	6 10:48:02	Area 1	WZ009-1H		Pad 11	Route 3	Low Casing Pressure
		10-Oct-14 02:27:34	6 10:46:00	Area 1		09-1H_M1	Pad 11	Route 3	Low Flow Rate
		10-Oct-14 03:06:50	0 0:14:01	Area 1		10-1H_M1	Pad 13	Route 3	High Flow Rate
		10-Oct-14 03:24:48	0 0:06:01	Area 1		10-1H_M1	Pad 13	Route 3	High Flow Rate
		10-Oct-14 03:48:57	0 0:08:23	Area 1	WZ010-1H		Pad 13	Route 3	Low Casing Pressure
		10-Oct-14 03:59:15	0 0:11:51	Area 1	WZ010-1H		Pad 13	Route 3	Low Casing Pressure
		10-Oct-14 04:45:19	0 0:01:32	Area 1	WZ010-1H		Pad 13	Route 3	Low Casing Pressure
		10-Oct-14 05:13:52	0 0:02:58	Area 1		02-2H_M1	Pad 2	Route 1	High Flow Rate
		10-Oct-14 05:17:36	0 0:01:58	Area 1	WZ010-1H		Pad 13	Route 3	Low Casing Pressure
		10-Oct-14 05:29:13	0 0:13:42	Area 1	WZ010-1H		Pad 13	Route 3	Low Casing Pressure
		10-Oct-14 06:16:54	0 0:02:11	Area 1	WZ010-1H		Pad 13	Route 3	Low Casing Pressure
		10-Oct-14 06:24:59	0 0:06:16	Area 1	WZ010-1H		Pad 13	Route 3	Low Casing Pressure
		10-Oct-14 06:33:03	0 0:01:48	Area 1	WZ010-1H		Pad 13	Route 3	Low Casing Pressure
		10-Oct-14 06:43:03	0 0:02:06	Area 1	WZ010-1H		Pad 13	Route 3	Low Casing Pressure
		10-Oct-14 07:25:51	0 0:03:00	Area 1		02-1H_M1	Pad 2	Route 1	High Flow Rate
		10-Oct-14 07:44:51	0 0:04:04	Area 1	WZ010-1H		Pad 13	Route 3	Low Casing Pressure



# Leveraging PI AF and Microsoft BI for Greater Insight to CygNet Information





# Customer Perspective.....

“The CygNet-PI Connector opens up new choices for Statoil. Previously, the process to export CygNet data in the PI System was very cumbersome – which made it cost and time prohibitive. The Cygnet-PI Connector allows us to quickly export not only the data points but also the valuable meta data from CygNet directly into the PI System, straight into a PI AF structure. Once in the PI System, the analysis and reporting options are at our fingertips.”

*Matthew Fleharty, SCADA/Automation Lead, US Onshore, at Statoil*



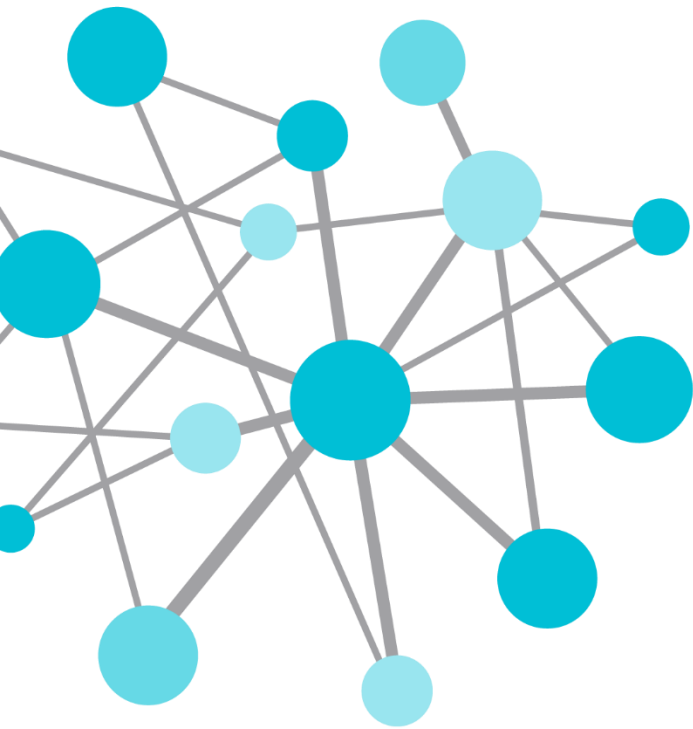
# A “Best of Breed Model”: CygNet & the PI System

---

- Excited about the Cygnet Connector
- Opportunity to address current pain points
- Ready for use...continuing to evolve features & functionality
- CES-Icon Ready to Engage
- Come Visit us at the CSE-Icon Table Top for a Demo







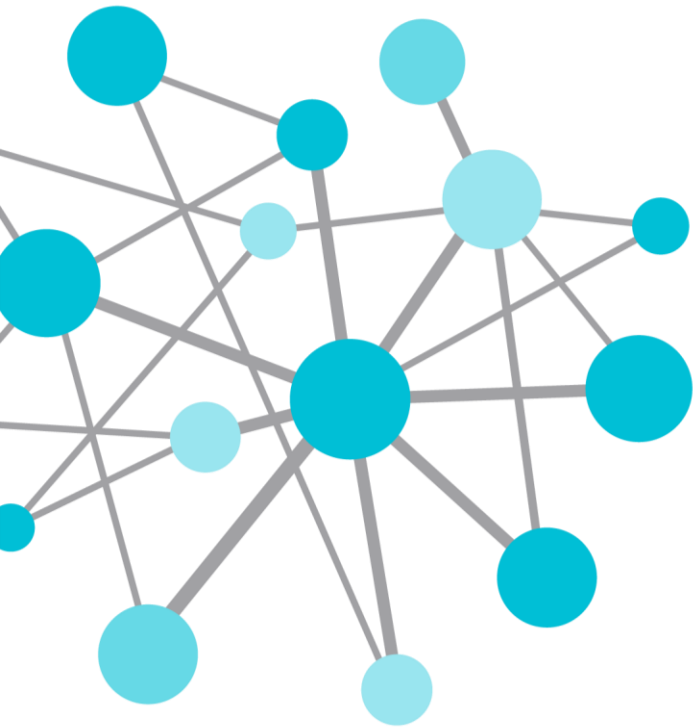
# Questions

**Please wait for the  
microphone** before  
asking your question



**Please state your name  
and your company**





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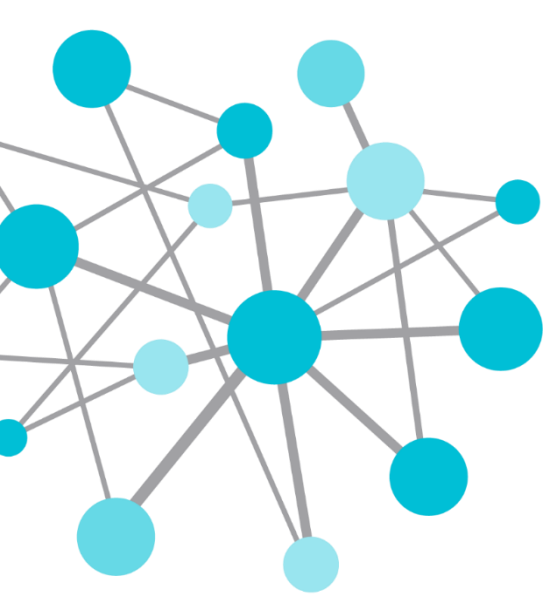
# John Miller

VP Operations

[John.Miller@cse-icon.com](mailto:John.Miller@cse-icon.com)

CSE-ICON





# Using PI 2014 for Advanced Analytics and Visualization in the Drilling of Oil and Gas Wells



(Highlights from the UC2014 EMEA Talk)

[Drilling and Completions with Real-Time Operational Intelligence](#)

Presented by **Ken Startz – Marathon Oil**





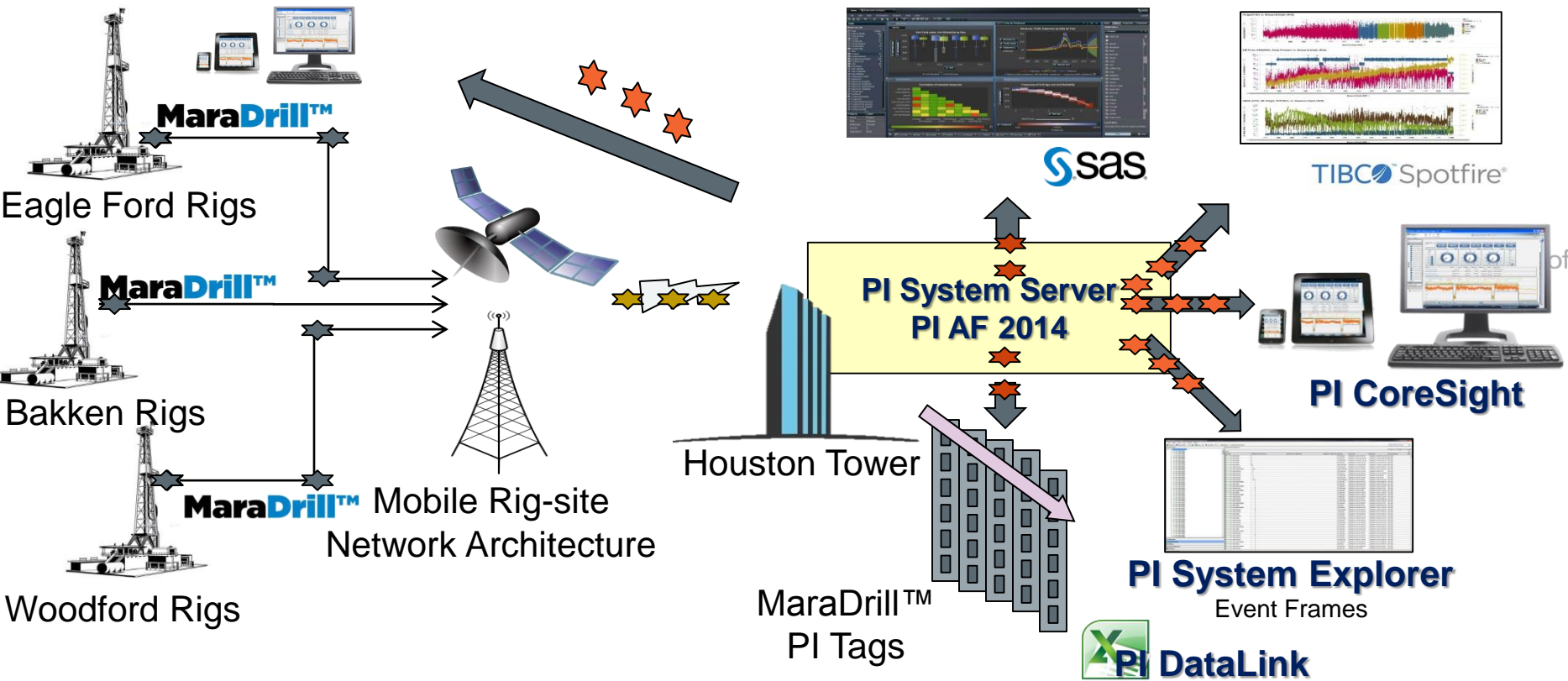
# Agenda

- Brief Update on MaraDrill <sup>tm</sup>
- Using PI 2014 for Drilling Performance Analytics
- Concluding Remarks





# Data Workflow – Collaboration & Guidance at the Drill Site





# Common Drilling Data Tags

## Engineering Units

ROP = Rate of Penetration – Ft / Hr

WOB = Weight on Bit – K Pounds

RPM = Revolutions per Minute – RPM

Mud Flow Rate – GPM

Torque – kFt\*Lbs

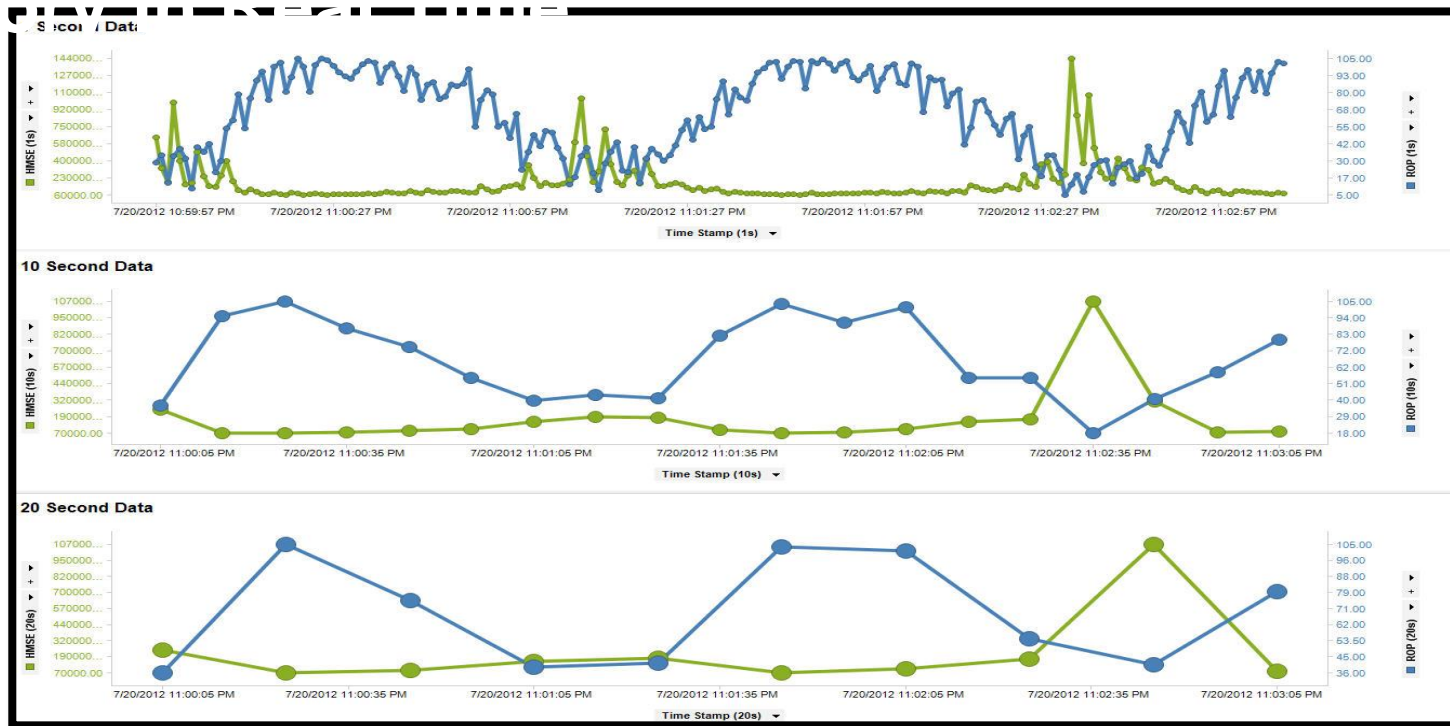
**Need 1 second time stamp resolution!**





# Importance of <1 second data

MaraDrill™



Other vendors

Rig Display



# PI Coresight – Stick-Slip Identification- Eagle Ford Rig

## Eagle Ford Rig



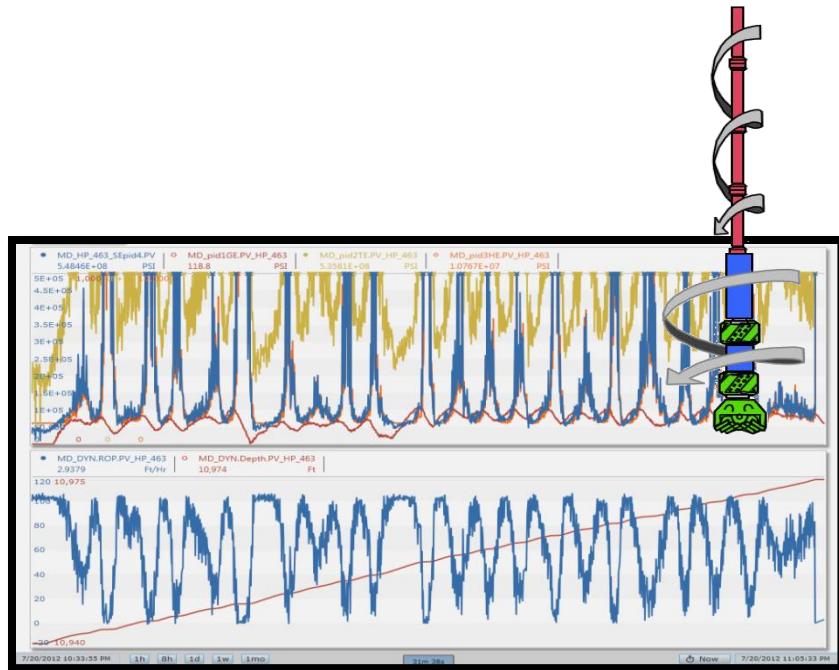
“Perfect” drilling

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

Sticking phase → bit stops

Slipping phase → bit “breaks” free

Drillstring torsional oscillations



Stick-slip



# PI Coresight View with XML Data Export



Enables integration with WellView data

Enables integration with Spotfire visualization



# Custom Spotfire Interface

Import from PI Coresight Data or Manual Selection

The screenshot displays the 'PI UI Template v6 (Coresight) - TIBCO Spotfire' application. The interface is divided into several sections:

- Control Panel:** Located on the left, it features the MaraDrill™ logo and a button labeled 'Step 0 (Optional)'. Below this are links for 'Control Panel Instructions' and 'PIDs Analysis Instructions'. A red circle highlights the 'Step 0 (Optional)' button, with an orange arrow pointing to the text 'Enables integration with PI data from PI Coresight'.
- Estimated Number of Records to be Retrieved:** A field showing '1,036,812'.
- Comments:** A text area for user notes.
- Step 1 - Select Rig:** A dropdown menu with options: 388, 430, 458, 473.
- Step 2 - Select Time Frame:** Includes 'Start Time' (1/1/2013 12:00:00 AM), 'Time Interval' (1 second(s)), and 'End Time' (1/2/2013 12:00:01 AM).
- Step 3 - Select Tags:** A section for selecting parameters, divided into 'MaraDrill™ State', 'Hydraulic Tags', 'Manually Entered Parameters', and 'Dynamic Tags'. It includes various dropdown menus for tags like 'State', 'Bit Press Loss', 'Annular Velocity', etc.
- Step 4 & 5 - Press Buttons to Run Query and Load Data:** Includes 'Step 4', 'Step 5', and a 'Clear Selections' button. A status message indicates 'Last query successfully executed.'
- Right Sidebar:** Contains links: 'View PI Data Table >>', 'Go To Power Curve Analysis >>', 'Go to Analysis by Depth / Time >>', and 'Go to PIDs Analysis >>'. A red circle highlights these links, with an orange arrow pointing to the text 'Guided analytics'.

The bottom status bar shows 'Online', '440 of 440 rows', '0 marked', '45 columns', and 'pivot (Pivot)'.

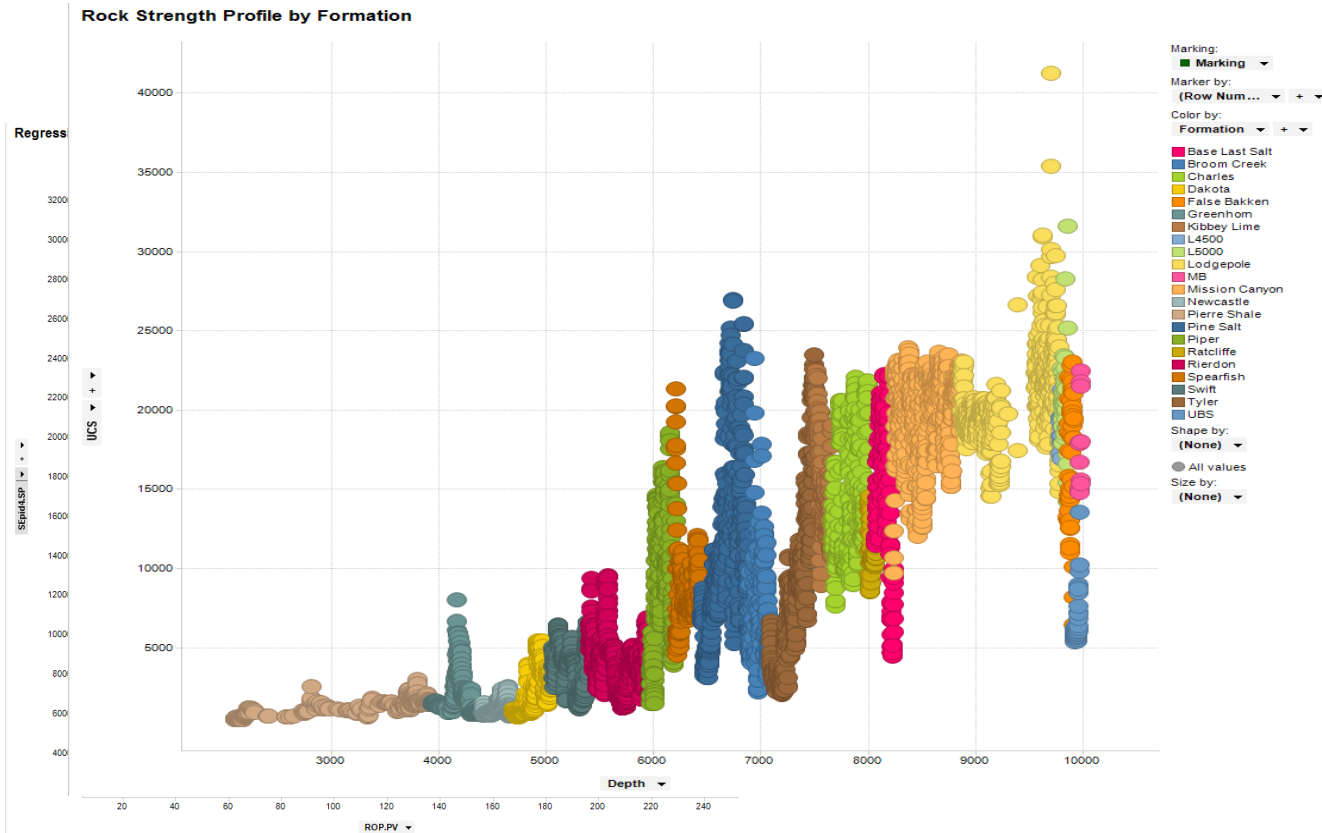
Enables integration with PI data from PI Coresight

Guided analytics



# Post-Well Science Using MaraDrill™ Data in SpotFire

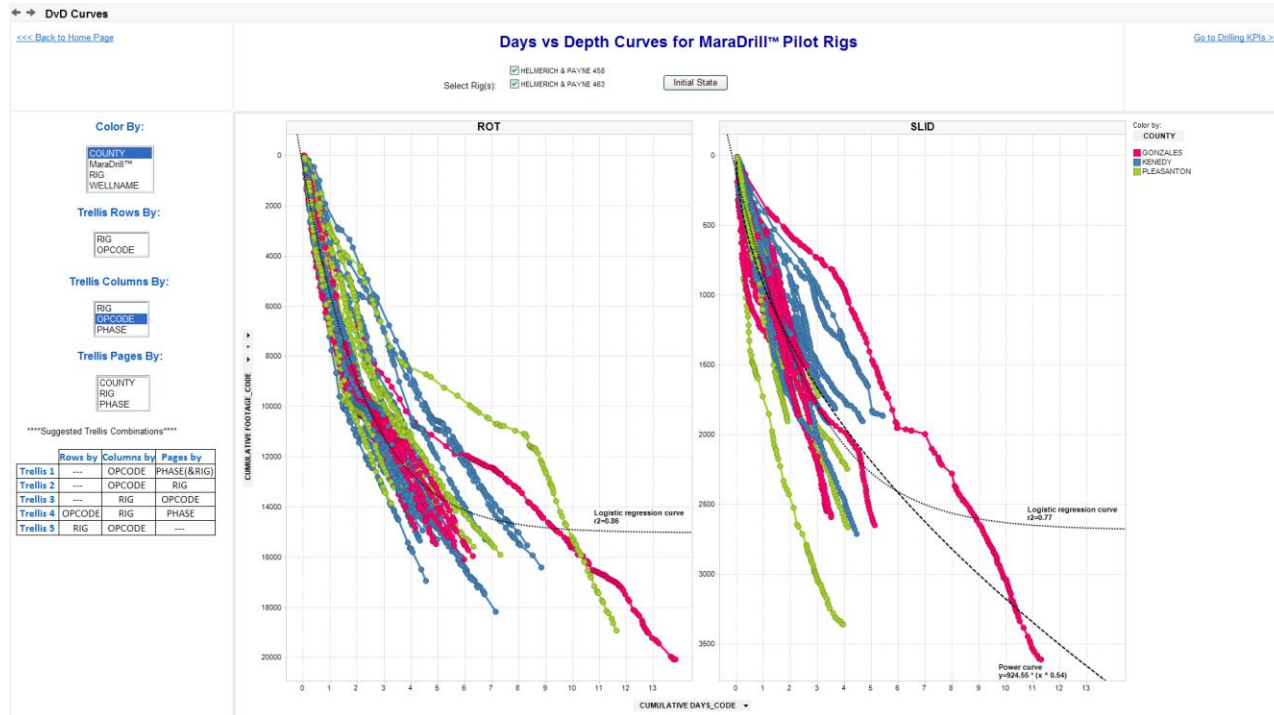
Modeling the rock strength & predicting ROP's on subsequent wells in the area to improve logistics and planning





# Days vs Depth Curves for MaraDrill™ Rigs

## Black = MD, Teal = No MD



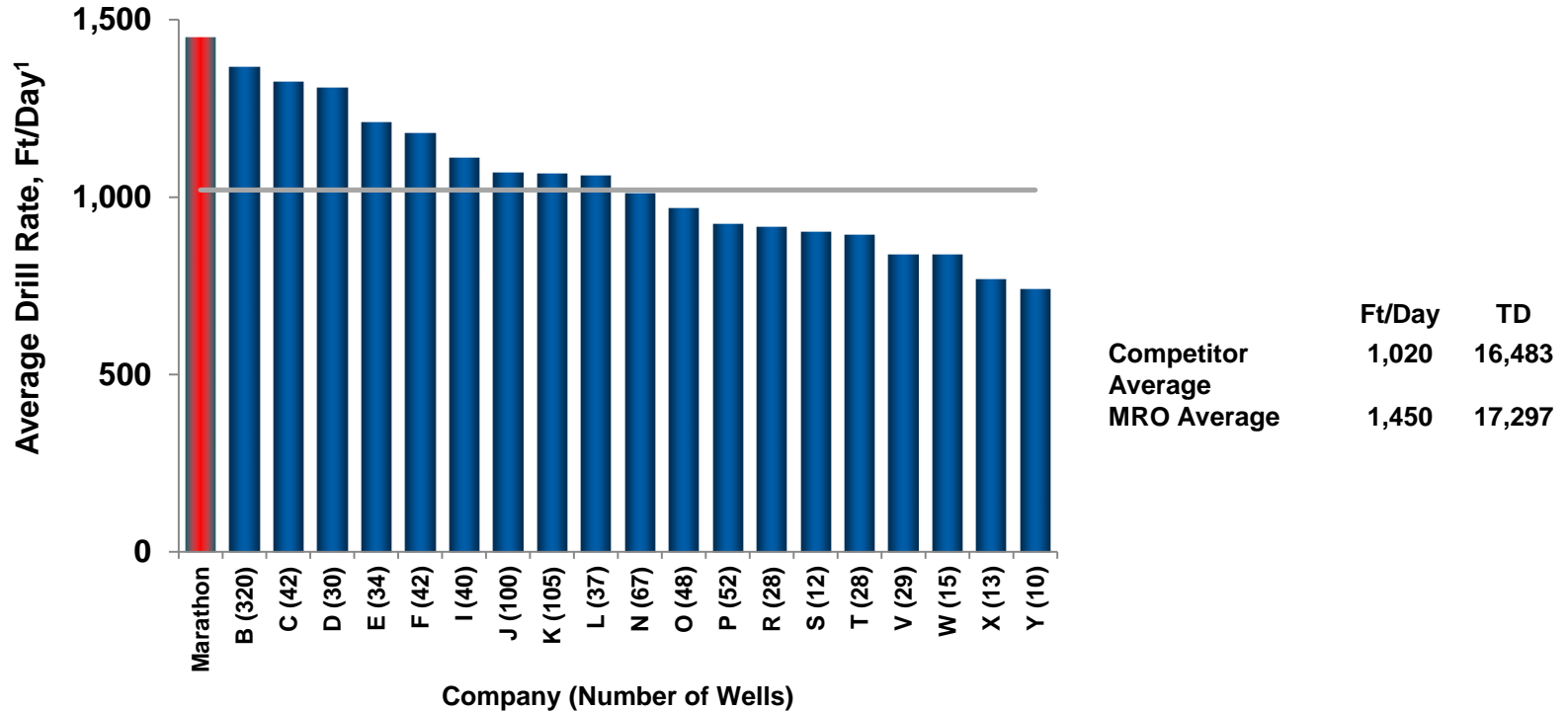


# Driller's Display in Dog House





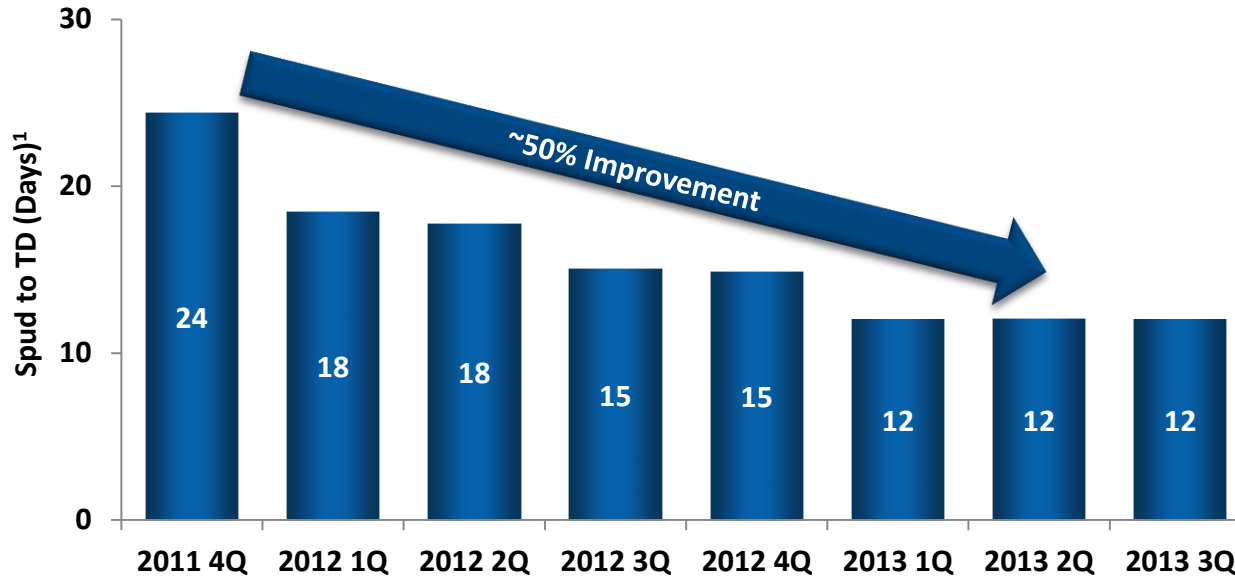
# Continuous Improvement in Rate of Penetration (ROP)



<sup>1</sup>Competitor Data Source: IHS – Drilling Wire; Wells drilled 2013 YTD (Oct) across Karnes, Wilson, Bee, Atascosa, Live Oak, McMullen, Gonzales, Lavaca and Dewitt Counties; Includes companies with at least 10 wells (AXAS, BHP, BHP, CHK, COP, CRK, EOG, FCX, FST, Geosouthern, HUNT OIL, MUR, PVA, PXD, PXP, Sea Eagle Ford, SFY, STO, TLM)



# Eagle Ford Drilling – Spud to Total Depth



*Note: Spud to TD Days: MRO-op wells, excludes pilot holes and wells with intermediate casing.*



# Agenda

- Brief Update on MaraDrill <sup>tm</sup>
- Using PI 2014 for Drilling Performance Analytics
- Concluding Remarks





# Drilling Performance Analytics

Minimizing the cost of and time to first production

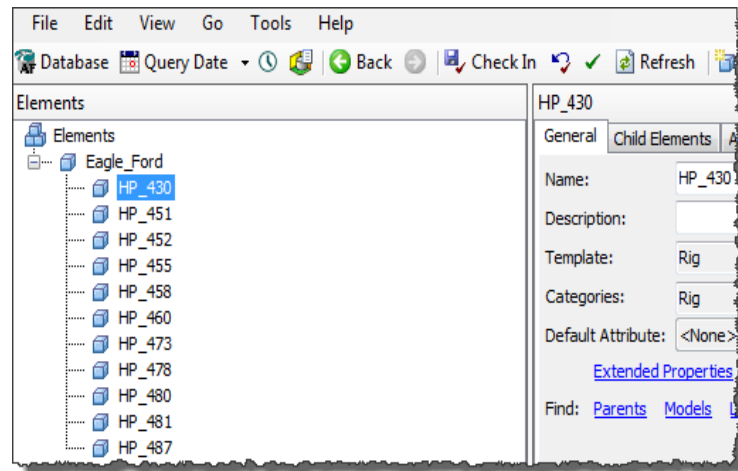
- The Problems we are trying to solve:
  - What are the sources of drilling idle time?
  - Which company and crew are best-in-class and why?
  - Which rigs are our top performers and why?

Improve drilling performance and optimization with improved drilling analytics and visualization with real-time data and information in context



# PI AF and PI EF for Drilling

- **Rig**
  - 20 to 30 Measurements – 1second (or less) resolution (PI System tags)
- **Well**
  - Drilling 3 to 4 weeks
  - Completion 2 months
- **PI AF Element**
  - Use for the Rig
- **PI Event Frames**
  - Use for the Wells
  - Each parent Event Frame is a Well



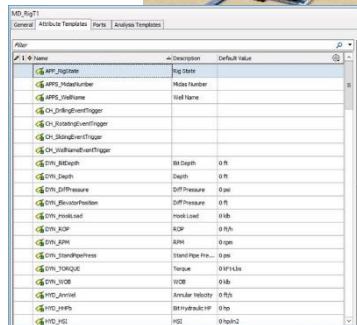


# Rigs and Wells

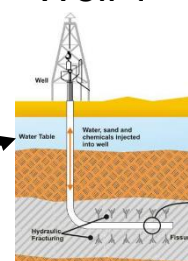
## Drilling Rig 1



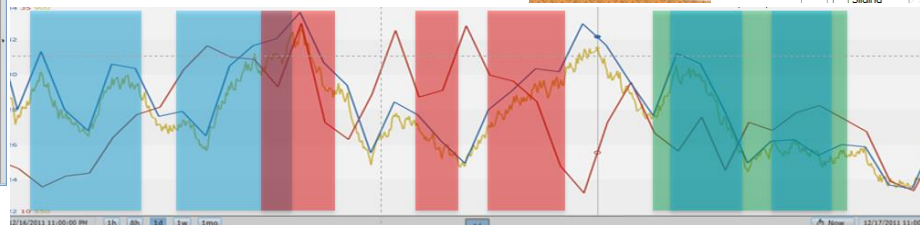
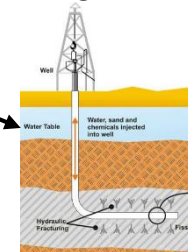
## AF Element



Well 1



Well 2



## Event Frames

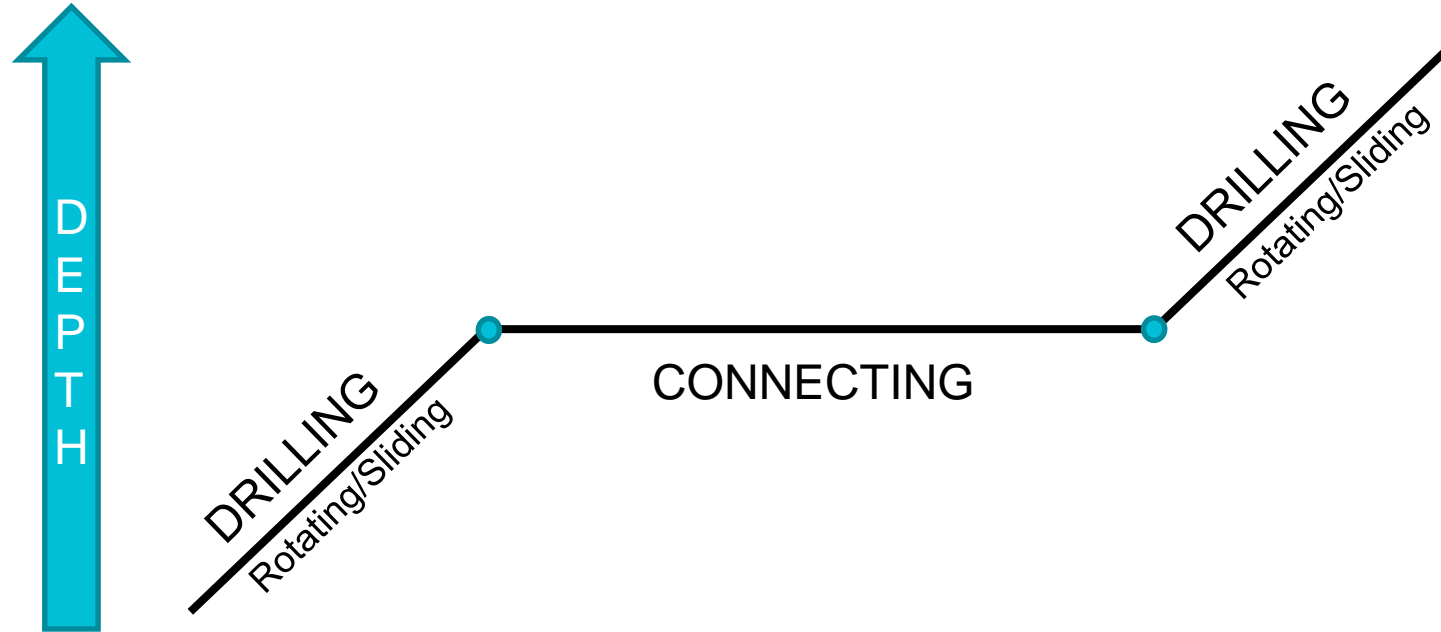
Well 1	24:11:41:12	4/1/2014 2:00:00 AM	4/25/2014 1:41:12 PM
Sliding	0:19:00	4/1/2014 2:40:00 PM	4/1/2014 2:59:00 PM
Rotary ...	4:40:38	4/1/2014 3:33:45 PM	4/1/2014 8:14:23 PM
Sliding	0:28:30	4/1/2014 5:23:04 PM	4/1/2014 5:51:34 PM
Stick-slip	0:03:30	4/2/2014 5:59:00 AM	4/2/2014 6:02:30 AM
Sliding	0:20:33	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
Sliding	0:19:00	4/15/2014 9:41:35 AM	4/15/2014 9:59:35 AM

## Event Frames

Well 2	24:00:33	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 AM
Sliding	0:35:04	5/7/2014 8:40:20 AM	5/7/2014 9:15:24 AM



# Major Drilling Events



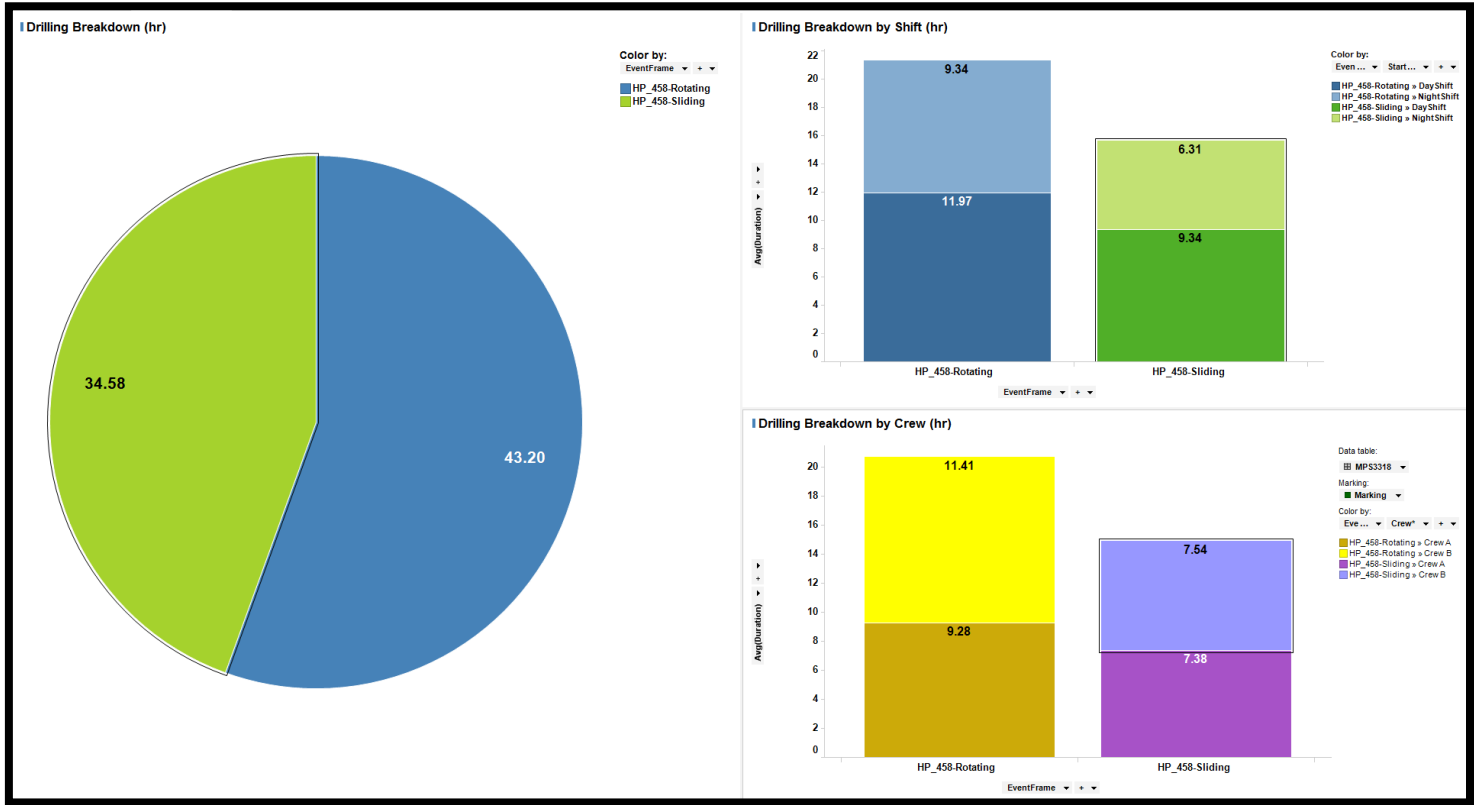


# PI Coresight with PI Event Frames Example





# Spotfire Shift & Crew Comparison From PI AF





# Agenda

- Brief Update on MaraDrill <sup>tm</sup>
- Using PI 2014 for Drilling Performance Analytics
- Concluding Remarks

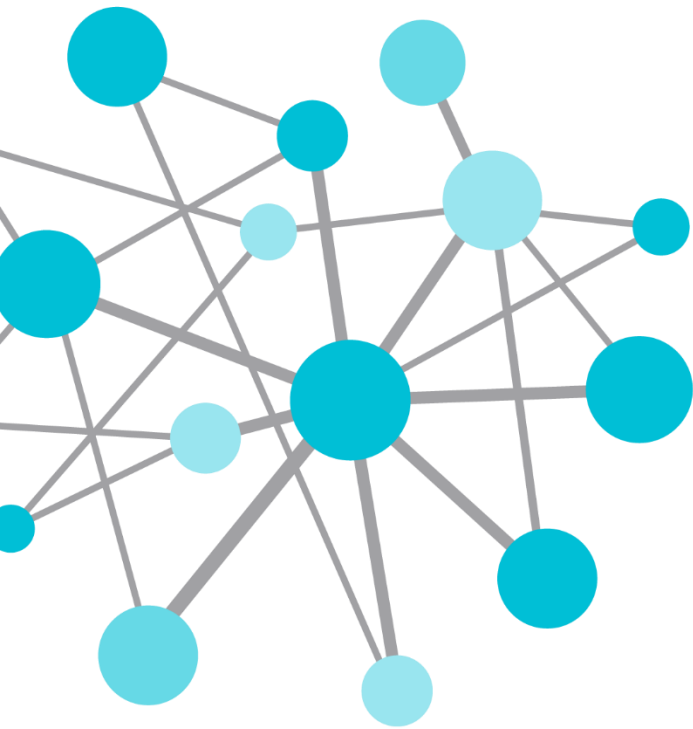




# Value Now, Value Over Time with the PI System

- 25+ years & Continuing to Find Incremental Value –“Future proofing” of our PI System Infrastructure Investment
- Using Features of PI 2014 – very powerful and strong value proposition
- MaraDrill™ has been rolled out across 25 rigs – Transformed Our Drilling
- Excited About the Use of New PI System Functionality





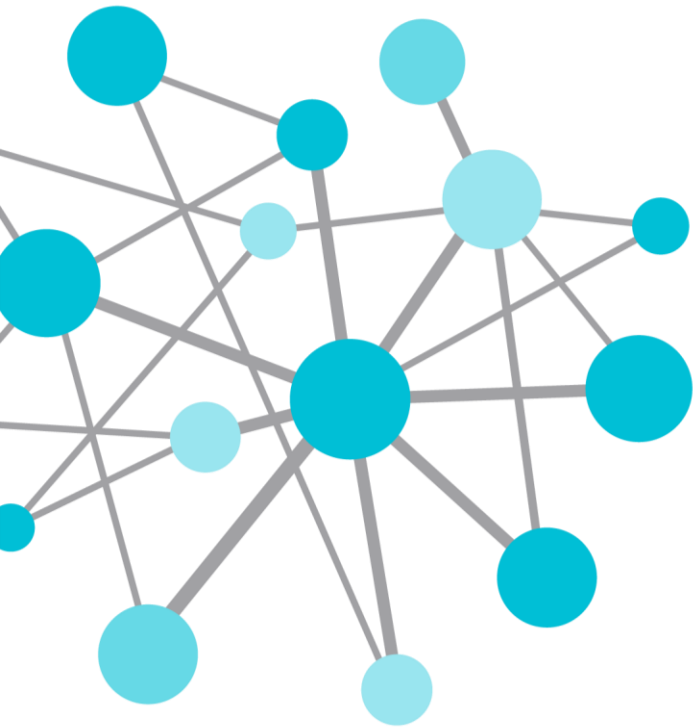
# Questions

**Please wait for the  
microphone** before  
asking your question



**Please state your name  
and your company**

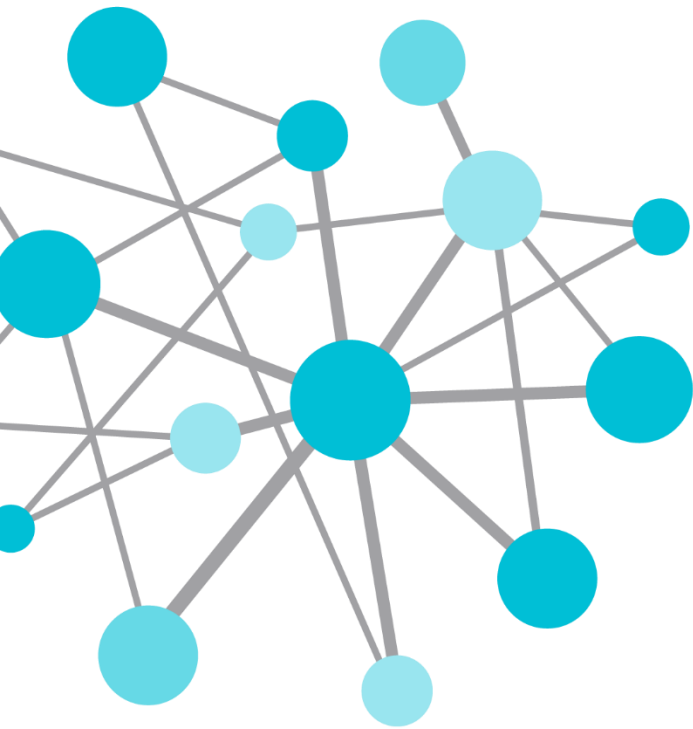




THANK  
YOU

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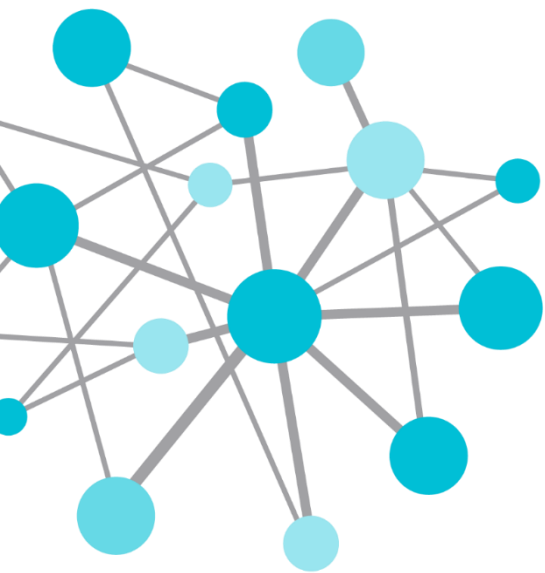
# Ken Startz

KLStartz@MarathonOil.Com

Advanced Senior Business Analyst

Marathon Oil Company





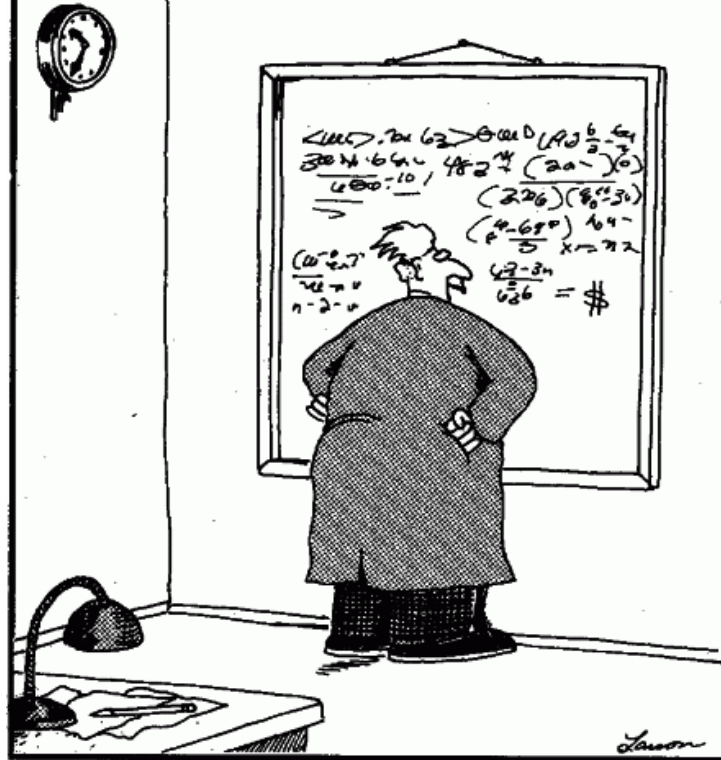
# Troubleshooting Operational Aspects of Well Drilling and Completion Using the PI System

Presented by **Ales Soudek**  
**Yung Wallace**





1985



Einstein discovers that time is actually money.



# Business Challenge

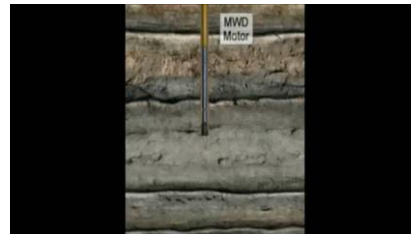
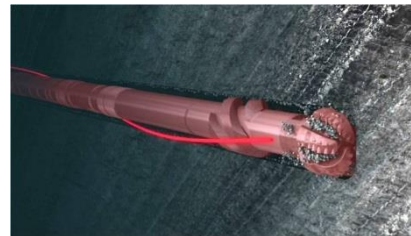
- High Cost - \$80,000/d to \$1,000,000/d
- Reduce Drilling/Completion Days
  - Drilling – 20 to 25 days
  - Completion – 50 to 70 days
- Current focus – Depth Based Analysis
- Compare Shifts, Crews, Drilling Outfits
- Noise in the Data





# Background and Terminology

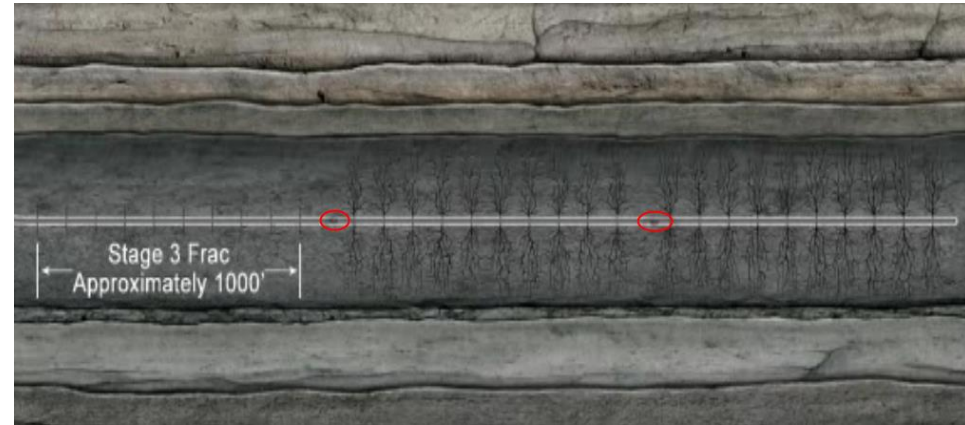
- Stick-Slip →
- Rotating Drilling ↘
- Sliding ↘
- Tripping In/Out
- On/Off Bottom
- Other Types of Events ...





# Completion - Fracking

- Process
  - Blast
  - High Pressure Fluid
  - Plug
- Stages
  - Typically 1000 ft



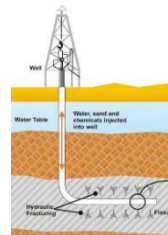


# The Approach

- PI AF Elements
  - Rigs
- PI Event Frames
  - Wells
- PI Asset Based Analytics
  - Triggers for Well Events



Name	Description	Default Value
Rig_Name	Rig Name	
Rig_MMSNumber	MMS Number	
Rig_EndName	End Name	
Rig_StartDepthTrigger		
Rig_EndDepthTrigger		
Rig_StartPressureTrigger		
Rig_EndPressureTrigger		
Rig_Depth	Depth	0 ft
Rig_Pressure	Pressure	0 psi
Rig_RotaryPressure	Rotary Pressure	0 psi
Rig_RotaryDepth	Rotary Depth	0 ft
Rig_RotaryRate	Rotary Rate	0 RPM
Rig_RotaryTorque	Rotary Torque	0 ft-lb
Rig_RotaryTemp	Rotary Temp	0 °F
Rig_RotaryVib	Rotary Vibration	0 g
Rig_RotaryVibF	Rotary Vibration Frequency	0 Hz
Rig_RotaryVibA	Rotary Vibration Amplitude	0 mm
Rig_RotaryVibR	Rotary Vibration Rate	0 mm/s



Name	Description	Default Value
Well_Name	Well Name	
Well_Depth	Depth	0 ft
Well_Pressure	Pressure	0 psi
Well_RotaryPressure	Rotary Pressure	0 psi
Well_RotaryDepth	Rotary Depth	0 ft
Well_RotaryRate	Rotary Rate	0 RPM
Well_RotaryTorque	Rotary Torque	0 ft-lb
Well_RotaryTemp	Rotary Temp	0 °F
Well_RotaryVib	Rotary Vibration	0 g
Well_RotaryVibF	Rotary Vibration Frequency	0 Hz
Well_RotaryVibA	Rotary Vibration Amplitude	0 mm
Well_RotaryVibR	Rotary Vibration Rate	0 mm/s

Name	Expression	Value
DepthChange	(Abs(TagVal("Mole Depth","")) - Abs(PrevVal("Mole Depth","-20s")))	
StartTrigger	DepthChange > 0.1 AND "ROP" > 0.1 AND "Top Drive RPM" > 15 AND Left("Well Name",4) = "Well1"	
EndTrigger	"ROP" > 0.1 AND "Top Drive RPM" < 15 AND Left("Well Name",4) = "Well1"	

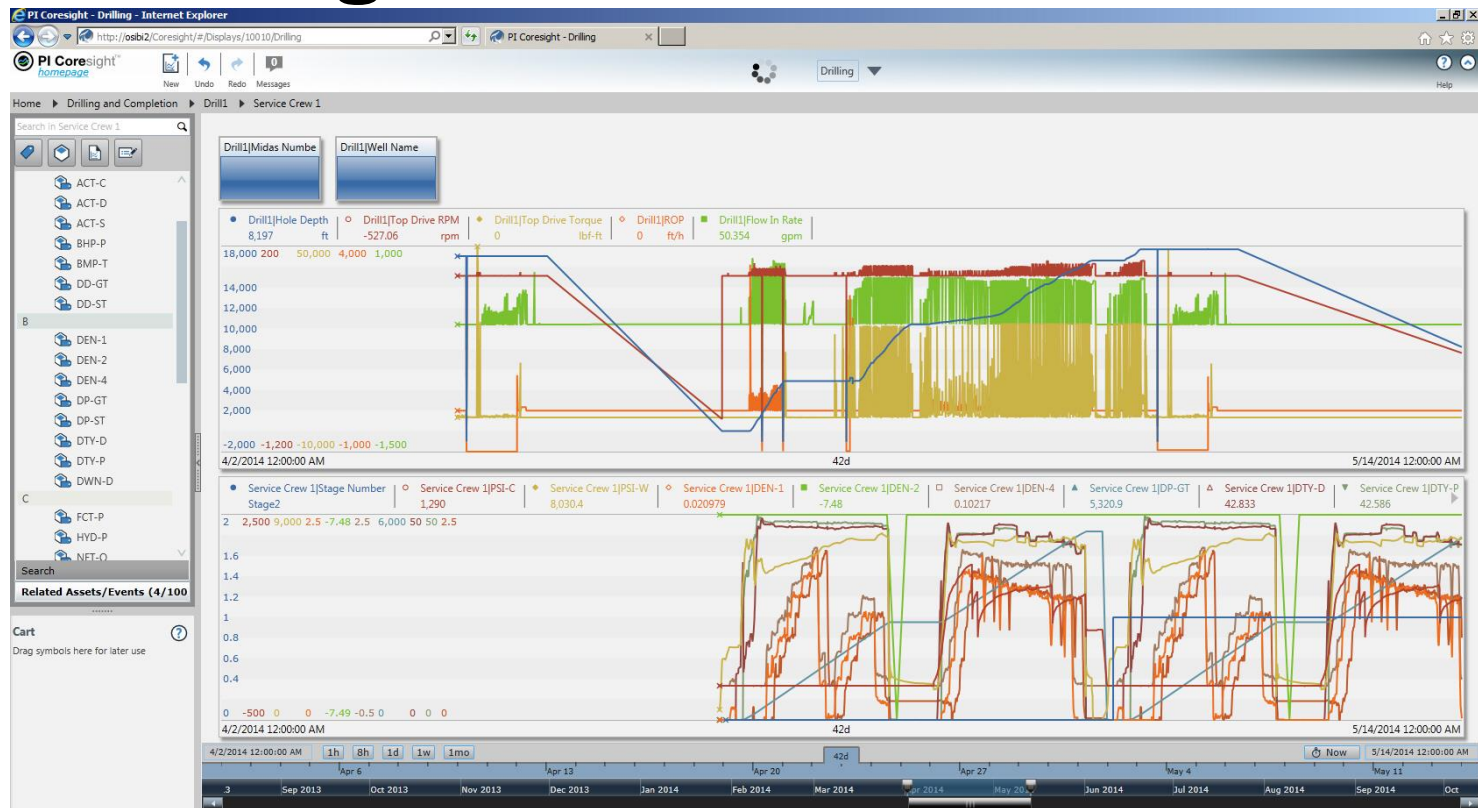


# Results

- Analyzing Results
  - PI Coresight
  - Microsoft PowerView
  - PI DataLink

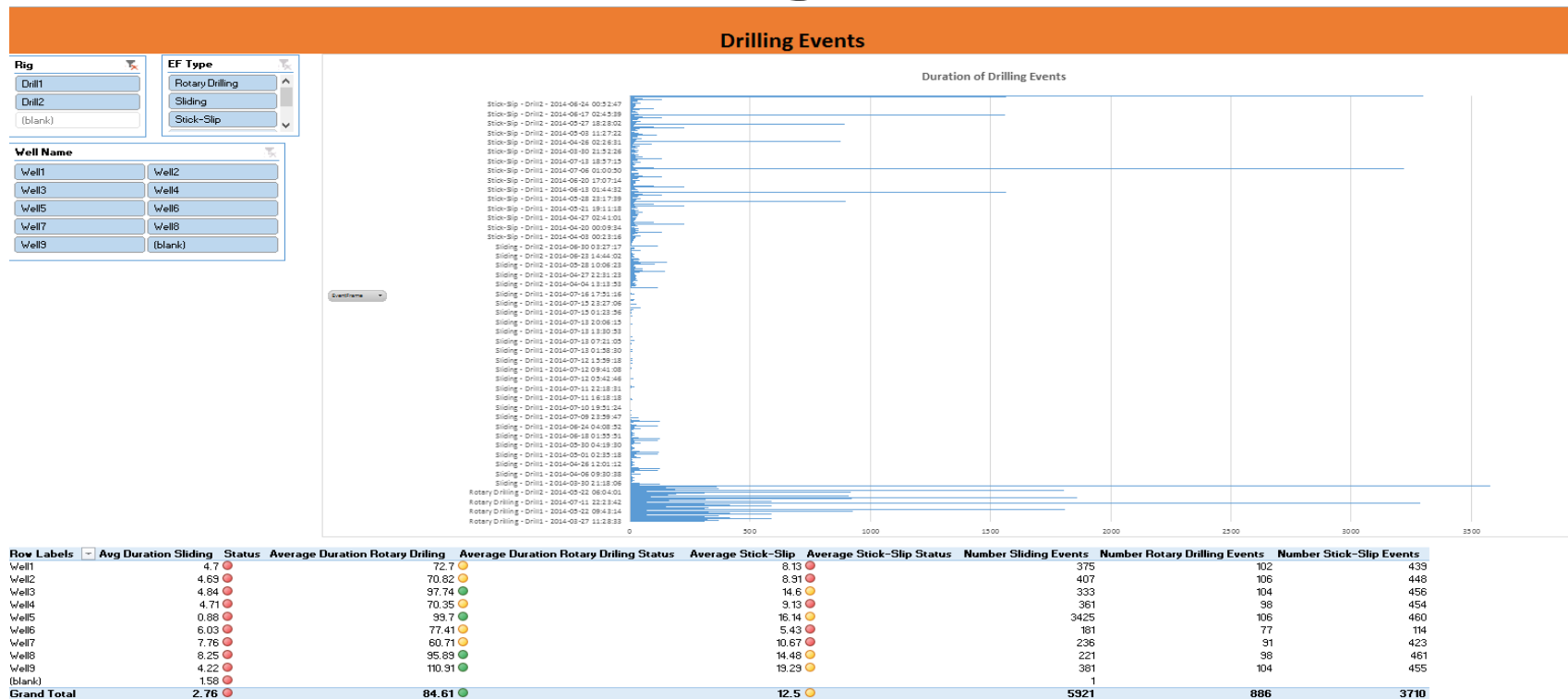


# PI Coresight



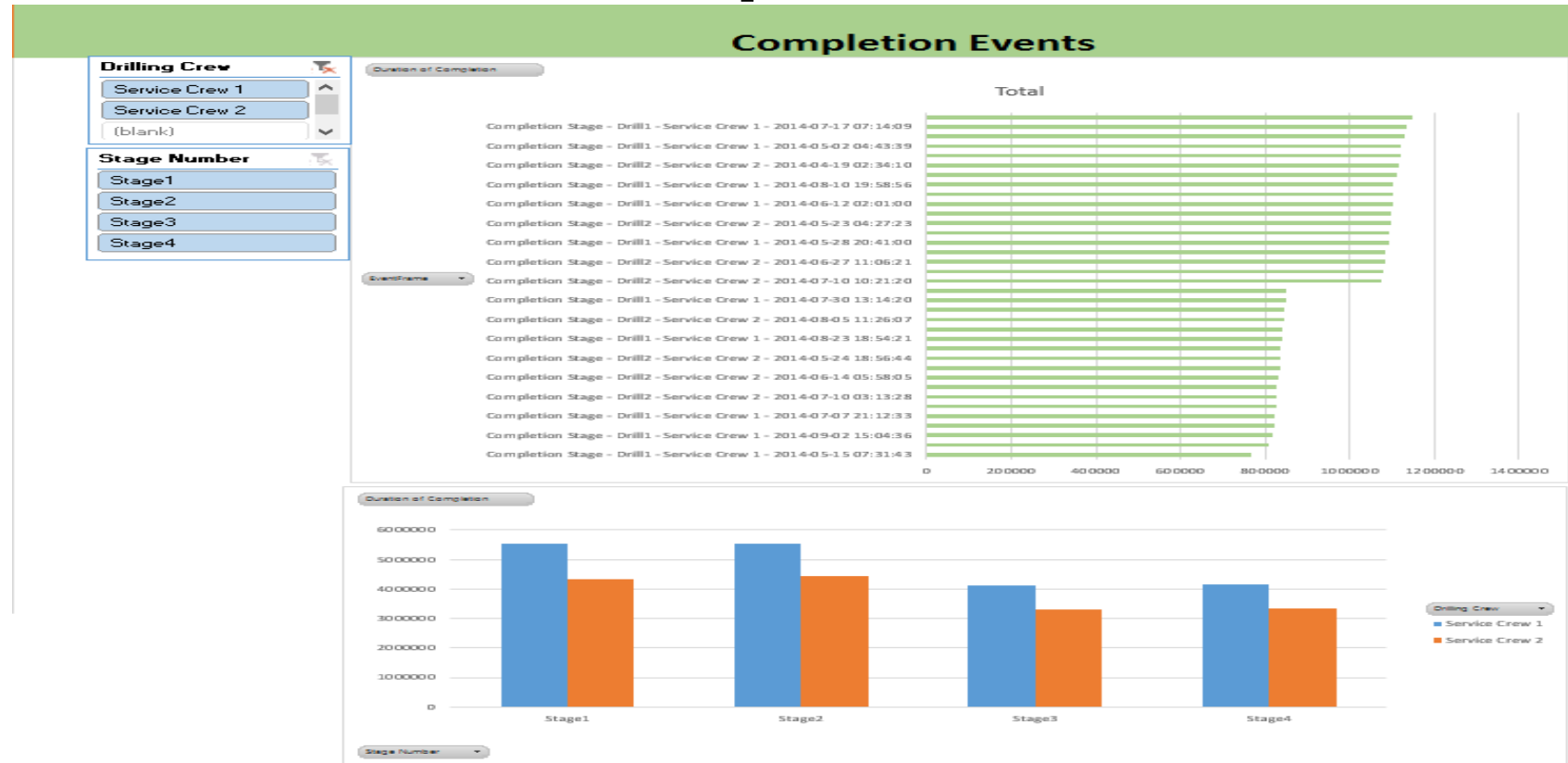


# Overview of Drilling Events





# Overview of Completion Events





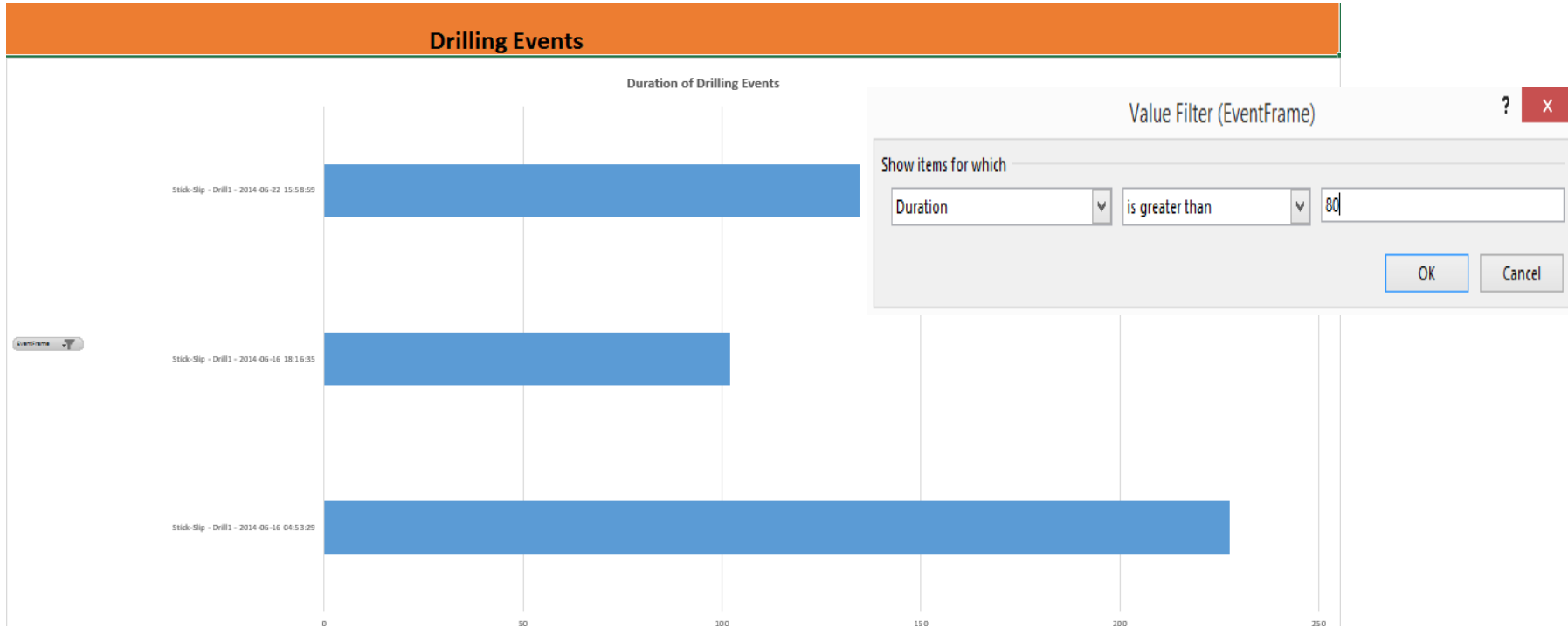
# Drilling Event – Ad hoc Analysis

## Drilling Events





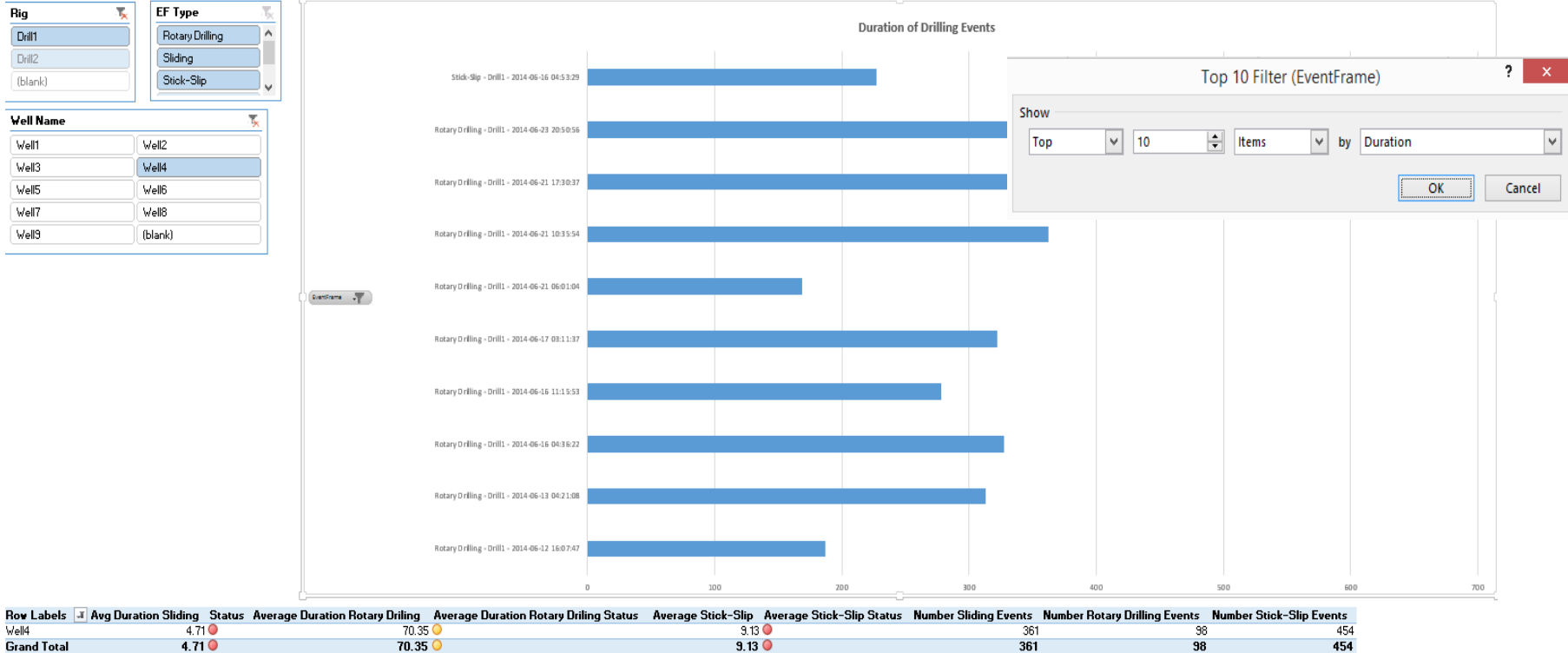
# Drilling Event – Search based on Duration





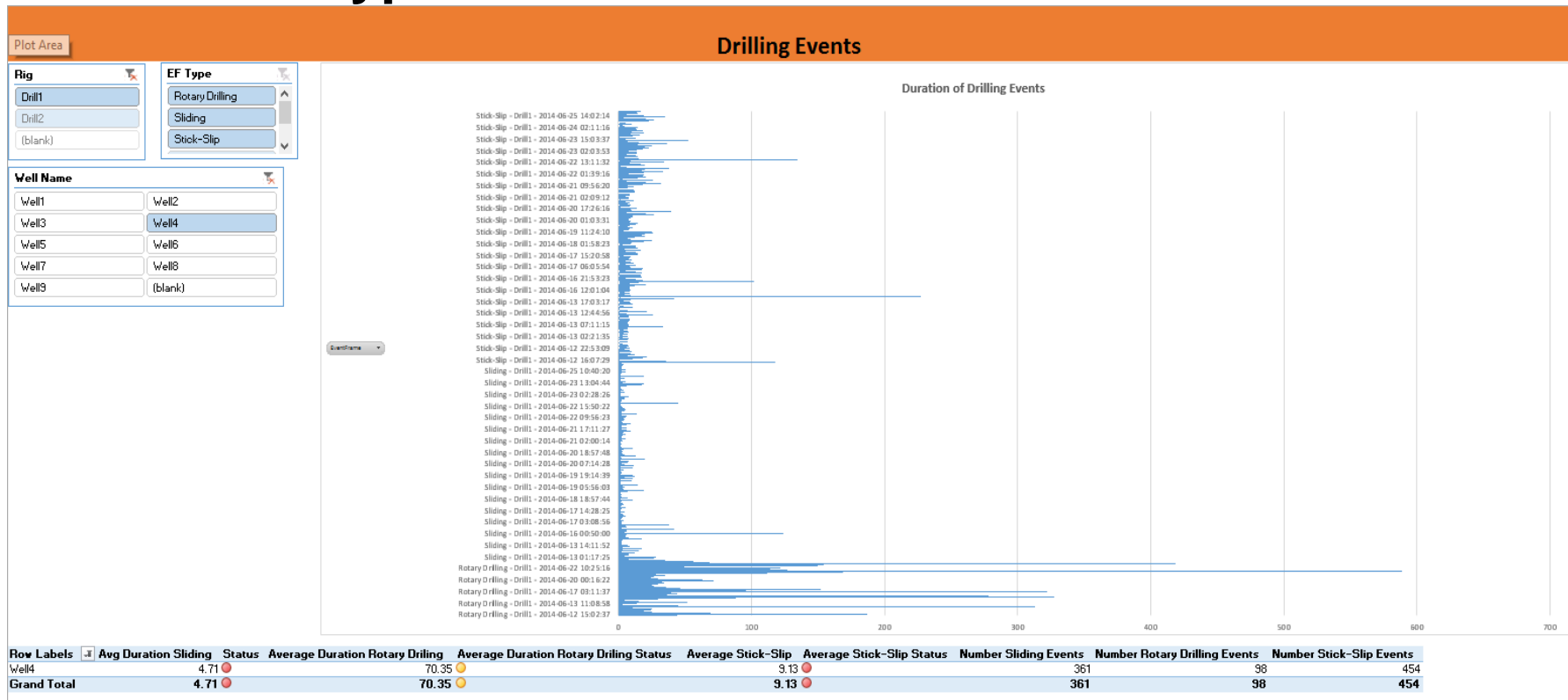
# Drilling Event – Search based on top 10 events

## Drilling Events



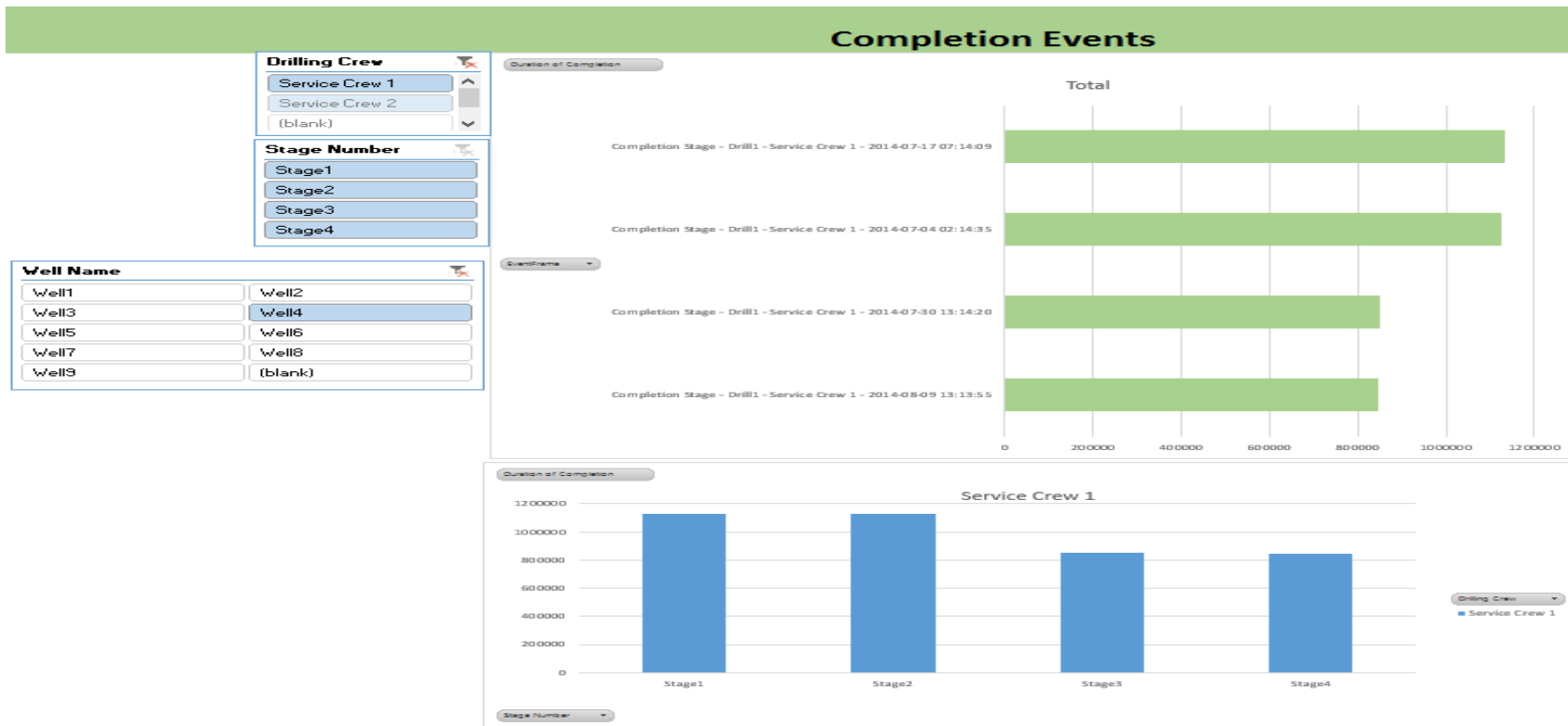


# Drilling Event – Calculate the average duration for each event type





# Completion Event – Search for completion events on a Well





# PI DataLink

## Sample Drilling Report

	A	B	C	D	E	F	G	H	I
1									
2									
3	Start Time	*-500d							
4	End Time	*							
5	EF Type	Stick-Slip							
6	Well Name	Well3							
7	Duration		5						
8									
9									
10									
11	Event name	Start time	End time	Duration	Event template	Primary element	EF Type	Drilling	
12	Stick-Slip - Drill1 - 2014-06-03 16:01:	03-Jun-14 16:01:15	05-Jun-14 23:02:27	2 7:01:12	Stick-Slip	Drill1	Stick-Slip	Service Crev Sti	
13	Stick-Slip - Drill1 - 2014-06-02 00:48:	02-Jun-14 00:48:27	03-Jun-14 02:55:19	1 2:06:52	Stick-Slip	Drill1	Stick-Slip	Service Crev Sti	
14	Stick-Slip - Drill1 - 2014-05-26 21:39:	26-May-14 21:39:18	27-May-14 12:35:38	0 14:56:20	Stick-Slip	Drill1	Stick-Slip	Service Crev Sti	
15	Stick-Slip - Drill1 - 2014-05-22 14:31:	22-May-14 14:31:13	24-May-14 20:07:28	2 5:36:15	Stick-Slip	Drill1	Stick-Slip	Service Crev Sti	
16									
17									

### Explore Events

Database

\NOSIB\3\Calgary Seminar 2014

Search start

'Raws'\\$B\$3

Search end

'Raws'\\$B\$4

☐ Limit to database level

More search options

Event category

\*

Minimum duration

'Raws'\\$B\$7

Maximum duration

Event name

\*

Event template

Stick-Slip

Element name

\*

Element template

\*

Search mode

active in range

Sort order

start time ascending

Attribute value filters

Attribute	Operator	Value
EF Type	=	'Raws'\\$B\$5
Well Name	=	'Raws'\\$B\$6



# Future Plans

- Expand PI Event Frames Template
- Expand Analyses
- Create Performance KPIs



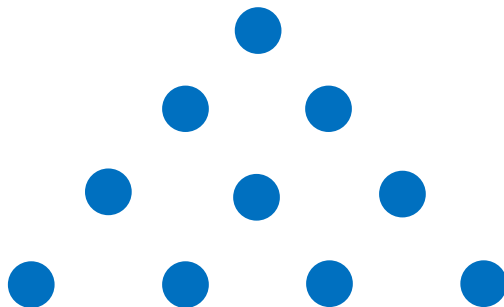
# Conclusion

- Ability to Analyze Operations
  - Event Frames
  - Analytics
  - BI Tools
- Shorten time for Drilling and Completions

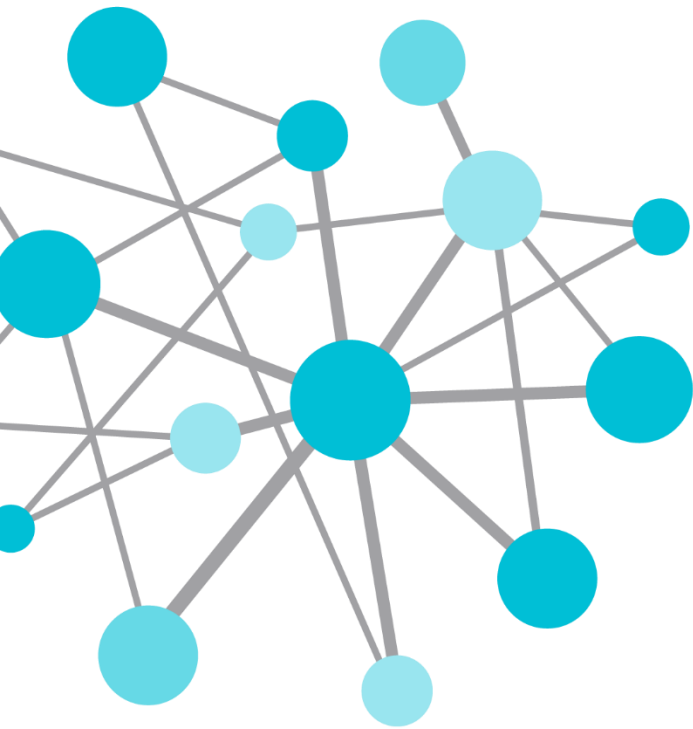


# Yearly Puzzle

“Move 3 dots to turn the triangle upside down.”







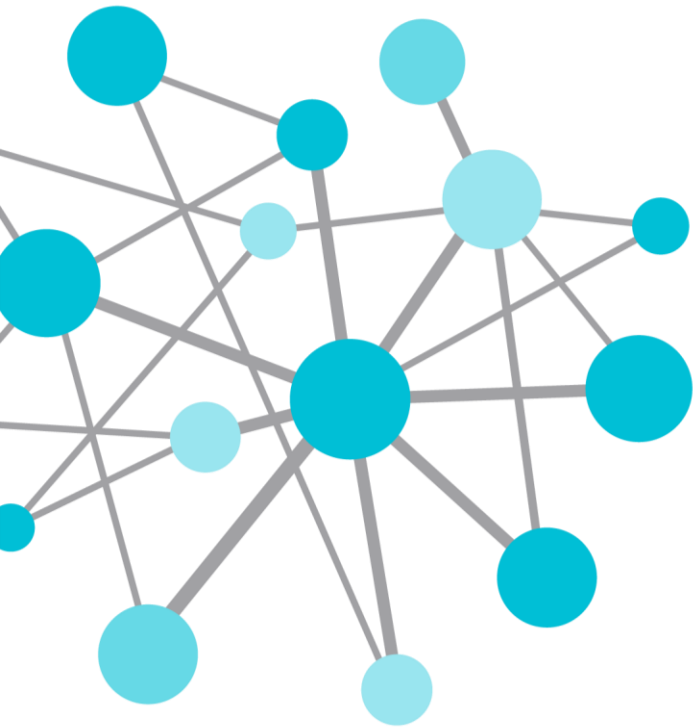
# Questions

**Please wait for the  
microphone** before  
asking your question



**Please state your name  
and your company**





THANK  
YOU

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# Ales Soudek

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Global Solutions Group  
OSIsoft, LLC

# Yung Wallace

[ywallace@osisoft.com](mailto:ywallace@osisoft.com)

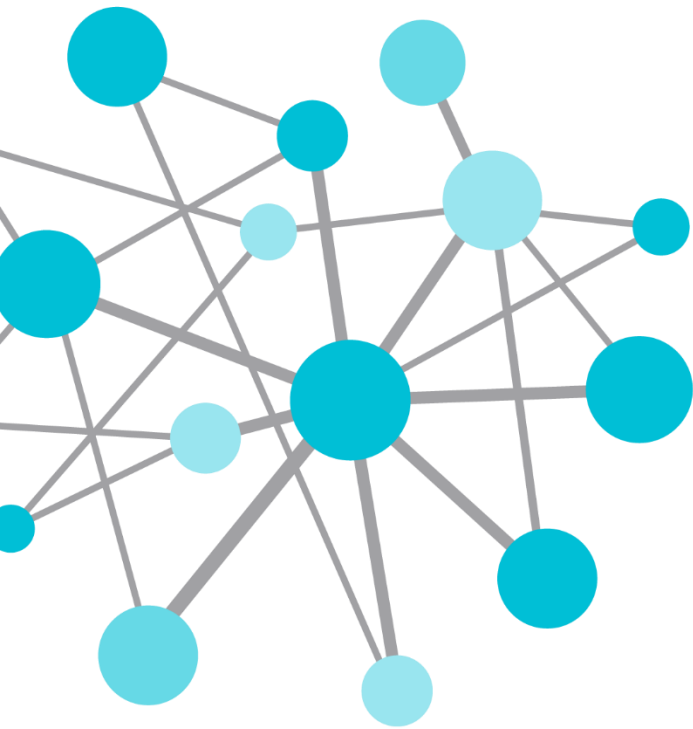
Global Solutions Group  
OSIsoft, LLC



# Segment Overview

- Introduction and Context
- The Integrated Value Chain
- Update on Key E&P Interfaces & Connectors
- Advanced Analytics and Visualization
- Concluding Remarks and Q&A





# Questions

**Please wait for the  
microphone** before  
asking your question



**Please state your name  
and your company**



# The OSIsoft O&G/PetChem IP Team

**Craig Harclerode**

[charclerode@osisoft.com](mailto:charclerode@osisoft.com)

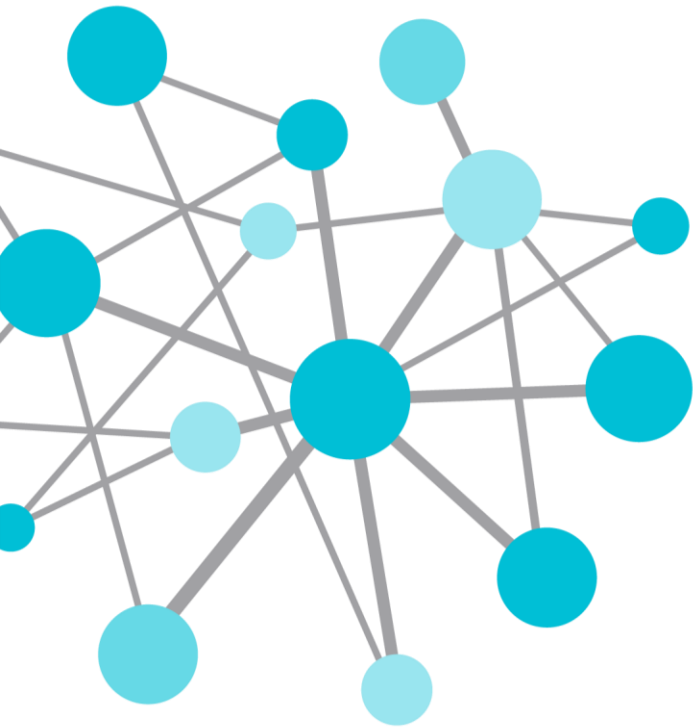
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