

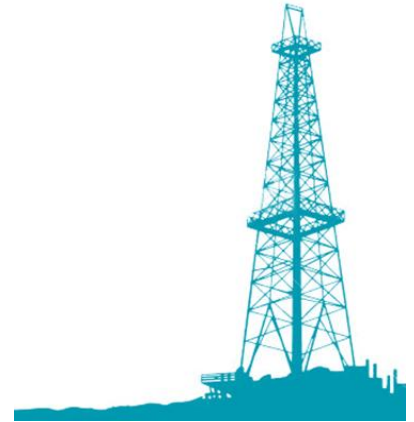
# Drilling & Completions with “Real-Time Operational Intelligence”

Presented by **Ken Startz – Marathon Oil Company**



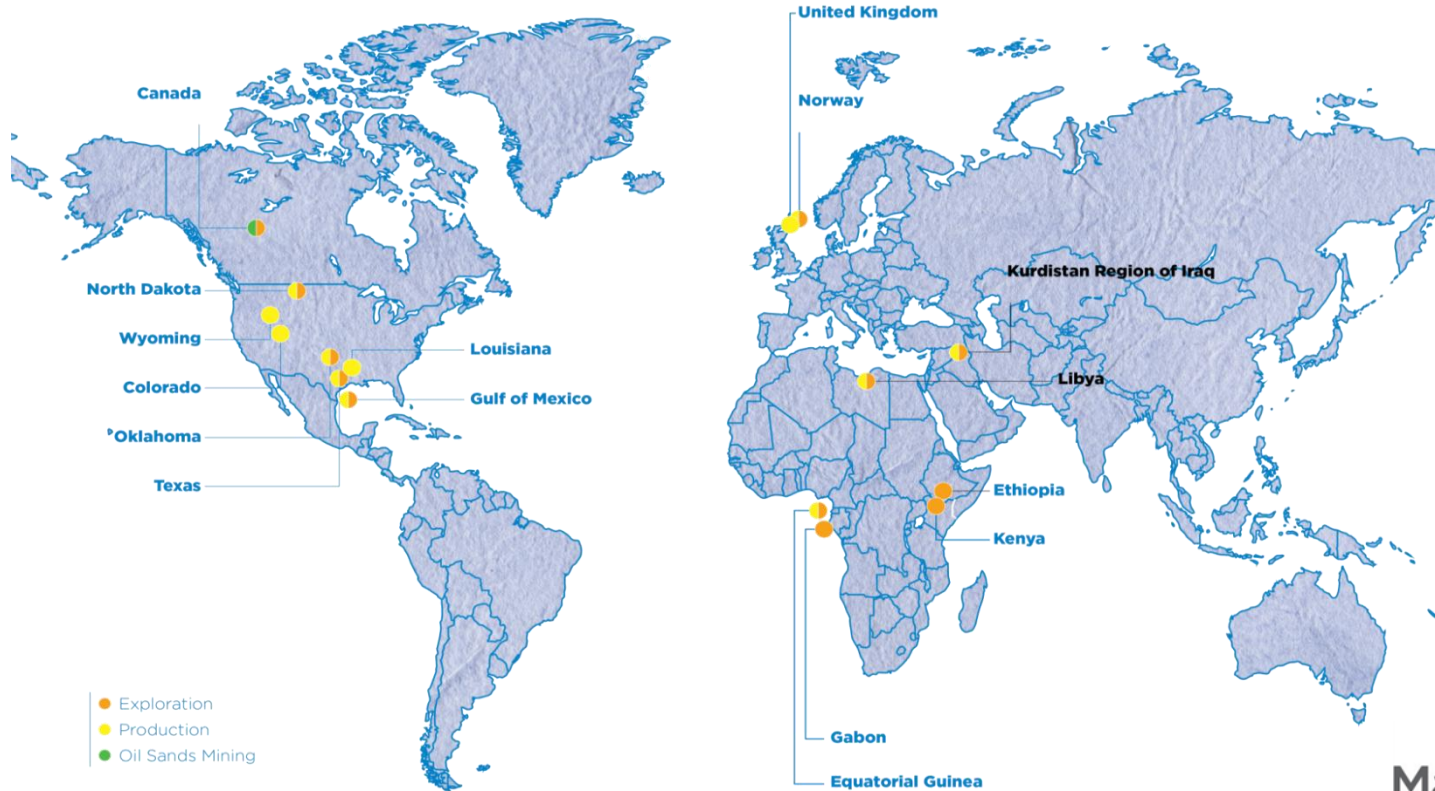
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# Marathon Oil – A Global E & P Company

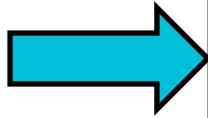


# The Journey of the PI System at Marathon Oil –

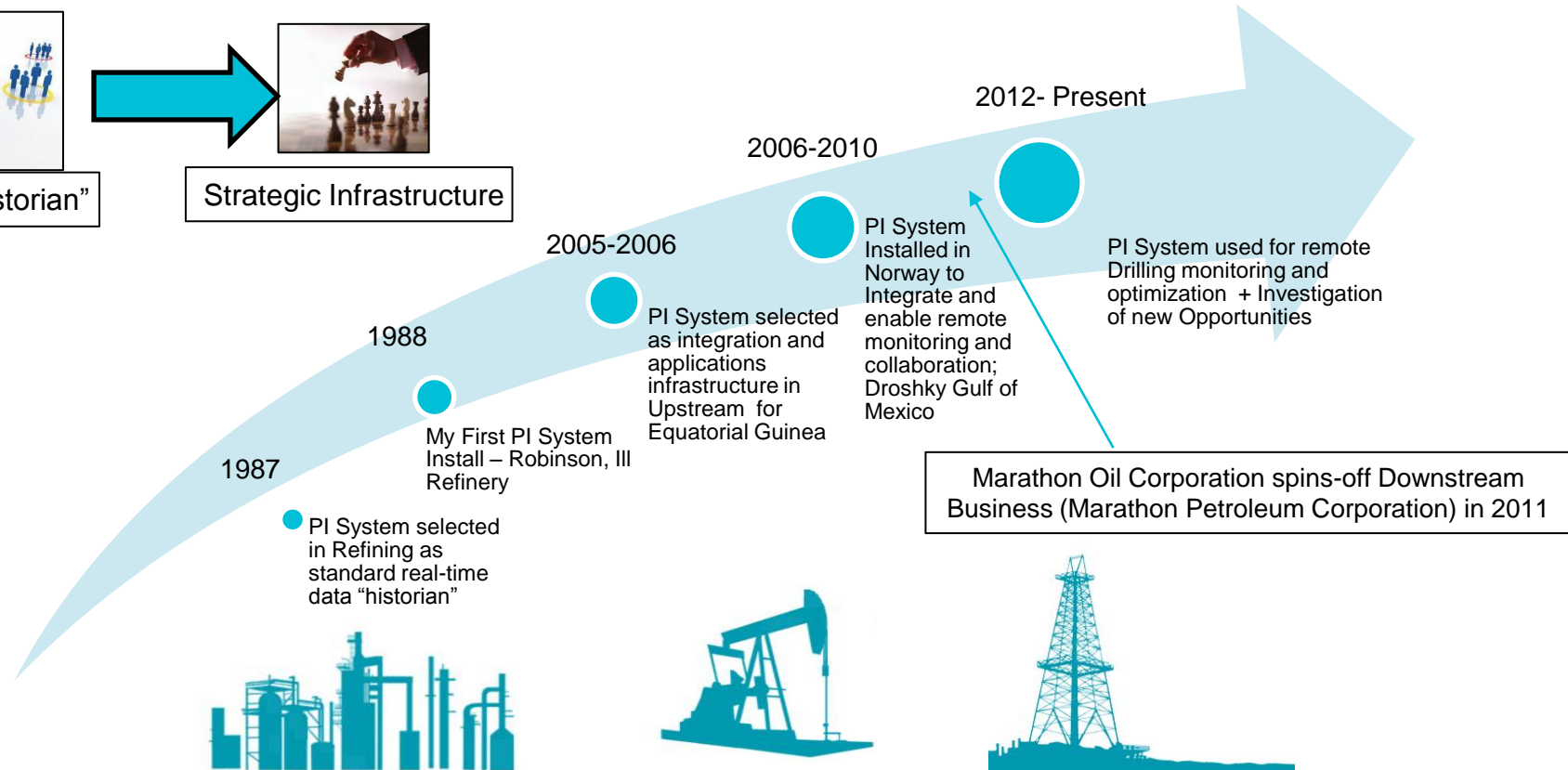
“Future Proofing” with the PI System as an Infrastructure



Tactical "Historian"



Strategic Infrastructure



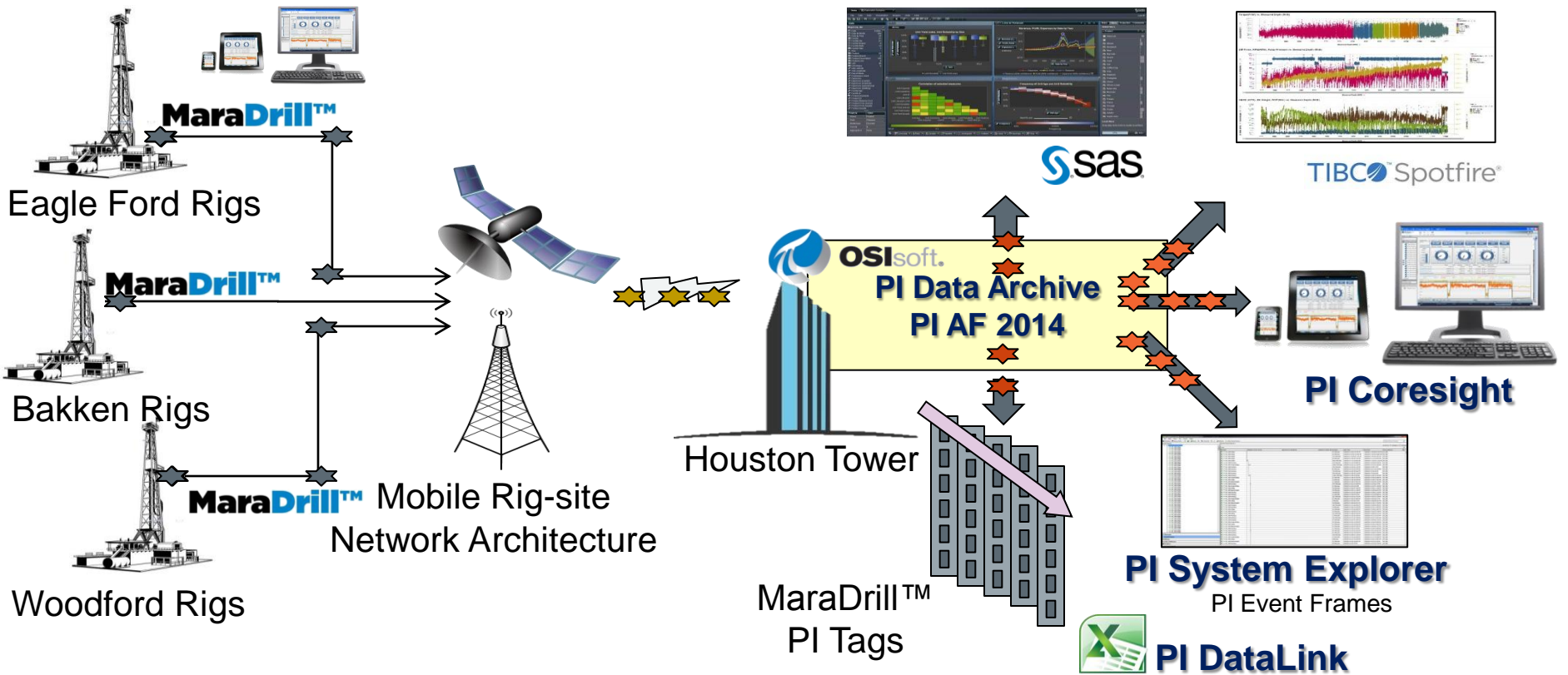
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# Data Workflow – Collaboration & Guidance at the Drill Site



# 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

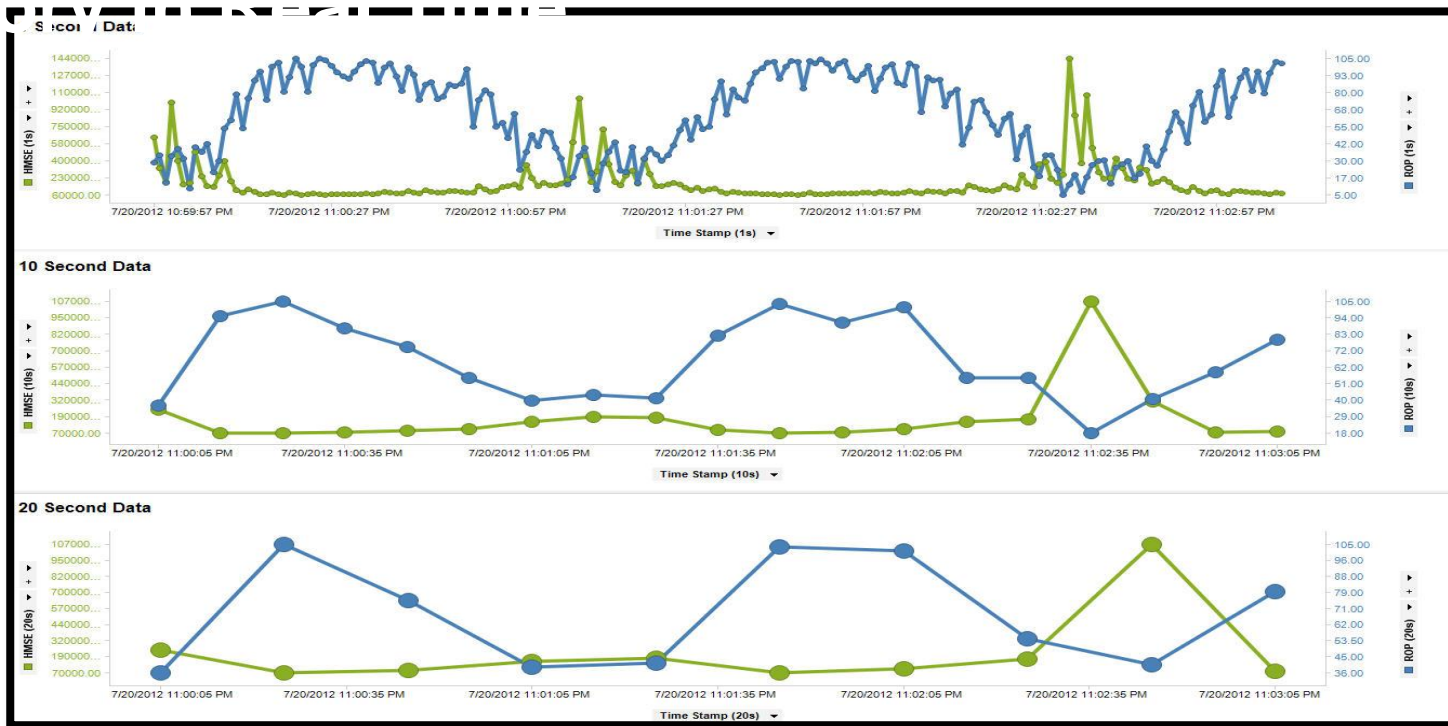
**Need 1 second time stamp resolution!**





# Importance of 1 second data

MaraDrill™



Other vendors

Rig Display

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

## Eagle Ford Rig



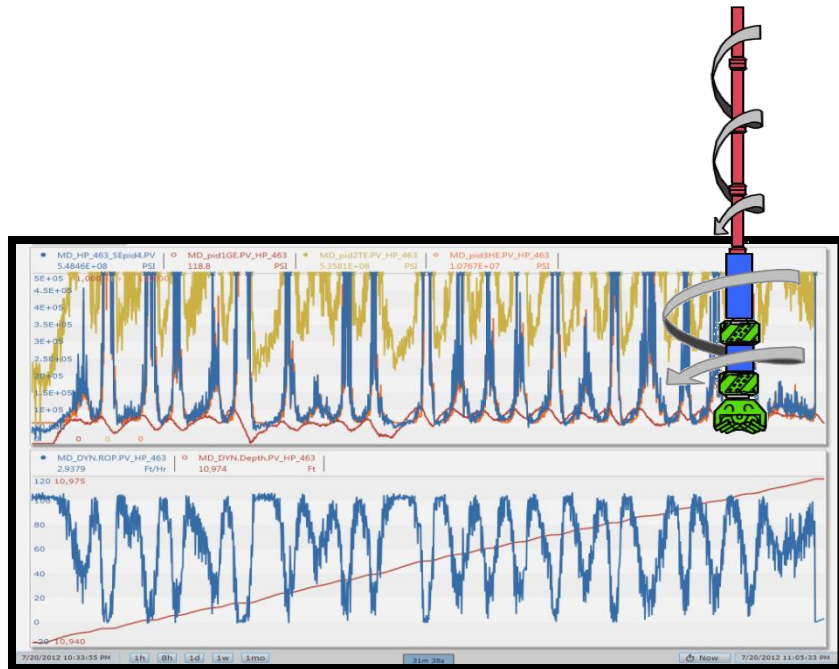
“Perfect” drilling

**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

PI UI Template v6 (Coresight) - TIBCO Spotfire

File Edit View Insert Tools Help

Control Panel

Estimated Number of Records to be Retrieved: 1,036,812

Comments

**Step 1 - Select Rig:** (Hold down Ctrl to select/unselect multiple items)

386  
430  
458  
473

**Step 2 - Select Time Frame:** Start Time: 1/1/2013 12:00:00 AM Time Interval: 1 second(s) End Time: 1/2/2013 12:00:01 AM

**Step 3 - Select Tags:** (Hold down Ctrl to select/unselect multiple items)

MarathonOil

MararaDrill™ State Hydraulic Tags Manually Entered Parameters Dynamic Tags

State: % Bit Press Loss Annular Velocity 38 Hydraulic HP HSI Bit Diam Drill Pipe Diam Dynamic Visc Fluid Jet Angle ROP RPM StandPipe Press Torque

PID Loop 1 PID Loop 2 PID Loop 3 PID Loop 4

Gravitational E Alarm HI Gravitational E Alarm LO Gravitational E PV Gravitational E Rate Torsional E Alarm LO Torsional E PV Torsional E Ratio Torsional E SP Hydraulic E PV Hydraulic E Reto Hydraulic E SP Loop 3 Kd HMSE SP Limit LO HMSE Alarm HI HMSE Alarm LO HMSE PV

**Step 4 & 5 - Press Buttons to Run Query and Load Data:**

Step 4 Step 5 Last query successfully executed. Clear Selections

Online 440 of 440 rows 0 marked 45 columns pivot (Pivot)

Enables integration with PI System data from PI Coresight

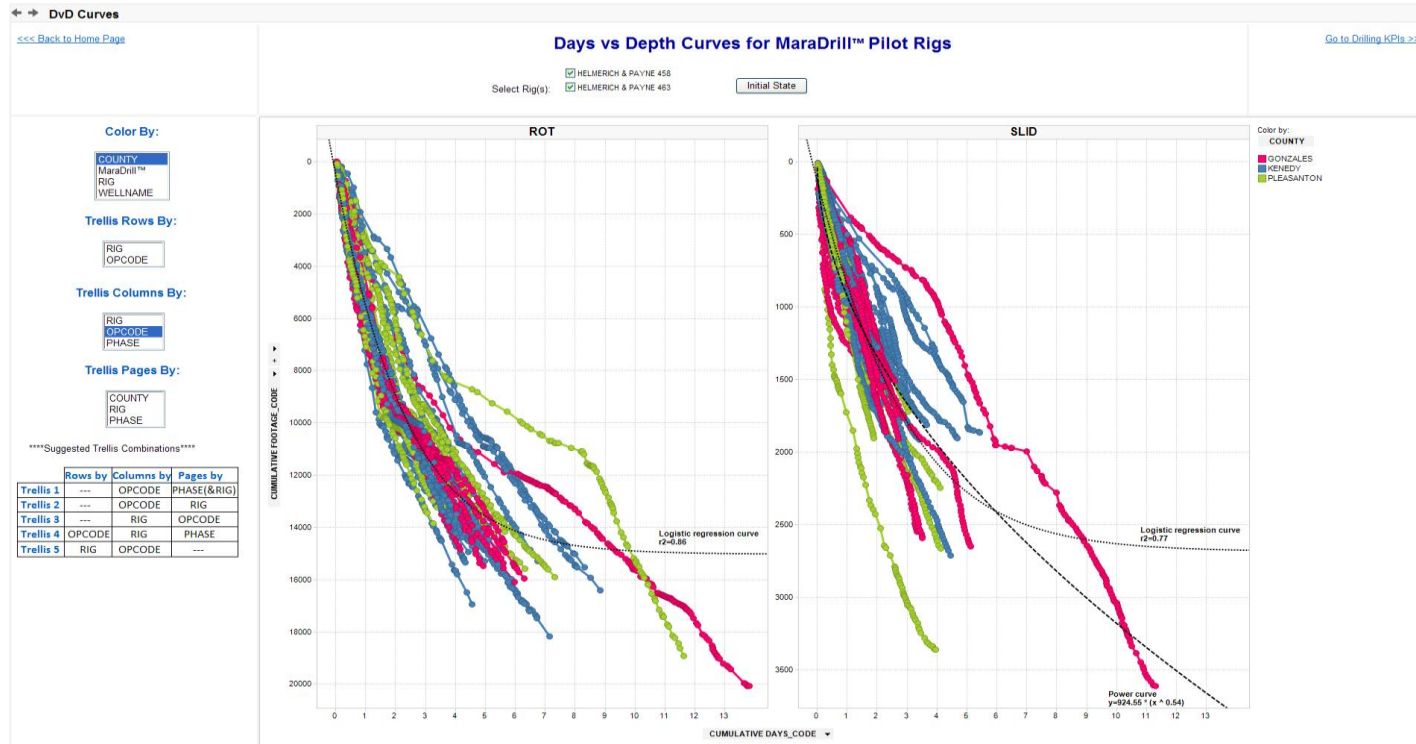
Guided analytics

# Guided Analysis – Time Based or Depth Based



# Days vs Depth Curves for MaraDrill™ Rigs

## Black = MD, Teal = No MD



# Helmerich and Payne Doghouse

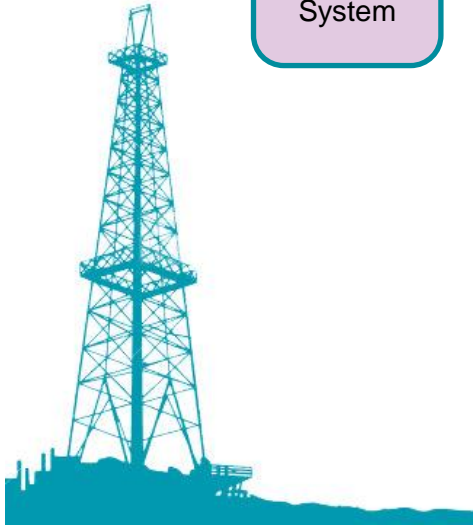
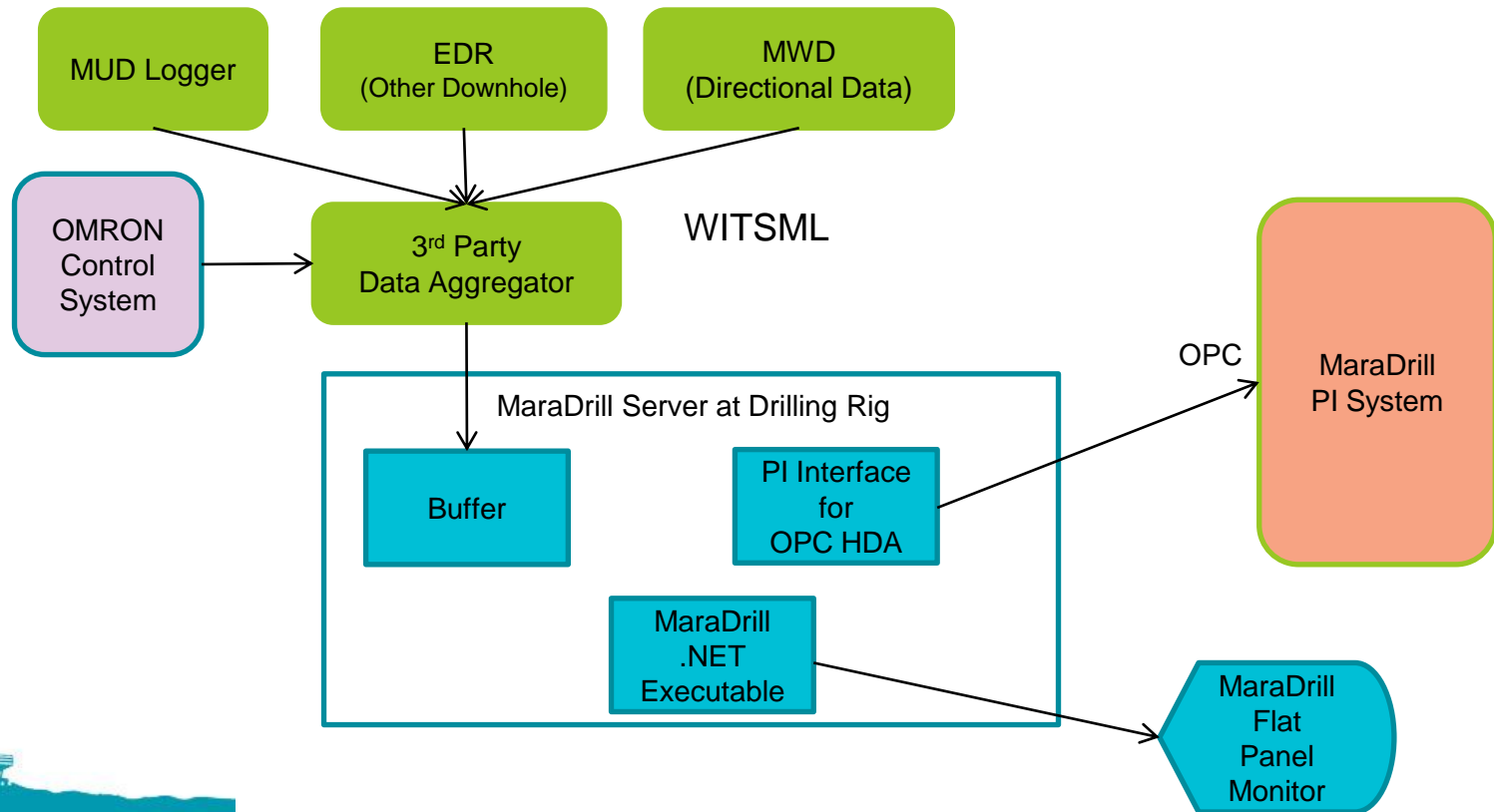




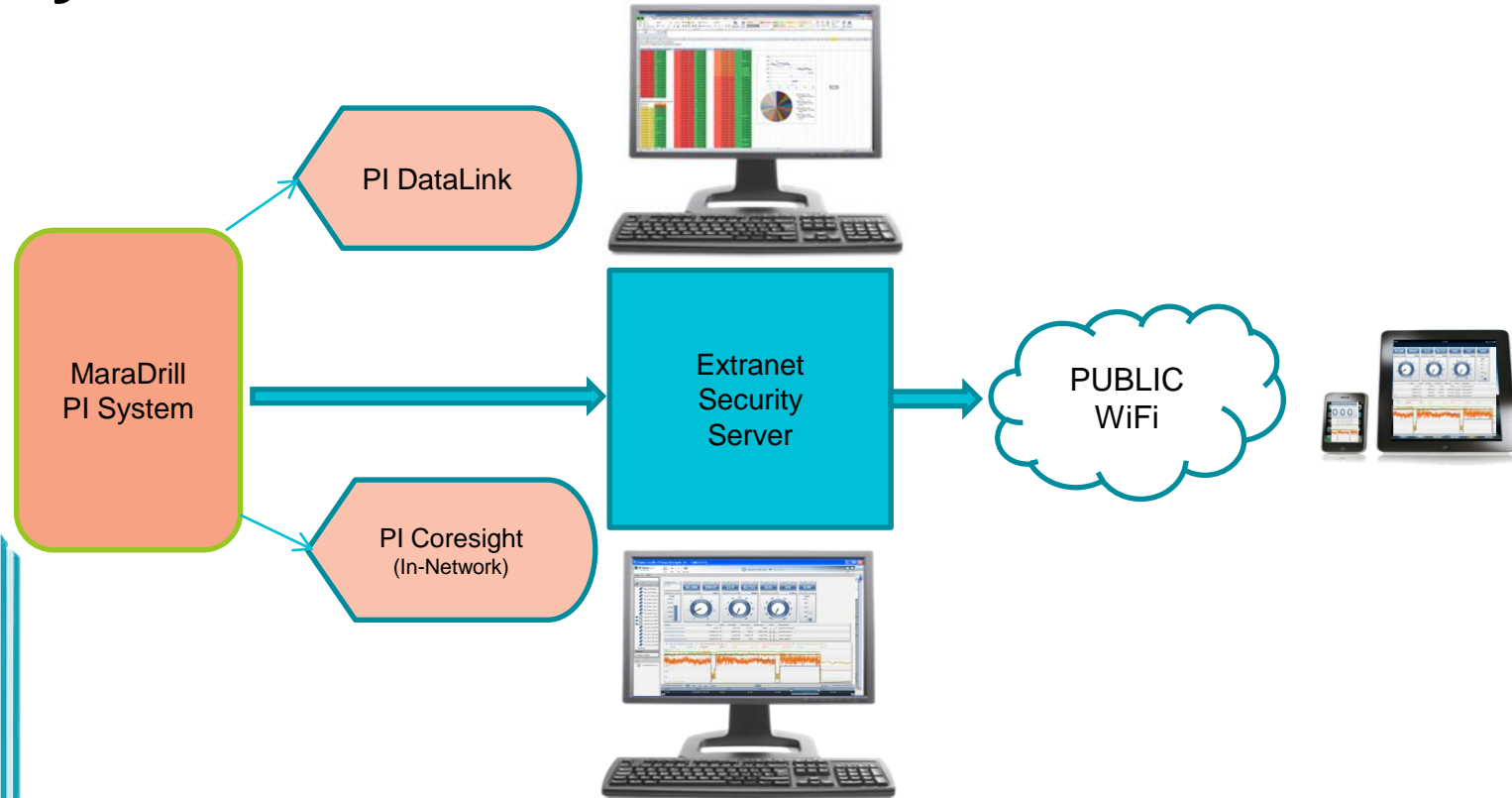
# Driller's Display in Dog House



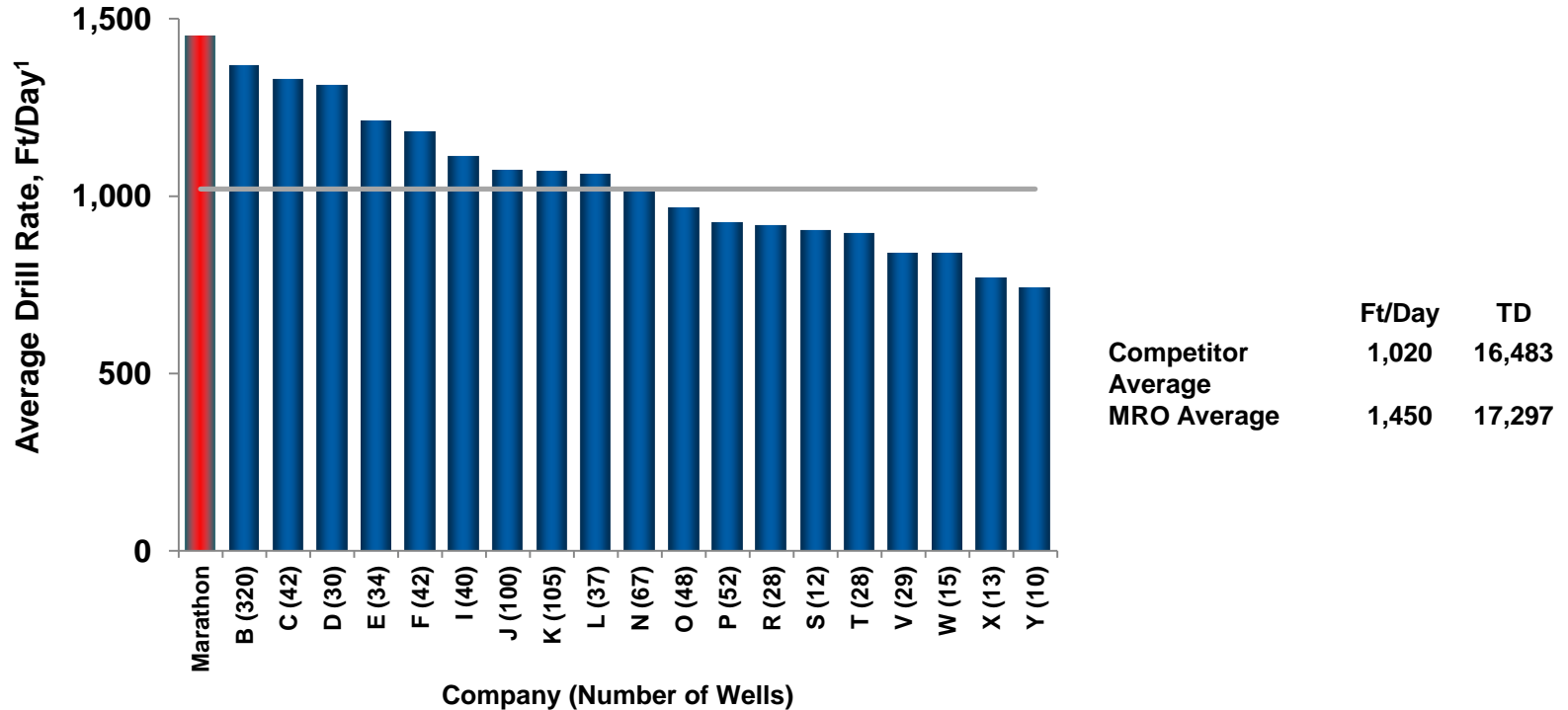
# MaraDrill™ – PI Data Flow Diagram



# PI System Visualization

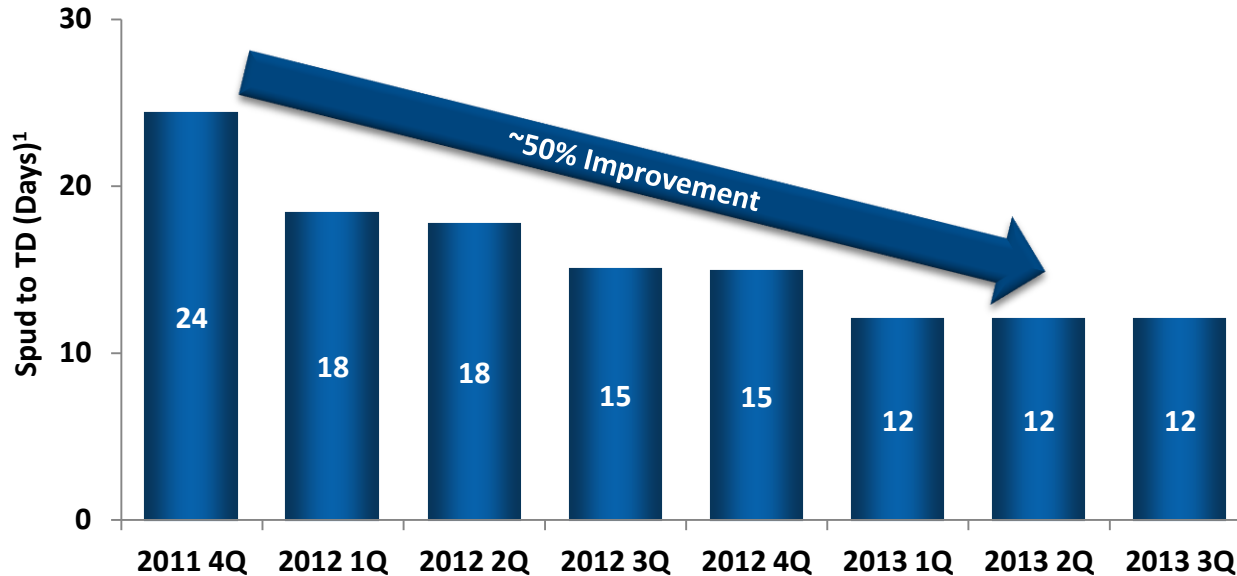


# Continuous Improvement in Rate of Penetration (ROP)



<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)

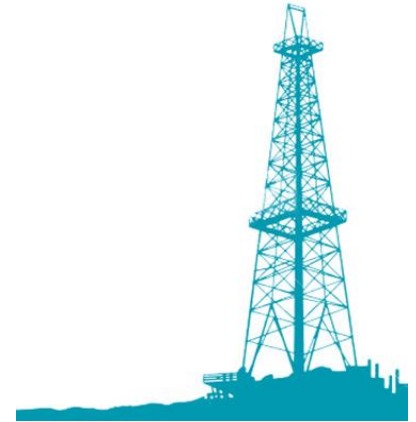
# Eagle Ford Drilling – Spud to Total Depth



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

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# Drilling Performance Analytics

Minimizing the cost of and time to first production

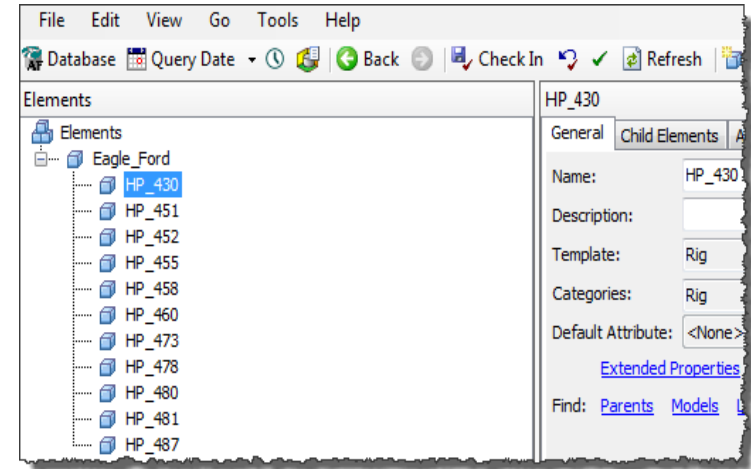
- The Problems we are trying to solve:
  - What are the sources of drilling idle time?
  - Which company and crew are best-in-class and why?
  - Which rigs are our top performers and why?

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



# PI AF and PI Event Frames for Drilling

- Rig
  - 20 to 30 Measurements – 1second (or less) resolution (PI 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

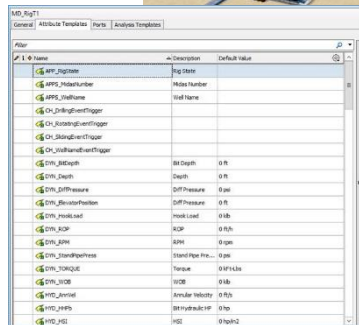


# Rigs and Wells

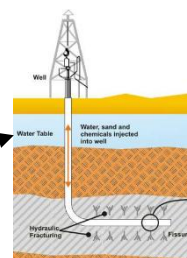
## Drilling Rig 1



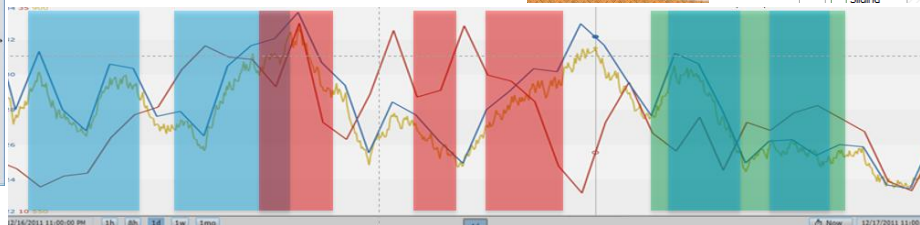
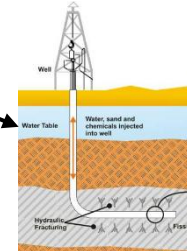
## PI AF Element



Well 1



Well 2



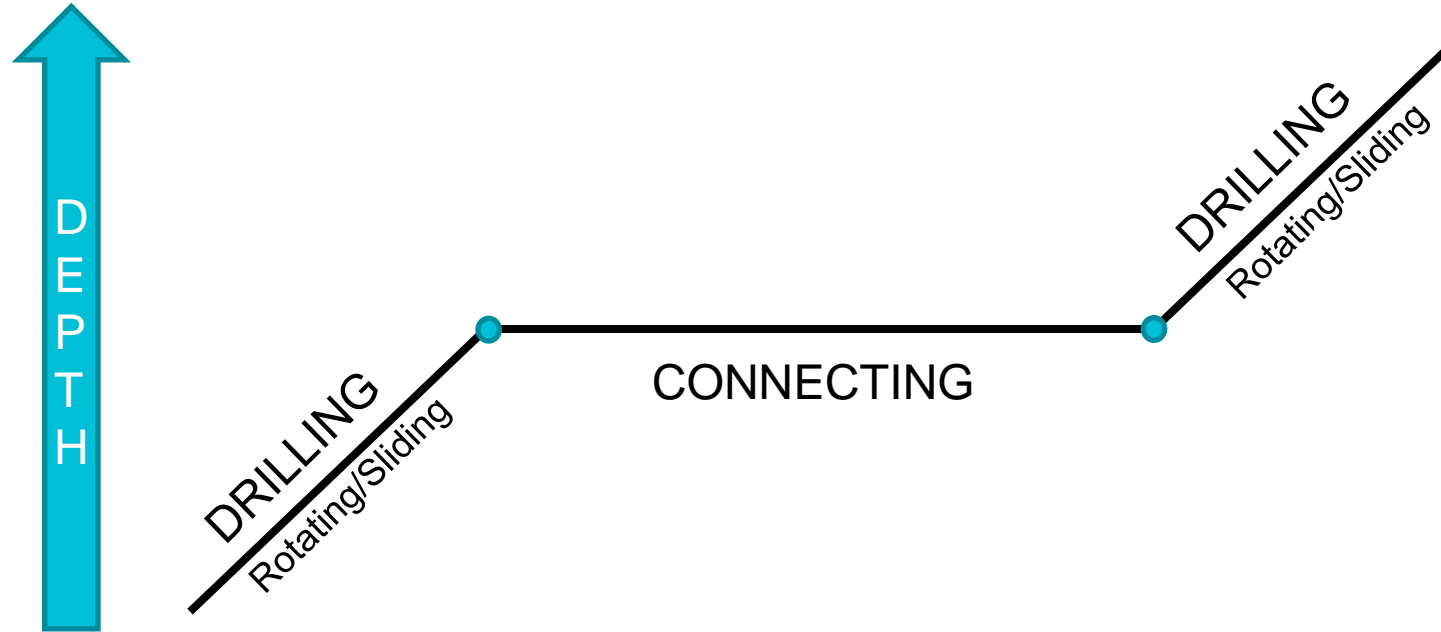
## PI Event Frames

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

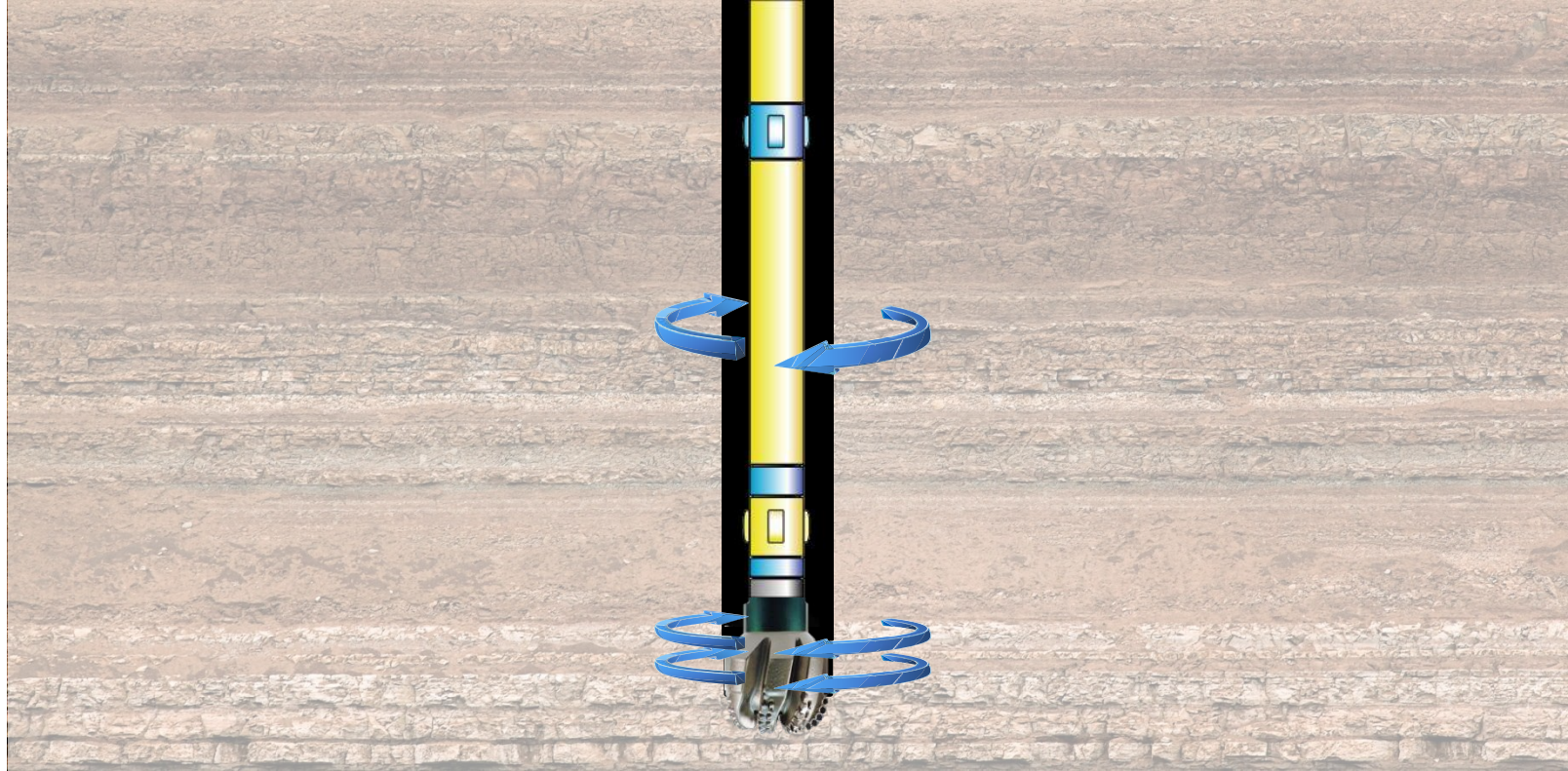
## PI Event Frames

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

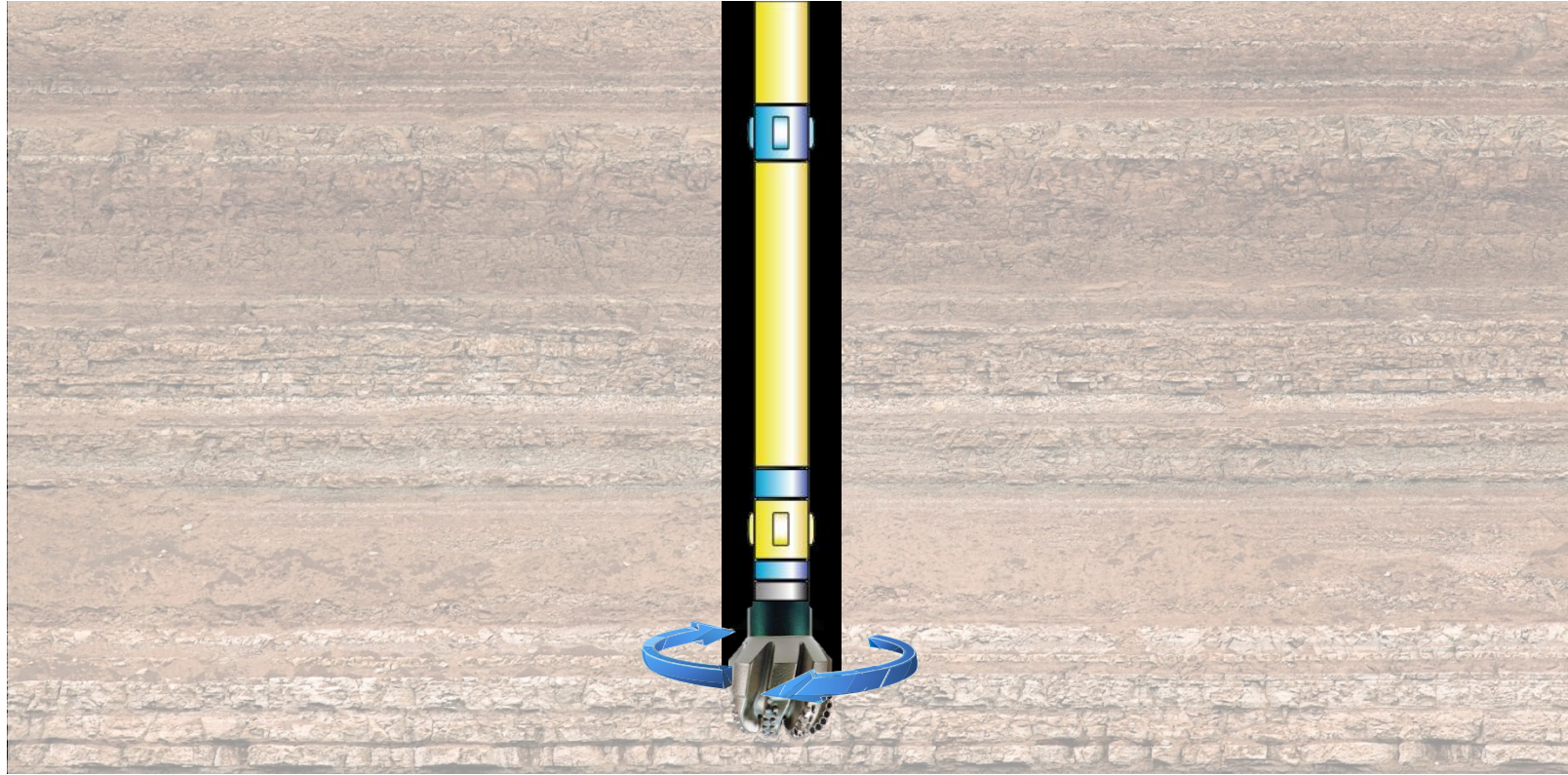


# Rotating Graphic

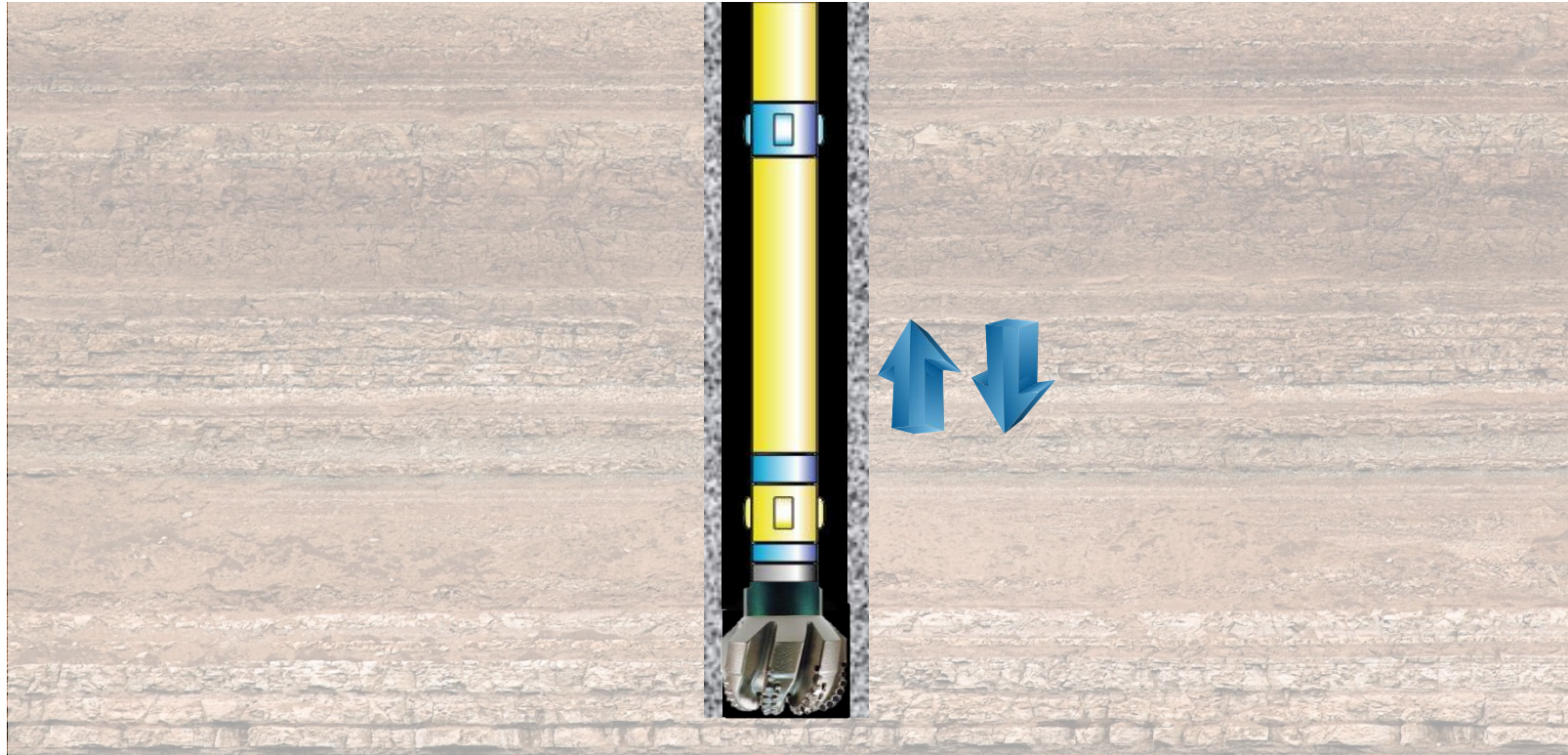




# Sliding Graphic



# Reaming graphic



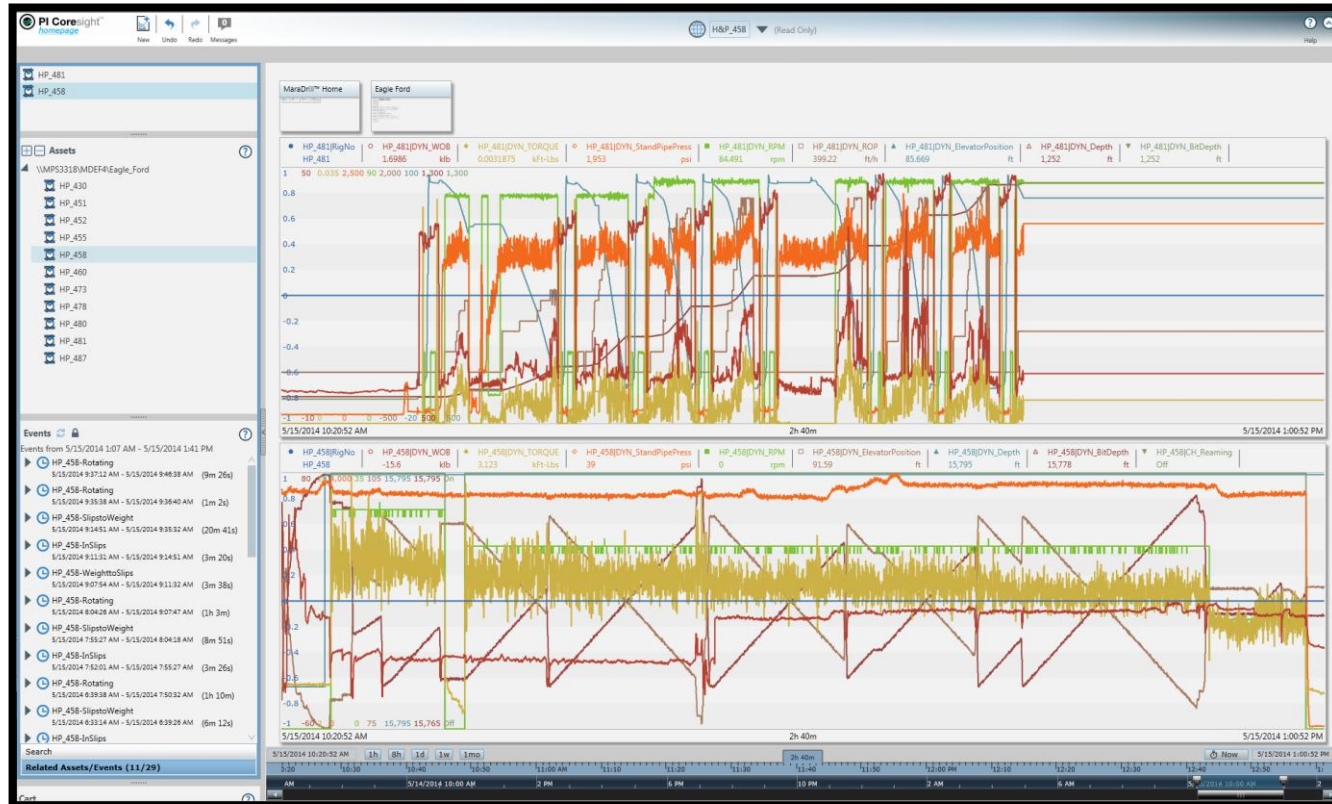


# PI Coresight with PI Event Frames Example

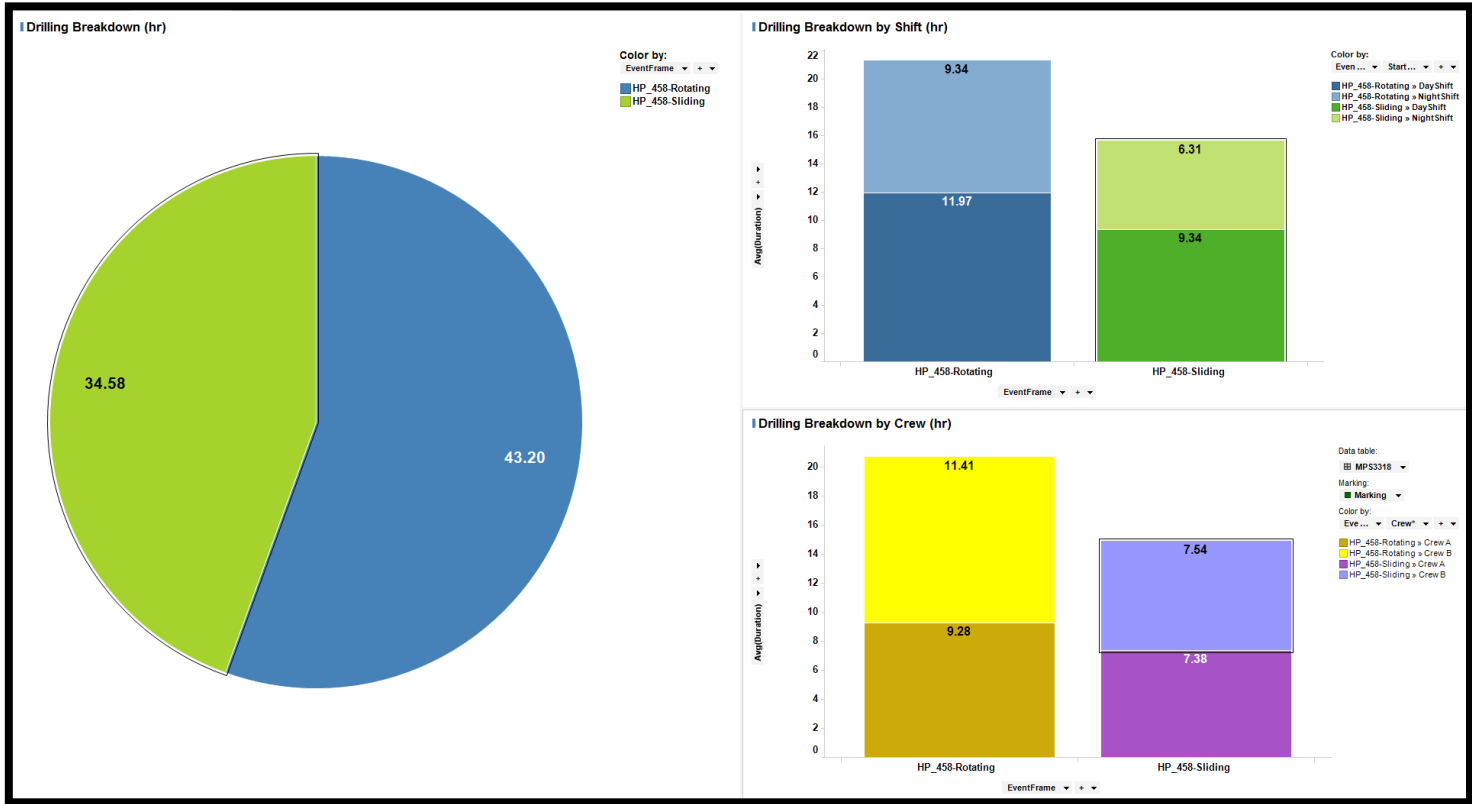




# PI Coresight with PI Event Frames Example

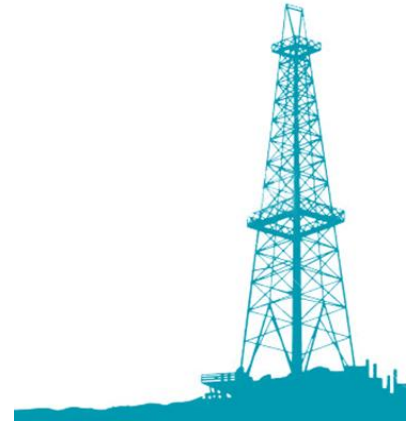


# Spotfire Shift & Crew Comparison From the PI System



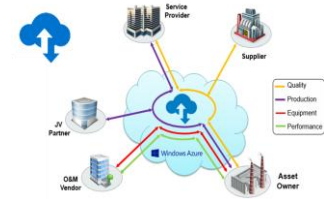
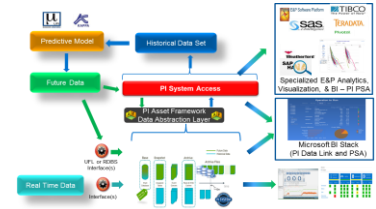
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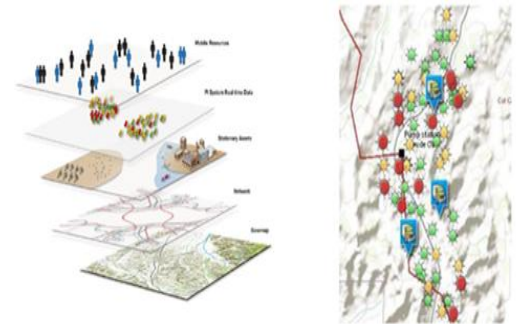
# Possibilities Under Consideration....

- Use of Integrated “High Fidelity Future Data”
  - PvA Analytics
  - Improved Model Accuracy
- Use of PI Cloud Connect
  - Stranded Data or no Data from Completions
  - Challenged by Getting Data from Service Providers
  - “It’s Our Data” – and we want to have a complete well Digital footprint
- Use of PI Integrator for ESRI ArcGIS
  - Integration of “Real-Time & Space”
  - Use in Distributed Systems



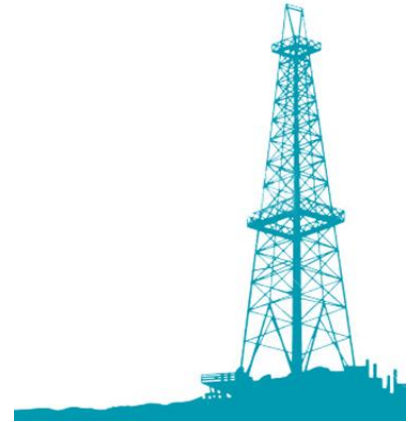
# Use of PI Connector for ESRI ArcGIS

- Integration of “Real-Time & Space”
- Anticipate Geospatial Analytics and Visualization a 21<sup>st</sup> Century Need and Value Opportunity
- Investigating the Use in Distributed Systems
- Stay Tuned for UC 2015!



# Agenda

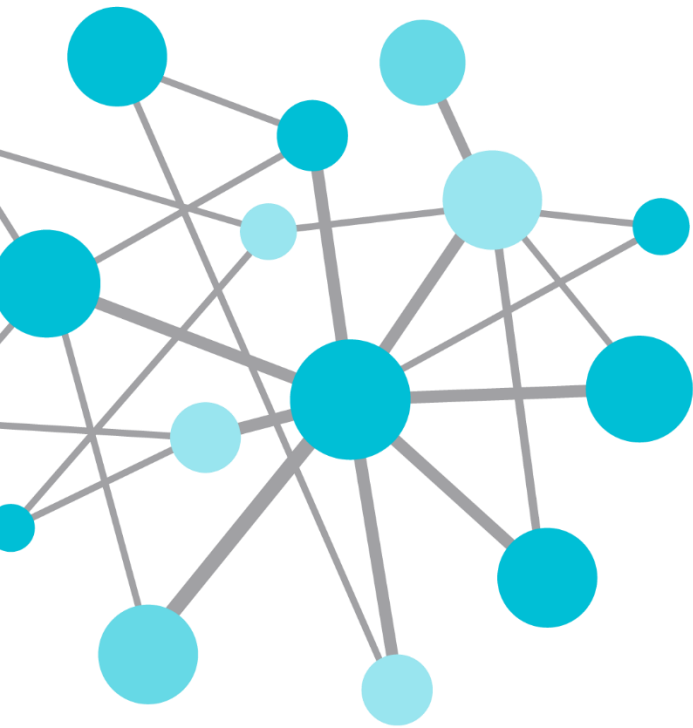
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# Value Now, Value Over Time with the PI System

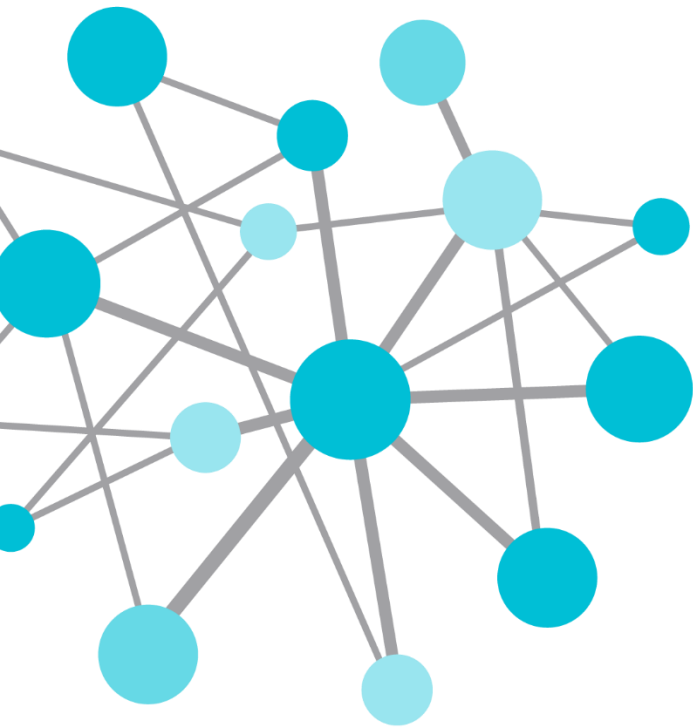
- 25+ years & Continuing to Find Incremental Value –“Future proofing” of our PI System Infrastructure Investment
- Using Features of PI Server 2014 – very powerful and strong value proposition
- MaraDrill™ has been rolled out across 25 rigs
- MaraDrill™ - Key Element in Drilling Optimization Vision
- PI Event Frames is superior in Event State Detection
- Excited About the Use of New PI System Functionality





# Ken Startz

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Advanced Senior Business Analyst  
Marathon Oil Company

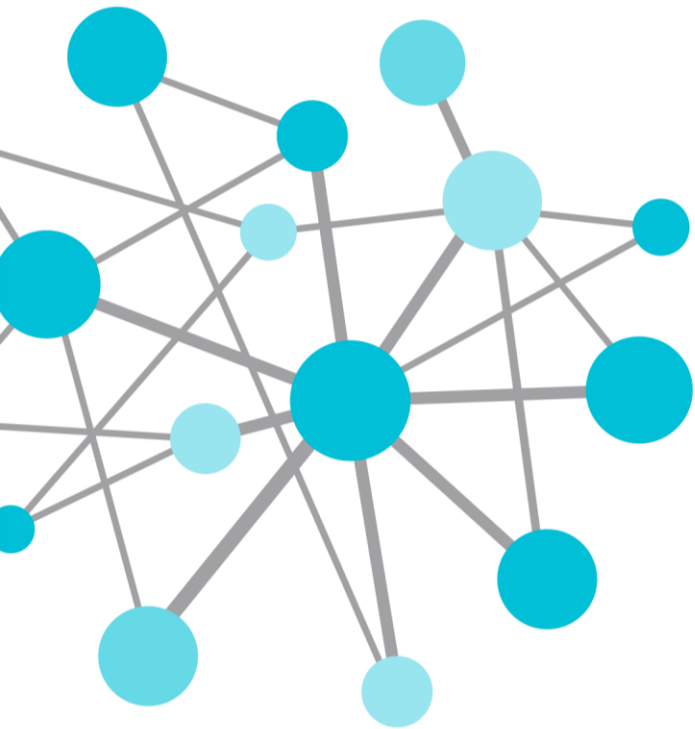


# Questions

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



State your  
**name &  
company**



THANK  
YOU

Brought to you by  **OSI**soft.

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