



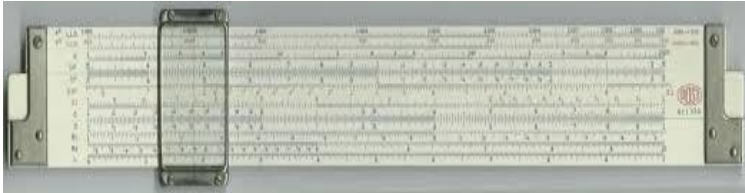
# **The Shale Revolution**

## **Supporting Energy Independence with New Innovations in the PI System**

**Craig Harclerode**  
**Global Industry Principal,**  
**O&G/Petrochem**



# My Career Leveraging Technology to Enable Business Value...What a Journey!



What I used in College as a Freshman



I moved up to a TI-TRS51 by the time I graduated..



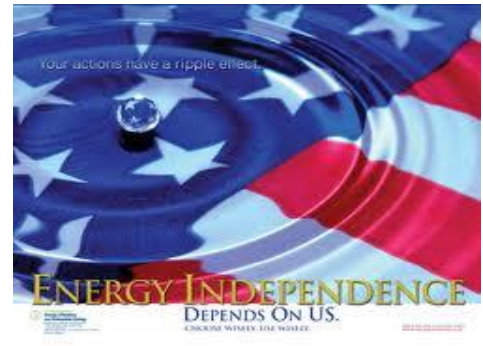
My First Job out of College..



In the not to distant future...

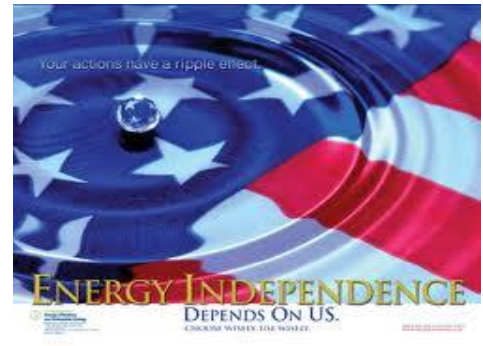
# Outline

- The PI System and “Energy Independence”
- Challenges and..... Opportunities
  - The Shale Revolution
  - Technological Trends
  - Industry Challenges
- Innovative PI System Applications - “The Art of the Possible”
- Closing Comments



# Outline

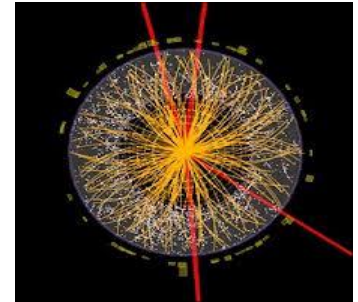
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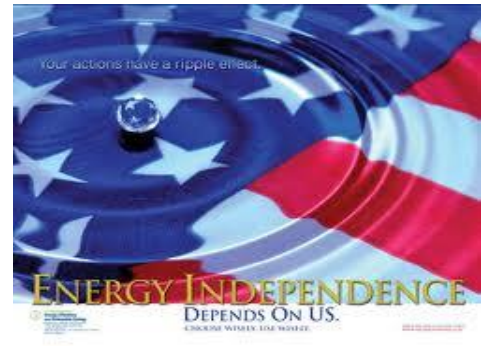
# The Foundation of “Energy Independence” is Real-Time Data & Information....in Context

1. Efficiency, effectiveness, transparency, context
2. Balanced “All the above” approach
3. Holistic View
4. Continuous Improvement
5. Ability to Empower, React, and Make Timely and Informed Decisions – the “Power of Data”



# Outline

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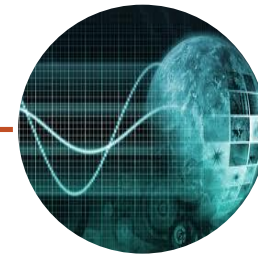
# The Perfect Storm.....and Solution



Technological  
Forces



Shale Revolution  
Forces



Industry  
Forces

# Technology ...Challenges & Opportunities



Data &  
Cyber  
Security



Big Data



The Cloud



Wireless,  
Networks,  
and  
Advanced  
Sensors

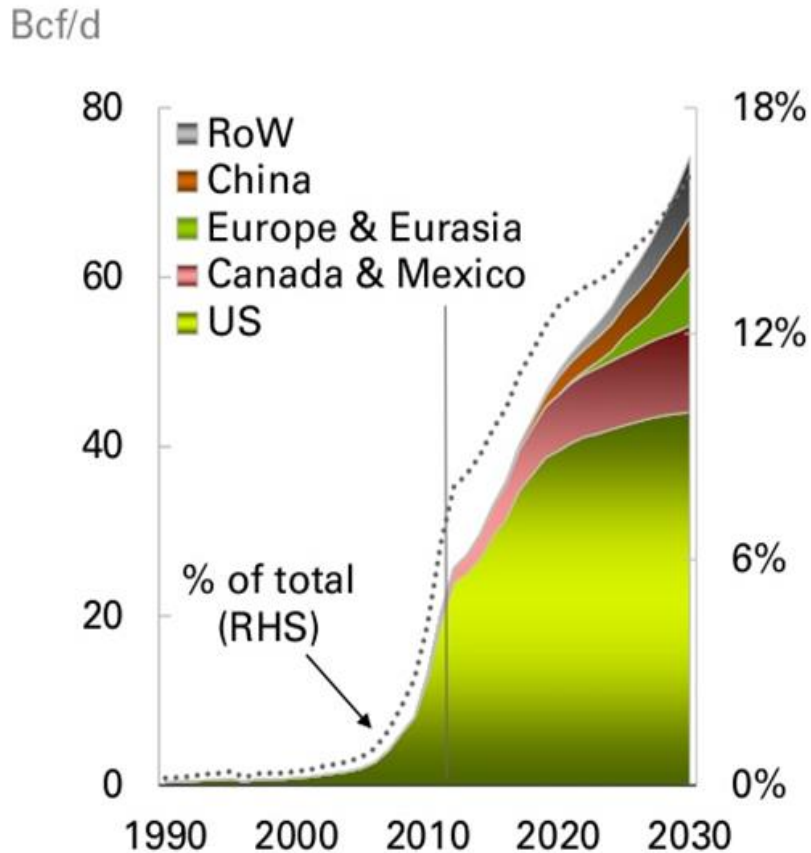


Mobility and  
Social  
Collaboration

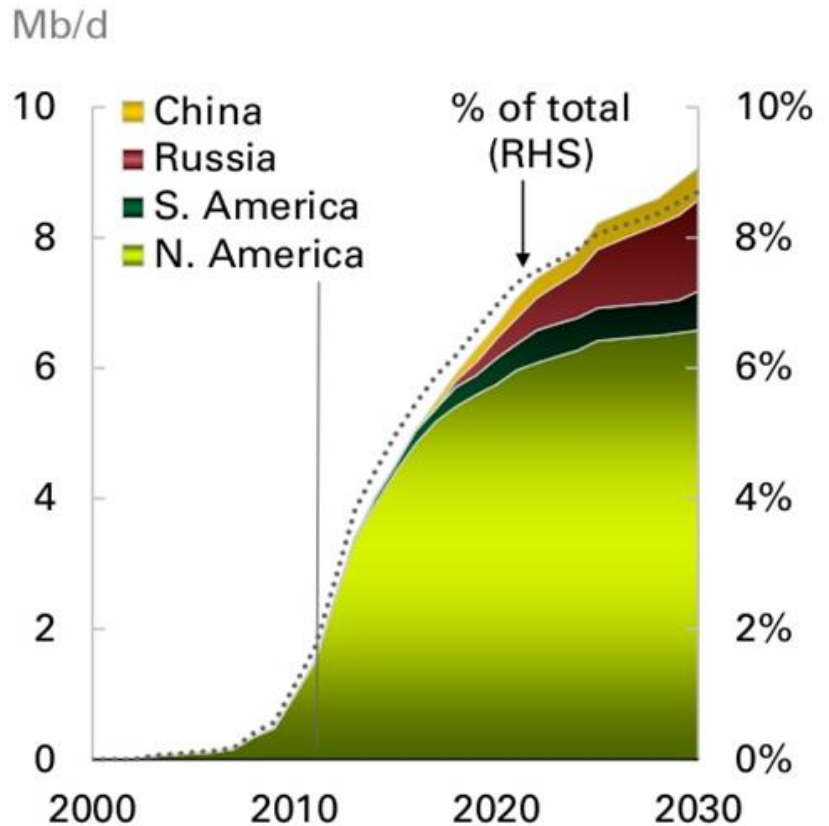
Leveraging the PI System to Solve Challenges and Leverage Technology Trends

# NA Shale - Changing the Global Energy Balance

Shale gas production



Tight oil output





# Movement Towards a Global Price for Gas

Facilitated by Improvements in Logistics and Gas Transportation (CNG/LPG/LNG)

## Impact

1. Power Generation/T&D/Utilities
2. Transportation
3. Petrochemicals
4. Metals, Mining, and Metallurgy
5. Energy Intensive Manufacturing
6. Many more.....

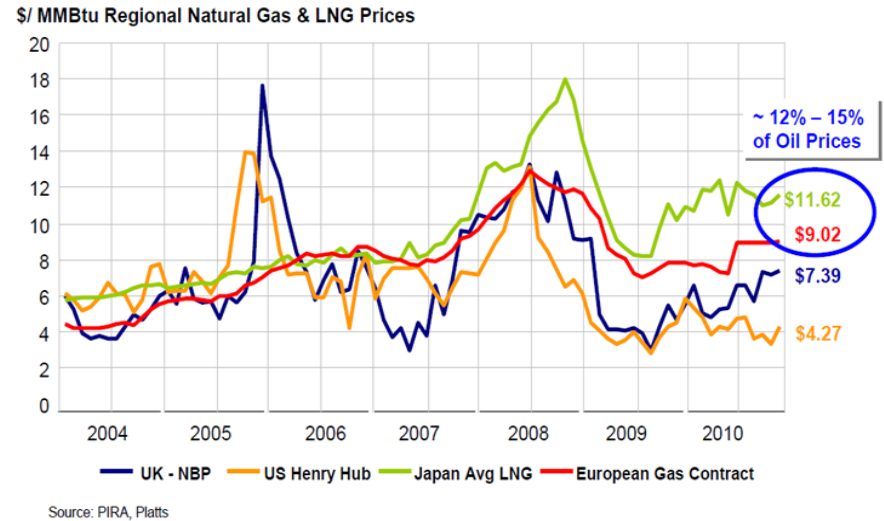
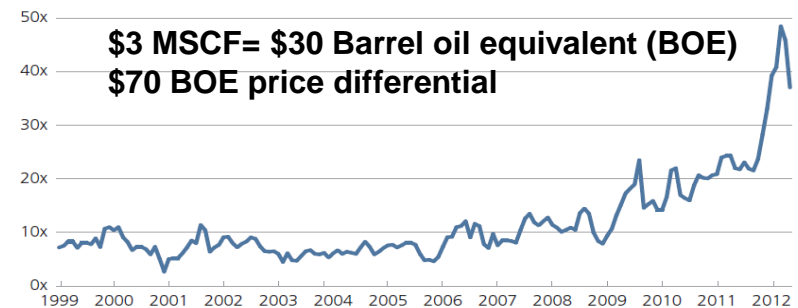


FIGURE 3: CRUDE OIL AND NATURAL GAS PRICE RATIO SOARS  
WTI/Henry Hub Ratio



Source: Bloomberg, "Record Oil-Gas Ratio May Spur Truck-Fuel Shift." From 1999 to 2009, the price of oil typically traded 8 to 12 times that of natural gas, but in 2012 the ratio skyrocketed to 50:1.

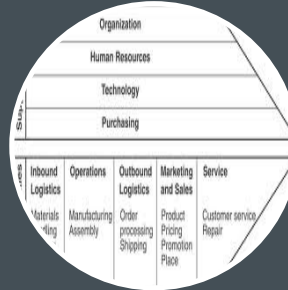
# Impact of The Shale Revolution



Logistics  
Integration  
&  
**RT**  
Situational  
Awareness



Big Data  
Volume  
Velocity  
Variability  
Complexity



Value Chain  
&  
Extended  
Value Chain  
Integration



MAD Activity  
  
Mergers  
Acquisitions  
Divestitures

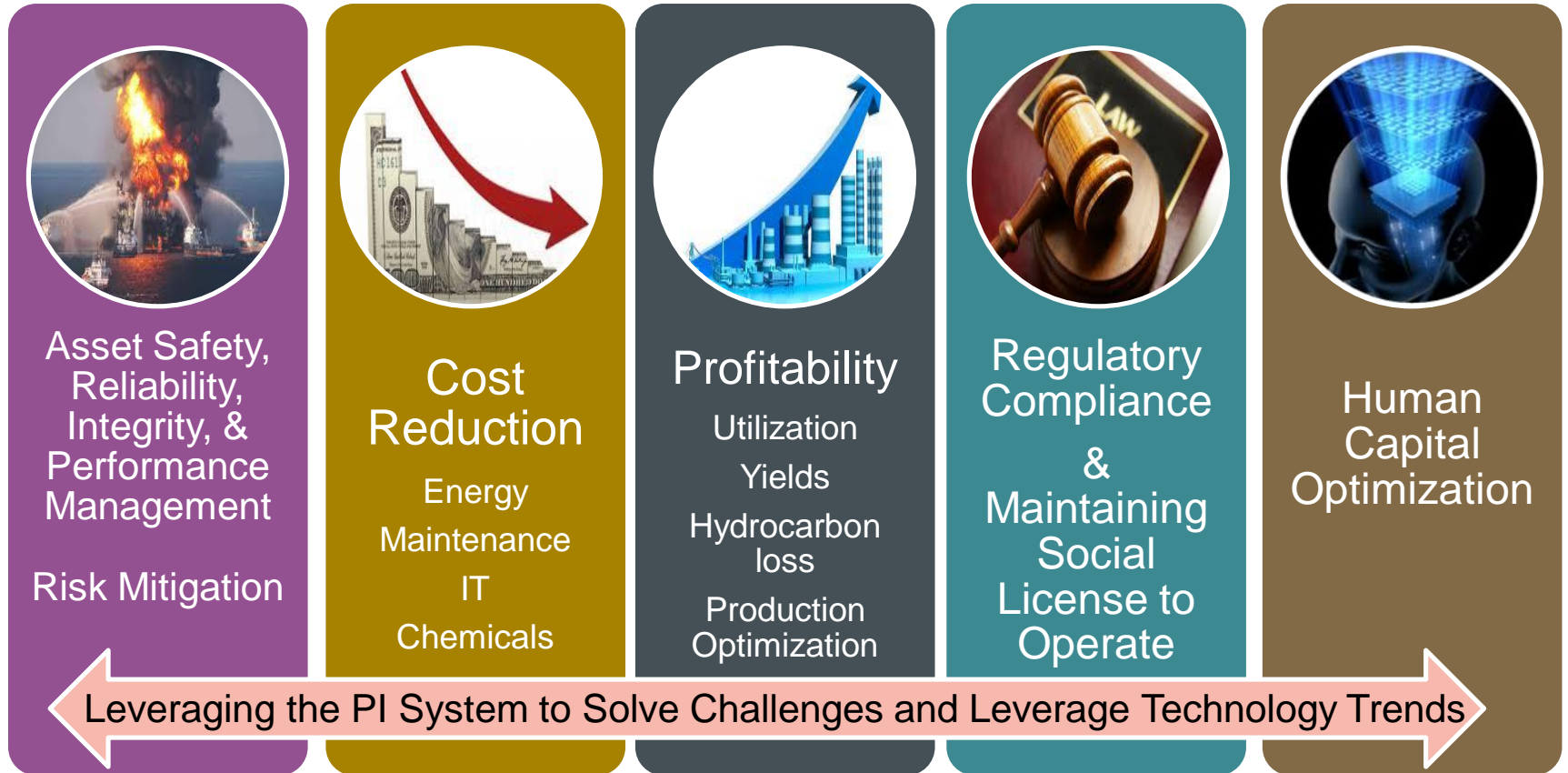


Time  
Sensitivity of  
Opportunity

Leveraging the PI System to Solve Challenges and Leverage Technology Trends

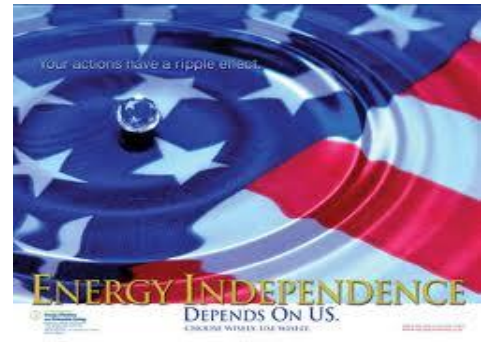
# Industry Challenge-Technology Enabled Globalization

## Collapse of Time, Space, and Access to Information



# Outline

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# The Standard in O&G - Statement of Value

% Global Capacity Using The PI System

Production

55%

Production



Pipelines

35%

Pipelines



LNG

25%

LNG



Manfgn

60%

Refining



Biofuels

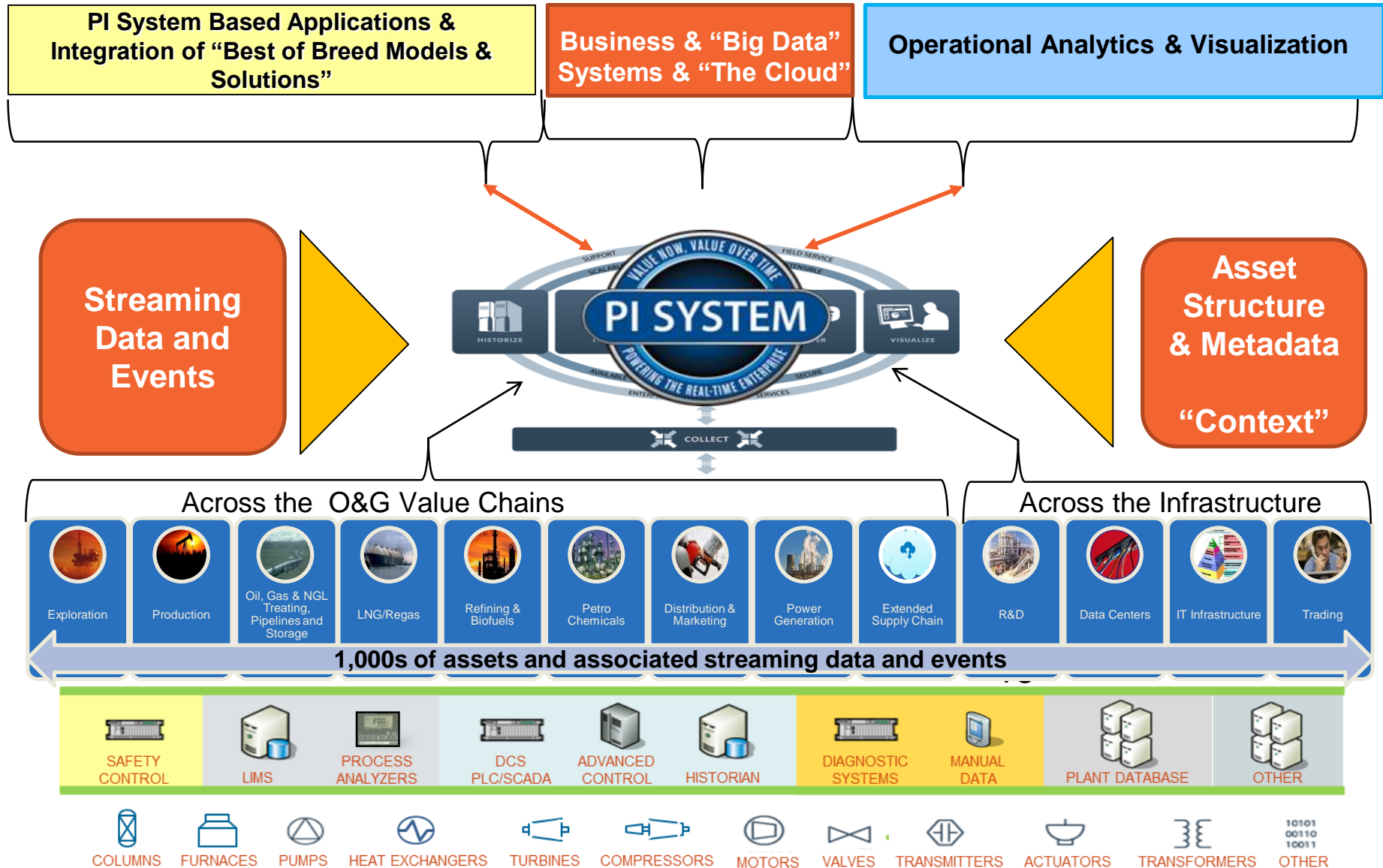
15%

Biofuels

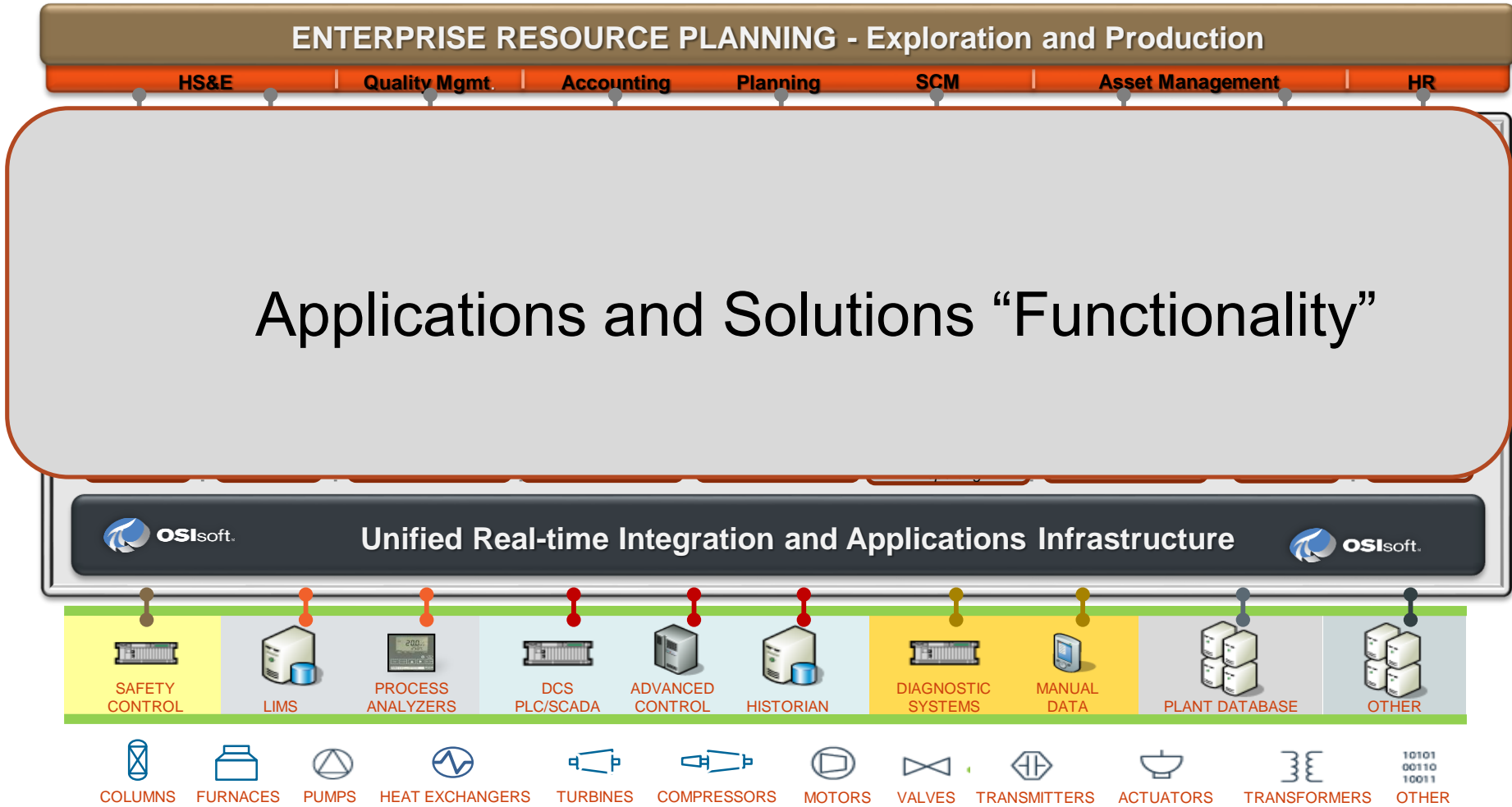




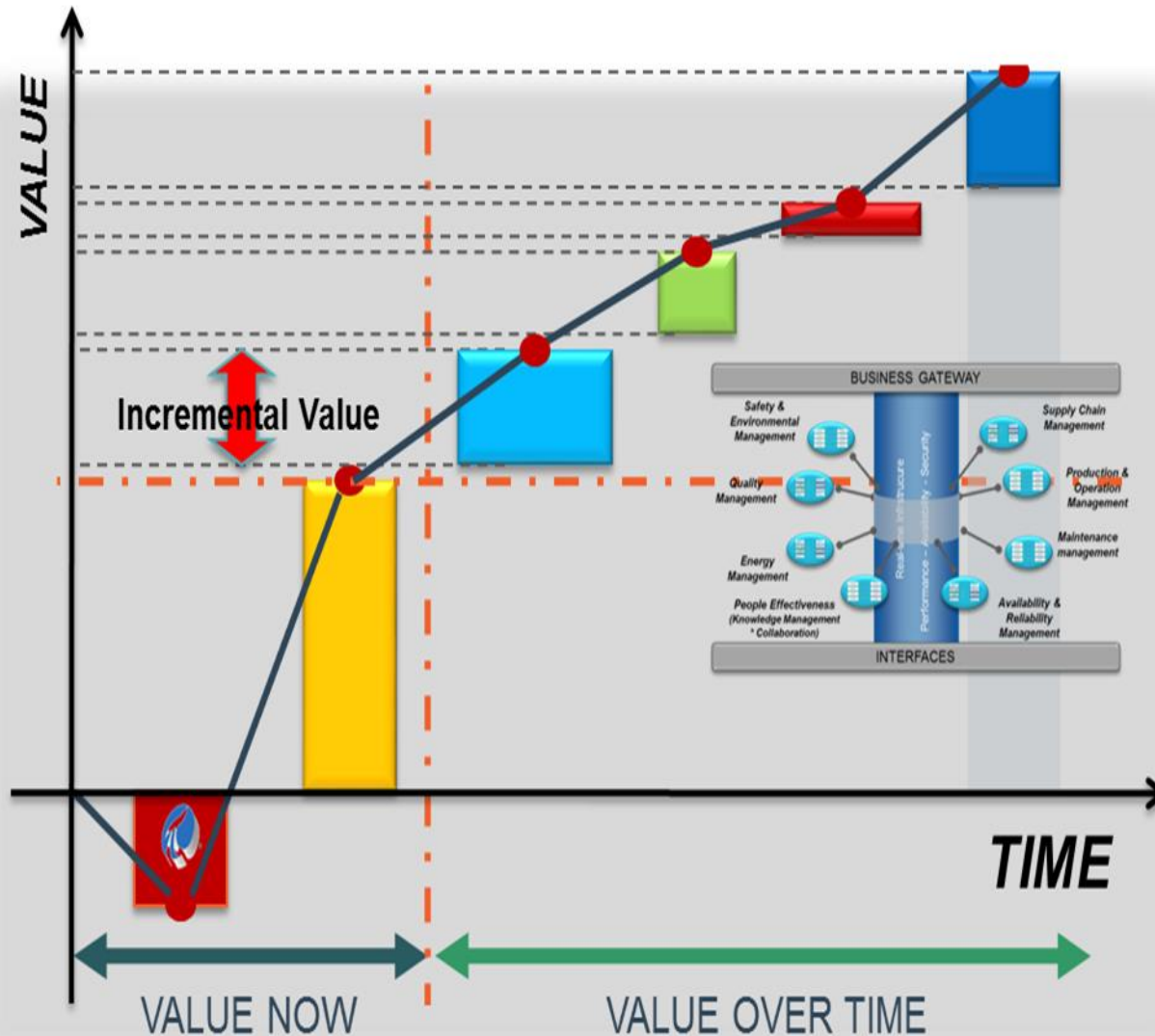
# Strategic Integration of the O&G Enterprise



# Simplifying the Applications and Solution Space with the PI System as an Integration & Applications Infrastructure



# Leverage of PI System as a Strategic Infrastructure



← *Performance Management*

← *Environmental Reporting*

← *Equipment Health Mgmt.*

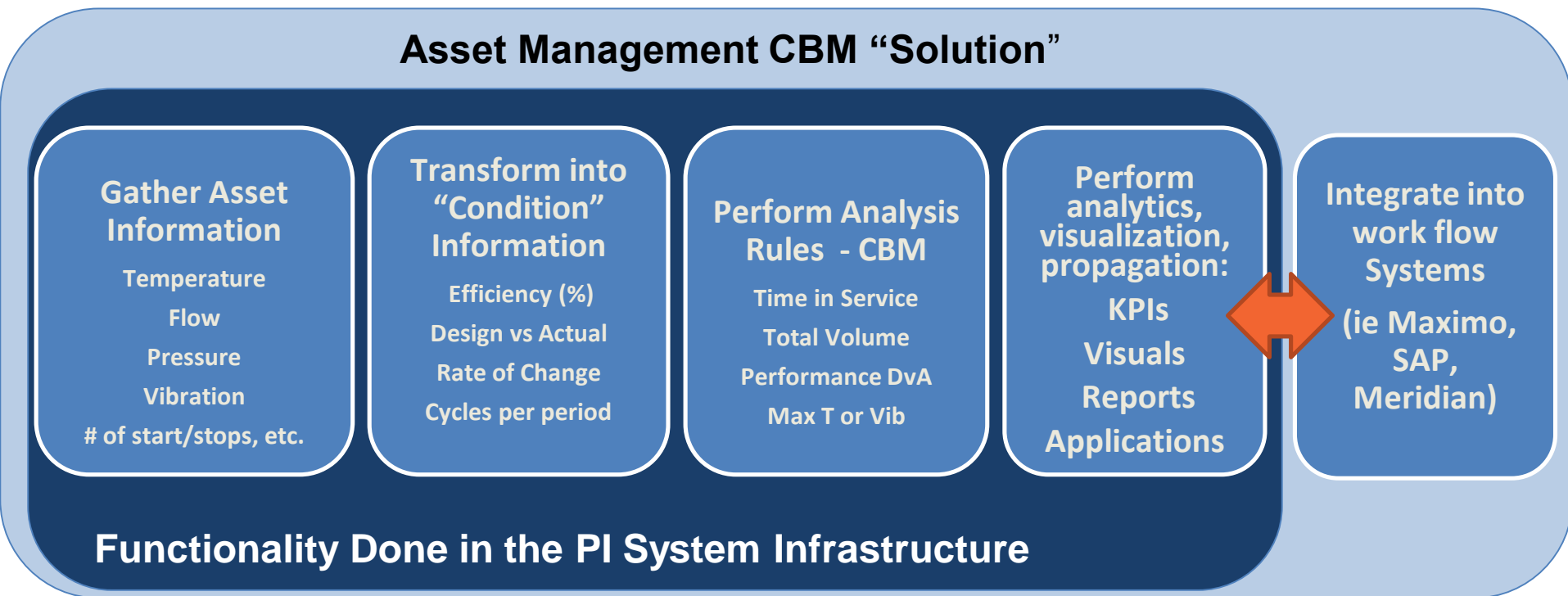
← *Operations Management*

**Infrastructure Configured Applications**

← **PI System Infrastructure**

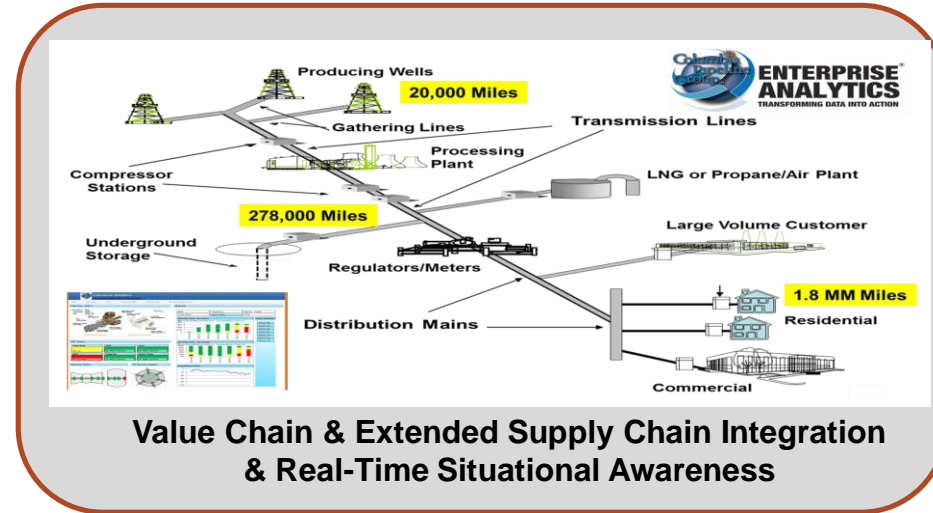
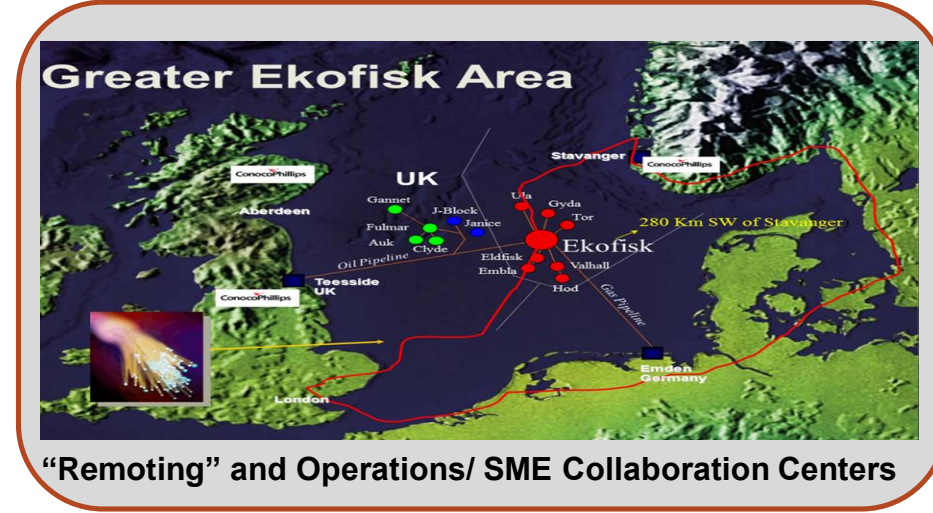
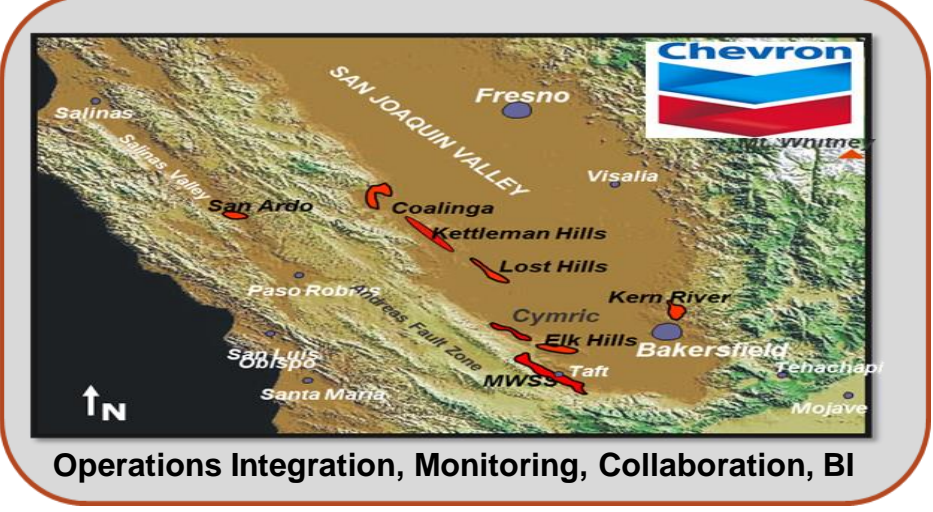
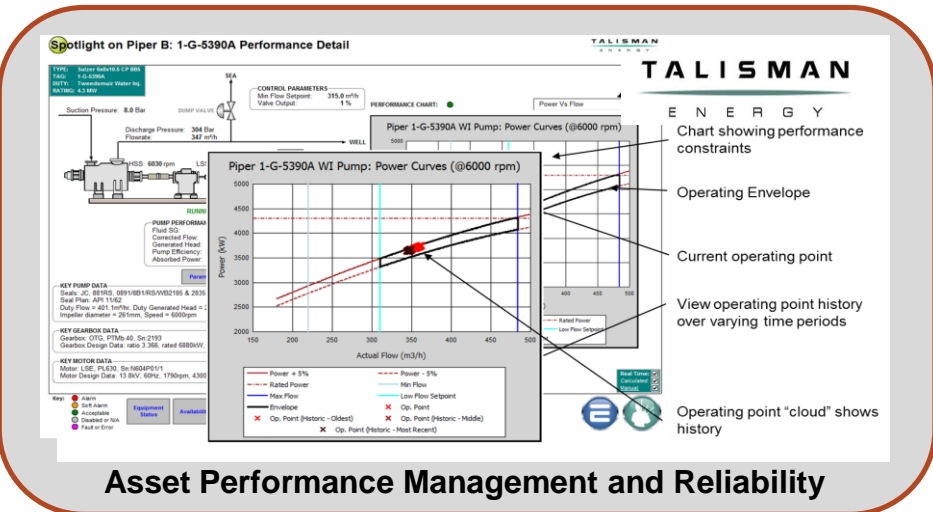
← **PI System Infrastructure Initial Investment**

# Decomposition of Typical “CBM Solution”



**80/20 Perspective – Limited by Imagination**

# Broad Areas of PI System Use in O&G

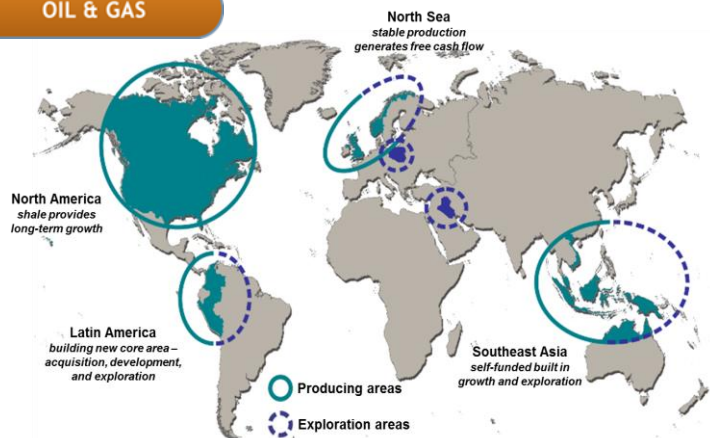




# Real-Time Monitoring of 2,900 Safety, Production, and Water Critical Pieces of Rotating Equipment – Globally

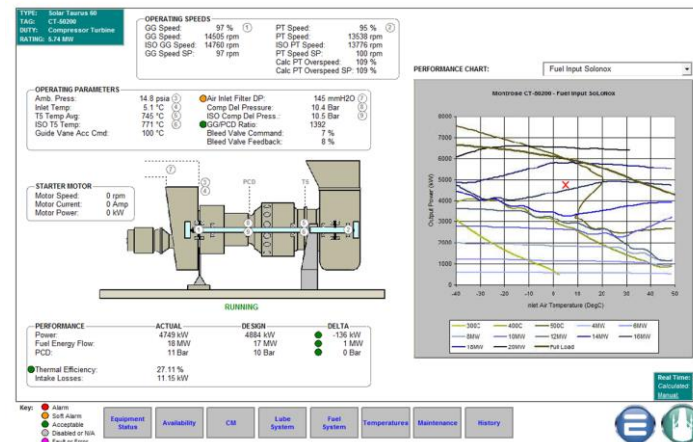


## OIL & GAS



**TALISMAN**  
ENERGY

## Spotlight on Monarb: CT-50200 Performance Detail



## Customer Business Challenge

- Globally diverse critical rotating equipment environment
- Issues with critical rotating equipment integrity, reliability, and related production losses
- Critical equipment included water injection, Bilge / Ballast Pumps, and other water related systems

## Solution

- Implemented the Strategic Rotating Equipment Excellence Program
- Creation of a PI System based solution – SPOTLIGHT to monitor 2900 critical pieces of equipment
- Goals:
  - Improve reliability and achieve availability targets
  - Reduce production losses from rotating equipment
  - Improve rotating equipment integrity

## Customer Results / Benefits

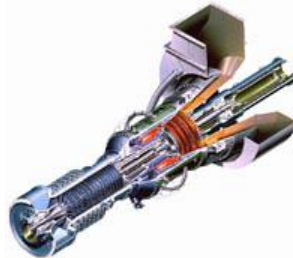
- Consistency in displays, calculations, process points, and equipment operating points
- Continuous monitoring of live and derived values against alarm limits and thresholds
- Improved overall production by reducing critical rotating equipment failures
- Improved water management from improved operation, reliability, and visibility of water related systems

# Business Challenge – Improve Reliability on 2,800+ Global Critical Equipment Assets

## Safety Critical Equipment

## Production 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



- 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





# KPI Displays with High Fidelity Drill Down

## Spotlight on Rotating Equipment: Piper Overview



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															

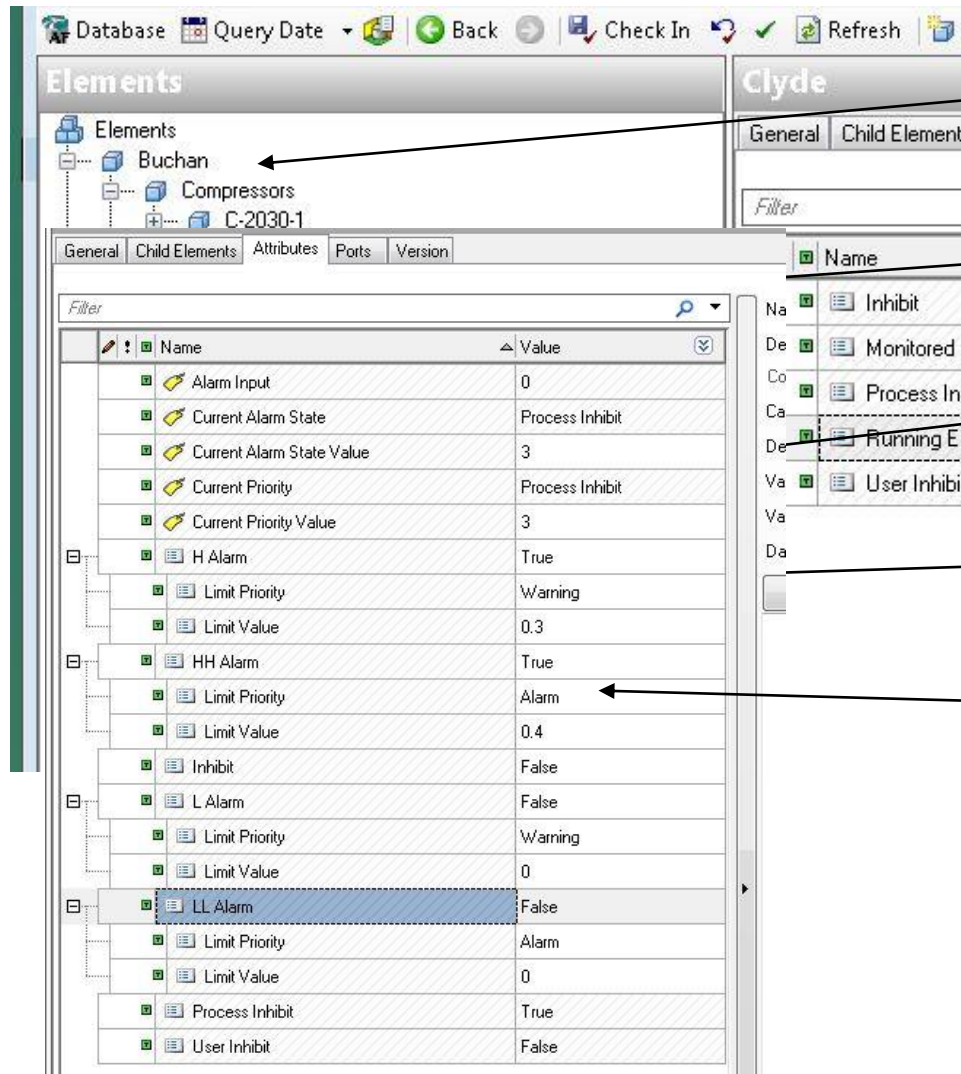
Traffic light shows rolled up alarm status for each sub-display

Links to detailed displays for each item of equipment

Water Injection Equipment and Systems

# Typical AF Configuration

## Alarm Limits and Alarm Roll-ups



**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**



# Normalization and Integration of 17 SCADA Systems Improves Regional Thermal Onshore Field Production and Ability to Deal with large well data size & growth

## OIL & GAS

*“Installing the PI System integration and applications infrastructure integrating and normalizing our 17 disparate SCADA systems has enabled us to perform analytics and data based decision to manage and optimize our 8 heavy oil production fields. We are continuing to integrate all assets in our local value chain leveraging the PI System. **Changing from component to asset based pricing was a game changer.**”*

Chevron Facilities & Automation Engineer



OSIsoft UC 2013



### Customer Business Challenge

- 17 different SCADA systems
- No standard tag naming stds
- Data quality/reliability issues
- Navigation & accessibility
- Data Ownership & Accountability
- No ability to share expertise or provide remote monitoring

### Solution

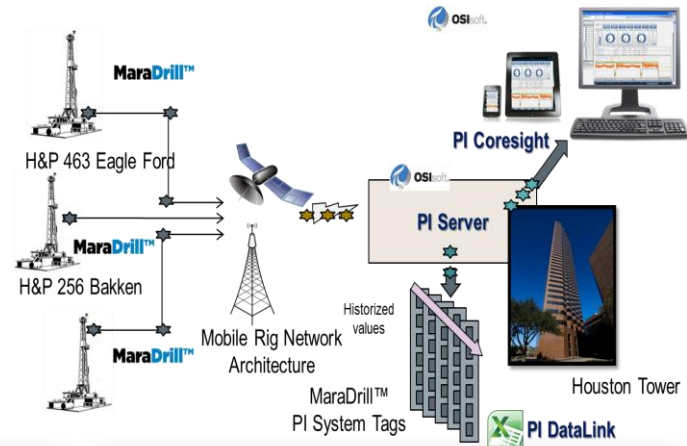
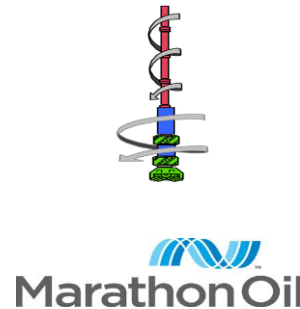
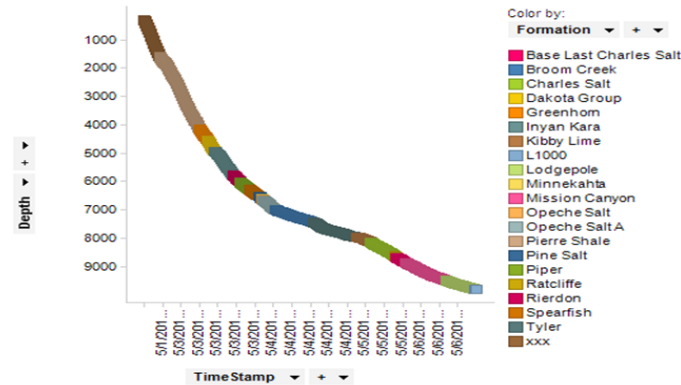
- Installed an enterprise PI System integrating SCADAs
- Systematic methodology to normalize naming standards with PI-AF for management and governance of tag and asset creation
- Use of PI-PE and PI-AF to capture and organize metadata
- Integrated collaboration centers between field and HQ

### Customer Results / Benefits

- Confidence in the data quality
- Governance of massive growth in Data & integration
- Improved field management and operation/production
- Improved culture of sharing of expertise, best practices, SME
- “One version of the truth”

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

Days vs Depth



## Customer Business Challenge

- Lack of high fidelity drilling analytics and guidance capability at the drill site
- Extended drill time and down hole tool damage
- Increased use of resources

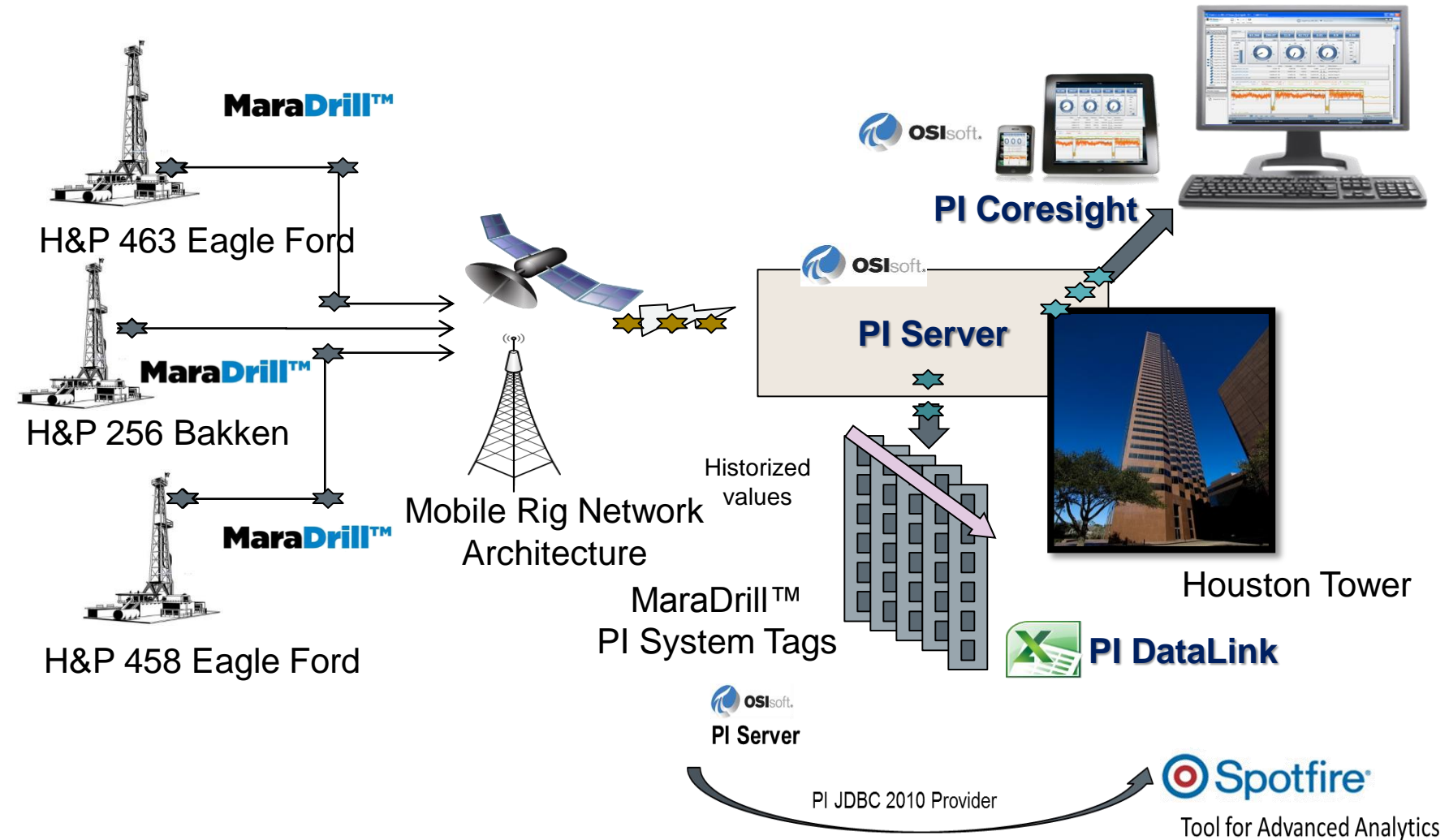
## Solution

- 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
- Provide real-time drilling operator guidance: RPM, torque, mud flow, mud density

## Customer Results / Benefits

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

# High Fidelity Data Between the Drill Site and the Corporate Support Center Enables Improved Drilling



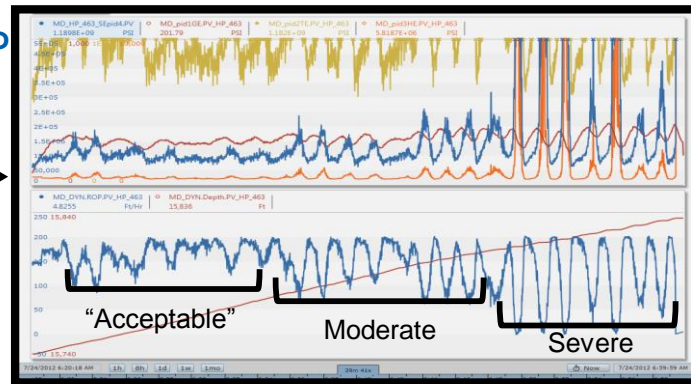
# Minimization of “Stick Slip”- 40% Sustained Increase in Rate of Penetration



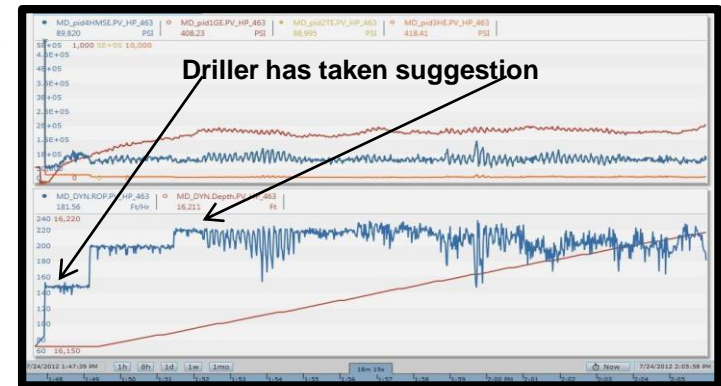
Stick-Slip Identification ...few stands later... Stick-Slip Mitigation

40% Sustained Increase in Rate of Penetration

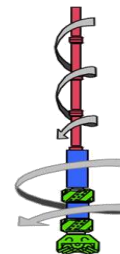
Avg. ROP  
for stand  
is 144  
ft/hr



Avg. ROP  
for stand  
is 201  
ft/hr



**Stick-slip:** Non-uniform rotation of the bit/BHA  
Sticking phase → bit stops  
Slipping phase → bit “breaks” free  
Drillstring torsional oscillations

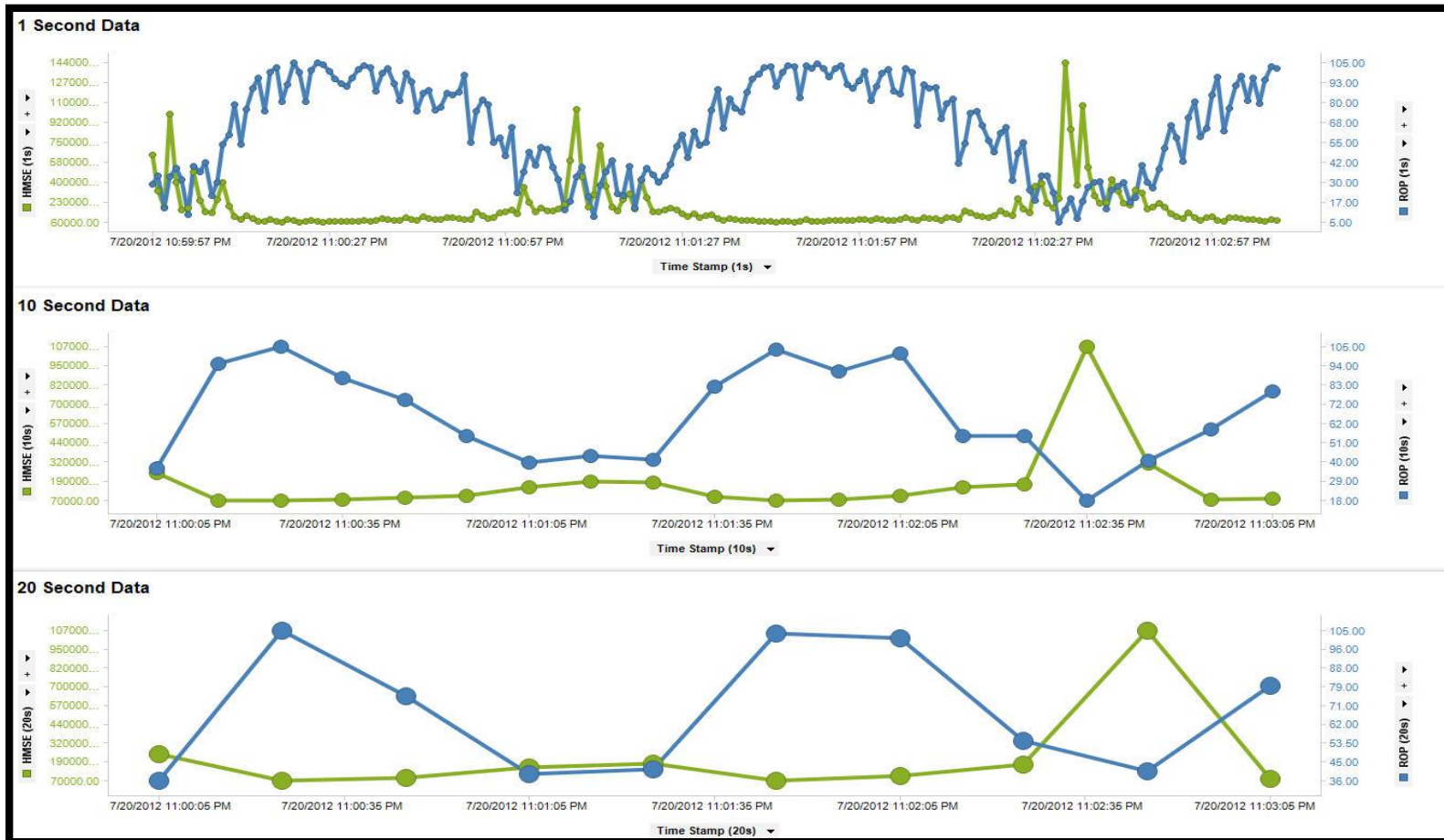




# PI Coresight/SpotFire – Stick-Slip Analyses

## Importance of 1 second/”High Fidelity” data

MaraDrill™



Other vendors

Rig Display



# CoreSight View with XML Data Export

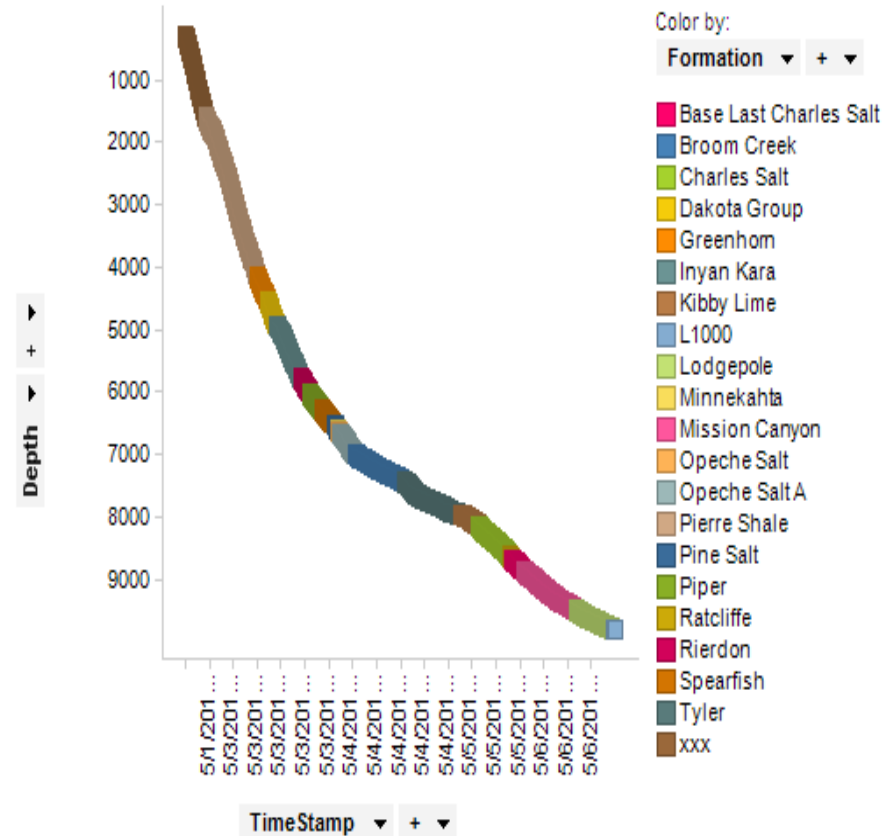


Enables integration with  
WellView data

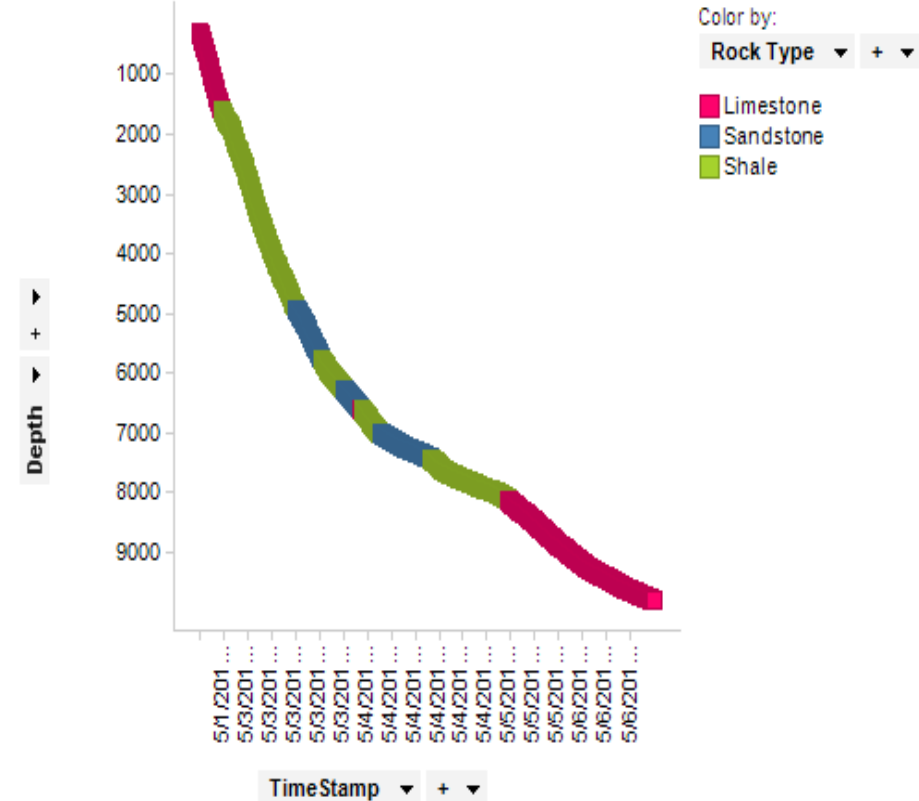
Enables integration with Spotfire  
visualization

# Days vs Depth: H&P 256 - Aisenbrey 21-25H

Days vs Depth

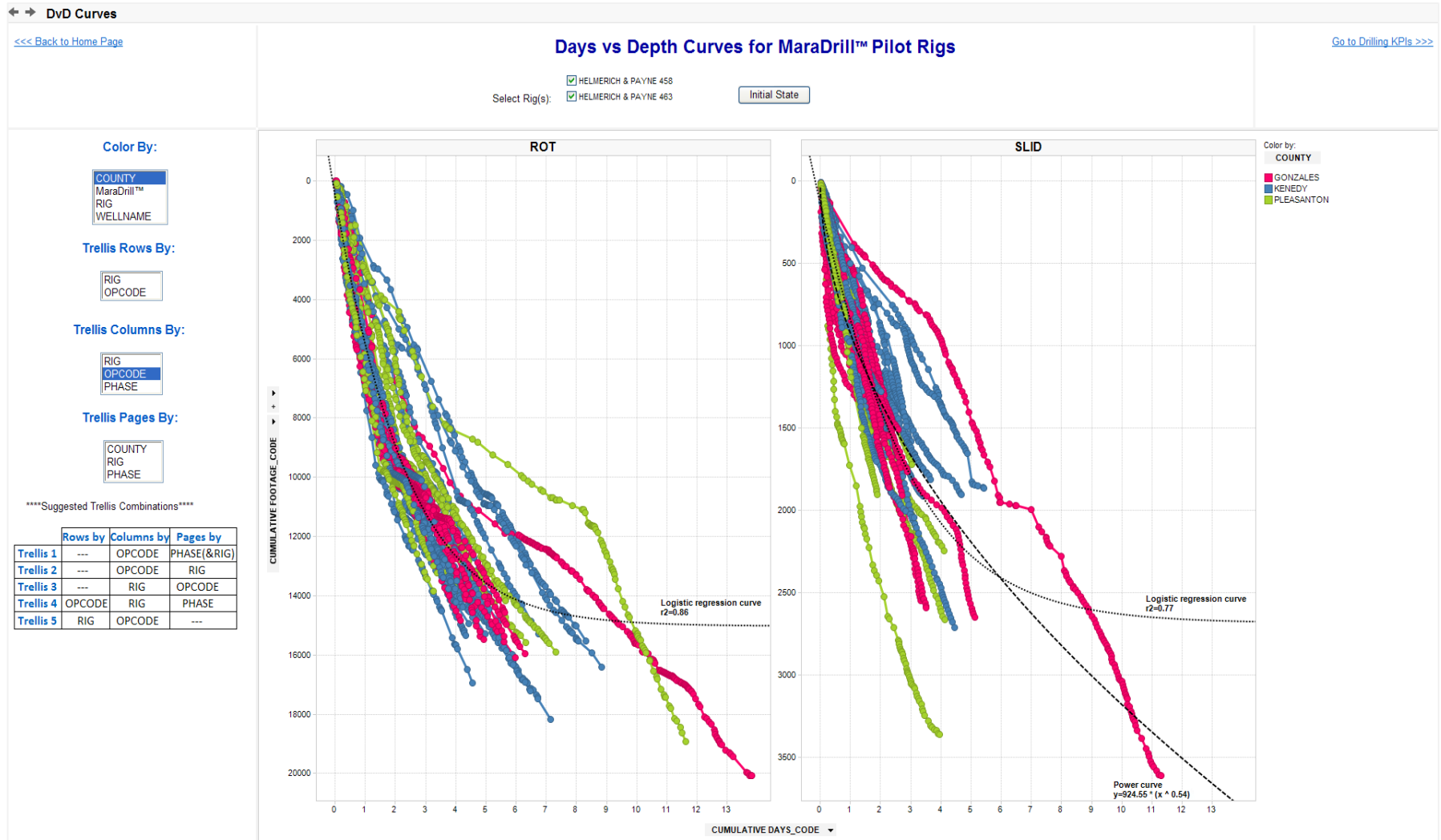


Days vs Depth



# Days vs Depth Curves for MaraDrill™ Rigs

## Black = MD, Teal = No MD

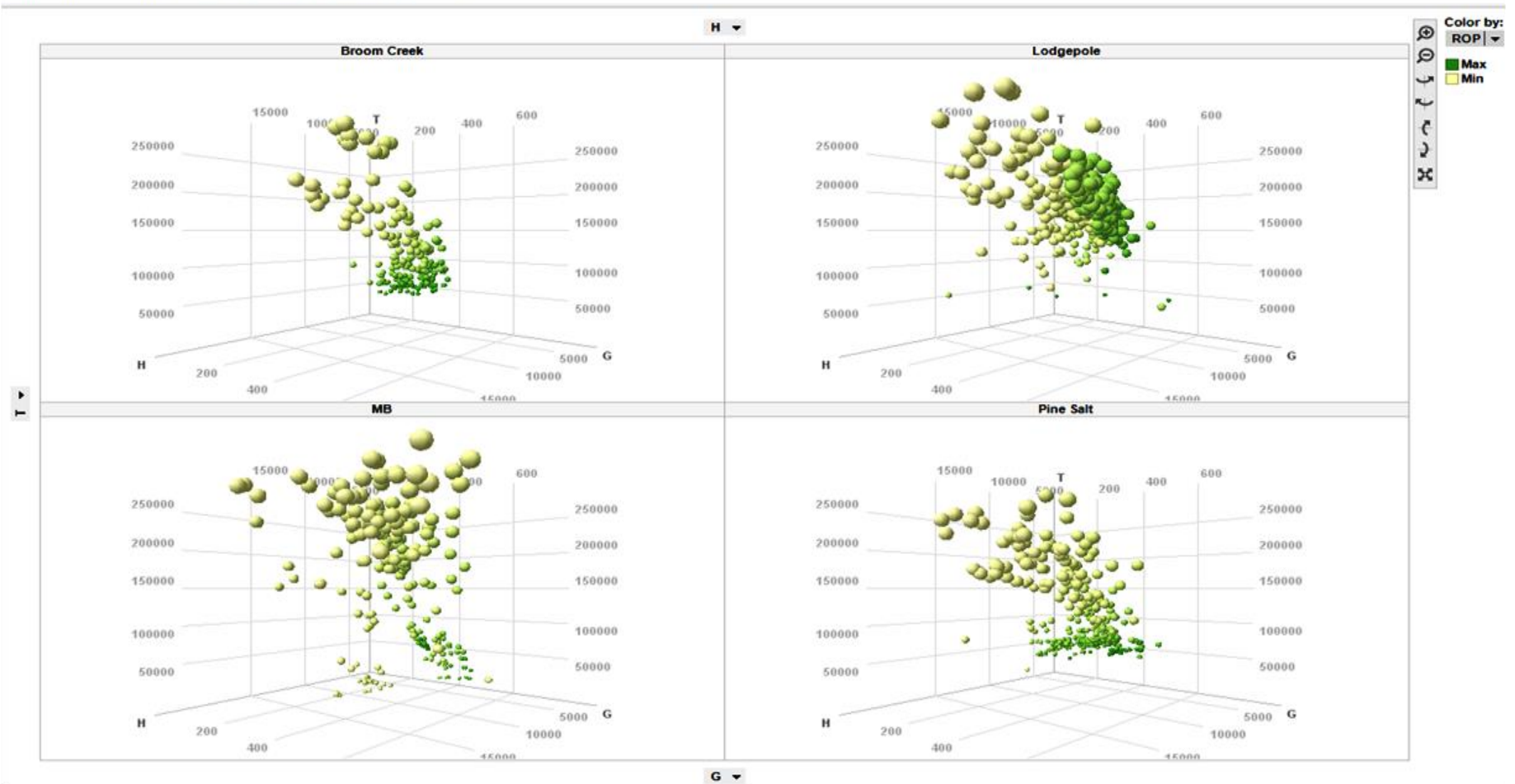


# Post-Well Science Using MaraDrill™ Data in SpotFire

## Formation Sweet-Spot Analysis

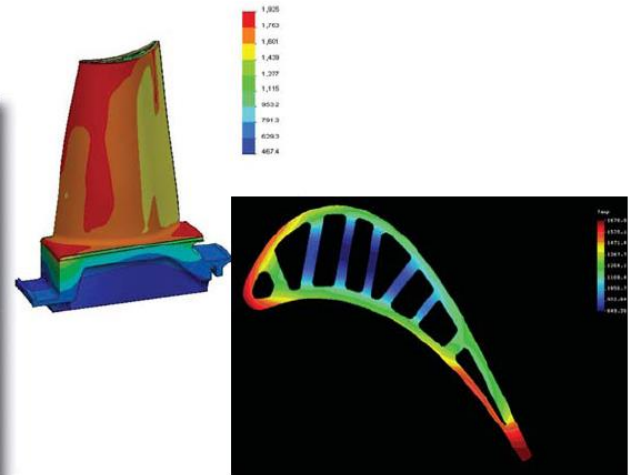
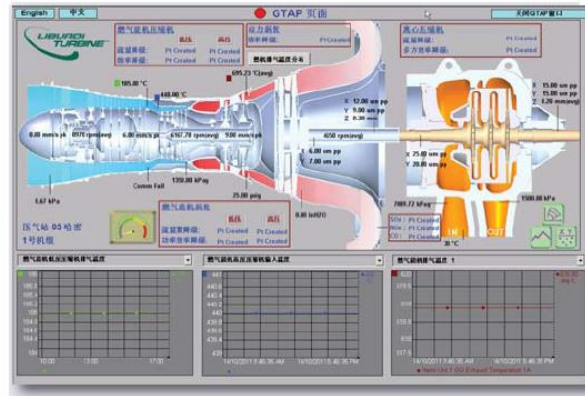
### 3D Scatter Plot: G vs T vs H

Sweet-Spot Analysis: Greener = Faster, Smaller = more efficient



# Case Study – Remote Gas Turbine Health Management

- 1) Enhancing asset reliability and performance management by leveraging the connected supply chain
- 2) Use of the PI System as an integration and applications infrastructure



## Customer Business Challenge

- Consolidate systems for a diverse fleet of compression equipment
- Improve diagnostics
- Optimize equipment service intervals

## Solution

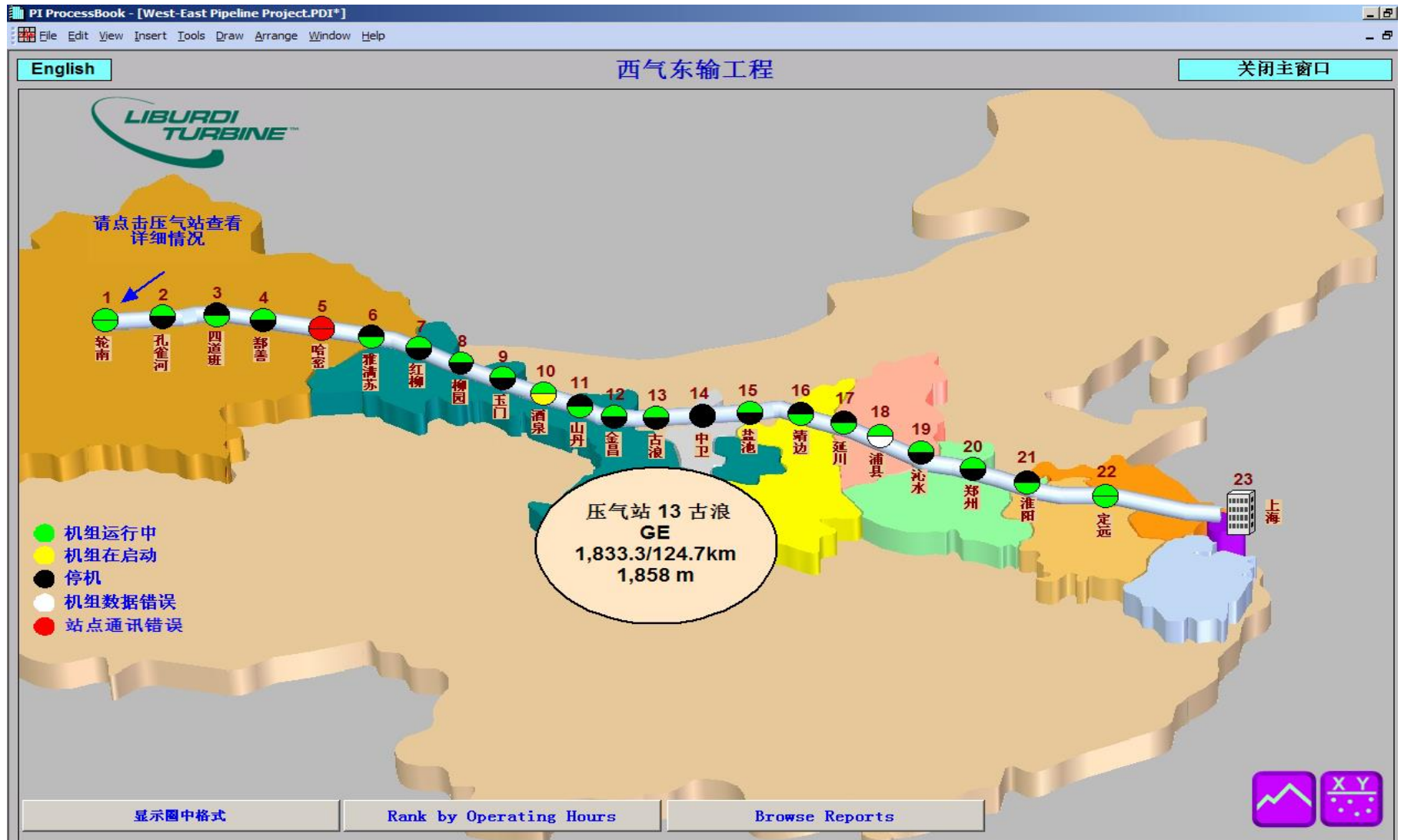
- PI Server + OPC data collection
- GTAP + Component Lifting
- PI ProcessBook Displays
- PI DataLink Reporting
- PI Notifications Alerting

## Customer Results / Benefits

- One system, consistent and comprehensive
- Continuous monitoring
- New metrics: Quantify the effectiveness of maintenance
- Extended overhaul intervals

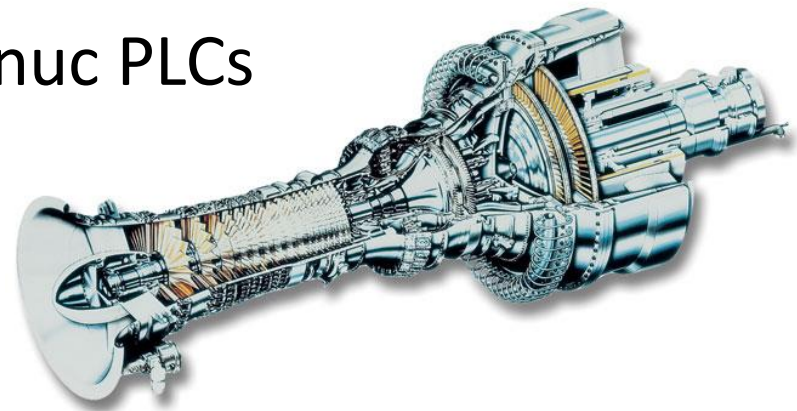


# Pipeline Map Screen



# Compressor Equipment

- 15 RR RB211-24G with Allen Bradley PLCs
- 22 GE LM2500+ with GE Fanuc PLCs
- 7 Variable Speed Drives
- with Siemens PLCs
- Bentley Nevada vibration monitors



# Building a GTHM Application

**Elements: PI Asset Framework**



**Display Screens: PI ProcessBook**



**Reporting: PI DataLink**



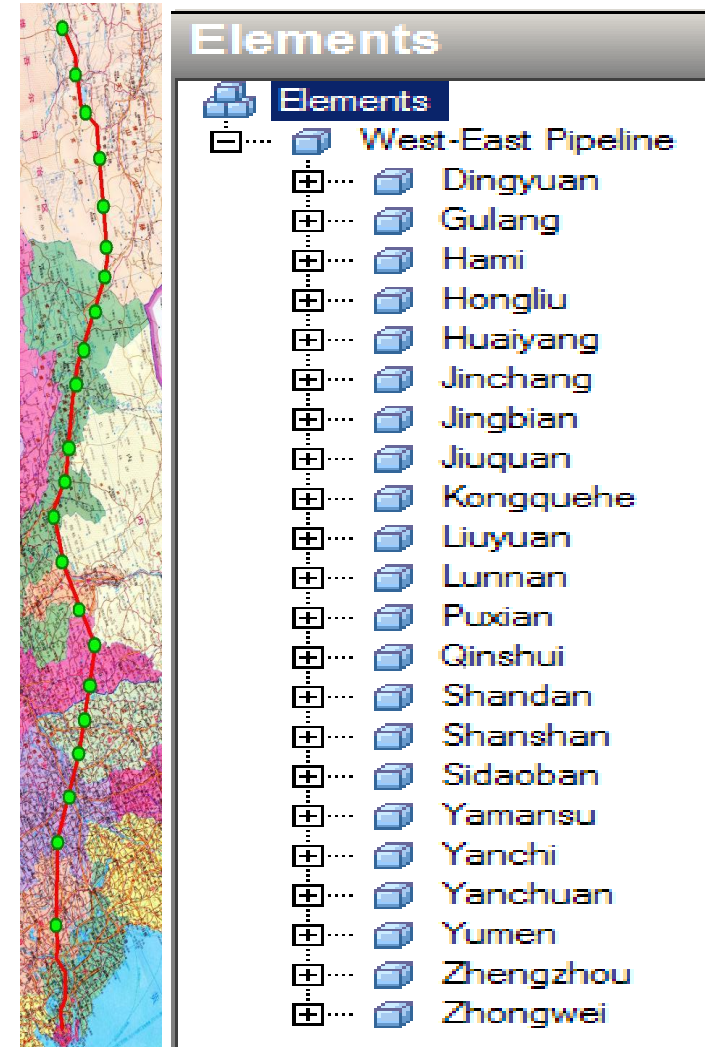
**Alerts: PI Notifications**

# Pipeline Framework

Top level is the Pipeline element  
Stations are child elements

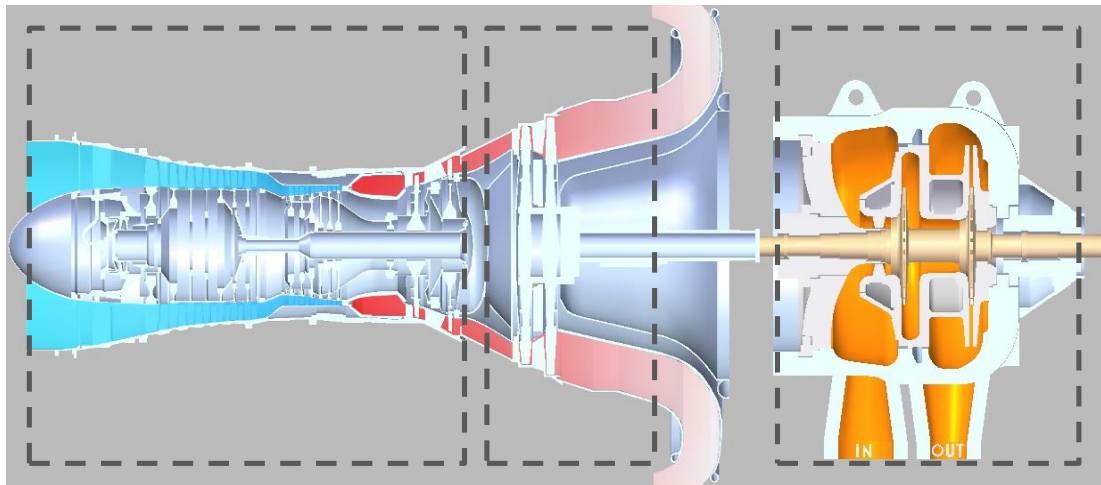
Hierarchy creates the framework  
for a drill down interface

Templates are used for scalability  
and maintainability



# Pipeline Element Hierarchy

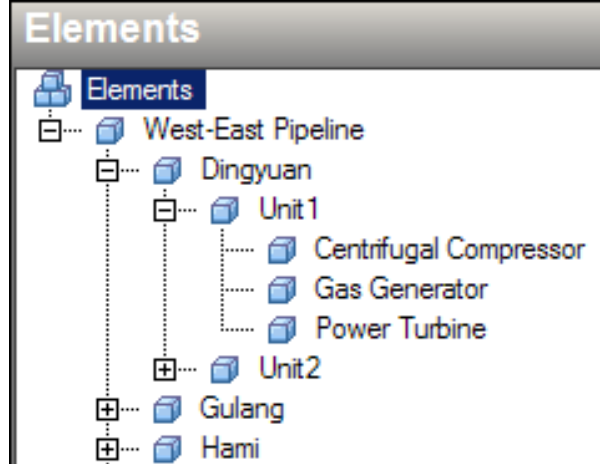
## RR RB211-24G Compressor Unit



GAS GENERATOR

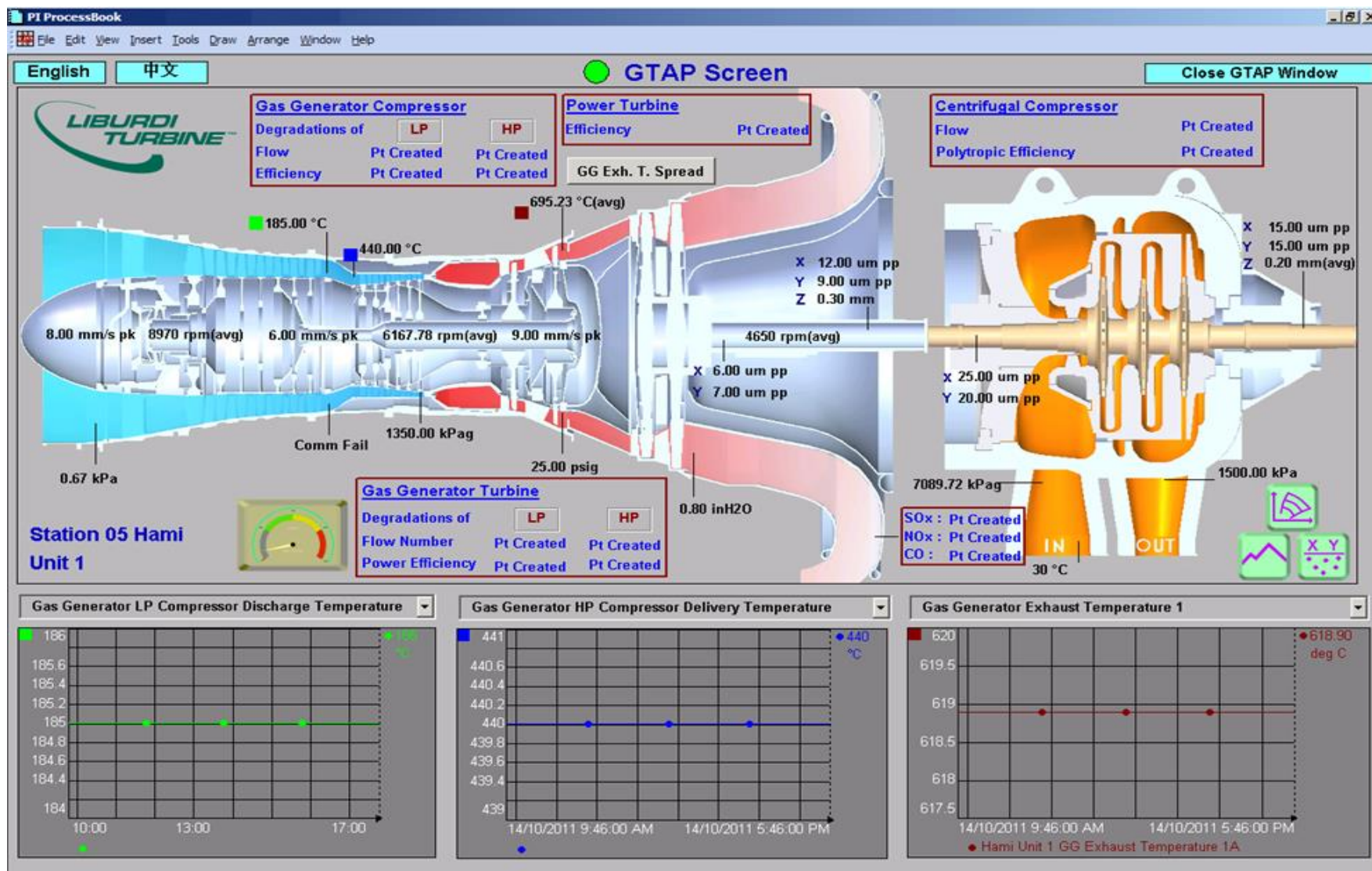
POWER  
TURBINE

CENTRIFUGAL  
COMPRESSOR





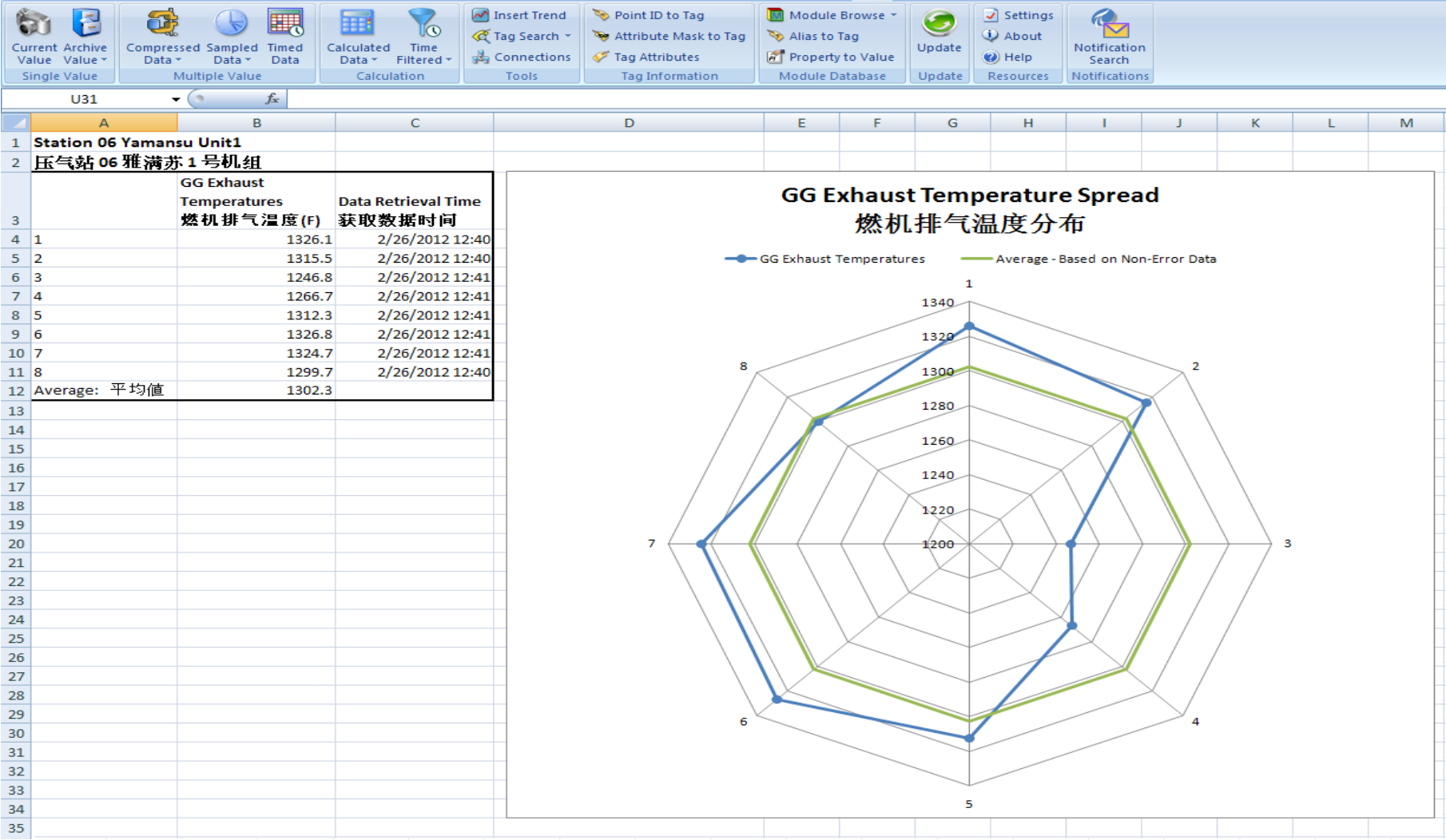
# RB211 Display



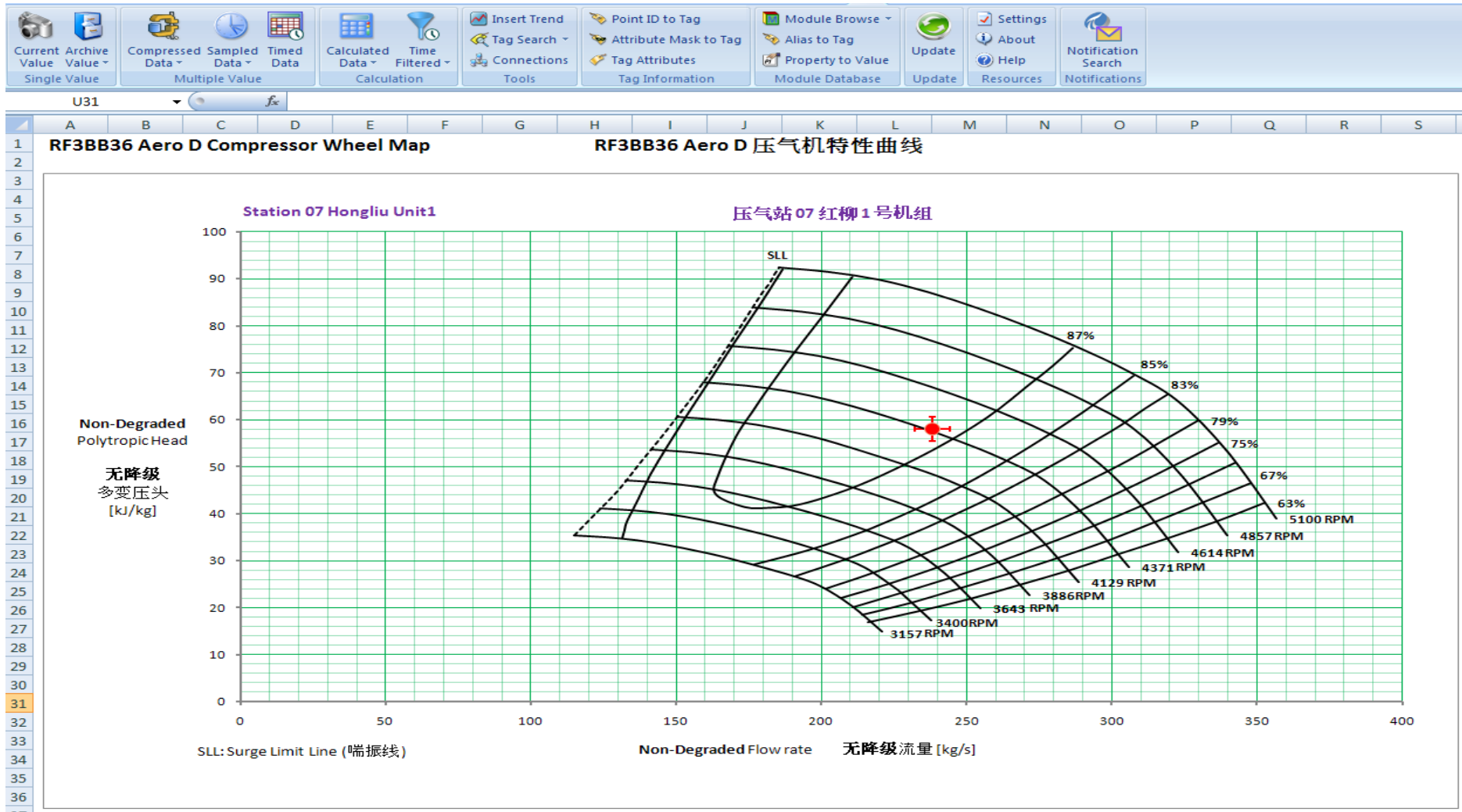
# Gas Turbine Load Report in Excel

U31												
fx												
1	A	B	C	D	E	F	G	H	I	J	K	L
1	Rank By Load 以负载排序				4/20/12 10:27							
2	排序	压气站	Station	Unit	Load 负载		排序	压气站	Station	Unit	Load 负载	
3	1	定远	Dingyuan	1	0.924		21	古浪	Gulang	1	0.580	
4	2	孔雀河	Kongquehe	1	0.889		22	酒泉	Jiuquan	2	0.558	
5	3	红柳	Hongliu	2	0.846		23	鄯善	Shanshan	2	0.556	
6	4	酒泉	Jiuquan	1	0.837		24	沁水	Qinshui	2	0.000	
7	5	靖边	Jingbian	2	0.822		25	延川	Yanchuan	2	0.000	
8	6	哈密	Hami	2	0.810		26	靖边	Jingbian	1	0.000	
9	7	中卫	Zhongwei	2	0.775		27	盐池	Yanchi	2	0.000	
10	8	金昌	Jinchang	1	0.771		28	中卫	Zhongwei	1	0.000	
11	9	哈密	Hami	1	0.724		29	金昌	Jinchang	2	0.000	
12	10	盐池	Yanchi	1	0.723		30	山丹	Shandan	2	0.000	
13	11	轮南	Lunnan	1	0.723		31	柳园	Liuyuan	2	0.000	
14	12	定远	Dingyuan	2	0.711		32	柳园	Liuyuan	1	0.000	
15	13	玉门	Yumen	2	0.699		33	红柳	Hongliu	1	0.000	
16	14	山丹	Shandan	1	0.682		34	雅满苏	Yamansu	2	0.000	
17	15	四道班	Sidaoban	1	0.677		35	鄯善	Shanshan	1	0.000	
18	16	古浪	Gulang	2	0.654		36	四道班	Sidaoban	2	0.000	
19	17	雅满苏	Yamansu	1	0.633		37	孔雀河	Kongquehe	2	0.000	
20	18	延川	Yanchuan	1	0.629							
21	19	轮南	Lunnan	2	0.616							
22	20	沁水	Qinshui	1	0.595							

# EGT Spread Monitor in Excel Radar Chart



# Centrifugal Compressor Wheel Map – Excel XY Scatter Plot



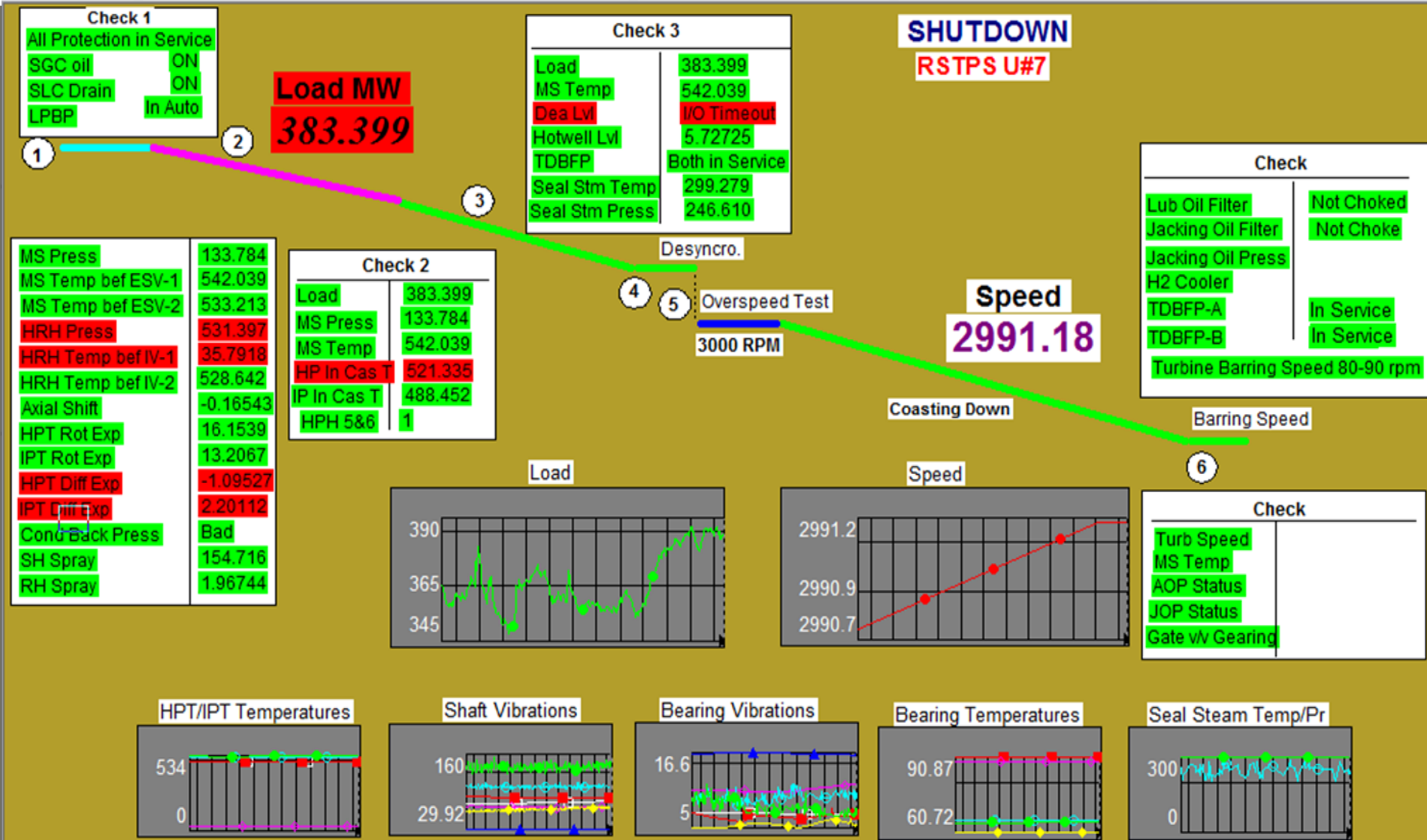




# Other “Art of the Possible” Examples



# Asset, Unit, and System Performance



# Example of Business Intelligence with the PI System and Microsoft “Excel+”

Gas Well Production Report - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW ADD-INS DATA EXPLORER PI DATALINK PI AF Builder POWERPivot ANALYZE DESIGN

Clipboard Font Alignment Number Styles Cells Editing

B7 Field J1

Monthly Gas Well Production to Target  
Exploration and Production Division

	Marine Region			North Region			South Region		
	MSCF	% Target	Target % Status	MSCF	% Target	Target % Status	MSCF	% Target	Target % Status
Field J1	1,577,597	93.12 %	●				1,577,598	99.79 %	●
Field J2	1,779,856	93.71 %	●				1,779,857	91.74 %	●
Field J3	1,969,446	95.14 %	●				1,654,016	94.82 %	●
Field J4	2,421,120	95.61 %	●				2,421,120	93.20 %	●
Field J5	723,875	92.63 %	●				723,875	98.16 %	●
Field 101	3,196,148	95.11 %	●						
Field 105	3,848,336	96.38 %	●						
Field 201	2,962,537	98.55 %	●						
Field 210	1,750,906	100.79 %	●						
Field 211	1,426,471	98.21 %	●						
Field 300	1,492,600	94.74 %	●						
Field 301	4,281,977	94.72 %	●						
Field 302	1,684,247	91.63 %	●						
Field 304	2,205,850	93.70 %	●						
Bagre				1,841,490	87.82 %	●			
Blue				1,251,376	100.69 %	●			
Brown				1,495,303	94.88 %	●			
Gold				1,496,741	95.88 %	●			
Maroon				1,662,188	100.31 %	●			
Purple				4,537,183	94.83 %	●			
Red				1,900,530	93.47 %	●			
Yellow				1,871,050	99.36 %	●			
Terminal 2D				1,841,491	94.28 %	●			
Grand Total	31,320,966	95.47 %	●	17,897,351	95.55 %	●	8,156,466	94.93 %	●

Production Performance Summary Production vs. Target Gas Production Field Analysis Geographical ...

READY 100%

# Value Delivery Options - Tactical/Strategic

- SLA — governs in both delivery options
- CPA (Component Pricing) — customer lead value delivery
  - License is component based
  - Standard Support
  - Price list limited services
- Enterprise Agreement (EA) — Partnership focused on value delivery
  - Unlimited license based on defined asset model & agreed change pricing metrics
  - Enhanced Support
  - Expanded Consultative services — center of excellence (COE), field support
  - OSIsoft focused on design, installation, and highly (24x7) available infrastructure
  - Joint focus on strategic & tactical value identification, attainment, & sustainment

# “Strategic” Enterprise Agreement Customers in O&G



250+ PI Systems, HA



200+ PI Systems, HA



20+ PI Systems, HA



15+ PI Systems, HA



10+ PI Systems, HA



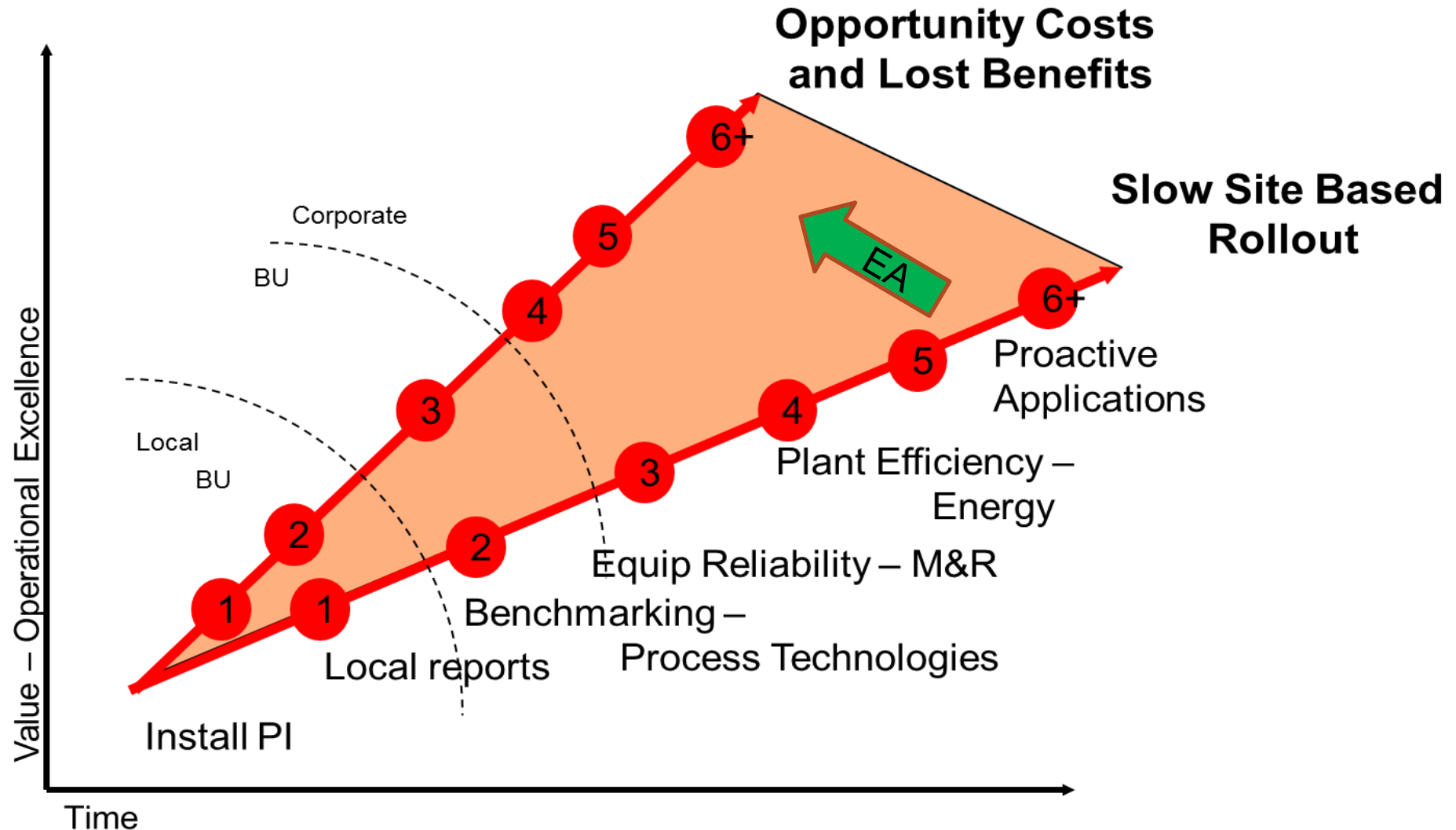
15+ PI Systems, HA



20+ PI Systems, HA

- **Strategic element of their technology landscape**
- Unlimited use of the PI System license across their enterprise
- Extensive Use of PI Analytics, PI-AF, PI-Notifications, & PI-Data Access
- Consultative partnership with OSIsoft focused on value creation and sustainment
- Revolutionizing their applications and solutions approach - significant value creation, usability, & TOC Impact
- Core element of cyber and information security strategy
- Typical tags per unit capacity or assets typically x2 that of non-EA customers with significant more use of PI AF and related advanced functionality delivering significance value add and TCO Reduction

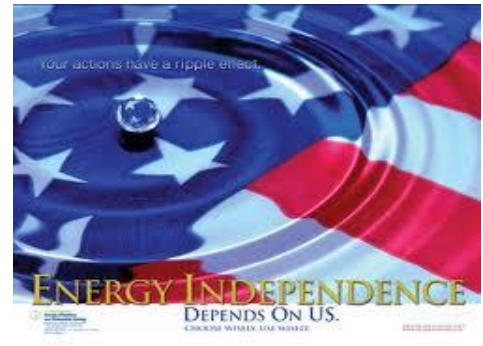
# Accelerating the Benefits - Time Value of Money





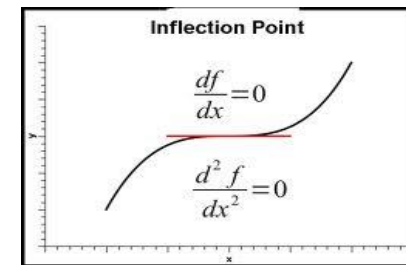
# Outline

- The PI System and “Energy Independence”
- Challenges and..... Opportunities
  - The Shale Revolution
  - Technological Trends
  - Industry Challenges
- Innovative PI System Applications - “The Art of the Possible”
- Closing Comments



# The Power of Data - Thriving in a World of Change & Supporting Energy Independence

- Energy Independence Enabled by Data and Information
- The Perfect Storm –
  - Technology Changes
  - Shale Revolution
  - Industry Challenges
- Leveraging the PI System as an Infrastructure for Change and Opportunity – “The Art of the Possible”
- The EA - From Tactical to Strategic
- At an Inflection Point - Winners and Losers





# THANK

# YOU

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