Welcome to the Oil & Gas and Petrochemical Industry Track
# The O&G and Petrochemicals Team

## Global Industry Principals

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cindy Crow</td>
<td>(Houston)</td>
</tr>
<tr>
<td>Russell Hebert</td>
<td>(London)</td>
</tr>
<tr>
<td>Craig Harclerode</td>
<td>(Houston)</td>
</tr>
</tbody>
</table>

## NA Industry Champions

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brian Harclerode</td>
<td>FSE</td>
</tr>
<tr>
<td>Ken Startz</td>
<td>SE</td>
</tr>
<tr>
<td>Stephen Reynolds</td>
<td>COE</td>
</tr>
<tr>
<td>Time Slot</td>
<td>Company(s)</td>
</tr>
<tr>
<td>-----------------</td>
<td>------------</td>
</tr>
<tr>
<td>9:00 - 9:30</td>
<td>OSIsoft</td>
</tr>
<tr>
<td>9:45 - 10:15</td>
<td>EOT Midstream</td>
</tr>
<tr>
<td>10:45 – 11:15</td>
<td>Shell</td>
</tr>
<tr>
<td>11:30 – 12:15</td>
<td>Noble Energy</td>
</tr>
<tr>
<td>12:15 – 2:15</td>
<td>OSIsoft</td>
</tr>
<tr>
<td>2:15 – 2:45</td>
<td>Shell</td>
</tr>
<tr>
<td>3:00 – 3:30</td>
<td>Chevron</td>
</tr>
<tr>
<td>4:00 – 4:45</td>
<td>MOL</td>
</tr>
<tr>
<td>4:45 – 5:15</td>
<td>Devon</td>
</tr>
</tbody>
</table>
Oil & Gas and Petrochemicals  PI User Groups

Join to discuss best practices, white papers, share news, and exchange ideas.

Objectives:
• Identify Best Practices
• Share knowledge and ideas across our industry
• Foster communication with OSIsoft regarding Industry needs

This is NOT an avenue for sales presentations or marketing

Want to opt in?
https://pisquare.osisoft.com/groups/midstream
Or contact jsirois@osisoft.com
Upstream – 2017/18
Hydrocarbon Processing Industry (HPI) 2017/18

Have questions?
• jsirois@osisoft.com
• ccrow@osisoft.com
• charclerode@osisoft.com
• Visit the PI Square Booth
Enabling Transformative Change & Business Value with IIOT, Advanced Analytics, & Big Data

Craig Harclerode
Global O&G/Petrochemicals IP
Successful implementations leverage fit for purpose technologies to address the unique characteristics and challenges of time series data and real time analytics.

""
#1

They Used the “4 M Approach”....

Make Me More Money
The MOL Story

A Journey with IIOT, Advanced Analytics, & Big Data

$1B EBITDA enabled by Strategic use of the PI System and PI AF as a smart OT Data Model
They Focused on the journey of Building A “smart” OT Analytical Foundation…first
An Infrastructure Investment Approach - “OT Data Utility”

Machine Learning
Yields & HCL
Advanced PSM
Advanced CBM

Initial Infrastructure Value
“Human Analytics”
Infrastructure Initial Investment

Incremental Value

Value Now
Value Over Time

VALUE
TIME
Moving to PI AF is a Vision and a Journey…..”Just do It!”

• Start PI AF with a key business initiative and build, capability, momentum and awareness;

• Market PI AF vision, capability, and value to leadership with alignment to strategic initiatives;

• Leverage PI AF Jumpstarts, OSIsoft consultation, PI AF templates, SIs, etc. to lower the barriers to PI AF use;

• Once PI AF critical mass is achieved, adoption will accelerate and be seen as transformative and strategic;

• MOL sees PI AF as enabling to many PI System capabilities like PI Coresight, PI Connectors, Integrators, etc.;
MOL Downstream Integrated Smart OT Data Model
They created & leveraged OT Configurable smart asset objects
Smart Asset Objects – Configuring the Smart OT Infrastructure-Smart FPS

- Compressor Template
- Water Injection Pump Template
- Smart Application Template

- Physics Based Attributes
- Meta data
- Sensors/Time Series
- Performance Curves
- Knowledge & Experience
- Health Index
- Limits
- KPIs
- SOP (.pdf)
- Events
- Notifications
- Etc.

Digital Twin or "Avatar"

Digital FPS #1

Physical FPS #1

Digital FPS #2

Physical FPS #2

Smart OT Infrastructure
Smart Asset Objects – **Configuring** the Smart Refinery OT Infrastructure

- **Exchanger Template**
- **Tower Template**
- **Pump Template**
- **Application Template (e.g., HTHA Corrosion)**

- **Physical Refinery #1**
- **Digital Refinery #1**
- **Physical Refinery #2**
- **Digital Refinery #2**

**Digital Enterprise**
TransCanada Anomaly Detection & Predictive Analytics

Centrifugal Compressor Templates

Physical Compressor Stations

Health Index Templates

Advanced Anomaly Detection Templates

Digital Compressor Stations

TransCanada Smart OT Infrastructure (illustrative)

Exception based KPI Dashboard system
Real-time Analytics – Multiple Layers of Contextual Information

Executive Dashboards
Visibility
Situational awareness

Drill into the Problem
Multiple layers of information

Data Analysis
Ad-hoc trending
Model training

Take Action, Track & Document

Executive Dashboards
Visibility
Situational awareness

Drill into the Problem
Multiple layers of information

Data Analysis
Ad-hoc trending
Model training

Take Action, Track & Document
PI AF is an “Abstraction Layer” – a Translator

Power Gen #1
Time Zone: US
Units of Measure: Std
Tagging & Asset Naming A, A*, A**

Power Gen #2
Time: Europe
Units of Measure Metric
Tagging & Asset Naming B, B*, B**

Power Gen #3
Time Zone C
Units of Measure C
Tagging & Asset Naming C, C*, C**
They rationalized & distributed what & where analytics were performed

..with an eye for the future – from the edge to the cloud...to the “community”
Data Infrastructure for Digital Transformation

Application Ready
Real-time Decisions
IIoT for 35 Years
Operational Intelligence

IIoT

PI System Smart OT Infrastructure
From the edge to the cloud
Rationalized & Distributed Analytics from the edge to the cloud

SMART OT Infrastructure
SMART Plant & Systems
SMART MACHINES
SMART DEVICES

BIG DATA
PI AF - the Foundation of MOL’s Distributed Analytics

IIOT Data

DCS SCADA

Yield Accounting P&S Unit Models

Financial Data

ERP

Equipment data

EAM

Laboratory data

LIMS

Natural Info Center

NICE

OT Data Model/Infrastructure

OT Object Model

Microsoft Azure

Python

R

Rationalized Analytics from the Edge to the Cloud

PI System
Natural Gas Consumption Prediction

BackGround

- Huge saving possibilities in the decrease of contracted natural gas daily maximum amount

Problem

- High penalty on daily amount exceedance
- Alerting system was needed

Solution

- Consumption prediction calculations in PI Analysis
- Detailed information on PI Coresight display (about consumption, prediction, contacts of decision makers)
- E-mail alerting system in Notifications
Improving Asset Integrity with Advanced Corrosion Analytics

- High Temperature Hydrogen Attack (HTHA)
- \( f^* \) (metallurgy, temperature, hydrogen partial pressure (PP), length of exposure)

Developed PI AF template that:
- Determine partial pressure
- Attribute of pipe class
- Temperature and length of exposure limits
- Total time above Temp and PP
- Alerts/notification/event frame

- Tested and rolled out in 6 units < 1 week
- All plants in 2015 < 2 months – 50+ nodes
Enterprise Analytics – Anomaly Detection

KPI Implementation in AF: Attribute Templates

Lookup curve-fit coefficients from SQL Table (performance curves)

<table>
<thead>
<tr>
<th>Data Reference</th>
<th>Table Lookup</th>
</tr>
</thead>
</table>

```
SELECT CoefficientValue FROM PerformanceCentriEff WHERE PerformanceModelID = @[]
PerformanceModelID] AND CoefficientType = @[_CoeffType] AND CoefficientOrder = 1
```

Apply curve-fit to calculate Efficiency

<table>
<thead>
<tr>
<th>Data Reference</th>
<th>Formula</th>
</tr>
</thead>
</table>

```
S = .:Driver|SteadySpeed;A = |[A];B = |[B];C = |[C];D = |D;E = |[E];F = |[F];G = |[G];H = |[H];I = |I;J = |J;K = |K;L = |L;M = |M;N = |N;O = |O;P = |[P];Q = |Q;X = FC_MaxSpeed;[if not(S) then 0 else (A + C^*X + E^*X^2 + G^*X^3 + F^*X^4 + C^*X^5 + M^*X^6 + O^*X^7 + Q^*X^8)/(1 + B^*X + D^*X^2 + F^*X^3 + H^*X^4 + J^*X^5 + K^*X^6 + L^*X^7 + P^*X^8)]
```
Enterprise Analytics – Findings

EA Finding using KPI Strategy

Found partially damaged compressor valve. The valve was replaced in a planned & controlled manner.
Perform the calculations/Analytics in the OT Infrastructure

- Excel Workbook
  - Excel (calculations, analytics, reporting, Visualization)
- Excel Workbook
- PI System (Asset Based)
  - Calculations, analytics
- Web/Mobility
  - Other Systems Visualization, reporting
- Excel Services Visualization/Reporting (Web)
- Data Sources (DCS/SCADA/PLC, etc.)
- Non-control Calculations
- "Historian" (Tag Based)
- Other Systems Calculations, analytics
  - Visualization, reporting
- Excel (calculations, analytics)
- Modeling Enterprise APM
  - PI Coresight (Web)
- Modeling Enterprise APM

Data Sources
- (DCS/SCADA/PLC, etc.)
Advanced APM using the Asset Health Index

PI Server
- Process database
- Online analysis of process information
- Calculation of asset health
  - Asset condition
  - Running hours
  - Performance
- User Interface
  - PI Coresight
  - PI DataLink

Connection (WebLogic)
- Calculated asset health
- Maintenance related information

SAP PM
- Technical database
- Management of maintenance processes
- Creation of work orders or notifications
- Trigger maintenance strategies based on asset health
PI System in IIoT Reference Architecture

Internet of Things Reference Model

Presented by Cisco at the IoT World Forum, October, 2014
PI System® IIoT Architecture
Rationalizing & Distributing Analytics
Devon Energy & NOV - Coil Tubing Analysis

Community Model
They leveraged the smart OT Infrastructure to redefine the IT/OT relationship...with the objective of unification of the “Ts” around delivering transformative business value
“OT Chart of Accounts” or “OT Data Object Model”
Devon’s Digital Transformation
Our Organization- A “Partnership” between OT & IT

“Devon’s Secret Sauce - OT Owns the smart OT Infrastructure, IT owns the platform – collaborative partnership” Quote from Rick Howell, OSIsoft IIOT. Advanced Analytics, and Big Data Forum Oct, 2016
Self Serve BI by Leveraging the Smart OT Infrastructure

Enterprise
Region
FPS
System
Asset (Elements)
Category xx
Attribute 1
Attribute 2
Category xx
Attribute 3
Attribute 4
Attribute 5
Category xx
Attribute 6
Attribute 7
Attribute 8

Company "Language"
PI Integrator for Business Analytics – Self Service BI

PI AF OT Data Model is Foundational for the Integrators

- **CLEANSE**
  - **Data quality:** Remove anomalies

- **AUGMENT**
  - **Model normalization:** Evenly spaced

- **SHAPE**
  - **Data aggregation:** Sums

- **TRANSMIT**
  - **Data Compatibility:** SQL and the tools we need
  - **PULL**
  - **PUSH**

Data quality:
- Remove anomalies

Model normalization:
- Evenly spaced

Data aggregation:
- Sums

Data Compatibility:
- SQL and the tools we need

PI AF OT Data Model is Foundational for the Integrators
Prescription to Transformative Business Value

1. Focus accelerating of business value;

2. Create a smart OT infrastructure as a foundation for ALL analytics;

3. Create smart asset object templates;

4. Rationalize & distribute analytics;

5. Partnerships between OT & IT;
<table>
<thead>
<tr>
<th>Time Slot</th>
<th>Company(s)</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 - 9:30</td>
<td>OSIsoft</td>
<td>“Smart”, Configurable OT Infrastructure</td>
</tr>
<tr>
<td>9:45 - 10:15</td>
<td>EOT Midstream</td>
<td>Enabling Reliability Centered Maintenance</td>
</tr>
<tr>
<td>10:45 – 11:15</td>
<td>Shell</td>
<td>Blowout Preventer Monitoring</td>
</tr>
<tr>
<td>11:30 – 12:15</td>
<td>Noble Energy</td>
<td>Corporate PI AF + Geospatial Analytics</td>
</tr>
<tr>
<td>12:15 – 2:15</td>
<td>OSIsoft</td>
<td>Lunch – Midstream Users Group Kick Off</td>
</tr>
<tr>
<td>2:15 – 2:45</td>
<td>Shell</td>
<td>Real-Time Operations on Shell Prelude FLNG</td>
</tr>
<tr>
<td>3:00 – 3:30</td>
<td>Chevron</td>
<td>CBM and Smart Monitoring on the Frade FPSO</td>
</tr>
<tr>
<td>4:00 – 4:45</td>
<td>MOL</td>
<td>Opportunity Crudes/IOW &amp; Advanced Analytics</td>
</tr>
<tr>
<td>4:45 – 5:15</td>
<td>Devon</td>
<td>Enabling the Journey of Operational Excellence</td>
</tr>
</tbody>
</table>
Thank You

“In God we trust; all others bring data.”

W. E. Deming