We believe People with Data can Transform their world
Building the PI 101 agenda:

Its Day 3 of the UC

- What gaps are in your knowledge?
- What else do you want to do with the PI System?
- What can we clarify?
- Simply put, what remaining questions do you have?
What PI 101 questions do you have?

1. Will this connect to IOC?
2. How long does this take to j stall?
PI 101 Agenda

- PI System 10,000 ft. view
- Power of the PI Server
- How to visualize PI System data
- How to build a PI System
The PI System is operations software

Operations software

Big Data aggregation software

Sales & Mking software

Core systems, business & IT software
Empowering Business in Real-Time.

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OSIsoft. PI System

Real-time data and event enterprise infrastructure

Safety & Security
Energy Utilization
Process Efficiency
Asset Health
Quality
Regulatory Performance

Control networks & Remote assets
From Silos and Complexity
One Common Infrastructure for your Operational Data

Collect
PI Interfaces, PI Connectors

Manage Enhance
PI Server

Deliver
To Users and Systems
Data collection & the PI Server
Connectivity – PI Interfaces & PI Connectors

Native connections to 100s of data sources
Configurable connections to everything else

• PI Connector for OPC
• PI Connector for UFL (and REST)
• PI Connector for Wonderware Historian
• PI Manual Logger
• PI Interface for Relational Database
• PI Interface for HTML
• And ~300 more…
PI Data Archive (Time-Series Database / “Historian”)

- Real-time data stream/sensor reading → PI Tag

<table>
<thead>
<tr>
<th>TAG</th>
<th>TIME</th>
<th>VALUE</th>
<th>STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIC1001.PV</td>
<td>23-MAY-16 11:01:02</td>
<td>12.3</td>
<td>GOOD</td>
</tr>
<tr>
<td>LIC30211.PV</td>
<td>23-MAY-16 11:01:03</td>
<td>198.4</td>
<td></td>
</tr>
<tr>
<td>GOOD</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Proprietary database optimized for time-series data
Proven Engine – PI Server

Core Capabilities
- System of Record
- Real-time Processing
- Data Calculations
- Alerting Engine
- Metadata Layer
- Event Tagging

<table>
<thead>
<tr>
<th>Core Capabilities</th>
<th>PI Data Archive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max PI Tag Count</td>
<td>20M+</td>
</tr>
<tr>
<td>Startup Time</td>
<td>&lt;30 sec/Mtags</td>
</tr>
<tr>
<td>Data Out (Archive)</td>
<td>&gt;10M ev/sec</td>
</tr>
<tr>
<td>Data In (Snapshot)</td>
<td>&gt;1M ev/sec</td>
</tr>
<tr>
<td>Data In (Archive)</td>
<td>&gt;500K ev/sec</td>
</tr>
</tbody>
</table>
Asset Framework

- A virtual asset for each physical asset
- Virtual assets are organized by physical and logical relationships
- Allows inclusion of meta data (information about the data)
Analytics & Templates

Boiler Efficiency = \( \text{AVG}(B_1..B_n) \)

- **Boiler 1**
  - Flow Out
  - Fuel Flow Rate
  - Efficiency = \( \frac{\text{Steam Flow Out}}{\text{Fuel Flow Rate}} \times \frac{(h_s - h_{fw})}{\text{HHV}} \)

- **Boiler 2**
  - Flow Out
  - Fuel Flow Rate
  - Efficiency

- **Boiler 3**
  - Flow Out
  - Fuel Flow Rate
  - Efficiency
### Complex equations and analytics

<table>
<thead>
<tr>
<th>Name</th>
<th>Expression</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>H2 Score</td>
<td>IF 'H2'&lt;=50 THEN 9 ELSE IF 'H2'&lt;=100 THEN 5 ELSE IF 'H2'&gt;=250 THEN 3 ELSE 1</td>
<td>THA Score, DGA Score, H2 Score</td>
</tr>
<tr>
<td>C2H4 Score</td>
<td>IF 'C2H4'&lt;=50 THEN 9 ELSE IF 'C2H4'&lt;=100 THEN 5 ELSE IF 'C2H4'&gt;=250 THEN 3 ELSE 1</td>
<td>THA Score, DGA Score, C2H4 Score</td>
</tr>
<tr>
<td>Total Gas Score</td>
<td>IF 'Total Gas'&lt;=719 THEN 9 ELSE IF 'Total Gas'&lt;=1919 THEN 5 ELSE IF 'Total Gas'&gt;=4629 THEN 3 ELSE 1</td>
<td>THA Score, DGA Score, COMB GAS S</td>
</tr>
<tr>
<td>C2H6 Score</td>
<td>IF 'C2H6'&lt;=65 THEN 9 ELSE IF 'C2H6'&lt;=100 THEN 5 ELSE IF 'C2H6'&gt;=150 THEN 3 ELSE 1</td>
<td>THA Score, DGA Score, C2H6 Score</td>
</tr>
<tr>
<td>CH4 Score</td>
<td>IF 'CH4'&lt;=120 THEN 9 ELSE IF 'CH4'&lt;=250 THEN 5 ELSE IF 'CH4'&gt;=400 THEN 3 ELSE 1</td>
<td>THA Score, DGA Score, CH4 Score</td>
</tr>
<tr>
<td>CO Score</td>
<td>IF 'CO'&lt;=350 THEN 9 ELSE IF 'CO'&lt;=570 THEN 5 ELSE IF 'CO'&gt;=1400 THEN 3 ELSE 1</td>
<td>THA Score, DGA Score, CO Score</td>
</tr>
<tr>
<td>CO2 Score</td>
<td>IF 'CO2'&lt;=2500 THEN 9 ELSE IF 'CO2'&gt;=4000 THEN 5 ELSE IF 'CO2'&gt;=10000 THEN 3 ELSE 1</td>
<td>THA Score, DGA Score, CO2 Score</td>
</tr>
<tr>
<td>DGA Score</td>
<td>0.46<em>C2H2 Score + 0.09</em>H2 Score + 0.15<em>C2H4 Score + 0.1</em>Total Gas Score + 0.05<em>C2H6 Score + 0.05</em>CH4 Score</td>
<td>THA Score, DGA Score</td>
</tr>
<tr>
<td>Load Score</td>
<td>IF 'Load'/MVA&lt;=0.7 THEN 9 ELSE IF ('Load'/MVA)&gt;0.7 AND 'Load'/MVA&lt;=0.9 THEN 5 ELSE IF 'Load'/MVA&gt;0.9 THEN 1</td>
<td>THA Score, Load Score</td>
</tr>
<tr>
<td>THA Score</td>
<td>(DesignScore<em>0.15 + MfgScore</em>0.1 + AgeScore<em>0.15 + DGA Score</em>0.35 + Load Score<em>0.25)/9</em>100</td>
<td>THA Score</td>
</tr>
</tbody>
</table>

**Scheduling:** Event-Triggered

**Trigger on:** Any Input

*Could not connect to the PI Analysis Service.*
Event Frames

\[ \text{Efficiency} = \left( \frac{\text{Flow Out}}{\text{Fuel Flow Rate}} \right) \times 3.14 \]

\[ \text{myEF.Start} = (\text{Efficiency} < \text{LIMIT}) \]

\[ \text{myEF.End} = (\text{Efficiency} > \text{LIMIT}) \text{ AND } (\text{Fuel Flow Rate} > 25) \]
Time-Series Data, Assets, and Events

- PI Data Archive
- PI Asset Framework
- PI Event Frames

- Rotor Speed

- GT56.TIC.PV
- WT11.SI.PV

- Event Frame Attributes
  - Pressure Avg
  - Product Loss
  - Reason Code
  - Temp Max

- Downtime
- Batch
- Process Excursion
- Shutdown
- Shift
- Startup
- Grade Change
- Environmental Excursion

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Trigger-based Notifications

- Pattern Recognition Alarm
  - Failure initiated
  - Ultrasonic Detection
  - Vibration Detection
  - Oil Analysis Detection

- Conventional Monitoring System Alarm
  - Audible Noise
  - Not to Touch
  - Mechanically Loose

- Equipment Condition
  - Predictive
  - Preventive
  - Run to failure

- Detection Limit
  - Opportunity window

- Damage Limit
  - Catastrophic failure

- Web Service / XML
  - CMMS / Maintenance System

- DF PI Notifications
  - Wind Farm availability is under 70%

Image from http://www.emisoftech.com/Site/Solutions/EMICBM.html
Get the Complete Picture

Analyses
- Efficiency analysis
- Key Performance Indicators (KPI)

Events
- Downtime
- Startup
- Failure

Notifications
- High speed
- Rotor failure
- Low pressure

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

Asset details
- Name
- Model
- Manufacturer

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

Elements
- Boilers
- Equipment
- NuGreen
- Houston
  - Cracking Process
  - Equipment
    - B-210
    - B-235
    - F-321
    - F-409
    - H-2043
    - H-230
    - K-304
    - K-556
    - P-214
    - P-456
    - P-560
  - Extruding Process
  - Milling Process
- Little Rock
- Tucson
- Wichita
- Pumps
  - P-007
  - P-009
  - P-020
  - P-099
  - P-101

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What PI 101 questions do you have?

- Will this connect to IOC?
- How long does this take to j stall?
PI System Visualization
PI System visualization tools

- Process Displays
- Mobile
- Spreadsheets

PI Vision
PI DataLink
PI Vision

Modern and intuitive web tool:

- Efficient search
- Rapid screen creation
- Intuitive learning of its functionalities
- Facilitated collaboration and sharing of insights
Compare modeled and predicted datasets against live sensor data.
Compare similar events with event overlays
PI DataLink

- PI System data in Microsoft Excel
- Allows summary calculations and filtering of the data
- Access to Excel functionalities
Building a PI System
Building blocks of a PI System: Block 1
Building blocks of a PI System: Block 2

Block 2

Data Source

Win OS

PI Connector software

Win Server OS

PI Server software

VM and Cloud server hosting possible
Building blocks of a PI System: Block 3

- **Data Source**
- **PI Connector software**
  - Win OS
- **PI Server software**
  - Win Server OS
- **PI Client software**
  - Mobile, PC, browser, etc.
Questions Interlude

Next: Moving data from A→B
PI Integrator for Business Analytics

CLEANSE
- data quality

AUGMENT
- data aggregation
- model normalization

SHAPE

TRANSMIT
- data compatibility

PULL

PUSH

Business Intelligence & Visual Analytics

Data Warehouse

Big Data
PI System data animates an ESRI map

PI AF Template

Attribute Symbology

Current Value
Internet of Hotel Things (IoHT)

Experience **PI Vision** from your own device!

For more information visit

https://ioht.osisoft.com

**Sensors and connectivity provided by the following partners:**
Have an idea how to improve our products?

OSIsoft wants to hear from you!

https://feedback.osisoft.com/
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