Welcome to the OSIsoft IIOT, Advanced Analytics, & Big Data Forum

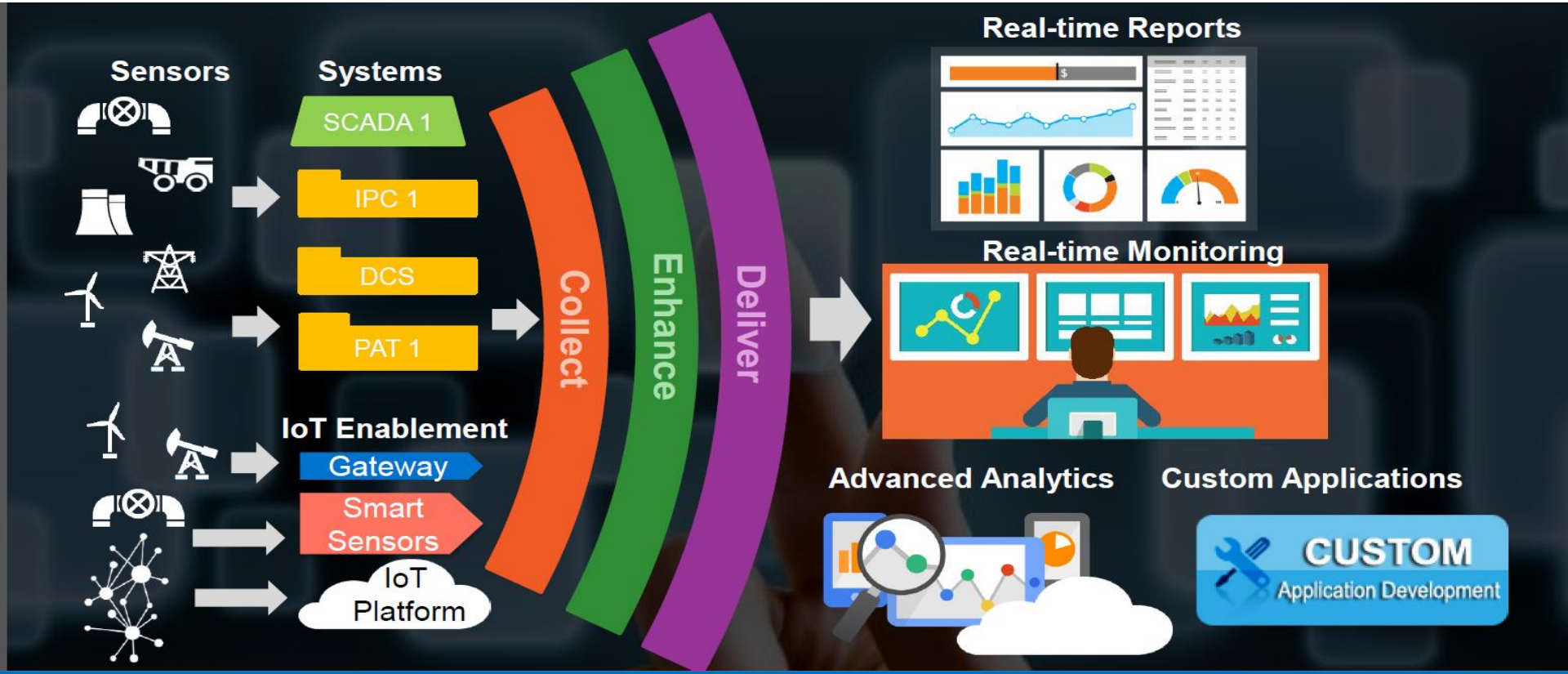
Eric Morehead, Business Development Manager

October 12th, 2016

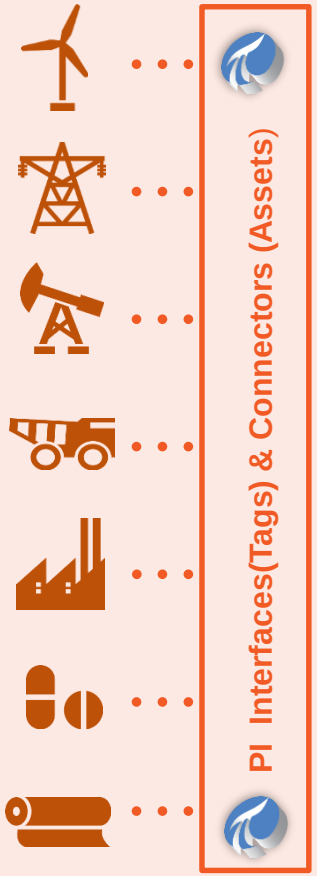
Agenda Review

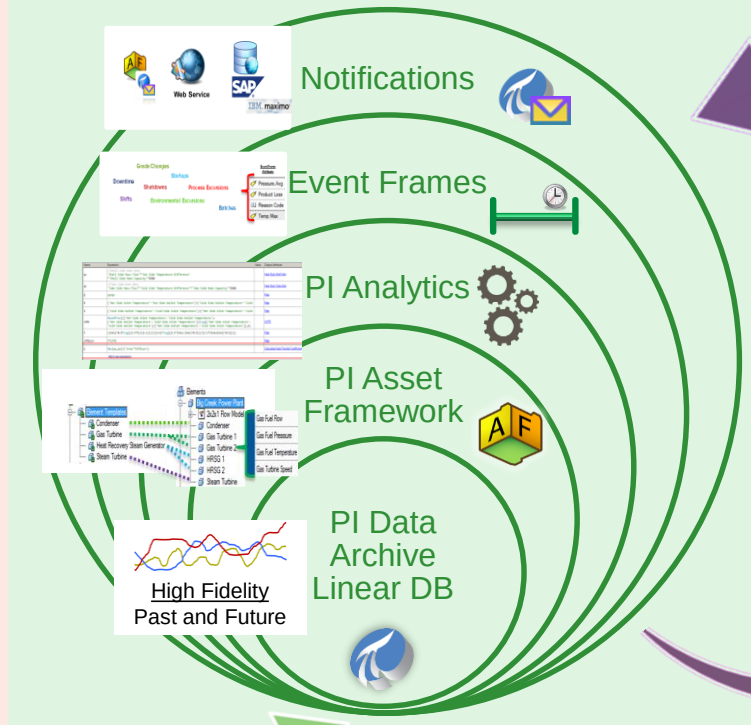
Forum Context

Bringing Order & Context to Time Series Data & Metadata



PI System Infrastructure – The Big Picture





PI Server Bundle
Perpetual License

PI System Access

PI Integrators

PI Cloud Services

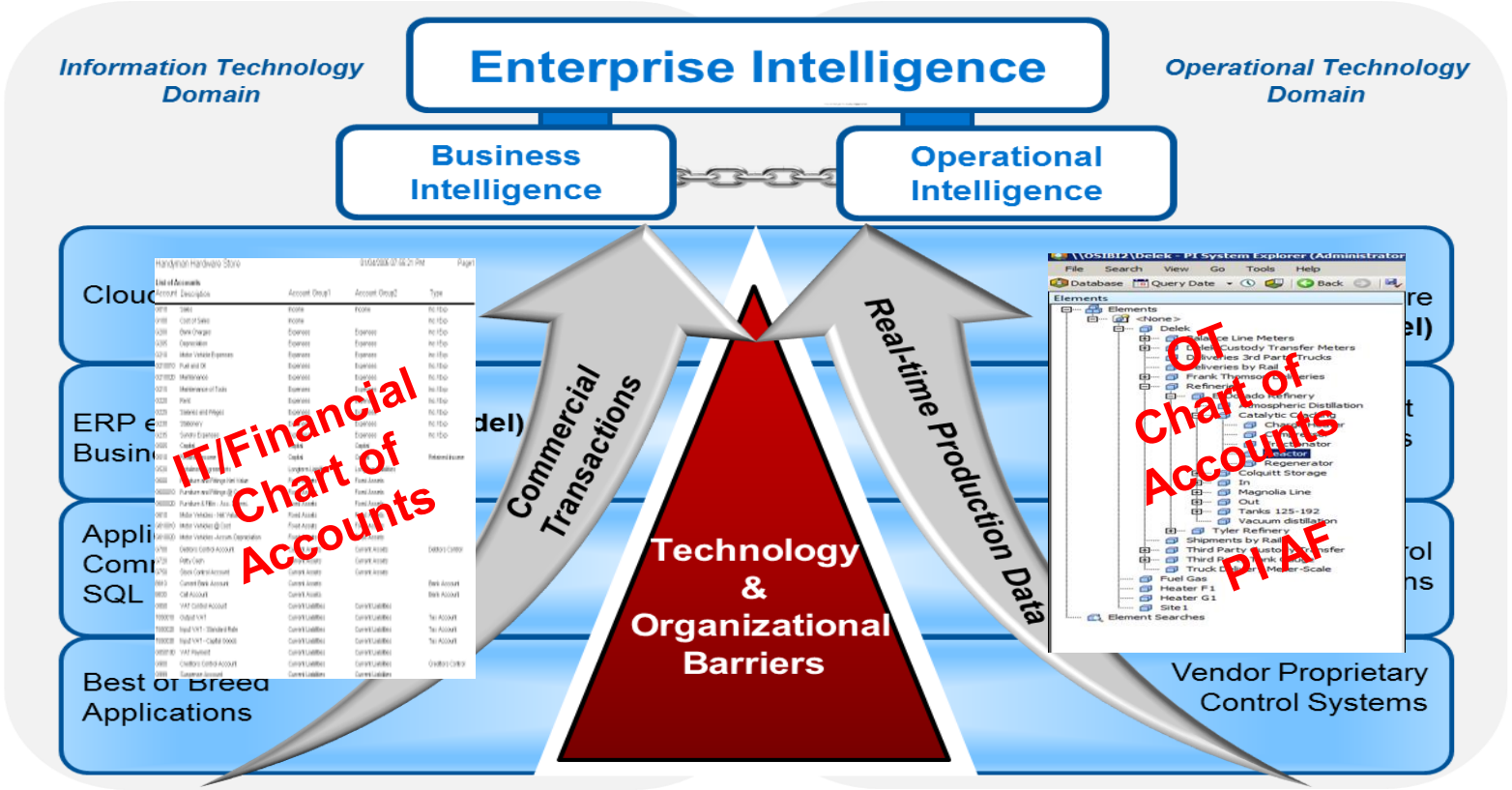
PI Visualization Suite

Business Analytics

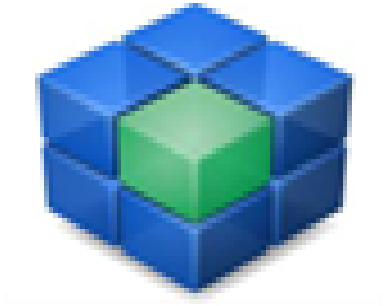
PI Cloud Connect

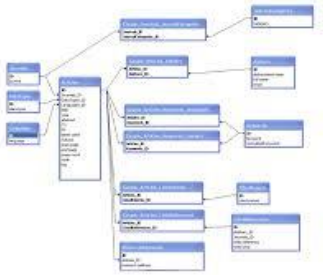
- PI Manual Logger
- PI Coresight
- PI ProcessBook
- PI DataLink
- PI WebParts

The “OT Chart of Accounts” or “OT Data Object Model”



OT Object Data Model Much More than a RDB or Data Lake

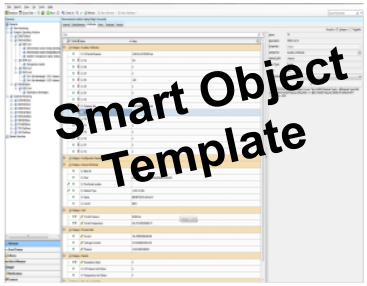


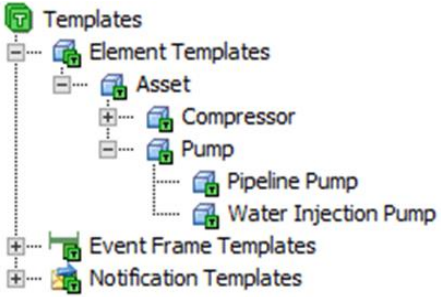


Typical Relational Data Model

Fixed Relationships
“Relational Oriented Functionality”
Fixed Context
Relational Tables

OT Object Data Model Much More than a RDB or Data Lake





OT Object Data Model

Flexible and Dynamic Relationships

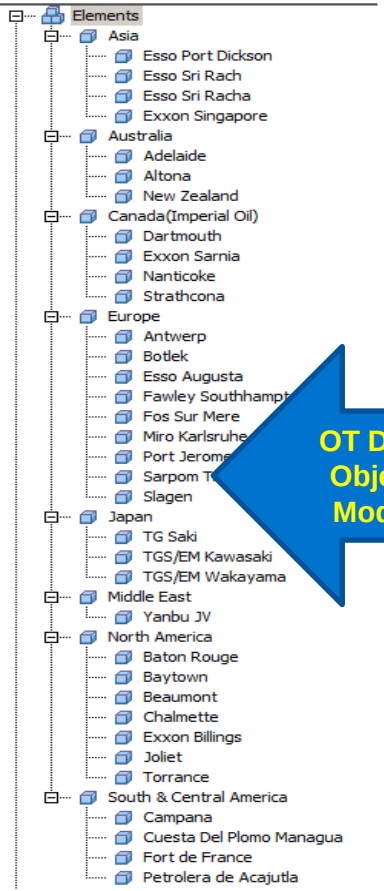
"Configurable Object Oriented Functionality"

Hybrid, Open, Agnostic, Product vs Solution

Smart Objects:

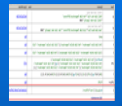
- **Classes (Templates)**
- **Elements & Attributes**
- **Methods**
- **Data References**
- **Inheritance & Persistence**

PI Asset Framework (PI AF) - OT Data Object Model & Abstraction Layer



OT Data Object Model

Analyses
- Efficiency analysis
- Key Performance Indicators (KPI)
- 1st level predictive analytics/forecasting
- .



Events
- Downtime
- Startup
- Movements
- Analytics

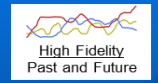
Notifications
- High speed
- Rotor failure
- Low pressure
- CBM (integration with EHMS)

Downstream
Chemicals
Lubes
Refining
Region
Refinery
Unit
Asset(Element)
Category xx
Attribute 1
Attribute 2
Category xx
Attribute 3
Attribute 4
Attribute 5
Category xx
Attribute 6
Attribute 7
Attribute 8

Smart Asset Template

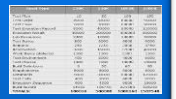
L1234

Time-series
+ External via Data Reference to **DCS, SCADA, IIOT , etc.**
- Flow
- Pressure
- Temperature
- State



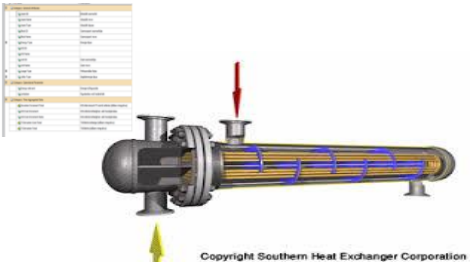
Manual Data Entry

Asset Details (via Asset Management System)
External Data via Data Reference)
- Name
- Model
- Manufacturer
- Lat/Long

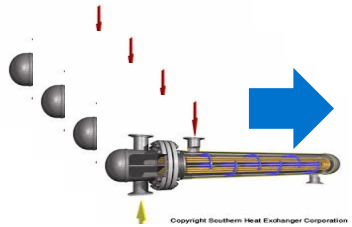


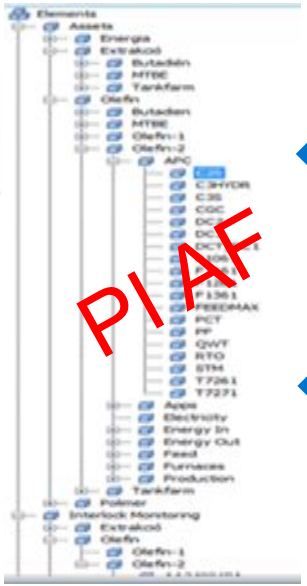
External Data (Data Reference)
- **Performance curves**
- **Last maintenance date (EHMS)**
- **Financial Data (ERP)**
- **Best operating procedures(.pdf references)**
- **Environmental Limits (CEMES)**
- **Targets/Future Data (model output)**

Using Smart Asset Objects – The "Lego Blocks" of the OT Data Model



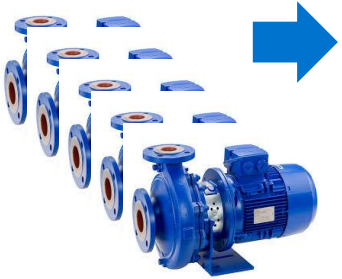
Exchanger Template



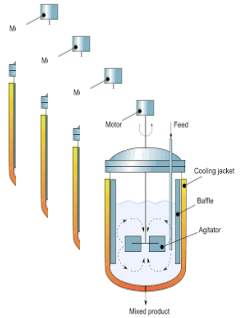


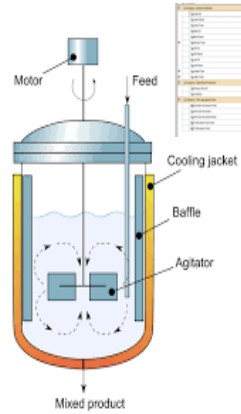
Tower Template

Pump Template



OT Data Model –
"OT Chart of Accounts"

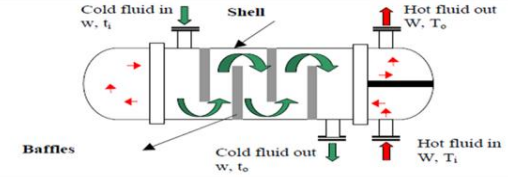




Reactor Template

First Principles Analytics – “Smart Asset Objects”

- ***Configure*** calculations at scale
- Math, statistical, logical and steam table functions
- Supports basic predictive analytics
- Supports future data for forecasting
- Can evolve over time by “tuning” expressions
- Can “ backfill” in the PI Archive



Heat Exchanger Key Performance Indicator:

Overall heat transfer coefficient

$$U = \frac{Q}{A \times \text{Corrected LMTD}}$$

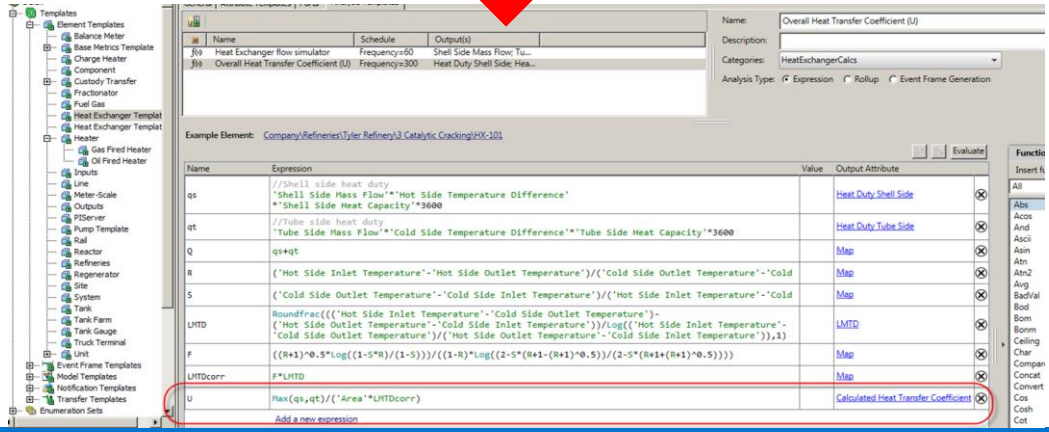
RULE: *IF the heat transfer coefficient is decreasing, THEN the* ***Heat Exchanger FOULING*** *!!! Cleaining is required!*

Calculation Steps:

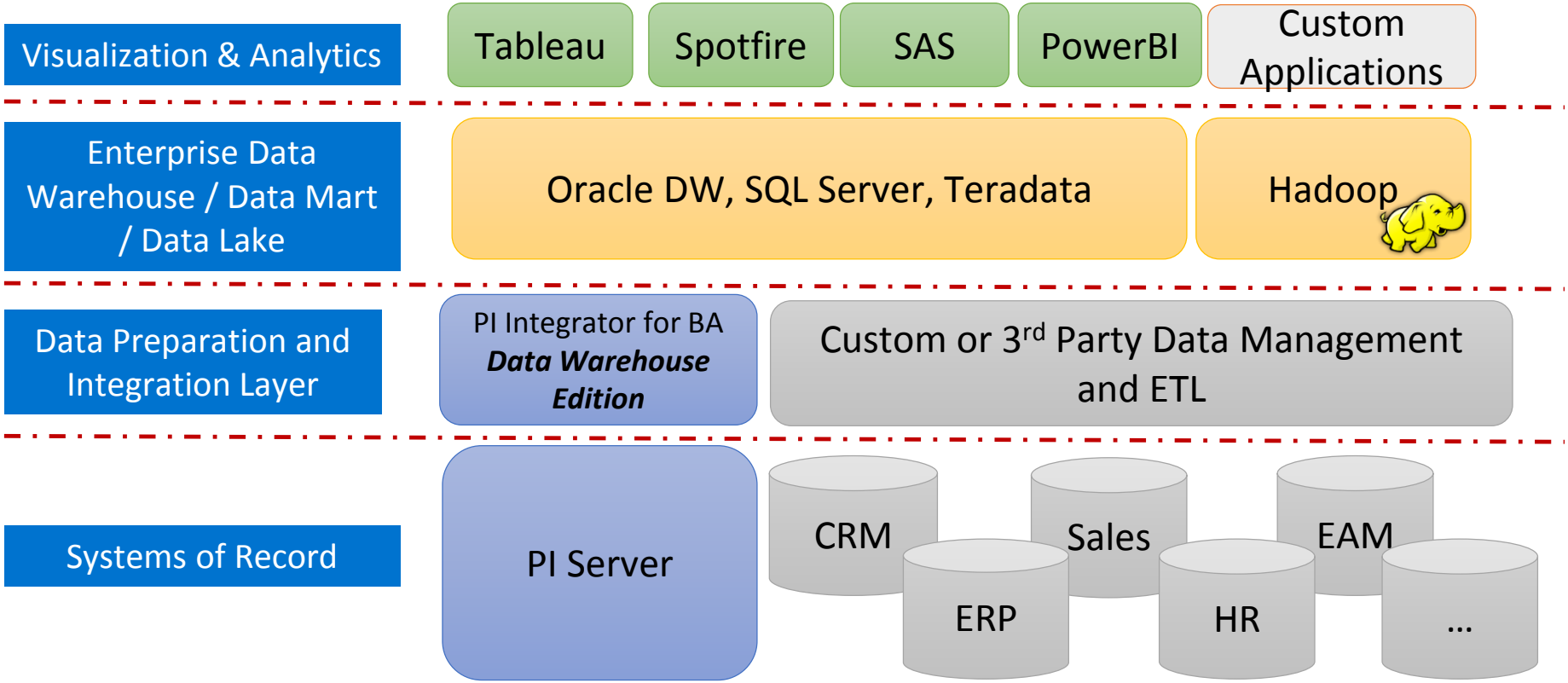
1. Heat Duty, $Q = q_s + q_t$
   $q_s = W \times C_{ph} \times (T_i - T_o)/1000/3600$
   $q_s = w \times C_{pc} \times (t_o - t_i)/1000/3600$
2. Hot Fluid Pressure Drop, $\Delta P_h = P_i - P_o$
3. Cold fluid pressure drop, $\Delta P_c = p_i - p_o$
4. Temperature range hot fluid, $\Delta T = T_i - T_o$
5. Temperature range cold fluid, $\Delta t = t_o - t_i$
6. Capacity ratio, $R = W \times C_{Ph} / w \times C_{pc}$ (or) $(T_i - T_o) / (t_o - t_i)$
7. Effectiveness, $S = (t_o - t_i) / (T_i - t_i)$
8. LMTD
   LMTD Counter current Flow = $((T_i - t_o) - (T_o - t_i)) / \ln ((T_i - t_o)/(T_o - t_i))$
   LMTD Co current Flow = $((T_i - t_i) - (T_o - t_o)) / \ln ((T_i - t_i)/(T_o - t_o))$
   Correction factor for LMTD to account for Cross flow

$$F = \frac{(R+1)^{1/2} \times \ln((1-SR)/(1-S))}{(1-R) \times \ln\left\{\frac{2-S(R+1-(R+1)^{1/2})}{2-S(R+1+(R+1)^{1/2})}\right\}}$$

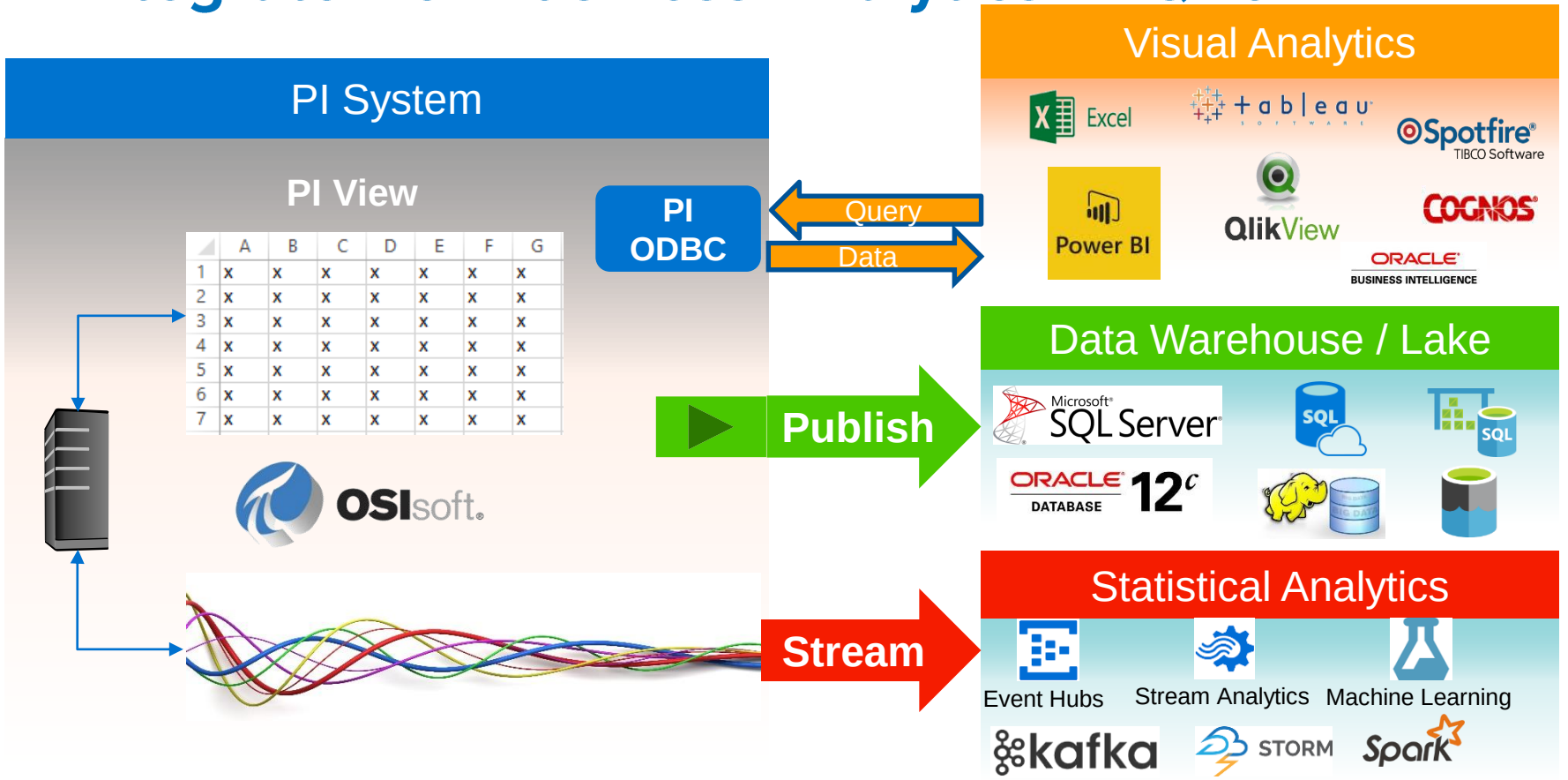
9. Corrected LMTD = F x LMTD



Enterprise Data Warehouse Architecture



PI Integrator for Business Analytics – 1Q2017



Thank You

For taking the time to attend

OSIsoft' IIOT, Advanced Analytics, & Big Data Forum

We hope by doing so, you too can learn how to transform your world

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