



OSIsoft.

REGIONAL SEMINAR

A P A C

The Power of Data

MALAYSIA



Explore and Expose your Data with PI Data Access and Business Intelligence

Presented by **Han Yong Lee**

Exploring and Exposing Data



Gain **visibility** into the right data,
at the right place, at the right time



How?

Need an easy way
to **disseminate** information

Business Challenges

Disparate systems

- Acquired independently, over time
- Different departments/units

Domain, industry, or user- specific needs

- PI System is an infrastructure

Many different targets

- Diverse types of workers
- Different platforms, media

A few use cases, some ideas

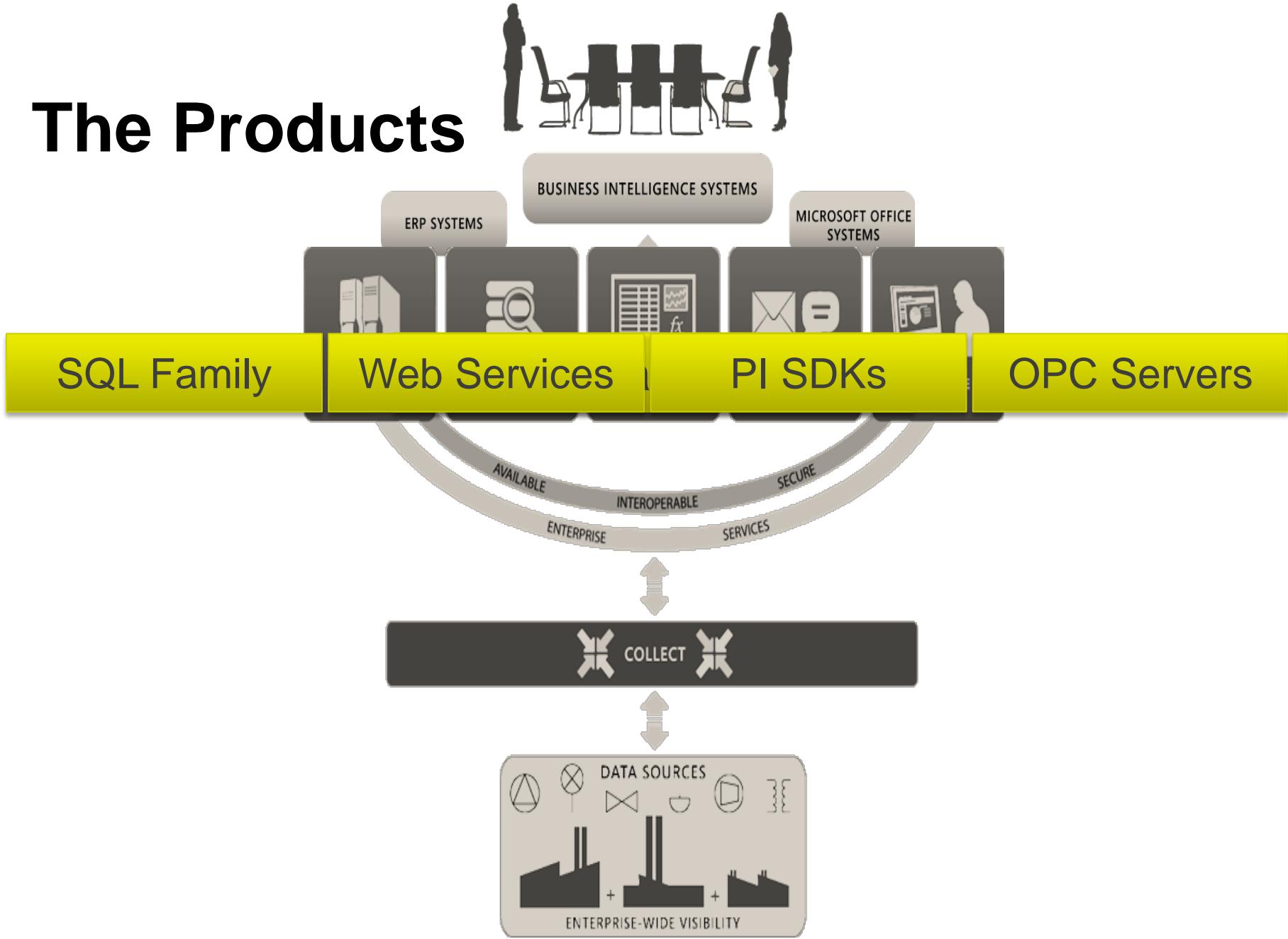
- LoB Systems/Databases
- Orchestration/Workflows
- Web/Non-Windows Platforms
- Analysis/BI/Reporting
- Custom Applications



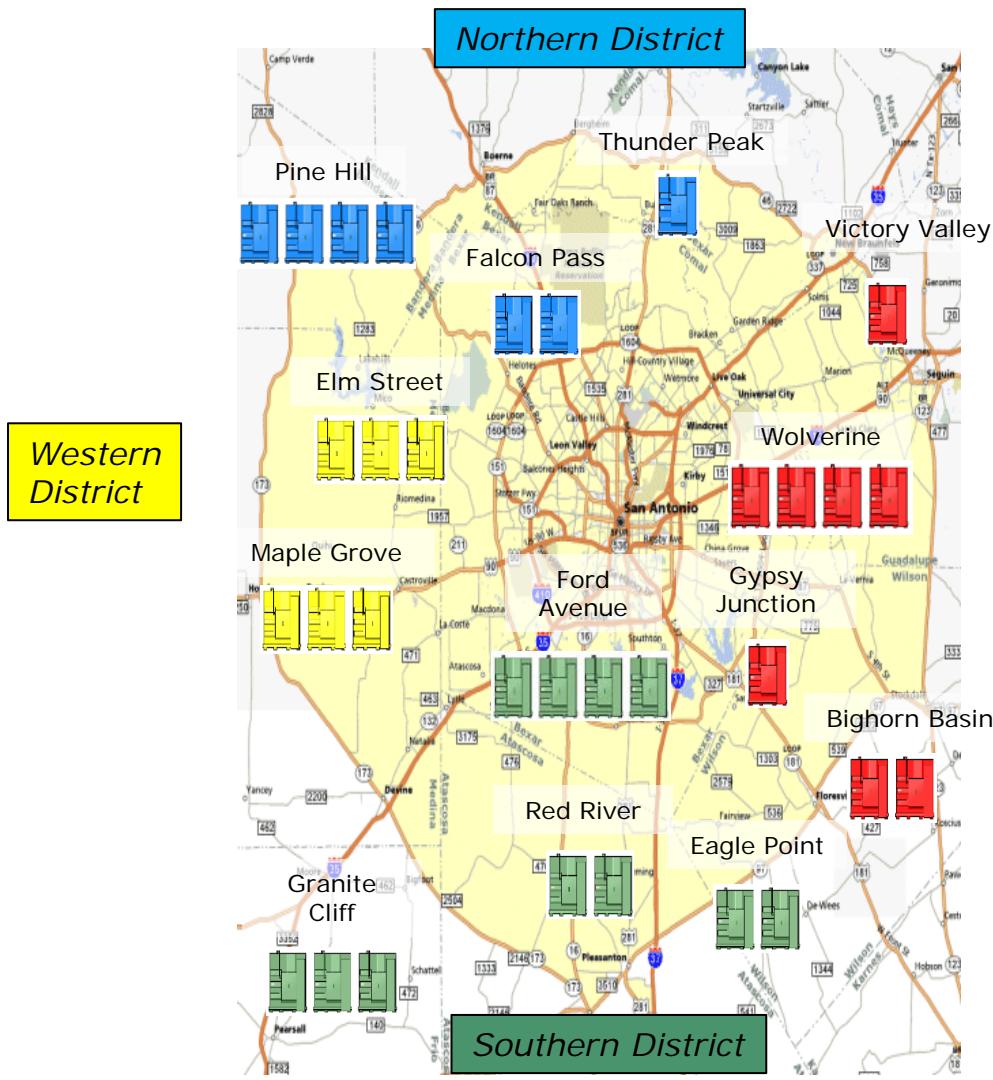
Custom Downtime Analysis Engine

Automated Ordering to Suppliers

The Products



Example: Substation Power Distribution Profile



My Objectives

- Profile 30 day Power Distribution
 - Filter and Analyze by Eastern District Location and Rate Period
 - Aging Asset Risk Assessment

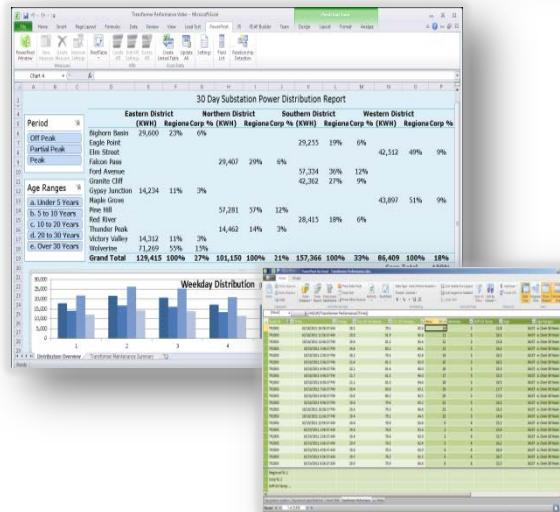
Business Analytics Toolkit



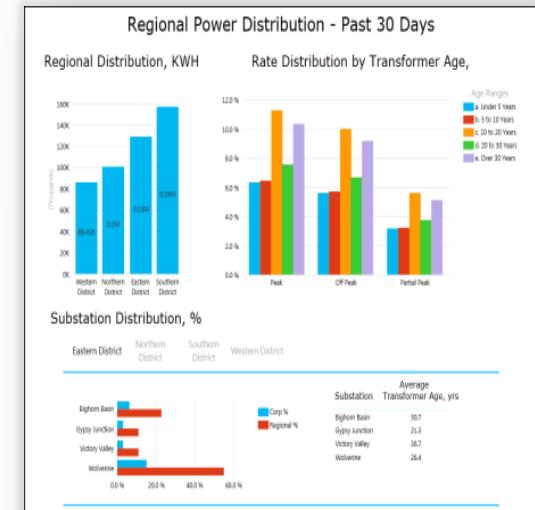
Microsoft®



Microsoft®
Excel® 2010



PowerPivot
for Excel 2010

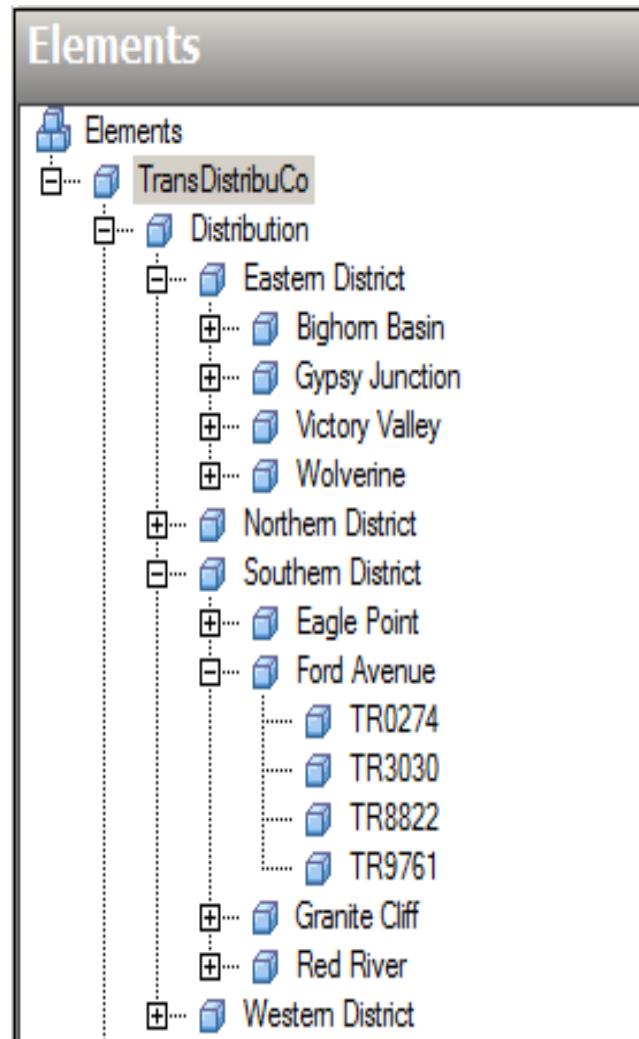


Power View

PI Server – PI Asset Framework

Asset Hierarchy

- District
- Substation
- Transformer



PI Server – PI Asset Framework

The screenshot shows the PI System's Element browser on the left and a detailed view of the PI Asset Framework for asset ID TR0274 on the right.

Elements Browser:

- Elements
- TransDistribCo
 - Distribution
 - Eastern District
 - Bighorn Basin
 - Gypsy Junction
 - Victory Valley
 - Wolverine
 - Northern District
 - Southern District
 - Eagle Point
 - Ford Avenue
 - TR0274
 - TR3030
 - TR8822
 - TR9761
 - Granite Cliff
 - Red River
 - Western District

Transformer Attributes

- PI System Data
- Equipment Specifications
- DGA analysis

TR0274																						
General Child Elements Attributes Ports Version																						
<input type="text"/> Filter <input type="button"/>																						
<table border="1"><thead><tr><th>Name</th><th>Value</th></tr></thead><tbody><tr><td>Acetylene</td><td>4 ppm</td></tr><tr><td>Carbon Dioxide</td><td>3004 ppm</td></tr><tr><td>Carbon Monoxide</td><td>123 ppm</td></tr><tr><td>Ethane</td><td>190 ppm</td></tr><tr><td>Ethylene</td><td>38 ppm</td></tr><tr><td>Hydrogen</td><td>294 ppm</td></tr><tr><td>Methane</td><td>121 ppm</td></tr><tr><td>Nitrogen</td><td>22698 ppm</td></tr><tr><td>Oxygen</td><td>2340 ppm</td></tr></tbody></table>			Name	Value	Acetylene	4 ppm	Carbon Dioxide	3004 ppm	Carbon Monoxide	123 ppm	Ethane	190 ppm	Ethylene	38 ppm	Hydrogen	294 ppm	Methane	121 ppm	Nitrogen	22698 ppm	Oxygen	2340 ppm
Name	Value																					
Acetylene	4 ppm																					
Carbon Dioxide	3004 ppm																					
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Nitrogen	22698 ppm																					
Oxygen	2340 ppm																					
<input type="checkbox"/> Category: Current DGA Analysis																						
<input type="checkbox"/> Category: Load Tap Changer																						
<input type="checkbox"/> Category: Performance																						
<input type="checkbox"/> Category: Specifications																						
<input type="checkbox"/> Category: Tank																						

PI OLEDB Enterprise

Important Considerations

- Leverage structure used throughout your PI Infrastructure
- Insure accurate aggregation of real-time events
- Scale-up by adding PI AF Structure
- Access Event Frames in next release

Asset ID	Time	Energy	Top Oil Temp	Hour	Weekday	Diff Oil Temp	Age Ranges	CH4 to H2
TR2003	8/14/2011 7:41:30 PM	19.95	80.79	19	1	15.5387721724381	e. Over 30 Years	1.471
TR2003	8/14/2011 8:41:30 PM	19.93	80.74	20	1	15.521973616169	e. Over 30 Years	1.471
TR2003	8/14/2011 9:41:30 PM	19.90	80.68	21	1	15.505208507958	e. Over 30 Years	1.471
TR2003	8/14/2011 10:41:30 PM	19.87	80.63	22	1	15.488481739978	e. Over 30 Years	1.471
TR2003	8/14/2011 11:41:30 PM	19.84	80.58	23	1	15.47173497915323	e. Over 30 Years	1.471
TR2003	8/15/2011 12:41:30 AM	19.82	80.52	0	2	15.4549881183323	e. Over 30 Years	1.471
TR2003	8/15/2011 1:41:30 AM	19.79	80.47	1	2	15.4382413075112	e. Over 30 Years	1.471
TR2003	8/15/2011 2:41:30 AM	19.76	80.41	2	2	15.421949066590	e. Over 30 Years	1.471
TR2003	8/15/2011 3:41:30 AM	19.73	80.36	3	2	15.4047478586689	e. Over 30 Years	1.471
TR2003	8/15/2011 4:41:30 AM	19.71	80.31	4	2	15.388008750478	e. Over 30 Years	1.471
TR2003	8/15/2011 5:41:30 AM	19.69	80.25	5	2	15.3712540042266	e. Over 30 Years	1.471
TR2003	8/15/2011 6:41:30 AM	19.65	80.20	6	2	15.3545072534055	e. Over 30 Years	1.471
TR2003	8/15/2011 7:41:30 AM	19.63	80.14	7	2	15.337760442584	e. Over 30 Years	1.471
TR2003	8/15/2011 8:41:30 AM	19.60	80.09	8	2	15.3210136317632	e. Over 30 Years	1.471
TR2003	8/15/2011 9:41:30 AM	21.03	79.96	9	2	13.2137407314932	e. Over 30 Years	1.471
TR2003	8/15/2011 10:41:30 AM	21.20	81.93	10	2	16.640707506529	e. Over 30 Years	1.471
TR2003	8/15/2011 11:41:30 AM	21.22	82.68	11	2	17.816716837883	e. Over 30 Years	1.471
TR2003	8/15/2011 12:41:30 PM	21.28	81.50	12	2	17.5523482481639	e. Over 30 Years	1.471
TR2003	8/15/2011 1:41:30 PM	20.93	81.59	13	2	16.5219141244000	e. Over 30 Years	1.471

PowerPivot for Excel 2010

Transformer Performance Video - Microsoft Excel

File Home Insert Page Layout Formulas Data Review View Load Test PowerPivot PI PI AF Builder Team Pivot Tools Design Layout Format Analyze

PowerPivot Window New Delete Measure Settings Measures PivotTable Create Edit KPI Delete KPIs Settings LinkedTable All Excel Data Settings Field List Relationship Detection

Chart 4 fx

A B C D E F G H I J K L M N O P

2

30 Day Substation Power Distribution Report

Period	Eastern District			Northern District			Southern District			Western District			
	(KWH)	Regiona Corp %	(KWH)	Regiona Corp %	(KWH)	Regiona Corp %	(KWH)	Regiona Corp %	(KWH)	Regiona Corp %	(KWH)	Regiona Corp %	
Off Peak	29,600	23%	6%				29,255	19%	6%				
Partial Peak										42,512	49%	9%	
Peak				29,407	29%	6%							
							57,334	36%	12%				
							42,362	27%	9%				
										43,897	51%	9%	
Age Ranges	a. Under 5 Years	14,234	11%	3%									
	b. 5 to 10 Years				57,281	57%	12%						
	c. 10 to 20 Years						28,415	18%	6%				
	d. 20 to 30 Years				14,462	14%	3%						
	e. Over 30 Years	14,312	11%	3%									
	Wolverine	71,269	55%	15%									
	Grand Total	129,415	100%	27%	101,150	100%	21%	157,366	100%	33%	86,409	100%	18%
													Corp Total 100%

30,000
25,000
20,000
15,000
10,000
5,000
0

Weekday Distribution (KWH)

1 2 3 4 5 6 7

Eastern District Northern District Southern District Western District

Distribution Overview Transformer Maintenance Summary

Ready

105%

Power Distribution Report

Transformer Performance - Microsoft Excel

File Home Insert Page Layout Formulas Data Review View Add-Ins PowerPivot PI AF Builder

Cut Copy Format Painter Clipboard Font Alignment Number Styles Cells Editing

A1 fx

1

2

30 Day Substation Power Distribution Report

Period	Eastern District			Northern District			Southern District			Western District		
	(KWH)	Regional %	Corp %	(KWH)	Regional %	Corp %	(KWH)	Regional %	Corp %	(KWH)	Regional %	Corp %
Off Peak	29,606	22.9%	6.2%				29,275	18.6%	6.2%			
Partial Peak										42,377	49.2%	8.9%
Peak												
Age Ranges												
a. Under 5 Years	14,135	10.9%	3.0%							43,763	50.8%	9.2%
b. 5 to 10 Years												
c. 10 to 20 Years												
d. 20 to 30 Years												
e. Over 30 Years												
Grand Total	129,473	100.0%	27.3%	101,097	100.0%	21.3%	157,641	100.0%	33.2%	86,140	100.0%	18.2%
										Corp Total		100.0%

21

22

23

24

25

26

27

28

29

30

31

30000.0
25000.0
20000.0
15000.0
10000.0
5000.0
0.0

1 2 3 4 5 6 7

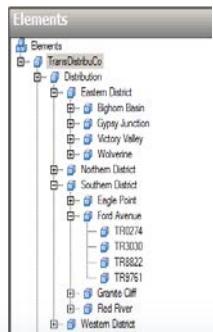
Regional Distribution by Weekday (KWH)

Eastern District
Northern District
Southern District
Western District

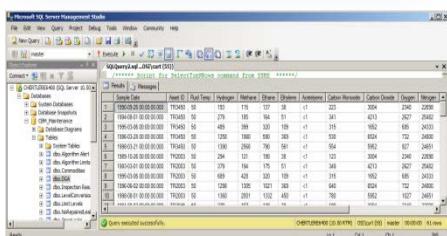
Distribution Overview Rates Transformer Maintenance Summary Measures Illustration Data for Distribution Overvi Sheet2

Ready 110% +

PowerPivot Enables Data Integration



This screenshot shows a Microsoft Excel spreadsheet titled 'Transformer Performance.xlsx'. The ribbon tabs include 'File', 'Home', 'Insert', 'Page Layout', 'Formulas', 'Review', 'View', 'AddIns', 'PowerPivot', 'PivotChart Tools', 'Design', 'Layout', 'Format', and 'Analyzer'. The 'PowerPivot' tab is selected. The main area displays a table of data with columns such as 'Time', 'Age', 'Energy', 'Top Oil Temp.', 'LTC Oil Temp...', 'H...', 'Weekday', 'Diff Oil Temp.', 'C14 to H2...', and 'C14 to C...'. A formula bar at the top shows '[C24H to C26H] = RELATED('Latest DGA['ethylene'])&RELATED('Latest DGA['ethane])'. The status bar at the bottom indicates '28 rows'.

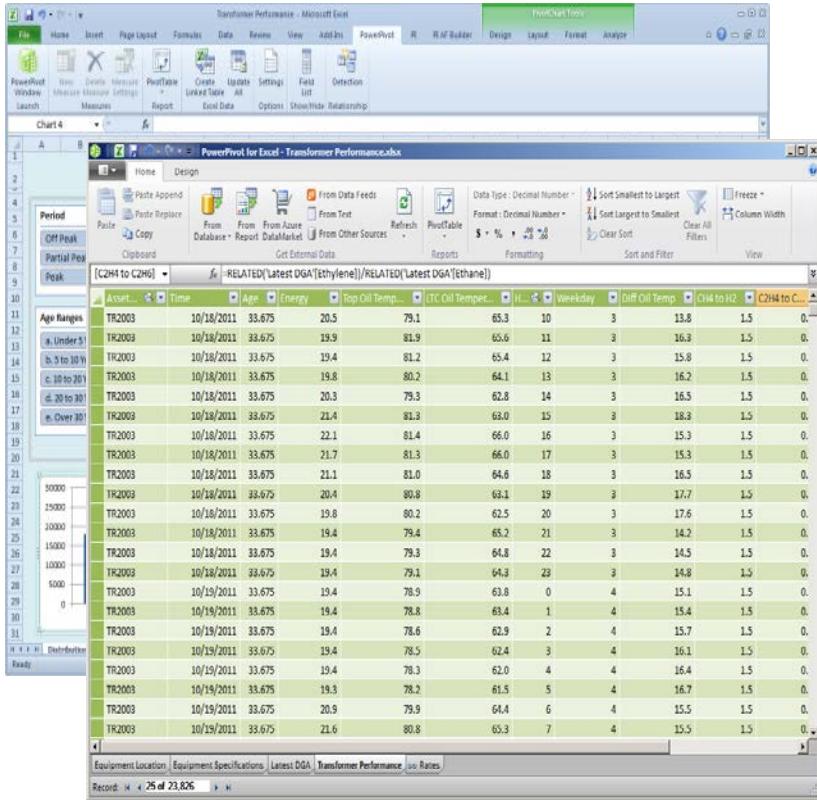


This screenshot shows a Microsoft Excel spreadsheet titled 'TransDistribCo Daily Rate Periods'. The table has columns for 'Hour' and 'Period'. The data shows a sequence of periods: Off Peak, Off Peak, Off Peak, Off Peak, Off Peak, Partial Peak, Partial Peak, Off Peak.

Hour	Period
0	Off Peak
1	Off Peak
2	Off Peak
3	Off Peak
4	Off Peak
5	Off Peak
6	Partial Peak
7	Partial Peak
8	Peak
9	Peak
10	Peak
11	Peak
12	Peak
13	Peak
14	Peak
15	Peak
16	Peak
17	Peak
18	Peak
19	Partial Peak
20	Partial Peak
21	Off Peak
22	Off Peak
23	Off Peak
24	Off Peak
25	Off Peak
26	Off Peak



PowerPivot Enables Data Integration



The screenshot shows the Microsoft Excel ribbon with the 'PowerPivot' tab selected. Below the ribbon, the PowerPivot ribbon bar displays various data integration options: PowerPivot Window, New, Create Measure, Measures, Paste Append, Paste Replace, PivotTable, Create Table, Settings, Field List, Refresh, PivotTable!, Design, Layout, Format, Analyze, and PivotChart. A dropdown menu for 'From Other Sources' is open, showing options like From Database, Report, DataMarket, From Azure, From Text, Refresh, PivotTable!, Get External Data, Reports, and View. The main worksheet area contains a table of data with columns including Date, Age Range, and various transformer performance metrics. The status bar at the bottom indicates 'Record: 14 of 23,826'.

Can I use DataLink?

- Manual refresh step required to copy and paste values
- Limited to ~1 million rows
- No support for upsizing to SQL Analysis Services 2012



PowerPivot Enables Extended Analysis

DAX – Data Analysis Expression Language

Transformer Age Column

=YEARFRAC('Equipment Specifications'[Installation Date],NOW())

Transformer Age Ranges Column

```
=IF('Transformer Performance'[Age]>30,"e. Over 30 Years", IF('Transformer Performance'[Age]>20,"d. 20 to 30 Years",IF('Transformer Performance'[Age]>10,"c. 10 to 20 Years",IF('Transformer Performance'[Age]>5,"b. 5 to 10 Years","a. Under 5 Years"))))
```

PowerPivot Creates the “Cube”

The image shows a Microsoft Excel ribbon with five PowerPivot windows open, illustrating how PowerPivot integrates multiple data sources into a single cube. The windows are:

- Equipment Location**: PI OLEDB Enterprise
- Equipment Specifications**: PI OLEDB Enterprise
- Latest DGA**: PI OLEDB Enterprise
- Transformer Performance**: PI OLEDB Enterprise
- Rates**: Excel Linked Table

Red arrows highlight the integration between the first three windows (Equipment Location, Equipment Specifications, and Latest DGA) and the last two windows (Transformer Performance and Rates).

Configure Relationships between tables based on like columns, i.e. “Asset ID” or “Hour”

SharePoint 2010 Enterprise – PowerPivot Gallery

The image displays two side-by-side screenshots of a SharePoint 2010 Enterprise environment, specifically focusing on the PowerPivot Examples gallery.

Left Screenshot: A SharePoint page titled "Transformer Performance". The page includes a "Last Modified By: Curt Hertler, Date: 1/11/2012" and "Created By: Curt Hertler". Below this, there are two main visual components: a "Distribution Overview" chart showing regional distribution by weekday (KWH) and a "30 Day Substation Power Distribution Report" table.

Right Screenshot: An Excel viewer window showing the same "30 Day Substation Power Distribution Report" from the SharePoint page. This view adds several interactive filters: "Period" (Off Peak, Partial Peak, Peak), "Age Ranges" (a. Under 5 Years, b. 5 to 10 Years, c. 10 to 20 Years, d. 20 to 30 Years, e. Over 30 Years), and a "Condition" filter for "Transformer Maintenance". The table provides detailed data for four districts: Eastern, Northern, Southern, and Western, across various substation locations like Bighorn Basin, Eagle Point, Elm Street, etc.

Additional Information

OSIsoft Resources

- “Business Analytics with your PI System Data using Microsoft PowerPivot”
- PI T&D Users Group Site extranet.osisoft.com
- OSIsoft vCampus vcampus.osisoft.com

Microsoft Resources

- www.microsoft.com/en-us/bi/powerpivot.aspx

Helpful Books

- “PowerPivot for the Data Analyst”, Bill Jelen
- “Practical PowerPivot & DAX Formulas for Excel 2010”, Art Tennick

The slide features the OSIsoft logo at the top left. The main title is 'Business Analytics with your PI System Data Using Microsoft PowerPivot'. Below the title, it says '2011 OSIsoft T & D Users Group Meet!' and 'September 23, 2011, Philadelphia'. A small note at the bottom left reads 'Business Analytics with your PI System Data Using Microsoft PowerPivot'.

I. Overview

The release of PI OLEDB Enterprise and Microsoft PowerPivot for Excel 2010 provide an exciting combination of new technologies supporting advanced data analysis and enterprise awareness. These tools bring the power of multidimensional data analysis to the forefront of every PI user's innovation within Microsoft Excel 2010. This document describes the steps needed to create an example PowerPivot report for analyzing substation power distribution, as well as substation asset condition scoring and benchmarking.

The document is organized in five sections. It begins by describing the PI Asset Framework (AF) structure used to provide the contextual organization required to make the PI System data meaningful for multidimensional analysis. Next, the role of PI OLEDB Enterprise is discussed as the means of extracting PI System data in a tabular form, as datasets, that can be imported directly into PowerPivot tables. The third section will discuss the use of PowerPivot to configure relationships between data tables, to add calculated columns and calculated measures to the multidimensional data cube used for analysis. In section four, we will build two example reports that demonstrate the features of PowerPivot tables and charts. Lastly, we will describe how PowerPivot reports developed in Excel 2010 can be deployed in Microsoft SharePoint 2010 Enterprise to extend the analytical experience to others in the organization through the browser.

The 30 Day Substation Power Distribution Profile Report shown below will demonstrate how PowerPivot can be used to aggregate total power delivered by region and substation. We will be adding measures to calculate the relative percentages of each total shown in the regional table. PowerPivot slices (on the left-hand side of the screenshot below) will be added to allow users to filter totals based on the time of day each rate is enforced and also by transformer age. A PowerPivot chart will be added to show total power delivery by region for each weekday.

The screenshot shows a PowerPivot report titled '30 Day Substation Power Distribution Profile Report'. It includes a table titled 'Regional Distribution' with columns for Region, Substation, and various power metrics like Peak Power, Average Power, and Total Power. Below the table is a bar chart titled 'Regional Distribution by Weekday' showing power distribution across different days of the week.

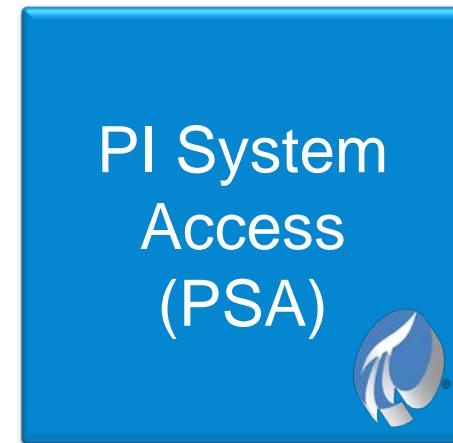
How to get PI Data Access

- ```
AFTimeRange tr = new AFTimeRange(new AFTime(tex)
AFValues vals = _afDB.Elements["Pump123"].Attri
lstValues.Items.Clear();
foreach(AFValue val in vals)
{
 lstValues.Items.Add(val.Value.ToString() +
})
```

 products  
*(it all)*
- time licenses



=



# OSIsoft Virtual Campus (vCampus)

- **Online, community-oriented** program
  - Software + Resources + Collaboration
  - Focus on development and integration
  - Partners, customers and OSIsoft
  - Exclusive contents (CTPs, Betas, technical papers)
- Personal **development PI System**
  - Development licenses for PI Data Access products (for developers and integrators)



<http://vCampus.osisoft.com>  
[vCampus@osisoft.com](mailto:vCampus@osisoft.com)



# vCampus Live! 2012

WHERE PI GEEKS MEET



**Week of November 26<sup>th</sup>**  
**Grand Hyatt Union Square, San Francisco**

# Han Yong Lee

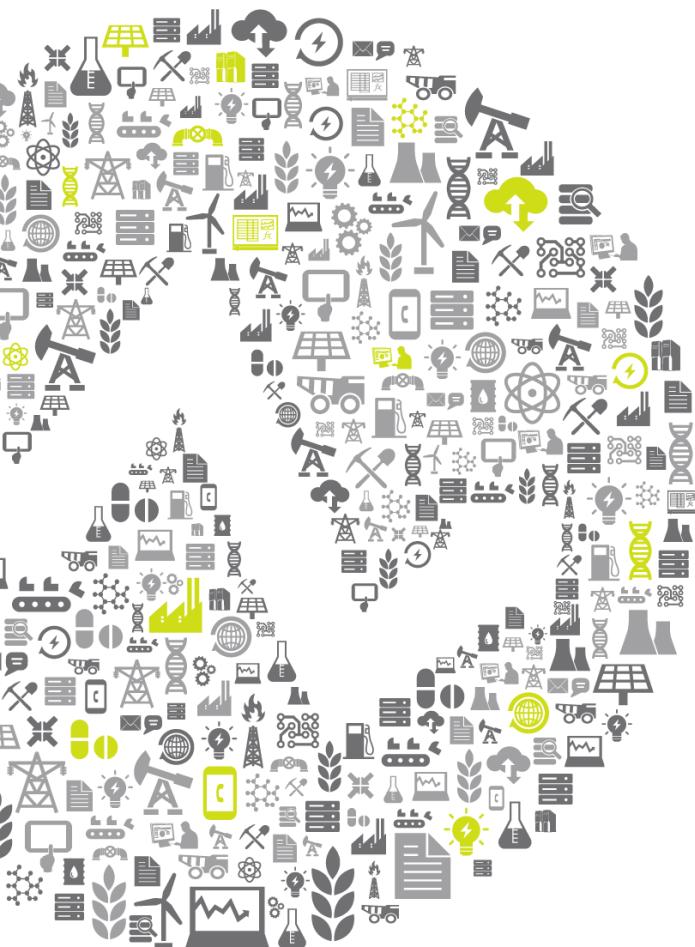
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