



OSIsoft.

REGIONAL SEMINAR

2012

A P A C

The **Power** of Data

INDIA



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

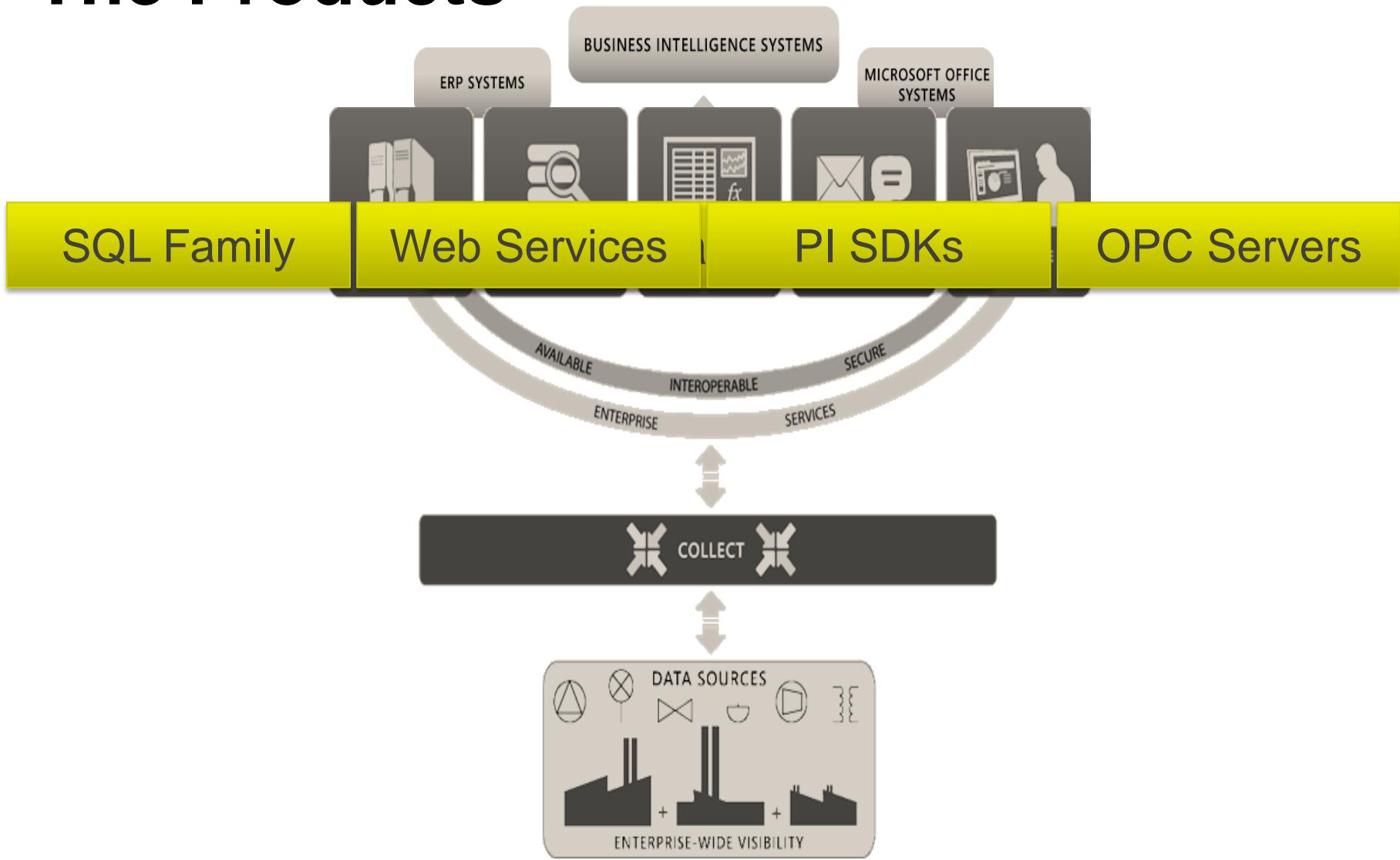
- LoB Systems/Databases
- Orchestration/Workflows
- Web/Non-Windows Platforms
- Analysis/BI/Reporting
- Custom Applications



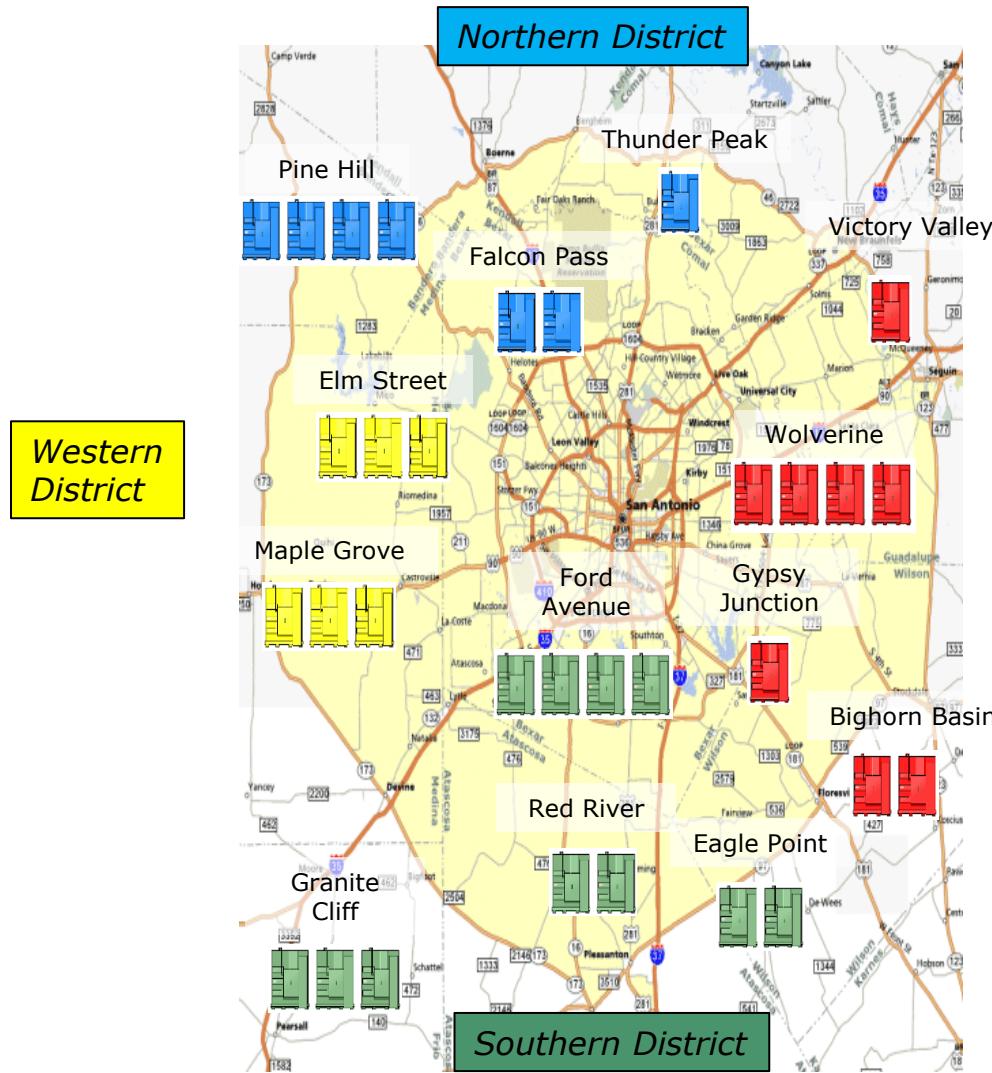
Custom Downtime Analysis Engine

Automated Ordering to Suppliers

The Products



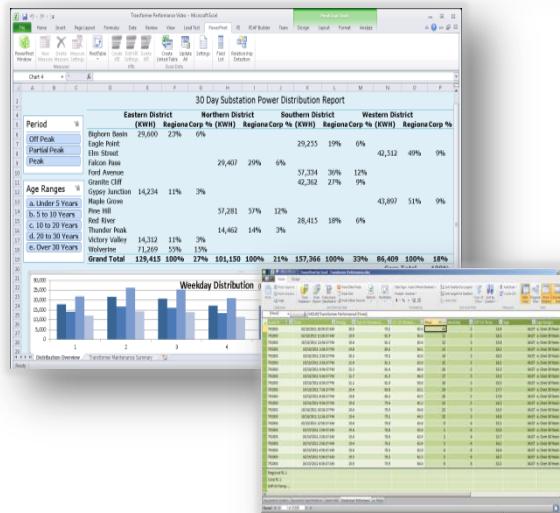
Example: Substation Power Distribution Profile



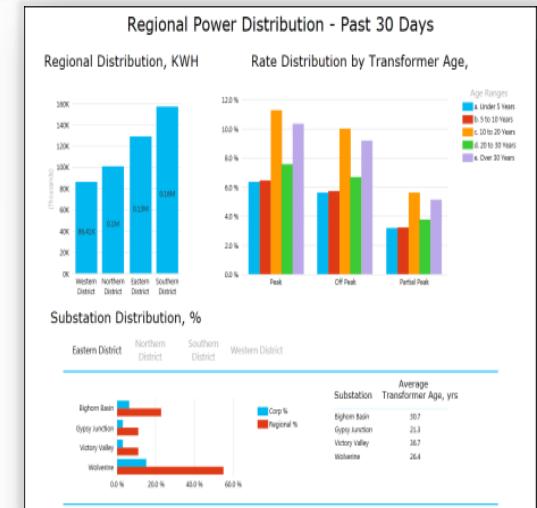
My Objectives

- Regional and Rate Period Power Distribution
- Aging Asset Risk Assessment
- Want to do it myself !

Business Analytics Toolkit



**PowerPivot
for Excel 2010**

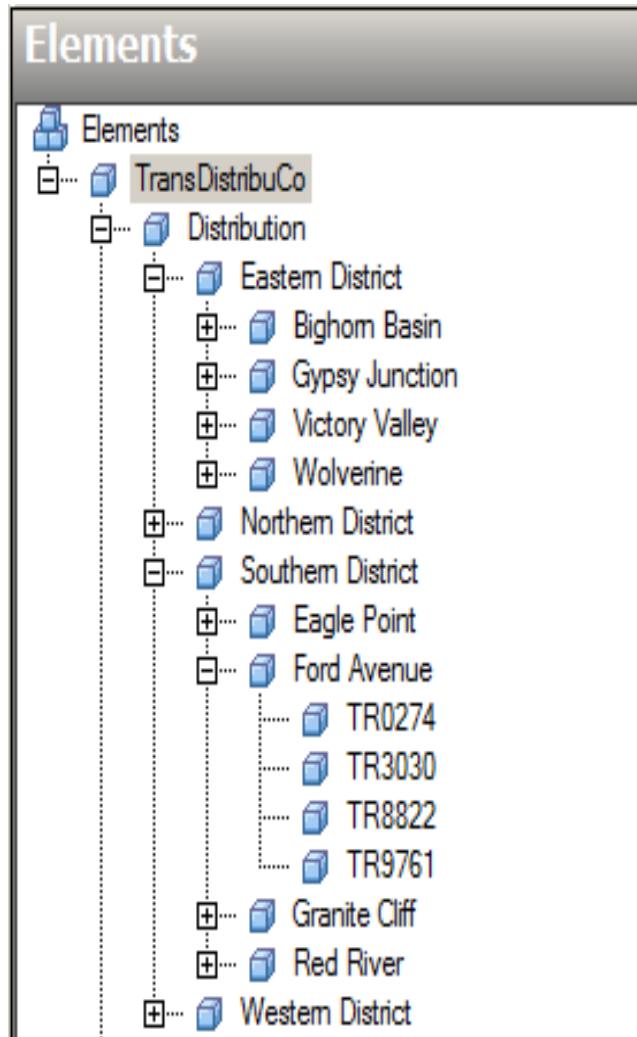


Power View

PI Server – PI Asset Framework

Asset Hierarchy

- District
- Substation
- Transformer



PI Server – PI Asset Framework

The screenshot shows two windows side-by-side. On the left is the 'Elements' browser, displaying a hierarchical tree of assets under 'TransDistribuCo'. On the right is the 'TR0274' editor window, showing various attributes categorized into groups like Current DGA Analysis, Load Tap Changer, Performance, Specifications, and Tank.

Elements Browser:

- Elements
- TransDistribuCo
 - 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

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

The screenshot shows a Microsoft Excel window titled "PowerPivot for Excel - Transformer Performance.xlsx". The ribbon is visible at the top with tabs for Home and Design. The main area displays a PivotTable with the following columns:

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	15.5387221724381	e. Over 30 Years	1.471
TR2003	8/14/2011 8:41:30 PM	19.93	80.74	20	1	15.5219753616169	e. Over 30 Years	1.471
TR2003	8/14/2011 9:41:30 PM	19.90	80.68	21	1	15.5052855079588	e. Over 30 Years	1.471
TR2003	8/14/2011 10:41:30 PM	19.87	80.63	22	1	15.4884817399748	e. Over 30 Years	1.471
TR2003	8/14/2011 11:41:30 PM	19.84	80.58	23	1	15.4717349291535	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	15.4214944866901	e. Over 30 Years	1.471
TR2003	8/15/2011 3:41:30 AM	19.73	80.36	3	2	15.4047476858689	e. Over 30 Years	1.471
TR2003	8/15/2011 4:41:30 AM	19.71	80.31	4	2	15.3880008750478	e. Over 30 Years	1.471
TR2003	8/15/2011 5:41:30 AM	19.68	80.25	5	2	15.3712540642266	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	15.3377604425844	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	21.09	79.96	9	2	13.2137487314932	e. Over 30 Years	1.471
TR2003	8/15/2011 10:41:30 AM	21.20	81.93	10	2	16.6404075066249	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	16.5219141244888	e. Over 30 Years	1.471

Below the table, there are four summary cells:
Regional %: 100.0%
COP %: 100.0%
Diff Oil Temp Deviation: 0.0
CH4 to C2H6 Deviation: 0.00
CH4 to H2 Deviation: 0.00

The status bar at the bottom shows "Record: 1 of 23,793".

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 ProChart Tools Design Layout Format Analyze

PowerPivot Window New Delete Measure Settings Measures PivotTable Create KPI Delete KPI Settings KPIs Create 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 %	Regiona Corp %	(KWH)	Regiona Corp %	Regiona Corp %	(KWH)	Regiona Corp %
Off Peak	29,600	23%	6%				29,255	19%	6%			
Partial Peak										42,512	49%	
Peak				29,407	29%	6%					9%	
							57,334	36%	12%			
							42,362	27%	9%			
										43,897	51%	
Age Ranges	14,234	11%	3%								9%	
a. Under 5 Years												
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%									
Victory Valley	71,269	55%	15%									
Wolverine	Grand Total	129,415	100%	27%	101,150	100%	21%	157,366	100%	33%	86,409	100%
							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

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 f

1

2

3 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

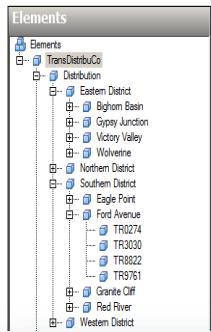
Regional Distribution by Weekday (KWH)

Eastern District
Northern District
Southern District
Western District

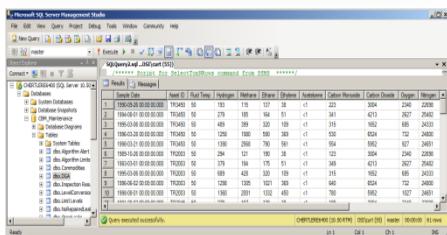
Distribution Overview Rates Transformer Maintenance Summary Measures Illustration Data for Distribution Overvi Sheet2

Ready 110% +

PowerPivot Enables Data Integration



This screenshot displays a Microsoft Excel spreadsheet titled 'Transformer Performance.xlsx'. It features a PivotTable in the foreground with columns for 'Time', 'Age', 'Energy', 'Top Oil Temp...', 'LTC Oil Temp...', 'H...', 'Weekday', 'Diff Oil Temp', 'CH4 to H2', and 'C2H4 to C...'. A PivotChart is visible in the background. The ribbon at the top has the 'PowerPivot' tab selected.



This screenshot shows a Microsoft Excel spreadsheet titled 'Transformer Performance - Microsoft Excel'. It contains a PivotTable with columns for 'Hour', 'Period', and various numerical values. A PivotChart is also present. The ribbon at the top has the 'PowerPivot' tab selected.



PowerPivot Enables Data Integration

The screenshot shows the Microsoft Excel ribbon with the 'PowerPivot' tab selected. A context menu is open over a data table, with the 'From PowerPivot' option highlighted. The table displays data from the 'Transformer Performance' dataset, including columns like Age, Energy, Top Oil Temp., LTC Oil Temp., and various CH4 to H2 ratios.

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

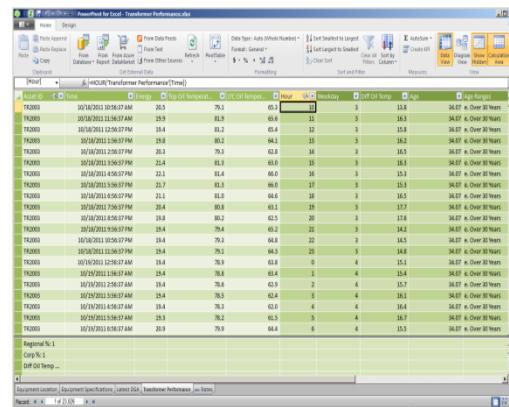
DAX – Data Analysis Expression Language

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"))))
```



The screenshot shows a Microsoft Excel spreadsheet titled 'Transformer Performance[Time]'. The data consists of 30 rows of transformer performance data, each with columns for 'Transformer', 'Regional No.', 'Date', 'Age', 'Hours', 'MWh/day', 'MWh/cu hr', and 'Age'. A formula bar at the top shows the formula =YEARFRAC('Equipment Specifications'[Installation Date],NOW()). The status bar at the bottom indicates 'Record: 1 of 3, 35'.

Transformer	Regional No.	Date	Age	Hours	MWh/day	MWh/cu hr	Age
T2009	10/14/2011 10:54:37 AM	26.5	79.1	63.5	21	3	11.8
T2008	10/14/2011 11:36:37 AM	25.9	81.5	63.6	21	3	16.3
T2003	10/14/2011 12:46:37 PM	18.4	81.2	63.4	12	3	15.4
T2009	10/14/2011 1:56:37 PM	26.8	80.2	64.1	20	3	16.3
T2003	10/14/2011 2:56:37 PM	26.3	79.3	63.8	14	3	16.3
T2003	10/14/2011 3:56:37 PM	21.4	81.3	63.0	23	3	18.3
T2003	10/14/2011 4:56:37 PM	21.1	81.3	66.0	16	3	15.3
T2003	10/14/2011 5:56:37 PM	21.7	81.3	66.0	17	3	15.3
T2003	10/14/2011 6:56:37 PM	21.4	81.3	64.4	28	3	15.3
T2003	10/14/2011 7:56:37 PM	26.4	80.3	63.1	28	3	17.7
T2003	10/14/2011 8:56:37 PM	18.8	80.2	62.5	20	3	17.8
T2003	10/14/2011 9:56:37 PM	18.4	79.4	63.2	21	3	14.4
T2003	10/14/2011 10:56:37 PM	18.4	79.3	64.3	22	3	14.3
T2003	10/14/2011 11:56:37 PM	26.4	79.3	64.3	20	3	14.8
T2003	10/14/2011 12:56:37 AM	19.4	78.9	63.8	9	4	15.1
T2003	10/14/2011 1:56:37 AM	25.4	78.8	63.4	1	4	15.4
T2003	10/14/2011 2:56:37 AM	18.4	78.6	62.9	2	4	15.7
T2003	10/14/2011 3:56:37 AM	18.4	78.5	64.4	9	4	16.1
T2003	10/14/2011 4:56:37 AM	18.4	78.3	62.0	6	4	16.4
T2003	10/14/2011 5:56:37 AM	25.3	78.2	63.5	5	4	16.7
T2003	10/14/2011 6:56:37 AM	26.0	79.9	64.4	6	4	15.5

PowerPivot Creates the “Cube”

Equipment Location
PI OLEDB Enterprise

Equipment Specifications
PI OLEDB Enterprise

Latest DGA
PI OLEDB Enterprise

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

Transformer Performance
PI OLEDB Enterprise

Rates
Excel Linked Table

SharePoint 2010 Enterprise – PowerPivot Gallery

The screenshot shows a SharePoint 2010 site with the URL <http://dfdenali/PowerPivot%20Examples/Forms/Carousel.aspx>. The page displays two PowerPivot examples:

- Transformer Performance**: A report titled "30 Day Substation Power Distribution Report" showing regional distribution by weekday (KWH) across four districts: Eastern, Northern, Southern, and Western. The report includes a table of data and a bar chart.
- Distribution Overview**: A report titled "Equipment Benchmarking: Fuel and Maintenance" showing regional distribution by weekday (KWH) across four districts: Eastern, Northern, Southern, and Western. The report includes a table of data and a bar chart.

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 a large image of power transmission towers on the right and a blue abstract graphic on the left. The title is at the top, followed by a summary of the document's purpose and date.

**Business Analytics with your PI System Data
Using Microsoft PowerPivot**

2011 OSIsoft T & D Users Group Meet!
September 23, 2011, Philadelphia

Business Analytics with your PI System Data Using Microsoft PowerPivot
2011 OSIsoft T&D Users Group Meeting Training
September 23, 2011, Philadelphia

I. Overview

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 tables, to add calculated columns and calculated measures to the model, and to generate the data cube used for analysis. In section four, we will see two reports that demonstrate the features of PowerPivot tables and charts. Lastly, we will describe how PowerPivot reports developed in Excel 2010 can be posted 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 using measures to calculate the relative percentage of each to be shown in the report pivot table. PowerPivot sliders (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 delivered by region for each weekday.

The report displays a table titled "30 Day Substation Power Distribution Report" with data for various regions and substations over a 30-day period. Below the table is a bar chart titled "Regional Distribution by Weekday avg." showing the average power distribution across different regions for each day of the week.

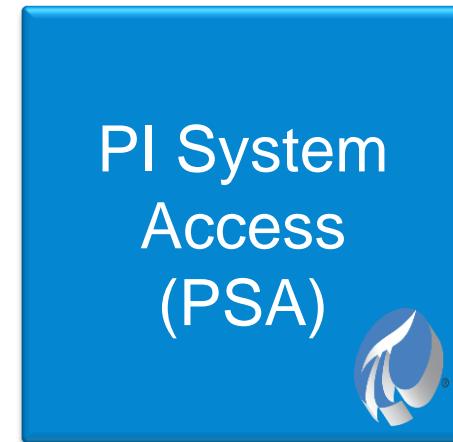
How to get PI Data Access

- ```
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

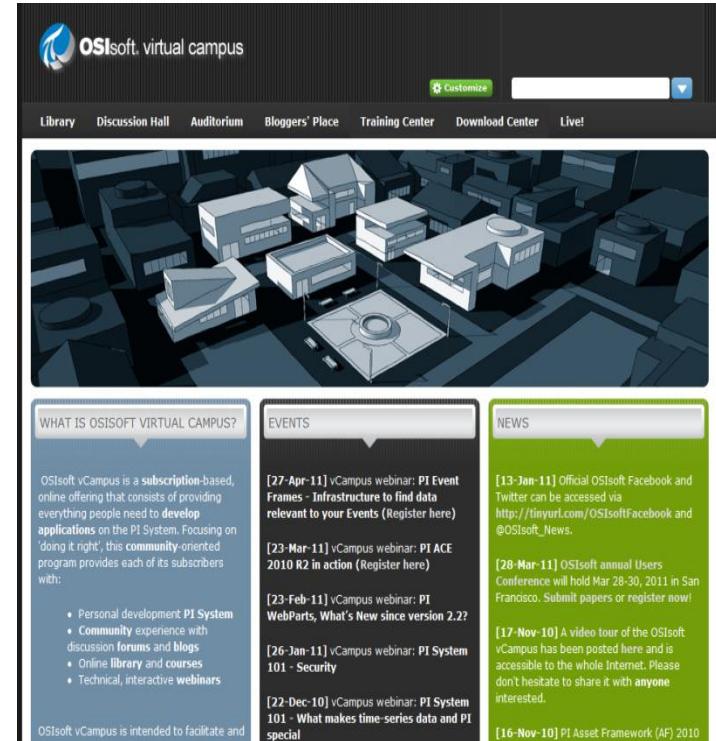


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- **Online, community-oriented** program
  - Software + Resources + Collaboration
  - Focus on development and integration
  - Partners, customers and OSIsoft
  - Exclusive contents (CTPs, Betas, technical papers)
- Personal **development PI System**
  - 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

[hanyong@osisoft.com](mailto:hanyong@osisoft.com)

vCampus Support Engineer  
OSIsoft, LLC

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