Enterprise Value:
How APS Creates Corporate Wide Benefits

22 March 2017
Presented by
Ravi Nair, APS
Pat Kelly, Industrial Knowledge
APS by the Numbers

• Arizona’s largest and longest serving utility
  – Serving Arizona since 1886
• Service Territory
  – 11 out of 15 counties
  – 1.2 Million Customers (89% residential)
  – 34,646 square miles
• Peak Demand ~ 7,300 MW in August 2015
• 33,000 miles of transmission, distribution lines and cable
• The second largest generation fleet in the western US
  – Palo Verde NGS, primary source of electricity in Southwest
• Solar Capacity ~ 950 MW
  – 4th largest in the nation
  – 50% of solar portfolio is distributed
  – Pioneer in solar research since 1970s
• Recently joined the CAISO Energy Imbalance Market
Business Challenges

Lack of visibility and access

Inability to find data

Islands of data; pockets of use

Lots of data ... and more everyday!

Additional data sources

Adding smart devices

Valuable data locked away
**Enterprise PI Program Evolution**

2017-2018
- Additional data sources (AMI, ADMS, …)
- Additional applications
- Expanding use of data; continued training
- Ongoing governance, PUG

2016
- Additional data sources (SPP, Smart Grid, EMS, AMI)
- Initial PI System applications
- Unlock data – direct access, user training
- Maturing governance processes; establish PUG

2015
- Launched Enterprise Analytics Strategy / Vision
- Connecting systems
- Entered into EA agreement; established foundation
- Recognized need for framework / governance

2013 - 2014
- Limited use of PI System (silos) for generation, EMS data
- Lack of analytics framework
- Maintained by PI System Support team and local super users
Program Vision

Direct access to data

One version of the truth

Improved situational awareness

Data in context

Foundation for Enterprise Analytics

Applications monitor conditions

Additional insights
Part of Enterprise Analytics

VISUALIZATION
- Reporting
- Ad-hoc Analysis
- Process Graphics
- Dashboards
- Data Discovery
- Geo Spatial Visualization (STI)

DATA HISTORY ANALYSIS
- Data Warehouse
- Time Series (PI Server)
- Analysis (PI System, STI)
- Data Federation

DATA SOURCES
- Commercial Trading
- Renewables
- Generation
- Transmission
- Distribution
- Advanced Grid
- Asset
- Geo Location

Real Time Data
Enterprise PI Roadmap

2017

- Governance
- Support
- System Mgmt
- System Visualization
- Ocotillo
- Unit Monitoring
- NextEra (Wind)
- Gen AF
- Trans AF
- PMU, DFR
- EMS Hist Migration
- Feeder Monitor
- ADMS
- HPFF Visualization
- BESS
- Visualisation Framework
- Mobile Views
- EMS
- Peak Report
- Feeder Monitor
- IVVC
- AMI (L&G)
- AGT Integ (Cap Bank, Fault Indic)
- AMI (Elster)
- EMS
- Water Usage
- Red Rock
- Unit Monitoring
- Water Usage
- Marketing & Trading

2016

- Governance
- Support
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Exposing Data Creates Value

Direct Access (Ad hoc)

Unlock creativity and innovation

Ensure the foundation is solid
Organize the data (AF model)
Train the users – “how do I find …?”
User group to share best practices

Applications (Supported)

Gather needs, package repeatable

User driven; users engaged
Start simple
Train the users
Address change management

EMS Data

Requires governance of roadmap, architecture, AF models, access to data
Making EMS Data Available

Before

Requires culture change
Need to focus on adoption

Now
Examples of Ad Hoc Value

- Using PI Coresight to quickly solve problems
  - Displays built by the end of 2 hour training
  - Using AF model as a framework
  - Displays used everyday

- Updated Transmission Loading Tool
  - Updated tools using PI DataLink
  - Addressing key challenge for transmission
Feeder Monitoring

Monitor feeder overloads, imbalances & power quality issues

Additional Insights
- Frequency
- Duration
- Impact

Real Time Data

Events Status Monitoring

Situational Awareness

Watchlists

Foundation for additional analytics

Visualize In Context

Diagnostic Views

Reporting
<table>
<thead>
<tr>
<th>Feeder Monitoring</th>
<th>Fault Indicators (CFI)</th>
<th>IVVC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree View</td>
<td>Tree View</td>
<td>IVVC R1 Dashboard</td>
</tr>
<tr>
<td>Select Feeders</td>
<td>Watch List</td>
<td>IVVC R2 (prototype)</td>
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<td>Problem Feeders</td>
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<td>Overloads</td>
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<td>Imbalances</td>
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<td>Power Quality Issues</td>
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<td>Reverse Flows</td>
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</table>

**Transformers**

- Overview (basic)
- Comparison

**Feeders**

- Overview (basic)
- Comparison

**EMS PI Historian**

**Enterprise PI Portal**
**Feeder Overload**

### Watchlist Items/Values

<table>
<thead>
<tr>
<th>Name</th>
<th>Division</th>
<th>District</th>
<th>Substation</th>
<th>MW</th>
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**Feeder Load Overview**

**Display:** For Mon Load (read-only)

- **Continuously Overload**
- **Max Rating Overload**

**PI CoreSight**

**Division**
- A
- B
- C

**District**
- D

**Substation**
- E

**Feeder**
- F

**APS Enterprise PI**

- MW
- 0AAMP
- 1AAMP
- 2AAMP
- 3AAMP
- MVAR

Showing 1 to 10 of 594 entries
Consistent Tools and Approach

- Leverage common AF model
- Common framework
- Common landing page
- Web based visualization

Feeder Monitoring
Cap Bank Monitoring
Fault Monitoring
# Program Impact in T&D

## Benefits
- End users creating tools
- Access to over 1,000 fault indicators
- Early notification of IVVC voltage exceptions
- Access to AG device info for 1,200 devices
- Less time gathering data
- Monitoring common conditions
- Improved situational awareness
- Align data from EMS, AGT, AMI (future)

## Results
- Increasing adoption, solving problems
- Earlier notification; outage time reduction
- Improved tuning; improved power quality
- See and address device status, conditions
- More time for analysis, corrective action
- Frees up time for solving problems
- Address most pressing issues
- Comprehensive view of feeder conditions
Take Aways

• Program Perspective is key
• Collaborate with Partners
• Focus on Governance
• Deliver and Manage Applications
• Unlock the Data and Engage Users
• Ensure Support and Plan for Growth

Complexity increases as the system grows
Creating Corporate Wide Benefits

**COMPANY and GOAL**

APS is creating a sustainable energy future for Arizona using time series data as a key pillar to improve the efficient, safe delivery of reliable energy.

**CHALLENGE**

Limited access to data and lack of visibility key impediment to enterprise analytics

- Systems used in silos with limited access to information
- Much more data being integrated from many more systems and devices

**SOLUTION**

Establish an Enterprise solution to enable ad hoc use and supported applications

- Enterprise PI established and growing
- Strong engagement with users to support adoption
- Delivering applications to solve specific business issues

**RESULTS**

Many more users have access to data; initial applications delivering value

- Reduced time to locate faults with fault analysis application
- Identification of cap bank issues improves system performance
- Foundation for additional analytics solutions
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Questions

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Thank You

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谢谢

Danke

Merci

Gracias

ありがとう

Спасибо

Obrigado