How to Build, Maintain and Get Value from the PI AF Model

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SPP *Southwest Power Pool*

SPP at a Glance

- Located in Little Rock

- About 600 employees

- Primary jobs — electrical engineering, operations, settlements, and IT

- 24 x 7 operation

- Full redundancy and backup site

Our Major Services

- Facilitation
- Reliability Coordination
- Transmission Service/ Tariff Administration
- Market Operation

- Standards Setting
- Compliance Enforcement
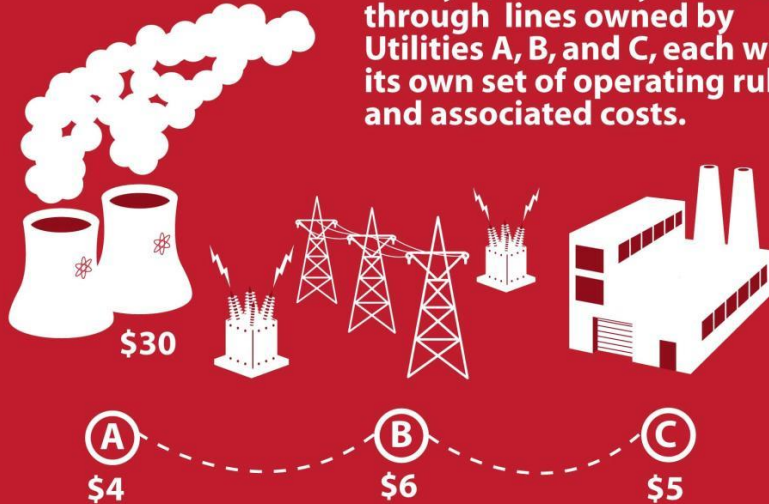- Transmission Planning
- Training
- Balancing Authority

Our Approach

- **Regional**
- **Cost-effective**
- **Independent**
- **Focus on reliability**
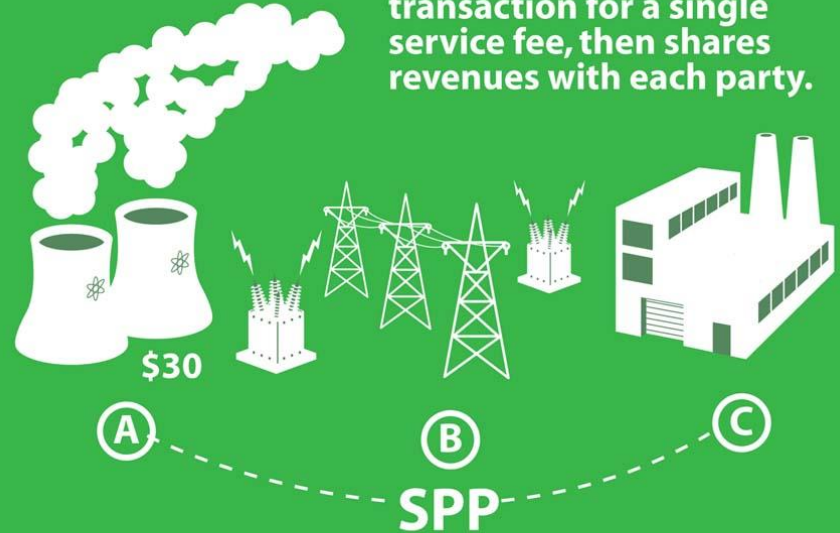
Transcription Service

Without SPP To get from a generator in Utility A to a customer in Utility C, electricity must flow through lines owned by Utilities A, B, and C, each with its own set of operating rules and associated costs.

$30

A $4   B $6   C $5

$15 transmission service + $30 energy = $45

With SPP SPP moves electricity across Utilities A, B, and C in one transaction for a single service fee, then shares revenues with each party.
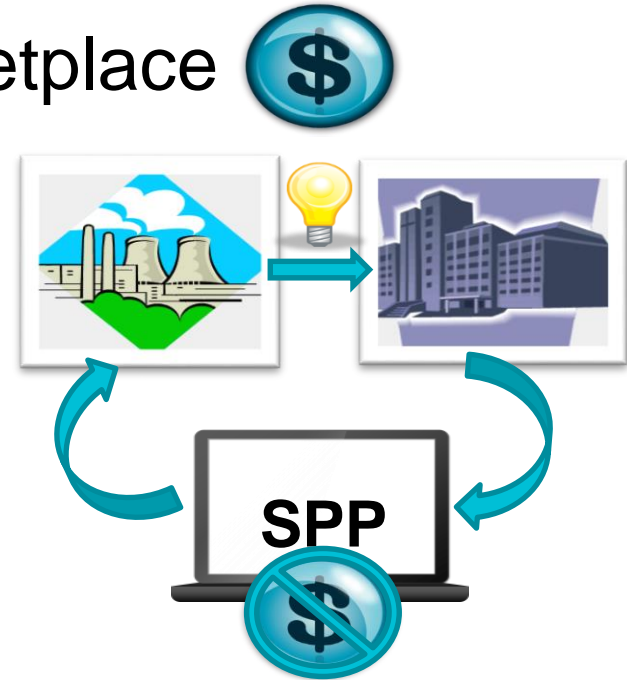
$30

A   B   C

SPP

$5 transmission service + $30 energy = $35

SPP's Energy Market: Integrated Marketplace

- ## SPP financially settles the Marketplace

  – Calculates prices

  – Captures wholesale energy production and consumption

  – Collects from Market Participants (MPs) who owe the Market

  – Pays MPs who are owed by the Market

  – Remains Revenue Neutral

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Integrated Marketplace Benefits

- Net Benefits estimated at approximately $100 million/year

- Reduce total energy costs through centralized unit commitment while maintaining reliable operations

- Day-Ahead Market allows additional price assurance capability prior to real-time

- Operating Reserve products support implementation of the SPP Balancing Authority (BA) and facilitate reserve sharing

Operating Region

- 370,000 miles of service territory
- More than 15 million people
- 627 generating plants
- 4,103 substations
- 48,930 miles transmission:
  - 69 kV – 12,569 miles
  - 115 kV – 10,239 miles
  - 138 kV – 9,691 miles
  - 161 kV – 5,049 miles
  - 230 kV – 3,889 miles
  - 345 kV – 7,401 miles
  - 500 kV – 93 miles
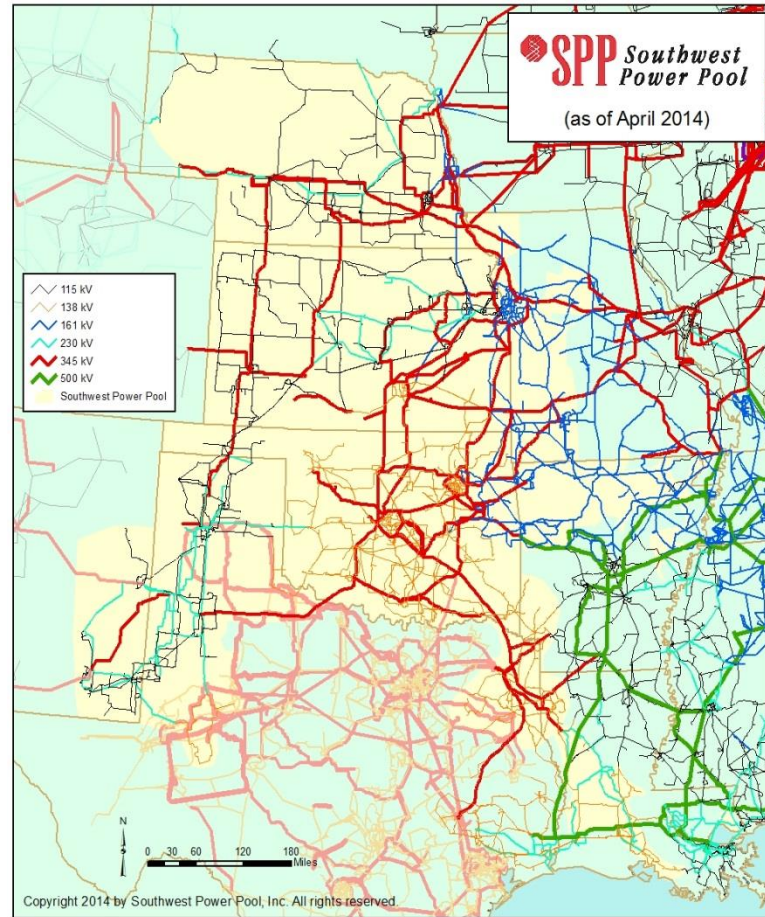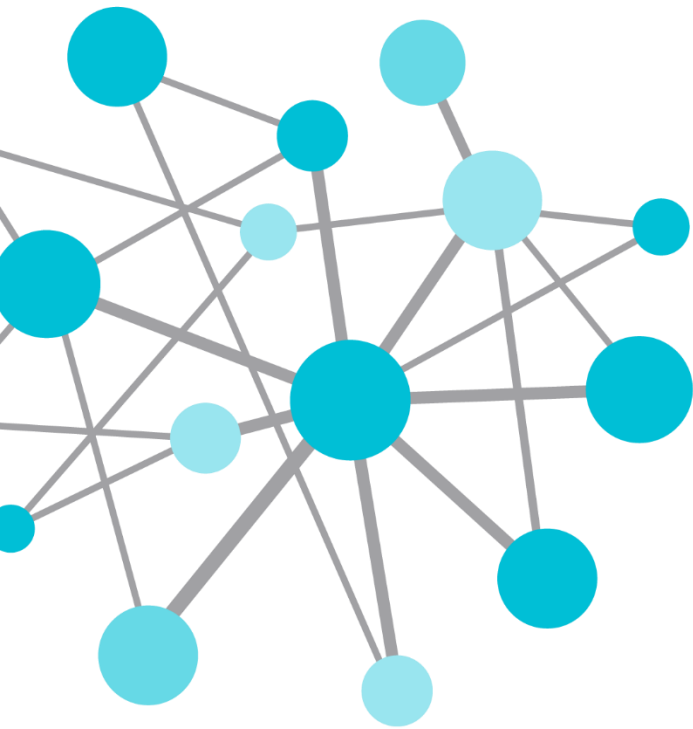
Building a PI AF Model

Building a PI AF Model

SPP has the need to record over a million streaming points with reasonably fast update times, perform calculations and have users be able to locate the data they need.

PI AF is able to provide the structure needed to group and locate data. However, with such a large model, over 150,000 AF Elements, the challenge was in creating robust templates, hierarchy and automated processes to generate the model.

SPP *Southwest Power Pool*

Business Challenge	**Solution**	**Results and Benefits**
• Recorded over 1 million data points with 4 second updates • Real time calculations	• PI AF • Custom PI System Explorer Plugins • PI AF SDK • PI Analytics	• Automated PI AF Elements and PI Tag creation • Complex PI AF calculations recorded as PI Tags
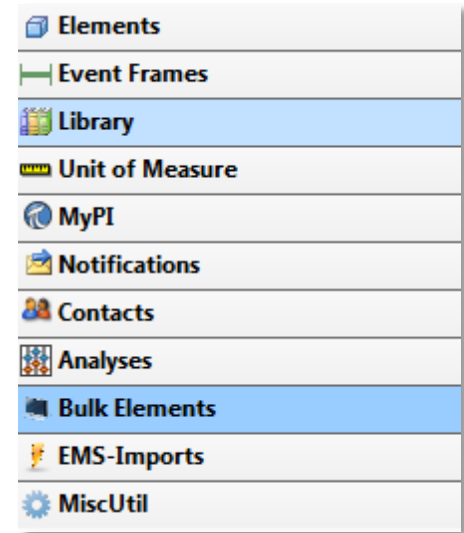
Designing and Maintaining PI AF Model

- Large Network Model
  - 12k Substations
  - 16k Lines
  - 3.5k Transformers
  - 2.7k Generators
  - 3k Capacitors and Reactors
  - 15k Loads
  - 70k Circuit Breakers
  - 130k SCADA Measurements

- Based on EMS hierarchy
- Keep nodes small as possible
- Make use of references (links) whenever possible
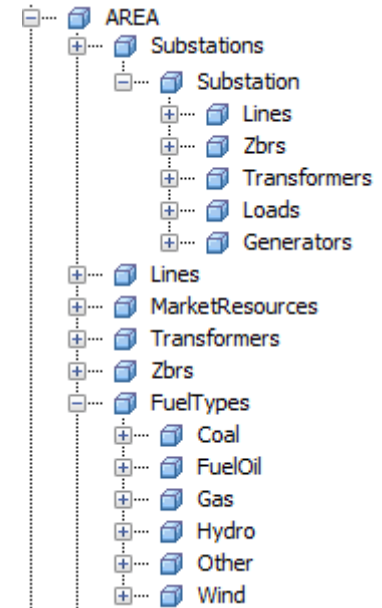
PI AF Modeling Process

PI Asset Framework is used to consolidate information from multiple systems: Energy Management System (EMS), Markets, Outage Data, Forecast Data. The models are combined in SQL Views and PI AF Elements are built using the PI AF SDK.

PI AF Templates

- Create AFElementTemplates for Equipment Types
- Create AFAttributeTemplates to build PI Tags

Import Other System Models

- Import EMS and Market Models into Staging Database
- Create SQL Views for each AFElementTemplate

Build PI AF Elements

- Build AFElements from AFElementTemplates and SQL Views
- Build PI Tags for each AFElement

PI AF Templates

- Build Templates for each equipment type

- Use PI Tag Creation feature to automatically generate PI Tags
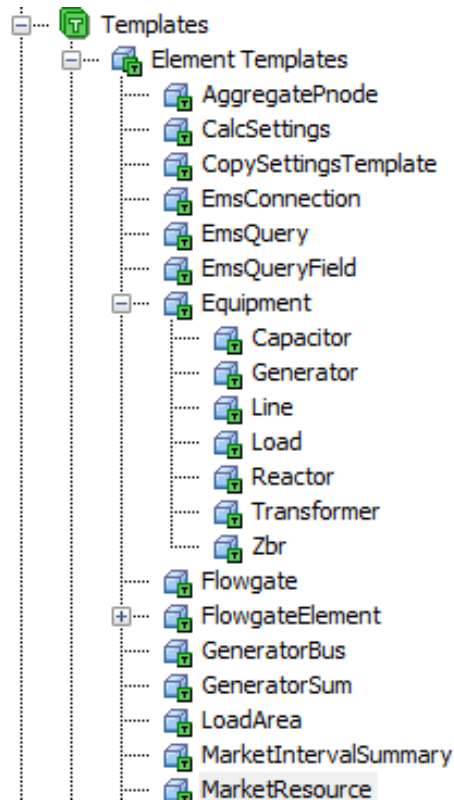
Customized Tools

- Import EMS and Market Models into Staging Database

- Develop PI System Explorer plugins to import data

- Store all plugin configuration as AF Elements
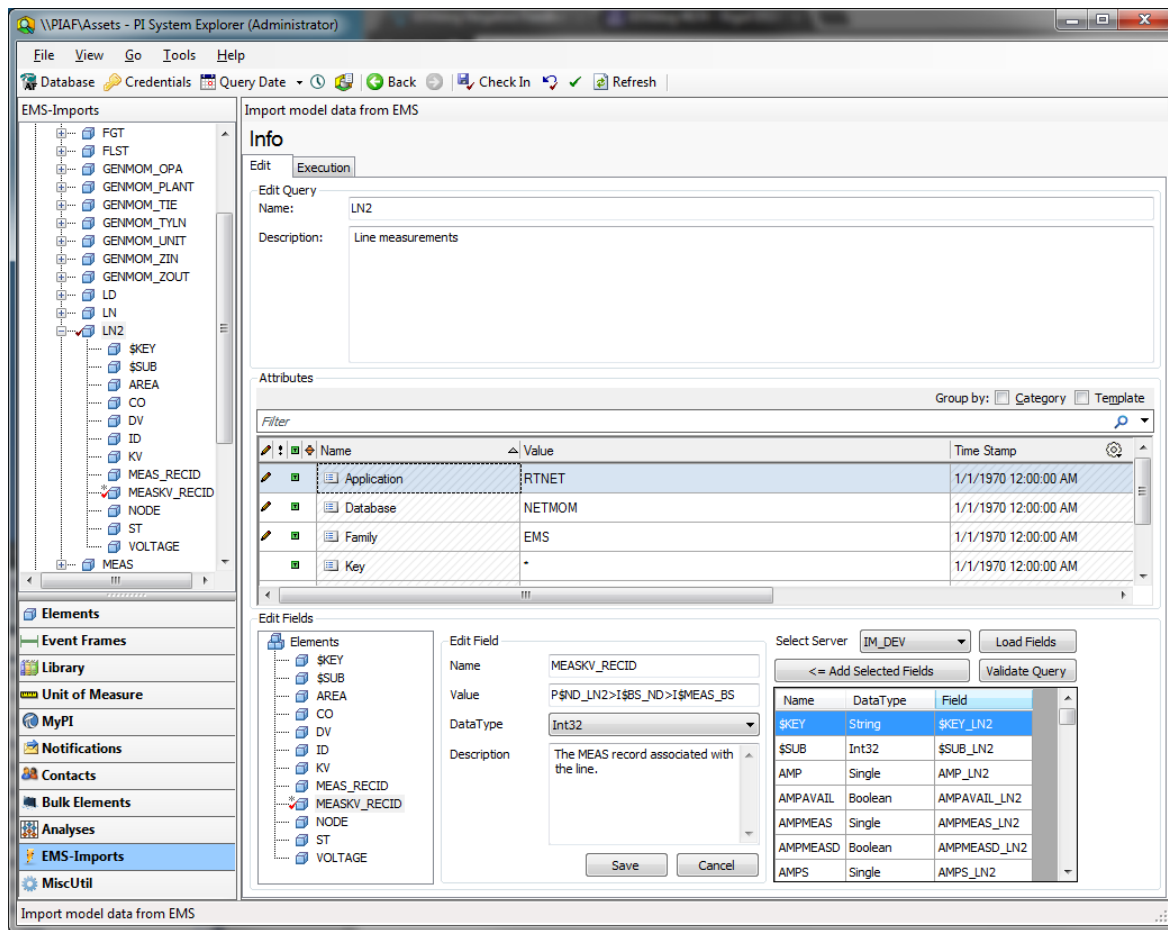
Customized Tools

- SQL Views showing all equipment attributes for an AF Element Template

Customized Tools

- Plugin to build PI AF Elements from SQL Views

- Processes Adds, Deletes and Renames

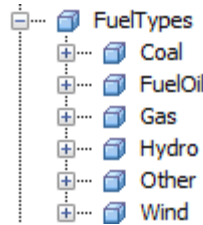- Command line version for running as a scheduled task or batch script
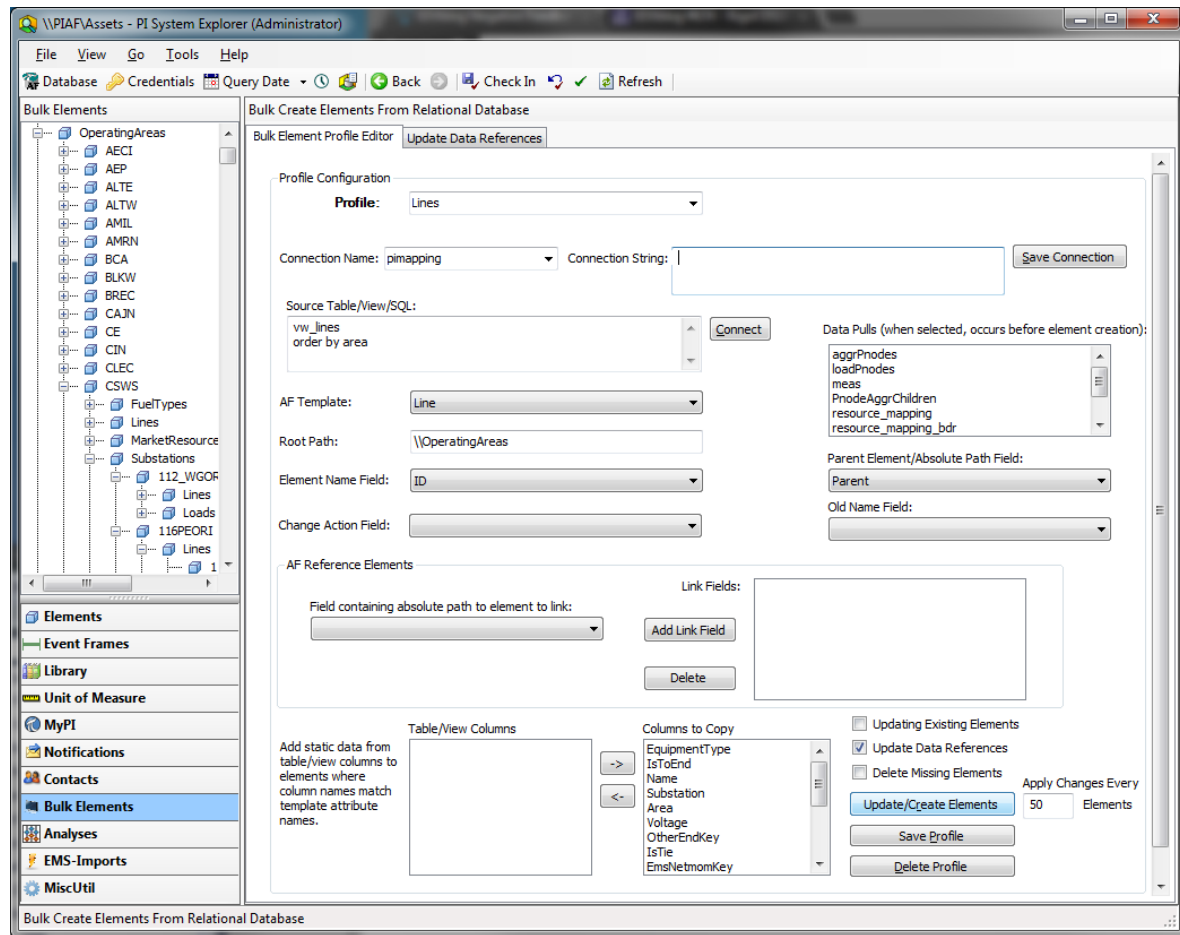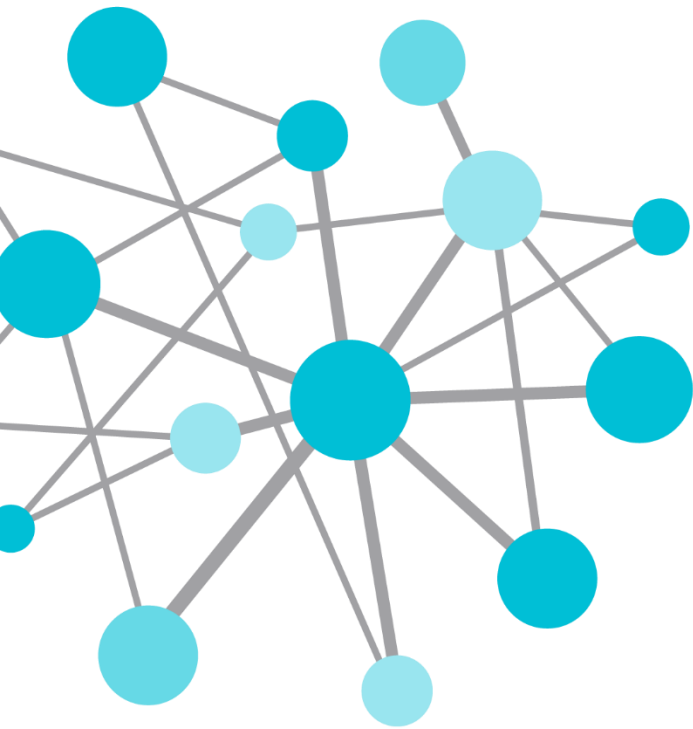
Results and Benefits

PI Analytics

- Use existing Hierarchy for calculations
- Analysis Templates for easy replication of calculations

Building a PI AF Model

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Solution

- PI System Explorer Plugins
- PI AF SDK
- PI Analytics

Results and Benefits

- Automated PI AF Elements and PI Tag creation
- Complex PI AF calculations recorded as PI Tags
- Customized user displays using AF Data

Next Steps

- AF Event Frames
- AF Notifications
- More Calculations
- **All based on existing AF Model**

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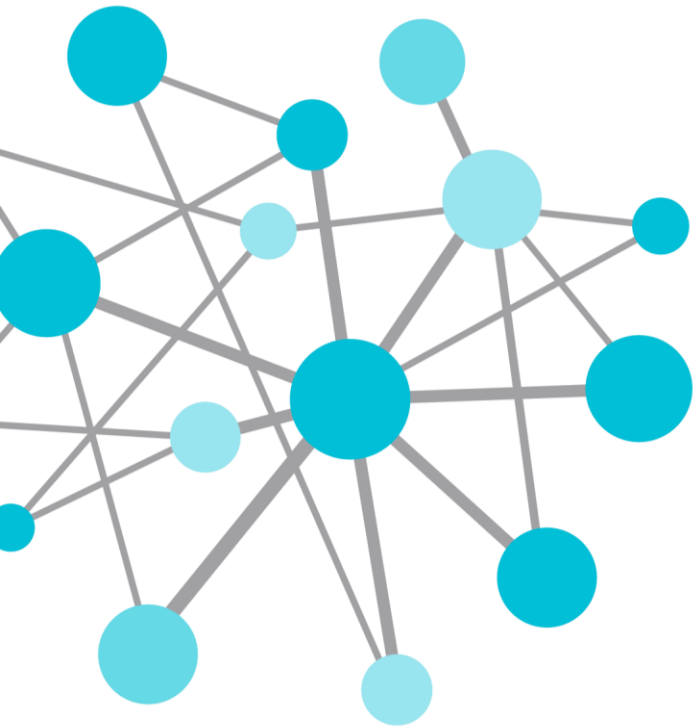
THANK YOU

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