

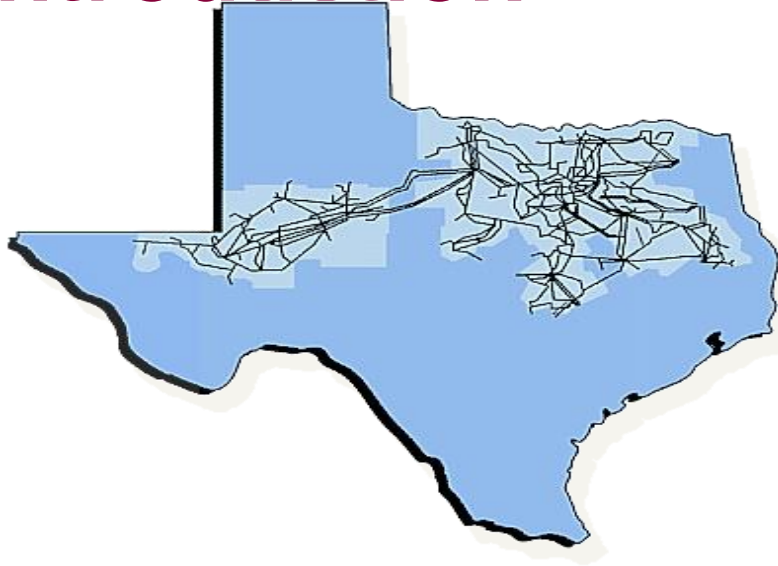
From Raw Data to Usable Insight: Calculating SAIDI from AMI Data

SOUTHWEST ELECTRIC
DISTRIBUTION EXCHANGE
CONFERENCE 2019

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Introduction



The 6th largest utility in the United States -
over 3.5 million meters

Serving over 10 million consumers (more than
1/3 of the state's population)

105,168 miles of dist. lines

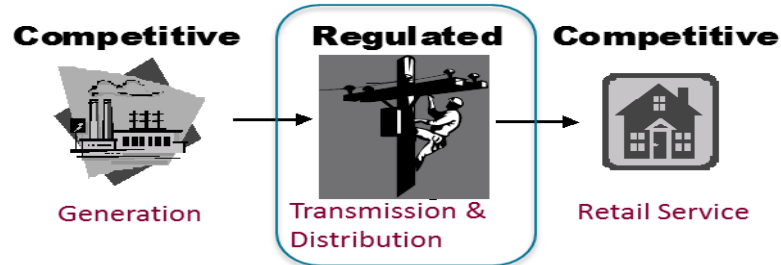
53,486 miles² service territory

4 million network nodes

890,000 distribution transformers

1370 substations and 3176 feeders

Highest electric demand growth region in the
United States



DEFINITION OF SAIDI

SYSTEM AVERAGE INTERRUPTION DURATION INDEX

- $SAIDI = \frac{SUM\ OF\ ALL\ CUSTOMER\ INTERRUPTION\ DURATIONS}{TOTAL\ NUMBER\ OF\ CUSTOMERS\ SERVED}$
- In other words, SAIDI is the:
 - AVERAGE OUTAGE DURATION FOR EVERY CUSTOMER
- Tracks interruptions greater than 5 minutes

CALCULATING SAIDI - TRADITIONAL

DRIVEN BY CONNECTIVITY MODEL THROUGH OMS

- OMS: OUTAGE MANAGEMENT SYSTEM
 - Tracks customer, meter, and device reported outages
 - Can infer other customers affected based on the connectivity model
- The CONNECTIVITY MODEL defines the relationship of a meter to an upper-level device
 - Transformer
 - Fuse
 - Recloser
 - Breaker

CALCULATING SAIDI – TRADITIONAL (cont.)

ERRORS IN REPORTING

- OMS
 - LENGTH OF OUTAGE
 - Customer reports call after outage began
 - Ticket is closed long after the power has been restored
 - NUMBER OF CUSTOMERS
 - Stepped restoration events are not recorded correctly
 - Outage identified at wrong device level
- CONNECTIVITY MODEL
 - NUMBER OF CUSTOMERS
 - Customers are erroneously included/excluded

Is There a Better Way?

CALCULATING SAIDI – AMS/AMI

DRIVEN BY SELF-REPORTING METERS

- AMS/AMI (ADVANCED METERING SYSTEM)
 - 15 minute interval data
 - Average Voltage
 - kWh +/-
 - Separate channels for consumed and generated energy
 - Status flags
 - Power Fails and Clock status
 - How much data in the interval
 - Unsolicited Power Status Events
 - Last Gasp (Lost Power)
 - Restoration (Restored Power)

CALCULATING SAIDI – AMS/AMI (cont.)

SUCCESS AND GAPS IN AMS SAIDI

- **SUCCESS**
 - Modeless Reporting
 - Outages are only recorded if they actually occur
 - No manual entry of outage and restoration times
- **MINOR GAPS**
 - Non-Existing AMS Data
 - Non-AMS meters and meter changes during restoration
 - Variance with Delivered Voltage (for shorter outages)
 - Use of average line frequency improves calculation
- **LIMITATION**
 - No Cause Codes
 - Loose Match to OMS for more Outage Information

ROAD BLOCKS

DATA ACCESSIBILITY

DATA TOOLS

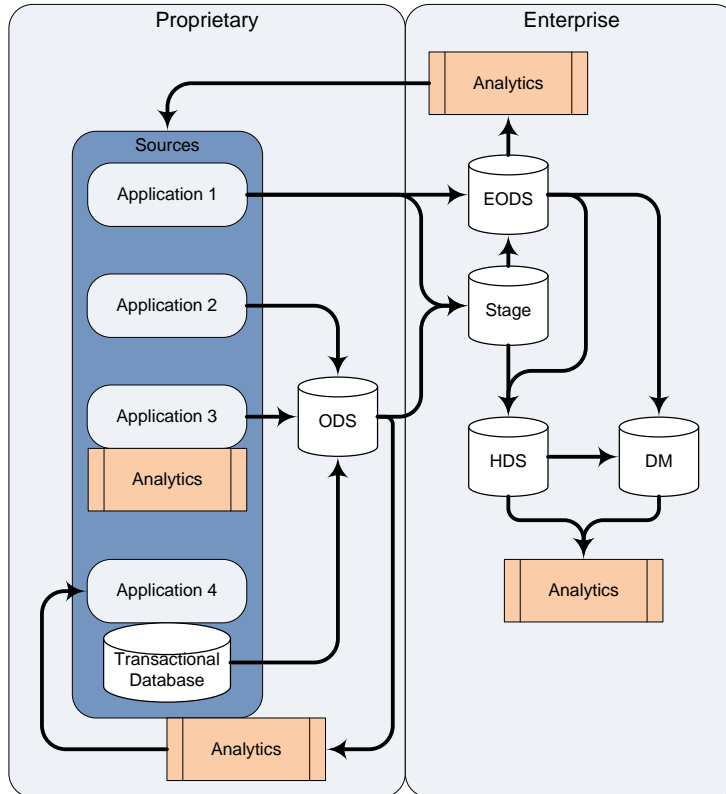
DATA KNOWLEDGE

ROAD BLOCKS

DATA ACCESSIBILITY

- Data Ownership
 - Each application belongs to a different group
 - AMS, OMS, MAXIMO, etc.
 - Ability to query data was limited to application owners
 - Requests for data were sent to group members

Data Management Framework (2013)



Proprietary

- Application and Operational data within Business Processing Domains. Data retention is for 25 months.

Enterprise

- Shared, aggregated data across Business Processing Domains. Data retention is for 7 years and must be CIM compliant.
- Data migration is purposeful (e.g. only migrates through Data Stores where there is value add).
- Business Reporting can be against any data store (except Staging).

Common

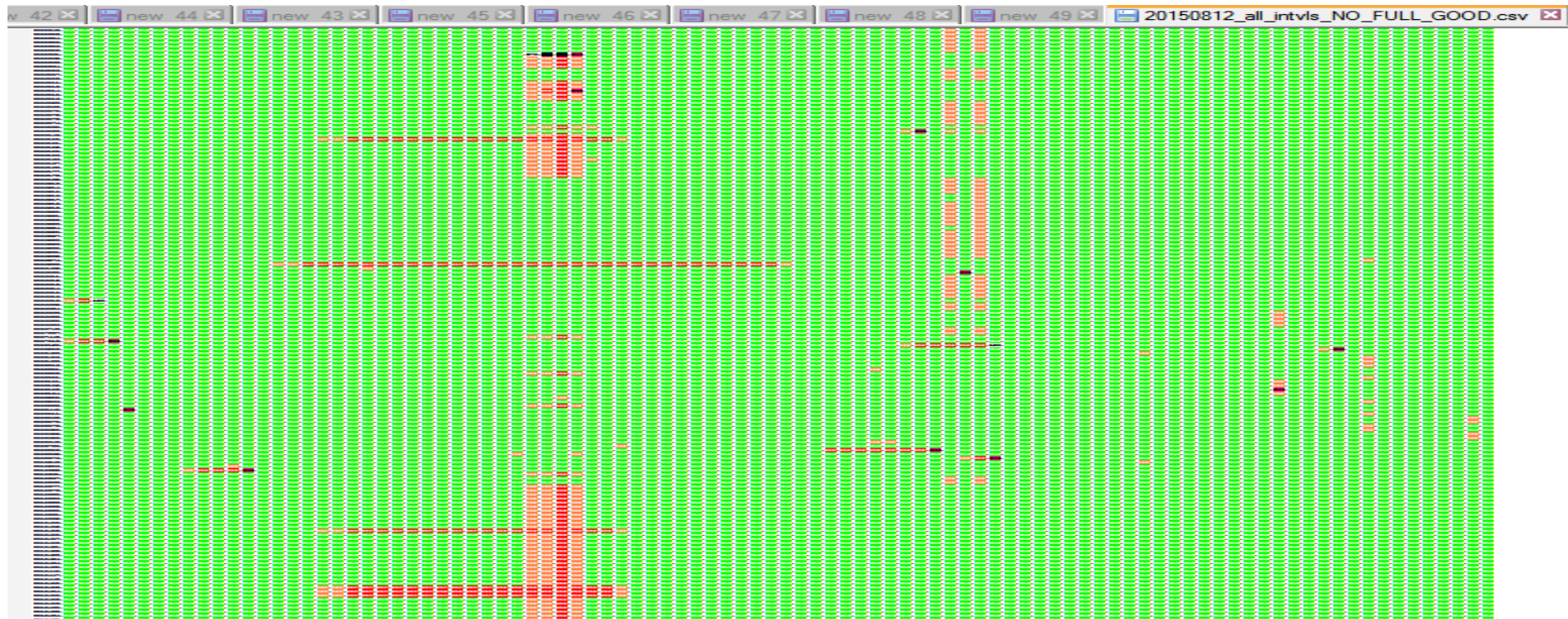
- Analytics are derived 'value add' data that may serve as input to other functional needs.
- COGNOS is the recommended reporting tool. Additional tools should be approved by BSP Data Management.

ROAD BLOCKS (cont.)

DATA TOOLS

- Excel
 - 1.4 million rows limit
- Access
 - 2GB limit
- Cognos 8

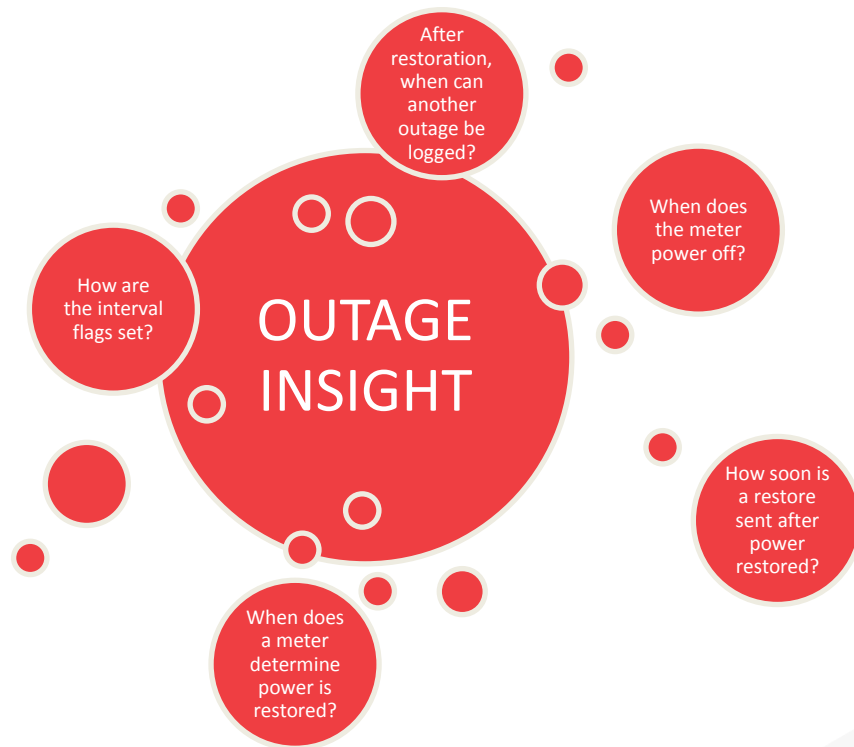
2015 INTERVAL DATA



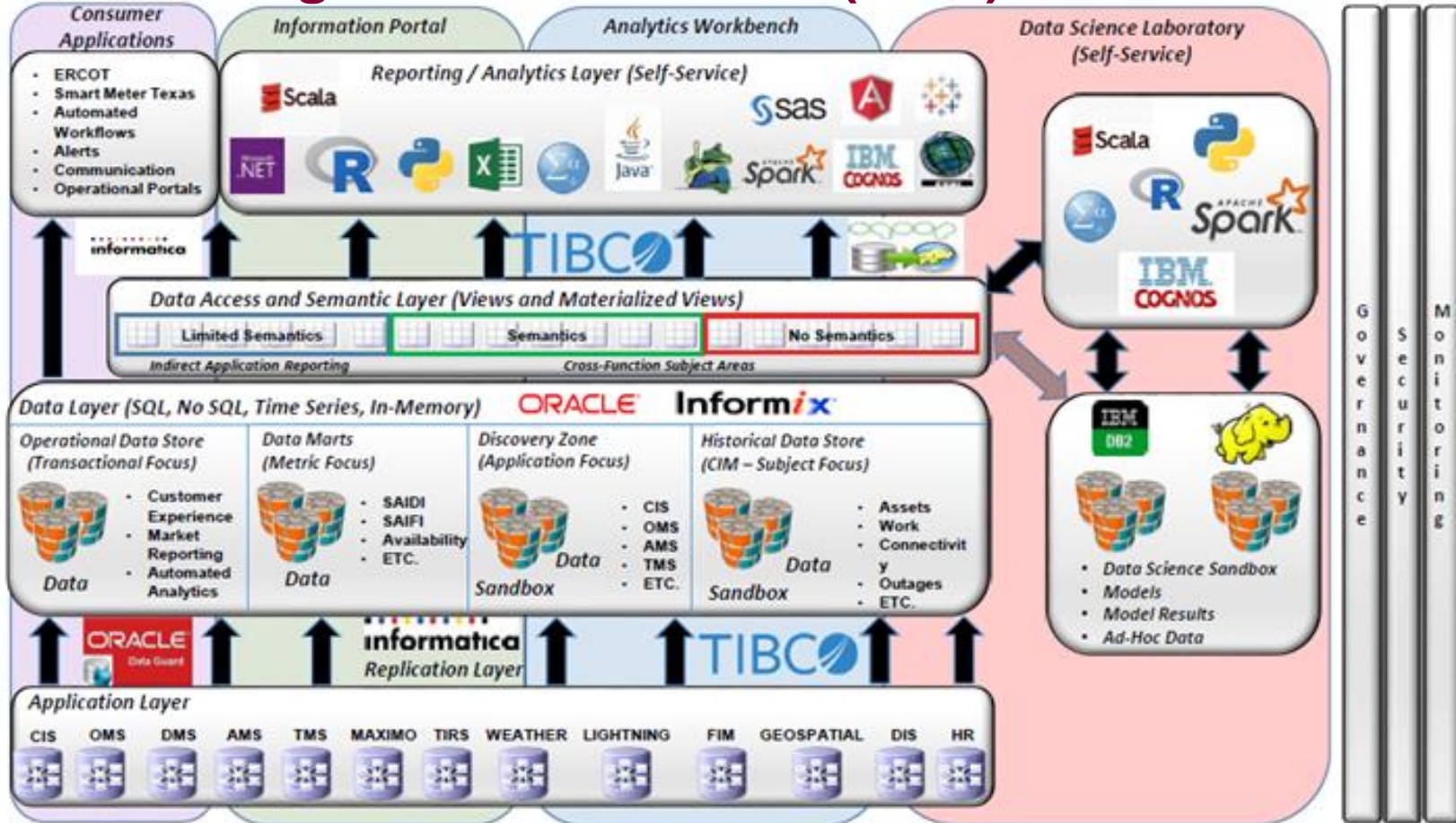
ROAD BLOCKS (cont.)

DATA KNOWLEDGE

- 2 Years fully deployed AMS in 2014
 - Typical AMS usage
 - Remote read, connect, and disconnect
 - Outage ticket creation
 - Non-technical loss studies
 - What else?
- What is the outage/restore logic?
 - Meter Level
 - Radio Level



Data Management Framework (2018)



DATA INSIGHT

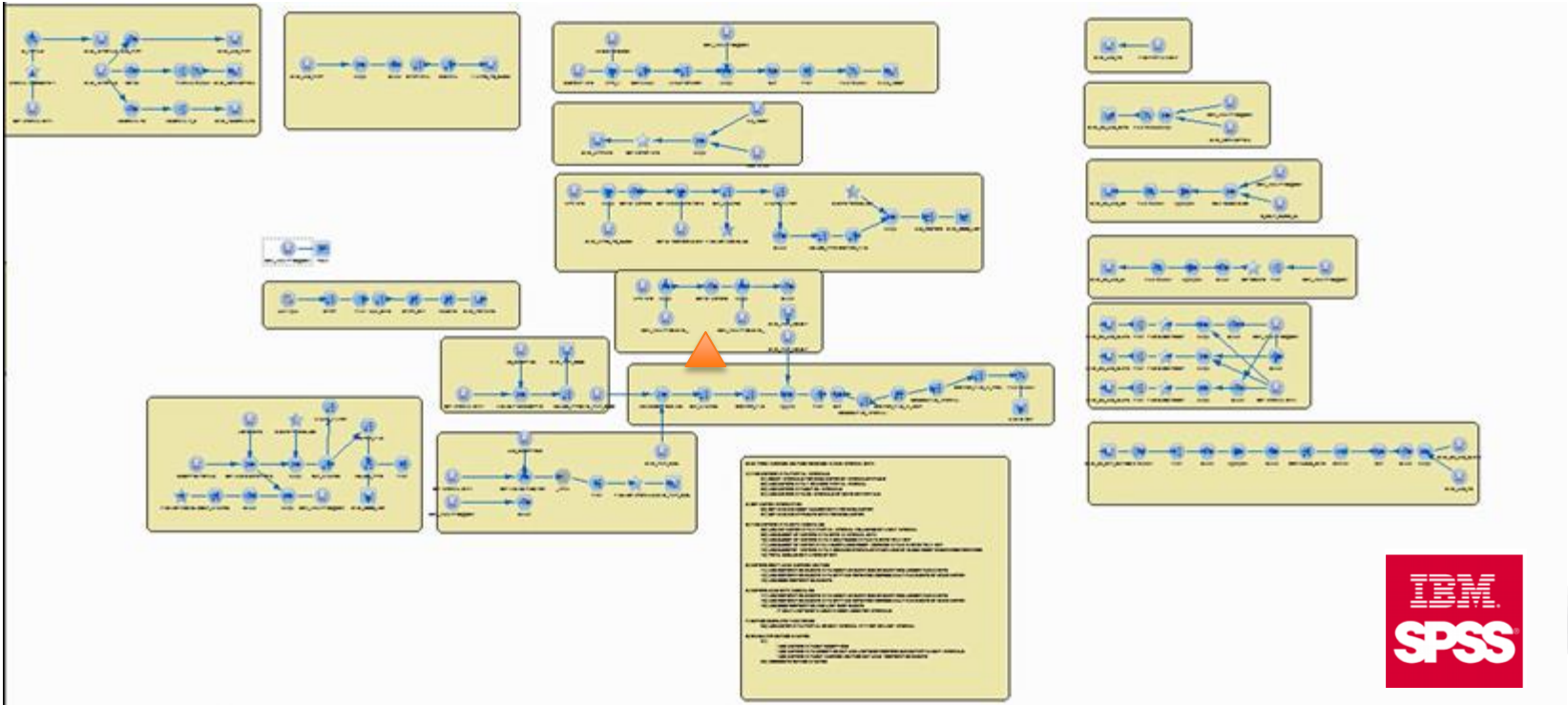


CALCULATING SAIDI – AMS/AMI (cont.)

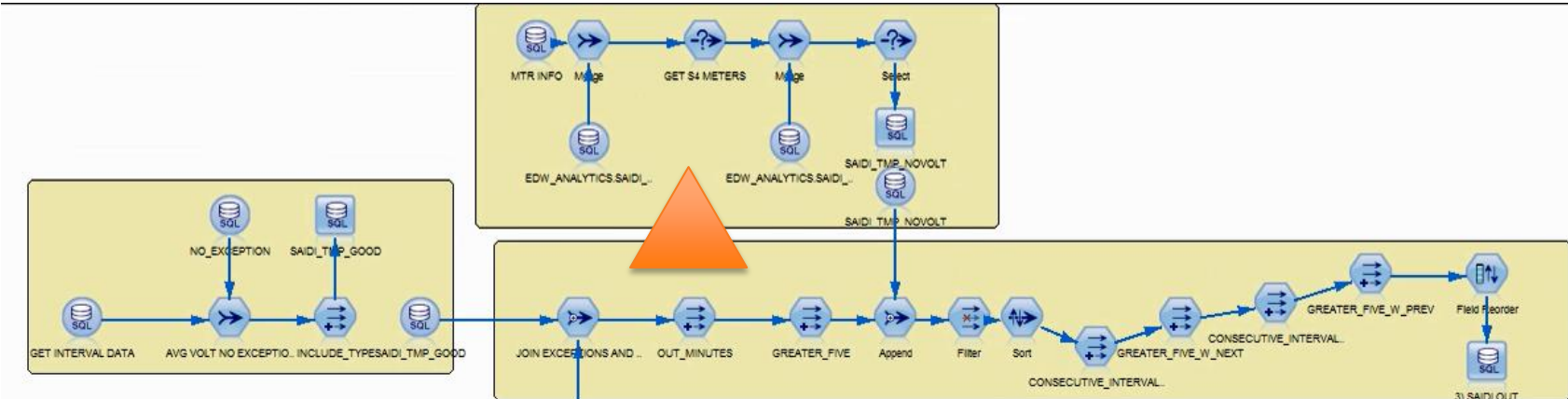
PROCESS TO CALCULATE SAIDI

- FIND METERS WITH POSSIBLE OUTAGE DATA
- GET METER INFORMATION
- PROCESS INTERVAL DATA FOR EXCEPTIONS
- GET POWER STATUS EVENTS FOR EXCEPTIONS
- CALCULATE OUTAGE MINUTES FOR EACH INTERVAL
 - $\left(\frac{NOMINAL\ VOLTAGE - AVERAGE\ VOLTAGE}{NOMINAL\ VOLTAGE} \right) * INTERVAL = OUT\ MINUTES$
 - $\left(\frac{240\ V - 104\ V}{240\ V} \right) * 15\ minutes = 8.5\ MINUTES\ OF\ OUTAGE$
 - $\frac{\sum\ OUT\ MINUTES}{TOTAL\ CUSTOMERS} = SAIDI$

SAIDI PROCESS STREAM



APPEND SAIDI SOURCES AND OUTPUT



Derive field:

OUT_MINUTES

Derive as:

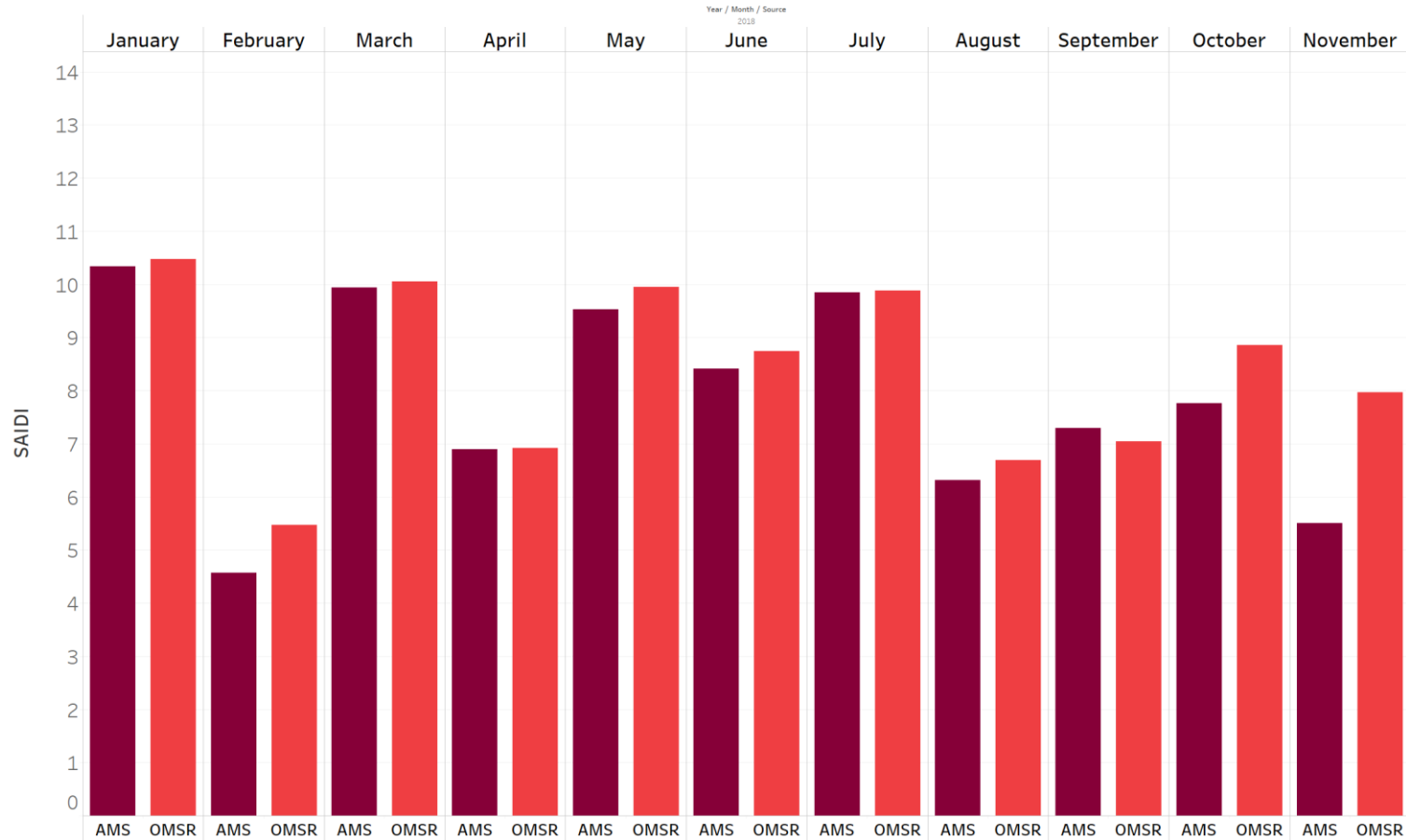
Field type:

Formula:

```

1 ((MX_METRVOLT-INTERVALVALUE) /MX_METRVOLT)
2 *15
    
```

AMS vs OMSR



SAIDI- FUTURE ENHANCEMENTS

DATA QUALITY

- Using IFE for CONNECTIVITY MODEL corrections
- Program meters for AVERAGE LINE FREQUENCY reporting
- Automatically update OMS records for correctness

ALGORITHM

- Join with OMS data for CAUSE CODES

GAINING INSIGHT

DATA ACCESIBILITY

- Replication
- Sandbox

DATA TOOLS

- Visualization
- Mining

DATA KNOWLEDGE

- Manufacturer collaboration
- Test devices

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