EPRI DATA ANALYTICS CASE

Selection of Bellwether Meters for Grid Optimization Programs

The Data Challenge

The selection of optimal voltage monitor locations on a distribution circuit for the purpose of optimizing grid operations is a challenge because of the dynamic characteristics of the loads and distributed energy resources connected to the grid. Supervisory control and data acquisition (SCADA) devices provide some visibility into the voltage profile at a limited number of points along the primary three-phase distribution line; however, the lowest or highest voltage on the circuit may not necessarily be at the end of the line or at the source of the line as one might suspect. These low- and high-voltage points will also vary from one time interval to the next. As a result, utilities are faced with selecting a few locations to provide voltage measurement inputs to their grid optimization programs.

Solution Overview

Robust algorithms must be developed to select the optimal voltage monitoring locations for each interval of time. Because of the dynamic nature of the grid, the algorithm must be flexible enough to provide visibility of the highest and lowest voltage segments of the circuit while limiting the voltage monitoring points to a manageable number.

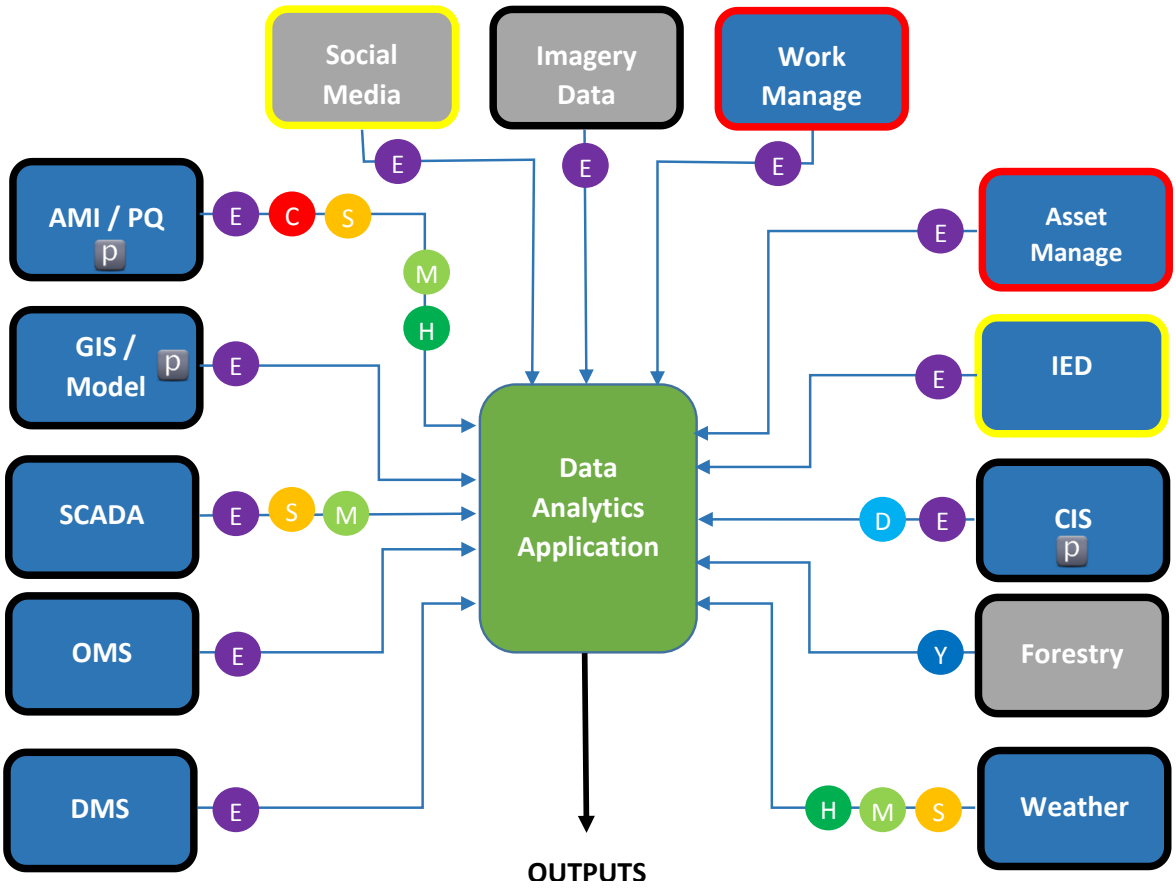
Potential Methods for Solving the Problem

The primary method would be to select enough bellwether meters to provide adequate coverage across the circuit to capture the lowest and highest average voltage for required time intervals: 1-, 5-, 15-, or 60-minute interval readings. Statistical analysis of historical voltage readings from the smart meter would provide a list of meters that typically have the highest and lowest voltage. Because customer loading patterns change hourly, daily, and seasonally, the list of meters would need to change based on load patterns and the resulting change in the voltage profile.

A second method, which could be used in conjunction with the primary method, would be to use the high- and low-voltage threshold alarm or alert messages from the smart meters to indicate when voltage exceeds a defined threshold. The threshold limits are usually configurable and would permit the utility to build in a safety margin to limit or eliminate the possibility of voltage violations. In addition, the alert message is usually sent immediately after the threshold is exceeded and may also contain the voltage measurement. This method would use all smart meters as pseudo-monitoring points and would not require a statistical analysis.

Available Data Sets

The data sets highlighted in the following figure are available in the EPRI Data Repository to solve this data analytics case.



Classifications of Data:

- Traditional Data Set
- New Data Set
- Structured Data
- Un-structured Data
- Format of Data Varies

Frequency of Measurement

- C — Cycles
- S — Seconds
- M — Minutes
- H — Hours
- D — Days
- Y — Months to Years
- E — Event Driven

p **Denotes a primary data set used to solve this data analytics case.**