EPRI DATA ANALYTICS CASE

Detection of Electric Vehicle Load Signatures

The Data Challenge

Unplanned charging of electric vehicles can lead to overloaded assets in a distribution system and premature equipment failure. Therefore, utilities need a method to detect this type of load, which can easily be the largest load for an electrical service, especially in residential areas.

Solution Overview

Basic algorithms are developed to accurately mine data sets from smart meters to detect the charging of electric vehicles. The algorithms must parse the profile of such charging from end-use loads of similar size and energy-use profile.

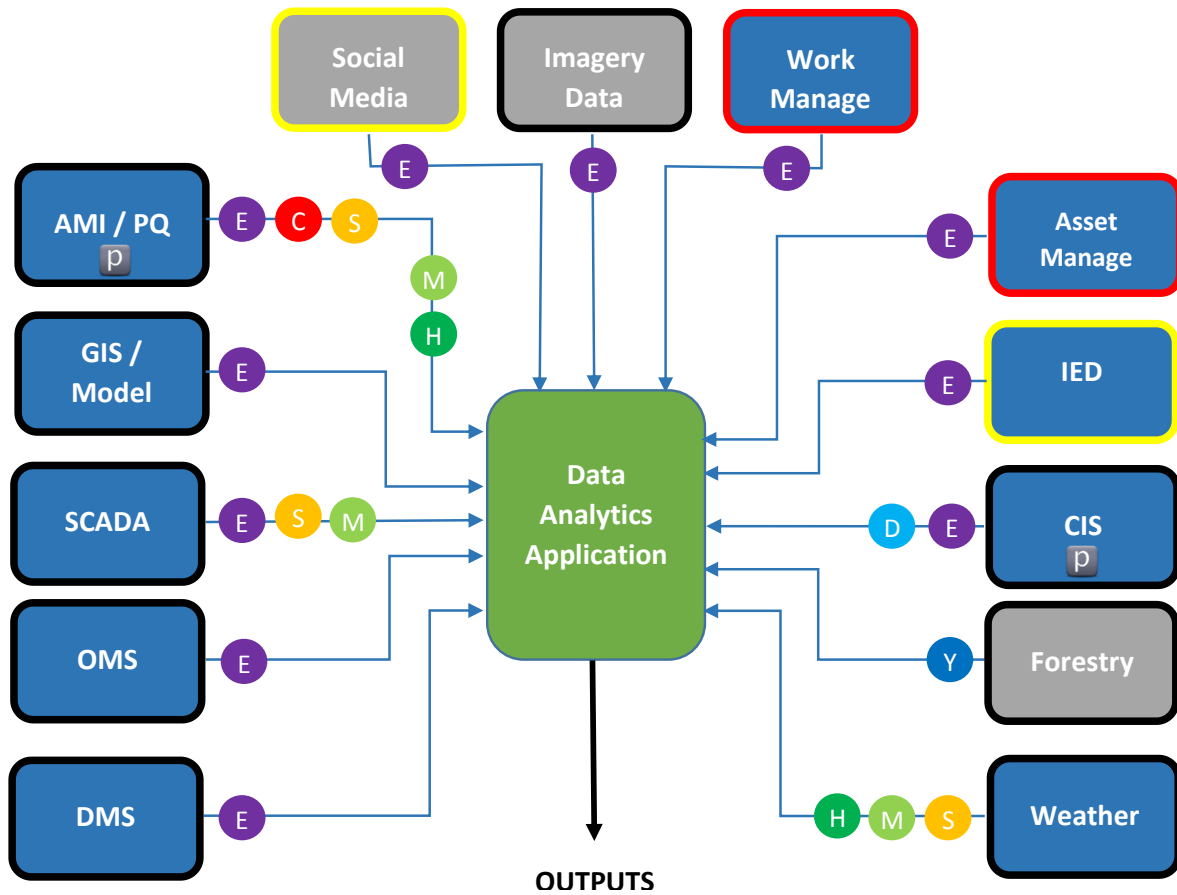### Potential Methods for Solving the Problem

A developed approach to detection of electric vehicles begins with a simple baseline comparison of interval data and answers the question, "Does the load of a residence for a single 15-minute interval exceed the power drawn for a charge cycle?[1]" Take for example a 3.7 kW charger. The first step of the algorithm is to identify all 15-minute intervals greater than 3.7 kW, which indicate possible charging activity. If the load is less than 3.7 kW, the interval is marked as an interval without charging activity. Intervals greater than 3.7 kW either contain charging activity or household activity or both. Intervals that exceed 3.7 kW but do not contain electric vehicle charging are considered false positives.

The next step is to apply filtering to eliminate the false positives. Successful application of the filter requires careful selection of the filter algorithm. A filter to preserve edge sharpness is needed to enable determination of both start and stop times. Also, ideally the filter will preserve the magnitude information to allow differentiation between the various charge levels. Filter types include moving average, bi-directional minimum, modified bi-directional minimum, and a delta filter. In addition to the type of filter, the size of the window is important. Loosely, the window defines the range of neighboring values, which are included within the calculation. The window is chosen to fine-tune the filter for improved performance.

Available Data Sets

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

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[1] *Automated Discovery of PEV Charging Using AMI Meter Data: Initial Algorithm Development and Validation.* EPRI, Palo Alto, CA: 2013. 3002000582.

Classifications of Data:

🟦 (Blue fill)	Traditional Data Set
⬜ (Gray fill)	New Data Set
⬛ (Black border)	Structured Data
🟨 (Yellow border)	Un-structured Data
🟥 (Red border)	Format of Data Varies

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

Frequency of Measurement

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