EPRI | ELECTRIC POWER RESEARCH INSTITUTE

T&D Asset Analytics Support Applications

Transmission and Distribution (T&D) utilities face several challenges—among them, aging infrastructure, stringent operating requirements, financial constraints, and retiring expertise—that make maintaining and managing power delivery assets challenging.

- **Aging infrastructure.** Many power delivery assets are now more than 50 years old.
- **Scheduled outages.** Increased oversight by regional T&D system operators and higher utilization of T&D corridors have affected the availability of scheduled outages.
- **Lack of data and performance metrics.** Data offering a complete description of an asset's condition, although attainable, is often lacking in practice.
- **Stakeholder requirements.** Stakeholders need utilities to maintain performance levels and limit rate increases.

To address these challenges, many electric utilities are considering or are moving towards more data driven processes to improve maintenance and reliability, and to minimize equipment costs and risks. Data driven analytical decision processes must: 1) Understand existing performance, 2) Determine required performance, 3) Project future performance and 4) Develop actions to bridge gaps. T&D companies require knowledge enablers such as data, analytical tools, and models to implement such data driven analytical decision processes. EPRI has extensive experience in performing asset analytical studies and implementing EPRI algorithms in asset health systems, and can offer the following applications.

Data Driven Analytics to Aid Informed Decision Making

EPRI can review readily available asset data (in-service, historical removal/failure records, maintenance and outage histories, data files from non-traditional sources such as relays, SCADA alarms etc.) and determine which analysis are feasible. For example, developing failure rates, quantifying present condition (health) of in-service assets, prioritizing asset maintenance and inspection activities, formulating spares policies, and prioritizing capital replacement decisions.

Apply Advanced Data Science & Statistical Techniques

Advanced data science techniques such as Natural Language Processing, Machine Learning and Simulation Techniques can be used to rapidly analyze large asset performance datasets to extract actionable insights like common problems with specific asset model/manufacturer. EPRI can use these advanced techniques and analyze large data sets. Resulting insights are useful in identifying assets with high maintenance requirements, finding leading practices, understanding useful life.

Assess Asset Fleet Condition Using EPRI-Developed Algorithms

EPRI has developed fleet management algorithms for power transformers, circuit breakers, and insulators. These algorithms rely on readily available data such as asset information, historical test, maintenance, and failure histories for analysis and produce a ranking of assets at risk that are in the need of maintenance, monitoring, inspection, or replacement. EPRI can apply these algorithms to utility T&D asset fleets, perform analysis and provide fleet assessment results.

Integrate EPRI Algorithms in Enterprise-wide Asset Health Systems

EPRI can assist utilities in integrating algorithms, data science techniques as well as equipment performance metrics in third party asset health systems.

Benchmark of Utility Asset Population Performance with Metrics Derived From Industry-Wide Data

EPRI maintains a growing industry-wide repository of T&D asset performance and failure data. To date EPRI has populated the database with 131,856 In-Service and 50,954 Removal Records from 83 utilities for 16 different T&D assets. This data, along with utility specific information, can be used to benchmark utility asset performance– e.g. wood pole reject rates, circuit breaker leak rates, transformer failure rates etc.
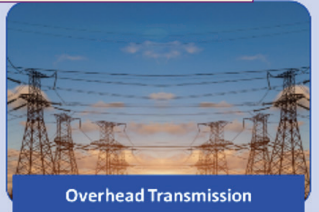
Examples of T&D Asset Analytics Support Applications

Asset Performance Data in EPRI's Industry-wide Database

Substations

	In-service	Removal
Transformers	69,000	9,795
Circuit breakers	62,856	4,200
CCVT's		10,543
Switches		9,915
Bushings		89
Arresters		77

Overhead Transmission

	Removal
Porcelain/Glass Insulators	11,565
Polymer Insulators	1,368
Conductor Sections	3,065
Connectors	129
Arresters	59

Underground Transmission

	Removal
Pipe type	73
Extruded	42
Self contained	27
Special application	7

131,856 In-Service and 50,954 Removal Records from 83 utilities

Example of applying Supervised Natural Language Processing Algorithms to Better Understand the Most Common Problems for Two Switch Manufacturers

Manufacturer B
Contacts, 20%
Crank, 3%
Grease, 5%

Manufacturer A
Contacts, 5%
Crank, 9%
Gear Drive, 3%
Grease, 8%
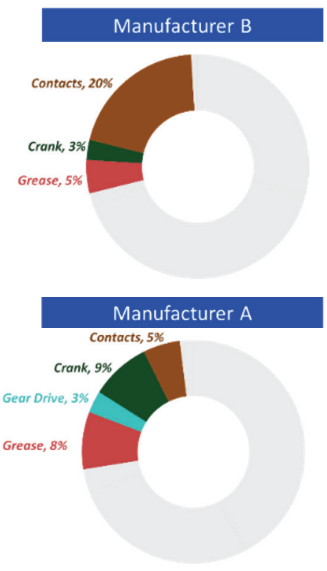
Example of Observed Reject Rates for Southern Pine Wood Poles Originally Treated with Creosote
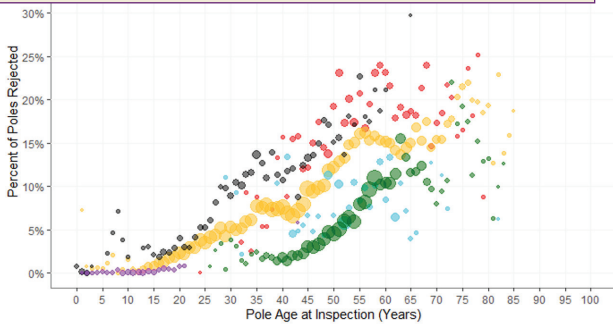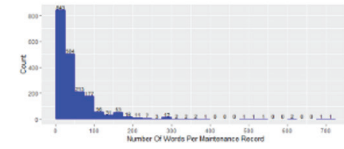

Example of Applying Unsupervised Natural Language Processing Algorithms to Better Understand the Top 3 Most Common Disconnect Switch Problems

1388 Raw Maintenance Records
98150 Total Words

Natural Language Processing
(Text Vectorization + Statistics)

Manufacturer	Fleet Size	# CMs	Top Phrase #1	Top Phrase #2	Top Phrase #3
A	2993	700	Frozen bearing assembly	Seized bearings	Replace bearings
B	708	146	Check switch	Contacts	Seating
C	663	208	Clean & grease	Inspect	Lower hinge
D	373	63	Blade latch	Full speed	Poor condition
E	347	168	Switch support	Support structure	Painting needed
F	243	103	Replacement mx order	Reseat disconnect	Micro ohm testing

Example of Integrating EPRI's Power Transformer Expert System Software with Enterprise Wide Asset Health System
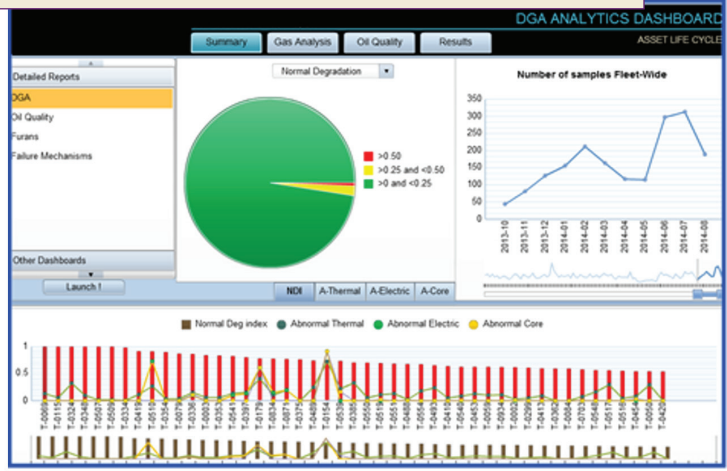
Why EPRI?

With decades of combined expertise in asset management, asset performance and data science and analytical techniques, EPRI is uniquely positioned to assist T&D utilities in developing and integrating data-driven, reliability focused decision making into the maintenance and management of power delivery assets. For more than 20 years EPRI has developed and applied a library of analytical tools (algorithms, metrics, advanced data science and statistical techniques) for analyzing a variety of readily available T&D asset performance data. EPRI has developed an extensive industry wide equipment performance and failure database that can provide greater insights than any single utility's database.

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