EPRI DATA ANALYTICS CASE

Predictive Health Index for Non-Communicating Reclosers

The Data Challenge

Health assessments of a non-communicating distribution oil-circuit recloser (OCR) are rare because of the lack of communications to the device and device sensors required to monitor its changing condition from thermal, electromagnetic, and environmental stresses. The lack of data and knowledge of the OCR prevents proper analysis from being conducted on the device to determine its health.

Solution Overview

Basic assessment algorithms can be created to provide a health index of the OCR based on the standard duty cycle rate, age and condition of the oil, age and condition of the recloser, past experience with the same recloser type, environmental factors, and other parameters determined during a maintenance cycle. The health index can be used to predict the time to perform maintenance on or retire the OCR.

Potential Methods for Solving the Problem

This paper proposes to replace or supplement field inspections with a data-driven solution(s). Because an OCR typically does not have communications to provide critical feedback data for a data analytics solution, the following potential methods use data from other communicating devices on the same circuit as an OCR to project its health using a health index assigned to each recloser:

- Operations counter: the algorithm(s) would count the number of operations over a given period of time. It would rely on outage event data from advanced metering infrastructure (AMI) meters within the protective zone of the OCR. The data analytics solution should eliminate the need for technicians to periodically visit each OCR installation to document the value on the OCR's operations counter. OMS data could also supplement the AMI meter data to assist with determining whether one or more of the single-phase OCRs operated in a multiple-recloser installation and serve as a source of validation on the OCR operation. The counter algorithm(s) would be an input into the health index because it would provide a way to project the wear on the contacts, the mechanic components, and oil condition. This algorithm(s) would feed into the algorithm(s) associated with the fault current magnitude.
- Fault current magnitude analyzer: the algorithm(s) would determine the magnitude of the fault current interrupted by the OCR by using data from source-side, communicating recloser(s) and/or circuit breaker that measure fault current. Feeder model information from the distribution management system (DMS) and/or geospatial information system (GIS) and distribution planning tools could be used to supplement the source-side recloser(s) and/or circuit breaker. The fault current magnitude algorithm would be an input into the health index because it would also provide a way to project the wear on the contacts, the mechanic components, and oil condition.
- Timing analyzer: data from the source-side, communicating recloser(s) and/or circuit breaker could be analyzed to determine whether the timing sequence of the recloser meets the design specification for each operation sequence. Tracking the timing of OCR operations would provide insights into the potential degradation of the timing mechanism and/or other mechanical components of the OCR. The timing analyzer algorithm(s) would be an input into the health index because it would provide a way to estimate the condition of the timing mechanism and other mechanic parts in the OCR.
- Probabilistic risk assessment (not covered in this paper): data from the asset management system combined with the data sets mentioned previously could be used in a statistical analysis to determine the probability of failure of an OCR based on failure rates of similar OCRs manufactured by the same company around the same period of time.

This data analytics case acknowledges the challenge of accounting for the health of the many different components that make up an OCR. Failure of one or more components could lead to a malfunction, a failure to operate, or even a failure of the OCR itself. The overall goal is to evaluate the conditions to which the OCR is exposed and the components that are most likely to lead to premature failure. From this assessment approach, a utility would be able to better predict the health of the OCR and determine an optimal time to perform maintenance on it based on its health index.

Available Data Sets

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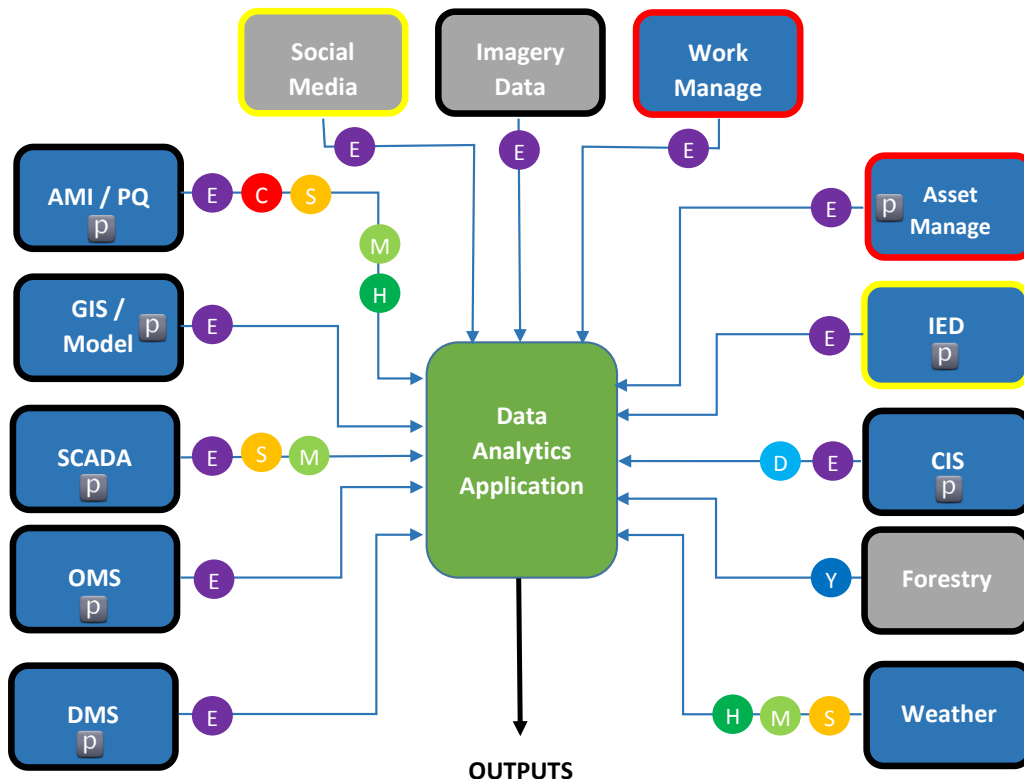
Classifications of Data:

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

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