



Data Analytics and Applications Demonstration Newsletter

An EPRI Update on the Multi-Year International Demonstrations on “Data Analytics”

April 2014

ABOUT THE NEWSLETTER

The EPRI *Data Analytics and Applications Demonstration* newsletter provides updates on EPRI’s “Data Analytics” demonstrations—the Distribution Modernization Demonstration (DMD) and Transmission Modernization Demonstration (TMD). These initiatives identify and analyze data-oriented applications and support infrastructure through collaborative demonstrations around the world. Contact Doug Dorr (DMD) (ddorr@epri.com) or Alberto Del Rosso (TMD) (adelrosso@epri.com) with comments or questions.

If you or a colleague would like to be added or removed from the newsletter mail list, please email one of the demonstration managers listed above.

EPRI Perspective

Data and analytics are the new enablers for the smart grid. The utility industry is clearly in the midst of an evolution toward data-driven decision making. Some consider this a disruptive change, while others embrace the change as the evolution of the smart grid. There are dozens of areas where improved grid visibility achieved through data analytics are going to re-script the way electric utilities view and manage their end product. This newsletter is designed to provide updates into a selection of interesting and evolving topics associated with analytics of the electric power system.



TECHNOLOGY TRANSFER AND INDUSTRY COORDINATION

Industry Advisors Provide Challenging Vision for EPRI’s Data Analytics Effort

With the second phase of the DMD and TMD projects getting under way this year, activities have turned to identifying demonstrations for the collaborative projects. For transmission systems, the emerging themes for the demonstrations discussed thus far involve system and asset health, including wide-area situational awareness and system visualization, on-line event detection and replay, and early warning of potential angular instability. Areas of interest in distribution include storm restoration and outage management and predictive tools for forecasting weather impacts. Also, applications are emerging that exploit advanced metering as a distribution asset, not just as something that customer service uses to produce a bill.

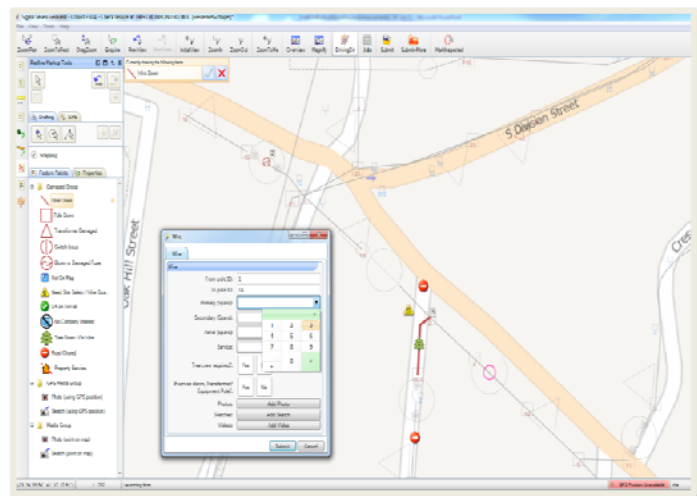


Figure 1 Screenshot from Con Edison of NY’s damage assessment tool

At the Huntington Beach advisory meeting, Consolidated Edison presented case studies related to storm response, outage restoration, and distributed generation. Con Edison's line workers make use of electronic maps that show damage locations on tablets that are tied to the OMS. The company is communicating customer-specific estimated time of restoration (ETR) and works to meet that ETR. The company also uses better weather data and other information to provide improved pre-event damage prediction.

Southern Company described its Transmission Monitoring, Diagnostics, and Visualization (TMDV) Project to the meeting attendees. Southern had data stored and maintained by different groups throughout the company, using it in different ways. The names of the same assets sometimes differed from one system to another, and the volume of data was increasing due to the implementation of more and more sensors. The concept of TMDV was to integrate this information so that it could be used in a consistent way across the company. The process kept a focus on the consumer of the data. One goal was to identify end-user tools that could be scaled without the need for customization.

Southern focused on four major sources of data to include in this project: Standard Transmission, Operations, and Maintenance Program (STOMP, SCADA/EMS, eDNA Historian, and relay fault records). Unique access, interpretation, and preprocessing issues had to be addressed for each dataset before it could be integrated. Communications, physical equipment, staffing, standards, and security were all considered as well.

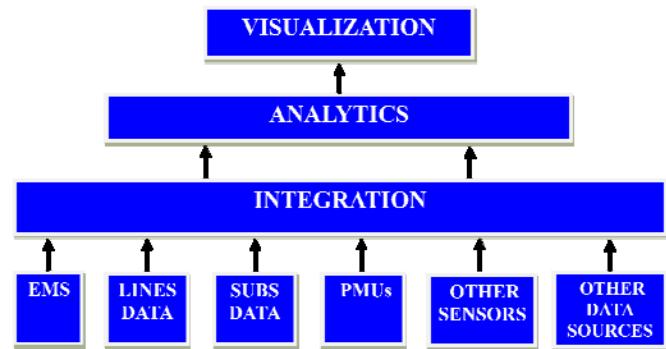


Figure 2 High level representation of TMDV structure

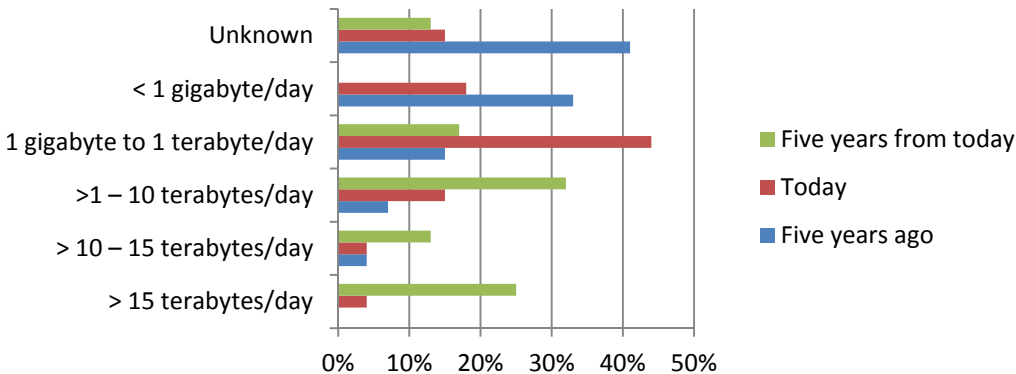
Some of the advisors challenged the EPRI team to consider demonstrations that would create more dynamic visualizations by bringing together data from multiple systems to predict operational issues. Such synthesis can advance the desirable outcome of creating actionable information for each of the affected organizations through the process of converting Data → Information → Knowledge → Action.

The development of an integration standard to reconcile the characteristic of the various data sources was discussed but was viewed as premature. Leveraging emerging alternative approaches, such as Hydro Quebec's pioneering work on complex integrations through the use of semantic models, was discussed as a possible alternative to data standardization. Such opportunities for exploring and sharing advanced information-management tools and techniques are at the core of the value proposition for EPRI's Data Analytics projects.

Utilities See Emerging Data Sources Playing Significant Role in Data Growth

Utilities seem to have a clearer perception on the data growth and the impact of new data sources, as revealed in the EPRI "Big Data" Survey. The results indicate that five years ago, many utilities did not know how much data they received on a day-to-day basis, with 41% indicating that the volume of data was unknown, followed by 33% indicating a volume of less than 1gigabyte of data per day. Today, more than 25% of the respondents expect to collect around 15 terabytes daily. Utilities may not be fully prepared to store and analyze this amount of data. This "data evolution" is similar to that of the financial services industry, which has been investing heavily in data management and analytics for decades. The utility industry may be required to participate in a period of heavy investment to meet the "big data" needs.

Volume of Data

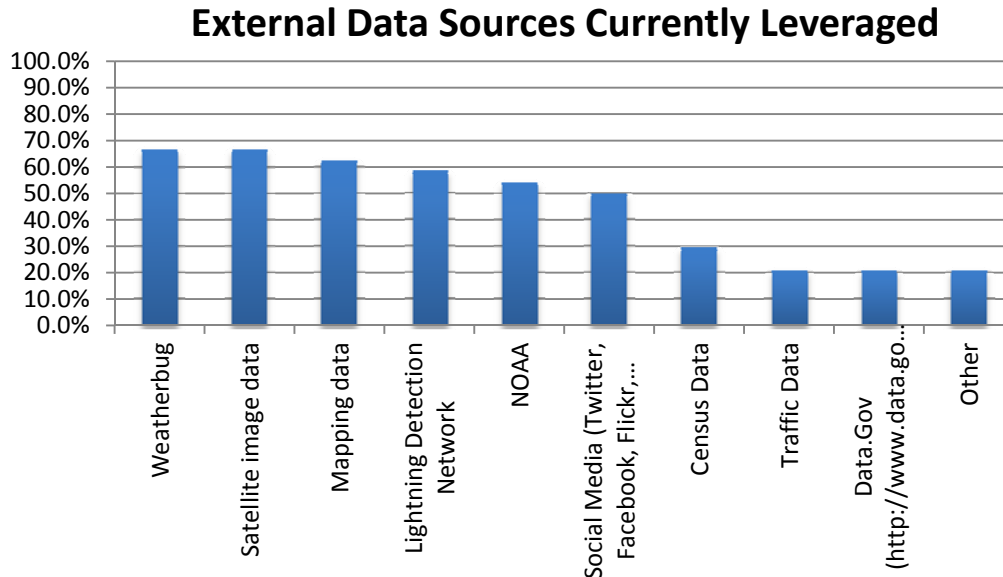


Understanding the existing and emerging data sources and how that data will be used is essential to identify the gaps and direct the investment. Survey respondents identified the following main data sources that their companies plan to capture in the future for the three areas of distribution, transmission, and AMI.

Distribution	Transmission	AMI
<ul style="list-style-type: none"> • Situational awareness: <ul style="list-style-type: none"> • Line sensors and SCADA • Data from deployed solar installation • Information from voltage regulators used to flag faults • Weather station data: <ul style="list-style-type: none"> • Daily wind speed and overcast conditions • Weather data for early detection of storms 	<ul style="list-style-type: none"> • Situational awareness: <ul style="list-style-type: none"> • Asset sensors for knowledge management • Local substation information to support asset management • Analytics: <ul style="list-style-type: none"> • Funneling operational data through an analysis algorithm • Planning: <ul style="list-style-type: none"> • Operational data • Social collaboration data • Aggregated consumption information 	<ul style="list-style-type: none"> • AMI meter data: <ul style="list-style-type: none"> • Voltage from AMI meters • Complex events processing for AMI and outage data • Situational Awareness: <ul style="list-style-type: none"> • Asset health for predictive maintenance • Integrated Demand/Consumption data for transmission

External data sources will play a substantial role in data growth because utilities are planning to incorporate increasing amount of unstructured data (such as social media). External data is currently used in several different ways among utilities, with weather data for predictive forecasting/modeling as preponderant use. The National Oceanic and Atmospheric Administration (NOAA) data is also used for similar purposes. Lightning detection is leveraged by all three domains (distribution, transmission, and

AMI). The data is primarily used for outage-management purposes to detect lightning strikes. Mapping data and satellite image data is almost unanimously used through a GIS system. Social media is increasingly used among utilities, primarily for corporate communications and outage-management purposes.



DISTRIBUTION MODERNIZATION

2013 DMD Activities and Deliverables

Data Analytics Immersions

EPRI is in the final phases of the data analytics workshops with each of the DMD and TMD project sponsors. The objectives of these workshops are to:

1. Identify those unique data-oriented applications and kernels of knowledge that are useful and insightful but have not yet become commonplace within the utility industry as a whole.
2. Establish a baseline for each project member to use as their relative metric in terms of how prepared they are (or will be in a few years) to take advantage of the data analytics applications.
3. Identify the best in class and best practices for managing data as an asset and document the state of the art related to data analytics and visualization.

In the last newsletter, we described a top-ten list of underlying challenges and perspectives associated with how data is leveraged across the electric power industry. Probably the most common challenges that keep coming up during the workshops are in the areas of data value, data silos, and the associated challenges with integration of disparate datasets. One of the other topics identified was the uncertainty in how to securely leverage new cloud hosting and cloud computing opportunities.

Converting this industry challenge into an opportunity is a focus of the EPRI Data Analytics initiative, and our next white paper on this exact topic is due out in June 2014. The document will take an unbiased look at cloud computing technology and interview a few electric industry “early adopters” to:

1. Describe how cloud-based data storage and access are being addressed within the electric utility industry.
2. Discuss challenges and opportunities with respect to the subject (cost, security, privacy, and so on).
3. Describe the list of candidate datasets or enabled applications that would be considered “first adoption” opportunities.

DMD Application Highlights

Using Data and Analytics During Storm Events

If you consider a severe weather event and the sequence of activities before, during, and after the event, you might envision a half dozen different process blocks like those show in the following two figures depicting key systems and critical phases, each with twenty or more activities that go under those process blocks. Consider a simple example such as giving a line crew the ability to query an individual customer meter and view a map with color-coded situational status on a portable electronic device. The data integration and data transfer transactions associated with just this single task are not easily standardized for system-wide deployment. The full list of information-driven activities is diverse—ranging from planning to normalization—and each activity has some number of information (or data) transactions that can be mapped out to understand both time-intensive bottlenecks and data-integration bottleneck in the overall process. In collaboration with EPRI’s Grid Resiliency Initiative, the Data Analytics Initiative will attempt to address the data-driven aspects of storm activities and define the most beneficial data-oriented practices that leading service providers are implementing to ultimately impact storm restoration metrics in a positive way. There is no silver bullet here, but there are several areas where data and analytics can reduce the overall time to accomplish certain storm-related activities. The first workshop on the subject matter was conducted at Ameren headquarters with EPRI staff and Ameren emergency response staff to accomplish the first data-mapping process. In conjunction with this effort, three more activities to more formally identify requirement and the emerging opportunities associated with storm datasets are described in the event calendar section of this newsletter.

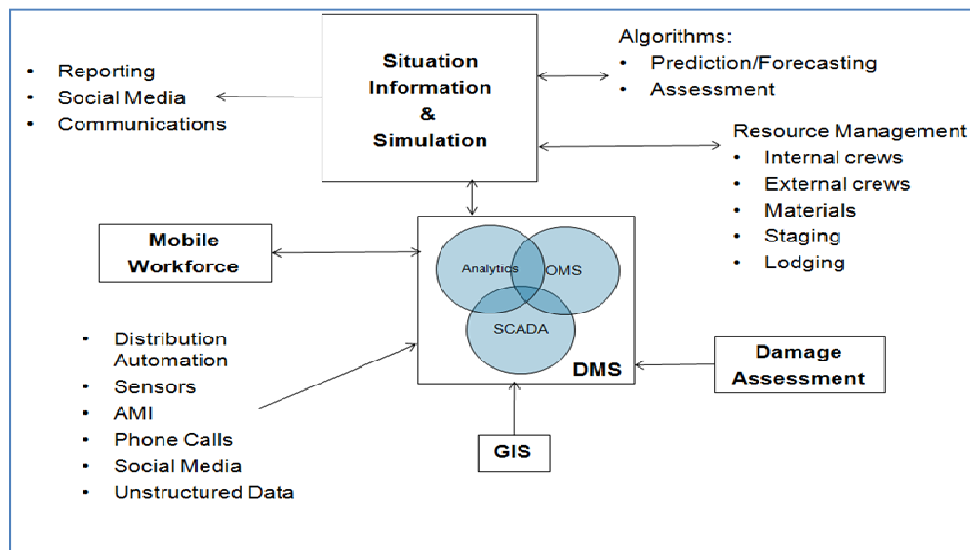


Figure 2 – Storm Activities Key Systems

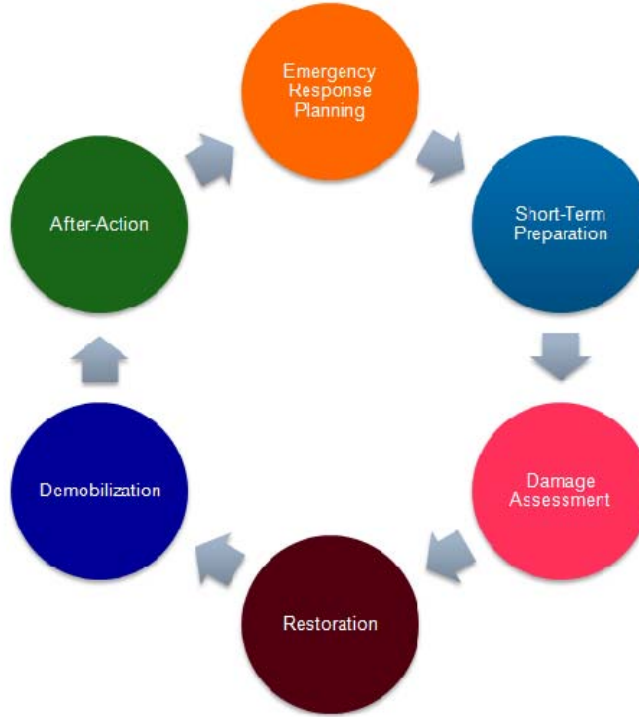


Figure 3 – Critical Phases of Storm Activities

EPRI Data Analytics Workshop at DistribuTech

On January 26th, 2014, Doug Dorr (DMD Program Manager) and Brian Deaver (EPRI Technical Executive) taught a Utility University Course titled *Leveraging New Data Sources and Analytics for Improved Distribution System Performance*. The course covered utility sensor and external data sources and how the data and information afforded by the resources can positively impact grid operations, planning, asset management, and customer engagement. Doug and Brian reviewed the range of data sources and applications for today and the near future and then worked through a selection of use cases by walking course attendees through a customized data and analytics variation of the EPRI Intelligrid Use Case Methodology. Specific applications detailed included outage-management data, storm predictive data sets, and numerous AMI applications using data analytics.



TRANSMISSION MODERNIZATION DEMONSTRATION UPDATE

2013 TMD Activities and Deliverables

Data Analytics Immersions

On January 23th, 2014, FirstEnergy hosted EPRI staff at a Transmission Modernization Demonstration (TMD) workshop in Akron, Ohio. The primary goals of the meeting were to discuss the “state of the industry” on selected topics related with data-oriented systems and applications, understand the status of FirstEnergy (current state and future state), and identify FirstEnergy high-priority needs in terms of new developments in data-intensive and data-analytic applications. The meeting was structured as a series of

presentations by EPRI staff on selected topics, followed by open discussion with FirstEnergy personnel. A variety of topics were covered in the main areas of asset management and health monitoring, system operations, and information and communication technology.

The main topics of interest for FirstEnergy in the asset-management field were the identification of the information to be displayed on asset health dashboards and the use of data from digital relays to infer equipment condition. FirstEnergy is also interested in understanding how other utilities are using EPRI's transformer and circuit breaker fleet-management tool.

Advanced alarm-management technologies for real-time operation and post-event analysis, along with applications for fault location and relay data, were the main operation topics discussed. Currently, FirstEnergy uses macros in CAPE to estimate a fault location, which is provided to the operators, usually in the form of distance in miles from the substation. FirstEnergy is interested in exploring options to automatically retrieve data from the relays and DFR to feed it into the software to calculate fault location and represent fault locations geographically to expedite the response of the dispatchers.

FirstEnergy is participating with EPRI and other utilities in the Common Database for Transmission System Applications effort. FirstEnergy has a goal of having a CIM-compliant EMS model by April 2015. The utility recognizes that EPRI's work on CIM extensions, as well as the novelty of introducing a standard data model across multiple systems, will be important for achieving a practical implementation that maximizes the value of its efforts. Other novel topics, such as the use of LIDAR data to calculate the line impedance, were discussed during the meeting.

The discussions focused on how a demonstration project in the selected data-oriented applications can help "move the needle" of the technology-readiness level, as well as demonstrate and quantify the value of implementing such technology.

TMD Application Highlights

Utility Field Data and Communications Survey of Current Practices

For the past few years, EPRI has increased its focus on achieving cross-program collaboration. One aspect that has become apparent in the course of this research is the need for cross-area experts to achieve a better understanding of what data and information are available in other areas of their organizations. To address these issues, EPRI is coordinating between TMD, the Grid Operations Program (P39), and the Intelligrid Program (P161B) to conduct an industry survey to characterize existing data sources from the field for the transmission system, such as transformer sensors, circuit breakers, digital fault recorders, intelligent electronic devices, and power system monitoring. This survey and analysis of the results will supply the participating members with a better understanding of current industry practices for monitoring, transmittal, and collection of field data, which will be valuable for identifying potential new uses of the field data and future needs of their communication and information infrastructure to support the data.

The results of this work will be an important contribution to the TMD effort because it can provide the TMD team with insight into what data, communications, and storage are currently available at utilities and which can help the cost/benefit analysis of applications. Organizations interested in participating in this survey and receiving a copy of the results, please contact the TMD manager, Alberto Del Rosso, at adelrosso@epri.com.



DMD-TMD Deliverables Updates

The data analytics research deliverable set for 2014 includes strategic documents indentified by project members as key foundational elements of the program. These include topical white papers, industry watch materials, application insights, workshop summaries, and state-of-the-industry validations.

Risk Assessment Methodology Applied to Data Analytics for Distribution and Transmission

The Nation’s power system consists of both legacy and next-generation technologies. New grid technologies are introducing millions of novel, intelligent components to the electric grid that communicate in much more advanced ways (two-way communications, dynamic optimization, and wired and wireless communications). These new components will operate in conjunction with legacy equipment that may be several decades old and provide no cyber security controls. With the increase in the use of digital devices and more advanced communications and information technology (IT), the overall attack surface has increased.

Cyber security must address deliberate attacks from internal and external sources. Because organizations, including utilities, have finite resources, such as personnel and funds, cyber security must be prioritized with the other components of enterprise risk. The purpose of the technical update is to apply a risk-assessment process to applications of data analytics for the distribution and transmission sectors of the electric grid. Included are high-level diagrams that illustrate the risk-assessment process at the security-requirements and security-control selection stages for ongoing assessment and for assessing emerging changes. The risk-assessment process was defined in the National Electric Sector Cybersecurity Organization Resource (NESCOR) document, Electric Sector Failure Scenarios and Impact Analyses, v1.0, September 2013. NESCOR is a public-private partnership funded by the Department of Energy (DOE) . For more information, please refer to EPRI Product ID 3002003171 (due mid-April).

KEY DATES

DMD and TMD (Member Advisor Committee) Webcasts

The schedule for DMD and TMD member steering committee webcasts is finalized for 2014. These interactive sessions are held every other month. Content and agenda material will be supplied to each of the DMD and TMD technical contacts for dissemination to their respective teams.

Meeting/ webcast - 2014												
	J	F	M	A	M	J	J	A	S	O	N	D
TMD Member update webcast			●				●		●		●	
DMD Member update webcast				●		●		●		●		●
DMD/TMD Member face-to-face meeting					●							

DMD-TMD Advisory Meeting in Charlotte, NC – May 22nd and 23rd, 2014

Please join us in Charlotte, North Carolina, for the Spring 2014 Data Analytics for Distribution and Transmission Modernization Advisory Meeting. The Advisory Council reviews the progress of ongoing research and demonstrations within this collaborative research area, identifies emerging areas of interest, and prioritizes the research efforts to meet the needs of the electric power industry related to data and data analytics . The meeting also provides an excellent opportunity to exchange information and experiences with your industry peers and to identify opportunities for your company related to analytics and data .

Venue: Our spring 2014 advisory meeting will take place at the EPRI Charlotte Facility. The general sessions will include program research and development updates, technology transfer presentations, utility project updates, prioritization discussions, and presentations on project focus areas. DMD and TMD project members are strongly encouraged to attend. This meeting is open to all EPRI members DMD and TMD project members. Non-members with interests in data analytics are encouraged to attend, but meeting space may be limited. Agenda and registration information can be found at epri.com (click on the “Event” menu).