CIGRE-257 **2020 CIGRE Canada Conference**
Toronto, Ontario, October 19-22, 2020

# Towards an Asset Health Capability

**GRG-Dr. Gerald R. Gray**
**Electric Power Research Institute**
**United States**

## SUMMARY

In order to make informed asset management decisions it is vital that utilities have a holistic view of the health of their assets. Utilities may be able to realize this goal through well-defined processes and technologies for data collection, integration and visualization. Several vendors are developing asset health systems with this goal in mind. However, the lack of well-defined standards and guidelines is creating challenges when utilities try to specify requirements to help them evaluate and select a suitable asset health system. This paper will reflect the considerations required to develop a guide to help specify asset health system requirements that will assist in selecting a suitable asset health component. This paper will provide guidance on facets of asset health data integration and visualization such as:

- Mechanisms for accessing and integrating existing data sources
- Data requirements for different analytics
- Communication approaches strengths/weaknesses
- What asset data should utilities collect? Why?
- Where does data typically reside?

With asset health data integration there is a significant information and communication technology (ICT) component to this work. An asset health capability requires more than just the sensors. Prior to acquiring an asset health monitoring system, the utility needs to:

- Develop visualization requirements and a selection matrix
- Select appropriate data sources
- Develop specification requirements; the list of questions utilities need to include as part of a request for proposal to help them assess where a vendor offering fits in the architecture
- Develop guidelines to use as part of their specification to ensure that the underlying data model is holistic – for example, are the data sources common information model (CIM) compliant (which reduces data integration costs and maintenance)?

## KEYWORDS

Asset health, standards, capabilities, data integration, architecture

ggray@epri.com

**Developing an Asset Health Capability**

In order to make informed asset management decisions it is vital that utilities have a holistic view of the health of their assets. However, most utilities don’t have this view. They may have some of the capabilities, some view into some assets, some based on maintenance actions of their work and asset management systems. Some may have taken some early steps to put real-time sensors on some of their critical assets. They might even be beginning to use that data (while sometimes it simply gathers dust in a data lake somewhere). The “holistic” is missing, with often heterogenous systems, disjoint data integration schemes, and a lack of a cohesive architecture to address the end-to-end needs of an asset health capability.

Utilities will be able to realize the goal of a mature asset health capability through well-defined processes and technologies for data collection, integration and visualization. Several vendors are developing asset health systems with this goal in mind. However, it is the rare vendor that offers an end-to-end solution. Usually different vendors offer different pieces of the architecture and it is up to the utility to determine how best to fit these pieces together. Worse, a vendor will offer to build a completely customized solution based solely on “their requirements”, which doesn’t leverage any of the commonality that exists in utility operations. This lack of well-defined standards and guidelines is creating challenges when utilities try to specify requirements to help them evaluate and select a suitable asset health system or those components of an asset health capability that match those parts of the architecture that the utility may already possess.

Examining the conceptual diagram below, one can see the main components of an asset health capability.

- The assets or asset classes
- The sensor matched to the asset
- The communications path to the utility back-office
- Visualization + command and control

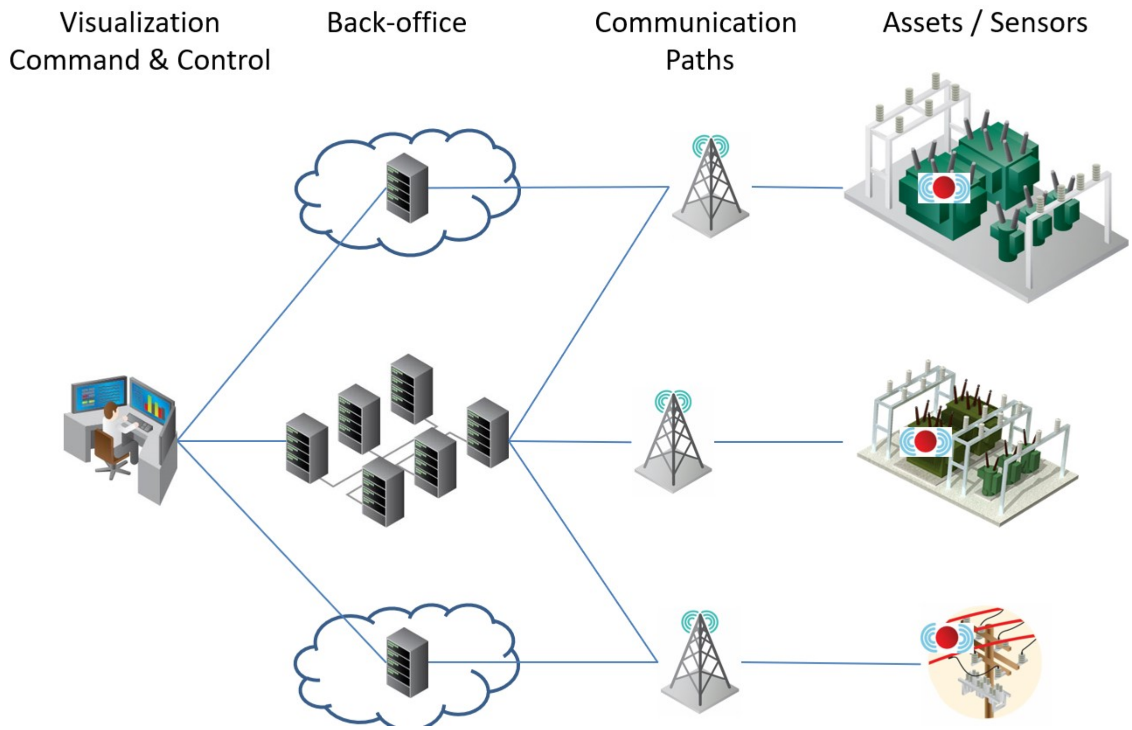


**Figure 1 Conceptual high-level asset health architect (Source : EPRI)**

**Assets/Sensors**

Although end-to-end data integration enables an asset health capability, the journey starts with understanding which assets require monitoring. Obvious targets to consider are high-value assets. High voltage transformers have been some of the first assets to get additional sensors. Other considerations might be if a traditional asset is seeing it's mean-time-to-failure being reduced due to more wear and tear and changes based on changing grid operation, for example, as load-tap-changers are asked to make greater numbers of adjustments. Another consideration might be the ease of adding a sensor. Is adding the sensor a complicated retrofit to legacy equipment or is it something that can be "snapped on" such as a line sensor. These questions arise because the installation of a sensor is part of the cost – and all things being equal, a retrofit is more time consuming, and hence costly, than rolling a truck to install line sensors. Thus, utilities need to consider the biggest value received for a sensor investment.

**Communication Paths**

A significant factor to consider will be the communication paths, and the related cost of data acquisition. Can the utility reuse its existing network, or will new communications paths need to be added, new fiber, or cellular data contracts negotiated? Can the utility leverage its existing supervisory control and data acquisition (SCADA) or advanced metering infrastructure (AMI) networks? The ability and cost of bringing the data to the utility is an important consideration. If an asset class isn't within the normal operating coverage of the utility network, this should influence which assets are monitored.

Utilities will also need to understand that not all internet of things (IoT) protocols are built the same. With the rise of IoT many vendors are bringing solutions to market that use a mix of cloud technologies and energy IoT (eIoT) to bring the data to the utility (or offer the asset health capability hosted in the cloud). For those not conversant in IoT protocols you might think there is just one, but several fall into this space. XMPP, MQTT, AMQP, and NATS. Different design choices were made for each, so they have different strengths and weaknesses. A one-size-fits-all approach to IoT may result in disappointment so it will be important for utilities to see vendors demonstrate data collection capabilities that will meet their requirements. For more information on early evaluation of a few of these protocols, please see the EPRI paper, *Program on Technology Innovation: Evaluating IoT Messaging Protocols for DER Management*. [1] Although written from the context of a DER deployment, the same communications capabilities apply to asset health data acquisition.

**Back-office**

For the purposes of this paper, cloud-hosted solutions will be considered an extension of the utility back-office. For all intents and purposes the capabilities are the same, the only thing that changes are the support models for the systems, and governance, regulatory, and compliance (GRC) issues. These are not trivial so if a utility is considering a cloud hosting solution as part of their asset management capability a review of *Utility Cloud Integration Guidebook, 4th Edition: A Guide for Enterprise Architects* [2] would be in order before proceeding. This guidebook contains a GRC framework and discusses other selection and change management issues associated with moving to a cloud-based footing.

Consider the conceptual back-office diagram below. Once sensors are deployed and communications from the field integrated, there are several systems that should be considered in the asset management ecosystem:

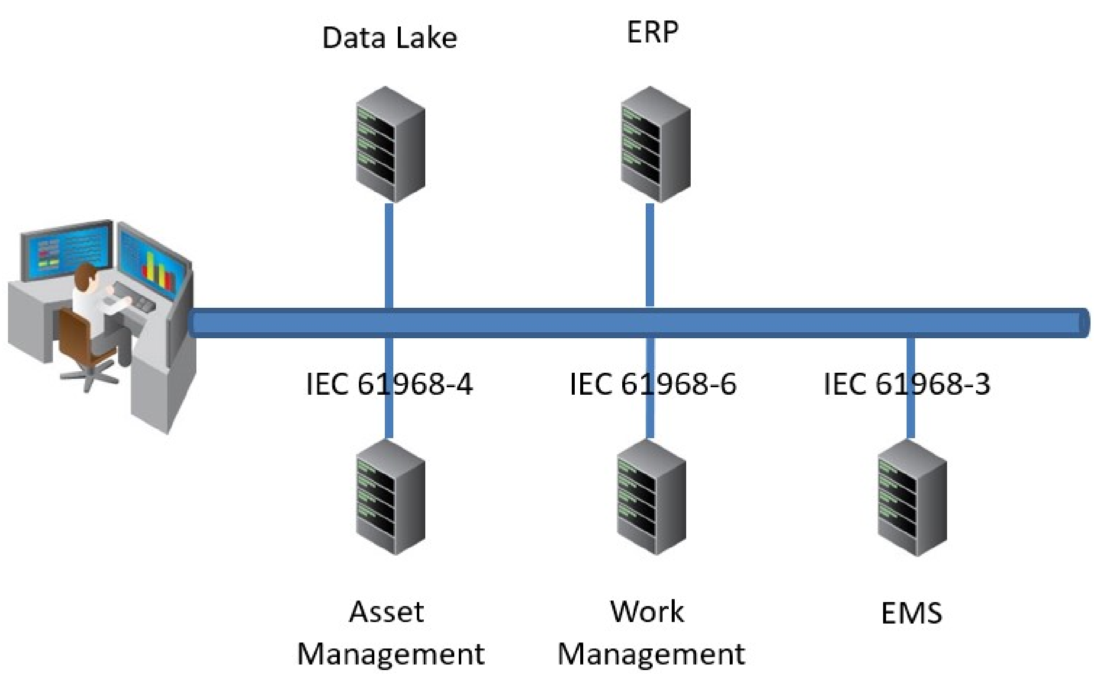


**Figure 2 Conceptual utility back-office**

Work Management – the system for tracking crews, work orders, locations, and maintenance tasks. Work Management is often paired with an Asset Management system. But depending on a given utilities architecture, these may be independent systems that exchange data.

Asset Management – inventory, maintenance and life-cycle management for assets.

Enterprise Resource Planning – the integrated management of an organizations business processes. Assets, their acquisition, tracking, and disposal, are an important facet of asset management.

Data Lake – storage for offline data, that can be used in conjunction with real-time data.

Visualization – Command & Control – Analytics – visualization is an important facet of asset management, as are the analytics that might inform an operators decision-making process. Data is only as good as its viability and use. It is not an uncommon story that utilities often stockpile data – but then are slow to leverage that data via analytics, to get more value from it.

**Existing Standards**

The utility common information model (CIM), the data model that underpins several International Electrotechnical Commission (IEC) standards will be of benefit in this problem space, providing definitions of assets, and the taxonomy of related classes and attributes. Also, specific standards from the IEC such as IEC 61970-301:2020 *Energy management system application program interface (EMS-API) - Part 301: Common information model (CIM) base*, [3] IEC 61968-3:2017 *Application integration at electric utilities - System interfaces for distribution management - Part 3: Interface for network operations* [4], IEC 61968-4:2019 *Application integration at electric utilities - System interfaces for distribution management - Part 4: Interfaces for records and asset management* [5], and IEC 61968-6:2015 *Application integration at electric utilities - System interfaces for distribution management - Part 6: Interfaces for maintenance and construction* [6] will assist both with network models and the application integration requirements for both work orders and asset exchanges. This provides a rich source of work that has already been vetted and used for years for utility operations, and work and asset management systems.

ISO 55000

The ISO 55000 family of standards related to asset management. [7]. This includes:

- ISO 55000 – overview, concepts and terminology
- ISO 55001 – requirements for a management system for Asset Management
- ISO 55002 – interpretation and implementation guidance
- ISO 55010 – alignment guidelines between financial and non-financial asset management functions

Not-withstanding the ISO claims of "first" (the IEC 61968-4 first published in 2007 and the underlying data model decades before), it is a cross-industry standard. IEC 61968-4 is specific to electric utilities. There could potentially be aspects that could be learned from other industries and applied to utility practices. A utility asset management effort would be wise to understands the gaps, and regardless of standards employed, have a good understanding of how a vendor supports a given standard, and not accepting such claims at face value.

Enterprise Data Integration

The IEC standards 61968-3, IEC 61968-4, and 61968-6 specify the messages for assets, operations, and maintenance and construction, which should be leveraged for defining the data that will be exchanged between enterprise systems, but another IEC standard, 61968-100:2013 *Application integration at electric utilities - System interfaces for distribution management - Part 100: Implementation profiles*, [8] provides the specific details on how to use these messages for information exchange between systems, specifying details such as naming conventions and error handling. This guidance accelerates understanding of developers and systems integrators in how to handle these activities in ways that reduce data integration costs, an oft-overlooked expense when considering adding new business capabilities.

**Looking Forward**

EPRI is working with utility stakeholders to begin addressing the gaps in the asset health architecture, both to prioritize where requirements need to be documented, and to engage the vendor community to help them develop solutions that address these needs. This research effort will also inform standards development organizations, specifically about utility needs, to ensure that use cases, their requirements, and data integration needs, get addressed and fed back to these organizations such that new requirements (especially as new capabilities and innovations are developed) are reflected in new editions of these existing standards. Utilities need to also think beyond acquiring sensors, asset management software, or visualization dashboards. They need to think about how each of these pieces fit into a holistic architecture; being mindful not to replicate existing capabilities that would create redundancies but focusing on where new investments need to be made. There are costs beyond simply acquiring the systems and hardware, that include data integration and communications, but also the costs of data scientists that can derive value from the data that is collected.

## BIBLIOGRAPHY


[1] Program on Technology Innovation: Evaluating IoT Messaging Protocols for DER Management. EPRI. Palo Alto, CA. Product ID: 3002014678 Available [Online]: https://www.epri.com/research/products/000000003002014678

[2] Utility Cloud Integration Guidebook, 4th Edition: A Guide for Enterprise Architects. EPRI. Palo Alto, CA. Product ID: 3002015915 Available [Online] https://www.epri.com/research/products/000000003002015915

[3] IEC 61970-301:2020 *Energy management system application program interface (EMS-API) - Part 301: Common information model (CIM)* Available [Online] https://webstore.iec.ch/publication/62698

[4] IEC 61968-3:2017 *Application integration at electric utilities - System interfaces for distribution management - Part 3: Interface for network operations*. Available [Online]: https://webstore.iec.ch/publication/27527

[5] IEC 61968-4:2019 *Application integration at electric utilities - System interfaces for distribution management - Part 4: Interfaces for records and asset management* Available [Online]: https://webstore.iec.ch/publication/27527

[6] IEC 61968-6:2015 *Application integration at electric utilities - System interfaces for distribution management - Part 6: Interfaces for maintenance and construction.* Available [Online]: https://webstore.iec.ch/publication/27527

[7] ISO 55000 *Asset management. Overview, principles and terminology*. Available [Online]: https://shop.bsigroup.com/ProductDetail/?pid=000000000030300420

[8] IEC 61968-100:2013 *Application integration at electric utilities - System interfaces for distribution management - Part 100: Implementation profiles*. Available [Online]: https://webstore.iec.ch/publication/6198