Asset management is already one of the next big things for the smart grid. While headlines are often focused on provocative topics such as renewables integration, electric vehicles, and smart cities, one of the most active smart grid domains today is optimizing the cost to own and manage utility assets. And while at a glance this may appear to encompass a stale subset of traditional utility operations, there is a rapidly growing set of technologies and solutions that offer many benefits, but which push utility limits in terms of systems and operational integration.

**Asset management 101**

In the past, asset management within a utility may have meant something as simple as a spreadsheet populated with asset counts, purchase dates, expected life and suggested maintenance schedules. More advanced utilities adopted a more sophisticated approach via the use of a dedicated asset management system, which significantly enhanced operations and lifecycle management. Still, asset management for utilities remained within a relatively static operational environment, where management decisions were typically made with outdated—and often incomplete—intelligence on actual asset states. Even today, it is not uncommon for otherwise advanced organisations to deploy a piecemeal approach to asset management, using a combination of run-to-failure and time-based maintenance.

The development of asset management standards such as Publicly Available Standard 55 (PAS55) and International Standards Organisation (ISO) 55000 have provided more structure to the strategies of leading organisations. More sophisticated approaches are now emerging for risk management and overall asset health strategies.

For example, utilities are applying cross-departmental approaches to gathering and storing information in order to develop a more holistic asset management strategy. A more comprehensive view of the asset base provides a 360-degree view of assets based on how they are being operated, under which types of conditions, and weighs the costs of proactively or reactively managing those assets. From here, utilities can develop a condition and/or risk-based management strategy, as opposed to a reactive one.

In order for this type of asset management strategy to work, however, it requires buy-in from stakeholders across the enterprise, from CEO to field staff, as well as a regulatory environment that is supportive of experimentation with advanced technologies and operational restructuring.

**IT and analytics at the heart**

The growth of big data analytics in asset management is opening up new value streams through advanced applications that enable 360-degree asset lifecycle management, including optimised maintenance scheduling, asset monitoring, and predictive maintenance of assets.

These applications require integration of systems and data across the enterprise, which is where much of the complexity comes from. Different sets of data within utilities, being derived from a variety of homogenous systems and sources, are riddled with inconsistency in terms of structure and nomenclature.

To date no common data model has been developed so that all this data can be easily integrated into multiple systems and/or analytical applications—and it is unlikely that one ever will be. This is an area where both vendors and utilities are working tirelessly to develop utility-specific data and analytics platforms that streamline...
the process of implementing advanced applications—but there is still much work to be done.

De-siloing for efficiency

Traditionally, many utilities have siloed the different segments of their business, resulting in minimally-integrated IT, operational technology (OT), capital planning, and field force operations. As mentioned, holistic asset management strategies are only brought to life through the integration of information and work from across the enterprise. Inevitably, there will also be disruptions to the ways in which these different silos have traditionally performed.

Utilities and vendors have to recognise that reorganising operational practices across the enterprise overnight is likely to be inefficient and ineffectual. Instead, this process must be done slowly and through collaboration across departments—not an easy or straightforward task. So, if the lofty technology investments are not enough to dampen an organisation’s appetite for a more holistic asset management programme, reorganisational costs and risks may be.

Sensing and measurement in the grid

Globally, the transition from electromechanical to digital technology in the electric grid is enabling a wealth of new smart grid technologies, including sensing and monitoring for asset health monitoring. Some sources have estimated that as much as 70% of the transmission network is digital today in North America and Europe, and many utilities are embarking on aggressive distribution-level projects. Other regions are further behind; as they modernise their grids, sensors and monitoring are likely to become more commonplace.

Broadly, there are three types of sensing and measurement useful in the power grid: physical monitoring, electrical monitoring and chemical analysis.

Physical monitoring

Physical monitoring in the grid measures a multitude of physical characteristics of devices and lines. Aside from mapping, these may include line temperature or tension, ambient temperature, wind speed and direction, pressure, position (open or closed), operations (how many times has a switch opened and how frequently), device failure, and so on. Physical monitoring is the most common form of monitoring, and can be performed by more basic sensor devices, robotic sensors, or via remote monitoring technologies such as drones, which employ high-resolution photography and Lidar, or ultraviolet imagery.

Electrical monitoring

Electrical monitoring encompasses all power measurement quantities, including watt (W), volt-ampere reactive (VAR), volt-ampere (VA), watt-hour (Wh), VAR-hour, VA-hour, PF, and phase angle. These quantities have traditionally been measured by standard power meters, but the growing availability of digital devices and communications in the grid are allowing sensors to monitor electrical conditions in real-time. Additionally, growing technology maturity around highly accurate phasor measurement units (PMUs) and synchrophasors, which is an orchestrated network of two or more PMUs, is leading to significant advances in electrical monitoring of the transmission and distribution grid.

Chemical analysis

Chemical analysis is typically done on oil- or gas-filled equipment, like transformers where, in fault conditions, different gasses are produced including nitrogen, hydrogen, and carbon dioxide. Dissolved gas analysis (DGA) is an important and commonly performed chemical analysis.

DGA has proved to be a valuable and reliable diagnostic technique for the detection of incipient fault conditions. It has been widely used throughout the power industry as the primary diagnostic tool for transformer maintenance. Installation of continuous gas-in-oil monitors may detect the start of incipient failure conditions, thus allowing for preventative maintenance.

DGA sensors have been spreading in critical transmission substations for large transformers; more recently, solutions have emerged for distribution transformers.

Self- or remote-powered devices

Increasingly, grid sensors are capable of using power harvesting techniques that eliminate the need for external power. This lowers the maintenance requirements for grid sensors (and thus truck rolls) by eliminating, for example, the need to change out batteries. These technologies may use the current flow through a conductor to power their measurement and communications electronics. The ability to harvest power simplifies the installation of remote sensors and allows them to be placed in locations that do not have a power source or where hazardous voltage would not be suitable for the connection of other power sources.

Emerging technologies

Diverse new sensing solutions are appearing with increased frequency. Portable sensors allow a utility to avoid the large upfront costs of purchasing hundreds (or even thousands) of devices by moving the device around as needed. Non-contact sensors have been developed that can take temperature reads from as many as several hundred feet away. Elsewhere, steel core conductors with fibre in the middle and sensors inside are under development, providing communications capabilities within the line, as well as the monitoring functionality. Mobile robots that travel along wires have also been invented that look for flaws in the lines and create a detailed map of the line’s characteristics. Lastly, drones are another area of development, providing remote temperature reads and visual access to T&D grid assets.

Moving forward

Utilities are becoming more focused on implementing best practices around asset management, yet there are still many barriers, regardless of the growing availability of new and more cost-effective technologies. R&D and thought leadership around asset management have become growing themes in the context of smart grids. In addition, commercial growth and developments in monitoring and IT have helped to usher in new investments.

Still, even bellwether utilities are only in the early stages of developing advanced asset management capabilities, as they struggle with finding the answers to technological, organisational, and regulatory challenges. As both awareness and best practices expand, the growth in the market for asset management technologies will follow suit—but first the industry must move beyond the current test and trial stage.