Embracing Holistic Data Management Prepares Utilities for the 21st Century: How power utilities can best manage data in the future, and be transformed

By John D. McDonald, P.E.

GE Power's Grid Solutions business

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Abstract

Data is the new enabler of value in the electric power industry. Though the power industry has always relied on data, the proliferation of sensors and actuators on the grid for improved monitoring and control is among drivers of data on an unprecedented scale. That scale is forecast to increase significantly with the advent of customer involvement in transactive energy markets and the harnessing of external data sources provided by the Internet of Things. These trends call for utilities to take a forward-looking, holistic approach to data management. This paper explores the challenges of such an approach, describes practical steps in achieving it, and how that leads to value creation in operations and the enterprise. The paper also explores how the pursuit of holistic data management drives change in business processes, organizational structure and even business models and how to manage those changes for competitive advantage.

Introduction

Data is an enabler of value[1.] Though that statement probably has always been true, the proliferation of sensors and data sources and our rapidly increasing ability to process data for actionable insights in recent years has placed data and its insights at the core of most enterprises and, indeed, our daily lives.

In a static world, that fact alone would motivate power utilities to embrace the collection, analysis and application of data and its insights. In the dynamic, even volatile world of power utilities at this juncture and looking ahead, however, the proper management of data is also the lifeblood of operational safety, reliability and efficiency, and enterprise value creation.

The takeaway, stated simply, is that a holistic approach to data management is the means to survive and thrive. The key word is "holistic," which implies that a utility should consider the totality of its operations and enterprise activities and their goals as it crafts its approach to data management. A holistic approach means that any authorized person in operations or the enterprise should have secure access to data on demand from any and all sources for the purpose of value creation.

A holistic approach to data management is guided by the need to align customer needs and expectations with utility business drivers. A utility's technology roadmap for grid modernization should support this alignment. If this goal is realized, stakeholder and shareholder expectations will likely be met as well.

What's new for the power industry is the speed, scale and granularity of available data and our rapidly increasing ability to analyze it and apply its actionable insights. Today, nearly every group within a utility organization, on both operations and enterprise sides, should be seeking to optimize their work and gain competitive advantages through data.

As we'll see, the very process of becoming a data-driven utility will transform the utility organization, how it operates and maintains the grid, how it pursues enterprise value creation – even how it adapts its business model to capture future market opportunities. Such an existential transformation can be experienced as a series of discoveries and surprises and arduous adaptations. Or it can be anticipated, embraced and orchestrated for maximum benefit.

On the question of what constitutes the "future," creating an arbitrary timeline and forecasting when utilities will achieve holistic data management yields little benefit. Every utility will pursue its future in data management as it is motivated by its own sense of urgency and as it sees practical gains from data-driven practices and strategies.

The process is likely to be incremental. First, each utility group will improve the return-on-investment (ROI) for every sensor or intelligent electronic device (IED) in its bailiwick by sharing its data with anyone in operations or the enterprise who can use it for value creation. The same logic will then be applied to systems. Both steps require organization-wide cooperation, which delivers a significant, related benefit: silos – long embedded in utility culture, but the bane of effective practices – become passé. Then, as each group within a utility applies the concept of holistic data management, the focus will shift from the success of individual groups to how they cooperate to drive the overall success of the enterprise. Silos crumble, business processes change, and power utilities will emerge better able to thrive and compete in a diverse, disruptive energy marketplace that is now emerging. For the purposes of this paper, this step-by-step evolution may be thought of as "the future."

This paper offers a high-level view of the concepts, pertinent steps, and challenges in pursuing holistic data management. It provides examples of data-driven value creation. And it offers insights into change management. Along the way, we'll spotlight valuable new sources of data from sources such as unmanned aerial vehicles (UAVs) and robotics and suggest how these nascent tools should be woven into a holistic data management approach.

Drivers

Readers undoubtedly are familiar with many of the drivers of big data. Let's name a few, recognize that they may well multiply over time, identify two new sources now being implemented and glance over the time horizon for other impending trends.

Historically, transmission lines and substations have been effectively monitored and controlled due to their key role in moving high-voltage power over long distances, thus their data streams are critical to overall grid operations and therefore familiar. Synchrophasors represent a relatively new addition on the transmission system, and have been deployed initially for wide-area situational awareness. The trend towards system-wide optimization and a more market-oriented approach to power will eventually lead to treating transmission and distribution as a single entity with its own set of data management challenges.

Until that consolidation occurs, however, the historic lack of visibility on the distribution system has driven a surge in monitoring and control in distribution substations, feeders and customer premises. For instance, SCADA systems have been augmented by integrated networks of intelligent electronic devices (IEDs) in substations and on feeders. These IEDs have largely replaced analog monitoring and control devices and include voltage, current and fault sensors. The drop in IED costs has accelerated their adoption. IEDs provide both operational and non-operational data, though the latter is under-utilized and will be discussed further in this paper.

The widespread implementation of smart meters on customer premises and advanced metering infrastructure (AMI) has provided data on every customer's energy use at 15-minute intervals, as well as end-of-line voltage readings, last gasps for dying meters and power quality information – all providing rising streams of data for operations and enterprise use.

Developments such as more frequent, extreme weather underscore the value of greater visibility, monitoring and control, and applications such as integrated volt-VAR control (IVVR) and fault detection, isolation, and restoration (FDIR) depend on that monitoring and control data.

The trend towards deregulation and a shift towards more competitive power markets, including the eventual realization of transactive energy markets, is also driving utilities to obtain, analyze and apply data to optimize operations and support value creation in the enterprise.

The ascendance of end-users from "ratepayers" to "customers" – with rising expectations for service quality and options in a digital age – is driving utilities to analyze end-user data to induce customers to engage and participate in utility programs and service options. That data includes customers' social media use, which can and should be harnessed to, for instance, locate and understand the cause of outages. Getting this piece correctly is particularly important as millennials go mobile and drop landline phone service.

Power utility use of UAVs and robotics is in its infancy, yet utilities that have applied them find that, under specific conditions, these tools can provide a highly effective and efficient means to monitor infrastructure health and even perform remedial work. Though their use is nascent across the power industry, enough progress has been made to recognize that now is the time to apply holistic data management thinking to how their outputs are managed for value creation.

Emerging on the horizon is the network of networks known as the Internet of Things (IoT), which will enable utilities to take advantage of myriad, external data streams relevant to their operations and enterprise, with attendant cyber security risks to industrial control systems and enterprise networks.

Pursuing a holistic data management approach is likely to transform utilities into data-driven organizations capable of navigating present and future technology and market trends, but these benefits invariably involve overcoming both traditional and new challenges in organizational practices and culture.

Challenges

The fundamental challenge to adopting a holistic data management approach is overcoming resistance to organizational culture change. The effort required to overcome tradition and its inertia should not be underestimated. Power utilities are by no means unique in this regard, but they are replete with silos at a juncture when silos have outlived their usefulness. The most prominent, but by no means only, silos are those that separate operations technology (OT) and information technology (IT). Integrating and supporting the networks of IEDs, sensors and meters that produce data and designing and operating the information and communications technology (ICT) foundation needed for holistic data management requires IT/OT cooperation and collaboration, if not convergence.

As we'll see, however, all operations and enterprise units have a stake in the process of holistic data management and its outcomes, so the cooperation and collaboration of all units across the entire organization are prerequisite to success. The guiding mantra should be that all authorized utility personnel who can create value from data should have secure access to that data. This egalitarian approach is not mere fairness; it ensures that every technology purchase has the best possible ROI, as will become apparent in the next section of this paper.

Overcoming deeply embedded utility culture requires determination, prioritization and some heavy lifting from within and without. The definition of inertia is, essentially, that things remain the same unless affected by an outside force. Internally, cultural change must be driven by top-tier executive leadership that establishes holistic data management as an organizational priority. An external force is also likely to be effective. Often a neutral third-party with no "political baggage" is needed to facilitate the steps outlined in this paper. This external force must be a trusted advisor with deep knowledge and experience in both holistic data management and change management. Select one carefully; check their credentials, ask hard questions, look for authentic cases that document their claims.

A utility that embarks on holistic data management must develop an appetite for change, a willingness to proceed in good faith across the organization, and the expectation that achieving the fundamentals will lead to ongoing organizational and business model evolution. Meeting these myriad challenges requires a major cultural shift, but that's a prerequisite for success in an era of rapid change, challenges from third-party energy service companies, rising customer expectations and a more competitive landscape.

A step-by-step approach

The relevance of the foregoing points becomes clearer as we take a high-level look at the steps needed to achieve holistic data management.

A utility's foundation must be *strong* before it can be *smart*[2]. That means that its ICT foundation must embrace open architectures and standards, which ensure interoperability and backwards and forwards compatibility between devices, networks and databases. This approach retains the value of legacy technology investments while ensuring full value from current and future investments.

IT and communications groups must work closely to determine the functional requirements (response requirements, bandwidth, latency) of each data path, from sensor to end-user, for all current systems and applications, as well as anticipating future needs. This ICT foundation will link all operational and enterprise aspects of the utility to support full information flow, data management and analytics, grid monitoring and control and enterprise initiatives. It should also support future functionalities such as the integration of distributed energy resources (DERs), new customer services and other needs. The efficacy of seeking a "strong" grid before a "smart" grid is illustrated by lessons learned from projects accomplished under the American Recovery and Reinvestment Act (ARRA) between 2009 and the present.

ARRA, enacted in 2009, enabled many utilities to adopt AMI and install interval meters at the customer premise. Some utilities assigned implementation to their metering group. Later, in implementing distribution automation (DA), these same utilities assigned DA to a distribution engineering group in operations. Alas, these utilities found that the data networks and IT infrastructure supporting AMI did not support DA or required a costly, arduous work-around. A holistic data management approach would have required the metering group and the distribution engineering group to share their goals and, ultimately, to design and build a service territory-wide communication network to support both initiatives and avoid redundancy and complexity and vastly improve ROI[3].

This specific example supports the holistic approach that requires that all operational and enterprise units convene over their future projects and agree on foundational ICT requirements that will serve them all. The result is culture change in motion, driven by a common-sense approach to a strong ICT foundation and optimized business case.

Integration before automation

Distribution system integration means tying together protection, control and data acquisition functions via the fewest number of platforms to reduce costs, footprint and possible redundancies in equipment and databases. The mantra: keep it simple and use the fewest and most optimal functional data paths from sensor to end-user.

The integration of data-producing devices and systems is the next step after building a strong ICT foundation. Integration should precede substation automation, which refers to implementing SCADA, alarm processing and other elements to optimize asset management and operational efficiencies on the distribution system[4].

The next step in holistic data management is to map data from sensor to end user. This requires IT/OT cooperation and collaboration to support the acquisition, transport, storage, analysis, and delivery of data to the right person at the right time for the right reasons.

Understanding IEDs' non-operational data

Let's begin at the device or sensor level. IEDs are rapidly replacing analog devices because, among other reasons, they produce two useful data streams. As most readers know, an IED may be a standalone sensor or a data-producing substation protection and control device such as a protective relay, load tap changer, voltage regulator, etc. An IED's operational data is routed in real time to control center operators to optimize monitoring and control functions.

But the value of an IED's nonoperational data is too often overlooked. Nonoperational data can fuel significant insights for value creation, if it is routed, stored, processed and made accessible to a utility's enterprise groups.

For instance, nonoperational data can drive enterprise goals for energy efficiency, load shaping and capital deferral. Interval meter data (another form of nonoperational data) can support energy efficiency and reliability programs such as demand response and dynamic pricing. The use of nonoperational data also enables a utility to move from time-based to condition-based asset management because that data tells maintenance when, for instance, a breaker is due for service based on the device's functional history.

Though the price of IEDs is dropping, they remain expensive, in the four- and five-figure range. An IEDs' ROI improves markedly when both operational and nonoperational data are fully exploited to achieve value.

As the routing and use of operational data is well-known, we'll focus instead on a holistic data management approach to nonoperational data. In doing so, we'll demonstrate the efficacy of a holistic approach. The following description is a brief, simplified overview; the cited sources provide greater detail for readers who wish to delve deeper.

From data maps to data marts

The process immediately requires that people talk to people and cooperate across organizational lines for the greater good. Business unit managers need to understand who in their unit needs nonoperational data as well as what specific nonoperational data is available. Managers may need technical assistance from IT/OT to fully grasp the nature of available data and how it can be used in value creation.

Each IED provides a collection of data-producing points typically referred to as “data maps.” An inventory of IEDs and their data maps can help managers grasp what types of data are available and who needs it for enterprise-wide value creation.

This step is potentially complex. IEDs’ data maps need careful documentation because different vendors’ IEDs capture and render different nonoperational data in different ways – this is known as an IED’s “attributes.” Data creation might occur at a predetermined sampling rate, when a preset threshold is exceeded, or it could be event-driven. An IED’s attributes must be understood for the data to be useful to an end-user.

Matching data sources with authorized end-users creates an enterprise-wide “data requirements matrix,” based on an IED template (the sensors and their data maps) and the needs of end-users. This data requirements matrix guides the network architecture that sends nonoperational data across the corporate firewall into a data repository/warehouse on the corporate network for end-users to access on-demand. Rigor and accuracy in this phase is critical to a successful outcome.

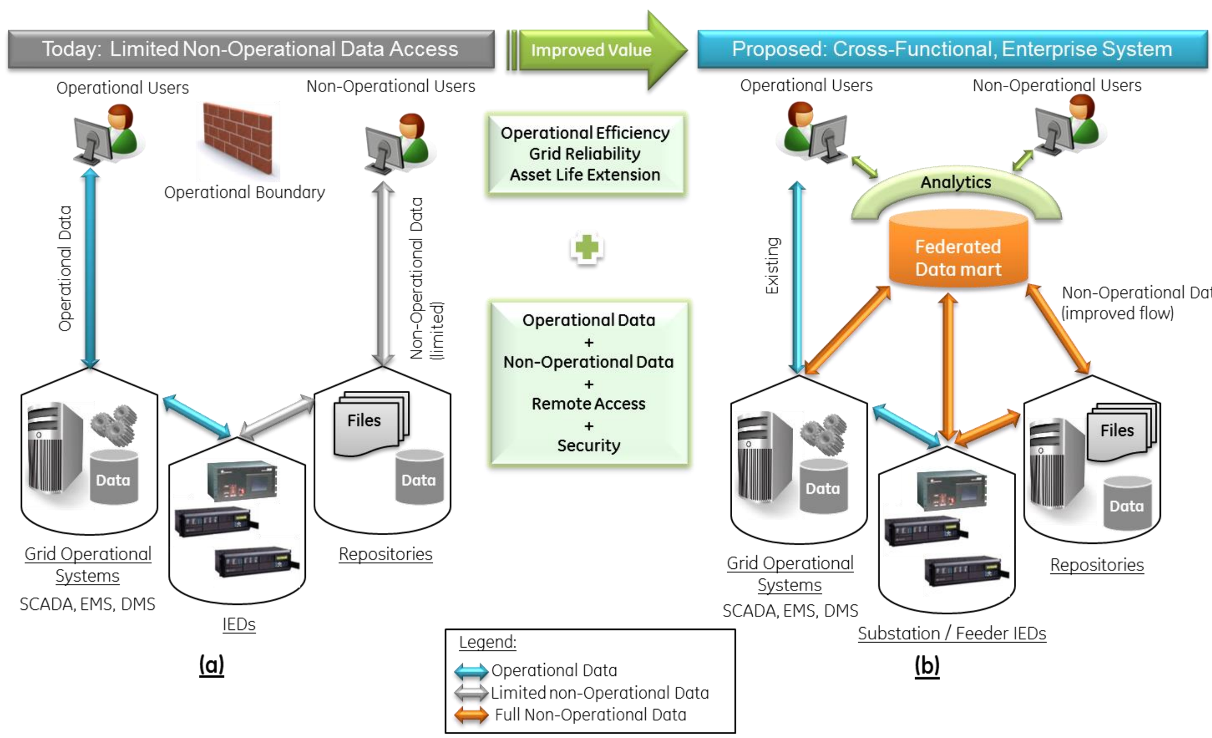

Figure 1. Common, current siloed practices vis-à-vis access to nonoperational data are depicted on the left. The use of a federated data mart to access nonoperational data holistically is depicted on the right. (Source: GE Grid Solutions)

Because utilities typically maintain several physical data repositories, a federated data server can sit atop those repositories (retaining the value of legacy infrastructure) and create a “virtual data mart,” or unified retrieval system. The data mart also contains operational data received from the operations (SCADA) historian, which records operational data at a predetermined sampling rate for export across the firewall to the enterprise[5].

The processes just described require cross-organizational cooperation between IT and OT, operations and enterprise, across all units, groups and departments. So de-siloing is both a prerequisite for the pursuit of holistic data management and an outcome of the process.

Of course, the desired outcome – the right data for the right person at the right time – is subject to data integrity and security measures as well as strict access controls for end-users such as multi-factor authentication. Under those conditions, authorized end users can access data from the data mart on demand for use with their enterprise applications and the results can be presented via dashboards that translate numbers into visually understandable values.

New data source: customers’ social media

One of the fundamental aspects of value creation in the enterprise going forward will be to understand and engage customers and meet their needs and expectations with innovative programs that influence customer satisfaction. Nonoperational data will play a role in the pursuit of that goal. In particular, external data sources – namely, customers’ social media output – will increasingly play a role. Consider that the fastest-growing demographic group of utility customers is millennials, who overwhelmingly rely on networked mobile devices rather than landline phones. Where utilities once identified and partially analyzed outages through landline calls from their customers, today’s and tomorrow’s customers are mobile and equipped with social media and high-resolution cameras and video capabilities.

Today, analytical software integrated with a utility’s outage management system (OMS) can, for example, mine the content of tweets for information on outages and associate that information with social media imagery. Utilities can and should incentivize their customers to share GPS location data to provide a useful picture of an outage’s location and nature, prior to rolling a truck, enabling field crews to be better equipped for a specific challenge and more efficient in addressing it. Improving reliability metrics through speedy power restoration will always be a core utility goal. And it markedly improves the business case for distribution automation, which includes other reliability applications such as IVVC and FDIR.

This approach can be used by utilities without AMI or it can be a useful tool to augment premise-level meter data. A full explanation of how such data is routed and integrated for best results is too detailed for the high-level purposes of this paper, but the accompanying citation provides it[6].

As the number of customers engaged in such a process increases, so does the quality and value of the data and insights that emerge. Research reveals that the more engaged customers are, the more satisfied they are with their service and their utility – and the more likely they are to adopt new utility programs for energy efficiency, demand response, and active energy management that serve broader utility goals.

In the overall pursuit of holistic data management, customers' social media output illustrates how a relatively new, external data source can and should be tied into a utility's data management practices for value creation.

Enter: UAVs and robotics

This last point should be embraced, as it appears that the emergence of new sources of data external to both operations and enterprise may well become commonplace. Two new sources of data make this point: unmanned aerial vehicles (UAVs) and robotics.

UAVs are simply one component of what is referred to as unmanned aerial systems (UAS) because they rely on pilots on the ground and a communications link between the two (hence "systems"). Pre-programmed, autonomous UAV flight is also possible, though largely prohibited for utilities at this point. At least in the utility industry, the synonymous, popular term "drone" typically is not used as it has negative connotations as a tool of war or unwarranted surveillance.

"Robotics" is a term that refers to machines that replace humans, backed by sensors, processing capabilities and communication systems, typically for difficult or dangerous tasks.

The LineScout, by MIR Innovation, a subsidiary of Hydro-Québec, inspects a ground wire and 735-kV lines near Ile d'Orléans in the Saint Lawrence River, east of downtown Québec City, Québec, Canada. Photo credit: Hydro-Québec

Though some utilities, in time-honored “fast follower” power industry tradition, may opt to let these emerging technologies and their market sector develop without taking action, I’d argue for the opposite approach.

As noted, power utilities face existential threats from the march of technology and market forces. They do not have the luxury of repeating past mistakes by not applying a firm hand to manage and shape emerging technologies to their advantage. The pursuit and application of holistic data management practices for UAVs and robotics would seem imperative in an increasingly competitive energy marketplace rattled by disruptive forces.

A brief, ad hoc survey of utilities, consultants and power industry consortia in late 2017 revealed how a coordinated industry response to the emergence of UAVs and robotics could speed time-to-value[7]. But let’s first look at this fascinating, emerging field and the diverse approaches that utilities are taking to it and its resulting data.

At this point, a few generalities appear possible. Currently, various utilities are exploring the available technologies and their capabilities and identifying potential use cases, while assessing value propositions and business cases. If properly harnessed and integrated into existing utility programs, UAVs and robotics promise to efficiently and safely perform tasks ordinarily too difficult or dangerous for humans or as an alternative to expensive, sometimes dangerous manned aerial reconnaissance. Asset inspection, damage assessment, non-destructive testing, live-line maintenance and other tasks are possible with UAVs and robotics. The current focus of UAV use tends to be on transmission lines, due to scale and ample rights-of-way clearances. But robotics are also being used underwater to inspect and perform remedial work on turbines in hydroelectric dams.

Already it’s clear that the power industry will benefit from influencing UAV policy. The Federal Aviation Administration (FAA) has strict rules regarding pilot certification, beyond line of sight (BLOS) uses and autonomous (non-piloted) flight. Though a waiver process is available, several utilities cited current policies disallowing BLOS and autonomous flight as barriers to a positive business case for UAVs. That said, it’s apparent that a positive business case depends on multiple factors and that cost-effective, targeted UAV and robotics roles are likely to emerge in the context of broader, asset-related utility programs.

It’s also clear that we’re seeing spasms of activity typical of emerging technologies, in the sense that work on related standards is not yet feasible in a heterogeneous, rapidly evolving marketplace for both UAVs and robotics.

In order to glimpse the potential for the use of UAVs, readers would profit from exploring what Southern Company, Dominion Energy, Hydro-Québec, Xcel Energy and Duke Energy – among many others – are doing.

The LineRover remote-controlled robot (right), by MIR Innovation, a subsidiary of Hydro-Québec, tows the LineCore sensor during a conductor inspection. Photo credit: Hydro-Québec

(In the course of preparing this paper, I spoke with Renato Salvaleon, information systems analyst, Alabama Power Company/Southern Company (and team lead for the IEEE Power and Energy Society's UAS geospatial data management task force); Steve Eisenrauch, manager of transmission forestry and line services, Dominion Energy; Serge Montambault, Manager – Inspection and Maintenance Robotics, Hydro-Québec Research Institute; and Andy Stewart, president, EDM International, Inc. I gratefully acknowledge their contribution to this paper, though the conclusions drawn here are my own.)

Industry consortia, including EPRI, IEEE and EEI, are currently at work on various UAV- and robotics-related initiatives. The foci, generally speaking, include an assessment of market offerings, utility best practices and automated image analysis, though very targeted applications and practices are being explored as well.

(In preparing this paper, I spoke with Drew McGuire, program manager, and Dexter Lewis, senior technical leader, both at EPRI. I gratefully acknowledge their contributions.)

To grasp the cutting-edge of robotics work, I'd recommend visiting a single, well-illustrated source: MIR Innovation, a subsidiary of Hydro-Québec. As an engineer, I'm astounded by the capabilities of robotics at this stage. The bigger picture, of course, is what these amazing technologies provide us with in terms of data and that data's relationship to value creation.

UAV equipped with LineCore sensor, by MIR Innovation, a subsidiary of Hydro-Québec, that is able to detect the first signs of conductor corrosion in a non-destructive way. Photo credit: Hydro-Québec

The challenge: wag the dog

UAVs and robotics are here now, moving rapidly towards commercial application, so it behooves us to explore the data management challenge that comes with them.

Generally speaking, UAVs and, to some extent, robotics, produce data from a variety of sources, including but not limited to video, still photography, LiDar and PhoDar imagery and infrared sensors.

From my ad hoc survey, I learned that UAV video imagery is often streamed live in low-resolution to guide a pilot and, in some cases, to inform a utility infrastructure inspector who might be making real-time analyses of asset health, subsequently vetted by more granular, post-flight vetting. High-resolution data from cameras and other sensors typically is stored on an onboard memory card for later download to a corporate network for storage and analysis.

As with many tools, utilities are beginning to manage UAV and robotics data in myriad ways, with no clear pattern yet emerging. This data is variously being used to inform asset management programs, geographic information systems (GIS), outage management systems (OMS), storm damage assessments, and construction site assessments. Advanced robotics are even performing in situ, live-line, non-destructive testing and remedial work on overhead lines as well as underwater hydroelectric power turbines.

So, how are utilities handling this data?

On the analysis side, the pursuit of automated image analysis promises to create value; having humans watching hours of streaming video is not practical or a beneficial use of resources. Presumably, the other data sources from UAVs and robotics also require processing for value creation.

Given the thesis for this paper, we must ask how raw and analyzed data from UAVs and robotics is stored, routed or otherwise made available across the utility organization. Again, my brief, ad hoc survey reveals a wide range of practices. One utility I spoke to houses its UAV/robotics program under a transmission maintenance group, which currently does not share the data with other operations or enterprise units. At the other end of the spectrum, one consultant is encouraging his clients to take an approach captured by the apt phrase “one flight, many uses” – i.e., sharing UAV/robotics data for its widest possible use benefits the utility in diverse ways and improves the business case.

Per my thesis on the organization-wide benefits of holistic data management, you’ll understand why I favor the latter approach. I’d suggest that these emerging technologies offer yet another opportunity to de-silo a utility and its approach to data management to achieve the organization-wide value creation that creates a positive business case for new technologies and makes a power utility more nimble and competitive.

Meanwhile, utilities must decide whether to proceed with these emerging technologies in-house or turn to a third-party. As UAV vendors extend their offerings to include data analysis, as a value-add, utilities should be wary of proprietary solutions that ultimately limit their future options.

Let me be clear: the free market is a font of innovation and competition that offers diverse choices and that’s generally beneficial. But it is important that power utilities continue to pursue and support the technologies, policies and standards that will create a positive business case for UAVs and robotics and the organization-wide value – indeed, the industry-wide value – they can create.

It is perhaps perilous to suggest prescriptive steps this early in the process. But a general observation is pertinent: power utilities en masse, through their representative organizations and programs dedicated to these emerging technologies, can exert their influence to shorten time-to-value in this area by ensuring that UAV and robotics vendors meet utility needs and requirements and not the other way around.

Innovation and differentiated services and solutions may be beneficial up to a point, but proprietary solutions historically have proven to be problematic, leading to vendor lock-in, stranded assets, isolated systems, unusable data, high costs and wasted time.

Thus, I humbly suggest that the power industry determine and pursue common requirements for these technologies and push UAV and robotics purveyors to meet them. This would include the adoption of standard data formats, data analytics based on open source architectures, and true enterprise wide integration of the information. If the power industry determines its particular needs – as opposed to, say, other industry verticals using UAVs and robotics – and uses its heft to bring vendors around to meet its requirements, adoption rates will grow and benefit both parties. Eventually, the power industry will coalesce around a variety of needed standards and the market will benefit from interoperability and economies of scale, further accelerating market adoption.

Conclusion: urgency needed

The other half of the equation is the sole responsibility of individual utilities. The emergence of UAVs and robotics presents a perfect opportunity to put holistic data management into action. Clearly, from the concepts and steps outlined in this paper, a strong ICT foundation must be in place before a utility can leverage new data sources for value creation. There is no better time – no more urgent time – to begin that journey than right now.

Perhaps UAVs and robotics appear too esoteric at this point to ignite a sense of urgency. But the IoT is not far behind, if it isn't here now. The IoT and its network of networks, all hosting innumerable devices and nodes, all generating myriad sources of potentially valuable data, will make preparations for UAV and robotics data look like child's play.

In a data-driven world, with proliferating energy options for utility customers, rising third-party competition, disruptive technologies and policy shifts all inevitable, it seems critical to lay the foundation of a strong grid, add intelligence and ensure that data from both traditional and emerging sources is fully exploited across the organization for value creation.

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Biography

John D. McDonald, P.E., is Smart Grid Business Development Leader for GE Power's Grid Solutions business. John has 43 years of experience in the electric utility transmission and distribution industry.

John is a Life Fellow of IEEE, and was awarded the IEEE Millennium Medal, the IEEE Power & Energy Society (PES) Excellence in Power Distribution Engineering Award, the IEEE PES Substations Committee Distinguished Service Award, the IEEE PES Meritorious Service Award, the 2015 CIGRE Distinguished Member Award and the 2015 CIGRE USNC Attwood Associate Award. John is Past President of the IEEE PES, the VP for Technical Activities for the US National Committee (USNC) of CIGRE, the Past Chair of the IEEE PES Substations Committee, and a member of the NIST Smart Grid Advisory Committee. John was elected to the Board of Governors of the IEEE-SA (Standards Association), focusing on long term IEEE Smart Grid standards strategy. John received the 2009 Outstanding Electrical and Computer Engineer Award from Purdue University. John teaches a Smart Grid course at the Georgia Institute of Technology, a Smart Grid course for GE, and Smart Grid courses for various IEEE PES local chapters as an IEEE PES Distinguished Lecturer. John has published eighty papers and articles and has co-authored five books.

John received his B.S.E.E. and M.S.E.E. (Power Engineering) degrees from Purdue University, and an M.B.A. (Finance) degree from the University of California-Berkeley.