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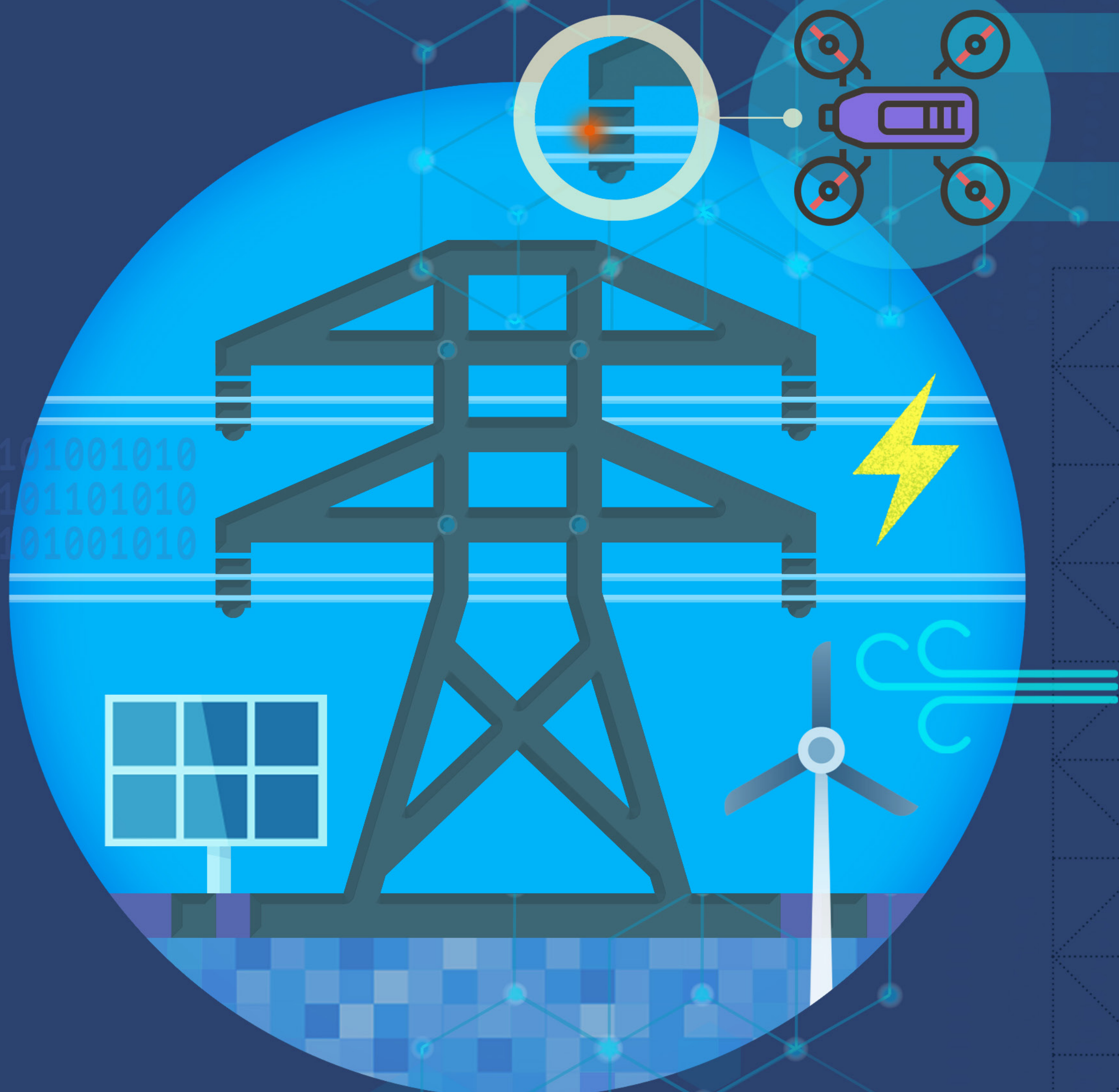
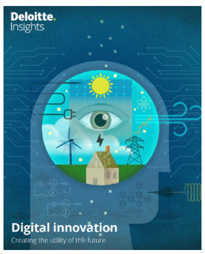


Digital utility asset management

Building the backbone of the energy transition

Digital transformation in the power, utilities, and renewables sector

Digital utility asset management: Building the backbone of the energy transition is the third report in a series on digital transformation in the electric power sector from the Deloitte Research Center for Energy & Industrials. Our goal in writing this series is to help executives in the power, utilities, and renewables sectors explore the exciting future the industry is moving toward and plot a digital path to thrive in that future.



The first report, *Digital Innovation: Creating the utility of the future* (April 2019), outlines the forces driving change in the sector; how companies are investing in digital transformation to address these forces; what the digital future could look like from a customer, employee, and asset/grid perspective; and how companies can begin their digital journeys.

The second report, *The utility customer of the future: Operating an energy platform built for elevated human experiences* (February 2020), explores how utilities can maintain and grow their relationships with residential customers by leveraging technology to connect, engage, and empower them.

Digital utilities stand to reap big rewards by improving processes, increasing understanding of the customer, empowering employees, boosting security, and mitigating risks. Our "see, think, do" approach to transformation means we can help you identify needs and opportunities, visualize your future state, thoughtfully design processes and strategies to support your "to be" vision, and perform the hands-on work for turning that vision into a reality. **Learn more**

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Introduction

THE POWER INDUSTRY is leading the way in the clean energy transition, with renewables at the center of many providers' strategies. This translates into a newer, more diverse set of assets to manage and integrate with the rapidly aging set of existing assets, together worth about $1.2 trillion.[1] At the same time, demand for affordable, clean, and uninterrupted power supplies is accelerating as businesses electrify and digitally transform their own operations and consumers increasingly work from home. Additional drivers, such as the COVID-19 pandemic and surging cyber risk, up the ante on the importance of managing assets by balancing cost, risk, and performance.

But moving to cleaner power sources while boosting reliability, resilience, and security is a tall order. To achieve this, companies will likely need to move away from traditional asset management strategies and develop comprehensive digital strategies with robust data governance and cybersecurity at the core. Unfortunately, our research shows that most electricity providers are still only dabbling in digital, and not approaching digital transformation with the comprehensive, holistic view that could make it a game changer to unlock the full range of benefits.

This report, the third in a series on digital transformation in the power, utilities, and renewables sector, presents Deloitte's Digital Utility Asset Management Model—a framework that lays out the digital asset management journey through nine stages of evolution, with cybersecurity and data governance at its core. It explores where utilities and renewable providers are now in the journey and what steps they should consider taking to develop a data-driven, risk-informed, digital asset management strategy. Building a system for value-based decision-making can help electric power providers build tomorrow's cleaner, more reliable, resilient, and secure grid—which will be the backbone of the energy transition in the power sector.

Our research shows that most electricity providers are still only dabbling in digital, and not approaching digital transformation with the comprehensive, holistic view that could make it a game changer to unlock the full range of benefits.

Five disruptors and an expanding asset mix compel new asset management strategies

FIGURE 1

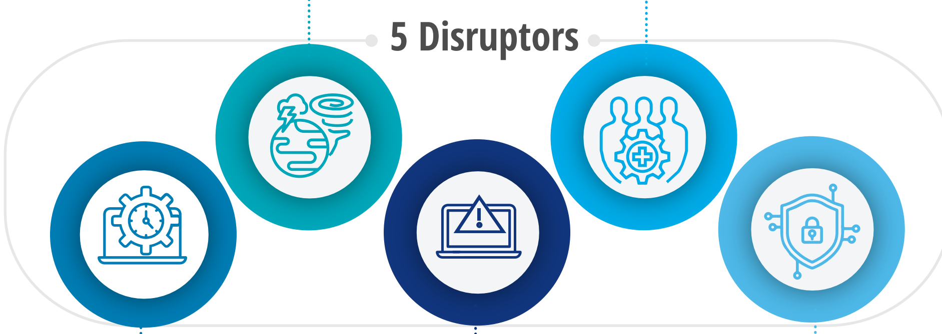
Five disruptors compel new asset management strategies

Key challenges facing electric power providers

Increasing severity of storms and disasters
The United States experienced twice as many billion-dollar disasters (14) annually from 2015 to 2019 as in the 40-year period from 1980 to 2019 (7).[a] Increasingly frequent and severe climate events, along with aging assets, can cause costly outages.

Mounting public health and demand challenges
COVID-19 highlighted the need for more agile decision-making capabilities.

Utilities needed new strategies to service new and shifting demand patterns as workers and students increasingly stayed home; social distancing required new remote asset maintenance protocols; supply chain disruptions prompted new supply sources; and revenue constraints triggered renewed capital program reviews.



Aging assets
Annual investment in US transmission and distribution infrastructure doubled to ~$54.5 billion between 2011 and 2020.[b]

Most assets are 60–70 years old, vs. an originally expected 50-year life span.[c]

Nuclear and fossil-fuelled generating plants are on average 35–50 years old, while nonhydro renewable plants are aged 22 years or less.[d]

Rising cyber and physical threats
Power infrastructure is increasingly threatened by bad actors intent on damaging assets and disrupting grid operations in the cyber and physical sphere.

A successful cyberattack on the US power grid could cost between $243 billion and $1 trillion.[e]

Increasing regulatory scrutiny and mandates
With increasing shift to performance-based regulation, utilities are required to track the benefits of their investments, which may need more sophisticated monitoring and analysis.

The industry must also comply with evolving cybersecurity mandates and sometimes confusing rules through which expenditures may qualify for capital asset treatment.

Sources: [a] Adam B. Smith, "2010-2019: A landmark decade of U.S. billion-dollar weather and climate disasters," National Oceanic and Atmospheric Administration Climate.gov, January 8, 2020.
[b] Analysis of S&P Global Market Intelligence capital expenditure database 2011–2020; Jason Lehmann, "Utility electric T&D capex on upward trend; forecast surpasses $54B in 2020," S&P Global, November 9, 2020.
[c] Deloitte analysis based on data from S&P Global Market Intelligence on power plants.
[d] Ibid.
[e] Lloyd's of London and University of Cambridge Center for Risk Studies, "Lloyd's report: Cyberattack on the US power grid could cost over $1 trillion dollars," July 16, 2015.

Five intensifying challenges are prompting many electric power providers to seek new tools and processes for asset management (figure 1).

At the same time, the slate of assets itself is expanding and becoming more complex. Until recently, asset management was typically compliance-driven, managed by different departments, and sometimes by individual employees who maintained their own reports based on bespoke data aggregation. Systems were often not fully connected or updated in real time—utilities often relied heavily on seasoned employees with decades of system knowledge and experience, who were difficult to replace as they retired. Risk management was not always informed by probability data. But the proliferation and complexity of assets is making this approach unsustainable.

- **Expanding number of assets:** With the growth of renewables and distributed energy resources (DER), utilities are managing 10 times more assets than they were managing 20 years ago and assets will likely continue to grow.[2] Unfortunately, utilities themselves do not own most of these DER, which increases the challenge in managing or controlling their impact on the grid. In addition, the more intermittent nature of wind and solar generation means additional solutions will likely be required to balance electricity load and supply. US DER capacity is projected to reach 387 gigawatts (GW) by 2025, driven by $110.3 billion in cumulative investment between 2020 and 2025.[3]
- **Increasing complexity of assets:** Utility asset life cycles are becoming increasingly complex with the addition of renewables and the infrastructure required to integrate them smoothly into the grid. Moreover, with the convergence of information technology (IT) and operational technology (OT), or systems that control a utility's physical infrastructure,[4] many assets have electronic components with different life spans, depreciation rates, operating scenarios, and maintenance requirements. To help manage this evolving mix, providers are deploying new classes of assets, such as energy storage, smart meters, sensing devices, data, software, firmware, and hardware, which also increase the complexity of assets a utility has to manage.

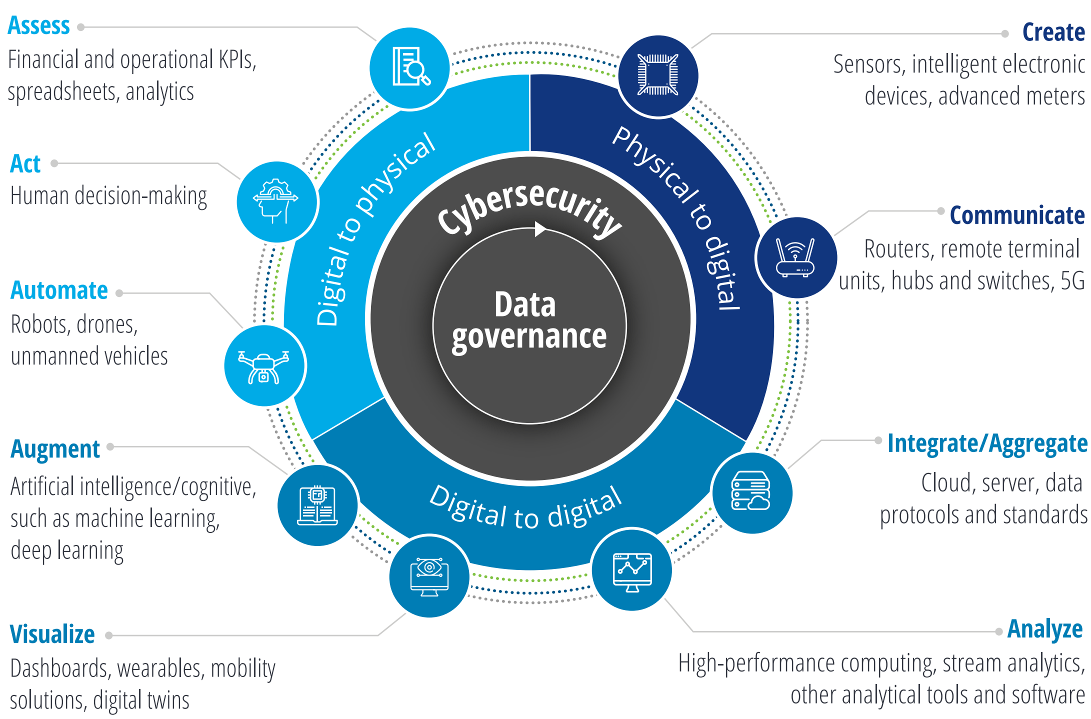
As power sector disrupters have accelerated and assets have become more numerous and complex, tools and technologies to manage them have also advanced. A proliferation of sensors provides a growing variety of metrics with greater frequency. New communications technologies enable faster data transfers from those sensors and cloud computing expands the scope and speed of data analysis. Artificial intelligence (AI) can help predict future behavior by learning from historical data. Such technological advances make new ways to manage assets possible. And improved asset management can help boost operational efficiencies, save costs, increase asset life expectancy, improve reliability, and enhance safety. But realizing these benefits through digital transformation requires a comprehensive framework, and like most good journeys, it begins with a road map.

The Digital Utility Asset Management Model helps map the digital transformation journey

DIGITALLY TRANSFORMING ASSET management means decisions can be data-driven and risk-informed, rather than "acting on a hunch." The Digital Utility Asset Management Model is a framework that describes the fundamental journey of digitally transforming and enabling assets (figure 2). This journey is backed by supporting technologies, with cybersecurity and data governance lying at its very core. Rather than being sequential, the journey instead requires the enterprise to identify its overarching vision and objectives, and construct an integrated solution with a customized road map that leads to specific business outcomes (see the section, "Next steps: Developing a digital asset management strategy").

FIGURE 2

Digital Utility Asset Management Model



Note: See next page for definitions of the 9 phases of the Digital Utility Asset Management Model.
Source: Deloitte analysis.

The physical-digital-physical (PDP) loop in the Digital Utility Asset Management Model contains nine phases of digital evolution.

	Create: Generate data (on temperature, humidity, pressure, voltage, current, load/usage, visual details, etc.) that captures conditions in the physical world from sensors, cameras, and other intelligent electronic devices monitoring power system assets.
	Communicate: Transmit the data to a central processing system, such as the supervisory control and data acquisition (SCADA) system or the enterprise asset management (EAM) system.
	Integrate/Aggregate: Combine the data in a common repository and enable user access and system/application integration; add external data and standardize as required. Growing volume of data and analytics software may be housed either on premises or in the cloud.
	Analyze: Deploy the appropriate tools and processes to harness available data and provide actionable insights. Insights can drive asset strategies and actions to balance risk, cost, and performance.
	Visualize: Use data and analytics to create integrated, real-time dashboards to inform decisions. For example, a geospatial platform may combine location and enterprise asset information plus external data such as weather conditions and component costs. This can help enhance situational awareness, predict asset risk, and inform proactive action. Some utilities also "virtualize" the asset by creating a digital twin, which integrates data on an asset's design, manufacturing, inspection, repair, sensor, and more. This digital profile can provide insights on the asset's historical, current, and expected behavior and help forecast the asset's health and performance over its lifetime.
	Augment: Use cognitive capabilities, such as machine learning, to analyze current and historical data and predict an asset's future condition and behavior. It can help asset managers make repair/replace decisions and facilitate scenario planning. Augmenting with cognitive capabilities enables predictive maintenance, a step up from more costly maintenance methods, such as planned (based on a schedule) or preventative (based on the asset's current condition and use) maintenance.[a]
	Automate: The augmented behavior technologies advance the process into the digital-to-physical side of the model where it can enable automated action by robots or other devices.
	Act: Humans use insights provided by the loop to inform decisions about where and when to inspect, monitor, repair, replace, or retire assets. The Act phase may also occur at other points in the loop.
	Assess: Measure benefits and ROI, and decide whether to finish a project or revise and refresh the strategy and start around the loop again.

[a] To understand more about the approaches to digital asset performance management see Andy Daecher et al., *Asset performance management: Driving value beyond predictive maintenance*, Deloitte Insights, February 26, 2019.

The inner core of the Digital Utility Asset Management Model focuses on two critical dependencies: **Data governance** and **cybersecurity**, which we discuss further in the final section, "Next steps: Developing a digital asset management strategy."

The digital transformation journey traverses the utility value chain

EFFICIENTLY MANAGING AN expanding portfolio of renewable assets is proving critical to electric power providers in leading the energy transition. The Digital Utility Asset Management Model can help them boost the reliability and resiliency of new and existing assets across the grid. Let's consider how the industry is performing within the model across each segment of the value chain (generation, transmission and distribution, and grid edge) and what next digital steps it should take in the coming 2–3 years. As for the methodology for our mapping of each segment, we did extensive secondary research on latest solutions and technologies provided by major utilities, renewable energy companies, and OEMs, validating our conclusions through interviews with industry experts from major utilities.

The generation segment is increasingly using digital innovation to manage renewable assets

Starting with power plant design and siting and continuing through the plant's entire life cycle, digital innovation is playing a key role in the transformation of asset management in the generation segment. It can be particularly valuable as the industry moves toward cleaner energy sources, including integrating intermittent wind and solar plants and harder-to-access offshore wind farms. Digital asset management can enhance performance by informing plant design and enabling health monitoring; reducing operations and maintenance (O&M) costs; and boosting reliability, availability, and profitability.

Current status: *The generation segment is largely in the* ***Analyze*** *and* ***Visualize*** *phases in the Digital Utility Asset Management Model.*

By using digital tools such as sensors, power generators can now access multiple data points, varying from fuel temperature and pressure to vibrations and humidity levels, depending on the type of plant. For example, gas turbines typically have hundreds of data points monitored while wind turbines may have over a hundred.[5] Utilities have aggregated and analyzed this sensor data and developed dashboards to track plant-specific parameters, such as increased turbine pressure. Previously, technicians had to manually collect data from remote sites after issues arose, and determine the health of components often with little additional data for context.

However, while sensor data combined with basic analytics and visualizations have improved plant monitoring and yielded maintenance cost savings and other benefits, only a small portion of the data collected is currently used to inform decision-making.[6] This implies that the scope to implement digital solutions and reap the resulting benefits could be immense.

Digital leap: *In the next two to three years, the generation segment will likely focus on advancing further into the* ***Visualize*** *and* ***Augment*** *phases.*

Asset managers have long used dashboards to display plant data. But many are just beginning to combine data, including real-time data, from diverse systems into those existing dashboards to enable continuous asset health monitoring and improve performance management. Some are combining real-time performance insights with historical trends and applying predictive or pattern-recognition algorithms to monitor equipment. This advanced asset health monitoring can enable plant technicians to walk through the plant and see "hot spots" in real time, or areas where advanced telemetry reveals anomalies that could lead to asset failure. They can also use this data to attenuate maintenance schedules and to create or upgrade existing digital twins.

As renewable penetration increases, real-time generation data can become an important tool to maintain grid balance, given the intermittency associated with wind and solar power. In solar plants, the shift will likely be toward machine learning–based signature detection algorithms that automatically quantify and categorize the causes of production loss, providing insight to enable better plant maintenance strategies. Similar strategies are being used in wind plants (see sidebar, "Using digital innovation to boost renewable asset performance").

Using these predictive maintenance strategies to reduce O&M costs would be an enormous boon for the power generation segment, which has seen such costs soar. In just the past two decades, nonfuel power generation O&M costs rose 74%,

USING DIGITAL INNOVATION TO BOOST RENEWABLE ASSET PERFORMANCE

Phase	Technology highlight
Visualize/ Virtualize	**Objective** **Reduce O&M costs and increase availability of wind fleet to boost asset profitability** **Solution** **Create a digital twin of a wind power plant** A consortium of companies is working on a project to deploy digital twin technology with enabling technologies that include high-performance cloud computing, system fault and degradation modeling, data analytics, and visualization for predictive maintenance of wind turbines. A sensor network system, utilizing optimized signal processing and condition monitoring algorithms, will be applied to live wind turbines to collect operational data that will then interface with a virtual 3D model. The output will be collected, and processed data will provide a description of the wind turbines' multidimensional, dynamic behavior and physical state during real-time operations. By using digital twins, the operators can harness real-time data to diagnose performance variations down to the level of individual constituent components, allowing them to predict failure and plan maintenance, thus reducing maintenance costs and downtime. **Expected benefits** • Reduced costs—The project is expected to reduce maintenance and monitoring costs by up to 30% for end users and operators • Increased reliability—Early detection of defects is expected to increase reliability by 99.5% and reduce losses due to downtime by 70%

Source: David Foxwell, "Digital doppelgangers could help maintain offshore wind farms and reduce costs," Riviera Maritime Media, Ltd., August 9, 2018.

according to an analysis of data from 2,500 US power plants.[7] In one nuclear plant, for example, an asset performance management application reduced hours spent annually on preventive and corrective maintenance by 37%; helped reduce cost by 20% or $10 million annually; and improved the overall capacity factor while setting a record for power production.[8] Analytics augmented with AI can also enhance scenario planning capabilities that are in growing demand as power providers increasingly focus on disaster preparedness plans.

Some electric power providers are already deploying advanced digital asset management technologies to extract the most value from their growing fleets of wind or solar plants (see sidebar, "Using digital innovation to boost renewable asset performance.")

The T&D segment is harnessing digital transformation to ensure reliability and resilience

The US transmission and distribution (T&D) segment is being buffeted simultaneously by the five disrupters mentioned earlier. These intensifying phenomena could impact reliability and resiliency, which are among the top concerns for utilities. Right behind that is keeping costs in check. And with an estimated $1.1 trillion required to replace, expand, and upgrade the US electric grid through 2040 to maintain reliability and resiliency,[9] the math is compelling. For example, if digital innovation could help avoid or defer even 3% of these expenditures, it would save a staggering $33 billion.

Current status: *The T&D segment is typically at the* **Integrate/Aggregate** *phase, though many rural utilities may still be in the* **Communicate** *phase as remote assets may lack access to high speed communications.*

Because it traverses thousands of miles and reaches into each individual home and business, the T&D system is especially difficult to monitor and the stakes of missing something can be high. That may explain why the segment has a keen interest in advanced monitoring and inspection technologies to help ensure reliability, boost resilience, and reduce costs. In some cases, such as during the ever-lengthening wildfire season, automated remote monitoring could even help prevent fires if objects touching high voltage wires are detected and the condition can be more immediately addressed. In comparison, conventional inspection techniques typically involve on-foot visual inspections, which are expensive, labor-intensive, and can lack accuracy and compromise worker safety.

Many US utilities have already installed sensors, smart meters, and other intelligent devices across their systems to measure and monitor a variety of events and conditions. Smart meters are becoming increasingly valuable for the data they provide, and with more than 60% penetration of customer sites, their value continues to increase.[10] Utilities are also starting to deploy "sensing aerial solutions," such as cameras mounted on drones, to inspect power lines, collect data on the condition of wires, poles, transmission towers, and other equipment, and to detect potential equipment failures.

However, one of the biggest challenges has been gathering data from multiple networked asset components and providing a single repository source to monitor and analyze the data. Utilities often lack the cloud capabilities required to derive actionable insights in real time from the growing web of connected assets and the data they generate. Another challenge that has slowed T&D digitalization in some areas compared with the generation segment is communications. While a stationary power plant has the capability to connect through mechanisms including fiber cable or Wi-Fi, far-flung T&D systems traversing rural areas may currently be beyond the reach of high-speed communications networks.

Digital leap: In the near term, the T&D segment will likely focus further on the **Integrate/Aggregate** phase while also progressing into the **Analyze** and **Visualize** phases.

In the next 2–3 years, asset managers in the T&D segment will likely continue efforts to aggregate and standardize data from disparate systems into one repository source. This can help break down siloes, such as between operations, maintenance, and asset management, so operators can harvest insights by examining relationships among data sets to which they did not previously have access. Cloud storage and analytics solutions can generate actionable insights in real time and they compare favorably with on-premise solutions in terms of speed, scope, and depth of insights. Some regulated utilities have hesitated to adopt cloud solutions both for security reasons and because the expenditures have historically been treated as

DIGITALIZING T&D ASSET INSPECTION AND MONITORING CAN CUT COSTS AND IMPROVE RELIABILITY

Phase	Technology highlight
Create, Communicate, Integrate, Analyze	**Objective** **Increase frequency and efficiency of asset inspection and remediation; obtain higher-resolution images to boost accuracy** **Solution** **Design and launch an aerial remote sensing program, including both unmanned aircraft system (UAS) and helicopters** Southern California Edison (SCE), a US investor-owned utility, designed and launched one of the largest fully operational aerial remote sensing programs in the industry. The program included selecting tailored UAS vendors and corresponding UAS platforms and sensors, developing program governance, standardizing data collection requirements, gaining regulatory approvals, deploying internal and external communications, and establishing dynamic operations safety and performance management for both UAS and helicopters. SCE leverages a cloud platform for data storage, curation, and analytics and is developing an end-to-end digital workflow platform solution to drive its data life cycle. To advance operations SCE is working towards scaled future deployment of edge UAS flight capabilities like Beyond Visual Line of Sight (BVLOS) that will enable greater efficiency and cost reduction. On the data side, SCE is working to increase capacity and insights by scaling machine learning and aggregating unstructured and structured data to visualize comprehensive views of its assets. **Expected benefits** • Aerial capacity to annually inspect 200,000+ T&D assets in high-risk areas • Inspection cycle time and efficiency to meet annual regulatory and corporate goals • Scalability to enable aerial inspections to become a primary means of data collection and enable the retirement of redundant legacy methods to create savings • Full digitization of workflow and cloud data platform in progress to enhance efficiency and data quality

Source: Southern California Edison.

operating expenses rather than being included in capital assets, which can make it a challenge to earn a sufficient ROI. But that trend is starting to change and many utilities are deploying cloud solutions for scalability and flexibility.[11] At the same time, a number of utilities have pursued private LTE/5G or fiber optics networks to upgrade communications latency and speed required by evolving IoT and data transmission needs.

As they access and analyze more data, the T&D segment will also likely focus on creating more complex dashboards and visualizations to provide situational awareness. More utilities may deploy geospatial systems that not only integrate locational data with data from multiple systems as in a conventional geographic information system (GIS); they also enable collaboration and sharing of data, such as asset conditions, weather, and customer complaints, through multiple devices. In addition, as utilities begin to solve the challenges of accessing, updating, and ensuring the accuracy of critical data across the network, they will likely increasingly develop digital twins.

The segment will almost certainly hone its drone capabilities further in the next few years, and many look forward to being able to fly drones beyond the visual line of site (BVLOS). In the longer term, those using advanced communications technologies such as 5G would be able to combine it with BVLOS, which could be a game changer for the segment. Paired with cloud capabilities, these technologies could enable real-time streaming video from remote drones, providing enhanced visibility for assessing equipment and damage status. The drones could quickly process data using AI, potentially identifying structural defects in T&D infrastructure in near real time. This could be especially valuable in the wake of disasters and outages to speed data transfer to work crews so that they can restore power faster.

Digital asset management provides more visibility and control at the grid edge

The "grid edge" is not a segment of utility-owned assets, but rather an expanding array of DER and devices, many of which are customer or third party–owned and controlled. Digital asset management applications can help utilities gain more visibility and better understand DER impact on the whole asset ecosystem. As DER are proliferating, the three segments of the value chain are converging and the siloed approach to asset management by individual teams is becoming obsolete. The systems are joining to eventually become a single holistic, shared network, controlled centrally, and optimized for decision-making across the value chain.

DER, such as rooftop solar systems, battery storage, EV chargers, and flexible load program capacity, may add up to nearly 24% of US generation capacity by 2025.[12] And these resources can increasingly help balance the growing volume of intermittent renewables on the grid as the energy transition progresses. In fact, flexible load programs are expected to triple current US demand response program capabilities by 2030, reaching about 200 GW, or 20% of system peak.[13]

For utilities, the goal is to help design and site these assets, where possible, and to gain visibility and control over their behavior to the degree possible. Digital applications, such as distributed energy resource management systems (DERMS), are helping utilities better understand load and manage these new assets at the grid edge.

Current status: *Assets at the grid edge typically range from the* **Create** *phase to the* **Integrate/Aggregate** *phase in their interaction with utility systems.*

Today many utilities are unable to detect and identify an EV-owning home on the distribution system. Rooftop solar systems are a different story, since utilities connect them to the grid, but many have little control over them after that. Analytics can be, and are, easily deployed to detect and identify the footprints of individual DER, such as EVs. And smart inverters and other software platforms can aggregate, control, and synchronize DER with grid operations, owner parameters, weather, and market conditions. But these solutions are unevenly deployed, as DER are a relatively recent addition to the grid, and rules and practices vary widely across utilities and jurisdictions. And in rural areas, network communication may also be a challenge.

As utilities continue to more precisely map and plan their distribution systems with DER in mind, and move forward with developing DER rules and protocols, they will likely increasingly integrate these resources into system models and use analytics to assess and predict DER impact on the entire asset ecosystem. They'll deploy more smart devices and distributed analytics at the grid edge to access more granular information in real time. And they'll use the data to inform decisions and enhance operational efficiency, to help reduce stress on the system that could shorten the life cycle of equipment such as distribution transformers.

Digital leap: *In the next two to three years, utilities will likely advance further into the* **Integrate/Aggregate**, **Analyze**, *and* **Visualize** *phases as they integrate DER into the asset ecosystem.*

MANAGING DER TO PROTECT GRID ASSETS AND RELIABILITY

Phase	Technology highlight
Create, Communicate, Integrate/ Aggregate, Analyze, Automate	**Objective** **Integrate distributed energy resources (DERs), such as customer load, distributed solar and wind, battery storage and electric vehicles, without risk of overloading the substation transformers or investing in costly new substation and distribution system equipment** **Solution** **Deploy DERMS to monitor transformer loading, generation output, generation and load forecasts, and send signals to curtail load and/or distributed energy output if system violations are expected**
	Multiple utilities are seeking to connect third-party–owned wind, solar, storage and other systems and the rate of interconnection is expected to increase. However, integrating these DERs onto existing distribution systems could overload the transformers, distribution lines and supporting equipment if not properly controlled. The problem is compounded by the reality that utilities often do not own the distributed energy assets. Utilities can avoid costly capital investment in new transformers, conduit, protection equipment and more by installing a DERMS to monitor power flows across the distribution system. The DERMS will monitor DER status/output, grid conditions, load and DER forecasts, and send control signals to DERs as needed to avoid system backflows and potential equipment overloads during times of high DER output.
	Expected benefits • Demonstrates that third-party assets can be integrated into grid operations with digital innovation rather than costly capital upgrades • Maintains reliability and resiliency while enabling DER that will help advance the energy transition and add flexibility to the grid

Source: Deloitte Power, Utilities & Renewables practice.

Digitally enabling asset management across the utility value chain

Figure 3 summarizes the current status and potential short- to medium-term digital leap in the Digital Utility Asset Management Model for each segment of the utility value chain.

The three segments are progressing through the same phases, but at different rates largely due to differences in the nature of the assets. Generation plants are stationary and usually have access to high-speed communications, so progression through the loop may be faster and more widespread in this segment. In contrast, the transmission system traverses thousands of miles, sometimes through remote areas that lack high-speed communications capabilities.

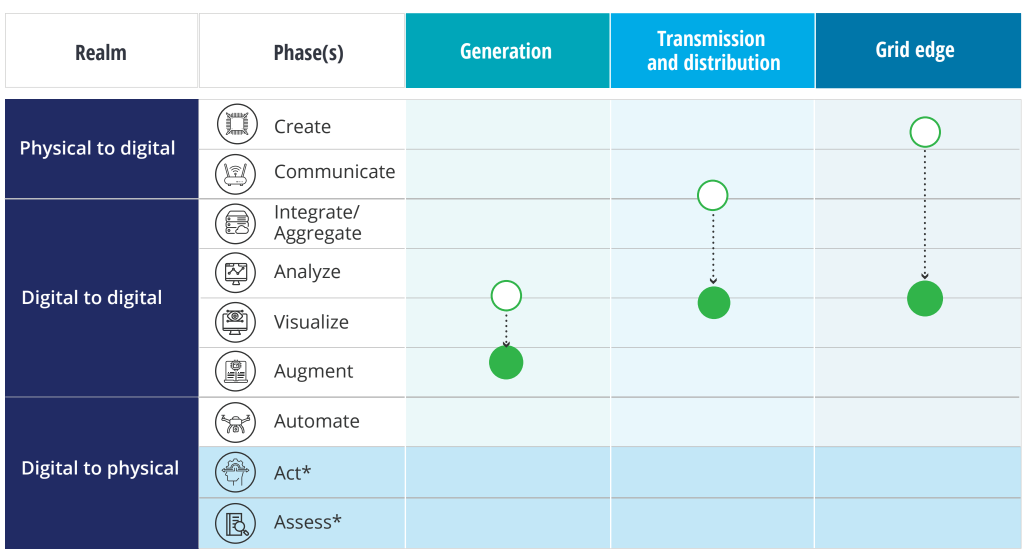
Distribution systems in rural areas may face the same challenge, including at the grid edge. In addition, since grid edge assets are often owned by customers or third parties, utilities may still lack the visibility to integrate and manage them optimally.

Generation plants are stationary and usually have access to high-speed communications, so progression through the loop may be faster and more widespread in this segment.

FIGURE 3

Digitally enabling asset management across the utility value chain

○ Current digital standing of the segment ● Suggested digital leap in the next 2–3 years



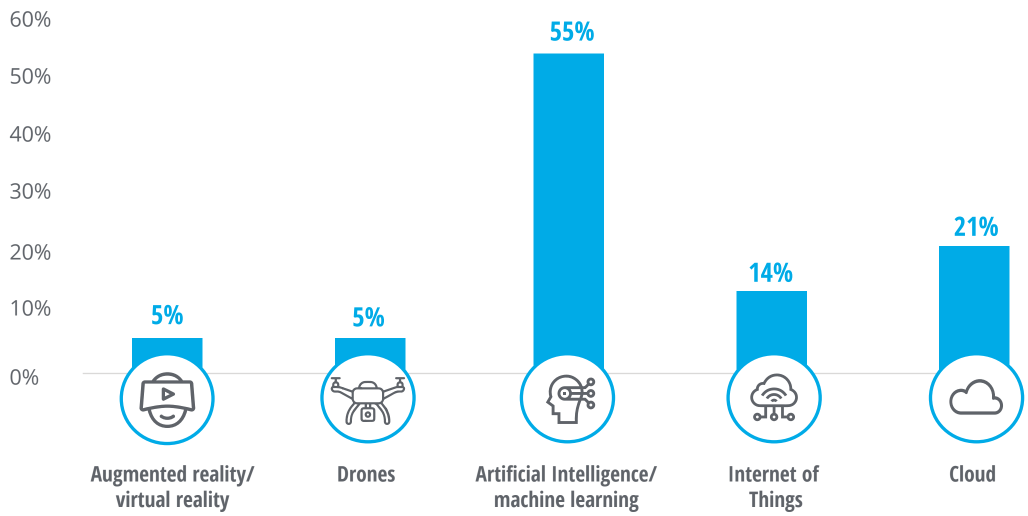
Note: * The journey may not be linear and the Act and Assess phases may occur at different points along the loop.
Source: Deloitte analysis.

While the three segments are progressing through the loop at different paces, planners across the value chain appear to be aiming for the Augment phase, in which AI can provide predictive insights to boost performance and save costs. This corresponds with results of a Deloitte survey in November 2020 that asked power industry respondents which technology was the most important for utilities right now (figure 4). More than half (55%) chose "Artificial intelligence/ Machine learning."

FIGURE 4

The power and utilities sector sees artificial intelligence as a key digital technology for utilities

Responses to the question "What is the most important digital technology for utilities right now?"

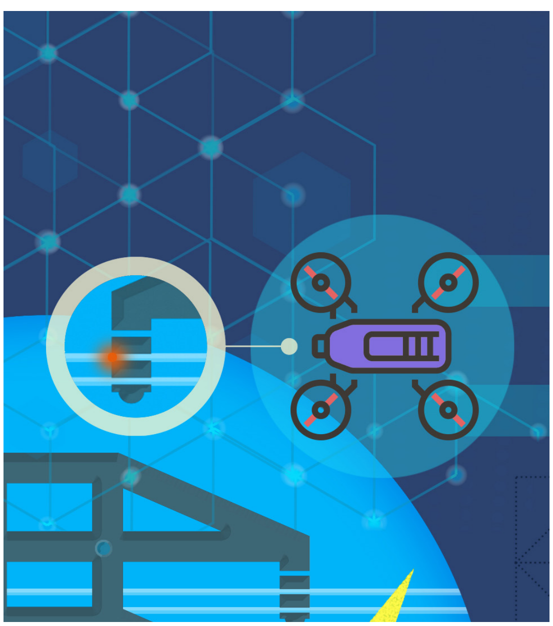


Source: Deloitte Postelection Survey; Deloitte 2021 Power and Utilities Industry Outlook, December 2020.

Next steps

Developing a digital asset management strategy

THE MOST CRITICAL step in a digital asset management strategy is to formulate the organization's vision and determine the desired business outcomes across the whole organization and asset ecosystem. The next step is to develop a comprehensive, integrated solution involving multiple technology components—a road map to success. This step is key because cherry-picking and experimenting with a few pilot projects in different phases of the framework without a comprehensive plan will likely not generate the expected benefits. Each project should be an integral part of a holistic digital strategy and road map, especially since the value chain is converging.

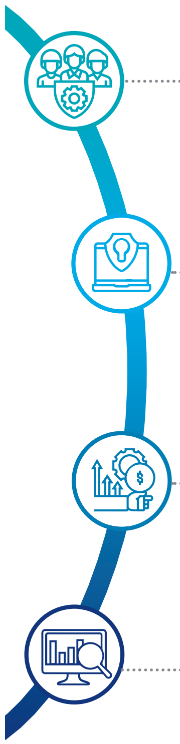


Two elements that should be at the core of any digital asset management strategy are **data governance** and **cybersecurity**. As the foundation for all analytics, data may well be a company's most valuable asset. Without rigorous management of the collection, cleansing, standardization, storage, and curation of data, digitalization and the insights it generates could have little value. Consider starting by designing the data architecture and the governance to maintain it. This is important because the architecture will likely evolve over time with changes in technology, security threats, business needs, and customer preferences. Individual project plans should demonstrate how the business processes, data objects, and architecture will work together, what the data quality standards should be, and how they'll be achieved.

Equally as important is cyber risk management. With the increased connectivity that digital transformation brings, cybersecurity threats now extend into the cloud, across third-party networks, and through connected assets and devices. Perils prowl across industrial control systems, such as SCADA, and extend into all of the components of the industrial internet of things (IIoT), including sensors, mobile apps, capital equipment, software, firmware, hardware, operating systems, databases, ports, and more (figure 5). The North American Electric Reliability Corporation's Critical Infrastructure Protection (NERC CIP) standards

FIGURE 5

Key elements of an IIoT cybersecurity program



Governance and leadership

Establish an IIoT cybersecurity team that includes stakeholders from across the organization. This can help improve resilience and ability to achieve goals and protect both data and safety.

Secure procurement

Understand the risk of individual IIoT device endpoints during procurement. This can inform asset purchase decisions and provide a sense of the security controls and architecture needed to reduce risk when introducing assets into a secure system.

Asset management

Establish processes for identifying assets and their characteristics to ensure the IIoT security program is operating as intended and that the risk and return continue to support strategic goals.

Monitoring and response

Since the threat environment is constantly evolving, continuously collect new threats, vulnerabilities, and intelligence from multiple sources.

Source: Deloitte analysis.

that address cybersecurity of the bulk electric power system continue to evolve, and should be considered as a floor from which to build.

Other issues to consider when developing a digital strategy include the implications of adopting technologies such as 5G or cloud computing and how to spread the impact of capital costs and O&M expenses to net maximum benefit for both the organization and customers. And finally, it's important to review the strategy periodically because as technologies advance, costs typically fall, implementation timelines can compress, and projects that had not been feasible yesterday may be possible today. While there are many issues to consider, the potential rewards will likely make the journey worthwhile.

Endnotes

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