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Digital twins can provide utilities with significant ROI in grid operations, asset performance management, and capital planning — all of which are strategic areas of investment as utilities strive for operational excellence.

Digital Twins: Enhancing Resiliency in Utilities' Assets and Grid Operations

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Introduction

The evolution of digital twin technologies in the utility industry can be a vehicle to propel utilities toward operational excellence. Digital twins can provide a foundation for utilities as they take on their digital transformation initiatives. More importantly, digital twins can help utilities address some of their main pain points, such as extending the life cycles of their critical assets and improving overall asset optimization. Additionally, digital twins can play an essential role in a utility's effort to build out energy infrastructure as well as be a powerful and modernized tool for a utility's capital planning efforts.

AT A GLANCE

WHAT'S IMPORTANT

Digital twins can provide a foundation for utilities as they take on their digital transformation initiatives. More importantly, digital twins can help utilities address some of their main pain points, such as extending the life cycles of their critical assets and improving overall asset optimization.

In the current business environment, with its low commodity prices and tight profit margins, utilities are heavily concentrated on cost reductions and improving efficiencies in their operations. Digital twins, which are virtual replicas of a utility's assets, can help a utility monitor, diagnose, and manage assets throughout its footprint. A digital twin can also provide a utility with both real-time and forecast scenarios of the performance of its assets, increasing the profitability of the assets while decreasing operational costs and risks. Digital twins have the ability to greatly enhance utility resiliency and can be a cornerstone for a solid asset performance management strategy. They provide a utility with a consolidated, single view of its operations, which leverages a combination of information technology, operational technology, and engineering data and expertise.

Benefits of Digital Twins in Utilities

Digital twin technologies can build operational resiliency and increase the resiliency of a utility's power grid and critical assets, such as generation, transmission and distribution lines, and substations. The power sector's business environment has utilities prioritizing improvements in operations as a way to increase the profitability of their assets while reducing maintenance and labor costs. Several benefits are driving utilities to invest in digital twin technologies. The following are some of the key benefits that digital twins can provide in a utility's operations strategy:

- **Increase reliability of the power grid and critical utility assets** through the use of advanced simulation models, which can detect operational inefficiencies and recommend corrective actions to improve operations

- **Reduce asset downtime by applying artificial intelligence and machine learning,** which is moving utilities toward a condition-based asset management approach that predicts and prevents asset failures as opposed to the traditional schedule-based or break/fix approach to asset maintenance
- **Provide real-time monitoring and diagnostics** that can reduce overall maintenance costs on equipment parts, repairs, and labor by giving a utility accurate data and information and ensuring the best skill sets, parts, and service are provided for the task at hand in a timely and efficient manner
- **Improve the performance and optimization of assets as well as the ability to extend the life cycles of critical assets** by simulating both asset and market conditions, including data and information such as weather, supply and demand, and energy commodity prices
- **Increase visibility of the overall health of a utility's assets** by creating a virtual replica of all assets in a utility's footprint, providing a holistic view of a utility's operations and processes
- **Enable utility system simulation modeling for asset stress testing** by running extreme scenarios to accurately gauge a utility asset's performance when exposed to maximum thresholds such as generation ramp rates and runtimes as well as transmission and distribution power flow capacity limits
- **Enable scenario-based planning for extreme weather events and abnormal market conditions** by providing utilities with asset, weather, and market condition scenarios and evaluating the performance and response of a utility's assets in extraordinary conditions
- **Support energy infrastructure projects and capital planning efforts** by having an accurate virtual replica of the assets in a utility's footprint and providing confidence in the justification for capital investment projects

Considering Bentley Systems' Digital Twin Services for Utilities

As utilities continue to focus on building resiliency and greater efficiencies in their operations, investments in digital twin capabilities are expected to rise. The ability to automate and fully optimize assets and increase reliability and performance of a utility's entire operation is becoming a top priority. Bentley's advanced approach to digital twins in utilities operations can provide utilities with several capabilities and advantages, which include but are not limited to the following:

- Enable the digital representation and virtual replica of a utility's assets, processes, systems, and engineering information and provide the ability to detect inefficiencies and then apply corrective measures throughout a utility's entire operation
- Provide the consolidation, validation, and alignment of 2D and 3D design, GIS, performance, power grid network simulation, and enterprise data to give utilities a holistic view of all assets in a utility's footprint
- Offer a unified grid modeling process across a utility's core functional areas, breaking down silos and eliminating redundancies and thus saving costs and increasing efficiencies
- Help utilities reduce time, effort, and resources used to maintain data repositories that support their operations strategy

- Supply utilities with actionable intelligence and insightful output from rigorous simulation models, which can lead to better-informed and quicker decision making
- Create efficiencies, transparency, and a unified approach to energy infrastructure projects throughout the design, construction, and operational phases incorporating Bentley's extensive building information modeling applications
- Ensure data quality and improve the accuracy and ease of model-based simulation using artificial intelligence and machine learning, which can identify and adjust for asset inefficiencies and market anomalies
- Produce visual tools that can duplicate a utility's network and assets through the use of advanced analytics, which can provide end users with intuitive dashboards of grid performance metrics
- Improve and digitalize traditional integrated resource planning efforts that enhance capital planning, including the onboarding of new DER assets with detailed analysis of what impact new assets will have on a utility's network
- Provide an open source offering that can ingest and integrate third-party data and information sources such as meteorological, commodity pricing, and regional power market data
- Integrate and coordinate with core utility systems, such as GIS, OMS, DERMS, and MWFMS, to provide a holistic view of a utility's assets while ensuring both operational security and cybersecurity
- Provide scalability and flexibility with Bentley's open source offering, allowing utilities to accelerate their digital transformation efforts

Bentley's OpenUtilities Digital Twin Services is designed to enable a digital representation of the physical grid assets, processes, and/or systems as well as the engineering information that allows utilities to understand and model grid performance. It converges engineering, operational, and informational data into a connected data environment, allowing users to visualize grid assets, monitor network behavior, perform analysis, and generate insights. The process involves consolidating, validating, and aligning 2D and 3D design, GIS, reality, performance, simulation, and other enterprise data across departmental and workflow silos to form a consolidated view of the grid. The benefits include the following:

- **Unify grid modeling processes across organizational silos and functions.** Integrate generation, transmission, and distribution modeling analysis; study the impact of DER penetration across the entire power grid; and view digital information in its proper digital context to its fullest extent in close to real time.
- **Reduce time, effort, and resources used to maintain data repositories.** Scale data maintenance and exchange across the information technology landscape with built-in governance and security.
- **Generate actionable insights for decision support.** Explore data from any device and data source to make decisions in context. Easily collaborate on and share customized dashboards and interactive reports. Rapidly understand bidirectional power flows, weather-related intermittency, and changing customer expectations.

Challenges

Although digital twins can assist utilities in many ways, there are some challenges for utilities to overcome when implementing digital twins into their operational strategies. Applying digital twins to operations will involve the use of a plethora of data, which will require a continuous effort to ensure that all data used in the digital twin is clean and accurate. Utilities' confidence in the output or recommended actions of digital twins depends on the accuracy of input data.

Additionally, both internal and external data from third parties will need to embrace data and information sharing without restrictions to ensure access to all the data required to build a state-of-the-art digital twin. As with any model, the availability, cleanliness, and accuracy of a model's input data will determine the quality of a model's output.

Conclusion

There is immense pressure on utilities to improve their operations to increase reliability and performance as well as build resiliency in their assets and grid operations. It is expected that with an ongoing initiative to gain and maintain operational excellence among utilities, the adoption of digital twin technologies and the capabilities they provide will grow and mature with time.

Digital twins can provide utilities with significant ROI in grid operations, asset performance management, and capital planning — all of which are strategic areas of investment as utilities strive for operational excellence. Digital twins can also serve as the underpinning of a utility's digital transformation in the effort to build, manage, and maintain core assets such as transmission, distribution, power generation, substations, and distributed energy resources. As digital twin technologies and capabilities advance and grow in the utility industry, and to the extent that Bentley can address the challenges described in this paper, the company has a significant opportunity for success.

About the Analyst

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John Villali is a Research Director for IDC Energy Insights, primarily responsible for thought leadership in the area of utility digital transformation.

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