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DC Water's Digital Twin Solution

Improving Operational and Financial Resilience by Implementing a Water Infrastructure Digital Twin

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ENHANCING READINESS AND RESILIENCE

DC Water distributes drinking water and collects and treats wastewater for more than 670,000 residents and 17.8 million annual visitors in the District of Columbia, and is committed to leveraging technological innovation to deliver high-quality services in an affordable, resilient, and environmentally friendly way to its customers.

In July 2021, DC Water approved a new five-year strategic plan, Blueprint 2.0, to enhance its readiness and resilience. The plan will drive performance by leveraging technology to improve reliability, increase efficiency, reduce cost, drive innovation, and enhance the customer experience. As part of its strategic plan, DC Water sought to implement a real-time, cloud-managed water infrastructure "digital twin."

When it comes to the water distribution systems, there are too many moving parts. Pumps, tanks, and system and boundary valves, coupled with unpredictable main breaks and power outages, have cascading effects on the delivery of reliable drinking water in a safe and resilient fashion. The decision to pilot a digital twin, or a replica of the water distribution system, was because of the sheer size of DC Water's water network, the dynamic nature in terms of operational unknowns, and, at times, the physical unknowns, and to test the benefits that we could gain from the implementation.

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SEEKING A DIGITAL TWIN

As cities and populations grow and systems face aging infrastructure, climate change, and ever-shifting challenges, utilities are turning to data and digitally integrated systems to help them better design, operate, and maintain these complex systems. They are measuring, capturing, and storing more data than ever before; however, data are typically locked into the system that created them and the departments that use them, resulting in siloed data repositories that are vastly underutilized.

For its pilot, DC Water selected Bentley's OpenFlows™ WaterSight™ to implement a digital twin that would help address these challenges. The solution brought together information technologies like GIS, asset data, operational technologies such as Maximo work order management, SCADA, and engineering applications like hydraulic simulation tools.

Image courtesy of DC Water

The goal was to mitigate service disruptions, reduce nonrevenue water losses, leverage data to reduce operational and capital expenditures, and improve the overall level of customer service.

With an implemented digital twin, DC Water could more easily replicate the data from their enterprise systems in a managed cloud application database, where they could organize and scrub the data in near real-time and then configure operational applications—such as use cases—to address key operational challenges for water utilities. For example, a digital twin can help utilities understand pump and tank operational performance, automate nonrevenue water audits by month or by pressure zone, or analyze and mitigate operational events—such as pump shutdowns or pipe breaks—using a browser-based SCADA integrated hydraulic model.

DEPLOYING DIGITALIZATION ACROSS THE DISTRICT

DC Water's digital twin implementation started in mid-2020 with their distribution system and went "live" at the beginning of 2021 with Phase 1, or pre-enterprise-wide deployment phase, of the implementation process. The team identified four goals for this phase. The first was SCADA, which included sensor "health" monitoring and anomaly alert notification. The second was pumps with hydraulic performance visualization. The third was hydraulic model/SCADA integration to improve calibration and support other operational use cases. The fourth was pipe break response and mitigation, which included using an integrated browser-based hydraulic simulator.

DC Water began by looking at how the sensors are sending the data and looking for anomalies. They also observed the pump combination, especially when multiple pumps were running together. The team was interested in a hydraulic model conducted at a regular interval by feeding the SCADA data near real-time data, seeing how the system behaves or produces the result when both of those are combined. They also wanted to know how the application would help them be better prepared in an emergency.

With the goals defined and data collected, the implementation team worked to make the data available for cloud applications so they could do live simulations and other SCADA data-related activities.

One of the key benefits of the water infrastructure digital twin is that the data output can be viewed in a browser-based application, making it accessible on any device by any authorized user.

LESSONS LEARNED

DC Water is in the first phase of the implementation process. However, all functionalities of the water infrastructure digital twin that the team tested have been validated. By using a water digital twin, DC Water learned the importance of setting both immediate and long-term objectives. Their immediate goals included integrating and establishing the connectivity among all data sources and functions like monitoring pump efficiency. The web-based accessibility of the hydraulic model will allow staff in operations to observe system performance in real time, which is key as they typically do not have access to the actual hydraulic modeling tool. The water digital twin will allow them to view readily generated results or even simulate some "what if" scenarios to make informed decisions. Long-term objectivities include tracking water consumption, or comparing production versus consumption, which involves the integration of all AMR sources, AMR data, and complete access to all the pump productions and production sources.

The benefits of a water infrastructure digital twin are numerous for DC Water. The team will now be able to leverage all the data across all the enterprise applications and a common environment, where the data and analytics of the operational applications are more visible across the enterprise. They have the potential to reduce both operational and capital expenditures and nonrevenue water losses. Perhaps most importantly, however, a digital twin can help them leverage and optimize investments in their enterprise software and tools to improve the customer's overall level of service, whether that is improving water quality, operating pressures, or just improving operational response.

As a forward-looking utility that considers implementing a digital twin as an essential business priority, DC Water knows that while data is crucial to the implementation, collaboration among stakeholders is key to success.