

A photograph of a water distribution system featuring blue pipes, yellow railings, and a blue staircase. The scene is set against a clear blue sky. A semi-transparent blue box is overlaid on the left side of the image, containing the main title and subtitle. The Bentley logo is located in the bottom right corner.

DIGITAL TWINS FOR WATER DISTRIBUTION SYSTEMS

Turn Data into
Operational Intelligence

Bentley[®]

In this e-book:

Making Sense of Data

Digital Twins for Water Utilities

Nonrevenue Water

Energy Efficiency

Customer Service

System Resilience

Water Quality

Capital Planning

Decision Intelligence





MAKE SENSE OF DATA TO MAKE BETTER DECISIONS

Water utilities have made great strides adopting digital solutions to improve monitoring and performance, reduce costs, and optimize operations. Smart sensors and advanced solutions such as GIS, SCADA, and artificial intelligence (AI) have revolutionized processes and improved performance, though they also have created a flood of new data sources.

Data has the power to dramatically transform and improve utility operations, but too often utilities lack the ability to integrate systems, analyze siloed data, and convert this valuable information into actionable insights.

As utilities' reliance on smart technologies and data continues to grow, so does their need to adopt a digital twin environment that connects these technologies. A digital twin will ensure systems integration, improve data management, and boost team collaboration.

This e-book looks at how the implementation of a digital twin for water distribution can help utilities gain operational intelligence and make better, faster decisions.



DIGITAL TWINS FOR WATER UTILITIES

Connect the Drops with Digital Twins

Why should water utilities consider implementing a digital twin?

Each utility relies on systems that, individually, have useful but somewhat restricted applications. Together, these systems and the critical data they provide give utilities the ability for smarter decision making. This is where digital twins play a significant role.

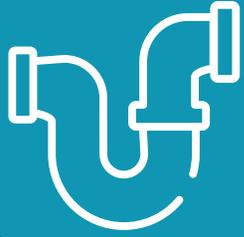
Bentley's OpenFlows™ WaterSight® is a scalable and flexible water infrastructure digital twin solution that integrates and analyzes disparate data sources, including SCADA, Internet of Things (IoT), GIS, hydraulic modeling, client information, and historical data, into a connected data environment.

Connected Data for Better Decisions

One of the key benefits of a digital twin is to share data in a single map view unifying different data silos across the utility. It provides actionable insights resulting in cost-effective, real-time operations strategies, including reducing nonrevenue water, energy use, and service interruptions. Moving data quickly and smoothly between teams also removes barriers created by traditional engineering functions and improves collaboration, enhances workflows, and enables problem solving.

The result is utility-wide access to critical systems and individual asset performance and risk information that enhance capital planning decisions, decrease risk, and ensure the delivery of safe, reliable water supply to customers.





REDUCE NONREVENUE WATER

Reduce Nonrevenue Water by 20% or More

Nonrevenue water has a significant economic impact. Recent data estimates that global annual nonrevenue water is 126 billion cubic meters, which translates to roughly USD 40 billion in annual losses.¹

While digital twins cannot help water utilities replace old pipes, fix leaks, or replace broken water meters, operation and engineering departments can gain valuable insights from existing data to improve network performance. Digital twins can help you monitor flows and pressures, identify anomalous events, understand water losses, and prioritize areas for replacement that need it most.

The result is a significant reduction of nonrevenue water by 20% or more.

Monitor Flows and Improve Network Performance

With a digital twin, utilities can understand trends and expected system behaviors by monitoring sensor data in real time. Staff can perform water balance and minimum night flow calculations. You can understand and compare water losses between different zones, including the division between real loss, which occur through leaks and is relatively constant over the day, and apparent loss, which follows patterns similar to overall demand.

An abrupt or continuous increase in flow or decrease in pressure not explained by anything else (such as a fire or special event) could also indicate the presence of a new leak. OpenFlows WaterSight automatically calculates expected patterns and forecasts for each sensor and zone using artificial intelligence and statistical algorithms. The digital twin can automatically trigger real-time alerts whenever sensor data is outside the expected operational behavior. Volumes lost in each event are automatically computed, allowing operators to manage those events with status updates, category classifications, and comments, improving response time and customer service.

Source:

1. Quantifying the global non-revenue water problem, R. Liemberger; A. Wyatt, IWA, Water Supply (2019).



IMPROVE ENERGY EFFICIENCY

Pump Optimization Meets Energy Efficiency

It takes a lot of energy to treat and distribute water. Energy costs often make up 25% to 30% of a utility's total operation and maintenance costs, and pump energy specifically can be as much as 50% of a water utility's total electricity consumption.²

As the demand for water continues to grow, water utilities are turning to digital twins to improve the efficiency of the water supply system operation by optimizing pump performance and thus minimizing energy use.

With a digital twin, operators and engineers can make sense of pump performance data, perform simulations under different operating conditions, and make informed decisions on pump maintenance and upgrades.

Monitor Real-time Operating Points

With a digital twin, operators can import pump performance data and compare operational data with pump curves to display how well the operating point matches the best efficiency point (BEP). They can compare pump operations over historical time periods by pulling pump data from different times to see if performance is changing.

By integrating readily available SCADA data or other telemetry data, the digital twin can calculate efficiencies, energy consumed, and potential inefficiency costs, which can help operators identify priority pumps for intervention and provide clues to correct the problem, improving energy efficiency while reducing energy costs and carbon footprint emissions.

Source:

2. Energy Efficiency for Water Utilities, U.S. EPA





IMPROVE CUSTOMER SERVICE

Improve Pressure Management, Reduce Shutdowns, and Improve Response Time

Having a safe and reliable water supply is the most important factor for customers. Utilities are guaranteed to hear from their customers when issues arise. Often, pressure drops significantly, or it segments of the distribution system must be shut down to repair leaks and address other problems. Thus, many utilities are turning to digital solutions that allow them to better manage pressures, as well as to prevent or reduce the impact of shutdowns and improve response times.

With digital twins, utilities can use AI and machine learning for anomaly detection and improve awareness of anomalous network events such as leaks, bursts, and meter failures. By making sure that an anomalous event, such as a pressure decrease event due to a burst, occurs in less time in the network, utilities can decrease response times, improve customer service, and improve operational cost.



Using a real-time operational hydraulic model that is constantly updated with boundary conditions from sensors as a basis, operators can easily understand areas of low or high pressures and zones with high water age levels or low chlorine levels, enabling a more proactive management of the system. In the case of an emergency event, such as a pipe break, a fire flow, or a sudden pump shutdown, operators can easily identify the impacts throughout the system, including customers without water or customers with low pressures. In case of a pipe break, operators can additionally identify the smallest segments and the nearest valves that need to be shut down to minimize the service interruption.



RESILIENCE

Improve Systems Resilience

Whether in the field or the control room, the entire team can evaluate current network performance, as well as test various what-if scenarios when quick decisions are needed due to a fire, pipe break, pump outage, or another time-critical event. By providing this capability, digital twins help ensure that you are taking the best tactics for preventing or minimizing service when an unexpected situation occurs.

Risk can be also assessed and mapped for all systems, based on the likelihood and consequences of failure determined through analysis. A digital twin can guide you when defining action plans to help reduce risk and improve systems resilience in the immediate and long term.



IMPROVE WATER QUALITY

Monitor and Predict Water Quality at Tanks and throughout the Network

OpenFlows WaterSight can help utilities monitor any water quality parameter, warn of anomalous situations, and advise you on the best measures to assure and improve water quality.

A digital twin helps you easily analyze tank levels in real time, assess tank turnover, or simulate and predict water age or chlorine concentration throughout the network using a real-time operational hydraulic model and map potential risk areas. You can improve management of chlorine dosages, improve your flushing plans, and ensure legal compliance with your digital twin.





CAPITAL PLANNING AND RISK REDUCTION

Proactive vs. Reactive Approach

OpenFlows WaterSight digital twins help utilities take a data-driven approach to capital planning so that time is spent on preventive planning versus reacting to issues. Additionally, they ensure decisions made yield the highest value for each dollar of investment.

The capital planning process supports continual and iterative improvements and refinement. As a starting point, all available data can be easily accessible for the decision support process. As decisions are made, data and the decision support process can be easily audited for validation and continually improved.

A digital twin helps you combine asset data, GIS, failure history data, and performance results into a single view of truth and decision-making. This scalable environment enables you to identify and prioritize areas and assets for renewal, replacement, and other actions.

Drive High-quality Decisions

Powered by a single water infrastructure digital twin, OpenFlows WaterSight provides logical, multidiscipline prioritization capabilities in parallel with the ability to perform multiple what-if, risk, and planning scenarios.

By employing flexible and customizable rules, you can create detailed queries across multiple datasets to support all the various stakeholders involved in the capital planning efforts, such as engineering, operations, and management, IT and GIS, finance, and executive management.

You can easily calculate the likelihood and consequence of failures and combine them by creating and comparing different risk scenarios. You can also combine risk with asset performance to drive high-quality decisions.





IMPROVE DECISION INTELLIGENCE

Improve Decision-making with Digital Twins

With OpenFlows WaterSight, water utilities can connect all data sources into a single interoperable solution to gain a better understanding of their system performance.

Once data are shared, there are countless opportunities for improved workflows, virtual walkthroughs, and simulations, giving operation and engineering departments enhanced visibility to system data and insights to help them arrive at the best solution to a problem.

Digital Twin Readiness

Every water utility, regardless of size, maturity level, and data sources can implement a digital twin. This is because digital twin readiness is scalable, typically phased over time, and dependent on the utility's unique needs, budget, infrastructure, and software requirements. While each utility takes a different path to implementation, the decision to deploy a digital twin solution is driven by the need to become more cost-efficient, optimize operations, meet growing demands, and reduce risk.



Learn how you can optimize decision-making to improve performance, reduce costs, and minimize risk.

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