Optimize Operations Using Real-Time Data and Predictive Tools

More real-time data reach water professionals than ever before thanks to a wide range of process automation and modeling tools. To harness such tools, operators can join predictive network modeling with operational analytics dashboards to improve event response, reduce water loss, and optimize system operation.

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THESE DAYS, every water utility operator is inundated with real-time process control and metering data. And more and more operational data streams pour out every hour of every day. Which ones really have something to say? How must they be presented to convey meaning rapidly, effectively, and reliably? And how can operators increase revenue and best understand the effects of any remedial actions they inspire?

Real-time network modeling and predictive operational analytics dashboards can help answer these questions, providing an actionable intelligence X-ray that helps operators continuously monitor their water distribution systems’ vital signs, spot patterns and deficiencies, act quickly and proactively, plan ahead, optimize operations and water loss control strategies, and improve customer service.

CONSIDERING WATER QUANTITY AND WATER QUALITY

Historically, drinking water regulations have focused on water quality first at the treatment plant and later in the distribution system. Now regulations are expanding to include water quantity as well. Drought always exists somewhere in the United States, and all water systems sustain water loss. Options for dealing with water scarcity include auditing, loss control, and pressure management as well as conservation and efficiency measures.

The primary responsibilities of water utility operators are supervision and control. Today, operators can benefit from technological advancements in smart water operational decision support systems to help them drive efficiency gains and proactively manage and control their distribution systems (Figure 1). Linking real-time predictive network modeling and operational analytics dashboards with their installed base of instrumentation, advanced metering infrastructure (AMI), telemetry, geographic information system (GIS), and supervisory control and data acquisition (SCADA) systems lets operators continuously view non-revenue water and critical asset performance; quickly and reliably assess system integrity; understand the impact of any action; gain insight and institute operational improvements; and respond fast to upsets, failures, and other nonroutine situations.

Armed with such comprehensive decision-making capabilities, operators become a driving force behind system improvements as well as preserve water quality and quantity for sustainable water supply planning. Smart integrated infrastructure is changing water asset management, resulting in smarter operations and positioning operators as a major force for regulatory compliance, risk management, financial planning, revenue generation, and customer satisfaction.

Figure 1. Decision Support
Smart water operational decision support systems help operators drive efficiency gains and proactively manage and control their distribution systems.
REAL-TIME PREDICTIVE WATER NETWORK MODELS

Hydraulic and water quality models of water distribution systems are the most effective way to predict network behavior. The models help operators determine pressure, flow, and water quality (movement and transformation) for specified system characteristics and operating conditions. Through their predictive capabilities, these deterministic models are powerful tools for evaluating system response to various operational and management alternatives targeting specific performance goals (Figure 2).

System Integrity. These goals are normally established to assure the integrity of three main network components: water quality (e.g., maintaining disinfection residual greater than 0.2 mg/L for free chlorine), hydraulic reliability (e.g., maintaining a minimum pressure of at least 20 psi), and physical infrastructure (e.g., reducing main-break frequency to less than 15/100 pipeline miles). To be effective, however, the models require an accurate, continuously updated view of the state of the water distribution network. This can be accomplished by synthesizing SCADA, AMI, and other real-time telemetry data with the network models to set operational boundary conditions and determine water consumption patterns. The resulting real-time network models provide utility operators continuous real-time insights into their water network performance.

Real-Time Data for Improved Event Response. With a constant stream of data (e.g., at 15-, 30-, or 60-min intervals) coupled with predictive modeling capabilities, operators can quickly assess events as they occur, identify potential problem areas before they reach a critical level, respond decisively to operational challenges, and minimize downstream effects. For example, given a predicted low storage-tank level, operators can analyze the resulting impact on network hydraulics and identify all customers negatively affected by low pressures. Alternative operating scenarios can then be quickly and accurately analyzed and compared to determine the level of improvement and associated cost, with the most appropriate scenario selected and quickly acted upon.

Operators are also able to assess the effects of main breaks and pump, valve, and reservoir shutdowns; other scheduled maintenance or repair; and any other planned or unplanned incidents. As a result, operators can respond in a timely manner with appropriate countermeasures. Operators can also predict key network parameters (i.e., flows, pressures, tank levels, and water quality) at times when data loggers aren’t available and predict system performance if SCADA data feeds go offline.

Tools for System Optimization. Many real-time network models also offer operational optimization to help operators improve the efficiency and pressure management of...
their water networks and ensure more reliable operations at maximum cost (energy and chemical) savings. Such models automatically read real-time field data, instantly update the network model, and determine the pump and treatment plant operation schedules that will yield the lowest operating cost while satisfying desired system performance requirements (e.g., tank trajectory curves, minimum and maximum flows and velocities, and total pump flows).

Using real-time network modeling, operators can progress from reactive to proactive network management. This can ultimately result in significantly more efficient and economical network operations, greater network integrity, and improved network maintenance and customer service. The Las Vegas (Nev.) Valley Water District, Yorba Linda Water District (Calif.), city of Boulder (Colo.), and Colorado Springs (Colo.) Utilities are among many progressive utilities currently realizing these benefits.

**REAL-TIME OPERATIONAL ANALYTICS MODELS**

Real-time operational analytics models bring business intelligence into interaction processes in the control room, enabling operators to proactively view, share, and analyze water operational information, key performance indicator measures, and hydraulic and water quality data in motion, both on real-time business dashboards and in proactive alerts. The dashboards enable operators to save time and monitor everything from uptime to analytics 24/7, gain high visibility of past asset performance for historical comparison, access timely information to make better decisions and share it across all the water utility functions and departments, react faster to important events, and identify opportunities for operational efficiencies as they happen.

The dashboards also automatically generate comprehensive, high-fidelity performance reports to help the operator develop the optimal course of action based on specific performance objectives. Overall performance of all critical assets can be displayed in real time and on a periodic basis (hourly, daily, weekly, monthly, or year-to-year overview). These capabilities automate and help optimize business performance, reduce operational costs and risk, and improve business responsiveness.

Real-time operational analytics models can also carry out nonrevenue water (apparent and real water losses) calculations for the overall system or for any pressure zone or district metering area (DMA) in real time (Figure 3). The effectiveness of any water conservation measures implemented can then be accurately assessed, and performance gaps can be addressed. These models can also summarize daily, weekly, monthly, seasonal, and annual water and energy usage; determine maximum, minimum, and average pressures; and extract other business performance indicators. Operators can better understand their water and energy usage, set realistic targets for both water and energy conservation, and monitor progress toward those goals.

The results allow operators to obtain real-time warning of network performance problems; gauge loss of system hydraulics, water quality, and physical integrity; and spot other operational inefficiencies. Powerful modeling tools also include accurate, up-to-date pump curve generation as well as pressure zone or DMA delineation showing total inflow, outflow, energy usage, and nonrevenue water in real time.

**THE RIGHT SOLUTION AT THE RIGHT TIME**

Water utilities have invested heavily in operational technology, smart metering, GIS, instrumentation, telemetry, SCADA, and network modeling. However, unless the information these tools produce is used to generate timely, actionable insights, it has limited inherent value. Implementing real-time predictive network modeling and operational analytics dashboards helps operators continuously monitor their water distribution systems’ vital signs, quickly and reliably assess system integrity, see the costs and performance of their asset systems, determine their nonrevenue water, and gain insight into and drive water loss control and operational improvements.

Such tools also help operators reduce the need to find new water sources and extend the life of existing sources; reduce severity of impacts from drought and climate change; manage risks; respond fast to disruptions, failures, and other nonroutine situations; and enhance customer service. Armed with such comprehensive decision-making capabilities, operators become a force for system improvements, preserving water quality and quantity, and generating new revenue.