Smart water strategies help communities prosper and grow

Significant savings in water utility operational costs can be achieved through investments in smart water strategies that deliver operational efficiencies and labor optimization. **Dennis Siegert** of Johnson Controls reports.

Investments in roads, bridges, communications, and power supplies help communities prosper and grow, and the same can be said for investments in water utilities and wastewater treatment systems. In fact, 20 to 30 percent of water utility operational expenses, which can account for 30 to 40 percent of a city's total energy spend, can be improved through investments in smart water strategies that help reduce water consumption, improve labor efficiencies, and enhance a community's quality of life.

A smart city considers the needs of today and tomorrow and invests in a strategy that takes advantage of connected technologies to manage energy and maintenance costs, reduce the city's environmental impact, enhance the comfort and safety of its residents, and increase building values. Critical to a successful smart city, a smart water strategy ensures that a city's water and wastewater systems are managed effectively, taking advantage of data to measure consumption, track distribution, confirm savings, and verify regulatory compliance. This data can be used to generate reports that identify existing leaks and point to probable leaks, compare water consumption from year to year, track customer payments received through auto transfer funds, and show water consumption by business type and size as well as by individual home and family size.

New technologies and the data they generate also give public works directors access to status reports from water resource recovery facilities. These reports include information about current running capacity versus design capacity, the remaining life of major assets, weekly spend on unplanned maintenance, security status of all facilities, and daily energy spend compared to the same day last year as well as the average spend for the last three days.

This information can lead to improved infrastructure performance and reduced labor costs. For example, Supervisory Control and Data Acquisition (SCADA), as it relates to water resource recovery facilities, provides the status of remote pumping and lift stations, reducing the need for human supervision and control of remote equipment. Meanwhile, maintenance management and work order systems provide data that allows facility personnel to make smart decisions about labor use and can reduce unnecessary overtime.

Smart water systems also support sustainability and green initiatives, which are now commonly being demanded by citizens and mandated by municipalities, many of which have set goals for efficiency. Modern, efficient water resource recovery facilities combine technology and data to conserve resources, reduce their environmental footprint, and help cities meet energy benchmarks.

Water efficiency

Among the technologies that contribute to a smart water strategy, leak detection is critical, given the fact that approximately 22.7 billion liters (6 billion gallons) of water are lost every day to leaks nationwide in the United States (US). A citywide leak detection system monitors the water distribution system daily, using acoustic signatures to detect leaks. Sensors permanently mounted on customer service lines upstream of water meters record vibrations caused by leakage. This data is uploaded to a proprietary website for analysis. The system provides internet mapping of possible and probable leaks in the distribution system and a spreadsheet that suggests repair priorities based on leak severity. The data, in turn, can be exported to a work order management system, so field teams can use noise correlators to pinpoint and repair the leaks that represent the largest losses.

Worker inspects valve at a treatment facility. Photo by Johnson Controls

In addition to reducing water loss and the production that goes with it, leak detection helps limit damage to surrounding infrastructure that occurs when leaks go unrepaired for long periods of time. It promotes prompt scheduling of repairs to avoid overtime work and reduces the possibility of sinkholes, which are a significant liability for cities.

Smart water technologies also provide efficiencies for a city's home and business owners. Smart controls for home and business heating, ventilation, and air-conditioning (HVAC) systems help minimize energy consumption by determining ideal start and stop times for water heating. Water is heated just before it is required, ensuring the availability of the hot water supply while keeping energy consumption and costs low.

To ensure accurate meter reading, smart cities are using advanced metering infrastructure (AMI) that provides incremental data on each customer's water activity. AMI minimizes labor compared to conventional meter reading and improves how utility managers track consumption among the largest users. Daily reports show notable changes in usage, so a technician can be sent to check for a faulty meter or other reason for an unusual decline or rise in reported usage.

Satellite irrigation control – an additional smart water technology – changes usage patterns for customers by zone to ensure that only the right amount of water for irrigation is used. Water usage patterns are determined using data on the previous day's weather, soil conditions, and input from the city.

One of the most valuable technologies for a smart water strategy is connected lighting. Smart LED, motion-sensing lighting systems illuminate city streets and ensure energy savings while providing water detection for flooded street notification. Lampposts provide a safe overhead location for sensors that detect weather events and video cameras that capture real-time activity such as road conditions and water main breaks. By connecting to the city network, lamppost-based sensors can communicate with city officials and activate digital signage that warns motorists and pedestrians to avoid certain areas that are flooded or are likely to become flooded. This technology can be crucial for keeping people safe, especially in cities where flooding can happen very quickly and with little warning.

Costs put upgrades out of reach

Although many technologies exist to improve efficiency and service, few communities are taking advantage of them. In fact, the American Society of Civil Engineer's 2017 infrastructure report card gives treated water systems in the United States a "D" and notes that upgrading existing water systems will require at least US$1 trillion. This need comes at a time when shrinking budgets and a more complex regulatory environment are forcing local government leaders to think creatively. They need to find innovative ways to fund the solutions that will make smart water a reality for their communities.

Bringing about these solutions begins with planning that includes identifying challenges and prioritizing short- and long-term goals and objectives. Goals vary from city to city but typically address safety and mobility improvements, climate change, growth, and smarter, more efficient infrastructure.

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Alternative funding

The search for funding follows the planning stage, with more attention being given to alternative funding sources. Among them, contingent payment programs and energy performance contracts (EPC) provide funding and guarantee that facility upgrades will deliver specified savings over a fixed period of time. Projects are designed so that annual energy and operational savings are greater than or equal to the required payments over the term of the contract, leaving a net neutral impact on a customer's budget. This programmatic approach to building retrofits and water utility upgrades results in energy reductions and lower long-term operating costs.

Another option, public-private partnership (P3), transfers the risk of design, construction, finance, and operations to the private sector in exchange for guaranteed fixed monthly payment terms and service levels over a designated time period. In each of these cases, communities are able to implement infrastructure and technology upgrades without burdening taxpayers with new taxes or higher rates.

City of Mt. Vernon uses EPC to fund improvements

The results can be impressive, as the US city of Mt. Vernon, Indiana, will attest. The city struggled for years to consistently provide its residents with safe drinking water. The problem was three-fold: The community's century-old, main water intake pipe was crumbling; its water filtration process was unreliable; and its metering system proved to be inaccurate. These challenges combined to create uncertainty among residents, who were often forced to boil drinking water. They also contributed to reluctance among prospective business owners to invest in the local economy.

The local Johnson Controls team designed a plan to fund a series of water system upgrades using a $14.8 million EPC. Under the contract, improvements would be paid for by a tax-free municipal lease and guaranteed to generate enough savings to pay for themselves over time.

The first phase of the project featured the installation of an Automated Meter Reading (AMR) system. The project included changing out 3,300 manual water meters for automatic meters, which are expected to save the city $3.7 million in increased billable consumption and operational efficiencies over 15 years.

A year later, Johnson Controls updated the city's water facility delivery systems. This update resulted in a 77 percent increase in the city's water clarity and a reduction in electricity use of more than 800,000 kilowatt-hours (kWh) per year, saving the city $10 million over 15 years. Phase three focused on updating the Mt. Vernon water treatment facility, increasing treatment capacity to 16.7 million liters (4.4 million gallons) and preventing 2.7 million liters (720,000 gallons) of contaminated water per day from being discharged into the Ohio River. This phase is expected to create more than $10 million in savings over the term of the contract.

An innovative financing method made it possible for the city to implement much-needed change without increasing taxes or municipal water rates. In fact, the results have been so impressive that the city is in pursuit of a fourth phase designed to improve the city's overhead storage and water distribution system.

Rome, New York, anticipates benefits totaling $8.6 million

In another example, the US city of Rome, New York, and its approximately 34,000 residents benefited from a $6.5 million performance contract that expanded capacity of the city's wastewater treatment facility, also improving its operating efficiency and minimizing the facility's impact on the environment. Johnson Controls installed a fine bubble aeration system at the wastewater treatment facility to replace the city's mechanical aerators, some of which were 30 years old. The fine bubble aeration system includes energy-efficient variable-vane blowers, dissolved oxygen controls, and efficient membrane diffusers. The dissolved oxygen controls automate the output of the blowers, thereby minimizing energy consumption. Variable-speed drives were also installed on low-lift pumps at the facility.

As a result, the city anticipates energy savings of more than $100,000 annually, which will contribute to benefits totaling $8.6 million over the 15-year contract term, with no taxes raised. The city will continue to enjoy cost savings even after the contract expires.

At a time when budgets are stretched and communities are being asked to do more with less, it might seem counterintuitive to embark on infrastructure improvements and technology upgrades. However, as these two cities prove, thanks to EPCs, the savings these improvements offer can pay for the upfront investment today and yield benefits that stretch far into the future.

Author's Note

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