Smart Water

Use Cases for Water Utilities

Prepared by

THE SHPIGLER GROUP

STRATEGY MANAGEMENT CONSULTING SERVICES

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The Shpigler Group is a strategy management consulting firm offering our clients a full range of services. We have designed our practice to add value to our clients' organizations, identifying suitable opportunities and optimal solutions. We deliver custom consulting services to four major industry groups:

- Energy
- Water
- Telecom
- Smart Cities

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The Shpigler Group offers services to clients in a wide range of areas:

- Developing feasibility studies for program implementation
- Performing benchmarking studies to support performance enhancement
- Conducting financial analysis of operations and detailing areas for improvement
- Supporting network design and construction management
- Performing technical research relating to projects or solutions designed
- Conducting management and operational audits
- Implementing go-to-market strategies
- Developing comprehensive and fact-based business plans
- Developing complete network designs and performing economic analysis of chosen models
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Executive Summary

For the better part of two decades, electric utilities have been generating a tremendous amount of activity in the field of "smart grid" – a field that has loosely become synonymous with the concept of utilizing data and communications networks to supported enhanced capabilities across the electric grid. While comparable activities on the water side have lagged to some extent, the water industry is catching up very quickly. New advances on a wide variety of automated water utility functions have emerged that now allow utilities to utilize data to support water distribution functions. In the process, water utilities are moving away from a purely service-orientation toward a more information-oriented one. A wide variety of use cases exist, including:

- Advanced metering
- Leak detection
- Smart pumping
- Pressure modulation
- Water quality
- Asset management

As is always the case, each water utility considering whether to utilize "smart water" applications must assess the value proposition of each – how each use case delivers tangible value, what is required to achieve operational gains, and the value proposition that results. As the capabilities of a variety of smart water applications continue to expand alongside lower costs, that value proposition has grown to the point where all water distributors should be evaluating how smart water fits within their own scope of operations.

What Is Smart Water?

The rapid growth of the smart water industry can lead one to ask the fundamental question, what exactly is smart water? According to WaterWorld magazine,

> *"Smart water can be broadly defined as a group of emerging technological solutions that help water managers operate more effectively. Smart water solutions harness state-of-the-art hardware and software solutions to provide increasing levels of system intelligence, visibility, automation and control, while enhancing customer service through new channels of engagement. These technologies are increasingly being delivered via new business models, like software-as-a-service (SaaS), or through the cloud."*[1]

The drivers for smart water programs are varied and often include water scarcity, regulatory requirements, and market dynamics. However, at the core lies a drive to utilize development in data management and communications to increase operating efficiency within the water distribution system. With the inherent differences that exist within the ecosystem of water utilities lies the truth that smart water initiatives can vary. However, they typically involve a number of common themes:

- Advanced Metering – The presence of advanced metering infrastructure continues to serve as the baseline upon which smart water programs are built. AMI systems help water utilities to increase the frequency of data collection, allowing utilities to deliver information to customers on a real-time basis while also providing for far greater visibility into network performance. The emergence of Internet-of-Things (IoT), coupled with new developments in communications protocols, have enabled utilities to achieve more with AMI systems than ever before.

- Customer Platforms – As water utilities enhance their ability to track operations across the entire distribution system, they also have the ability to deliver new information to customers on an ongoing basis. Now customers have the ability to monitor their own consumption patterns and pay bills, creating greater efficiency for water operations. Furthermore, increasing data delivered to customers has been shown to enhance the ability to identify and fix customer-side leaks.

- Leak Detection – As water distribution mains continue to age, the threat of system leaks that result in increasing levels of non-revenue water continues to grow. The ability to enable acoustic sensors across the water distribution system delivers new tools to water utilities to be proactive in addressing the issue.

- Asset Management – Utilities are always seeking ways to make the right decisions with respect to system maintenance. As financially constrained utilities seek to extend service life and defer capital investments across the distribution system, smart water systems enable system operators to make informed, data-driven replacement and pro-active maintenance decisions.

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[1] Maize, W. (March 1, 2018). "Smart Water: What to Expect in 2018". WaterWorld.

- GIS-Enabled Systems – Too many water systems are run without fundamental data regarding the placement of assets. With mapping tools that align with smart water protocols, water utilities now have the tools available to better operate their systems, providing system operators and field crews with enhanced capabilities.

Use Cases

Each smart water application offers the potential for water utilities to engage in activities that deliver potential efficiency gains. Below we consider some of the promising smart water use cases.

Leak Detection

It is often difficult for water utilities to identify many leaks that occur in locations where normal detection would be difficult – for example, underground or in drainage ditches. As these leaks can generate significant amounts of water loss, non-revenue water amounts can increase dramatically. For example, in 2013, 226 water utilities located in Georgia collectively reported over 51 billion gallons of water lost to leaking pipes.[2]

Acoustic leak detection is a form of technology that utilizes sensors placed across the water distribution system to address this issue. The sensors monitor sounds within the water distribution system and identify acoustic anomalies that correspond with leaks. The impact of automated leak detection programs can be quite dramatic. For example, San Jose Water has saved over 40 million gallons of water in under one year through the identification of 53 leaks, 28 of which were found on San Jose Water pipes and the other 25 in customer-side leaks.[3]

Smart Pumping

While advanced metering programs are heavily focused on billing issues, the data that stems from them can be utilized for great value in other areas of water distribution operations. Using system data from the metering system, water utilities are able to implement a system to better utilize field operations in order to reduce electric demand charges. Specifically, the goal is to develop a system that will allow for the operation of the right (most efficient available) component pumping systems at the right time, for the right duration, and to meet operational requirements at the lowest cost. Ideally, the targeted program includes the following elements to optimize pumping operation:

- Pumping systems' energy efficiency
- Optimum pumping system operating configuration
- Optimum pump systems' operating strategies
- Potential cost savings
- Potential environmental impact
- Opportunities to shave peak load
- Opportunities to reduce demand charges
- Additional capacity requirements
- Excess capacity requirements
- Nonconformance identification and communication
- Out-of-service capacity needing expedited resolution

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[2] Water Loss Audit Results (2013). Georgia Department of Environmental Protection. Reported by Kunkel, G. "Water Network Leak Detector – New Tools for Water Utilities" (July 8, 2016). FluksAqua insights.
[3] "Preventing Water Loss with Acoustic Leak Detection Technology" (February 12, 2019). San Jose Water.

- Identification of potential maintenance and capital improvement opportunities
- Validation of efficiency countermeasures

Pressure Modulation

Pressure management is of vital interest to any water utility to ensure the consistent and reliable delivery of water across the distribution system. When pressure runs high, there is a risk of an overflow, resulting in water loss. In the event of low pressure, there is a risk of improper delivery of water to customers.

The installation of District Metered Areas (DMAs) is one of the most successful methods that water utilities use for implementing pressure management programs. This involves the segregation of the water distribution network into small zones by controlling isolation valves. With advances in hydraulic modeling, monitoring, optimization, and control systems, water utilities now have the potential to moderate controls in the event of a tank overflow or low pressure to ensure reliable distribution operations.

Water Quality

The water distribution system includes infrastructure needed to convey treated water to service connections throughout the service area. Many utilities have explored ways to support an online water quality monitoring system. This system involves the deployment of resources that enable online water quality instruments that deliver real-time measurement of water quality across the distribution system. The purpose is to more efficiently manage distribution system operations by detecting changes in water quality as they occur, facilitating a timely and effective response for two desired effects: (a) to maintain and/or improve the overall quality of drinking water for customers, and (b) to improve water quality to improve the life of assets across the distribution system. As such, there are two primary design goals:

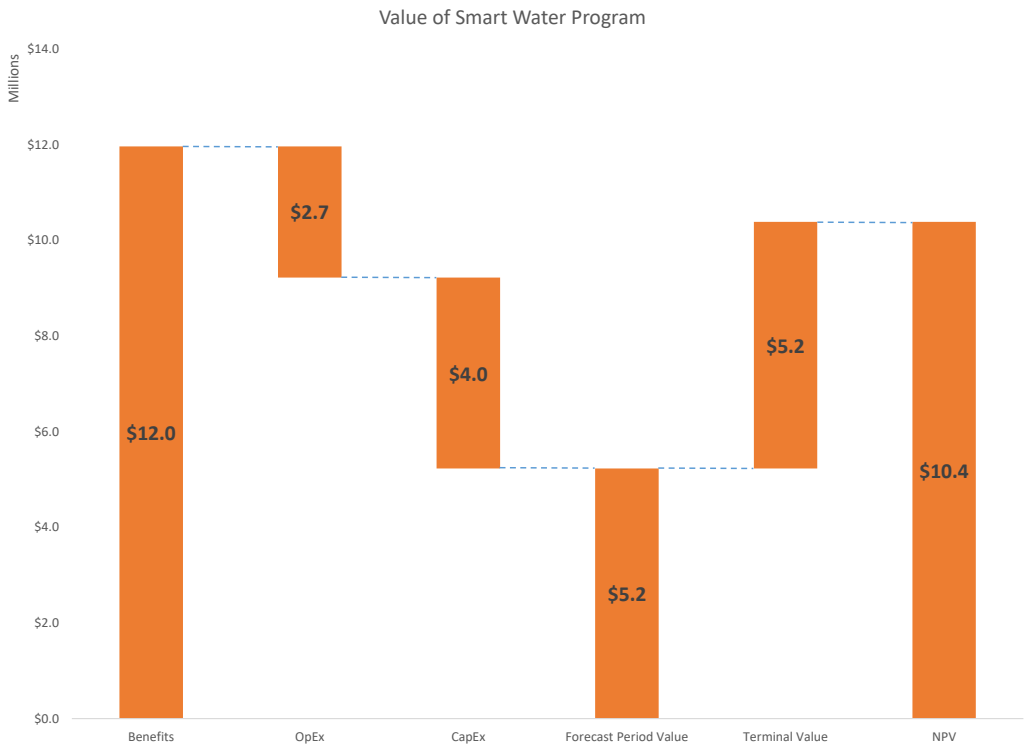
- Monitor for Contamination Incidents – The presence of a contaminant in a drinking water distribution system has the potential to cause harm to the community and utility infrastructure. Contamination incidents may be unintentional (e.g. treatment process failure and contaminant pass through, backflow incidents) or intentional (e.g. purposeful contamination of a storage tank). The goal of this program is to gather information that can be used to detect contamination incidents, enabling utilities to isolate affected areas of the system and implement corrective actions, as needed.
- Optimize Distribution System Water Quality – Optimization of distribution system water quality involves operating a treatment plant and distribution system in a manner that meets selected water quality objectives. Such an effort provides support for water quality goals such as chlorine residual management and corrosion control while preventing water quality problems such as nitrification, regrowth, and disinfection byproduct formation.

The Business Case

In order to assess the financial viability of a smart water program, it is important to understand the key components of the business case. The key elements to consider for each use case under consideration include:

- Benefits – What is saved through the adoption of automated systems?
    - Reduction of water loss
    - Reduction of overtime labor
    - Reduction of water treatment expense
    - Reduction of electric bills associated with pumping
    - Increased system revenue
    - Deferral of capital investment
- Operating Expense – What is needed for the ongoing operation of the system?
    - Personnel
    - System maintenance
    - Management expenses
- Capital Expense – What will the required system cost?
    - Devices installed across the system
    - Installation
    - Operating systems
- Terminal Value – What is the system worth at the end of the forecast period?
    - Recurring benefits less expense

It should be noted that each water utility considering a smart water program should develop their own business case, as the operating requirements for each vary. Nevertheless, we can illustrate the potential economics by looking at the business case of a water distribution utility conducted by The Shpigler Group. This utility featured 100,000 meters in operation and looked into the viability of four use cases (leak detection, smart pumping, pressure modulation, and water quality):



[4]

An analysis of this water utility's smart water program revealed the following potential financials over a ten-year forecast period:

- A cumulative ten-year benefit value of $19.6 million, which translates to $12.0 million in current dollars
- A total capital investment of $4.7 million over ten years ($4.0 million in current dollars)
- A "terminal value" of $5.2 million based on the forecasted value of the system at the end of the forecast period
- A total Net Present Value of positive $10.4 million
- An Internal Rate of Return of 37.9% over the life of the project

[4] The Shpigler Group analysis.

Summary

Water utilities are continuously seeking to implement programs to enable them to better serve customers and to become more operationally efficient. Smart Water involves a non-stop, on-demand, re-design journey of the business models, business processes, technologies, organizational structures, and applied human capital to seamlessly leverage existing and new trends into a more profitable, faster growing, and more customer driven utility reality. Utilities that implement smart water programs fundamentally believe that:

- Smart water delivers success by committing to pervasive performance management, which helps streamline processes by creating a smart, agile and aligned utility
- Smart water enables the close monitoring of performance, flexible integrated planning, and reestablishes and/or enhances trust with stakeholders
- Smart water also drives insight in investments and offers techniques that help in rethinking strategies and managing innovation as a competitive advantage

Ultimately, by implementing these programs, it will enable the development of a host of new programs that are beneficial for a wide variety of stakeholders.