Black & Veatch Insights Group

WATER INDUSTRY REPORT

2017

STRATEGIC DIRECTIONS

BUILDING A WORLD OF DIFFERENCE®

BLACK & VEATCH

About This Report

Last year's *Black & Veatch Strategic Directions: Water Industry Report* called for widespread industry collaboration to overcome concerns about costs and customer demand. Since the 2016 report, increased levels of focus on sustainability and the role of data are showing promise as answers to the years-long conflicts between our aging infrastructure and a safe, resilient water supply.

For the first time, we asked water providers exactly how aging infrastructure was affecting their operations. Capital costs, unbudgeted emergency work and operational costs predictably came out on top. The report examines how data analytics, consumer education on infrastructure modernization and a more comprehensive view of sustainability are helping water utilities gain ground on these challenges.

Valuable lessons have also been learned on the urgency of addressing lead service lines and alternative water supply. Finding efficiencies, incorporating integrated planning and making educated technology investments are being tied into better data management. A much-needed merge of data into water system operations could similarly explain a change in perspective on asset maintenance, financial viability, budgets, water conservation and water loss.

How water providers explore and embrace these shifts can help cities more holistically manage water's role in their communities.

We welcome your questions and comments regarding this report and/or Black & Veatch services. You can reach us at **MediaInfo@bv.com**.

Sincerely,

CINDY WALLIS-LAGE | President
Black & Veatch's water business

JOHN CHEVRETTE | President
Black & Veatch's management consulting business

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Executive Summary

COLLABORATION, LEADERSHIP WILL CLEAR THE PATH TOWARD SUSTAINABILITY

By Cindy Wallis-Lage

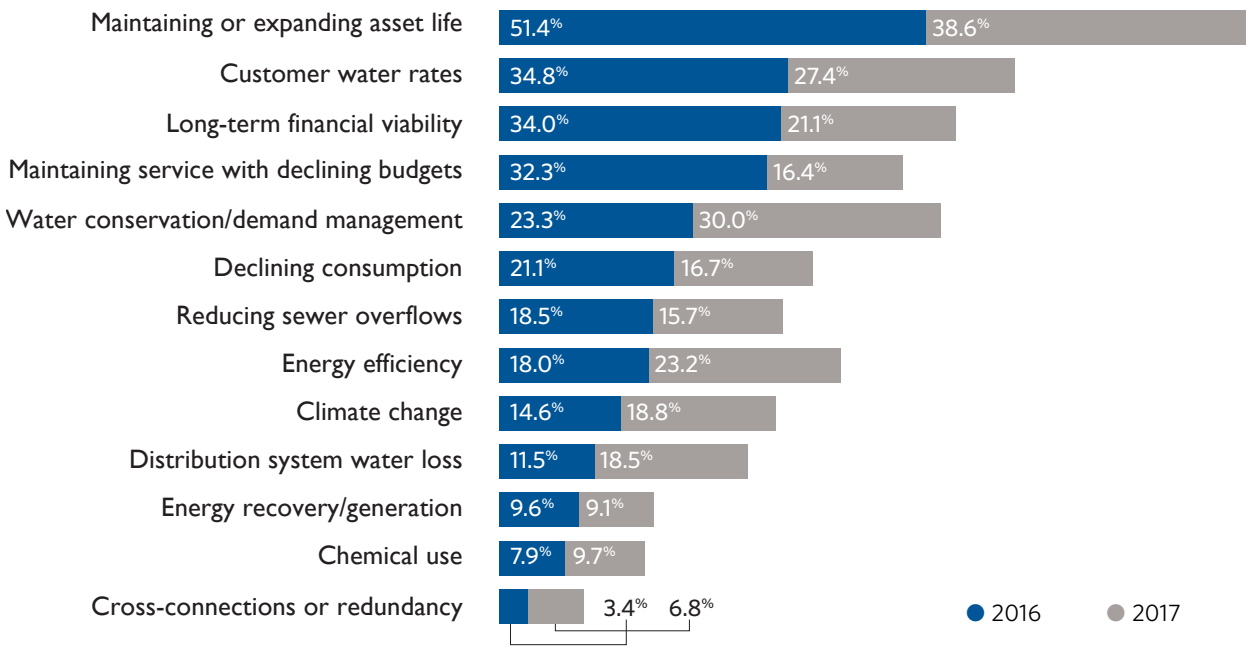
Sustainability is the goal that guides our industry. We pursue sustainable water supplies in the face of major changes in our demographics and climate. We look for ways to become more economically sustainable by balancing system and user needs with available capital. And we seek a social sustainability through deeper relationships with customers, a compact that is critical to balancing what customers pay for water with the true cost of its delivery.

The *2017 Black & Veatch Strategic Directions: Water Industry Report* reflects this pursuit, but reveals some interesting shifts and divergent approaches to achievement of that ultimate goal:

- The financial challenges associated with sustainable water systems have shifted. Our report finds fewer providers selected finance-driven topics as their top critical issues on the path to sustainability. This may reflect growing confidence in funding from two important channels: greater confidence that government leaders and customers may be more prepared to accept rate increases as a means to pay for critical improvements, and the Water Infrastructure Finance and Innovation Act (WIFIA).
- A reduction in how respondents connected financial sustainability to the expansion or maintenance of asset life suggests an increased focus on asset management. Commitments to measuring existing assets drive smarter decisions about what to spend/when to spend and can reduce costs associated with unbudgeted emergency work.
- Upticks in how respondents viewed the role of water loss and conservation in achieving sustainability suggests the industry may be moving away from a traditional view of growing supply towards optimizing what we have (Figure 1).
- A mounting focus on system resilience is clearly communicated through the increasing prioritization of climate change as a concern. Utilities are concerned with protecting assets from natural disasters and storms.
- More real-time, two-way communication between utilities and their ratepayers is helping push social sustainability – helping customers better understand usage, rates and the value of water services to the community.

FIGURE 1

Which items represent the most significant sustainability issues for water utilities? (Select top three choices)



Source: Black & Veatch

In the United States, where rate cases are being designed to help fund replacement of the nation's outdated infrastructure, utility and government leaders are more deeply engaging customers about the complexities and costs of reliable water infrastructure.

The confluence of these shifts supports a path toward driving down capital investment, through increased proactive planning versus reactive investments in order to more effectively anticipate and manage asset needs. This is particularly important given that utilities, depending on their geography, face diverse threats to system health. For instance, in California, an increased focus on water loss detection may counter some of the ongoing costs associated with transferring water great distances. In the northeast United States where older systems are predominant, providers are focused on managing and optimizing existing assets to balance capital spend with system resilience.

A NEW NORMAL

In these and many other ways, water leaders are moving to make their systems stronger and more sustainable. They are adapting to a new normal of accommodating a changing climate and rising public scrutiny of the water supply, and in the process exhibiting new levels of leadership and political will.

In Singapore—where decades of water dependency have given way to vibrant and tangible advocacy for self-sufficiency—the national water agency Public Utilities Board (PUB) has once again demonstrated strong political leadership in its move to increase the water tariff for cost recovery. The agency, given the need to build additional infrastructure, is also vigorously investing in innovation. A great example is the Deep Tunnel Sewerage System (DTSS) Phase 2 project, which will free up land for other higher-value developments while supporting the production of ultra-clean, high-grade reclaimed water. In addition, the project's

water reclamation facility will be co-located with the National Environment Agency's Integrated Waste Management Facility to reap the potential synergies of the water-energy-waste nexus, maximizing energy and resource recovery.

In the United States, where rate cases are being designed to help fund replacement of the nation's outdated infrastructure, utility and government leaders are more deeply engaging customers about the complexities and costs of reliable water infrastructure. Many are exploring alternative, collaborative financing models—including public-private partnerships—to fund needed infrastructure investment that otherwise would be unpalatable to residents and the elected officials that serve them.

The pursuit of sustainable water systems is a common thread throughout our report, which examines a host of issues facing our industry:

Rate Design

Raising base or fixed charges continues to be critical for revenue stability in the United States, with almost 40 percent of survey respondents indicating they plan such increases to stabilize revenue. Others are planning increases to charges outside the base rate to fund operations. However, selling the public on these strategies will be a delicate exercise because, while public awareness of water quality and water infrastructure is heightened, appetites for increased costs are low in a "do more with less" political environment.

Public-Private Partnerships (P3s)

In our section on alternative financing, we examine how communities are using innovative public-private partnerships to solve their infrastructure and supply challenges. Our report finds that more than 50 percent of respondents said they would consider a P3 if it could deliver a predictable and stabilized rate structure, while decreasing life cycle and operation and maintenance costs. We highlight a pair of case studies that demonstrate how P3s deliver value while challenging the myth that P3s amount to outright privatization.

Data Analytics

The rise of data provides exciting opportunities for water, wastewater and stormwater utilities to assess and optimize their systems. But, while there is widening agreement that data analytics can improve performance, predictability and reliability, many providers are sitting out these benefits for perceived cost reasons. Data analytics may prove to be something utilities can't afford to live without, as some interesting case studies demonstrate utilities can reduce operating costs, provide deeper understandings of system performance, increase predictability of operational and maintenance needs and position our infrastructure for long-term health.

Integrated Planning

When addressing the challenges of aging infrastructure, capital investment or water quality issues, utilities often tackle these issues individually and without an overarching plan. Integrated planning resolves this by encouraging providers to consider all aspects of the water management cycle. The report shows while early adopters are making progress with implementing more holistic approaches to planning, opportunity exists to go further.

Security

The proliferation of smart devices on our systems has created untold new channels for hackers to disable critical infrastructure. This year's responses finds opportunities for utilities

Models of innovation around the world demonstrate what is possible when leaders stand up for the health of our water infrastructure.

to shore up their systems against physical and digital threats. One interesting data point: Roughly a quarter of survey respondents said they had conducted an environmental, physical or cybersecurity attack simulation, and nearly 70 percent of those were so-called "tabletop" exercises that may not thoroughly simulate prospective threats.

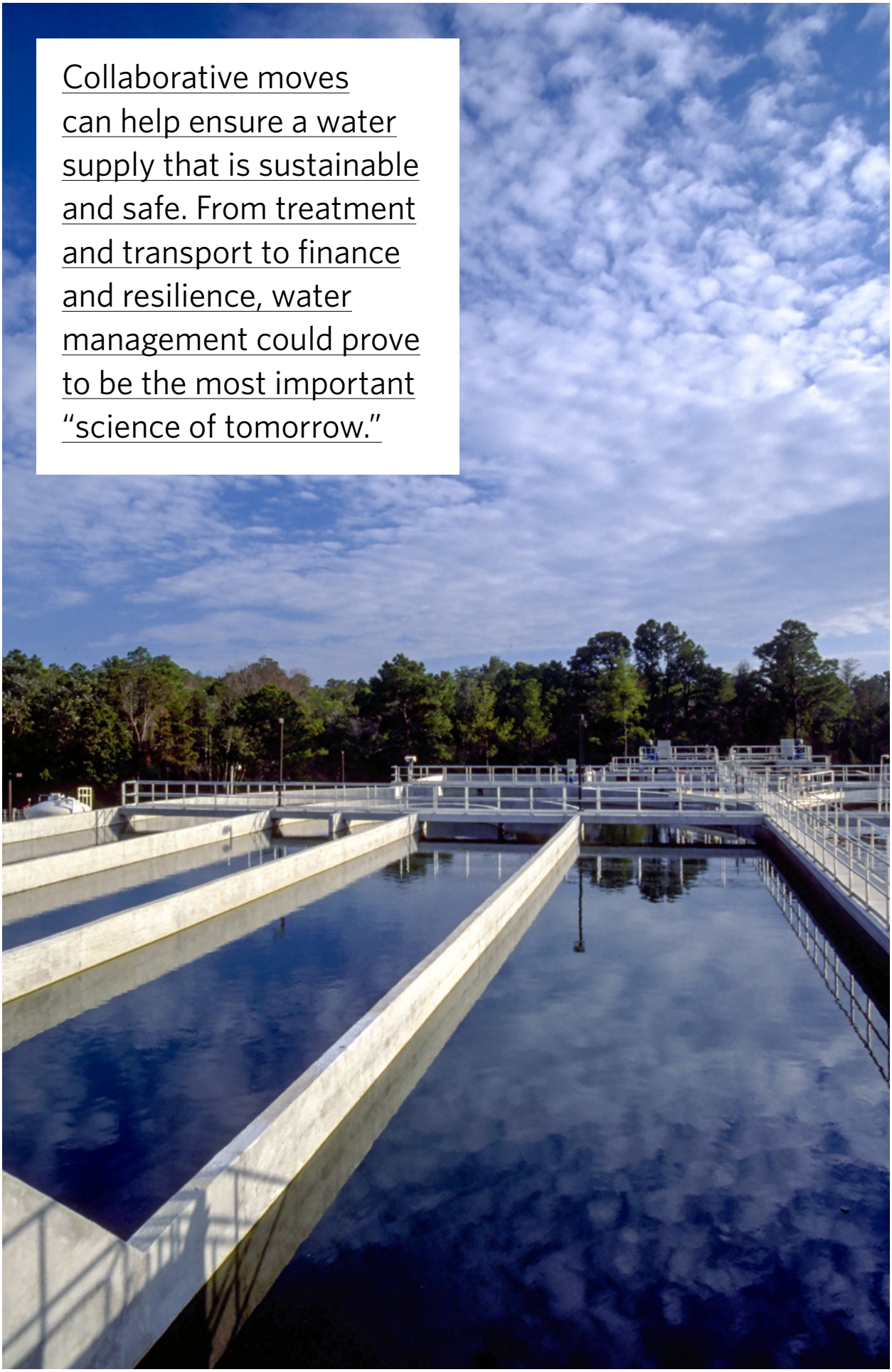
WATER AS "THE SCIENCE OF TOMORROW"

Moves we make across these diverse issues are ultimately in service to a water supply that is sustainable, safe, continuous and plentiful – yet finite. How we manage the world's most precious resource could prove to be the most important science of tomorrow. From the technical details of treatment and transport to the visions that will finance and ensure resilience, this science is viewed as increasingly critical. Its practitioners must be strong leaders who can empower innovation, while reaching across every aisle to positively engage the public, the politicians and the regulators.

Models of innovation around the world demonstrate what is possible when leaders stand up for the health of our water infrastructure. They drive change in their organizations. They champion the imperative of long-term viability to customers who may not thoroughly understand what's at stake. They unite diverse groups of stakeholders to move in one direction, toward more resilient systems.

Without them, the path to sustainability becomes a lost opportunity.

Collaborative moves can help ensure a water supply that is sustainable and safe. From treatment and transport to finance and resilience, water management could prove to be the most important "science of tomorrow."



Customer Engagement

CLOSING THE CUSTOMER GAP: MESSAGING WATER'S TRUE COST TO A SKEPTICAL PUBLIC

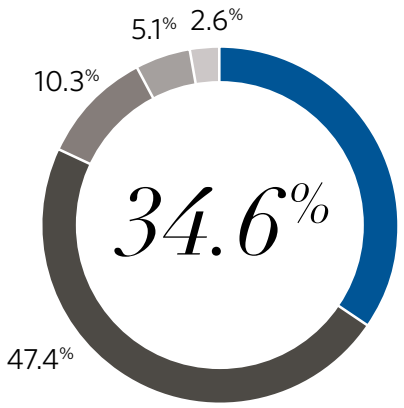
By Ann Bui

The water industry is at a critical inflection point in 2017. The Flint, Michigan, crisis raised public awareness of water quality issues to new heights, and acknowledgement of aging infrastructure is growing. Moreover, the economy continues to build momentum following the Great Recession, and the Federal Reserve has taken its first steps to bring the time of historically low interest rates to an end.

To get the most out of this confluence, water utilities must rethink some of their capital improvement program (CIP) funding strategies. This may include raising rates to support system investments and other growth or operational priorities, as well as reimagining how to communicate the value of water to customers to secure buy-in from consumers and government leaders.

FIGURE 2

Over the past five years, how would you rate the level of understanding and acceptance from key stakeholders and the public about the "value of water" and proposed rate increases? (Select one choice)



- They understand the "need" and accept that increases are necessary
- They understand the "need," but still want us to cut costs (do more with less)
- They don't understand but accept that increases are a part of life
- They protest every increase regardless of the need
- Other

Source: Black & Veatch

Municipal bonds are still important sources of funding for CIP efforts, although there is concern among utilities that the traditional 30-year tenure is not sufficient to address full asset life cycle costs. Almost two-thirds of *2017 Strategic Directions: Water Industry Report* survey respondents are planning to implement regular user charge increases, a welcome acknowledgment that slow and steady revenue increases are a financially prudent way to address utility needs. Interestingly, grant funding efforts are growing, even though grant funding levels at the national level are still scarce. Additionally, hopes of funding from the Water Infrastructure Finance and Innovation Act (WIFIA) saw a small bump as well, as the window for applications opened, and political leaders suggested they favor maintaining funding levels for the program.

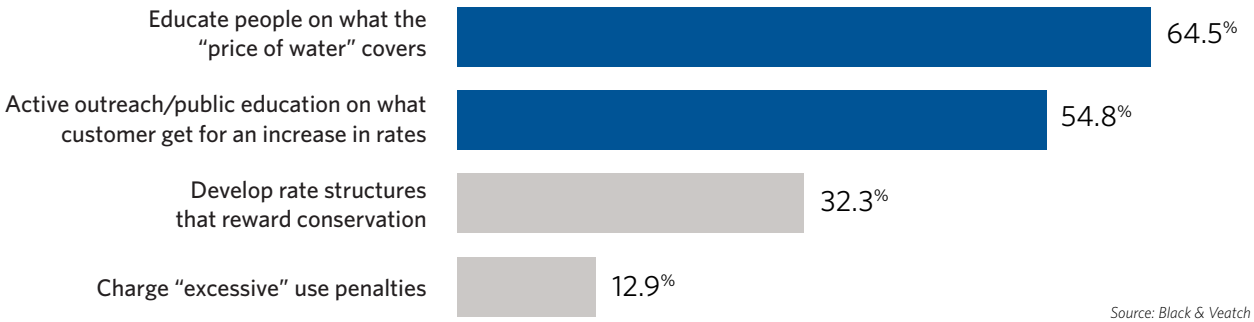
No matter how the funding picture plays out in 2017, increasing base or fixed charges continues to be critical for revenue stability. Nearly 40 percent of respondents indicated they are planning on hikes in rates and fixed charges to stabilize revenues, and many others indicated they were considering increases to charges outside the base rate to fund operations.

Communicating these increases and securing the public's acknowledgment of their importance—and thus securing requests—will be one of the most significant challenges facing many utilities this year. While public awareness of water quality is high, the appetite for rate increases remains low. Nearly 50 percent of survey respondents indicated their key stakeholders and customers may understand the need for increases, but nevertheless want their water provider to cut costs and "do more with less" (Figure 2).

No matter how the funding picture plays out in 2017, increasing base or fixed charges continues to be critical for revenue stability.

FIGURE 3

Water conservation efforts can create difficulty in predicting how much consumption will decline. What methods are your utility using to address the ratepayer conundrum: "We conserve water and rates increase." (Select all that apply)



Source: Black & Veatch

Faced with the conundrum of communicating the need for rate increases to a skeptical public, providers should consider changing how they engage customers. Utilities generally approach the rate increase process with: "What do I need to maintain a safe and reliable system?" This traditional approach of defining new rates and justifying those changes with public relations efforts on a "hike-by-hike," campaign-by-campaign basis, no longer works with most consumers.

On the other hand, customers view rate increases through the lens of: "What's in it for me?" Many customers, in this framework, think: "Okay, the price is going up again. My water is still clear and clean, so what's the incremental improvement that this increase will bring to me?" More engaged customers, who may be actively working to reduce consumption in their own household and see others doing the same, are asking why conservation efforts aren't leading to more rate stability, or even decreases.

The industry needs to shift this thinking—to "flip the script"—and communicate the larger story to its stakeholders and customers. It needs to be able to counter the concerns that this vocal minority will inevitably share publicly at rate hearings or other forums (Figure 3).

Increasingly, utilities are turning to social media to communicate – the very same channel where many concerns and misperceptions can fester and grow. While utility websites and print campaigns still top the list of primary communication channels, the strategic use of social media can help bridge the gap between campaigns, and between perception and reality.

Successful water providers are engaging with consumers online by presenting a myriad of issues facing their industry as a coherent story arc. They tell the story about delivering a necessary good through an aging infrastructure at the same time that declining federal and state grants and subsidies are shifting the burden directly to utilities and their customers. Effective leaders understand that every touchpoint is an opportunity to communicate their story, the reasons for today's low rates, the risks that accompany those rate levels and the true value of water.

The reality is that the industry's ability to provide safe and reliable drinking water has become

increasingly difficult because of deteriorating infrastructure, an aging workforce and declining public funding sources, among other factors. It just takes one water main break to undo the conservation efforts of hundreds of homes. To message water's true value, the industry must communicate the costs of failure. Otherwise, revenue will stagnate and ultimately fail to reconcile rate pressure from customers and the need for infrastructure investment.

Once we overcome this major barrier to funding success, organizations can then shift focus to other infrastructure efforts, such as finding ways to fund technological improvements that have shorter life spans than infrastructure assets and that are typically cash financed. This may be where public-private partnerships (P3s), or a performance-based contract variant of the true P3, ultimately find the most success. Utilities in the water sector may also be able to look to P3s to help homeowners fund improvements on their side of the meter, where utilities can't reach. This could reinforce messaging about the need for infrastructure improvements down the road.

Effective leaders understand that every touchpoint is an opportunity to communicate their story, the reasons for today's low rates, the risks that accompany those rate levels and the true value of water.

Changing how we tell the story:

City G in California serves a population of more than 100,000 and had not raised its water user fees in more than five years. After exhausting all its reserves, slashing operations to a bare minimum and deferring all capital, the water utility was in bad shape. Further exacerbating the situation was a city council that was against rate increases.

To get the utility back on stable financial footing, Black & Veatch worked with city staff to develop a plan that accomplished the following things:

- Extensive public meetings (more than 15) to hear the public's concerns and answer questions – town hall formats.
- Messages using everyday language and everyday examples.
- Clear proof of the improvements they would get for their dollar and the measures of success.
- Teams of consultants and staff presenting together.

The public and city council approved five years of increase, totaling more than 110 percent. Of critical importance to the success of the campaign was staff stepping up and taking responsibility for executing the CIP. As part of the effort, the staff committed to annual accountability reports to the city council on progress. The staff executed the CIP as promised and managed to improve finances to the point that the utility could enter the bond market and get competitive rates.

Customer Engagement

THE CUSTOMER-DRIVEN WORLD-CLASS UTILITY

By Ralph Eberts

Every utility, large or small, that is committed to its core mission of protecting public health, safety and the environment, aspires to achieve business and service excellence. Utilities often define their best-in-class performance goals on the basis of their current operational performance and where they strive to be in the future. The Effective Utility Management (EUM) framework can help organizations assess their current performance levels by using prescribed attributes of top-performing utilities and defining focus areas for continuous improvement. Leading water utilities are expanding the EUM approach to accelerate their evolution into more customer-centric, responsive service providers.

To build and sustain a customer-driven organizational culture, utilities will need to chart an integrated path to service excellence, financial resilience and proactive customer engagement. As this year's *Strategic Directions: Water Industry Report* indicates, challenges such as aging infrastructure, loss of talented workforce and financial constraints continue to influence business decisions and utility performance. In an environment of continuing challenges and limited resources, how does a utility create its path to "business excellence" status?

ENHANCING THE CUSTOMER EXPERIENCE

With media headlines about water service incidents increasing in recent years, proactive customer engagement should be a critical principle of the modern water utility's strategic plan. More dynamic two-way communication can go a long way in building trust and enhancing customer experience. Initiatives such as communication through mobile apps and other media channels can help with timely and consistent dialogue between the utility and the ratepayer to benefit both parties.

With media headlines about water service incidents increasing in recent years, proactive customer engagement should be a critical principle of the modern water utility's strategic plan.

A utility in California illustrated the importance of not only consistent, constant communication, but also utilization of a variety of media channels when it transitioned from its historical rate structure. Building on lessons learned from a rate change effort that was previously blocked, the utility embarked on an extensive outreach and educational program to support a water budget-based, inclining block structure to support conservation efforts.

During the initial months of adopting the new structure, variance requests overloaded call centers. The utility engaged with ratepayers via its website and other channels to handle

customer inquiries and successfully reduced incoming call center traffic. Through ongoing communication efforts, the utility is successfully managing its water demand and conservation efforts, and customers have adapted to the modified structure.

Other utility service providers, such as internet and mobile service providers, issue customer alerts when users near their data plan limits. Similarly, water utilities can enhance customer care by providing timely notifications on various aspects such as high usage, potential leaks, water conservation tips, water quality alerts and payments that are due. Receiving these notifications and obtaining actionable information will not only foster a positive customer experience but also help support the utility's conservation efforts by educating customers on best practices and increasing their awareness of the value of water.

Empowering customers with this smart data could help build goodwill, trust and transparency, as well as manage demand and non-revenue water. Communication methods should also include mechanisms for customers to provide feedback that can help utilities better understand and respond to their community's needs while enhancing their operations.

ROLE OF SMART ANALYTICS IN UTILITY RESILIENCY

Although water utilities are beginning to utilize data analytics for operations and asset management, smart integration and optimization of data for real-time analytics and enhanced efficiencies is still fairly nascent. According to survey respondents, only 7 percent are currently benefiting from these smart technologies. Through comprehensive analysis and dissemination, data can—and should—drive business decisions, master planning and capital investments that support greater resilience/ authority for water providers.

Data analytics can drive how a water utility models its operations from finances to asset management, utilizing real-time information. Organizations then have the flexibility to adjust technical and strategic models for more effective and economical operations. Among this year's survey participants, 93 percent indicated that system resilience was one of the most important challenges to the water industry, making its correlation with asset management critical for the water industry.

Data, resilience and asset management can work hand-in-hand. For example, a water pumping station with an expected life span of 30 years houses a water pump with an operating life of seven years. Instead of planning to replace the pump in seven years, a world-class utility would collect granular data on a daily basis to optimize the operation of the pump to ultimately extend its life through an integrated proactive maintenance program. Therefore, a capital investment can be delayed and deferred to a higher priority project.

Conversely, data analysis can also help create a holistic risk management profile for assets. If operations are impacted by external factors, it may be determined that an asset should be replaced before initially planned to minimize potential for service disruptions. To minimize impact to customers, a risk-based framework that is based on data can help identify tangible

consequences and the likelihood of an asset failure. Establishing a strong groundwork for resilience through asset management is essential to the success of a modern water utility.

CHANGING VALUE PERCEPTIONS

With respect to building financial capacity, most utilities strive to achieve the required bond covenants while balancing customer affordability requirements and adequately meeting operation and capital budgets. Utilities that aim to build long-term sustainability, however, exercise a deliberate and holistic focus on key factors including best practices that are based on asset management, service delivery excellence, customer convenience and low-income assistance, enhanced financial performance metrics and consistent stakeholder engagement.

A world-class utility should ask itself: To get to that ultimate level of performance, what resources and strategies do I need to apply? Where can I incrementally add or reduce costs to deliver the best value to stakeholders? A consistent focus on providing value in all facets of service delivery while communicating the alignment between the costs of water and the value of water could further help garner political and public support for timely rate adjustments.

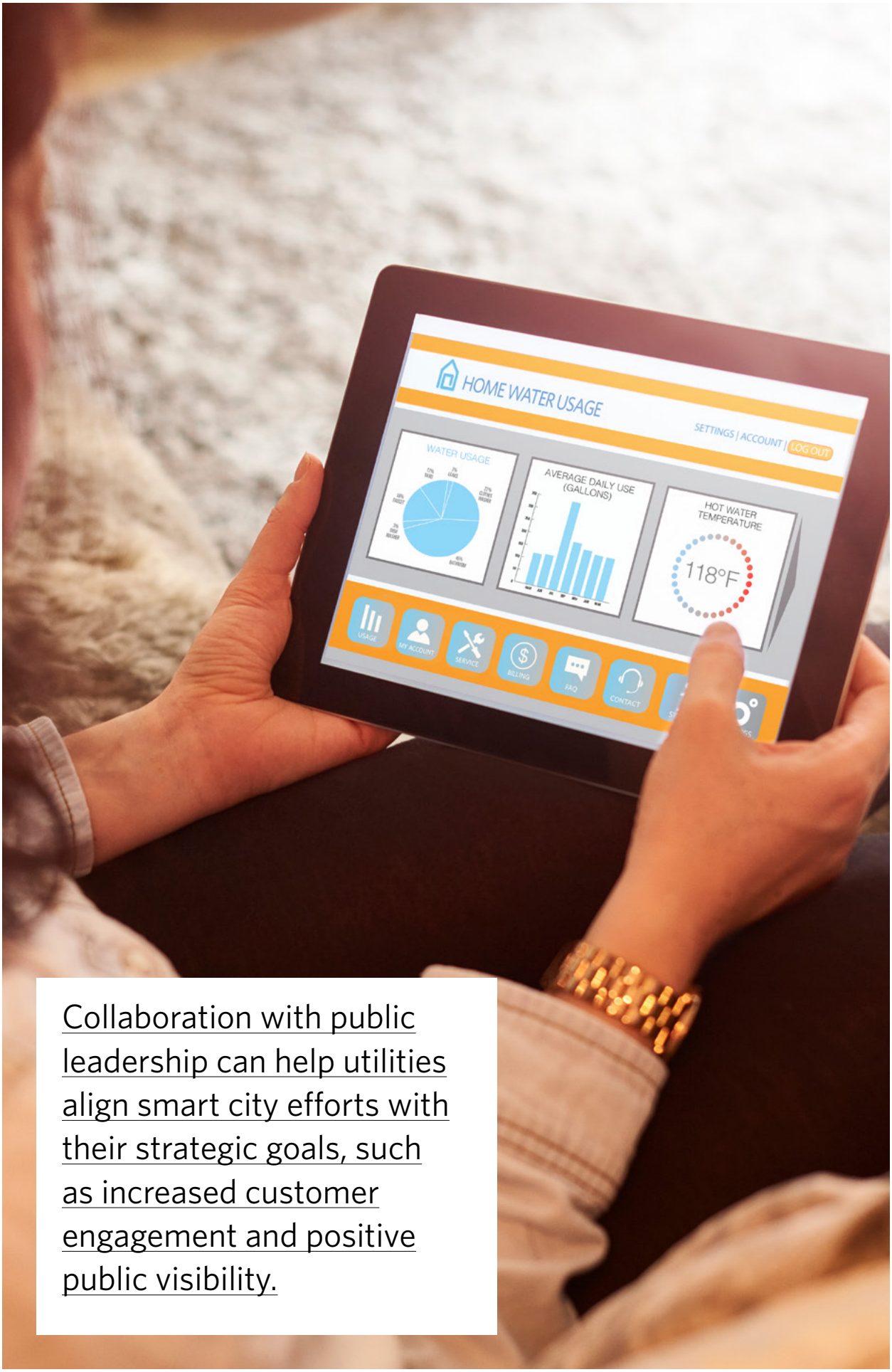
To enhance customer experience, a utility in the northeast United States recently evaluated the financial impact of the utility absorbing the credit card transaction fees its customers were charged when paying monthly bills online. Based on that analysis, the utility determined that it would absorb the $90,000 annual credit card transaction fees on behalf of its customers. Such instances of deliberate focus on customer value may add incremental costs to the utility's revenue requirements, but can be effective in mitigating customer burden and enhancing customer convenience.

COLLABORATING WITH SMART CITY INITIATIVES

As the smart city movement progresses, water utilities must also play a more collaborative role with cities and municipalities on smart initiatives. The water sector captures information on public issues such as water quality, infrastructure maintenance and urbanization projects that can be shared within a city or municipality to better the lives of citizens and meet energy goals.

Collaboration with public leadership can help utilities align smart city efforts with their strategic goals, such as increased customer engagement and positive public visibility. Water utility leadership's promotion of water's role in a smart city could alleviate concerns about where ratepayers' fees are being allocated. At a time when rates must increase to support integrated infrastructure investments, aligning with the more attractive initiatives could play an integral role in garnering customer buy-in for overdue upgrades and projects.

Today's world-class utility takes customer experience, continuous improvement through performance analytics, financial resilience and community collaboration with smart city initiatives into account as part of a holistic, long-term plan. A defined roadmap and tailored framework will give water utilities greater business flexibility and provide added value to ratepayers throughout the community.



Collaboration with public leadership can help utilities align smart city efforts with their strategic goals, such as increased customer engagement and positive public visibility.

Customer Engagement

FROM FLINT TO CALIFORNIA, HEADLINES SHOW WATER QUALITY IS TOP OF MIND

By Bob Hulsey, Jeff Neeman and Clint Robinson

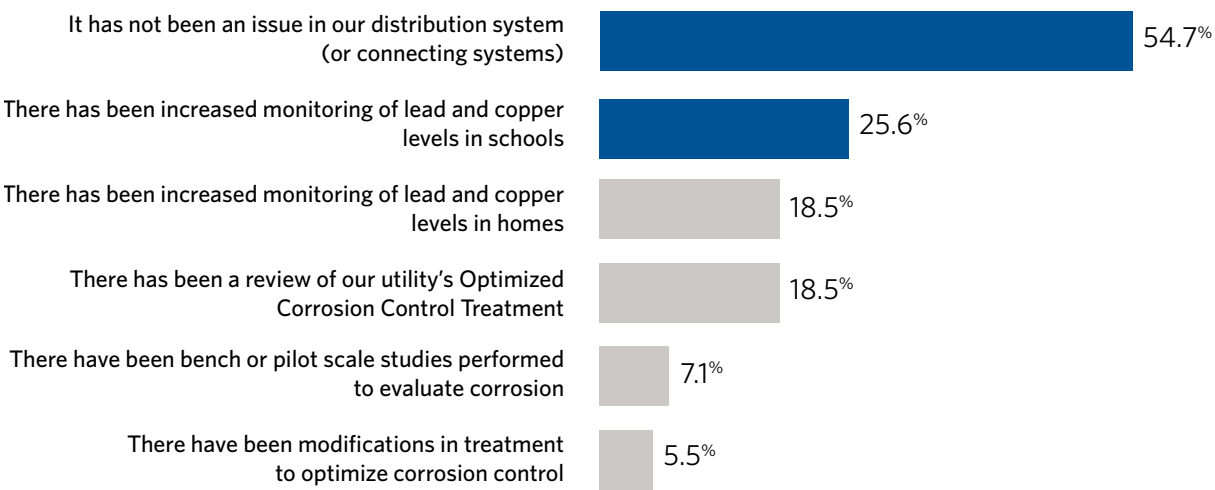
2016 was the year when advances in communications technology ran headlong into high-profile water service challenges. The continuing story of lead levels in Flint, Michigan, coupled with drought across the southwest and Southern California generated high levels of traffic across social media. This spurred a focus on water quality and supply challenges, while contributing to rising levels of customer engagement and new requests for providers to offer information and assurance.

Lead and copper rules have been around for decades, but the reality is that it took a crisis for the issue to garner widespread attention. Flint served as the catalyst, but a December 2016 Reuters report that looked at increased blood lead levels in children from all sources found "nearly 3,000 areas with recently recorded lead poisoning rates at least double those in Flint during the peak of that city's contamination crisis. And more than 1,100 of these communities had a rate of elevated blood tests at least four times higher."

To allay customer concerns, many system operators are going through their organizations to make sure that things are in order. Fifty-five percent said they don't have copper and lead, but many are confirming anyway (Figure 4). In California, addressing the water crisis is hitting home in schools. The State Water Resources Control Board's Division of Drinking Water, in

FIGURE 4

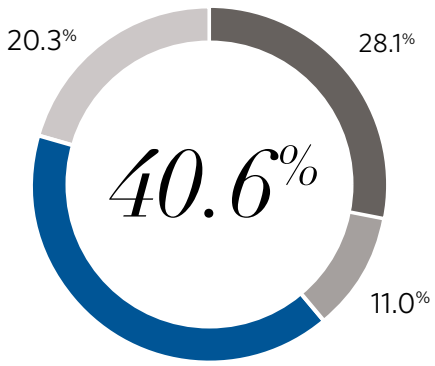
Has the issue of lead and copper corrosion been addressed in your system in any of the following ways?



Source: Black & Veatch

FIGURE 5

What kind of financing options are available for homeowners to pay for service line remediations? (Select one choice)



- We are in the process of developing a policy to allocate costs between the homeowner and utility and any financing involved.
- The utility is offering a financing plan to assist the home owner pay for service line replacement.
- The financing for service line replacement is the home owner's responsibility.
- Other

Source: Black & Veatch

collaboration with the California Department of Education, recently issued a mandate that if a school wants its utility to test its water supply, then the utility has to perform and pay for the work and provide technical assistance if elevated lead samples are identified.

However, complicating the issue for many providers, particularly in regions with older systems, is that lead may not be present in the transmission and distribution network. Instead, like the situation in Flint, it can be present largely within customer homes or privately-owned piping outside the home.

This then raises questions regarding any service provider responsibility that extends beyond the meter. Flint's issues were exposed when a change in water supply altered the chemistry within the system; however, many systems have benefited from years of coatings that reduced the potential release of compounds such as lead and copper in their systems.

Yet, the vast majority of monitoring focus/testing occurs at the point where water enters, or at a few key points in the distribution system versus the household level. Sending work crews out to test a neighborhood can be cost-prohibitive, but technology (e.g., sensor deployments) can offer an increasingly real, effective, low-cost solution. As water supplies are stressed, new sources tapped, and distribution systems become larger and more intertwined with neighboring utilities, accurate downstream data will be critical to ensure water stability and consistent quality to all consumers.

Flint's issues were exposed when a change in water supply altered the chemistry within the system; however, many systems have benefited from years of coatings that reduced the potential release of compounds such as lead and copper in their systems.

Presently there does not appear to be a policy or regulatory trigger to address in-home lead line remediation. Much of the remediation work is done only when homes change hands as part of buyer-seller concession agreements. For example, a contingency of sale could involve the existing owner's need to replace the pipes or lower the price.

But with the absence of an external trigger, system operators and their local government counterparts must explore how to allocate costs between the homeowner and the utility. Forty percent of utility respondents indicate their responsibility ends at the meter, while 30 percent are presently developing a plan beyond their system. Yet, a full 41 percent indicate that financing in-home remediation is the homeowners' responsibility (Figure 5). Though local, state and federal policy indicates support for that approach, Flint's more than $750 million price tag raises the question as to whether there is an obligation for cities or utilities to identify financing solutions.

Further, for mayors and other elected officials, the question remains: How do we take care of those populations who cannot afford to remediate on their own? Politically, it has proven challenging to raise water rates to fund existing operations, so the prospects of distributing remediation costs across the entire community via a rate increase may be a non-starter in many jurisdictions. But, the prospect of letting disadvantaged groups access unsafe water supplies is likely even more unpalatable.

Given rising customer concern and the long-term threats of litigation, it's likely that sooner or later all lead lines will be replaced. Unfortunately, public focus prioritizes spending for road and bridge infrastructure rather than water, but given the strong returns on water investment, it should actually trump other infrastructure projects.

While it would be ideal for a federal infrastructure program to support the water sector, system operators run the risk of their networks deterioting while they wait for funding to materialize. Perhaps the long-term needs of the industry can propel new discussion around alternative financing and commercial transactions that can help improve the reliability, resilience and safety of our nation's most vital infrastructure.

Sustainable Water Supply

BEYOND FINANCING: KEY ATTRIBUTES OF A PUBLIC-PRIVATE PARTNERSHIP

By Bruce Allender and Francesca McCann

Public-private partnerships (P3s) are commonly associated with the financing of large-scale projects that a utility can't otherwise afford. While a P3 can be used in this instance, other key attributes in the P3 model merit consideration in a variety of circumstances.

In a P3 structure, the private entity may provide the financing, but the true benefits of the partnership structure go well beyond financing alone. These benefits include the following:

- Economic development and job creation
- Rate predictability and stability
- Predictability around asset maintenance
- Optimal risk allocation

Life cycle cost management and long-term partnerships can help a utility manage the affordability of its services to its customer base. This can be done through a system, program or project-wide approach. The long-term partnership should be structured to include economic goals for the community along with key performance indicators (KPIs) to deliver system improvements through a program approach or through a specific project as part of its capital program through the P3.

P3s can help solve some of the greatest challenges faced by water/wastewater utilities. Of the top five most important challenges revealed by respondents to the *2017 Strategic Directions: Water Industry Report* survey, P3s can directly help solve all five: aging water and wastewater infrastructure, managing operational costs, system resilience, managing capital costs, and justifying capital improvement programs (CIPs) and/or rate requirements (Figure 6).

ECONOMIC DEVELOPMENT AND JOB CREATION

There have been several examples where P3s have spurred economic development and job creation. In the case of Rialto, California, the city went from bankruptcy talks in 2012 to a strong fiscal condition by 2016. Rialto's public-private solution generates new jobs, infrastructure and $2 to $3 million in annual payments. The Rialto partnership's investment in the water and wastewater CIP resulted in over 400 jobs directly, and the partnership's upfront economic development funding enabled a major redevelopment effort for the city that has created 4,450 new jobs to date, with another 4,000 scheduled to come online over the next two to three years.

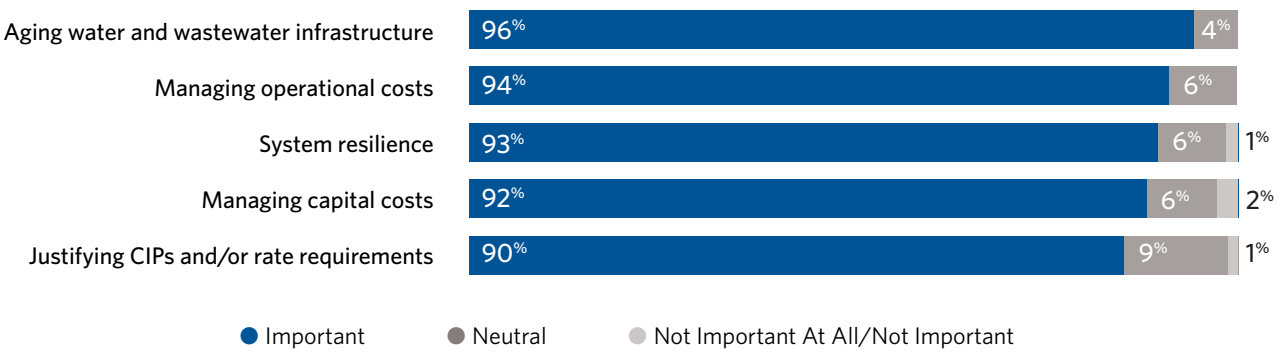
In Maryland, Corvias Solutions' Clean Water Partnership with Prince George's County to retrofit up to 4,000 acres of impervious surfaces using green infrastructure is another example. The partnership recruits local disadvantaged businesses and provides access to training and work experience. Overall, the partnership is designed to spur local jobs and economic development, while meeting a regulatory requirement.

"The partnership ensures that the city's water and wastewater infrastructure is upgraded and run in the most cost-efficient manner, while also laying the groundwork for new economic development."

MIKE STORY
RIALTO CITY ADMINISTRATOR

FIGURE 6

Please rate the importance of each of the following challenges to the water/wastewater/stormwater industry.



Source: Black & Veatch

SAN ANTONIO – PROTECTING THE RATEPAYER

The financial structure of the Vista Ridge P3 sets a flat rate for the 30-year contract period. In most P3 projects, rates increase over time as population, usage and inflation increase. In the case of the Vista Ridge P3, SAWS maintained that what was critical for them was a structure that provided "tomorrow's water at today's price." This type of structure is unique to a P3 project (including non-water P3s) and illustrates the flexibility of the P3 model.

AFFORDABILITY, RATE PREDICTABILITY AND STABILITY

One of the benefits of a P3 model is that it allows the utility to contractually obligate the private party to keep rates consistent in the long term. This allows rate stability and protects ratepayers from unpredictable, dramatic increases over the life of private sector involvement in the project. This year's report found that over 50 percent of respondents said they would likely consider a P3 if they could have a predictable and stabilized rate structure, while decreasing life cycle and operation and maintenance costs.

In the case of the Rialto P3, the structure yielded a significant initial jump in rates, 115 percent over five years, followed by anticipated long-term rate stability throughout the 30-year period. In the San Antonio Vista Ridge P3, San Antonio Water Systems (SAWS) took an innovative approach to rate structuring, obligating the private partner to maintain a flat rate throughout the life of the project.

ASSET MAINTENANCE PREDICTABILITY

In this year's survey, over 55 percent of respondents said they have adopted or are considering a P3 to gain certainty in asset investment. Likewise, the most critical sustainability issue for water utilities is maintaining or expanding asset life. With a long-term (generally 30 years) project structure in place and agreed-to KPIs, assets can have a structured, predictable maintenance plan. Moreover, often the long-term maintenance costs are notably lower in a P3 than under a traditional model because of an integrated delivery approach that includes enhanced planning and better efficiencies. The total cost saving for the life cycle of the asset can be between 10 and 30 percent compared to the traditional delivery model.

One of the benefits of a P3 model is that it allows the utility to contractually obligate the private party to keep rates consistent in the long term.

FAIR AND OPTIMAL RISK ALLOCATION

One of the primary advantages of adopting the P3 model is the ability of the public partner to transfer agreed risks to the private sector. The public partner has the option to negotiate which elements of financing, technical, construction and operating risk are borne by the private sector. In the case of the Vista Ridge P3, SAWS was able to contractually allocate regulatory risk onto the private partner. In the case of the Rialto P3, the contract was structured to allow performance risk to shift from the city of Rialto to the private party over time. The opportunity allowed under the P3 model for the public partner to transfer risk to the private sector can't be overemphasized.

CONSIDERATION OF THE P3 MODEL

In the U.S., P3s are still a developing approach, and it appears that many utility directors are more comfortable implementing specific projects than system-wide P3 approaches. However, several successful system-wide P3s that deliver capital projects through a mix of alternative and traditional delivery methods have been implemented.

Of the survey respondents who are currently using or considering a P3, more than 60 percent said they are using it for a specific project, which are now diversifying in nature. Initially, utilities considered P3s for water and wastewater projects/systems; however, in recent years, P3s are now being considered for stormwater, combined sewer overflow, septic-to-sewer, irrigation and other challenges.

P3S VERSUS PRIVATIZATION

It is important to distinguish P3s from outright privatization. Privatization implies selling the entire assets of a given entity, while through a P3 the government entity retains ownership of the assets: facilities, pipes, rights-of-way, pumps, etc. Depending on the agreed-upon structure of the deal, the government can then turn over the operations, maintenance, investment and/or finances of the organization. P3s are truly a partnership between the public and private sector, not an asset sale.

P3 FINANCING MODEL GAINS MOMENTUM

"P3s are only about the financing" is one of many myths about P3s that is important to dispel. Financing can be, but isn't necessarily, a critical component of a P3. While a P3 is not a one-size-fits-all solution, use of the P3 model can provide a workable, flexible option that aligns interests and provides a critical solution to some of utilities' most pressing problems.

Education and persistence will be the two biggest factors in greater adoption of the P3 model. As more utilities actively engage with the private sector to explore the P3 model, the more likely that greater adoption of P3s will continue to advance.

Sustainable Water Supply

WATER SUPPLY DIVERSIFICATION CONTINUES RISING TO REACH SUSTAINABILITY GOALS

By Jonathan Loveland

Increased industrial development continues to be a crucial driver in spurring demand for alternative water supplies for non-potable reuse.

Objectives for developing alternative water supplies to increase availability and improve water system resilience continue as top priorities for resource stakeholders. This year more than 50 percent of *Strategic Directions: Water Industry Report* respondents cited resiliency as an increasingly important driver for ensuring reliable water system delivery. This indicates that they are open to making the necessary financial investments to achieve resiliency and sustainability goals.

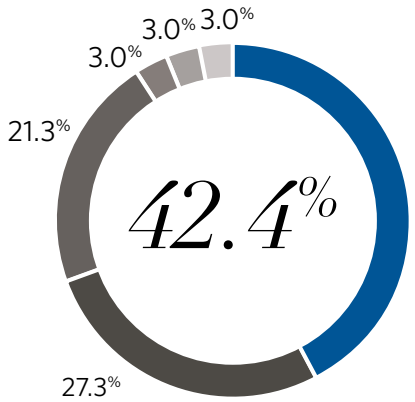
For example, in the coastal areas of Virginia and the Carolinas, supply challenges are being addressed by recycled water supply initiatives as increasing saltwater intrusion into freshwater aquifers threatens drinking water sources. Survey results also confirm the expected support for water conservation and strong support for non-potable reuse and ground water replenishment. The results also indicate there is less interest in potable reuse in areas where respondents have the ability to develop other, lower-cost alternative water supplies.

The drive for potable reuse is being seen in regions where water supply scarcity and increasing demand co-exist, such as Florida and the arid Southwest. These areas have already implemented water conservation programs and substantial non-potable reuse programs, and we expect a growing trend for indirect potable reuse and direct potable reuse options. Delivering this capability has the added benefit of avoiding restrictions on water usage caused by periodic or intermittent supply constraints.

Although cost remains the biggest issue for 42 percent of respondents in developing new alternative water supplies, projects are becoming more competitive as utilities' fixed infrastructure costs and needs for investment continue to increase (Figure 7). These infrastructure repair, replacement and operating costs are independent of the potential investment recovery available for alternative water supply projects. Although these projects are still

FIGURE 7

What is the biggest challenge your organization faces in developing new Alternative Water Supplies (AWS) projects? (Select one choice)



Source: Black & Veatch

cost-sensitive, innovative solutions for project implementation, including various types of public-private partnerships, are becoming more popular.

Increased industrial development continues to be a crucial driver in spurring demand for alternative water supplies for non-potable reuse. A decade ago, data centers' significant water demand for system cooling wasn't even on the radar for most industry observers. In this year's survey, 22 percent of respondents either had implemented or were planning to increase non-potable reuse to serve this sector. For example, in the Washington, D.C., area, the high concentration of data centers is a key driver in the growth of alternative water supply projects, with similar projects to serve this sector rapidly expanding in pockets across the United States.

Fifty percent of respondents either have a water reuse master plan or intend to develop one for increasing alternative water supplies. Master planning efforts are resulting in more and larger water reuse projects across the United States.

An example is the Central Florida Water Initiative, a collaborative water supply planning effort among the state's three largest water management districts. The initiative includes participation from state environmental protection and agricultural agencies as well as environmental groups, business organizations and agricultural communities. The planning group's collective goal is to expand water supply and diversification in a region that includes Dayton, Tampa, Orlando and Central Florida. This integrated and regional master planning effort includes a myriad of water projects, such as additional ground water and surface water projects as well as alternative water supply.

In California, master planning and execution is addressing water demand and scarcity pressures with implementation of almost every type of alternative water supply. The state is well into the development of increased recycled water production for irrigation, industrial and cooling water demands, indirect potable reuse as well as the development of large-scale seawater desalination.

Alternative water supplies will remain a key and growing component of water supply diversification efforts because of the vast range of increasingly affordable applications and end uses. Expanding water sources will be largely predicated on the continued growth and environmental benefits of recycled water supply development.

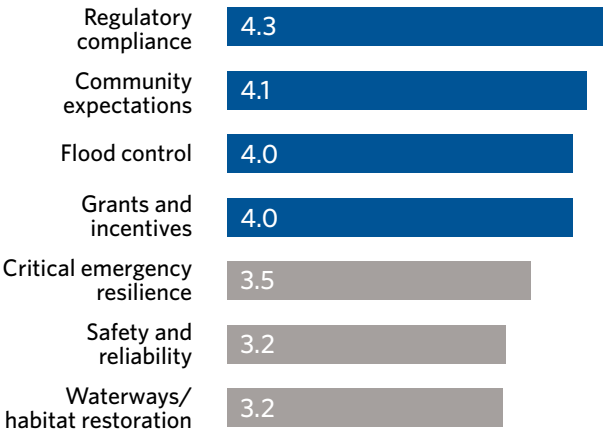
Sustainable Water Supply

TURNING ASIA'S FLOOD CHALLENGES INTO OPPORTUNITIES

By James Currie, Prabha Kumar and Andy Kwok

FIGURE 8

Please rank on a scale of 1 to 5, how the following issues drive infrastructure investment planning and decisions within your stormwater utility.



Source: Black & Veatch

Utilities throughout the Asia Pacific region are steadily investing in advanced stormwater management strategies to improve water resource resilience and overall sustainability.

The changing dynamics of weather patterns, urbanization, population and the economic/social environments are prompting the region's utilities to enhance investments in advanced stormwater management strategies. This urgency is underlined by increased urban development in Asia that is putting pressure on available land, and by rising seawater levels and increased frequency of intense rainfall events.

Utilities in the region are analyzing climate change impacts on existing resources, key risks and opportunities, and the steps they can take to ensure water portfolio resilience while mitigating risks. Through such proactive efforts, they understand that diverse infrastructure and management strategies are necessary to holistically manage wet weather events, land use and the changing economic/social environments.

For example, findings from a 2016 Black & Veatch survey of stormwater utilities in the United States show that regulatory compliance, flood control, safety, and community expectations are the key drivers of stormwater infrastructure investments (Figure 8).

Adequate and dedicated stormwater funding is critical to comprehensively addressing the operational and capital needs of stormwater management. In the absence of distinct

stormwater service tariffs in the Asia Pacific region, funding and prioritizing stormwater infrastructure and management strategies remain challenging. However, advances in asset management as well as the emergence of stormwater fees are facilitating change.

ASIA PACIFIC IS EXPLORING ADVANCED UNDERGROUND SOLUTIONS

Rather than digging deeper drains, interception and temporary storage facilities can function as the stormwater system's release valve. Solutions being built today are integrating more responsive storage schemes.

Drainage Services Department (DSD) of the Government of the Hong Kong Special Administrative Region's award-winning Happy Valley Underground Stormwater Storage Scheme (HVUSSS) project reflects how cities facing greater impermeable areas and more land reclamation are rethinking the way they plan and manage intense rainfall in crowded urban spaces.

The objective of the HVUSSS, which won the 2012 International Water Association's (IWA) Project Innovation Awards in the Planning Category, is to provide off-line flood retention in the Happy Valley catchment during a 1-in-50 year rainfall event.

Major components include an inlet structure, twin cells diversion box culvert with overflow side weir system, an underground storage tank of 60,000m3 and a pump house with a pumping rate of 5,400m3/hr.

A movable crest weir system, Supervisory Control and Data Acquisition (SCADA) real-time monitoring of water and tidal levels and intelligent data feedback are critical components ensuring that the volume of water within the storage tank is monitored and adjusted to prevent either pre-mature or late overspill of stormwater.

The adoption of this movable overflow weir system ensures the storage tank is filled at the most optimal time, avoiding premature or late overspill. As a result, the design capacity of the storage tank can be reduced by as much as 30 percent. The environmentally-friendly design also minimized the amount of excavation and the volume of materials required for construction. This shortened the total construction time and reduced costs considerably.

The HK$1 billion (US$128 million) project was implemented through two contracts. The advanced contract commenced construction in October 2011, whereas the main contract composing the major components as mentioned above commenced in September 2012. The latter was carried out in two phases with the first phase completed in March 2015.

Following the completion of the second phase in March 2017, the scheme has since been fully commissioned. New technologies used at HVUSSS are now being considered for the optimization of the existing Tai Hang Tung Stormwater Storage Scheme (THTSSS), Hong Kong's first large-scale underground storage scheme, which has helped alleviate flooding for the central Kowloon area.

PROACTIVE STORMWATER MANAGEMENT

Singapore's national water agency Public Utilities Board (PUB) is evaluating the feasibility of an integrated Underground Drainage and Reservoir System (UDRS). The study looks into the possibilities of constructing an underground

stormwater conveyance and storage system to mitigate the impact of climate change and flood risks.

With highly urbanized tropical cities often facing the challenge of having too much or too little water, the study is looking into leveraging existing technologies in new ways to meet multiple requirements – flood mitigation, storing water for other possible uses and generating power. The objective is to build tunnels to convey excess stormwater into underground reservoir caverns for storage. Water stored underground could then be circulated within the system to generate power. The study is ongoing and is scheduled for completion in 2018.

PUB has adopted a holistic stormwater management approach since 2012 to introduce flexibility and adaptability to the nation's drainage system. It went beyond implementing pathway solutions (e.g., drain capacity improvements, new diversion canals and centralized detention tanks) to work with developers to install source solutions (e.g., decentralized detention tanks and retention ponds) and receptor solutions (e.g., flood barriers, minimum platform and reclamation levels) in order to better manage stormwater runoff and protect developments from floods.

MITIGATING INCREASED RISKS FROM AGING WATER INFRASTRUCTURE

Recognizing that proper maintenance would be necessary as embankments could collapse and cause more severe flooding downstream, Melbourne, Australia, has started investing in retarding basin upgrades.

Utility provider Melbourne Water, which maintains these retarding basins, views them as essential features of the city's drainage system that help to reduce flooding. They are designed to catch heavy rainfall and hold it in the basin, a reserved low-lying area of land. The basins are critical in built-up areas because pavement, driveways and other hard surfaces restrict infiltration and create more stormwater runoff.

ENHANCING THE VALUE OF DRAINAGE ASSETS

Regional governments are optimising their physical infrastructure to enhance cost benefits while achieving multi-benefit outcomes.

In Melbourne, retarding basins not only help manage stormwater but also serve the community as recreational areas.

Singapore launched the Active, Beautiful, Clean Waters Programme (ABC Waters) in 2006 to enhance its water infrastructure. The aim of the program is to integrate its pervasive network of waterways and waterbodies with the surrounding environment to enhance the recreational aspects of streams, rivers and lakes for the community to enjoy so that they, in turn, help keep the waters clean.

For the HVUSSS project in Hong Kong, DSD plans to include the reprovisioning of sports pitches with a state-of-the-art turfing surface as well as developing other community amenities aimed to enhance quality of living.

The trends in Asia clearly point to a stormwater management opportunity leveraging integrated water resources management as a key driver for institutional reform.

OPTIMIZING STORMWATER REUSE

In the HVUSSS project, the storage system facilitates collection of a considerable amount of runoff, irrigation water and groundwater via the sub-soil drainage system. This water is reused, aligning with the overall water management strategy of Hong Kong.

In Australia, utility provider South East Water is collaborating with a property developer to create Aquarevo, a residential development in Melbourne where homes will feature a range of water-saving features. Aquarevo homes will be supplied with three types of water: drinking, recycled and rainwater. According to South East Water, each water type has been specifically chosen to reduce reliance on drinking water. The homes will include a high-tech rain-to-hot water system for bathing and showering that includes screening, filtering, treatment and temperature sensing devices. The system connects to a pressure sewer system that pumps wastewater to a local water recycling plant, treats the water to the appropriate standard and sends it back to each home for use in the garden, toilet or washing machine.

In China, the State Council issued a guideline in October 2015 on building "sponge cities," which would enable buildings, streets and wetlands in cities to absorb, store and release rainwater to better serve the country's urban development. Under this guideline, cities in China will collect and use 70 percent of rainwater, with 20 percent of urban areas meeting the target by 2020. The proportion will increase to 80 percent by 2030.

"The aim of constructing such cities is to flexibly control the rainwater, address waterlogging in cities, thus achieving a city development mode during which the rainwater can be naturally stored, permeated and purified," a State Council water leader explained.

MOVING FORWARD

The trends in the Asia Pacific region clearly point to a stormwater management opportunity leveraging integrated water resources as a key driver for institutional reform. These efforts serve to manage water resources in a cooperative manner that encourages sustainability. By better coordination of land and water use, surface water and groundwater, water quantity and quality, upstream and downstream use, and freshwater and coastal waters, water leaders in this region can acknowledge the interconnections between each factor in planning for use of alternative sources of water.

The Next Frontier:
VALUING STORMWATER AS A SERVICE

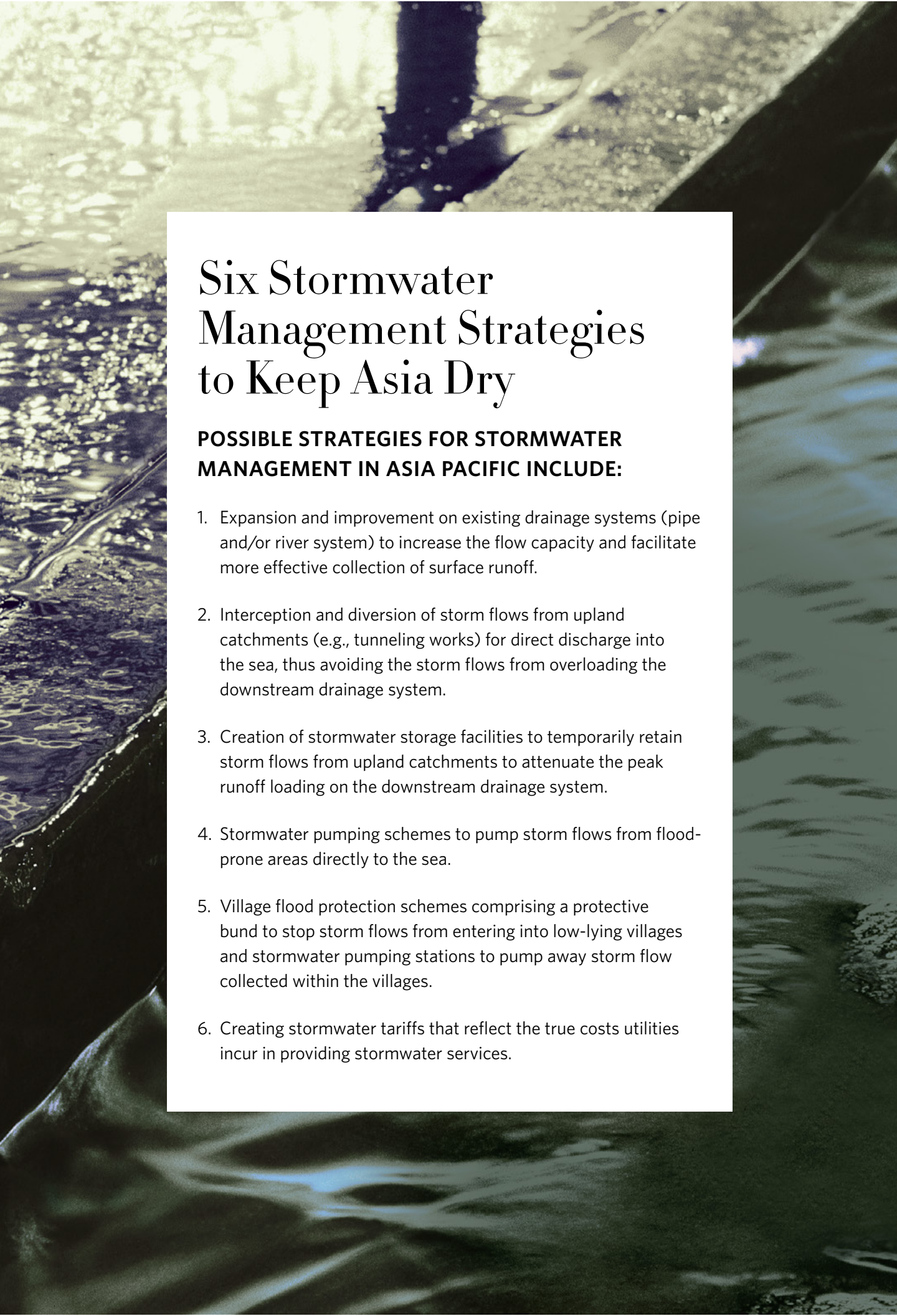
Distinct stormwater service tariffs in the Asia Pacific region would help to fund and prioritize stormwater infrastructure and management strategies. Key factors that would facilitate the success of integrated stormwater management strategies include the following:

Public Awareness: Stormwater services are as critical as water and sewer utility services in ensuring public health, safety and quality of life. Therefore, for sustainable and resilient stormwater management, it is critical to enhance public awareness of (i) the value of stormwater management, (ii) the need for dedicated funding and (iii) effective approaches to equitable cost recovery.

Sustainable Stormwater Funding: A user-fee funded stormwater program has a greater potential to build fiscal and operational resilience through revenue stability, a dedicated funding stream and a stronger nexus between stormwater management costs and user fees.

Equity of Cost Recovery: Stormwater user fees are typically based on the impervious area, which directly correlates to the demand a property places on the stormwater system. However, taxes are often based on aspects such as a property's value or the level of sales, which have no direct correlation to the stormwater contributed to the system. According to **Black & Veatch's 2016 Stormwater Utility Survey**, a more equitable cost recovery can be achieved when utilities strive to recover their full cost of stormwater service through stormwater user fees rather than recover costs through a combination of "user fees," and other "non-user fees" such as taxes. When the fee reflects the full cost of a service, customers can better understand the true costs a utility incurs in providing that service.

On-Site Stormwater Management: Establishing a stormwater credits and incentives program in conjunction with a dedicated stormwater user fee will give utilities the ability to encourage and incentivise decentralised private stormwater management practices that reduce the stormwater contribution to the public system.



Six Stormwater Management Strategies to Keep Asia Dry

POSSIBLE STRATEGIES FOR STORMWATER MANAGEMENT IN ASIA PACIFIC INCLUDE:

1. Expansion and improvement on existing drainage systems (pipe and/or river system) to increase the flow capacity and facilitate more effective collection of surface runoff.

2. Interception and diversion of storm flows from upland catchments (e.g., tunneling works) for direct discharge into the sea, thus avoiding the storm flows from overloading the downstream drainage system.

3. Creation of stormwater storage facilities to temporarily retain storm flows from upland catchments to attenuate the peak runoff loading on the downstream drainage system.

4. Stormwater pumping schemes to pump storm flows from flood-prone areas directly to the sea.

5. Village flood protection schemes comprising a protective bund to stop storm flows from entering into low-lying villages and stormwater pumping stations to pump away storm flow collected within the villages.

6. Creating stormwater tariffs that reflect the true costs utilities incur in providing stormwater services.

Data Driving the Modern Utility

ELEVATING WATER SERVICES AND ACHIEVING COMPLIANCE THROUGH INTEGRATED PLANNING

By Jim Schlaman

Integrated planning has been something of a buzzword over the last five years. Growing adoption shows that it's slowly being cemented not only in the industry's lexicon but also in its approach to watershed management.

It's not news that across the United States, water service providers have struggled to fulfill Clean Water Act (CWA) mandates related to wastewater and stormwater obligations. Vulnerable to a host of well-known challenges—aging infrastructure, growing populations, increasingly complex water quality issues, limited resources and other economic stressors—utilities, agencies and municipalities end up tackling issues individually, without an overarching plan.

To address these challenges, the Environmental Protection Agency (EPA) has encouraged the use of integrated planning—a comprehensive form of planning that considers all aspects of the water management cycle. In 2012, the agency released its *Integrated Municipal Stormwater and Wastewater Planning Approach Framework* to assist municipalities in this effort.

Ultimately, the goal of integrated planning is to establish long-term, sustainable solutions that improve water quality, ensure water resource protection, and support community needs and vitality. The *2017 Strategic Directions: Water Industry Report* shows that while early adopters are making progress with implementing an "Integrated Planning Approach," opportunity exists to implement this approach on a larger scale, across the board.

CURRENT STATE: EARLY ADOPTION AND GROWING AWARENESS

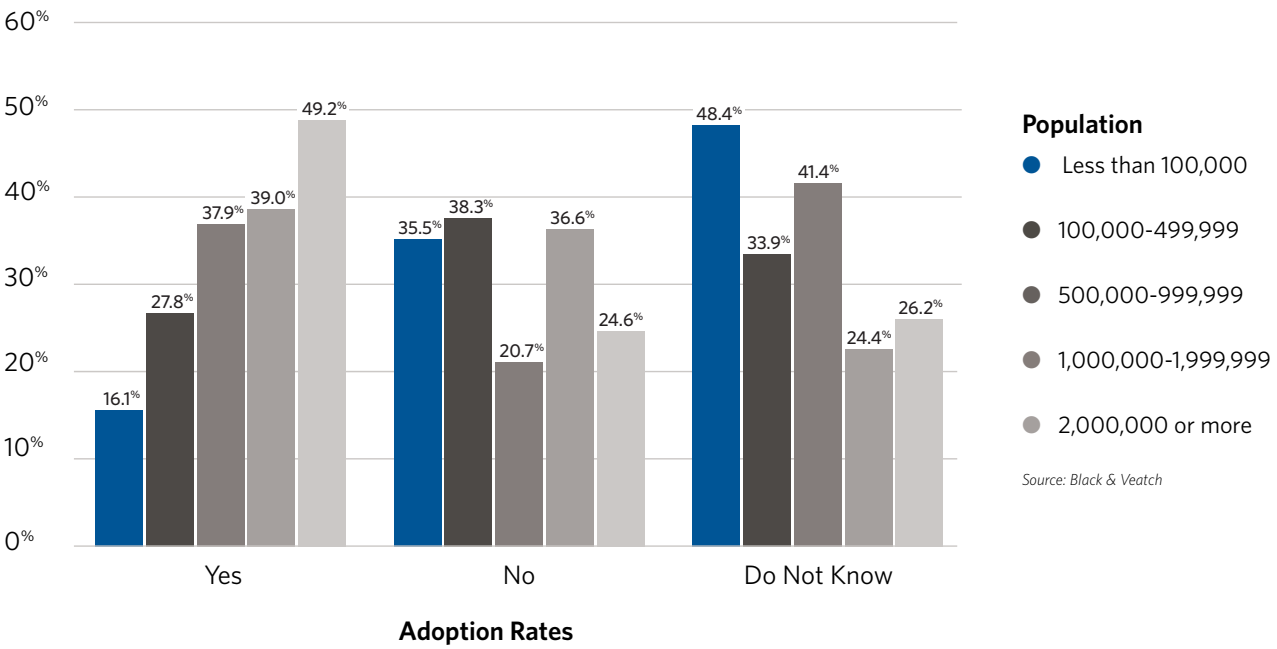
The past five years have shown solid growth among early adopters, with approximately one-third (32 percent) of utilities and/or agencies relying on integrated planning to develop holistic stormwater/wastewater capital improvement strategies.

However, there is room for growth, as 33 percent do not rely on integrated planning, and 35 percent "do not know what the Integrated Planning Approach is." Diving deeper, the survey found that integrated planning trends higher among larger communities; the larger the population, the greater the rate of adoption. Of the respondents who already use the approach, 49 percent are from communities of 2 million people or more, and the acceptance rate drops as the community shrinks in size (Figure 9).

The ratio of adoption to size is unsurprising and is indicative of larger entities' need to obtain compliance among multiple jurisdictions and across political boundaries. Conversely, smaller communities tend to be less complicated and, thus, less likely to need integrated planning. However, that is not to say that service populations of all sizes could not benefit from the approach.

FIGURE 9

Does your utility/agency use the Integrated Planning Approach to develop holistic stormwater/wastewater capital improvement strategies to achieve permit compliance and best value solutions? (Select one choice)



Source: Black & Veatch

Encouraging communities of all sizes to adopt integrated planning would benefit the industry as a whole, and the effort is not without its champions.

For example, Sanitation District No. 1 of Northern Kentucky implemented an integrated plan that balances water quality compliance between its combined sewer overflow, sanitary sewer overflow and stormwater programs. This Integrated Planning Approach has been accepted by EPA Region 4 and is currently being implemented and adapted in a manner that prioritizes the best value solutions first. Springfield, Missouri, is another community that has taken advantage of this framework by adjusting its strategy to manage ongoing sanitary sewer overflow, stormwater and total maximum daily load compliance programs. More information about current integrated planning efforts can be found on the EPA website: https://www.epa.gov/npdes/integrated-planning-municipal-stormwater-and-wastewater.

Encouraging communities of all sizes to adopt integrated planning would benefit the industry as a whole, and the effort is not without its champions. Numerous communities around the country are pushing integrated planning language, and the U.S. Conference of Mayors recently included it in Section 7203 of the Water Resources Development Act of 2016. To further educate water stewards, industry trade groups are working collaboratively with the private sector, EPA headquarters and regions, and state environmental agencies on a series of learning opportunities. For example, the Water Environment Federation will host an Integrated Planning Workshop at its annual conference in September, as well as a series of regional workshops to educate attendees on the localized benefits of integrated planning.

ADDING THE SMART ELEMENT: TURNING TO TECHNOLOGY

While beneficial in their own right, integrated planning frameworks that include smart technology can be even more effective at supporting sustainable, energy-efficient and resilient water infrastructure. Modern life is driven by technology; today, the world relies on 50 billion connected devices, and by 2020, that number will be 200 billion. At this point, the question is not "if" the industry will implement technology, it's "when."

According to survey data, the majority of the industry identifies innovation and best practices, and better management of assets and resources, as the top areas that would help them overcome the barriers to integrated planning. While these selections trended high across all types of utilities, they were weighted most heavily among stormwater, electricity and drinking water service providers.

This trend is supported by what appears to be a deepening interest in implementing asset management and real-time control/ big data analytics technologies – two halves of a whole solution that would allow utilities to manage their systems better, at lower cost. Fifty-five percent of survey respondents prioritized asset management as an area of interest moving forward, while 33 percent would like to implement real-time control and big data system analytics (Figure 10). Asset management, through the use of data analytics platforms, can put system information in the industry's hands, enabling it to more efficiently manage and control even the most complicated, geographically diverse systems.

Although the industry faces a host of challenges, integrated planning is an effective way to address the increasingly complex issues facing the water industry today. If leveraged correctly, this strategy can achieve more effective results, better balance stakeholders' varying priorities, allow asset management to be considered in community affordability calculations, lower costs and drive water quality compliance. Eliminating the silo effect and developing more holistic and cost-effective watershed management strategies is a win-win for all stakeholders.

FIGURE 10

How interested are you in implementing the following Integrated Planning Techniques and Technologies moving forward? (Select all that apply)

Source: Black & Veatch

Data Driving the Modern Utility

INTELLIGENT METERING ENABLES SMARTER UTILITY MANAGEMENT

By Jeff Buxton and Andrew Chastain-Howley

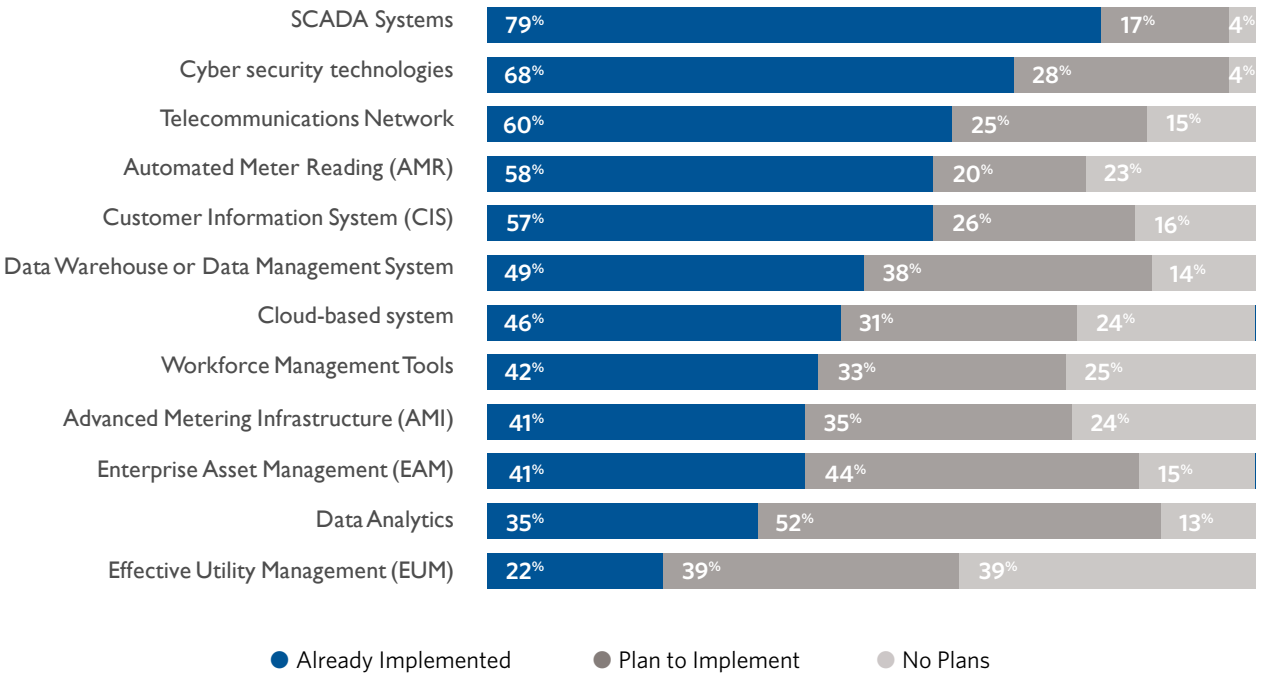
Among the most notable findings from this year's *Strategic Directions: Water Industry Report* is the velocity of planning throughout the industry for implementing more advanced operational technologies, such as advanced metering infrastructure (AMI) and enterprise asset management. More than 30 percent of utilities have indicated plans to implement each of the aforementioned technologies, indicating the industry's evolution and response to perennial issues of tightening budgets, rising costs and providing enhanced customer service (Figure 11).

Decades ago, many water utilities began adopting automated meter reading (AMR) technology to reduce the cost of meter reading and improve the meter-to-cash business process. The benefits of the technology are proven and well-documented. Now, as survey results show, approximately three-quarters of utilities have or are planning to implement advanced metering infrastructure.

AMI is not the next step in improving the meter-to-cash functionality; it is the foundational technology for the next generation of water utility management. For utility leaders

FIGURE 11

What information and/or operational technologies has your organization implemented or planning to implement?



Source: Black & Veatch

considering a move from manual reading to AMI, improvements in the meter-to-cash process will be substantial. However, utilities that have already successfully implemented AMR, justifying the investment in AMI will require a business case based on total, smart water management capabilities and enhanced customer benefits.

AMI meter reading provides more than just streamlined billing operations (Figure 12). The data generated from AMI can be used in virtually all business and operational functions. Beyond simple meter reading, AMI enables a network of metering, control valves, pressure monitoring and other sensing devices to transmit valuable operational and customer data.

According to survey data, 74 percent of water utilities prioritize water consumption profiling as the intended use for AMI (Figure 13). Monthly meter reading and daily meter reading were ranked second and third, respectively, reflecting the core capabilities of AMI.

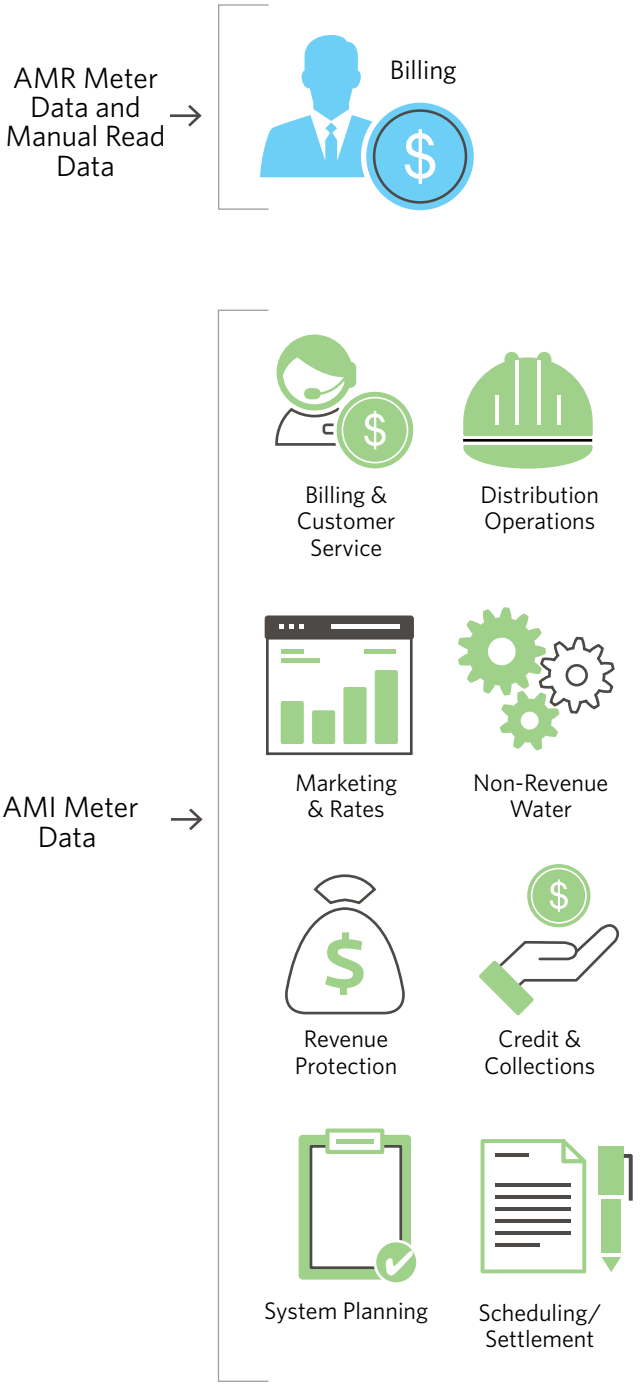
Though respondents ranked the four advanced remote technology capabilities (acoustic leak detection, shut-off valves, pressure sensors and water quality monitors) lower in priority, they still showed interest in these types of advanced devices that would directly improve distribution system insights and controls. The lower ranking could be due to the fact that these capabilities are dependent on getting an AMI system network in place first, or because they require additional devices that would incur additional cost.

PLOTTING A ROADMAP FOR TRANSITION

When approaching the transition to AMI, survey results show that 33 percent are considering a migratable transition from AMR to AMI, 33 percent are planning to implement a full proactive deployment of AMI, 18 percent are planning to implement AMR first, with a full AMI replacement

FIGURE 12

AMR Meter Data vs. AMI Meter Data



Source: Black & Veatch

in the distant future, and the remaining 16 percent plan to follow another path.

These investments can be substantial, and the technology is ever-evolving. Thus, no matter which path they choose, utility leaders need to develop a strategy and a roadmap that demonstrate full awareness of how their transition to automated and advanced systems will evolve and expand over time. To fully realize the benefits of AMR and AMI, the utility will need to have a framework in place that can not only capture and analyze the data but can also be trusted to determine the utility's path forward for a decade or more.

The strategy will need to cover a number of elements:

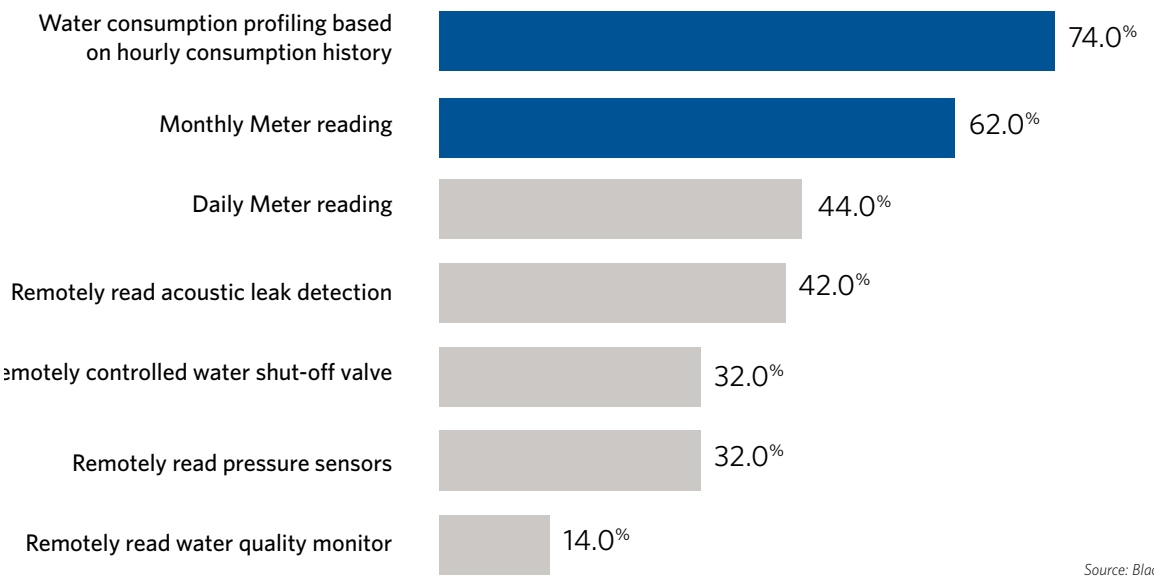
- Key drivers for automation and management perspective on smart water utility technologies
- Key opportunities for process improvements and automation, workforce efficiencies and system performance optimization
- Key opportunities for customer engagement and enhancement
- Capital planning scenarios
- Regulatory influences
- Organizational change receptivity and readiness

There is no shortage of proven technologies that support enhanced operational performance. To make the most of these technology investments, utility leaders should have a firm understanding and vision of their organizational goals and strategic objectives. Technology roadmaps enable utility leaders to map their desired objectives to the best enabling technologies, prioritize implementation and re-map business process to facilitate and engrain change throughout their organization.

AMR, AMI and operational technology investment has now transitioned from a one-time consideration to a continuous improvement paradigm. Water utilities are now facing the daunting challenge of recognizing the pace of technology advancements in smart water utility capabilities and forecasting the optimum integration of that technology into the future.

FIGURE 13

What is or will be your intended use for AMI capabilities? (Select all that apply)



Source: Black & Veatch

Data Driving the Modern Utility

DATA ANALYTICS: MORE THAN A MERE NUMBERS GAME FOR WATER PROVIDERS

By Jacques Brados and Andrew Chastain-Howley

Water providers have been collecting and utilizing data to perform important but traditional tasks: Supervisory control and data acquisition (SCADA) devices speed information across networks, and advanced metering infrastructure systems measure consumption and contribute to customer billing. But, as utilities wrestle with addressing aging foundational assets while balancing limited capital and rising calls for lower costs and safer water, there is new urgency to explore how data can drive and optimize asset performance and reduce risk.

A new generation of innovative analytics tools coupled with the development of smart integrated infrastructure offers plant operators and management a new opportunity to meet those needs and more easily transform raw data into actionable intelligence.

When capital is low, tense questions arise about where and how to apply these solutions in order to achieve the biggest return on investment. Despite organizational mandates for smarter operations, many water utilities still appear unclear about analytics-based decision-making. Nearly 40 percent of respondents to Black & Veatch's *2017 Strategic Directions: Water Industry Report* survey said data figured into their processes but not operationally; another 20 percent said data analytics weren't part of their current processes but is figured into their strategic planning.

39.0%

UTILITIES THAT SAID DATA FIGURED INTO THEIR PROCESSES, BUT NOT IN OPERATIONAL ACTIVITIES

Outside the fence (distribution and collection), data has a range of applications that can more quickly identify leaks, reduce water wasted, reduce sewer overflows and measure asset health. Inside, data can unlock dramatic operational efficiencies and inform new planning and investment strategies because information is not only collected but also conveniently visualized to help operators make smarter decisions.

Three examples from a recent case involving a southwestern U.S. treatment plant demonstrate how data play starring roles in improving the water treatment process, reducing energy costs and predicting asset failure.

EXAMPLE ONE: A WATER QUALITY MYSTERY

A series of high-turbidity events was adversely affecting operations in a 60-million-gallon-per-day plant. Plant operators could not correlate the events to flow rate, time of day, time of year or other obvious conditions. Black & Veatch engineers analyzed historical water quality data

from the plant's SCADA system, labs and other sources archived in the data infrastructure. Turbidity was observed and analyzed at different stages of the filtration process.

Operators injected chemicals into raw water entering the plant, which routes water through a sedimentation process before filtration. Operators measured turbidity at three points in the process: raw water upon plant entry, after chemical addition, and before filtration at the end of sedimentation.

Using analytics tools in a software tool called ASSET360®, engineers developed a simple solution to this complex problem: Operators and management at all levels could have access to a user-friendly dashboard that tracks the turbidity of raw versus applied water. Review of data in this fashion led to two important observations: (1) high-turbidity events occurred only when the turbidity of the applied water exceeded 1.5 nephelometric turbidity units (NTUs), and (2) these events occurred only when the turbidity of the applied water exceeded the turbidity of the raw water.

Under these conditions, water exiting the sedimentation process to the filters was dirtier than water entering the treatment plant. The dashboard alerts plant operators when the turbidity level of applied water rises too high, and it prompts operators to add additional chemicals when raw water turbidity becomes elevated. A data-centered solution has prevented further turbidity incidents.

EXAMPLE TWO: REDUCING ENERGY COSTS

The utility also pursued the most efficient way to supply water to a district metered area. The area's 4,000 residents receive water from a reservoir with a pump station and a well site.

The water utility sought the most energy-efficient method of supplying water via its two water sources. Engineers observed flow rates exiting the SCADA system and reviewed the electric bill rate and efficiency curves from the pump's design documents. They noted that during a one-month period, the well site cost approximately $53 per million gallons, and the pump station on the reservoir cost approximately $54 per million gallons.

The sources appeared to have similar costs, but engineers then reviewed the cost of a million gallons of water produced in relation to the energy expended. The well site used 31 kilowatts per hour (kW/h), while the pump station consumed 23 kW/h. The energy expenditures indicated that the well site generated 1.1 million gallons per megawatt (MW) while the pump station generated 1.4 million gallons per MW. The pump station was significantly more energy-efficient than the well site; however, that advantage was not reflected in the cost.

Engineers then discovered that the well site operated on a highly advantageous seasonal billing rate, while the pump station billing accrued at a time-of-use rate. In this case, simply changing the rate structure for the pump

station created an immediate savings. The utility reduced the electrical cost of the pumping station by 21 percent and, by doing so, reduced the overall district costs by 10 percent.

EXAMPLE THREE: PREDICTING ASSET FAILURE

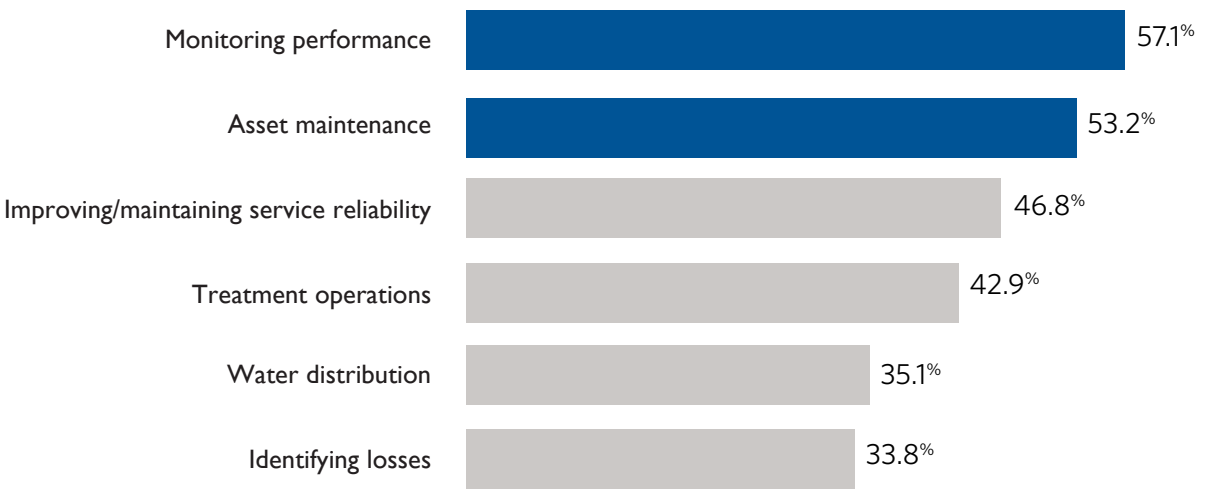
Asset performance and management are significant issues for utilities. Survey responses showed that even if adoption of data programs lags, there is wide agreement that data analytics can improve performance, asset maintenance and service reliability (Figure 14).

At the utility, which operated a drinking water pumping station with three 250 horsepower (hp) pumps, operators noted an unusual trend: Over time, they needed to run all three pumps more often to meet flow requirements. Engineers collected data on pump speed, flow rate, pressure and supply reservoir level from the SCADA system and collected pump curve and system curve data from the station's design documents. Seven years of plotted data revealed nothing unusual.

When engineers placed the design curves on top of the SCADA data, however, they realized there was a minimum 2,000 gallon per hour (gal/h) recommended flow rate for each pump. The pumps spent a significant amount of time at the lower flow rates. The engineers pondered the effect of operating pumps at 70 percent or better speed at low flow rates. The

FIGURE 14

What operational areas do you feel that data analytics and automated monitoring will help improve most at your organization? (Select top three choices)



Source: Black & Veatch

Analytics can measure activity within systems—rather than merely estimating it—to help operators react quickly to emerging conditions.

answer was recirculation cavitation. Further inspection revealed impeller damage, and when engineers reviewed the raw data, they noticed that the pumping station's kWh/million gallon rate steadily increased over time, indicative of impeller wear.

Engineers created a dashboard and notification system that helps operators predict impeller wear. Now when the kWh/million gallon rate rises 5 percent higher than pump design specifications, the operators receive a warning. When the increase exceeds a 10 percent rise, the notification system issues another warning to operators and prompts them to begin impeller inspection. Such systems can now calculate impeller wear by dividing mechanical energy by electrical energy. That, in turn, allows the plant operators to plan ahead and schedule the optimal rebuild time into capital improvement program planning.

ANALYTICS IN ACTION

Evolving a program toward the use of predictive and prescriptive analytics will provide utility leaders with better information to support future action. Analytics can measure activity within systems—rather than merely estimating it—to help operators react quickly to emerging conditions. This approach moves providers from a reactive to a proactive business mentality, while helping managers develop new opportunities for cost control and improving risk management.

Data Driving the Modern Utility

BIG CHANGES IN ASSET MANAGEMENT DON'T REQUIRE LUMP-SUM SPENDING

By Jim Nightingale and David Price

Many water leaders face a conundrum – they know massive system investments are needed, but have a steep hill to climb to gain necessary approvals and rate recovery for such investments. Stand-alone, multimillion dollar technology programs often take a back seat to repairing and replacing aging distribution system assets. However, it is possible to economically replace aging assets and implement greater levels of intelligence and security across systems – utilities just have to take a comprehensive, rather than piecemeal, approach.

Combining technology, security, and repair and replacement plans enables utility leaders to make incremental changes by overlaying data collection technology and security updates on already planned infrastructure investments. In the years ahead, it will be even more important to add design intelligence into assets, rather than limiting the industry by replacing like with like.

THE ROLE OF ASSET MANAGEMENT

Asset management is the alignment of people, processes and technology to improve operations and create cost efficiencies, enhance service levels and extend asset life. This year's *Strategic Directions: Water Industry Report,* data show that more and more, utility leaders are considering a formal asset management program to take on this challenge, providing the perfect opportunity to implement quality processes at the ground level.

Asset management programs boil down to using data to inform investment decisions on the basis of risk, or the likelihood and impact of potential asset failure. As noted in this report's *Data Analytics: More Than a Mere Numbers Game for Water Providers* section, most utility leaders believe data analytics and automated monitoring will help improve performance and asset management. However, data is only useful if it provides the right information to the right people to inform the right decisions.

For example, 75 percent of utilities currently have remote data collection at all pumping stations. However, if the data collected are not being actively used to monitor current operations and identify trends, pumping operations cannot be optimized in a quantifiable manner.

78.2%

UTILITY RESPONDENTS THAT ARE CONSIDERING USING ASSET MANAGEMENT TO CREATE EFFICIENCIES

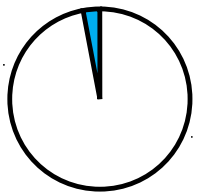
FIGURE 15

Challenges with Capturing, Processing and Using Data

QUANTITY OF DATA

Utilities generate massive amounts of data, but only use a fraction of it

1

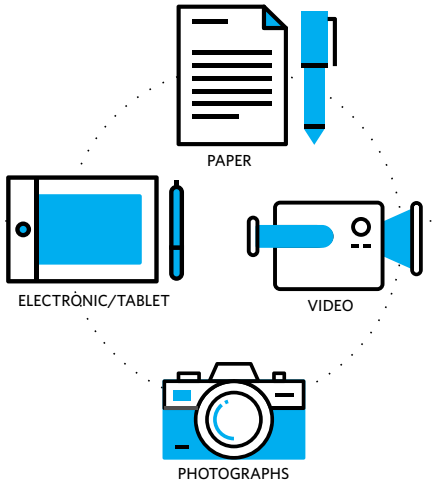


There is a lack of business and technology functionality to interpret, organize, process and secure new data

CAPTURING ALL DATA

Data capture varies from staff to vendors

2



Different people doing similar work capture data through different means

INCONSISTENCIES

Inconsistencies in how data is captured and stored result in incomplete asset data, or gaps in asset knowledge

3

Inhibits utility leaders' ability to prioritize and justify investments and efficiently manage work

Source: Black & Veatch

PUTTING YOUR DATA TO WORK

Every utility, regardless of technologies used, generates tremendous amounts of data. The challenges are in creating the functionality to use existing data and consistently capture and store data to identify and remediate data gaps (Figure 15).

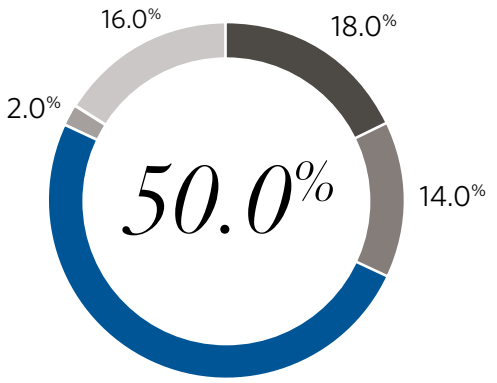
Data management processes and procedures are critical to managing the proverbial "data tsunami," the intensity of which increases exponentially with each new source of data. However, sometimes quality is much more important than quantity. Insufficient or poor data can create issues when utility leaders look to maximize the business value from their asset fleet, often leaving basic questions unanswered, such as the following:

- What is the configuration of the system?
- What are the critical assets?
- How old are the assets?
- What is the condition of the assets?
- How are budgets for these assets best spent?

Capturing data consistently among stakeholders who do similar work (e.g., utilities field operations and vendors) is a common challenge. Half of utilities indicated they currently have or are planning to implement a web-based maintenance management software system that is accessible in the field with integration to other platforms, such as a geographic information system (GIS) (Figure 16). The challenges with such systems are who uses them and who has access to submit and/or access data. Often vendors conducting fieldwork do not have access to the tools that input into the maintenance management system, forcing them to capture and file photos and notes manually and haphazardly.

FIGURE 16

What workforce management tools does your organization currently or plan to employ?



- Server or Workstation based Maintenance Management Software (not available in the field)
- Web-based Maintenance Management Software system accessible in the field
- Web-based Maintenance Management Software system accessible in the field with integration to other platforms (such as GIS)
- Other
- Don't know

Source: Black & Veatch

In the years ahead, it will be even more important to add design intelligence into assets, rather than limiting the industry by replacing like with like.

The good news is that this asset data dilemma is a manageable problem. Four key steps are needed to fix the issue:

1. Identify Critical Asset Data

Because asset management is most effective when it is targeted, the first step is to identify the critical assets, then define and prioritize the data needed to track that equipment. Utilities can even be a bit aspirational at this stage. For example, a utility could create an "asset health index" that, rather than simply using age as a proxy for health, looks at inspections, repairs, parts replacements and maintenance at timed intervals to paint a comprehensive picture.

2. Understand the Gaps

It is important to know where the gaps are, and a utility's Information Technology (IT) department can be a key player in designing asset management solutions and filling the gaps. For example, if a utility wants to know about data volume, its IT department can suggest methods to gain good input and consistency across multiple data systems. Capital improvement plans offer opportunity to close gaps quickly; if data are missing from a key asset class, utilities can implement data collection as they repair and replace these assets at incremental cost.

3. Fix the Data

Now is the time to deep dive into the data and systems, since this will inform the process later when it is expanded to include additional assets. This may include cleaning up the data, ensuring consistency across the various databases and putting in place key algorithms for analysis. At this stage, the utility is still focusing on satisfying urgent needs first.

4. Fix the Process and Change the Work Culture

A key part of asset data quality is inculcating a "culture of respect for data" in the workforce; this requires explanation, repetition and ongoing monitoring of the process and its outputs. Field staff will be integral to this effort – to encourage the return of good information, management should seek field staff buy-in and understanding.

Once utility leaders have been through this process for critical equipment and critical data, they're ready to think about organization-wide systems and IT applications, from a solid knowledge base.

Data Driving the Modern Utility

TECHNOLOGY CREATES NEW EFFICIENCIES, BUT ARE WATER UTILITIES PREPARED FOR THE SECURITY RISK?

By David Mayers and Jacques Brados

Yahoo!, the Democratic National Convention and the U.S. Department of Justice were among the high-profile victims hit by major cyber attacks in 2016. Many people believe it's only a matter of time before a water utility joins the list. Some consider physical security to be the weak link in ensuring a well-protected water supply; while others worry that the Internet of Things has created an incalculable number of entry points for hackers to create mischief.

The water industry is challenged with near crisis-level aging infrastructure in many parts of the nation, inconsistent revenue, rising costs, justifying rate increases, achieving threat resilience, information technology adding new Information Technology (IT) infrastructure improvements and an aging workforce. Risk and vulnerability assessments can guide resources to the highest priorities.

INVESTING IN SECURITY

Digitalization—through high-tech local systems or cloud-based analytics—is helping an increasing numbers of utilities monitor more valves, pumps and breakers and interact with their customers in more ways than ever. These advances promise new efficiencies, but they also offer more potential vectors for hackers that can lead to disabling critical infrastructure or releasing personal information.

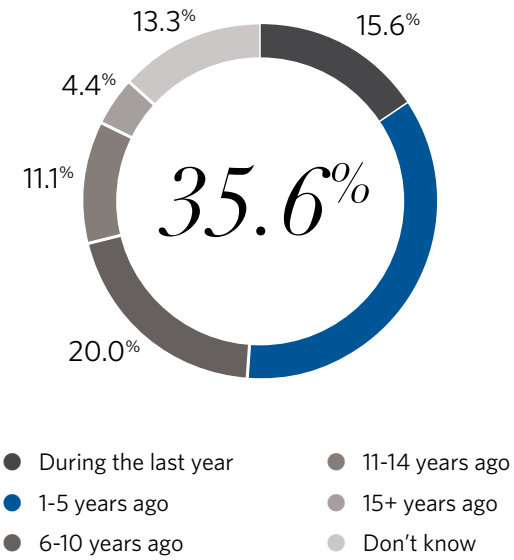
Such threats haven't appeared to induce broader investments in systems or applications to lock down these key assets. The *2017 Strategic Directions: Water Industry Report* reveals that 57 percent of respondents are spending less than $1 million annually on physical security for water treatment plants and large remote facilities. Another 59 percent reported they're earmarking less than $1 million per year on cybersecurity for IT. More than a third of survey respondents are spending up to $5 million a year to shore up their security efforts in these two critical areas.

Survey responses, however, provide reasons for cautious optimism that risk and vulnerability assessments are being funded and completed. More than 50 percent of water utility survey respondents indicated they have completed a risk or vulnerability assessment in the past five years (Figure 17). Still, more needs to be done because the industry as a whole appears to be underinvesting in, and undervaluing, security.

Water utilities have a number of funding instruments available to them to allow for increased spending to boost security on their systems and to ensure a reliable supply, free of physical and hacking threats. These include public-private partnerships, municipal bonds, grants, government funding and rate increases. However, rate cases are often a tough sell because of the public's generally low valuation of water and utilities' challenges in effectively communicating the benefits of paying a few extra dollars each month.

FIGURE 17

How long has it been since your organization has completed a Vulnerability Assessment?



Source: Black & Veatch

TECHNOLOGY IMPACTS

The increased use of technology by water utilities, although certainly necessary and beneficial for both water providers and consumers, introduces new physical and cybersecurity concerns. How water utilities can best protect water supplies while mitigating security risks—such as the exposure of sensitive customer financial information—has become a critical issue.

One important technology impact is the convergence and connection of IT and operational technology (OT) control systems. The intersection of IT and OT creates operational efficiencies but also presents added security vulnerabilities. To help reduce the risks associated with the connection of IT/OT systems, water organizations must ensure that only qualified and well-trained staff with extensive security experience and knowledge are given physical and cybersecurity responsibilities.

According to survey results, 43 percent of water utility security positions are assigned to a dedicated staff member for supervisory control and data acquisition (SCADA) systems, cybersecurity for IT, physical security for water treatment plants and large remote facilities, and physical security for water administration buildings. These findings are worrisome because it means that, in most cases, critical security responsibilities are only part of a utility staff position.

THE VALUE OF SIMULATED THREATS

Water and municipal leaders are facing increasing unease about the level of security in their water delivery and IT/OT systems but appear, at times, to be doing the bare minimum. That raises vital questions of why that is and what's the best way forward to addressing security in the water industry. Having a solid framework of security policies and procedures is essential.

The National Institute of Standards and Technology (NIST) is the measurement standard agency of the federal government and is versatile enough to address any industry. There are nearly 200 publications available for cybersecurity. A good place to start is the NIST Cybersecurity Framework, which provides a common language for individuals at all levels in an organization to discuss security. NIST Special Publication 800-53, "Security and Privacy Controls for Federal Information Systems and Organizations," covers the IT side in detail. NIST Special Publication 800-82, "Guide to Industrial Control Systems (ICS) Security," covers the OT side. Many other publications can help guide the water industry.

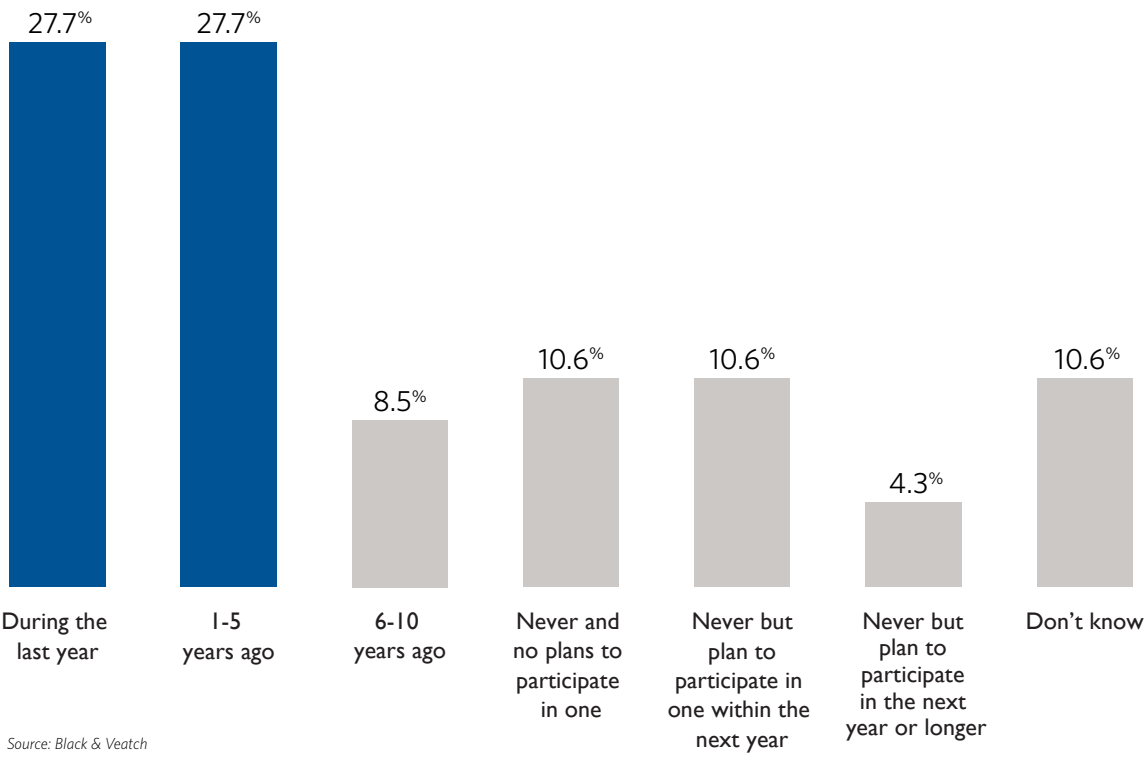
Once risk is determined, a plan is developed and steps are taken toward improving physical and cybersecurity. Water organizations should simulate an attack and, at a minimum, practice their response on a yearly basis. Somewhat surprisingly, only 27 percent of survey respondents had conducted an environmental, physical or cybersecurity attack simulation during the last year, and 69 percent of those were tabletop exercises (Figure 18).

Even more concerning, only 12 percent of respondents indicated they would not focus on cybersecurity until it is mandated by the Environmental Protection Agency (EPA) or until a large or neighboring utility is impacted.

These data suggest that water providers, both large and small, should strongly contemplate taking more proactive measures to meet their physical and cybersecurity goals and to better protect their communities' water supply. The stakes are high.

FIGURE 18

When was the last time that you participated in an exercise that simulated an environmental, cyber or physical attack?



Source: Black & Veatch

Closing Commentary

WHAT CAN DATA DO FOR OUR WORLD'S MOST PRECIOUS RESOURCE?

By Mike Orth

Data is proving to be a revolutionary force across many segments of the world's infrastructure, raising the game for energy, construction and telecommunications. It's time we turned the power of data onto our world's most important commodity: water.

Water and wastewater systems are increasingly outfitted with data-producing instruments, but that information is too often siloed, or buried and out of sight like much of the infrastructure itself. What if water industry leaders actively embraced not just collecting data from their assets, but uniting the data with information from adjacent yet dependent systems? What if we enabled operators to rapidly process intelligent sensor data at the device level and take immediate action if warranted?

Evidence is growing that data analytics can help address many of the sustainability challenges facing our water supply. While in recent years the industry has taken steps toward the development of tools to harness data—both inside and outside the plant fence—the *2017 Strategic Directions: Water Industry Report* suggests far too many providers are sitting out data's impact on their systems. New software-based management tools enable us to turn all that

data into understandable, useful insights that can address everything from water safety, asset performance and leak detection, to integrated planning and energy reduction.

SELLING TO SKEPTICAL CUSTOMERS

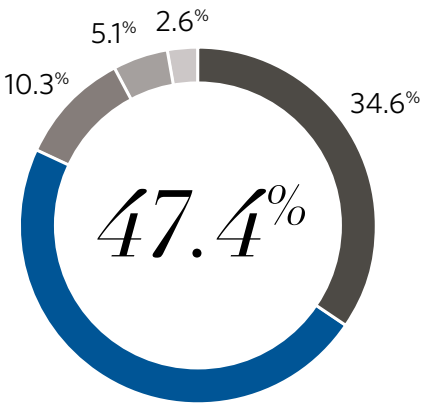
It is widely accepted that water providers are caught in a tight spot – customers demand safety and efficiency, modern distribution systems and reliability at the tap. But nearly half of report survey respondents said customers acknowledge utilities have financing challenges needs yet want them to do more with less (Figure 19).

It is a formidable dilemma whose solution carries some cost at a time when utilities lack the capital to maintain existing assets, let alone next-generation technology. Providers are fighting a long and often uphill battle over the public's perception of the true cost of delivering a sustainable and reliable water supply. Rate cases are met with enormous scrutiny and frequently become political. Necessary discussions about water's real value—plus the tools to make it safe and resilient—are frequently lost in the scrum.

In some cases, the question of cost is joined by concern over the perceived encroachment of automation technology. Some utilities are unwilling to embrace cloud computing — where analytics can really flex its muscle by quickly collating, processing and presenting massive amounts of data — because of security concerns. Managers may also fear that data analytics and other automation technology could ultimately reduce the labor force and at least partly remove human intuitive decision-making from the operational equation.

FIGURE 19

How would you rate the level of understanding about the value of water and proposed rate increases?



- They understand the "need" and accept that increases are necessary
- They understand the "need," but still want us to cut costs (do more with less)
- They don't understand but accept that increases are a part of life
- They protest every increase regardless of the need
- Other

Source: Black & Veatch

Next-generation dashboards, such as those utilized by Black & Veatch's ASSET360® system, overcome silos by capturing, uniting, analyzing and displaying these data in ways that demystify our systems and help us assess and plan.

Data has been with us for a long time. Since being introduced decades ago, supervisory control and data acquisition (SCADA) devices have gathered valuable information and insights, providing a way to measure such things as flow statistics or dissolved oxygen. Other data tools, such as laboratory information management systems (LIMS) and computerized maintenance management systems (CMMS), have proven worthy complements.

Unfortunately, far too much data remains captive within bucketed systems that don't communicate. Next-generation dashboards, such as those utilized by Black & Veatch's ASSET360® system, overcome silos by capturing, uniting, analyzing and displaying these data in ways that demystify our systems and help us assess and plan.

For instance, we know that data has a direct connection to equipment runtime. Many years ago, a pump simply indicated whether it was on or off. Now we can know its speed, efficiency, vibration, temperature and more. These data are collected across systems and dashboarded for easy, one-stop access by operators and managers. The pump's operation can be optimized, and operators can manage it better by doing the right amount of maintenance at the right time.

MAKING THE BUSINESS CASE FOR ANALYTICS

The business case for data analytics is strong. Long-term payoffs are tied to the ways data communicates consumption or asset life, offering clues that aid the utility's planning process. Data can give us deep looks into our physical assets, allowing operators to, for instance, optimize pressure to avoid pipe leaks or bursts. This year's survey has revealed growing interest in using data technology as part of the integrated planning process, with more than half of survey respondents prioritizing asset management as an area of interest moving forward. About a third of respondents said they would want to incorporate data into their strategies.

These insights are changing the age-old question of "Can I really afford it?" to "Can I really afford not to have it?" The business case for data collection overlaid by smart and easily accessible software has given water providers a tremendous opportunity. They can learn more about the health of their systems, the habits of their customers and what that information says about planning for the future.

This is one chance the industry can't afford to pass up.

The Black & Veatch Analysis Team

EXECUTIVE SUMMARY

Cindy Wallis-Lage is President of Black & Veatch's water business, leading the company's efforts to address billions of dollars in water infrastructure needs around the world. Wallis-Lage joined the company in 1986 and has provided technical and management leadership expertise to more than 100 projects around the globe. Wallis-Lage joined the Black & Veatch Board of Directors in 2012 and is currently on the Board of Directors for the WateReuse Association and for the U.S. Water Alliance. She is based in Kansas City, Missouri.

CUSTOMER ENGAGEMENT

Ann Bui is Managing Director for water services in Black & Veatch management consulting. She has over 25 years of experience working with utilities on more than 250 engagements and has provided financial and business services across the United States for public and investor-owned utilities of various sizes, ranging from those with only 5,000 service connections to those that serve populations over 3 million. Bui is based in Los Angeles, California.

Ralph Eberts is Executive Vice President for Black & Veatch management consulting. Eberts and his team provide strategic, financial and technological services to the water industry. He is based in San Francisco, California.

Bob Hulsey is Associate Vice President and a Global Practice and Technology Leader for Black & Veatch's water business. He leads a group of process engineers dealing with advanced treatment technologies, such as oxidation and removal of microcontaminants, taste and odor control, membrane and biological filtration, ozone/ultraviolet/chlorine dioxide disinfection, distribution system water quality and desalination. Based in Kansas City, Missouri, Hulsey also works with major technology providers on bid and contracting best practices.

Jeff Neemann, P.E. is a Client Director for Black & Veatch. His expertise is in the development and application of advanced water process technologies with experience in evaluation, pilot testing, design, and operation of UV, ozone, chlorine dioxide, granular activated carbon, and membrane technologies. He received his B.S. in Civil Engineering and his M.S. in Environmental Engineering from Missouri University of Science and Technology and his Doctorate of Engineering from the University of Kansas. He is a licensed engineer in the state of Kansas and a member of IUVA, IOA, IWA, WEF and AWWA.

Clint Robinson is Associate Vice President of Black & Veatch's Government Affairs team and works collaboratively with professionals within Black & Veatch's businesses, industry stakeholders, association partners and consultants to build relationships with government officials to achieve Black & Veatch's overall global growth strategies. Robinson has more than 32 years of experience as a registered professional engineer. He is currently engaged with the U.S. Conference of Mayors, the National League of Cities, the Edison Awards Steering Committee and the American Council of Engineering Companies as a business partner participating in discussions on sustainable, resilient smart city concepts.

SUSTAINABLE WATER SUPPLY

Bruce Allender is Chief Operating Officer of infraManagement Group LLC (iMG), a wholly owned subsidiary of Black & Veatch. He has more than 25 years of experience in the water and wastewater sector and has been part of teams

that have proposed and implemented public-private partnership schemes in North America, Australia and Asia Pacific for the water and wastewater municipal and industrial marketplace. He is based in Kansas City, Missouri.

James Currie is a Project Director of Black & Veatch in Australia. He has over 30 years of experience in planning, studies, design, construction supervision and project management of diverse multi-disciplinary water resources, water supply, water treatment, wastewater management, environmental and infrastructure projects in Australia, Singapore, South-East Asia and the U.K.

Prabha Kumar is a Director for Black & Veatch management consulting. She leads the water, wastewater, and stormwater utilities offering within the Advisory & Planning group. Kumar specializes in stormwater utility feasibility studies, utility development, and implementation and helping utilities with both internal stakeholder education and engagement and external public education and outreach.

Andy Kwok is Director of Black & Veatch Hong Kong Limited. He has 23 years of experience in civil engineering including planning, feasibility studies, design and contract administration of infrastructure projects for government and private sectors. His expertise encompasses hydrology, hydraulics and drainage works design. Kwok is also an accredited New Engineering Contract (NEC) Engineering and Construction Contract Project Manager.

Jonathan Loveland is the Global Practice Leader for Alternative Water Supply in Black & Veatch's water business. He is a subject matter specialist in water resources and water treatment and is responsible for coordinating Black & Veatch resources in the development and growth of projects in the recycled water and desalination markets. Loveland has 24 years of experience in advanced water quality and treatment including all phases of development and execution for seawater desalination, recycled water treatment, groundwater treatment, filtration and low- and high pressure membrane treatment projects.

Francesca McCann is a leader in the U.S. water industry with expertise in investments, public-private partnerships and project development. Before joining iMG, McCann served as CEO for Abengoa Water USA, where she successfully led the team to contracting the $3.4 billion Vista Ridge Project in San Antonio, Texas. McCann also founded a consulting company, Global Water Strategies, and started her water career in 2003, covering the water sector for Wall Street. She is based in Washington, D.C.

DATA DRIVING THE MODERN UTILITY

Jacques Brados is a Principal Consultant in Black & Veatch management consulting and is dedicated to providing tools, coaching and methods to enable clients to better manage physical and cybersecurity risks. He has focused the past 12 years on water and wastewater, industrial control systems and their support staff. In previous engagements, Brados spent five years managing an industrial control system in pharmaceutical manufacturing and eight years in nuclear power in the U.S. Navy.

Jeff Buxton is an Executive Consultant with Black & Veatch. He has more than 30 years of industry experience with particular expertise in strategic business planning, technology roadmapping, deployment and organization planning, and regulatory support.

Andrew Chastain-Howley is a Director at Black & Veatch who specializes in water-loss reduction and water-demand management. He is based in Fort Worth, Texas, and has 26 years of experience in the fields of water loss control and water conservation.

David Mayers is a Senior Managing Director at Black & Veatch and leads the Security, Risk & Resilience team. He has 27 years of management consulting experience, including 12 years in the banking industry and 15 years in the energy industry.

Jim Nightingale is a Director in Black & Veatch management consulting. He focuses on the energy and utilities industries, including water, electric, gas distribution, and the oil and gas industry both upstream and downstream. His background is in asset management, system implementation, organizational transformation and customer service in those industries. Nightingale manages complex projects requiring a combination of organizational and change skills and deep functional expertise.

David Price is Senior Managing Director for Asset Management in Black & Veatch management consulting. He has developed utility products and solutions currently in use by utilities in North America and Europe. Price has 30 years of experience in management, strategy, product development, consulting, delivery and operations in the utility and enterprise solutions markets. He is an expert in work and asset management, field operations, energy market operations, meter data management, and smart grid systems and processes.

Jim Schlaman is the Director of Water Resources for Black & Veatch, and serves on the One Water Council for the U.S. Water Alliance. Over the past 16 years, he's worked across the country on all types of water resources projects, including water supply and reuse/alternative water supply evaluations, integrated planning and water quality studies, and stormwater/flood control planning and design projects.

CLOSING COMMENTARY

Mike Orth is Executive Managing Director for the Americas in Black & Veatch's water business. Orth guides the company's growth efforts in supply, storage, treatment and conveyance by delivering projects for clients through both traditional methods and alternative solutions such as design-build, performance contracting and public-private partnerships. He currently serves on the Board of Directors for the American Water Works Association. He is based in Kansas City, Missouri.

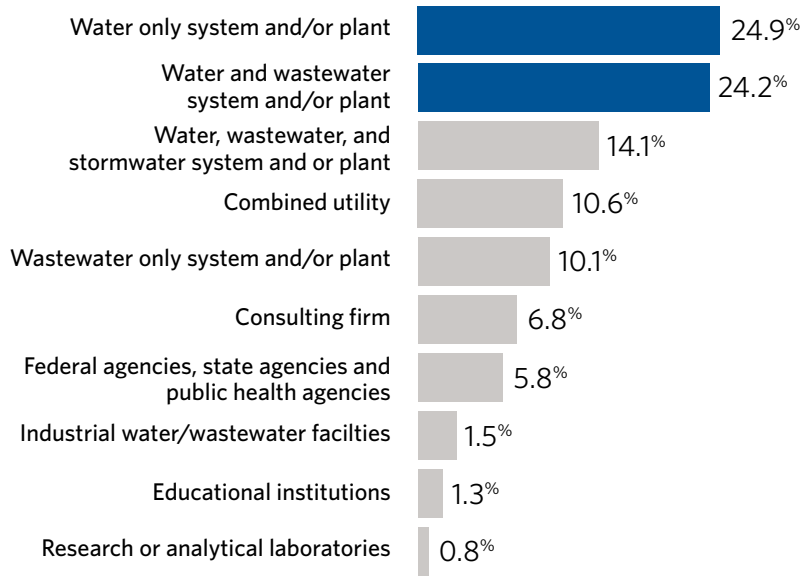
2017 Report Background

The Black & Veatch *2017 Strategic Directions: Water Industry Report* is a compilation of data and analysis from an industrywide survey. This year's survey was conducted online from 10 March 2017 through 29 March 2017.

A total of 397 qualified utility, municipal, commercial and community stakeholders completed a majority of the survey. Because the survey was administered online, the amount of self-selection bias is unknown; therefore, no estimates of sampling error have been calculated. The following figures provide additional details on the participants in this year's survey:

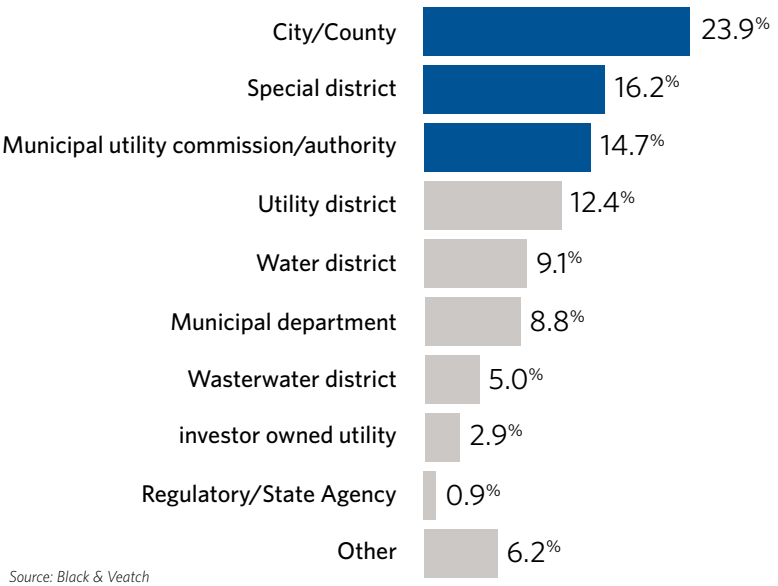
ORGANIZATION TYPE

Which of the following best describes your organization? (Select one)



Source: Black & Veatch

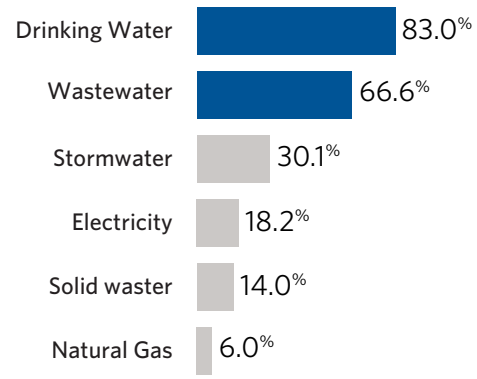
What category best describes your organization? (Select one)



Source: Black & Veatch

UTILITY SERVICES PROVIDED

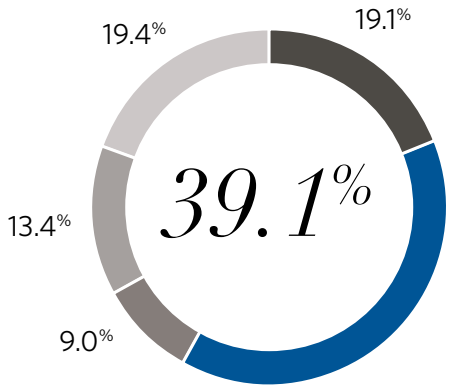
Please identify all the serices provided by your utility (Select all that apply)



Source: Black & Veatch

POPULATION SERVED

What is the estimated population serviced by your organization? (Select one)

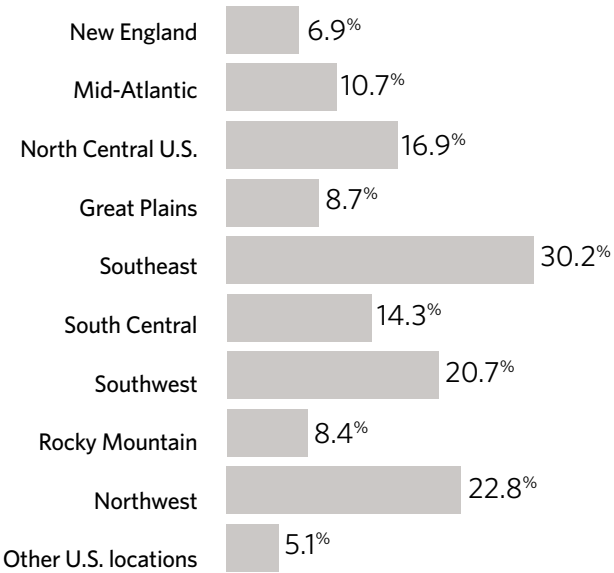


- Less than 100,000
- 100,00-499,999
- 500,000-999,999
- 1,000,000-1,999,999
- 2,000,000 or more

Source: Black & Veatch

PRIMARY U.S. BUSINESS REGION

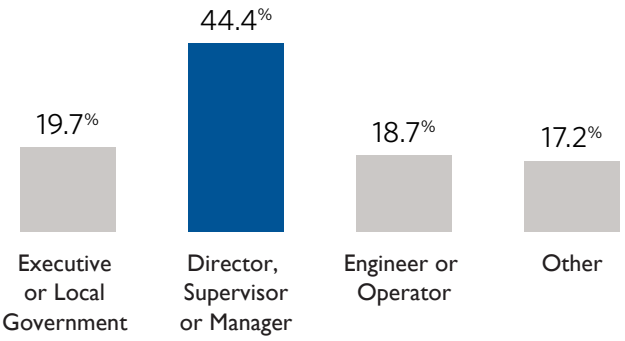
In which regions of the United States is your organization located and/or provides services? (Select all that apply)



Source: Black & Veatch

JOB FUNCTION

Which of the following best describes the position your currently hold within your company? (Select one)



Source: Black & Veatch

List of Figures

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