ARCADIS

DEMYSTIFYING INTELLIGENT WATER

Realizing the value of change with advanced asset management

This paper is the third in our Demystifying Intelligent Water series. It examines the changing asset management landscape and how a framework that incorporates advanced technology can address affordability, workforce and regulatory challenges.

A research collaboration with

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Improving quality of life

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Communities are defined by the water that surrounds and flows through them. Be it the harbors of New York, the rivers of Louisiana, the lakes of Michigan or the beaches of Florida and California, water gives communities their unique attractiveness and supports their abilities to thrive.

Managing, treating and distributing this critical resource is a substantial undertaking. In the U.S., the responsibility falls almost entirely on the shoulders of local governments and municipal water utilities (water, wastewater and stormwater).

The pressure on them to perform is intensified by deteriorating infrastructure assets, an aging workforce, the need for high-in-demand skillsets, and changing social and cultural dynamics. Further challenges — diverging demands in cities and rural areas, depleting aquifers, emerging contaminants, escalating extreme weather disruptions and expanding affordability gaps — continue to mount.

With the odds seemingly stacked against utilities, it's no wonder the people leading them are looking to modernize their game plans. Achieving today's goals while preparing for tomorrow's challenges means reimagining how utilities manage their assets — the pipes, people and everything in between.

Technology for monitoring, managing and predicting asset health and performance is giving rise to a new paradigm of digitally enabled asset management. Data-informed decisions around operations, maintenance and capital investment across time horizons empowers utility leaders to optimize scarce financial and staff resources, service levels and value for customers.

Adoption of advanced asset management remains limited to a relatively small group of innovative, tech-savvy utilities. More widespread acceptance could help narrow U.S. utilities' funding gap by as much as $62.4 billion over the next decade by eliminating $27.5 billion from capital investment burden and $34.9 billion in unnecessary operating costs.[1]

Advanced asset management 101: **Key terms**

Advanced asset management: An enhancement of the traditional asset management framework that adds digital skillsets and technologies, focuses on total expenditures and considers assets beyond the physical infrastructure. These elements work together to optimize spending decisions, reducing the infrastructure funding gap while maintaining assets at an acceptable service level.

What's driving the demand for change?

The investment gap is growing

Total public and private capital investment in U.S. water and wastewater infrastructure reached an estimated $36.6 billion in 2018, less than a third of the $119.0 billion in annual investment the American Society of Civil Engineers (ASCE) projected would be necessary by 2018. This $82.3 billion investment gap is the highest it's ever been after two decades of steady growth, increasing nearly sevenfold since 2000, when the gap was $11.9 billion.[1]

Water and wastewater capital needs vs. historical investment

Sources: American Society of Civil Engineers, U.S. Congressional Budget Office, Bluefield Research

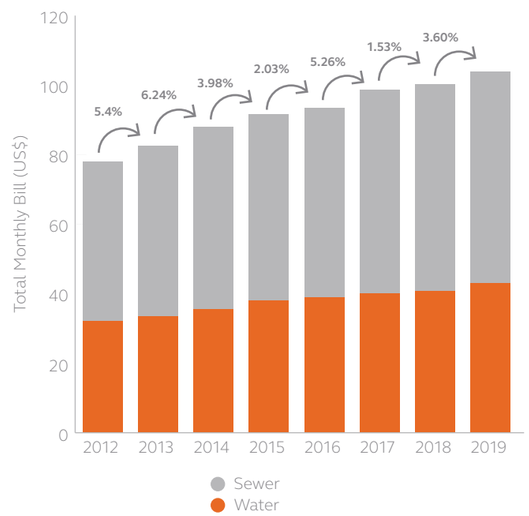
Stormwater assets will soon enter the conversation as well. ASCE will include stormwater as part of its annual report card for the first time in 2021, and the data it and other organizations are collecting regarding stormwater will likely reveal more funding needs.

Affordability isn't a buzzword, it's a real problem

Average U.S. monthly water and sewer rates increased 31% in real terms since 2012, more than double the growth in median household income between 2012 and 2018.[1,2] Despite rate increases, utility revenues are still falling short, with only 21% of U.S. utilities able to fully cover the cost of providing services.[3]

If these trends continue, 36% of households will not be able to afford water within the next five years.[4] Meanwhile, only 37% of utilities have low-income affordability programs for water and wastewater bills.[5] Raising rates to fund asset replacements will not be a long-term solution.

Water and wastewater monthly bills for largest U.S. cities by population served, 2012-2019



Source: Bluefield Research

Institutional knowledge is leaving

An estimated 10.6% of water sector workers will retire or transfer each year between 2016 and 2026, with some utilities expecting as much as half of their staff to retire in the next five to 10 years.[6] This will drain utilities of the institutional knowledge that veteran system operators have built up over decades. Not to mention, competition to attract and retain the next generation of leaders is heating up.

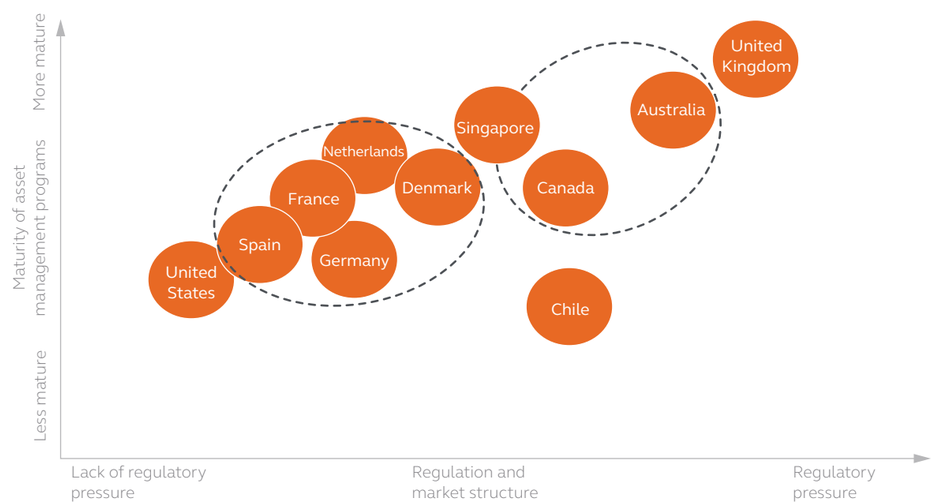
Regulations are slow to evolve

As the figure below shows, the U.S. ranks last and the U.K. first in asset management maturity, with the large disparity attributed to the market structure and regulatory requirements. The U.K., which privatized utilities in 1991, is initiating its seventh five-year Asset Management Plan period, meaning the U.K. has been advancing comprehensive asset management regulations for almost 30 years.

The U.S. regulatory climate is much different. While some states are enacting rules around asset management with ties to funding and/or operating permits, the process is slow, and may only address one utility service (water or sewer). The recent federal requirements in the American Water Infrastructure Act (AWIA) include many asset management principles. However, the AWIA only addresses water and is focused primarily on resilience and security rather than overall asset health.

While these individual regulatory requirements help raise asset management awareness, a seismic shift like the one that occurred in the U.K. is nowhere on the horizon. Rather, utilities can look beyond the regulations to focus on the lessons learned from three decades of asset management maturity in the U.K.: 1) Include more than just physical assets. 2) Take a total expenditure (TOTEX) perspective. 3) Leverage data and technology. Embracing proven solutions can help push utilities into new forward-looking territory where advanced asset management becomes business as usual.

Maturity of asset management programs vs. regulation and market structure, globally



Source: Bluefield Research

What's enabling progress?

Advanced technology

Using advanced technology for monitoring, managing and predicting asset health and performance creates new opportunities for utility leaders to address longstanding infrastructure challenges. Digitally enabled asset management provides better line of sight into what's happening within a utility, shining light on opportunities to proactively address maintenance in cost-effective ways.

Solutions such as artificial intelligence (AI) have redefined what we consider data. Once bound by the limits of a spreadsheet or database, data now includes point clouds, 360-degree imaging, video feeds and sound signatures as readily accessible data for asset monitoring and management.

Innovative cultures

Leaders in the water sector are recognizing the value of creative thinking. By infusing innovation into workplace culture, employees feel more engaged with digital transformations and more able to suggest ideas for improvement. This cultural shift is creating new avenues for maximizing advanced asset management's potential.

Intelligent Water

Intelligent Water combines advanced solutions and innovation with a skilled workforce to form a collective intelligence (CI) more powerful than each element on its own. It's creating technology-enabled staff ready to extend public infrastructure lifespans by becoming a fit-for-future utility. CI can help teams fortify their established knowledge base and pave the way for incoming leaders eager to push digital innovation.

These advances are generating new roles and changing the face of the utility workforce. The Asset Manager role, born out of the need to optimize capital improvement planning and prioritization, is maturing to include operations optimization, better maintenance practices, and consideration of customers and workforce as assets.

Advanced asset management surpasses traditional limits

Traditional asset management's greatest limitations are that it doesn't consider all of the assets and spend that a utility manages nor does it leverage the power of advanced technology, such as machine learning (ML) and predictive analytics, to do so. Embracing a new framework that includes advanced enablers can help utility leaders address affordability, workforce and regulatory challenges.

Traditional vs. Advanced Asset Management

Traditional Asset Management (limitations)	Advanced Asset Management (enablers)
• Focused on physical infrastructure	• Focused on total assets, incl. people
• CAPEX for repair and replacement prioritization	• TOTEX optimization
• Historical data and snapshots	• Real-time data streams
• Relies heavily on industry standards	• Continuously learns - utility specific

Source: Arcadis

Traditional limitation:

Focused on physical infrastructure

When it comes to assets, traditional approaches don't look past the pipes, plants and equipment. This narrow view hampers utilities' abilities to leverage their entire cache of strengths, leaving opportunities to maximize resources or create cost savings unexplored.

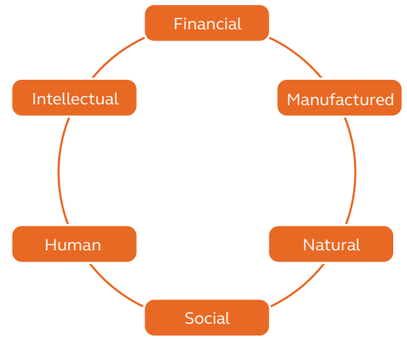
Advanced enabler:

Total asset focus

Advanced asset management recognizes the substantial value that utility workers create for their organizations, customers and communities. Organizations should prioritize investments not just in treatment and conveyance infrastructure, but also in people, skills and safety. The expanded view leads to a better understanding of how to apply strengths to prioritized risks before infrastructure fails instead of after.

U.K. water utility Yorkshire Water, for instance, has pioneered a unique "Six Capitals" philosophy, including human, intellectual and social capital in its accounting and asset management practices in addition to more conventional financial, manufactured and natural capital. This framework guides Yorkshire's asset valuations and long-term investment decisions. Yorkshire has also included its operations and maintenance staff in decisions about the collection, classification and prioritization of asset data, enabling the utility to leverage the experience and institutional knowledge of its veteran operators for long-term asset management and data strategy planning.

Yorkshire Water's Six Capitals framework



Sources: Yorkshire Water, Natural Capital Coalition, Bluefield Research

Traditional limitation:

Historical data, departmental silos and industry standards

Data-informed decisions are the crux of optimization. However, traditional approaches fail to capture and share it effectively. Or, they rely too heavily on historical data and industry standards rather than real-time information.

Disparate datasets on utility assets are housed across multiple platforms and databases — including geographic information systems (GIS), hydraulic models, enterprise asset management (EAM) or computerized maintenance management systems (CMMS), customer information systems, supervisory control and data acquisition (SCADA), or simple spreadsheets. Many organizations struggle to break down these data silos. But even if they could, the differing standards that departments apply to asset identification, valuation and lifecycle planning would make collaboration difficult.

For example, a finance department might rely primarily on asset age to determine book value, depreciation, and replacement schedules, with generic depreciation curves for different types of assets. Meanwhile, the engineering, planning and operations departments determine asset worth as a function of operational or business risk.

Reflecting these diverging, siloed approaches to asset valuation, most U.S. utilities have not yet incorporated systematic measurements of risk into their asset management planning workflows. Many utilities rely solely on asset age when prioritizing capital replacement.

Advanced enabler:

Real-time data collection, analysis and learning

Advanced asset management emphasizes openness and integration, bringing together data from multiple sources in order to optimize asset operations, maintenance and investment decisions. For example, combining core asset data stored in a GIS asset registry (e.g., age, size, material), historical maintenance and repair data housed in an EAM or CMMS platform and hydraulic data from a hydraulic model would allow staff to accurately assess the probability of failure (PoF) and consequence of failure (CoF) of a particular length of pipe.

In addition, advanced asset management relies on real-time data on asset health and operations rather than static snapshots of historical data alone. It uses remote meters, sensors and other Internet-of-Things (IoT) devices to collect continuous data streams from across a utility's asset base. Intelligent analytics software leveraging AI and ML may be trained on these feeds in a predictive or prescriptive maintenance regime, detecting deviations from each individual asset's baseline trends (which may suggest deteriorating performance or condition); analyzing what-if scenarios; and recommending optimal operations, maintenance or replacement interventions.

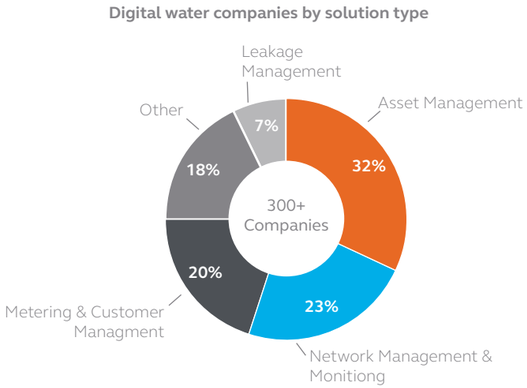
Arcadis has seen firsthand how these tools can improve service, such as work with Severn Trent Water, a U.K. water utility that serves 7 million households and businesses using nearly 3 million different assets. Arcadis supplied a predictive analytics toolkit that uses AI and ML to calculate asset deterioration, costs and service to optimize investments. The change in planning processes increased Severn Trent's cost efficiencies by 15%, helped it consistently attain an upper quartile industry ranking and allowed it to exceed regulatory performance commitments. These achievements resulted in a record-breaking $65 million in rewards.

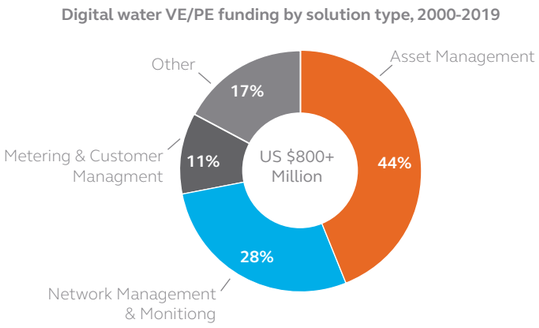
An expanding digital vendor landscape

The municipal water and wastewater industry's supply chain plays an instrumental role in facilitating the evolution to advanced asset management, bringing to market a wide range of hardware, software, and digitally enabled services for collecting and analyzing real-time asset condition and performance data. Of the more than 300 solutions providers that Bluefield has tracked in the municipal digital water landscape, nearly 100 of them (or 32%) provide digital asset management solutions, while more than 70 (or 23%) offer network monitoring and management technologies. Moreover, 57% of asset management providers and 55% of network monitoring and management providers have been founded since 2000, with these technologies together accounting for nearly $575 million in venture capital (VC) and private equity (PE) funding over the same period (72% of the more than $800 million in total municipal digital water investment).

These figures highlight the rapid expansion of the vendor landscape, and the increasing availability of solutions for collecting, analyzing and learning from real-time water and wastewater asset data. They also underscore the importance of having a clear framework in place for the management, integration and use of disparate asset data streams.

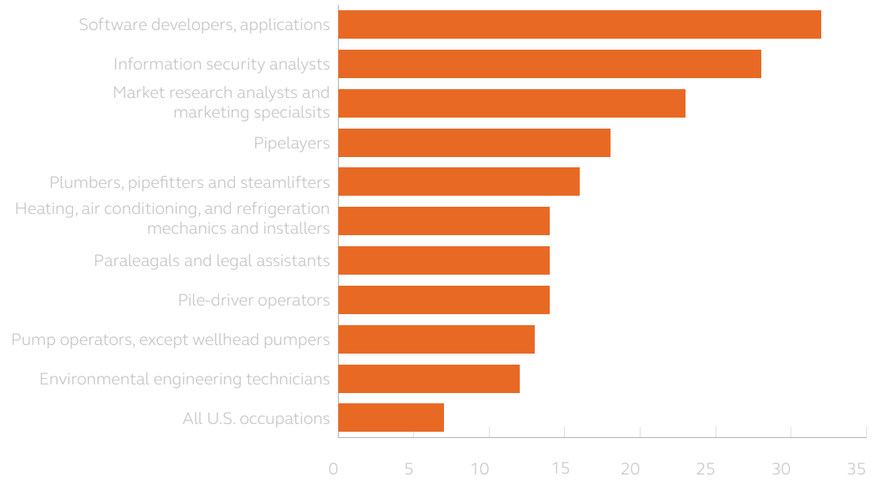
Digital water companies and venture capital/private equity (VC/PE) funding by solution type





Source: Bluefield Research

Projected employment change, 2016 - 2026



Source: National Centers for Environmental Information, Bluefield Research

Digital skillsets will be in high demand

Adopting an advanced approach means targeting new skillsets to complement the financial, engineering, and operations and maintenance resources central to traditional asset management. In particular, the hiring of new personnel trained in data science, statistics and economics will be required.

A number of innovative, proactive U.S. utilities and municipalities have begun to accept these new realities of the digital economy, adding new roles or entire departments focused on data analytics. According to Bluefield's survey of 100 of the largest municipal water and wastewater providers in the country, 10 utilities have created dedicated data, economic or asset management analyst positions, with an additional eight municipal governments establishing interdepartmental, citywide data science and analytics roles. More than half of these positions are brand new, with 11 of these 18 municipal organizations creating or expanding their data analyst roles in FY2019 or FY2020.

Utility managers must also prepare to welcome the next generation of water workers by adjusting roles and workflows to align with the opportunities, challenges and expectations of an increasingly connected world. Anticipated demand for software developers and information security analysts in the water sector will grow more than 25% from 2016 to 2026, more than double the growth rate of more conventional roles such as pump operators and environmental engineers.[7] Water utilities will face significant competition from other industries for these in-demand digital skillsets, increasing pressure to create workplace cultures conducive to digital growth and innovation.

Traditional limitation:
CAPEX prioritization

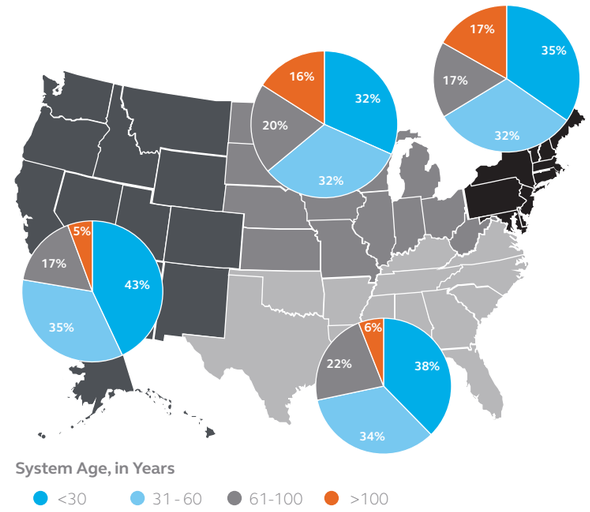
Currently, many utilities rely on asset rehabilitation and replacement decisions made in the context of multi-year capital planning initiatives that prioritize upfront capital expenditure (CAPEX) considerations without considering the operational expenditure (OPEX) costs associated with operating and maintaining an asset over its full lifecycle.

This creates an untenable scenario where maintenance is predominantly reactive (i.e., in response to asset faults or failures) or preventive (i.e., on a static, time-based schedule, determined by historical data or standard industry assumptions about the mean time between failures for a specific asset type). The approach is failing for four main reasons:

1. Assets don't get better with age

U.S. water and wastewater infrastructure is deteriorating faster than utilities can rehabilitate or replace it. The estimated average age of U.S. water pipes is 45 years, and their advanced age might play a role in the 27% rise in North American water main breaks between 2012 and 2018.[8]

Average age of U.S. water pipe infrastructure by region



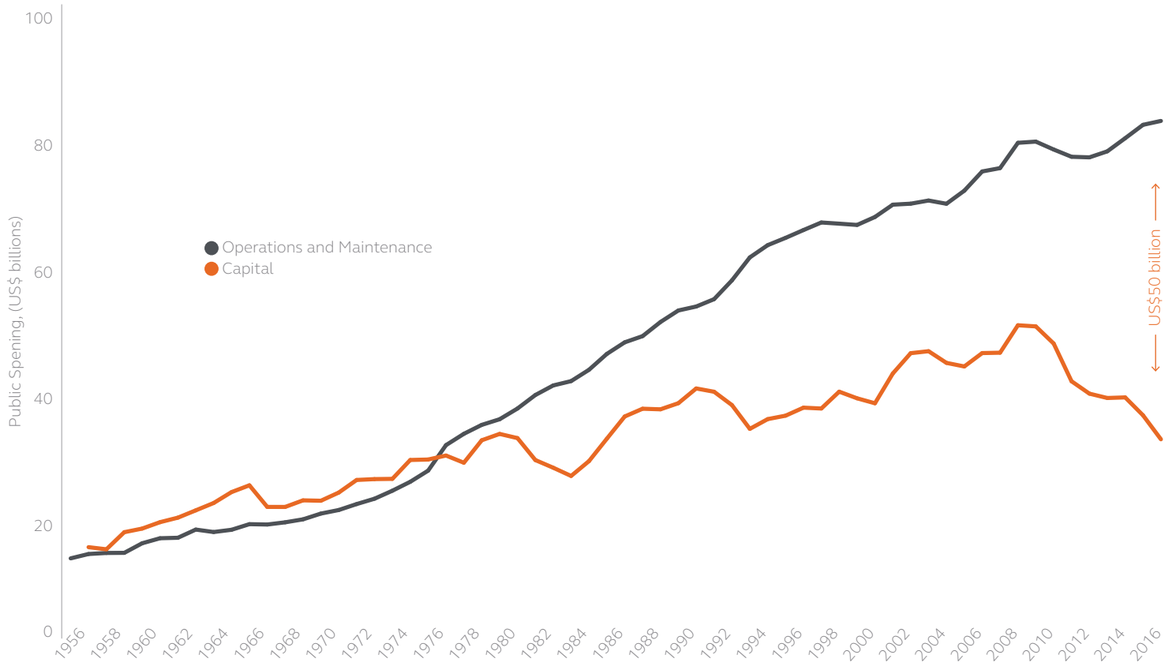
Source: American Water Works Association, Bluefield Research

Advanced asset management 101:
Key terms

Capital expenditure (CAPEX): Funds used to build, rehabilitate or replace physical infrastructure assets.

Operational expenditure (OPEX): Funds used to operate and maintain physical infrastructure assets over their complete lifecycles.

Operations and maintenance costs, 1956-2016



Source: U.S. Congressional Budget Office

2. Maintenance costs at an all-time high

Maintenance costs reached an all-time high of $50.2 billion above capital in 2017.[9] Utilities are increasingly forced to operate in a more reactive mode, exacerbating affordability challenges. A shift to less costly preventive and predictive data-driven maintenance programs is required.

3. Revenue projections are based on usage, which is declining

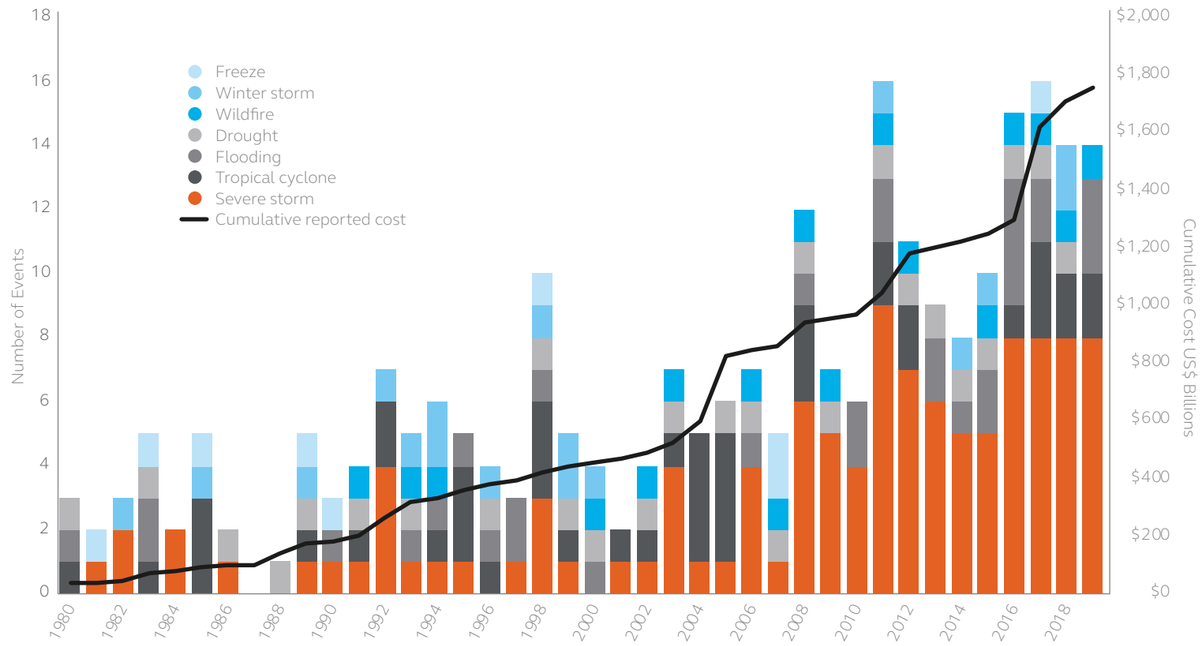
Investments in physical infrastructure renewal and replacement often take a replace-in-kind approach to sizing and capacity needs while population, wet weather intensity and water usage trends continue to shift. Indoor water consumption is forecasted to decrease from recent highs of 80 to 120 gallons per capita per day (gpcd) to less than 40 gpcd.[10] Census Bureau estimates released in 2020 showed 2019 U.S. population growth was the lowest it's been in the past 100 years.[11]

4. Shocks and stressors create service commitment obstacles

Environmental shocks and stressors (e.g., droughts, wildfires, extreme weather events) strain utilities' assets and make it more difficult to deliver on Level of Service commitments. The 2010s saw an average of 12 billion-dollar disasters each year, up from only three such events per year in the 1980s.[12] This increased frequency of acute shocks creates large capital expenditures organizations can't afford. Plus, the required utility responses prevent the utility workforce from focusing on programmatic asset replacement and renewal.

Utilities, especially those in vulnerable areas, might need to rethink replacement strategies altogether. Many replace assets in-kind based on age. However, if a weather event or rising sea level threatens to put an asset underwater, the organization might be better off elevating it or moving it entirely.

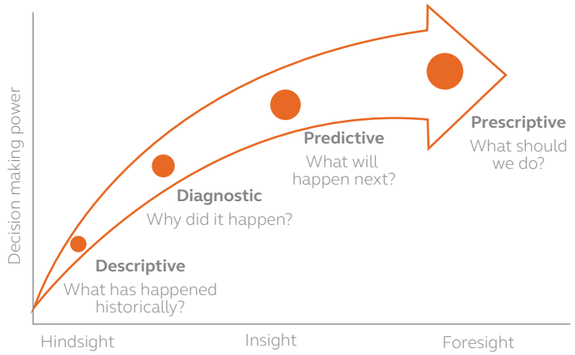
Billion-dollar U.S. weather disasters and cumulative costs



Sources: Brookings Institution, U.S. Bureau of Labor Statistics

Advanced enabler:
TOTEX optimization

Advanced asset management takes a more expansive view of asset costs, optimizing TOTEX over the lifecycle of an asset rather than upfront CAPEX alone. TOTEX, which was introduced by U.K. water industry regulator Ofwat in 2013, equates to the sum of CAPEX and OPEX. It encourages utilities to make more holistic asset management and investment decisions that maximize value over an infrastructure asset's full operating life. For large-scale assets such as water and wastewater treatment facilities, for example, OPEX costs (such as operations and maintenance labor, supplies, and energy) can account for 75% to 85% of total lifecycle costs.[13] Optimizing these day-to-day operating costs creates significant long-term savings.



Source: Arcadis Gen

TOTEX optimization requires a shift in maintenance philosophy from reactive or preventive maintenance modes to predictive or prescriptive approaches that prioritize real-time asset condition. Condition-based or reliability-centered maintenance approaches generate OPEX savings (as both labor and asset performance are optimized) and CAPEX savings (as asset life is prolonged, and replacement expenditures are deferred), driving down overall TOTEX.

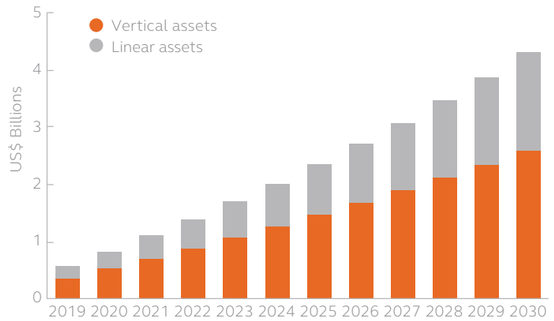
Optimization is key to minimizing OPEX costs. The cost of unplanned maintenance is roughly 1.5 times the cost of planned maintenance, and emergency maintenance costs about three times as much. Cross-industry studies show only 18% of asset failures follow standard time- and usage-based preventive maintenance patterns.[14] The ability to find and fix asset failures proactively, or even prevent them altogether, maximizes OPEX savings.

Adoption is picking up steam

Adoption of advanced digital platforms for asset investment planning and risk analysis is picking up steam worldwide, with Bluefield tracking nearly 40 deployments between 2015 and 2019 (compared to 11 over the previous five-year period). The U.S. is no exception, accounting for more than a third of the project announcements for advanced asset management software systems since 2015. The U.S. and Canadian market for risk analysis software — which leverages AI and ML to analyze PoF and CoF for water and wastewater infrastructure assets — will grow from $18.0 million in 2019 to $109.1 million by 2030. This equates to a compound annual growth rate (CAGR) of 17.8%, far outpacing more established asset management technologies such as EAM (2.9% CAGR) and GIS (7.9% CAGR), as well as the overall U.S. and Canadian digital water technology market (6.5% CAGR).[1]

Success from early adopters will drive the rollout of advanced asset management solutions. Digital asset investment planning and risk analysis tools have allowed utilities to reduce annual CAPEX by as much as 20%. Using a median estimate of 11.3% in CAPEX avoidance, these platforms could help utilities to save a total of $27.5 billion in CAPEX between 2019 and 2030, including $17.0 billion in vertical asset CAPEX (61.7% of total savings) and $10.5 billion in linear asset CAPEX (38.3% of total).[1]

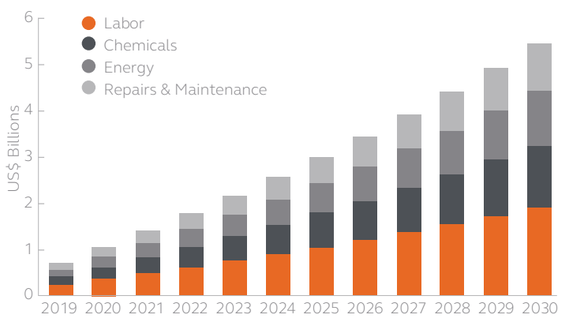
Advanced asset management CAPEX savings forecast, 2019-2030



Source: Bluefield Research

The savings opportunities don't end with CAPEX. By optimizing labor and equipment for operations and maintenance, and by enabling utilities to keep critical assets in optimal condition, advanced asset management creates significant follow-on OPEX savings as well. Early adopters of advanced asset management practices have seen savings of as much as 30% of annual maintenance, chemicals and labor costs, and as much as 50% of annual energy and contract services costs. Using these figures, advanced asset management could save U.S. utilities a total of $34.9 billion from 2019 to 2030, including $12.3 billion in in-house and contract labor (35.1% of total savings), $8.6 billion in chemicals (24.6% of total), $7.5 billion in energy (21.5% of total), and $6.5 billion in maintenance expenses (18.7% of total).[1]

Advanced asset management OPEX savings forecast, 2019-2030



Source: Bluefield Research

Altogether, advanced asset management practices stand to help U.S. water and wastewater utilities save as much as $62.4 billion in TOTEX costs between 2019 and 2030, with annual savings increasing from $1.3 billion in 2019 to $9.8 billion by 2030 — or 6% of total projected utility expenditure nationwide by the end of the decade.[1]

Advanced asset management 101:
Key terms

Total expenditure (TOTEX): A combination of CAPEX and OPEX used to assess the complete economic impact of an asset decision, regardless of expenditure classification.

Optimization: Making the most effective use of asset management resources based on all permutations of a given scenario, including those beyond human comprehension.

Vertical asset: Above-ground physical infrastructure, such as treatment plants, pump and lift stations, and storage facilities.

Linear asset: Below-ground physical infrastructure, such as water distribution and transmission mains, wastewater and stormwater collection pipelines.

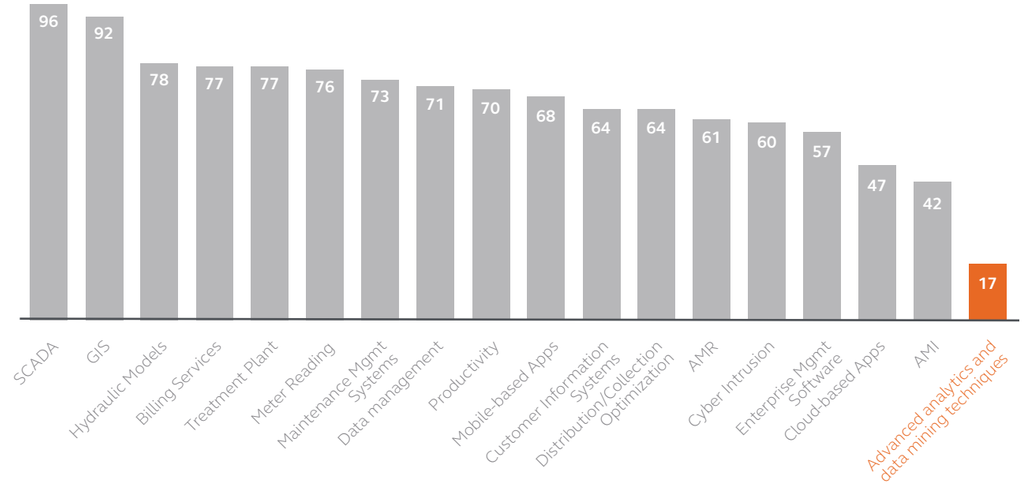
Probability of failure: The likelihood that an asset will cease to perform required functions within a given timeframe based on stated conditions.

Consequence of failure: The risk level posed by failure of a given asset. Consequences can include costs of repair/replacement, effects on the workforce, service interruptions and more.

Momentum is building

Communities that use their water assets for strategic advantage are ultimately more livable, safe and competitive. Many water utilities are feeling the pressure to change, but implementation of advanced asset management solutions remains limited. While a majority have adopted core digital platforms for collecting and storing core asset data, such as SCADA (96%), GIS (92%), hydraulic models (78%) and CMMS (73%), only 17% have begun to leverage the data mining and analytics technologies necessary for advanced asset management and predictive or prescriptive maintenance.[3]

However, some utilities are blazing new trails to leverage advanced asset management solutions. Their stories are proof positive that venturing into advanced asset management might come with challenges, but the journey undoubtedly makes organizations more adept at accomplishing their missions.



Source: American Water Works Association

Building world-class reliability from the ground up

Metropolitan Sewer District of Greater Cincinnati

Developing world-class reliability isn't always a linear journey. For the Metropolitan Sewer District of Greater Cincinnati (MSDGC), the journey included a number of detours, but MSDGC turned those challenges into opportunities that drove success.

It started in the 1990s, when sewer rate increases funded collection system improvements, but there wasn't enough left over to fund facility assets. To minimize the impact on ratepayers, the utility explored how other industries' best-in-class companies identified cost savings, reduced anticipated capital needs and maximized asset lifespans.

In 1996, upper management enrolled in reliability and manufacturing process trainings at the University of Dayton, where they received an education on changing the utility's mindset around reliability. Not long after, MSDGC hired consultants to apply new technology and processes to its century-old system.

The expanding knowledge base and capabilities improved service, but MSDGC soon recognized holes in its plan, said Supervisor of Maintenance Eric Stevens. "Those who got the training on ideas like LEAN Manufacturing began retiring, taking all that knowledge with them. And the consultants weren't teaching us how to maintain systems in-house after they left. We weren't retaining the improvements we worked hard for."

MSDGC pivoted from top-down trainings to creating a program resilient to brain drain. The utility hired nationally recognized reliability thought leaders to train the operations and maintenance departments.

The bottom-up approach created a mass of practitioners instead of a select few. A group of engaged MSDGC staff members was developed and came to be known as "The Positive Energy Team." Establishment of the team, which was open to anyone with an optimistic view and a desire to try new solutions, further increased ownership of the reliability initiative.

"The Positive Energy Team was about acting on good ideas no matter where they came from," Stevens said. "This allowed crew leaders and others to make strong cases for implementation of new programs despite opposition from some management. As a result, laser alignment has become an in-house standard."

"Once staff saw that they were being heard, they began to speak up," added Supervising Engineer Justin Bahar. "Attitudes changed. Phrases like optimize and proactive maintenance became commonplace."

Prioritizing fresh ideas led to international accolades, including MSDGC's Best Asset Condition Monitoring Program and Best Emerging Maintenance and Reliability Program awards.

In preparation for future consent decree negotiations, MSDGC began using asset condition and risk data to project long-term capital investment needs. An Arcadis team was enlisted to help implement a customized software solution that MSDGC helped establish to document the needs of the utility.

MSDGC had refreshed its approach to consultants as well, using the partnership to build an internal team that worked alongside Arcadis' team to develop a proper scope for condition monitoring. Early wins included an assessment outside of its existing capital investment project, where the team spotted a treatment plant gate in desperate need of improvement. A $37 million repair initiative was put in place within a year.

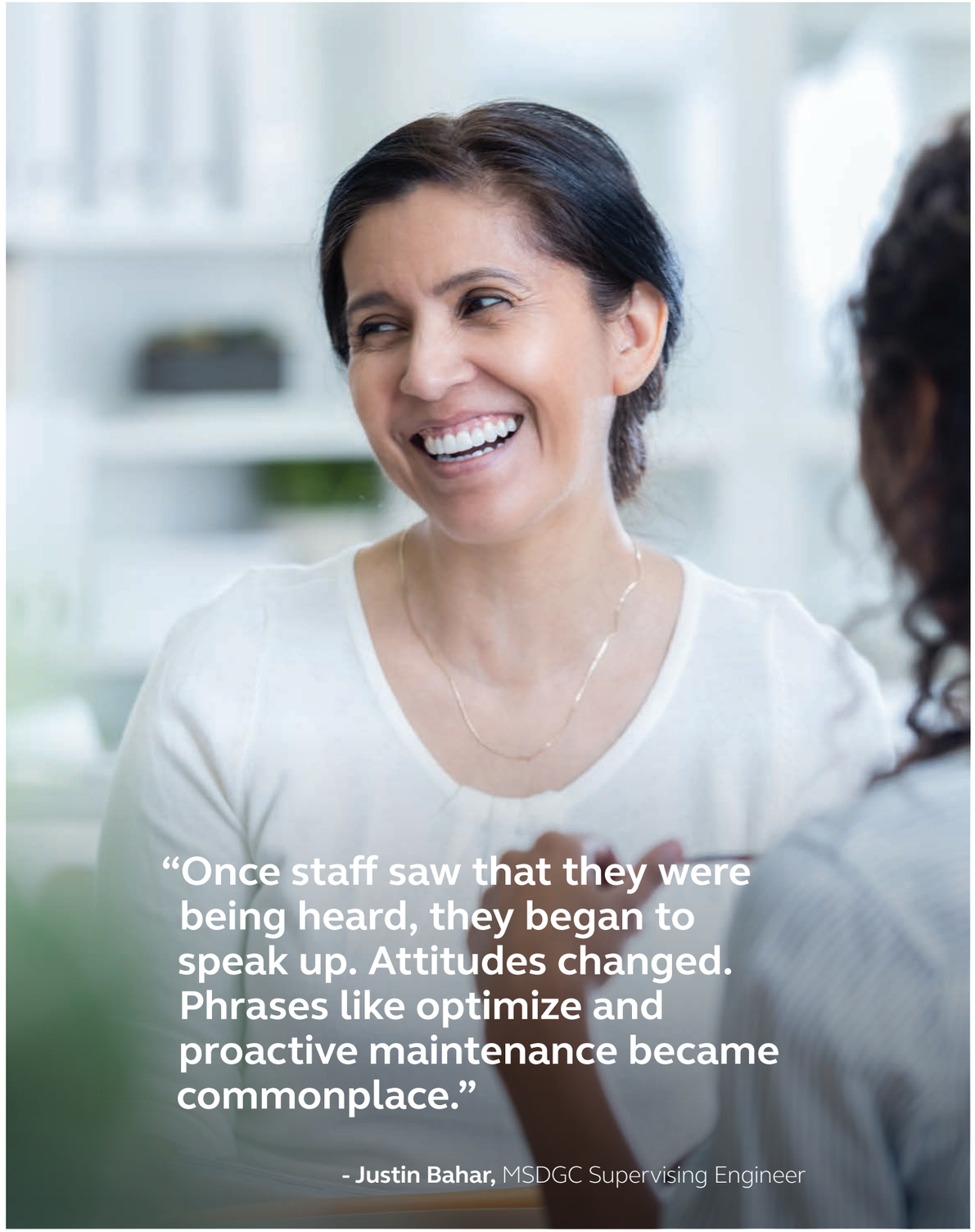
"That's the power of the program, seeing where the risk is that we need to address," said Bahar. "Projects like that increased awareness and built confidence in the new tools."

New tools also put optimization within reach for MSDGC's largest plant. "After the reliability upgrade, the staff could finally run equipment long enough to make process improvements," Stevens recalled. "A few years ago was the first time that the facility didn't have a permit violation. It felt great to have the plant supervisor credit us for that."

There's also been an uptick in worker safety. Scheduled maintenance plans outline what crews need and the associated hazards they might encounter well ahead of a job, lowering MSDGC's reportable injury rate. Likewise, proactive inventory processes allow for more cost-effective restocking of parts and tools.

Beyond the horizon sits more advanced solutions, from wearables and remote monitoring sensors to improved data hierarchies. MSDGC stressed that it would continue to rely on cross-training, staff feedback and other engagement efforts to strengthen sustainability.

MSDGC's journey is ongoing, but it's already learned a critical rule of the road: Utilities must turn detours into opportunities to accelerate progress.



Maximizing resources to meet transforming goals

The Metropolitan District Commission of Hartford, Connecticut

One of advanced asset management’s greatest strengths is a total asset focus. It aligns every piece of the puzzle —pipes, people, technology, capital and more —to connect strengths to needs. This helps utilities like The Metropolitan District Commission of Hartford, CT (MDC) evolve alongside transforming goals.

In the early 2000s, MDC’s policies prioritized replacing mains by age. With parts of the system dating back to the Civil War, the assumption was that those areas needed it most. But that wasn’t the case. “Some of the oldest pipes weren’t the worst performing or highest priority for replacement,” said Project Manager and Team Leader David Banker.

Instead, leaders hoped to prioritize replacements by consequence of failure, while also coordinating with a township paving program to save costs. After procuring a software, teams compiled records to create remaining asset lifespan curve projections that would support replacement priorities.

Initially a success, within a few years the vendor no longer supported the software. When it became too difficult to maintain, MDC leveraged its experience using the limited software to build a vision of its ideal solution. The organization partnered with Arcadis to identify a flexible, simplified tool it could tune to shifting needs.

“One of the biggest benefits with the newer tool is being able to easily adjust it. We can set it to maintain current breakage rate, or investment in main replacement rate. We can put together different packages to chase different goals or scenarios,” said Banker.

These abilities made it easier for executive staff to present portfolios of projects to the board and helped the teams in the trenches understand how day-to-day work fit into higher-level strategies. The improved communication fueled a cultural shift around the power of data sharing. Departmental silos between operations, engineering and technical services teams were torn down.

As the teams worked more closely, they investigated new opportunities to collect insights in the field and identify valuable correlations between asset conditions and future main breaks.

Collaborating over data collection and analysis helped the organization get more mileage out of its resources. The operations team could prepare areas for contract-led replacements involving lower-priority pipes, leaving more time for experts to focus on the critical mains.

With improved resource allocation, the utility raised its water main replacement program’s annual replacement target from 2 miles to 10 miles of pipe.

Expanding service is no small feat considering the utility’s shrinking staff. “Over the last 10 years, we’ve had a 20% decline in workforce across the organization,” noted Banker. “[With the workforce shrinking,] there’s been a definite push for innovation and data collection, from leaders to teams in the field. We’re trying to automate and streamline what we can, anything to maintain or maybe improve the level of work.”

Banker is eager to see what the explosion in asset management advances could do to help. He foresees further adoption of tools that will maximize pipeline lifespans and outputs from investments.

“It’ll be a flurry of technologies and improvements. And they’re becoming easier to implement. For customers, that will mean better resilience, better responses to fires or different developments. Just better overall,” he said.

In Banker’s view, consistent evolution and flexibility will encourage success. “As long as we can continue to identify valuable data, I don’t think there’s a downside to trying something new.”

Improving the journey

In order to meet the challenges of the coming decades, utility leaders will need to move away from siloed, traditional asset management philosophies to more holistic understandings of (and transparent communication regarding) their assets, data, workflows and priorities.

Advanced Asset Management Do's and Don'ts

Do's	Don'ts
• **DO** recognize the value of your organizations human assets and capital, and involve them in asset management and investment decisions • **DO** prioritize and optimize full lifecycle TOTEX costs (i.e., CAPEX + OPEX) when making asset management and investment decisions • **DO** incorporate real-time asset condition and performance data into maintenance programs, and leverage predictive analytics tools (e.g. AI, ML) to inform decisions • **DO** supplement your organization's workforce with trained data scientists and analysts to help you unlock the potential of advanced, digitally enabled asset management	• **DON'T** base your organization's asset management and investment on physical linear and vertical assets alone • **DON'T** make asset management and investment decision on the basis of upfront CAPEX costs alone • **DON'T** wait for failures, or rely on industry standard assumptions or asset age alone, to determine which assets to prioritize for maintenance or replacement • **DON'T** rely on traditional utility skillsets alone to confront the challenges of 21st century water and wastewater infrastructure operations and asset management

Source: Arcadis, Bluefield Research

These guidelines can support effective change, but it takes action to realize value. Investing in new ways of working and advanced technology is essential to creating a sustainable water future. Together, they can empower the workforce to overcome affordability and resilience challenges, seize optimization opportunities and foster thriving communities.

Change doesn't need to be instant or revolutionary to be worthwhile. Evolving in increments can help organizations fine tune their strategies using lessons learned along the way. For utilities looking to begin their journeys, here are the critical first steps to take and tools that can help.

Know who you are and where you're at

Create or update your strategic plan

When implementing an advanced asset management program, a key measure of success is whether it helps the utility achieve its strategic goals and objectives. Alignment between the program and the plan provides a line of sight for employees to understand how the higher-level strategy fits into the day-to-day activities required to execute it.

A strategic plan should identify internal and external strengths, weaknesses, opportunities and threats to the organization. Key examples of internal and external factors include rate constraints, workforce skillsets, regulatory requirements, data availability, customer expectations and resistance to change.

Conduct a formal assessment on asset management maturity

The Water Environment Research Foundation, which is now the Water Research Foundation (WRF), developed an asset management knowledge base focused on utility members' needs, called SIMPLE. WRF members can access the framework and decision support tools such as the WRF Strategic Asset Management GAP analysis, developed specifically for the water sector. The analysis assesses practice levels for seven core quality elements of asset management: processes and practices, information systems, data and knowledge, commercial tactics (service delivery), people issues, organizational issues and asset management planning.

Another useful benchmarking tool is based on the International Standards Organization (ISO) 55000 series of asset management standards. This series describes the elements of a management system for asset management, including Leadership, Planning, Support, Operation, Performance Evaluation and Improvement. The Institute of Asset Management provides a self-assessment tool based upon these standards.

Understand your workforce and the role people play

Foster a culture of innovation

One of the disciplines of the Utility Innovation Framework is maximizing workforce engagement, which allows utilities to create an agile environment that encourages new ideas and adopts new concepts. In turn, these new ideas can accelerate growth and support of advanced asset management programs.

Creating and maintaining a culture of innovation can be a challenge. More than 100 utilities have used the Innovation Environment Self-Assessment Survey to benchmark their innovation environments. When combined with fact-based validation, it provides a clear understanding of where to begin.

Employ change management best practices

It is estimated that 70% of change programs fail, mostly due to employee resistance.[15] It is crucial to put people at the center of the change to ensure the solution is utilized long-term. Change management is not simply a task to be completed near the end of the project or program. It must be consistently addressed throughout the entire process to ensure acceptance and adoption. Many successful change management models can be applied, including the ADKAR model by Prosci, which defines five tangible outcomes that people need to achieve for lasting change: awareness, desire, knowledge, ability and reinforcement.

Key elements of change management for an asset management program include creating and communicating an overall mission and vision, defining roles and responsibilities, documenting a communications plan, providing training and measuring progress on a routine basis.

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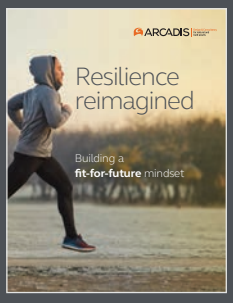

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