A Frost & Sullivan Whitepaper

# Accelerating Digital Transformation of the Water and Wastewater Sector

## Smart water solutions across the edge and software layers

FROST & SULLIVAN

Schneider Electric

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# Accelerating Digital Transformation of the Water and Wastewater Sector

## The Digital Transformation Imperative

To survive (and indeed, thrive) in the face of drastic change, in both external and internal environments, the water and wastewater sector is increasingly leveraging advanced digital technologies and services, with a number of factors driving the need for digital transformation.

**Digital Transformation Drivers**


*Source: Frost & Sullivan*

### Climate change and sustainability

In 2022, natural disasters[1] resulted in economic losses totalling US$313 billion globally, with 31,300 human fatalities due to these events.[2] Since the insurance protection gap was 58%,[3] most of these disaster losses were uninsured.[4] Given that water and wastewater utilities, and their residential, commercial, and industrial customers, are vulnerable to the impacts of natural disasters, resilience is a critical area of focus. Also, apart from disruption and damage to operational equipment, plants, and networks, some natural disasters such as storms and floods can compromise water quality (in terms of pollutants, colour, taste, and odour).

In the context of a global push toward net zero,[5] digital technology is being leveraged to minimise carbon emissions and extreme event damage to assets, manage future-proofing infrastructure (such as desalination plants, wastewater recycling systems, etc), and increase energy efficiency especially at critical applications like pumping or aeration.

[1] Including droughts, earthquakes, floods, wildfires, heatwaves, storms, etc.
[2] 2023 Weather, Climate and Catastrophe Insight, Aon plc
[3] Only 42% of direct aggregated economic losses was covered by public and private insurance entities.
[4] 2023 Weather, Climate and Catastrophe Insight, Aon plc
[5] Net zero means cutting greenhouse gas emissions to as close to zero as possible, with any remaining emissions re-absorbed from the atmosphere, by oceans and forests for instance. (UN)

In addition, the sludge produced from water and wastewater treatment plants plays a critical role in achieving net zero and circularity goals. Sludge from wastewater streams (especially those that have significant biological oxygen demand (BOD) content) could be used to generate green energy and thus reduce the energy dependence of the wastewater treatment plant. Sludge from water treatment plants could also be used as fertilisers, in re-mineralisation of water, or in neutralisation of wastewater. From their wastewater streams, industrial sites that have installed zero liquid discharge (ZLD) systems could recover water for reuse and recycling, minerals, nutrients, and other resources. This shift from linear to closed loop systems will require robust, real-time operational visibility and control, which digital solutions can facilitate.

Finally, the 'S' in "ESG'[6] is coming to the fore as water utilities seek to define their role beyond being merely providers of water and wastewater services, to delivering wider social value to the public. This means improving the monitoring and management of other assets such as dams, parks, golf courses, recreational water bodies, etc., to improve quality of life of residents. It also means ensuring better overall services, reduced incidents, as well as minimised traffic disruption due to unplanned works. And for those disruptions that cannot be avoided, it means improved data to help utilities inform the public of any disruptions or inconveniences in a clear and timely manner, or to enable industrial sites to comply with reporting to external stakeholders.

## Water scarcity

Climate change and climate-related catastrophes also contribute to the problem of water scarcity. This is the result of population growth (with its subsequent need for expansion of industrialisation, agriculture, and food production – consequently increasing water demand), ground water contamination (through the increasing use of pesticides and fertilisers), and the release of untreated municipal waste into water bodies. Half of the world's population could be living in areas facing water scarcity by as early as 2025.[7] By 2040, roughly one in four children worldwide will be living in areas of extremely high water-stress.[8]

Whilst new and disruptive technologies within the water generation and purification industries, as well as treated wastewater (as a sustainable alternative to freshwater) will help address this challenge to a significant extent, water conservation and efficient processes are already being enabled through digital tools. One of the most important areas of focus in terms of water conservation is the roll out of smart water meters to obtain real-time and granular visibility of usage and water savings.

Frost & Sullivan estimates that global unit shipments of smart water meters[9] will have grown 12.2% each year from 2021 to 2025, to reach 52.6 million units per year by 2025.[10]

[6] ESG: Environmental, Social, and Governance
[7] Water scarcity - Addressing the growing lack of available water to meet children's needs, UNICEF
[8] Ibid
[9] Both one-way automated metering reading (AMR) and two-way automated metering infrastructure (AMI)
[10] Global Smart Water Meter Tracker, 2022, Frost & Sullivan, June 2022

## Infrastructure challenges

Ageing infrastructure is one of the major operational challenges for the water and wastewater industry. In many parts of the world, underground pipe networks have reached the end of their useful life, creating new challenges in terms renewal of assets. Ageing infrastructure (and the need to replace these failing assets) creates enormous operational pressures that drive digital transformation as it prompts operators to leverage advanced digital technologies to manage their assets better (and extend their useful life as a result).

For example, in terms of non-revenue water (NRW),[11] apart from water theft and human error, most NRW is the result of deteriorating infrastructure (leaks and breaks in pipes, storage tanks, cisterns, etc. due to rust, corrosion, electrochemical reactions, or biological fouling). The consequences of NRW include lower revenue, infrastructure damage due to poor maintenance, potential loss of water pressure, and higher energy costs. This drives the use of novel technologies such as leak detection solutions, artificial intelligence (AI) models, smart metering, digital twins,[12] and data analytics.

## Ageing workforce and the skills shortage

The ageing workforce trend means that there is likely to be a knowledge and skills vacuum in the future as older workers retire and exit the water and wastewater industry. In addition, competition for talent from other industries aggravates the shortage of skilled and experienced workers in the water and wastewater sector. These factors spur the uptake of digital tools to raise productivity, as well as improve other operational metrics such as quality, safety, workforce retention, etc. Tools such as mobile solutions, apps, and remote access also help operators address the expectations of the younger generation of workers entering the sector who are digital natives (comfortable with digital tools and expecting their workplace environment to be connected, intuitive, and agile).

## Demand for enhanced agility

As a result of the COVID-19 pandemic, utilities are realising the importance of resiliency in service and operations, so that unexpected disruptions and emergencies can be managed effectively in the future. By future-proofing their operations with digital transformation technologies such as digital twins to run contingency simulations, utilities can develop appropriate response plans that do not compromise service/customer/workforce outcomes.

Over the long term, the shift towards increased work-from-home practices will mean a redistribution of peak water demand from households across the day (towards later in the morning, as households rise later) and similar impacts on drainage and sewerage. This calls for greater flexibility from operators to meet changed demand patterns.

## Need for improved safety

Internally, one of the key areas of social value delivery is worker health safety – both short term incidents (injuries and fatalities on account of accidents), as well as long term risks (such chemical exposure).

[11] NRW refers to the volume of water that does not reach the end user from the distribution system source.

[12] A digital twin is a virtual copy of a physical entity. In the real world, the entity can vary from a simple component or an asset to an entire network of bigger and more complex systems.

Workers in the water and wastewater sector must contend with a variety of occupational health and safety (OHS) risks, such as working in confined spaces (e.g. in pump stations, manholes, sewers, tanks, tunnels, pipelines, wells, etc.), working at heights, working with hazardous chemicals, construction/civil works site hazards, etc. Apart from improving OHS policies and standard operating procedures (SOPs), utilities are also using technologies such as wearables, drones, augmented reality (AR), and digital twins to eliminate or minimise workforce exposure to risks in dangerous and hazardous work environments. For example, LiDAR[13] sensors are being used on drones to inspect water infrastructure sites without the need for onsite workers. Another use case seeing rapid uptake of digital tools is in the OHS training/onboarding and continuous learning and development of workers and contractors.

In the future, as more of these technologies become standardised, work-related injuries are likely to be minimised.

### Call for greater customer-centricity

Despite water and wastewater utilities and municipalities being for the most part not in direct competition with each other, the call for greater customer-centricity is gaining more attention among senior management. Operators are realising that any transformation that they undertake in terms of operations and services must factor in the needs and perceptions of customers (both the public, as well as commercial and industrial customers). This is because the customer decides value, and the consequences of service disruptions/failures go beyond regulatory penalties to include severe reputational damage.

To enable a customer-centric approach, digital technologies are being leveraged to inform (and draw from) operational technology (OT) system environments[14] to enhanced linkage and value to customer-focused systems (such as customer relationship management (CRM) and billing systems, as well as marketing and messaging to customers).

## Enabling a more Proactive and Effective Response to the Challenges

Digital technologies such as 5G, Internet of Things (IoT), sensors, AI/ machine learning (ML), AR, smart meters, mobile solutions, and cloud solutions are being viewed as tools to improve decision-making in operations, to help reduce costs, as well as to provide enhanced services to customers.

The understanding of available technology options has improved over time (especially given the larger body of evidence now available through successful pilots and trials undertaken by the larger first-mover utilities). Progress from pilots and demonstrations to wider rollouts has gathered momentum. Fortunately, water and wastewater utilities have, in general, shown remarkable openness to sharing their learnings with each other. Most importantly, the scope of digital transformation projects is moving well beyond smart meter rollouts (to helping influence customer behaviour through real-time usage information and greater customer-centricity in processes) and through to enterprise-wide projects focused on internal processes and network operations. Apart from using specific digital technologies, this has also led to better integration of information technology (IT) and OT system environments, and integration with business systems.

[13] LiDAR stands for Light Detection and Ranging, and is a remote sensing method
[14] OT covers physical equipment/infrastructure (and related systems and processes)

Whilst the water and wastewater sector remains behind a number of other sectors (in terms of maturity of digital transformation) such as defence, automotive, pharmaceutical manufacturing, banking and financial services, retail, and energy, the improved leverage of digital technologies is expected to drive further uptake and expansion of use cases.

In addition, with the clear shift toward more online transactions for utility services, the wider uptake of social media, the already high use of mobile devices (smart phones, tablets, wearables, etc.), the higher expectations of the younger generation within the workforce in terms of convenience of tools used, along with the "consumerisation of IT" trend (the use of consumer technology in the workplace), there is a shift in user expectations in regard to the ease-of-use of water sector specific applications. This calls for the access to preconfigured modules, but with the option and flexibility to customise. It also calls for increased use of no-code/low-code drag-and-drop interfaces and intuitive visualisation. Apart from improving user experience, this has benefits for operational agility and flexibility as well. For instance, using the customer's in-app data, water utilities could also obtain relevant information on overall system efficiency, which drives operational improvements.

Frost & Sullivan estimates that these drivers are expected to grow the global market for digital water solutions and services[15] by 23.5% each year from 2021 to 2025, to reach US$63.02 billion in 2025.[16]

## Barriers to Successful Digital Transformation

While the transformational impact of moving toward the goal of smart operations is increasingly acknowledged, there are significant barriers to success in such initiatives:

**Barriers to Successful Digital Transformation in the Water and Wastewater Sector**


*Source: Frost & Sullivan*

**Funding:** Many water utilities (especially the smaller operators and municipalities) do not have significant cash reserves and spend much of their operating budgets implementing repairs just to maintain operations without disruption. Furthermore, securing investments is a problem in the current weak macroeconomic environment which leads to much higher increases in hardship customer volumes (the number of water and wastewater customers facing financial hardship and receiving flexible payment options, deferred payment, debt waivers or concessional tariffs) and this could result in additional financial stress on water utilities/municipalities.

[15] Smart water metering; Smart online water sensors; Smart leak detection and NRW management solutions; Smart pipe network management and optimisation solutions (including smart pumps and pumping stations); Digital twin solutions; Smart operation and maintenance (including enterprise asset management and asset health and condition monitoring)

[16] Global Digital Water Solutions and Services Growth Opportunities, Frost & Sullivan, February 2022

**Evidence and ROI:** The quantification of return on investment (ROI) is difficult for several novel technologies because there is limited guidance that utilities can use to evaluate these technologies (since there is still limited documentation of results due to the relatively brief time period with novel technologies in operation). To counter this restraint, utilities and municipalities are focusing on:

- Increasing collaboration and information sharing (so that critical success factors are visible to all)
- Expanding the scope of benefits from proposed digital transformation projects (from immediate operational outcomes to adjacent benefits, such as enhanced customer service and liveability outcomes, improved workforce wellbeing and retention, etc.).

**People and Process Challenges:** Short-term thinking prevents digital transformation projects from progressing despite visible payback. Overall, priority given to reactive tasks is challenging the industry. In addition, the senior management's appreciation of the benefits of specific advanced digital tools is often lacking.

The siloed nature of operations and management teams, and at times, a conservative and risk-averse mindset are also internal barriers.

Resistance from internal IT departments, difficulties in transitioning from legacy systems that work on diverse platforms, point-solution-focused approaches that hinder a holistic, enterprise-wide approach, and the insufficient articulation of enterprise-wide benefits often hamper potentially significant digital transformation efforts.

As a result, achieving scale beyond pilots remains a major challenge. To address this restraint, a significant paradigm shift is required within utilities and municipalities in terms of thinking and processes to embrace collaboration across the enterprise, to educate employees on digital transformation initiatives underway, and to ensure the commitment and ownership for digital transformation moves from C-level to middle management level.

**Cybersecurity Risks:** Over time, increased openness and collaboration on digital networks has made industrial systems more vulnerable to cyber-attacks. The use of IP-based, wireless, and mobile devices in industrial environments has increased. Also, with the increased use of commercial off-the-shelf IT systems in industrial environments, industrial control systems face increased exposure to malware and security threats that are targeted at commercial systems. However, the water and wastewater sector's operations workforce tends to be skilled in automation and control, and not as much in IT security. This hampers digital transformation as it weakens their ability to devise comprehensive protection and prevention strategies and protocols.

## Leveraging Smart Water Solutions across the Edge and Software layers

In the face of such formidable challenges, some utility operators and industrial users may be forgiven for placing digital transformation projects in the "too hard" basket. For one, there is the misconception that they need to start from a clean slate. This is not only financially unviable, but also unrealistic and unnecessary. By partnering with a trusted advisor who can factor in existing infrastructure and orchestrate new solutions on top of existing assets, utility operators and industrial users can accelerate their digital transformation journey. One such trusted advisor is Schneider Electric, with its suite of smart water solutions at different levels:

automation and control, water analytics, and enterprise operations. This suite of disruptive smart water solutions includes EcoStruxure™ Automation Expert, EcoStruxure ™ Water Advisor, and AVEVA ™ Unified Operations Center (UOC).

**EcoStruxure™ Automation Expert** is an open, software-centric industrial automation system with edge level control linked to the IT level of the organisation. It enables an entirely new category of interoperable, portable, and "plug-and-produce" automation solutions and delivers operators the ability to:

| Hasköy project |
| --- |
| Water and sewage services for Izmir, Turkey's 3rd largest city. |
| **CHALLENGE** |
| Water scarcity; prompting the development of a recycling water project including filtration, ultra-filtration, and disinfection units |
| **SOLUTION** |
| EcoStruxure Automation Expert |
| **RESULTS** |
| • 2,000 to 3,000 m3/day water savings through reuse for agriculture<br>• 20% less engineering time |

- Reuse design (thus reducing engineering time and cost, eliminating errors, and greatly shortening implementation time)
- Enjoy flexible control that is independent of hardware choices
- Virtually commission and modify control systems using digital twins, so that performance can be validated before the real-world systems are built and deployed
- Factor in and reuse existing systems integrated with new systems without having to adopt a "start from scratch" approach

**EcoStruxure™ Water Advisor** is a comprehensive software suite that can be leveraged across the complete water cycle management for utilities and industrial sites. This includes:

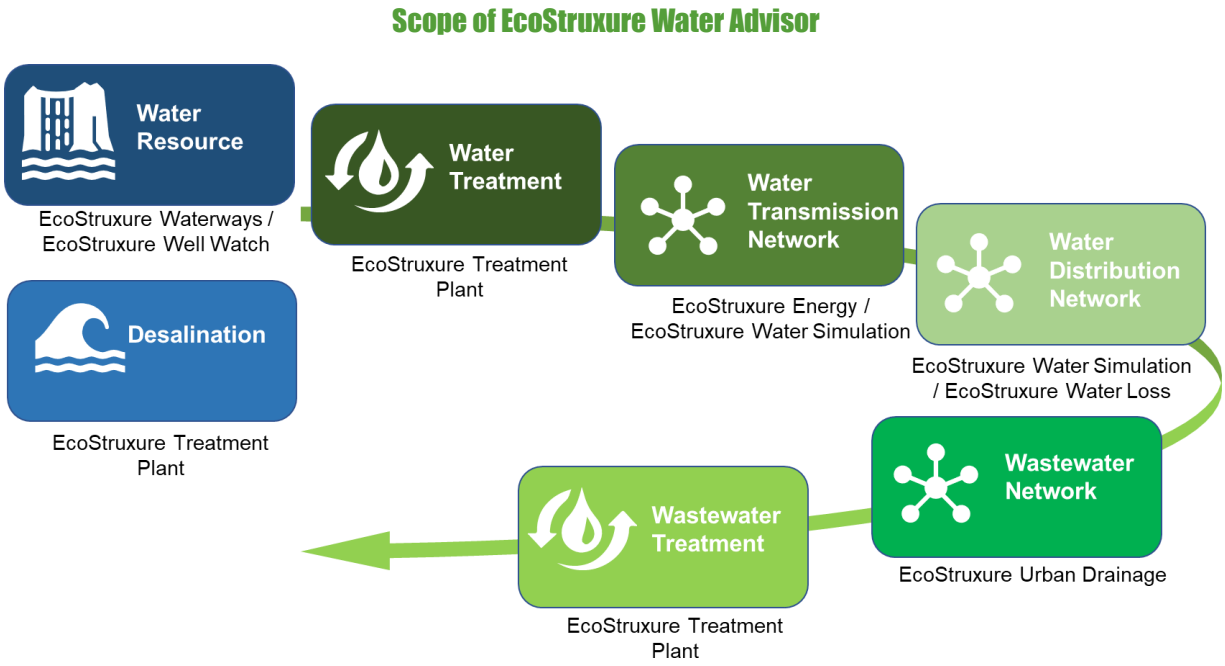
| Acqua Novara.Vco S.P.A |
| --- |
| Italian water services provider for domestic, agricultural, and industrial uses. Serving 450,000 inhabitants in 139 municipalities with over 3.7 billion cubic meters/year. |
| **CHALLENGE** |
| • Improve operational efficiency through aggregation of different management organisations into one company, standardising processes/procedures, and migrating to centralised management systems<br>• Increase overall water supply performance - reduce water loss and energy use<br>• Regulatory compliance around increased efficiency |
| **SOLUTION** |
| Integrated SCADA and Telemetry and EcoStruxure Water Advisor |
| **RESULTS** |
| • 10% less water loss<br>• 15% less energy used |

- **EcoStruxure™ Water Advisor – Plant:** Schneider Electric's real-time management and predictive system for water and wastewater treatment municipal and industrial plants' 360° performance. With incremental layers of decision support tools, it enables operators to optimise OPEX (energy and chemicals), while meeting compliance obligations.
- **EcoStruxure™ Water Advisor – Simulation:** Optimisation and simulation of water distribution networks, monitoring of water quality, and optimisation of metrics. This provides expanded control both geographically and over time; supported by 'what-if' scenarios for planned and unplanned events.

- **EcoStruxure™ Water Advisor – Water Loss:** Offers automatic leakage calculation and real-time alarming, as well as management of leak detection teams and monitoring of leak repair activities to reduce NRW.
- **EcoStruxure™ Water Advisor – Urban Drainage:** This provides real-time management and optimisation of wastewater and stormwater networks, with prediction of severe rain and storm events, automatic event detection, and control of assets and water quality.
- **EcoStruxure™ Water Advisor – Energy:** This solution for energy management of drinking water distribution networks enables users to arrive at optimised pumping strategies that can be implemented automatically through integration into the SCADA system.
- **EcoStruxure ™ Water Advisor – Well Watch:** Monitors productivity, pump efficiency, and pump condition at wells, aquifers, and boreholes.
- **EcoStruxure™ Water Advisor – Waterways:** Provides a surface-water management solution to manage flood/low-water levels, surface water quality, as well as advanced control of structures such as dams and reservoirs.

| East Water |
|---|
| Largest supplier of untreated water for industrial use in eastern Thailand, and the country's first complete water pipeline stretching nearly 500 kms. |
| **CHALLENGE** |
| • Pumping water from multiple sources while ensuring constant water pressure and volume<br>• Energy costs ~40% of OpEx<br>• Droughts<br>• Leaks in pipeline network<br>• Coordinating efforts & workflow between operation, maintenance, management, and other departments |
| **SOLUTION** |
| EcoStruxure Water Advisor and AVEVA Unified Operations Center |
| **RESULTS** |
| • Up to 30% increase in operational efficiency<br>• 15% drop in energy costs |

| NRDA Naya Raipur |
|---|
| India's 1st smart greenfield city. |
| **CHALLENGE** |
| • Rapid urbanisation<br>• Severe pressure on city resources<br>• Unequal distribution of city resources<br>• Lack of social inclusion<br>• Livability challenges for citizens<br>• Environmental sustainability<br>• Inefficient city operations |
| **SOLUTION** |
| EcoStruxure Water Advisor and AVEVA Unified Operations Center |
| **RESULTS** |
| • Increased efficiency of operators and management<br>• Improved situational awareness and operational readiness through advanced unified dashboards<br>• Immediate access to critical KPIs and reporting data in the field |




*Source: Schneider Electric and Frost & Sullivan*

**AVEVA ™ Unified Operations Center (UOC)** is a system of systems that connects IT and OT to enhance business insight and decision making around water and wastewater infrastructure, operations, workforce, and resources. By providing a single pane of glass (via a unified user interface) to management, it helps break down organisational silos that threaten to weaken contextual awareness and the quality of decision making. This ensures optimal visibility and control across not only OT environments, but also integrated with IT, security and CCTV, safety systems, building management systems, etc.

## Partnering with a Trusted Advisor

On the journey of digital transformation, it is essential that digital continuity is maintained over the entire lifecycle of the infrastructure – across the design, build, operate, and maintain phases of the assets. That is why operators today are less concerned with one-fix solutions and are more interested in a long-term partnering approach where a solution or service provider is capable of informing and enabling a roadmap to operational excellence.

It is also critical that the approach is holistic i.e., across the full water cycle – water sources, treatment, distribution, wastewater collection, treatment, and recycling - and across both municipal and industrial users.

Finally, it is important that solutions are tailored to meet the unique needs of water and wastewater operators at the specific stage that they are at in terms of digital maturity.

Given that Schneider Electric's offer extends well beyond automation and control (through to a range of other solutions used across the lifecycle of assets and across different types of assets – for example, power distribution equipment, data centre solutions, security solutions, building management systems, etc.), it is ideally positioned to support utilities and industrial users with solutions and services that enable successful holistic digital transformation.

As Schneider Electric directly addresses the needs of diverse sectors such as consumer packaged goods (CPG), semiconductor, mining, chemicals, and other segments, they bring an inside-out understanding of the unique considerations for industrial sites.

In addition, the company's open solutions such as EcoStruxure™ Automation Expert allow integration with third party apps, or with diverse data streams (operational, financial, and commercial).

Based on the maturity of the customer, Schneider Electric's solutions can provide real-time visibility of operations, recommend actions to be taken to optimise, or even automate for unmanned operations.

Since water authorities and industrial sites are typically geographically dispersed, the ability to address their needs on a local basis is critical. In this context, Schneider Electric's vast ecosystem of specialist partners (systems integrators, wholesalers, installers, electrical contractors, etc.) enables local support to meet specific needs.

Finally, the heightened cybersecurity risk that comes with the overlap of IT and OT environments calls for partnering with providers who can address this challenge with the requisite expertise and tools. Schneider Electric's focus has been and is on building cybersecurity embedded products, and on maintaining a strong security consulting team to deliver services and recommendations for customers, in partnership with other security specialists.

| Anglian Water |
| --- |
| Largest water and water recycling company in England and Wales by geographic area. |
| **CHALLENGE** |
| • Maintain position as leading innovator in leakage control and water resource protection<br>• Detect leaks quicker and improve response times<br>• Reduce the cost of outsourced leak detection<br>• Regulatory compliance<br>• Reduce the cost of ownership |
| **SOLUTION** |
| Integrated SCADA and Telemetry, EcoStruxure Water Advisor, and Enterprise Historian |
| **RESULTS** |
| • Water leakage cut by 10% - now one of the lowest levels in the UK<br>• Operational efficiency increased by 10% |

## Conclusions

In the context of the increased frequency and intensity of natural disasters, water and wastewater sector operators are asking key questions such as: "What is the definition of safe critical infrastructure?" "How can operational data and modelling help improve readiness and inform decision making during extreme events?"

To combat water scarcity, they are asking, "How best can we conserve, optimise, and recover water?"

In the face of infrastructure challenges, their focus is on: "How can we move from reactive approaches to more predictive and prescriptive approaches to asset management?"

To get both ageing workers and younger workers to own the continuous and enterprise-wide digital transformation journey, operators want to know, "What tools, processes, and training

do we put in place to help the workforce serve customers better, meet operational and business goals, as well as find satisfaction on the job?"

In the search for enhanced agility, their question is: "How can we transform from slow, analogue, closed, and siloed systems to agile, digitally empowered, open, and integrated systems?"

In the push to improve their track record on workforce safety, their demand is: "With the constantly changing asset mix, how can we ensure safety of our personnel?"

When progressing customer-centric initiatives, operators are asking the question: "How close does the end-user want to be to water and wastewater usage data, and how can we support them in this regard in the most appropriate manner?"

Addressing all these questions calls for building and optimising business and operational capabilities around people, processes, data, and technology. Whilst water and wastewater operators and industrial users are often confused by the sheer volume and diversity of solution options available to assist them on this journey, it is critical that they find and partner with a trusted advisor who understands their industry, has an open, software-centric solution which covers the whole water cycle and the entire lifecycle of assets, and provides expertise and support tailored to the digital maturity of the customer.

## About Frost & Sullivan

For over six decades, Frost & Sullivan has helped build sustainable growth strategies for Fortune 1000 companies, governments, and investors. With a team of experts based in 45 global offices, we generate intelligence spanning 10 industries, 35 sectors, and 300 markets, providing actionable insights to navigate economic changes, identify disruptive technologies, formulate new business models, and create a stream of innovative growth opportunities that drive future success. www.frost.com

## About Schneider Electric

Schneider's purpose is to empower all to make the most of our energy and resources, bridging progress and sustainability for all. We call this Life Is On. Our mission is to be your digital partner for Sustainability and Efficiency. We drive digital transformation by integrating world-leading process and energy technologies, endpoint to cloud connecting products, controls, software and services, across the entire lifecycle, enabling integrated company management, for homes, buildings, data centers, infrastructure and industries. We are the most local of global companies. We are advocates of open standards and partnership ecosystems that are passionate about our shared Meaningful Purpose, Inclusive and Empowered values. www.se.com