xylem

WATER TECHNOLOGY TRENDS 2026

A strategic guide to
the future of smart water

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INTRODUCTION

2026 is set to be another pivotal year in the profound transformation of how water infrastructure is planned, operated and maintained.

Artificial intelligence is expected to play a central role in this shift. First, **generative AI** will begin to emerge as an operational capability in its own right, going beyond synthesizing knowledge and recommending actions to help break down information silos and unlock the value of unstructured data. This will enable utilities to become more resilient, efficient, and better equipped to measure, anticipate, and act in real time.

Second, the year will see the emergence of **agent-based architectures**. These new approaches will enable natural language queries to be converted into analytical flows that can be audited and automated, with a special focus on security and control in critical infrastructures.

Security, and more specifically **cybersecurity,** remains a cornerstone of this transformation. As water systems become more interconnected, the risk of cyberattacks continues to grow. These threats have multiplied in recent years and represent a serious challenge for essential services. For this reason, investing in cybersecurity is no longer optional but a strategic necessity, not only to comply with regulations, but also to ensure service continuity and protect public health.

At the same time, several reports indicate that extreme weather events will remain a constant feature of the years ahead. In this context, **Early Warning Systems** will continue to play a critical role. These systems combine updated hydrological and hydraulic models with multiple meteorological forecasts, probabilistic scenarios, and alternative simulations to enable highly accurate predictions of how river basins are likely to respond to severe meteorological events.

Another key development is the growing importance of **partnerships between public authorities and private enterprises.** In 2026, these collaborations are expected to take on a new dimension, becoming a real driving force behind the transformation required across the sector. Initiatives such as the PERTE program in Spain, the Sustainable Water Initiative for Tomorrow (SWIFT) in the United States, and the West Bengal Drinking Water Sector Improvement Project in India show how cooperation, including collaboration between companies, can multiply operational efficiency and reduce risk, especially when data governance and interoperability are built in from the start.

The future of water will be digital, or there will be no future. This white paper is part of that transformation. It offers a clear, accessible overview of some of the most relevant trends set to shape water digitalization in 2026, helping policymakers, utilities, and private companies better understand the changes ahead and identify the opportunities the coming year will bring.

Jaime Barba
Head of Xylem Vue
Idrica Chief Executive Officer

Water management in 2026: generative Artificial Intelligence as a strategic asset for utilities

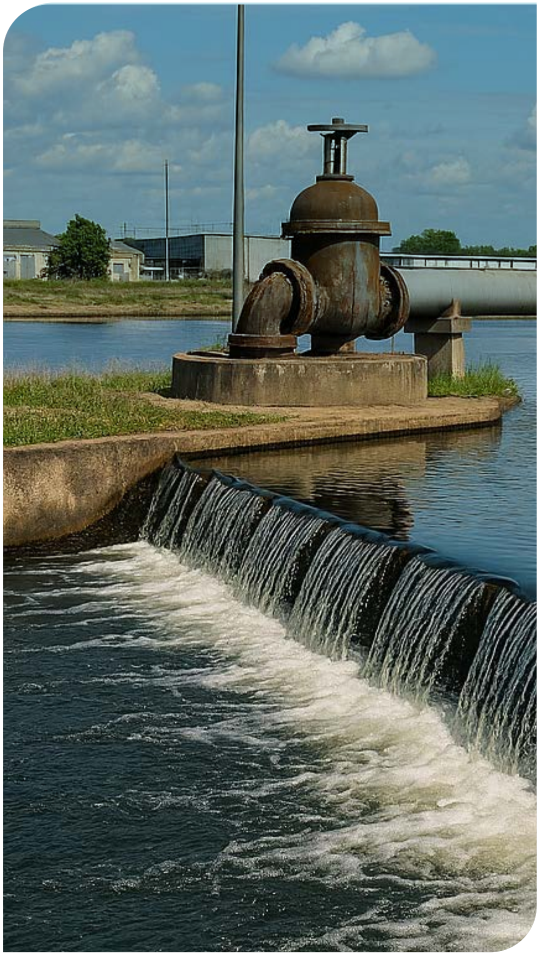
The water sector is at an unprecedented turning point. The convergence of aging infrastructure, a workforce in transition, regulatory pressure, and the growing impact of climate change is forcing utilities to rethink their strategies and operations. In this context, generative artificial intelligence (GenAI) is emerging not only as a tool for digital transformation, but also as a driver of change in asset management, decision-making, and customer relations.

Utilities are facing a complex reality: outdated infrastructure, an aging workforce (over 30% of utility workers in the US are set to retire by 2030), and insufficient investment to fund much-needed renewal and expansion. These challenges are compounded by climate volatility and growing demands for more resilient, transparent, and efficient services.

Incremental responses to these challenges will not suffice. Disruptive tools are required to manage complexity, optimize resources, and anticipate risks. This is where GenAI can be fully leveraged.

In this sense, GenAI represents a step forward from advanced analytics and traditional machine learning. Whereas these technologies focus on well-defined tasks (leak detection, demand forecasting, etc.), GenAI can navigate ambiguity, scale human knowledge, and extract value from unstructured data. Its ability to generate contextualized content, such as summaries, recommendations, and simulations, makes it a strategic asset for decision-making in complex environments.

The timing is right: technological maturity now coincides with an urgent need for efficiency and resilience. In addition, private investment in GenAI has surged, and major technology players (Amazon, Microsoft) are developing specific solutions tailored to the water sector.



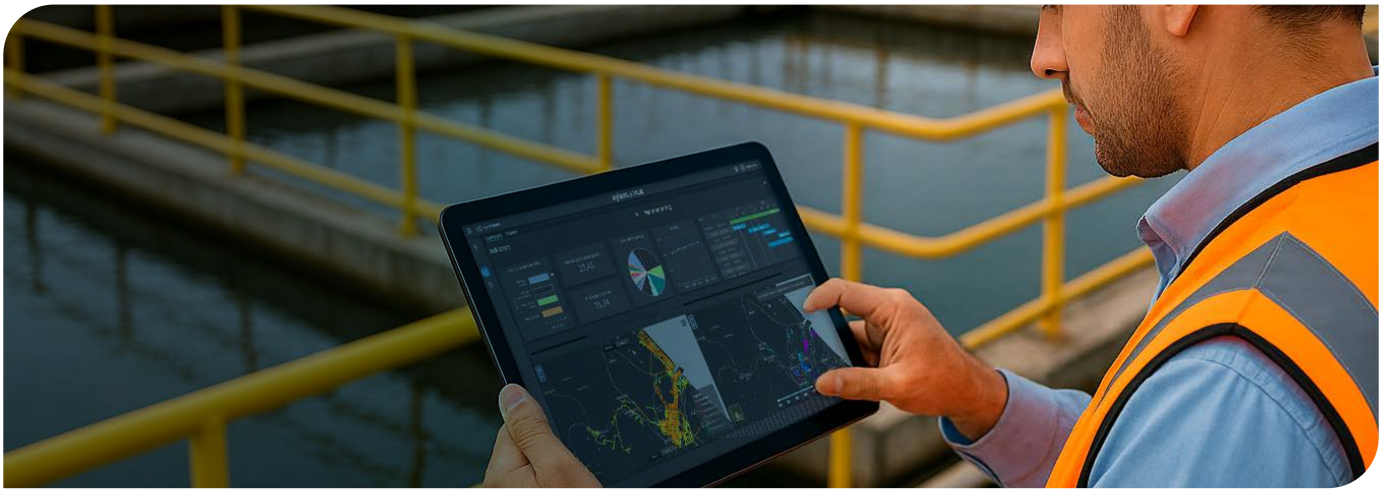
THE EUM FRAMEWORK AND GENAI INTEGRATION

The Effective Utility Management (EUM) model, which has been widely adopted in the US, sets out ten key attributes for sustainable utility management. GenAI does not seek to replace existing systems; instead, it integrates with them as a high-value tool to unlock data potential, break down functional silos, and scale best practices.

Current opportunities fall into two categories:

Active application areas: domains where GenAI is already delivering tangible value (operational optimization, customer experience, resource sustainability, infrastructure management).

Emerging potential: areas with significant short- to medium-term prospects (business resilience, regulatory performance, financial viability, talent development, community sustainability).



Use cases and global trends

Digital dissemination and global uptake

The adoption of GenAI in the water sector is a global phenomenon, with initiatives reported across the US, Europe, Asia-Pacific, and the Middle East. While more mature markets are leading implementation, operational demands and the need for efficiency are accelerating digital transformation worldwide.

Active application areas: applications with proven impact

a. Strategic infrastructure planning and performance improvements

Utilities such as San Antonio Water Systems (NA), Yorkshire Water (UK), and Las Vegas Valley Water District (NA) are using GenAI to consolidate diverse data sources and optimize investment planning, network renewal, and risk management. AI-enabled conservation platforms provide alerts about water losses and encourage responsible water use among customers.

b. Operational optimization

GenAI is helping to close the O&M funding gap by automating tasks, improving process reliability, and enabling scalability. The Hampton Roads Sanitation District (NA) pilot is a notable example, where it uses GenAI to optimize energy consumption and chemical dosing, delivering measurable results in efficiency and operational stability.

c. Customer experience and satisfaction

Customer service is a critical priority, especially given the difficulties inherent to expanding teams. Solutions implemented by DC Water (NA), based on natural language processing and GenAI, enable 24/7 service in multiple languages, improving accessibility and user confidence. Tools such as Microsoft Copilot have demonstrated significant gains in productivity and service quality.

d. Water resource sustainability

Integrating GenAI into watershed management, reuse planning, and dynamic resource allocation is key to anticipating scarcity scenarios, optimizing use, and reducing environmental impact. The Las Vegas Valley Water District, through its gamified conservation platform built on advanced telemetry data, demonstrates how AI can foster behavioral change and improve demand forecasting.

Emerging potential: the challenges ahead

Business resilience

GenAI can transform static contingency plans into dynamic crisis response tools (climate, cyber, etc.) by providing real-time guidance and ensuring operational continuity.

Regulatory performance and reliability

Automating regulatory monitoring, reporting, and the delivery of multilingual alerts reduces paperwork and mitigates the risk of non-compliance. Examples such as Anglian Water, which uses AI to identify safety risks and generate automated reports, illustrate GenAI's potential in this area.

Financial viability

Financial constraints are driving the need to optimize both investments and operations. GenAI supports capital planning, budget management, and data-driven decision-making, strengthening long-term financial sustainability.

Stakeholder understanding and support

Public trust is a strategic asset. GenAI enables the generation of personalized content, such as FAQs, infographics, and summaries, for different audiences, improving transparency and understanding of complex decisions without having to expand communication teams.

Community sustainability

AI supports the design of more equitable and sustainable programs by analyzing unstructured community data and simulating the impact of alternative policy choices. These types of tools are already being used to build equity and sustainability into decision-making processes.

Talent development

As utility workers retire en masse, GenAI becomes a key ally in retaining institutional knowledge and accelerating training for new generations. This reduces dependence on static procedures and fosters the development of a digital culture.

Governance and responsible use: the key factor

Adopting GenAI in utilities requires a rigorous approach to governance. AI systems must be transparent, auditable, and subject to human oversight, especially in safety-critical contexts. Data protection requirements (GDPR and local regulations), risk management, and fairness in application design are essential.

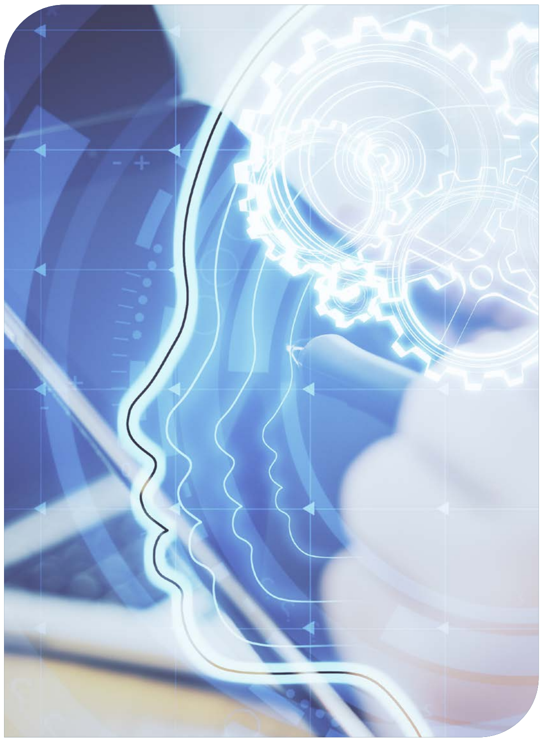
The recent approval of the EU AI Regulation (2024) classifies AI systems used in utilities as “high risk”, requiring documented risk management processes, transparency, and human oversight. Governance is no longer an aspirational goal but a prerequisite for the strategic and sustainable deployment of AI.

Generative artificial intelligence is moving beyond a technological trend to become a strategic tool in water management. Its applications are already delivering measurable improvements in cost control, productivity, and customer satisfaction. However, its greatest value lies in its ability to address challenges that are not yet fully digitized, including resilience, regulatory performance, and public trust.

The immediate future demands leadership, vision, and a firm commitment to responsible innovation. Utilities do not need to become technology companies, but they must integrate GenAI as a cornerstone of their transformation, aligning future pilots with high-impact capabilities and laying the foundations for a more resilient, efficient, and reliable sector.

TREND 2

Artificial Intelligence: agent-based architectures for water utility operations



In 2026, agent-based architectures are expected to become one of the main drivers of transformation in water utility operations. They are enabled by Model Context Protocols (MCPs), a standard that enables AI models (such as ChatGPT) to connect securely and seamlessly to external tools, data, and systems. They represent a major step forward in how artificial intelligence can be applied to utility processes and day-to-day operations. Large Language Models (LLMs), i.e., artificial intelligence models trained with enormous amounts of text to understand and generate human language, can now be deployed as coordinating agents to engage with business systems through structured and governed interactions, rather than relying on isolated analyses, rigid dashboards, and monolithic models tailored to a single task.

LLM-based agents are given controlled access to operational data, analytical services, and deployment capabilities through MCPs. According to David Torres, AI Product Manager at Xylem Vue, MCPs "define standardized mechanisms that enable agents to identify available tools, retrieve contextual information, invoke analytical processes, and, in some cases, activate operational tasks. This ensures that reasoning and rollout take place within auditable, secure, and domain-specific boundaries, which are key factors in critical industries such as water”.

Extensive customization and operator-centric decision support

MCP-enabled AI approaches represent a fundamentally different paradigm from traditional software systems, enabling operator-driven customization. Operators can express analytical needs and goals in natural language, rather than relying on predefined dashboards, reports, and KPIs. Agents convert these requests into structured workflows for real-time data retrieval, analysis, and visualization. This is revolutionizing how applications are designed, and software companies are already adapting their stacks and architectures to take full advantage of this new technology.

Agents can retrieve, combine, and format data on demand, presenting it in the most effective form for decision-making, such as:

- Time series graphs, showing KPI trends and predictions
- Summary tables and anomaly lists, classified by different criteria
- Customized thematic maps using geoprocessing techniques
- Comparative analyses of DMAs or assets across different time windows and operating conditions

In addition to ad hoc queries, operators can define recurring analytical workflows, such as daily and weekly reports highlighting key events, anomalies, and KPIs. These processes run automatically and are distributed through the existing channels. This flexibility reduces friction between data and decisions, enabling teams to focus on interpreting results and prioritizing actions, rather than gathering information and juggling multiple systems.

Human governance in the loop for key actions

Despite advances in AI agents, there are still numerous security, reliability, and accountability risks, especially in critical infrastructures such as water systems, where a single error can have serious consequences. Therefore, not all decisions should be automated or fully delegated to these new technologies. MCP-based agent architectures are well suited to embedding governance that keeps humans in the loop, enabling the definition of which critical decisions require human validation at the design stage. This is why MCPs tailored to the water sector are needed.

Agents can be designed to:

1. Analyze conditions and recommend courses of action
2. Clearly explain the reasoning and evidence behind each recommendation
3. Request explicit human approval before performing predefined operations

Common cases include approving interventions and operational changes, activating emergency procedures, and sending customer communications, keeping expert judgment at the center of decision-making and providing advanced analytical support.

This human-AI integration enables gradual adoption, starting with advisory systems and increasing automation as trust and organizational maturity increase. In addition, human decisions can be used as key data to evaluate and improve AI performance.

Regulatory constraints can be enforced as security barriers in servers and MCP tools: LLMs provide part of the intelligence, but implementation depends on MCPs that are specifically designed for the water sector.

Transparency, traceability, and explanability by design

A key advantage of MCP-based architecture is the built-in transparency it provides. As all interactions between agents and business systems are mediated through MCPs, every step of an agent-driven workflow is observable, traceable, and auditable.

For each workflow, utilities can track:

- The tools and data sources that were accessed
- The sequence of analytical and reasoning steps performed
- The intermediate and final results obtained
- The explanations or justifications presented to users
- Any actions proposed, approved, or performed

Traceability is key in highly regulated and critical environments, as it facilitates explainability, audits, post-event analysis, regulatory compliance, and continuous improvement of workflows and decisions.

Unlike "black boxes," MCP-enabled agents act as transparent collaborators, presenting their reasoning in a structured, understandable way to operators, engineers, and auditors, explaining not only what is recommended, but why.

Water-specific MCPs can integrate industry standards, operational constraints, and domain semantics, reinforcing explainability and control, in line with best practices.

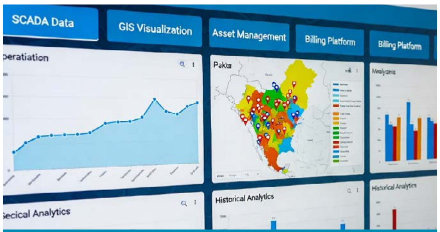
Even in isolated OT environments, where access to cloud models may be restricted, local and open-source models can be deployed for AI agents, providing an additional layer of privacy and security. Under normal conditions, when proprietary foundational models are used, decisions can also be made during the design phase of these systems as to which data are disclosed externally, limiting the exposure of confidential and sensitive information.

Enabling inter-system reasoning once data silos have been broken down

MCPs unlock significant additional value for companies that have already invested in data integration. Exposing SCADA systems, GIS platforms, asset management systems, billing platforms, and historical analytics through standardized interfaces and integrated data empowers agents to reason across previously isolated domains.

This cross-domain reasoning enables agents to:

Detect inconsistencies, correlations, and emerging risks across systems



Provide contextual recommendations by combining operational, geospatial, and historical data

Suggest or initiate coordinated actions across multiple platforms

MCPs act as a layer of governance, ensuring that these interactions remain secure, traceable, and aligned with established operational policies and access controls.

Automation of repetitive tasks that require specific industry knowledge

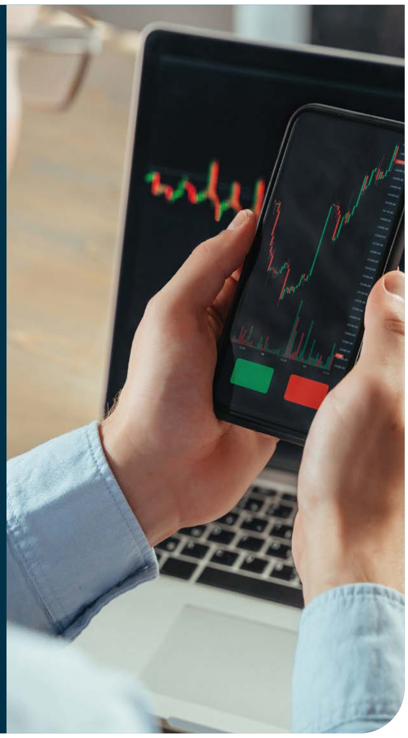
Many critical water utility tasks are repetitive and require a high level of industry knowledge. DMA-level monitoring for leak detection is a clear example, where the operator's decisions are based on ongoing expert analysis of multiple indicators such as nighttime flows, minimum consumption patterns, pressure, and historical trends.

LLMs alone cannot accurately capture these industry-specific flows and concepts. MCP-enabled architecture enables experts to embed domain knowledge, operational rules, and contextual constraints directly into the natural language agent through a series of contexts. When combined with access to data analytics tools, this bridges the gap between general-purpose AI and water industry-specific operational intelligence.

Utilities can use MCP-enabled agents to automate workflows such as leak detection by:

- extracting key indicators for each DMA
- evaluating KPIs and predefined thresholds such as water balances, minimum nighttime flows, and pressure trends
- identifying anomalies and uncertainties using historical baselines and learned behaviors
- generating structured insights for the operator using the most appropriate interface components, such as time series charts, maps, tables, and natural language explanations
- triggering follow-up actions such as generating field work orders, recommending pressure adjustments, and initiating customer notifications when conditions are met, leaving the final decision to the operator, where pre-established.

This automation shifts human input from manual data inspection to monitoring, validation, and higher-value strategic decision-making.



Leveraging digital twins and hydraulic models through MCP interfaces

The mechanistic and hydraulic models that underpin digital twins are powerful yet complex. Although research is ongoing to replace them with purely data-driven AI models, the agent-based approach offers a complementary path: expanding and enhancing them, rather than substituting them.

Digital twins and hydraulic simulators can be exposed to agents through controlled abstractions using MCP interfaces. This enables AI agents to programmatically configure inputs, constraints, and scenarios without requiring operators to interact directly with specialized modeling software.

Agents can interact with digital twins by:

a. **running simulations under current conditions and predefined or novel "what-if" scenarios**

b. **dynamically modifying variables based on context and objectives**

c. **analyzing and summarizing simulation results**

d. **comparing results with operational objectives such as service levels, energy efficiency, and risk reduction**

Agents can use the right context and tools to evaluate multiple scenarios, compare results, and identify optimal strategies for mitigating risks and solving operational problems. They can also suggest recalibrations when there are discrepancies between the model and reality.

This approach brings advanced modeling capabilities to a wider range of operational flows, reduces dependence on hydraulic experts for scenario simulation, and enables operators to create, run, and evaluate scenarios without in-depth knowledge of hydraulic modeling through natural language interfaces.

Exploring AI-powered optimization systems for water utility operations

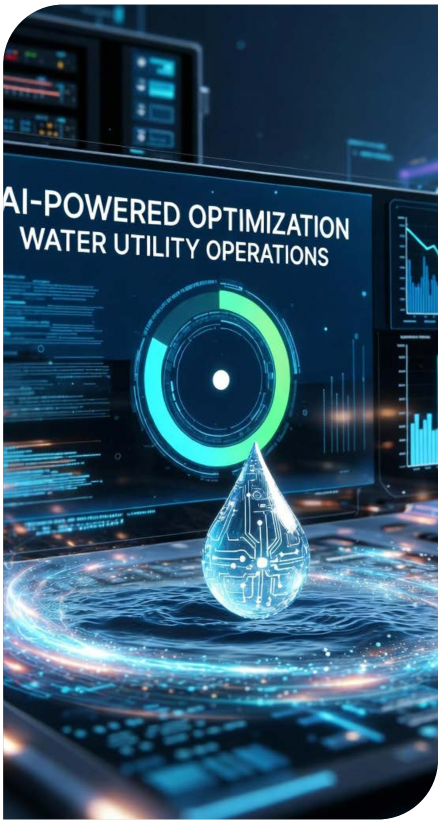
Traditional optimization systems are based on mechanistic or machine-learning models embedded into rigid workflows. While they deliver accurate results, their structure limits operational flexibility.

LLMs can extend these frameworks by analyzing results and generating recommendations. Instead of treating inputs and constraints as static parameters, they can vary them dynamically to perform sensitivity analyses and investigate how changes affect optimal solutions. Similarly, optimization engines can be exposed as modular components that LLMs orchestrate to design and run optimization workflows on demand.

Practical examples include:

- **improving optimization results:** an LLM can analyze the sensitivity of key variables (such as forecast demand) and propose alternative strategies based on different scenarios, in response to operational recommendations.
- **dynamic orchestration of optimization modules:** an LLM can activate optimization routines to define how to operate the network and minimize discharge volumes during events such as overflows or relief discharges in sewer systems.

These capabilities, which are available through natural language interfaces, enable operators and experts to explore and adjust complex scenarios without relying on data scientists or hydraulic experts, thereby democratizing the use of advanced optimization tools and accelerating their operational deployment.



Harnessing the technical expertise of water specialists and hydraulic engineers

Expert knowledge from hydraulic engineers and water industry specialists can be built into LLMs, making best practices, procedures, decision trees, and advanced real-time interpretation more widely accessible. These systems can then suggest courses of action under different operating conditions, interpret model results, and provide recommendations grounded in engineering principles.

Xylem's extensive experience in the water sector provides a solid foundation for equipping these models with domain-specific knowledge. What once required large engineering teams with decades of experience can now be made immediately available to business users through LLMs embedded in the Xylem Vue platform, at lower cost and without operational limitations. In addition, the ability to incorporate and refine user-specific contexts significantly improves the performance and experience of AI agents. This provides a scenario in which utilities and technology companies combine their knowledge to improve the behavior of AI agents in specific environments.

By integrating expert knowledge into the platform, operators benefit from a dedicated knowledge base, enabling more consistent, well-informed and more confident decision-making in the water sector. Xylem Vue democratizes technical knowledge, turning what previously depended on the expertise of hundreds of specialists into a universally accessible, AI-powered suite of advanced capabilities.

From alert to impact: why Early Warning Systems must become operational systems in 2026

The latest reports from the World Meteorological Organization confirm that global average temperatures are continuing to hit record highs. Extreme events are becoming more frequent, more intense, and, above all, more difficult to predict using conventional models. However, the real problem is no longer just meteorological. It is operational: floods do not cause serious damage due to a lack of data. They cause damage because there is too little time to make decisions and take action.

For years, early warning systems have been understood as sophisticated monitoring networks, made up of weather radars and sensors, and level and flow stations with automatic thresholds. They are designed to provide a warning about something that is already happening. However, in 2026, this approach is clearly insufficient. Alerting is not the same as anticipating, and anticipating is not the same as taking action.

Above all, today, a modern Early Warning System must be an operational risk management system. In this regard, Sergio Morant, Head of EWS at Xylem Vue, pointed out that these systems “cannot simply indicate that a level has exceeded a threshold. They must be able to convert information into specific implications for the area and, more importantly, link it automatically to the activation of emergency plans, municipal protocols, and inter-administrative decisions. The real value of these systems does not lie in their data, but in the actions they trigger."

This paradigm shift requires placing hydrodynamic knowledge at the center of the system. The potential flood risk areas in Spain were defined years ago. However, defining them does not mean understanding them. A river basin's actual response to an intense convective rainfall event depends on dynamic factors, including time of concentration, prior soil saturation, urban development, interactions with drainage networks, natural and engineered flood attenuation, and downstream propagation. Operational knowledge of these areas remains incomplete if there is no continuous, up-to-date hydrological and hydraulic modeling.

Simulation speed as a strategic variable

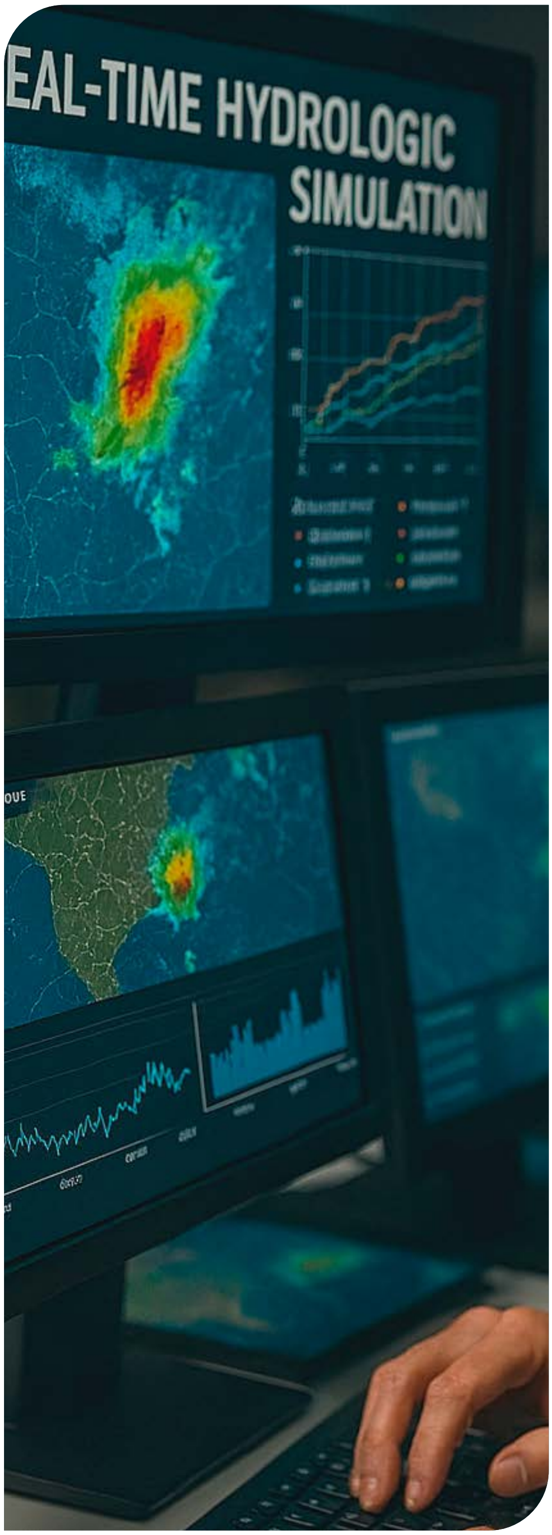
The major advance lies in running hydrological and hydraulic models in real time, driven by multiple forecast scenarios and real-time observations, with continuous updating. This makes simulation speed a strategic variable. When it comes to emergency management, a highly accurate model that takes hours to calculate results may be less useful than a robust model that can recalculate scenarios every few minutes. Simulations every ten minutes, assimilating real-time rainfall and flow data, automatically correcting parameters, and adjusting the hydrological response using data-driven approaches, provide dynamic information that no static model can offer.

During cut-off low convective events, where spatial and temporal uncertainty is at its highest, working with a single deterministic forecast is a conceptual error. The key lies in being able to analyze the forecast envelope: integrating different meteorological models, probabilistic scenarios, and alternative simulations to ensure that critical information is not overlooked. The envelope enables us to identify not only the most probable scenario but also the most plausible high-impact scenario. This provides utilities with a comprehensive view of the risk." This additional information is crucial in situations where a few minutes can make all the difference.

However, even the best model is useless if it is not part of a clear operational framework. An effective Early Warning System has three essential components:

- The first is technology and knowledge: the ability to simulate, predict, and analyze impacts with hydrodynamic accuracy using platforms and software.
- The second is institutional coordination: effective cooperation between water authorities, local councils, civil defense agencies and infrastructure operators so that information can be converted into actionable decisions.
- The third is societal awareness: education, risk culture and trust in the warning system.

Without these three elements: the brain, muscles and heart, technology alone cannot save lives.



What goes on behind the scenes

There is also a less visible but absolutely critical dimension: the behind-the-scenes work that sustains the system when it is not raining. Real response capacity is not built during a storm, but during long periods of apparent normality.

An Early Warning System cannot be activated only when it starts to rain. It must be calibrated, updated, tested, and coordinated throughout the year. Models must be reviewed, sensors verified, protocols tested, plans updated, and authorities coordinated. The digital and operational infrastructure must be in perfect condition long before the first millimeter of rain falls in the basin.

The ultimate goal is not to generate more data or deploy more sensors. It is to gain time. Time to close a road before it becomes flooded. Time to protect a pumping station. Time to activate a municipal response plan before the floodwaters reach vulnerable areas. Time to prevent a family from becoming trapped in their home.

In 2026, the difference between a monitoring system and an operating system can be measured in minutes; and those minutes can be measured in lives. In fact, organizations such as the World Meteorological Organization and UNEP underscore that the real value of a warning system lies not in the warning itself, but in the ability to trigger timely decisions before impacts occur. The current Secretary-General of the United Nations, António Guterres, pointed out in the report "Early Warnings for all. The UN Global Early Warning Initiative for the Implementation of Climate Adaptation", that "early warnings save lives and deliver vast financial benefits." He urged "all governments, financial institutions and civil society to support this effort."

According to Sergio Morant, "the future of early warning systems is not a technological issue; it is a strategic one. The real challenge is to move from warning to impact, from threshold to consequence, and from reaction to anticipation. This is the only way to ensure that hydrodynamic knowledge, simulation speed, and institutional coordination become what they should always have been: tools to protect people in an increasingly challenging climate reality."

Digital Twins and EWS: natural convergence

In this context, the convergence between Early Warning Systems and Digital Twins for the water cycle is no longer a trend; it is a natural evolution. In 2026, it no longer makes sense to view EWS as a stand-alone tool that is only activated during an extreme weather event. Its logical place is within a real-time digital twin, permanently driven by real-time data, multiple weather forecasts, and continuous simulations.

When embedded in a digital twin, an Early Warning System goes beyond monitoring the present and begins planning for the future. It is the mechanism that drives the twin forward in time, repeatedly running predictive scenarios, recalculating hydrological and hydraulic responses every few minutes, and assimilating observed data to reduce uncertainty. This dynamic simulation capability connects planning, operation, and risk management in a single, unified environment.

At this point, technology is no longer just about more accurate models, but about more operational ones. The integration of deterministic and probabilistic forecasts, the generation of scenario envelopes, and the ability to continuously self-calibrate make digital twins a real-time decision-making platform. Prediction is not an academic pursuit; it is a tool for activating resources, prioritizing initiatives, and coordinating authorities with sufficient advance warning.

This convergence represents a structural change for utilities, cities, and management agencies. It means moving from reactive infrastructure management to preemptive systems capable of estimating impacts before they happen. It means reducing damage thanks to improved accuracy, faster analysis, and greater institutional coordination. Above all, it means turning accumulated hydrodynamic knowledge into real operational capabilities.

In 2026, Early Warning Systems can no longer be understood as simple alert platforms. They are predictive engines embedded in digital twins that connect data, models, administrative coordination, and preventive culture in a single ecosystem. This integration is the key to saving time, optimizing resources, and ultimately protecting lives and critical infrastructure in an increasingly challenging climate context.

Cybersecurity: the cornerstone of water in 2026

The water sector is essential for society and thanks to digital transformation across the water cycle operational efficiency has been improved. That is why the increasing digitization of every phase of the full water cycle has enabled improvements in operational efficiency. However, this technological progress also increases vulnerabilities to cyberattacks that could compromise service continuity and water quality. Indeed, agencies such as Spain's National Cybersecurity Institute (INCIBE), the U.S. Cybersecurity and Infrastructure Security Agency (CISA), and France's National Agency for the Security of Information Systems (ANSSI) have already raised concerns over the need to monitor the growing interconnection of control and management systems in treatment plants and distribution networks with IT infrastructures. This requires robust cybersecurity measures to safeguard operations and ensure public safety.

Over recent years, there has been a rise in digital threats within the water sector. Hackers — whether cyber-criminals looking to make profit (ransomware), or geopolitical actors seeking sabotage — have ceased to be a theoretical risk and have become an urgent reality, underscoring the importance of strengthening cybersecurity in the water sector to prevent potentially catastrophic consequences in the water cycle.

Cybersecurity in the water cycle

Water abstraction

Water abstraction relies on often-isolated pumping stations and remote sensors managed by SCADA systems. An intrusion could stop pumps or manipulate valves and quality sensors, compromising supply from the source.

Water treatment (potabilization)

Water treatment plants use ICS systems to control dosage, filtration, and disinfection. Manipulating these parameters could directly affect public health.

Water distribution

Distribution involves extensive networks which remotely control pressure, flow rates, and reservoirs. In this case, an attack could shut down valves, alter pressure values, disable alarms, and compromise sensitive data. Therefore, strengthening this phase would improve service continuity, reduce losses, and protect user data.

Wastewater collection (sewer networks)

Sanitation relies on pumps, gates, and sensors that prevent overflows and spills. Therefore, an attack could cause serious operational failures and environmental damage, as occurred in Maroochy (Australia, 2000), where an attack led to the release of 800,000 liters of sewage. It is key to reinforce cybersecurity in this phase to prevent illicit discharges, protect public health, and strengthen system resilience.

Wastewater treatment plants

Wastewater treatment plants depend on SCADA systems and PLCs to regulate biological and chemical processes. An attack could result in discharges over and above regulatory norms, damage to sensitive equipment, and/or deletion of records required for environmental compliance. Many facilities operate with legacy technology and lack comprehensive operational technology (OT) inventories.

Water reuse

Water reuse systems incorporate advanced processes (microfiltration, reverse osmosis, disinfection) that must be integrated into the overall security architecture. Their growing interconnection with treatment plants and irrigation networks opens new areas for attacks. Manipulation of these processes could produce inadequately treated water or result in incorrect mixing of reclaimed water with drinking water. In this case, cybersecurity measures ensure sanitary compliance and a robust circular water economy.

CISA provides a series of recommendations to reduce risks and enhance the resilience of water utilities at all stages of the water cycle:

1. Secure access pathways

- **Dedicated IP links or VPNs:** it is advisable to use secure and dedicated access routes, such as private IP links and Virtual Private Networks (VPNs), for remote access to the OT network.
- **Multi-factor authentication (MFA):** mandatory MFA should be enforced for all personnel, including employees and third-party vendors, before granting access to any critical OT systems. Each vendor must have unique credentials.

2. Network architecture and segmentation

- **Network segmentation:** OT networks (e.g., pump station PLCs, SCADA systems) should be isolated from the IT network using robust firewalls or demilitarized zones (DMZs).
- **Asset inventory and exposure management:** maintain an inventory of all human-machine interfaces (HMIs) and programmable logic controllers (PLCs) as well as assessing their exposure to publicly accessible networks. Ideally, these devices should not be directly accessible from the Internet.
- **Backup maintenance:** to ensure rapid recovery and regularly create and maintain backups of all critical operational data, including PLC logic/configurations and SCADA system settings.

3. Credential and device management

- **Robust credential management,** which should include:
  - Changing all default passwords after installation.
  - Enforcing password complexity policies.
  - Implementing scheduled key rotation for service accounts and privileged access.
- **Principle of least privilege:** grant personnel and systems only the minimum access rights required for their roles.

4. Resilience and incident response

- **Contingency procedures:** develop and regularly test comprehensive contingency procedures, such as manual controls and local overrides, to ensure operational continuity, should the OT network become compromised or inaccessible.
- **System hardening:** disable all unnecessary services, ports, and protocols on OT devices to reduce the potential attack surface.

Cybersecurity expert Damien Hugoo, Product Security Leader at Xylem, recommends continuous monitoring:

"It is essential to implement passive monitoring tools within OT environments. These are solutions that analyze network traffic for unusual commands, atypical communication patterns, and configuration changes."

Outlook for 2026: transformation and paradigm shift

Therefore, cybersecurity continues to be a growing trend during 2026, shaping up as a key transformational factor in the water sector. Water utilities must continue to integrate security from the design phase of all new projects ("security by design"), as recommended by the United States Environmental Protection Agency (EPA), in response to increasing system hyperconnectivity, accelerated digitalization, and the growing number of cyberattacks.

In this context, all stakeholders involved in the digital transformation of the water sector recognize that secure digital transformation is not feasible without robust cybersecurity. Accordingly, investments supported by governmental digitalization programs will continue to allocate a substantial share of funding to the cyber protection of critical infrastructure and assets. At the same time, cybersecurity projects are growing by 35% across Europe, and forecasts indicate that the global market for governance, risk, and compliance platforms will reach €95 billion by 2034 (Market Growth Reports).

One of the most noteworthy changes will be the consolidation of Zero Trust architectures and Defense-in-Depth in water-sector environments. According to the INCIBE Chair for Water Digitalization and Cybersecurity, in 2026, water utilities will continue to invest in continuous identity and equipment-state verification before granting access to critical systems. Network segmentation will become increasingly granular, isolating components to prevent breaches at individual points from easily propagating across the system.

At the same time, demand for specialists will continue to increase. The hiring of industrial systems specialists will increase in order to monitor plant and network signals for potential intrusions. (This is common across all sectors where cybersecurity will need to be strengthened, , as noted by Malt Tech Trends 2025).

Likewise, the regulatory framework will be tightened. As of 2025, the approval of the Cyber Resilience Act (CRA) requires all products with digital elements sold within the European Union to comply with established cybersecurity requirements. Looking ahead to 2026, EU Member States will begin incorporating the NIS2 Directive into their own national laws. In parallel, similar initiatives are gaining momentum in the United States, where the Environmental Protection Agency (EPA) and CISA have already issued mandatory guidance and assessment frameworks. Discussions are also underway over the establishment of dedicated water resilience agencies, which would further compel water utilities to professionalize and institutionalize cybersecurity within their organizational structures.

Additionally, operational processes will be redefined. Emergency plans will incorporate cyberattack scenarios (for example, how to supply water through alternative channels if the main SCADA system fails, or how to operate a treatment plant manually during an incident), requiring specialist teams to be trained and drilled through simulation exercises.

Moreover, inter-sector collaboration will intensify. Utilities will share information on threats and effective responses to reinforce national water security.

Main challenges and obstacles

Despite progress, significant challenges remain in achieving high levels of cybersecurity in the water sector:

Technological obsolescence. One of the greatest challenges lies in the aging systems used by many utilities which were designed at a time when cybersecurity was not a priority. In these cases, robust authentication and encryption mechanisms are often absent, leaving insecure protocols and known vulnerabilities in place and making such systems prime targets for attackers. Updating or patching these systems without interrupting service is a major technical and budgetary challenge.

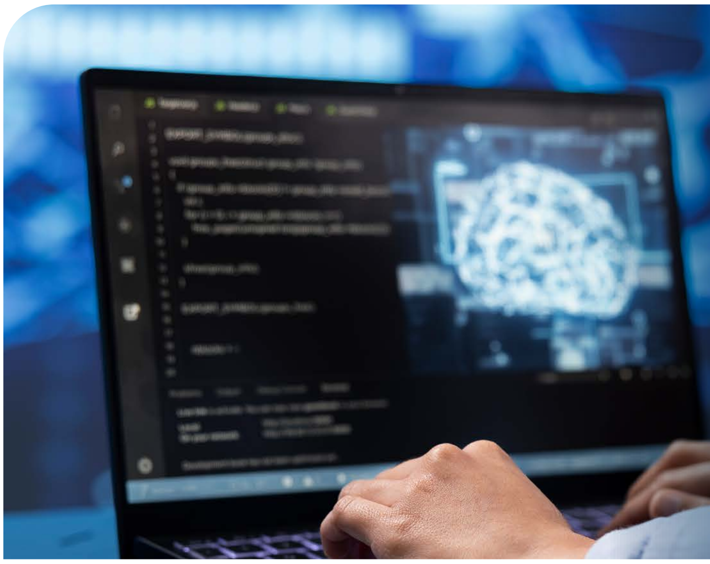
Expanded attack surface due to connectivity. The accelerating digital transformation of the water sector increases the number of potential attack vectors when it is not accompanied by robust cybersecurity protocols. In this context, limiting external exposure, for example, by closing unnecessary access points or using secure VPNs, remains an ongoing challenge for many utilities, as also noted by the EPA.

Need for continuous improvement. The water sector must remain constantly alert as new malware variants, increasingly stealthy intrusion tactics, and more sophisticated threat actors emerge each year. This requires continuously strengthening and updating defenses, conducting regular penetration testing, and actively monitoring cybersecurity threat trends that may affect the sector.

Lack of culture and specialized training. If the digital transformation of utilities, including cybersecurity, is to succeed, it must go hand in hand with a cultural shift within organizations, particularly in an increasingly complex threat environment. Cybersecurity agencies point out the importance of instilling a cybersecurity culture which requires continuous staff training at all levels, from plant technicians (to maintain good practices and detect anomalies) to senior management (to support and invest in security).

Resource limitations in small operators. This disparity is also evident between large companies and small operators. While larger utilities are already incorporating cybersecurity tools and establishing dedicated security departments, smaller utilities face greater operational and financial constraints. For this reason, government support is essential, along with the development of cooperative networks and best-practice sharing. This approach could be strengthened by providing jointly managed cybersecurity services that enable multiple utilities to pool protection resources.

In addition, three key deficiencies often hinder the achievement of adequate cybersecurity standards: **lack of manpower, lack of expertise, and lack of funding.** The combined effect of these factors represents a significant challenge for many utilities.



Cybersecurity will remain a growing priority in 2026, given its role as a foundational element of the water sector's digital transformation. Over the next 12 months, the sector will continue to undergo a paradigm shift that teams must address by acquiring new competencies and strengthening operational preparedness.

In 2026, trends in the water sector will be shaped by the inseparable link between water and cybersecurity, ensuring that digitalization remains secure, resilient, and sustainable for the benefit of society.

TREND 5

Public-private partnerships in water: accelerating digitalization

Although it is not, in itself, a technology trend, digitalization will accelerate in 2026, driven by public–private partnerships and a range of collaboration models. These mechanisms are acting as a catalyst for digital transformation worldwide, mobilizing advanced technologies and innovative operating models supported by public, multilateral, and sectoral policies.

In this regard, the World Bank is clear: "The private sector brings unique strengths to water challenges. Private companies are well placed to innovate by, for example, structuring new financing mechanisms and developing new applications for technologies. Collaboration can augment financing, operational efficiency, and expertise."

Types of public-private partnerships

Cooperation between the public and private sectors in the water industry can take many forms, including partnerships focused on operations, innovation, public policy, data, and technology.

The main categories are as follows:

PPP management and financing models

The main purposes of public-private partnership (PPP) models include operations, financing, construction and maintenance. While the public sector retains ownership of the service or infrastructure, the private sector contributes know-how, technical innovation, and operational efficiency.

R&D and innovation consortia and partnerships

The main objective in this case is to develop new technologies for digitalization, sensors, AI, smart grids, and advanced desalination. The aim is not to operate a public service but to generate knowledge and validate technologies.

Cooperation around data, platforms, and standardization

This increasingly common model supports the water sector's digital transition through shared data ecosystems, platforms, interoperability frameworks, sector-specific data spaces, and joint governance. It is particularly prevalent in the European Union, where regulation is a strong driver of data governance.

Public cooperation programs and policies

This category includes public policies that encourage collaboration with the private sector to accelerate innovation, digitalization, and sector-wide transformation projects.

Sandboxes (regulatory experimentation spaces)

This model is common in countries with tighter regulatory frameworks, as it enables technologies to be tested in controlled environments.

Private company partnerships

While not a public-private model, partnership agreements between private companies are worth mentioning here as a key driver of innovation and digitalization in the sector.

According to Manuel Parra, Vice President of Strategic Partnerships and Marketing at Xylem, "cross-cutting cooperation between companies in the water sector enables organizations with complementary capabilities and expertise to join forces and accelerate the sector's digital transformation so as to develop solutions, scale up technologies, or explore new business models."

There are several different types of partnerships:

- Technological partnerships, which focus on developing new technologies and water treatments.
- Private joint ventures, in which two or more companies join forces to target a specific market or set up a new line of business.
- Commercial and strategic agreements, in which a partnership between two companies aims to market complementary products and solutions.
- Co-development and co-innovation, where both parties contribute knowledge, equipment, and/or technology to develop innovative solutions.
- Private-sector networks and consortia, based on partnerships between a group of companies that share the same technological objectives.

In the opinion of Manuel Parra, these types of partnership models provide a number of advantages "which enable digitalization challenges to be tackled more efficiently, as they accelerate innovation by fostering new solutions while strengthening competitiveness and indirectly promoting public-private partnerships."

International examples of public-private partnerships

Given the importance of this model in accelerating water digitalization, incentives have been put in place to support policies that promote public-private partnerships.

Europe

The Water4All Partnership initiative seeks to promote international cooperation to "enable water security at a large scale and in the long term." The European Union states that the objective of this funding program is to "to tackle water challenges to face climate change, help to achieve the United Nations' Sustainable Development Goals and boost the EU's competitiveness and growth."

Spain, for example, has launched **the Strategic Projects for Economic Recovery and Transformation** (PERTE), which are initiatives designed to boost key areas of the economy including water, so as to modernize the industry, foster innovation, promote economic growth and employment, and enhance the country's competitiveness.

United States

The United States is also strongly committed to partnership models for water digitalization, bringing together public, private, and academic stakeholders to fast-track the transition to more efficient, resilient, and sustainable water management. In fact, studies such as the report published by StartUs Insights show that public-private investment is increasingly concentrated in AI, digital twins, advanced control, and predictive management.

One of the projects underway is the Sustainable Water Initiative for Tomorrow **(SWIFT Program)**, which involves both public funding and innovation in digitalization technologies. Its key initiatives include managed aquifer recharge (MAR) into the Potomac Aquifer, advanced water treatment, environmental impact mitigation, water quality improvement, and the SWIFT Research Center.

The National Alliance for Water Innovation **(NAWI)** is another significant endeavor. This research program and public-private partnership, supported by the U.S. Department of Energy (DOE), aims to identify critical technical barriers and carry out the research necessary to radically reduce the cost and energy consumption of desalination and water reuse.

Asia

Several countries in Asia are also supporting projects that use this collaborative model to promote smart water resource management. According to the World Economic Forum, Singapore has demonstrated that these models are beneficial for all parties through its **Public Utility Board (PUB)**. This approach "gives businesses a suitable platform for innovation that effectively contributes to a broad water policy and security objective."

Likewise, the **West Bengal Drinking Water Sector Improvement Project** is leading the way in collaboration in India, building digitalization into rural and urban management using data control systems and IoT sensors to improve transparency, efficiency, and public health. The Asian Development Bank highlights that the project leverages advanced smart management technologies, including SCADA systems, GIS, and metered household connections (over 390,000), with the goal of providing safe and sustainable drinking water to over 1.65 million people in rural areas affected by arsenic, fluoride, and salinity contamination.

Africa and Latin America

Meanwhile, some countries in Africa and Latin America are promoting sandbox models (secure, isolated testing environments for piloting new technologies) and flexible multilateral financing mechanisms to accelerate the deployment of innovative solutions in high-risk water contexts.

Some of these sandboxes receive financial backing from organizations such as the World Bank, which invests in programs that support innovation, digitalization and water management in crisis contexts, including the Global Water Security & Sanitation Partnership (GWSP) and the 2030 Water Resources Group (2030 WRG).

The Inter-American Development Bank (IDB) is another key player in this area, and is heavily involved in this type of financing, focusing mainly on water distribution and sanitation (Source: Water Security Financing Report 2024).

Benefits of these models

In addition to clear improvements in water management, these partnerships bring a number of advantages that are likely to make them increasingly important in 2026 and beyond, positioning them as a major trend:

DIGITALIZATION

They accelerate digitalization in the water sector by combining capital, expertise, and technology. This is difficult to achieve for a single organization.

INNOVATION

They drive innovation through knowledge transfer between public and private organizations, improving service quality.

OPERATIONAL EFFICIENCY

They increase operational efficiency by leveraging the technical expertise of the private sector in operations, maintenance, and the deployment of new technologies.

EXTERNAL FINANCING

They provide access to external funding, enabling major investments without increasing public-sector debt and putting pressure on government budgets.

RISK MANAGEMENT

They improve risk management and distribution, promoting transparency, ensuring stability, and strengthening operational oversight.

Emerging trends

There are several international trends in partnership models, depending on specific project needs and/or the technologies being deployed.

On the one hand, **rapid growth in technologies such as digital twins, predictive analytics, and AI, combined with the need to respond to extreme events** such as floods, are driving the development of public-private digital specialization hubs focused on resilience planning.

Another trend is the **growing use of collaborative platforms and open data ecosystems** that foster citizen participation and support evidence-based decision-making, as reported by the Organization for Economic Cooperation and Development (OECD).

Incorporating cybersecurity and adaptive systems into infrastructure is already a priority in North America and the European Union, where the digital transformation of water must comply with strict standards and digital defense systems.

International challenges and opportunities

Public-private partnerships also bring challenges. This was acknowledged by the OECD in 2025 at the 20th meeting of the Water Governance Initiative, where it presented 12 core recommendations for governments.

Two particular challenges were highlighted:

1. Transnational interoperability, scalability of solutions, and equitable access to technology.

2. The need for specialized training to retain digital talent, promoting public-private educational networks adapted to water digitalization.

At the same time, opportunities are emerging in hybrid financing (green bonds, multilateral funds, NextGen EU) and flexible regulatory frameworks that foster inclusive innovation.

In Europe, data management is also becoming a differentiating factor, as regulations require clearly defined policies on governance, protection, and the accessibility of information to be built in from the outset.

This context opens up new opportunities in three key areas:

Shared data spaces with standardized and tiered access.

Interoperable platforms that integrate sensors, SCADA, AI, and advanced analytics, reducing the risk of closed technology dependencies.

Growing demand for data governance specialists in 2026, with 93% of companies planning to increase investment in this area (Cisco's 2026 Data and Privacy Benchmark Study).

Strategic recommendations

As a result, there is a need to understand and implement strategic recommendations that will enable efficient and sustainable water resource management. These include:

- Promoting cross-border public-private partnerships in digital innovation that combine business expertise, scientific knowledge, and social participation.
- Fostering open-data platforms and international observatories to share standards, best practices, and technical results.
- Aligning partnership models with the Sustainable Development Goals and existing multilateral regulatory frameworks, while prioritizing cybersecurity and climate risk management in infrastructure digitalization.
- Investing in training worldwide and building collaborative networks to attract diverse, highly skilled digital talent.
- Integrating regulatory sandboxes, adaptive financing, and flexible governance to speed up the rollout and scalability of water digitalization across all continents.

The digital transformation of water, supported by horizontal (business-to-business) and vertical (business-to-government) partnership models, is key to ensuring water security, resilience, and sustainability in increasingly complex scenarios shaped by rising global risks.

Conclusion

Last January, the UN declared a **state of "water bankruptcy" in its Global Water Bankruptcy report,** pointing to the irreversible depletion of aquifer reserves due to increasing human demand.

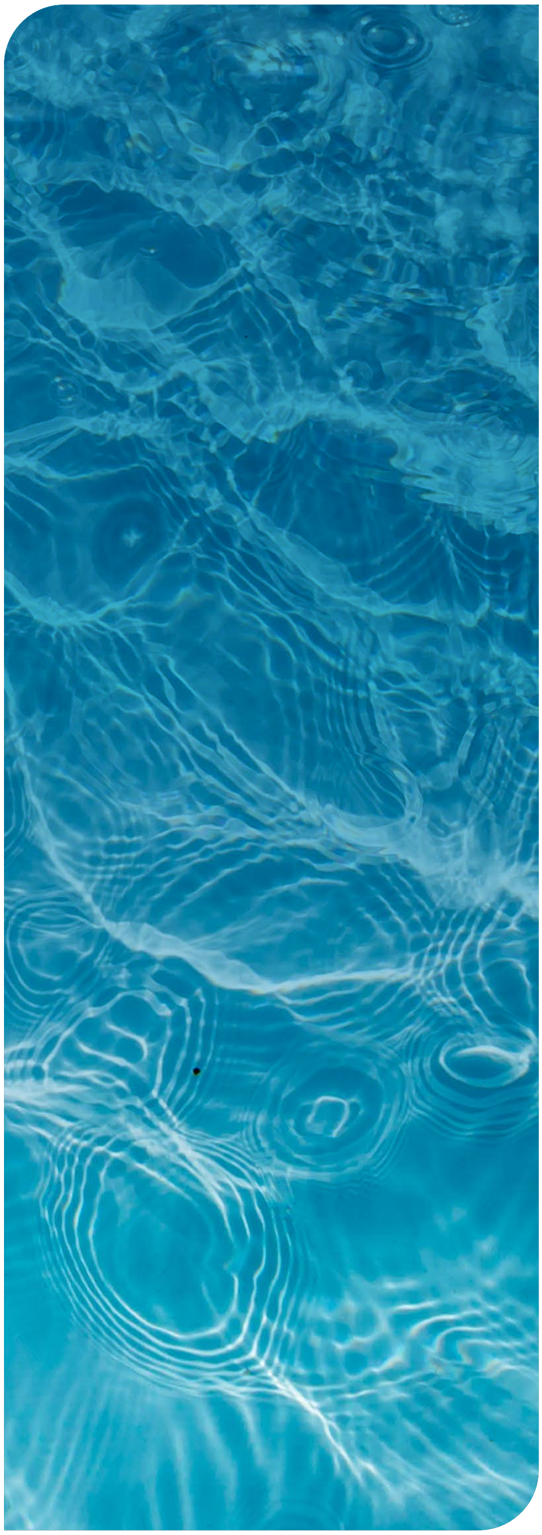
In this context, **the digital trends analyzed in this white paper are no longer optional.** They are now essential operational requirements to respond to the UN Water Conference 2026 call to protect every drop. In fact, the UN and the World Bank agree that **digitalization is a key lever for improving efficiency, reducing losses, and closing funding gaps** in utilities facing increasing operational and financial pressure. This is where generative artificial intelligence and agent-based architectures emerge as a robust response, transforming scattered data into structured, data-driven decisions.

However, it is not only about protecting every drop, **but also about protecting people**. If extreme events continue to grow in number and intensity, it is essential to reduce response times. This is why Early Warning Systems remain fully relevant. Their transition into platforms that integrate high-resolution hydraulic models, advanced weather forecasting, and stochastic and statistical analysis, combining multiple information sources in real time, underscores **the importance of enhancing the safety of citizens when these events occur.**

In fact, information and safety are two interdependent variables within this transformation. Both are supported by technologies such as blockchain, reinforcing the confidence of citizens and public administrations in water quality. **Cybersecurity is therefore a critical enabling condition** at a time when water is more strategic than ever for social and economic stability.

However, digital transformation of the water sector must be carried out within a framework of **collaboration between the public and private sectors**, supported by technology and by the exchange of experience and knowledge, to ensure improved water resource management.

This white paper proposes **a pragmatic roadmap for bringing these aspects together,** in a context where technology, data, and cooperation move from being accelerators to becoming the basic building blocks of water resilience. Organizations that embrace these trends will be better prepared for a world with less water and more uncertainty. **They will also be actively contributing to protecting every drop,** sustaining one of the cornerstones of global development, stability, and prosperity.



Xylem |'zīləm|

1) the tissue in plants that brings water and nutrients upward from the roots.
2) a leading global water solutions company.

Xylem is the connective tissue and system in plants which cleanses and transports water from the root to where it is needed most to sustain life.

And this is the essence of Xylem as a company. We are committed to driving sustainable impact by ensuring our connected technologies and solutions support our customers and the communities they serve, to tackle the water challenges that matter most to them.

For more information on how Xylem can help you, visit xylem.com.

xylem vue

Xylem Vue is the result of the partnership between Xylem, a global leader in water technology and Idrica, an international pioneer in water data management, analytics and smart-water solutions. Through this partnership, Xylem and Idrica bring together their technology, innovation, and expertise to solve the world's most critical drinking water, wastewater and other water-related challenges.

Our single, integrated software and analytics platform – built by utilities, for utilities – enables utilities to take digital transformation to the next level, maximize investments, identify and solve problems more quickly, operate more efficiently and deliver water more effectively and affordably to their communities.

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