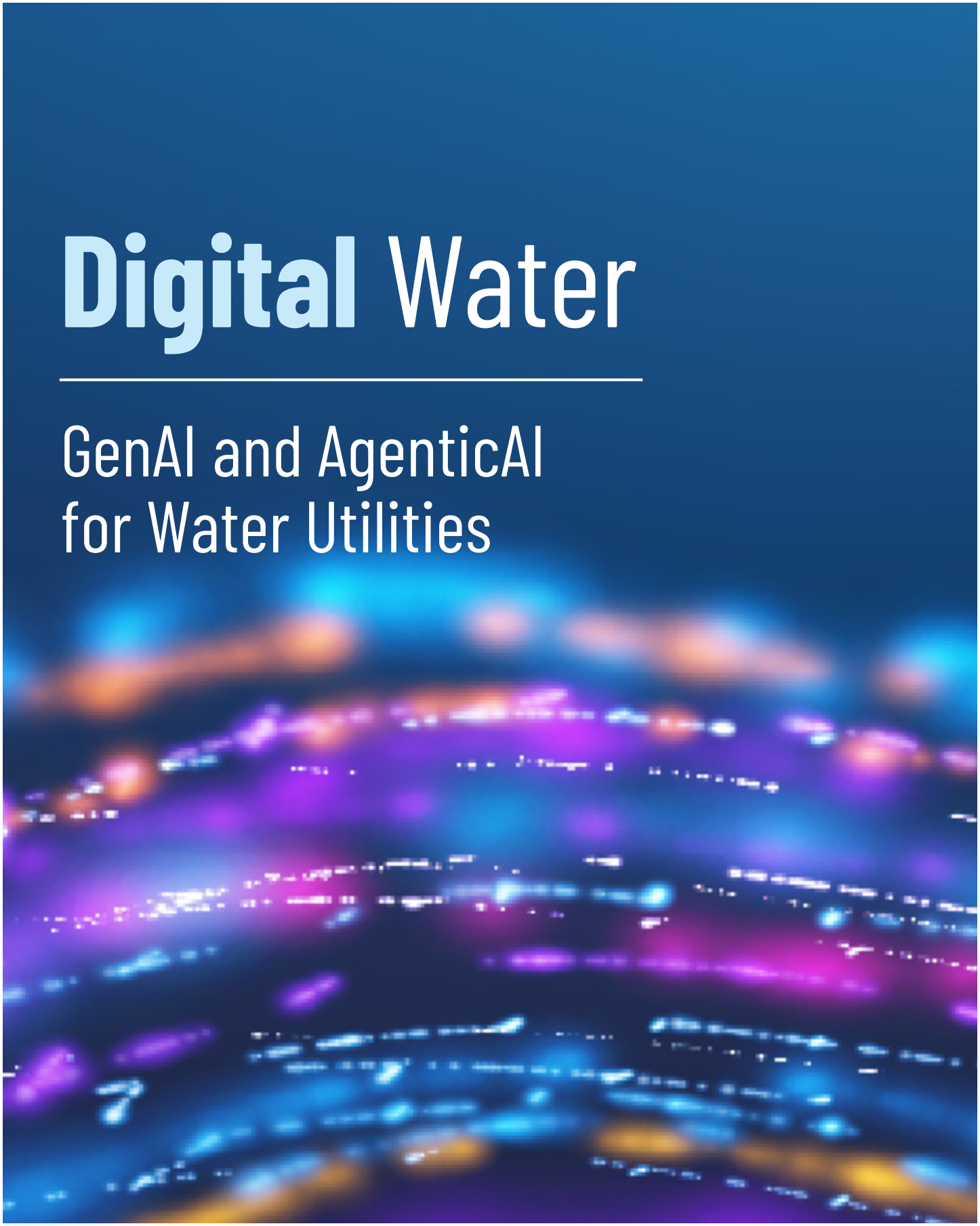
the international water association

Digital Water

GenAI and AgenticAI for Water Utilities



the international water association

Digital Water

GenAI and AgenticAI for Water Utilities

Author

Prabhu Chandrasekeran, *Arcadis*

Reviewers

Mogan Padayachee, *Rand Water*

Robin Wong, *TeamSolve*

Oliver Grievson, *AtkinsRéalis*

Acknowledgements

The authors would like to thank the members of the DWP Steering Committee for their guidance, the IWA Secretariat for their valuable comments, and Vivian Langmaack for the design support.

Acronyms

AI	Artificial Intelligence	Broad field of computer science focused on creating systems that can perform tasks normally requiring human intelligence.
AI/ML	Artificial Intelligence / Machine Learning	Refers to early or classical applications of AI powered by statistical or algorithmic learning models.
AGENTICAI	Agentic Artificial Intelligence	AI systems capable of autonomous actions, decision-making, and multi-step task execution without human intervention.
BI	Business Intelligence	Technologies and tools that transform raw data into useful insights, typically through dashboards and reports.
CCTV	(Used in the context of) inspection findings	In water utilities, refers to Closed-Circuit Television used to inspect pipes and record defects or structural issues.
CMMS	Computerized Maintenance Management System	Software used to manage asset maintenance, work orders, inventory, and maintenance schedules.
CRM	Customer Relationship Management	Software that helps organizations manage customer interactions, service requests, and communication.
DW	Digital Water	The integration of digital technologies and data-driven approaches in water and wastewater management.
ERP	Enterprise Resource Planning	A system integrating internal business processes such as finance, HR, procurement, and operations.
FMS	Foundation Models	Large, general-purpose AI models that can be adapted for multiple downstream tasks.
GENAI	Generative Artificial Intelligence	AI that can generate text, images, code or other content based on training data.
GIS	Geographic Information System	Technology for capturing, analyzing, and visualizing geographic and spatial data.
IOT	Internet of Things	Network of connected devices that collect and exchange data in real time.
IT	Information Technology	Refers to software, computers, and information systems used across an organization.

IT/OT	Information Technology / Operational Technology	Convergence of IT and OT systems to improve monitoring, control, and analytics.
IWA	International Water Association	Global network of water professionals advancing water management worldwide.
KPIS	Key Performance Indicators	Metrics used to measure performance and progress toward objectives.
LLMS	Large Language Models	AI models trained on massive datasets to understand and generate human language (e.g., GPT, Gemini).
NRW	Non-Revenue Water	Water that has been produced but is lost before it reaches the customer due to leaks, theft, or metering inaccuracies.
OPEX	Operational Expenditure	Ongoing costs of running operations, such as energy, chemicals, and labor.
OT	Operational Technology	Systems used to monitor and control physical processes (e.g., SCADA, sensors, pumps).
PLCS	Programmable Logic Controllers	Industrial digital computers used for automation of electromechanical processes.
POF × COF	Probability of Failure × Consequence of Failure	A risk-based prioritization method for asset management decision-making.
RAG	Retrieval-Augmented Generation	AI technique that retrieves external information to improve response accuracy.
SCADA	Supervisory Control and Data Acquisition	System used to monitor, control, and collect data from industrial processes.
SLMS	Small Language Models	Lightweight AI models designed for efficient deployment with lower compute needs.
SOPS	Standard Operating Procedures	Step-by-step instructions that describe how to perform routine operations safely and consistently.

Foreword

GenAI and AgenticAI for Water Utilities

Digitalisation has transformed resource and asset management, rapidly expanding the technological frontier with tools once considered beyond reach. Breakthroughs such as advanced AI models, real-time digital twins, autonomous optimisation engines, and sector-specific analytics platforms are redefining how water and sanitation utilities understand, manage, and plan their systems. These innovations are enabling improved visibility into network behaviour, faster and more accurate decision making, and a shift toward predictive and increasingly intelligent utility operations.

Yet even as digital capabilities accelerate, water utilities around the world continue to navigate interconnected pressures, including climate-induced extremes, rapid urban expansion, growing water scarcity, ageing and fragile infrastructure, and persistent financial constraints. These challenges compound one another, resulting in system inefficiencies, service risks, and operational volatility. Digitalisation provides a pathway forward by transforming fragmented datasets into integrated intelligence and laying the groundwork for automated and resilient operations.

The latest paper of the IWA Digital Water Programme examines how Generative AI and Agentic AI can advance the next stage of digital transformation in the water and sanitation sector. It explores how Generative AI unlocks insights from existing data and streamlines tasks such as reporting, analysis, and knowledge capture, while Agentic AI builds on these insights to enable autonomous decision making, continuous scenario testing, and proactive system optimisation. Together, these technologies can help mitigate critical sector challenges such as the ageing workforce and rising operational complexity while enhancing resource efficiency, resilience, and executive foresight. The paper offers a practical roadmap for responsible adoption that delivers measurable value and supports long-term sustainability and stewardship.

In IWA's 2025-2030 Strategic Plan, digitalisation is highlighted as a transformational force influencing all aspects of water management. This white paper is aligned with that outlook, reflecting how Generative AI and Agentic AI contribute to that transformation and support the sector's shift toward more intelligent, adaptive, and future-ready operations.

It also advances IWA's Digital Water Programme, through which IWA continues to inspire and guide the sector toward smarter, more connected approaches to water management. Such initiatives under the programme aim to build understanding and capacity in digital technologies, supporting utilities and other stakeholders in their digital transformation journey as well as improving their performance.

As global leaders in water related knowledge creation, we believe that application is essential to improving water services worldwide. Through the dissemination of best practices and by highlighting emerging technologies, we can build a more intelligent and sustainable water future.

Kalanithy Vairavamoorthy
Executive Director of the International Water Association

Foreword

One of the key challenges of Digital Transformation has always been extracting meaningful insight from the vast array of data the water industry collects. The sector is often described as “data rich but information poor,” and this imbalance is only set to grow as more data is generated. Paradoxically, the sheer volume of data can increase this information poverty, making it harder to see the proverbial “wood for the trees.”

Although often considered a new technology, Artificial Intelligence has been applied in the water industry for many years. Yet, it has never become mainstream enough to realise its full potential. Digital Transformation, at its core, leverages these diverse data sources to create actionable situational awareness—helping utilities understand and optimise the performance of their systems.

I first encountered AgenticAI in a rudimentary form just months before this paper was published, with water companies beginning to explore its concepts in basic ways. Its potential was immediately apparent. However, developing it into a tool that can operate effectively within the water sector’s operational environment is a far more complex challenge. Success in this area represents the forefront of technical innovation, with the power to solve some of the industry’s toughest problems, improve environmental outcomes, and transform the sector into one that is both data and insight rich. This is the promise of GenAI, AgenticAI, and Digital Transformation.

The IWA Digital Water Programme is committed to equipping water utilities worldwide with a roadmap for the responsible adoption of these emerging technologies. By providing guidance and best practices, the programme seeks to ensure that AI and Digital Transformation initiatives deliver measurable value while aligning with principles of sustainability, stewardship, and the long-term resilience of the water sector.

Oliver Grievson
Associate Director and Technical Authority at AtkinsRéalis,
Chair of the IWA Digital Water Programme Steering Committee

Table of Contents

Summary 9

Key Takeaways 10

Generative AI and Agentic AI: The Next Wave of Digital Water 11

Understanding Generative AI 11
Understanding Agentic AI 11
Why Now? The Business Case 12
Core Value Levers of GenAI & AgenticAI 13

Applications Across Utility Functions 14

1. Operations & Maintenance 14
2. Customer Service & Engagement 14
3. Asset Management & Investment Planning 15
4. Water Quality & Treatment 15
5. Network Management & Non-Revenue Water (NRW) 16
6. Leadership & Executives 16
Empowering the Water Workforce (WHAT GenAI/AgenticAI deliver) 17
How to Enable Workforce Adoption (HOW utilities prepare) 17

Integration into the Digital Water Ecosystem 18

Why Integration Matters 18
Techniques for Integration 18
Open vs Closed Models 19
Digital Twins + AI 19

Call to action 21

Summary

The global water sector faces unprecedented challenges, including climate change, ageing infrastructure, financial pressures, and a rapidly ageing workforce. At the same time, expectations for reliability, sustainability, and customer engagement continue to rise (Figure 1).

Generative Artificial Intelligence **(GenAI)** and Agentic Artificial Intelligence **(AgenticAI)** represent the next wave of digital transformation in the water sector. GenAI creates new knowledge and insights from existing data, while AgenticAI acts on those insights with autonomy and foresight. Together, they extend the value of previous AI efforts—moving utilities beyond prediction toward action, foresight, and resilience (Figure 2).

This paper explores how GenAI and AgenticAI can:

- Boost **productivity** by automating reporting, analysis, and frontline support.
- Capture and transfer knowledge to address the **ageing workforce** challenge.
- Support **complex, non-linear decision-making** through scenario analysis and strategic simulations.
- Enhance **resource efficiency** by optimising energy, water use, and investment planning.
- Empower **leaders and executives** with real-time foresight into risks, opportunities, and long-term resilience.

The goal is to equip water utilities worldwide with a roadmap for responsibly adopting these technologies, ensuring they deliver measurable value while aligning with sustainability and stewardship.

Figure 1. Key challenges of water utilities

Key Takeaways

- **Productivity Gains –** GenAI copilots automate reporting, summaries, and customer responses, freeing staff for higher-value work.
- **Workforce Enablement** – AI helps capture tacit knowledge, train new staff faster, and support operators as the experienced workforce retires.
- **Complex Decision Support –** AgenticAI continuously runs "what-if" scenarios to help leaders plan for uncertain and non-linear futures.
- **Resource Stewardship –** AI optimises water, energy, and chemical use, reducing operational costs and environmental impact.
- **Leadership Advantage –** Executives gain synthesised insights and foresight, enabling faster and more confident strategic decisions.

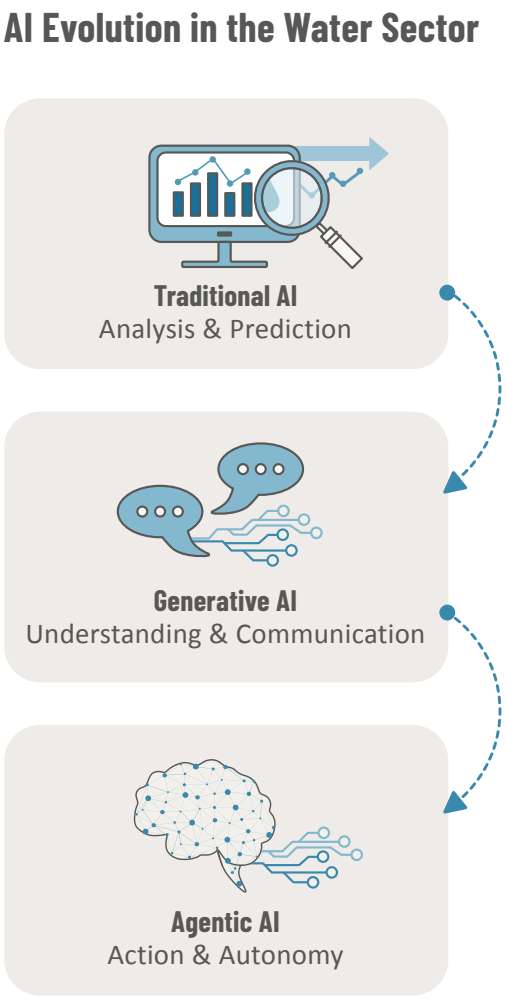


Figure 2. AI evolution in the water sector: from analysis, to understanding, to autonomous action.

Generative AI and Agentic AI: The Next Wave of Digital Water

The water sector is facing a perfect storm of challenges: climate change disrupting hydrological cycles, ageing infrastructure in need of renewal, rapid urbanisation, and rising expectations for efficiency, compliance, and customer service. At the same time, utilities are experiencing workforce transitions, with critical skills retiring faster than they can be replaced. Managing this complexity demands more than incremental improvements — it requires a step change.

The IWA Digital Water Programme has laid a strong foundation, guiding utilities through IoT, SCADA, CMMS, GIS, and early AI/ML applications for leak detection, water quality, and asset optimisation. These have improved monitoring and awareness. But "digital water" is evolving. It's no longer just about more sensors or predictive models — it's about creating intelligent systems that help us understand, decide, and act.

Understanding Generative AI

Generative AI (GenAI) creates new content from data — text, code, images, or process summaries — instead of only classifying or predicting. Think of it as a sophisticated "autocomplete" that can summarise SCADA logs, draft regulatory reports, or generate troubleshooting guides.

- **Foundation Models (FMs):** broad models trained on huge datasets, adaptable to multiple tasks.
- **LLMs (Large Language Models):** GPT, Claude, Gemini, Llama — strongest at natural language tasks.
- **SLMs (Small Language Models):** leaner, cost-effective, and practical for smaller utilities or LMICs.
- **Open vs Closed Source:** open models (Llama, Mistral) give control and privacy; closed models (GPT-4, Gemini Pro) offer top performance but depend on vendors.

In practice: GenAI copilots help staff across IT/OT — from operators getting natural language explanations of SCADA alarms, to planners drafting risk reports, to executives receiving concise summaries of KPIs or regulatory documents.

Understanding Agentic AI

Agentic AI goes a step further: **autonomy**. These systems don't just generate content; they can pursue goals, plan steps, and act on data. They perceive their environment, make decisions, and carry out tasks with minimal oversight.

- **Goal-Oriented Autonomy:** given an objective (e.g., optimise pumping costs), an agent can plan and execute.
- **Proactive Decision-Making:** detects issues before operators flag them, tests options, and chooses a course of action.
- **Environment Awareness:** integrates sensor data, forecasts, and external feeds to act in context.

In practice: Traditional AI predicts pipe failures; GenAI generates a draft incident report; AgenticAI adjusts pump schedules in real time, balancing demand forecasts with energy tariffs.

Table 1. Comparison of AI Types

FEATURE	TRADITIONAL AI/ML	GENERATIVE AI (GENAI)	AGENTIC AI
PRIMARY FUNCTION	Prediction, classification	Content creation, summarisation	Goal achievement, autonomous action
AUTONOMY	Low	Medium	High
KEY CAPABILITY	Pattern recognition	Natural language + novel outputs	Planning, reasoning, task execution
EXAMPLE IN WATER	Predict pipe failure probability	Draft incident report from SCADA alerts	Adjust pump schedules based on energy + demand

Why Now? The Business Case

The water sector is at a crossroads. Climate change is reshaping hydrological patterns, infrastructure is ageing, urban populations are growing, and financial pressures are intensifying. At the same time, utilities face a dual challenge: retaining customer trust while adapting to rapidly evolving regulatory, environmental, and social expectations (Figure 3).

Compounding these pressures is the workforce transition. A generation of skilled operators, engineers, and managers is retiring, and utilities struggle to fill the knowledge gap while meeting higher demands for efficiency and accountability.

In this environment, traditional digital tools (SCADA dashboards, CMMS reports, GIS layers) often deliver more data than decision support. Utilities require systems that enable them to **interpret complexity, act more quickly, and plan more strategically**. GenAI and AgenticAI are uniquely positioned to meet this need.

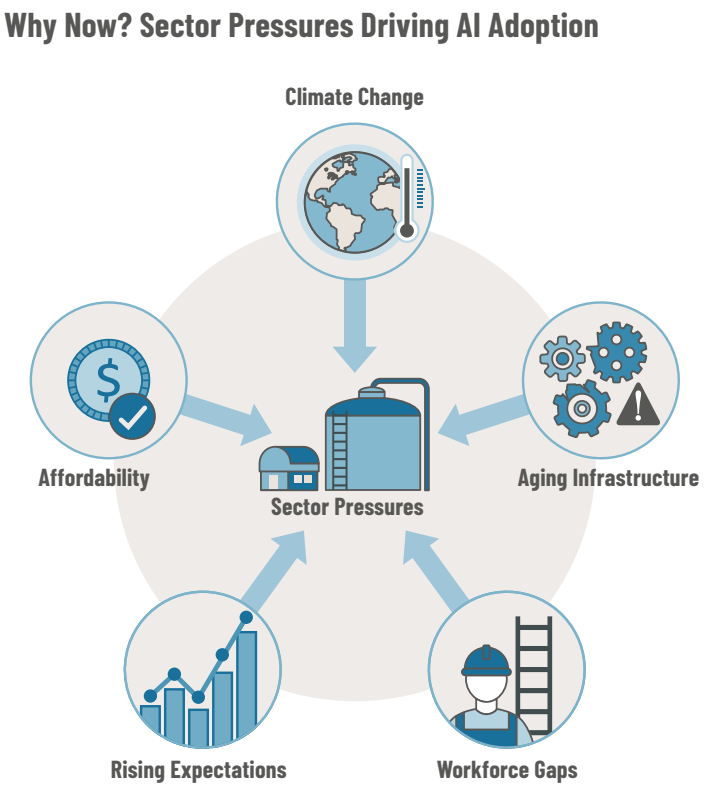


Figure 3. Sector pressure driving AI adoption

Core Value Levers of GenAI & AgenticAI

GenAI and AgenticAI extend digital transformation beyond prediction to *understanding and action*. Their impact aligns directly with the sector's most urgent needs (Table 2):

- **Productivity –** Automating reporting, compliance summaries, and customer communication.
- **Workforce Enablement –** Acting as digital copilots to transfer knowledge, train faster, and augment expertise.
- **Complex Decision Support –** Running scenarios, integrating cross-silo data, and providing clear foresight.
- **Resource Optimisation –** Reducing energy, water, and chemical use across treatment and distribution.
- **Strategic Leadership –** Providing executives with synthesised intelligence to manage uncertainty and set direction.

Table 2. Business Value by Theme

THEME	GenAI CONTRIBUTION	AgenticAI CONTRIBUTION	EXAMPLE IMPACT
PRODUCTIVITY	Generates reports, summaries, customer responses	Automates work order scheduling	15–20% reduction in manual workload
WORKFORCE	Captures tacit knowledge, training copilots	Personalised training pathways	Faster onboarding, retained expertise
DECISION-MAKING	Natural language synthesis of scenarios	Autonomous simulations & planning	Better long-term strategies
RESOURCES	Optimises dosing & pumping recommendations	Dynamic control of pumps & dosing	Reduced OpEx, lower emissions
LEADERSHIP	Summarises KPIs & industry reports	Early risk alerts, optimised strategies	Faster executive decisions

The true business case goes beyond cost savings. AI adoption is about **building organisational resilience and foresight**. Utilities that move early will:

- Anticipate regulatory changes and public expectations more effectively.
- Build more robust investment plans under climate uncertainty.
- Retain and empower staff by augmenting, not replacing, expertise.
- Position themselves as **innovation leaders** within the global water community.

For executives, GenAI and AgenticAI provide something unprecedented: the ability to combine **system-wide data** with **proactive simulations** to answer the hardest questions:

- "What happens to our risk profile under different climate scenarios?"
- "How do we balance affordability with resilience investments?"
- "What skills and workforce structures do we need five years from now?"

Applications Across Utility Functions

Utilities are already gathering large amounts of data through SCADA systems, IoT sensors, maintenance platforms, and customer service channels. Yet in many cases, the data remains under-utilised because staff are overwhelmed, processes are manual, and decisions still rely on individual judgement and experience. Generative AI (GenAI) can help by transforming raw data into clear summaries and insights, while AgenticAI goes a step further: using those insights to take autonomous, optimised actions within defined parameters.

The examples below illustrate how these capabilities support the entire utility value chain.

1. Operations & Maintenance

Day-to-day operations increasingly rely on interconnected digital infrastructure. However, operators often face information overload — thousands of alarms, extensive logs, and manual work scheduling. GenAI can ease this burden by interpreting events and generating clear guidance. AgenticAI then advances from interpretation to execution, automatically scheduling work, coordinating field teams, and implementing setpoint adjustments where appropriate.

Table 3. Operation and Maintenance: GenAI vs AgenticAI

FUNCTION	GenAI ROLE	AgenticAI ROLE	BENEFIT
SCADA ALARMS	Summarise events, explain anomalies	Correlate alarms and suggest root causes	Faster operator response
MAINTENANCE	Draft work orders, retrieve manuals	Schedule tasks, route technicians	Reduced downtime
ASSET HEALTH	Analyse logs, generate summaries	Trigger prescriptive maintenance interventions	Extended asset life

2. Customer Service & Engagement

Customer expectations for responsiveness and personalisation are rising. GenAI enables conversational, context-aware support and tailored water-use insights. AgenticAI complements this by identifying when outreach is needed (e.g., suspected leaks, high bills) and managing workflows such as booking field visits. The result is proactive customer care that reduces call centre demand while improving satisfaction.

Table 4. Customer Sevice & Engagement: GenAI vs AgenticAI

FUNCTION	GenAI ROLE	AgenticAI ROLE	BENEFIT
CHATBOTS	Provides natural-language responses to billing/service queries	Automatically escalates complex cases when needed	24/7 consistent service
REPORTS	Generates personalised conservation reports	Initiates customer leak alerts and follow-ups	Reduced NRW, stronger engagement
AGENTS SUPPORT	Summarises customer interaction histories	Auto-schedules appointments and tasks	Lower handling time

3. Asset Management & Investment Planning

Strategic planning requires integrating diverse datasets — from GIS layers to condition assessments and maintenance history. GenAI can synthesise these sources to produce draft analyses and planning scenarios. AgenticAI expands this into optimisation, running simulations under different assumptions and prioritising investments for greatest resilience and value.

Table 5. Asset Management & Investment Planning: GenAI vs AgenticAI

FUNCTION	GenAI ROLE	AgenticAI ROLE	BENEFIT
CONDITION ASSESSMENT	Summarise inspections & CCTV findings	Updates condition models automatically	Better risk data and understanding
PLANNING	Draft rehabilitation scenarios	Prioritises projects based on risk (Probability of Failure x Consequence of Failure)	Optimised capital planning
INVESTMENT	Generate business case narratives	Runs simulations to test long-term outcomes	Runs simulations to test long-term outcomes

4. Water Quality & Treatment

Ensuring consistent water quality depends on accurately interpreting sensor and laboratory data — often under time pressure. GenAI supports operators by generating explanatory insights and compliance report drafts. AgenticAI then adjusts process controls dynamically to stabilise performance and reduce energy and chemical consumption.

Table 6. Water Quality and Treatment: GenAI vs AgenticAI

FUNCTION	GenAI ROLE	AgenticAI ROLE	BENEFIT
MONITORING	Summarises trends & anomalies	Adjusts setpoints autonomously	Optimised operations
REPORTING	Drafts compliance reports	Prepares and Submits data packages	Reduced admin load
TRAINING	Generate SOP guides and troubleshooting steps	Tailors competency-based learning modules	Stronger Knowledge retention

5. Network Management & Non-Revenue Water (NRW)

Non-Revenue Water (NRW) drains financial and natural resources. Reducing NRW requires both detection and timely action. GenAI enhances leakage analytics by providing interpretable explanations. AgenticAI operationalises the response — correlating multiple data streams to pinpoint leaks, rebalance pressure zones, and automate isolation where appropriate.

Table 7. Network Management and NWR: GenAI vs AgenticAI

FUNCTION	GenAI ROLE	AgenticAI ROLE	BENEFIT
LEAK DETECTION	Generates descriptive alerts	Locates leaks through data correlation	Faster response
METER DATA	Spots consumption anomalies	Triggers customer notifications	Reduced losses
PRESSURE MANAGEMENT	Explains zone conditions	Dynamically optimises Pressure Management Zones	Energy + NRW savings

6. Leadership & Executives

For senior leaders, the primary challenge is making well-informed decisions despite complexity. GenAI supports this by translating technical details into strategic narratives and dashboards. AgenticAI enables scenario analysis, early-warning alerts, and automated decision recommendations, transforming data into executive-level decision intelligence.

Table 8. Leadership & Executive: GenAI vs AgenticAI

FUNCTION	GenAI ROLE	AgenticAI ROLE	BENEFIT
OVERSIGHT	Summarises KPIs, reports, and regulations	Early warning of risks/ opportunities	Faster, clearer decisions
STRATEGY	Drafts board/executive reports	Tests policy & investment scenarios	More resilient strategic planning
COMMUNICATION	Generates public/ stakeholder statements	Coordinates cross-departmental alerts	Improved trust and transparency

Empowering the Water Workforce (WHAT GenAI/AgenticAI deliver)

Generative AI has the potential to act as an intelligent collaborator or "copilot," supporting operators, technicians, engineers, planners, analysts, managers, and executives across the water utility. Instead of replacing human expertise, it extends staff capacity, provides real-time guidance, and makes institutional knowledge more accessible. AgenticAI adds a layer of proactive support, managing workflows and tasks autonomously, so staff can focus on oversight, complex decisions, and innovation.

Table 9. How GenAI and AgenticAI can support the water workforce

FUNCTION	GenAI ROLE	AgenticAI ROLE	BENEFIT
OPERATOR	Explains SCADA alarms in plain language	Runs routine checks, adjust minor setpoints	Faster response, reduced stress
TECHNICIAN	Generates repair steps, access manuals	Schedules work orders, route crews	Less downtime, better first-time fix
ENGINEER	Drafts specs, analyse data, retrieve standards	Runs simulations, optimise designs	Higher productivity, better design options
PLANNER	Summarises reports, generate scenarios	Optimises long-term capital & resource plans	Smarter investment prioritisation
ANALYST	Automates KPI reports, query datasets	Proactively flags anomalies or risks	Faster insights, better forecasting
EXECUTIVE	Synthesises KPIs, draft comms	Simulates strategic scenarios, flag risks	Quicker, more confident decisions

How to Enable Workforce Adoption (HOW utilities prepare)

Technology alone does not empower the workforce — adoption depends on culture, trust, and training. Utilities must ensure staff see AI as augmenting, not replacing, their expertise. Building confidence in AI requires transparency, role-specific training, and organisational structures that prioritise human oversight and control.

Callout Box: Culture & Training Essentials

- **TRUST & TRANSPARENCY:** Communicate AI's limits; design human-in-the-loop controls.
- **KNOWLEDGE RETENTION:** Use GenAI copilots to capture tacit knowledge from retiring staff.
- **LAYERED TRAINING:** Start with digital literacy, then move to applied role-specific training.
- **INCREMENTAL BUY-IN:** Start with pilots tied to real business needs (safety, compliance, affordability).
- **CHANGE MANAGEMENT:** Support staff through clear governance, feedback loops, and involvement in design.

Integration into the Digital Water Ecosystem

Why Integration Matters

Utilities already operate with an array of IT (ERP, CRM, GIS, billing) and OT (SCADA, PLCs, IoT) systems. The challenge isn't lack of data — it's fragmented systems, siloed workflows, and limited ability to turn information into decisions. GenAI and AgenticAI act as a bridge, bringing context from IT, real-time insight from OT, and foresight from Digital Twins together into a more coherent decision ecosystem.

Think of today's IT and OT systems as musicians in an orchestra — **SCADA plays percussion, GIS plays strings, ERP handles the brass**. Without a conductor, the music is noisy and disjointed. GenAI provides the sheet music (context and explanations), while AgenticAI is the *conductor*, ensuring the different sections play together in harmony to create a coherent symphony.

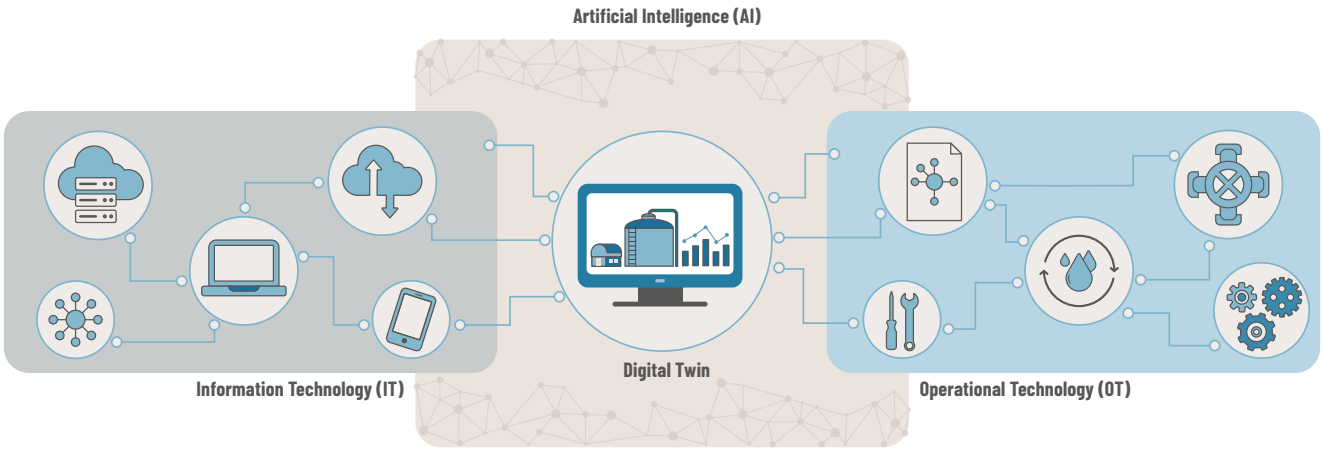


Figure 4. Integrated decision ecosystem: IT, OT, AI, and Digital Twin

Techniques for Integration

Three major techniques underpin AI integration: **Retrieval-Augmented Generation (RAG), fine-tuning, and Information Technology (IT)/Operational Technology (OT) convergence**. RAG allows AI to access the utility's own documents and datasets in real time, reducing hallucinations. Fine-tuning adapts foundation models to utility language, workflows, and report formats. IT/OT convergence — long discussed but difficult — becomes essential, since AI insights lose value if they can't flow between control rooms and boardrooms.

Table 10. Integration Approaches

APPROACH	WHAT IT DOES	WHY IT MATTERS	BENEFIT
RAG	Retrieves utility docs & structured data at runtime	Grounded, accurate answers	Faster response
FINE-TUNING	Trains models with sector-specific datasets	Improves relevance & trust	Reduced losses
IT/OT CONVERGENCE	Bridges enterprise (IT) and operational (OT) systems	Enables holistic decision-making	Energy + NRW savings
DIGITAL TWINS	Dynamic system replicas with real-time data	Enhances foresight & scenario planning	

Open vs Closed Models

Choosing between open-source and closed-source AI models is like deciding between leasing and owning. Closed-source (e.g., GPT-4, Claude, Gemini) are like renting — **you get the latest features without the hassle, but you don't control the property**. Open-source (e.g., Llama, Mistral, Falcon) is like owning — you customise and secure it your way, but you're responsible for maintenance.

Most utilities will adopt a **hybrid approach**, using closed-source solutions for quick pilots and broad tasks, and open-source solutions for sensitive data or specialised domain applications.

Callout Box:

- Closed-source: top performance, low setup, higher dependency.
- Open-source: secure, customizable, requires expertise.
- Hybrid: flexibility to match use cases.

Digital Twins + AI

Digital Twins are virtual replicas of physical assets — like a flight simulator for your water plant or network. They're powerful but often hard to use outside of specialist teams. GenAI makes Digital Twins conversational ("Explain why ammonia levels are predicted to rise tomorrow"), while AgenticAI makes them proactive ("Reconfigure aeration to prevent ammonia spikes") (Figure 5).

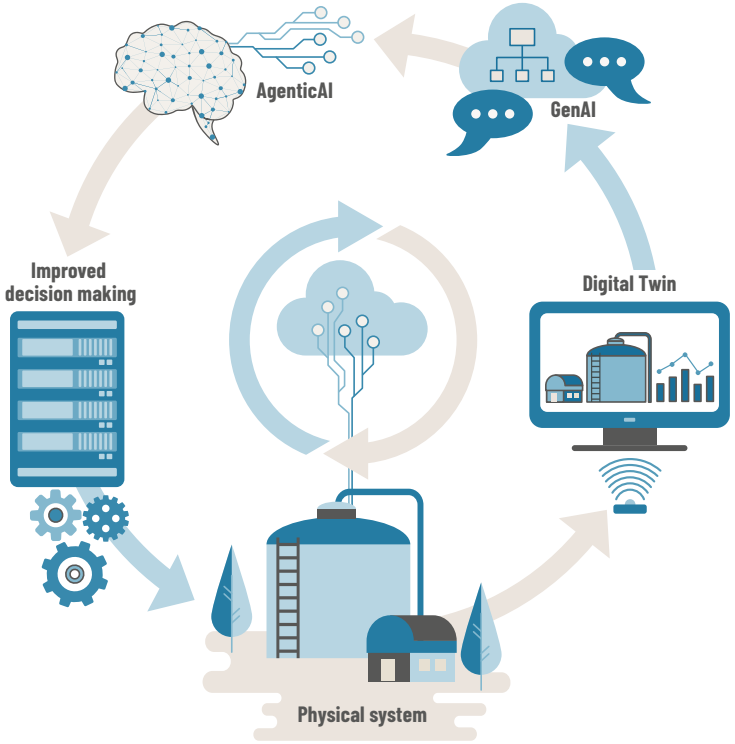


Figure 5. Digital Twins, GenAI, and AgenticAI for integrated decision-making

A Digital Twin is like Google Maps for your water system. On its own, it shows routes and traffic. Add GenAI, and you can *ask it questions* in plain language. Add AgenticAI, and it becomes your *navigator* — not only showing routes but rerouting you automatically when it detects an accident ahead.

Integrated into the digital ecosystem, GenAI and AgenticAI don't replace existing systems — they elevate them. Together, they unlock a **sense → analyse → decide → act** loop that utilities have long aspired to. Integration turns AI from an experimental tool into a **core operating system for digital water**.

Table 11. Sense–Analyse–Decide–Act Framework

STAGE	TRADITIONAL TOOLS	GENAI CONTRIBUTION	AGENTICAI CONTRIBUTION
SENSE	Sensors, SCADA, GIS	Describe anomalies in plain language	Detect early signals & escalate
ANALYZE	BI dashboards, analysts	Summarise cross-system patterns	Correlate, simulate, optimise
DECIDE	Human managers	Draft recommendations, business cases	Test what-if scenarios autonomously
ACT	Operators, technicians	Generate work orders, SOPs	Execute actions (pump schedules, routing crews)

Call to action

The water sector stands at the edge of a new digital wave. Generative AI provides the ability to understand — turning data into insights, reports, and guidance. Agentic AI extends that ability to act — running scenarios, orchestrating workflows, and enabling autonomous optimisation. Together, they move us from *data-driven utilities* to *decision-intelligent utilities*.

But technology is not enough. Success will depend on three commitments:

1. Start with Purpose. Deploy GenAI and AgenticAI where they solve real problems: workforce transition, resource optimisation, affordability, and resilience.

2. Empower People. Use AI as a copilot, not a replacement — capturing expertise, training faster, and supporting staff across every role.

3. Adopt Responsibly. Balance innovation with governance, ethics, and sustainability — ensuring that AI reduces, rather than increases, the sector's environmental footprint.

This is not a journey for individual utilities alone. It is a collective opportunity:

- For **utilities**, to pilot high-value use cases and share learnings.
- For **technology providers**, to build solutions tailored to water.
- For **regulators and policymakers**, to enable innovation while safeguarding trust and equity.
- For **IWA and the global community**, to foster collaboration, consolidate lessons, and amplify successes across regions and contexts.

The next wave of digital water is here. By acting with purpose, responsibility, and ambition, we can harness GenAI and AgenticAI to create utilities that are smarter, more resilient, and more sustainable — securing water services for future generations.

The IWA Digital Water Programme

The International Water Association (IWA) Digital Water Programme is a comprehensive initiative designed to support water utilities, service providers, and stakeholders in leveraging digital technologies to improve the efficiency, resilience, and sustainability of water management. The programme provides a structured approach to digital transformation, helping organisations assess their current digital maturity, identify opportunities for improvement, and implement practical solutions that are aligned with industry best practices. It facilitates knowledge exchange through peer-led learning, case studies, technical guidance, and access to a global network of experts, enabling utilities to adopt technologies ranging from data analytics and IoT to advanced AI applications.

By fostering digital capabilities, the IWA Digital Water Programme helps utilities move from reactive operations to proactive, predictive, and automated systems, setting the stage for advanced solutions which ultimately support the sector's goal of delivering safe, reliable, and sustainable water services.

Importantly, the programme aligns with the *IWA Strategic Plan 2025–2030*, which recognises digitalisation as a cross-cutting enabler for the sector, emphasising its potential to transform water management, optimise operations, and support evidence-based decision-making.

For more information about the IWA Digital Water Programme, please visit: *https://www.iwa-network.org/our-work/digital-water*

the international water association

INTERNATIONAL WATER ASSOCIATION
Export Building, 1st Floor
1 Clove Crescent
London E14 2BA
United Kingdom
Tel: +44 207 654 5500
Fax: +44 207 654 5555
E-mail: water@iwahq.org

Company registered in England No.3597005
Registered Charity in England No.1076690

inspiring change
www.iwa-network.org