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SIEMENS & CAPGEMINI JOINT APPROACH

From Reactive to Resilient

Why Water Utilities Need Digital Revolution
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Siemens & Capgemini White Paper

Agenda:

1. Executive summary
2. Confronting the global water crisis: Why digitalization is imperative
3. Digital transformation in action
4. Blueprint of "Low-risk pathway"
5. The innovative ecosystem: Siemens and Capgemini

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1. Executive summary

We are in a global crisis related to our most precious resource—water. Water utilities around the globe face increasing challenges to ensure secure water supply as well as access to sanitation and reliable and environmentally safe wastewater treatment. Digital technologies provide the opportunity to address these challenges in a more efficient, resilient and sustainable way. Digitalization is not merely an option but a necessity. This white paper outlines a strategic framework for transforming the global water sector through digital innovation, jointly presented by Siemens and Capgemini.

Siemens and Capgemini offer a synergistic ecosystem of solutions that integrates Siemens' industrial automation and software platforms with Capgemini's consulting, engineering and digital capabilities. This partnership enables utilities to pursue low-risk, scalable digital transformations that yield measurable improvements in operational efficiency, environmental sustainability, and customer satisfaction.

This paper underscores the urgency of modernization and the strategic advantages of leveraging Siemens and Capgemini's joint innovations to meet the evolving demands of the water sector.

2. Confronting the global water crisis: Why digitalization is imperative

2.1 Digitalization as a necessity: Confronting the sector's pressing challenges

We face a lot of crises / challenges within the water sector; here are some examples:

- Globally, ~33% of distributed water never reaches paying customers — that's 126 billion m^3 lost annually as Non-Revenue Water. In the U.S., 19.5% of treated drinking water is lost, costing utilities $6.4 billion annually. (Source: Proparco)
- Non-Revenue Water costs the global water sector nearly USD 50 billion every year in lost revenue.
- By 2050, the global population will reach ~9 billion, with 55% living in urban areas — dramatically increasing pressure on water infrastructure. As a result, improving energy efficiency has become a strategic priority for utilities aiming to reduce operational expenses (OPEX). (Source: Applied Energy Journal) (MDPI)
- By 2050, the global population is projected to reach roughly 9 billion people, with around 55% residing in urban areas. This demographic shift will significantly increase demand for water services, placing additional pressure on already strained infrastructure and resources. (Source: UN Water)
- In many regions, the water utility workforce is aging, with roughly 33% of U.S. water utilities workforce being over the age of 55. This trend raises concerns about a looming wave of retirments and the potential loss of institutional knowledge. (Source: EPA)
- As digital adoption accelerates, water utilities face heightened exposure to cyber threats. 62% of water utilities report cyberattacks every year, with a 300% increase in targeted attacks since 2018. (Source: Semperis Study)

Water utilities must urgently transform their operations in response to critical challenges and digitalization helps to do so. For example, a unified water operating center for a water utility can add up to 15% reduction in water lost before reaching the customer, 30% energy savings and renewable management and 20% operational efficiency improvement through faster detection of issues and subsequent intervention. (Source: Digital Europe)

Digitalization promises enormous potential in response to critical challenges. However, the utilities' decisions on adoption of digitalization are still primarily driven by the prospective economic benefits (66% of utilities) (Source: NPJ clean water)—a fair reasoning.

Siemens and Capgemini partner up to show that both are possible—tackling critical water challenge and obtaining economic benefits. How? This is what this paper is about.

33%
of Distributed Water Lost

USD 50
Billion Annual Financial Loss

30–40%
of Operational Costs Go to Energy

9 Billion
People by 2050 — 55% in Cities

33%
of the U.S. Water Workforce Is Over 55

62%
of Utilities Hit by Cyberattacks Annually

2.2 From insight to action: Digital solutions in practice

1) Digital twin

Digital twin technology is revolutionizing water utility modernization, with 66% of utilities adopting digital technologies primarily for economic and operational benefits. (Source: Smart Water Magazine, 2024) By deploying Digital twin systems, SCADA integration, and cloud-based platforms, utilities transform legacy networks into intelligent infrastructure. These technologies enable predictive maintenance and real-time simulation, while also allowing digital simulations during the pre-implementation stage to visualize system performance and guide infrastructure planning, thereby optimizing infrastructural costs (CAPEX), minimizing downtime, and reducing operational expenditure (OPEX).

Research further highlights data-centric management as a promising strategy to address aging infrastructure and contamination challenges (Source: MDPI, 2025). Digital twins are well-positioned to mitigate these issues because they enable seamless modernization of outdated facilities without disrupting operations.

2) AI / ML

Artificial Intelligence (AI) and Machine Learning (ML) are pivotal in optimizing water utility operations. They can be applied to improve planned upgrades during the design phase or enable real-time optimization. For instance, AI-driven leak detection algorithms help reduce water losses and enhance billing accuracy. AI also improves energy efficiency through intelligent process control and pump scheduling aligned with energy tariffs Moreover, Generative AI (Gen-AI) and advanced AI technologies are being leveraged to transform water utility operations through phased adoption strategies, encompassing governance frameworks and expansion into real-time operational domains. (Source: Capgemini Research Institute)

3) Smart Metering / DMA Monitoring

Smart metering and District Metered Areas (DMAs) based monitoring are critical for minimizing water loss and managing demand effectively. Establishing DMAs and deploying IoT-enabled smart meters, coupled with advanced analytics, allows utilities to isolate leak zones in drinking water, detect blockages in sewer system, detect anomalies early, and prioritize maintenance interventions.

As an example, the growing reliance on real-time data to inform operational decisions enables utilities to detect customer-side leaks as small as 1 l/h and analyze meter performance to optimize maintenance strategies.

4) Cybersecurity

Cybersecurity is a foundational pillar of digital transformation in the water sector. Integrating robust cybersecurity measures into digitalization initiatives—including IT/OT integration, network segmentation, secure IoT frameworks, incident response protocols, and routine penetration testing—effectively mitigates risks associated with industrial control systems (ICS) and remote access vulnerabilities.

Industry experts emphasize that cybersecurity must be embedded as a core component of digital implementation strategies, rather than treated as a supplementary feature. (Source: BCG, 2025)

5) Energy Efficiency Monitoring

Energy efficiency is a vital performance metric in water utility operations. Continuous monitoring of key performance indicators (KPIs)—such as energy efficiency (kWh/m³, kW/ PW*a), water loss (%), and asset uptime—enables utilities to quantify improvements and make informed, data-driven decisions.

However, efficiency gains are most effective when paired with upgrades to plants and process equipment.Relying solely on advanced metering for outdated infrastructure can limit benefits and raise costs. A balanced approach of combining asset renewal with smart technologies creates a sustainable path for long-term resilience.

2.3 Innovation in action: Key enablers of utility modernization

Water industry is undergoing a profound transformation, driven by the imperative for smarter, more sustainable operations. Digital tools are at the forefront of this shift, empowering utilities to enhance performance, reduce costs, and improve service delivery. This section outlines the key technologies enabling value creation across the water value chain—from source to reuse—and highlights their impact across operational domains.

Technology overview and value contribution across the water lifecycle:

Tech enabling the impact	Value addition / Description	Water source	Water treatment/ Desalination	Transmission & distribution	Sewage collection	Sewage treatment	Water re-use	Environmental monitoring
IT/OT integration and IoT sensors	Over the past five years, sensor technology has advanced significantly in terms of battery lifetime durability and seamless integration with existing infrastructure, enabling utilities of all sizes to make decisions in real-time.	++	++	++	++	++	++	++
Edge & cloud technology	Cloud platforms enhance data storage and cybersecurity capabilities, while cost-effective communication technologies such as NB-IoT and 5G improve connectivity and scalability.	+	+	++	++	+	+	++
Unified SCADA (Data integration & interoperability using open standards)	Modern SCADA systems eliminate operational silos by providing unified visibility across disparate water systems. Open standards (e.g. OPC UA, MQTT) enable seamless data exchange between legacy and modern systems. In municipal utilities, SCADA platforms have achieved approximately 10—20% reductions in energy consumption, facilitated predictive maintenance.	+	+	++	++	+	+	
Simulation & Digital twin (Closed-loop integration between twin insights and control actions)	Digital twins create virtual replicas of individual water infrastructure, enabling scenario testing and process optimization without disrupting physical operations. Real-time integration between simulation models and control systems allows for automated adjustments based on dynamic conditions.	++	++	++	++	++	++	++
AI & ML Learning	Advances in AI and analytics provide deep insights by analyzing operational patterns across specific plants and processes.	+	+	++	++	+	++	+
Cyber security & trust (like segmentation / zero trust / patch management)	Defense-in-depth strategies are now essential as utilities face a 300% increase in targeted cyberattacks since 2018. A recent study of cyberattacks on water and electricity utilities in the U.S. and U.K. revealed that 80% of affected utilities were attacked multiple times, and 54% experienced permanent data corruption or system destruction—highlighting the growing severity of threats. (Source: Semperis)	++	++	++	++	++	++	+

3. Digital transformation in action

Digital journey of Scottish Water in cooperation with Siemens and Capgemini

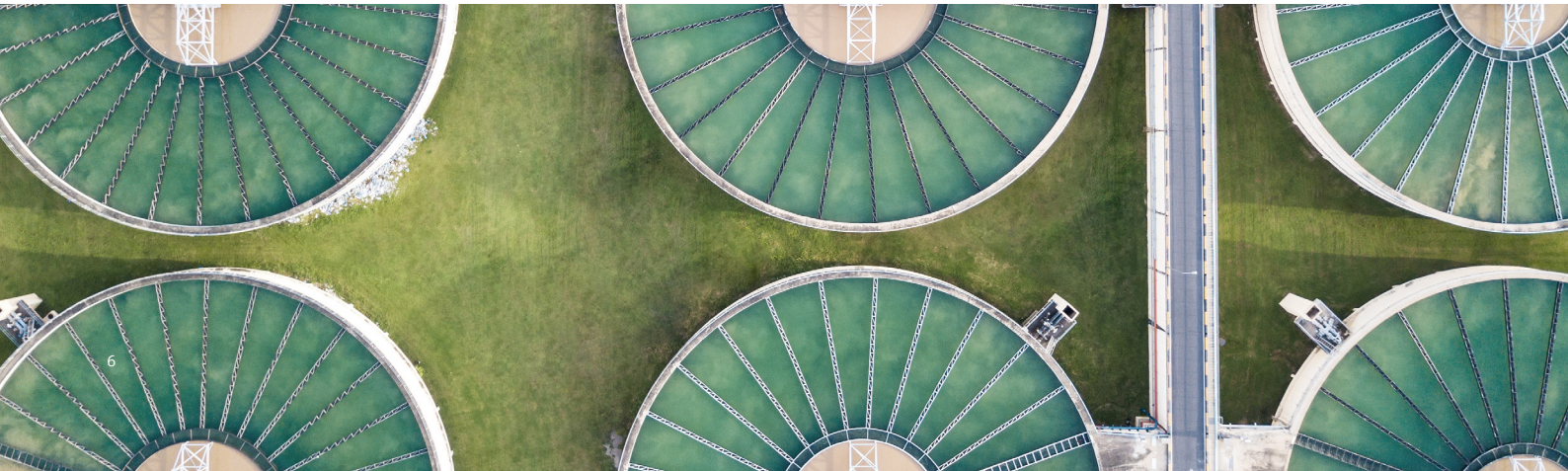
Capgemini combines consulting and AI innovation with Siemens' Xcelerator platform, integrating IoT data, AI models, and digital twin. This collaboration enables utilities like Scottish Water to move from siloed legacy systems to real-time, data-driven operations, improving sustainability and regulatory compliance.

Scottish Water's Digital Evolution: A Siemens—Capgemini collaboration

"This collaboration helped us to deliver a scalable solution that we can now take across multiple assets, in both water and wastewater."

Nathan Weild, wastewater operations manager, Scottish Water

Timeline	Customer challenge	Solution	Benefits / Impact
2021—2023: Intelligent Field Force Transformation (SWIFT) (Source: MCA)	Ageing software for managing 1,200 field technicians caused inefficiencies and poor customer experience.	Capgemini designed and implemented a new digital architecture using Salesforce Field Service and Microsoft Dynamics and Siemens supported integration with operational technology for asset data continuity.	First-time fix rates improved from 49% to 62%. 13% reduction in CO_2 emissions through route optimization.
2022: Wastewater digital transformation (Source: Capgemini case study)	Scottish Water had limited access to connected data across large wastewater treatment sites, relying on manual processes that increased energy consumption, chemical use, and compliance risk.	Capgemini led the digital transformation program and integration strategy, and Siemens provided Siemens Xcelerator platform and IoT sensors for near real-time operational data.	End-to-end site performance visibility. Remote site management and predictive maintenance. Reduced energy consumption and chemical use; extended asset life.
2024: Automation for non-complex projects (Source: Capgemini, Siemens)	Routine asset replacement projects were slow and costly.	Capgemini delivered automation and process optimization, and Siemens provided OT integration and digital continuity tools.	Annual cost savings. Delivery time reduced from months to weeks. Reduced unplanned downtime.



Interested in more digital journeys of our clients from around the world? Here we go:

Smart infrastructure for revenue optimization and leak reduction

	Customer challenge	Solution	Benefits / Impact
Smart water networks	High non-revenue water rate within drinking water network. Challenge to detect leakages.	Implementation of AI driven software to detect and locate leakages. Onboarding of all available sensors from the field / network.	Pinpointing leaks through smart metering zones up to 0.2—0.5 l/sec. Detecting and fixing small critical leaks efficiently.
Smart meter data management	Need for a big data tool to monitor and analyze large volumes of information from water meters, enabling the detection of anomalies, meter replacement assessment, identification of meter size issues, fraud detection, and early incident warning.	Smart meter data management tailored to meet most customer sizes with proven algorithms. Easy-to-use for billing function as well as for identifying and locating non-technical losses, leaks and issues with meters.	Reduced cost of ownership. Increased staff efficiency (by decreasing time spent on routine maintenance). Improved customer satisfaction (improved billing and basic meter to cash). Optimized meter replacement strategy.

Digital twin and real-time monitoring for end-to-end optimization

	Customer challenge	Solution	Benefits / Impact
Digital twin for desalination	To build a new desalination plant serving 350,000 inhabitants and running at high energy efficiency.	Digital twin technology which optimized the process during design, as well as enabled the virtual commissioning of the plant on time (despite the restrictions on mobility imposed by the pandemic) and can be further used for trainings.	Resource saving thanks to remote start-up. Efficient process operation (the plant produces water beyond its nominal capacity). Operation training system for operators and technicians.
Real-time wastewater network operations	Need for real-time visibility & proactive maintenance across wastewater networks to provide insights and reduce environmental impact.	Provide real-time insights into 170+ waste-water facilities. Implemented hybrid monitoring with IoT/SCADA integration, scenario modelling, and predictive maintenance powered by AI/GenAI.	Massive reduction in environmental impact, improved transparency and responsivity. Enabled early failure detection, reduced pollution incidents, and improved operational efficiency.

Cybersecurity in action: safeguarding operational technology

Customer challenge	Solution	Benefits / Impact
The customer wanted to protect critical water and wastewater infrastructure from sophisticated cyber-attacks targeting OT (automation) environments, given the high societal impact to comply with cybersecurity regulations such as NIS 2.	Remote industrial operations with security operation centre SaaS including 24/7 threat detection, and anomaly identification in OT network.	End-to-end approach for security monitoring and vulnerability management from a single source. 24/7 cybersecurity protection from a service provider with deep OT know-how.

Cloud migration & digital wallet integration

Customer challenge	Solution	Benefits / Impact
To improve data center efficiency, reduce operational costs, and enhance customer experience by enabling secure and convenient digital payment options	Implementation of cloud-first architecture, leveraging microservices for scalability and resilience and integrating Apple Pay and Google Pay for digital wallet functionality using API-based integration, supported by a secure migration framework for phased transition.	Reduced operational costs, while enhancing scalability and agility for future digital services. Furthermore, improved customer experience with faster, secure digital payments and simplified billing.

4. Blueprint of “Low-risk pathway”

Time to act is now, but successful transformations require a measured approach balancing innovation with stability. This blueprint provides a low-risk digitalization pathway through sequenced initiatives, starting small and expanding toward comprehensive transformation.

Low hanging fruits

Begin with targeted initiatives which deliver quick returns while establishing transformation foundations. Define KPIs, ensure scalability, and start small. Examples include remote monitoring for one or a few critical assets and mobile workforce solutions that digitize paper processes. These projects typically deliver ROI within 6—12 months through maintenance cost reduction (15—20%) and workforce efficiency improvements (25—30%), while building confidence in digital technologies.

Early steps should combine digital pilots with targeted upgrades to critical assets. For example, improving aeration or chemical dosing alongside remote monitoring delivers quick wins and sets the stage for broader transformation.

System optimization

Optimize individual systems using AI and real-time analytics to reduce emissions and energy use. Connect previously siloed OT and IT systems to enable coordinated planning. This 12—24-month phase builds on earlier data foundations, creating self-funding mechanisms through operational savings while developing expertise in managing digital ecosystems.

As utilities progress, pairing advanced operational strategies with real-time analytics unlocks deeper efficiencies. Aligning digital tools with equipment renewal and process improvements ensures sustainable gains in energy use, water quality, and compliance.

Visionary moves

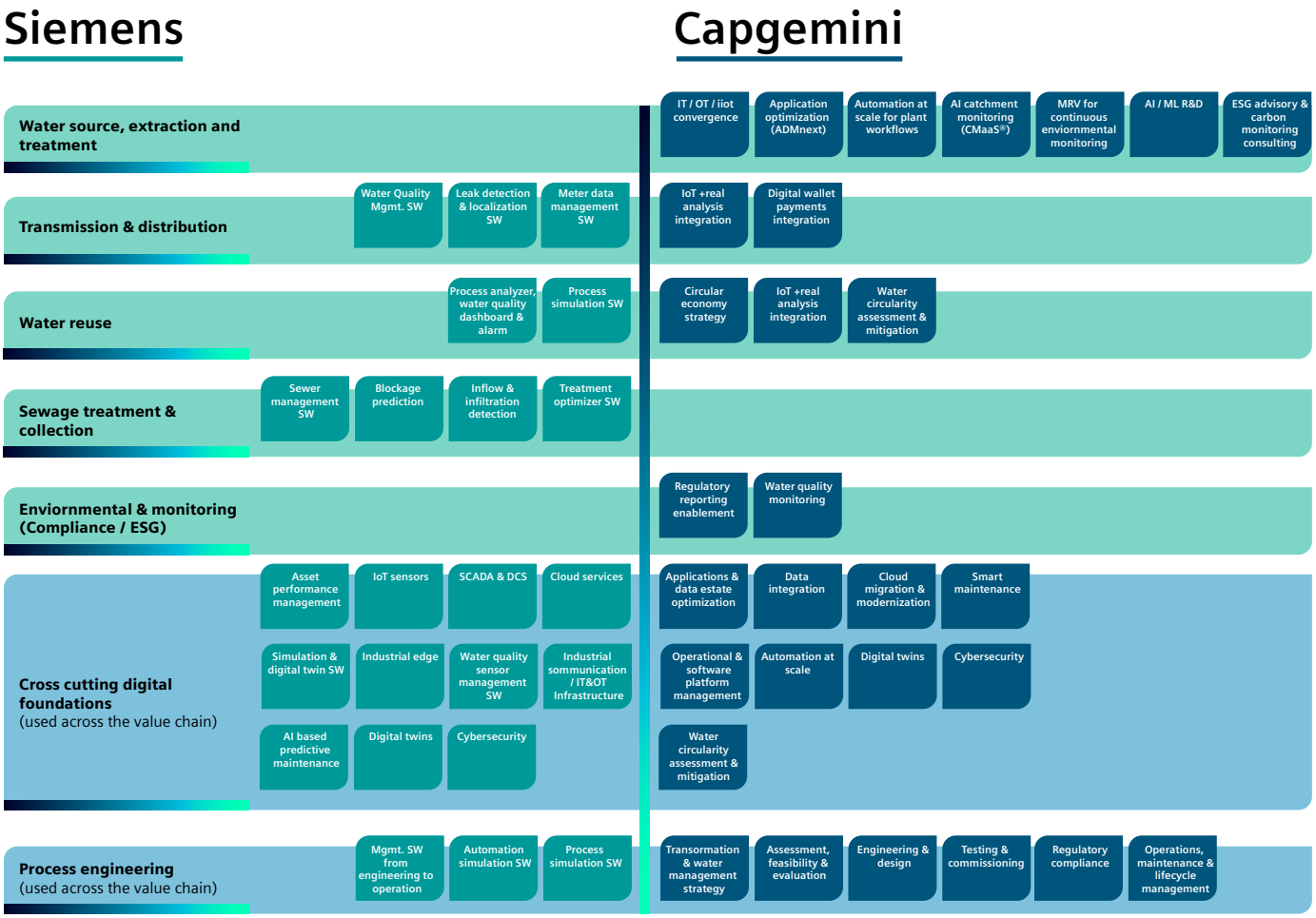
With a robust digital foundation in place, implement transformative capabilities like comprehensive digital twins, predictive AI systems, and autonomous operations. Stick to the predictive maintenance example from “low hanging fruits”. After Proof-of-Concept, scale it up and include further assets within one plant—“system optimization”. Follow with “visionary moves” and implementation of predictive maintenance for all assets of all plants (e.g. remote pump stations). These initiatives require significant digital maturity but deliver breakthrough improvements—they reduce non-revenue water, improve overall efficiency, and enable adaptive infrastructure that responds dynamically to changing environmental conditions.

5. The innovative ecosystem: Siemens and Capgemini

Many utilities with fragmented systems, siloed data, and legacy infrastructure are piloting digital tools. Siemens and Capgemini have started their partnership to support all types and sizes of utilities regardless of their digital transformation stage. Together, we deliver comprehensive digital technology, combining industrial expertise with consulting and engineering capabilities across the entire water cycle. We help utilities to move beyond experimentation into scalable and sustainable transformation.

Complementing this collaborative ecosystem, Capgemini's Applied Innovation Exchange (AIE) brings deep innovation capabilities by providing continuous research, technology analysis, and strategic framing of emerging trends that underpin our joint approach to digital transformation in the water sector.

The following overview illustrates our combined capabilities across the water lifecycle:



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About Siemens

Siemens AG (Berlin and Munich) is a leading technology company focused on industry, infrastructure, mobility, and healthcare. The company's purpose is to create technology to be finalized! the everyday, for everyone. By combining the real and the digital worlds, Siemens empowers customers to accelerate their digital and sustainability transformations, making factories more efficient, cities more livable, and transportation more sustainable.

Further information is available on the Internet at **www.siemens.com**

About Capgemini

Capgemini is an AI-powered global business and technology transformation partner, delivering tangible business value. We imagine the future of organizations and make it real with AI, technology, and people. With our strong heritage of nearly 60 years, we are a responsible and diverse group of 420,000 team members in more than 50 countries. We deliver end-to-end services and solutions with our deep industry expertise and strong partner ecosystem, leveraging our capabilities across strategy, technology, design, engineering, and business operations. The Group reported 2024 global revenues of €22.1 billion.

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