



Kozani Water Distribution System Leads Greece in Technological Advancement

Water Utility Implements Digital Twin Model to Decrease Water Loss and Improve Water Monitoring

Following Greece's government-debt crisis and subsequent economic burdens introduced by the COVID-19 pandemic, the country has honed in on a [National Recovery and Resilience Plan](#). The plan prioritizes bringing digital transformation to key infrastructure to create environmentally and economically positive outcomes. One key reform outlined in the plan is the improvement of water and wastewater regulation.

Greece's public water supply loses around 26% of its water to leaks every year, according to a 2017 [report](#) from the Organisation for Economic Co-operation and Development. As a result, Greek households consume more drinking water than any other country in the European Union, around 170 cubic meters per household each year.

Leading the charge for water system reform in Greece is Kozani, a city in Western Macedonia with a modest population of around 60,000. Concerted improvements to Kozani's water system began in 1985 when the Municipal Water Supply and Sewerage Company of Kozani, also known as DEYAK, was founded. DEYAK expanded the water network over several decades, eventually offering service to 63 settlements in and around Kozani. Over the past 12 years, the system has undergone significant technological upgrades, including segmentation in district metered areas, (DMAs), pressure management, and, recently, creation of a comprehensive digital twin model to streamline water monitoring processes and system performance.

Dimitris Papailiopoulos owns the Greek company Tech-Go-Round, which consulted on the implementation of the digital twin. When his team began working with the Kozani Water Distribution System, he said that it had many of the same challenges and shortcomings as other water networks across Greece.

"Everything was done manually, if at all," he said. "There were great water losses. The quality of the water was manually tested on a regular basis, but they knew they could do better."

Kozani also presented an ideal opportunity to create a model system for other Greek utilities.

“It’s easier to bring smaller water authorities to a point where they can adopt this innovative technology,” Papailiopoulos said. “[With] a large water authority, like the Athens Water Authority for example, there is a lot of preparatory work that has to take place, and it may take several years before they are even in a position to install it.”

Digital Upgrades

Before any digital upgrades could be incorporated, DEYAK first had to conduct a thorough mapping assessment. According to Papailiopoulos, the water utility did not have a complete map of the water network. There were areas where it was not known what materials were used or on what side of the road pipes passed.

Once the map was complete, the utility’s next step was to implement a supervisory control and data acquisition (SCADA) system supported by Bentley’s water distribution analysis software, OpenFlows. Using digital sensors, the SCADA system measures water pressure, flow, and quality. Later, Papailiopoulos’ team assisted in furthering that model by incorporating Bentley’s water infrastructure digital twin software solution. This solution allows the utility to view data collected through the SCADA system on a unified platform, enabling quicker assessments and more accurate decision-making about possible system issues and necessary repairs.

“In the past, they had to go to the SCADA system to monitor whether the tanks were full, and on a different screen, monitor water pressure,” Papailiopoulos said. “Now, they can have everything on one screen, which expedites their day-to-day process.”

In the near future, Papailiopoulos’ team hopes that the utility will be able to use the digital twin to help automate decision-making around repairs and system adjustments and generate corresponding work orders.

However, there are some challenges to overcome before the digital twin’s potential can be fully tapped. Throughout the course of mapping the system, implementing the SCADA system, and adding other technological upgrades, DEYAK contracted with various vendors who used different—and often encrypted—software platforms, making it difficult to create a single open platform that vendors and utility staff can access.

Konstantinos Gkonelas, Ph.D., the hydraulics technical manager for the digital twin project, said that this challenge is common among water distribution networks.

“This is something that I believe happens worldwide unfortunately,” Gkonelas said.

Additionally, he said that Kozani’s water utility is still working through maintaining the system so that it operates continuously and efficiently.

“There is a lot of effort needed in order to keep the system in operation,” Gkonelas said. “You need people to keep the connections and signals of the equipment connected with the digital twin to gain the right insights at the right time from all the data.”

Positive Outcomes

The introduction of the digital twin has brought multiple benefits to Kozani. Utility staff spend 40% less time on pressure management tasks. Leaks are also identified more quickly, leading to faster and higher-quality repairs. Improved leak management has cut down on water waste, with 20% less water flowing through the network. Kozani residents will reap the benefits as well, with reduced water loss translating to lower utility bills.

Additionally, preventing water loss is important from an environmental and economic perspective. At the end of 2022, EU leadership released a [directive](#) focused on ensuring residents’ right to access clean water. EU member states were urged to put systems in place to ensure water is “wholesome and clean,” meaning that it is clear of microplastics, toxic chemicals, and dangerous micro-organisms.

Additionally, states were ordered to assess leakage rates from their water infrastructure. By 2028, the EU is expected to enact legislation to formally enforce regulations surrounding these water standards, including a requirement to report water quality and system performance data to consumers.

“You cannot provide all this information to the customer without a digital twin, so we are ready for this positive change” Gkonelas said.

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Spotlight on Konstantinos Gkonelas

Hydraulics Expert Wants to See His Field Embrace Technological Advancement

[Konstantinos Gkonelas, Ph.D.](#), a civil engineer specializing in management of water networks, has been involved in many efforts to implement and upgrade water networks across Greece, the Balkans, and the Persian Gulf over the past decade—both as a co-founder of the hydraulic engineering firm ReonHydor and as a freelance consultant working alongside companies that include Tech-Go-Round.

While earning his Ph.D. in Water Distribution Systems Management from the University of Thessaly, Gkonelas began to hone his interest in the hydraulics field, focusing on how new digital technologies could be used to optimize pressure management and reduce water losses.

Most recently, this interest has manifested in harnessing the power of digital twins, which Gkonelas sees as the future of water supply management. One of his recent projects, a digital twin of the Kozani Water Distribution System in Northern Greece, went live in June this year.

“The implementation of a digital twin helped us gain useful insights to improve the performance and operations of our entire water supply network,” Gkonelas said. “[A number of] strategies regarding reducing nonrevenue water were improved: pressure management, active leak control, speed and quality of repairs, and asset management.”

Compared to many other types of infrastructure, Gkonelas feels that water networks have been slow to adopt 21st-century technology and digital advancements due to a persistent out-of-sight, out-of-mind attitude.

“I think that there is a gap between the ongoing technology and its implementation in water networks because it is an underground—and in many cases, unknown—infrastructure,” he said.

However, Gkonelas also considers the field of water management to be uniquely suited to digital transformation. Where water is concerned, there is no such thing as a fixed or static environment. Water models, therefore, should be dynamic and sensitive to minute-to-minute system changes to best optimize network functionality. It is something a digital twin can offer—along with many other associated efficiencies, as the Kozani digital twin has proven.

“[Resource hour] times for pressure management were reduced by 40% [in Kozani], and the speed and quality of repairs on newly reported and unreported leaks were improved by 50% due to the automatic location of isolation valves and the use of genetic algorithms that helped to identify them,” Gkonelas said.

In the decades to come, Gkonelas is confident that these benefits will have even greater weight as clean water becomes a scarcer resource, becoming “the oil of the future.” And across Greece and the globe, water utilities will look to the cutting-edge improvements in Kozani as a model.



[Image link](#)

Image caption/courtesy: Once the map was complete, the utility implemented a SCADA system supported by Bentley’s OpenFlows water distribution analysis software to measure water pressure, flow, and quality. *Image courtesy of DEYAK (Municipal Water Supply and Sewerage Company of Kozani).*

Author: Sandra DiMatteo is the industry marketing director for water infrastructure at Bentley Systems. She has more than 25 years of industry experience and is an expert in digital twin cloud solutions in the water and wastewater, energy, and process industries. Sandra holds an honors degree in accounting and is a Certified Reliability Leader. She can be reached at sandra.dimatteo@bentley.com.

2023 *Going Digital* Awards Nominee

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