Improving wastewater management with Digital Twins

A digital twin is a virtual representation of real-world systems or processes that are connected to data sources, sensors and APIs. It can be used for visualisation, monitoring, analysis, scenario simulation and control.

By enhancing efficiency, enabling predictive maintenance, and improving decision-making, digital twins offer transformative potential to wastewater treatment.

Digital twins can:

- ☑ Eliminate time-consuming and error-prone manual monitoring and control processes
- ☑ End the cycle of reactive maintenance, thereby reducing costs and disruptions
- ☑ Remediate inconsistent data integration causing information gaps and suboptimal decision-making

Optimising efficiency and resilience

By enabling alerts, simulations and AI predictions based on trends and patterns, digital twins offer multiple advantages:

- **Proactive management:** Real-time alerts enable immediate response to critical situations, such as overflows or blockages, reducing downtime and costs.
- **Enhanced predictive maintenance:** By using AI for preventative maintenance optimisation of schedules and extending longevity of assets.
- **Improved decision-making:** Simulations and predictive analytics provide insights into potential scenarios, allowing for better planning and resource allocation.
- **Weather-responsive operations:** By incorporating weather data, Digital Twins help manage the impact of environmental factors on wastewater systems, ensuring more resilient operations.
- **Comprehensive data integration:** Unified data from multiple sources offers a holistic view of the system, improving accuracy and efficiency in monitoring and management.

Core features and capabilities

Sensors: Measure the flow, pressure, temperature, or quality of water or electricity at different points.

Alerts:

Inform users of abnormal or critical situations that require attention, such as overflows, blockages, outages, or surges. Alerts can be triggered by:

- ☑ Predefined thresholds or rules
- ☑ AI models that detect data anomalies or patterns

Calculations:

Transform data from sensors into meaningful and actionable information, such as:

- ☑ Current reservoir levels
- ☑ Average building consumption
- ☑ Optimal machine operation
- ☑ Impact of weather events

AI models:

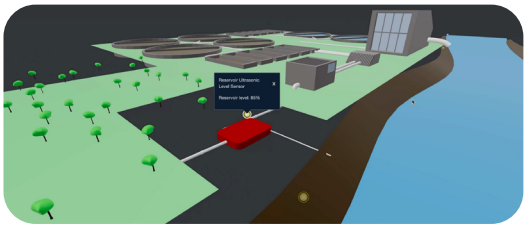
Algorithms learn from data and provide insights, predictions, or recommendations. For example, how to:

- ☑ Optimise performance, efficiency, or sustainability of the system or process
- ☑ Prevent or mitigate risks or failures
- ☑ Simulate different scenarios or outcomes

Digital Twins in action on the Grafana dashboard

AWS IoT TwinMaker integrates with other AWS IoT products and tools like Grafana and Factory Plus to enhance digital twin solutions.

- Shows a 3D model of the digital twin, detailing houses, pipes, reservoirs, sewage treatment plants, and rivers.
- Provides real-time insights and alerts for abnormalities, driven by sensor data and AI models.
- Allows you to remove the ground tile or the top of the reservoir to see the details inside.
- Uses a Red, Amber, Green (RAG) system to display different levels of overflow risk.
- Currently connected to simulated data, the goal is for the dashboard to use real data from sensors and the Met Office API.



Possible challenges to consider

- **Specialised skills:** Digital twins require expertise in software and data sources
- **Data translation:** Data must be converted from multiple sources into usable forms
- **Security and scalability:** Cloud infrastructure is needed to ensure robust, reliable, and scalable digital twins

Cross-industry benefits

Digital Twins provide real-time insights, predictive analytics, and operational efficiencies that can transform industry practices. They also have various applications beyond wastewater management, including:

Aviation:
Uses digital twins for aircraft design and simulation to reduce costs and improve safety.

Technology:
Enhance predictive maintenance and optimisation for industrial equipment and water systems.

Healthcare:
Creates digital twins of patients for personalised medicine and surgery simulation.

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