The smarter water utility

The acute need to become an insights-driven enterprise

Water utilities are at a difficult juncture in business. In the UK, they have invested over $170 billion in the last 10 years in a bid to maintain and improve assets. In the US, capital expenditure on clean and waste water infrastructure will exceed $683 billion over the next decade. These costs are unsustainable. To add to the cost challenges, traditional solutions have begun to fall short of the expectations.

The situation calls for the adoption of next generation solutions that go above and beyond traditional solutions.

Situation on the ground

The problem that water utilities find most frustrating is with their ageing below-ground assets. There is a lack of visibility into their performance due to opaque operating conditions. Failure to fix problems related to assets can result in non-compliance and hefty penalties.

In addition, water utilities are under tremendous pressure from growing customer expectations. Customers are used to services like Amazon and Uber, where everything happens in real time and they have complete control over the service. Utilities have to match the experience.

Finally, the unforeseen impact of climate shifts and the ineffective management of a distributed field workforce are sending costs spiraling. These are monstrous challenges. But they also present the perfect opportunity to examine technological advances and solutions that can transform the face of water utilities.

Some water utilities have already made remarkable progress in their efforts to leverage technology. For example, the water utility in Japan's Fukuoka city uses an unsupervised class of Artificial Neural Networks (ANN) named self-organizing maps (SOM). Sensors attached to distribution pipes are continuously monitored, helping regulate pressure through remote motor valve operations. These sensors also help reduce the dependence on operators with experience in managing distribution. Utilities like the one in Fukuoka are discovering just how useful these systems can be in the event of leaks and damage to pipes that require immediate and precise responses. The systems also help determine precise flow to consumers based on real-time demand.

An US-based water company replaced primary in-pipe inspection method that uses manual CCTV analysis with artificial intelligence (AI) and neural networking to monitor below-ground assets. The water utility leveraged open source neural networks and a code framework to hone its AI and machine learning (ML) applications in the field of pipe inspection for automated cracks, structural deformations, blockages, debris, etc. This enabled proactive maintenance, wherein more pipes could be inspected in a shorter span of time, maximizing budgeting allocation, and ensuring overall system stability.

The number of utilities that deploy technologies like ML and AI, to forge a path into a real-time insights-driven future, are bound to grow.

Groundbreaking technologies

Traditional systems have major gaps in addressing asset management KPIs. Fortunately, the proliferation of sensors, real-time monitoring devices and video/image feeds is changing this. Advanced asset-centric technologies, aimed at generating water insights, are taking the guesswork out of leak detection, pressure management, work order distribution, etc. Technologies like the Internet of Things (IoT), ML, AI, deep learning, data and analytics make a difference by targeting asset management KPIs.

The question before smart water utilities is: Should they invest the next few million dollars in identifying and servicing leaks after they have impacted consumers or in insights and predictive systems that help minimize leaks, flooding and incidents before they impact customers? The answer is self-evident.

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Smart utility built on the right technology

A predictive system/insights tool, specifically built for water utilities, will allow utilities to stay one turn ahead of issues at each stage of clean and waste water supply, distribution and management. The tool will use data leveraged using extraction and analytical processes, algorithms, models and best practices that are specific to water utilities. The insights, decisions and recommendations will be provided to business users and applications across a variety of devices. (See Figure 1 for the reference architecture of the insights tool)

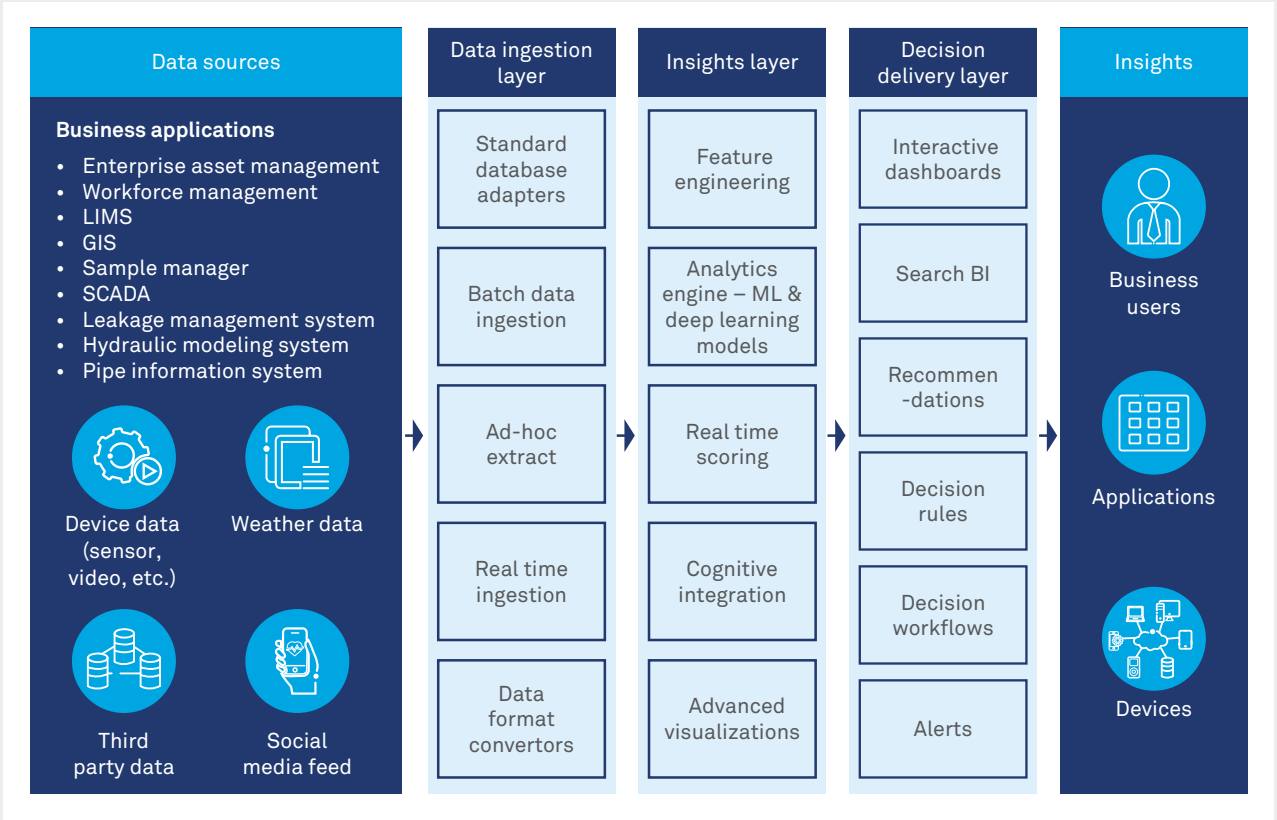

Figure 1: The building blocks of the insights tool

The insights developed by the predictive system, in the form of support for decision-making and action, will be crafted for different personas and roles. For example, water quality analysts, asset maintenance engineers, heads of HSE, compliance management, billing and customer

service executives will be able to quickly access information and support on interactive dashboards relevant to their roles.

In effect, the tool will be a one-stop solution for comprehensive water insights aimed at improving business outcomes across clean and waste water operations.

The business outcomes addressed by the insights tool for clean water will include:

Abstraction:

- Process framework for extracting water from groundwater, rivers, lakes, aquifers, etc. for treatment to produce drinking water
- Evolving a water balance model of extraction volume-supply-consumption

Treatment:

- Availability of clean purified water at adequate pressures, flows, velocities so as to meet junction demands monitored through digitized clean water networks
- Treatment controls of extracted water
- Reducing the amount of water leakages
- Recycling of water from waste water in waste water treatment plants
- Optimal chemicals dosage to improve water quality
- Optimized storage of drinking water for optimal supply
- Reducing rate of water related diseases through optimal water quality controls

Distribution:

- Monitoring of delivery of water to consumer with appropriate quality, quantity and pressure
- Monitoring of water quality in the distribution pipes
- Simulating digitized water networks to optimize and maintain sufficient pressure head
- Mitigating planned and unplanned interruptions of water using appropriate technology frameworks
- Proactive maintenance of distribution pipes to keep leakage to the minimum

Supply:

- Maintaining service quality
- Ensuring continuity of supply
- Ensuring proper water quality
- Maintaining adequate water pressure to ensure that water reaches the target customers
- Ensuring adequate metering of the water supplied

The business outcomes addressed by the insights tool for waste water will include:

Collection:

- Waste water flow monitoring and optimal controls
- Monitoring sewerage levels to prevent overflows and sewer flooding incidents proactively
- Avoidance of pollution incidents

Transfer:

- Efficient sludge disposal
- Control of adequate waste water network flow parameters
- Optimal management of waste water networks

Treatment:

- Reducing chemicals usage and treatment costs
- Maintaining toxic chemicals free effluent water that meets H&S regulations
- Maintaining operational efficiency of water treatment plant
- Avoidance of air pollution

Discharge:

- Ensuring risk free discharge adhering to regulatory norms

The insights tool will be more effective when it works jointly with the IT team of the utility. The IT team will be able to provide a nuanced understanding of the critical business, operational and technological factors typical to the utility. These should then be leveraged to create sharper and deeper contextual insights.

Making everything smart

A few select use cases will help understand the relevance of the insights tool. For instance, data from sensors will be pulled in to monitor various stages of water treatment processes. IoT analytics will be used to deliver automated dashboards with insights related to asset and network performance. Co-relating data from different external and internal sources will provide alerts about supply disruptions or demand spikes. Similarly, AI can be applied to waste water sensor data to analyze effluent parameters and drive decisions on treatment. ML and domain-specific algorithms can be applied to predict sewer flooding and to design/optimize management processes.

The overall benefits of the insights tool will include increased asset availability, work order planning, cost optimization, product quality improvement and increased customer satisfaction. These are the fundamental challenges that water utilities have been trying to address for decades.

Water utilities stand to benefit most when they are able to access the insights based on their needs. Such insights create a smarter, intelligent and future-ready water utility.

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