# WATER LOSS

## Study touts artificial intelligence for water loss tracking

*Cloud-based artificial intelligence technology is the way to go for leakage management, according to a position paper from the Water Research Commission (WRC) position paper. Article by Sue Matthews.*

Although artificial intelligence (AI) has been an integral part of our everyday lives for some years now – influencing what we see on social media, streaming platforms, online shopping and internet searches, for example – perhaps nothing has brought home its practical applications as much as ChatGPT, launched in November 2022. Now the vast potential of AI is being more widely recognised, so it should come as no surprise that the technology has a role to play in reducing non-revenue water (NRW).

Typically defined as the water provided by utilities – such as municipalities, water boards and other water service providers – but 'lost' before reaching the customer, NRW includes both real (physical) losses and apparent (commercial) losses. In other words, real losses are due to leakages from water distribution pipes and their connections, while apparent losses represent water for which no revenue is received because of illegal water consumption, deliberate non-payment and inaccurate metering.

Honing in on leakages specifically, a market analysis identifying trends and developments in leakage management technology was recently undertaken as part of a WRC project. The findings are outlined in a position paper titled 'Next generation water loss tracking, compliance, management, and performance solutions', written by the project team of Alisha Syal, Elizabeth Court and Jo Burgess of Isle Utilities, together with the WRC's Executive Manager for Water Use and Waste Management, Jay Bhagwan.

The focus on leakages was warranted, because about 40% of water 'produced' in South Africa is lost in this way, compared

to about 6.5% representing other forms of NRW losses. The 2022/23 No Drop Watch Report, released in early June, revealed that the Infrastructure Leakage Index for the 2021/22 municipal financial year had peaked at 6.4 in 2022, following signs of improvement in 2017 and 2018. The increase in leakage-related water losses was attributed to the COVID-19 pandemic, which resulted in operations and maintenance budget cuts and a lack of capacity in municipalities to undertake repairs, due to ill health and deaths. However, the report was based on data submitted by only 42 of the 144 municipalities that are water services authorities (WSAs), and then extrapolated to those that did not submit any information. A more accurate picture should emerge once the full No Drop Report covering the 2022 audits is published.

In their position paper, the project team point out that minimising leakages is not just about reducing water wastage and ensuring municipalities don't lose their product before it can be billed to a customer (any leaks on a customer's property will obviously be for their own account). The water-energy nexus means that more efficient water distribution will save electricity too, because pumping water through the distribution network consumes massive amounts of energy. Indeed, the authors report that the City of Toronto saved US$1 million in energy costs annually through optimal pump scheduling alone. Of course, treating raw water to a potable standard that is ready to be distributed also uses electricity and requires chemicals, human resources and ongoing maintenance – and that's just the operating costs.

Apart from reasons related to financial sustainability, reducing leakages will increase customer satisfaction and improve public opinion of a municipality's competence and enviro-social responsibility, because people generally don't take kindly to water supply disruptions, low water pressure, and precious water spewing from broken pipes.

The project team note that water loss tracking and management consists of four fundamental pillars: pressure management, active leak detection, asset condition monitoring, and smart analytics. Cloud-based smart analytics platforms allow all four to be integrated, and there is growing competition within this rapidly evolving field between large and small technology providers. The large players include established companies such as Royal HaskoningDHV and Xylem, which have extensive experience in producing or implementing a range of smart technologies. The smaller companies include FIDO Tech, a UK-based start-up that has extended its reach internationally.

The company was approached by Thames Water, which serves some 10 million customers in London and surrounds, to help target leakage in a defined area. The FIDO AI algorithm analysed more than 35 000 sound files collected by acoustic loggers over the previous four months in just 2.5 hours, returning a report that Thames Water compared with its own leakage repair records and dig data. An analysis was then conducted on the entire logger estate of 27 000 devices so that Thames Water could decide whether to replace or maintain its existing loggers. Daily reports allowed Thames Water to identify 33 points of interest for follow-up, 11 of which led to the discovery of misaligned loggers and 20 correctly confirmed as leaks or not leaks (including four customer side leaks), representing an accuracy of over 92%. In its 2022/23

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*The latest available figures suggest that around 40% of municipal water is lost to leaks.*

financial year, Thames Water fixed more than 66 800 leaks and has committed to replacing 112 km of the leakiest water mains pipes across London. This should ensure a daily saving of 27.8 million litres of water, equivalent to 11 Olympic-sized swimming pools every day!

The FIDO solution was just one of 35 identified by the project team through a technology scan, and all but two had cloud-based capabilities. "Cloud-based systems enable multiple users to access a GIS system at one time, whilst further enabling operators to download and publish maps to the internet," they note. "Furthermore, operators can now leverage cloud-based AI and analytics to analyse spatial data without having to install additional on-premises software or hardware."

The benefits of GIS mapping are clear – a cluster of leaks, even if repaired, may indicate that a pipe needs to be replaced. But cloud-based AI enables real-time monitoring of pipes, pumps and reservoirs, and when coupled with predictive analytics can provide early warning signs of potential failures, enabling proactive action to prevent system disruptions and optimise maintenance schedules. Cloud-based platforms can also be integrated with customer communication systems to send out notifications of when leak repairs or pipe replacements will be carried out, while AI-powered chatbots or virtual assistants can respond to customer queries and provide information and suggestions.

There are also opportunities to integrate customer billing systems – data that has previously only been used for billing can also be used to identify leakages. This is already possible with the smart meters that are being rolled out in many South African municipalities. Apart from allowing more accurate billing and remote reading, the smart meters detect excessive usage and water leakages, and instantly send an alert to the customer via email and SMS.

But getting municipalities to take the extra step of integrating the meters into a cloud-based platform with smart analytics capable of aggregating and visualising data from various loggers, sensors and other sources may be a bridge too far.

"Water utilities are generally conservative when it comes to investing in new software, often preferring the stability of legacy solutions rather than embracing new digital platforms," they note, adding that utilities may also remain resistant to paying the monthly OpEx fees associated with cloud-based systems. There are concerns about data security and cybersecurity, as well as uncertainty in less-developed markets as to whether GIS software offers a clear return on investment. Uptake of GIS may be particularly limited in municipalities where little information is available on an ageing network of underground and inaccessible pipes, never properly mapped.

Furthermore, field technicians and control room staff tend to be reactive, typically only responding to leaks and alarms, so a change in mindset will be needed for them to adopt a more proactive, predictive approach that allows them to detect events before they cause significant incidents. "However groundbreaking or cutting-edge a technology is, its full potential can absolutely not be realised without behavioural change and the correct attitudes to use the system and achieve the most effective results," note the project team. There may also be a skills gap within the organisation, requiring specialised expertise to implement cloud-based platforms and AI technologies.

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*Water leaks are not always as spectacular as this burst water main, however, they present a real problem for South Africa's water service providers.*

Of course, AI and machine learning tools are only as good as the data available to them, so the project team make a number of recommendations to prepare utilities for the way forward. For example, centralising existing datasets and adopting common data standards across the organisation will be crucial to providing better data accessibility, and data literacy should be prioritised in training and recruitment. But sharing and integrating data should be seen as just one component of interdepartmental collaboration – staff will also need to be able to communicate better across departments if the silo mentality is to be overcome.

Addressing concerns over data security and cybersecurity, the project team suggest implementing a central hub to be managed by a neutral science council, such as the WRC's Research Observatory, or housed by the soon-to-be Water Infrastructure Agency. They point out that the South African government has been working to finalise the National Data and Cloud Policy, which will provide guidelines and recommendations for the adoption and utilisation of cloud services in both the public and private sectors. Regardless, water utilities need to strengthen their capacity to determine gaps in security technologies and improve their risk-management approaches.

"Defending critical infrastructure is a cat-and-mouse game, forcing water utilities to stay on guard, innovate constantly, and implement new technologies," they state. And to ensure utilities take their responsibility to address leakages and other water losses seriously, whether or not they embrace the latest technologies, they conclude the position paper with a strong standpoint: "Stricter regulation is required whereby NRW targets are set and penalties issued if they are not met."