Water solutions for smart cities – Smart water systems make cities more liveable, resilient and sustainable

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5. WATER SOLUTIONS FOR SMART CITIES

Smart water systems make cities more liveable, resilient and sustainable

onventional water infrastructure is challenged by urbanisation and climate change while solutions aim at increasing urban liveability and resilience. It is time to integrate and smarten urban water systems and connect with the broader smart cities agenda.

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Urban water systems - for drinking water provision, wastewater collection and treatment, and stormwater management – are key to human health and environmental protection in cities around the globe. They are also challenged by urbanisation, by decades of neglected maintenance and by an increased frequency of floods and droughts due to extreme weather events exacerbated by climate change. The digital era, however, is currently transforming urban water systems from passive, single-purpose infrastructure elements into active, adaptive and multifunctional units that can respond differently according to the situation and be operated in an integrated manner as part of the broader smart cities concept.

Digital solutions for more efficiency in design and operations

Advanced GIS network databases and hydraulic modelling software allow simulating the performance of the widespread underground pipe networks. Increased use of online monitoring furthermore contributes to smarten network management, through household and district metering and noise logging aimed at detecting leaks in distribution networks, as well as level and flow gauging in sewers aimed at optimising the storage capacity to minimise combined sewer overflows during rain. Increased combined use of IoT-driven, system-wide monitoring and real-time modelling is expected to increase efficiency further.

Visibly multifunctional water solutions increase liveability and resilience

Digital elevation models (DEMs) that reflect the physical features determining water flow at the city surface during cloudbursts and storm surge events, as well as associated software solutions, enable integrated planning and design of climate change adaptation measures. These employ both underground pipe networks and above-ground public amenity areas and traffic ores for water storage and transport. These 'grey' infrastructure elements are combined with 'green' and 'blue' water sensitive urban design (WSUD) elements. A wave of city-wide monitoring efforts to document performance and optimise operation and maintenance is expected. These should be based on Open Data standards that allow new smart city services to be developed by third parties.

Resource conservation and integrated solutions

Wastewater treatment plants are increasingly operated with advanced control systems to minimise energy consumption by utilising the biogas potential. With time, they are also expected to minimise GHG emissions and utilise the nutrient content to produce fertilizers. Digital solutions are increasingly used to optimise performance across sectors, e.g. wet-weather control of wastewater treatment plants aimed at temporarily increasing their capacity to avoid combined sewer overflow and bypass during rain. The next generation of integrated control is focusing on scheduling the aeration at treatment plants by buffering wastewater in the upstream drainage system to ensure a primary use of renewable energy sources (wind and solar) during dry weather. In both cases, reliable forecasts from weather radars and numerical weather prediction models are used. These will also increasingly be used for scheduling maintenance activities and flood forecasting, which allows for improved mobility services during rain and flooding.

Increasing liveability and climate resiliency through integrated control and warning systems

The coastal City of Aarhus aims to be a blue and green city. This involves restoring the old industrial harbour area into residential and recreational areas and reopening a cased river flowing through the old city center into the harbour. To obtain proper water quality and prevent flooding as a result of climate change, approximately EUR 50 million was invested in constructing trunk sewers, storage tanks and increasing rainwater handling capacity at the city's wastewater treatment plants. A real-time control and warning system was also developed, which has saved nearly half of the needed storage capacity for less than 5% of the total costs. The control system optimises the use of the storage capacity in the combined sewer system through real-time control of weirs and pumps, which subsequently minimises combined sewer overflows during heavy rain. The warning system forecasts deteriorated water quality in the receiving waters based on automatic operation of integrated models of the sewer system and receiving waters. The models use real-time data from the sewer systems and wastewater treatment plants as well as forecasted rainfall data from a Local Area Weather Radar.

Aarhus Vand, DHI and Krüger

Combining multiple data sources in automatic leakage management

In the capital region of Denmark, they listen carefully to their water distribution networks. The country's two largest water suppliers, HOFOR and Novafos, are transforming parts of their water distribution networks around Copenhagen with state-of-the-art technology. Here, noise loggers now listen for the sounds of leaks. Smart water meters measure end user consumption. Intelligent valves and pumps enable active pressure management which reduce the risk of bursts. The collected data is combined with SCADA and GIS in real-time hydraulic modelling and processed in online management information systems to facilitate automatic leakage management and online monitoring of KPIs. This enables leakage teams to target the weakest pipeline segments with the goal of reducing Non-Revenue Water levels to 4-6%.The project is called LEAKman and consists of nine Danish partners representing technology providers, consultants, water utilities and the Technical University of Denmark, who have joined forces to demonstrate Danish solutions and pave the way for new technology. The ambition is to make water utilities more smart, efficient and sustainable – in Denmark as well as worldwide.

NIRAS, Grundfos, Schneider Electric, AVK, Kamstrup, Leif Koch, Technical University of Denmark, HOFOR and Novafos