European Partnership on Metrology
Call 2023 –Fundamental Metrology, Industry, Normative and Research Potential

Selected Research Topic number: **SRT-i24**
Version: 1.0

Title: Metrology for smart water supply networks

Abstract

Water will become the most valuable resource on Earth as aquifers and river basins are depleted or polluted, and reservoir capacities prove insufficient. Climate change and increased water demand (in 2030 water demand in Europe is likely to exceed water supply by 40 %) have already produced an urgent need to increase the monitoring of water consumption. Indeed, the Water Framework Directive, requires EU member states to ensure that water pricing policies provide incentives for users to consume water efficiently and that industries contribute to the full cost recovery. Smart water meters, sensors for water quality monitoring and smart analyses of the associated sensor networks are gaining more and more importance in the water sector. This digital transition of water supply management will support more efficient data-driven water distribution, active water management and early warning system for water quality. However, currently, the uncertainty of the measurement data and the learning algorithms are not fully accounted for. Further to this, the use of AI-based algorithms for water supply networks is still at an early stage, and they lack metrological evaluation.

Keywords

Water supply, water meters, water consumption, autonomous sensors, network monitoring, AI, data fusion

Background to the Metrological Challenges

Climate change, changing demographics, pollution, and overexploitation pose significant challenges to the sustainable and reliable supply of potable water. Currently in Europe, 30 % of the population is affected by water stress and shortages during an average year and in approx. half of the EU's member states > 20 % of potable water was lost in the distribution networks before it could reach the consumer.

The supply of water to consumers and the manufacturing of water and flow meters represents a 30 billion € business in the EU. However, non-revenue losses are a serious issue with average distribution losses of approx. 23 %. Thus, there is an urgent need for smart water supply networks, with digital solutions that incorporate advanced analytics in order to prevent leaks, safeguard water supplies and create significant savings.

Technological developments in recent years such as digitalisation and intelligent networked sensor systems offer promising opportunities to enable a better use of water resources and to avoid unnecessary water losses. Improving the efficiency and responsiveness of water supply management has the potential to be a game-changer in boosting the resilience of water supplies and making early warning systems possible. However, for this to become possible, new accurate and reliable water supply network monitoring systems, combined with efficient and reliable smart analysis tools are needed. The systems also need to be optimised in terms of leak detection, consumption prediction, data synchronisation, sampling rate and their smart algorithms need to be validated.

Future-proof water supply management will also rely on the reduction of consumption peaks, which are expected to increase in the coming years. Water suppliers as well as politicians are discussing incentives to customers to avoid peaks, such as the separate billing of peaks or shorter billing periods. This is where the new quantity of water consumption per time comes into play, and with it the need for sufficiently accurate measurements, conformity assessments and testing procedures for water meters and validated smart algorithms for data analysis.

Finally, without intelligent processing of sensor information reliable smart water supply networks cannot be setup. An increase in the number of sensors in a network does not automatically equate to an increase in quality data. Instead, modern data fusion techniques in combination with AI and machine learning are needed to obtain optimal results from networks of heterogeneous sensors.

Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the protocol.

The JRP shall focus on the traceable measurement and characterisation of smart water supply networks.

The specific objectives are

1. To develop new methods and guidelines for the set up and quality assessment of sensor network(s) for measuring water loss at different scales. This will include (i) the mitigation of synchronisation issues, (ii) heterogeneous measurement ranges, (iii) water meter quality, (iv) data accuracy requirements, (v) algorithm efficiency and (vi) algorithm validation.
2. To assess the applicability of time-resolved water meter data for predictive maintenance of water meters including reliable time-dependent detection of consumption peaks.
3. To develop tools for the smart analyses of data from water meter networks, for reliably forecasting consumption over varying spatial scales. This should include the determination of algorithm uncertainties.
4. To produce guidelines for the set up and operation of a network dedicated to water quality monitoring for microbial contamination. This will include (i) data sampling, (ii) measurement accuracies, (iii) optimising network setup (iv) assessment of sensor health using machine learning, (v) data fusion and (vi) combined analysis of water supply hydraulic condition data from different networks.
5. To facilitate the take up of the technology and measurement infrastructure developed in the project by the measurement supply chain, standards developing organisations (WELMEC WG13 Utility meters, OIML TC8/SC5 Water meters, CEN/TC 230 Water Analysis, ISO/TC 147 Water Quality and ISO/TC 30/SC 7 Water meters), and end users (e.g. water suppliers, water meter manufacturers).

These objectives will require large-scale approaches that are beyond the capabilities of single National Metrology Institutes and Designated Institutes. Proposers shall give priority to work that meets documented industrial needs and include measures to support transfer into industry by cooperation and by standardisation. An active involvement of industrial stakeholders is expected in order to align the project with their needs – both through project steering boards and participation in the research activities.

Proposers should establish the current state of the art and explain how their proposed project goes beyond this. In particular, proposers should outline the achievements of the EMPIR project 17IND13 Metrowamet and how their proposal will build on it.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 1.9 M€ and has defined an upper limit of 2.3 M€ for this project.

EURAMET also expects the EU Contribution to the external funded beneficiaries to not exceed 35 % of the total EU Contribution across all selected projects in this TP.

Any industrial beneficiaries that will receive significant benefit from the results of the proposed project are expected to be beneficiaries without receiving funding or associated partners.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the 'end user' community, describing how the project partners will engage with relevant communities during the project to facilitate knowledge transfer and accelerate the uptake of project outputs. Evidence of support from the "end user" community (e.g. letters of support) is also encouraged.

You should detail how your JRP results are going to:

- Address the SRT objectives and deliver solutions to the documented needs,
- Feed into the development of urgent documentary standards through appropriate standards bodies,
- Facilitate improved industrial capability or improved quality of life for European citizens in terms of personal health, protection of the environment and the climate, or energy security,
- Transfer knowledge to the water sector.

You should detail other impacts of your proposed JRP as specified in the document "Guide 4: Writing Joint Research Projects (JRPs)"

You should also detail how your approach to realising the objectives will further the aim of the Partnership to develop a coherent approach at the European level in the field of metrology and include the best available contributions from across the metrology community. Specifically, the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of EURAMET Member States whose metrology programmes are at an early stage of development to be increased
- organisations other than NMIs and DIs to be involved in the work.

Time-scale

The project should be of up to 3 years duration.