European Partnership on Metrology
Call 2024 –Digital Transformation, Green Deal, Normative and Research Potential

Selected Research Topic number: **SRT-d05**
Version: 1.0

Title: Predictive maintenance, remote verification, and optimised procedures for measuring instruments in-situ

Abstract

Legal metrology imposes periodic verifications of meters, governed by the Measurement Instrument Directive, to ensure that measurements and measuring instruments are constantly reliable. National legislation requires periodic recalibration or replacement of utility meters, which incurs significant labour and equipment costs. However, the advent of digitalisation and Internet of Things (IoT) presents an opportunity for automated in-situ monitoring of meters in large sensor networks. This leads to early detection of measurement errors and prolongs the service life of the products. There is a need for research into reliable, and feasible methods for remote diagnostics and verification, serving as the foundation for an updated and modern legislation for utility meters.

Keywords

Legal metrology, remote verification, predictive maintenance, machine learning, smart meters

Background to the Metrological Challenges

The purpose of legal metrology is to ensure that society has confidence in essential measurements. Historically, legal metrology procedures have been based on verification at fixed intervals, on checking of random samples without using prior knowledge of individual devices or on plausibility checks based on data obtained locally or remotely at random sampling rates (hours, days, months). As with any government activity, legal metrology must comply with the principle of proportionality. Measures must be necessary and appropriate, but also socially, economically, and environmentally sustainable. This implies a trade-off between benefits and costs. Every year many utility meters are replaced because they have reached the end of their pre-defined (re-)verification period. Some of these meters are still fully functional, resulting in unnecessary costs and waste of human, material, and environmental resources. Modern digital technologies enable remote verification methods. However, these methods will only be used if their reliability is convincingly demonstrated in a methodologically sound way. In its new proposal for a standardisation strategy the European Commission has emphasised that *"the EU's ambitions for a climate-neutral, resilient and circular economy cannot be achieved without European standards for testing methods, management systems or interoperability solutions"*. WELMEC, the European Cooperation in Legal Metrology, also recognises the need for flexible reverification periods to save resources, e.g. using predictive maintenance and big data. Research is needed to prepare standards for the transition of remote utility meter verification into the digital and green age.

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 proposal shall focus on metrology research necessary to support digital transformation in dynamic reverification procedures of utility meters by delivering reliable methods for remote verification in-situ and contribute as a result in changing the current legislation.

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The specific objectives are:

1. To develop at least two methods for remote diagnostics and verification of at least one type of utility meters (electricity, gas, thermal energy, water meters), which provide predictions on the meters' reliability. These methods should enable probability statements and should include at least the selection of key relevant influential parameters and quantifying their impact.
2. To statistically validate the predictions of the reliability using simulated and independent real data-sets for remote diagnostics and verification of selected utility meters from objective 1.
3. To adapt the developed methods to FAIR (Findable, Accessible, Interoperable, Reusable) data and to validate the methods in real-world applications on at least two meters which would be subjected to a reverification afterwards.
4. To investigate and test the applicability of the developed methods to other types of utility meters/ Measuring Instruments Directive (MID) instruments and to other instruments possibly covered by MID in the future.
5. To facilitate the take up of the technology and measurement infrastructure developed in the project by the standards developing organisations (CEN-CENELEC, CEN TC92 WG2 and CEN TC176 WG2,) and by regional and international legal organisations (WELMEC WG7, WG8, WG11, WG13 and OIML TC 5/SC2) and end users (associations of utilities and manufacturers).

These objectives will require large-scale approaches that are beyond the capabilities of single National Metrology Institutes and Designated Institutes. To enhance the impact of the research, the involvement of the appropriate user community such as industry, standardisation and regulatory bodies, and other European Partnerships is strongly recommended, both prior to and during methodology development.

Proposers should establish the current state of the art and explain how their proposed project goes beyond this.

Proposers should note that the programme funds the activity of researchers to develop the capability, not the required infrastructure and capital equipment, which must be provided from other sources.

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 2.4 M€ for this proposal.

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 proposal’s 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 utility 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 Metrology 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.

Timescale

The project should be of up to 3 years duration.

Additional information

The links provided in this section are only correct at the time of publication up until the end of the Call year.

The references below were provided by PRT submitters; proposers should therefore establish the relevance of any references.

[1] EMN for Mathematics and Statistics in Metrology Strategic Research Agenda https://www.euramet.org/research-innovation/metrology-partnership/strategic-research-and-innovation-agendas