Speeding-up Scientific Knowledge Transfer and Improvement of Capabilities of emerging European National Metrology Institutes and Designated Institutes in the field of thermal measurements: Benefits and Impacts

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Speeding-up Scientific Knowledge Transfer and Improvement of Capabilities of emerging European National Metrology Institutes and Designated Institutes in the field of thermal measurements: Benefits and Impacts

J-R Filtz[1], B Hay[1], N Arifovic[9], M Sadli[4], G Failleau[1], D Mac Lochlainn[8], J Bojkovski[10], S Boles[8], F Bourson[4], S Cohodarevic[6], A Corman[9], J Drnovsek[10], N Hodzic[6], N Jandric[6], M Kalemci[9], L Knazovicka[3], M Kludsky[3], N Milosevic[11], I Nikolic[11], I Pusnik[10], L Rongione[1], D Sestan[5], S Simic[7], V Stankovic[7], N Stepanic[11], V Stepanovic[7], R Strnad[3], E Turzo-Andras[2] and D Zvizdic[5]

1-LNE, National Laboratory for Metrology and Testing, 29, Avenue Roger Hennequin, 78190 Trappes, Paris Area, France
2-BFKH, Government Office of the Capital City Budapest, Németvölgyi út 37-39, 1124 Budapest Hungary
3-CMI, Czech Metrology Institute, Okružní 772/31, 638 00 Brno, Czech Republic
4-CNAM, National Conservatory of Arts and Crafts, 61, Rue du Landy, 93210 La Plaine St Denis, France
5-FSB, Faculty of Mechanical Engineering and Naval Architecture, Ulica Ivana Lučića 5, 10000, Zagreb, Croatia
6-IMBiH, Institute of Metrology of Bosnia and Herzegovina, Augusta Brauna 2, 71 000 Sarajevo, Bosnia and Herzegovina
7-MoE - Directorate of Measures and Precious Metals, Mike Alasa 14, 11000 Belgrade, Republic of Serbia
8-NSAI, National Standards Authority of Ireland, Griffith Avenue Extension, Glasnevin, Dublin 9, Ireland
9-TUBITAK, Scientific and Technological Research Council of Turkey, Gebze Yerleşkesi, 41470 Gebze/Kocaeli, Turkey
10-UL, University of Ljubljana, Kongresni trg 12, 1000 Ljubljana, Slovenia
11-VINS, „Vinča“ Institute of Nuclear Science, P.fax 522, 11001 Belgrade, Republic of Serbia

E-mail: jean-remy.filtz@lne.fr

Abstract. Within the frame of a European project called Eura-Thermal, the general objective was to upgrade the regional metrological infrastructure (Bosnia & Herzegovina, Croatia, Ireland, Serbia...) with new capabilities, especially in the field of thermal measurements. This paper highlights the strategy used for improving in the short term, scientific knowledge transfer and the capabilities of different emerging institutes. Furthermore, as a main output, the impacts and benefit for Industry and for the end-users are also presented as examples.

[1] To whom any correspondence should be addressed.

1. Rationale and Overall Objective

Many industries, such as metallurgy, glass fabrication, foundries, tyre production and the automotive sector rely on processes operating at high temperatures, for example in the range from 500 °C to 2000 °C. In order to ensure reliable and consistent products and to optimise energy and raw material usage, it is necessary for manufacturers to monitor and control the manufacturing process, and this requires reliable and accurate measurement of temperature. For example, during the process of smelting in a local copper-smelting facility it was identified that there is a need for non-contact temperature measurement in the blast furnaces. The company is implementing the process for measurement of temperatures using radiation thermometers, but there is a need for measurements up to at least 1500 °C. These measurements should be traceable and accepted on both local and international markets.

In thermal metrology, as in many other scientific fields, the traceability chain for any thermal sensor to be calibrated is normally implemented from the National Metrology Institutes/Designated Institutes (NMIs/DIs) level to the industrial application field through an unbroken chain of calibrations. Each NMI/DI provides calibrations at the highest level of the reference sensors, thus providing the most precise thermal measurements with the lowest uncertainties.

Therefore, the overall objective of the project was to enhance the availability of facilities in the field of thermal metrology (i.e. high temperature contact thermometry, non-contact thermometry and thermophysical properties characterisation) in emerging NMIs, where access to these types of facilities is currently limited.

2. Knowledge Transfer Objectives and Tools Developments

The aim of this project is to transfer scientific and technical knowledge from the scientific and technical experts of NMIs/DIs which have significant experience in the field of thermal measurements to the laboratories which are developing, improving, or upgrading their own metrological infrastructure. The final objective is that they can exploit their new or existing facilities for the benefit of regional or local Industry.

2.1. Website - Newsletter

A project webpage was first created (www.eura-thermal.org hosting by Wix.com) with public access, and a part restricted for partners only. The webpage was regularly updated with information on the project. This was done through a special section dedicated to “News of the project” where information about workshops, public reports, presentations, papers, etc. were made available to the public.

In order to generate awareness and keep potential stakeholders up to date on the progress of the project, a set of newsletters was produced approximately once annually. The newsletter contained a summary of the project and how it impacts on industry. It also provided contact details for all those who wish to become involved as stakeholders. The newsletter was distributed among each partners’ contacts.

2.2. Surveys

In order to increase interaction with stakeholders and/or industrial users, a questionnaire was drafted and shared between the partners who also translated it in their respective languages. The questionnaire was circulated widely by all consortium members. The results were analysed and were used to identify key stakeholders in each region, as well as areas in which research should be focussed in future.

2.3. Publications - Conferences

Several papers were submitted to peer-reviewed journals for publication. The topics of the papers were as follows:

- A paper describing improved accuracy of high temperature measurements by contact thermometry in the range of 960 °C to 1084 °C
- A paper confirming the enhanced capabilities of radiation thermometry in the range from 50 °C to 2000 °C
- A paper describing the improved capabilities and developments of Guarded Hot Plate facilities.
- A paper describing an inter-comparison of Ag fixed-points between different partners

Wherever possible, these papers were made open access in order to maximise their readership and therefore the impact of the project.

Furthermore, several oral or poster presentations were presented at relevant conferences. Networking opportunities at international conferences were a well-established way to interact with stakeholders and peers.

2.4. Workshops- Trainings

This project organised two types of workshops, one aimed at the project partners and one aimed at the stakeholders identified during the course of the project.

- Internal (partner NMI/DI) Workshops - Trainings

In order to facilitate knowledge transfer from the more developed laboratories to the emerging laboratories, internal workshops were run.

- External (Stakeholder) Workshops - Trainings

In order to maximise the impact of the project on industry workshops was held to increase awareness and knowledge in the fields of high temperature measurement and thermophysical properties. The target audience was industrial stakeholders in each partner country. These training courses provided attendees with information on the practical application of measurement techniques in the field. The courses were developed in conjunction with Work Package leaders in charge of the different work package topics ensuring that all relevant aspects are covered. The course material was translated into local languages to maximise its coverage.

3. Impacts - Targets

The main impact of the project was to build upon the existing capacity and capability in partner institutes in the field of thermal measurements. The project organised workshops and presented the project results at conferences and in relevant scientific journals. As previously described, Knowledge Transfer was also disseminated by developing training courses, and an advisory board, consisting of industry stakeholders, was regularly met to exchange information with the consortium and ensure that the project was delivering relevant results.

3.1. Intermediate impact on industrial and other user communities

The infrastructure for an intra-European high temperature calibration service, accessible to all industrial end-users in the relevant European regions can be provided. This, in turn, ensures that calibration services are more readily available for each instrument and therefore reduce calibration costs and risks from not having monitoring equipment available (e.g. thermometers, thermocouples, radiation thermometers and guarded hot plates).

3.2. Intermediate impact on the metrological and scientific communities

The metrological community (i.e. NMIs, DIs and accredited calibration laboratories) of emerging EURAMET member countries will benefit from the project outputs through the improvement of their measurement capabilities (in terms of accuracy and temperature range in particular) in the field of thermal metrology.

3.3. Capacity building impact

The project has enabled the support of research and innovation in the scientific community of the involved countries by:

- Offering access to more comprehensive high quality facilities in the field of thermal metrology.
- Providing traceable and verified thermal conductivity data, useful for their own research
- Enhancing the consistency of measurements performed in the scientific community thanks to improved traceability chains.

3.4. Environmental impact

The reduction of emissions and pollutants and the efficient use of energy and raw resources are important issues for all new emerging countries. Temperature is one of the most widely measured parameters in a power plant and irrespective of the type of plant, accurate and reliable temperature measurement is essential for operational excellence.

4. Conclusion

As practical outputs of this project, Knowledge Transfer, New tools and Capabilities have been efficiently developed and improved. The main outputs are:

- Improved availability and capability of metrology services (calibration, measurement, training, consultancy, etc.) for the end-users of thermal instrumentation (e.g. thermocouples and radiation thermometers), or thermal measurements of materials (thermal conductivity) and better identification of their needs.
- New skills and expertise in thermal and thermophysical properties metrology available in National Metrology Institutes and Designated and Associated Institutes, in central and south-east Europe and Ireland.
- Efficient and practical tools developed, such as measurement guidelines and calibration procedures, in order to accelerate the knowledge transfer between scientific partners and provide easy access to end-users.
- Traceable temperature calibration and measurement services available to regional industries.
- The fostering of European traceability capabilities on thermal calibration facilities between European NMIs/DIs in new emerging countries.

5. References

[1] Developing traceable capabilities in thermal metrology, Annex I, JRP Protocol 14RPT05 Eura-Thermal, June 2015
[2] Exploitation Plan, 14RPT05 Eura-Thermal, May 2017

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