EURAMET & the Partnership on Metrology

05 October 2021

JT Janssen
STAIR EMPIR Chair, BoD member

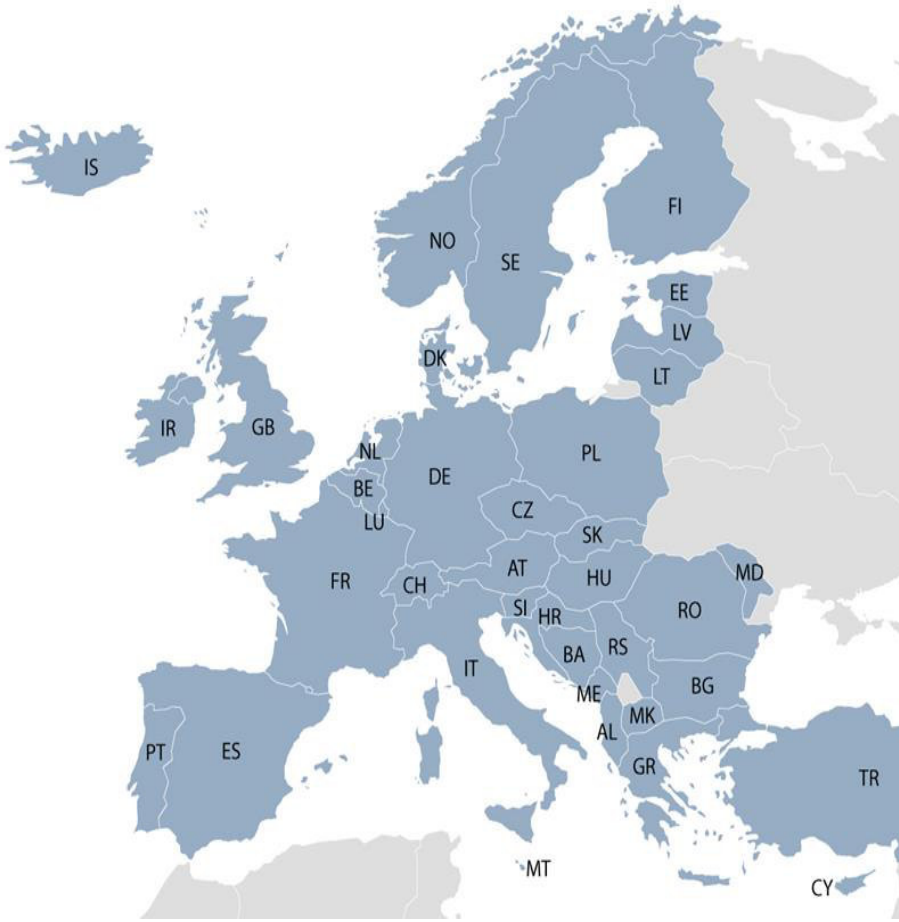
Agenda for today

Time	Topic	Speaker
10:00	Welcome to the webinar	JT Janssen EURAMET Chair of STAIR EMPIR
10:00-10:15	EURAMET/EPM in general	JT Janssen EURAMET Chair of STAIR EMPIR
10:15-10:20	STAIR EMPIR	Luc Van den Berghe CEN/CENELEC Project Manager Innovation-
10:20-10:40	The call for pre normative projects in 2022 : opportunities for standardisation	Eveline Domini Standardisation support for EURAMET
10:40-11:00	Examples of EMPIR projects with direct link from need to project and outcome	Dagmar Auerbach EURAMET Programme Manager
11:00 - 11:20	Metrology for digital transformation	Sascha Eichstädt PTB Convener of the EURAMET TC-IM work group on digitalisation
11:20-11:30	Questions and Answers	All Run by Dagmar Auerbach
11:30	End of the meeting	

EURAMET e.V.

The European Association of National Metrology Institutes

- **38 National Metrology Institutes** (Members)
- **77 Designated Institutes** (Associates)
- **16 international Liaison Organisations** (e.g. IAEA, BIPM)
- Providing stakeholders with **world-leading measurement solutions and standards**
- Securing **world-wide trust** and **acceptance** of measurements, for all aspects of business and society
- Implementing **Metrology Research Programmes**



Regional Metrology Organisations (RMO)

RMOs coordinate the cooperation of NMIs and DIs in:

- National Measurement Standards (traceability, international recognition)
- Research in metrology
- Capacity building
- Interaction with key stakeholders
- Influence on policy makers (regional)
- and others

The European Partnership on Metrology– Draft General Objective

To Create, by 2030, a sustainable and effective system for metrology at European level that ensures Europe has a world-class metrology system that:

- Provides metrology solutions, fundamental metrological reference data and methods, offering fit-for-purpose solutions supporting and stimulating European innovation and responding to societal challenges.
- Supports and enables effective design and implementation of regulation and standards that underpin public policies that address societal challenges

The European Partnership on Metrology– Draft Specific Objectives

1. That the national contributions to the Partnership should enable the development of sustainable European Metrology Networks that provide metrological solutions for
    i. innovative technologies and
    ii. public policy and regulation for key societal challenges.

These networks should have a strong stakeholder focus and significant role in the development of the strategic research and innovation agenda for the partnership.

The European Partnership on Metrology– Draft Specific Objectives

3. That supporting activities associated with the Partnership should increase the role of metrology in design and implementation of public policy and regulation for key societal challenges. This should be demonstrated by the numbers of:

- roles on European and international policy, regulation and standards committees directly related to addressing social challenges
- contributions to European and international standards directly related to EU

Partnership call plan

2021	Green Deal
2022	Health, Integrated European Metrology, Digital Transformation
2023	Fundamental, Industry
2024	Green Deal, Digital Transformation
2025	Health, Integrated European Metrology
2026	Fundamental, Industry
2027	Green Deal

- Normative (written standards and regulation) each year
- “Integrated European Metrology” replaces SI calls of EMPIR with a focus on joint capabilities and infrastructures
- “Green Deal” replaces Environment and Energy calls
- New: “Digital Transformation”
- CB measures
- Implementation similar to EMPIR
  (two-stage call, project eligibility and characteristics, reporting, ...)

Questions?

European Standardization Organizations

STAIR EMPIR

Luc Van den Berghe, programme manager Innovation

STAIR EMPIR

Context:

- Cooperation Agreement with EURAMET (2010, renewed end 2015)
- The European Partnership on Metrology EPM under Horizon Europe, the successor of EMPIR, the "European Metrology Programme for Research and Innovation" in the frame of Horizon 2020
- CEN-CENELEC/ BT WG STAIR (STAIR = STAndards, Innovation and Research) provides strategic advice to the Technical Boards in order to reach an integrated approach between research, innovation and standardization

STAIR-EMPIR was created by the CEN and CENELEC BTs with the aim to bring together the metrology research and standardization communities; main activities under STAIR-EMPIR:

- Yearly submission of needs for metrology research originating from the standardization work as basis of PRTs
- Support of interactions between both communities (various ways: originally yearly meeting in Brussels, today a webinar and organizing F2F or virtual interactions between experts)

Contacts at CEN-CENELEC side during 2021: Luc Van den Berghe (CCMC) – lvandenberghe@cencenelec.eu and Ortwin Costenoble (NEN) - empir@nen.nl

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The new European Partnership on Metrology : Opportunities for standardization

CEN-STAIR EMPIR Webinar

6 October 2021

Speaker

Eveline Domini
Eveline.domini@lne.fr

Standardisation manager in LNE

Standardisation support for EURAMET

LNE : French National Metrology Institute (Paris-France)

EURAMET : European Association of National Metrology Institutes

Content

The European Partnership on Metrology - EPM

Background about Normative projects in the previous program EMPIR

NRM projects in the EPM

- Strategic aim
- Call scope 2021
- Role of the standardisation bodies
- What topics
- The process for the NRM EPM Call

CEN-CENELEC/STAIR EMPIR

- The process
- Input for the 2022 EPM NRM call

The European Partnership on Metrology

- EPM = European Partnership on Metrology
- Funding of Joint Research Projects = JRP
- To enable the collaboration of European metrology institutes, industry, research organizations, standardization, regulators…
- EPM is the successor of EMPIR *European Metrology Programme For Innovation and Research (*2014-2020)
- The process for the annual call similar to EMPIR, already well known

Background: Normative Projects in EMPIR

EMPIR : previous research programme for metrology

- 6 annual NRM Calls from 2015 to 2020
- 37 Normative projects funded = NRM JRPs
- 16 Normative projects address a need directly coming from form the standardization organizations, via the STAIR EMPIR process
- Standardization organisations involved in NRM JRPs : members of CEN/CENELEC/ISO/IEC/CIE- TC or WG

Background: Normative Projects in EMPIR

Please see detailed information on EMPIR NRM JRPs at :

https://www.euramet.org/research-innovation/research-empir/empir-calls-and-projects/

Example : EMPIR call 2015

NORMATIVE

PROJECT NUMBER	SHORT NAME	TITLE	COORDINATOR
15NRM01	Sulf-Norm	Metrology for sampling and conditioning SO2 emissions from stacks	Garry Hensey (NPL)
15NRM02	UHV	Techniques for ultra-high voltage and very fast transients	Alf-Peter Elg (RISE)
15NRM03	Hydrogen	Metrology for sustainable hydrogen energy applications	Jacques Hameury (LNE)
15NRM04	ROCOF	Standard tests and requirements for rate-of-change of frequency (ROCOF) measurements in smart grids	Paul Wright (NPL)

Normative Calls in the EPM

EPM - *European Partnership on Metrology*

- 7 annual Calls planned – 2021-2027
- A NORM Call planned every year
- First NORM Call in 2021, in progress
- Next NORM call : in 2022
- The STAIR EMPIR process : still operational

The NRM Projects in EPM

Strategic aim

- to develop metrological methods and techniques required for standardisation, regulation and conformity assessment
- enable collaborative research going beyond the state of art
- generate benefit for European and International Standards Organisations by exploiting the expertise and unique capabilities of the metrology institutes.

The NRM Call scope in 2021 EPM

2021 NRM Call scope
Metrology research for Regulation and Standards

Strand 1
Standardisation

Projects addressing **specific documented demands of European and International Standards Organizations for measurements research, in any area.**

- Expected to develop research activities to contribute to the current standardization work or feed any future standardization work.

Strand 2
European Regulation

Projects addressing **specific documented demands of European Regulators and Conformity Assessment Bodies for metrological research**.

Includes research for standardization in support to European Regulation and for possible future regulation.

EPM NRM projects

Role of the standardisation bodies

- The ESO - European Standardisation Organisations and Regulators will continue the role they have in EMPIR :
  - contributing to the definition of programme calls and being a key exploitation route for the project outputs.
  - play a key role in identifying needs for better measurements.

- For all the projects, EURAMET encourages proposals that include representatives from industry, regulators and standardization bodies for their active participation in the projects.

  EPM : around 40% of the budget are dedicated to external partners

EPM NRM projects

- must include at least 3 National Metrology Institutes or Designated Institutes from different countries
- must be led by a metrologist coordinator
- has a maximum duration of 3 years, can be 2 years
- expected to includes external partners (funded or unfunded): industry, research organizations, standardization, regulators..
- Total budget per project in 2021 : 1 M€ maximum
- with around 30% dedicated to the external partners.

What topics in a NRM JRP?

JRPs are metrology research projects.

Must address topics dealing with **traceable measurements** methods or validated data set, as for example :

- The development of :
  - traceable measurement methods for measuring parameters
  - a new reference materials in close collaboration with instruments manufacturers
  - a new calibration method
  - metrological improvements of standardized test methods
  - calculation uncertainties
- The determination of all relevant parameters to design an accurate, robust and stable measuring instrument to elaborate a standardization document.

What topics are not relevant in a NRM JRP?

Topics that

- do not deal with traceable measurements **(**not be selected at the first stage)
- do no need research (for example restricted to a simple interlaboratory survey)
- address specific needs of a single industrial (JRPs are collaborative research project)
- are limited to a national concern (JRPs are expected to have an European dimension)
- are urgent and need to be finalized within 3 years : the EMP process required 18 months between the knowledge of the initial problem (PRT) and the start of JRP work (not suitable for some industrial users).

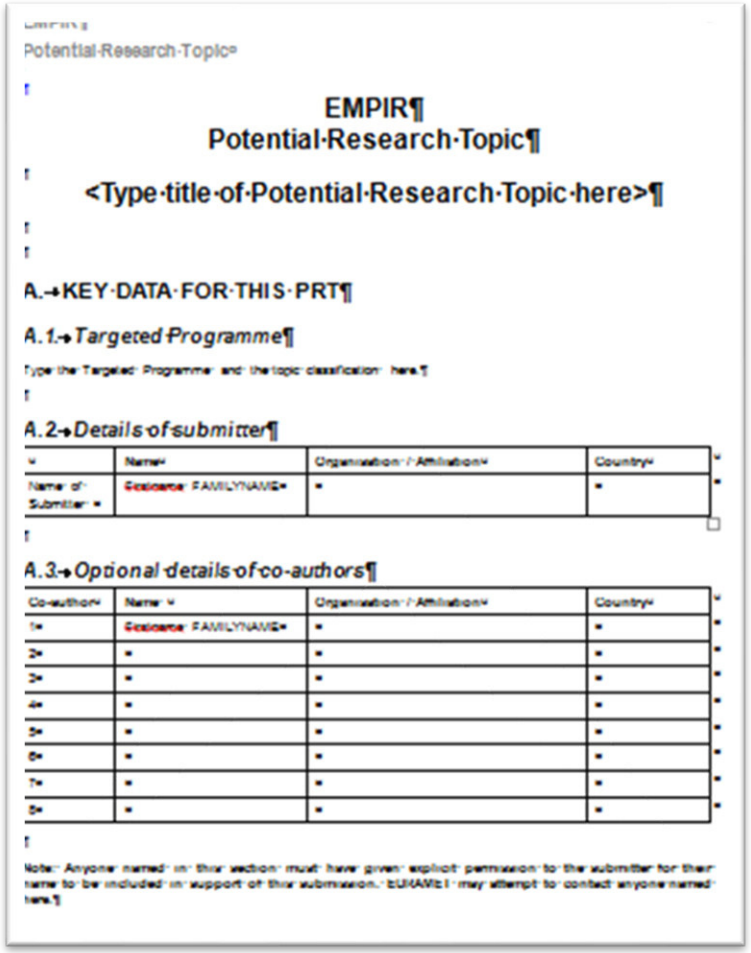
EPM call
The process

CEN and CENELEC TCs can submit a metrology research need that assist their standardisation and can be taken up in a PRT

- Input from CEN-CENELEC throught STAIR EMPIR — December Year – 1
- Stage 1 : Submission of ideas — Jan – Feb
  PRT = Potential Research Topic
- Selection of the best ideas (**SRT**) — Apr-May
  SRT = Selected Research Topic
- Stage 2 : Call for proposals for the SRT
  Consortia write the project proposals — Jun – Sept
- Review of proposals (referee) — Nov
- Start of work — Year+1/1st Semester

Stage 1 : Submission of ideas or PRT

- Anyone can submit a **Potential Research Topic (PRT)**
- **PRT Template** : **5 pages maximum :** the submitters, the scientific objectives, the stakeholder needs and the potential impact of the proposed research
- **What helps the selection of the PRT :**
  - Early discussion between NMI/DI and standardisation experts
  - CEN-CENELEC co-authoring the PRT
  - need from the CEN STAIR consultation
  - 3 metrology institutes with a potential budget.
- It does not imply any commitment of submitters even when the PRT is selected.
- *In 2022 : PRT to be submitted by February 2022*



Potential Research Topic

EMPIR
Potential Research Topic

<Type title of Potential Research Topic here>

A. KEY DATA FOR THIS PRT

A.1. Targeted Programme

Type the Targeted Programme and the topic classification here.

A.2. Details of submitter

	Name	Organisation / Affiliation	Country
Name of Submitter *	Forename FAMILYNAME	*	*

A.3. Optional details of co-authors

Co-author	Name	Organisation / Affiliation	Country
1	Forename FAMILYNAME	*	*
2	*	*	*
3	*	*	*
4	*	*	*
5	*	*	*
6	*	*	*
7	*	*	*
8	*	*	*

Note: Anyone named in this section must have given explicit permission to the submitter for their name to be included in support of this submission. EURAMET may attempt to contact anyone named here.

PRT Template available on EMPIR website
https://msu.euramet.org/calls.html

Stage 2 : Preparing the project proposal

- **Selected Research Topics are public – Include the objectives**
- Forming the consortium, writing and costing the proposal
- Partners and Stakeholders decide how much they want to be involved and contribute to the works :
  - Have valid contributions and deliver tasks that can be funded.

    Standardization representatives can be leader of the impact Work Package. Funded and unfunded partners sign an agreement with EURAMET.
  - Offer guidance/support without any tasks to deliver and don't sign an agreement (collaborator or member of the stakeholder group).
- The standardisation group generally provides a letter of support joined to the project proposal to demonstrate the support of the standardisation.

- *In 2022 : JRP proposals should be submitted by September/October 2022*

STAIR EMPIR : the process

Euramet considers important to get some potential needs from industries and society via the standardisation organisations.

To enable that discussion, a common platform between EURAMET and CEN-CENELEC was created, the platform STAIR-EMPIR - STAndards Innovation & Research.

Since 2014, the CEN/CENELEC has consulted its Technical Committees about the emerging research and measurement needs related to standardisation.

In addition, metrologists contribute to many standardisation committees on national, European and international level. This provides strong links to industrial partners

This process will be continued in the Partnership calls.

The 2022 NRM EPM call & STAIR EMPIR

- All CEN and CENELEC TC/SCs have been invited to submit their needs for metrology research to STAIR EMPIR

  Mail sent by CEN STAIR to all CEN and CENELEC TC/SCs on 8 Sept. 2021

  Response Form to be sent to empir@nen.nl by 14 December 2021

  Response form available on CEN/CENELEC website

- From now, recommended to have early exchanges between TC/WG and metrology experts to ensure to collect relevant metrology research topics and a higher quality of the PRT :
  - *Discuss with metrology institutes involved in your TC/WG*
  - *Contact STAIR EMPIR to organize an exchange with EURAMET experts.*
- Standardisation needs are published on EURAMET website in January for a wider dissemination.

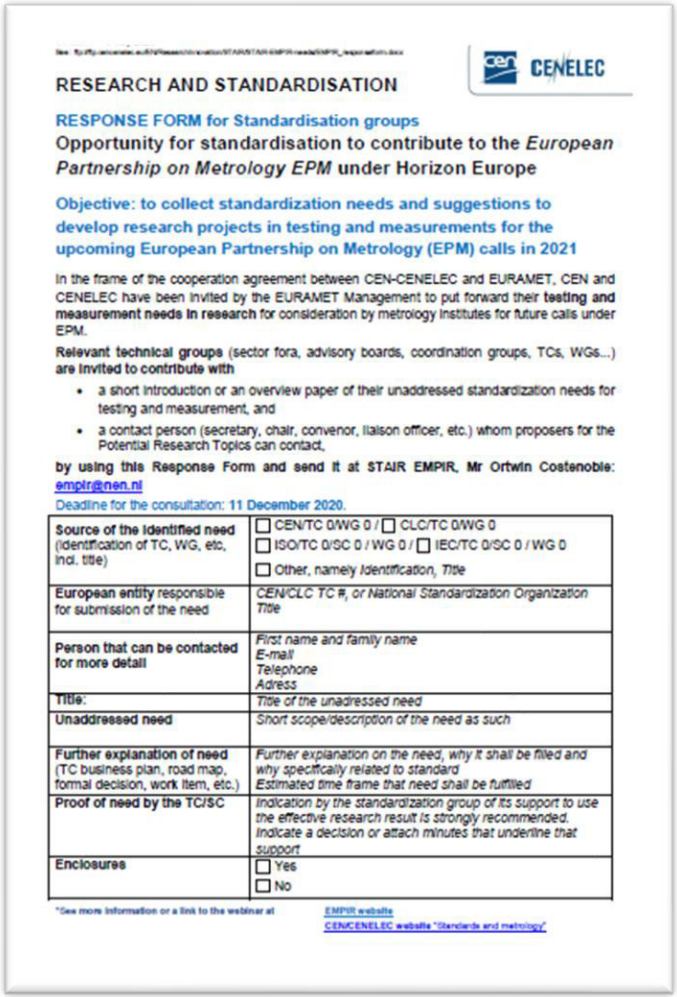
The 2022 NRM EPM call & STAIR EMPIR

RESPONSE FORM for Standardisation groups

Available at CEN/CENELEC website "Standards and metrology

All standardization needs will not result in a PRT :

- depending on the metrology institutes interested
- at least 3 for the JRP- their internal strategy,
- their budget….



RESEARCH AND STANDARDISATION

CENELEC

RESPONSE FORM for Standardisation groups

Opportunity for standardisation to contribute to the *European Partnership on Metrology EPM* under Horizon Europe

Objective: to collect standardization needs and suggestions to develop research projects in testing and measurements for the upcoming European Partnership on Metrology (EPM) calls in 2021

In the frame of the cooperation agreement between CEN-CENELEC and EURAMET, CEN and CENELEC have been invited by the EURAMET Management to put forward their **testing and measurement needs in research** for consideration by metrology institutes for future calls under EPM.

Relevant technical groups (sector fora, advisory boards, coordination groups, TCs, WGs...) **are invited to contribute with**

- a short introduction or an overview paper of their unaddressed standardization needs for testing and measurement, and
- a contact person (secretary, chair, convenor, liaison officer, etc.) whom proposers for the Potential Research Topics can contact,

by using this Response Form and send it at STAIR EMPIR, Mr Ortwin Costenoble: empir@nen.nl

Deadline for the consultation: **11 December 2020.**

Source of the identified need (identification of TC, WG, etc, incl. title)	☐ CEN/TC 0/WG 0 / ☐ CLC/TC 0/WG 0 ☐ ISO/TC 0/SC 0 / WG 0 / ☐ IEC/TC 0/SC 0 / WG 0 ☐ Other, namely *Identification, Title*
European entity responsible for submission of the need	*CEN/CLC TC #, or National Standardization Organization Title*
Person that can be contacted for more detail	*First name and family name* *E-mail* *Telephone* *Adress*
Title:	*Title of the unadressed need*
Unaddressed need	*Short scope/description of the need as such*
Further explanation of need (TC business plan, road map, formal decision, work item, etc.)	*Further explanation on the need, why it shall be filled and why specifically related to standard* *Estimated time frame that need shall be fulfilled*
Proof of need by the TC/SC	*Indication by the standardization group of its support to use the effective research result is strongly recommended. Indicate a decision or attach minutes that underline that support*
Enclosures	☐ Yes ☐ No

*See more information or a link to the webinar at EMPIR website CEN/CENELEC website "Standards and metrology"

This year ‘s opportunity - recap

- Submission of metrology research needs by standardisation by 14 December 2021
- Recommended prior discussion between metrology researchers and standardizers to qualify relevant topics
- Contacts at CEN-CENELEC :
  - Luc Van den Berghe (CCMC) lvandenberghe@cencenelec.eu
  - Ortwin Costenoble (NEN) - empir@nen.nl

More information:

EURAMET Website :
http://www.euramet.org/

EMPIR Website :
http://msu.euramet.org/

EMPIR Brochures
https://www.euramet.org/publications-media-centre/empir-publicity/

Standardisation Projects EMPIR calls 2015 -2019

European Metrology Programme for Innovation and Research

EURAMET

Standardisation - Projects (Call 2016)

An overview of the funded projects from the Targeted Programme Pre- and Co- Normative research

Standards for industrial production of graphene (16NRM01)

New methods to be developed for electrical characterisation of graphene

Producing large areas of graphene with uniform electrical properties is a major challenge in making this unique material commercially viable for the electronics industry. This project will address a key aspect of this challenge by investigating methodologies for the electrical characterisation of graphene, producing Good Practice Guides and informing standards. This will underpin production of validated commercial specifications of graphene at an industrial scale.

Measuring road reflection to improve street lights (16NRM02)

Better tools to calculate light reflection will create safer roads

Road lighting must provide sufficient light for road safety, but international standards prescribe reference tables based on 40 year old measurements to calculate light levels. This project will provide updated measurement guidance and reference materials based on current road materials and a variety of road surface conditions, to solve these problems. Resulting standards will improve performance of road lighting and lead to safer night-time driving.

New correction factors for radiotherapy calibration (16NRM03)

New cancer treatments need new calibration calculations to ensure accuracy

Ionizing radiation beams for cancer treatment must be calibrated accurately, an important aspect of which is correcting for beam quality differences between calibration laboratories and hospitals. This project will update current correction values using measurements and models of the latest ionizing radiation technologies, ensuring SI traceability. These will be incorporated into a revised standard, ensuring beams which treat 1.7 million citizens annually are accurately calibrated.

Building trust in magnetic nanoparticles (16NRM04)

New measurement approaches will characterise magnetic nanoparticles and spur innovation

Magnetic nanoparticles (MNPs), which can be precisely manoeuvred by magnetic fields, could have many valuable applications including targeting cancer cells. This project will support MNP innovation by investigating new measurement approaches, which will feed into the first international standard for measuring MNP magnetic properties. The MNP industry will then be able to market new innovations, with confidence in their properties.

Partnership Programme examples from the EMPIR Programme

Dagmar Auerbach
Programme Manager
Dagmar.auerbach@euramet.org

The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States

Current news on ongoing NRM projects based on CEN/Cenelec needs

NEWS

EMPIR project improves emissivity measurements

Building a new house with insulation

Research helps to ensure more reliable measurements for thermal insulation

The project

EMPIR project Improvement of emissivity measurements on reflective insulation materials (16NRM06, EMIRIM) is working to test commercial emissivity measurement techniques to understand their limitations, and improve reference techniques at National Measurement Institutes to lower uncertainties.

It will create reference samples and best practice calibration and measurement procedures which bring traceability to commercial instruments. The results will be used to propose amendments to current standards EN 16012 and EN 15976.

This work will allow developers of thermal insulation materials to perform more reliable emissivity measurements on low emissivity foils and develop higher performance products. The use of low emissivity foils, together with appropriate spaces between the surfaces, allows increasing thermal resistance of insulation products without using more insulation matter. These products will help improve energy efficiency in buildings, and support other industries which use reflective foils, including aerospace, automotive, nuclear power, and packaging.

EMPIR smart meter project runs workshop at major international conference

Home energy smart meter

Methods under development to test the accuracy of smart meters were presented and discussed

The project

EMPIR project Electromagnetic Interference on Static Electricity Meters (17NRM02, MeterEMI) is working to develop methods to test the accuracy of smart meters for electricity consumption. Some meters have been in error by hundreds of percent, when exposed to electrical interference related to fast transient currents.

Using high-precision measurements of real-world electrical disturbances, a new testbed is being built in order to assess meter performance under similar, recreated conditions. To help settle billing disputes, interference-immune meter designs will be identified for on-site inspections; diagnostic algorithms will also be developed for the identification of transient current types. Ultimately, the results will support European and international standards and help assure consumer confidence in smart meter usage.

Improving nanoparticle size measurement accuracy for safety assessment

Researcher holding pill

EMPIR nanoparticle project contributes to new written standard and other outputs

The project

Nanomaterials and nanoparticles are finding applications across a wide range of technology sectors, from medicine and food to transportation and construction. In order to assess these new materials for potential risks to health and the environment, they need to be well-characterised. The measurement of constituent nanoparticle size, shape, and size distribution are important factors for the risk evaluation process.

EMPIR project Improved traceability chain of nanoparticle size measurements (17NRM04, nPSize) is working to assess a range of traceable nanoparticle measurement approaches, including Scanning Electron Microscopy (also in Transmission Mode), Atomic Force Microscopy and Small Angle X-ray Scattering, and deliver improved calibration methods to users. For the techniques under investigation, physical models of their response to a range of nanoparticle types are developed. Validated reference materials will also be used for an inter-comparison of measurement systems, with an evaluation of the associated measurement uncertainty. With project contributions to standards development work, manufacturers will be better placed to assess the human and environmental risks posed by nanomaterials across a whole range of products.

Chief stakeholders in these projects were…

ABB AB Power Transformers
Netbeheer Nederland – Utilities Association for the Netherlands
ŠKODA AUTO a.s.
CEN/TC 352, WG1
Joint Committee for Guides in Metrology – Working Group 1 (GUM)
World Meteorological Organisation (WMO)
GE Sensing & Inspection Technologies GmbH
Commission Internationale de l'Eclairage (CIE)
Uniper Technologies Ltd
IEC Technical Committee 38 Instrument transformers

Participation in the Partnership

Internal Funded Partner(s	• EURAMET NMIs and DIs (within their area of designation) from countries that have made a financial contribution to Partnership Programme (see List 1a).
External Funded Partner(s)	• All other legal entities established in: Member States, Overseas Countries and Territories (OCT) linked to Member States, countries automatically eligible for Horizon Europe funding, countries associated to Horizon Europe, including non-PartnershipNMIs and DIs plus Partnership DIs participating outside their field of designation (see List 1b)
Unfunded Partner(s)	• Any legal entity whose participation adds benefit to the project. • Legal entities that are eligible to participate as 'internal' or 'external' may participate as an unfunded partner

Indirect costs and EU contribution

Partnership for metrology

- Eligible indirect costs are fixed
  - **25** % for Internal Funded Partners
  - 25 % (H2020 Europe rate) for other partners

- EU contribution is calculated as 100 % of total eligible “Costs”

Questions?

www.euramet.org

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EURAMET TC-IM WG M4D

- Consists of experts from EURAMET Members
- Manages existing TC-IM projects on digital transformation topics and suggests new ones where necessary;
- Organises communications channels between TC-IM and EURAMET internal and external stakeholders and other organisations active in this field;
- Organises workshops, development of guidelines and tutorials by combining expertise from the EURAMET members to ensure an efficient uptake and harmonisation of digital transformation in metrology.

Digital Strategy: mission statement

- Foster uptake of digital tools, services and processes amongst its members
- Oversee the digital transformation of metrology and industry and connect the individual developments to a harmonised approach
- Engage with external parties in relevant areas to establish metrological principles for data quality

General topics in digital transformation in metrology

- Digital transformation in metrological services
  (digital certificates, remote services, automation,
  digital service infrastructures, eLearning)
- Mathematics and confidence in data
  (artificial intelligence, digital twins and virtual measurements, validation of algorithms, uncertainty in complex systems)
- Adopting Open Science for metrology
  (research data management, FAIR+X principles, open access)
- Connectivity and data quality in distributed systems
  (data provenance, security, traceability, interfaces, communication technologies, sensor networks)

TP DIT 2022: Metrology support for Digital Transformation

- Specific digital topics that have a generic or cross-disciplinary character
- Address metrological methods and solutions both for digitized measurement scenarios and for data such as
  - Metrology for large sensor networks and “big data”, including modelling of systems
  - Generic in-situ methods for IoT use cases, including in-situ traceability in fully-digital sensor scenarios
  - Development of fundamental requirements for reference data for the validation of digital measurement scenarios and algorithms
- Expected outputs include guidelines and standards for metadata and protocols supporting the reliable, trusted and unambiguous communication of data in digital infrastructures
- Methods and tools for automated assessment of data quality

Potential topics

- Trustworthy machine learning and artificial intelligence
- Sensor network metrology
- Data quality
- Big data
- Virtual metrology
- Digital sensors

Trustworthy machine learning and artificial intelligence

- Development of methods to assess performance and reliability of ML/AI methods
- Trustworthy application of ML/AI in sensor networks
- Artificial Intelligence - applications of AI usage in other industries (learning from others and application of their experience in metrology
- Propagation of uncertainty through the algorithm
- Machine Learning - automation/robotization of repeating simple operations (measurements) – instructions not only coded, but also provided via ML
- Use of machine learning to fuse heterogeneous sensor data into a “soft sensor”

Sensor network metrology

- Propagation of uncertainties in sensor networks
- Impact of sensor faults (drift, ageing, etc.) on ML results
- Robust (w. r. t. uncertainty) ML training for practical sensor networks
- Co-calibration methods in sensor networks (single-/multi-hop methods, mobile references)
- Calibration of sensor networks in a systems metrology sense (i.e., considering the network as a complex measuring instrument)
- ML methods for predictive maintenance, fraud detection and future performance estimation based on sensor network data

Data quality

- Quantitative and qualitative assessment of data quality for relevant scenarios (“data fit-for-purpose”)
- Machine-readable information about core metrological aspects of a data set
- The role of metrology in realizing the FAIR principles

Big data

- Very large data sets collected over a long time period - measures, results, uncertainties - used for deep analysis and predictions
- Collected data should be agreed with customer – what data to be collected and how it should be usad (for the customer's benefit) – providing acceptable quality of the data with parameters (e. g. when and how the data have been collected)
- Labelling data and adding metadata to aid their future use

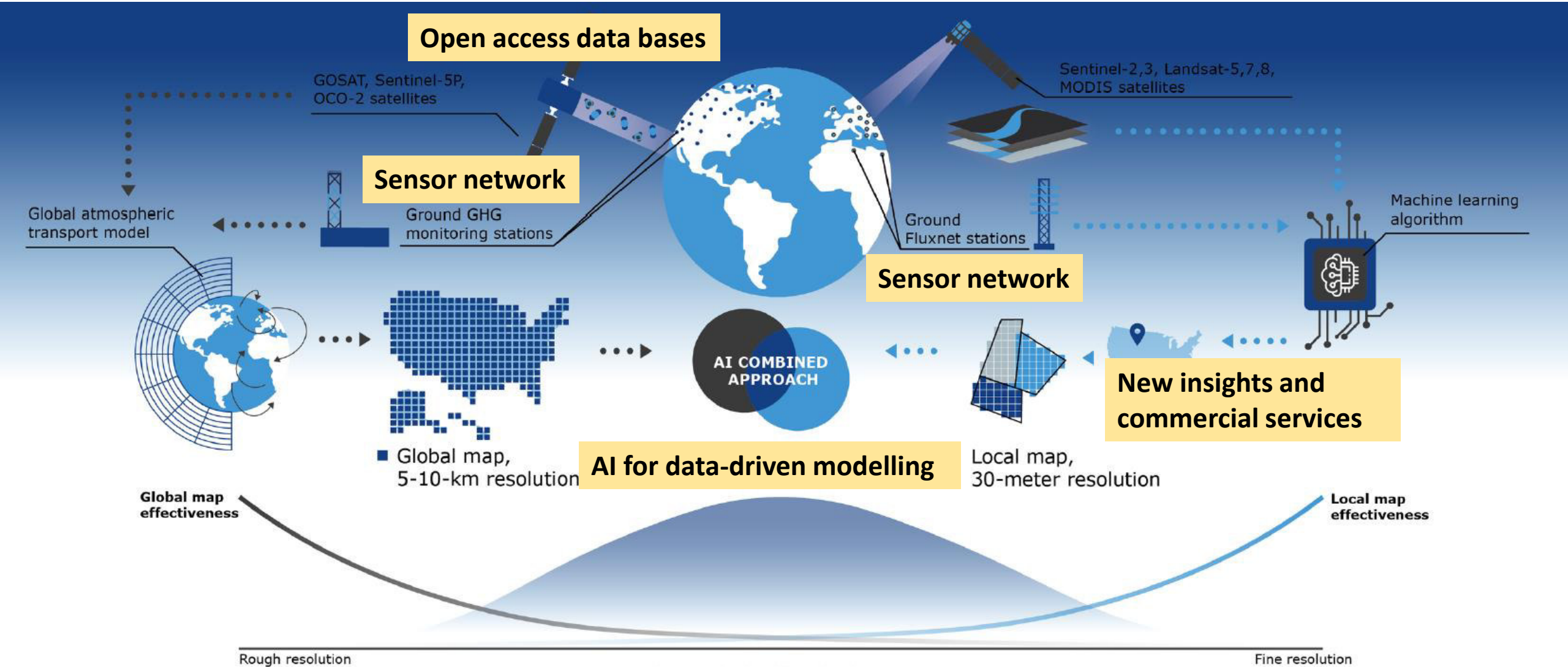
Virtual metrology

- Virtual measuring instruments and digital twins
- Verification and validation of virtual measuring instruments
- Calibration of digital twins
- Digital Twins – model improved by using of the Big Data – e.g. aging, drift

Digital sensors

- Calibration of “black-box” sensors with internal signal conditioning (amplification, filtering, etc.) and internal derivation of signal metrics
- Metrology for calibration of digital sensing systems for acoustics and vibration. Ultimately, this will provide support for international standardisation within ISO/TC 43, ISO/TC 108, IEC/TC 29 and IEC/TC 87.
- Remote metrology (pushed by COVID pandemic) - checking measurements from sensors at distance, remote calibration through the internet

Concrete example



Source: http://www.carbonspace.tech/

Next steps

11th October 2021

EMN Advanced Manufacturing Stakeholder Meeting 2021

9th November 2021

Open Consultation on Metrology for Digital Transformation

29th November 2021

EURAMET Orientation Workshop for TP DIT 2022