



# Report of EURAMET TC-M

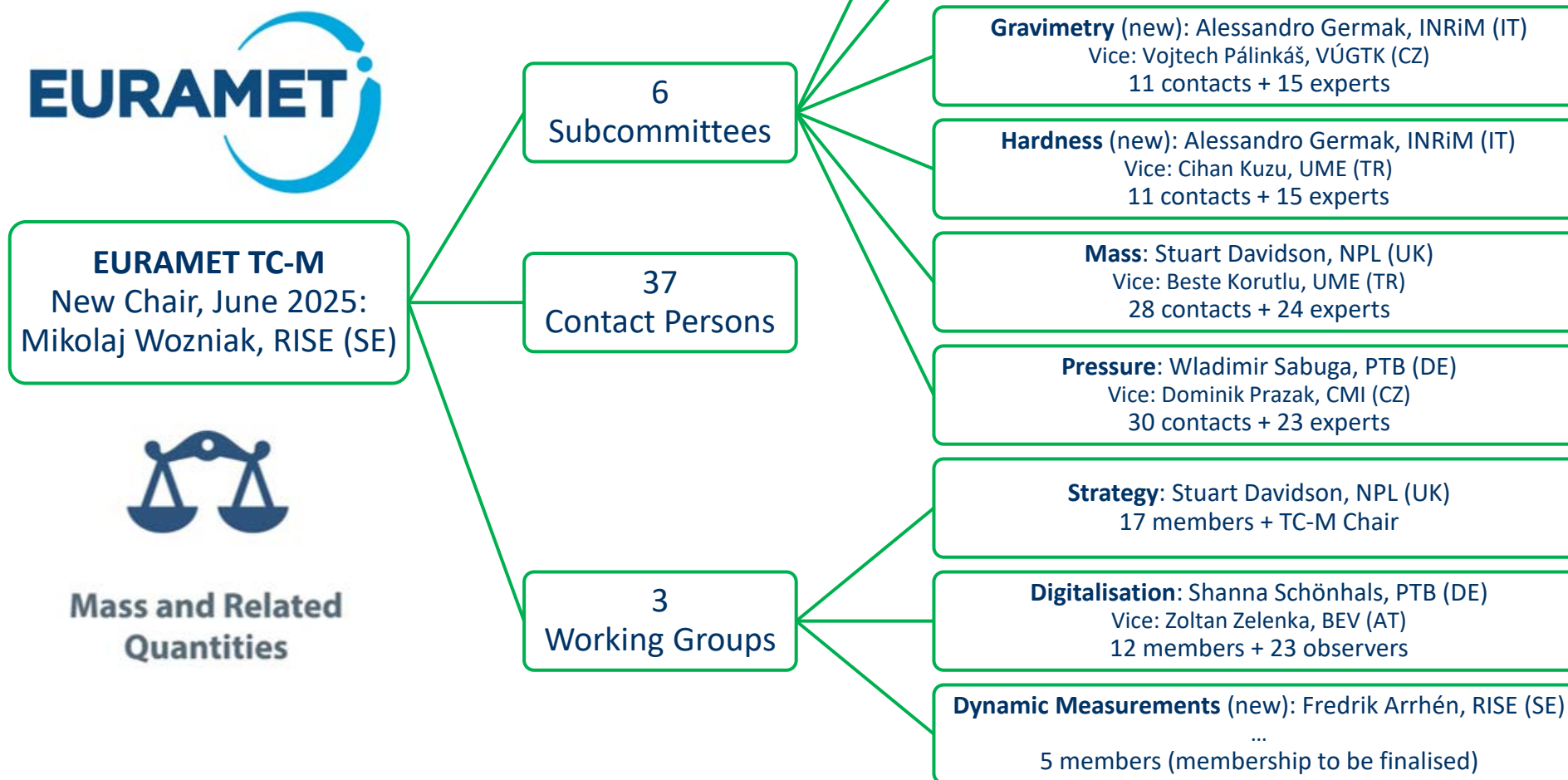
2023 - 2025

Mikolaj Wozniak (RISE, SE)

20<sup>th</sup> CCM meeting, 26-27 June 2025



# Structure



# Meeting 2023



Annual meeting (hybrid) 18 – 21 September 2023 in Brussels (SMD, BE)

- Subcommittee and Working Group meetings
- Research project (EMPIR/EPM) meetings
- Contact Person meeting
- Lab tour



# Meeting 2024



Annual meeting (hybrid) 7 – 10 October 2024 in Turin (INRiM, IT)

- Subcommittee and Working Group meetings
- Research project (EMPIR/EPM) meetings
- Contact Person meeting
- Lab tour
- 142 participants



# Meeting 2025



Annual meeting (hybrid) 13 – 16 October 2025 in Delft (VSL, NL)





# R&D Projects – 7 completed



- EMPIR 18SIB04, “Towards quantum-based realisations of the pascal (QuantumPascal)”, finished in 2023, <https://www.ptb.de/empir2019/quantumpascal/home/>
- EMPIR 18SIB08, “Comprehensive traceability for force metrology services (ComTraForce)”, finished in 2023, <https://www.ptb.de/empir2019/comtraforce/home/>
- EMPIR 19ENG08, “Traceable mechanical and electrical power measurement for efficiency determination of wind turbines (WinDEFcy)”, finished in 2023, <https://www.ptb.de/empir2020/windefcy/home/>
- EMPIR 19RPT02, “Improvement of the realisation of the mass scale (RealMass)”, finished in 2024, <https://realmass.cz/>
- EMPIR 20SIP01, “Developing an ISO Technical Specification 6737 ‘Characteristics for a stable ionisation vacuum gauge’ (ISO Gauge)”, finished in 2024, <https://www.ptb.de/empir2021/iso-gauge/home/>
- EMPIR 20NRM02, “Establishing metrology standards in microfluidic devices (MFMET)”, finished in 2024, <https://mfmet.eu/>
- EMPIR 20IND13, “Sustainable advanced flow meter calibration for the transport sector (SAFEST)”, finished in 2024, <https://www.ptb.de/empir2021/safest/the-project/>

# R&D Projects – 4 ongoing



- EPM 22IEM04, "Metrology for quantum-based traceability of the pascal (MQB-Pascal)", started in 2023, <https://www.mqb-pascal.ptb.de/home>
- EPM 22RPT01, "Traceability for Indentation Measurements in Brinell-Vickers-Knoop Hardness (TracInd BVK-H)", started in 2023, <https://tracind-bvk-h.org/>
- EPM 23IND09, "Metrology for green maritime shipping: Emission control through traceable measurements and machine learning approaches (MaritimeMET)", started in 2024, <https://maritimemet.eu/>
- EPM 24NRM03, "Establishing metrology standards in microfluidic devices (MFMET II)", starts June 2025, <https://mfmet.eu/>

# Guide Projects – 2 completed



- No. 3 “Guidelines on the Calibration of Pressure Balances”,  
Version 2.0 (05/2024) – updated
- No. 26 “Guidelines on the Calibration of Automatic Catchweighing Instruments”,  
Version 2.0 (12/2024) – updated





# Guide Projects – 8 ongoing



- No. 17 “Guidelines on the Calibration of Electromechanical and Mechanical Manometers”, under revision (project 1570)
- New “Guidelines for the uncertainty determination and calibration of torque measurements”, under development (project 1596)
- New “Guidelines for the traceability and uncertainty evaluation in absolute gravity measurements”, under development (project 1620)
- New "Guideline on the Calibration of Automatic Gravimetric Filling Instruments“, under development (project 1662)
- New "Guidelines for Realisation of the Mass Scale“ under development (project 1664)
- New “Guidelines on the production and use of certified reference materials for liquid density“, under development (project 1671)
- New “Guideline on liquid density measurements by hydrostatic weighing method“, under development (project 1672)
- No. 14 "Guidelines on the Calibration of Static Torque Measuring Devices“, under revision (project 1690)

# Guide Projects – 2 will start



- No. 16 “Guidelines for the Estimation of Uncertainty in Hardness Measurements”  
Version 2.0 (03/2011),  
to be revised
- New “Liquids density measurements with oscillation-type density meters”,  
to be developed

# Training Projects



## EURAMET mass training course 18 – 21 September 2023, Borås (RISE, SE)

- Part of the EURAMET Capacity Building programme
- Provided by NPL, UK and RISE, SE

## Mentorship 2024

- Pressure: RISE, SE for NSAI, IR

## Workshop on Dynamic Measurements

- Planned Spring 2026, Borås (RISE, SE)
- EURAMET event with invited speakers



EPM 23CBC01 CaBuCo – general EURAMET project: research mobility grants, mentoring, trainings, started in 2024, <https://cabuco.cmi.gov.cz/>

# Projects: Pilot Studies & Hybrid Comparisons –

## 1 competed, 4 ongoing



- Pilot study: Comparison for the realisation of the mass scale, started in 2022 (project 1556), pilot IMBiH, Final Report 2024-09-10
- Bilateral study comparison in the high vacuum range from  $5 \cdot 10^{-7}$  Pa to  $9 \cdot 10^{-4}$  Pa, started in 2017 (project 1416), pilot CMI, measurements in progress
- Pilot study: Comparison of dynamic pressure measurements, started in 2024 (project 1601), pilot PTB, measurements in progress
- Pilot study: Inter-laboratory comparison in dynamic pressure in the range 0.5 MPa – 30 MPa, started in 2025 (project 1707), pilot RISE, measurements in progress
- Hybrid bilateral comparison in viscosity determination, stated in 2024 (project 1607), pilot PTB, measurements in progress

# CIPM MRA: KCs & SCs – 5 completed



- EURAMET.M.T-S4, Comparison of torque standards from 0,1 N·m to 50 N·m, started in 2014 (project 1304), pilot LNE, Final Report 2025-05-01
- EURAMET.M.P-S16, Bilateral comparison in high gauge pressure 250 MPa, started in 2015 (project 1375), pilot GUM, Final Report 2024-01-31
- EURAMET.M.P-K4.2020, Key comparison of National Pressure Standards in the Range 1 Pa to 15 kPa of Absolute and Gauge Pressure started in 2019 (project 1494), pilot PTB, Final Report 2024-11-28
- EURAMET.M.D-K2.1, Key comparison on density determination of liquids by hydrostatic weighing, started in 2021 (project 1522), pilot BEV, Final Report 2024-03-19
- EURAMET.M.M-S11, EURAMET supplementary comparison of mass standards 20 kg, started in 2022 (project 1555), pilot BEV, Final Report 2025-02-03

# CIPM MRA: KCs & SCs – 14 ongoing



- EURAMET.M.F-K3, Comparison of force standards from 500 kN to 4 MN, started in 2000 (project 505), pilot PTB, Draft B report
- EURAMET.M.F-S2, Determination of Forces (tension and compression) from 5 N up to 250 kN with two new Dead Weight Machines developed and realised by BEV, started in 2012 (project 1262), pilot BEV, Draft B report
- EURAMET.M.T-S5, Comparison of torque standards from 100 N·m to 5000 N·m, started in 2018 (project 1428), pilot LNE, measurements in progress
- EURAMET.M.D-K5, KC Density of liquids, started in 2018 (project 1440), pilot BEV, Draft A report
- EURAMET.M.T-S6, Supplementary comparison of torque standards from 10 N·m to 500 N·m, started in 2020 (project 1529), pilot LNE, Draft A report



# CIPM MRA: KCs & SCs – 14 ongoing



- EURAMET.M.M-K7, Key comparison of stainless steel multiples and sub-multiples of the kilogram,  
started in 2020 (project 1532), pilot UME, measurements in progress
- EURAMET.M.P-S19, Bilateral supplementary comparison in gas media (absolute mode) in the range from 10 kPa to 200 kPa,  
started in 2022 (project 1549), pilot MIRS/IMT/LMT, measurements in progress
- EURAMET.M.P-S20, Bilateral supplementary comparison in gas media (gauge mode) in the range from 0.1 MPa to 3.5 MPa,  
started in 2022 (project 1550), pilot MIRS/IMT/LMT, measurements in progress
- EURAMET.M.P-K8.2023, Bilateral key comparison in gas media (gauge mode) in the range 15 kPa to 175 kPa,  
started in 2022 (project 1566), pilot RISE, Draft A report

# CIPM MRA: KCs & SCs – 14 ongoing



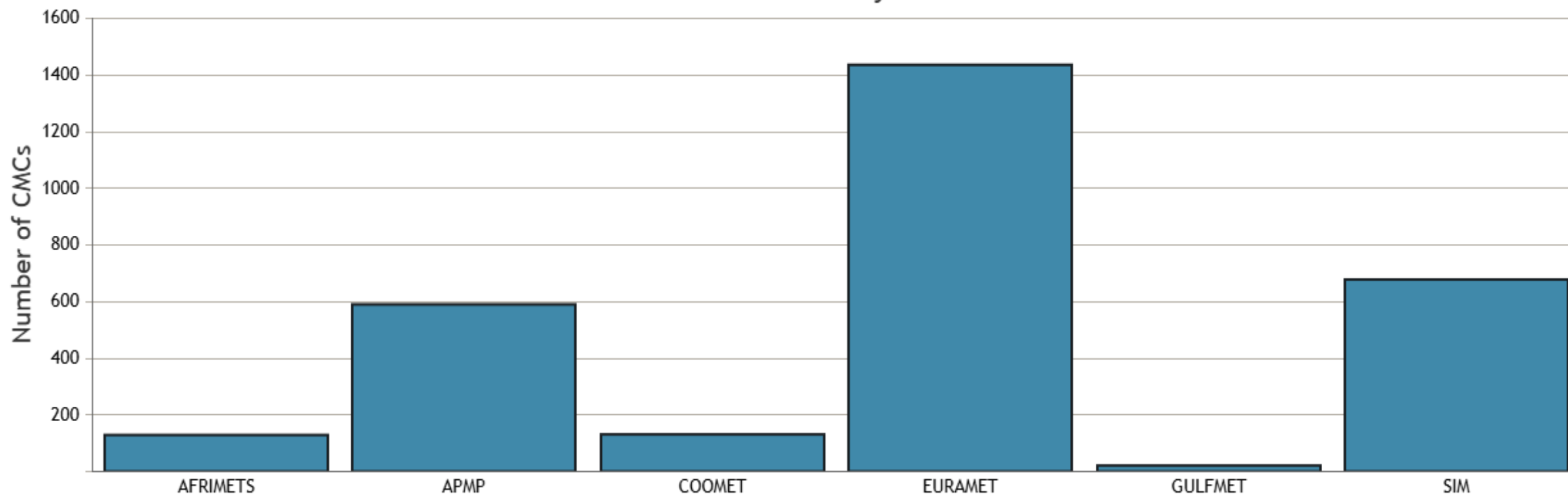
- EURAMET.M.P-K15.2, EURAMET key comparison in gas media from 0.3 mPa to 1 Pa (absolute mode),  
started in 2023 (project 1580), pilot INRiM, measurements in progress
- EURAMET.M.P-S21, Bilateral supplementary comparison in high gauge pressure up to 1 GPa,  
started in 2022 (project 1585), pilot CMI, measurements in progress
- EURAMET.M.F-K2.a, Force subsequent key comparison (50 kN and 100 kN),  
started 2023 (project 1597), pilot INRiM, measurements in progress
- EURAMET.M.G-K2.2023, Key comparison of absolute gravimeters,  
started in 2024 (project 1603), pilot VÚGTK, Draft B report
- Bilateral Key Comparison of gas pressure in the range 25 kPa to 200 kPa (gauge and absolute mode) and 0.7 MPa to 7 MPa (gauge mode),  
started in 2025 (project 1694), pilot LEI, measurements in progress

# CIPM MRA: CMCs



KCDB 22 June 2025: **1436** CMCs (together with EURAMET TC-Flow)

Number of CMCs by RMO

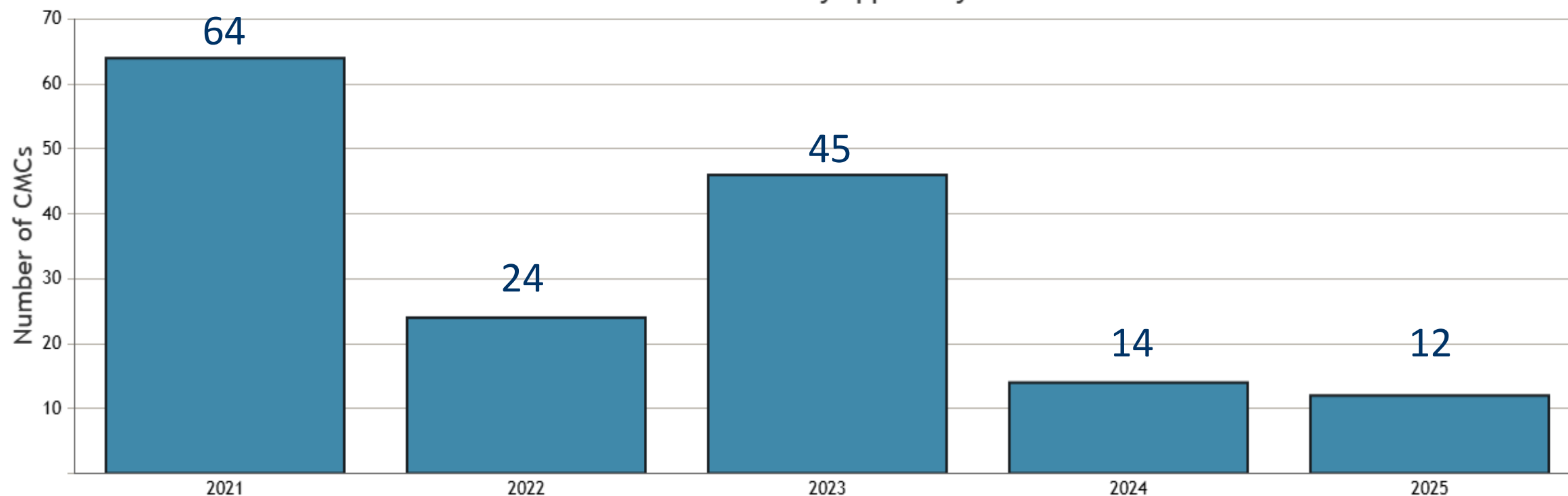


# CIPM MRA: CMCs



KCDB 22 June 2025 (together with EURAMET TC-Flow)

Number of CMCs by approval year



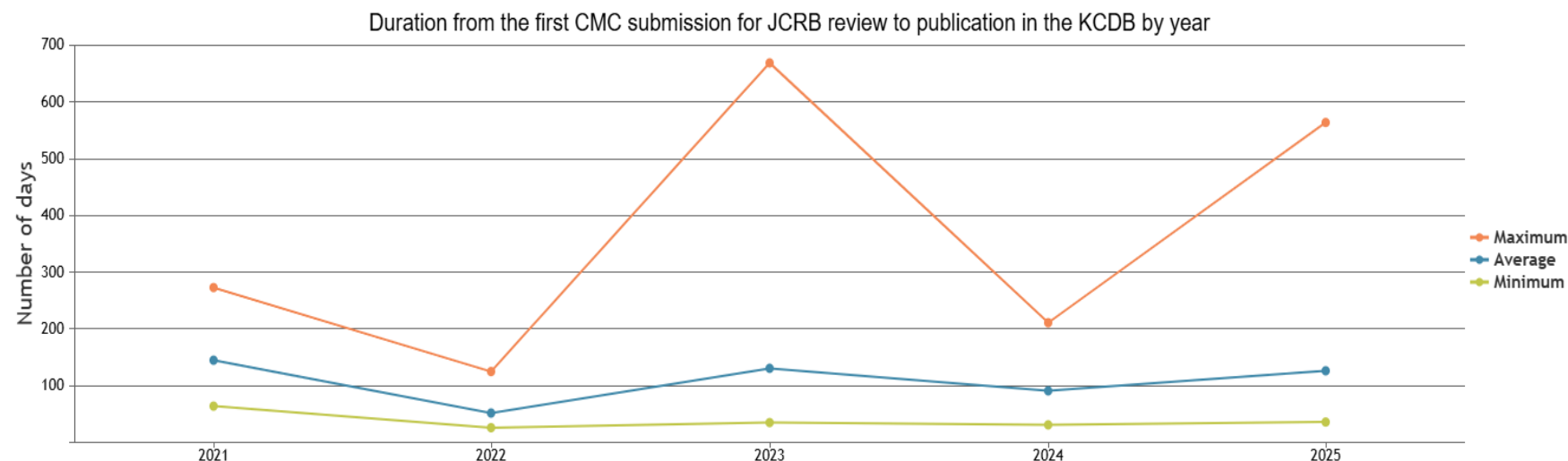
# CIPM MRA: CMC Reviews



KCDB 22 June 2025 (together with EURAMET TC-Flow)

- CMCs presently under revision in the JCRB review process: 20
- CMCs presently under JCRB review by submitting RMO: 15
- Comments issued during the JCRB review:
  - 26 Technical
  - 31 Editorial
  - 1 Missing evidence
  - 2 Other
- Greyed-out CMCs: 20

Reason for loss of rights	EURAMET
No reply to review request	2
Accepted but did not complete the review	0
Reviewed but did not vote when requested	0
<b>Total loss of rights</b>	<b>2</b>



# CIPM MRA: CMCs



Issues and challenges:

- **Harmonisation of CMCs**
  - For example, discrepancies in gravity and hardness
  - Negative gauge pressure – real or simulated?



# Digitalisation – Working Group



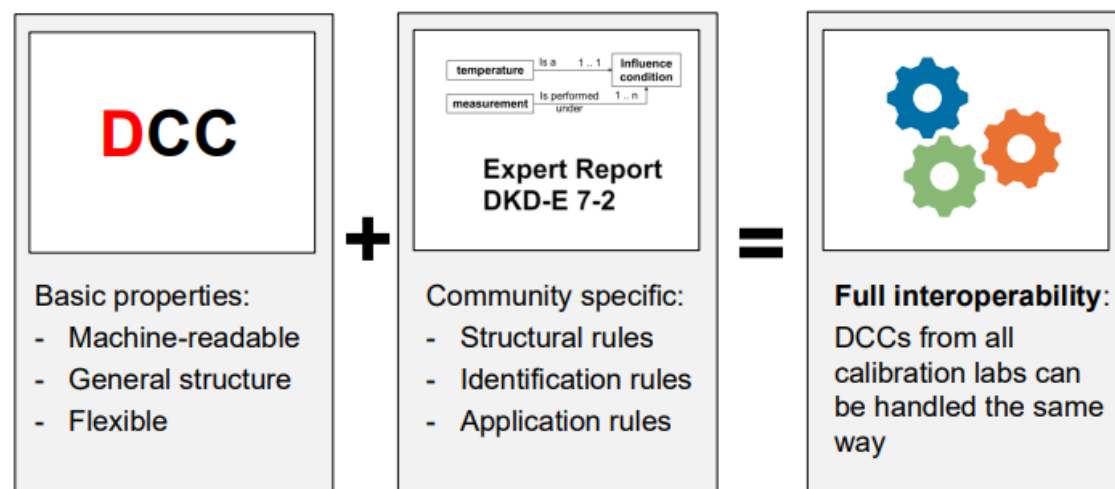
- Cooperation with TC-IM (Interdisciplinary Metrology) and its WG M4D (Metrology for Digital Transformation Group)
- Use of Digital Metrological Expert (DME) – automated end-to-end comparison of measurement laboratories – pilot in comparison of mass
  - Project on a fully automated evaluation of a virtual comparison of mass using the DCC – completed
  - Next: real comparison in mass and other TC-M areas
- Development of DCC for Force transducers (ISO 376) well advanced – Report on Good Practice to be published
- Next: torque transducers

# Digitalisation – Working Group



DCC for weights:

- Expert report DKD-E 7-2 from 2022: rules for DCC for weights
- Report will be revised to include DCC for volume calibration (similar rules)
- DCC Mass – Achieving Interoperability



# Strategy – Working Group



- Regular meetings and dissemination of information to contact persons and subcommittee members
- Initialisation and coordination of European Metrology Network (EMN) project proposals across TC-M technical areas – support for new European Partnership on Metrology (EPM) projects
- Provide a platform for the coordination of technical collaboration outside the scope of EMNs within and across TC-M technical areas
- Improve engagement with manufacturers, trade, technical, legal and standard bodies, academia and end users via the EPM or otherwise
- Promote knowledge transfer and capacity building activities and offer appropriate training to TC-M members
- Provide guidance on CMC submission and review in the EURAMET area including the coordination of EURAMET Key and Supplementary Comparisons
- Coordinate the production and review of Calibration (and Technical) Guides and Roadmaps
- WG on Comparisons within SC Force: use of its work in other areas
- Further development of “How To TC-M” and SharePoint structure to enhance its use

Thank you.

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