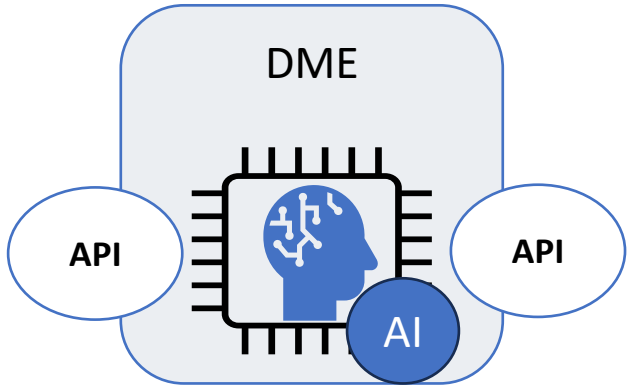
Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin
Nationales Metrologieinstitut

Digitalizing the evaluation of interlaboratory comparison

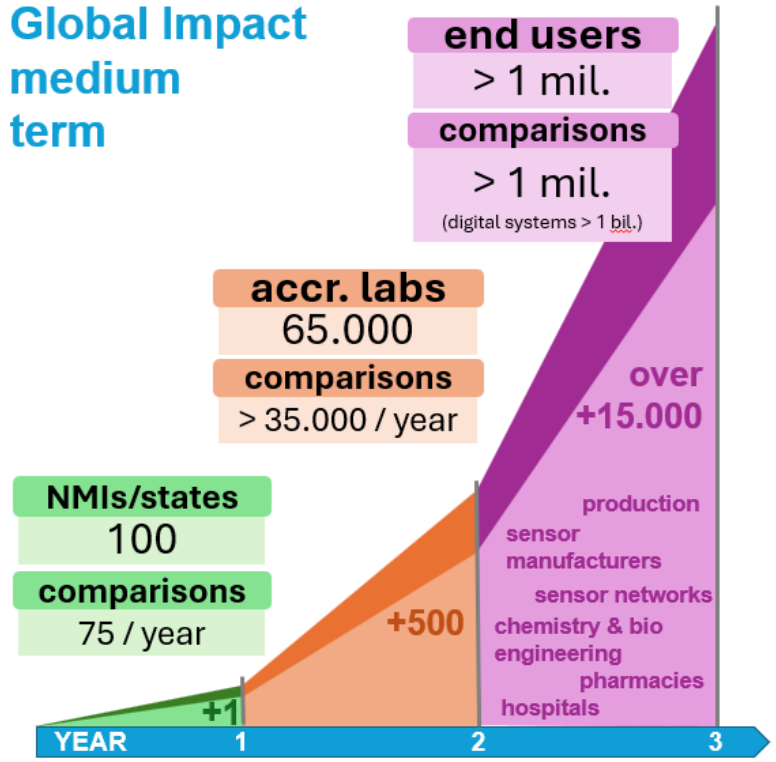


A Digital Metrological Expert software tool

D. Hutzschenreuter, W. El-Jaoua, D. Urban, M. Gafert, C. Brown

Motivation

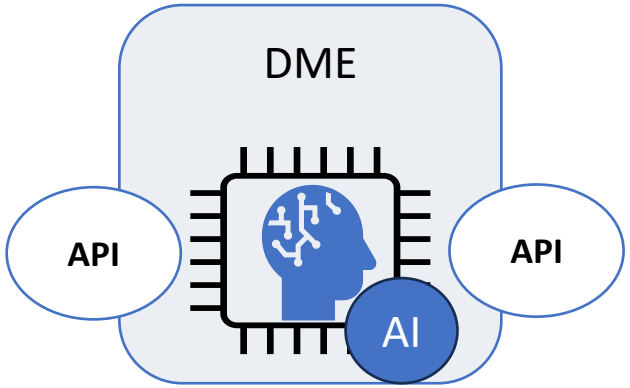
- ❑ Improving consistency and integrity of outcomes
- ❑ Supporting suitable measurements and reporting
- ❑ Saving time for creation of reports
- ❑ Enabling non-IT experts to use emerging digital tools
- ❑ Emerging interdisciplinary use of comparison methods



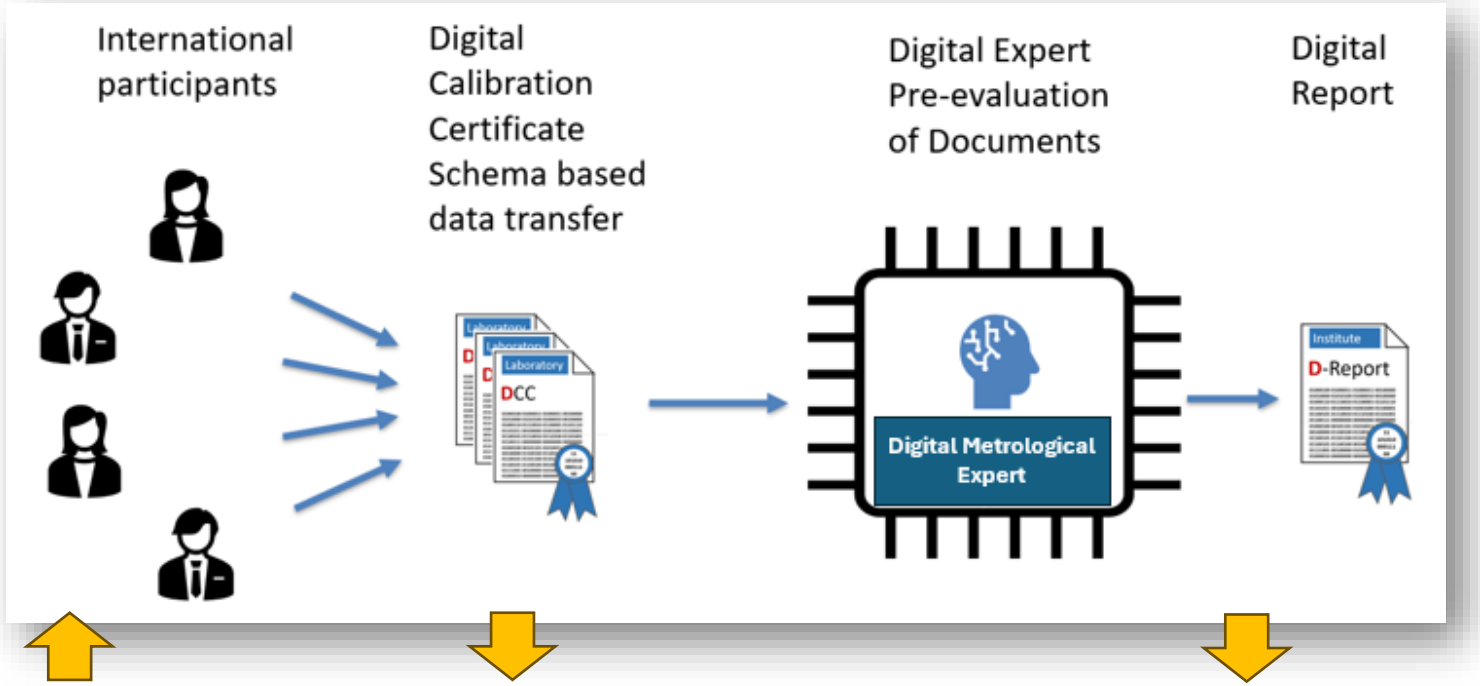
Numbers estimated for participants under CIPM MRA and their customers

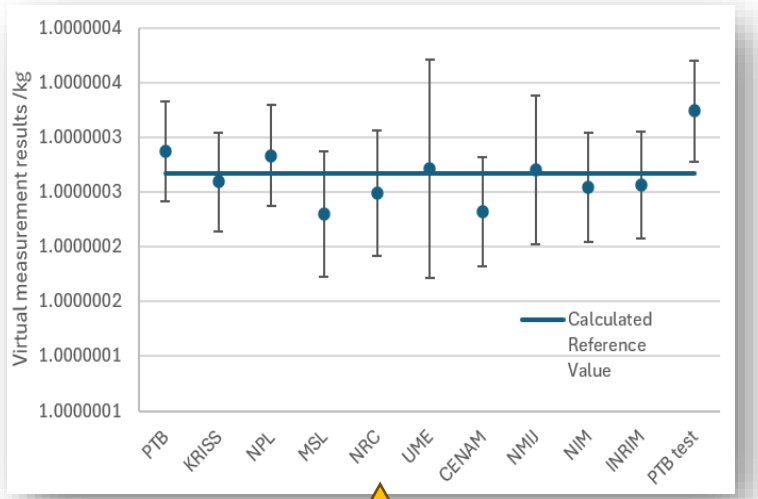
Digital Metrological Expert concept

- For standard work, e.g., evaluation of comparison, calculation of measurands, etc. (taking over tedious human work)
- Exchange information in environment of quality infrastructure (QI) through SI-based data and FAIR services
- Assess data and propose ways of processing including verification, filter, uncertainty propagation, use of AI, etc.
- Results as machine-actionable reports disclosing (metrological) traceability of outputs to inputs (utilizing PIDs)
- Itself digital standard in QI when operated and maintained by authoritative organizations



Example: Virtual Mass Comparison





Measured values

x_1 = 1.000000287 kg
U_1 = 4.6E-8 kg
…
x_n = 1.000000324 kg
U_n = 4.5E-8 kg

Reference value: weighted mean

x_{ref} = 1.0000002596 kg
U_{ref} = 1.670E-8 kg

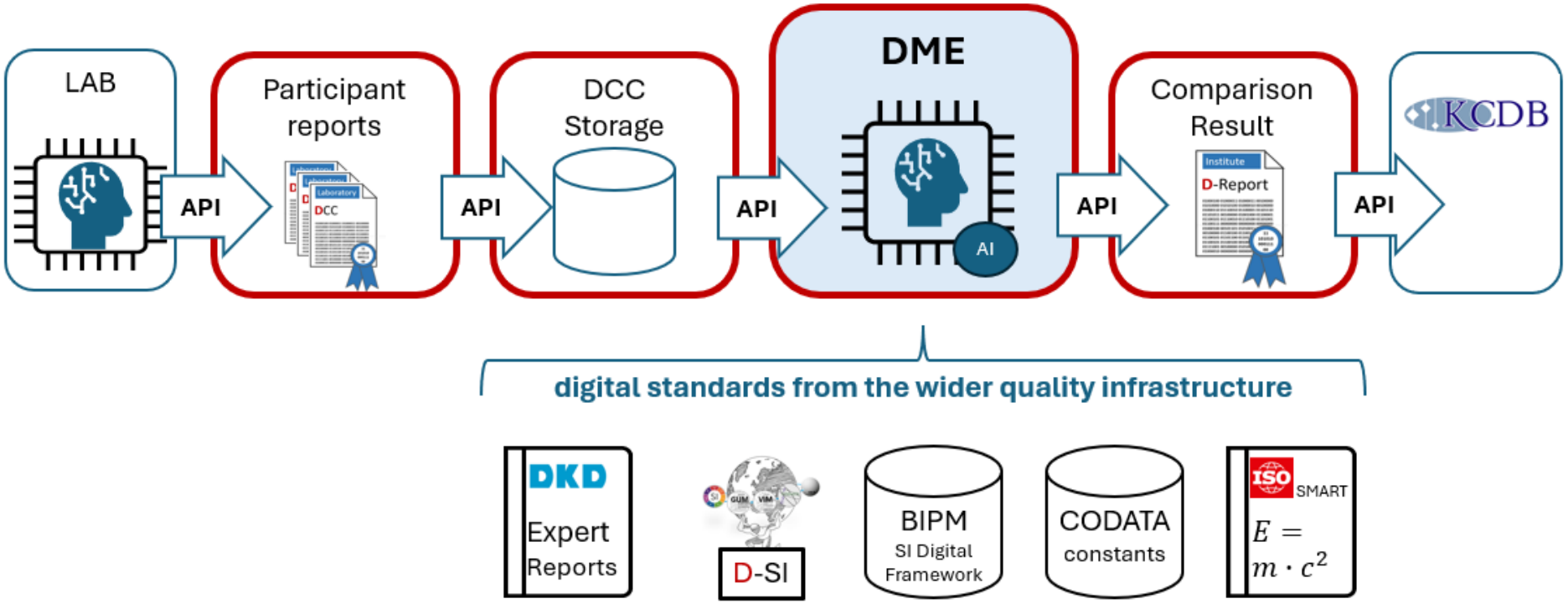
Outlier filter

$|En| = |x_i - x_{ref}| / U(x_i - x_{ref}) > 1$

Concept of workflow(s)

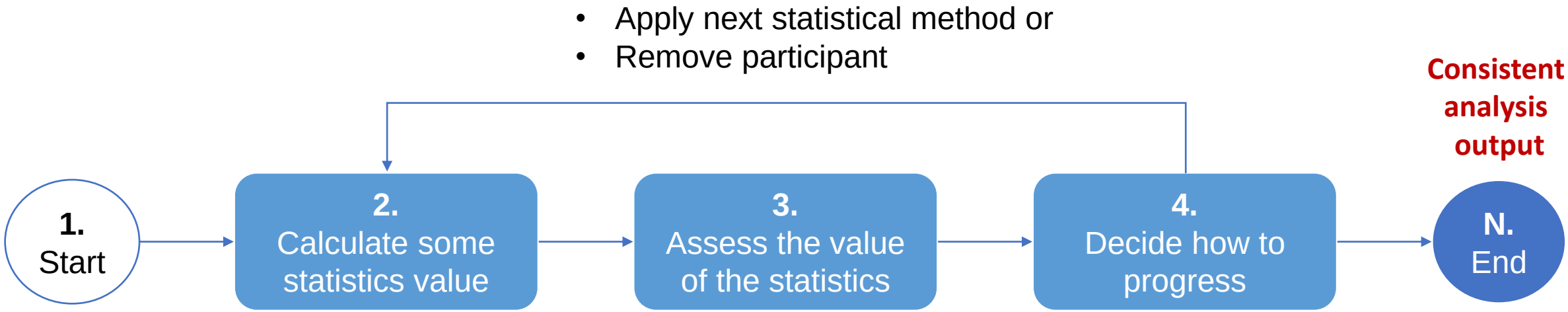
round robin, star, petal, running KCRV →

draft A, B, final →



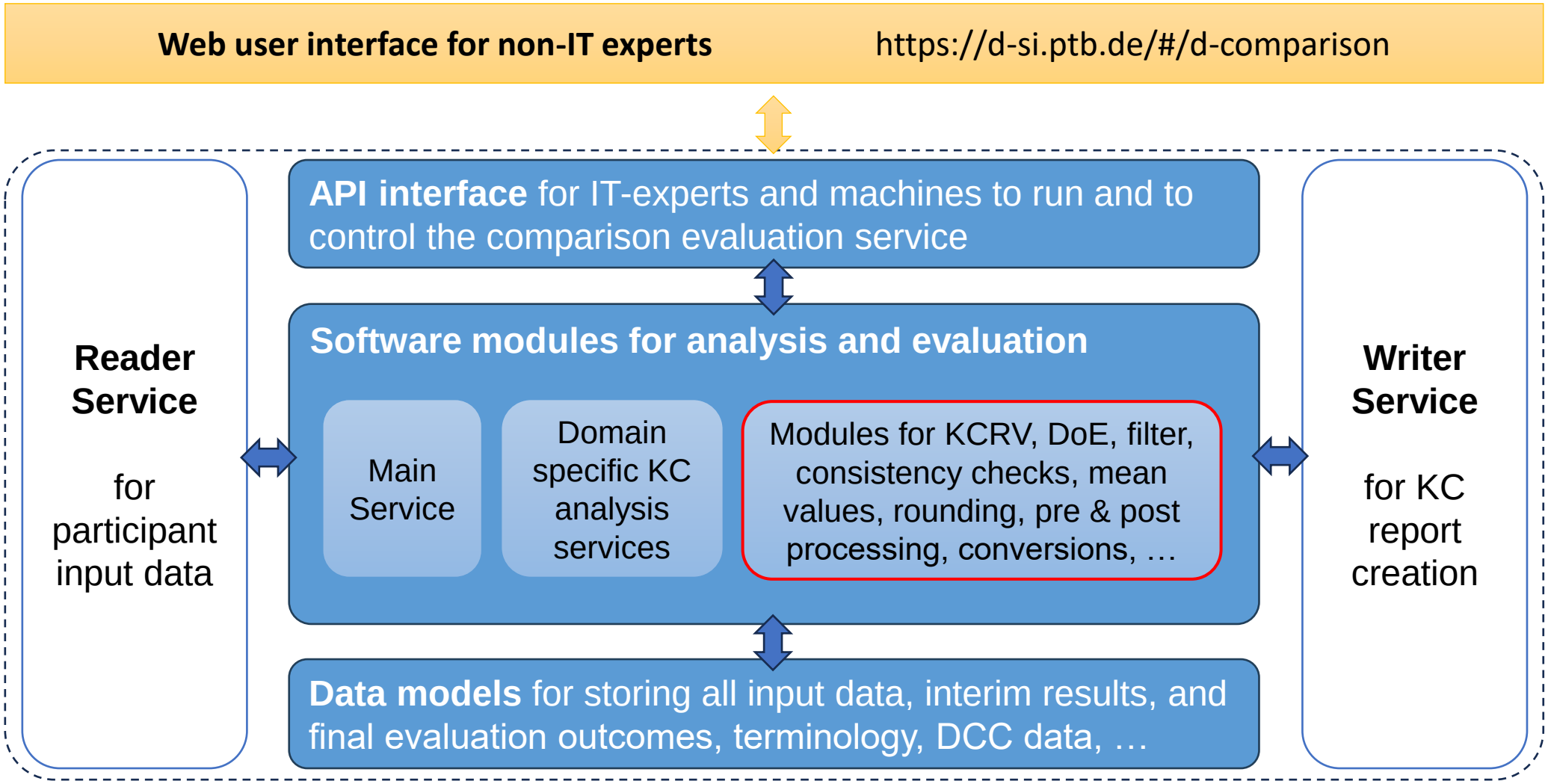
pre-normative

Generic data analysis process

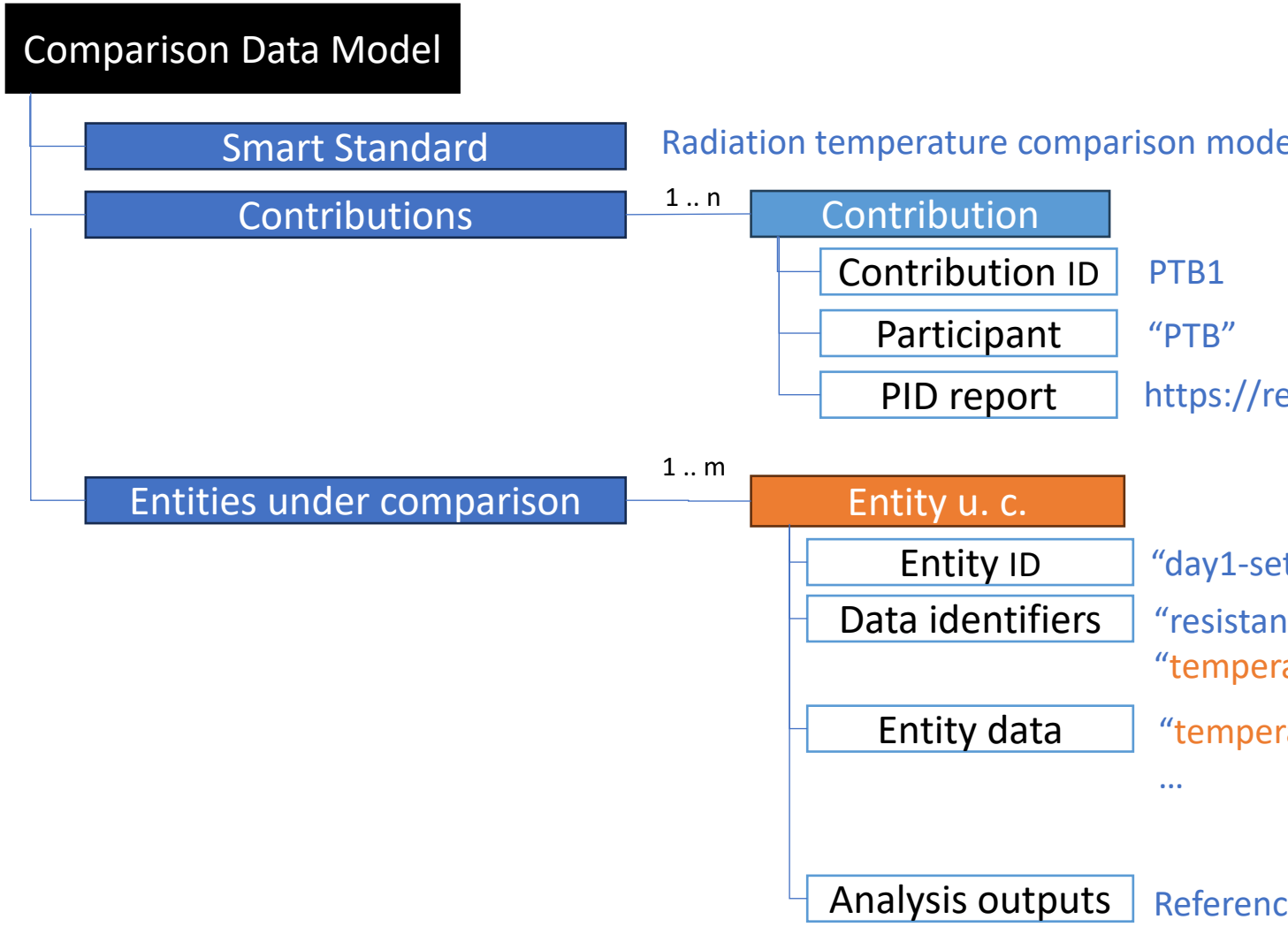


Examples	Calculate KCRV, En-values	Is there En > 1?	Remove first En > 1 and repeat
	Calculate test statistic “normal data”	Does threshold for normal data apply?	If “normal data” continue with method A, else use method B

DME Architecture



Comparison data model inside DME



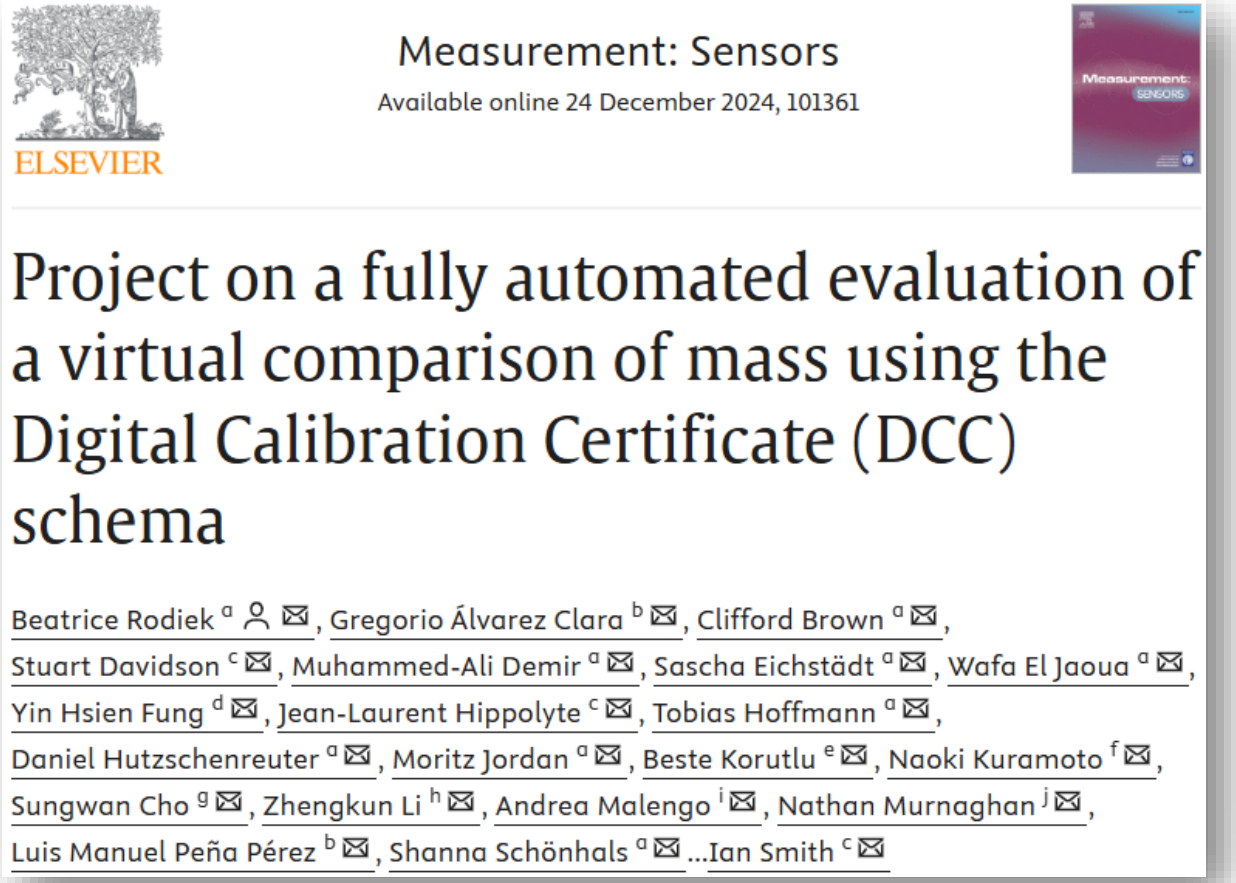
Example reporting template
CCT-K11 EURAMET loop

Date of measurement (Day 1)				
Room humidity (% rh)				
Set temperature (°C)	Average Resistance of monitor PRT (Ω)	Average Indicated temperature (°C)	Average Radiance temperature measured by participant(°C)	Room temperature (°C)
34.5			34.45	
37.0				

Conclusion & Outlook

- DME ready to accommodate and automate various comparison approaches
- Open-source tool and open for metrology community to use and extend
- First implementations accompanying virtual mass comparison and EURAMET loop of CCT-K11
- Starting implementation CCQM comparison use-case; utilizing NIST Decision Tree
- Testbed for ongoing digitalization in the quality infrastructure for interoperating SMART standards, BIPM's SI Digital Framework, etc.

Acknowledgements



ELSEVIER

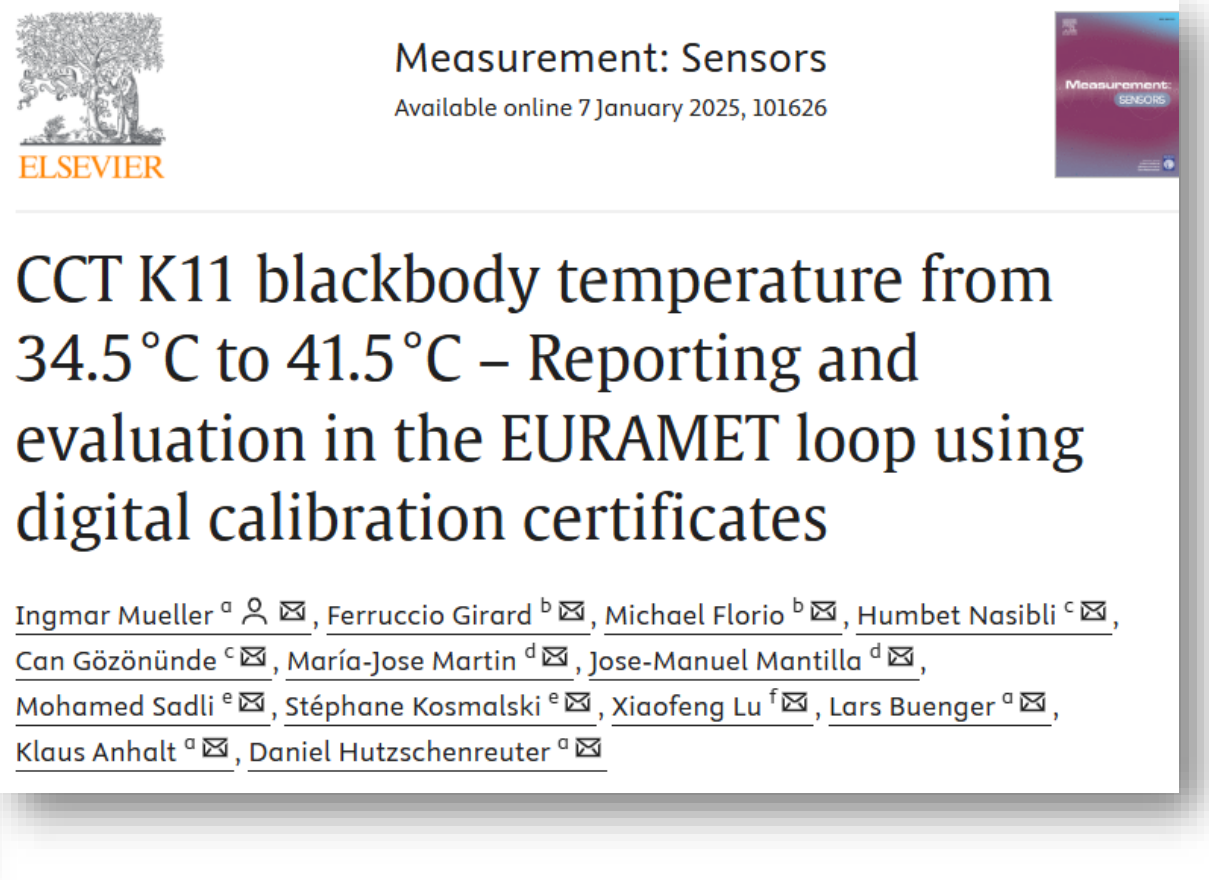
Measurement: Sensors

Available online 24 December 2024, 101361

Project on a fully automated evaluation of a virtual comparison of mass using the Digital Calibration Certificate (DCC) schema

Beatrice Rodiek [a], Gregorio Álvarez Clara [b], Clifford Brown [a], Stuart Davidson [c], Muhammed-Ali Demir [a], Sascha Eichstädt [a], Wafa El Jaoua [a], Yin Hsien Fung [d], Jean-Laurent Hippolyte [c], Tobias Hoffmann [a], Daniel Hutzschenreuter [a], Moritz Jordan [a], Beste Korutlu [e], Naoki Kuramoto [f], Sungwan Cho [g], Zhengkun Li [h], Andrea Malengo [i], Nathan Murnaghan [j], Luis Manuel Peña Pérez [b], Shanna Schönhals [a] ...Ian Smith [c]

https://doi.org/10.1016/j.measen.2024.101361



ELSEVIER

Measurement: Sensors

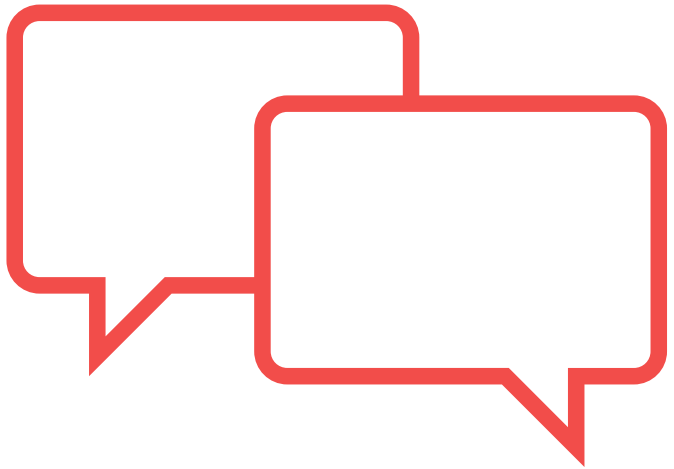
Available online 7 January 2025, 101626

CCT K11 blackbody temperature from 34.5 °C to 41.5 °C – Reporting and evaluation in the EURAMET loop using digital calibration certificates

Ingmar Mueller [a], Ferruccio Girard [b], Michael Florio [b], Humbet Nasibli [c], Can Gözönünde [c], María-Jose Martin [d], Jose-Manuel Mantilla [d], Mohamed Sadli [e], Stéphane Kosmalski [e], Xiaofeng Lu [f], Lars Buenger [a], Klaus Anhalt [a], Daniel Hutzschenreuter [a]

https://doi.org/10.1016/j.measen.2024.101626

Thank you



CONTACT

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