

# **IMEKO TC6: International Conference on Metrology and Digital Transformation**

**Monday, 19 September 2022 - Wednesday, 21 September 2022**

**Berlin, Germany**

## **Scientific Programme**

## General Sessions

Tracks organized and managed by IMEKO TC6

### **Digital representation and use of metrological information**

digital representations of physical quantities and units of measurement  
digital representations of measurement error, uncertainty and models  
digital representation of measurement scale types and associated data  
computations with physical quantities  
information retrieval and knowledge representations (semantics, ontologies, etc.)

### **Digital transformation in the quality infrastructure**

digitalisation in legal metrology and the quality infrastructure  
metrology for the quality assessment and validation of algorithms and software  
digital calibration, conformity assessment, testing, and inspection certificates  
principles and technologies for remote monitoring, remote calibration, and remote conformity assessment  
digital infrastructures and technologies for interlaboratory comparisons and proficiency testing

### **Digitalisation and digital technologies in industry and science**

application of FAIR principles to measurement data (metadata, data quality, etc.) and the role of metrology for FAIR data  
decision making in autonomous digital measurement systems  
infrastructures for and application of machine learning and artificial intelligence  
metrology for industry 4.0  
digital sensor networks and systems metrology  
cybersecurity and network communication  
digital metrology for additive manufacturing  
augmented and virtual reality in metrological app

### **Digital transformation in traceability**

digital representation of metrological traceability  
metrological traceability in digital shadows, digital models and digital twins  
metrological traceability in the Internet

## Special sessions

Submitted and approved Special Sessions

### **Pathways to Digital Transformation**

There are 256 institutes currently participating in the CIPM MRA, and many more laboratories and regulatory bodies that will be affected by digital transformation of the international quality infrastructure. The needs, expertise, and resources of these various participants will vary greatly; a few are advanced along their digitalisation pathway, while many more feel daunted by the task

ahead. However, unlike other sweeping technological changes in metrology, digital systems are ubiquitous. Institutes in all economies are facing the challenge of designing and implementing innovative solutions that are fit for the needs of particular communities and compatible with the emerging global standards. This session is intended for participants still in the early stages of transformation, or with needs that differ substantially from more advanced technological economies. It is a forum to share experience about novel and innovative approaches to digital transformation.

The session will consist of experience reports or innovative solutions relating to the following topics, or to other aspects of transformation journeys.

### **Topics to which the session is related**

**Strategic planning:** Everyone needs a plan---a roadmap for successful transformation. How do you develop such a plan; how do you evaluate stakeholder needs; are there obstacles; how do you raise awareness; what are the costs and expected benefits?

**Obstacles to transformation:** Transformation will not be not easy. What are some of the obstacles; how can they be overcome; how can influential decision-makers be engaged in the transformation process; how can traditional approaches be reconciled with new digital ones?

**Capability development:** Digital transformation will produce a whole new quality infrastructure. To build and maintain these systems, all participants need to acquire the necessary expertise, skills and knowledge. What are these skills; how can they be fostered and developed; is the new skill-set of 'digital metrologist' recognised, encouraged, and rewarded?

**Data:** Data is at the heart of digital transformation. How do we handle data correctly; how do we process it, and ensure that it is durable and of high quality? What are the best tools; which formats are best; how can the durability of data be assessed; how can the quality of data be assessed; what are the best ways to maintain and curate data records?

## **Modeling metrology in software for digital transformation**

Society relies on sophisticated measurement infrastructures that use behind-the-scenes experts to generate, communicate, interpret, and consume data. Information technology now presents the challenge and opportunity to transform these apparently transparent infrastructures for the digital economy. Ideally, computing systems would generate, communicate, and consume the data without human intervention up and down the traceability chain and broadly across all measurement disciplines.

This session will focus on modelling metrological concepts and processes.

Modelling develops abstract representations of knowledge specific to a domain. Domain models, expressed as design patterns, allow individuals and teams to work together using shared terminology and recognised best practices, thus streamlining and standardising software development.

### **Topics to which the session is related**

This special session invites discussion contributions, including but not limited to:

- Metrological concept modeling
- Universal measurement models
- Measurement metadata, semantics and ontology concepts
- Digital representations for quantities, scales, units and their interrelations
- Measurand and other metrological taxonomies
- Digital metrological traceability models
- Machine-readable-document models

## **Digitalization of Metrology in Pharma Industry**

The pharmaceutical industry as a whole (including the rapid development of new vaccines) is heavily regulated and competitive at the same time. The regulatory issues and its high risk products make it often the leader among manufacturing industries in adopting new technologies which then bring new regulations. US FDA Title 21 CFR Part 11 (1997-) is the most famous example of the now globally accepted code of regulations on electronic records and electronic signatures. And right now, moving from electronic towards digitalized metrology brings a whole new set of possibilities and challenges to GxP guidelines, ALCOA, and relevant data that has huge impact on product quality and patient safety. Especially important part of that is data integrity, and the main challenge is how to fulfill requirements to be compliant and produce data relevant for making quality decisions.

### **Topics to which the session is related**

- Digital metrology records
- Quality relevant metrological data
- Digitalization of GxP records
- Digitalization and ALCOA principle in metrology
- Data integrity
- GxP Validation of Metrology Equipment
- Trending
- Risk assessment: what could go wrong with the digital system which produces GxP records, mitigation measures
- Corrective and preventive actions
- Storage of GxP relevant digital records
- Digital data (records) backup and restore
- Digital metrological records, audits and audit findings

## **Sensor Network Metrology**

### **Towards digital metrological services for measuring sensor networks**

Sensor networks are becoming a standard approach in many applications, ranging from regulated areas such as energy, water, gas and heat consumption (Legal Metrology) to low-cost Internet of Things (IoT) for Industry 4.0 (Industrial Metrology), even multi-sensor secondary realizations (fundamental metrology), and other areas such as healthcare, chemical and pharmaceutical industries.

The research work in this topic area focuses on linking the existing research from individual disciplines such as information theory, communication theory and data science, in order to address metrological questions for such sensor networks.

The underlying methods for most metrological services must be fundamentally revised, in order to

accommodate these new measuring sensor networks, allowing new features of anomaly detection, condition monitoring, state prediction, automatic determination the quality of measurement data, etc.

**Topics to which the session is related**

Use of sensor networks in regulated areas, such as smart grids and water, gas and heat networks;  
Use of low cost sensor networks for applications that require trustworthy and reliable measurements, such as air quality monitoring;  
New/updated calibration procedures for multi-sensor measuring systems;  
Digital representation of sensor networks as digital twin or for virtual measurements, such as ML/AI-based models for estimation of water/gas consumption;  
Data quality and measurement uncertainty in sensor networks;  
Wireless and dynamic sensor networks; and  
Semantics and ontologies for sensor network metrology.

**Machine-readable Digital Calibration Certificates (DCC)**

One of the first and highest priority step for the metrology community is recognized in the replacement of paper-based calibration certificates with their digital counterparts, Digital Calibration Certificates (DCCs). A DCC is not a simple digitalization of the paper-based certificate in the sense of an exact copy in electronic format like PDF or Word. DCCs provide the calibration data in fully machine-readable data structures in a way that a software can automatically read the data from a DCC without error-prone human transcription. DCCs potentially allowing automated and machine-aided approaches to be used throughout all parts of calibration and measurement processes are essential for many organisations on the road to full digital transformation. The adoption of DCCs will thus lead to increased efficiency within those processes.

The organizers of the session are encouraging participants to submit papers on their recent findings in the domain of DCCs, new innovations and challenges. For all accepted contributions there will be time for a presentation in the session followed by a short Q&A.

**Topics to which the session is related**

Digital Transformation in the Quality Infrastructure related to DCCs  
Hands-on example for issuing DCCs  
Representations of measurement data in DCCs  
Establishing links of metrological traceability with DCCs  
DCCs for end-users and laboratories in the calibration chain  
Usage of DCCs in automated processes like Industry 4.0  
Tools and services for the creation, use and interoperation of DCCs  
Harmonization and good practise examples for DCCs in different areas  
Examples of new measurement capabilities enabled by DCCs  
Digital infrastructure for the secure exchange and storage of DCCs

**Digital transformation in legal metrology**