DOI 10.5162/SMSI2025/C6.4

Digital Certificates: Enabling Automation in Quality Assurance and Metrological Traceability

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Summary:
Automation in the metrological traceability of measurements bears high potential for a more effective quality management with less human interaction and reduced risks from manual data processing. For this purpose all metrological and administrative information in quality certificates must be provided in a fully machine-readable and machine-interpretable form. Following the well-established approach of digital calibration certificates (DCCs) also other digital quality certificates are currently under development.

Keywords: Digital metrology, calibration, reference materials, quality assurance, automation

Introduction

Conformity assessment documents, especially calibration and reference material certificates, contain valuable metrological information for laboratories and the industrial measurement technology. The correct handling and processing of this information can lead to more precise measurement results, more effective and resilient processes and increased yield. However, since a comprehensive metrological know-how and a well-documented quality infrastructure is necessary to enable these advantages, the information in these quality certificates often remains unutilized.

For the automated handling and processing of quality certificates, their quantitative and administrative data must be interpretable by machines and algorithms. In view of nowadays complex and globally entangled value chains the data structure of such digital certificates should be harmonized to be readily utilizable across all stakeholder communities.

The DCC as a Model for Digital Certificates

With XML being a markup language that is established and stable since decades, *Digital Calibration Certificates* (DCCs) were recently converted into a structured data format. For a fundamental harmonization an XML-schema was developed with the global participation of many stakeholders from the metrological and quality infrastructure sector, which is freely available and currently hosted by the *Physikalisch-Technische Bundesanstalt* (PTB). [1] This DCC-schema defines the basic architecture and terminology of DCCs, which is mainly regulated by the ISO/IEC 17025 standard [2]. Further harmonization within specific metrological areas is achieved by good practice definitions which are currently under development [3-6].

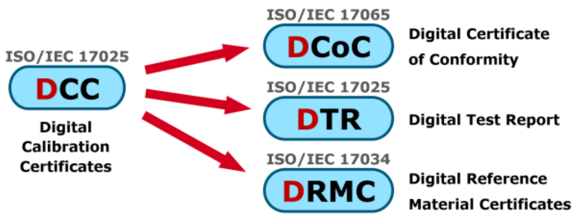

Fig. 1. The DCC-Schema is adapted for other digital quality documents.

Adaptations for Further Quality Certificates

Besides calibration certificates, there are other conformity assessment documents that could be processed automatically in a digital quality management environment. Although there are broad similarities, especially in terms of content and terminology of the administrative information, each of those document types has specific requirements, mainly determined by a respective standard of the ISO 17XXX series. Hence the established DCC-Schema is not suitable for other quality documents as a whole and is currently adapted by experts for each certificate type accordingly (see Fig. 1).

Digital Certificates of Conformity (DCoC) [7] contain less quantitative information but require a clear semantic concerning the certification criteria which are mostly derived from harmonized standards. These standards are linked directly with a reference to the specific clause in DCoCs.

Digital Reference Material Certificates (DRMC) contain material properties as metrological information that are mostly represented in a similar way as in DCCs, including uncertainties. In both cases, this quantitative data is provided via the *Digital-SI* format which is directly included into both schemas. The D-SI implies a formalism for the machine-interpretable statements of units and their origin from the SI base units as well as the associated measurement uncertainties. [8] With a direct relation to the novel *BIPM SI-Digital Reference Point* [9], the interpretation of digital units becomes unambiguous around the globe.

Digital test reports (DTR) require a large variety of possible data representations and conformity assessment formats. First DTR realizations for specific testing procedures are currently under development will probably result in individual schema implementations. The universe of testing procedures is highly diverse and the harmonization between different testing communities beyond the administrative information will remain a challenge.

Digitally Verifiable Accreditation for Quality Services

Often, conformity assessment services are requested from accredited service providers to assure the defined requirements for the execution of their procedures are met. The fact that a conformity assessment service was provided within the scope of an accreditation needs to be apparent on the resulting certificate. On human readable certificates, this is usually represented by a logo of the national accreditation body and a reference to the accreditation case number for the respective service provider.

For the representation of the accreditation on machine-readable certificates, the *German Accreditation Body* (DAkkS) has set up the public key infrastructure (PKI) for a *Digital Accreditation Symbol* (d-AS). [9] This allows accredited bodies to equip their machine-readable certificates with an advanced electronic seal, which represents their digital identity as a holder of an active accreditation for their services at the time of final certificate authorization. As it also provides all other functionalities of an electronic seal, (*i.e.* data integrity and authenticity), it can fully replace a digital signature on accredited quality certificates (*eAttestations*). The verification on the receiver side can be fully automated and seamlessly integrated into digital workflows.

Fig. 2. The advantages of machine-readable certificates and an automated quality management.

Conclusion

Digital conformity assessment certificates enable the automatization of quality assurance in laboratories and the industrial measurement technology (see Fig. 2). The automated validation, transfer, and data processing releases manual workload and lead to more effective and resilient processes with reduced risks.

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