OPEN INDUSTRY 4.0 ALLIANCE

DIGITAL CALIBRATION CERTIFICATES

USING CALIBRATION DATA INSTEAD OF MANAGING CERTIFICATES



SHORT CUT

WHAT

A Digital Calibration Certificate replaces calibration documents with structured, machine-readable data. Today, certificates are created as PDFs or paper documents, each with its own format and structure. This makes the data hard to process and requires manual handling. With DCC, calibration results are standardized so systems can exchange and use the data directly.

WHY

Because all calibration results from different sources can be compared, exchanged, and used together consistently, instead of being locked in separate formats that cannot be aligned.

WHO

For companies and roles responsible for calibration processes across multiple systems and partners, especially where many certificates are created and exchanged regularly.

DR. THOMAS ENGEL, PRINCIPAL KEY EXPERT @SIEMENS AG

DIGITAL CERTIFICATES ALLOW TO ACCESS AND PROCESS ALL DATA CONTAINED AUTOMATICALLY – A MAJOY DRIVER FOR PROCESS EFFICIENCY AND ROBUSTNESS

DO YOU HANDLE CALIBRATION CERTIFICATES IN DIFFERENT FORMATS ACROSS SYSTEMS AND PARTNERS?

DO YOU SPEND SIGNIFICANT EFFORT REVIEWING AND MANAGING CALIBRATION DOCUMENTS?

IS YOUR CALIBRATION DATA STORED BUT NOT ACTIVELY USED IN YOUR PROCESSES?

IF YOU ANSWER ONE OF THE Q'S WITH „YES" - YOU SHOULD CONTINUE READING.

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01 | WHAT IS A DIGITAL CALIBRATION CERTIFICATE?

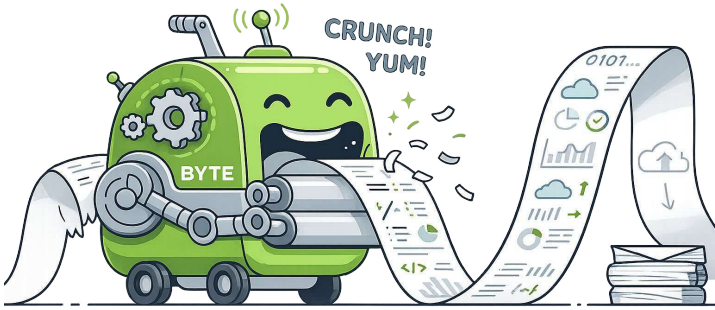
FROM DOCUMENT-BASED CERTIFICATES TO STRUCTURED CALIBRATION DATA

A Digital Calibration Certificate (DCC) is a structured representation of calibration results in a machine-readable format. It replaces calibration certificates that are currently exchanged as paper documents or PDFs. These documents contain all required information, including measurement values, traceability, and metadata, but they are not designed for direct processing in digital systems.

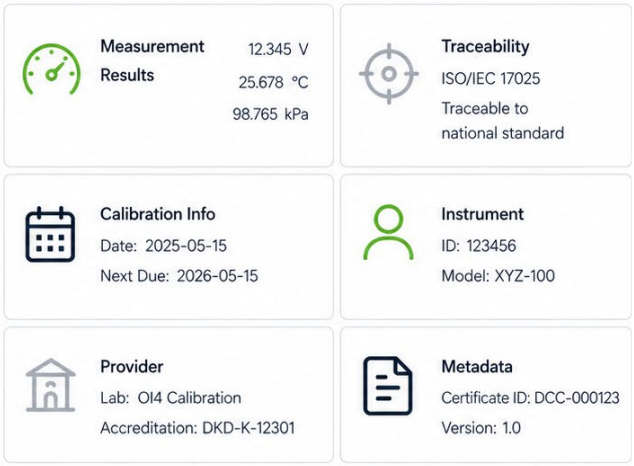
In practice, each certificate follows its own structure depending on the provider. Formats, terminology, and level of detail vary, which means the information must be interpreted manually before it can be used. As a result, the data remains tied to the document and cannot be consistently integrated into system-based processes. The DCC defines a uniform structure for this information. Measurement results and related data are represented in a way that systems can process directly. This separates the data from the document and allows calibration information to be exchanged and handled as structured data rather than static files.

It establishes a common format across all participants, independent of the source of the certificate. This ensures that calibration results can be interpreted consistently and processed without adapting to individual document structures.

„STUDIES“ SHOW: MACHINES HAVE A VERY SIMPLE TASTE — THEY ONLY CONSUME STANDARDIZED, MACHINE-READABLE DATA. EVERYTHING ELSE IS NOT EVEN TOUCHED.





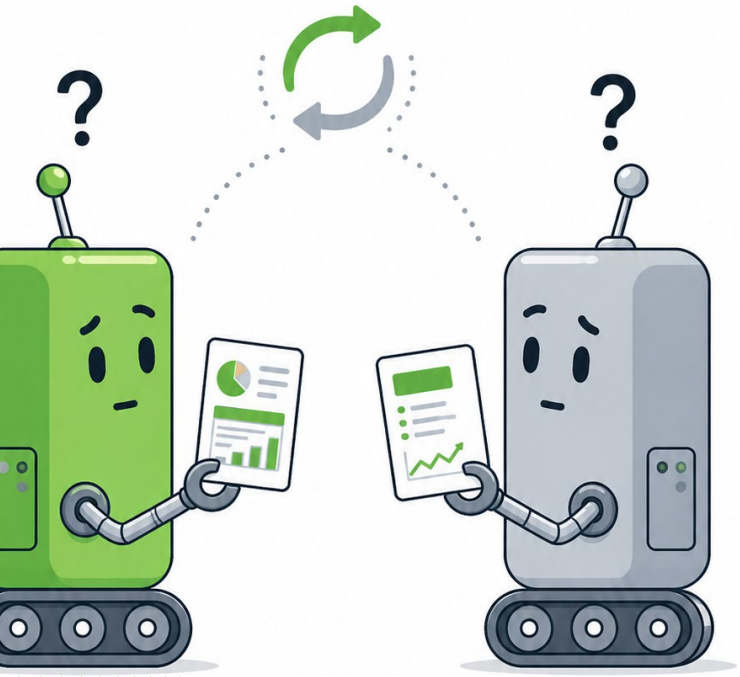


02 | WHY IS THE DIGITAL CALIBRATION CERTIFICATE IMPORTANT?

MANAGING CALIBRATION AT SCALE REQUIRES CONSISTENT & USABLE DATA

Calibration ensures that measurement systems operate within defined tolerances. This directly affects process stability, product quality, and compliance. Sensors and measurement devices are used continuously and must be verified at defined intervals.

The limitation lies in how calibration results are handled. Certificates are exchanged between measurement device manufacturers, service providers, and end users. Each participant uses its own format and structure. As a result, calibration data must be reviewed and interpreted before it can be used. With increasing numbers of assets, partners, and calibration cycles, the required effort grows proportionally.



This impacts how calibration data can be applied. Results from different sources cannot be compared directly. Evaluating measurement behavior over time requires manual consolidation of individual certificates. Adjusting calibration intervals or identifying deviations depends on manual analysis. In practice, calibration data remains limited to documentation and compliance checks.

The same limitation affects system integration. Calibration results cannot be transferred directly into systems for maintenance, quality control, or monitoring. Each use requires prior interpretation and alignment of the data. This prevents consistent use across systems and organizations.

The DCC defines a uniform structure for calibration data. Results from different sources can be compared directly and linked over time. Calibration data can be transferred into systems without prior interpretation. This supports consistent evaluation of measurement behavior, systematic adjustment of calibration intervals, and alignment of standards across systems. Calibration data becomes part of operational processes instead of remaining documentation.

This introduces a different way of managing calibration across the organization. Instead of following fixed schedules, calibration activities can be aligned with actual measurement behavior, allowing stable devices to be handled differently from those with recurring deviations. This creates the basis for adjusting calibration intervals in a controlled and traceable way rather than applying the same rules across all assets. At the same time, calibration data can be evaluated across systems and locations to detect patterns that are not visible at the level of individual certificates, enabling deviations across similar devices, environments, or operating conditions to be identified and addressed systematically. This shifts the focus from reacting to individual findings toward managing measurement performance as a whole, with decisions based on consolidated data instead of isolated observations.

03 | HOW IS THE DIGITAL CALIBRATION CERTIFICATE APPLIED?

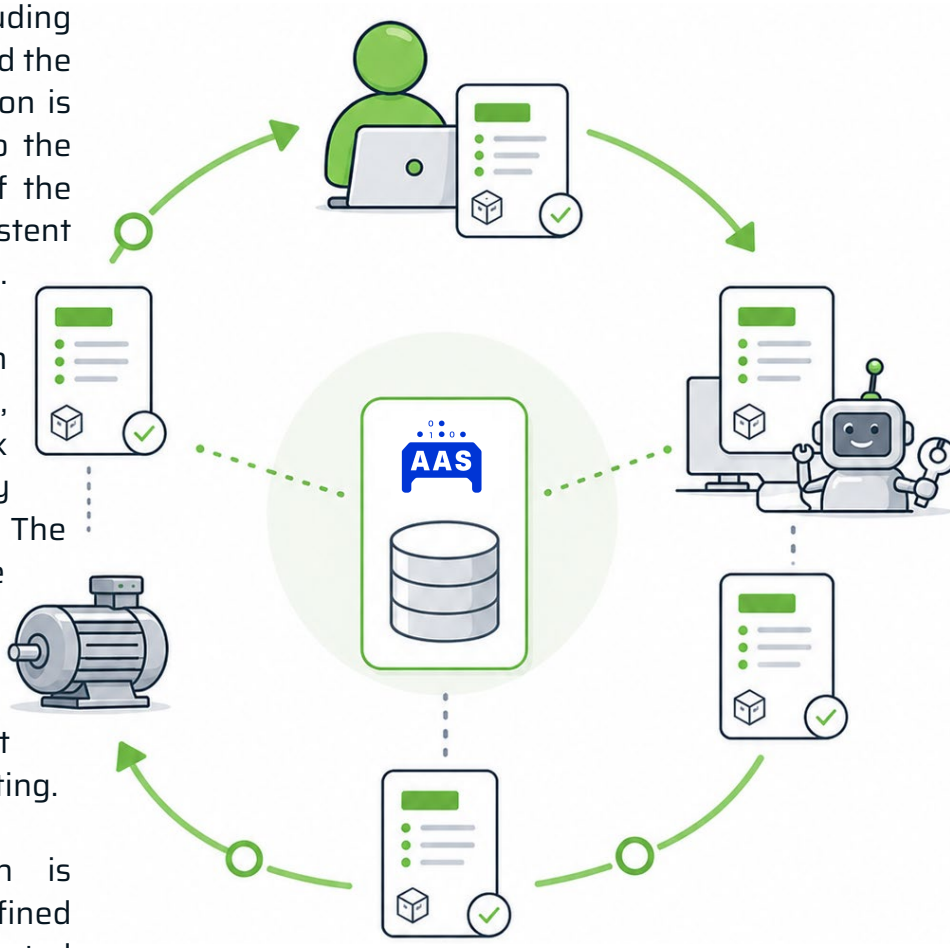
FROM CALIBRATION REQUEST TO VALIDATED DIGITAL CERTIFICATE

The DCC is part of a structured calibration process that connects request, execution, and result. A Digital Calibration Request (DCR) defines the calibration task, including the asset, the required procedure, and the conditions under which the calibration is performed. This request is linked to the Asset Administration Shell (AAS) of the asset, which serves as the consistent digital representation across systems.

The process begins with the creation of the DCR within the AAS context, ensuring that the calibration task is clearly defined and uniquely assigned to a specific asset. The request is then transferred to the service provider responsible for execution. Since the information is structured, the service provider can process the request directly without manual interpretation or reformatting.

During execution, the calibration is performed according to the defined requirements. The results are generated as a DCC, which contains measurement values, metadata, and traceability information in a structured format. Because both the DCR and the DCC follow a defined model, the result can be checked directly against the original specification. This removes the need to compare documents manually and ensures that deviations are identified immediately.

After validation, the DCC is transferred back and linked to the AAS of the asset. The structured format allows the data to be processed directly without extraction or transformation. It can be used for documentation, analysis, or integration into other processes. This



creates a continuous data flow from request to result, where information remains consistent across all steps.

The link to the AAS also ensures traceability across the calibration chain. Each calibration result is stored in context of the asset and can be related to previous calibrations and reference data. This allows measurement behavior to be tracked over time and ensures that calibration information remains consistent and accessible across systems.

04 | IMPLEMENTATION WITHIN THE OPEN INDUSTRY 4.0 ALLIANCE

VALIDATION OF A CONSISTENT CALIBRATION WORKFLOW ACROSS MULTIPLE PARTICIPANTS

Within the Open Industry 4.0 Alliance, the Digital Calibration Certificate was implemented in a joint setup across multiple participants in the OI4 ecosystem. The implementation established a complete workflow from Digital Calibration Request to Digital Calibration Certificate using the Asset Administration Shell as the common integration layer. End users, measurement device manufacturers, service providers, and research organizations contributed their systems and components to this setup.

Digital Calibration Requests were created and linked to the Asset Administration Shell of the asset. The request defined the calibration task, including scope and requirements, and was transferred as structured data to the service provider. The service provider processed the request directly and executed the calibration based on the defined specification. The results were generated as Digital Calibration Certificates following the same structured model and linked back to the Asset Administration Shell.

The implementation covered the full exchange between participants. Requests and results were transferred as structured data without using documents. The Digital Calibration Certificate was validated against the corresponding request, ensuring that the defined procedure was executed correctly. The data remained consistent across all steps and could be processed without manual interpretation.

The setup also addressed interaction across multiple organizations. Each participant operated its own systems, while data exchange followed a shared structure based on the Asset Administration Shell. This removed the need for individual integrations between partners. Instead of connecting systems pairwise, participants exchanged calibration data through a consistent model.

The implementation demonstrates that calibration processes can be executed as structured data flows across organizational boundaries. It confirms that Digital Calibration Requests and Certificates can be integrated into existing environments and used to connect participants without relying on document-based exchange.

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PROJECT INFORMATION? CLICK HERE.

DCC Project



05 | RESULTS AND IMPACT

FROM DOCUMENT-BASED HANDLING TO DATA-DRIVEN CALIBRATION PROCESSES

DCC changes how calibration data is handled across its lifecycle. Certificates are no longer treated as documents that require manual review and interpretation. Calibration data is available in a structured format and can be processed directly within systems. This removes the dependency on document-based handling and reduces the effort required for verification and storage.

Validation of calibration results is no longer performed by reviewing individual certificates. The Digital Calibration Certificate can be checked directly against the corresponding Digital Calibration Request. This ensures that the defined procedure was executed correctly and that the results are complete and consistent. Validation becomes part of the data flow instead of a separate manual step.

The consistent structure also changes how calibration data is used. Results from different sources can be combined without prior alignment. Calibration data can be evaluated across assets, systems, and locations without consolidating individual documents. This creates a consistent basis for analyzing measurement behavior and managing calibration activities across the organization.



The impact increases with scale. In environments with a high number of assets and calibration cycles, document-based processes require proportional increases in manual effort. A structured data approach removes this dependency. The effort to handle calibration data remains stable even as the number of certificates and participants grows.

HELLO, WE ARE OPEN

The results also show that this approach requires coordination beyond a single company. Calibration involves device manufacturers, service providers, and end users, and a DCC only works if all of them share the same understanding of how calibration data is structured and used. The Open Industry 4.0 Alliance provides the environment for this. Companies validate approaches in joint setups and align on practical solutions. Participation gives direct access to existing implementations, technical expertise, and ongoing developments, so you don't have to build everything from scratch.

START WITH OI4

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VERSION HISTORY

VERSION	DATE	DESCRIPTION	EDITOR
1.0	July 1st 2026	Initial release	Lucas Wolf