

Data Transfer & Processing of machine-readable Reports

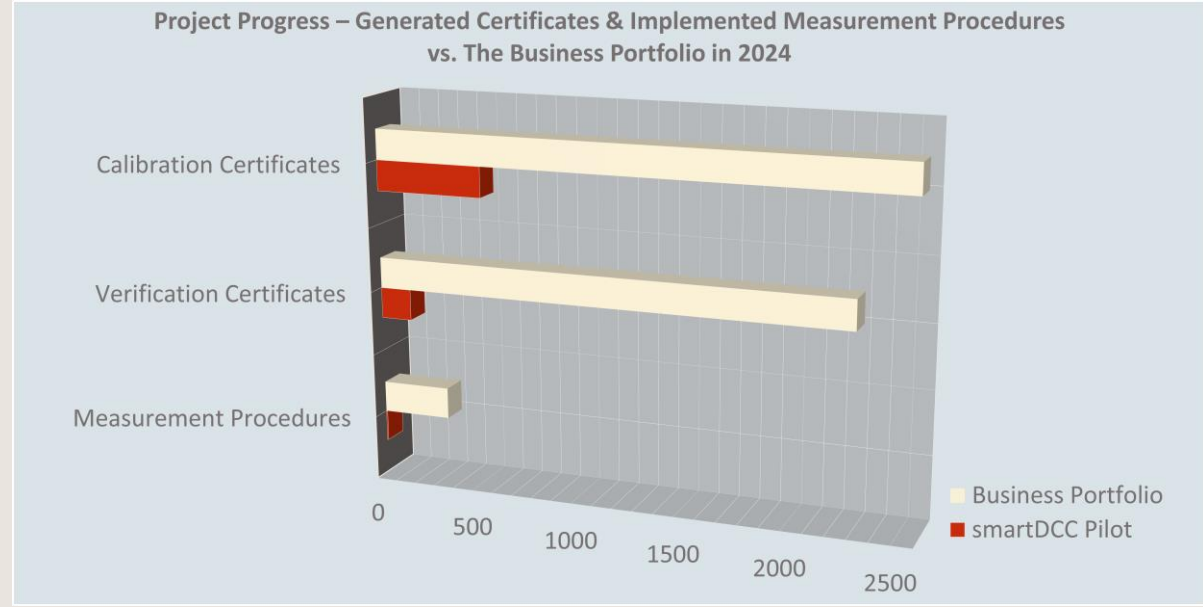
Validation & verification of document-oriented data models and their usage for machine-readable certificates (smartDCC Austria)

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Results

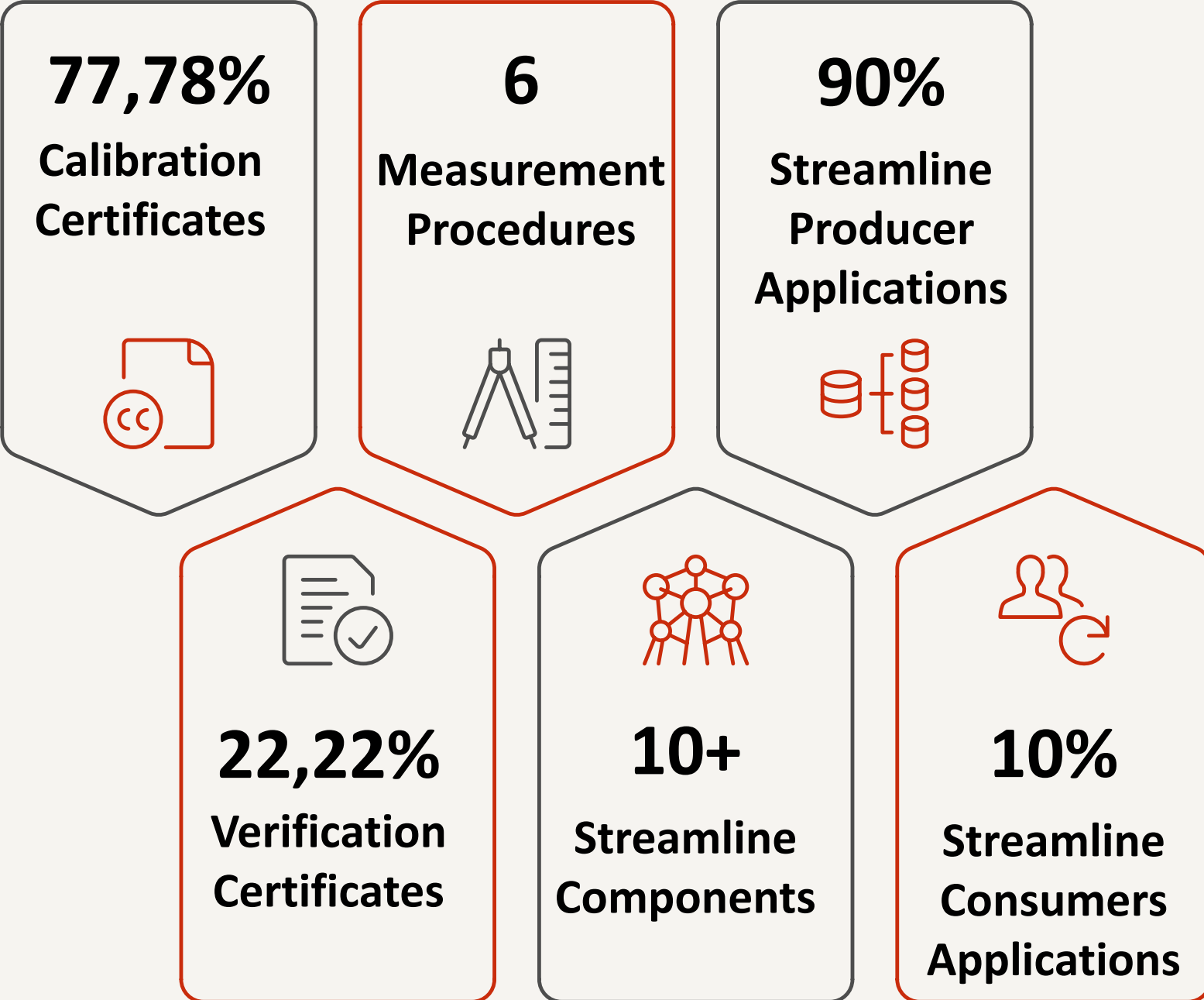
The system has successfully automated the creation of machine-readable reports for six distinct measurement procedures. Although the amount of measurement procedures is a small percentage of the overall measurement procedures in the organization, they belong to the most performed measurement procedures of the organization's business portfolio and hereby a significant amount of machine-readable calibration certificates were generated. Moreover, the pilot project has shown that the system enables:

- **Data traceability through data origin mapping**
- **Communication between various enterprise applications and the new written microservices for data model validation & verification, and automated document generation**



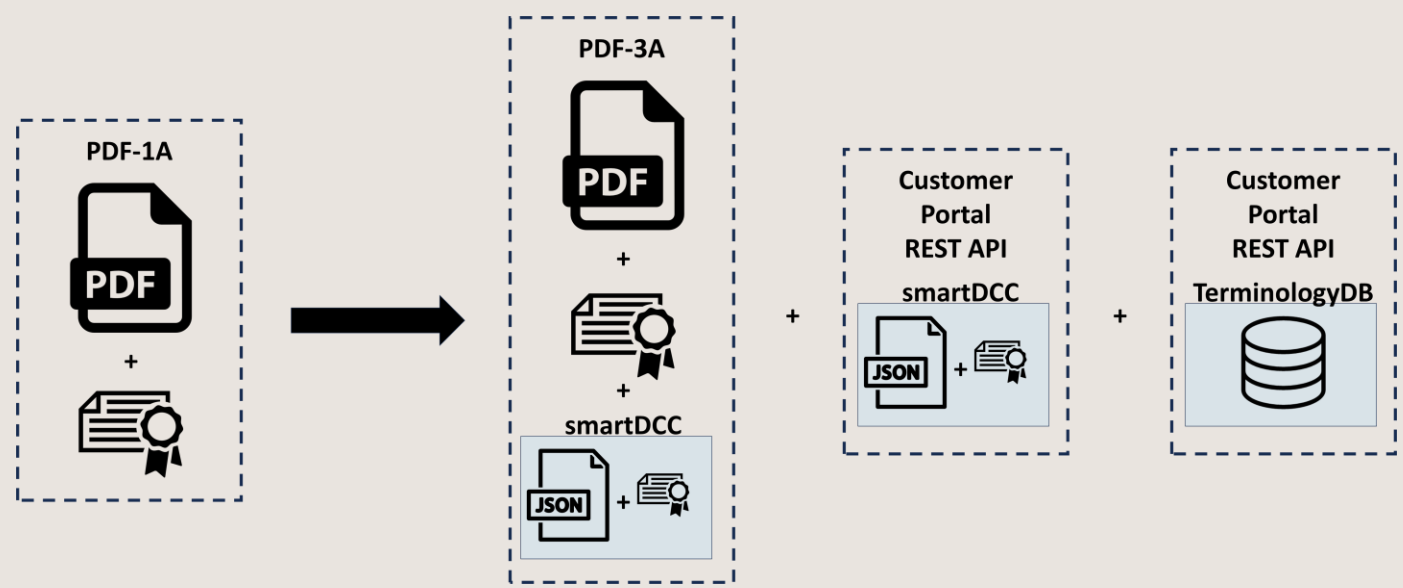
Project Output & Outcomes

675+ Machine-Readable Reports
in One Year



Introduction

This project of the National Metrology Institute of Austria (BEV) focuses on the development of an automated system for creating machine-readable reports, specifically digital calibration and verification certificates (DCC). The approach combines microservices and document-oriented data models and storages to create an interoperable, scalable e-service system architecture. **The goal is to streamline automated data collection, processing, and report preparation while adhering to metrological norms and regulations, ensuring machine-readable data traceability and integrity.** The outcome is framework for an IT architecture that connects new modular microservices with data acquisition, distribution, validation, and verification purposes to existing business management systems of the institute.



Currently, BEV provides PDF/1A digitally signed calibration certificates. The project aims to expand this by offering three options: a PDF/3A digitally signed certificate with an attached machine-readable JSON certificate, the ability to access the machine-readable certificate through the customer portal's REST API, and the use of the TerminologyDB to provide oversight of the JSON structure.

Calibration Certificate Process for Modular Applications

Measurement Process

Initial measurement of parameters

Data Processing & Validation

Analysing and validating data

Document Generation

Creating the final machine-readable certificate

Data Acquisition

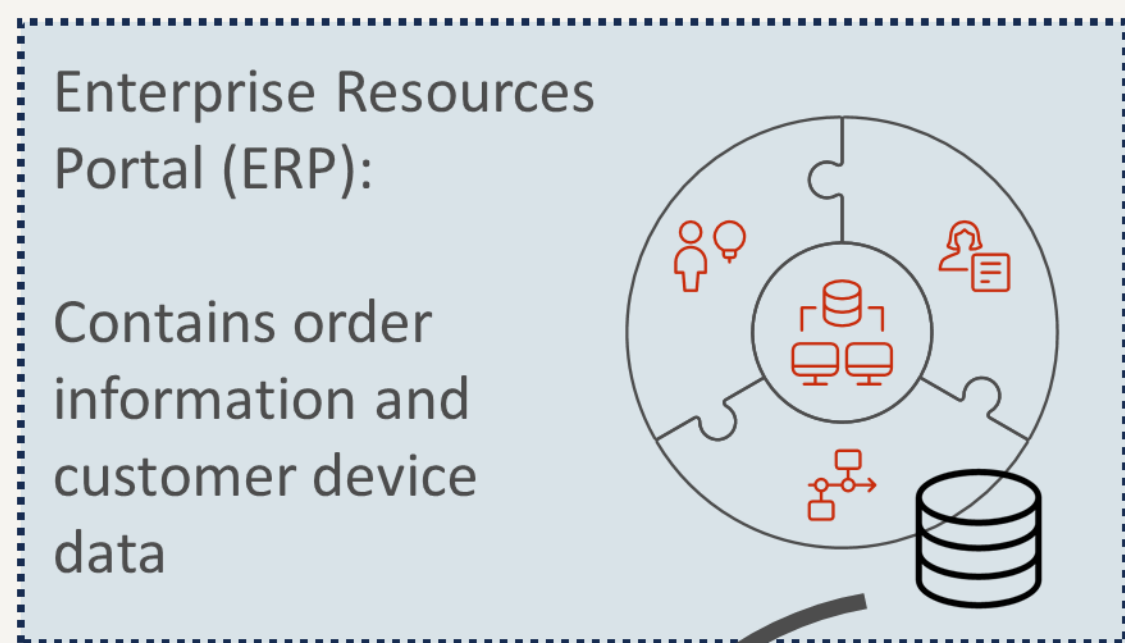
Collecting data from measurement tools

Data Reshaping & Verification

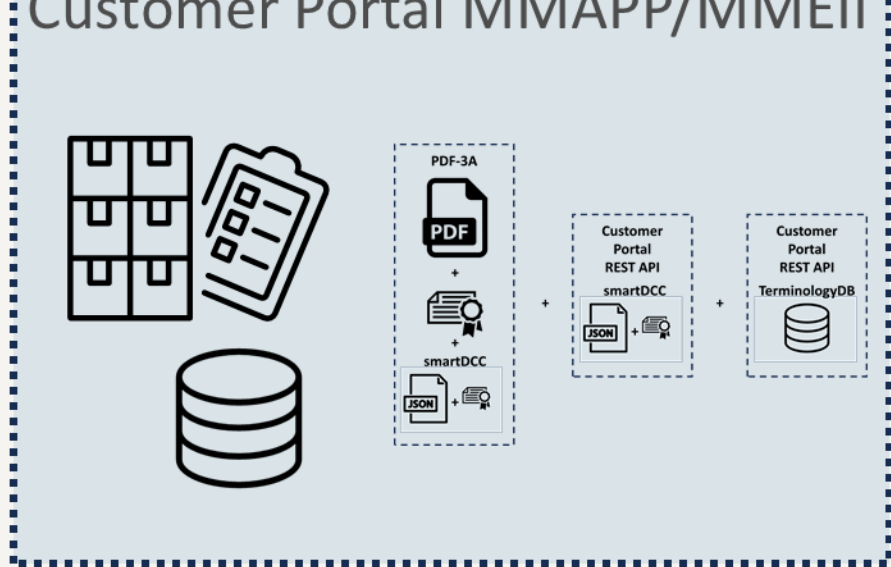
Modifying and verifying data structure

Data Workflow

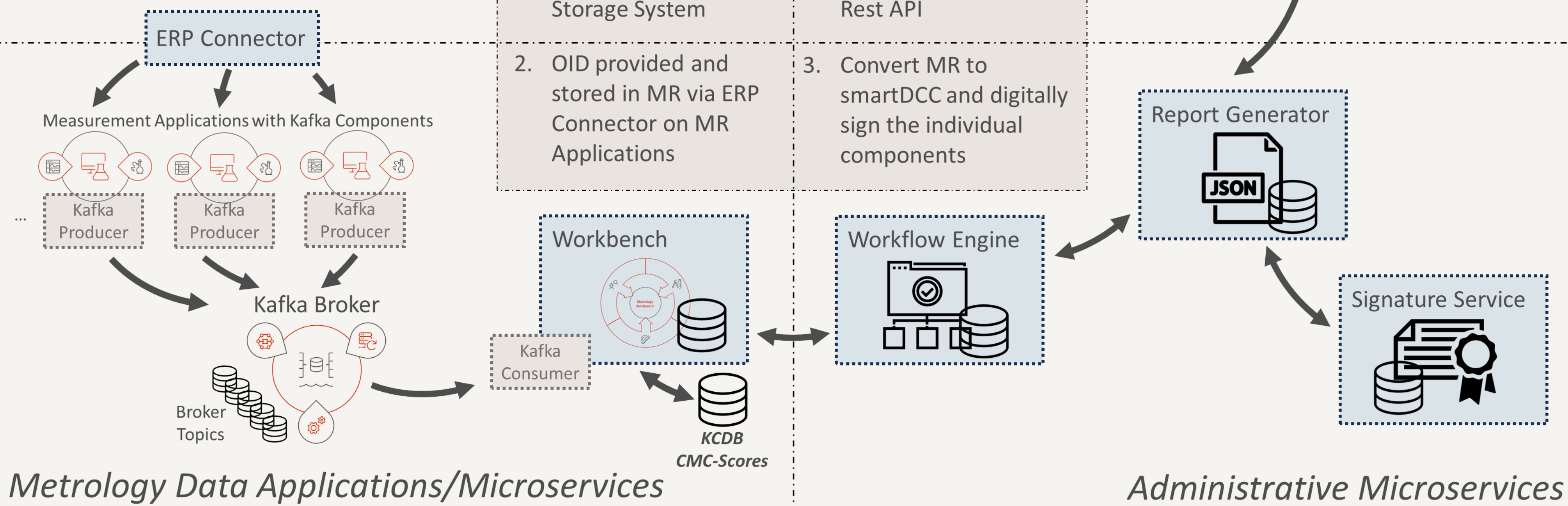
Business Applications



Customer Applications



Our Customers



Conclusion

Traceability is a cornerstone of metrology, and this pilot ensures that measurement data is validated and stored in a manner that guarantees its integrity. This implementation allows customer data and measurement data to be fused into machine-readable measurement reports. These reports are subsequently transferred and used to generate DCCs.

The implementation of microservices allows integration with existing business management applications, ensuring that all data is accessible and usable across different business processes. As the system grows, new measurement stations can be added with no disruption to the overall digital infrastructure. This scalability also enables the addition of new result report structures, ensuring that the system remains interoperable and capable of adapting to unified data structures over time.

Future Steps

The numbers and outputs presented in this project stem from a pilot implementation. At this stage, our customers are not yet receiving the final product. Moving forward, we are continuously monitoring the overall system performance and expanding the implementation to cover additional measurement procedures. **Our goal is to provide the first versions of the system to our initial customers by fall 2026.** With the first customers onboard, we aim to establish an improvement feedback loop to refine the machine-readable structure in alignment with actual market needs. **Thanks to the modularity and scalability considered in our approach, our data models are highly flexible, allowing us to easily create modified models for specific customer requirements.** Furthermore, our system is designed to adapt to evolving standards, ensuring compatibility with future harmonized document architectures, such as those being developed for the EU market. Moreover, once we have established a fully monitored architecture, we will actively seek engagement with international stakeholders. While we initially focused on internal development, we are open to discussing our outcomes with workgroups in EURAMET, OIML, and BIPM.

Methods

Examining the entire data workflow of the framework, the data transactions are separated into four distinct levels (**see Data Workflow**):

- **Business Applications:** Customer services receive customer orders either directly input order information and measurement device details into the organization's ERP system. To facilitate integration, a microservice called the ERP Connector was designed to communicate with business applications. This enables the measurement applications in the laboratory to retrieve order and device information for further processing.
- **Metrology Data Management/Microservices:** Through the ERP Connector, measurement stations retrieve order and device information to generate the first part of the machine-readable report, which includes relevant administrative data. This process triggers the activation of the measurement program, where measurement data is generated and automatically inserted into the report. A Kafka producer within the measurement station validates the report's structure and sends it to a Kafka broker. A connected consumer for the Metrology Workbench allows laboratory technicians to verify the measurement data and authorize the reports for further processing.
- **Administrative Microservices:** The Workflow Engine serves as the platform where technicians access their assigned orders. It also manages the measurement reports sent from the Workbench, enabling the technician and their superior to finalize the certificate. The finalized report is digitally signed through the Report Generator microservice, which also calls the Signature Service to sign both the PDF and the machine-readable content, generating the smartDCC.
- **Customer Applications:** The finalized machine-readable reports and structured data formats, as described in the introduction, are made available on the customer portal. The Report Generator ensures that all finalized documents are sent to the portal, where customers can securely access their calibration and/or verification certificates.

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