19th Meeting of the Directors of NMIs and Member State Representatives with BIPM

Session on Advanced Manufacturing, Digitization and Internet of Things

Thursday, 19th October 2017

11:10 to 13:00 – Advanced Manufacturing, Digitalization, and the Internet of Things

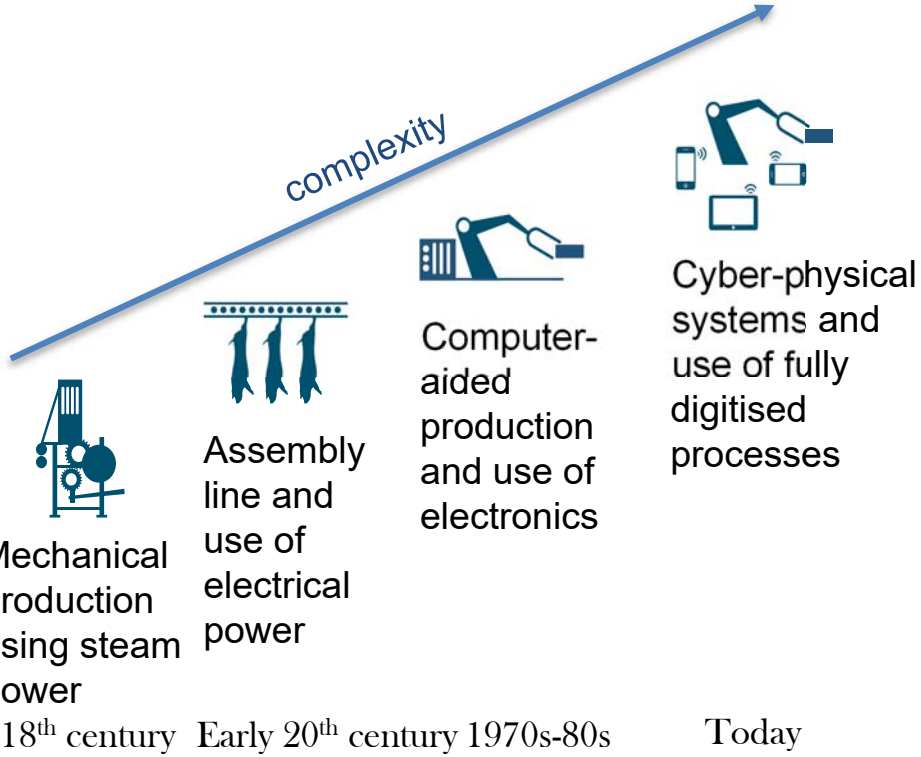
- Topic to be led by Jörn Stenger (PTB)
- Key question:
  - These big themes and novel approaches to innovation are discussed widely by Governments, what is the role of measurement science in bringing them into practice in our various economies?

- Opening presentation: Digitalization and Industry 4.0
- Panel discussion including: Takashi Usuda (NMIJ), Hector Laiz (INTI), Ajchara Charoensook (NIMT)

Discussion

- Presentation on the Internet Metrology Resource Registry (Bob Hanisch, NIST)

What is digitalization? What is Industry 4.0?



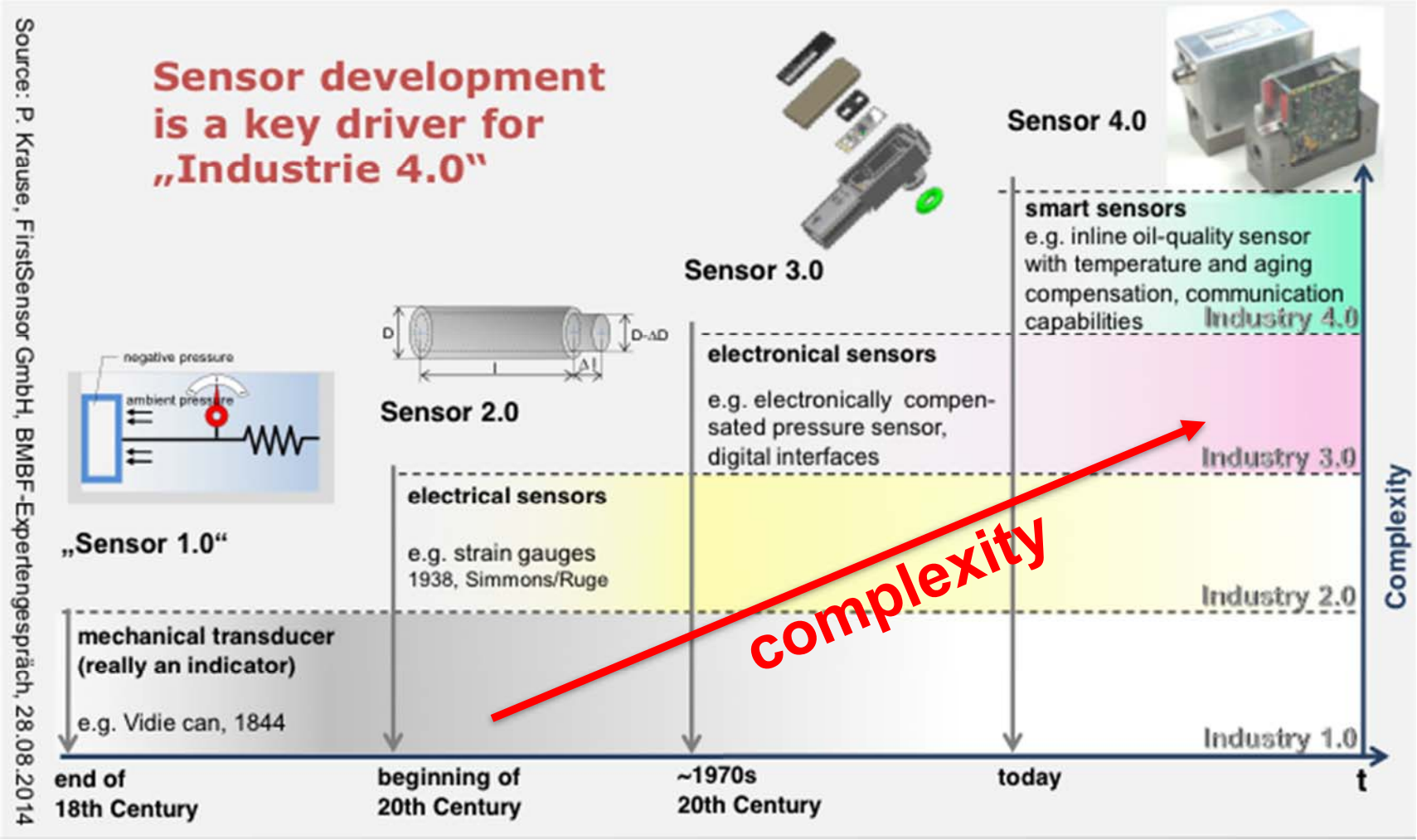
Digitalization
Translation of analogue quantities into discrete values for electronic storage and analysis

Digital hull
Physical objects are equipped with a digital representation and communication capabilities.

Network
Physical and virtual objects connected with each other and with humans.

Analysis
From large and big data to smart data by using intelligent and automated data analysis methods.

Digitalization and Metrology

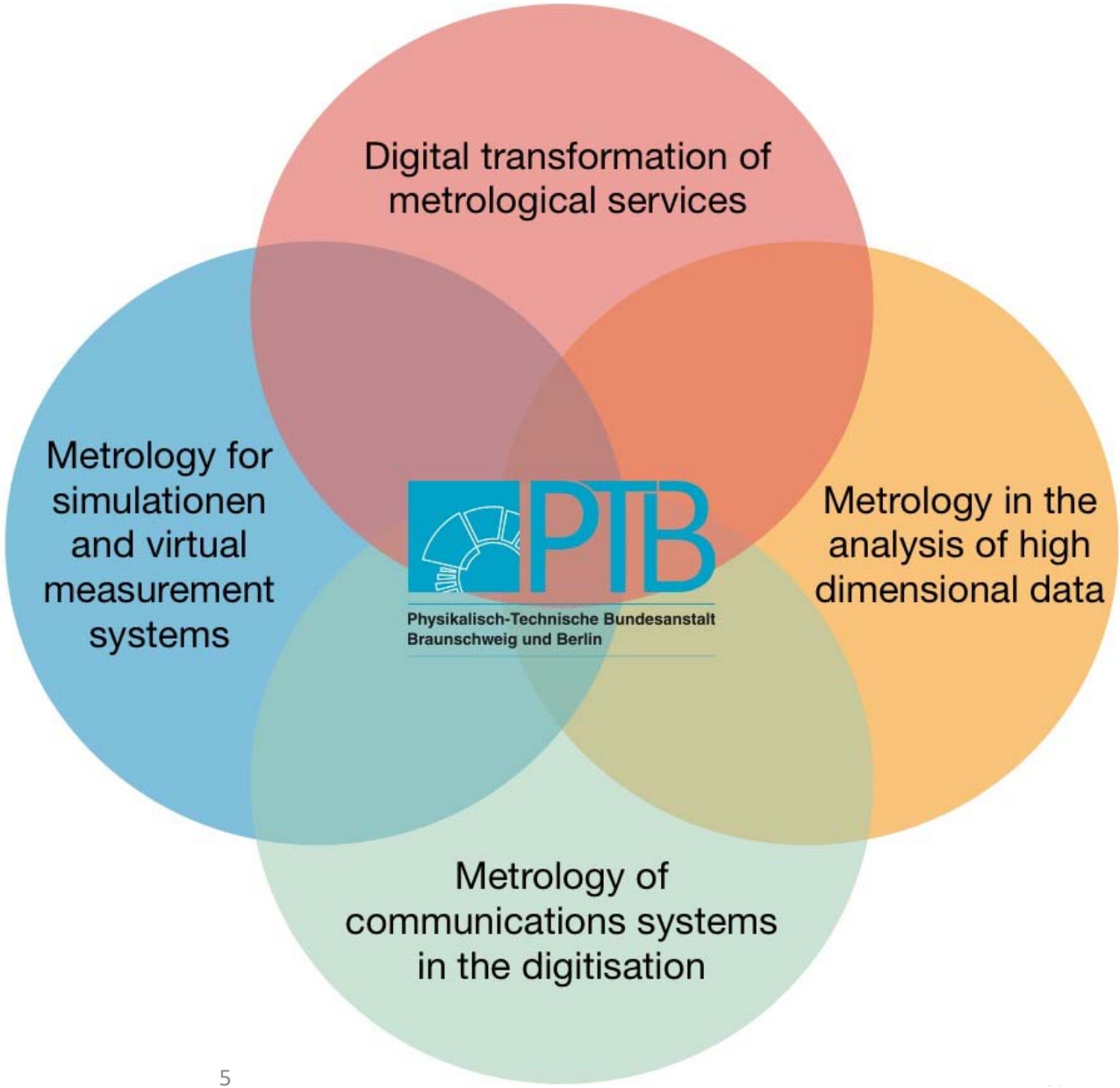


- Built-in data pre-processing
- Fully digitized communication
- Quasi real-time data analysis
- Combine physical and virtual
- Simulations and virtual measurements

Key areas

What does industry4.0/ digitalization mean for an NMI – example PTB

Find study provided on BIPM website

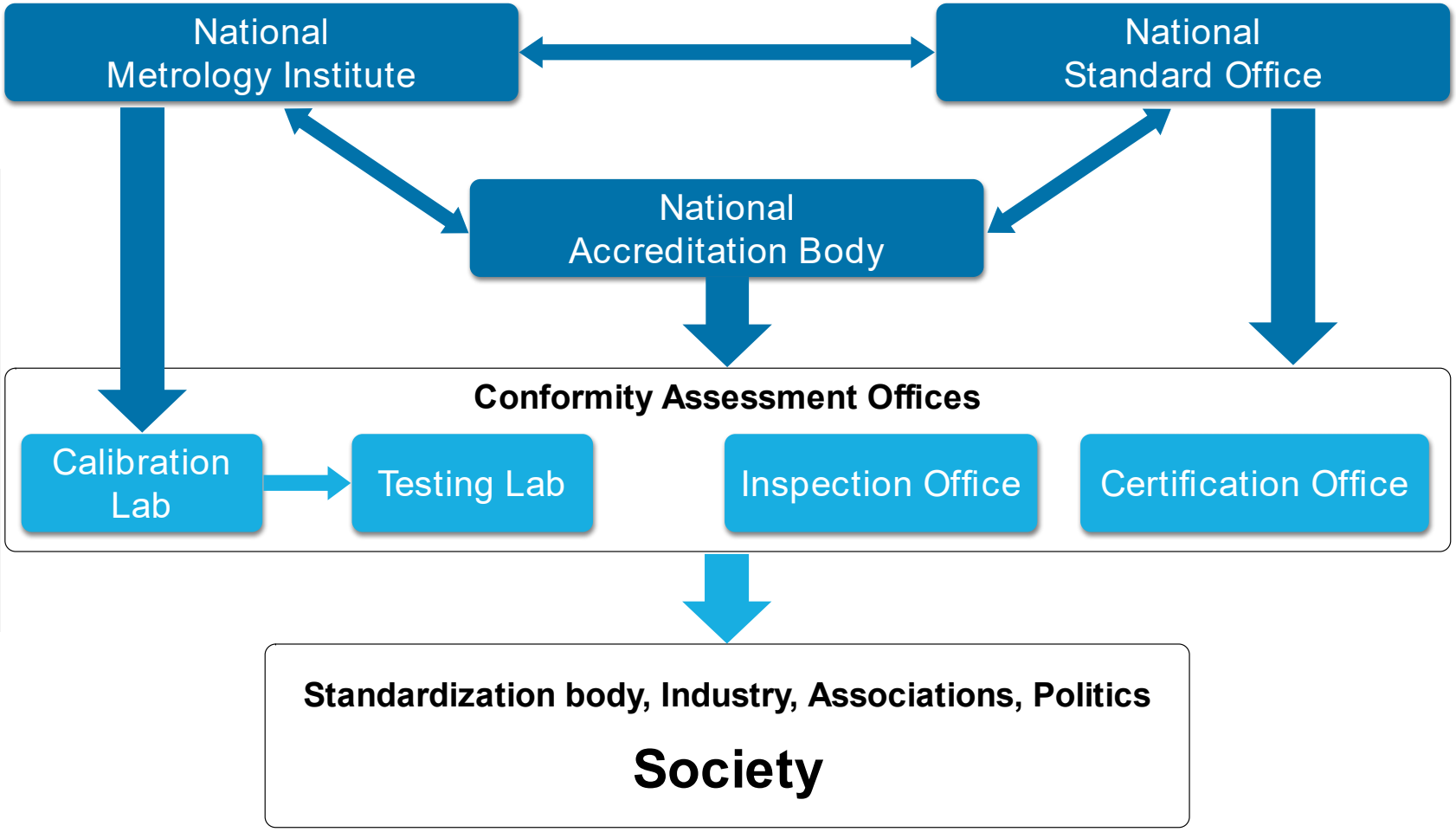


Digitalization in the Quality Infrastructure

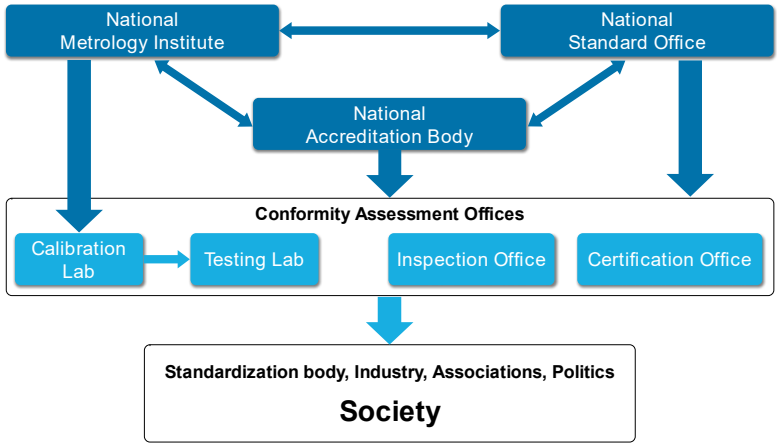
Digitalization in the Quality Infrastructure

Pillars of QI

- Calibration
- Standardisation
- Accreditation
- Conformity assessment



Digitalization in the Quality Infrastructure



Pillars of QI

- Calibration
- Standardisation
- Accreditation
- Conformity assessment

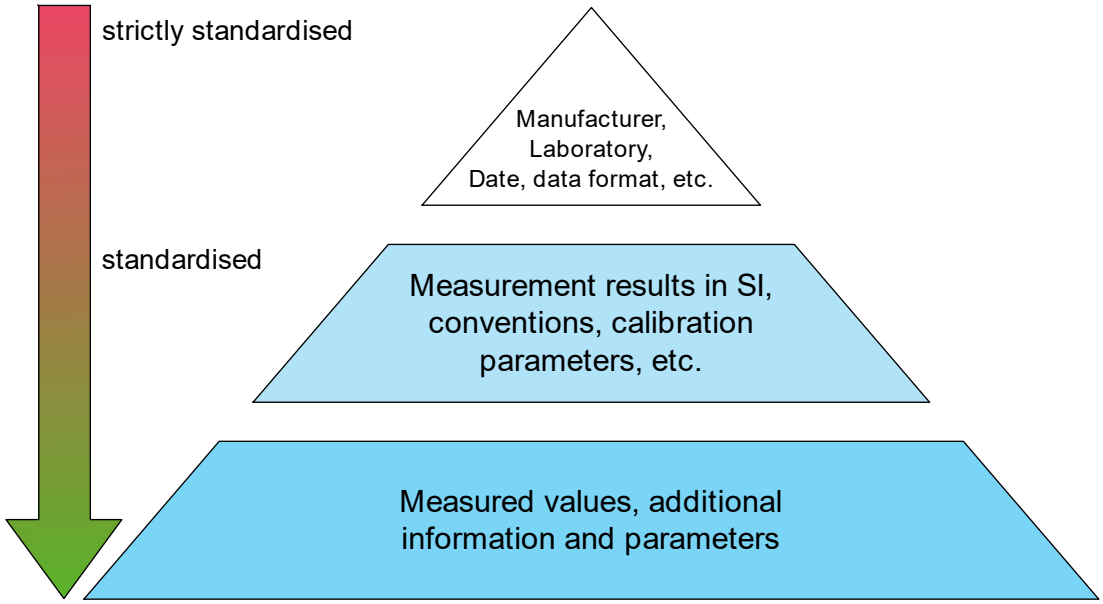
Importance of QI

- Quality infrastructure (QI) as selling point and access to global markets for companies
- Backbone of QI built by accreditation and traceability to SI units along a well-defined traceability chain

Digitalization

- **New processes**: interconnected systems, cloud solutions
- **New measurands**: high-frequency communications, simulations and virtual measurements, additive manufacturing
- **New devices**: smart home, smart sensors, smart city, …
- **New approaches**: sensor networks, massive data, cloud computing, distributed measuring instruments

Key example: digital calibration certificate



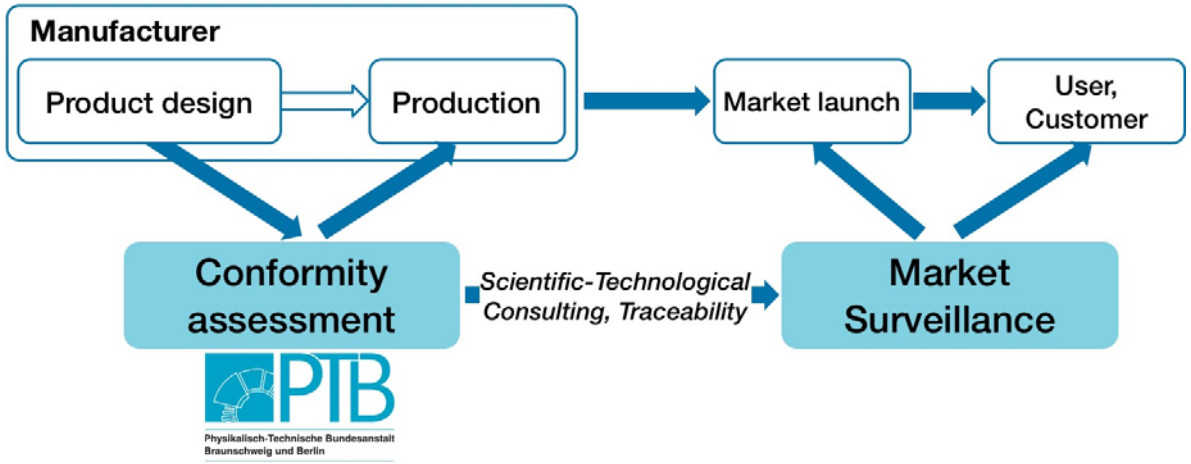
Structure

- Standardized und machine readable
- Contains all necessary information
- All changes are documented
- Accounting for IoT, CPS and other industrial standards

Not just electronic version of written certificate

- ready for use in industry 4.0 scenarios
- may be used to control processes
- …

Digitalization in legal metrology



General tasks

Establish trust of consumers and users of measuring devices in the measurements carried out in official or business transactions.

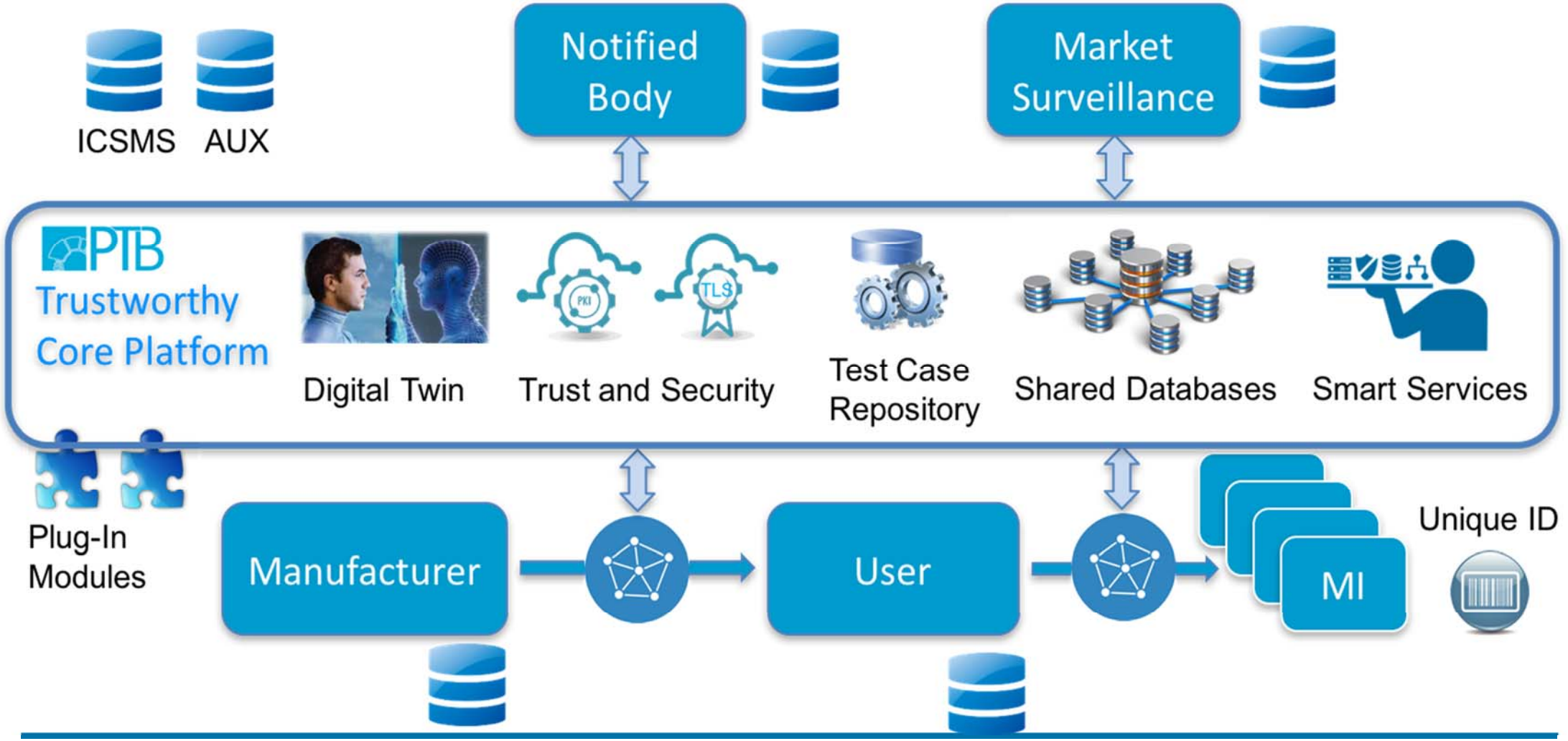
Role in the digitalization

Integration of innovative technologies taking into account legal conformity requirements and practicality of market surveillance.

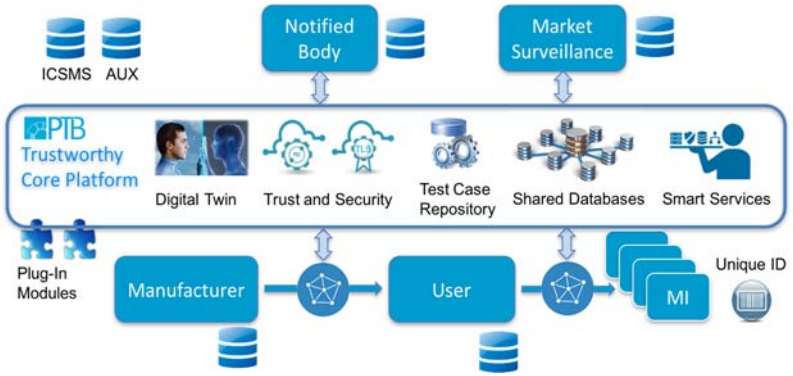
Tasks for PTB

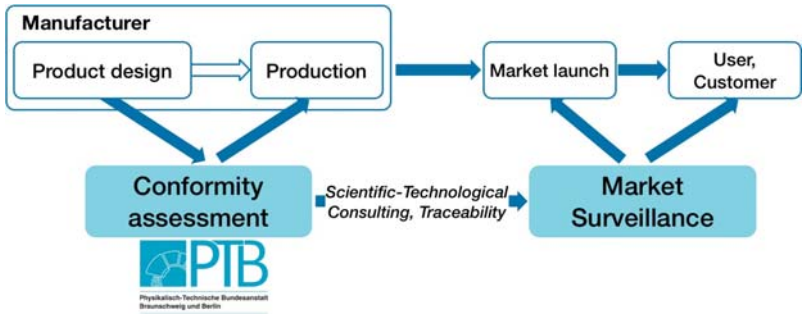
Development of national standards und digital references (measurements, data, algorithms) as well as establishment of the prerequisites for efficient conformity assessment procedures.

Key example: Metrology Cloud



Key example: Metrology Cloud





- Digital quality infrastructure (QI)
- Specific access for all players in the QI
- Attachment of existing infrastructures
- Secure, trustworthy „Core-Platform“ @ PTB
- Realisation of new concepts for the digital transformation of metrological services
- Reduction of barriers to innovation and support for data-based services
- Model for a European Metrology Cloud

New Technologies

New measurands and principles

Stochastic measurands

Complex protocols

Quality measures

5G

Non-linear measurements

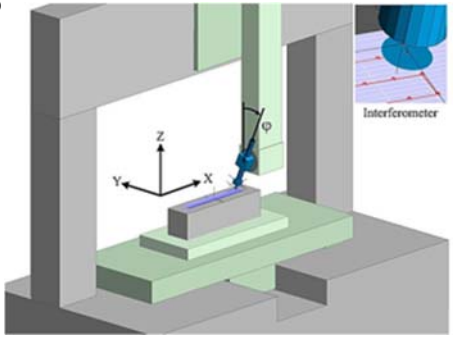
Derived measurands

High-frequency communications

Traceability of simulations

Computationally expensive

Numerical stability

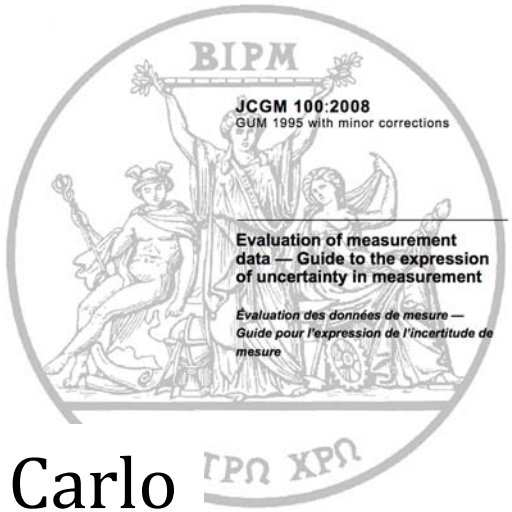


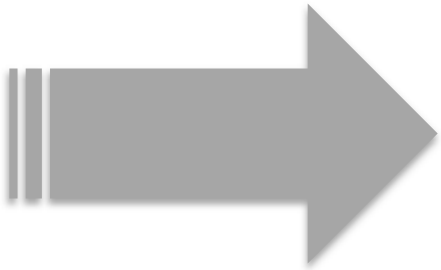
Complex calculations

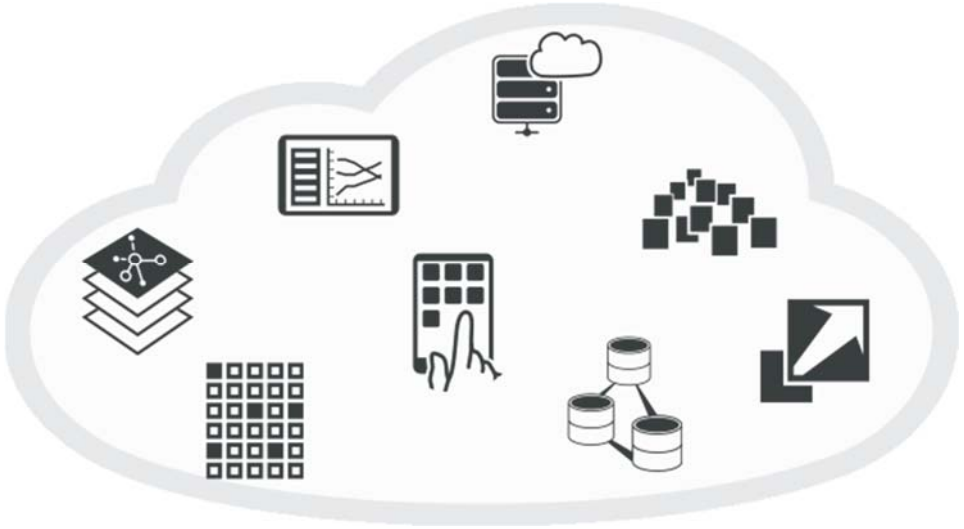
Virtualised measurement uncertainty

Simulation-based results

New approaches for data analysis





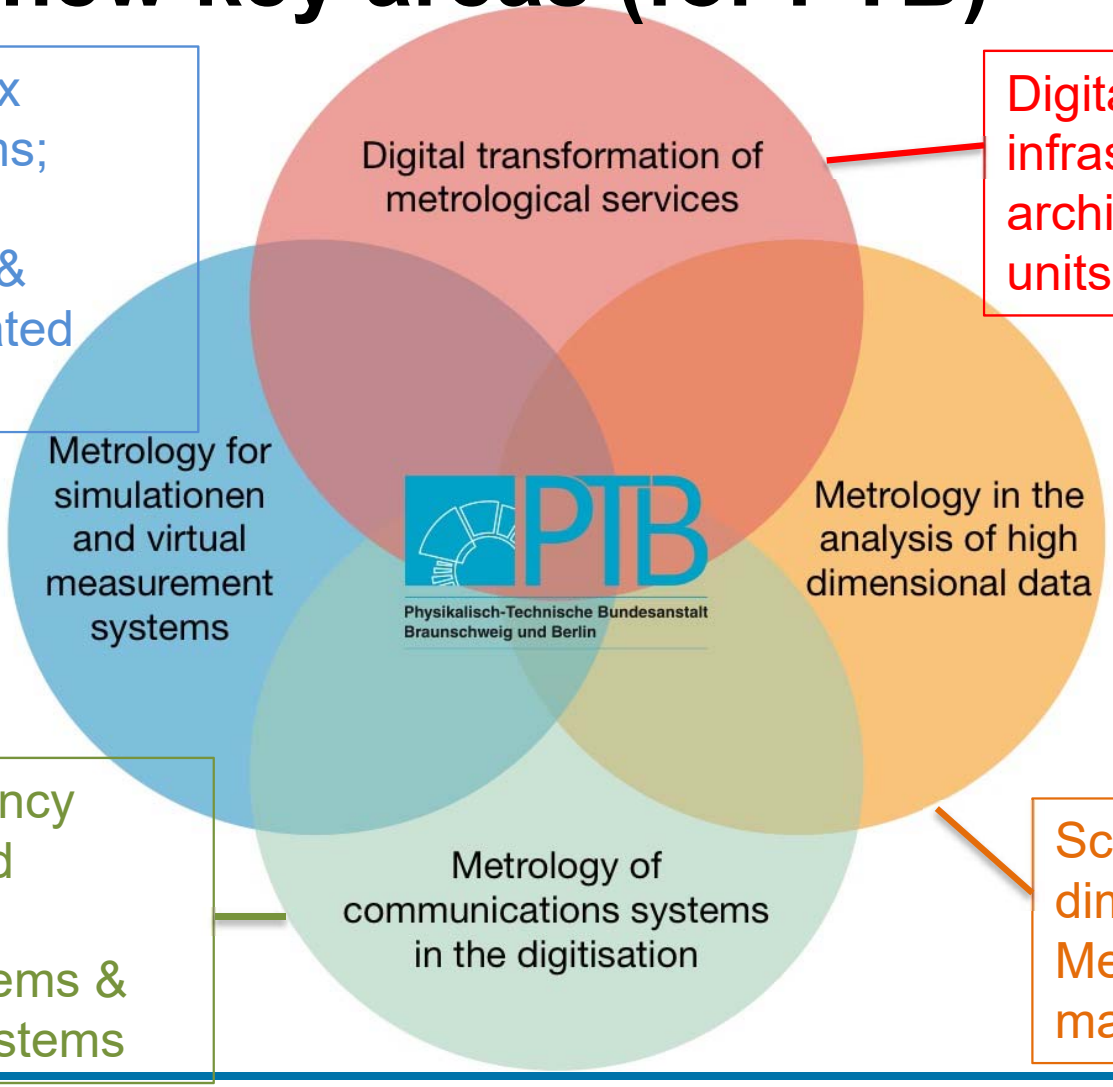


Monte Carlo

Signal processing

Summary: new key areas (for PTB)

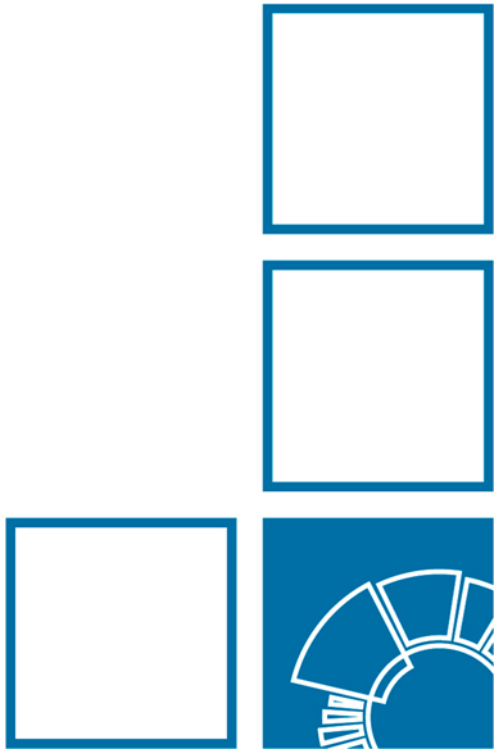
Simulation of complex measurement systems; virtual measurement processes; methods & standards for automated production



Digital enabling of the quality infrastructure; reference architectures; transfer of units

complex high frequency measurands; derived measurands; digital communication systems & complex antenna systems

Scalable methods for high dimensional data analysis; Metrological evaluation of machine learning methods



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