

Metrology in the Digital Transformation

This project proposal is about to establish a European metrology data infrastructure, a “European Metrology Cloud” to support the processes of conformity assessment and market surveillance, and develop new technology- and data-driven metrological services for this infrastructure to push manufacturer’s innovations. The project therefore addresses the main inhibitors to innovations.

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Metrology in the digital transformation:

The European

“The internet and digital technologies are transforming our world. But existing barriers online mean citizens miss out on goods and services, internet companies and start-ups have their horizons limited, and businesses and governments cannot fully benefit from digital tools. It's time to make the EU's single market fit for the digital age – tearing down regulatory walls and moving from 28 national markets to a single one. This could contribute €415 billion per year to our economy and create hundreds of thousands of new jobs.”

Jean-Claude Juncker, President of the European Commission [1]

The European Commission has been convinced by several studies that an enormous economic benefit could be gained from a digital single market. Hence, the Commission has issued a Digital Single Market Strategy for Europe to push the most essential aspects.

The essential and interwoven European initiatives aim at setting up an efficient infrastructure to support, for example, Cloud Computing and Big Data. [2]

Within the Digital Single Market Strategy for Europe, cloud computing plays a key role through the European Cloud Initiative, the European Free Flow of Data Initiative, and through the emerging issues related to ownership, access, portability of data, and switching of cloud service providers [3]. The "European Cloud Initiative – Building a competitive data and knowledge economy in Europe" [4] aims to strengthen Europe's position in data-driven innovation, improve its competitiveness and cohesion, and help create a Digital Single Market in Europe.

As part of the package of measures for digitizing Europe's industry, the Commission has outlined a new strategy on Big Data, supporting and accelerating the transition towards a data-driven economy in Europe. The data-driven economy will stimulate research and innovation on data while leading to more business opportunities and an increased availability of knowledge and capital, in particular for SMEs, across Europe [5].

The impact of these initiatives is already palpable in areas where innovations are subject to legal control, e.g. to ensure a certain level of quality and market acceptance of products. Such a field, where manufacturers and legal authorities are working closely together to reach such objectives, is Legal Metrology [6].

Seizing the chances of digitalization could resolve existing obstacles for innovation within the quality infrastructure set up by Legal Metrology and foster Legal Metrology's digital transformation. This will be beneficial for all collaborators in this area and will make Legal Metrology fit for the digital age. In the following the required actions to reach this aim are motivated and identified.

The Aims of Legal Metrology

Legal Metrology establishes confidence in the correctness of measurements and the protection of users of measuring instruments and their customers. This confidence is established by a legal framework which is provided by several European Directives which are embedded in the “New Approach” [7] and are implemented into national law of the member states, as has, for example, been done with the Measuring Instruments Directive [8].

The Directives within the New Approach define Essential Requirements, which products must meet when they are put on the market. Governmental Bodies tasked within Legal Metrology all across Europe design technical requirements for the production and placing on the market of products conforming to the Essential Requirements established by the Directives, while taking into account the state of the art in technology.

This legal framework demands a quality infrastructure, which supervises the integration of new products in the market and also encompasses the product design and the subsequent production, the placing on the market and finally the use of the product. This supervision is shared by national Notified Bodies and Market Surveillance authorities.

Notified Bodies, like PTB in Germany, assess the conformity of the design and the production to the Essential Requirements, whereas the Market and User Surveillance supervise the placing on the market and the correct use of the instruments. Scientific and technical counseling for the Market Surveillance is provided in Germany by PTB.

In this way, a chain of trust is established, stretching from the development phase via production to the instrument in use. This adds to the acceptance of new technologies and is considered a sign of quality not only in emerging markets like Asia and Africa.

Challenges and Chances in Legal Metrology

Recent innovations were driven by technologies which have matured significantly over the past ten years - namely Embedded Systems, the Internet of Things (IoT), Cyber physical Systems, Cloud Computing and Big Data concepts. These have converged into complete new technology fields like the industrial internet and Smart Services. Both fields offer technology and data driven possibilities which could be exploited for the benefit of all stakeholders in legal metrology, e.g. to reduce development costs, overcome typical barriers to innovation, and speed up the time to market of new products. One such concept is the “digital twin”, an exact digital copy of a physical measuring instrument. This copy could, for instance, be checked automatically during conformity assessment. For this reason, activities aiming at the advancement of metrology services should support the realization of the digital single market envisioned by the European commission.

In Legal Metrology, the tendency of a transition from an instrument with locally concentrated parts towards a distributed hardware and virtualized software parts is easily recognizable. This approach is pushed by the manufacturers associations in Europe who ever more frequently ask for legally acceptable solutions for such technologies, where they see an economic advantage.

Such virtual measuring instruments will provide data storage in a cloud infrastructure, combine those data with other data sources, offer measuring and processing software in the cloud as “Software as a Service” (SaaS) and provide access to the instrument or its parts via communication networks. On this basis, new technological and data-driven services are possible.

In the context of Legal Metrology, the question arises how confidence in the correctness of measurements, the protection of the customers, and the users could be ensured for such approaches at an adequate level.

To this end Manufacturers and Notified Bodies (NB) require technical solutions that meet the legal requirements. At the same time, Market Surveillance authorities require verification procedures which provide an easy check of conformity for complex technologies.

Urgent needs to be tackled to improve metrological services in Europe

Manufacturers often consider regulations as an "inhibitor to innovation" due to the following reasons: Regulations are considered to increase the time to market. The costs for the requested IT security are not considered to be adequate. A technology gap between manufacturers, the Notified Bodies and/or the Market Surveillance Authorities is stated, i.e. the authorities are not acting on “eye level” with the manufacturers (or vice versa). It is felt that the authorities refuse innovative solutions and “bend” them to squeeze them into known concepts. It is also claimed that Notified Bodies require too much security or, the other way around, do not require a sufficient security level. Additionally, the manufacturers complain that there is no real harmonized in Europe, i.e. they feel that there is no coherency in conformity assessment and verification of measurement instruments in the field and that unified quality standard exists in the European single market.

The urgent needs of the manufacturers and the technological possibilities form the guiding aims which the European project described in the following hopes to address whilst guaranteeing transparency appropriate for conformity assessment and market surveillance in an increasingly globalising economy.

Our proposal for a European virtual quality infrastructure is based on the possibilities, which the measurement instrument of the future will offer, and aims at the improvement of the coordination of legal metrology services, driven by technology and data, in Europe.

The project therefore addresses the main inhibitors to innovations.

Overview of the scientific and technical objectives of the envisioned project:**Main Objectives****1. Speed up the administrative process of conformity assessment and market surveillance:****Establishing a European metrology infrastructure**

The “Metrology Cloud” is to connect existing infrastructures and serve to implement digital concepts for the coordination, concentration, simplification, harmonization and quality assurance of metrological services in Europe for all parties involved. Existing barriers to trade can thus be technically eliminated.

Envisaged result: Requirements, first steps and experiences to setup a European digital data infrastructure for Legal Metrology.

- Identify potentials within the process of conformity assessment, market and user surveillance.
- Identify and incorporate existing infrastructures and data bases already in use by the authorities (institutionally, nationally and on European level).
- Identify and specify virtual areas for unrestricted and confidential communication.
- Define communication interfaces for an unhampered flow of information.
- Define the requirements for a trustworthy virtual core to support the confidential exchange of data between trustworthy partners and to guaranty a certain quality level.
- Feasibility study with focus on a restricted number of collaborators.

- Standardization and maintenance for a digital data infrastructure for Legal Metrology
- Identification of potentials to be exploited by new digital concepts to incorporate coordination, simplification, harmonization and quality assurance measures for metrological services and administrative processes.
- Develop an IT based concepts to exploit these potentials and therewith optimise metrological services (technical and strategic means).

2. Support innovative products:**Reference Architectures for measuring instruments beyond “smart meter”**

Vital to the success of the digital transformation in Legal Metrology is the use of contemporary digital technologies. These technologies have matured significantly over the past ten years - namely Embedded Systems, the Internet of Things (IoT), Cyber physical Systems, Cloud Computing and Big Data concepts.

For these technologies so called trustworthy and secure *Reference Architectures* will be made available.

These reference architectures provide acceptable technical solutions, which demand „adequate“ IT security, offer simple verification methods for the Market Surveillance Authorities, and guaranty not to put unreasonable demands on the user.

- Trustworthy and secure reference architectures and procedures for the most pressing new technologies (IoT, Cloud Computing, intelligent meter which are the fundament for Big Data)
- Adequate risk analysis and assessment for these architectures to achieve “adequate” IT-security based on current threats.
- Development of simple and trustworthy verification methods for the Market and User Surveillance.
- No unreasonable demands on the user/customer
- A generalized test bed for new instruments which are embedded in IT ecosystems.
- Feasibility study of the “digital twin” concept in legal metrology within the aforementioned test bed.

3. Develop new technology and data-driven metrological services

The possibilities of the new technologies and of the aggregated data within the digital data infrastructure for Legal Metrology may offer new opportunities for all stakeholders such as Market Surveillance Authorities, manufacturers, and Notified Bodies. Technical and data driven services could be derived not available nowadays. Especially the administrative data collected over the whole life cycle of the instrument could serve as a valuable data base to improve established services and to offer new metrological services. In addition, a new trend may take hold, where manufacturers no longer offer measuring instruments to customers, but rather measurement services. This development may already be seen in other areas like mobility (car2go, Drive Now) and computing (Amazon EC2 and others).

Exploiting technological possibilities for new technological services

- Strategies and procedures for **autonomous or remote diagnostics**, e.g. autonomous or remote conformity assessment, re/calibration, re/certification (e-Compliance [9]).
- Strategies and procedures to establish **remote and predictive maintenance**.
- Strategies and procedures to establish dynamic, **evidence based re-verification intervals**.
- New concepts to flexible **update software** on measuring instruments.
- Concepts for Metrology-as-a-Service (**MaaS**)

With a digital data infrastructure for manufacturers and users of measuring instruments alike may use the data to optimize the production and usage of instruments

Exploiting the metrological data lake for data driven services

Today, measuring instrument sensors are often fully developed within the scope of the required measurement accuracy. New business models therefore address individual customer requirements which are determined on the basis of user data. Consequently, the offer of data-based services – for example, on the basis of big data (smart data, smart

services) – will increase. In the case of the billions of measuring instruments which are used on the EU single market –160 billions in Germany alone – data volumes are created during their complete life cycle in the course of the approval and market surveillance processes. These data volumes suggest the use of big data solutions in order to derive from them smart services to simplify the processes and the work of all parties involved.

- Identify the separate data sources within the administrative shell of the measuring instrument and specify their availability.
- Identify the potentials for the use of the measuring data and their combination with secondary and administrative data within and outside of the focus of legal metrology and specify their availability.
- Develop strategies for data mining and machine learning for the benefit of all partners in legal metrology.
- Concepts for the transition from a reactive towards a dynamic, real-time threat analysis as a basis for adequate responses to threats in time.
- Exploit synergy effects resulting from the reusability of approved virtualized components of a measuring instrument
- Develop concepts for shared services resulting from the availability of virtual measuring instruments wherever they are needed
- Ensure Data privacy by integrating into the data protection impact assessments (DPIAs). DPIAs need to be carried out when organizations are thinking about engaging in certain personal data processing activities.

4. Establish a European Centre of excellence for Metrological Information Technology

- Concentrate experts in Metrological Information Technology from different NMIs and Market Surveillance organisations to tackle relevant technological and legal questions regarding new technologies.
- Build up structures for counselling of NMIs, Market Surveillance, and manufacturers' associations.
- Coordination of metrological services in Europe, e.g. by subcontracting.
- Provide forensic support by analysing complex incidences in the market.
- Provide support for the evaluation of contemporary risks.
- Provide a unified quality level across Europe.

Envisioned Time-scale: 10 years and beyond.

How to get started: For the interval of the first three years, we would like to apply for a funding by EMPIR within the industry call 2017 to give the concept an adequate momentum. For this EMPIR project we like to motivate all partners within the stakeholders of Legal Metrology.

Potential Project Partners:

- national metrology institutes
- market surveillance bodies
- manufacturers' associations
- single manufacturers
- Administrative Cooperation Groups (AdCos)
- Consumer organisations
- ...

References

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