European Partnership on Metrology
Call 2022 – Digital Transformation, Health, Integrated European Metrology, Normative and Research Potential

Selected Research Topic number: **SRT-n14**
Version: 1.0

Title: Towards standards for the exchange of metrology product data (model-based) in the high-tech supply chain

Abstract

There is a need deriving from the semiconductor industry, requesting standardisation of data exchange in the supply chain following the model-based design (MBD) workflow. Nowadays, manufacturers downstream receive product information digitally, containing designs, specifications, tolerances, and test conditions in an MBD format [Computer-Aided-Design (CAD) with Product Manufacturing Information (PMI)]. However, the upstream direction is lacking in standardisation making CMM data, test results, and quality reports of manufactured parts to use formats that depend on the equipment. Further digitalisation of the high-tech supply chain is needed to enable automated processing of metrology data in model-based enterprises, increasing the trust between supplier and integrator.

Keywords

Metrology data, Standardization, Digitalisation, Supply Chain integration, Industry 4.0, 3D Model-based manufacturing

Background to the Metrological Challenges

Standardisation of metrology data can be found in many communication interfaces, protocols, and data formats within the vertical integration in the manufacturing process. The current protocols, recently released, are focussing mainly on dimensional measuring systems, such as coordinate measuring machines (CMM). Focussing on the exchange of product design information within the supply chain, the so-called model-based definition (MBD) workflow is being realised. The key aspect is the digital product definition as a single source of truth for product and process data, consisting of 3D models, and product manufacturing information (PMI), sometimes called a digital twin. Currently, the STEP format is generally accepted as the standard for 3D model-based definitions of machined, laser-cut, 3D/AM and moulded parts.

There is a need for an open protocol for the exchange of metrology product data within the supply chain. Different suppliers use different metrology equipment, but high-tech integrators need to process the metrology data in a generic standardised format for full automation. It is expected that digital twin (DT) standards such as the AAS (Asset Administration Shell) for manufacturing data spaces will gain acceptance and will be used in communications in the supply chain. Therefore, measurement data from metrology equipment on machined, laser-cut, and 3D/AM parts need to be standardised following the model-based engineering for further exchange automation. The need for rapid development of an open standard for digital formats to exchange data (objective 1) is recognized by the ISO/TP 10 (Technical Product Documentation) to avoid market “standards” and to support interoperability regardless of the media involved. The need to express the measurement results including the measurement uncertainty accordingly to the GUM (objective 2) is recognised by the ISO/TC 213 (Dimensional and geometrical product specifications and verification) as of being utmost importance for the product specification and then only it is possible to perform the correct quality verification of products.

Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the protocol.

The JRP shall focus on developing a framework for exchanging metrology data of products between enterprises within the high-tech supply chain to support standardisation in ISO/TC 184/SC 4 “Industrial Data” and related technical committees.

The specific objectives are

1. To conduct pre-normative research by studying current relevant standards, such as STEP (STEP AP242 ISO 10303), DMIS (ISO 22093:2011), QIF (ISO 23592:2020), AAS (IEC 63278-1), to identify the missing definitions and methods for the exchange of metrology product data within the supply chain. In addition, to investigate other relevant formats of metrology data, besides standards for big data analysis tools, and to investigate other closed-loop feedback methods in manufacturing.
2. To provide metrology input for and draft the requirements for a standardised metrology data exchange format, such that all information about measurement equipment, traceability, methods, values, uncertainties, measurement conditions, and calibration status is complete and can therefore be trusted by all partners in the supply chain.
3. To develop and validate methods for metrology data exchange between supplier and integrator following the principles of the MBD workflow: using a single source of truth (i.e., MBD CAD and PMI design reference) and being an interoperable standard. To provide at least 3 real-life tests of those methods, focussing on the application of dimensional measurements (CMM, 3D scanning and surface properties).
4. To contribute to Industry 4.0, working with digital twins of the physics world, such as MBD, STEP, AAS proposed standards and upcoming digital product passport standards, by providing at least 3 case studies of product metrology data exchange in the supply chain.
5. To contribute to the standards development work of the technical committees ISO/TC 184/SC 4 (Industrial Data), ISO/TC 10 (Technical Product Documentation) and ISO/TC 213 (Dimensional and geometrical product specifications and verification) to ensure that the outputs of the project are aligned with their needs, communicated quickly to those developing the standards and to end-users, and in a form that can be incorporated into the standards at the earliest opportunity.

The proposed research shall be justified by clear reference to the measurement needs within strategic documents published by the relevant Regulatory body or Standards Developing Organisation or by a letter signed by the convenor of the respective TC/WG. EURAMET encourages proposals that include representatives from industry, regulators and standardisation bodies actively participating in the projects. The proposal must name a “Chief Stakeholder”, not a member of the consortium, but a representative of the user community that will benefit from the proposed work. The “Chief Stakeholder” should write a letter of support explaining how their organisation will make use of the outcomes from the research, be consulted regularly by the consortium during the project to ensure that the planned outcomes are still relevant, and be prepared to report to EURAMET on the benefits they have gained from the project.

Proposers should establish the current state of the art and explain how their proposed research goes beyond this.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 0.8 M€ and has defined an upper limit of 1.2 M€ for this project.

EURAMET also expects the EU Contribution to the external funded beneficiaries to not exceed 30 % of the total EU Contribution across all selected projects in this TP.

Any industrial beneficiaries that will receive significant benefit from the results of the proposed project are expected to be beneficiaries without receiving funding or associated partners.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the ‘end user’ community, describing how the project partners will engage with relevant communities during the project to facilitate knowledge transfer and accelerate the uptake of project outputs. Evidence of support from the ‘end user’ community (e.g. letters of support) is also encouraged.

You should detail how your JRP results are going to:

- Address the SRT objectives and deliver solutions to the documented needs,
- Feed into the development of urgent documentary standards through appropriate standards bodies,
- Transfer knowledge to the manufacturing sector.

You should detail other impacts of your proposed JRP as specified in the document “Guide 4: Writing Joint Research Projects (JRPs)”

You should also detail how your approach to realising the objectives will further the aim of the Partnership to develop a coherent approach at the European level in the field of metrology and include the best available contributions from across the metrology community. Specifically, the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of EURAMET Member States whose metrology programmes are at an early stage of development to be increased
- organisations other than NMIs and DIs to be involved in the work.

Time-scale

The project should be of up to 3 years duration.