Prenormative Research into Standard Messaging Formats for Engineering Materials Data

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IDCC13, 14-16 January 2013, Amsterdam
Joint Research Centre
The European Commission’s in-house science service

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Máire Geoghegan-Quinn

SG, RELEX, ENTR, MOVE, ENER, RTD, CLIMA

IRMM, IES, IPSC, IPTS, IET, IHCP, ITU

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The Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle:

• Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new methods, tools and standards, and sharing its know-how with the Member States, the scientific community and international partners.

• Key policy areas include: environment and climate change; energy and transport; agriculture and food security; health and consumer protection; information society and digital agenda; safety and security, including nuclear; all supported through a cross-cutting and multidisciplinary approach.
Seven institutes in five countries:

- Germany
  - ITU
- The Netherlands
  - IET
- Belgium
  - IRMM
- Italy
  - IPSC, IES, IHCP (IET, ITU)T
- Spain
  - IPTS
European policy provides the mandate for all activities at the JRC, including data management:

- **COM(2011) 882**—Open data, an engine for innovation, growth and transparent governance
  - The legislative framework—revised Commission Decision on the re-use of Commission information
  - European open data portal—a portal at [http://open-data.europa.eu](http://open-data.europa.eu) giving access to Commission data and data from other EU institutions and agencies
  - Expansion of the open access pilot for scientific publications to the whole of Horizon 2020 + pilot with open access to research data
Context for Data Management


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The engineering materials community invests considerable effort in generating and managing data:

- **Characteristics of engineering materials data**
  - Rich data model and low volume
  - High inherent value
  - Well defined and extensive collection of Standard testing procedures that encapsulate best practice and know-how

- **Characteristics of engineering materials data management**
  - Initiatives beginning in 1980s and extending over a 20-year period have failed to find widespread adoption, including ISO 10303, ASTM E49, and NIST MatML
  - Generally recognized that engineering materials lags approximately 20 years behind other disciplines
  - Recent initiatives, such as the EPSRC policy framework (UK) and the Materials Genome Initiative (US), are motivating the engineering materials community to participate in the data management renaissance
It is a matter of concern that simply preserving and transferring data is still an issue for the engineering materials community:

- From supply to delivery, the impact of a lack of any widely accepted means to store and transfer data is universal:
  - Ineffective data preservation practices
  - Inefficient data transfer and a fragmented electronic supply chain
  - Severely restricted opportunities for reuse for simulation, validation, and reporting
- The materials community has grown to accept this circumstance, seemingly ambivalent to the benefits of preserving, exchanging, and reusing the data generated by businesses, research centres, and universities across the globe.
Integrating heterogeneous systems is difficult when they rely on local data formats:
ICT Standards for engineering materials data provide a *lingua franca* that facilitate systems interoperability:
CEN Workshops provide a platform that is very well suited to undertaking the development of ICT Standards:

- CEN Workshops enable effective stakeholder engagement, offer reduced procedural burden compared to conventional standards activities, and provide a path to normalization.

- Prenormative research to investigate the viability of ICT Standards for engineering materials data undertaken from technical, business, and standardization perspectives:
  - Technical—development and use of schemas and ontologies.
  - Business analysis—assess the business case.
  - Standardization—assess the ownership options.

- To date, two CEN Workshops:
  - ELSSI-EMD—on the viability of Standards-compliant data formats.
  - SERES—on a transition to electronic reporting.
The ELSSI-EMD CEN Workshop examined the viability of deriving ICT Standards from a documentary Standard for materials testing:

- **Technical**—schemas and ontology derived from a single, widely used materials testing Standard
  - ISO 6892 Part 1 — ambient temperature tensile test.
  - ISO 6892 Part 1 already supports a rudimentary data format for software validation.
- **Business case**—a business study of the potential for a transition to electronic reporting
  - Interview with Workshop participants.
- **Standardization**—examine the practicalities of publication and ownership
  - Assigning HTTP URIs.
  - Dialog with TC 164/SC 1.
The recently completed ELSSI-EMD CEN Workshop has demonstrated the technical viability of deriving data formats materials testing Standards:

- Conventional documentary testing Standards can act as software specifications
  - The rules and relationships defined by a documentary testing Standard provide the basis for a data model.
  - A documentary testing Standard defines common terms and definitions.
- Working within the scope of a documentary Standard is particularly effective in engaging the end-user community
  - Dialog is maintained with industrial partners on TCs and SCs and with stakeholders in the engineering sector.
  - The data formats come immediately within the scope of the normalization process.
An interested but cautious response from the standardization and business sectors:

- CEN is evaluating a DOI-based approach to assigning HTTP URIs e.g. http://dx.doi.org/10.5555/demo_1.1
- Conventional Standards bodies exhibit a characteristically cautious response to the adoption new technologies
  - ISO TC 164/SC 1 has approved revisions to ISO 6892 Part 1 Informative Annex on computer controlled testing
  - A lack of the required competency to maintain and develop ICT Standards prevented a handover of ownership to ISO TC 164
- Varying degrees of enthusiasm across different subcommittees
- Most Workshop participants in favour of ICT Standards for engineering materials but with some reservations
  - Potential to disrupt established business models
  - Concerns raised over the scalability of the approach
Although Standards-compliant data formats have been demonstrated to be technically viable, their long-term viability remains an issue.

- The limited success of prior efforts to develop Standard data formats provides a clear indication that technical viability is no guarantee of widespread adoption and that overlooking maintenance responsibilities and commercial viability is a recipe for failure.
- Commercial organizations with sufficient financial resources to develop organization-level solutions may be reluctant to adopt new (disruptive) technologies.
- The long-term maintenance of Standards-compliant data formats adds to the workload of already over-burdened Technical Committees.
As well as demonstrating the technical viability of Standard data formats, CEN/WS ELSSI-EMD identified further needs for representing and reporting engineering materials test data:

- **Key recommendations of the ELSSI-EMD CWA¹**
  - Develop a unified, Standards-based architecture for representing engineering materials data.
  - eReporting proof-of-concept to demonstrate the viability of a transition to electronic reporting.

- **SERES is a new CEN Workshop that acts on the recommendations of the ELSSI-EMD CWA**
  - SERES is a CEN Workshop on Standards for Electronic Reporting in the Engineering Sector
  - SERES aims to develop and demonstrate ICT Standards for representing and reporting engineering materials test data

The information architecture required for electronic reporting will depend on developing unified ICT Standards for representing engineering materials data:

- Unify different models for representing engineering materials data into a prenormative ICT Standard
  - E 49
  - ISO 10303 AP 235
  - MatML, JRC:MatDB, NMC:MatDB
- Analyse and model the information architecture
  - Define a conceptual model
  - Define a vocabulary consistent with the conceptual model
  - Derive a UML from the conceptual model
- Deliver XML, RDF, and P21/8 reference implementations, the validation and use of which will be demonstrated in the PoC
The proof-of-concept aims to demonstrate the viability of a transition to eReporting using the prenormative ICT Standards for representing and reporting in combination with eBusiness Standards and best practices.
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- Prenormative ICT Standards for engineering materials test data

CWA 16200:2010
Existing and new technologies are needed for the PoC:
- Existing reporting Standards
- Prenormative ICT Standards for engineering materials test data
- Emerging Standards for eSigning and eInvoicing
The proof-of-concept aims at an intervention in the business process that involves replacing conventional reporting with electronic reporting in the materials supply chain, from the supplier all the way through to the OEM.
The PoC is reliant on prenormative ICT Standards for representing engineering materials data:

- The existing CEN/WS ELSSI-EMD ICT Standards for test data.
- The new CEN/WS SERES formats for representing materials data.
Alongside the unified information architecture, ICT Standards for reporting engineering materials data will be developed:

- Derive ICT Standards from conventional reporting Standards.
- Use eInvoicing and digital signing technologies and best practices.
Recognizing and addressing the concerns of industry and Standardization bodies is fundamental to the adoption and long-term viability of ICT Standards:

- In-house solutions and best practices developed by industrial organizations should be taken into consideration when formulating ICT Standards.
- Engage Standards bodies with a history of developing documentary Standards in the ICT Standardization process.
  - Ownership—liaise with existing technical committees with an interest in engineering materials data, such as ISO TC 164 and ECISS/TC100 through TC111.
  - Maintenance—investigate the options for delegating the maintenance and development of ICT Standards.
  - Publication—liaise with ISO, CEN and OASIS on the issue of assigning HTTP URIs to the reference implementations derived from the unified information architecture.