Towards materials data sharing across value chain: an interoperable, trust and sovereign approach

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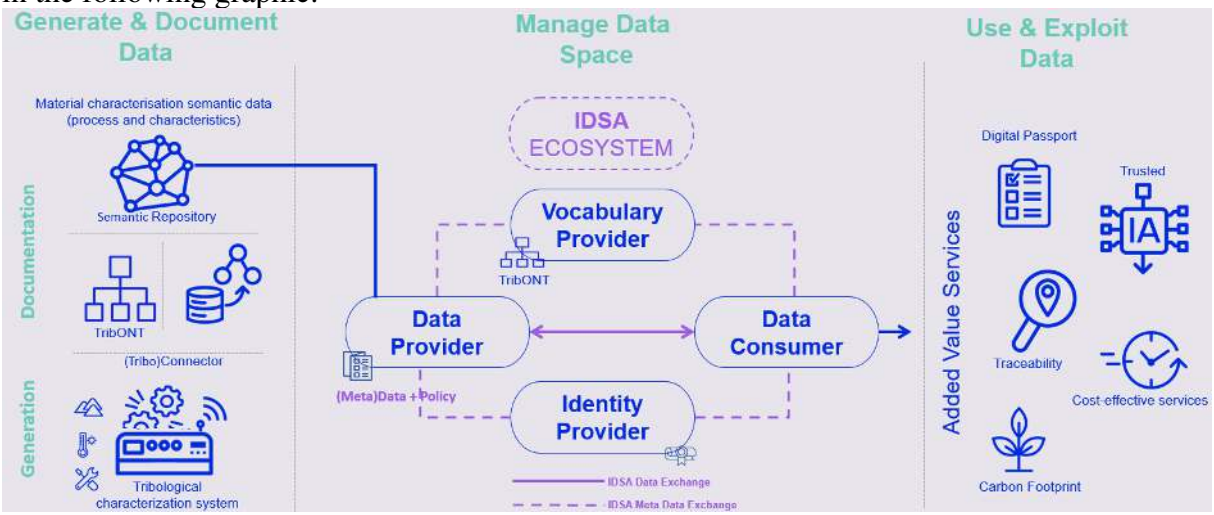
Abstract

Advances on technologies regarding acquisition, communication, storage and processing of data and information is leading to unprecedent impact regarding the potential to transform the way knowledge is produced, and the new business models that can generate. In the Materials domain, AMI2030 initiative, in the roadmap [1], envisions four main work areas to, among others, foster data life-cycle of advanced materials for establishing and strengthening safe and sustainable, resilient, and circular advanced materials value chains to support the Green Deal: (1) Generate new data with harmonized and digitalized techniques; (2) Document data for FAIRness and in support of materials standards; (3) Common materials data space with trusted management, data access and exchange and distributed data repositories; (4) Use and exploit data supported by semantic and AI strategies.

Tekniker is working in a holistic approach that contributes to these four topics as summarized in the following graphic.



For data generation and documentation area, in order to promote digitalized **semantically interoperable data,** Tekniker approach is supported in the following main components, focused on this work to tribology domain:

- **Connector:** IT component, based on interfaces (automatic/manual), aims to collect relevant information of the characterization process and results, and store in a (local) data repository.
- **Domain Ontology:** common representation of tribological experiments, enriching existing data with additional background knowledge to easy data retrieval and navigation through related resources, aligning to existing TLOs and reusing other MLO/DLO. TribONT follows a modular approach covering the key aspects involved in the tribological experiments (i.e., Test, Equipment, Sample and Material). All the modules are aligned with relevant existing ontologies (e.g., TribAIn, EMMO etc.) to increase interoperability, ensure clarity in modelling and avoid

errors that may have unintended reasoning implications.
- **Semantic Repository:** aimed to store and make available semantically annotated data, created by direct ontology instantiation and/or mapping other data repositories schemas & the ontology.

The semantically documented data, by itself enables many new advanced data exploitation functionalities, leading to for example, reduce the number, size, and time required for tribological experiments to characterize (new) materials behaviours.
But combining data from different companies presents even greater benefits. Data spaces establish a reference architecture model to encourage companies to collaborate and benefit from data sharing by ensuring interoperability, trust, and data sovereignty [2]. Based on a shared language for data description, reference models are established to publish data catalogues on the data space. Trust is established by managing certifications made on the capabilities of the participants. Data sovereignty is addressed through usage control. It enables the definition and enforcement of highly expressive restrictions regulating the usage of the data following different policy languages. Tekniker is working in an interoperable, **trusted, and sovereign data sharing** approach along the materials value chain, taking as basis the following components from the IDSA RAM [3]:

- **Vocabulary Provider:** Manages and provides a certified Ontology (i.e. TribOnt) that describes the resources that can be respectively shared and consumed by Data Providers and Data Consumers through the data space.
- **Identity Provider:** Creates, maintains, manages, monitors, and validates the capabilities of the participants and technical components in the data space.
- **Data Provider-Consumer (Connector):** Responsible for correct data sharing through the data space. Interoperability is ensured through the IDSA Information Model (IM) and the Vocabulary Provider. Trust is provided through the Identity Provider. Data sovereignty is granted through a distributed usage control solution.
- **Data User:** taking as basis the data provided by the Data Provider(s) through the Data Consumer(s), generates **new added value services**.

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