Enterprise Interoperability for International Data Spaces (EI4IDS)

Marten van Sinderen[1], Patrício de Alencar Silva[1,2] and João L.R. Moreira[1]

[1] University of Twente, Drienerlolaan 5, Enschede, 7522 NB, The Netherlands.
[2] Graduate Program in Computer Science UERN/UFERSA, Rio Grande do Norte State University (UERN), Federal University of the Semi-Arid Region (UFERSA), Mossoró, RN – Brazil.

1. Theme introduction

There is general agreement that digital data sharing between companies in a collaboration relationship would contribute to the efficiency and effectiveness of such collaborations. However, two significant barriers slow down the uptake of digital data sharing, viz. lack of (1) cost-effective interoperability solutions and (2) mutual trust regarding the usage of shared data. The first barrier comprises the interoperability mismatches that exist at several levels between companies and the financial risk that comes with implementing any of the available solutions as part of their long-term business strategy. The second barrier relates to sharing companies' sensitive and valuable data and the risk of data usage beyond what was intended by the data owners. The International Data Spaces (IDS) approach aims to overcome these barriers by providing guidelines and standards for data sharing and data sovereignty through federated data spaces. However, the adoption and implementation of IDS are not straightforward for small and medium enterprises (SMEs): they have to invest in an IDS-based digital transformation, but are not fully aware of the various options with associated costs and benefits.

2. Summary of contributions and discussion

The workshop comprehended the following presentations:

- *Aligning the Dutch Logistics Data Spaces Infrastructure to the International Data Spaces: A state-of-the-art discussion paper*
- *Harmonization profile assessment for controlled and trusted data sharing between autonomous data sharing domains*
- *Semantic discovery and selection of data connectors in International Data Spaces*
- *Towards a Digital Twin for simulation of organizational and Semantic Interoperability in IDS Ecosystems*

The keynote presentation by Silvia Castellvi provided an overview of the Reference Architecture Model proposed by the International Data Spaces Association (IDSA). The model consists of organizational and technical guidelines for building data ecosystems through five logical layers: business, functional, process, information, and system. Besides essential updates on the IDSA Rule Book, Information Model, and Reference Architecture Model, the keynote pointed to future developments from IDSA that might soon benefit actors interested in embracing the IDS vision: (1) IDSA recommendations will become a family of ISO standards; (2) digital twins will help to explore and to predict interoperability pitfalls in IDS; and (3) first business cases of data connectors for real-time IoT system applications will soon become available.

The second presentation provided a monitoring report on the alignment of the Dutch Logistics Data Spaces with the upper-level vision of the International Data Spaces. The presenter highlighted that the challenges encountered spread through all the Enterprise Interoperability layers, i.e., technical, semantic, organizational, and legal. Some of the main challenges include that: (1) the adoption of the IDS vision by SMEs will require more facilitation or even a more explicit motivation; (2) the identification of the actual needs of these companies must precede the actual promotion of potential benefits of the IDS vision; and (3) proof-of-concept implementations and business cases will help SMEs looking for more tangible business value from investing in the IDS vision.

The third presentation reported on current developments to provide an infrastructure for trusted data exchange between different IDS ecosystems. Data spaces interoperability, in this case, is grounded on harmonization profiles, i.e., an infrastructure of proxies operating according to the exact data-sharing requirements and principles. Two aspects are critical to implementing such an infrastructure: policy management and a trusted ecosystem. Implementing the policy management infrastructure demands access tokes (based on OAuth 2.0) and contract negotiation (based on IDS Communication Protocol – IDSCP). The technical assessment of trust in inter-space interoperability is somewhat more complex, as it requires analysis of chains of responsibilities between the business roles of both ecosystems involved. The "trust-by-security" approach taken by the project aims to furnish IDS newcomers with building trust by competence and not by good past performance.

The fourth presentation provided the proposal of an ontology to describe data connectors for IDS ecosystems. The ontology is part of implementing a connector store, which will support a data broker in helping data owners and data users meet in IDS ecosystems to share sensitive data. The presenter provided a preliminary version of the ontology described in the OntoUML language and an Ontology Requirements Specification Document (ORSD) describing the most relevant requirements to build the ontology. The ontology will support semi-automatic discovery and selection of data connectors according to the needs of the data users yet complying with data policies expressing data sovereignty restrictions of data usage. Further developments of this work include the translation of the OntoUML into an OWL serialization and translating the competency questions declared in the ORSD into SPARQL queries for ontology verification of consistency, completeness, and correctness.

The last presentation introduced the idea of exploring semantic and organizational interoperability problems in IDS ecosystems using digital twin technology. The presenter highlighted that the notion of data sovereignty is relational and discussed what the term means for the underlying research project. Further, the presenter described a preliminary architecture of the digital twin, which combines elements from the ISO/DIS 23247 standard with more concrete software components identified by companion research. The discussion also included a set of critical requirements for building the digital twin and selecting a tool for implementation and analysis.

Except for the keynote, all the presentations have corresponding research papers submitted to the workshop for peer-review and inclusion in the final proceedings.