Semantic Interoperability Courses

Course Module 1
Introduction and overview of existing initiatives

ISA

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Learning objectives

By the end of this training you should have an understanding of:

→ Interoperability and semantic interoperability and how they relate.

→ The basics on semantic interoperability

→ The basics to achieve semantic interoperability.

→ Existing semantic interoperability initiatives.

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Outline

1. Definitions

- Introductory definitions
  - Interoperability
  - Semantic interoperability
  - How to achieve semantic interoperability?

2. Semantic interoperability conflicts

- What conflicts can arise without managing interoperability?
  - Data-level conflicts
  - Schema-level conflicts

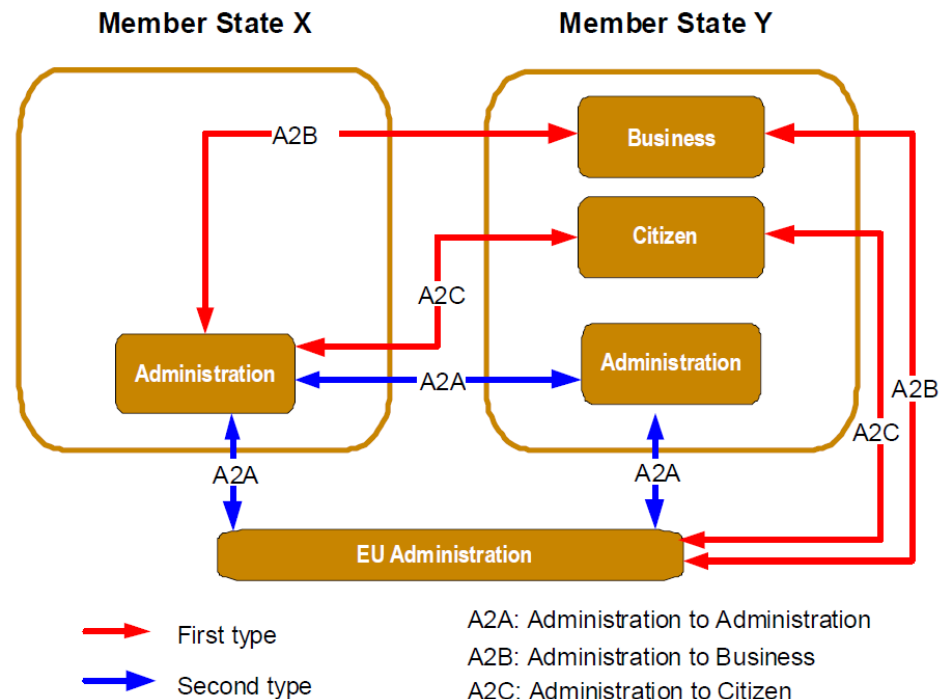## 3. Examples of existing initiatives

- ISA Programme Action 1.1
- INSPIRE Data Models
- EU Large-scale pilots
- UN/CEFACT
- US National Information Exchange Model

What is interoperability?

Interoperability, within the context of European public service delivery, is the ability of disparate and diverse organisations to interact towards mutually beneficial and agreed common goals, involving the sharing of information and knowledge between the organisations, through the business processes they support, by means of the exchange of data between their respective ICT systems.

Source: EIF, http://ec.europa.eu/isa/documents/isa_annex_ii_eif_en.pdf

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The ABC of interoperability

- **A**dministrations, **B**usiness and **C**itizens must interact efficiently and effectively.

- They therefore need interoperable electronic information exchange.

- Interoperability addresses the need for:

  o Cooperation among public administrations with the aim to establish public services;

  o Exchanging information among public administrations to fulfil legal requirements or political commitments;

  o Sharing and reusing information among public administrations to increase administrative efficiency and cut red tape for citizens and businesses.

Source: EIF, http://ec.europa.eu/isa/documents/isa_annex_ii_eif_en.pdf

Member State X   Member State Y

A2B

A2C

A2A

Business

Citizen

Administration

Administration

EU Administration

A2A   A2A

A2B   A2C

First type
Second type

A2A: Administration to Administration
A2B: Administration to Business
A2C: Administration to Citizen

Levels of interoperability

Legal	• Aligned legislation and legal meaning
Organisational	• Coordinated processes
Semantic	• Preservation of precise meaning of information
Technical	• Technical linking of systems

Source: EIF, **http://ec.europa.eu/isa/documents/isa_annex_ii_eif_en.pdf**

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Definition: semantic interoperability
Preservation of meaning

- Semantic interoperability enables organisations to **process information from external sources** in a meaningful manner.

- It ensures that the **precise meaning** of exchanged information is **understood and preserved** throughout exchanges between parties.

- Benefits of semantic interoperability are:
  - Reduction of errors
  - Management of costs
  - Monitoring and responding to trends & problems
  - Expanding knowledge

Source: EIF, http://ec.europa.eu/isa/documents/isa_annex_ii_eif_en.pdf

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Definition: structural metadata

Indication of meaning and structure

Metadata is **data** that defines and describes other data (ISO/IEC 11179-1).

Structural metadata: data that gives *meaning* to data and indicates how it is *structured*:

- A **data model** is a collection of entities, their properties and the relationships among them, which aims at formally representing a domain, a concept or a real-world thing.
- **Reference data** is a small, discrete set of values that are not updated as part of business transactions but are usually used to impose consistent classification. Reference data normally has a low update frequency.

See also: **NISO, Understanding Metadata, 2004**
http://www.niso.org/publications/press/UnderstandingMetadata.pdf

How to achieve?

Forge a semantic interoperability agreement on structural metadata

Semantic interoperability agreement:

- A social approach to agree on common specifications for naming things.

- An agreement on structural metadata (models and reference data) used in information exchanges.

- It ensures that data elements are understood in the same way by communicating parties.

Read more: Process and methodology for developing semantic agreements, June 2013.

How to achieve?

Governance and management of structural metadata

Inter-organisational coordination requires:

- **Metadata governance**: decision mechanism
- **Metadata management**: process to manage the lifecycle of structural metadata
- **Metadata standards and tools**: common standards and tools to support the management process.
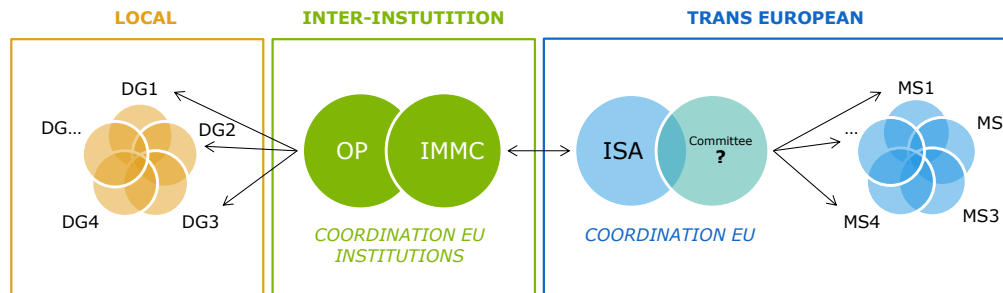
Read more: Specification for metadata management and governance for EU institutions and Member States, May 2014.

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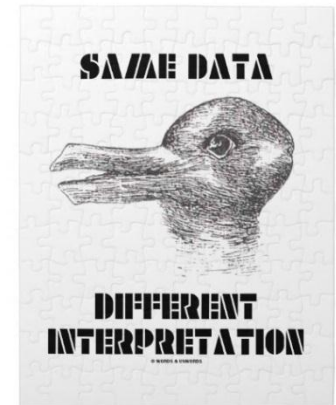- Data-level conflicts
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Without semantic interoperability

Interoperability conflicts arise

Semantic conflicts can occur at **two different levels**, at the **data level** and at the **schema level**. Conflicts on a data level occur due to **data differences** in different domains. Conflicts on **schema level** are semantic conflicts characterized by differences in **logical structures**

Data-level conflicts

- Different representation and interpretation of similar data

Schema-level conflicts

- Different logical structure or inconsistencies in metadata

SAME DATA

DIFFERENT INTERPRETATION

How do <u>you</u> interpret this data?

Schema isomorphism conflict i.e. Different attributes on ID cards in different states

More on semantic conflicts: Peristeras - JIS-2008-34-6-877 - **A conceptual analysis of semantic conflicts in pan-European e-government services**

Data-level conflicts

Data value	• "adult" = 17 or 18 years old?
Data representation	• Date formats: DMY, MDY, YMD?
Data units	• lbs or kg? • Miles or kilometres
Data precision	• School grade scales
Granularity	• "name" = full name or only surname?

More on semantic conflicts: Peristeras - JIS-2008-34-6-877 - **A conceptual analysis of semantic conflicts in pan-European e-government services**

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Schema-level conflicts

Naming	• Citizen information is verified against the wrong source*
Entity identifier	• Citizens identified by ID card number or national number or none?
Schema isomorphism	• Different attributes on ID cards in different states
Generalization	• Birth certificate of one state can contain all info of birth and family certificates of another state
Aggregation	• "full name" or "surname", "middle name", "first name"
Schematic discrepancies	• Detailed Information cannot be exchanged due to schematic differences (ex. different xml schemas)

** **Naming conflicts**: evidence placeholders with the same name but different purpose and usage may exist in different Member States, or evidence placeholders with different names may have similar usage and hold similar evidence items.*

More on semantic conflicts: Peristeras - JIS-2008-34-6-877 - **A conceptual analysis of semantic conflicts in pan-European e-government services**

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3. Examples of existing initiatives

- ISA Programme Action 1.1 – SEMIC
- INSPIRE Data Models
- Large-scale pilots
- UN/CEFACT
- US National Information Exchange Model (NIEM)

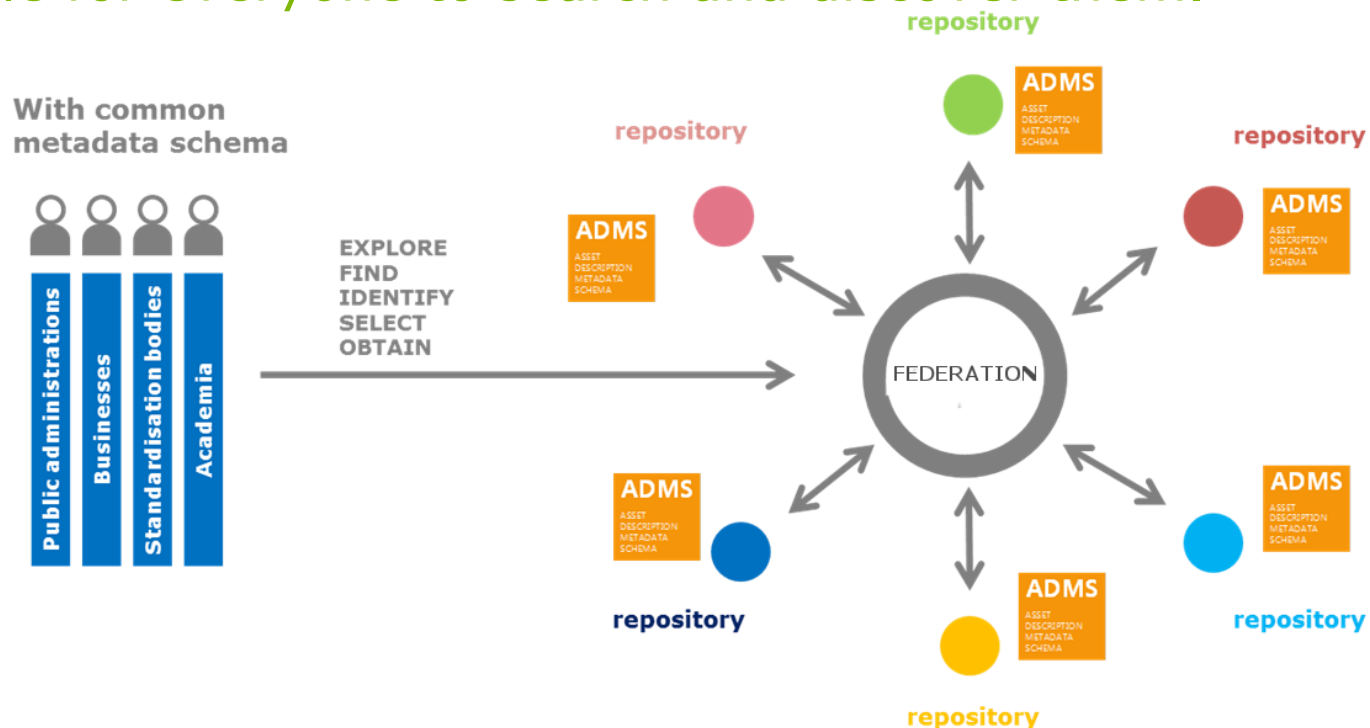# Examples of existing initiatives
ISA Programme – Action 1.1

- **ISA supports and facilitates** efficient and effective cross-border electronic collaboration between European public administrations. The programme enables the delivery of electronic public services and ensures the availability, interoperability, re-use and sharing of common solutions.

- **SEMIC** is a European Commission initiative funded under Action 1.1 of the ISA Programme to **improve the semantic interoperability** of interconnected e-Government systems. It focuses on the following activities:

  1. Make visible existing solutions: ADMS & catalogue of semantic standards.
  2. Develop, promote and use core vocabularies at the European, national and local level to reach a minimum level of semantic interoperability.
  3. Foster the interoperability of open data portals by building consensus on the DCAT Application profile for data portals in Europe (DCAT-AP).
  4. Raising awareness on semantic interoperability and metadata management

Sources: http://ec.europa.eu/isa/ http://semic.eu

Examples of existing initiatives

ISA Programme – Action 1.1
The Asset Description Metadata Schema (ADMS) is a common way to describe semantic interoperability assets making it possible for everyone to search and discover them.
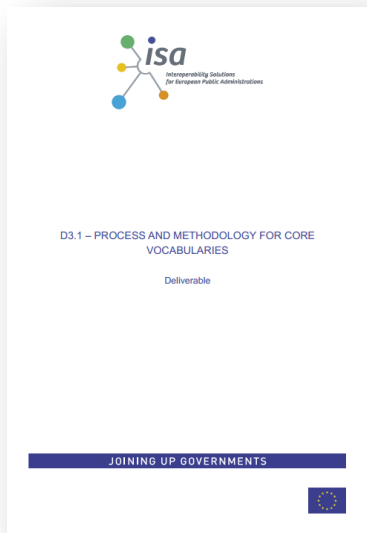

Source: https://joinup.ec.europa.eu/asset/adms/description

Examples of existing initiatives

ISA Programme – Action 1.1
Core Vocabularies: agreements on basic semantics

*Part of **action 1.1** highlights the importance to agree on a small set of simplified, reusable, context-free Core Vocabularies as a fundamental semantic basis for interoperable electronic public services.*

***Simplified**, **re-usable**, and **extensible** data models that capture the fundamental characteristics of a data entity in a context-neutral fashion.*

CORE PERSON VOCABULARY

REGISTERED ORGANIZATION VOCABULARY

CORE LOCATION VOCABULARY

CORE PUBLIC SERVICE VOCABULARY

More on Core Vocabularies: see Course Module 2

Source: http://semic.eu

Examples of existing initiatives

ISA Programme – Action 1.1
DCAT: application profile for European data portal

DCAT
APPLICATION PROFILE FOR EUROPEAN DATA PORTALS

The DCAT Application profile for data portals in Europe (DCAT-AP) is a specification based on the Data Catalogue vocabulary (DCAT) for describing public sector datasets in Europe. Its basic use case is to enable cross-data portal search for data sets and make public sector data better searchable across borders and sectors. This can be achieved by the exchange and federation of descriptions of data sets among data portals

Source: https://joinup.ec.europa.eu/asset/dcat_application_profile/description

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Examples of existing initiatives

ISA Programme – Action 1.1
Raising awareness on semantic interoperability and metadata management

To bring the issue of semantic interoperability to the attention of policy makers and ICT solution developers, a Semantic Interoperability Conference (SEMIC) is held annually.

Furthermore, Action 1.1 acts as an observatory and brings news and events about initiatives and issues related to semantic interoperability to the Joinup platform and to social media such as Twitter, and LinkedIn.

Semantic Interoperability Conference
SEMIC 2014
Highlights Report
Athens 9 April 2014

Source: http://semic.eu

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Examples of existing initiatives
INSPIRE Data Models

- The **INSPIRE directive** aims to create a European Union (EU) spatial data infrastructure. This will enable the **sharing of** environmental spatial information among public sector organisations and **better facilitate** public access to spatial information across Europe.

- A **European Spatial Data Infrastructure** will assist in policy-making across boundaries. Therefore the spatial information considered under the directive is extensive and includes **a great variety of topical and technical themes.**

Themes:
- Agricultural and Aquaculture Facilities
- Area Management / Restriction / Regulation Zones and Reporting Units
- Atmospheric Conditions and Meteorological Geographical Features
- Bio-geographical Regions
- Buildings
- Energy Resources
- Geology
- Habitats and Biotopes
- Land Cover
- Mineral Resources
- Natural Risk Zones
- Oceanographic geographical features
- Orthoimagery
- Population Distribution
- Sea Regions
- Species Distribution
- Statistical Units

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Examples of existing initiatives

Semantic interoperability solutions by EU large-scale pilots

The **"Large Scale Pilot"** projects (LSPs) develop practical solutions tested in real government service cases **across Europe**. The LSP Programme is active **in five main areas;** eID, eProcurement, eBusiness, eHealth and eJustice to engage public authorities, service providers and research centres across the EU.

Examples of large scale pilots are:

- e-CODEX: making justice faster
- epSOS: making healthcare better
- Stork: making access smarter
- SPOCS: making business easier
- PEPPOL: making procurement better
- e-SENS: move services forward

http://ec.europa.eu/digital-agenda/en/egovernment
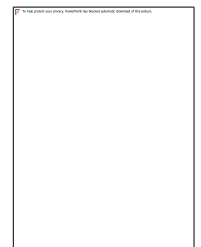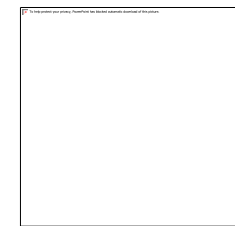
Examples of existing initiatives
UN/CEFACT Core Component Technical Specification (CCTS)

Within the United Nations framework of the Economic and Social Council, the United Nations Economic Commission for Europe (UNECE) serves as the focal point for trade facilitation recommendations and electronic business standards, covering both commercial and government business processes that can foster growth in international trade and related services. In this context, the United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) was established, as a subsidiary, intergovernmental body of the UNECE Committee on Trade, mandated to develop a programme of work of global relevance to achieve improved worldwide coordination and cooperation in these areas.
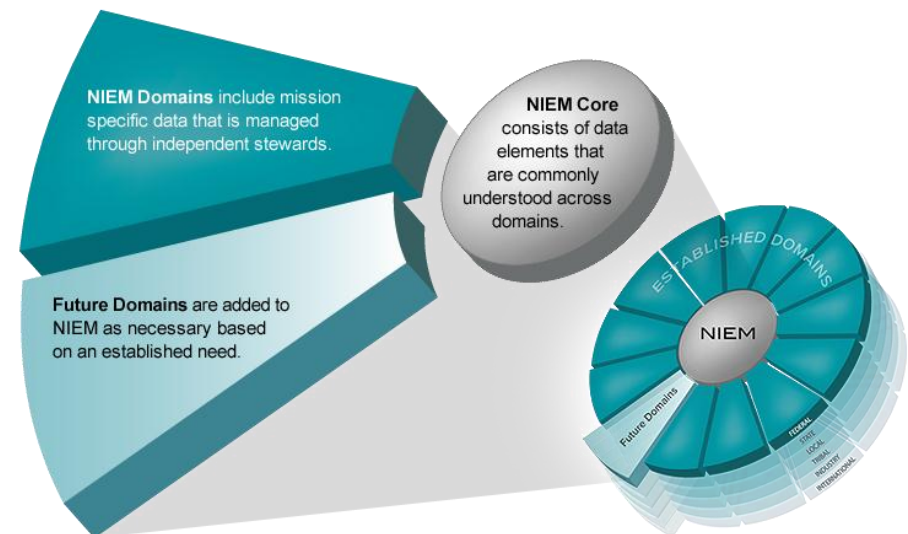
Methodology for:
- *creating new business vocabularies*
- *restructuring existing business vocabularies to achieve semantic interoperability of data.*

Source: http://www.unece.org/fileadmin/DAM/cefact/codesfortrade/CCTS/CCTS-Version3.pdf

Examples of existing initiatives
NIEM (US initiative)

- NIEM—the National Information Exchange Model—is a community-driven, government-wide, standards-based approach to exchanging information.

- NIEM is designed as a core set of building blocks that are used as a consistent baseline for creating exchange documents and transactions across government.

- NIEM is a framework consisting out of 2 key Components:
    o A data dictionary of 6,000 agreed-upon terms that are commonly used in an information exchange, and
    o A repeatable, reusable process for developing information exchange requirements

NIEM Domains include mission specific data that is managed through independent stewards.

NIEM Core consists of data elements that are commonly understood across domains.

Future Domains are added to NIEM as necessary based on an established need.

Source: https://www.niem.gov/Pages/default.aspx

References

European Interoperability Framework (EIF) for European public services.
http://ec.europa.eu/isa/documents/isa_annex_ii_eif_en.pdf

ISO/IEC 11179-1, Information Technology – Metadata Registries (MDR) – Part 1: Framework (2004)

NISO, Understanding Metadata, 2004.
http://www.niso.org/publications/press/UnderstandingMetadata.pdf

Peristeras, V., Loutas, N., Goudos, S. K., & Tarabanis, K. (2008). A conceptual analysis of semantic conflicts in pan-European e-government services. Journal of Information Science, 34(6), 877-891.

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Visit our initiatives

ADMS ASSET DESCRIPTION METADATA SCHEMA

DCAT APPLICATION PROFILE FOR EUROPEAN DATA PORTALS

ADMS.SW

REGISTERED ORGANIZATION VOCABULARY

eGOVERNMENT **CORE** VOCABULARIES

CORE PUBLIC SERVICE VOCABULARY

CORE LOCATION VOCABULARY

CORE PERSON VOCABULARY

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