



LEARNING, APPLYING, MULTIPLYING BIG DATA ANALYTICS

Horizon 2020 Grant Agreement No 809965
Contract start date: July 1st 2018, Duration: 36 months

LAMBDA Lecture
Using Semantic Web technologies in the
public sector

Due date of deliverable: 30/06/2021
Actual submission date: 30/06/2021

Revision: Version 1.0



This project has received funding from the European Union's Horizon 2020 Research and Innovation programme, H2020-WIDESPREAD-2016-2017 Spreading Excellence and Widening Participation under grant agreement No 809965.



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Executive Summary

The process of providing cross-border public services across EU Member States is complex, due to the heterogeneity of the actors, information and services of the different Member States. The complexity of exchanging data may lead to semantic interoperability conflicts. The Core Vocabularies can be used to reduce these semantic conflicts in two ways:

- The design of new data models that extend the Core Vocabularies: new data models that make use of the Core Vocabularies as building blocks, either at conceptual level or at syntax level, guarantee a minimum of cross-sector interoperability.
- The mapping of existing data models to the Core Vocabularies: existing data models that have mappings to the Core Vocabularies allow using the Core Vocabularies as a common foundational data model allowing to bridge different data models.

The goal of this technical report is to analyze the core vocabularies within the European Union through the activities SEMIC organization and analysis of the existence of core vocabularies and datasets in the United States. Also, it is necessary to analyze the core vocabularies and datasets and determine compliance with W3C standards. The first section of this article includes a description of SEMIC activities, modes of operation and information collection while the second section shows the examination of the existence of core vocabularies and datasets in the United States.



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1. Introduction

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2. Semantic Interoperability Community - activities

The Semantic Interoperability Community (SEMIC) is a European Commission initiative aiming to improve the semantic interoperability of interconnected e-Government systems. It is funded under the Action on Promoting semantic interoperability amongst the European Union Member States of the Interoperability Solutions for European Public Administrations (ISA²) Programme. Semantic interoperability refers to the preservation of meaning in the exchange of electronic information (see also European Interoperability Framework). It means that, in the context of an information exchange, the receiver and the sender of information can understand and interpret it the same way. The lack of semantic interoperability between European e-Government systems is one of the major obstacles in the provision of cross-border and cross-sector digital public services. [1]

2.1 Development and promotion of Core Vocabularies

The e-Government Core Vocabularies are simplified, re-usable and extensible data models that capture the fundamental characteristics of an entity, such as a person, a business, a location or a public service, in a context-neutral way. [1] They can be used by public administrations to attain a minimum level of semantic interoperability for e-Government systems. Semantic interoperability conflicts are caused by discrepancies in the interpretation of administrative procedures and legislation, the lack of commonly agreed data models, the absence of universal reference data.

2.1.1 What are the Core Vocabularies

Public administrations can use and extend the Core Vocabularies in the following contexts: Development of new systems: the Core Vocabularies can be used as a default starting point for designing the conceptual and logical data models in newly developed information systems. Information exchange between systems: the Core Vocabularies can become the basis of a context-specific data model used to exchange data among existing information systems. Data integration: the Core Vocabularies can be used to integrate data that comes from disparate data sources and create a data mesh-up. Open data publishing: the Core Vocabularies can be used as the foundation of a common export format for data in base registries like cadastres, business registers and public service portals. [1]

The mapping of existing data models to the Core Vocabularies: existing data models that have mappings to the Core Vocabularies allow using the Core Vocabularies as a common foundational data model allowing to bridge different data models.

2.1.2 Who is using the Core Vocabularies

Core vocabularies are generated and used in thirty-four centers in Europe. The obtained information are publicly available and can be downloaded from the website in various formats.

Sweden - Stockholm:

1. The Swedish innovation agency Vinnova: Runs the Swedish Open Data Portal in collaboration with Open Knowledge UK and MetaSolutions (many activities to support the implementation of DCAT-AP in the Open Data Portal).

2. DCAT-AP manager: Tool to create and manage descriptions of catalogues and datasets (DCAT application profile for data portals in Europe)

3. DCAT-AP validator: Has been developed to validate DCAT-AP based dataset descriptions.

4. EntryScope Catalog: Open source information



Estonija - Talin:

1. The Estonian service catalogue: Helps to create harmonized, machine-readable and semantically interoperable descriptions of Estonia's public services.
2. Register App Engine Graph: Provides access to continuously maintained, linked open government and commercial data for business applications.

Ireland - Dublin

1. The Irish Open Data portal: Promotes innovation and transparency through the publication of Irish Public Sector data in open, free and reusable formats.

Great Britain - Cambridge

1. DCAT Harvester for CKAN: For expose and consume metadata from other catalogs using RDF documents.

Spain - Madrid

1. The point of Single Contact: allows that a business person applies for specific procedures to exercise their specialized professional activity.
2. The Technology Transfer Centre: publishes a general directory of information technology solutions interesting in the area of e-government.
3. The National Technical Interoperability Standard: for reusing public information for describe data sets within the Spanish Public.

Italy – Rome

1. The Linked Open Data of the Italian Interoperability Framework SPC: includes four important datasets: the dataset about the National Catalogue of the Italian Public Administrations, the dataset on SPC contracts established on the basis of past public tenders, and two official classifications published in LOD.
2. The Italian Application Profile of the Core Public Service: used in the implementation of the Italian national catalogue of public services
3. The Italian Application Profile of the Data Catalog Vocabulary: used in the implementation of the Italian national catalog of data of public administrations

Switzerland - Bern

1. Geocat CKAN Harvester: extension of CKAN for data harvesting from the Swiss CSW service geocat.ch to Swiss open data portal.
2. The Swiss Open Data Portal: brings together a wide range of datasets such as Swiss communal boundaries, population statistics, and current weather data.
3. Inspire GeoDCat-AP Sandbox: provides access to the metadata records harvested by the Inspire Geoportal.

Austria - Wien

1. Poolparty Semantic Suite: offers solutions for knowledge mmanagement, business information with valuable metadata and links content.

Luxembourg - Luxembourg

1. The European Data Portal: harvests the metadata of Public Sector Information with public data from portals across European countries.



2. The European Union Open Data Portal: data are free to use and reuse for commercial or non-commercial purposes.

3. Exporters implemented on the MDR of the OP: registers and maintains data definition (metadata elements, named authority lists, shemas) used by the different European Institutions.

Germany - Koblenz

1. GeoPortal: used by three German Federal States (manages metadata for special datasets and services)

2. The German XRepository: provides a central location for storing and managing subject-specific and interdisciplinary solutions for public administrations

Netherlands - Den Haag

1. Dutch Open Data Portal: provides an overview of all available datasets provided by government organisations.

2. GeoNetwork: provides an easy to use web interface to search geospatial data across multiple catalogs

Belgium - Gent

1. The Open Data Portal of Ghent: publishes most of the content which is available on its public website as Linked Open Data (RDF)

2. Open Standards for Linked Administrations in Flanders: simplified, reusable and extensible data model that captures the fundamental characteristics of information exchanged by public administration (contact information, localisation and public services)

3. DCAT - BE: extension of DCAT-AP, including a theme taxonomy for Belgium

4. The DataTank: open source tool that facilitates open data for public entities.

5. Belgian Open Data Portal: defines and implements the federal e-government strategy.

6. Joinup: offers several services that aim to help e-Government professionals.

7. Bris: makes basic company information searchable and exchangeable, based on XML syntax.

8. Convertor of ISO 19139 records into GeoDCAT-AP: used to convert ISO19139 into GeoDCAT-AP either by submitting a call to a CSW.

9. Open Data Support DCAT AP Validator: web application that checks metadata description of datasets for integrity and consistency against the DCAT-AP specifications

2.2 Development and promotion of the ADMS

The Asset Description Metadata Schema (ADMS) is a vocabulary to describe and document reusable interoperability solutions, such as data models and specifications, reference datasets, and open-source software. The objective of ADMS is to facilitate the discoverability of reusable interoperability solutions, in order to reduce the development costs of cross-border and/or cross-sector e-Government systems.[4]

2.2.1 What is ADMS

It was created with the help of a working group of experts. On 1 August 2013, W3C published ADMS as a W3C Working Group note. ADMS allows: Solution providers, such as standardization organisations and public administrations, to describe their solutions and share the standardised metadata across platforms, hence increasing the discoverability of the solutions; Content aggregators, such as Joinup, to aggregate such descriptions into a single point of access; ICT developers and researchers to more easily explore, find, identify, select and obtain interoperability solutions from a single point of access. [4]



2.3 Development and promotion of the DCAT-AP

SEMIC fosters the interoperability of open data portals by building consensus on and promoting the DCAT Application profile for data portals in Europe (DCAT-AP). DCAT-AP provides a common specification for describing public sector datasets and enables the exchange of descriptions of datasets among data portals.

2.3.1 What is the DCAT-AP

The DCAT Application Profile for data portals (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 of descriptions of datasets among data portals. The DCAT-AP was developed by working group of experts following an open collaborative process. The DCAT-AP is a joint initiative of: the Directorate-General for Communications Networks, Content & Technology: DG CONNECT; the Directorate-General for Informatics: DG DIGIT; and the Publications Office of the EU.

2.3.2 What is the GeoDCAT-AP

GeoDCAT-AP is an extension of DCAT-AP for describing geospatial datasets, dataset series, and services. It provides an RDF syntax binding for the union of metadata elements defined in the core profile of ISO 19115:2003 and those defined in the framework of the INSPIRE Directive. Its basic use case is to make spatial datasets, data series, and services searchable on general data portals, thereby making geospatial information better searchable across borders and sectors. This can be achieved by the exchange of descriptions of data sets among data portals. The GeoDCAT-AP specification does not replace the INSPIRE Metadata Regulation nor the INSPIRE Metadata technical guidelines based on ISO 19115 and ISO19119. Its purpose is give owners of geospatial metadata the possibility to achieve more by providing an additional RDF syntax binding.

GeoDCAT-AP is a joint initiative of the Joint Research Centre (JRC), Unit H.6 (Digital Earth and Reference Data), the Publications Office of the European Union (PO), and the Directorates-General for Informatics (DIGIT, in the context of the ISA² programme and Communications Networks, Content & Technology (CONNECT) of the European Commission. More than 52 people from 12 EU Member States contributed to the specification in the Working Group or during the public review period.

2.3.3 What is the StatDCAT-AP

The StatDCAT-AP aims to deliver specifications and tools that enhance interoperability between descriptions of statistical data sets within the statistical domain and between statistical data and open data portals.

Throughout the development process of the StatDCAT-AP, several drafts will be prepared by the editors. The first draft was reviewed by the Working Group and the final version will be soon made available.



The concrete objective of the work is to develop and reach consensus on an Application Profile of the Data Catalog Vocabulary (DCAT) to be used for the description of statistical data sets with an initial focus on discovery of those data sets in a wider context. The StatDCAT-AP will be based on the DCAT Application Profile for Data Portals in Europe (DCAT-AP). In addition, initial guidelines on the extraction of relevant metadata from the existing implementation at Eurostat and possibly others will be elaborated in order to enable the export of metadata conforming to the application profile from existing data. Based on the contributions of the main stakeholders, extensions to DCAT-AP can be proposed with descriptive elements particularly useful for discovery of statistical data sets beyond the possibilities offered by the generic DCAT-AP. The work in this phase will concentrate on use cases that improve the discovery of statistical data sets published in open data portals across European institutions and EU Member States and in particular in the European Open Data Portal, as well as use cases that facilitate the integration of statistical data sets with open data from other domains.

2.4 Management of data standards

The European Interoperability Reference Architecture (EIRA) defines a data standard as “a structural metadata specification that describes or defines other data. Structural metadata indicates how compound objects are put together. It can consist of among others data models, reference data, and identifier schemas”. SEMIC has established an international Community of Practice which is working on specifications, good practices and lessons learned for setting up proper governance and management of data standards, and for selecting the right support tools. Such activities will greatly enhance the potential for coordination and interoperability between public administrations in the context of cross-border and/or cross-sector information exchanges.

2.4.1 Mission and purpose

The international Community of Practice on Core Data Models is an informal network of representatives in EU Member States and other countries, such as Japan and the U.S., for sharing knowledge and experience on core data models. Core data models are defined as: “reusable data models that are defined, managed, promoted and maintained centrally to facilitate interoperability across different systems, applications and domains.”

2.4.2 Goals

The Community of Practice has the following goals: To identify and share good practices and lessons-learned; To set up a repository of frameworks, tools and services for core data models, increasing the visibility of existing initiatives in the field, and providing an entry point of expertise and knowledge for new initiatives; To create mappings between core data models; To join forces and identify opportunities for alignment and standardisation; To propose ideas for new activities and project which could be supported by the ISA Programme following the normal process of the ISA Work Programme execution.

2.4.3 Practical information

Publicly archived mailing list: the following public mail archive will be used for efficient communication between members of Community of Practice. Publicly accessible shared file system: all documents will be shared via the Joinup file server.



2.5 Exploring Linked Open Government Data (LOGD)

Linked Data enables the provision of “data as a service” and conceives the Web as an open ecosystem where data owners, data publishers, and data consumers can interconnect and integrate disparate datasets. SEMIC explores the potential of linked open government data, from a business and a technical point of view, as an enabler to the flexible integration of data coming from different e-Government systems.

2.5.1 What is LOGD

Linked Data enables the provision of “data as a service” and conceives the Web as an open ecosystem where data owners, data publishers, and data consumers can interconnect and integrate disparate datasets. SEMIC explores the potential of Linked Open Government Data (LOGD), from a business and a technical point of view, as an enabler to the flexible integration of data coming from different e-Government systems. The Study on Business Models for Linked Open Government Data - BM4LOGD identifies the number of enablers to the provision and reuse LOGD for public administrations: The main driver for the use of LOGD is that it allows for flexible data integration; this helps to increase data quality by allowing cross-references to authoritative data to be included and may drive future development of new services. The use of LOGD increases the efficiency of the internal operation of the data provider and allows them to fulfil their public task more effectively and efficiently. LOGD is applied most successfully in reference data, such as in the case of the Named Authority Lists of the Publications Office, Eurovoc thesaurus and ESCO. LOGD makes future upgrades of data models much easier, for example to include new data or connect data from different sources together. URIs allow a ‘follow-your-nose’ navigation structure that provides better navigation through complex data. LOGD is mostly provided free of charge and under open licences which enables further use and reuse of data. Availability of guidelines and dissemination of best practices create common approaches and reduce risk in implementation by enabling organisations to learn from each other.

2.6 SEMIC Conference

The SEMIC conference is an annual international event which brings together policy makers, ICT solution developers, industry and researchers with a common interest in topics related to information exchange and management for public administration.



3. Analysis of core government vocabulary and datasets in United States

After the analysis of core government vocabulary in Europe (under SEMIC), analysis was performed and for the United States. The analysis is focused on finding the core government vocabularies used in public administration. The analysis results shows that the use of RDF datasets referenced to W3C [3] dictionaries. Within the analysis were found more than 700 datasets and further in this document it is presented the eight characteristic analysis results.

The results of the research are found datasets:

1. Hospital General Information

Publisher: Centers for Medicare and Medicaid Services

A list of all Hospitals that have been registered with Medicare. The list includes addresses, phone numbers, and hospital type.[2]

```

<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
xmlns:socrata="http://www.socrata.com/rdf/terms#"
xmlns:dcat="http://www.w3.org/ns/dcat#"
xmlns:ods="http://open-data-standards.github.com/2012/01/open-data-standards#"
xmlns:dcterms="http://purl.org/dc/terms/"
xmlns:geo="http://www.w3.org/2003/01/geo/wgs84_pos#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xmlns:foaf="http://xmlns.com/foaf/0.1/"
xmlns:dsbase="http://data.medicare.gov/resource/"
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  <ds:emergency_services>true</ds:emergency_services>
  <ds:meets_criteria_for_meaningful_use_of_ehrs>true</ds:meets_criteria_for_meaningful_use_of_ehrs>
  <ds:hospital_overall_rating>3</ds:hospital_overall_rating>
  <ds:mortality_national_comparison>Below the national average</ds:mortality_national_comparison>

```

Figure 1. Hospital General Information

2. CGB - Consumer Complaints Data

Publisher: Federal Communications Commission

Individual informal consumer complaint data detailing complaints filed with the Consumer Help Center beginning October 31, 2014. This data represents information selected by the consumer. The FCC does not verify the facts alleged in these complaints. [2]



```

<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
xmlns:socrata="http://www.socrata.com/rdf/terms#"
xmlns:dcat="http://www.w3.org/ns/dcat#"
xmlns:ods="http://open-data-standards.github.com/2012/01/open-data-standards#"
xmlns:dcterms="http://purl.org/dc/terms/"
xmlns:geo="http://www.w3.org/2003/01/geo/wgs84_pos#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xmlns:foaf="http://xmlns.com/foaf/0.1/"
xmlns:dsbase="http://opendata.fcc.gov/resource/"
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    <usps:zipCode>33324</usps:zipCode></geo:SpatialThing></ds:location_1></rdf:Description>

```

Figure 2. CGB - Consumer Complaints Data

3. Fixed Broadband Deployment Data: December, 2015 Status

Publisher: Federal Communications Commission

All facilities-based broadband providers are required to file data with the FCC twice a year (Form 477) on where they offer Internet access service at speeds exceeding 200 kbps in at least one direction. Fixed providers file lists of census blocks in which they can or do offer service to at least one location, with additional information about the service.[2]

```

<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
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xmlns:dcat="http://www.w3.org/ns/dcat#"
xmlns:ods="http://open-data-standards.github.com/2012/01/open-data-standards#"
xmlns:dcterms="http://purl.org/dc/terms/"
xmlns:geo="http://www.w3.org/2003/01/geo/wgs84_pos#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
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  <ds:maxcirup>0</ds:maxcirup>
  <ds:maxcirup>0</ds:maxcirup></rdf:Description>
</rdf:Description rdf:about="http://opendata.fcc.gov/resource/mx87-nb5s/64302649">

```

Figure 3. Fixed Broadband Deployment Data: December, 2015 Status



4. ULS 3650 Locations

Publisher: Federal Communications Commission

Daily Transfer of ULS 3650 Locations with Submitted Grandfathered Wireless Protection Zone Information.[2]

```

<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
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xmlns:ods="http://open-data-standards.github.com/2012/01/open-data-standards#"
xmlns:dcterms="http://purl.org/dc/terms/"
xmlns:geo="http://www.w3.org/2003/01/geo/wgs84_pos#"
xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xmlns:foaf="http://xmlns.com/foaf/0.1/"
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Figure 4. RDF of ULS 3650 Locations

5. U.S. Chronic Disease Indicators (CDI)

Publisher: U.S. Department of Health & Human Services

CDC's Division of Population Health provides cross-cutting set of 124 indicators that were developed by consensus and that allows states and territories and large metropolitan areas to uniformly define, collect, and report chronic disease data that are important to public health practice and available for states, territories and large metropolitan areas. In addition to providing access to state-specific indicator data, the CDI web site serves as a gateway to additional information and data resources.[2]

6. Nutrition, Physical Activity, and Obesity - Behavioral Risk Factor Surveillance System

Publisher: U.S. Department of Health & Human Services

This dataset includes data on adult's diet, physical activity, and weight status from Behavioral Risk Factor Surveillance System. This data is used for DNPAO's Data, Trends, and Maps database, which provides national and state specific data on obesity, nutrition, physical activity, and breastfeeding.[2]



7. NCHS - Births, Birth Rates, and Fertility Rates, by Race of Mother: United States, 1960-2013

Publisher: U.S. Department of Health & Human Services

The number of states in the reporting area differs historically. In 1915, 10 states and the District of Columbia reported births; as of 1933, all 50 states and the District of Columbia started reporting births. Reporting area information is detailed in “Vital Statistics of the United States, 1950, Volume I” (see Table 1.03, http://www.cdc.gov/nchs/data/vsus/vsus_1950_1.pdf). Trend lines for 1909–1958 are based on live births adjusted for under registration; beginning with 1959, trend lines are based on registered live births. All birth data by race before 1980 are based on race of the child; starting in 1980, birth data by race are based on race of the mother. National data on births by Hispanic origin exclude data for Louisiana, New Hampshire, and Oklahoma in 1989; New Hampshire and Oklahoma in 1990; and New Hampshire in 1991 and 1992. Information on reporting Hispanic origin is detailed in the Technical Appendix for the 1999 public-use natality data file. [2]

8. Stroke Mortality Data Among US Adults (35+) by State/Territory and County

Publisher: U.S. Department of Health & Human Services

2013 to 2015, 3-year average. Rates are age-standardized. County rates are spatially smoothed. The data can be viewed by gender and race/ethnicity. Data source: National Vital Statistics System. Additional data, maps, and methodology can be viewed on the Interactive Atlas of Heart Disease and Stroke [2]



4. Conclusion

Application of core vocabularies in the field of public administration is multiple. The data obtained allow the generation of different types of statistics, reports, and analysis.

SEMIC supported international working groups to forge consensus on the following Core Vocabularies. In order to overcome conflicts, the ISA Programme has created the Core Vocabularies specifications in the period 2011-2013 with international Working Groups of Member State representatives and experts.

The design of new data models that extend the Core Vocabularies: new data models that make use of the Core Vocabularies as building blocks, either at conceptual level or at syntax-level, guarantee a minimum of cross-sector interoperability.

Within the SEMIC organizations there are:

- The Core Business Vocabulary
- The Core Location Vocabulary
- The Core Person Vocabulary
- The Core Public Service Vocabulary
- The Core Evidence and Criterion Vocabulary
- The Core Public Organisation Vocabulary

that can be downloaded and used for various purposes.

The analysis results showed that datasets published in United States refer to dictionaries by W3C (RDF format). The third section points to datasets that were found and analysed:

- Hospital General Information
- CGB - Consumer Complaints Data
- Fixed Broadband Deployment Data: December, 2015 Status
- ULS 3650 Locations
- U.S. Chronic Disease Indicators (CDI)
- Nutrition, Physical Activity, and Obesity - Behavioral Risk Factor Surveillance System
- Stroke Mortality Data Among US Adults (35+) by State/Territory and County

These datasets can be downloaded in RDF format and they are publicly available.



Literature

- [1] SEMIC - Semantic Interoperability Community, Core Vocabularies (https://joinup.ec.europa.eu/community/semic/og_page/core-vocabularies), September 28, 2015
- [2] U.S. Government's open data (<https://www.data.gov>)
- [3] W3C (2016, November). W3C Resource Description Framework (RDF) (<http://www.w3.org/RDF/>)
- [4] The Asset Description Metadata Schema (ADMS) (https://joinup.ec.europa.eu/community/semic/og_page/adms)