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1. INTRODUCTION

Throughout recent years, the implementation of the ISA[2] Programme (Jan 2016 - Dec 2020) has sought to develop and improve the methods and tools to support and operate public services and common frameworks. This implementation has allowed to create interoperable cross-border and cross-sector public services for public administrations, citizens and businesses interacting with those administrations in Europe. Within the Semantic Interoperability package of the Programme, the project "2016.07 SEMIC: Promoting semantic interoperability among the EU Member States"[1], commonly known as SEMIC has contributed to the provision of solutions to help European public administrations perform seamless and meaningful cross-border and cross-domain data exchanges. This project has allowed reach agreements on:

- Using common semantic standards,
- Promoting transparent and well-documented metadata policies, and
- Increasing the visibility and reuse of existing semantic interoperability solutions.

The present report provides a concise description of the activities that have been carried out and the milestones that have been reached throughout the implementation of the project. This report documents the history of the SEMIC action from its phases two to eleven.

1.1. Context

Throughout the past two decades, a change in the paradigm governing the World Wide Web has driven a series of technological changes marking the evolution of the Semantic Web. These changes have been harnessed by the legislation to create the framework conditions necessary to grasp the benefits from the transformation.

The implementation of the SEMIC action within the ISA[2] Programme has found its original motivation in the **evolution of the Semantic Web and its key paradigm change**. The Semantic Web is an extension of the World Wide Web through standards established by the World Wide Web Consortium (W3C) which represents a community vision on how the information circulating throughout the World Wide Web is defined, and how its meaning is accurately understood and optimally processed by electronic and digital devices. This vision on how information is structured allows digital devices to accurately perform reasoning tasks and assist humans in problem-solving and decision making. Significant research has therefore been carried out in order to push our understanding of how to structure the information to be used by electronic and digital devices, and improve how relationships are defined amongst datasets. Hence, particular attention has been given to eliciting how computers are able to "understand" the semantics (or the meaning) of the data. This is currently the core challenge that Semantic Web technologies are addressing.

Technical and legal circumstances associated to these changes have led to advances in the **legislative and regulatory domains;** these domains have evolved to harness the evolution of the semantic web and to create the necessary conditions for Member States to step up their efforts with regard to **semantic interoperability.** The figure below provides insight on both the technical and legal/policy milestones that have shaped the framework conditions allowing to improve public services through seamless and meaningful cross-border and cross-domain data exchanges.

[1] https://ec.europa.eu/isa2/actions/improving-semantic-interoperability-european-egovernment-systems_en

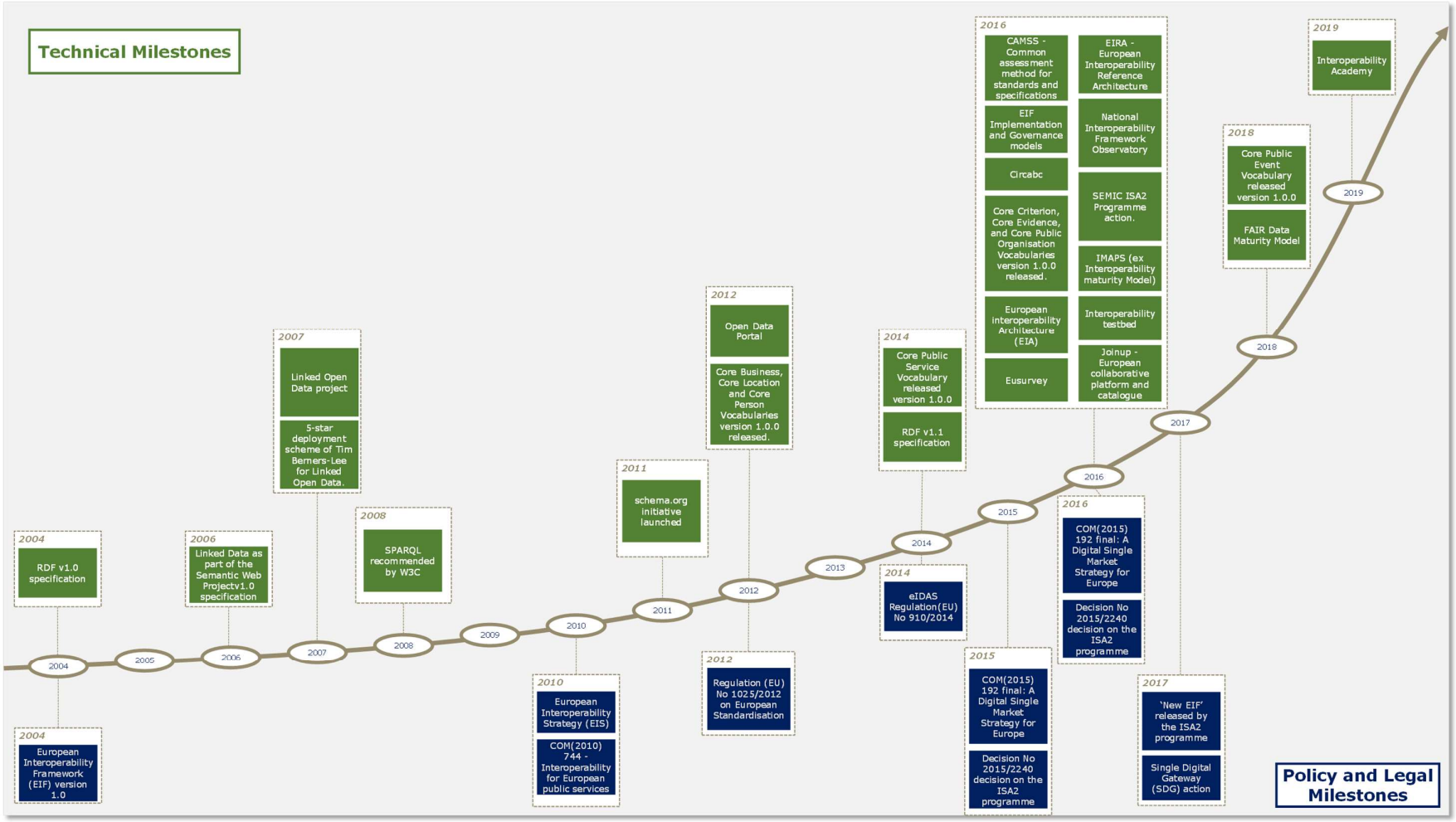


Figure 1 : Timeline of key technical, policy and legal milestones leading to and shaping the implementation of the SEMIC action

A more detailed list of milestones can be found in ***ANNEX IV. TECHNICAL, POLICY AND LEGAL MILESTONES***. This annex provides the links to the sources of information on each milestone mapped within the above figure.

1.2. Historical background

The chronology of the above mentioned key milestones led to the developments made under the implementation of activities by the Semantic Interoperability Community (SEMIC) started in 2010. This action enables public administrations from EU Member States to provide digital cross-border public services supported by semantic interoperability to ensure the exchange of data between public administrations of different EU countries.

These milestones have taken place ever since the adoption of the Interoperability Decision of the European Council and the European Parliament in July 1999. Indeed, the development of the Resource Description Framework (RDF) in 2004 settled the technological advancement by providing a language for representing information about resources in the World Wide Web, while the definition of the European Interoperability Framework (EIF), highlighted the need for interoperability of national public ICT infrastructures for a more service-oriented and competitive public sector.

These milestones prepared the way to developments in the Web of Data which introduced in 2006 the concept of Linked Data as part of the Semantic Web Project highlighting the standards and formats that made vast volumes of data reachable and manageable by Semantic Web tools. This concept later integrated the notion of Linked Open Data in 2007 which aimed to make information available on the Web under an open license regardless of its format. Following that year, the W3C consortium continued contributing to the RDF by defining the syntax and semantics of the SPARQL query language for RDF in 2008. This definition allowed to label graph data format for representing information in the Web to express queries across diverse data sources, whether the data is stored natively as RDF or viewed as RDF via middleware.

Following those technical developments, and in the context of the 2008 economic crisis aftermath, the European Interoperability Strategy (EIS) of 2010 highlighted the short-term priority of a successful exit from the crisis by achieving business sustainability. To reach this sustainability, several flagship initiatives were adopted, amongst which the Digital Agenda for Europe aims to deliver sustainable economic and social benefits from a Digital Single Market based on fast and ultra-fast internet and interoperable applications. Additional policy milestones were reached to stress that interoperability is essential to maximise the social and economic potential of information and communication technologies (ICT), hence promoting interoperability amongst public administrations.

Following these milestones, further technical advances to structure Web data took place, such as the Schema.org initiative launched in 2011 as a collaborative community with a mission to create, maintain, and promote schemas for structured data on the Internet.

Subsequent years saw the definition and publication of the Core Business, Core Location and Core Person Vocabularies whose version 1.0.0 was released in 2012; for further details, a specific section is dedicated to this artefacts in the present report. The publication of the vocabularies was accompanied by the creation of the Open Data Portal of the European Union (EU ODP), which enabled the access for citizens to open data published by EU institutions and bodies, free to use and reuse for commercial or non-commercial purposes.

During the same year, the regulation on European Standardisation was adopted. This regulation established the rules and specifications for European standards and European standardisation deliverables for products and services in support of Union legislation and policies. The angular point of the regulation was to help to boost the competitiveness of enterprises innovation on network interoperability and communications in support of the free movement of goods and services. The regulation facilitated the evolution of the RDF specification which was updated in 2014 to adapt the RDF Schema and provide a standard data-modelling vocabulary for RDF data. 2014 also marked the adoption of the eIDAS regulation which sought to enhance trust in electronic transactions in the internal market by providing a common foundation for secure electronic interaction between citizens, businesses and public authorities. The text settled the grounds to increase the effectiveness of public and private online services, electronic business and electronic commerce in the European Union.

The understanding of the basic requirements to achieve interoperability combined with the rapid digitalisation of the global economy raised awareness about the need to create a Digital Single Market. This was highlighted by the 2015 communication on the Digital Single Market Strategy for Europe which advocated for the creation of the framework conditions to generate a level playing field for advanced digital networks and innovative services. Since these networks constitute the backbone for digital products and service, the rules needed to be fit for purpose to boost competitiveness through interoperability and standardisation. These policies led to the 2015 decision to implement the ISA[2] Programme[2], establishing a line of work for the period 2016-2020 on the development of interoperability solutions and common frameworks for European public administrations, businesses and citizens.

The year 2016 saw the implementation of the SEMIC ISA[2] along with the development of the Core Criterion, Core Evidence, and Core Public Organisation Vocabularies. Details are provided in chapter three of the present report.

Furthermore, the development of the European interoperability Architecture (EIA) in 2016 allowed to define the metamodeling of the most salient architectural building blocks (ABBs) needed to build interoperable e-Government systems. This architecture referential plays a crucial in the realisation of such coordination as it provides a reference model that describes in a common way digital European public services, making it possible for you to search, share and reuse digital solutions. It uses (and extends) the ArchiMate language as a modelling notation and uses service orientation as an architectural style. In addition to the referential architecture, the IMAPS (Interoperability Maturity Model) was also developed in 2016 to provide public administrations insight the current interoperability maturity level of Digital Public Services, as well as guidelines to assess and improve their interoperability maturity.

2016 was a fruitful year for the implementation of actions under the ISA² Programme; the National Interoperability Framework Observatory contributed to the implementation of EIF recommendations and monitoring the State of Play of interoperability in the Member States, hence carrying out regular monitoring of interoperability activities and eGovernment state of play in Member States and associated countries. Moreover, the Common Assessment Method for Standards and Specifications (CAMSS) promoted collaboration between EU Member States to cooperate in the development of eGovernment services in line with the implementation and governance models of the European Interoperability Framework

[2] https://ec.europa.eu/isa2/home_en

(EIF) focusing on interoperability governance, organisational interoperability, and integrated public service governance.

Beyond these actions, the ISA² Programme also launched in 206 the CIRCABC project which delivered a web application and services enabling the collaboration, communication and exchange of documentation between Member States administrations, businesses, citizens, and European institutions.

Finally, the Interoperability Test Bed (ITB) was launched to provide a platform for hosting reference implementations of cross-border services, hence enabling Member States' public administrations and to test existing national systems as well as individual services or products, against a neutral, reliable and responsive reference test environment. This ecosystem was logged into the Joinup European collaborative platform and catalogue that generated the opportunity to share and reuse IT solutions and good practices across Europe. The platform is freely accessible and facilitates communication and collaboration on common projects between public administrations.

Since 2017, these actions have been complemented by the 'New EIF' released under the ISA² Programme to guide to public administrations on how to improve governance of their interoperability activities, establish cross-organisational relationships, streamline processes supporting end-to-end digital services, and ensure that existing and new legislation do not compromise interoperability efforts. Within this context, the Single Digital Gateway (SDG) action has facilitated online access to the information, administrative procedures and assistance services that citizens and businesses need in cross-border settings. By the end of 2020, citizens and companies moving across EU borders will easily be able to find out what rules and assistance services apply in their new place residency. By the end of 2023 at the latest, they will be able to perform several procedures in all EU member states without any physical paperwork, like registering a car or claiming pension benefits.

Nowadays, the actions are covering the training domain, with the Interoperability Academy deployed in 2019 under the ISA² programme aiming at contributing to diffuse advanced digital skills of civil servants in the area of interoperability to support policy, service delivery and impact evaluation.

1.3. Key objectives of the report

The SEMIC action has taken place to reach agreements on the use of common semantic standards have been sought after in order to achieve semantic interoperability. Key outcomes from the action include:

- The promotion of transparent and well-documented metadata policies, and
- The increase of the visibility and awareness on the reuse of existing semantic interoperability solutions amongst EU Member States.

In particular, since its inception, the SEMIC Action of the ISA² Programme[3] has contributed to the simplification of the environment in which EU countries exchange data for the delivery of electronic public services, addressing the issues and barriers related to semantic interoperability. This outcome has been achieved through:

- The definition of eGovernment Core Vocabularies and Application Profiles,

[3] https://ec.europa.eu/isa2/home_en

- The design and development of technical solutions enabling semantic interoperability,
- The conduction of numerous pilots with different public administrations across Europe, and
- The participation in a set of initiatives promoting similar objectives as those of the SEMIC action.

The primary objective of the present report is to provide a holistic overview of the set of deliverables developed within the frame of the execution of the SEMIC action. This holistic overview comprises a succinct description of the project outputs and represents a monitoring mechanism on the reach and achievements of the project. In particular, the present report aims at documenting the key assets that the SEMIC action has developed and maintained with the ultimate aim of facilitating their future maintenance and sustainability. Furthermore, the present report plays a key supporting role in:

- Documenting the project achievements and highlights per phase of the SEMIC action;
- Enabling the creation of a series of visual artefacts (e.g. infographics, presentations, etc.) representing the information contained in such documentation;
- Conducting an impact assessment of the work carried out under the SEMIC action through the past decade, including the related initiatives conducted by other organisations and EU Member States; and
- Facilitating further follow-up actions for the SEMIC conference 2020 as well as the identification of key events that triggered the different activities the action has been involved in.

2. METHODOLOGY

The overall methodological approach followed to develop this report is based on desk research, to a large extent limited to the project's outputs. This deliverable has therefore been completed through analysis and synthesis of the key takeaways of the deliverables provided during previous project phases. This synthesis comprises the identification of key highlights and key stakeholders. Whenever it has been necessary, complementary desk research and consultation of specific stakeholders involved in past phases have been carried out with the aim of completing the analysis.

The operationalisation of this methodological approach has structured the present deliverable across a set of key elements for description: a) the main outputs from the SEMIC action, b) the pilots that have been implemented, the considerations on the maintenance of SEMIC products, and d) the interactions with other initiatives and organisations. These key elements set the basis for the report structure.

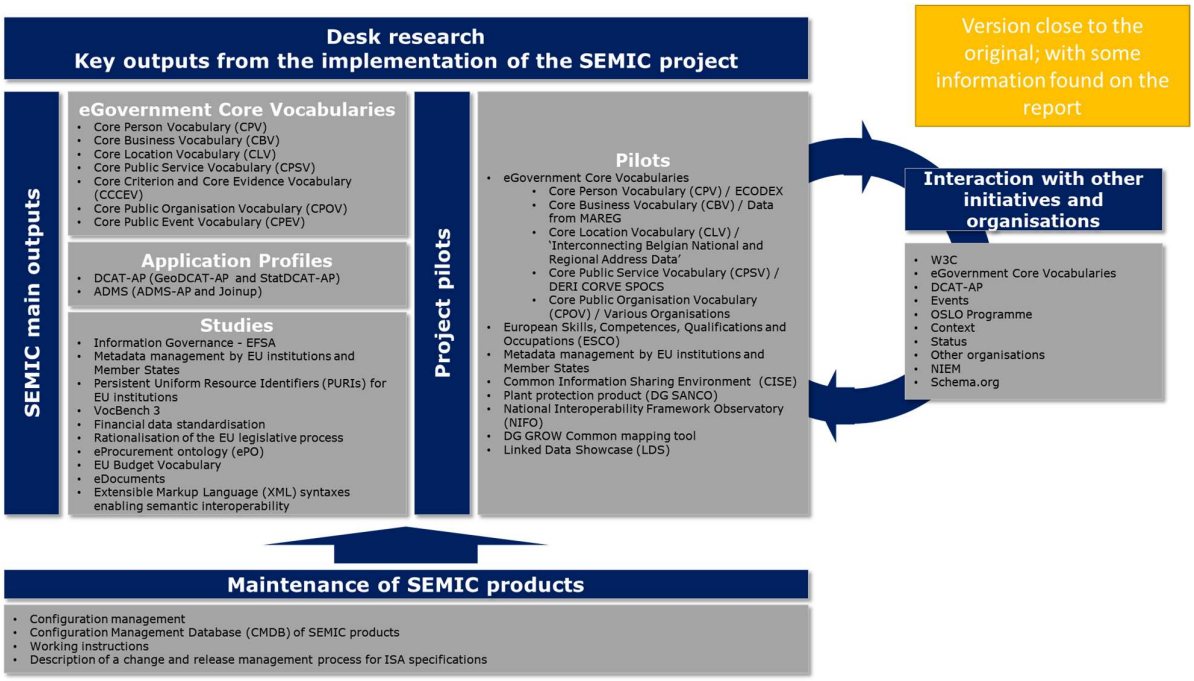


Figure 2: Operationalisation of the methodological approach

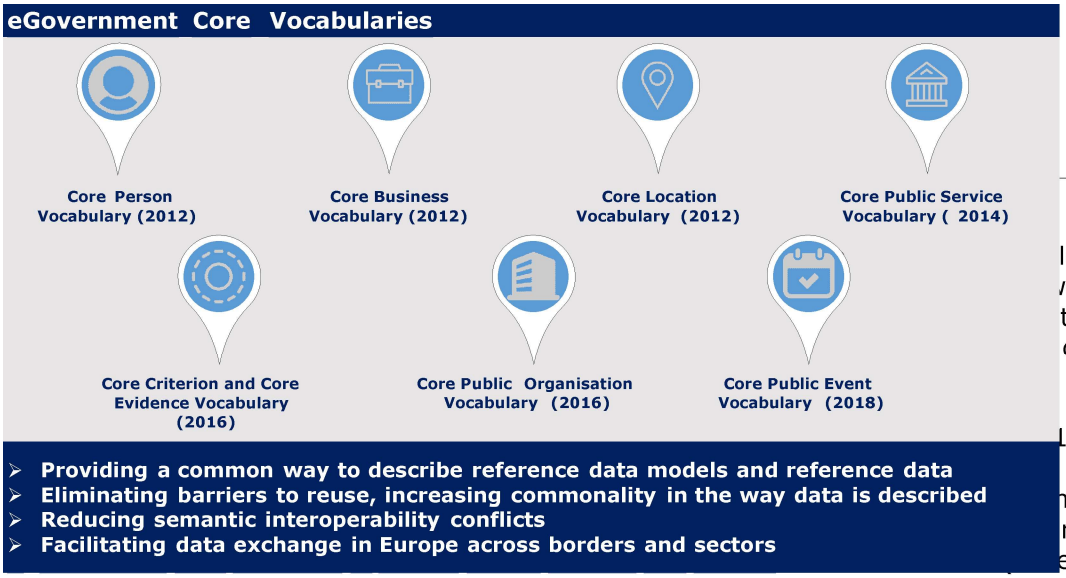
3. eGOVERNMENT CORE VOCABULARIES

Semantic interoperability has been one of the key objectives of the SEMIC action given that increasing mobility of citizens and businesses have amplified the need to support cross border-public services. Within the frame of the project, the development of eGovernment Core Vocabularies[4] represents the backbone of the solutions aimed at addressing complex semantic interoperability conflicts. These vocabularies were defined as a common way to describe reference data models and reference data to eliminate the barriers to reuse, therefore increasing commonality in the way data is described (common code lists, common identifiers, common taxonomies etc.), and reducing semantic interoperability conflicts to facilitate data exchange in Europe across borders and sectors.

The development and implementation of these vocabularies followed a prioritized roadmap that was established through discussion and validation amongst public administrations, and was based on key criteria. In 2012, a set of existing vocabularies were assessed for prioritization based on their potential for implementation as eGovernment Core Vocabularies throughout the period 2012 – 2015. The prioritization was based on discussions with public administrations at EU and national levels concerning the following key criteria:

- The relevance of the beneficiary,
- The interest in the specific vocabulary,
- The capacity to implement the vocabulary,
- The feasibility of creating the working group on the specific vocabulary,
- The feasibility of completing the work in whereas, and
- The added value of the implementation.

[4] https://joinup.ec.europa.eu/solution/e-government-core-vocabularies/about



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Person, and Core Location Vocabularies). This separation addressed differences in their specifications, which made it challenging to develop a "one-size-fits-all" solution for Core Vocabularies consistently.

In 2017 the version 2.0 of the Core Vocabularies was published; this update included:

- Two new Core Vocabularies (the Core Evidence and Core Criterion Vocabulary, and Core Public Organisation Vocabulary),
- The updated version of the Core Public Service Vocabulary Application Profile (CPSV-AP), and
- The mapping to core data models as e.g. NIEM 3.0[7] and OASIS UBL Common Library 2.1[8].

To facilitate the uptake of the eGovernment Core Vocabularies, an e-Government Core Vocabularies handbook was released in 2013 and updated in 2016[9].

Following the development and implementation of the Core Vocabularies and their Handbook, an ex-post assessment study was conducted in 2018 to examine their use and application. In particular, this study examined the extent to which the Core Person Vocabulary has acted as a potential enabler for the data portability right comprised within the provisions of the General Data Protection Regulation (GDPR)[10] and assessed how public administrations in the EU could comply with these provisions on eGovernment using the Core Vocabularies.

Further to the development of each of the eGovernment Core Vocabularies, whose key highlights are documented below, activities such as their maintenance (of e.g. metadata descriptions) and mappings[11] with existing initiatives (e.g. NIEM, eIDAS Person Model) were performed regularly. For more detail of the changes made on all analysed vocabularies, please refer to chapter ***11 Annex II. Vocabularies change log.***

[5] https://joinup.ec.europa.eu/solution/e-government-core-vocabularies/releases
[6] The eGovernment Core Vocabularies were developed in different years, by different stakeholders, for different purposes and with a different governance model.
[7] https://release.niem.gov/niem/3.0/
[8] https://www.oasis-open.org/committees/tc_home.php?wg_abbrev=ubl
[9] https://ec.europa.eu/isa2/library/e-government-core-vocabularies-handbook_en

[10] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons, with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation – GDPR).
[11] For a preliminary list of mappings available please see: https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/practical-guide-using-egovernment-core-vocabularies

Figure 3: Key highlights from the development of eGovernment Core Vocabularies

3.1. Core Person Vocabulary (CPV)

The Core Person Vocabulary[12] was the first eGovernment Core Vocabulary developed by the ISA Programme. Aimed at describing a natural person, it was drafted in 2011 and first published in 2012.

3.2. Core Business Vocabulary (CBV)

The Core Business Vocabulary[13] (corresponding to W3C's Registered Organization Vocabulary[14]) was designed to enable interoperability among business registers and any other ICT based solutions exchanging and processing information about businesses. Its first version was released in 2012 in a task force chaired by DG MARKT/F2 as this organisation was responsible for the European Business Register project.

3.3. Core Location Vocabulary (CLV)

The Core Location Vocabulary was designed for describing geographical locations and addresses, enabling interoperability among land registers and any other ICT based solution exchanging and processing location information. The task force was chaired by JRC/H6 Spatial Data Infrastructures and the version 1.00 was released in 2012.

3.4. Core Public Service Vocabulary (CPSV)

The Core Public Service Vocabulary (CPSV) was released in 2014 to make it easy to exchange basic information about individual public sector services.

In 2015, the CPSV Application Profile[15] (CPSV-AP) was released within the context of Action "Accessing Member State information resources at European level – Catalogue of Services"[16] of the ISA Programme. The application profile aimed at supporting public administrations to exchange machine-readable description of their public services by using a common data model.

3.5. Core Criterion and Core Evidence Vocabulary (CCCEV)

Drafted, publicly reviewed and published in 2016, the Core Criterion and Core Evidence Vocabulary (CCCEV)[17] aims to facilitate the development of interoperable information services, create a repository of reusable criteria in machine-readable formats, promote cross-border participation in public procurement and enable comparability of evidences through criteria mapping.

[12] https://joinup.ec.europa.eu/solution/e-government-core-vocabularies/core-person-vocabulary
[13] https://joinup.ec.europa.eu/solution/e-government-core-vocabularies/core-business-vocabulary
[14] https://www.w3.org/TR/vocab-regorg/
[15] https://joinup.ec.europa.eu/solution/e-government-core-vocabularies/core-public-service-vocabulary-application-profile
[16] https://ec.europa.eu/isa2/actions/CoS_en
[17] https://joinup.ec.europa.eu/solution/e-government-core-vocabularies/core-criterion-and-core-evidence-vocabulary

3.6. Core Public Organisation Vocabulary (CPOV)

Drafted, publicly reviewed and published in 2016, the Core Public Organisation Vocabulary (CPOV)[18] aims to support the exchange of basic information about individual public organizations.

3.7. Core Public Event Vocabulary (CPEV)

The Core Public Event Vocabulary (CPEV)[19] was drafted in 2017 and further elaborated in 2018 with the aim to describe public events.

4. APPLICATION PROFILES

As part of the ISA² Programme specifications, the SEMIC action has promoted two key application profiles to increase the visibility of semantic interoperability standards at the European, national, and local levels. These profiles entail:

- A Data Catalog Application Profile for data portals in Europe (DCAT-AP) which provides:
  - A specification for metadata records to meet the specific application needs of data portals in Europe, and
  - Semantic interoperability with other applications based on reuse of established controlled vocabularies (e.g. EuroVoc) and mappings to existing metadata vocabularies (e.g. Dublin Core, SDMX, INSPIRE metadata, etc.).
- An Asset Description Metadata Schema (ADMS), which is a vocabulary to describe interoperability assets making it possible for ICT developers to explore and search for interoperability assets and allows solution providers (e.g. standardisation organisations and public administrations) to describe their solutions and share the standardised metadata across platforms; thereby increasing the discoverability of the solutions.

These application profiles were developed to ensure the consistency of datasets for public services by fostering standardisation for organisations and public administrations. They allow to describe solutions and share the standardised metadata across platforms, and increase the discoverability of interoperable solutions. The actions fostered through the development of the application profiles have therefore elicited the grounds on which standards for the description of metadata are published by data portals across Europe. These have contributed to building an overview of which datasets exist and which public administrations are maintaining them, hence reducing the costs by rendering datasets searchable and accessible at several data portals.

[18] https://joinup.ec.europa.eu/solution/e-government-core-vocabularies/core-public-organisation-vocabulary
[19] https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/news/region-trentino-italy

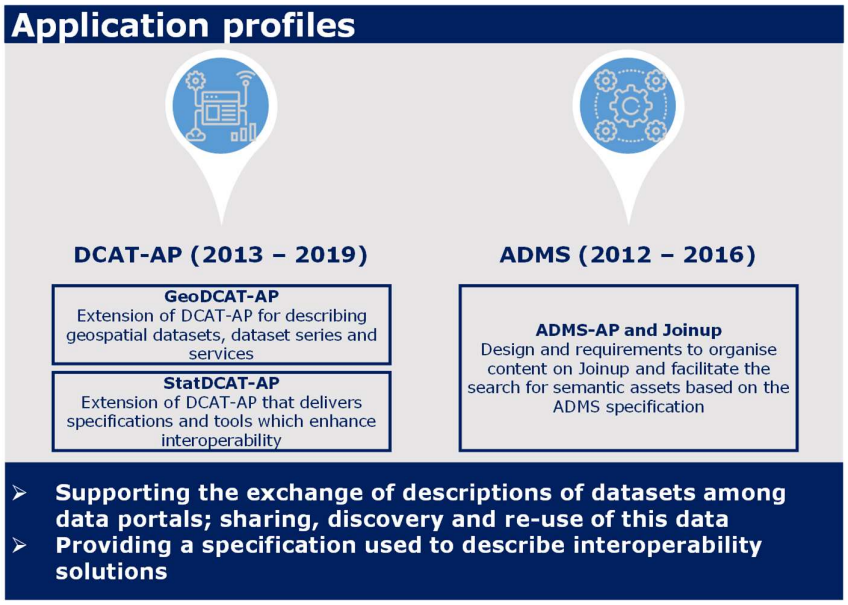

Figure 4: Key highlights from the development of application profiles

4.1. DCAT-AP

The Data Catalog Application Profile is based on the specification of the **Data Catalog Vocabulary** (DCAT)[20] developed under the responsibility of the Government Linked Data Working Group[21] at W3C. The work on DCAT was initiated[22] at the Digital Enterprise Research Institute (DERI) and the Greek National Institute for Public Administration and Decentralization. DCAT is an RDF[23] vocabulary designed to facilitate interoperability between data catalogues published on the Web.

In its communication on Open Data[24] of 12 December 2011, the European Commission stated that the availability of the information in a machine-readable format as well as a thin layer of commonly agreed metadata could facilitate data cross-reference and interoperability and therefore considerably enhance its value for reuse. In alignment with this communication, the objective of the Data Catalog Vocabulary Application Profile is to support the exchange of descriptions of datasets among data portals, hence the sharing, discovery, and re-use of this data.

DCAT-AP was drafted and sent for Working Group review and discussion in 2013. It was reviewed in 2015 to version 1.1, in 2018 to version 1.2, and in 2019 to version 2.0. Version 2.0 includes the alignment with W3C DCAT 2.0 introducing the ability to share data services.

[20] W3C. Data Catalog Vocabulary (DCAT). https://www.w3.org/TR/vocab-dcat/
[21] W3C. Government Linked Data (GLD) Working Group. http://www.w3.org/2011/gld/wiki/Main_Page
[22] Fadi Maali, Richard Cyganiak, Vassilios Peristeras: Enabling Interoperability of Government Data Catalogues. EGOV 2010: 339-350
[23] W3C. Resource Description Framework (RDF). http://www.w3.org/RDF/
[24] http://ec.europa.eu/information_society/policy/psi/docs/pdfs/opendata2012/open_data_communication/en.pdf

Several activities have been conducted to support the uptake of the DCAT-AP, including:

- The documentation of technical guidelines for implementation in 2016 and 2017 based on feedback received from implementers;
- The definition of OWL and SHACL expressions (based on DCAT-AP v1.1) in 2018 with stakeholders from the Publications Office of the EU and JRC;
- An analysis of the actual use of classes and properties in 2018;
- The definition of a change and release management policy in 2018; and
- An analysis in 2018 of DCAT-AP as a common language between research metadata models, which thus supports the exchange of metadata between research data catalogues.

4.1.1. GeoDCAT-AP

GeoDCAT-AP is an extension of DCAT-AP for describing geospatial datasets, dataset series and services. It first version was drafted and released 2015, which was updated to version 1.0.1 in 2016.

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 ISA Programme) and Communications Networks, Content and Technology (DG CONNECT) of the European Commission.

4.1.2. StatDCAT-AP

StatDCAT-AP is an extension of DCAT-AP that delivers specifications and tools which enhance interoperability between descriptions of statistical data sets within the statistical domain, and between statistical data and open data portals. It was drafted in 2015, further elaborated in 2016, and publicly reviewed and published in 2017. This extension to DCAT-AP defines a small number of additions to the DCAT-AP model that are particularly relevant for statistical datasets.

4.2. ADMS

The Asset Description Metadata Schema (ADMS) is a specification used to describe interoperability solutions, such as data models and specifications, reference data and open source software. It was drafted in 2012, and its version 1.00 was endorsed by EU Member States in the ISA Coordination Group meeting on 23 May 2012. It was updated to version 2.00 in 2016.

4.2.1. ADMS-AP and Joinup

The design and requirements to organise content on Joinup and facilitate the search for semantic assets based on the ADMS specification were defined in 2012.

In 2013 the promotion of the ADMS-based federation of semantic asset repositories (Joinup) was achieved by both expanding its coverage with increasing the number of participating repositories and improving the functionalities (e.g. querying). In addition, vocabularies as the ADMS.SW[25] (a metadata vocabulary to describe software) and activities as the identification of existing EU Institutions semantic assets aimed at further consolidating semantic assets on Joinup. During that phase, Joinup was further tested in 2013 as part of the SEMIC activities of phase

For more detail of the changes made on all analysed application profiles, please refer to the chapter ***12 Annex III. Application profiles change log***.

5. PILOTS

Following the development of the Core Vocabularies and the definitions of standards under the Application Profiles, the SEMIC action implemented several pilot implementations intending to demonstrate the applicability of ISA² specifications on e-Government Core Vocabularies, Linked Data, and metadata governance and management.

These pilot projects were conducted in close collaboration with public administrations in several EU Member States as well as European Commission services and other EU bodies and agencies; they were carried by the SEMIC team either through the use of SEMIC interoperability solutions (assets) or the provision of services by experts in semantic interoperability matters. Figure 5 below provides a summary of the pilots implemented within the frame of the project.

[25] https://joinup.ec.europa.eu/release/admssw-100/v100

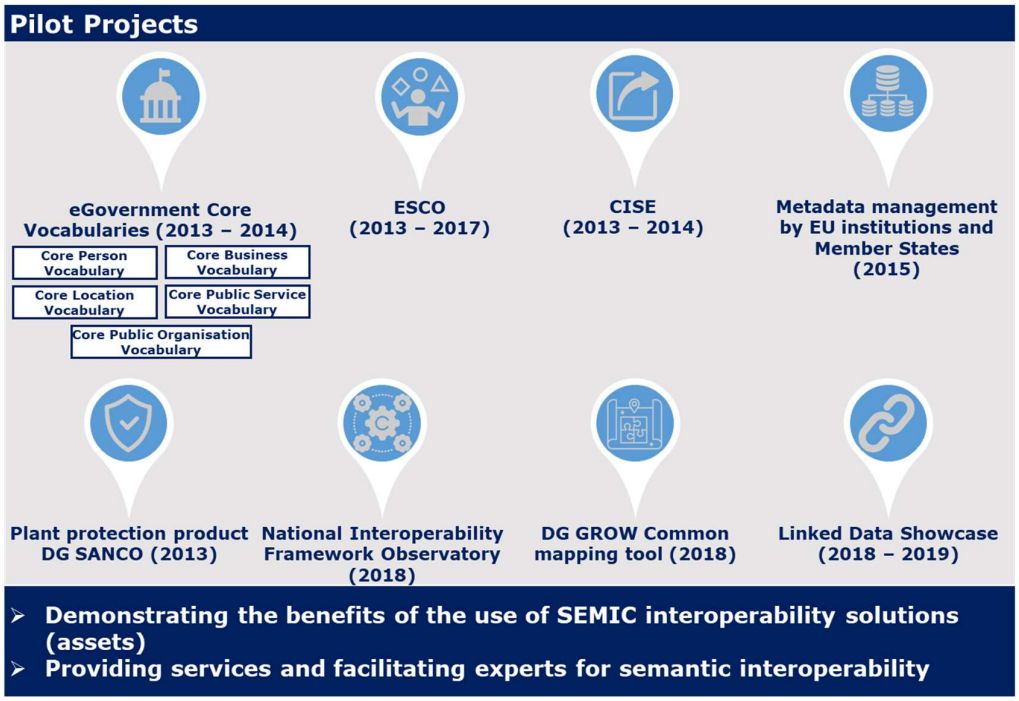

Figure 5 : Key highlights from the development of SEMIC pilot projects

5.1. eGovernment Core Vocabularies

This section documents a subset of the pilots conducted for the implementation of SEMIC eGovernment Core Vocabularies[26]. The implementations varied in its form depending on the needs of the stakeholders. Also, whilst some stakeholders opted for uptaking several of the eGovernment Core Vocabularies (as the region of Trentino in Italy for their platform CommunWeb[27]) others opted to only adopt the Core Vocabulary most relevant to their specific business needs.

5.1.1. Core Person Vocabulary (CPV)

The Core Person Vocabulary[28] was reused by the e-CODEX large-scale pilot[29], and was mapped with the Minimum Patient Summary Dataset for Electronic Exchange in accordance with the cross-border Directive 2011/24/EU[30] in 2014.

[26] https://joinup.ec.europa.eu/solution/e-government-core-vocabularies/about
[27] The region of Trentino (Italy) piloted the Core Business, Core Person and Core Public Organisation Vocabularies in 2018. https://ec.europa.eu/isa2/sites/isa/files/docs/publications/2017_core_vocabularies_leaflet_lr_v11.pdf
[28] https://joinup.ec.europa.eu/solution/e-government-core-vocabularies/core-person-vocabulary
[29] https://ec.europa.eu/isa2/actions/improving-semantic-interoperability-european-egovernment-systems_en
[30] https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:088:0045:0065:EN:PDF

5.1.2. Core Business Vocabulary (CBV)

The Core Business Vocabulary[31] was piloted[32] with data of the Greek tax administration on Linking public sector's organisational data with the Greek Ministry of Administrative Reform and e-Governance (MAREG)[33].

5.1.3. Core Location Vocabulary (CLV)

The Core Location Vocabulary was piloted[34] with Belgian regional and national address registers 'Interconnecting Belgian National and Regional Address Data'.

5.1.4. Core Public Service Vocabulary (CPSV)

The Core Public Service Vocabulary was piloted[35] with various organisations, including the Digital Enterprise Research Institute (DERI: Irish public service catalogue), the Flemish e-Government Coordination Unit (CORVE), and the 'SPOCS' Large Scale Project.

5.1.5. Core Public Organisation Vocabulary (CPOV)

The Core Public Organisation Vocabulary[36] was piloted with various organisations[37], including the region of Trentino in Italy, the Flemish Information Agency, and the Publications Office of the EU.

5.2. European Skills, Competences, Qualifications and Occupations (ESCO)

The main purposes of the European Skills, Competences, Qualifications and Occupations (ESCO) pilot were to test the Qualification Metadata Schema (QMS)[38] and its different format publishing options, with the objective to demonstrate that qualification information published in a decentralised way can be retrieved and represented in a harmonized way in the portals developed by the Commission, namely ESCO[39] and Learning Opportunities and Qualifications (LOQ)[40]. The pilot started in 2015 and continued its different phases until 2017. Some of the stakeholders involved in the project included public administrations from Spain and Sweden, and the Microsoft Corporation that respectively provided information about nationally recognised qualifications and information about its qualifications. One of the key objectives of the pilot was to help to describe qualifications in terms of learning outcomes in

[31] https://joinup.ec.europa.eu/solution/registered-organization-vocabulary
[32] https://joinup.ec.europa.eu/node/51862
[33] http://www.ydmed.gov.gr/
[34] https://joinup.ec.europa.eu/node/63242
[35] https://joinup.ec.europa.eu/node/63148
[36] https://joinup.ec.europa.eu/solution/core-public-organisation-vocabulary/about
[37] https://ec.europa.eu/isa2/solutions/core-vocabularies_en
[38] The Qualification Metadata Schema (QMS) is an application profile used to describe qualifications which aims at supporting linked data publishing of qualifications across Europe. https://ec.europa.eu/esco/resources/grd/QMSspecifications.pdf
[39] ESCO, Multilingual classification of European Skills, Competences, Qualifications and Occupations, https://ec.europa.eu/esco/portal/home
[40] LOQ, Learning opportunities and qualifications in Europe. https://ec.europa.eu/education/resources-and-tools/related-websites-and-tools/learning-opportunities-and-qualifications-in-europe_fr

line with the European Qualifications Framework (EQF)[41] and the National Qualifications Frameworks (NQFs)[42].

5.3. Metadata management by EU institutions and Member States

In parallel with the various studies conducted on the subject of metadata management, several pilots were conducted.

In SEMIC phase 4, 2 pilots were conducted based on the deliverable defining a methodology and tools for Metadata Governance and Management for EU Institutions and Member States[43]:

- One of the pilots consisted in the tailoring of a methodology for the management and governance of reference data for the State-aid information systems (register of planned State-aid) of DG COMP[44]. In these systems, the Commission exchanges information both internally (with DG AGRI, DG MARE and Eurostat) and with European public administrations in all Member States. The outcome of the pilot included an assessment of the extent to which the Generic Interoperable Notification Services (GENIS) Reference Data Component (RDC) could support the reference data governance and management processes, the identification of the most suitable governance and management procedures, standards and best practices, and an inventory of existing tools to support these.

- The other pilot[45] consisted of the definition of a governance and management methodology determining roles, responsibilities and high-level process for managing the lifecycle of structural metadata. The objective of this pilot was to support DG MARE in building consensus about structural metadata and promoting its sharing and reuse within the Marine and Maritime domain, within Europe and beyond.

In SEMIC phase 5, a pilot[46] was conducted to analyse to which extent the Reference Data Deployment Adapter (REDDA)[47] could be tailored to support the needs of domains other than State Aid control and by other entities, such as in the marine and maritime domain managed by DG MARE.

5.4. Common Information Sharing Environment (CISE)

The Common Information Sharing Environment (CISE)[48] for the EU Maritime Domain aimed to integrate in 2013 existing surveillance

[41] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008H0506%2801%29&from=EN
[42] https://www.cedefop.europa.eu/es/events-and-projects/projects/national-qualifications-framework-nqf
[43] Elaborated by SEMIC team https://joinup.ec.europa.eu/sites/default/files/inline-files/Methodology-and-tools-for-Structural-Metadata-Management-and-Governance-for-EU-Institutions-and-Member-States_v1.00.pdf
[44] https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/our-pilots
[45] https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/our-pilots
[46] Additional information can be found on https://joinup.ec.europa.eu/sites/default/files/inline-files/Methodology-and-tools-for-Structural-Metadata-Management-and-Governance-for-EU-Institutions-and-Member-States_v1.00.pdf
[47] The reference data deployment adapter (Redda) is a building block which functionalities include importing, managing, govering and disseminating semantic assets (metadata and, more specifically, reference data). https://joinup.ec.europa.eu/solution/redda
[48] http://www.emsa.europa.eu/cise.html

systems and networks and give all concerned authorities access to the information they need for their missions at sea. The pilot[49] conducted focused on the semantic and technical aspects of information and data exchange between public administrations in the maritime domain and its key stakeholders were DG MARE, the European Maritime Safety Agency (EMSA) and the Spanish Armada (ARMADA).

5.5. Plant protection product (DG SANCO)

In 2012-2013 a pilot[50] was conducted on linking data about applications and decisions for the authorisation of plant protection products (PPP) in collaboration with the Directorate-General for Health and Consumers (DG SANCO), which became in 2014 the Directorate-General for Health and Food Safety (DG SANTE). The pilot aimed at facilitating the exchange of information among the Member States, the Commission and stakeholders with regards to applications for authorisation of plant protection products that are submitted at a national level. Such a system is also foreseen in Regulation No 1107/2009[51] of the European Parliament and Council concerning the placing of plant protection product on the market.

5.6. National Interoperability Framework Observatory

The SEMIC action has been collaborating with the National Interoperability Framework Observatory (NIFO)[52] action since 2018 to provide a mechanism that converts the NIFO factsheets into Linked Open Data. Specifically, the SEMIC action provides support to the NIFO action by creating machine-readable representations of the NIFO factsheets. The result is that factsheet documents that are currently available on Joinup under the NIFO collection[53] are published as Linked Open Data so that they can be enriched with data from other sources.

5.7. DG GROW Common mapping tool

The ISA Programme supported DG GROW through the SEMIC action in 2018 in their project aiming to develop an interoperable mapping solution[54]. This solution[55] will support the development of a platform consolidating the information about the tools to support innovation and the supporting actors for enterprises and SMEs. Within this context, the main objective of the collaboration between DG GROW and SEMIC was to develop a reusable common data model, which would be as generic as possible to ensure that the Common Mapping Tool is able to merge information on the projects with inherently diverse data models. This common data model will facilitate the exchange of data among the various European and national platforms and a federated central website. The ultimate goals of the collaboration were to reduce duplication of effort for European data providers, increase the overall data quality and trust,

[49] https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/our-pilots
[50] https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/our-pilots
[51] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32009R1107&from=EN
[52] https://joinup.ec.europa.eu/collection/nifo-national-interoperability-framework-observatory/about
[53] https://joinup.ec.europa.eu/collection/national-interoperability-framework-observatory-nifo/nifo-factsheets
[54] https://ec.europa.eu/isa2/news/interested-semantic-interoperability-read-about-semic-highlights-second-half-2018_en
[55] https://ec.europa.eu/isa2/news/interested-semantic-interoperability-read-about-semic-highlights-second-half-2018_en

and improve the user experience for any authorities and enterprises looking for key information.

5.8. Linked Data Showcase

The Linked Data Showcase (LDS) pilot[56] was requested by the Member States with the objective of showcasing the use of a reference architecture to provide machine-readable linked data based on existing relational databases. The solution aims to help national public administrations make the first steps towards realizing their own linked data solutions on a regional, national or supra-national level.

6. STUDIES

Throughout its implementation, the SEMIC action has focused on addressing different topics within to achieve seamless and high-quality data transmissions between European public administrations, via the promotion of interoperability solutions as a fundamental enabler of such exchanges.

Across its main areas of activity, the project has carried out several studies which are documented and summarised in this chapter. These studies explore the governance, technological, and policy application aspects of semantic interoperability for public administration. They provide a set of case studies and policy recommendations in support of the European Commission data strategy. The main topics discussed through the studies include:

- Policy support measures,
- Supporting organisations in their semantic interoperability journey through different means, and/or
- The provision of expertise within specific data domains.

Figure 6 below provides a summary of the studies produced within the frame of the project. Amongst these are included studies on policy support for semantic interoperability. Details on these studies are further provided in this section.

[56] https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/linked-data-showcase-lds-pilot-value-interlinking-data

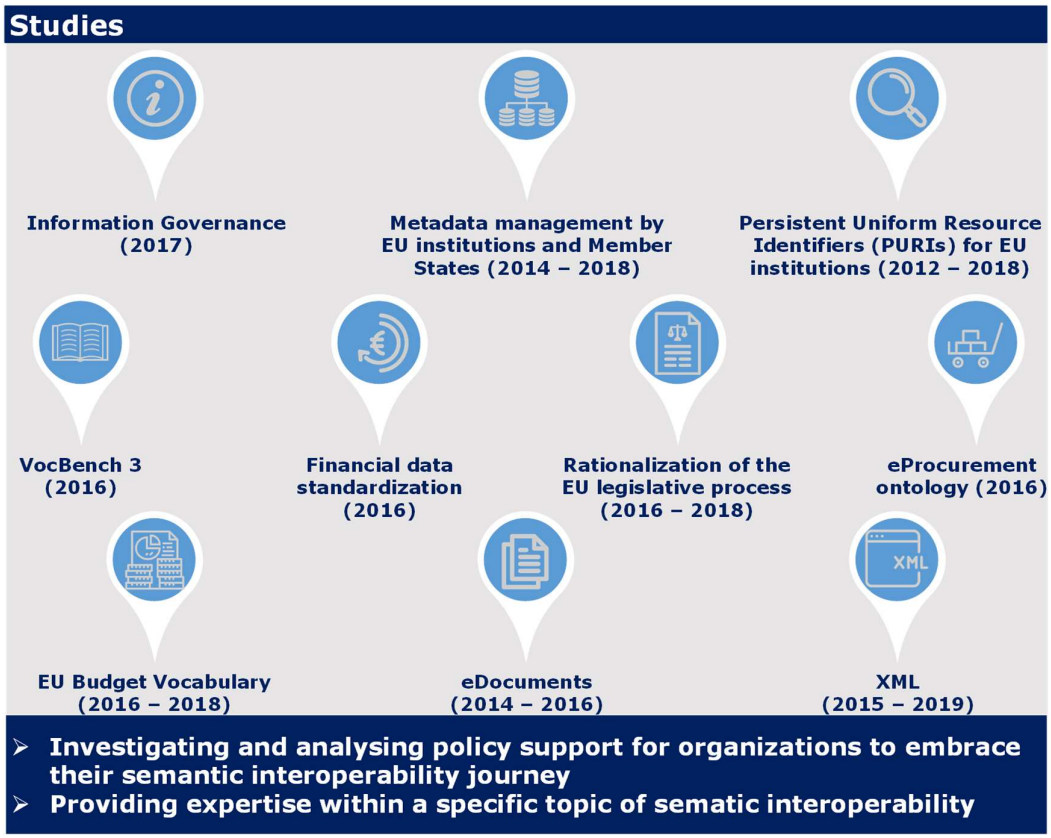

Figure 6: Key highlights from the studies provided under the SEMIC action

6.1. Information Governance

The communication to the Commission on "Data, information and knowledge management at the European Commission"[57] in 2016 recognised the strategic use of data, information and knowledge as a key element for improving the current way of working in the Commission, emphasising teamwork, overcoming silo mentalities, and harnessing synergies between portfolios. In alignment with this communication, SEMIC aimed to help public administrations to put in place information governance, analysed 5 case studies in 2017 (from ECDC, EFSA, Eurocontrol, Malta national data governance council and the European Commission's Information Management Steering Board) and in parallel supported from then some of these stakeholders to establish an information governance framework.

6.1.1. EFSA

The SEMIC team supported EFSA[58] in SEMIC phase 7 by documenting the generic principles and tools for the development and implementation of their information governance model. Later in phase 8, the team worked on proposing the governance structure as part of EFSA Information

[57] https://ec.europa.eu/transparency/regdoc/rep/3/2016/EN/C-2016-6626-F1-EN-MAIN.PDF
[58] https://ec.europa.eu/isa2/sites/isa/files/leaflet_information_governance_lr_title_v12.pdf

Governance Charter work package "1. Setting up of Information Governance Council and Information Management Desk", and highlighting the expected benefits following the implementation of such governance structure.

6.2. Metadata management by EU institutions and Member States

As structural metadata is a key enabler to promote semantic interoperability since it allows to represent information in a machine-readable way thus data automatic processing, the SEMIC action has focused on the matter in its different phases.

An analysis was performed from 2014[59] on the existing metadata policies and practices on management of structural metadata (i.e. data models and reference data). In parallel, raise awareness activities were conducted on the importance of metadata governance management.

More precisely, in 2014[60] a study was conducted on existing metadata management and governance practices and tools in EU Institutions and Member States, and an analysis was performed on practical solutions related to metadata alignment, which derived in the identification of lessons learnt and good practices.

In 2015, the requirements and specifications for the governance and management of structural metadata[61] as well as for metadata tools that may be used by EU institutions and Member States were defined.

These activities lead to the definition in 2015 of a set of processes and identify tools for the management and governance of data models that were further updated in 2018[62].

6.3. Persistent Uniform Resource Identifiers (PURIs) for EU institutions

As an enabler to persistent discoverability and reusability of public sector information, Unique Resource Identifiers (URIs) have increasingly become important in the context of application integration and data integration. They indeed allow to identify data and other types of resources on the web in a unique and persistent manner.

With the ultimate goals to support the establishment of a service and draft a policy for persistent URIs for EU institutions, the first activities on PURIs by the SEMIC team were carried out in 2012 with a survey[63] on good practices on the publication of URIs, both in terms of format and of their design rules and management.

[59] https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/document/metadata-management-requirements-and-solutions-euis-and-mss
[60] https://joinup.ec.europa.eu/sites/default/files/inline-files/Methodology-and-tools-for-Structural-Metadata-Management-and-Governance-for-EU-Institutions-and-Member-States_v1.00.pdf
[61] https://joinup.ec.europa.eu/sites/default/files/custom-page/attachment/methodology_and_tools_for_metadata_governance_and_management_for_eu_institutions.pdf
[62] https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/document/updated-metadata-governance-tools-report
[63] https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/document/10-rules-persistent-uris

From then on, support was provided in every phase of the SEMIC action to define and implement a Persistent URI Service and later a policy, i.e. a common approach for the management of URIs by EU institutions that meets the needs of data providers and consumers:

- In 2013 a study[64] was carried out on the existing practices and case studies;
- In 2014 a study[65] was conducted on a common approach for the management of persistent Uniform Resource Identifiers (URIs) by EU institutions. It contained a business case, specifications for the governance and management of persistent URI sets, design rules for persistent URI sets, and the functional specifications for a persistent URI application;
- The proposed approach for establishing a PURI Committee was drafted in 2015[66,67], and the responsibilities defined in 2016; and
- The local URI design patterns[68] were documented in 2018.

In addition, an analysis[69] of the Nomenclature of Territorial Units for Statistics (NUTS)[70] and a proposal on an RDF model and on the approach to provide persistent URIs for NUTS codes was done in 2017 and revised in 2018.

6.4. VocBench 3

The SEMIC team supported the development of VocBench 3[71] in 2016 with the definition of a list of user requirements and technological stack. VocBench 3 offers a solution for the management, alignment and publication of controlled vocabularies as linked data. The key stakeholder and reviewer of the study was the Publications Office of the EU.

[64] https://joinup.ec.europa.eu/solution/study-persistent-uris-identification-best-practices-and-recommendations-topic-mss-and-ec/distribution/study-persistent-uris-identification-best-practices-and-recommendations-topic-mss-and-ec

[65] https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/document/towards-common-approach-management-persistent-http-uris-eu-institutions

[66] https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/news/eu-institutions-define-comm

[67] https://www.slideshare.net/stijngoedertier/towards-a-persistent-uri-service-for-eu-institutions-a-proofofconcpet

[68] https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/document/supporting-implementation-persistent-uri-policy-eu-institutions

[69] https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/document/supporting-implementation-persistent-uri-policy-eu-institutions

[70] Reference framework: European Commission Regulation No 1059/2003 https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32003R1059

[71] https://ec.europa.eu/isa2/isa2conf18/vocbench-3_en

6.5. Financial data standardisation

The SEMIC team conducted in 2016 an assessment[72] in the area of financial data reporting standardization in collaboration with DG FISMA. It aimed at analysing the potential of standardization in financial data reporting, as the lack of harmonization hinders the data analytics capabilities in e.g. risk analysis and market monitoring.

6.6. eProcurement ontology (ePO)

The objective of the work carried out on the eProcurement ontology[73] aimed at putting together the necessary information to proceed with the specification of the eProcurement Ontology (ePO), including a process and methodology to be followed for the development of the ePO. More specifically, the scope of this work carried out in 2016 was to identify the target audience and the key use cases for the ePO, document and analyse existing initiatives to discover overlaps and gaps, identify which ones to reuse and with which ones to align, and identify reference data and code lists that can be referenced to by the ePO.

In order to achieve the ultimate objective of the ePO which back in 2016 was to put forth a commonly agreed OWL ontology that will conceptualise, formally encode and make available in an open, structured and machine-readable format data about public procurement, covering it from end to end, the work was continued in the following years in a separate project under the supervision of the Publications Office of the EU.

6.7. EU Budget Vocabulary

Owned by the Publications Office of the EU, the EU Budget Vocabulary[74] and its RDF serialisation were first published in 2016 and updated in 2018 by the SEMIC team. The objectives of this vocabulary are to facilitate the exchange, increase the understandability and foster the reusability of budgetary information published by the EU. Hence it aims to increase government transparency by improving the availability, usability and understandability of the EU Budget.

6.8. eDocuments

Several studies, pilots, mappings and activities were conducted with regards to e-Documents[75], triggered by the EU Regulation 2016/1191[76] promoting the free movement of citizens by simplifying the requirements for presenting certain public documents in the EU.

In 2014 the SEMIC team conducted the 'Analysis of structured e-Document formats used in Trans-European Systems'[77] including a

[72] https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/news/european-commission-suppo
[73] https://joinup.ec.europa.eu/sites/default/files/document/2017-03/sc245di07171_d04.07_report_on_policy_support_for_e-procurement_v1.00_0.docx
[74] https://joinup.ec.europa.eu/solution/eu-budget-vocabulary/about
[75] https://joinup.ec.europa.eu/solution/isa2-action-201626-e-documents-and-e-files/about
[76] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32016R1191
[77] https://ec.europa.eu/isa2/sites/isa/files/miscellaneous/analysis-of-structured-e-document-formats-used-in-trans-european-systems_en.pdf

detailed analysis of fourteen e-Document formats. In addition, that year the SEMIC team also conducted a study[78] and pilot with the e-SENS[79] WP6.2 Competence Cluster on Semantics, processes and Documents, on e-Document engineering methods.

During the next phase in 2015, recommendations for public administrations on e-Document engineering methods[80] and Survey on standardized e-Document formats[81] were documented.

The work was continued in the following years in a separate action of the ISA Programme focusing specifically on Interoperability agreements on electronic documents and electronic files.

6.9. XML

As one of the syntaxes enabling semantic interoperability, several activities were conducted with regards to the Extensible Markup Language (XML).

In 2015 an XML vocabulary was built for the Business Registers Interconnection System (BRIS) to be used for making basic company information searchable and exchangeable. This vocabulary[82] was based on the XML syntax of the eGovernment Core Vocabularies.

In 2017 an analysis[83] was completed on the XML schemas from the Mutual Legal Assistance e-CODEX project and on the European Land Registry Association (ELRD) XML schemas from a Land Registers project, with the aim of assessing the existing overlaps and differences between these schemas and the eGovernment Core Vocabularies.

In 2019 a study[84] was conducted aiming to provide an overview of the most relevant XML specifications used in message exchange between applications including short descriptions of international standards as UN/CEFACT, UBL, XBRL, LegalXML, NIEM. During that same phase of the action in 2019, a second study focused on the basic principles and defining a set of guidelines for producing XML schemas in public administrations.

7. MAINTENANCE OF SEMIC PRODUCTS

With the objective of defining a consistent and long-term process for the maintenance of SEMIC products, several components have been put in place or further documented since 2018.

[78] https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/news/two-new-studies-e-document
[79] https://ec.europa.eu/digital-single-market/en/news/e-sens-paving-way-live-phase-cross-border-digital-public-services
[80] https://joinup.ec.europa.eu/node/93213
[81] https://joinup.ec.europa.eu/node/78169
[82] https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/news/core-business-vocabulary-0
[83] https://www.elra.eu/wp-content/uploads/2019/09/Fidel-SantiagoCore-Vocabularies-IMOLA.pdf
[84] https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/document/study-landscape-xml-syntaxes

7.1. Configuration management

The objective of the configuration management of SEMIC products is to define and control the components of services and infrastructure and maintain accurate configuration information on the historical, planned and current state of the services and infrastructure.

7.1.1. Configuration Management Database (CMDB) of SEMIC products

The CMDB aims to provide a consolidated information of all the assets of the SEMIC action.

In 2018 the key functional and technical aspects of the SEMIC configuration management database (Access database) were described. The aim was to store in one place, in a structured format, an exhaustive overview of SEMIC assets (including SEMIC's products), specifications, studies, etc. being considered Configuration Items (CIs) in the CMDB.

7.1.2. Working instructions

In 2019 the working instructions were documented for updating SEMIC CMDB with product information, publishing product information on JoinUp and uploading product information on GitHub.

7.2. Description of a change and release management process for ISA specifications

A change and release management process for ISA specifications was documented from 2015 to 2018[85], formalising how changes to the specifications of the ISA Programme were to be managed and how new releases should be published. The change management process was reviewed and updated as needed, in order to formalize how changes are recorded and then evaluated, authorized, prioritized, planned, tested, implemented, documented and reviewed in a controlled manner. Similarly the release management process was as well reviewed and considered as a continuation of the change management process.

[85] https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/document/description-change-management-release-and-publication-process-structural-metadata-specifications

8. COLLABORATION WITH OTHER INITIATIVES AND ORGANISATIONS

This chapter documents some of the key initiatives and organisations with which the SEMIC Action of the ISA Programme has most or more regularly collaborated with.

8.1. W3C

The World Wide Web Consortium (W3C) is an international community which develops open standards with the aim to ensure the long-term growth and maintenance of the Web.

W3C has been a strategic partner[86] of SEMIC since its initiation, originally through its W3C's eGovernment Activity and Interest Group Charter[87]. Both initiatives have collaborated in synergic and parallel activities which details are documented below.

8.1.1. eGovernment Core Vocabularies

The SEMIC team included team members from W3C[88] in the inception[89] of the Core Person Vocabulary, the Core Business Vocabulary, and the Core Location Vocabulary. SEMIC played the role of incubator of these 3 Core Vocabularies jointly with W3C, and handed over their maintenance to W3C where they were planned to undergo a global standardisation process. The first versions of these vocabularies[90] were hosted within the w3.org domain[91], and were later transferred to joinup. The change of governance from ISA Programme as solely incubator to incubator and maintainer of the eGovernment Core Vocabularies was effective as from 2015, due to the changes within W3C's organisation that no longer comprise a dedicated working group[92] to maintain this responsibility. However, the eGovernment Core Vocabularies have since remained governed jointly by both the ISA Programme and W3C.

In parallel, W3C standards and recommendations were used as a reference and/or a basis to construct some of SEMIC's semantic specifications, e.g. W3C's Organization Ontology[93] was one of the references reviewed when defining the Core Public Organisation Vocabulary. In addition, the maintenance of SEMIC semantic specifications has been aligned with the changes taking place within the W3C Government Linked Data Working Group with regards to description metadata.

There has been a strong link between the ISA Programme and W3C in the eGovernment Core Vocabularies since the beginning of the SEMIC, related to

[86] https://www.w3.org/egov/wiki/Related_Initiatives
[87] https://www.w3.org/egov/IG/charter-2011
[88] W3C was e.g. part of EU ISA Programme Core Vocabularies Working Group (Core Location Vocabulary Task Force) : https://www.w3.org/2015/04/locn
[89] https://www.w3.org/blog/2012/06/implementing-adms-and-the-core/
[90] ADMS was also initially published by W3C : https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/news/w3c-publishes-two-specificati
[91] See how the eGovernment Core Vocabularies (Person, Business, Location) are presented on the W3C domain: Core Business Vocabulary as the Core Registered Organisation Vocabulary: https://www.w3.org/TR/vocab-regorg/; Core Person Vocabulary: https://www.w3.org/ns/person; and Core Location Vocabulary: https://www.w3.org/ns/locn.
[92] The Government Linked Data Working group was discontinued in May 2013.
[93] https://www.w3.org/TR/vocab-org/

its inception, maintenance, hosting and synergic and parallel initiatives with regards to vocabularies. In the future, for a more efficient development and maintenance of the eGovernment Core Vocabularies, it would be beneficial to re-assess the roles and responsibilities of each initiative in order to establish a simpler governance model.

8.1.2. DCAT-AP

The application profile of DCAT (DCAT-AP) was created for describing public sector datasets in Europe based on W3C's DCAT standard. Whereas the maintenance of DCAT-AP was initially conducted in alignment with and in sequence after the updates on DCAT, in 2017 the ISA Programme released its own change and release management policy for DCAT-AP[94] and accordingly proceeded in November 2019 to the publication of DCAT-AP major release (version 2.0) prior to W3C's DCAT version 2.0. Even though version 2.0 of DCAT-AP was published before version 2.0 of DCAT, there were stakeholders from W3C involved in the maintenance process for DCAT-AP so that the planned changes for DCAT 2.0 were included in DCAT-AP 2.0.

8.1.3. Events

The SEMIC initiative has been present and presented at W3C relevant events (e.g. at the Open Geospatial Consortium event, at the Smart Descriptions & Smarter Vocabularies Workshop (SDSVoc), etc.) and similarly W3C has been a regular participant to the yearly SEMIC conferences.

8.2. OSLO Programme

8.2.1. Context

The Open Standards for Linked Organisations (OSLO)[95] initiative from Flanders (Belgium) aims to achieve standardisation for the exchange of data by enabling and recognising semantic and technical data standards. Started in 2012, the first phase of this project ended in 2015 and was the result of a public-private partnership and supported by a wider community including the European Commission's programme "Interoperability Solutions for European Public Administrations (ISA)". The project stakeholders opted to follow ISA best practices[96] to develop their semantic agreement based on ISA's "Process and methodology for developing core vocabularies"[97] as a generic process and methodology, which they complemented with practical insights on how to overcome the specificities of their administration and government. The lessons learned in the process can serve as a basis to efficiently conduct similar initiatives in other countries.

8.2.2. Status

Data models

[94] https://joinup.ec.europa.eu/solution/dcat-application-profile-data-portals-europe/document/change-and-release-management-policy-dcat-ap
[95] https://joinup.ec.europa.eu/collection/oslo-open-standards-linked-organisations-0/about
[96] https://biblio.ugent.be/publication/8504205/file/8504206
[97] Version from 2011: https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/document/process-and-methodology-developing-core-vocabularies

The initiative currently comprises a simplified, reusable and extensible data model with local extensions of the Core Person, Business, Location, and Public Service Vocabularies. These data models capture the fundamental characteristics of information exchanged by Flemish public administration such as contact information, localisation and public services. OSLO extended the Core Vocabularies to include properties and relationships required in the data exchanges in Flanders, like family composition, contact details, or persons acting on behalf of a registered organization. They also developed their own Core Vocabularies such as the Road vocabulary.

Tools

Across its different phases, SEMIC has supported OSLO in their journey to define a process and methodology for developing their semantic agreement, in their adoption and extension of the eGovernment Core Vocabularies[98] and by conducting several pilots. More recently, OSLO has developed a set of processes and tools for an efficient development and maintenance of semantic specifications (e.g. a toolchain[99]) which is aligned with the current roadmap of SEMIC. Therefore, OSLO is nowadays a referent in the field of semantic interoperability implemented at local level, from which SEMIC and other Member States can leverage its experience and ecosystem of tools for providing better public services through, among others, their experience in integrating information intensive processes between different applications, administrations and government levels.

8.3. Other organisations

8.3.1. NIEM

The US National Information Exchange Model (NIEM) data model is a data dictionary of agreed-upon terms, definitions, relationships, and formats. It has been developed by United States' state and local practitioners overseen by an Executive Steering Council (ESC) comprised of the US Department of Homeland Security, the US Department of Justice and the US Department of Health and Human Services. The NIEM model includes the NIEM Core and 12 individual NIEM Domains. The NIEM Core consists of data elements commonly understood and defined across domains, such as person, activity, document, location, and item. It is governed jointly by all NIEM domains. NIEM domains contain mission-specific data components that build upon NIEM core concepts.

Similarly as to other parallel initiatives across Europe and abroad, the work of NIEM has been followed by the SEMIC team across the phases. The team analysed the approach, the synergies and opportunities of NIEM. In addition to a mapping to their data model, SEMIC also assessed NIEM core library of data elements (NIEM Core) for harmonising different data models which led to the creation of the page http://mapping.semic.eu/.

[98] https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/news/flemish-oslo-standard-beco
[99] https://joinup.ec.europa.eu/collection/oslo-open-standards-linked-organisations-0/about

8.3.2. Schema.org

Schema.org is a community activity with the objective to create, maintain, and promote schemas for structured data on the Internet. The mapping of the eGovernment Core Vocabularies to schema.org was conducted in 2018 and included the documentation of the conceptual mapping in Excel, its formal encoding in RDF and the transformation of the mapping to RDFa.

9. CONCLUSIONS AND NEXT STEPS

The SEMIC action has been a hub and incubator of semantic interoperability activities across Europe. The different activities conducted between 2010 and 2019 have achieved:

- The creation of the largest community of semantic interoperability experts, growing and meeting year after year in the SEMIC conference and more importantly exchanging their views and lessons learnt within the field of semantic interoperability, allowing to learn from each other's experiences;

- The raise in awareness on the importance of semantic standards to policy makers and ICT solution developers among others;

- The provision of expert support to public administrations in the Member States in their semantic interoperability journey, aiming for the achievement of a seamless exchange of information across public administrations in Europe and facilitating the provision of digital public services, in anticipation of and later in alignment with the Digital Single Market policy;

- The development of solutions and data specifications enabling cross border exchange of information and therefore improved provision of public services;

- Finally, the provision of support within the European Commission and other EU Institutions in their needs and duties related to semantic interoperability, but more broadly on (meta)data governance and management driven by the latest policy developments.

As one of the incubator and accelerator of the activities related to semantic interoperability, it is key that the legacy of the action remains a centralised hub in the domain to be able to maintain and enrich the knowledge acquired and the assets developed in the past decade.

The future steps of the action should therefore focus on establishing a clear governance of SEMIC assets based on the lessons learned, as well as on a definition of roles and responsibilities within the data standardisation ecosystem. Indeed, past activities of previous phases of the action depict at times a lack of efficiency towards the intended objectives due to inefficacious, fragmented or unclear distribution of roles and responsibilities, as well as to inconsistent ways of working. In this direction, the on-going work of deliverable D02.01 SEMIC style guide for drafting semantic specifications of the present contract documents guidelines for consistently developing and maintaining SEMIC specifications.

10. ANNEX I. SEMIC CONFERENCES

This annex documents the programme of the yearly SEMIC Conferences from phases 2 to 11.

10.1. Phase 2: 2011

Location: Brussels (Belgium)

Theme: Rethinking Semantic Interoperability Through Collaboration

Programme (speakers and topics):

Start	Finish	Subject
9:00	9:30	Registration & Coffee
9:30	9:40	**Welcome to the SEMIC.EU Yearly Conference** Mr. Declan Deasy, European Commission DIGIT.B2, Information Systems and Interoperability Solutions, Director
9:40	10:15	**The Semantic Interoperability Community of Practice experience in the USA** Keynote Speaker: Dr. Brand Niemann, Semantic Community, Director and Senior Data Scientist
10:15	10:30	Coffee Break
10:30	10:50	Opportunities and challenges for using semantic technologies Prof. Stefan Decker, National University of Ireland, the Digital Enterprise Research Institute (DERI), Director
10:50	11:10	Can the lack of Semantic Interoperability in Europe be seen as a collaborative challenge? How SEMIC.EU aims to help Public Administrations overcoming it João Rodrigues Frade, PwC, Manager
11:10	11:30	Core Concepts and first steps towards a federation of asset repositories Dr. Renke Fahl-Spiewack, Jinit[, Team Leader
11:30	12:00	Discussion and wrap-up of morning sessions Interactive Q&A
12:00	13:30	Lunch Break
PART 2: Semantic Interoperability for Public Services		
13:30	14:15	**How to harness collaboration, National Semantic Interoperability** **Projects in Europe** - Digitaliser.dk - more than a repository Adam Arndt, National IT and Telecom Agency, Special Adviser - Yhteentoimivuus.fi is how you spell interoperability in Finnish Tommi Karttaavi, Association of Finnish Local and Regional Authorities, Senior Advisor, Information Society - The Estonian Semantic Interoperability Framework: Building a Better e-State through Collaboration Dr. Peep Küngas, University of Tartu, Institute of Computer Science, Senior Researcher - The Essence project: collaborative and contextual semantic interoperability Paul Oude Luttighuis, Essence, Project Manager

14:15	15:15	**Case Studies: Semantic Interoperability in Pan-European Projects** - A Linked Data approach to sharing public sector service and project information Mike Thacker, Porism Limited, Technical Director - UK local government electronic service delivery (esd) toolkit, Technical Partner - Creating an Ecosystem of Linked Governmental Data Dr. Sören Auer, AKSW/Computer Science Dept., University of Leipzig – leader of several large-scale collaborative research projects such as German BmBF funded project LE4SW, EU-FP7-ICT funded integrated project LOD2 or Eureka funded SCMS - EuroFiling project: Semantic interoperability in primary financial reporting Ignacio Boixo, European Banking Authority XBRL Operational Network, Coordinator - SPOCS (Simple Procedures Online for Cross- Border Services) project [To be Confirmed] Dinand Tinholt, SPOCS Programme, Director
15:15	15:30	Coffee Break
15:30	16:15	**Panel Discussion: Semantic Interoperability Community of Practice** Dr. Vassilios Peristeras, European Commission DIGIT.B2, Information Systems and Interoperability Solutions, Programme Manager Dr. Brand Niemann, Semantic Community, Director and Senior Data Scientist Prof. Stefan Decker, National University of Ireland, the Digital Enterprise Research Institute (DERI), Director Representatives from Member States Dr. Renke Fahl-Spiewack,]init[, Team Leader Pieter Breyne, PwC, Director
16:15	16:30	Conference wrap-up Interactive Q&A
16:30	17:30	**Networking drink**

Table 1: SEMIC 2011 Conference

10.2. Phase 3: 2012

Location: Brussels (Belgium)

Theme: Explore semantic technologies for increased interoperability

Programme (speakers and topics):

Start	Finish	Subject
9:00	9:30	Registration & Coffee
9:30	9:45	**Welcome to the SEMIC 2012** Declan Deasy (European Commission, Director of Directorate-General for Informatics – DIGIT B)
09:45	10:15	**Keynote – National Information Exchange Model (NIEM)** Anthony Hoang (U.S. Dept. of Homeland Security - DHS, National Information Exchange Model - NIEM)
10:15	10:35	**ADMS, Federation and Core Vocabularies - Improving semantic interoperability in European e-Government systems** Vassilios Peristeras (European Commission, Interoperability Solutions for European Public Administrations (ISA) Unit)
10:35	10:55	Coffee Break
10:55	11:15	**Putting ADMS into practice, the case of the German XRepository** Dr. Andreas Gehlert (German Federal Office for Information Technology)

11:15	12:00	**Panel Session - "Towards Semantic Standards"** This panel will bring together representatives of standardisation bodies to discuss about the future of semantic standards and the rapid transition from academic topic to adoption by the ICT industry. **Facilitator: Margarida Abecasis,** (European Commission, Head of Interoperability Solutions for European Public Administrations (ISA) Unit) **Panellists:** • **Tim McGrath**, plenary bureau vice-chair - UN/CEFACT • **John Borras**, ICT standards expert - OASIS • **Edmund Gray**, business methodologies and standards expert - CEN/CENELEC • **Prof. Dr. Jos van Hillegersberg**, extensive work on quality of semantic standards - University of Twente • **Milan Zoric**, standards expert - ETSI • **Thomas Roessler**, technology and society domain leader - W3C
12:00	13:30	Lunch break
13:30	14:00	**Keynote – Semantic technologies and open data** Jeanne Holm (Data.gov, U.S. General Services Administration)
14:00	14:20	**Use of semantic technologies by Open Data platforms** Bastiaan Deblieck (TenForce)
14:20	14:40	**Use of semantic technologies for publishing and sharing European Spatial Data** Andrea Perego (Joint Research Centre of the European Commission - JRC)
14:40	15:00	**Use of semantic technologies for publishing and re-using cultural and scientific heritage data** Antoine Isaac (Europeana)
15:00	15:20	**Use of semantic technologies by the Estonian Public Sector** Priit Parmakson (Estonian Information System's Authority)
15:20	15:40	Coffee Break
15:40	16:25	**Panel Session - "Is it the right time to invest in semantic technologies?"** This panel will bring together experts in semantic technologies who have practical experience in implementing these technologies. This panel will focus on "why" others should consider using semantic technologies. **Facilitator:** *Vassilios Peristeras* (European Commission - Interoperability Solutions for European Public Administrations (ISA) Unit) **Panellists:** • **Pieter Breyne,** Director - PwC Technology Consulting • **Martin Kaltenböck,** Managing Partner & CFO of Semantic Web Company, Austria - Semantic Web Company • **Philippe Loopuyt,** European Commission, Head of Unit Information Systems - Directorate-General for Health and Consumers - DG SANCO • **Bastiaan Deblieck,** Business Unit Manager - Semantic Technology - TenForce • **Antoine Isaac,** *Scientific Coordinator* **-** Europeana
16:25	16:40	**Conference wrap-up** Declan Deasy (European Commission, Director of Directorate-General for Informatics DIGIT B)
16:40	17:30	**Networking drink**

Table 2: SEMIC 2012 Conference

10.1. Phase 4: 2013

Location: Dublin (Ireland)

Theme: Semantic interoperability for basic public services

Programme (speakers and topics):

Start	Finish	Subject

9:00	9:30	Registration & Coffee
9:30	9:35	**Welcome to SEMIC 2013** Margarida Abecasis - European Commission, DG DIGIT, Interoperability Solutions for European Public Administrations
9:35	9:50	**ISA fostering semantic interoperability between public administrations in Europe** Vassilios Peristeras - European Commission, DG DIGIT, Interoperability Solutions for European Public Administrations
PART 1: Achieving interoperability through reuse		
9:50	10:20	Keynote - Maintaining the quality of EU statistics while enabling re-use Marco Pellegrino - Eurostat
10:20	10:40	Open Standards for eGovernment – The evolution of the eGov Core Vocabularies and ADMS Phil Archer - W3C
10:40	11:00	Putting the eGov Core Vocabularies into practice Stijn Goedertier & Nikolaos Loutas - PwC EU Services
11:00	11:20	Coffee Break
11:20	11:40	Extending the eGov Core Vocabularies to a local level by the OSLO project (Open Standards for Local Administrations – Belgium) Raf Buyle - V-ICT-OR, the Flemish ICT organisation
11:40	12:00	Integrating plant protection product data using semantic technologies Giorgos Georgiannakis - European Commission, DG SANCO
12:00	12:20	ISA methodologies supporting the Common Information Sharing Environment for the EU Maritime Domain Fernando Dias Marques - Portuguese Directorate-General for Maritime Policy
12:20	13:30	Networking Lunch
PART 2: Semantic Interoperability for Public Services		
13:30	14:00	**Keynote - Peta vs. Meta, Rethinking Data Interoperability on the World Wide Web** James Hendler - Rensselaer Polytechnic Institute (RPI)
14:00	14:20	**Semantic Interoperability of Basic Data in the Italian Public Sector** Giorgia Lodi - Agenzia per l'Italia Digitale (AgID)
14:20	14:40	**Applying semantics and language technology in TMClass to harmonise trademark registrations** Jochen Hummel & Gudrún Magnúsdóttir - ESTeam AB
14:40	15:00	**Semantic interoperability of Civil Status Registers by the International Commission on Civil Status (ICCS-CIEC)** Panagiotis Gouvas - UBITECH
15:00	15:20	Coffee Break
15:20	15:40	**Building on INSPIRE: Existing and missing components for cross-domain interoperability in the EU** Andrea Perego - Joint Research Centre
15:40	16:00	**Metadata interoperability - The DCAT Application profile for data portals in Europe** Leda Bargiotti - Publications Office of the European Union
16:00	16:20	**Open Data Pipeline – publishing and linking government data** Richard Cyganiak - DERI, NUI Galway

16:20	16:30	Conference wrap-up Margarida Abecasis - European Commission, DG DIGIT, Interoperability Solutions for European Public Administrations
16:30	17:30	**Networking drink**

Table 3: SEMIC 2013 Conference

10.2. Phase 5: 2014

Location: Athens (Greece)

Theme: Metadata governance and management

Programme (speakers and topics):

Start	Finish	Subject
8:30	9:15	Registration & Coffee
9:15	9:30	**Opening- Greek Presidency** Paraskevi (Evy) Christofilopoulou, Deputy Minister- Hellenic Ministry of Administrative Reform and e-Governance
9:30	9:40	**Welcome to SEMIC 2014** Gertrud Ingestad, Director- DG Informatics B-Information Systems and Interoperability Solutions.
9:40	9:50	**ISA fostering semantic interoperability between public administrations in Europe** Vassilios Peristeras, Programme Manager- Interoperability Solutions for European Public Administrations - ISA Programme - European Commission
9:50	10:35	Keynote talk Kshemendra Paul, Program Manager- Information Sharing Environment, United States
10:35	11:00	Coffee Break
Session I: Metadata Governance and Management		
11:00	11:20	Metadata Management for Communicating Value of Public Services Mihkel Tikk, Head of Department- Estonian Information System's Authority
11:20	11:40	Metadata Governance in the German public sector: the XÖV Framework Lutz Rabe, Project Manager- IT-Standards Coordination Office (KoSIT)
11:40	12:00	Management of Metadata and XML Schemas for e-Justice Interoperability Pim Keizer, Data Analyst- Ministry of Justice the Netherlands Pim van der Eijk, Owner- Sonnenglanz Consulting
12:00	12:20	Survey on metadata management and governance in Europe Makx Dekkers, SEMIC team- AMI Consult
12:20	13:50	Networking Lunch
Session II: Semantic interoperability		
13:50	14:10	**The role of Publications Office in semantic web and standardisation activities** Willem Van Gemert, Information Systems Architect Marc Wilhelm Kuster, Head of Section Publications Office of the European Union

14:10	14:30	**European Legislation Identifier "ELI" – towards a legal semantic interoperability** John Dann, Chair of the ELI Task Force -Luxembourg
14:30	14:50	**Linking Legal Data** John Sheridan, Head of Legislation Services- UK National Archives
14:50	15:10	**Boosting online job search with semantic interoperability throughout Europe** Martin Le Vrang, Team Leader-DG Employment,Social Affairs&Inclusion,ESCO
15:10	15:30	**Semantic building block convergence to support** e-Government in Europe Muriel Foulonneau, Research Engineer- Henri Tudor Research Center, e-SENS
15:30	15:50	**An industry perspective on deployed semantic interoperability solutions** Ralph Hodgson, CTO- TopQuadrant
15:50	16:20	Coffee Break
16:20	16:50	**Panel: Semantic interoperability and access to base registers** Antonis Stasis, Head of Directorate- Hellenic Ministry of Administrative Reform and e-Governance,STORK project David Norheim, Head of Department- Computas Katrien De Smet,Project Manager- CORVE Nikolaj Skovmann Malkov,Enterprise Architect- KL Moderator: Stijn Goedertier, Manager- PwC.
16:50	17:10	Making Open Data work for Europe Daniele Rizzi, Policy Officer- DG Communications Networks, Content and Technology Nikolaos Loutas, Manager- PwC
17:10	17:30	Open vocabularies, a need for linked open data infrastructures Johannes Keizer, Information Systems Officer- UN FAO
17:30	17:45	Conference wrap-up Gertrud Ingestad, Director- DG Informatics B-Information Systems and Interoperability Solutions
17:45	18:30	**Networking drink**

Table 4: SEMIC 2014 Conference

10.3. Phase 6: 2015

Location: Riga (Latvia)

Theme: Bringing Enterprise Information Management and Service Portfolio Management to public administration

Programme (speakers and topics):

Start	Finish	Subject
8:30	9:30	Registration & Coffee
9:30	9:40	**Opening – Latvian Presidency** Arnis Daugulis – Deputy State Secretary, Ministry of Environmental Protection and Regional Development of the Republic of Latvia.
9:40	9:50	**Welcome to SEMIC 2015** Gertrud Ingestad – Director, DG Informatics B-Information Systems and Interoperability Solutions Chairperson of SEMIC 2015.

9:50	10:10	**Enterprise Information Management and Service Portfolio Management for the Public Sector** Vassilios Peristeras – Programme Officer, ISA Programme of the European Commission.
10:10	10:50	**Keynote – Japanese Common Vocabulary Project** Shuichi Tashiro (田代 秀一) – General Manager, IPA Open Standards Promotion Centre. Takashi Wada (和田 恭) – Director, Ministry of Economy, Trade and Industry.
10:50	11:10	**Challenges of the semantic interoperability layer: core registers and their contribution to core data model establishment.** Peter Reichstädter - Senior Strategy Evangelist, Austrian Federal Chancellery.
11:10	11:40	Coffee Break
Part 1: Enterprise Information Management		
11:40	12:00	**Different dimensions of the once-only principle** Mechthild Rohen - Head of Unit, Public Services (Unit H.3), DG CNECT of the European Commission.
12:00	12:20	**Presentation on the Stelselcatalogus** Kristian Mul - Programme Manager Stelselcatalogus, Logius
12:20	12:40	**Finnish Act of 2011 on Information Management Governance in Public Administration** Jari Kallela - Ministerial adviser, Ministry of Finance
12:40	13:00	**The Value and Implications of Master Data Management (MDM) and Metadata Management** Dimitris Geragas - VP Consulting, Gartner
13:00	14:30	Networking Lunch
14:30	14:50	**Creating Data Value Chains by Linking Enterprise Data** Sören Auer - University of Bonn, Germany.
14:50	15:10	**The Technology Transfer Center of Spain - The portfolio of solutions (services, applications, data models, legislation, etc.) for Spanish public administrations.** Elena Muñoz Salinero - Head of Telematic Systems, Ministry of Finance and Public Administration.
15:10	15:30	**Core data models in E-governement interoperability - roadmap for Latvia** Dita Gabaliņa - Ministry of Environmental protection and Regional Development, Latvia.
Part 2: Service Portfolio Management		
15:30	16:00	Coffee Break
16:00	17:00	**Panel discussion: Best practices for service portfolio management** Panel moderators: Miguel Alvarez-Rodriguez & Peter Burian – Programme Officers, ISA Programme of the European Commission, responsible for ISA Action 1.3 "Catalogue of Services".
17:00	17:15	**Closing speech** Gertrud Ingestad – Director, DG Informatics B-Information Systems and Interoperability Solutions Chairperson of SEMIC 2015.
17:30	19:00	**Networking drink** Organised in collaboration with the ContAct Riga event.

Table 5: SEMIC 2015 Conference

10.4. Phase 7: 2016

Location: Rome (Italy)

Theme: Data standards for interconnected Public Administrations

Programme (speakers and topics):

Start	Finish	Subject
8:30	9:30	Registration & Coffee
9:30	9:50	**Opening** Stefano Quintarelli - Deputy of the Italian Parliament and chairman of the Steering Committee of Agenzia per l'Italia Digitale - AgID, Italy Antonio Samaritani - General Director, Agenzia per l'Italia Digitale - AgID, Italy

9:50	10:00	**Welcome to SEMIC 2016** Gertrud Ingestad – Director General , DG Informatics, European Commission Conference chair Dave Keating - Multimedia Journalist, Belgium Conference moderator
10:00	10:30	**Keynote speech: Global Standards enabling interoperability – a case study** Feargal Mc Groarty - National Haemophilia System Project Manager, St. James's Hospital, Ireland
10:30	10:40	**Core vocabulary project in Japan - Corporate information portal website** Kenji Hiramoto - Chief Strategist, National Strategy Office of IT, Cabinet Secretariat, Government of Japan
10:40	10:50	**Enabling Information Interoperability** Steve Ambrosini - Executive Director, IJIS Institute, USA
10:50	11:15	Coffee Break
11:15	11:35	**The role of Data Standards in semantic interoperability** Vassilios Peristeras – Programme Manager, ISA² Programme of the European Commission
11:35	12:20	**Panel discussion: Data Standards – Experience from practical implementations at national and international level** Panel moderator: Nikolaos Loutas – Senior Manager Data and Analytics, PwC, Belgium Panellists: - John Dann - Director at the Central Legislation Service at the Ministry of State in Luxembourg, and Chair of the "ELI Task Force" of the EU Council on the implementation of the "European Legislation Identifier" (ELI), Government of Luxembourg - Marc Kuster - Head of the"Storage and electronic archive" sector, EU Publications Office - Patrocinio Nieto Moreno - Service Manager, Ministry of Finance and Public Administration, the Government of Spain - Lutz Rabe - Desk Officer, IT-Standards Coordination Office (KoSIT), Germany - Shuichi Tashiro - General Manager, Information Promotion Agency (IPA), Japan - Steve Ambrosini - Executive Director, IJIS Institute, USA
12:20	12:40	**A Corporate Information Management Framework for the European public sector - the sine qua non for Information Interoperability** Declan Deasy - Former Director DG Informatics, European Commission
12:40	13:00	**The Legal Entity Identifier: an industry standard providing open and reliable data for unique identification management** Clare Rowley - Head of Business Operations, Global Legal Entity Identifier Foundation (GLEIF), Switzerland
13:00	14:15	Networking Lunch
14:15	14:30	**Base Registries Data Management, the importance of semantics and the challenges ahead of us** Peter Burian - Programme Manager, ISA² Programme of the European Commission
14:30	14:50	**Linked Base Registries as a key enabler for eGovernment in Flanders** Ziggy Vanlishout - Programme Manager Flemish Base Registries, The Flemish Information Agency (AGIV), Belgium
14:50	15:05	**ISA Action on Catalogue of Services: A common vocabulary for linking-up and exchanging information about public services** Miguel Alvarez - Programme Manager, ISA² Programme of the European Commission
15:05	15:25	**The Italian PSI infrastructure: The National Public Service Catalogue** Giorgia Lodi - Agenzia per l'Italia Digitale - AgID, Italy
15:25	15:40	**EIRA semantic interoperability specifications based on standards** Raúl Mario Abril Jiménez - Programme Manager, ISA² Programme of the European Commission
15:40	16:05	Coffee Break
16:05	16:25	**Linked Open Economy: take full advantage of economic data** Michalis Vafopoulos - Affiliate Researcher, National Centre for Scientific Research DEMOKRITOS, Greece
16:25	16:45	**Use of International Standards in the Financial Industry** Paul Janssens - Programme Director, SWIFT, Belgium
16:45	17:05	**Access to re-usable public sector information: the European Data Portal and the CEF programme** Daniele Rizzi - Policy Officer, DG CNECT, European Commission

17:05	17:35	**Panel discussion: Creating a European Open Data Ecosystem: DCAT Application profile for data portals in Europe - implementation cases** Panel moderator: Makx Dekkers - Data Standards expert, consultant, Spain Panellists: – Simon Dutkowski - Senior System Architect, Fraunhofer FOKUS, Germany – Marco Pellegrino - Statistical officer and project manager c/o Eurostat European Commission – Andrea Perego - Scientific Project Officer, European Commission's Joint Research Centre – Bart Hanssens - Interoperability Expert, Fedict, Belgium – Hans Overbeek - Senior advisor standardisation, Netherlands Publication Office
17:35	17:55	**Conclusions** Gertrud Ingestad – Director General , DG Informatics, European Commission Conference chair
17:55	18:30	**Networking drink**

Table 6: SEMIC 2016 Conference

10.5. Phase 8: 2017

Location: Valleta

Theme: Data and Information Management

Programme (speakers and topics):

Start	Finish	Subject
8:30	9:30	Registration & Coffee
9:30	9:40	**Opening** Hon. Silvio Schembri, Parliamentary Secretary for Financial Services, Digital Economy and Innovation at the Office of the Prime Minister, Malta
9:40	9:55	**Welcome to SEMIC 2017** Gertrud Ingestad – Director General , DG Informatics, European Commission
9:55	10:15	**ISA fostering semantic interoperability between public administrations in Europe** Natalia Aristimuño Pérez, Head of Interoperability Unit, ISA² Programme, DG Informatics, European Commission
10:15	11:00	**Keynote speech: Data and information management from the end-user's point of view** Janek Rozov, Head of Department of Information Society Services Development, Ministry of Economic Affairs and Communications for Estonia
11:00	11:15	Coffee Break
Session I - Information Governance and Management in Member States, EU Institutions and Agencies Moderator: Nikolaos Loutas, PwC Belgium		
11:15	11:30	**The National Data Strategy of Malta** Dr. Joseph Saviour Azzopardi LL.D., Doctor of Laws / Data Advocacy, Malta Information Technology Agency (MITA)
11:30	11:35	**Q&A**
11:35	11:50	**Data, Information and Knowledge Management at the European Commission** Peter van Landegem, Policy Officer on Corporate Management and IT Governance, Secretariat-General, European Commission
11:50	11:55	**Q&A**
11:55	12:10	**The Luxembourg Experience** Gilles Feith, Luxembourg Government CIO and Director of Luxembourg's Government IT Center (CTIE)
12:10	12:15	**Q&A**
12:15	12:30	**Developing an Information Asset Catalogue at ECDC** Gaetan Guyodo, Senior Expert Data Manager, European Centre for Disease Prevention and Control (ECDC)

12:30	12:35	**Q&A**
12:35	12:50	**Information Governance Framework at EFSA** Guido Zunino, Programme Officer, European Food Safety Authority (EFSA)
12:55	14:30	Networking Lunch
Session II - Data Analytics Moderator: Brecht Wyns, PwC Belgium		
14:30	14:43	**Social Inclusion Big Data Pilot** Manuel Pérez Gómez, Advisor, Region of Madrid
14:43	14:56	**Text mining for policy making: a semantic tool to support evaluation of research proposals** Olivier Eulaerts, Data and Analytics at Joint Research Centre, European Commission
14:56	15:09	**Changes to IT architecture to enable Data Analytics within Eurostat** Titus Purdea, Head of Unit IT Governance and Service Management at Eurostat, European Commission
Session III - Master data: Base registries as a source of Master Data, Interoperability of Master Data Moderator: Brecht Wyns, PwC Belgium		
15:09	15:25	**The Once Only Principle: Large Scale Pilot** Robert Krimmer, Professor of e-Governance at Tallinn University of Technology
15:25	15:35	**Q&A**
15:35	16:05	Coffee Break
Session IV - Open Data: Knowledge Sharing Moderator: Brecht Wyns, PwC Belgium		
16:05	16:17	**Tailoring ISA² Vocabularies to German GovData metadata federation needs** Sebastian Sklarß, Consultant, init AG (German National Open Data Portal)
16:17	16:30	**Joined-up Data Standards** Beata Lisowska, Ph.D., Data Scientist
16:30	16:35	**Q&A**
Panel - Metadata: Information retrieval and delivery Moderator: Vassilios Peristeras, International Hellenic University		
16:35	17:15	**Semantically marking up government portals** Raf Buyle, Information Architect, Informatie Vlaanderen Francesca Gleria, Program Manager, Provincia Autonoma di Trento **Metadata Standards at the Publications Office** Norbert Hohn, Head of Open Data Portal sector, The Publications Office of the European Union
17:15	17:30	**Closing** Markku Markkula, President of the European Committee of the Regions
17:30	19:00	**Networking drink**

Table 7: SEMIC 2017 Conference

10.6. Phases 9-10: 2018

Location: Sofia (Bulgaria)

Theme: Linked Digital Public Administrations

Programme (speakers and topics):

Start	Finish	Subject

8:30	9:30	Registration & Coffee
9:30	11:00	**Opening – Bulgarian Presidency:** Promotional video by the Bulgarian Presidency to the Council of the EU Alexander Yolovski, S.E.G.A, Bulgaria **Keynote**: Mariya Gabriel, EU Commissioner for Digital Economy and Society **Introduction** by Gertrud Ingestad, Director-General of DG DIGIT, European Commission "**Access to base registers and interconnections between the building blocks - key enablers in the end-to-end principle of eGovernment**" - Alexander Yolovski, S.E.G.A, Bulgaria Keynote: "**Efficient data sharing under democratic governance**" - Jens Krieger Røyen, Head of Division, Danish Agency for Digitisation
11:00	11:30	Coffee Break
Session I: Base Registries		
11:30	13:00	**ISA² Access to Base Registries**: Peter Burian, DG DIGIT, European Commission **Business Registers Interconnection Systems**: Vincent Dijkstra, DG DIGIT, European Commission **A Common Semantic Model for the Once-Only Principle**: Jack Verhoosel, TNO **Central Ontological Model for Base Registries Data in Slovakia**: Miroslav Liska, Slovakia **Land Registers Interconnection**: Gabriel Sima, DG JUST, European Commission
13:00	14:30	Networking Lunch
13:00	14:30	**Project corners / Demos:** Vocbench Demo: Denis Dechandon, EU Publications Office SCOOP4C, Stakeholder Community Once-Only Principle for Citizens: Michaela Führer ELRC, Europan Language Resource Coordination: Lili Smal and Aivars Berzinš IMOLA II: Jesús Camy (ELRA) ISA² SEMIC ChatBot
Session II: The Single Digital Gateway		
14:30	14:45	**The Single Digital Gateway** Fleur Breuillin, DG GROW, European Commission
Session III: Parallel sessions (14:50-15:30)		
14:50	15:30	1) OSLO: Raf Buyle, Flanders Methodology and Tools - support for Semantic Interoperability: Per de Place Bjørn, Denmark 2) Financial Data Standardisation, DG FISMA RegTech project: Peter van den Hul, DG FISMA, European Commission Interoperability of Chemical Data: Francois Mestre, European Chemicals Agency (ECHA) 3) National Metadata Architecture & Interoperability Workbench: Suvi Remes, Ministry of Finance, Finland Doris: Franco Accordino, DG CNECT, European Commission
15:30	16:00	Coffee Break
Session IV: Emerging Technologies		
16:00	16:45	Artificial Intelligence at the service of the citizen: the Italian task force: Enzo Maria Le Fevre / Dr. Marco Bani, Agenzia per l'Italia Digitale Blockchain Cadastre: Jacques Vos, Kadaster, Netherlands

Panel: Digital Strategies		
16:45	17:30	Laura Rodríguez, AGESIC, Uruguay Kenji Hiramoto, National strategy office of IT, Cabinet Secretariat, Japan Anna Panagopoulou, Director, DG RTD J, European Commission Luis Felipe Salin Monteiro, Secretary of State, Brazil Moderator: Vassilios Peristeras
17:30	17:45	**Closing speech** Emanuele Baldacci, Director of DIGIT, European Commission
17:45	19:00	**Networking drink**

Table 8: SEMIC 2018 Conference

10.7. Phase 11: 2019

Location: Helsinki (Finland)

Theme: Linked Data Spaces for Citizens

Programme (speakers and topics):

Start	Finish	Subject
8:30	9:15	Registration & Coffee
9:15	10:30	Anna-Maija Karjalainen | Director General of Public Sector ICT, Ministry of Finance, Finland Gertrud Ingestad | Director-General of DG DIGIT, European Commission Keynotes: Magdalena Cordero | Director of Information, Workplace and Innovation, European Court of Auditors João Vasconcelos | Digital government policy analyst at the Reform of the Public Sector Division, Public Governance Directorate, OECD
10:30	11:00	Coffee Break
Main session - From Reactive to Proactive City		
11:00	13:00	Mikko Rusama | Chief Digital Officer, The City of Helsinki and Chairman of the Board, Forum Virium Helsinki, Finland Panel on the Linked Data Showcase (LDS) pilot Moderator Jaana Nevalainen | Senior specialist, Ministry of Finance, Finland Jakub Klímek | Linked Open Data Expert, Ministry of the Interior, Czech Republic Steinar Skagemo | Senior Advisor, Brønnøysund Register Center, Norway Peter Bruhn Andersen | Linked Data Architect, Agency for Digitisation, Denmark
13:00	14:30	Networking Lunch
Parallel tracks (14:30-16:00)		

14:30	16:00	**Track I: Cross-border examples of data exchange between public administrations** Moderator Eileen Fuchs | Head of Division for Digital Policy, EU and International Affairs at the Federal Ministry of the Interior, for Building and Community Session I: Cross-border exchange between Slovenia and Sweden Alenka Žužek Nemec | Secretary, Ministry of Public Administration, Slovenia Hans Ekstål | Strategist on Information Supply, Companies Registration Office, Sweden Session II: Cross-border exchange between Finland and Estonia: The Nordic Institute for Interoperability Solutions Miia Mänd | Head of Department of IT Policy, Ministry of Economic Affairs and Communications, Estonia Katja Väänänen | Senior Specialist, Public Sector ICT, Ministry of Finance, Finland **Track II: New technologies** Moderator Riitta Autere | Ministerial Adviser, Ministry of Finance, Finland Session I: Streamlining governmental data-processes by putting citizens in control of their own data - Solid Ruben Verborgh | Professor of Semantic Web technology, IDLab - Ghent University, Belgium Katrien Mostaert | Programme Manager, Informatie Vlaanderen, Belgium Session II: Natural Language and AI solutions for citizen services evolution Salvador Estevan Martínez | Deputy Head of Unit, General Secretariat for Digital Administration, Ministry of Territorial Policy and Public Function, Spain Doaa Samy, PhD | Advanced Computational Linguist Member of the General Technical Office of Plan TL
16:00	16:45	Coffee Break
Closing		
16:45	17:30	**Closing Panel** Moderator Natalia Aristimuño | Head of Interoperability Unit, DG DIGIT, European Commission Eileen Fuchs | Head of Division for Digital Policy, EU and International Affairs at the Federal Ministry of the Interior, for Building and Community Riitta Autere | Ministerial Adviser, Ministry of Finance, Finland **Conclusions** Emanuele Baldacci | Director of Digital Services, DG DIGIT, European Commission
17:30	19:00	**Networking drink**

Table 9: SEMIC 2019 Conference

10.8. Phase 12: 2020

Location: Online

Theme: Sustainable Data Services

Programme (speakers and topics):

Start	Finish	Subject
9:00	10:00	Networking event / exhibition
10:00	10:30	**Opening session** • Dr. Markus Richter, State Secretary at the Federal Ministry of the Interior, Building and Community and Federal Government Commissioner for Information Technology, Germany • Mario Campolargo, Acting Director-General DG DIGIT, European Commission
10:30	11:05	**Keynote: Sustainable API Platforms for Public Administrations** • Erik Wilde, Digital Catalyst, Axway
11:15	12:15	Parallel tracks
11:15	12:15	**PARALLEL TRACK 1 Maintenance of semantic assets - methods and tools** Moderator: Dr. Anastasia Dimou Speakers • Annelies Decraene and Eveline Vlassenroot: "How to keep 40 vocabularies up and running – a success story from Flanders" • Giorgia Lodi: "Lessons learned from public sector LOD deployments in Italy" • Christoph Lange: "Assessing the quality of Linked Data – automating workflows and improving public services"
11:15	12:15	**PARALLEL TRACK 2 Fighting COVID19 through data sharing** Moderator: Blanca Martinez De Aragon Speakers • Stéphane Bégué and Orsi Nagy: "Convalescent plasma database project by European Blood Alliance (EBA)" • Laia Buigues Pastor: "Text-mining through vast quantities of COVID19 scientific papers" • Maria Claudia Bodino and Roberto Polli: "Italy and COVID-19: Data management lessons Learned from the Front Lines"
11:15	12:15	**PARALLEL TRACK 3 Optimizing open data portals and user interfaces** Moderator: Prof. Dr. Elena Demidova Speakers • Eileen Fuchs: "Using and strengthening the German open data ecosystem – experiences and next steps" • Christian Horn: "One step further: using data versus presenting data" • Rhoda Kerins: "Organizational requirements for high quality data provision – insights from Ireland" • Michal Kuban: "Is the Quality of Open Data really a Challenge for an entire Open Data Ecosystem?"
11:15	12:15	**PARALLEL TRACK 4 Providing sustainable data services through Wikibase and Wikidata** Moderator: Seth van Hooland Speakers • Francesco Foglia and Max De Wilde: "Encoding, sharing and promoting DG REGIO funding outcomes as Linked Data via Wikibase – state of play of the KOHESIO project" • Anila Angjeli, Benjamin Bober, Barbara Fischer, Joel Thill, Christel Kayser: "Decentralising the management of national authority files through Wikidata" • Lieven Baert: "Exploration of potential synergies between VocBench and Wikidata for the creation of archival reference"
12:15	14:00	Lunch Break and meeting opportunities Networking event / exhibition
14:00	14:15	**Announcement of EU Datathon 2020 winners** Innovating for Europe with open data Inmaculada Farfán Velasco
14:20	15:20	**Interoperability Academy Speaking Corner** Graduate & master students pitching research idea's at the SEMIC community moderation by Joep Crompvoets and Georges Lobo

15:30	16:10	**Closing debate: Semantics and data policies: what should be the EU priorities** Moderator: David Osimo Speakers • Rufus Pollock • Ruben Verborgh • Heather Broomfield
16:10	16:25	**Conclusions by Emanuele Baldacci**, Director of Digital Services DG DIGIT, European Commission

Table 10: SEMIC 2020 Conference

11. ANNEX II. VOCABULARIES CHANGE LOG

The following table shows the differences between versions of the eGovernment Core Vocabularies analysed:

Vocabulary	Release	Release date	Status	Changes
Core Person Vocabulary (CPV)	0.2	January 2012	Draft version - Deprecated	
	0.3	April 2012	Draft version - Deprecated	This release of the Core Person Specification, version 0.3, is an editorial draft open for review.
	1.0	May 2012	Completed	The Person Core Vocabulary provides a minimum set of classes and properties for describing a natural person, i.e. the individual as opposed to any role they may play in society or the relationships they have to other people, organisations and property; all of which contribute significantly to the broader concept of identity. The vocabulary is closely integrated with the Location and Business Core Vocabularies.
Core Business Vocabulary (CBV)	0.2	January 2012	Draft version - Deprecated	
	0.3	April 2012	Draft version - Deprecated	This release of the Core Business Specification, version 0.3, is an editorial draft open for review.
	1.0	May 2012	Completed	This specification was produced by the Core Vocabularies Working Group (Business Task Force), following the Process and Methodology for Developing Core Vocabularies. It has been reviewed by representatives of the Member States of the European Union, PSI publishers, and by other interested parties. Publication of this Final Draft does not imply endorsement by the European Commission or its representatives. On 23 May 2012, the Member State representatives in the ISA Coordination Group endorsed the Core Business vocabulary v1.00, acknowledging the work and promising to further disseminate it at national level.
Core Location Vocabulary (CLV)	0.2	January 2012	Draft version - Deprecated	
	0.3	April 2012	Draft version - Deprecated	This release of the Core Location Specification, version 0.3, is an editorial draft open for review.

Vocabulary	Release	Release date	Status	Changes
	1.0	May 2012	Completed	This specification was produced by the Core Vocabularies Working Group (Location Task Force), following the Process and Methodology for Developing Core Vocabularies. It has been reviewed by representatives of the Member States of the European Union, PSI publishers, and by other interested parties. On 23 May 2012, the Member State representatives in the ISA Coordination Group endorsed the Core Location vocabulary v1.00, acknowledging the work and promising to further disseminate it at national level.
Core Public Service Vocabulary (CPSV)	0.07	January 2013	Under development	Draft asset release of the CPSV sent ouf for public review.
	1.01	March 2013	Completed	The Core Public Service Vocabulary is a simplified, reusable and extensible data model that captures the fundamental characteristics of a service offered by public administration.
Core Criterion and Core Evidence Vocabulary (CCCEV)	Draft 1	March 2016	Draft version - Deprecated	First editor's draft of the Core Criterion and Core Evidence Vocabulary sent ouf for Working Group review and discussion.
	Draft 2	April 2016	Draft version - Deprecated	The second editor's draft of the Core Criterion and Core Evidence Vocabulary includes an updated data model, taking into account the issues proposed via the issue tracker.
	Draft 3	May 2016	Draft version - Deprecated	The third editor's draft of the Core Criterion and Core Evidence Vocabulary includes an updated data model, taking into account the issues proposed via the issue tracker.
	Draft 4	July 2016	Draft version - Deprecated	The fourth editor's draft of the Core Criterion and Core Evidence Vocabulary has been made available for public review and discussion.
	1.0.0	December 2016	Completed	Version 1.0.0 of the CCCEV specification addressing all the comments and recommendations received during the public review period.
Core Public Organisation Vocabulary (CPOV)	Draft 1	January 2016	Draft version - Deprecated	First editor's draft of the Core Public Organisation Vocabulary sent ouf for Working Group review and discussion.
	Draft 2	February 2016	Draft version - Deprecated	The second editor's draft of the Core Public Organisation Vocabulary includes an updated data model, taking into account the issues proposed via the issue tracker.

Vocabulary	Release	Release date	Status	Changes
	Draft 3	February 2016	Draft version - Deprecated	The third editor's draft of the Core Public Organisation Vocabulary includes an updated data model, taking into account the issues proposed via the issue tracker and discussed during the previous Working Group meetings.
	Draft 4	April 2016	Draft version - Deprecated	The fourth editor's draft of the Core Public Organisation Vocabulary includes an updated data model, taking into account the issues proposed via the issue tracker and discussed during the previous Working Group meetings.
	1.0.0	December 2016	Completed	Version 1.0.0 of the CPOV specification addressing all the comments and recommendations received during the public review period.
Core Public Event Vocabulary (CPEV)	0.04	May 18	Under development	The current version is a first public draft, intended to be piloted in order to find gaps.

12. ANNEX III. APPLICATION PROFILES CHANGE LOG

The following table shows the differences between versions of the application profiles analysed:

Vocabulary	Release	Release date	Status	Changes
DCAT-AP	0.01	March 2013	Draft version - Deprecated	First editor's draft of the DCAT Application Profile for Data Portals in Europe sent ouf for Working Group review and discussion.
	0.02	April 2013	Draft version - Deprecated	Second editor's draft of the DCAT Application Profile for Data Portals in Europe sent ouf for Working Group review and discussion.
	0.03	May 2013	Draft version - Deprecated	Third editor's draft of the DCAT Application Profile for Data Portals in Europe sent ouf for Working Group review and discussion.
	0.04	May 2013	Draft version - Deprecated	Fourth editor's draft of the DCAT Application Profile for Data Portals in Europe sent ouf for Working Group review and discussion.
	1.0	August 2013	Deprecated	The elaboration of the DCAT-AP was a joint initiative of DG CONNECT, the EU Publications Office and the ISA Programme. The specification was elaborated by a multi-disciplinary Working Group with representatives from 16 European Member States, some European Institutions and the US. From April till July 4 2013, Virtual Meetings were held and the specification has gone through a public review period of 2 months.
	1.01	February 2015	Deprecated	The ISA² Programme of the European Commission was starting an activity to review and revise the DCAT Application Profile for Data Portals in Europe, based on experience gained since its initial specification in 2013.
	1.1	November 2015	Deprecated	The UML diagram was corrected on 24/02/2017, fixing an error by removing the dct:creator property.
	1.2	May 2019	Deprecated	The changes implemented in DCAT-AP version 1.2 are related to the comments provided in this issue (https://github.com/SEMICeu/DCAT-AP/issues/1) from GitHub. • Changed cardinality for the Licence Document class – Licence type property (dct:type) from 0… 1 to 0…n, and, as a result, this property can be repeated in the case that multiple licence

Vocabulary	Release	Release date	Status	Changes
				types apply to a licence document. The UML schema, RDF and SCHACL distributions were updated accordingly. • UML schema updated with all the cardinalities described in the specification documentation for easier access to the information. • Editorial fix on page 26 of the DCAT-AP v1.2 published documentation (.DOC, .PDF and .ODT formats) where LicenceDocument dct:type property was represented as a mandatory property instead of a recommended property.

	1.2.1	May 2019	Deprecated	This new version 1.2.1 implements bug fix changes to DCAT-AP version 1.2 addressing comments received via GitHub:
				
				• Updated references to Publications Office Metadata Registry in DCAT-AP v1.2.1 published .DOC, .PDF and .ODT, as mentioned in DCAT-AP-54:
				  ○ Updated references 21-27 and 41 to point from Metadata Registry (MDR) to EU Vocabularies.
				  ○ In Section 5.2 - Controlled vocabularies to be used, updated the entries in table column "Vocabulary name" (MDR-> EU Vocabularies) and "Vocabulary URI".
				• Updated DCAT-AP UML schema as in DCAT-AP-50, by changing the order of startDate and endDate in dct:PeriodOfTime in the diagram DCAT-AP 1.2.1.PNG. The diagram was updated in DCAT-AP v1.2.1 published .SVG, .DOC, .PDF and .ODT.

	2.0.0	November 2019	Completed	The changes implemented in DCAT-AP version 2.0.0 are related to the following issues: • Alignment with W3C DCAT 2.0 which introduces the ability to share data services. • In order to steer towards quality metadata descriptions, the implementation of a number of properties are recommended or made mandatory; • Removal of non-existing controlled vocabularies adms:change_type; • Addition of a new property dcatap:availability that indicates the planned availability of the distribution; • Coherency improvements on the specification and its distributions; • The alignment with W3C DCAT 2.0 resulted in the replacement of the URIs with respect to the last DCAT-AP release 1.2.1. Namely, for describing a Period of Time the DCAT native properties dcat:startDate and dcat:endDate will be used instead of schema:startDate or schema:endDate. A dedicated set of SHACL validation rules are provided in order to support catalogue's owners in the identification of the issue.

Vocabulary	Release	Release date	Status	Changes
				• The supporting distributions, namely the common JSON-LD context and the SHACL templates are improved. To increase their reuse, the distributions are now released under the CC-BY 4.0 licence.
	2.0.1	June 2020	Completed	This new version 2.0.1 implements bug fix changes to the DCAT-AP version 2.0.0, addressing the comments received via GitHub. The main updates cover minor editorial changes, such as: • corrections to the prefix mappings; • insertion of reference on the recommendation URL of DCAT; • updates to the dcterms version to the 012-06-14 version; • corrections to the shacl templates; • version change from 2.0.0 to 2.0.1.
GeoDCAT-AP	1.0	December 2015	Completed	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.
	1.0.1	August 2016	Completed	Version 1.0.1 of the GeoDCAT-AP has been amended with respect to the original one (v1.0) in order to correct a typo concerning the URIs of the code lists of the INSPIRE Registry. No other changes have been done on the original specification.
StatDCAT-AP	0.1	March 2016	Draft version - Deprecated	First editor's draft of the StatDCAT-AP specification sent ouf for Working Group review and discussion.
	0.2	May 2016	Draft version - Deprecated	Second editor's draft of the StatDCAT-AP specification has been made available for review and discussion.
	0.3	June 2016	Draft version - Deprecated	Third editor's draft of the StatDCAT-AP specification has been made available for review and discussion.
	0.4	June 2016	Draft version - Deprecated	Fourth editor's draft of the StatDCAT-AP specification has been made available for public review and discussion.

Vocabulary	Release	Release date	Status	Changes
	0.5	November 2016	Draft version - Deprecated	This is an interim final draft of the StatDCAT-AP specification during the review period addressing comments and recommendattions received at that time.
	1.0	December 2016	Deprecated	Version 1.0.0 of the StatDCAT-AP specification addressing all the comments and recommendations received during the public review period.
	1.0.1	May 2019	Completed	This new version 1.0.1 implements bug fix changes to StatDCAT-AP version 1.0.0 addressing comments received via GitHub: • Aligned the use of the dcterms and dct prefixes in StatDCAT-AP version 1.0.1 in Annex VIII.2 as in StatDCAT-AP-1: @prefix dcterms: http://purl.org/dc/terms/ has been changed to @prefix dct: http://purl.org/dc/terms/ • Updated Annex VI, SDMX structural metadata example as in StatDCAT-AP-2. In order to avoid any ambiguity, URIs are used instead of keywords for DCAT-AP and StatDCAT-AP. • Updated references to Publications Office Metadata Registry as in DCAT-AP-54 and in Table1, Column Vocabulary name for all rows containing MDR: MDR has been changed to EU Vocabularies. • Updated DCAT-AP UML schema as in DCAT-AP-50 by changing the order of startDate and endDate in dct:PeriodOfTime.
ADMS	0.6	May 2011	Draft version - Deprecated	Draft Specification v0.6 for Community Consultation
	0.7	November 2011	Draft version - Deprecated	Proposed ADMS Conceptual Model and Controlled Vocabularies, Second WG Draft
	0.8	February 2012	Draft version - Deprecated	Draft Specification v0.8 for Community Consultation
	0.9	March 2012	Draft version - Deprecated	This release, ADMS Specification v0.9, is intended for Working Group review only. It contains the specification both with and without track changes.
	0.98	March 2012	Completed	This release, ADMS Specification v0.98 is considered the editorial draft in anticipation to v1.0. It incorporates the Working Group's processing of the comments that were raised during the public review period. It contains the specification both with and without track changes.
	1.0	April 2012	Completed	This specification was produced by the ADMS Working Group, following the Process and Methodology for Developing Core Vocabularies. It has been reviewed by representatives of the Member States of

Vocabulary	Release	Release date	Status	Changes
				the European Union, Standardisation bodies and other parties. On 23 May 2012, the Member State representatives in the ISA Coordination Group have endorsed the ADMS v1.00, acknowledging the work and promising to further disseminate it at national level. Several, Member States and Standardisation Bodies have started to implement ADMS and will participate in the first wave of the federation of semantic asset repertories. All of them are part of the Community of Semantic Asset Repositories (CESAR)
	2.0	April 2016	Completed	The changes made from version 1.0 to 2.0 have been collected in an Annex, on the specifications. The alignment between DCAT and ADMS could be considered the main change of the new version, i.e. the use of DCAT classes instead of ADMS classes.
ADMS-AP and Joinup	0.6	May 2011	Draft version - Deprecated	Draft Specification v0.6 for Community Consultation
	0.7	November 2011	Draft version - Deprecated	Proposed ADMS Conceptual Model and Controlled Vocabularies, Second WG Draft
	0.8	January 2012	Draft version - Deprecated	This release, ADMS Specification v0.8, is open for public comments until February 6 2012. Members of the public are invited to download the specification and share their public review by posting comments to the forum (registration required).
	0.9	May 2012	Draft version - Deprecated	This release, ADMS Specification v0.9, is intended for Working Group review only. It contains the specification both with and without track changes.
	0.98	May 2012	Completed	This release, ADMS Specification v0.98 is considered the editorial draft in anticipation to v1.0. It incorporates the Working Group's processing of the comments that were raised during the public review period. It contains the specification both with and without track changes.
	1.0	April 2012	Completed	This specification was produced by the ADMS Working Group, following the Process and Methodology for Developing Core Vocabularies. It has been reviewed by representatives of the Member States of the European Union, Standardisation bodies and other parties. On 23 May 2012, the Member State representatives in the ISA Coordination Group have endorsed the ADMS v1.00, acknowledging the work and promising to further disseminate it at national level. Several, Member States and Standardisation Bodies have started to implement ADMS and will participate in the first wave of the federation of semantic asset repertories. All of them are part of the Community of Semantic Asset Repositories (CESAR)

Vocabulary	Release	Release date	Status	Changes
	2.0	April 2016	Completed	The changes made from version 1.0 to 2.0 have been collected in an Annex, on the specifications. The alignment between DCAT and ADMS could be considered the main change of the new version, i.e. the use of DCAT classes instead of ADMS classes.

13. ANNEX IV. TECHNICAL, POLICY AND LEGAL MILESTONES

The following table summarizes the main legal milestones that have been regulating the evolution of the Semantic Web.

ID	Year	Milestone	Milestone Description	Location
L1	2004	European Interoperability Framework (EIF) version 1.0	European Interoperability Framework (EIF) version 1.0: the EIF is a set of recommendations which specify how administrations, businesses and citizens communicate with each other within the European Union and across member State borders.	http://xml.coverpages.org/IDA-EIF-Final10.pdf
L3	2010	CEN (European Committee for Standardization) & CENELEC (European Committee for Electrotechnical Standardization)	CEN (European Committee for Standardization) & CENELEC (European Committee for Electrotechnical Standardization): association that brings together the National Standardization Bodies of 34 European countries	https://www.cencenelec.eu/standards/Pages/default.aspx
L4	2010	European Interoperability Strategy (EIS)	European Interoperability Strategy (EIS): Europe 2020: a strategy for smart, sustainable and inclusive growth', seeks to turn the EU into a smart, sustainable and inclusive economy, delivering high levels of employment, productivity and social cohesion	https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52010DC2020&from=ES
L5	2010	COM(2010) 744 - Interoperability for European public services	COM(2010) 744 final towards interoperability for European public services	https://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:52010DC0744
L6	2011	European Commission Decision 2011/833/EU on the reuse of Commission documents	European Commission Decision 2011/833/EU on the reuse of Commission documents: all EU institutions are invited to make their data publicly available whenever possible, free of charge and without any copyright restrictions	https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A32011D0833
L7	2012	Regulation (EU) No 1025/2012 on European Standardisation	Regulation (EU) No 1025/2012 on European Standardisation: its objective is to define technical or qualitative specifications with which current or future products, production processes or services can be satisfied.	https://eur-lex.europa.eu/eli/reg/2012/1025/oj
L8	2014	CEF (Connecting Europe Facility)	CEF (Connecting Europe Facility): key EU funding instrument to promote growth, jobs and competitiveness through targeted infrastructure investment at European level	https://ec.europa.eu/inea/en/connecting-europe-facility
L9	2014	Directive 2014/55/EU on eInvoicing	Directive 2014/55/EU on eInvoicing: it establishes a European Standard for eInvoicing in order to streamline various eInvoice formats being used throughout the EU and ensure the seamless flow of eInvoices across the EU	https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32014L0055&from=ES
L10	2014	eIDAS Regulation(EU) No 910/2014	eIDAS Regulation(EU) No 910/2014: it ensured that people and businesses can use their own national electronic identification schemes (eIDs) to access public services in other EU countries where eIDs are also available	https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32014R0910&from=EN

ID	Year	Milestone	Milestone Description	Location
L11	2015	COM(2015) 192 final: A Digital Single Market Strategy for Europe	COM(2015) 192 final: A Digital Single Market Strategy for Europe	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52015DC0192
L12	2015	Decision No 2015/2240 decision on the ISA2 programme	Decision No 2015/2240: decision on Interoperability Solutions and Common Frameworks for European Public Administrations, Businesses and Citizens (the ISA2 programme)	https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32015D2240&from=EN
L13	2016	Follow-up programme to ISA (2016 - 2020)	Follow-up programme to ISA (2016 - 2020). It supports the development of digital solutions that enable public administrations, businesses and citizens in Europe to benefit from interoperable cross-border and cross-sector public services.	https://ec.europa.eu/isa2/isa2_en
L14	2016	Regulation (EU) No 2016/679 on the protection of natural persons	Regulation (EU) No 2016/679 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data.	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32016R0679
L15	2016	eGovernment Action Plan (2016 - 2020)	eGovernment Action Plan (2016 - 2020): it proposes an ambitious vision to make public administrations and public institutions in the European Union open, efficient and inclusive, providing borderless, personalised, user-friendly, end-to-end digital public services to all citizens and businesses in the EU. The Digital Transition Action Plan examines how to effectively implement the eGovernment Action Plan at the local government level.	https://ec.europa.eu/digital-single-market/en/european-egovernment-action-plan-2016-2020
L16	2017	Ministerial Declaration on eGovernment - the Tallinn Declaration	Ministerial Declaration on eGovernment - the Tallinn Declaration: it marks a new political commitment at EU level on significant priorities towards ensuring high quality, user-centric digital public services for citizens and seamless cross-border public services for businesses.	https://ec.europa.eu/digital-single-market/en/news/ministerial-declaration-egovernment-tallinn-declaration
L17	2017	'New EIF' released by the ISA2 programme	'New EIF' was released by the ISA2 programme: this version include policy changes of the past years. (COM(2017) 134). The Interoperability Action Plan sets the base for the European interoperability implementation strategy	https://ec.europa.eu/isa2/sites/isa/files/eif_brochure_final.pdf
L18	2017	Once-Only Principle (TOOP)	The Once-Only Principle (TOOP): its objective is to reduce the administrative burden for individuals and organizations.	https://toop.eu/once-only
L19	2017	Single Digital Gateway (SDG) action	Single Digital Gateway (SDG) action: it aims to provide the technical basis for the implementation of the SDG Regulation by detailing the IT architecture of the Single Digital Gateway and by identifying functional, technical and semantic interoperability challenges for the development of the IT tools and their interconnection with EU Member States IT tools and EU level tools.	https://ec.europa.eu/isa2/actions/common-architecture-single-digital-gateway_en
L20	2018	EC Digital Strategy (C(2018) 7118 final)	EC Digital Strategy (C(2018) 7118 final): it provides the vision of a digitally transformed, user-focused and data-driven administration — a truly digital Commission.	https://ec.europa.eu/info/sites/info/files/file_import/digitally-transformed_user-focused_data-driven_commission_en.pdf

ID	Year	Milestone	Milestone Description	Location
L21	2018	Regulation on the Single Digital Gateway (EU) No 2018/1724	Regulation on the Single Digital Gateway (EU) No 2018/1724: it establishes a single digital gateway to provide access to information, to procedures and to assistance and problem-solving services and amending Regulation (EU) No 1024/2012	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.295.01.0001.01.ENG
L22	2018	Regulation on a framework for the Free Flow of Non-Personal Data in the EU No 2018/1807	Regulation on a framework for the Free Flow of Non-Personal Data in the EU No 2018/1807: it defines the unrestricted movement of data across borders and IT systems in the EU	https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32018R1807&from=EN
L23	2019	Open data and the re-use of public sector information directive (Directive (EU) 2019/1024)	Open data and the re-use of public sector information directive (Directive (EU) 2019/1024): it provides a common legal framework for a European market for government-held data (public sector information). It is built around two key pillars of the internal market: transparency and fair competition	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2019.172.01.0056.01.ENG
L24	2019	"A Europe Fit for the Digital Age" priority	"A Europe Fit for the Digital Age" (2019 - 2014): it is one of the Commission's 6 main priorities for the period 2019-2024. The political communication Shaping Europe's Digital Future is the Commission's overarching strategy to guide the EU's digital transformation.	https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age_en
L25	2020	European Data Strategy	European Data Strategy: it approaches the creation of a single market for data to make the EU more competitive globally and to enable innovative processes, products and services	https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/european-data-strategy_en
L26	2020	EC White Paper on Artificial Intelligence	White Paper on Artificial Intelligence. It presents policy options to enable a trustworthy and secure development of AI in Europe, in full respect of the values and rights of EU citizens	https://ec.europa.eu/info/publications/white-paper-artificial-intelligence-european-approach-excellence-and-trust_en
L27	2020	Digital Europe Programme	Digital Europe Programme: it is focused on building the strategic digital capacities of the EU and on facilitating the wide deployment of digital technologies. It will shape and support the digital transformation of Europe's society and economy.	https://ec.europa.eu/digital-single-market/en/europe-investing-digital-digital-europe-programme

The following table summarizes the main technical milestones that characterize the evolution of the Semantic Web.

ID	Year	Milestone	Milestone Description	Location
T1	1999	RDF Recommendation by W3C	RDF Recommendation by W3C.	https://www.w3.org/TR/1999/PR-rdf-schema-19990303/
T2	2004	RDF v1.0 specification	RDF v1.0 specification: semantic web linked data format. A graph model is used to store data in triples (subject, predicate, and object). Publication by W3C.	https://www.w3.org/TR/rdf-primer/

ID	Year	Milestone	Milestone Description	Location
T3	2006	Linked Data as part of the Semantic Web Project	Linked Data: structured data which is interlinked with other data.	https://www.w3.org/standards/semanticweb/data.html
T4	2007	Linked Open Data project	Linked Open Data: linked data that is open data.	https://www.w3.org/wiki/SweoIG/TaskForces/CommunityProjects/LinkingOpenData#LOD_Community_Gatherings
T5	2007	5-star deployment scheme for Linked Open Data.	5-star deployment scheme of Tim Berners-Lee for Linked Open Data.	https://5stardata.info/en/
T6	2008	SPARQL recommended by W3C	SPARQL recommended by W3C.	https://www.w3.org/TR/rdf-sparql-query/
T7	2009	OWL latest version created (OWL2)	OWL latest version created (OWL2). It is a family of knowledge representation languages for authoring ontologies.	https://www.w3.org/OWL/
T8	2010	JSON-LD: method of encoding linked data using JSON.	JSON-LD: method of encoding linked data using JSON.	https://json-ld.org/
T9	2011	schema.org initiative launched	schema.org: initiative to create a structured mark-up schema. Initiative launched by Bing, Google and Yahoo!	https://schema.org/docs/about.html
T10	2011	DBPedia	DBPedia: crowd-sourced community effort to extract structured content from the information created in various Wikimedia projects	https://es.dbpedia.org/index-en.html
T11	2011	First edition of the SEMIC conference in Brussels.	First edition of the SEMIC conference in Brussels.	https://ec.europa.eu/isa2/story-semic_en#:~:text=The%20first%20edition%20of%20SEMIC,public%20administrations%20and%20private%20companies.
T12	2012	Core Business, Core Location and Core Person Vocabularies version 1.0.0 released.	Core Business, Core Location and Core Person Vocabularies version 1.0.0 were released.	Core Business: https://joinup.ec.europa.eu/solution/e-government-core-vocabularies/core-business-vocabulary Core Location: https://joinup.ec.europa.eu/solution/e-government-core-vocabularies/core-location-vocabulary Core person: https://joinup.ec.europa.eu/solution/e-government-core-vocabularies/core-person-vocabulary
T13	2012	Google Knowledge Graph	Google Knowledge Graph: knowledge base used by Google and its services to enhance its search engine's results with information gathered from a variety of sources	https://developers.google.com/knowledge-graph

ID	Year	Milestone	Milestone Description	Location
T14	2012	Wikidata: linked open data set	Wikidata: linked open data set. The database of linked open data.	https://www.wikidata.org/wiki/Wikidata:Main_Page
T15	2012	Open Data Portal	Open Data Portal: European portal to enable the general public to reuse data boosts.	https://data.europa.eu/euodp/en/home
T16	2014	RDF v1.1 specification	RDF v1.1 specification: Publication by W3C.	https://www.w3.org/TR/rdf-schema/
T17	2014	JSON-LD 1.0 recommended by W3C.	JSON-LD 1.0 recommended by W3C.	https://www.w3.org/TR/2014/REC-json-ld-20140116/
T18	2016	Fair principles definition.	Fair principles definition.	https://www.go-fair.org/fair-principles/
T19	2016	Core Criterion, Core Evidence, and Core Public Organisation Vocabularies version 1.0.0 released.	Core Criterion and Core Evidence, and Core Public Organisation Vocabularies version 1.0.0 were released.	Core Criterion and Core Evidence: https://joinup.ec.europa.eu/solution/e-government-core-vocabularies/core-criterion-and-core-evidence-vocabulary Core public Organisation Vocabulary: https://joinup.ec.europa.eu/solution/e-government-core-vocabularies/core-public-organisation-vocabulary
T20	2016	SEMIC ISA2 Programme action.	SEMIC: Promoting Semantic Interoperability amongst the EU Member States. It is an ISA2 Programme action.	https://ec.europa.eu/isa2/actions/improving-semantic-interoperability-european-egovernment-systems_en
T21_a	2016	European interoperability Architecture (EIA)	European interoperability Architecture (EIA) (2016.32)	https://ec.europa.eu/isa2/sites/isa/files/library/documents/isa2-work-programme-2016-summary_en.pdf
T21_b	2016	IMAPS (ex Interoperability maturity Model)	IMAPS (ex Interoperability maturity Model) (2016.37)	https://ec.europa.eu/isa2/sites/isa/files/library/documents/isa2-work-programme-2016-summary_en.pdf
T21_c	2016	National Interoperability Framework Observatory	National Interoperability Framework Observatory (2016.21)	https://ec.europa.eu/isa2/sites/isa/files/library/documents/isa2-work-programme-2016-summary_en.pdf
T21_d	2016	CAMSS - Common assessment method for standards and specifications	CAMSS - Common assessment method for standards and specifications (2016.27)	https://ec.europa.eu/isa2/sites/isa/files/library/documents/isa2-work-programme-2016-summary_en.pdf
T21_e	2016	EIRA - European Interoperability Reference Architecture	EIRA - European Interoperability Reference Architecture (2016.32)	https://ec.europa.eu/isa2/sites/isa/files/library/documents/isa2-work-programme-2016-summary_en.pdf
T21_f	2016	EIF Implementation and Governance models	EIF Implementation and Governance models (2016.33)	https://ec.europa.eu/isa2/sites/isa/files/library/documents/isa2-work-programme-2016-summary_en.pdf

ID	Year	Milestone	Milestone Description	Location
T21_g	2016	Circabc	Circabc (2016.34)	https://ec.europa.eu/isa2/sites/isa/files/library/documents/isa2-work-programme-2016-summary_en.pdf
T21_h	2016	Eusurvey	Eusurvey (2016.35)	https://ec.europa.eu/isa2/sites/isa/files/library/documents/isa2-work-programme-2016-summary_en.pdf
T21_i	2016	Interoperability testbed	Interoperability testbed (2016.25)	https://ec.europa.eu/isa2/sites/isa/files/library/documents/isa2-work-programme-2016-summary_en.pdf
T21_j	2016	Joinup - European collaborative platform and catalogue	Joinup - European collaborative platform and catalogue (2016.20)	https://ec.europa.eu/isa2/sites/isa/files/library/documents/isa2-work-programme-2016-summary_en.pdf
T21_k	2018	FAIR Data Maturity Model	FAIR Data Maturity Model (2018.06)	https://ec.europa.eu/isa2/sites/isa/files/library/documents/isa2-work-programme-2016-summary_en.pdf
T21_l	2019	Interoperability Academy	Interoperability Academy (2019.01)	https://ec.europa.eu/isa2/sites/isa/files/library/documents/isa2-work-programme-2016-summary_en.pdf
T22	2019	Graph Query Language (GQL)	Graph Query Language (GQL): query language specifically for property graphs.	https://graphql.org/
T23	2020	Semantic Artificial Intelligence	Semantic Artificial Intelligence: the Fusion of Machine Learning and Knowledge Graphs	https://www.poolparty.biz/semantic-ai/#:~:text=Semantic%20Artificial%20Intelligence%20(Semantic%20AI,with%20technical%20and%20organizational%20advantages.&text=Semantic%20AI%20combines%20thoroughly%20selected,in%20a%20highly%20precise%20manner.