D3.3 Semantic Framework – Initial version

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Table of Contents

List of Tables

List of Figures

List of Acronyms

Abbreviation / Acronym	Description
ADMS	Asset Description Metadata Schema
API	Application Programming Interface
BB	Building Block
BBXL	Business Document Metadata Service Location
BPMN	Business Process Model and Notation
BRIS	Business Registers Interconnection System
CA	Consortium Agreement
CCCEV	Core Criteria and Core Evidence Vocabulary
CEF	Connecting Europe Facility
CFS	Certificate on the Financial Statements
CPOV	Core Public Organization Vocabulary
CPSV	Core Public Services Vocabulary
CPSV-AP	Core Public Services Vocabulary - Application Profile
DBA	Doing Business Abroad – one of the three DE4A pilots
DC	Data Consumer
DCAT	Data Catalogue Vocabulary
DE	Data Evaluator
DE4A	Digital Europe for All
DoA	Description of Action
DO	Data Owner
DP	Data Provider
DQV	Data Quality Vocabulary
DR	Data Requestor
DSD	Data Services Directory
DSI	Digital Service Infrastructure
DT	Data Transferor
Dx.y	Deliverable number y, belonging to WP number x
EB	Evidence Broker
EBSI	European Blockchain Services Infrastructure
EC	European Commission
EDCI	Europass Digital Credentials Infrastructure
EDM	Exchange Data Model

Abbreviation / Acronym	Description
eID	Electronic Identification
eIDU	eID for University
eIDAS	Electronic Identification and Signature (EU regulation)
EESSI	Electronic Exchange of Social Security Information
EIF	European Interoperability Framework
EIRA	European Interoperability Reference Architecture
ESC	European Student Card
ESCO	European Skills, Competences, Qualifications and Occupations
ESI	European Student Identifier
ESMO	eIDAS-enabled Student Mobility
EUID	European Unique Identifier
FOAF	Friend of a Friend
HEI	Higher Education Institution
IETF	Internet Engineering Task Force
IHU	International Hellenic University
IOP	Interoperability
IMI	Internal Market Information system
ISA^2	Interoperability solutions for public administrations, businesses and citizens
JSON	JavaScript Object Notation
MA	Moving Abroad – one of the three DE4A pilots
ML	Machine Learning
OOP	Once-Only Principle
OOTS	Once-Only Technical System
OWL	Web Ontology Language
PKI	Public Key Infrastructure
PSA	Project Start Architecture
RDF	Resource Description Framework
RDFS	Resource Description Framework Schema
RP	Reporting Period
RPaM	Representation Powers and Mandates
SA	Studying Abroad – one of the three DE4A pilots
SCOOP4C	Stakeholder Community Once-Only Principle for Citizens
SDG	Single Digital Gateway
SDGR	Single Digital Gateway Regulation
SEMIC	Semantic Interoperability Centre Europe

Abbreviation / Acronym	Description
SEMPER	Cross-border Semantic Interoperability of Powers and Mandates
SKOS	Simple Knowledge Organization System
SML	Service Metadata Locator
SMP	Service Metadata Publisher
SP	Service Provider
SPARQL	Protocol and RDF Query Language
TL	Task Leader
TOOP	The Once-Only Principle Project
U	User
UC	Use Case
UML	Unified Modelling Language
VC	Verifiable Credential
W3C	World Wide Web Consortium
WP	Work Package
WPL	Work Package Leader
XML	Extensible Markup Language

Glossary

Term	Explanation
Controlled Vocabulary	Controlled vocabularies are a source of authoritative terms to be entered for values of certain elements, such as personal, family, or corporate names, subjects, and coverage elements.
Canonical Evidence	Structured data models that includes a common set of attributes associated with the evidence type that can be provided by the corresponding lawfully issued evidences. [45]
Competent Authority	The competent authorities for the procedures are most often public bodies at the national, regional and local levels – such as Ministries, National Social Security and Pensions systems, Regulatory Authorities, Local authorities and others. However, the competent authority may be a private body or institution acting with a mandate from public authorities.[7]
Certificate	A document certifying the truth of something.
Criteria	Procedural requirements as conditions to be met and used as a basis for making judgements or decisions in the procedure.
Data Model	A data model contains inherent specifications regarding attribute-level constraints, cross-table relationships, and cardinality.
Dictionary	List of terms about a particular subject with their meanings in the same or in another language
eDelivery	Delivery helps public administrations to exchange electronic data and documents with other public administrations, businesses and citizens, in an interoperable, secure, reliable and trusted way
Electronic Evidence	Lawfully issued evidence by competent authorities ranging from completely unstructured formats (such as pdf or picture formats) to structured databases.
Evidence	Any document or data, including text or sound, visual or audiovisual recording, irrespective of the medium used, required by a competent authority to prove facts or compliance with procedural requirements referred to Article 2.2.b (SDGR).
Evidence Exchange System	An IT system through which EU Member States can be able to exchange of evidences across States Borders.
Federated OOP Architecture	One of the key innovative solutions to be developed within TOOP is a generic federated architecture that supports the interconnection and interoperability of national base registries across state borders. Such a generic, federated OOP architecture aims at providing consolidated reusable building blocks for the implementation of the “once-only” principle in public services in Europe. From a methodological point of view, such an architecture will not be developed from scratch. Efforts have been made in the development of generic building blocks for European cross-border public services.
Information Desk	A central system that provides evidence metadata to parties it in order to make the direct exchange of Evidence between Data Provider (DP) and Data Consumer (DC) possible. [48]

Term	Explanation
Legal Entity	An association, corporation, partnership, proprietorship, trust, or individual that has legal standing in the eyes of law.
Metadata Standard	A metadata standard is a high-level document which establishes a common way of structuring and understanding data and includes principles and implementation issues for utilizing the standard. [52]
Once Only Principle	The public administrations should ensure that citizens and business can supply the same information only once to a public administration and administrations should be able to retrieve and share this data to serve the user, in accordance with data protection rules.
Ontology	An ontology – within the scope of computer and information sciences – can be defined as a formal specification for the purpose of delimiting and grouping instances/concepts (facts, events, entities, elements, etc.), based on their common class (types, properties, interrelationships, etc.), and thus formalizing a full or a subset of a domain.[51] A formal model that allows knowledge to be represented for a specific domain. An ontology describes the types of things that exist (classes), the relationships between them (properties) and the logical ways those classes and properties can be used together (axioms).[50]
Person Legal	A legal person is a registered organization, having its registered office in a Member State. [49]
Person, Natural	A natural person is a citizen of the Union or a human residing in a Member State. [49]
Proof	Fact or piece of information that shows that something exists or is true (Cambridge), something that induces certainty or establishes validity (Merriam-webster) evidence operating to determine the finding or judgment of a tribunal (Merriam-webster)
Public Service	The concept of public service is twofold: it embraces both the bodies providing services and the services of general interest they provide. Public service obligations may be imposed by the public authorities on the body providing a service (airlines, road or rail carriers, energy producers and so on) either nationally or regionally. [51]
Relevant Only Principle	Users should be asked to provide only the information that is absolutely necessary to obtain a given public service (EIF)
Scenario	One typical way in which a system is used or in which a user carries out some activity.
Semantic Asset	A specific type of standard which involves highly reusable metadata (e.g. xml schemata, generic data models) and/ or reference data (e.g. code lists, taxonomies, dictionaries, vocabularies).
Taxonomy	A systematic arrangement in groups or categories of concepts according to established criteria
Technical Coordinator	The Technical Coordinator is a senior technical expert who will facilitate the smooth execution of the whole development lifecycle within the DE4A project.
TOOP	The Once-Only Principle Project (TOOP) was launched by the European Commission in January 2017 as an initiative of about 50 organizations from 20 EU Member States and Associated Countries. The main objective of TOOP is to explore and demonstrate the once-only principle across borders, focusing on data from businesses. Doing this,

Term	Explanation
	TOOP wants to enable better exchange of business-related data or documents with and between public administrations and reduce administrative burden for both businesses and public administrations.
Use case	A specification of one type of interaction with a system. One use case may involve several scenarios (usually a main success scenario and alternative scenarios)
User	User is anyone who is a citizen of the Union, a natural person residing in a Member State or a legal person having its registered office in a Member State, and who accesses the information, the procedures, or the assistance or problem-solving services, referred to in Article 2(2), through the gateway.[49]
Vocabulary	A collection of terms for a particular purpose. Vocabularies can range from simple, such as the widely used RDF schema, FOAF and DCMI element set, to complex vocabularies with thousands of terms, such as those used in healthcare to describe symptoms, diseases and treatments. Vocabularies play a very important role in linked data, specifically to help with data integration. For example, metadata vocabulary. The use of this term overlaps with that of 'ontology'. [50]

Executive Summary

This document is a first version of the design of the DE4A semantic framework produced in the context of Task 3.2 “Design of the semantic interoperability framework” in “WP3 Semantic Interoperability Solutions”. This framework sets the basis for semantic interoperability needed for evidence exchanges at a pan-European level of public service provision. This document serves as the key design guidelines for the implementation of the DE4A Semantic toolkit (D3.5 Semantic Toolkit – Initial version).

The **DE4A semantic framework** covers three main strands: the **Information Desk**, the common **Information Exchange Model** and the **pilot-specific ontologies** that will provide the basis to develop common evidence data models.

The Information Desk (IDK) offers information to the Data consumer (DC), and the Data Provider (DP) that is required for smooth cross-border exchange of evidences in the context of DE4A. The IDK consists of following core components: the **Issuing Authority Locator** that helps the DC to find out the issuing authority that can provide the required canonical evidence within a particular country, the **Evidence Service Locator** that helps the DC to locate the evidence service to request a canonical evidence to a particular issuing authority, the **Cross-border Access Authorisation Registry** that helps the DP to check if the request has the required authorization, and the **Multilingual Ontology Repository** that helps to understand the meaning of canonical evidence attributes and, specifically, helps the Preview Component to show the user the evidence data along with their corresponding labels in the language chosen by the user to interact with the portal.

The **DE4A Information Exchange Model (IEM)** provides the payload specification of the messages to be exchanged between competent authorities. IEM is agnostic to any technical implementation and according to the DE4A project specific pilot needs and architecture. IEM will be designed considering TOOP EDM and other national models by WP3 in collaboration of the rest of technical work packages (architecture, pilots and common components).

The **pilots’ ontologies** provide data models for the DE4A pilots’ domain-specific information needs. They have been defined as a maximum set of concepts and attributes, so evidence data models will be defined from these ontologies by considering the specific needs of pilot use cases principles and applying the data minimization.

To provide the semantic interoperability framework and undertake the needed semantic modelling, WP3 has analysed the project start architectures provided by “WP2 Architecture Vision and Framework” (D2.4 Project Start Architectures) and the required and available data for evidence exchange in pilot use cases specified in “WP4 Cross-border Pilots for Citizens and Business and Evaluation” (“Pilot Use cases definition and requirements” deliverables).

A final version of this deliverable capturing all the improvements and semantic interoperability findings will be reflected in “D3.4 Semantic framework – Final version” due to December 2021.

1 Introduction

1.1 Purpose of the document

The purpose of this document is to provide the first version of the design of the DE4A semantic interoperability framework for the delivery of integrated cross-border public services. Towards this purpose, standards and efforts for service description (e.g. TOOP, SDG) and provision (e.g. SDG evidence data models) are considered. Moreover, existing infrastructures and standard approaches in the EU context that facilitate the access to information are taken into account.

One key aspect for the DE4A approach is reusability, thus the sematic framework will reuse and extend relevant metadata efforts (e.g. EDCI data model) as well as central components and services from other initiatives (e.g. DSD, Evidence Broker) and will attempt to link those with the needs and requirements identified by other work packages of the DE4A project. Consequently, the work and scope of this deliverable is taking into consideration on the three following dimensions:

- The three DE4A cross-border pilots
- The WP2 Project Start Architecture (PSA)
- The SDG OOP Architecture

Additionally, DE4A aims to explore alternative solutions to once-only functionality or to efficient e-government services in general, with other interaction patterns that may go beyond the SDGR requirements [1].

The DE4A Semantic framework focuses on two aspects semantic interoperability:

- to safeguard that the correct semantics of exchanged data and information is preserved and understood throughout exchanges between EU Member States needed to deliver integrated cross-border public services. The disclaimer is that these data models are dedicated on the ones promoted and used by the 3 pilots of DE4A.
- to provide the central components of the information desk. Information Desk (IDK) offers information to DC, and DP that is required for smooth cross-border exchange of evidences in the context of DE4A. The IDK consists of following core components: **Issuing Authority Locator** that helps the DC to find out the issuing authority that can provide the required canonical evidence within a particular country, **Evidence Service Locator** that helps the DC to locate the evidence service to request a canonical evidence to a particular issuing authority, **Cross-border Access Authorization Registry** that helps the DP to check if the request has the required authorization, and **Multilingual Ontology Repository** that to understand the meaning of canonical evidence attributes and, specifically, supports the Preview Component to show the user the data along with their corresponding labels in the language chosen by the user to interact with the portal. As described at deliverable D2.4 Project Start Architecture, there are two approaches for mapping between domestic and cross-border evidences: criteria-based and evidence-bases. The DE4A Semantic Framework considers both approaches. D3.3 provides a high-level view of the Information Desk. However, according the DE4A pilot needs, criteria-based approach is not needed in the scope of the project.

The semantic framework will be iterated, reviewed, and improved in the following months, and a second version of the current document will be delivered in December 2021.

The process for the design of this first version of the semantic framework has been the following:

- Firstly, the project thoroughly investigated the existing data models, controlled vocabularies, services, EU infrastructures (e.g. eID, eIDAS), metadata efforts, and IT systems for evidence

exchange that apply standards from relevant bodies (e. g, ISA[2], and W3C), core public service vocabularies that facilitate the access to information.

- Secondly, in order to ensure linking of this work with other WPs of DE4A, the project has studied and detailed evidence modelling of the three DE4A pilots. From these pilots, WP3 has analysed required data and performed mapping of the related attributes with standards vocabularies. At a next step holistic common data models per DE4A pilot will be designed.
- WP3 went one step further to cover semantic aspects beyond the DE4A pilots' requirements. Therefore, the project will consider the SDG OOP and TOOP data models and components to offer a semantic layer for delivering cross-border public services.
- Lastly, WP3 proposes the use of multilingual labels for evidence models that are required for cross-border evidence exchange by approaching the multilingual issue in a pan-European context with focus on relevant data models and elements that are evidence based. It is proposed the Multi-lingual Ontology Repository (MOR) as a component of Information Desk that helps to understand the meaning of canonical evidence attributes and, specifically, supports the preview component to show the user the data along with their cross-ponding labels in the language chosen by the user to interact with portal. It also helps the processing of the evidence by DE. MOR is based on the multilingual public documents.

We will consider and analyse the following TOOP components and their information models: TOOP DSD, TOOP RoA, TOOP Evidence Broker, TOOP Semantic Repository [47].

Worth mentioning is that the output of this deliverable of the semantic framework will be the groundwork for the next deliverable D3.5 "Semantic toolkit – Initial version", which is the initial implementation of the semantic tools. More specifically, the semantic framework will be the basis for creating the RDF or XSD files of the DE4A data models that will be used as input to the semantic tools for data and metadata management.

1.2 Structure of the document

This deliverable is structured as follows:

Chapter 2 explains the approach for the development of the semantic framework of DE4A and the ontologies that will provide the basis for the evidence data models. Chapter 3 includes the semantic assets that are used for the semantic framework. Chapter 4 describes the required metadata for each pilot use case, the conceptual models of each use case that provide an initial understanding of the data to be exchanged in each scenario and the use of multilingual labels in the course of DE4A. Finally, Chapter 5 provides a high-level view of the central components of the Information Desk and showcases the use of these components and the related semantic assets in the DE4A Project Start Architecture. It also proposes the ontologies that provide data models for the DE4A pilots' domain-specific information needs.

2 The approach of DE4A Semantic Framework

This chapter presents the DE4A approach to define the DE4A Semantic Framework.

2.1 Evidence modelling

1. Identification of the main actors and entities that take place in the cross-border evidence exchange
2. Selection of required data for each use case based on the pilot requirement documents [2], [3], [4].
3. Unification of selected attribute names that have similar meanings to avoid duplicates.
4. Selection of semantic assets that can be used and extended for the DE4A semantic framework
5. Creation of conceptual models for each use case required data from step 1 based on the concepts of the ISA[2] Core Vocabularies providing an initial understanding of the pilot required data.
6. Consolidation of these conceptual models of the ontologies that provide data models for the DE4A pilots' domain-specific information needs based on each DE4A pilot following the data minimisation principle.
7. Mapping the attributes of the conceptual models to existing semantic models and vocabularies
8. Selection of controlled vocabularies (presented in Annex IV) based on recommended controlled vocabularies from the selected existing data models and vocabularies.

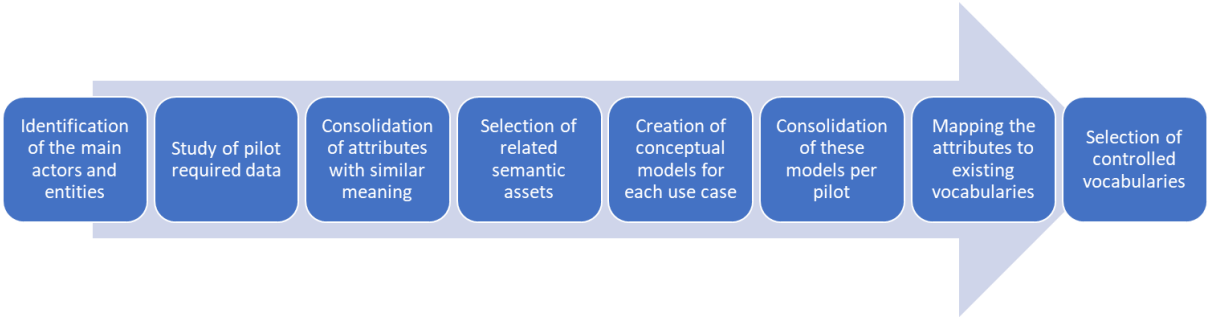

Figure 1: The process of the evidence modelling of common data models

2.2 Use of semantics in the DE4A business processes

1. Selection of semantic assets based on defined selection and exclusion criteria in Chapter 3.
2. In the business process we first consider existing services and components (e.g. TOOP Evidence Broker) that include semantic aspects related to DE4A and SDGR and we will reuse these semantic aspects for the components of the information desk of DE4A (e.g. Issuing Authority Locator).
3. Identification of relevant existing semantic metadata models, ontologies and vocabularies that can be used in every activity of the business process.

3 Assets with semantic relevance for DE4A

This chapter describes the assets with semantic relevance for the design of the DE4A semantic framework. Following are the selection and exclusion criteria for the consideration of the semantic assets:

Selection Criteria

a. The semantic asset is a vocabulary, ontology and data model and application profile that is a unique specification (e.g. ISA^2 core vocabularies).
b. The domain of the semantic asset is related to the required attributes based on each pilot use case, i.e. studying abroad, doing business abroad and moving abroad.
c. The semantic asset is recommended by W3C and EU (e.g. ISA^2 Core Vocabularies).
d. Consideration of building blocks that include related data models that can be used in the context of DE4A (e.g. data model of EDCI)

Exclusion criteria

a. Assets cover only legal, organizational, and technical aspects of interoperability of cross-border evidence exchange. For example, we did not consider technical components such as TOOP eDelivery.

3.1 ISA^2 Core Vocabularies

The ISA^2 e-Government Core Vocabularies are simplified, re-usable and extensible data models that capture the fundamental characteristics of a data entity in a context-neutral fashion. They consist of the following vocabularies:

- Core Person: captures the fundamental characteristics of a person, e.g. name, gender, date of birth, location
- Core Business: captures the fundamental characteristics of a legal entity (e.g. its identifier, activities) which is created through a formal registration process, typically in a national or regional register
- Core Location: captures the fundamental characteristics of a location, represented as an address, a geographic name or geometry
- Core Criterion and Core Evidence: describes the principles and the means that a private entity must fulfil to become eligible or qualified to perform public services. A Criterion is a rule or a principle that is used to judge, evaluate or test something. An Evidence is a means to prove a Criterion.
- Core Public Organisation: describes public organisations in the European Union.
- Core Public Service Vocabulary - Application Profile: Describes public services. Public services are described in a structured and machine-readable way by standardising the semantics. Public administrations and service providers can in turn use this approach to describe their services and guarantee a level of cross-domain and cross-border interoperability at European, national and local level.

Core Person-Business-Location vocabularies

Core Person Vocabulary

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, organizations 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 and can be the basis for describing natural person in the context of DE4A which is part of all DE4A pilot uses cases. Specifically, it will be used to describe the person in the authentication process with the eIDAS attributes. Furthermore, it will be the main vocabulary that describes the person in all the related components of DE4A and the ontologies for the evidence data models.

Core Business Vocabulary

The Core Business Vocabulary provides a minimum set of classes and properties for describing a legal entity i.e. trading bodies that are formally registered with the relevant authority and that appear in business registers. This excludes sole traders, virtual organizations and other types of 'agent' that are able to do business. This part of the core vocabularies is also closely integrated with the Person and Location Core Vocabularies and will constitute the basis for describing legal entities in the context of DE4A pilot use case and more specifically the “Doing Business Abroad” pilot.

Core Location Vocabulary

Core Location Vocabulary provides a minimum set of classes and properties for describing a location represented as an address, a geographic name, or a geometry. This semantic asset can be used to describe locations and addresses in all DE4A pilot use cases.

Core Criterion and Core Evidence Vocabulary (CCCEV):

The Core Criterion and Core Evidence Vocabulary (CCCEV) is designed to support the exchange of information between organizations defining criteria and organizations responding to these criteria by means of evidences.

CCCEV contains two basic and complementary core concepts:

- the criterion, something used as the basis for making a judgement or decision, e.g. a requirement set in a public tender or a condition that has to be fulfilled for a public service to be executed; and
- the evidence, something which proves that something else exists or is true, in particular an evidence is used to prove that a specific criterion is met by someone of by something.

CCCEV will be the basis for the component Issuing Authority Locator that is described at section 5.1.1.

Core Public Organisation Vocabulary (CPOV)

Public organisation is a body that is liable for a scope of government capacities. CPOV is intended to help the exchange of basic information about individual public organizations including relevant base registries like registry of competent authorities. CPOV will be used to describe the issuing authorities in the ontologies for the evidence data models.

Core Public Service Vocabulary – Application Profile (CPSV-AP)

At its simplest, a public service is the capacity to carry out a procedure and exists whether it is used or not. It is a set of deeds and acts performed by or on behalf of a public agency for the benefit of a citizen,

a business or another public agency. Public services operate according to rules that are derived from some combination of legislation and policy which can be set at local, national or supranational level. A public service:

- is atomic, meaning that its use can be triggered by businesses, citizens or other public administrations
- usually requires information that is checked before the public administration issues an official decision that is registered in a system (in an automatic or manual way).

In case of DE4A project, CPSV-AP provides the representation of the life event that will be used in the ontologies for evidence for the moving abroad pilot. It also includes the Agent class that will be included for the connection with main entities DC and DP.

CPSV-AP is an Application Profile, i.e. it is a specification that re-uses terms from one or more base standards, adding more specificity by identifying mandatory, recommended and optional elements to be used for a particular application, as well as recommendations for controlled vocabularies to be used.

The application profile has been updated to a new version (CPSV-AP 2.2) already including some changes to accommodate the implementation of the Single Digital Gateway initiative; more change requests are expected in the upcoming years [6], [7].

3.2 DCAT Application Profile for data portals (DCAT-AP)

The DCAT Application Profile for data portals in Europe (DCAT-AP) is a specification based on W3C's Data Catalogue vocabulary (DCAT) for describing public sector datasets in Europe. The basic use case of DCAT-AP is to enable cross-data portal search for data sets and make public sector data better searchable across borders and sectors. This can be achieved by the exchange of descriptions of datasets among data portals. It allows:

- Data catalogues to describe their dataset collections using a standardized description, while keeping their own system for documenting and storing them.
- Content aggregators, such as the European Data Portal, to aggregate such descriptions into a single point of access.
- Data consumers to more easily find datasets from a single point of access.

In relation with the scope of DE4A, DCAT-AP will provide a way for data consumers to easily find information about the data providers that use DCAT-AP to publish information about their (evidence) datasets. We mention the use of DCAT-AP in the context of DE4A in the sections 5.2 and 5.3. It will be used to describe datasets and evidences as well as distributions.

3.3 Asset Description Metadata Schema – Application Profile (ADMS-AP)

ADMS-AP is a specification used to describe interoperability solutions helping everyone to search and to discover them [8]. ADMS-AP will be used to describe the identifier of resources for all DE4A pilots. Additionally, it also allows:

- Solution providers, such as standardization organisations and public administrations, to describe their interoperability solutions using the standardized descriptive metadata terms of ADMS while keeping their own system for documenting and storing them.

- Content aggregators, such as Joinup, to aggregate such descriptions into a single point of access.
- ICT developers to more easily explore, find, identify, select and obtain interoperability solutions from a single point of access.

3.4 BRegDCAT-AP

BRegDCAT-AP specification is an application profile for enabling cross-border interoperability between Base Registries and Registries of Base Registries, defining a semantic model to describe registries and their contents, facilitating data discovery and exchange of data, reducing redundancy by supporting the Once-Only principle. This set of recommendations will enable a mechanism for the update of EU base registries and their content, reducing technical, organizational and multilingual barriers.

The Application Profile specified in this document is based on the specification of the latest DCAT Application Profile for data portals in Europe, specifically version 1.2.1, issued on 28th May 2019. Public services representing base registers are based on the CPSV-AP (Core Public Service Vocabulary Application Profile) model, and its latest version (2.2.1) [5]. The legal information regarding the implementation of services is represented through the ELI Ontology. BRegDCAT-AP will be reused and extended for the Evidence Service Locator component of the Information Desk that is described at section 5.1.2. BRegDCAT-AP will act as a baseline to offer a catalog with meta-data on the datasets that are available by the DPs.

3.5 SDG Metadata model

SDG metadata model aims to structure the data exchange for the European Single Digital Gateway in-line with SDG Regulations [9]. This model is a common "Language" for the European public administrations, so that information can be exchanged easily [10]. This Model reuses already existing elements and most of the elements are aligned with CPSV-AP, DCAT-AP, and the e-Government Core Vocabularies and the various standards they point to. In this model, the respective team translated the SDGR requirements into a data model to carry out the following multiple goals: i) a cost-efficient means of sharing public service (meta)data with the repository of Links; ii) compliance with the SDGR; iii) offering the Member States with this information so that not all EU Member States necessity to do this; iv) structuring related information in a way that could be reused for future applications (e.g. chatbot, profiling); v) Delivering a flexible data model that could be easily implemented or extended to the respective needs [9], [10]. In the context of DE4A, it will be used for Data Providers to verify the Data Consumers identity and their related procedures and public services if this functionality is required. We will further explore it in the next iteration.

3.6 Data quality vocabulary

Data quality is a well-known issue accompanying information systems in every evolution from the database systems to the current Web of Data. As discussed in the recent W3C Recommendation Data on the Web Best Practices [11].“The quality of a dataset can have a big impact on the quality of applications that use it. As a consequence, the inclusion of data quality information in data publishing and consumption pipelines is of primary importance.” The Data Quality Vocabulary (DQV) provides a metadata model for expressing data quality and is a W3C recommendation. DQV relates (DCAT) datasets and distributions with different types of quality statements, which include Quality Annotations, Standards, Quality Policies, Quality Measurements and Quality Provenance. Quality

information pertains to one or more quality characteristics relevant to the consumer (Quality Dimensions). DQV is also based on the Dataset Usage Vocabulary [12] which is used to describe user experience, such as citations and feedback about the dataset from the human perspective. Therefore, it can also facilitate the gathering of user statistics and user feedback that will allow the use of machine learning algorithms to understand the usage patterns of the services as per the scope of the DE4A task T3.4 *Machine learning for Semantic Interoperability*. An example of the use of DQV that shows the metadata for the distribution of the data providers dataset with the inclusion of the data quality metadata is presented at Annex VIII. It is pertinent to mention that DQV would be assessed for the second iteration of the project. Additionally, the Machine-learning aspect will also be covered in D3.7 deliverable "DE4A machine learning algorithms".

3.7 Organization ontology

The Organization Ontology is a W3C recommendation that describes a core ontology for organizational structures, aimed at supporting linked data publishing of organizational information across a number of domains [13]. It is designed to allow domain-specific extensions to add classification of organizations and roles, as well as extensions to support neighbouring information such as organizational activities. In the context of DE4A, this ontology can help in describing organisations in a more abstract way. For example, in the studying abroad pilot, the organization could be a private educational institution or a public organization, which is represented through the Core Public Organisation Vocabulary.

This ontology is designed to enable publication of information on organizations and organizational structures including governmental organizations. It is intended to provide a generic, reusable core ontology that can be extended or specialized for use in particular situations.

The ontology gives terms to support the representation of:

- organizational structure
    - notion of an organization
    - decomposition into sub-organizations and units
    - purpose and classification of organizations
- reporting structure
    - membership and reporting structure within an organization
    - roles, posts, and the relationship between people and organizations
- location information
    - sites or buildings, locations within sites
- organizational history (merger, renaming)

The ontology does not provide category structures for organization type, organization purpose or roles. Different domains will have different requirements for classification of such concepts. Instead the ontology provides just the core base concepts needed to allow extensions to add specific sub-class structures or classification schemes as required. Users of the ontology are encouraged to define profiles which strengthen interoperability by specifying particular controlled vocabularies to use for these concepts.

A pictorial illustration of the main classes and relationships in ORG is shown in Figure 2.

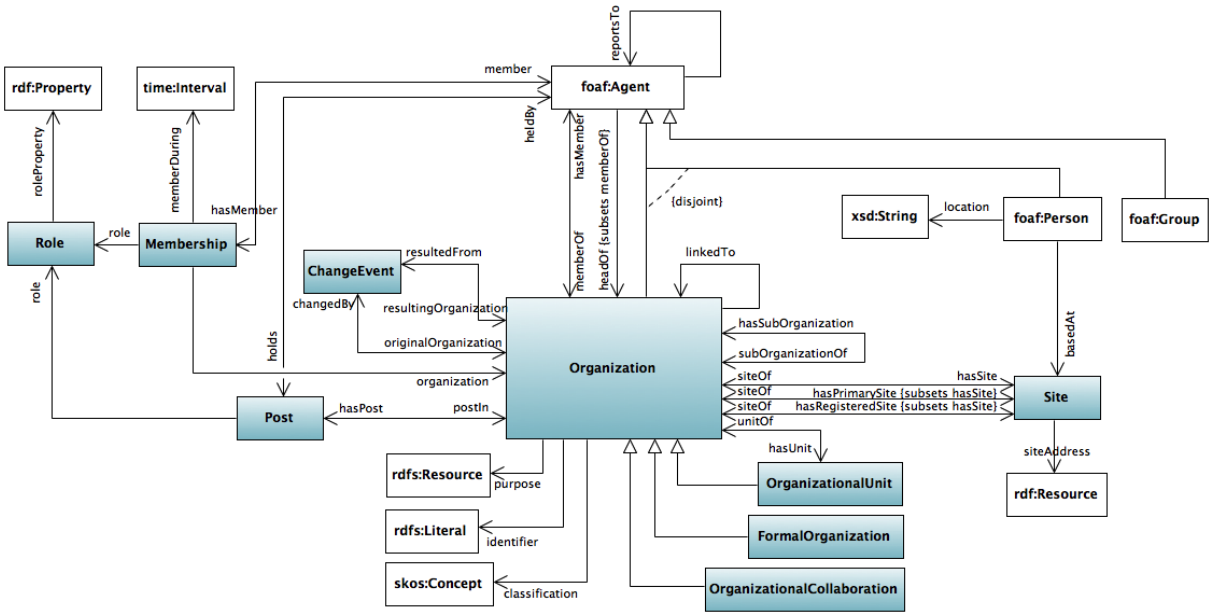

Figure 2: UML diagram of the Organization Ontology

3.8 Registered Organization Vocabulary

The Registered Organization Vocabulary (ROV) is a vocabulary for describing organizations that have gained legal entity status through a formal registration process, typically in a national or regional register [14]. It focuses solely on such organizations and excludes natural persons, virtual organizations and other types of legal entity or 'agent' that are able to act. It is a profile of the more flexible and comprehensive Organization Ontology.

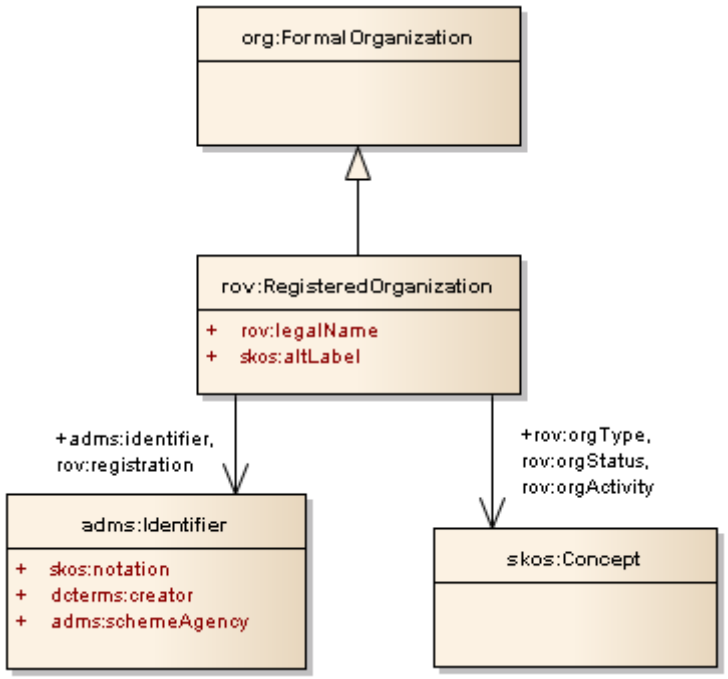

Figure 3: UML diagram of the Registered Organization Vocabulary

The Registered Organization Vocabulary includes a minimal number of classes and properties that are designed to capture the typical details recorded by business registers and thereby facilitate information exchange between them, although there is significant variation between business registers in what they record and publish. Figure 3 depicts the conceptual model of the Registered Organisation Vocabulary.

3.9 TOOP Registered Organization Vocabulary

TOOP Registered Organization Vocabulary represents an organization that has gained legal status by one of the European member states. It is based on the Registered Organization Vocabulary [14]and the Organization Ontology [13] that are W3C recommendations. The TOOP RegisteredOrganization class contains the following object properties and datatype properties are related to this class: company name, foundation date, capital type, company code, company type, legal representative, legal status, NACE code, registered site, registration number, SS number, VAT number, and legal status effective date. This vocabulary covers the business domain and can be extended according to the pilot required data. Annex IX illustrates the conceptual model of the Registered Organization vocabulary developed by TOOP.

3.10 TOOP Evidence Broker

The Evidence Broker (EB), which is the new name for eCERTB (Criterion & Evidence Type Rule Base), is a central service of the TOOP solution architecture that publishes which types of evidence Member States can offer to prove a requirement is met. It provides metadata on the criteria applicable in a procedure and which evidence can be used by the user to proof fulfilment. Using the mapping from criterion to possible evidences the Data Consumers can find the kind of Datasets that can prove that the User fulfils the requirements of the procedure.

The EB Information Model is based on the ISA^2 SEMIC Core Criterion and Core Evidence Vocabulary (CCCEV). The CCCEV is designed to support the exchange of information between organisations defining criteria and organisations responding to these criteria by means of evidence. There are two major concepts of this model that include criteria and the evidence.

The ***criteria*** provide basis to take a decision or judgement for example in a procurement tender scenario, a company having at-least five-year experience, and has at-least 10 data scientists on this company payroll is eligible to submit bid against a public tender. In the said example 5-year experience, and at-least 10 data scientists are an example of a criteria. The public organization will take a decision to short-list vendors for the public tender based on the above-mentioned criteria.

The ***evidence*** is used to prove that a specific criterion is met by someone or by something. For example, DC wants to verify the age of a natural person from DP. In this case DP will share a doc/extract/digital info about that person with DC as per the request of the DC that is something that supports to prove the person claim about his/her age.

In terms of technical specifications, EU eCertis, will act as the Evidence Broker system. The European Commission offers an eCertis tool that supports identifying different certificates requested in procurement procedures across Europe [15], [16]. The purpose of this system is to facilitate the exchange of certificates and other documentary evidence frequently required by contracting authorities. eCertis, as a service, will also act as the Evidence Broker system.

It gives metadata on the criteria related to a procedure and which evidence can be used by the user to witness fulfilment. Currently, eCertis is under an updating process of its internal functionalities, in order to become multi-domain and to cover some other aspects as well [17]. It provides a REST API that can be used to query various mappings between criteria and evidence. It will help Member States to push all the information related to certificates and national databases into eCertis. Through this BB, services will be added to eCertis to permit Member States to link connect their own Information Technology systems, and base registries to push that information [15]. As eCertis up-gradation work is completed, we will consider eCertis as the Evidence Broker system in the relevant WP3 tasks, if deemed appropriate.

Our proposed component "Issuing Authority Locator" (described at section 5.1.1) of the Information Desk is partially inspired in the TOOP Evidence Broker and its purpose is to find out the issuing authority that can provide the required evidence within a particular country by adapting this according to the requirements of DE4A pilot use cases.

3.11 TOOP Data Service Directory

The TOOP Data Services Directory (DSD) is a central service of the TOOP solution architecture that holds a catalog of Data Providers with the Datasets they are capable to offer upon request. It is utilized in the Evidence Exchange Process by the Data Consumers to find out the Data Providers that can give the evidences they require.

The TOOP DSD information data model is a profile of the BReg-DCAT-AP specification, an application profile of DCAT, profiled by ISA2 for use in "Access to Base Registries", to achieve both organizational and semantic interoperability. The Service API is implemented using the “OASIS RegRep v4” Query Protocol with the REST API Binding [18].The UML data model of DSD is depicted in Annex VII.

The W3C DCAT describes a standardized vocabulary for explaining the meta-data on data sets and their related data services on how to access the data. ISA^2 profile DCAT-AP can be used in the context of European Interoperability Reference Architecture -EIRA. While ISA^2 profile BRegDCAT-AP can be used to illustrate the contents of and access to a Base Registry in the context of access to base registries.

The TOOP DSD consists of the following classes, dataset, distribution, data service, data provider, address, and catalog. The description of the aforesaid classes, and the DSD profile of BREG-DCAT-AP is placed at Annex-II of this report. Figure 4 provides an illustration of the UML diagram of DSD.

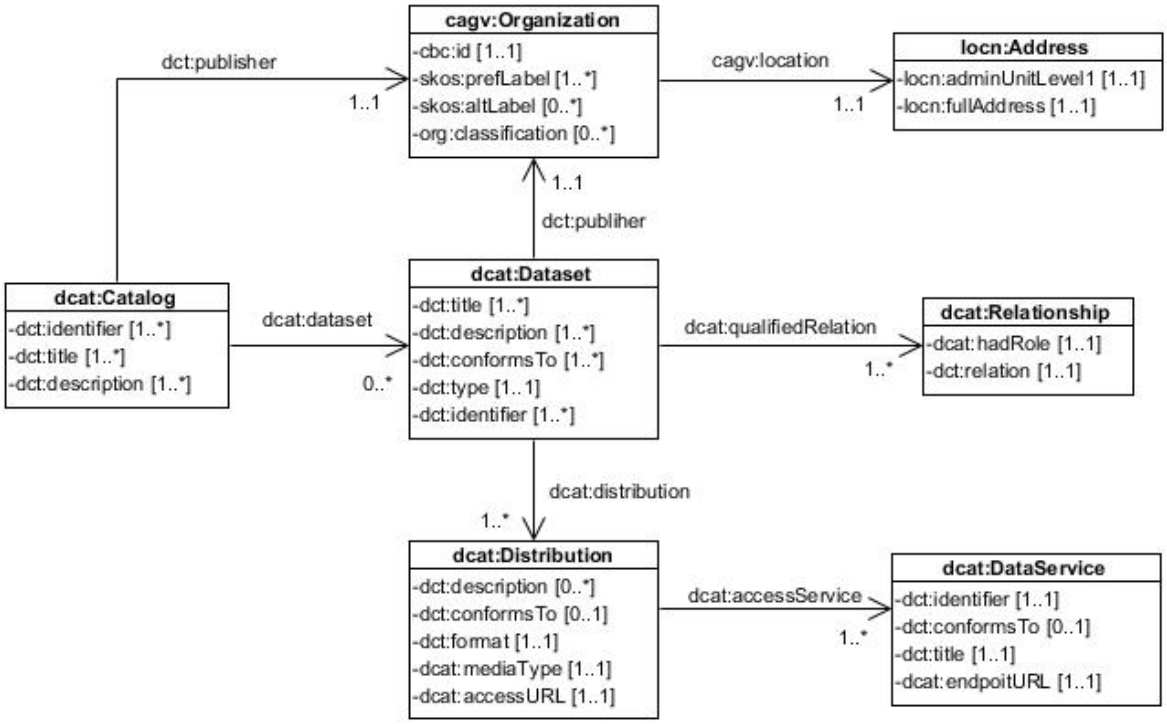

Figure 4: UML diagram of the Data Service Directory data model

Table 1: TOOP DSD Data Models

dataset	A dataset that represents the information maintained by a Data provider
distribution	The distribution of a dataset. Indicates if a dataset is structured/unstructured/concept
data service	The service that serves a distribution
data provider	A public organization that maintains the datasets
address	The address of a data provider
catalog	A catalog that groups all datasets of the DSD

Our proposed semantic component Evidence Service Locator (ESL) of Information Desk is different from TOOP DSD as an evidence service accommodates both evidence as data (DSD) and evidence as document. Therefore, we will re-use the concept of TOOP DSD by adapting to also consider evidence as document and domestic evidence with legal value attached to the canonical evidence.

3.12 TOOP Exchange Data Model

The TOOP Exchange Data Model (EDM) specification describes the process of message exchange of evidences, which can be concepts or documents. This information model consists of two different types of messages: the TOOP request message and the TOOP response message. While the TOOP request enables DCs to initiate concept and document queries to the DPs, the TOOP response provides the possibility to return the concrete concept values and document metadata that were requested. Thus:

- the TOOP Request describes the transaction from DC to DP to request certain concepts or documents
- the TOOP Response describes the transaction from DP to DC to deliver the requested concept values or document (metadata)

After careful investigation and analysis of the TOOP EDM it was identified that:

- The TOOP EDM is too specific concentrating on the one and only pilot of the TOOP project and it is not reusable for DE4A pilots and needs.
- EDM is not use case agnostic and sufficiently abstracted. This means that the TOOP EDM constructs messages with specific SDG/ISA^2 elements that do not cater for generic or even other specific services and use cases e.g. covering the use case of a citizen Moving abroad.
- The EDM is implementation-oriented. This means that EDM models message exchanges and even error-handling procedures. Furthermore, the order of elements within such a message should not play a role limiting the implementation. Although TOOP refers to such models as semantic, EDM is based on OASIS ebXML RegRep 4.0 specification which also includes technical aspects as services to write/read information.

Our proposed semantic asset Information Evidence Model (IEM) is different from TOOP EDM to accommodate both DE4A architecture and pilots' specificities.

3.13 TOOP Semantic Repository

The Semantic Repository is another central service of the TOOP solution architecture. This service functions as data portal for the TOOP storing commonly settled on information models, grouped by domain, offering them under multiple representation techniques.

The subject service offers following functionalities, i) ability to externally reference these models from other components; ii) ability to define and extract subsets of models, iii) provision of documentations, and query of assets based on metadata. The information model is aligned with DCAT-AP for the best practices on the asset repositories like the EU vocabularies. We placed TOOP ontology repository in the Annex-II of the report [19]. The UML diagram of the Semantic Repository is presented in Annex VII.

We will adapt the TOOP semantic repository in our proposed semantic component "Multilingual Ontology Repository" of Information Desk by including specification of multilingual labels, enabling the automatic legal translation of exchanged data as described in the forthcoming section 4.4.

3.14 TOOP Registry of Authorities

Registry of Authorities (RoA) is a TOOP core service that maintains a catalogue of Data Consumers with the Procedures they are able to execute [46]. The service is used by the Data Providers in the Member States which are required to determine whether a particular public administration in another Member State is allowed to ask for a certain requested type of evidence in a particular context. RoA facilitates this by listing, for public administrations in EU Member States, the procedures for which these administrations are authorized to request which types of evidence. RoA can complement, and provides a context for, but is not a replacement of, the explicit request/input of the user.

The ISA^2 Action "Catalogue of Services" supports the creation of catalogues with an integrated view on life events, business events and their related public services. The most important output of this action is the CPSV-AP model, an information model structuring the information needed to describe a public

service. SDG-Model is an extension of the CPSV-AP model, which aims at extending the CPSV-AP model to fit the modelling requirements of the public services and their executable procedures that is described in section 3.1.5.

At the moment, the Cross-border Access Authorization Registry (CAAR) is a candidate component of the DE4A architecture to be further analysed in the second iteration of this deliverable, and RoA concept will be reused and adapted to build the CAAR.

3.15 Other general semantic assets

Apart from the abovementioned semantic assets, we will reuse existing international semantic standards that are W3C recommendations and facilitate in designing the ontologies for the evidence data models. In case we do not find any existing EU vocabulary that describes the pilot required data for evidence, we consider the following general semantic assets:

- **Dublin Core (DC) [20]**: Ontology for describing generic metadata. The vocabulary serves to describe resources (documents) and includes a basic set of fifteen generic, widely used elements; Creator, Contributor, Publisher, Title, Date, Language, Format, Subject, Description, Identifier, Relation, Source, Type, Coverage, and Rights. One of the uses of this vocabulary is the documentation of web pages. Metadata in this style uses Uniform Resource Identifiers (URIs) as global identifiers both for the things described by the metadata and for the terms used to describe them (vocabularies).
- **OP Core metadata element set [21]**: Based on the Dublin Core metadata element set, the Publications Office of the EU has defined its own OP Core metadata element set. It consists of 16 elements that any resource managed and published by the Publications Office –through the EU Vocabularies portal– can and should contain.
- **Friend of a Friend (FOAF) [22]**: This ontology defines metadata about **people and their interests, relationships, activities on the Web**. It is mostly focused on people's existence in the virtual world, with many properties related to online activity or identity: foaf:mbox, foaf:skypeID, foaf:msnID, foaf:geekcode, etc. Nothing about family relations, physical address... It provides similar information on organisations or groups with a similar focus on their existence on the Web (workplace webpage, etc). In FOAF descriptions, there are only various kinds of things and links, which we call classes and properties respectively. FOAF is therefore defined as a dictionary of terms, each of which is either a class or a property.
- **vCard [23]** vCard is an ontology developed by the IETF (Internet Engineering Task Force) aiming to promote the description of people and organisations utilising semantic web techniques and allowing compatibility with traditional vCard implementations.
- **Schema.org [24]**: A collection of vocabularies that can be used to embed metadata in web pages and are understood by the main search engines: Google, Microsoft, Yandex and Yahoo!. The metadata can be embedded using microdata (or tags), RDFa or JSON-LD. It describes entities, relationships between entities and actions, and can easily be extended through a well-documented extension model.
- **PROV [25]**: An important type of information about published data refers to the provenance of the data: Who generated it, how it was generated, and what the sources were. The PROV document ontology defines a model, corresponding serializations and other definitions to enable the exchange of information coming from the Web. The provenance model defined by PROV takes into account three basic elements: entities, activities and agents. These three elements are connected through a set of relationships. For example, "an entity (a web page, file, etc.) was generated by an activity associated with a particular agent."

- **VoID [26]**: RDF Schema vocabulary for expressing metadata about RDF datasets. It is intended as a bridge between the publishers and users of RDF data, with applications ranging from data discovery to cataloging and archiving of datasets.
- **ELI [27]**: The ELI ontology provides a descriptive framework for structuring metadata of legislative resources and publishing them as linked data. The ELI ontology is a cornerstone of a 'legal linked data', as it describes relationships between national and European legislative resources. The European Legislation Identifier framework includes technical specifications on:
    - Web identifiers for legal resources (building on URI templates at European, national and regional levels, based on a defined set of components)
    - Metadata set specifying how to describe legal information, and its expression in a formal ontology
    - Recommendations for exchanging legislation in machine-readable formats, integrating metadata into legislative website
- **Data Privacy Vocabulary [28], [29]**: The Data Privacy Vocabulary (DPV) provides terms (classes and properties) to annotate and categorize instances of legally compliant personal data handling according to the EU General Data Protection Regulation. The vocabulary provides terms to describe which personal data Categories are undergoing a specified kind of processing by a specific data controller and/or transferred to some recipient for a particular purpose, based on a specific legal ground (e.g., consent, or other legal grounds such as legitimate interest, etc.), with specified technical and organisational measures and restrictions (e.g., storage locations and storage durations) in place. However, this specification was published by the Data Privacy Vocabularies and Controls Community Group (DPVCG) as a first public working draft.

3.16 SEMPER - Cross-border Semantic Interoperability of Powers and Mandates

The objective of SEMPER is to accomplish a harmonized definition of e-mandates and to enhance the electronic Identification, Authentication, and trust Services - eIDAS Interoperability Framework with suitable elements on the protocol level and integration modules for connecting national mandate management infrastructures. By doing so, on the one hand, Service Providers will be able to permit the representation of legal or natural persons within their eIDAS enabled services. On the other hand, eIDAS node operators will be capable to not only connect to their national identity providers but to also access national mandate management infrastructures, either through their Identity Providers or directly as Attribute Providers. Both use-cases of retrieving e-mandate attributes from mandate management systems and providing e-mandate attributes will be demonstrated and piloted within the SEMPER project in a cross-border context between project partners. The SEMPER project is in progress and ends by 31st December 2020 [30].

A high-level process structure of the SEMPER, consist of 4 elements that include validating member state, relying Member State, service provider, and service provider, that supports bilateral communication between member states. One Member State authenticates the user and validates powers, and the other member state relies on the mandate attributes to provide the service to the user. Annex II provides more details.

The DE4A Pilot "Doing Business Abroad" relies on (and interacts with) several programs, components, and regulations, including the SEMPER project. The DE4A pilot "Doing Business Abroad" use case 'UC#1' requires data to register a company at the company portal register of a data consumer of another Member State. This can be implemented as the enrolment of a company in the company

register of the competent authority or as the registration of a company in a database of a service provider.

SEMPER provides a more advance outcome on ISA^2 Representation Powers and Mandates (RPaM) Ontology. RPaM aims to provide commonly agreed vocabulary that conceptualizes, formally encodes and makes data available about the representation of powers and mandates in an open, structured and machine-readable format. It is the intention of the vocabulary to unify existing practices, thus facilitating seamless exchange, access and reuse of data. RPaM describes the mandatee (i.e. the natural or legal person that acts on behalf of another natural or legal person), the mandator (i.e. the person who needs an activity executed in his name) and the power concept (i.e. the capacity of a person to act on its own behalf). The following are the concepts for cross-border information flow on powers of representation: person, powers of representation, the scope of power, power use constraint. We also showcase the above-mentioned interrelated core concepts of SEMPER semantic model in Figure 5, below. Such concepts for cross-border information flow on powers of representation are vital for a common understanding of cross-border mandate information.

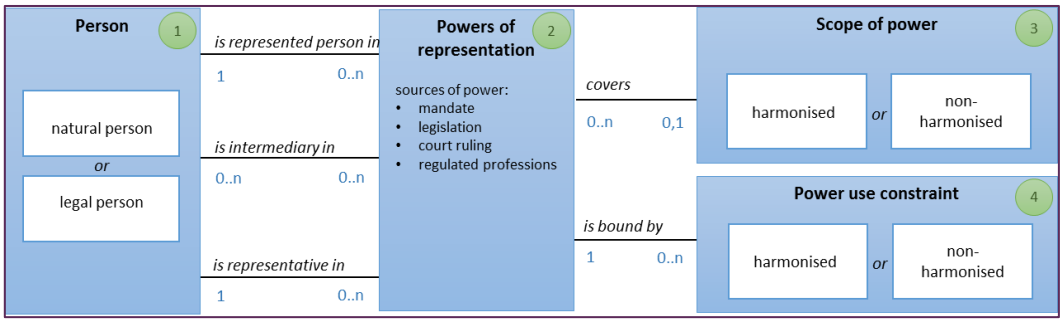

Figure 5: Interrelated core concepts of the SEMPER Semantic Model

The SEMPER model adds several mandates attributes to eIDAS. Following are the mandate attribute about a person: person types allowed; requested powers of representation: sources of power allowed, and regulated professions allowed; powers of representation: validation result, source of power, and regulated profession; the scope of power: full powers, service catalogue, harmonized service, member state, a service provider, service, procedure, and type of procedure; and power use constraints: constraint, value [30].

3.17 Verifiable Credentials data model

Credentials are a part of our daily lives; driver's licenses are used to assert that we are capable of operating a motor vehicle, university degrees can be used to assert our level of education, and government-issued passports enable us to travel between countries. This specification provides a mechanism to express these sorts of credentials on the Web in a way that is cryptographically secure, privacy respecting, and machine-verifiable. It describes a data model for a digital entity profile and a collection of digital entity credentials that assert verifiable claims about that entity profile [35], [36].

The verifiable credentials ecosystem is composed of five primary roles:

- ***issuer*** - A role an entity might perform by creating a verifiable credential, associating it with a specific ***subject***, and transmitting it to a ***holder***. Example ***issuers*** include corporations, non-profit organizations, trade associations, governments, and individuals.
- ***subject*** - A role an entity might perform by having one or more verifiable credentials asserted about it. Example ***subjects*** include human beings, animals, and things.

- ***holder*** - A role an entity might perform by possessing one or more verifiable credentials about a ***subject*** and generating presentations from them. Example ***holders*** include students, employees, and customers.
- ***verifier*** - A role an entity might perform by requesting and receiving a verifiable presentation that proves the ***holder*** possesses the required verifiable credentials. Example ***verifiers*** include employers, security personnel, and websites.
- ***verifiable data registry*** - A role a system might perform by mediating the creation and verification of identifiers, keys, and other relevant data, such as verifiable credential schemas and revocation registries, which might be required to use verifiable credentials. Some configurations might require correlatable identifiers for ***subjects***. Example verifiable data registries include trusted databases, decentralized databases, government ID databases, and distributed ledgers.

Figure 6 provides a visual depiction of the Verifiable Credentials data model.

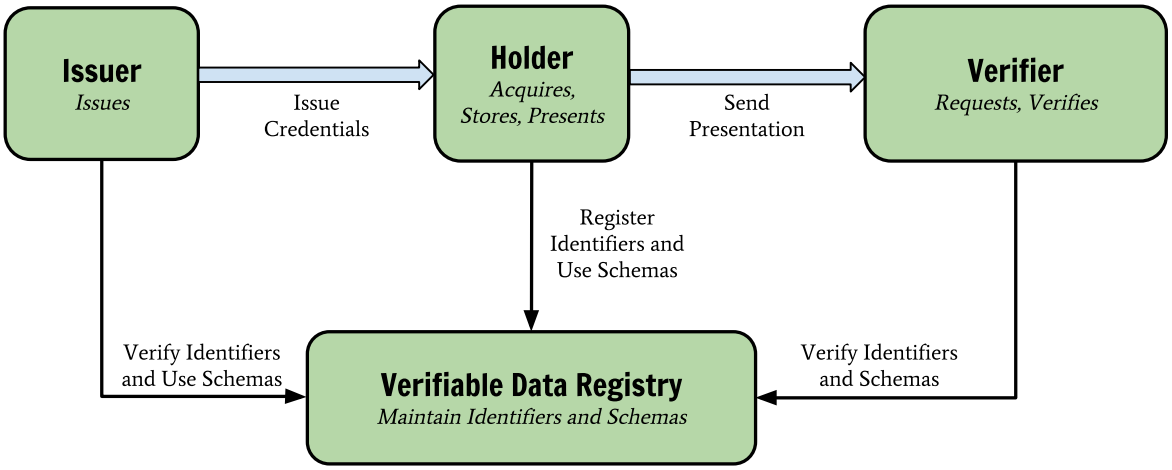

Figure 6: Conceptual model of the main entities in the Verifiable Credentials data model

3.18 Europass Digital Credentials Infrastructure data model

European Commission, Directorate-General for Education, Youth, Sport and Culture (DG EAC) is emerging a Europass framework for digitally signed credentials intended at fostering the implementation of verified, trustworthy digital certificates, and at encouraging the recognition of qualifications, competences and skills acquired [37], [2]. Europass Digital Credentials Infrastructure (EDCI) is a set of standards, services and software that permits institutions to issue digital, tamper-proof qualifications and other learning credentials within the European Education Area. The EDCI Data Model is an extension of the W3C Verifiable Credentials Data Model [2]. The Commission is presently working on a technical infrastructure that organizations can utilize to issue digital credentials across the EU. This technical infrastructure could be applied by the Member States and various stakeholders when issuing Europass Digital Credentials to learners.

EDCI streamlines the issuing, viewing and automatic verification of credentials. These acts will benefit a wide range of stakeholders, including individuals, universities, vocational training providers and

employers. The infrastructure can guarantee a common understanding of qualifications and types of certifications across and beyond the European Union; that qualifications, competences and skills can be easily identified and understood by any EU Member State. The infrastructure can also enhance transparency and portability of qualifications and skills between countries, reduce administrative burden for citizens, learning providers and employers, make tampering and credential-fraud easily identifiable, empower people to own and control their own credentials; and contribute towards digitization of government processes. Moreover, issuers can identify the individual who is going to be awarded a certificate documenting her/his skills, competences or qualifications, issue a Europass Digital Credential or a revocation certificate to an individual. Both certificates should be issued by an awarding body. The EDCI ecosystem, graduates and learners that receive credentials can store and organise their digital credentials in their Europass library, e-Portfolio or other platforms and wallets; share their Europass Digital Credentials with employers or other organisations. Additionally, owners will control what they share, like whether they will send a web link or send information directly and for how long, like they can determine how long the web link stays active. While in the above-mentioned ecosystem, employers can verify the authenticity of digital credentials that holders willingly shared. The accreditation of the awarding body could also be verified (i.e. if an awarding body is licensed or authorized to issue a specific qualification), where applicable.

Europass and EDCI data model can constitute the basis for describing the concepts of higher and secondary education, while providing the necessary credentials for certifying the evidences related to the domain of education. These concepts will be used by the Diploma/Certs/Studies/Professional Recognition use case of the pilot "Studying abroad".

3.19 SDG OOP common data models for evidence types

The SDG OOP Semantics Working Group is in the process of developing common data models for the following evidences based on the Deloitte study recommendations which are also relevant for DE4A [38].

- Birth certificate
- Marriage certificate
- Certificate of completion of secondary education
- University diploma evidence

The birth and marriage certificate data models can provide valuable contribution to the pilot *Moving abroad* for the use case #2 –*Request an extract or copy of a civil state certificate*. Furthermore, the conceptual model of the certificate of completion of secondary education and the university diploma evidence can be considered for the "Studying Abroad" pilot. For more information, Annex I presents the conceptual data models of these certificates.

3.20 Electronic Exchange of Social Security Information

Electronic Exchange of Social Security Information (EESSI) is an IT system enabling information exchange between social security institutions across the EU. In the context of DE4A "Moving Abroad" pilot, for instance, the competent authority responsible for administering study loans and grants may want to request from the competent national social security institution information about benefits through the EESSI system in order to better evaluate a citizen's claim, in case the institution is connected to EESSI. However, we consider this semantic asset relevant to the Moving Abroad (pension – uc#3) pilots and we will investigate it further in the second iteration of this deliverable.

3.21 BRIS Legal Entity data model

BRIS is the interconnection of business registers, allowing business registers to exchange cross-border messages on mergers and branches, and the users of the e-Justice portal to obtain multilingual information on EU companies. The DBA pilot will not use the BRIS network but will use the BRIS semantics as much as possible [45]. The BRIS data model reused elements of the "Legal Entity" concept of the Core Business Vocabulary. It will be investigated further in the second iteration, when it is available to us.

3.22 ISA^2 models for multilingual public documents

Regulation (EU) 2016/1191 of the European Parliament and of the Council of 6 July 2016 on promoting the free movement of citizens by simplifying the requirements for presenting certain public documents in the European Union and amending Regulation (EU) No 1024/2012 aims to simplify the circulation of certain public documents between Member States.

It applies to public documents issued by the authorities of a Member State that need to be presented to the authorities of another Member State. The Regulation abolishes the apostille requirement and simplifies formalities with regard to certified copies and translations.

The Regulation also introduces optional multilingual standard forms in 11 areas in order to avoid translation requirements. The forms are to be used in another Member State as translation aids attached to the public document. In the context of DE4A, the life, birth, marriage and death forms will be considered as part of the use case 2 about civil certificates (birth, marriage, death).

ISA^2 has provided XML Schemas for describing these public documents in a structured format. We will reuse these XML Schemas and extend them according to the DE4A pilot requirements.

3.23 Mapping of assets with semantic relevance to DE4A Pilots

This section provides a mapping of semantic assets to the related DE4A pilots. This is an initial mapping effort and will further be extended in the final version of the semantic framework. Table 2 presents the mapping of the semantic assets to each pilot as below.

Table 2: Mapping of assets with semantic relevance to DE4A Pilots

Assets with semantic relevance	Relevance to DE4A Pilots		
	Studying Abroad pilot	Doing Business Abroad Pilot	Moving Abroad Pilot
ISA^2 Core Vocabularies	x	x	x
DCAT-AP	x	x	x
ADMS-AP	x	x	x
BRegDCAT-AP	x	x	x
SDG metadata model	x	x	x
DQV	x	x	x
ROV		x	
TOOP ROV		x	

TOOP Evidence Broker	x	x	x
TOOP DSD	x	x	x
TOOP EDM	x	x	x
TOOP RoA	x	x	x
SEMPER semantic model		x	
Verifiable Credentials	x		
EDCI	x		
SDG evidence data models			x
EESSI data model	x		x
BRIS Legal Entity data model		x	
ISA^2 models for multilingual public documents			x

4 Evidence modelling of pilot required data

In the course of DE4A, the scope of WP4 *Cross-border Pilots for Citizens and Business and Evaluation* is the planning, setting-up, running and evaluation of three cross-border and cross-domain Pilots Studying Abroad, Doing Business Abroad and Moving Abroad -, comprising different functional use cases focused on different high-impact and viable administrative procedures, and aimed to realize tangible benefits in fully operational environments to real users (citizens, students, business persons and public servants). The use cases of each pilot are as follows:

4.1 Pilot description and related evidences

4.1.1 Studying abroad

In DE4A, the Pilot "Studying Abroad" [2], consists of the following three use cases.

- Application to public higher education (UC#1)
- Applying for study grant (UC#2)
- Diploma-Certs-Studies-Professional Recognition (UC#3)

Belgium, Slovenia, and Spain are the participants EU Member States of this Pilot. The respective pilot highlighted the identified evidence relevant to each use case that can be located abroad, and which is lawfully issued by a competent authority. This category is related to education domain.

- In case of UC#1, following are the identified evidence to be provided:
  - Completion of secondary education
  - Confirming that country's secondary education completion certificate entitles the applicant to entry in country's universities
  - Confirming the country and curriculum of the secondary education system attended by the applicant
  - Full attendance of the last two classes of secondary education
  - University diploma recognized in Member State of origin giving access to studies/work
  - Language proficiency, if applicable
- While UC#2, consists of the following evidences:
  - Perception of subsistence minimum allowance or care allowance for individual or their household
  - Perception of orphan allowance or military orphan allowance
  - Institutional care/educational measure/other urgent measure
  - Custody of the applicant to someone other than the applicant's parent(s)
  - Perception of scholarship in previous or current academic year
  - The applicant has three or more underage and unprovided-for siblings or two or more underage and unprovided-for siblings who study full-time at university
  - Results of previous academic year
- While UC#3 consists of the following evidences:
  - Student Digital Identity
  - Student - Educational degree
  - Professional experience certificate

4.1.2 Doing business abroad

This pilot consists of the following use cases:

- Starting a business in another Member State (UC#1)
- Doing business in another Member State (notify and update company data, unsubscribe – UC#2)

According to the pilot of doing business abroad [3], all attributes:

- are available through derived access (e.g. data layers);
- are available in a standard, structured format (e.g. xml);
- are from the source 'business register' of the concerning Member State.

The evidence of natural person registration is provided by eIDAS.

4.1.3 Moving abroad

The pilot "Moving Abroad" consists of the following use cases:

- Request address change (UC#1)
- Request and extract of copy of a civil certificate (UC#2)
- Request pension information – claim pension (UC#3)

The following types of evidence have been identified in this pilot.

- Use Case 1 (UC#1):
  - Proof of change of address

- Use Case 2 (UC#2):
  - Proof of birth
  - Proof of marriage
  - Proof of death

- Use Case 3 (UC# 3):
  - Employment details of the citizen from the respective pension service register (s) or institution (s).

After communication and collaboration with WP4 Moving Abroad pilot team, we concluded on the following items:

- The evidences of **use cases 1 and 2** (proof of change of address, proof of birth, proof of marriage, proof of death) are based on the EU Regulation 2016/1191 that specifies standardized representation of multilingual public documents that have a legal value and can be represented in a structured format. As described at section 3.22, we will reuse and extend the XSD models for multilingual public documents provided by ISA^2 to facilitate the structured view of these documents. The mapping of the pilot required data to existing vocabularies is presented in tabular form at section 5.4.3.
- For the evidence required for use case 3 (pension), may be further aligned with EESSI in further iterations.

4.2 Definition of Entities and Attributes per Evidence for Pilot Use cases required for exchange of information

This section covers the entities and attributes per evidence for above-mentioned pilot use case. Additionally, the section provides unification of these attributes particularly that have similar meanings to avoid duplicates.

The conceptual models for Pilot Use Cases are based on deliverables D4.1 *Studying abroad - Use Case Definition & Requirements*, D4.5 *Doing Business Abroad - Use Case Definition & Requirements* and D4.9 *Moving Abroad - Use Case Definition & Requirements*, below.

This section provides the conceptual models of the ontologies for the pilot required data for evidence exchange **for each use case** that can provide a preliminary understanding in order to define the evidence data models:

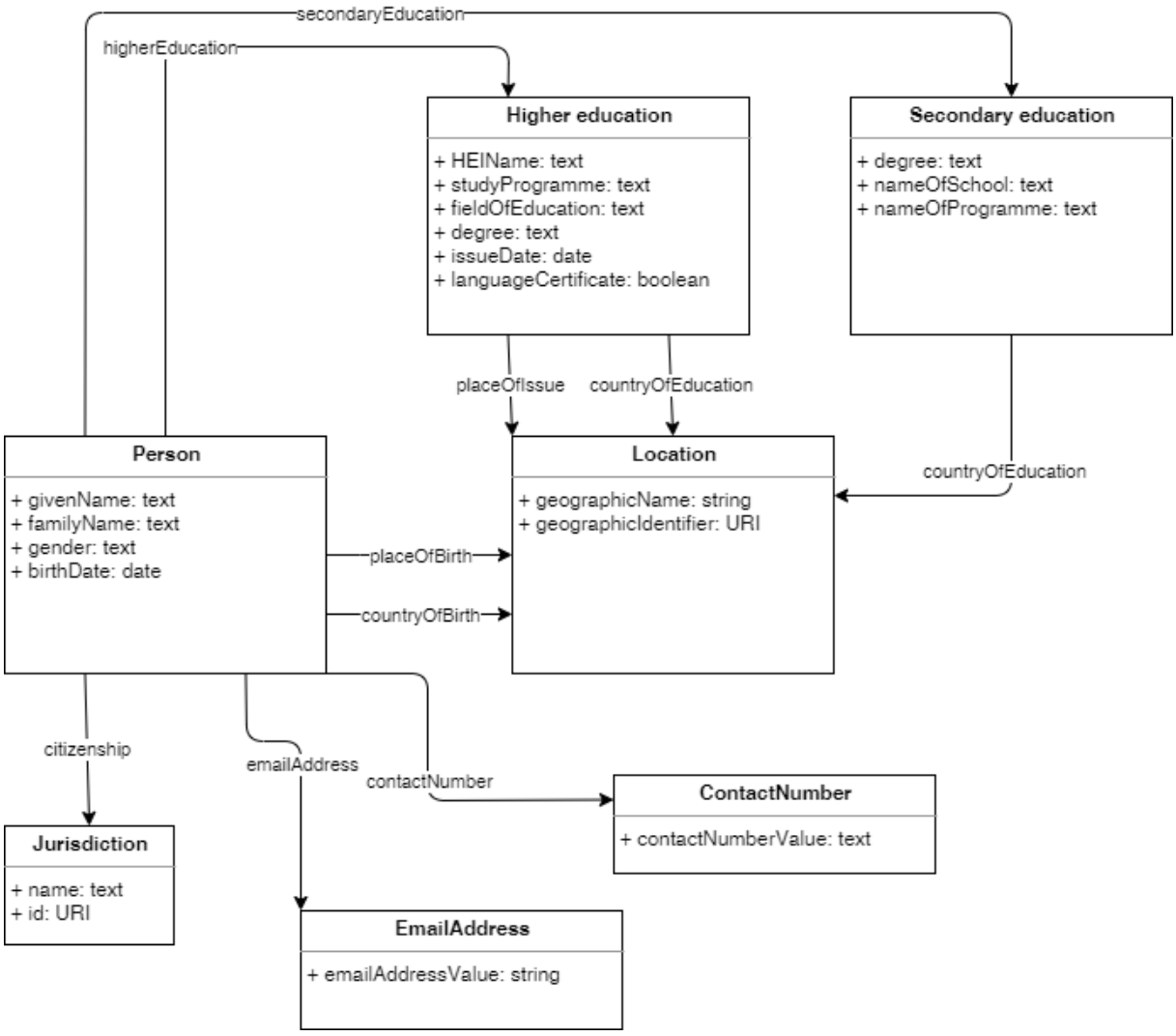

Figure 7: Conceptual model of the ontology for the pilot required data for evidence exchange use case "Application to public higher education"

The Studying Abroad pilot use case#1 “Application to public higher education” (Figure 7) covers the following main concepts and entities that can be used to describe the DE4A pilot required evidences for cross-border exchange:

- Completion of higher education
- Completion of secondary education
- Attributes of person, location and contact point

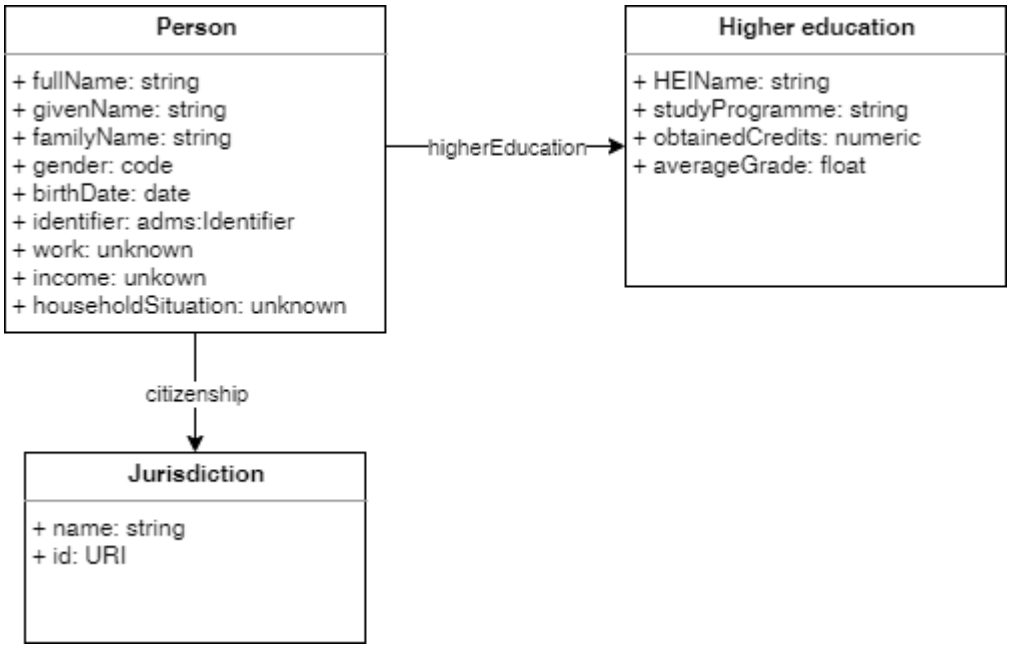

Figure 8: Conceptual model of the use case “Applying for Study Grant”

The Studying Abroad pilot use case#2 “Applying for Study Grant” (Figure 8) covers the following main concepts and entities that can be used to describe the DE4A pilot required evidences for cross-border exchange:

- The enrolled programme in higher education
- Main attributes of person and location

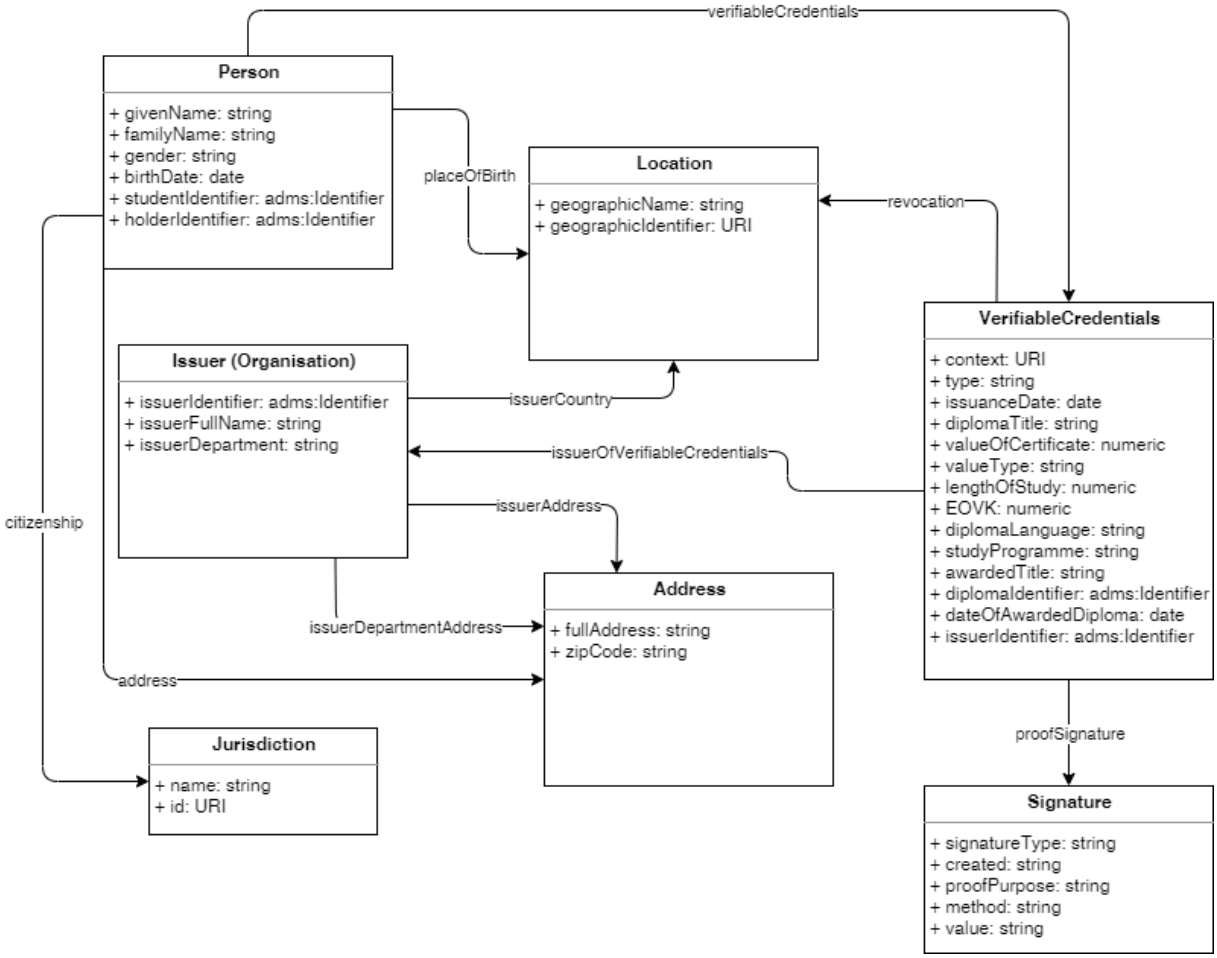

Figure 9: Conceptual model of the use case “Diploma-Certs-Studies-Professional Recognition”

The Studying Abroad pilot use case#3 “Diploma-Certs-Studies-Professional Recognition” (Figure 9) covers the following main concepts and entities that can be used to describe the DE4A pilot required evidences for cross-border exchange:

- Attributes of person, location, address
- The enrolled programme in higher education
- The verifiable credentials
- The issuer of the verifiable credentials

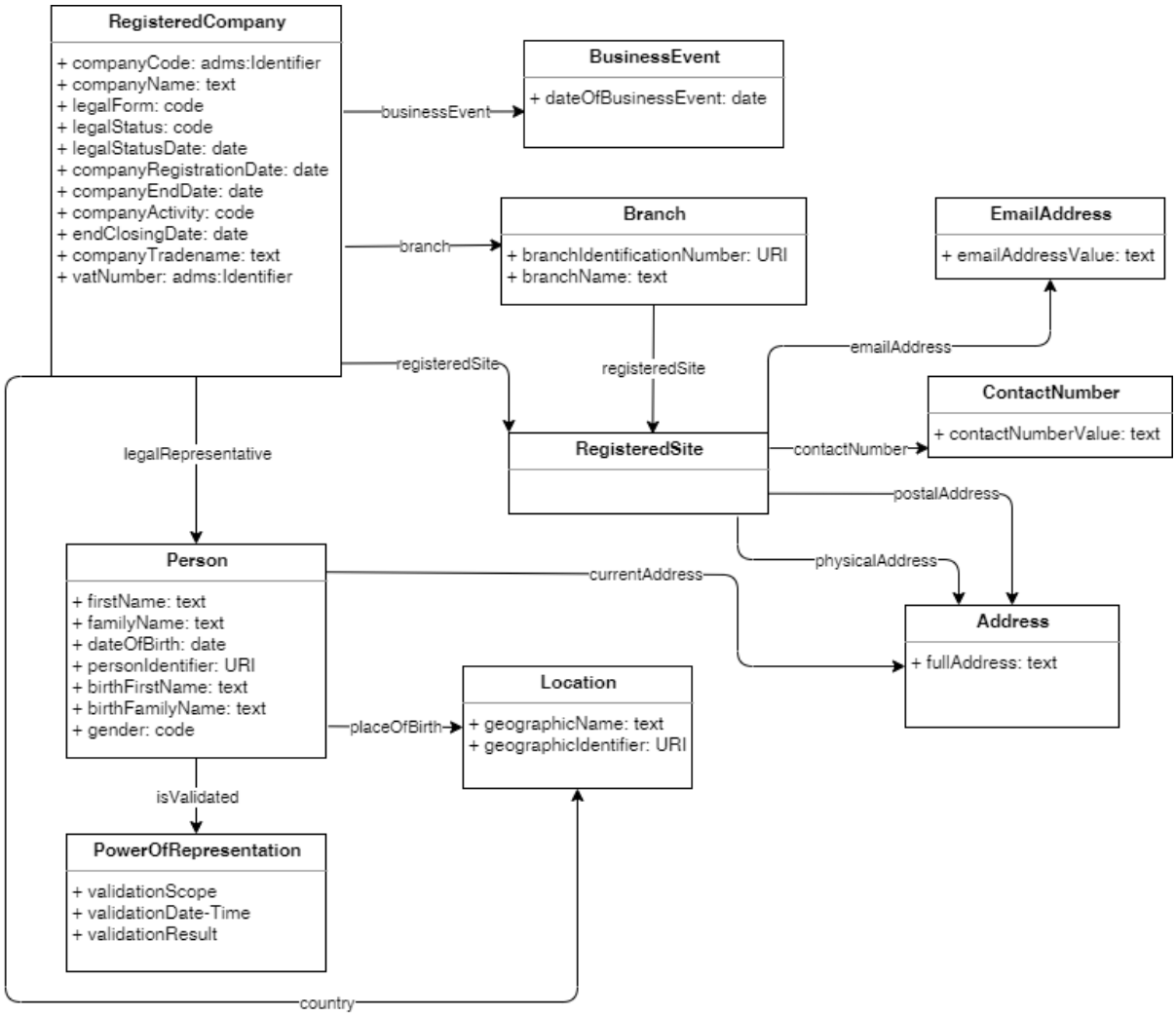

Figure 10: Conceptual model of the Doing Business Abroad "Starting a business in another Member State" (UC#1) and "Doing business in another Member State" (notify and update company data, unsubscribe – UC#2)

In the Doing Business Abroad pilot (Figure 10) we consider both use cases "Starting a business in another Member State" (UC#1) and "Doing business in another Member State" (notify and update company data, unsubscribe – UC#2), as the latter has very few required attributes. The Doing Business Abroad pilot covers the following main concepts and entities that can be used to describe the DE4A pilot required evidences for cross-border exchange:

- Attributes of natural person
- The legal entity (company) and related branches
- The case of power of representation
- The location, address and contact information of natural person and company.

4.3 Propositions for common semantic models based on Pilot use cases to exchange evidences

The SDGR aims on the implementation of an exchange system that would be able to automatically distribute the required evidences between European countries. To achieve the above-mentioned aim by 2023, the Member States and the European Commission need to set-up the Once Only technical system, adopting all the necessary acts towards its inextricable and efficient completion.

The SDGR covered a series of administrative procedures. These procedures constitute a sequence of actions that is required, to provide to the users all the necessary evidences that will result on their capability to exercise their rights.

In DE4A, the propositions of common data models that contribute to exchange evidences are based on the analysis of the existing data models. More specific, the exchanged evidence is divided into following domains related to DE4A pilots.

4.3.1 DE4A Controlled Vocabularies – Code Lists

Many elements values are constrained to adapt to agreed EU vocabularies for list of codes known as Code lists or controlled vocabularies. Detailed information regarding DE4A controlled vocabularies can be found at Annex IV.

4.3.2 Recommendations for ISA^2 Core Vocabularies

At first, Deloitte study [7] suggests that characteristics of high importance should be included within the Core Person section of the Core Vocabulary. Furthermore, it is suggested that complex type elements should be included in the Core Vocabularies Basic Components, achieving this way both hierarchy of attributes and maintenance of the existing structure.

Regarding the Core Person Vocabulary, the study recommends the adoption of the vocabulary listed on the following Table 3. These new definitions will help the system to obtain all the necessary personal information, resulting in a fast and comprehensive description of the person of interest.

Table 3: High-level attributes recommendations of ISA^2 Core Person Vocabulary Extension

Core Person Elements	Type
Citizenship	String
Nationality	String
Academic qualification	String
Marriage info	CVB.MarriageInfoType
Student information	CVB.StudentInfoType
Criminal Record	String
Tax information	CVB.TaxInfoType
Social security coverage start date	Date (“YYYY-MM-DD”)

Furthermore, the study suggests the extension of CV Basic Components to enable the easier sharing of basic personal information. More specific, it segregates personal information in five categories that consist of data related to marriage, education, taxation, courses and driving, and it recommends new ISA^2 vocabulary on these fields. These recommendations are shown on Table 4.

Table 4: Complex types recommendations for ISA2 CV Basic Components extension [16]

Core Vocabularies Basic Components Types	Core Vocabularies Basic Components Elements	Type
MarriageInfoType	MarriageDate	Date ("YYYY-MM-DD")
	Prior Marital Status	String
StudentInfoType	Education Institution Name	String
	Student ID Number	IdentifierType
	Overall Grade	String
	Total Credit	Float
	Courses Info	CourseInfoType
	Academic Year	Date ("YYYY-MM-DD")
	Grade Point Average	Float
TaxInfoType	Total Income	Float
	Income Tax	Float
	National Physical Number	IdentifierType
	Date of Payment	Date ("YYYY-MM-DD")
CourseInfoType	Course Name	String
	Course Grade	Float
	Course Academic Year	Date ("YYYY-MM-DD")
-	Evidence Serial Number	IdentifierType

4.4 Multilingual evidence model

In the public administration context, evidence is information to legally prove that procedural requirements are met. Because of the required legal value of evidences, the provided information has to be expressed in an official language legally recognized by the competent authority of the procedure, which is a problem in a cross-border scenario when evidence is issued in a different language. Traditionally, public administrations resolve this issue by asking the applicant to provide a legal translation of the evidence along with the evidence itself, which has a cost to them. However, traditional legal translations are not applicable when evidences are automatically exchanged between competent authorities and the multilingual issue needs to be resolved otherwise. Automatic translations are not a solution at all today because their lack of accuracy, so other solutions should be implemented.

When evidence is written information, such information can be presented as unstructured text or as structured data. However, for the collaborative provision of public services in line with the Once-Only principle within the EU, there are agreements for certain evidence types to provide their information in accordance to ad-hoc common data models. Then, per evidence type, evidences as structured data

are transformed to the corresponding agreed common data model and evidences as unstructured texts can be accompanied by the equivalent structured data according to such a model.

Common data models are composed by sets of attributes with labels that are not expressed in any human-style language, but each label has an agreed meaning that is known by the machine algorithms that process such information. In this sense, the multilingual issue is reduced to understanding the language in which attribute values are expressed; this issue can be mostly avoided by using standardized lists that are mainly classifications, code lists or dictionaries developed for statistical purposes at European level (Eurostat). For specific-domain concepts, there are international and European standardized lists as well. However, there are some values that cannot be easily standardized because they are peoples' names, or they are old names of places that are not included in the standard lists now. In these cases, the only possible agreement is using a common alphabet to represent the characters.

Nonetheless, automatic processing of evidences is not the only need for the collaborative provision of public services in the EU, because human processing of evidences is required in some cases as well as the user preview functionality requirement, or even any later accesses to the exchanged data for transparency or auditability purposes. When evidence information has to be presented to people (applicants or civil servants), labels and standardised lists need to be translated into a human-understandable language according to the language of the procedure. Most of the standardised lists have an official translation to every European language that can be used in this context, but mostly there are not official translations for attributes of the common data models. Thus, human interfaces need labels to show in each of the official languages of the EU and, for such a task, the methodology used by the Regulation on Public Documents (Regulation 2016/1191) may serve as a major reference.

The Regulation 2016/1191 methodology is based not only on the agreement of which fields (attributes) can be found in each public document type, but also in the labels of such fields in each of the EU official languages, as well as in the recognition of the legal value of such multilingual labels. In this way, any evidence is expressed in the languages of both the issuing and consuming authorities, with recognised legal value on both sides. However, the legal recognition of these multilingual labels is only aimed to replace the need of legal translations; it is not aimed to provide legal value to the information expressed with such labels. In this sense, Regulation 2016/1191 leaves at the discretion of each Member State the recognition of the legal value of the agreed multilingual set of attributes or their use only to be attached to legal evidences as a replacement of legal translations.

Because the implementation of the Once-Only principle at EU level mostly requires the agreement on a common data model per evidence type, their attributes can be labelled and defined in each of the EU official languages and the agreement can be extended to recognise such labels and definitions for avoiding legal translations, provided that attribute values do not require translation (e.g. standardised lists and proper names). The recognition of the legal value as evidence of information expressed with such common data models can be left at the discretion of each Member State or competent authority; if such legal value is not recognised, then the evidence with legal value has to be attached and the information expressed accordingly to the multilingual common data model is aimed only to replace the need of legal translations. Besides, the multilingual labels of the issuing and consuming authorities may be used to show the information to users and civil servants with equivalent value to legal translations, so applicants save costs and burdens.

An evidence type may be seen as a dataset according to an agreed common data model that is composed by complex or simple data elements. These data elements are part of some domain-specific or general ontology, and their description is registered with two strings per language, a label and a definition; at least, each data element in any ontology should be defined in English. Besides, data elements might be composed by other data elements. Because data elements that belongs to domain-

agnostic ontologies might represent different concepts in different evidence types (parent, newborn, spouse, etc.), these concepts can be seen as specialised data elements that are described with their own set of labels and definitions according to their meaning in the associated evidence type. Besides, the same specialised data element might be present in several evidence types, such as “applicant”.

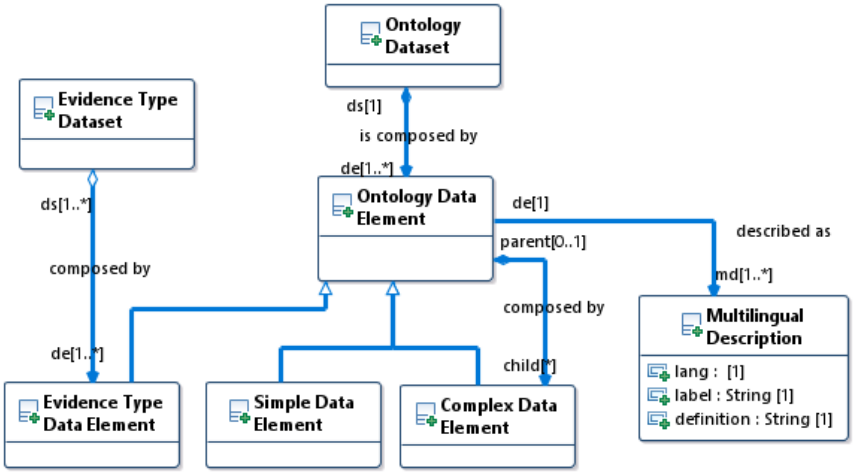

Figure 11: Multilingual description of evidences

In summary, multilingual labels and descriptions are useful for cases from two different points of view:

- Purpose:
    1. Replacement of legal translations (if required)
    2. Human understandability
- Functionality:
    1. User preview
    2. User a posteriori access to exchange data (transparency)
    3. Evidence processing by civil servants
    4. Procedure processing auditability

5 The DE4A Semantic framework

DE4A semantic is based on a complex structure that involves public services, public and private organizations, businesses and many other bodies. For the optimal sharing of the required personal information, every single link in the chain of interoperability must function correctly. Thus, all the actions, channels, agents and events should work harmonically in order to achieve sufficient and correct file sharing among European Member States. This chapter integrates the semantic components and services to the DE4A architecture, and presents the common data models per pilot for describing the evidence required data.

5.1 Semantic assets in the Information Desk

Information Desk (IDK) is an information place holder in OOTS, where the actors (e.g. DP, DC) may obtain requisite information before making requests and/or sending responses to the respective actors. The Information Desk ensures ease in the exchange of evidences in full respect of the substance and availability of online procedures and evidence issuing. For example, actors can make the following queries for the requisite information from the IDK, i) which cross-border authority is competent to issue the user's evidence?, or ii) does the semantic of the evidence follow a common data model? The scope of the Information Desk is to provide accurate information to enable the proper selection of Member States' evidences that are valid and actionable for the procedure processing. It is mentioned that this deliverable provides a high-level view of the Information Desk.

IDK has the following responsibilities:

- **Allow the registration of evidences**
  - Canonical evidence definitions
  - Correspondence between canonical evidences and electronic domestic evidences,
  - Provision properties per electronic domestic evidence.
- **Allow the registration of authorization grants**
  - Agreements for consuming electronic evidences issued by competent authorities according to their legal/organizational provision properties
- **Provide Information to online procedures on demand**
  - For authorization to access the canonical evidences and corresponding electronic evidences
  - For conducting the interaction with the user regarding a particular evidence (availability according requested provision properties, exceptions to user consents and user previews, etc)
  - For requesting the proper evidences corresponding to requested canonical evidences
  - Provision properties of the electronic evidence to consider in the procedure processing

The IDK consists of the following components, Issuing Authority Locator, Evidence Service Locator, Cross-border Access Authorization Registry, and Multilingual Ontology Repository. We described a high-level overview of these components of IDK in the sub-sequent paragraphs. Additionally, we will further investigate, and implement the semantic assets (e.g. in the format of RDF, Turtle or other interoperable formats) of the above-mentioned components of IDK, registries and REST APIs will be developed in the forthcoming deliverable D3.5 "Semantic Toolkit – Initial Version".

5.1.1 Issuing Authority Locator

Issuing Authority Locator (IAL) component helps the DC to find out the competent issuing authority that can provide the required evidence within a particular country.

In order to identify the corresponding issuing authority by the DC, this component requires the following preconditions:

1. The user has said to the DC that the evidence must be provided by other country.
2. DC knows which canonical criterion or canonical evidence corresponds to the evidence to get through the technical system
3. Each canonical evidence is only provided by one competent authority within a certain territorial or administrative scope (e.g, in Spain, evidence of a person has some university degree is in the registries of the corresponding university and the Ministry, but only this last one is the competence authority to prove such a fact, and it also serves as a single point of access that eases the evidence location). In this way, the user's evidence can only be provided by one issuing authority.
4. Every canonical evidence has been registered in IAL along with their relevant characteristics (e.g. description, register date, granted by an EU law or by explicit request, etc.)
5. Every country has registered in IAL their competence distribution per canonical evidence when there is an evidence service to provide such a canonical evidence

As the first step to build the cross-border evidence request, DC consults IAL about the availability of an issuing authority of the canonical evidence in a specific country and following are the possible flows:

A. National Issuing Authority for Canonical Evidence (Main flow 1): DC enquires from IDK about the issuing authority for a specific canonical evidence in the respective country. IDK will provide three possible outcomes:

R1 (Success)**:** the issuing authority for the canonical evidence is at national level.

R2 (Partial Success)**:** the territorial or administrative scope (regional/local or university level) where the competence to issue the canonical evidence is distributed in the country.

R3 (Error)**:** error message because there is no issuing authority for such canonical evidence in such country.

B. Subnational Issuing Authority for Canonical Evidence (Extended Flow 1.R2): After Main Flow (1) results with the outcome R2, the users have to select the regional/local/university level authority that holds their required evidence. For such a task, IAL can be enquired by DC to know about the composition of the territorial or administrative scope in the issuing country:

R1 (Success)**:** list of subnational administrative territorial units at a certain administrative level that can issue the canonical evidence within the country. Selection of the proper competent issuing authority has to be done in several steps by requiring the user to select the item from the returned lists the chosen item lets to identify the issuing competent authority. NUTS/LAU authoritative lists can be used by IAL to help DC to ask the user; for universities should be agreed how to proceed for providing the corresponding authoritative list.

R2 (Error)**:** There are no subnational authorities that can issue the canonical evidence within the country at a certain administrative level or the user has cancelled the search.

If DE4A pilots require locating canonical evidence from canonical procedural criteria, IAL will register the agreed list of canonical procedural criteria and their correspondence to canonical evidences per country. Then IAL will provide to DC such a correspondence with the next Flow 0:

C. **Canonical Evidence for Canonical Procedural Criterion (Extended Flow 0):** DC asks IDK about the canonical evidence for a given canonical criterion. Following are the possible results from the IDK:

R1 (Success): list of canonical evidences that can be used to verify the given canonical criterion within such country. Then the user will select the desired canonical evidence and finally DC will adopt Main Flow 1.

R2 (Error): there is no canonical evidence associated to the given canonical criterion within the country e-A2. DC does not choose any canonical evidence, and DC does not able to choose any canonical evidence.

IAL approaches to ease the mapping between domestic and cross-border evidences can be criteria-based or evidence-based, or both, which can together fulfil the needs of both consuming competent authorities that work with procedural requirements and with evidences, as described in the deliverable D2.4 of the Project Start Architecture [45]. For the criteria-based approach, if needed by DE4A pilots, IAL will use an adapted version of the TOOP Evidence Broker that is described at section 3.1.10, whose data model is based on CCCEV, DCAT and Core Agent vocabularies (UML diagram is presented in Annex V).

Both criteria-based and evidence-based approaches need agreements on common data models to represent canonical evidences from a country-agnostic perspective, data models that are created from the domain-specific ontologies described in section 5.3. Criteria-based approach also needs agreements on canonical criteria from a country-agnostic perspective.

5.1.2 Evidence Service Locator

Evidence Service Locator (ESL) helps the DC to locate the evidence service able to provide the canonical evidence from a particular competent issuing authority, along with the relevant evidence service characteristics.

For such a task, ESL requires the following preconditions:

1) DC knows the canonical evidence to request the corresponding issuing authority level after consulting the IAL.
2) Every issuing authority registered the service in the ESL to provide each canonical evidence along with the relevant service characteristics.
3) Each evidence service has a unique identifier and provides data for a particular canonical evidence issued by an issuing authority at the level specified by IAL.

After locating with the IAL the proper cross-border authority administrative level to issue a canonical evidence for the user, DC consults the ESL for the corresponding evidence service with the following possible consultation flows:

A. **Evidence Service Location (Main flow 1)**: DC asks for the evidence service for a certain canonical evidence and issuing administrative level.

R1 (Success): metadata of evidence service that provides such canonical evidence (e.g. input parameters, SLA, constraints if any, attached legal evidences, etc.) and connection details.

R2 (Partial Success): list of evidence services that provide the canonical evidence issued by the given issuing authority

R3 (Error): there is no available evidence service that corresponds to the given canonical evidence and issuing authority.

B. Evidence Service Metadata (Extended Flow 1.R2): After Main Flow (1) results with the outcome R2 and DC has selected one of the available evidence services, DC consults on the connection details of the selected evidence service with two possible outcomes:

R1 (Success): metadata connection details and relevant characteristics of the given evidence service.

R2 (Error): no metadata found on the given evidence service.

ESL will use an adapted version of TOOP DSD, which uses the BRegDCAT-AP application profile as a baseline. Data Quality Vocabulary (DQV) can be also used to include quality metadata of the information provided by evidence services; documenting data quality significantly eases the process of evidence service selection and information reuse as shown in the example presented at Annex VIII.

5.1.3 Cross-border Access Authorization Registry

Cross-border Access Authorization Registry (CAAR) helps the DP to check if the request has the required authorization. The request authorization is a function of four main parameters: requesting authority, procedure, issuing authority and canonical evidence. These parameters can be extended with legislation that authorizes the access. The result could be also conditioned to periods of validity.

In order the DP knows if the request has the appropriate authorization, this component requires the following preconditions:

1. DC has requested a canonical evidence through a certain evidence service
2. DP requires some specific authorization to response such a request
3. Request authorizations are stored in the CAAR

There are several possibilities to implement the consultation to the CAAR that should be agreed according to the DE4A pilots' needs. For instance, the next situations could be considered:

- authorised any access to information corresponding to a given canonical evidence
- authorised any access to information provided by a given issuing authority / evidence service to a given requested authority / procedure
- authorised any access to information corresponding to a given canonical evidence by a given requested authority under a given / any legislation
- authorised any access to information corresponding to a given canonical evidence for a given public service (in abstract, not a given public service instance)

CAAR consultation could result with **only one main flow** with two possible outcomes:

R1 (Success): Yes/No to indicate whether DC is authorized to make the request under the given parameters.

R2 (Error): no authorization information is found associated to the parameters provided by the DP. Absence of authorization information might be considered as an authorization grant.

CAAR will use an adapted version of TOOP RoA that is described at 3.15, which is currently under development to consider IMI authority model.

CAAR will be further examined and considered in the second iteration of the DE4A project.

5.1.4 Multilingual Ontology Repository

Multilingual Ontology Repository (MOR) helps to know and understand canonical evidences. MOR is especially helpful for the Preview Component to show the user the evidence data to be exchanged along with their corresponding labels in the language chosen by the user to interact with the portal, as well for the DC users that manually process or audit the exchanged evidence data. MOR can also help DCs to know and understand input parameters of evidence services.

MOR consultation requires the following preconditions:

1. Every domain ontology has been registered in MOR along with their datasets
2. Each dataset attribute has been registered in MOR with a description, vocabulary term and, at least, an English label to show to users. Labels in other EU official languages can be registered as well.
3. Each canonical evidence is associated with the dataset attributes that compose its common data model.

The main flow of MOA is that DP asks for the labels of a set of data elements in one or several languages. MOA returns two possible results:

A. Success: System returns the requested labels
B. Error: System does not find the label of certain term in certain language

MOA will use an adapted version of the TOOP Semantic Repository that is described at 3.13. The inclusion of multilingual labels enables a reliable automatic legal translation of exchanged data as described at section 4.4.

5.2 Use of semantics in DE4A Semantic Framework

Table 5 indicates Core Vocabularies and Application Profiles that are being used in DE4ASem for describing main actors, concepts and entities.

Table 5: Connection of Core Vocabularies and Application Profiles to the main actors, concepts and entities of the DE4A architecture

Actor / Entity	Description	Core Vocabularies Used	Accessed from
Data Consumer (DC)	The Data Consumer is the initiator of a DE4A transaction. It can be a public service which requires some data about the data subject.	Core Agent, CPSV-AP (Agent)	CAAR
Data Provider (DP)	The Data Provider is the responder of a DE4A transaction. It can be either a public or private organization providing data on behalf of the Data Subject.	Core Agent, CPSV-AP (Agent)	IAL, ESL

User / Data Subject	The User is the Entity for which the requested evidence concern. It can be either a Natural Person or a Legal Person.	Core Person (Natural Person), Core Business (Legal Person), SEMPER semantic model	eIDAS, SEMPER
Evidence	Evidence is a Dataset which is required to prove a Requirement or Criterion.	CCCEV, ISA^2 models for multilingual public documents	IAL, MOR
Dataset	A collection of data, published or curated by a single agent (DP), and available for access in one or more representations.	CCCEV, DCAT-AP, BREG-DCAT-AP, ISA^2 models for multilingual public documents	IAL,ESL, MOR
Criterion/ Information Requirement	A procedural requirement with a legal basis expressed either as a criterion or an information requirement, is a question or a request for data that must be fulfilled.	CCCEV	IAL

5.3 Semantic aspects for the Business Process Collaboration

The DE4A WP2 Team described technical aspects for the DE4A business process collaboration. They covered this aspect into following three main interacting processes in in their deliverable D2. 4 “Project Start Architecture”. As this WP2 deliverable, and the preceding deliverables cover almost all EU EIF layers including semantic layer as well. To align with DE4A project start architecture, WP3 team describe the related semantic aspects for the DE4A business process collaboration of the intermediation interaction pattern. In this deliverable, we initially cover the semantic aspects of the intermediation pattern for the business process collaboration. The remaining patterns will be covered in the next iteration of the semantic framework.

5.3.1 Business Activities of the Intermediation pattern

In this part, we described semantic aspects the DE4A business activities of the intermediation pattern in line with WP2 deliverable D2. 4 “Project Start Architecture” [45].

1) **Request authentication and establish user identity**: After selecting the public service, the DE requests authentication to the user. This can happen either by using eIDAS or the eID on the DC country. The eIDAS attributes of the authenticated user can be described by the Core Person and Core Business vocabularies. In case of a person that represents another entity (typically legal entity) the upcoming SEMPER semantic model could be integrated with the eIDAS infrastructure. We will further study the aforesaid data models for this step and its possible use in the context of DE4A in the next iteration of this deliverable.
2) **Determine procedural requirements and/or cross-border evidence**: The DE compares the available information in the OOTS with the information required by the eProcedure. The result can be a (list of) corresponding canonical evidence which is then displayed as the option for the user to request the evidence via the OOTS. This functionality will be the part of **IAL** component of IDK. Then, the user chooses to request the evidence to be fetched for them using the OOTS – the explicit OOP request. The user also indicates – in a guided way – which MS, and possibly lower administrative level, issues the required evidence.

3) **Lookup routing information**: As knows which canonical evidence can be used to fulfil the requirement, but it needs to find the DPs that can provide it. Therefore, DC needs to make a query to **ESL** component of IDK with the canonical evidences and issuing authority type retrieved from the **IAL** component..
4) **Request evidence**: The DR encrypts, signs and sends the evidence request to the identified technical data service interface of (potentially several) DT. The evidence request must include information that enables the DP to identify for which user or represented company the evidence must be issued, along with other information to identify the request (i.e. DE, procedure, canonical evidence or, if needed, input parameters of the request). This information will be modelling according to the **DE4A Information Exchange Model (IEM)**, proposed as an alternative of TOOP EDM for a better matching to the DE4A technical architecture and pilots' needs.
5) **Evaluate evidence request**: The DT receives and decrypts the request and checks whether the request meets formal requirements and can be accepted. It should be checked whether the requesting competent authority can reasonably and rightfully request that specific type of evidence. To do this, the authorization information is queried in the Query Interface of the **CAAR**.
6) **Transfer evidence as a response**: The DT encrypts and signs the evidence and sends it to the DR. as a response to the evidence request. Similarly, to the evidence request from the DR, TOOP EDM is not considered as part of the DE4ASem for the evidence response. The same semantic assets in step 4 of the business process, the DE4A IEM, will be considered for the evidence response.
7) **Prepare preview**: The DE prepares a preview for the User and provides it to UI to be displayed in the User session. A service for mapping the preview to any language is considered with the use of **MOR**, which is a component that allows any actor to show data labels to the User in a foreign language in a degree of accuracy that automatic translations cannot achieve.
8) **Process evidence**: When the User agrees to proceed with the evidence exchange and, consequently, the DC receives the evidence sent by the DP, the evidence data is processed automatically or manually by the DE. Additionally, here **MOR** allows the DE staff to see data labels in the original languages of the DO/DE, which might provide legal value.

5.3.2 Core Components and Semantic Assets aligned with DE4A Architecture

In this section, we provide an illustration (Figure 12) of the core components and semantic assets (green boxes) that are aligned with DE4A Project Start Architecture for the intermediation interaction pattern. Boxes in yellow represent summarised parts of the PSA.

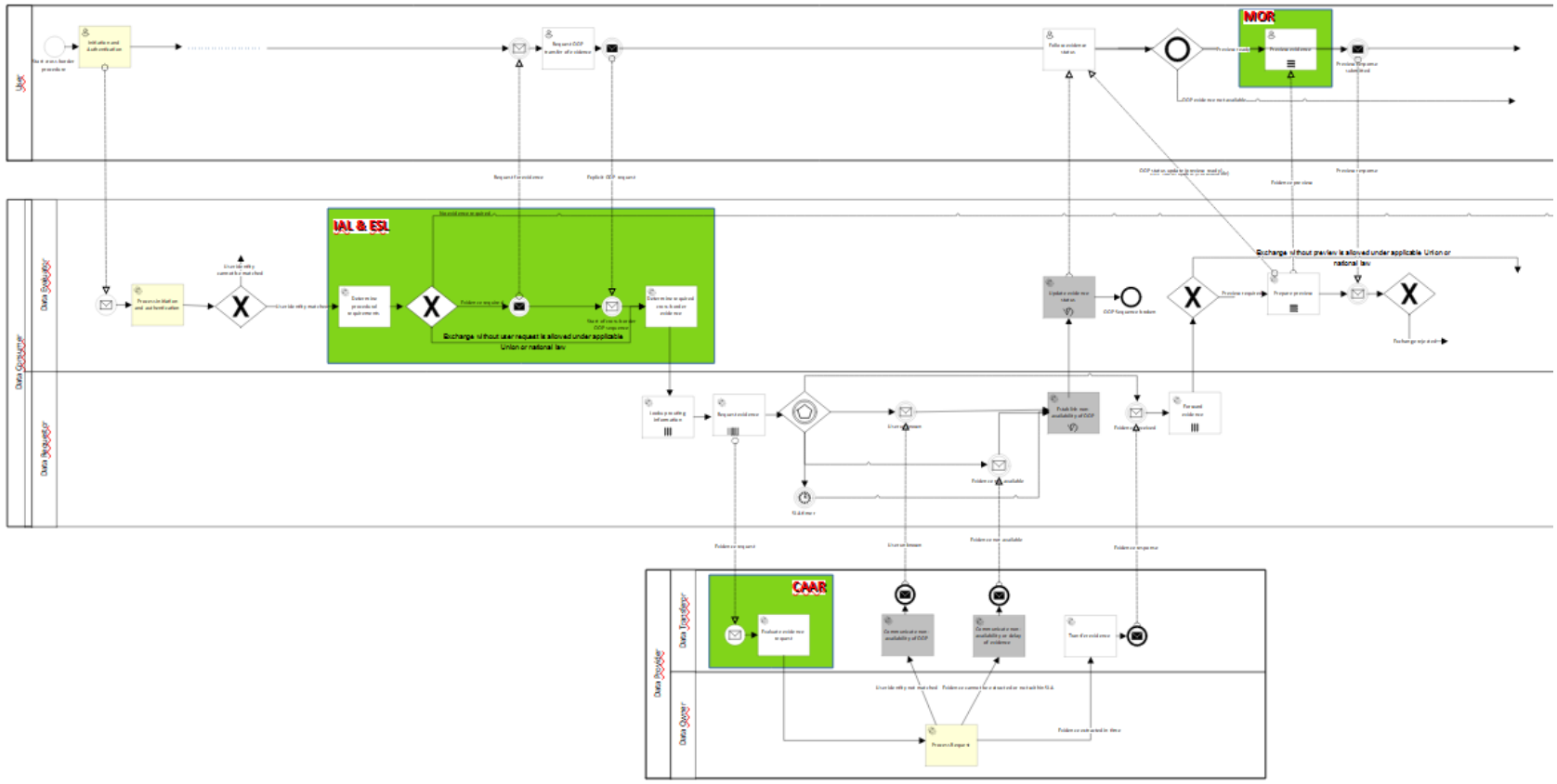

Figure 12: Integration of core components (green boxes) to the business process of the intermediation pattern of Project Start Architecture.

5.3.3 Information Exchange Model

The DE4A Information Exchange Model (IEM) is the payload specification of the messages to be exchanged between competent authorities. IEM is agnostic to any technical implementation and according to the DE4A project specific pilot needs and architecture.

IEM will be designed from TOOP EDM and other national models by WP3 in collaboration of the rest of technical work packages (architecture, pilots and common components) under the next basic assumptions:

- DE4A IEM allows a message exchange between the DR and the DT.
- A DR can automatically generate an EIM response according to the EIM requests of a DR.
- DE4A IEM is abstract to allow the request for data or documents in any business domain.
- DE4A IEM is based on existing international vocabularies and standards.
- DE4A IEM satisfies the specific needs of DE4A pilots and architecture.
- DE4A IEM models general information to include in request, response and error messages
- DE4A IEM allows the representation of exchanged evidence as structure data according to the canonical evidence data model with or without attached unstructured data (PDFs) with the legal value.

General information to include in request, response and error messages regards details about the transmission event, that data subject, the evidence requestor, the evidence issuer and the evidence service. IEM will model all the information required to properly process the request and the response of evidences, as well as to log and audit the transmissions, from the public administrations' point of view.

IEM will model information according to vocabularies, code lists, authoritative lists, etc. defined at European or international level.

In the first iteration of the DE4A project, the aim of IEM is to be a Minimum-Value-Product (MVP) to satisfy the early needs of the project for the mid 2021 goal and to provide feedback for further development.

5.4 DE4A Pilot-specific Ontologies

These ontologies provide data models for the DE4A pilots' domain-specific information needs. They have been defined as a maximum set of concepts and attributes, so evidence data models will be defined from these ontologies by considering the specific needs of pilot use cases principles and applying the data minimization. On the other hand, these models reuse concepts from the previously identified assets.

5.4.1 Ontology for Studying Abroad pilot

This section details the ontology for the Studying Abroad pilot. Figure 13 depicts the UML diagram of this model. It covers the following basic concepts: Person, Location, Organisation (private or public), the evidence of education and the related verifiable credentials.

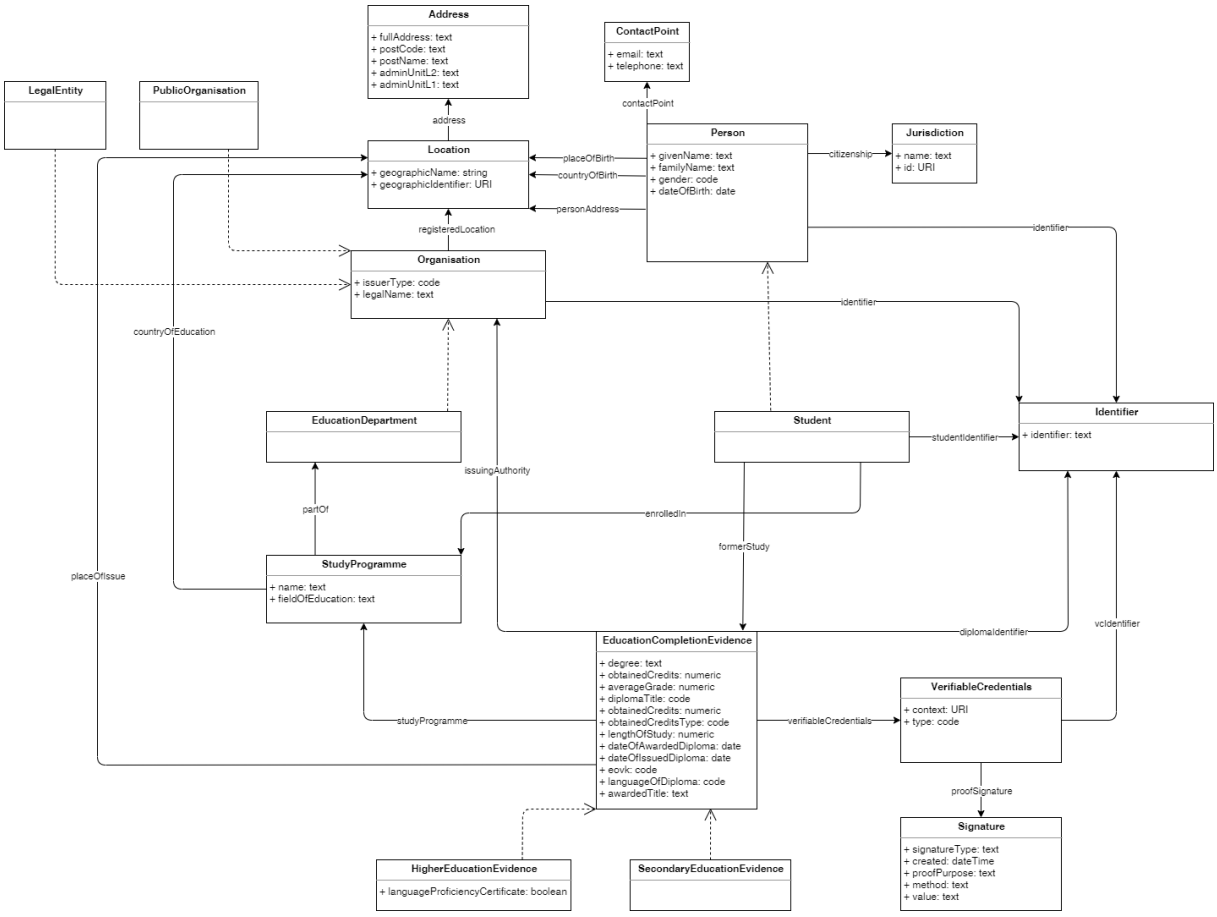

Figure 13: UML diagram of the ontology for the Studying Abroad Pilot

Table 7 and Table 8 in Annex X provide the DE4A concepts and the related mappings to existing vocabularies in more detail. In the initial version, we used naming conventions for DE4A concepts based on the ISA[2] Core Vocabularies, SDG data models for evidence and pilot required data mentioned at D4.1. These tables refer to common mandatory and optional data for evidence exchange for all use cases. Regarding the use case 2 “Applying for Study Grant” of pilot Studying Abroad, still participating MS need discussions for clarification on the data semantics and the related common mandatory and optional data. WP3 team will incorporate relevant concepts in the next iteration of DE4A semantic-related deliverables once they discussed and provide agreed attributes.

5.4.2 Ontology for Doing Business Abroad pilot

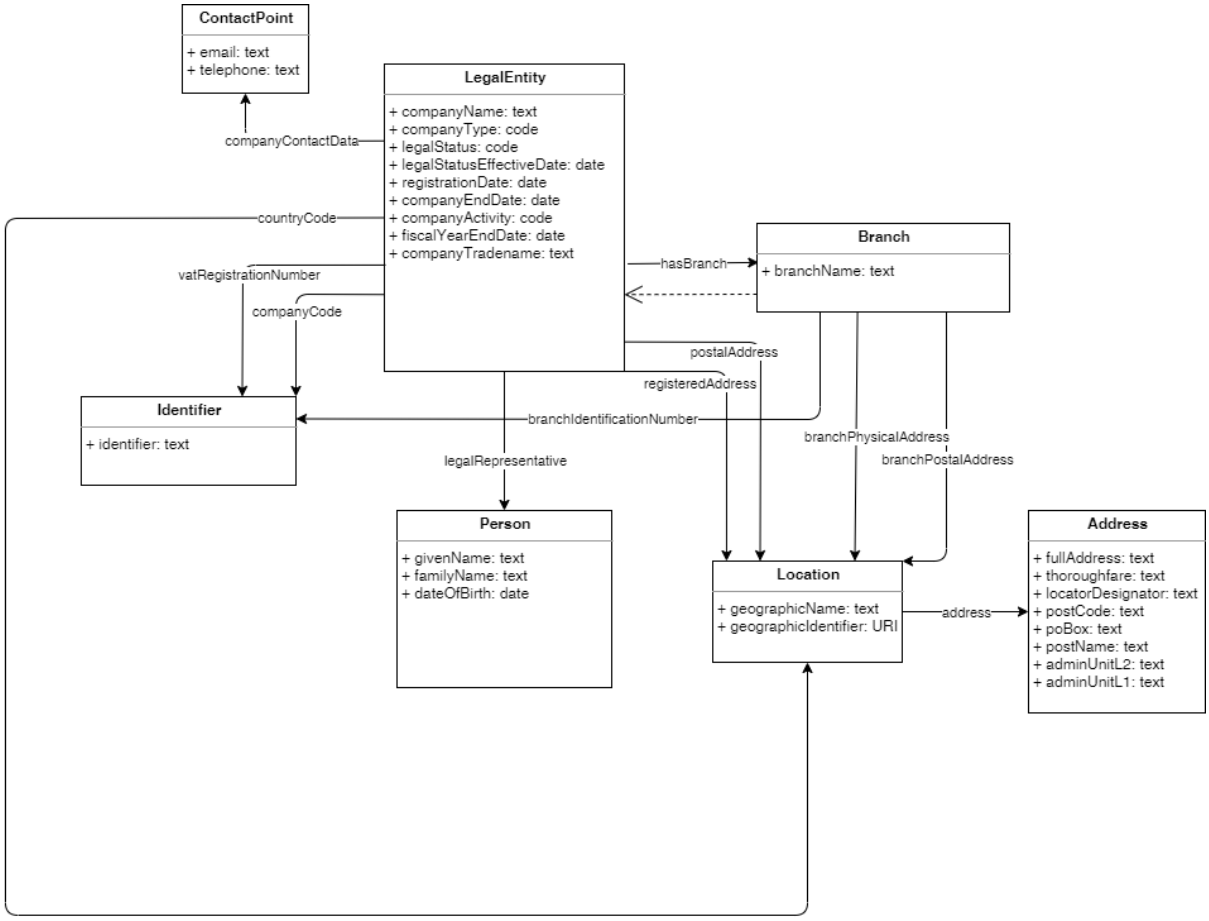

Figure 14: UML diagram of the ontology for Doing Business Abroad Pilot

Table 9 in Annex XI provides the DE4A concepts and the related mappings to existing vocabularies in more detail. In the initial version, we used naming conventions for DE4A concepts based on the TOOP RegisteredOrganisation ontology, the ISA^2 Core Vocabularies and pilot required data mentioned at D4.5.

5.4.3 Ontology for Moving Abroad pilot

As described in section 4.1.3, we will reuse and extend the ISA^2 models for multilingual public documents. The DE4A concepts and the related mappings to existing vocabularies are provided at Annex XII in Table 10 for the use case 1 regarding evidence for the change of address, Table 11 for the use case 2 – birth certificate, Table 12 for the use case 2 – marriage certificate and Table 13 for the use case 2 – death certificate. Regarding the ontology for the evidence of the use case 3 (pension), we will reuse and extend (if needed) the EESSI data model subject to its availability in the next iteration of the semantic framework. In the initial version, we used naming conventions for DE4A concepts based on the ISA^2 models for multilingual public documents described in section 3.22.

6 Conclusions

This deliverable has provided the necessary design guidelines for upcoming DE4A semantic toolkits to be delivered in "D3.5 Semantic toolkit – Initial version". The purpose of the provided semantic framework is to ensure that the correct format and meaning of exchanged data and information is preserved and understood throughout exchanges between EU Member States needed to deliver integrated cross-border public services.

The deliverable sets the basis of the DE4A semantic framework by first making an assessment of existing data models of EU infrastructure, metadata efforts, and vertical systems for evidence exchange that uses semantic standards (e. g, ISA2, and W3C).

The resulting initial version of the DE4A semantic framework comprises the Information Desk, the common Information Exchange Model and the pilot-specific ontologies that will provide the basis to develop common evidence data models. These are essential semantic artefacts that will be integrated in the overall DE4A once-only platform.

This document serves as the key design guidelines for the implementation of the DE4A Semantic toolkit (D3.5 Semantic Toolkit – Initial version). A final version of this deliverable capturing all the improvements and semantic interoperability findings will be reflected in "D3.4 Semantic framework – Final version" due to December 2021.

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Annexes

The following annexes are presented below for reference.

Annex I – UML Diagrams of SDG evidence common data models

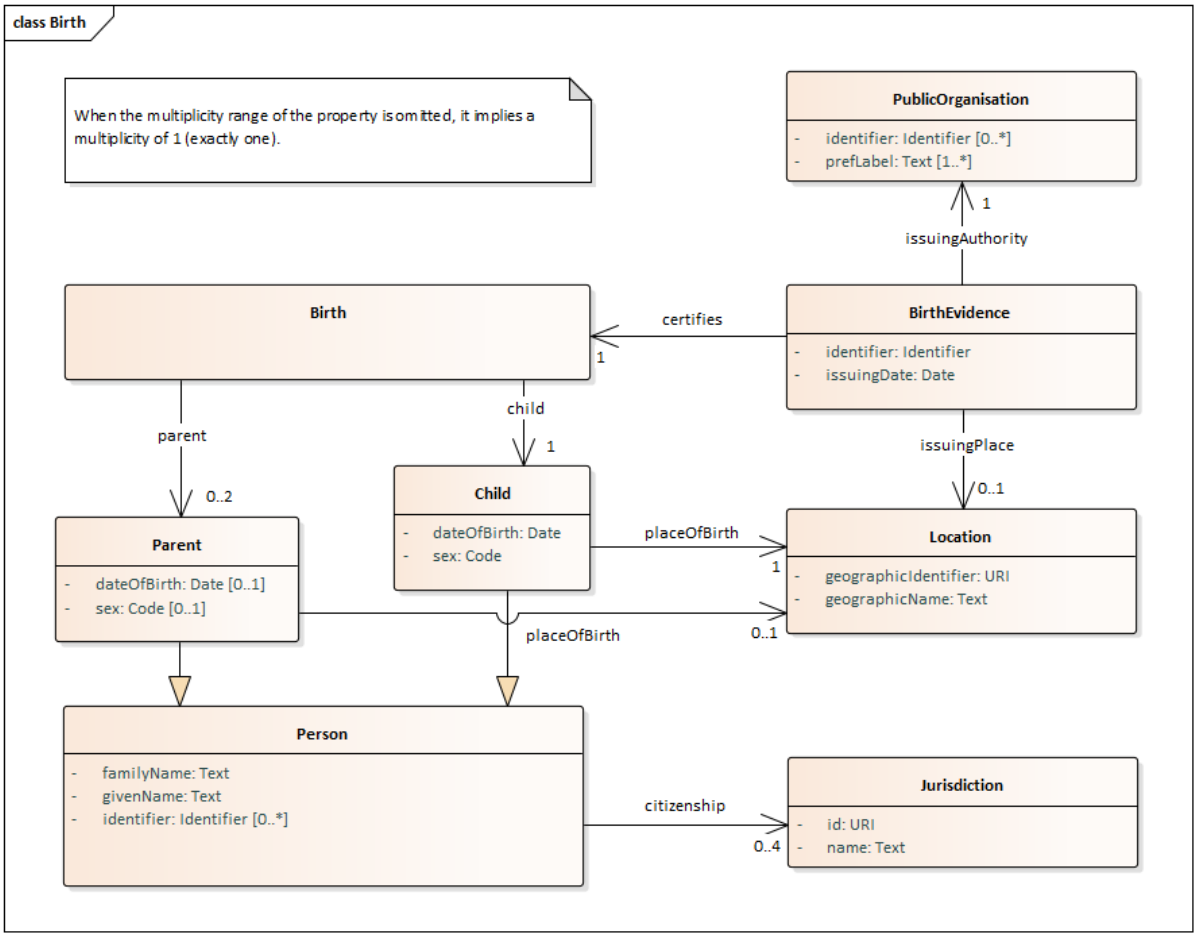


Figure 15: UML diagram for the SDG birth evidence data model

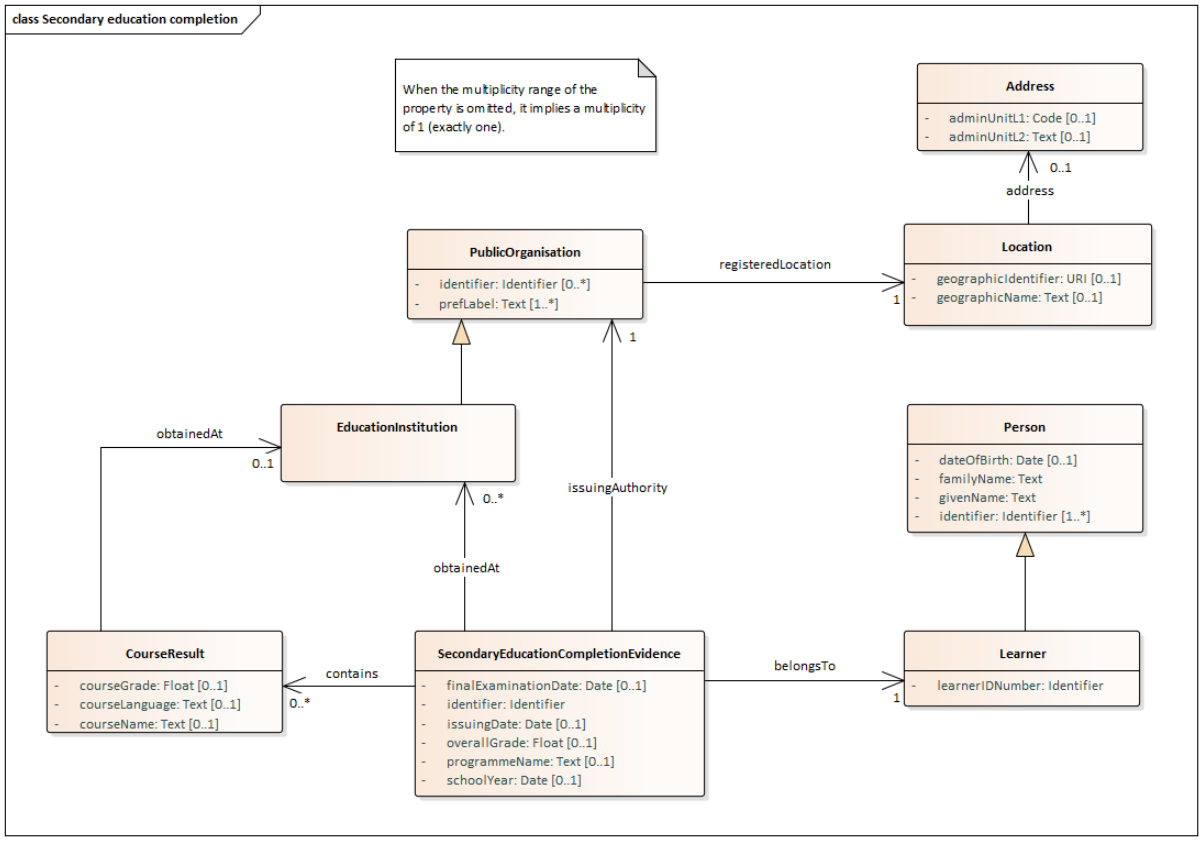


Figure 16: UML diagram for the SDG evidence of completion of secondary education data model

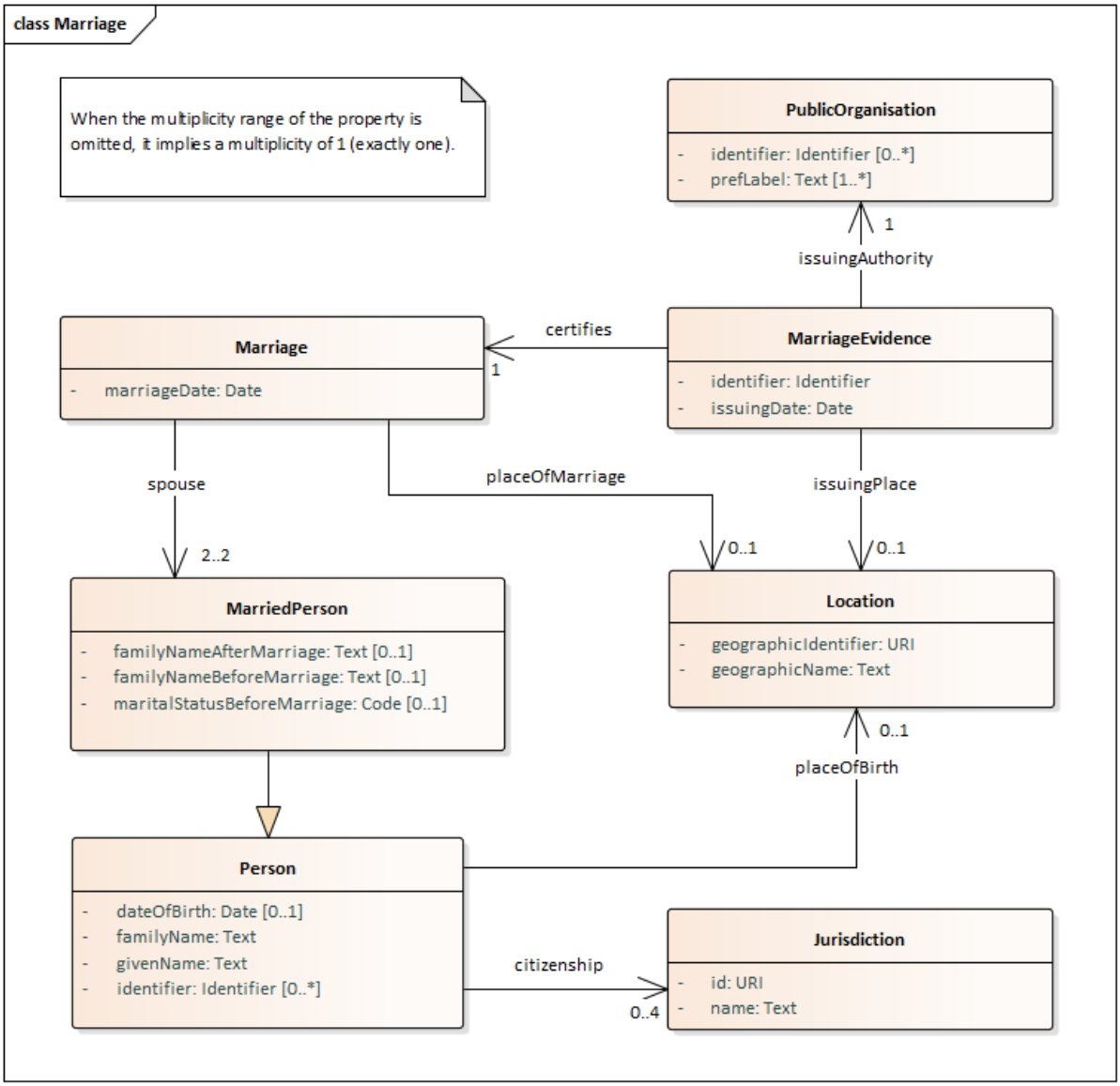


Figure 17: UML diagram for the SDG marriage evidence data model

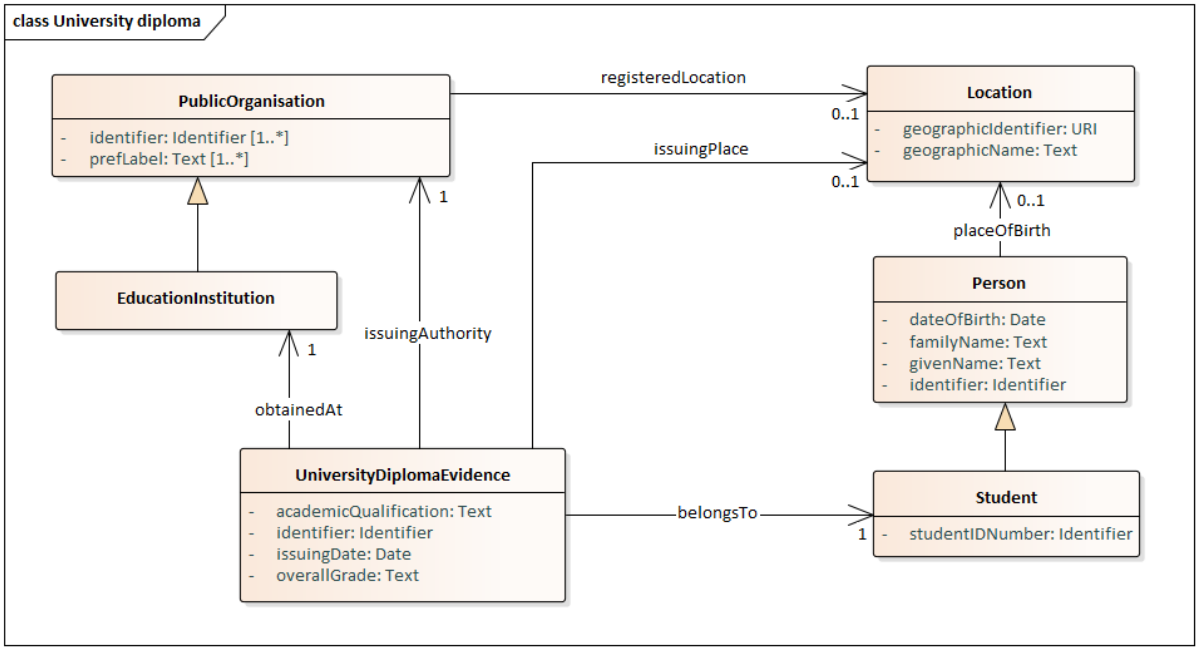
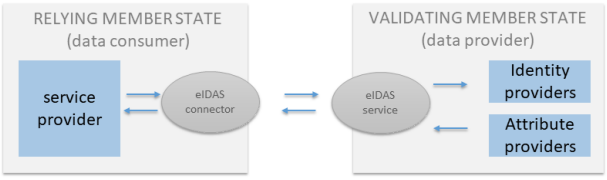


Figure 18: UML diagram for the SDG university diploma evidence data model

Annex II. Assets with semantic relevance

1) SEMPER

SEMPER - High-level Process Structure: SEMPER extends on eIDAS to offer the service provider with proper information on the powers a (natural or legal) person has to represent another (natural or legal) person. The SEMPER model specifies the information flow between mandate attribute providers and service providers through the eIDAS network in order to provide access to electronic services in another member state. Furthermore, SEMPER extends eIDAS nodes to perform semantic translation of powers of representation from formats that are particular to member states to SEMPER's format. A high-level process structure of the SEMPER is shown below:



SEMPER - High level proces flow

Figure 19: High-Level Process Flow

The SEMPER model supports bilateral communication between member states. One Member State authenticates the user and validates powers, and the other member state relies on the mandate attributes to provide the service to the user. In SEMPER, the V*alidating Member State* is the country wherein the mandate management attribute provider is located. The validating member state is the 'sending country of mandate attributes'. It is pertinent to mention that within SEMPER, the member state base registries are integrated 'as is' to ensure the use of already available information on

mandates despite harmonizing and redesigning national mandate solutions from zero. ***Relying Member State*** is the state of the service provider that is responsible for granting access and fulfilling the service. The relying member state is the 'receiving member state of mandate attributes'. In the SEMPER model, different actors are involved. The key actors in the relying member state are the ***Service Providers,*** in the validating member states the (mandate) attribute providers. The ***representative*** and ***represented*** are persons from the validating member state that act (or being acted on behalf of) in the relying member state. The ***attribute providers*** are the organizations that handle and provide information on the powers of a person to represent another person. The attribute providers need to connect their systems to the eIDAS service to provide cross-border information on powers. An ***identity provider*** of the validating member state authenticates the representative. The mandate management system of the validating member state identifies the represented through different methods like requesting to enter the identifier of the represented. SEMPER also involves following systems that include, but not limited to: portals, eServices, base registries, eIDAS connectors **[30], [41]**.

Concepts of the SEMPER Semantic Model

First, a ***person*** may be a natural or legal person. As this model compacts with representation, in every scenario, at least two persons are discovered in the procedure. One as a represented person and another as representative. There are other possible scenarios, like chained mandates, wherein additional persons may be identified as intermediaries like an accounting firm liable for the firm's employee (representative) acting on behalf of a client (represented person).

A represented person, representative, and intermediary are the roles a person can have when utilizing a mandate. Second, the ***power of representation*** means the *right to act on behalf of another person.* By utilizing these powers, a representative act out on behalf of the represented person. The SEMPER model defines all other powers as non-full, meaning they cover a specified scope of activities and maybe bound by constraints, like maximum transaction value. Powers to represent stem from sources, like mandates and regulated professions. Third, the ***scope of power*** explains the extent to which *the representative can perform on behalf of the represented person.* The scope has to be communicated in a machine-readable way to provide digital access to services. Therefore, the SEMPER model defines the following two methods for expressing the scope of powers, a) harmonized services, like the services defined by SDGR, b) non-harmonized services, which have been defined by individual service providers and are not harmonized across the EU. Additionally, It is up to each service provider and mandate management system to select one or more of the above-mentioned methods for expressing/interpreting powers of representation. For cross-border access to a service, both the service provider and mandate management system are required to support the same method or be able to resolve the scope of powers from one method to another. The last, ***power use constraints*** imply *a restriction of the right to act on behalf of another person.* The power someone must utilize one or more services may be restricted. Such restrictions are called Power Use Constraints (PUC). PUCs are stated in a facet, like "maximum transaction value", and value like "€200.000". Non-harmonized PUCs are specified by individual mandate management systems **[30], [41]**.

2) Europass Tools

Europass Diploma Supplement*:* This Diploma Supplement model was developed by the European Commission, Council of Europe and Unesco/CEPES. The purpose of the supplement is to provide sufficient independent data to improve the international 'transparency' and fair academic and professional recognition of qualifications (diplomas, degrees, certificates etc.). It is designed to provide a description of the nature, level, context, content, and status of the studies that were pursued and successfully completed by the individual named on the original qualification to which this supplement is appended. It should be free from any value judgements, equivalence statements or suggestions about recognition. Information in all eight sections should be provided. Where information is not

provided, an explanation should give the reason why. It contains information confirming the following: i) the type and level of qualification awarded, ii) the institution that issued the qualification, iii) the content of the course and results gained, and iv) details of the national education system. The individuals can request their Diploma Supplement from the Higher Education institution where they studied **[42]**.

Europass Certificate Supplement*: The* Europass Certificate Supplement is a document that provides information that makes it easier for employers and educational institutions to understand persons vocational qualification. The Europass Certificate Supplement describes the following: i) the purpose of person qualification, ii) its level, iii) its learning outcomes, and iv) information on the relevant education system. When people apply abroad for a job or courses, it can be challenging to explain what people learned during their training. This is where the Europass Certificate Supplement can help them. People can search for the Europass Certificate Supplement for their vocational qualification in the respective country database or contact their institution for further information [37].

Europass mobility for stakeholders*:* It is a document to record knowledge and skills acquired in another European country. The document may be about a work placement in a company; an academic term as part of an exchange programme; a voluntary placement in an NGO. It is for any person moving to a European country to learn or acquire a work experience, whatever their age or level of education. It is completed by two partner organisations involved in the mobility project, the first in the country of origin and the second in the host country. The partners may be universities, schools, training centers, companies, NGOs **[43]**.

Annex III. Semantic Mapping for Doing Business Abroad Pilot Use Case III

		BMDW (AT)	CBE (BE)	ONRC (RO)	BVE (SE)	KVK (NL)	Existing vocabularies
#	Required attribute	Available	Available	Available	Available	Available	
1	Company						
1.1	Company code	Company identifier	Company registration number	Company registration number	Organisations nummer	tbd	adms:Identifier
1.2	Company name	Legal company name	Name	Company name	UD0001 Registrerat företagsnamn	tbd	
1.3	Company physical address	Head office address	Address	Head office address	UD0003 Juridisk person postadress	tbd	
1.4	Company postal address	Mailing address	N/A	Postal address	UD0003 Juridisk person postadress	tbd	

1.5	Country code	Part of address of head office	Part of address	Part of address of head office	UD0012 Länskod säte	tbd	
1.6	Company legal form	Legal form	Legal form	Legal form	UD0025 Företagsform	tbd	
1.7	Company legal status	N/A	Status	Status	UD0027 Företagets status	tbd	
1.8	Company legal status date	N/A	N/A	N/A	N/A*	tbd	
1.9	Company registration date	Company registration / incorporation date	Start date	Company registration / incorporation date	UD0026 Datum för företagets registrering	tbd	
1.10	Company end date	Date of cancellation	N/A	N/A	N/A*	tbd	
1.11	Company activity/branch-code	NACE classification	Economic activities	NACE classification	UD0039 SNI-koder för företagets arbetsställen	tbd	
1.12	Year-end closing date	N/A	End date of fiscal year	N/A	N/A*	tbd	
1.13	Company tradename(s)	N/A	N/A	N/A	N/A	tbd	
1.14	VAT-registration number	N/A	N/A	CUI registration number	N/A*	tbd	
1.15	Company contact data	N/A	Contact data	Company contact data	N/A *	tbd	
1.16	Representatives	Person data of position	Name and first name of founders / representatives	Person data of position	N/A*	tbd	
2	Company branch/location						
2.1	Branch identification number	N/A	Establishment unit registration number	Establishment unit registration number	N/A	tbd	
2.2	Branch name	N/A	Name	Name	N/A	tbd	
2.3	Branch postal address	N/A	Address	N/A	N/A	tbd	
2.4	Branch physical address	N/A	N/A	Address	N/A	tbd	

Annex IV. Proposed Controlled Vocabularies for DE4ASem

Table 6: Proposed controlled vocabularies for DE4ASem

Title	Description	Links
EU Vocabulary Human Sex	This table provides the list of human sexes.	https://op.europa.eu/en/web/eu-vocabularies/at-dataset/-/resource/dataset/human-sex
ISO 3166-1	This document specifies basic guidelines for the implementation and maintenance of country codes.	https://www.iso.org/standard/72482.html
INSPIRE	This document describes the INSPIRE Data Specification for the spatial data theme Addresses	https://inspire.ec.europa.eu/id/document/tg/ad
European Central Bank list of legal forms	This list contains all the possible legal forms in each EU country	https://www.ecb.europa.eu/stats/money/aggregates/anacredit/shared/pdf/List_of_legal_forms.xlsx?13e9c46e6fc6acc4cd0f9ba71352702f
ISO 20275	This document lists more than 3,100 entity legal forms across more than 160 jurisdictions. The list contains legal forms/types in their native language, such as limited liability companies (Ltd), Gesellschaft mit beschränkter Haftung (GmbH) or Société Anonyme (SA).	https://www.gleif.org/en/about-lei/code-lists/iso-20275-entity-legal-forms-code-list
Directive 2009/101/EC	Article 1 of this directive provides a list of legal forms by each country as used by BRIS	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32009L0101
Digitalisation Directive (directive 2019/1151)	Article 19 of this directive provides a list of company statuses as used by BRIS	https://eur-lex.europa.eu/eli/dir/2019/1151/oj
XBRL Europe	The xEBR Taxonomy defines common concepts for financial statements and company identification.	https://www.xbrleurope.org/?page_id=201
NACE (CompanyNaceCode)	NACE (Nomenclature of Economic Activities) is the European statistical classification of economic activities. NACE groups	https://ec.europa.eu/competition/mergers/cases/index/nace_all.html

	organizations according to their business activities.	
ISIC4	The International Standard Industrial Classification of All Economic Activities (ISIC) is the international reference classification of productive activities. Its main purpose is to provide a set of activity categories that can be utilized for the collection and reporting of statistics according to such activities.	https://unstats.un.org/unsd/publication/seriesm/seriesm_4rev4e.pdf
EU Vocabularies – Human sex, ISO/IEC 5218:2004, Eurostat SCL - Sex, HL7 and SDMX		
ISO/IEC 5218:2004	ISO/IEC 5218:2004 specifies a uniform representation of human sexes for the interchange of information. It provides a set of numeric codes that are independent of language-derived codes and as such is intended to provide a common basis for the international exchange of information containing human sex data.	https://www.iso.org/standard/36266.html
Eurostat SCL - Sex	These are code lists that have been standardized within Eurostat. This means that unique concepts defined by single identifiers (codes) are used across statistical domains.	https://ec.europa.eu/eurostat/data/metadata/code-lists
HL7	This resource includes content from SNOMED Clinical Terms (SNOMED CT) which is copyright of the International Health Terminology Standards Development Organisation (IHTSDO)	https://www.hl7.org/fhir/codesystem-gender-identity.html
SDMX	The SDMX technical standards are sufficiently generic to allow institutions to adopt and implement any specific representation. However, the use of common code lists would facilitate users to work even more efficiently as it eases	https://sdmx.org/?page_id=3215

	the maintenance of, and reduces the need for, mapping systems and interfaces delivering data and metadata to users. Therefore, a choice over code lists has a great impact on the efficiency of data sharing.	
EU Vocabulary Honorific	This table provides the honorific titles used in addressing or referring to a person as used in the EU Whoiswho.	https://op.europa.eu/en/web/eu-vocabularies/at-dataset/-/resource/dataset/honorific
ESCO Occupations	The occupations pillar is one of the three pillars of ESCO. It organises the occupation concepts in ESCO. It uses hierarchical relationships between them, metadata as well as mappings to the International Standard Classification of Occupations (ISCO) in order to structure the occupations.	https://ec.europa.eu/esco/portal/occupation
EU Vocabulary Currency	The Currency authority table is a controlled vocabulary that lists concepts associated with currencies and currency subunits. The concepts included are correlated with the ISO 4217 international standard.	https://op.europa.eu/en/web/eu-vocabularies/at-dataset/-/resource/dataset/currency
ISCED	ISCED is the reference international classification for organising education programmes and related qualifications by levels and fields.	https://ec.europa.eu/eurostat/statistics-explained/index.php/International_Standard_Classification_of_Education_(ISCED)
EQF	The European Qualifications Framework (EQF) is a common European reference framework whose purpose is to make qualifications more readable and understandable across different countries and systems.	https://www.cedefop.europa.eu/en/events-and-projects/projects/european-qualifications-framework-eqf

BLS O*NET-SOC	O*NET-SOC taxonomy includes 1,016 occupational titles, 923 of which represent O*NET data-level occupations.	https://www.onetcenter.org/taxonomy.html
ISCO-08	ISCO-08 links job titles that may be used in response to questions on occupation in statistical and administrative data collections	https://www.ilo.org/public/english/bureau/stat/isco/isco08/

Annex V. Evidence Broker data model

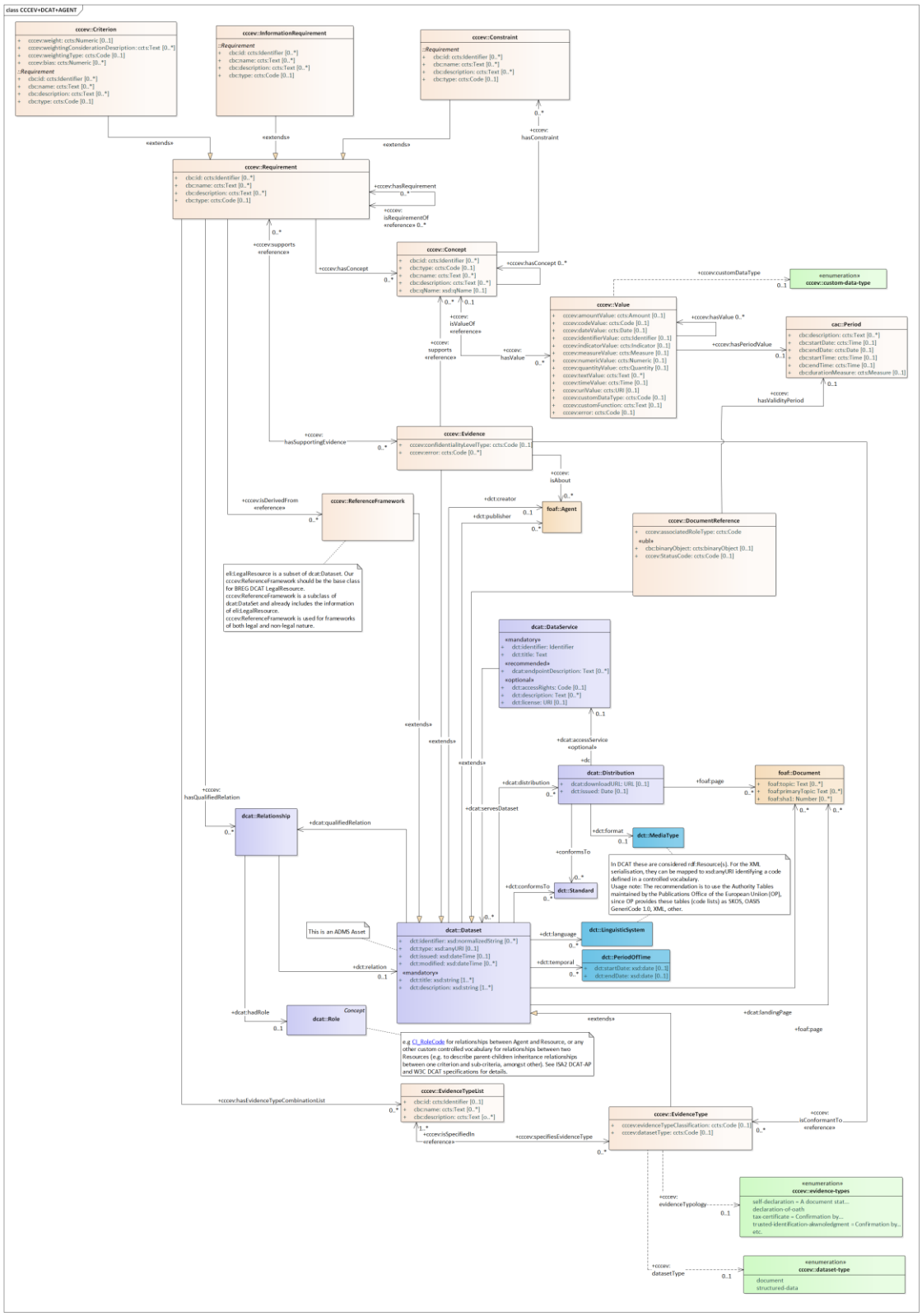


Figure 20: UML diagram for the Evidence Broker data model

Annex VI. Data quality vocabulary data model

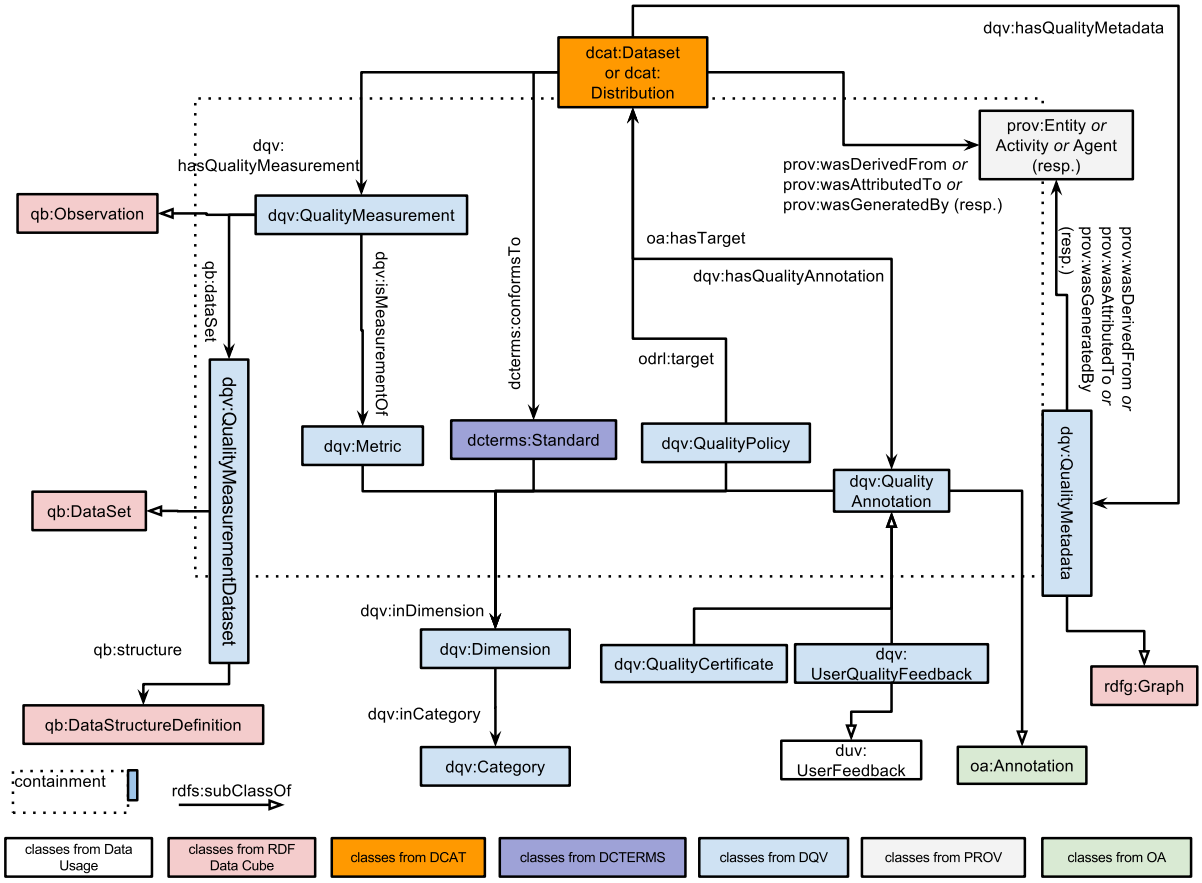


Figure 21: UML diagram for the data quality vocabulary data model

Annex VII. TOOP Semantic Repository data model

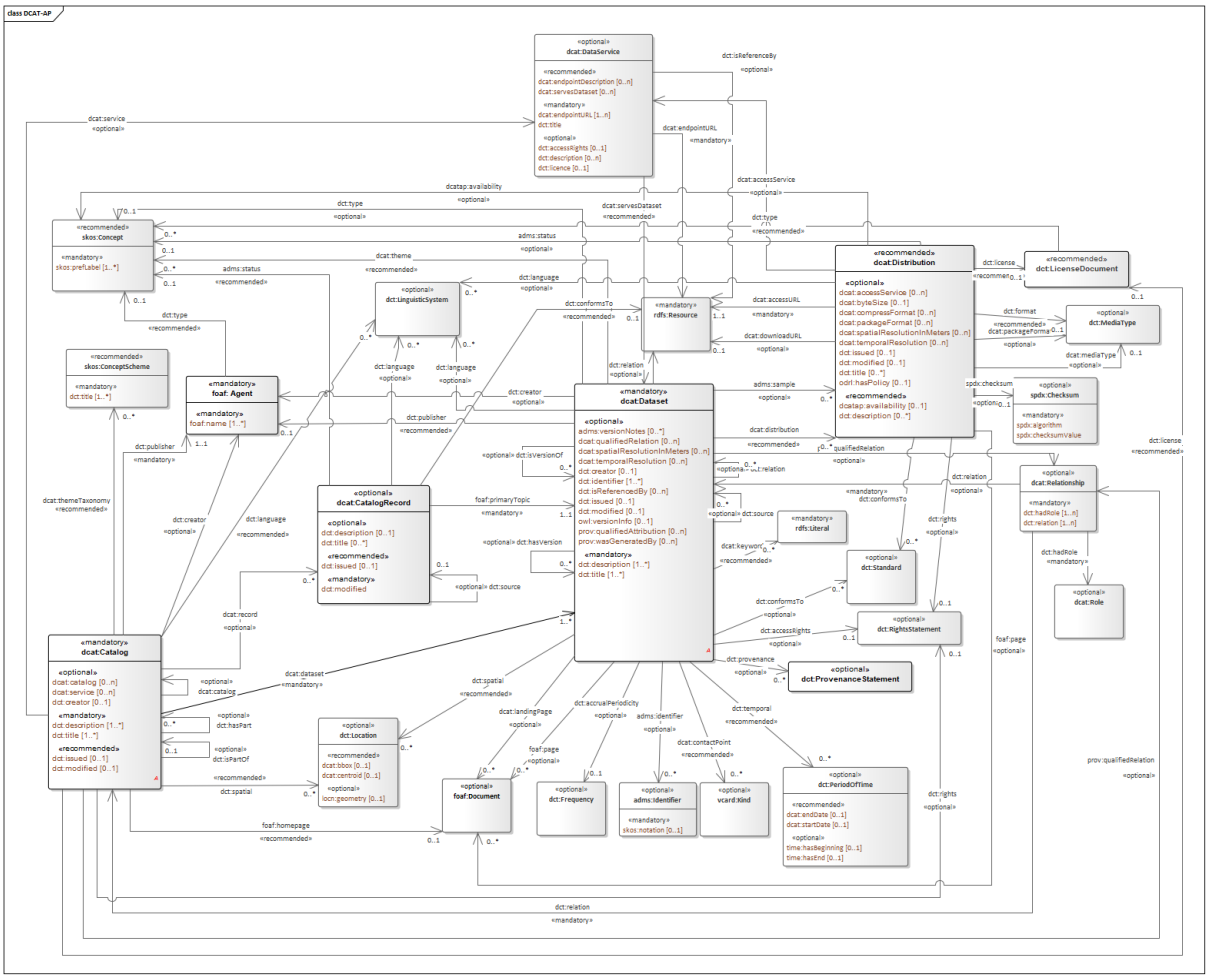


Figure 22: UML diagram for the TOOP Semantic Repository data model

Annex VIII. Example of the use of DQV in DE4A

```
:issuingAuthorities.csv

    a dcat:Distribution ;

    dcat:downloadURL <http://de4a.example.com/dataset/issuingAuthorities.csv> ;

    dct:title "CSV distribution of the issuing authorities dataset" ;

    dct:description "CSV distribution of the issuing authorities dataset;

    dcat:mediaType "text/csv;charset=UTF-8" ;

    dct:license <http://creativecommons.org/licenses/by-sa/3.0/> ;

    dqv:hasQualityMeasurement :measure1, :measure2

    .

 :measure1

    a dqv:QualityMeasurement ;

    dqv:computedOn :issuingAuthorities.csv ;

    dqv:isMeasurementOf :downloadURLAvailabilityMetric ;

    dqv:value "true"^^xsd:boolean

    .

 :measure2

    a dqv:QualityMeasurement ;

    dqv:computedOn :issuingAuthorities.csv ;

    dqv:isMeasurementOf :csvCompletenessMetric ;

    dqv:value "0.5"^^xsd:double

    .


#definition of dimensions and metrics

 :availability

    a dqv:Dimension ;

    skos:prefLabel "Availability"@en ;

    skos:definition "Availability of a dataset is the extent to which data (or some portion of it) is present, obtainable and
ready for use."@en ;

    dqv:inCategory :accessibility

    .

 :completeness
```

```
    a dqv:Dimension ;

    skos:prefLabel "Completeness"@en ;

    skos:definition "Completeness refers to the degree to which all required information is present in a particular dataset."@en ;

    dqv:inCategory :intrinsicDimensions

    .

 :downloadURLAvailabilityMetric

    a dqv:Metric ;

    skos:definition "It checks if dcat:downloadURL is available and if its value is dereferenceable."@en ;

    dqv:inDimension :availability

    .

 :csvCompletenessMetric

    a dqv:Metric ;

    skos:definition "Ratio between the number of objects represented in the cvs and the number of objects expected to be represented according to the declared dataset scope."@en ;

    dqv:inDimension :completeness

    .
```

Annex IX. TOOP Registered Organisation Vocabulary

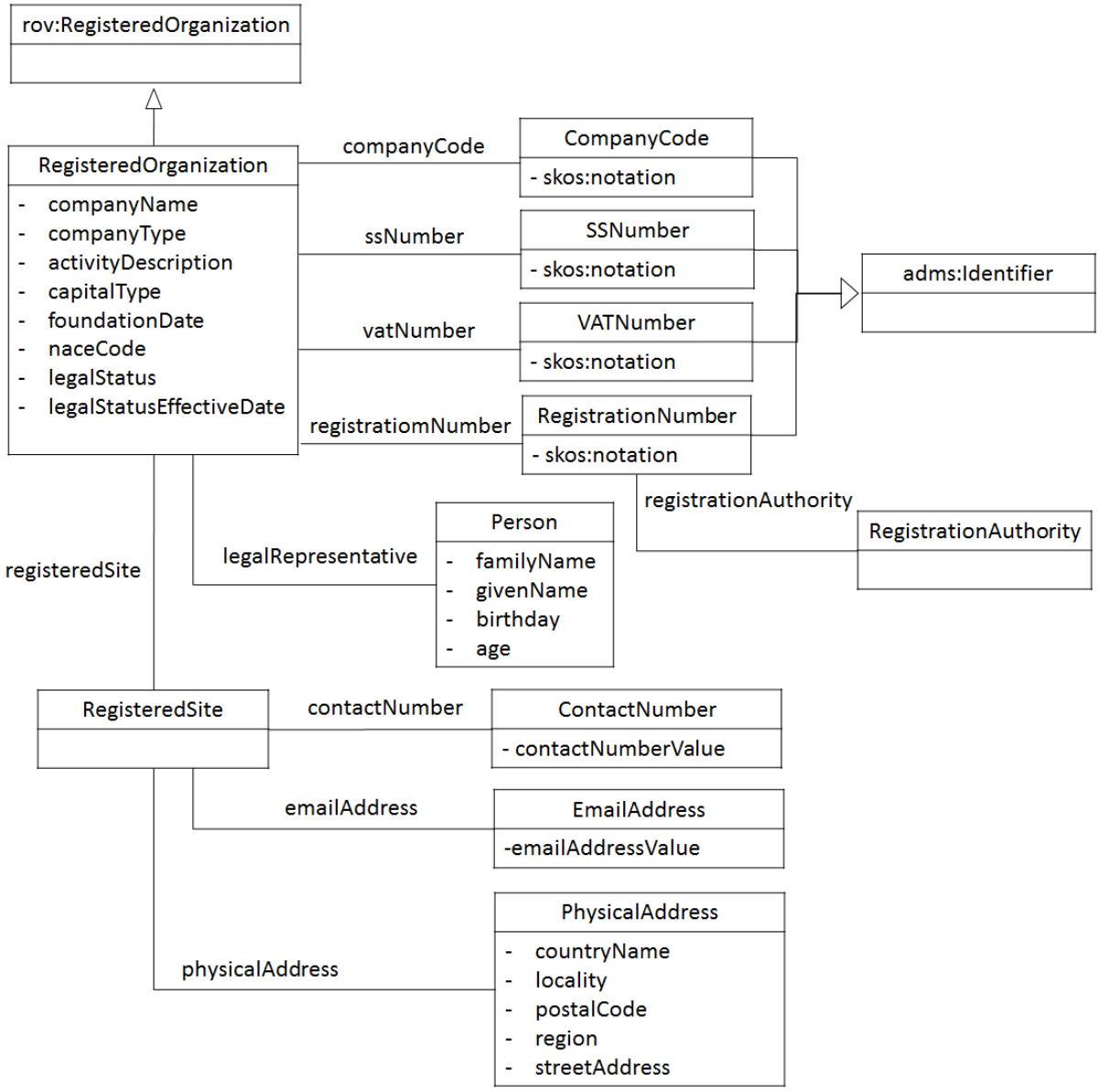


Figure 23: UML diagram for the TOOP Registered Organisation Vocabulary

Annex X. Studying Abroad – Mapping DE4A Concepts to Existing Vocabularies

Table 7: Mapping of the attributes of the conceptual model for the Studying Abroad pilot to existing vocabularies – Person, Organisation and Education Completion Evidence

DE4A concept	Property type	Related Existing Vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
Person	**Class**	**CPV**	**Person**		
givenName	DatatypeProperty	CPV	givenName	Text	
familyName	DatatypeProperty	CPV	familyName	Text	
gender	DatatypeProperty	CPV	gender	Code	EU Vocabulary Human Sex
dateOfBirth	DatatypeProperty	CPV	dateOfBirth	Date	
contactPoint	ObjectProperty	schema.org	contactPoint	ContactPoint	
citizenship	ObjectProperty	CLV	citizenship	Jurisdiction	
placeOfBirth	ObjectProperty	CLV	placeOfBirth	Location	
countryOfBirth	ObjectProperty	CLV	countryOfBirth	Location	
personAddress	ObjectProperty	CLV	fulllAddress	Location	
ContactPoint	**Class**	**schema.org**			
email	DatatypeProperty	schema.org	email	Text	
telephone	DatatypeProperty	schema.org	telephone	Text	
Jurisdiction	**Class**				
name	DatatypeProperty	CLV	name	Text	ISO 3166-1
id	DatatypeProperty	CLV	id	URI	

DE4A concept	Property type	Related Existing Vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
Location	**Class**	**CLV**	**Location**		
geographicName	DatatypeProperty	CLV	geographicName	Location	INSPIRE INGN / ISO 3166-1
geographicIdentifier	DatatypeProperty	CLV	geographicIdentifier	URI	
address	ObjectProperty	CLV	address	Address	
Address	**Class**	**CLV**	**Address**		
fullAddress	DatatypeProperty	CLV	fullAddress	Text	
postCode	DatatypeProperty	CLV	postCode	Text	
postName	DatatypeProperty	CLV	postName	Text	
adminUnitL2	DatatypeProperty	CLV	adminUnitL2	Text	
adminUnitL1	DatatypeProperty	CLV	adminUnitL1	Text	
Organisation	**Class**	**ROV**	**RegisteredOrganization**		
issuerType	DatatypeProperty	Organization	classification	Code	EU Vocabulary Organization type
registeredLocation	ObjectProperty	CLV	location	Location	
PublicOrganisation	**Class**	**Organization**	**Organisation**		
LegalEntity	**Class**	**Organization**	**Organisation**		
EducationCompletionEvidence	**Class**				
degree	DatatypeProperty	EDCI	LearningAchievement.title	Text	
diplomaTitle	DatatypeProperty			Text	

DE4A concept	Property type	Related Existing Vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
obtainedCredits	DatatypeProperty	EDCI	LearningSpecification.ECTSCreditPoints	Numeric	ECTS scoring scheme from Europass Standard List of Educational Credit Systems.
obtainedCreditsType	DatatypeProperty			Code	
lengthOfStudy	DatatypeProperty			Numeric	
dateOfAwardedDiploma	DatatypeProperty	EDCI	AwardingProcess.awardingDate	Date	
dateOfIssuedDiploma	DatatypeProperty	EDCI	VerifiableCredential.issuanceDate	Date	
eovk	DatatypeProperty	EDCI	Qualification.EQFLevel	Date	EQF. QDR List of qualification frameworks.
languageOfDiploma	DatatypeProperty	EDCI	LearningSpecification.language	Code	MDR Languages Named Authority List
awardedTitle	DatatypeProperty	EDCI	LearningAchievement.title	Code	
diplomaIdentifier	ObjectProperty	ADMS-AP	identifier	Identifier	
issuingAuthority	ObjectProperty	CCCEV	Evidence.issuedByOrganisation	Organisation	
studyProgramme	ObjectProperty			StudyProgramme	

DE4A concept	Property type	Related Existing Vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
placeOfIssue	ObjectProperty	CLV	location	Location	
SecondaryEducationEvidence	**Class**		**EducationCompletionEvidence**		
HigherEducationEvidence	**Class**		**EducationCompletionEvidence**		
languageProficiencyCertificate	DatatypeProperty			Boolean	
StudyProgramme	**Class**				
name	DatatypeProperty	EDCI	LearningSpecification.title	Text	
fieldOfEducation	DatatypeProperty	EDCI	LearningSpecification.ISCEDFCode	Text	ISCED
partOf	ObjectProperty	EDCI	Organisation.unitOf	EducationDepartment	
countryOfEducation	ObjectProperty	CLV	location	Location	
EducationDepartment	**Class**		**Organisation**		
issuingAuthority	**Class**		**Organisation**		
Student	**Class**		**Person**		
studentIdentifier	ObjectProperty	EDCI	Person	Identifier	
enrolledIn	ObjectProperty			StudyProgramme	
formerStudy	ObjectProperty			EducationCompletionEvidence	
Identifer	**Class**	**ADMS-AP**	**Identifier**		
identifier	DatatypeProperty	ADMS-AP	identifier	Text	

Table 8: Mapping of the attributes of the conceptual model for the Doing Business Abroad pilot to existing vocabularies – Additional properties described by the W3C Verifiable Credentials data model

DE4A concept	Property type	Related Existing Vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
VerifiableCredentials	**Class**				
context	DatatypeProperty	VC	context	URI	
type	DatatypeProperty	VC	type	Code	
proofSignature	ObjectProperty	VC	proof	Signature	
vcIdentifier	ObjectProperty	ADMS-AP	identifier	Identifier	
certifies	ObjectProperty			EducationCompletionEvidence	
Signature	**Class**				
signatureType	DatatypeProperty	VC	signatureType	Text	
created	DatatypeProperty	VC	created	dateTime	
proofPurpose	DatatypeProperty	VC	proofPurpose	Text	
method	DatatypeProperty	VC	method	Text	
value	DatatypeProperty	VC	value	Text	

Annex XI. Doing Business Abroad – Mapping DE4A Concepts to Existing Vocabularies

Table 9: Mapping of the attributes of the conceptual model for the Doing Business Abroad pilot to existing vocabularies

DE4A concept	Property type	Related Existing Vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
LegalEntity	**Class**				
companyName	DatatypeProperty	CBV	legalName	text	
companyType	DatatypeProperty	CBV	companyType	code	European Central Bank list of legal forms, ISO 20275, Directive 2009/101/EC
legalStatus	DatatypeProperty	CBV	companyStatus	code	Proposition from Core Vocabularies specification*, BRIS status codelist (based on XBRL)**
legalStatusEffectiveDate	DatatypeProperty	DCTerms	date	date	
registrationDate	DatatypeProperty	DCTerms	issued	date	
companyEndDate	DatatypeProperty	DCTerms	date	date	
companyActivity	DatatypeProperty	CBV	companyActivity	code	NACE
fiscalYearEndDate	DatatypeProperty	DCTerms	date	date	
companyTradename	DatatypeProperty	CBV	alternateName	text	
companyContactData	ObjectProperty	schema.org	contactPoint	ContactPoint	
countryCode	ObjectProperty	CLV	location	Location	
vatRegistrationNumber	ObjectProperty	ADMS-AP	identifier	Identifier	
companyCode	ObjectProperty	ADMS-AP	identifier	Identifier	
registeredAddress	ObjectProperty	CBV	address	Location	
postalAddress	ObjectProperty	CBV	address	Location	

DE4A concept	Property type	Related Existing Vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
legalRepresentative	ObjectProperty	Organization	hasMember	Person	
hasBranch	ObjectProperty	Organization	hasUnit	Branch	
ContactPoint	**Class**	**schema.org**	**contactPoint**		
email	DatatypeProperty	schema.org	email	text	
telephone	DatatypeProperty	schema.org	telephone	text	
Identifier	**Class**				
identifier	DatatypeProperty	ADMS-AP	identifier	text	
Branch	**Class**		**LegalEntity**		
branchName	DatatypeProperty	CBV	legalName	text	
branchIdentificationNumber	ObjectProperty	CBV	identifier	Identifier	
branchPhysicalAddress	ObjectProperty	CLV	address	Location	
branchPostalAddress	ObjectProperty	CLV	address	Location	
Location	**Class**	**CLV**			
geographicName	DatatypeProperty	CLV	geographicName	Location	
geographicIdentifier	DatatypeProperty	CLV	geographicIdentifier	URI	
address	ObjectProperty	CLV	address	Address	
Address	**Class**	**CLV**	**Address**		
fullAddress	DatatypeProperty	CLV	fullAddress	text	
thoroughfare	DatatypeProperty	CLV	thoroughfare	text	INSPIRE INGN
locatorDesignator	DatatypeProperty	CLV	locatorDesignator	text	INSPIRE INGN
postCode	DatatypeProperty	CLV	postCode	text	INSPIRE INGN
poBox	DatatypeProperty	CLV	poBox	text	INSPIRE INGN

DE4A concept	Property type	Related Existing Vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
postName	DatatypeProperty	CLV	postName	text	INSPIRE INGN
adminUnitL2	DatatypeProperty	CLV	adminUnitL2	text	INSPIRE INGN
adminUnitL1	DatatypeProperty	CLV	adminUnitL1	text	ISO 3166-1
Person	**Class**	**CPV**	**Person**		
givenName	DatatypeProperty	CPV	givenName	text	
familyName	DatatypeProperty	CPV	familyName	text	
dateOfBirth	DatatypeProperty	CPV	dateOfBirth	dateTime	

Disclaimer:

DE4A concept “legalStatus”

***** We described sample common values based on proposition from the Core Business Vocabulary specification. However, we need more input on that from the related piloting MS.

** BRIS uses the status of the company as defined by Article 19 of the Digitalisation Directive (directive 2019/1151). One of the predefined statutes or other when country-specific. If other status, BR must provide Explanatory Label. PredefinedStatus: Closed, Struck off the register, Wound up, Dissolved, Economically Active, and Economically Inactive or OtherStatus: String value or Explanatory Labels

Annex XII. Moving Abroad – Mapping DE4A Concepts to Existing Vocabularies

Table 10: Mapping of the attributes of the conceptual model for the Moving Abroad pilot use case 1 (change of address) to existing vocabularies

MS	Label	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ALL	***lifeForm-1.1***							
ALL	Header		0	Class				
ALL	Title	x	0.1	DatatypeProperty	DCTerms	title	text	
ALL	Country	x	0.2	DatatypeProperty	CLV	Location:geographicName	text	http://publications.europa.eu/resource/dataset/country
ALL	ImportantNotice	x	0.3	DatatypeProperty			text	
ALL	NoteForTheIssuingAuthority		0.4	DatatypeProperty	vCard	note	text	
ALL	AuthorityIssuingForm		1	Class	CPOV	PublicOrganisation		
ALL	Designation	x	1.1	DatatypeProperty	CPOV	prefLabel	text	
ALL	AuthorityIssuingDocument		2	Class	CPOV	PublicOrganisation		
ALL	Designation	x	1.1	DatatypeProperty	CPOV	prefLabel	text	
ALL	DocumentInfo			Class				
ALL	DocumentKind			Class				
ALL	DocumentFromCourtOrTribunal		3.1	DatatypeProperty			code	Values of 3.1.1 - 3.1.5
ALL	CourtDecision	x	3.1.1					

MS	Label	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ALL	DocumentEmanatingFromAPublicProsecutor	x	3.1.2					
ALL	DocumentEmanatingFromAClerkOfACourt	x	3.1.3					
ALL	DocumentEmanatingFromAJudicialOfficer	x	3.1.4					
ALL	Other	x	3.1.5	DatatypeProperty			text	
ALL	AdministrativeDocument		3.2	DatatypeProperty			code	values of 3.2.1-3.2.4
ALL	Certificate	x	3.2.1					
ALL	ExtractFromTheCivilStatusRegister	x	3.2.2					
ALL	ExtractFromThePopulationRegister	x	3.2.3					
ALL	VerbatimCopyOfCivilStatusRecords	x	3.2.4					
ALL	Other	x	3.1.5	DatatypeProperty			text	
ALL	NotarialAct	x	3.3	DatatypeProperty			boolean	
ALL	OfficialCertificateOnDocumentSignedByPerson	x	3.4	DatatypeProperty			boolean	

MS	Label	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ALL	DocumentDrawnUpByDiplomaticOrConsularAgent	x	3.5	DatatypeProperty			boolean	
ALL	IssueDate	x	3.6	DatatypeProperty	DCTerms	issued	date	
ALL	ReferenceNumber	x	3.7	DatatypeProperty	ELI	number	text	
ALL	LifePerson			Class	CPV	Person		
ALL	Surname	x		DatatypeProperty	CPV	familyName	text	
ALL	Forename	x		DatatypeProperty	CPV	givenName	text	
ALL	DateOfBirth	x		DatatypeProperty	CPV	dateOfBirth	date	
ALL	Sex			DatatypeProperty	CPV	gender	code	
ALL	Female	x						
ALL	Male	x						
ALL	Undertermined	x						
ALL	PlaceCountryOfBirth			DatatypeProperty	CLV	Location:geographicName	text	
ALL	Address			Class	CLV	Address		
ALL	StreetPOBox	x		DatatypeProperty	CLV	poBox	text	
ALL	PlacePostalCode	x		DatatypeProperty	CLV	postCode	text	
ALL	Country	x		DatatypeProperty	CLV	Location:geographicName	text	http://publications.europa.eu/resource/dataset/country
ALL	Life			Class				

MS	Label	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ALL	IsAlive	x	5	DatatypeProperty				
ALL	Footer		6	Class				
ALL	SurnameForenameOfficial	x	6.1	DatatypeProperty	CPV	fullName	text	
ALL	PositionOfOfficial	x	6.2	DatatypeProperty	vCard	title	text	
ALL	IssueDate	x	6.3	DatatypeProperty	DCTerms	issued	date	
ALL	Signature	x	6.4	DatatypeProperty				
ALL	SealOrStamp	x	6.5	DatatypeProperty				
BE	***BE-Life***							
BE	DocumentInfo							
BE	ThisDocumentIsIssued		3.8	DatatypeProperty			code	
BE	FollowingThePersonsAppearanceInCourt	x						
BE	OnTheBasisOfThePopulationRegister	x	3.8.2					
BE	OnTheBasisOfTheIdCard	x	3.8.3					
BE	LifePerson							
BE	TitleOfNobility	x	4.1.1	DatatypeProperty	FOAF	title	code	EU Vocabulary Honorific
BE	Pseudonym	x	4.2.1	DatatypeProperty	vCard	nickname	text	

MS	Label	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
BE	NationalRegistrationNumber	x	4.2.2	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
BE	Nationality	x	4.7	DatatypeProperty	CLV	Jurisdiction:name	text	http://publications.europa.eu/resource/dataset/country
BE	CivilStatus		4.8	Class				
BE	CivilStatusChoice			DatatypeProperty	DPV	maritalStatus	code	
BE	Married	x						
BE	Unmarried	x						
BE	Divorced	x						
BE	Widowed	x						
BE	DateOfMarriage	x	4.8.5	DatatypeProperty	DCTerms	date	date	
BE	DateOfDivorce	x	4.8.6	DatatypeProperty	DCTerms	date	date	
BE	DateOfDeath	x	4.8.7	DatatypeProperty	DCTerms	date	date	
BE	SurnameOfFormerSpouse	x	4.8.8	DatatypeProperty	CPV	familyName	text	
BE	FirstNameOfFormerSpouse	x	4.8.9	DatatypeProperty	CPV	givenName	text	
DK	***No additional information***							
LU	***LU-Life***							
LU	DocumentInfo							

MS	Label	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
LU	DataExtractedFromTheNationalRegister	x	3.2.1.1	Datatype			boolean	
LU	PlaceAndCountryOfIssue	x	3.6.1	Datatype	CLV	Location:geographicName	text	
LU	LifePerson							
LU	IdentificationNumber	x	4.7	Datatype	ADMS-AP	Identifier:identifier	text	
RO	***RO-Life***							
RO	LifePerson							
RO	PersonalIdentificationNumber	x	4.0	Datatype	ADMS-AP	Identifier:identifier	text	
RO	DocumentOfIdentity		4.7	Class				
RO	TypeOfDocument	x	4.7.1	Datatype	DCTerms	type	text	
RO	SeriesAndNumber	x	4.7.2				text	
RO	IssuedByrelevantAuthority	x	4.7.3	DatatypeProperty	CPOV	prefLabel	text	
RO	DateOfIssuance	x	4.7.4	DatatypeProperty	DCTerms	issued	date	
RO	Footer							
RO	ReferenceNumberOfTheAnnex	x	6.3.1	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
SI	***No additional information***							

MS	Label	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ES	***ES-Life***							
ES	DocumentInfo							
ES	CivilRegister	x	3.8	DatatypeProperty			text	
ES	LifePerson							
ES	NameAndSurnamesOfParentA	x	4.2.1	DatatypeProperty	CPV	fullName	text	
ES	NameAndSurnamesOfParentB	x	4.2.2	DatatypeProperty	CPV	fullName	text	
SE	***SE-Life***							
SE	LifePerson							
SE	NationalIdentificationNo	x	4.7	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
SE	RegistrationInNationalPopulationRegister		4.8					
SE	Date	x	4.8.1	DatatypeProperty	DCTerms	date	date	
SE	County	x	4.8.2	DatatypeProperty	CLV	Address:adminUnitL2	text	
SE	Municipality	x	4.8.3	DatatypeProperty	CLV	Address:postName	text	
SE	ConfidentialPersonalData	x	4.9	DatatypeProperty			text	
PT	***No additional information***							

Table 11: Mapping of the attributes of the conceptual model for the Moving Abroad pilot use case 2 (extract of birth certificate) to existing vocabularies

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ALL	***birthForm-1.1***							
ALL	Header		0	Class				
ALL	Title	x	0.1	DatatypeProperty	DCTerms	title	text	
ALL	Country	x	0.2	DatatypeProperty	CLV	Location:geographicName	text	http://publications.europa.eu/resource/dataset/country
ALL	ImportantNotice	x	0.3	DatatypeProperty			text	
ALL	NoteForTheIssuingAuthority	x	0.4	DatatypeProperty	vCard	note	text	
ALL	AuthorityIssuingForm		1	Class	CPOV	PublicOrganisation		
ALL	Designation	x	1.1	DatatypeProperty	CPOV	prefLabel	text	
ALL	AuthorityIssuingDocument		2	Class	CPOV	PublicOrganisation		
ALL	Designation	x	1.1	DatatypeProperty	CPOV	prefLabel	text	
ALL	DocumentInfo		3	Class				
ALL	DocumentKind			Class				
ALL	DocumentFromCourtOrTribunal		3.1	DatatypeProperty			code	Values of 3.1.1 - 3.1.5
ALL	CourtDecision	x	3.1.1					

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ALL	DocumentEmanatingFromAPublicProsecutor	x	3.1.2					
ALL	DocumentEmanatingFromAClerkOfACourt	x	3.1.3					
ALL	DocumentEmanatingFromAJudicialOfficer	x	3.1.4					
ALL	Other	x	3.1.5	DatatypeProperty			text	
ALL	AdministrativeDocument		3.2	DatatypeProperty			code	values of 3.2.1-3.2.4
ALL	Certificate	x	3.2.1					
ALL	ExtractFromTheCivilStatusRegister	x	3.2.2					
ALL	ExtractFromThePopulationRegister	x	3.2.3					
ALL	VerbatimCopyOfCivilStatusRecords	x	3.2.4					
ALL	Other	x	3.1.5	DatatypeProperty			text	
ALL	NotarialAct	x	3.3	DatatypeProperty			boolean	
ALL	OfficialCertificateOnDocumentSignedByPerson	x	3.4	DatatypeProperty			boolean	
ALL	DocumentDrawnUpByDiplomaticOrConsularAgent	x	3.5	DatatypeProperty			boolean	
ALL	IssueDate	x	3.6	DatatypeProperty	DCTerms	issued	date	
ALL	ReferenceNumber	x	3.7	DatatypeProperty	ELI	number	text	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ALL	BirthPerson		4	Class	CPV	Person		
ALL	Surname	x	4.1	DatatypeProperty	CPV	familyName	text	
ALL	Forename	x	4.2	DatatypeProperty	CPV	givenName	text	
ALL	DateOfBirth	x	4.3	DatatypeProperty	CPV	dateOfBirth	date	
ALL	Sex		4.5	Sex	CPV	gender	code	
ALL	Female	x	4.5.1					
ALL	Male	x	4.5.2					
ALL	Undertermined	x	4.5.3					
ALL	PlaceCountryOfBirth	x	4.4	DatatypeProperty	CLV	Location:geographicName	text	
ALL	Footer		5	Class				
ALL	SurnameForenameOfficial	x	5.1	DatatypeProperty	CPV	fullName	text	
ALL	PositionOfOfficial	x	5.2	DatatypeProperty	vCard	title	text	
ALL	IssueDate	x	5.3	DatatypeProperty	DCTerms	issued	date	
ALL	Signature	x	5.4	DatatypeProperty				

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ALL	SealOrStamp	x	5.5	DatatypeProperty				
BE	***BE-Birth***							
BE	BirthPerson			Class	CPV	Person		
BE	Section1	x	4.1.1	DatatypeProperty				
BE	Section2	x	4.1.2	DatatypeProperty				
BE	DeclaredByTheParent		4.1.3	DatatypeProperty			boolean	
BE	TitleOfNobility	x	4.1.4	DatatypeProperty	FOAF	title	code	EU Vocabulary Honorific
BE	TimeOfBirth	x	4.3.1	DatatypeProperty	CPV	dateOfBirth	Time	
BE	MothersDetails		4.6	Class	CPV	Person		
BE	Surname	x	4.1	DatatypeProperty	CPV	familyName	text	
BE	TitleOfNobility	x	4.1.4	DatatypeProperty	FOAF	title	code	EU Vocabulary Honorific
BE	FirstName	x	4.2	DatatypeProperty	CPV	givenName	text	
BE	DateOfBirth	x	4.3	DatatypeProperty	CPV	dateOfBirth	date	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
BE	PlaceAndCountryOfBirth	x	4.4	DatatypeProperty	CLV	Location:geographicName		
BE	FathersDetails		4.8	DatatypeProperty	CPV	Person		
BE	Surname	x	4.1	DatatypeProperty	CPV	familyName	text	
BE	TitleOfNobility	x	4.1.4	DatatypeProperty	FOAF	title	code	EU Vocabulary Honorific
BE	FirstName	x	4.2	DatatypeProperty	CPV	givenName	text	
BE	DateOfBirth	x	4.3	DatatypeProperty	CPV	dateOfBirth	date	
BE	PlaceAndCountryOfBirth	x	4.4	DatatypeProperty	CLV	Location:geographicName		
BE	ComothersDetails		4.9	DatatypeProperty	CPV	Person		
BE	Surname	x	4.1	DatatypeProperty	CPV	familyName	text	
BE	TitleOfNobility	x	4.1.4	DatatypeProperty	FOAF	title	code	EU Vocabulary Honorific
BE	FirstName	x	4.2	DatatypeProperty	CPV	givenName	text	
BE	DateOfBirth	x	4.3	DatatypeProperty	CPV	dateOfBirth	date	
BE	PlaceAndCountryOfBirth	x	4.4	DatatypeProperty	CLV	Location:geographicName		

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
BE	Acknowledgment		4.11	Class				
BE	PrenatalAcknowledgementCertificateNumber	x	4.11.1	DatatypeProperty			text	
BE	AcknowledgedBy		4.11.2	Class				
BE	AcknowledgmentChoice			DatatypeProperty			code	values of 4.11.2.1-4.11.2.4
BE	TheMother	x	4.11.2.1					
BE	TheFather	x	4.11.2.2					
BE	TheComother	x	4.11.2.3					
BE	DateOfAcknowledgement	x	4.11.2.4					
BE	Consent		4.11.3	Class				
BE	ConsentChoice			DatatypeProperty			code	values of 4.11.2.1-4.11.2.3, 4.11.3.1, 4.11.3.2
BE	TheMother	x	4.11.2.1					
BE	TheFather	x	4.11.2.2					
BE	TheComother	x	4.11.2.3					
BE	TheLegalRepresentative	x	4.11.3.1					
BE	TheChild	x	4.11.3.2					
BE	DateOfConsent	x	4.11.3.3	DatatypeProperty	DCTerms	issued	date	
BE	PlaceWhereTheConsentWasGiven	x	4.11.3.4	DatatypeProperty	CLV	Location:geographicName	text	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
BE	AuthorityBeforeWhichTheConsentWasGiven	x	4.11.3.5	DatatypeProperty	CPOV	PublicOrganisation:prefLabel	text	
BE	CourtDecisionEstablishingTheConsent	x	4.11.3.6	Class	ELI	LegalResource		
BE	Court	x	4.11.3.6.1	DatatypeProperty			text	
BE	DateOfTheDecision	x	4.11.3.6.2	DatatypeProperty	DCTerms	issued	date	
BE	CaseNumberOrDecisionReferenceNumber	x	4.11.3.6.3	DatatypeProperty	ELI	number	text	
DK	***DK-Birth***							
DK	BirthPerson			DatatypeProperty	CPV	Person		
DK	MiddleName	x	4.2.1	DatatypeProperty	CPV	alternativeName	text	
DK	PlaceWhereChildWasNamed	x	4.2.2	DatatypeProperty	CLV	Location:geographicName	text	
DK	DateOnWhichChildWasNamed	x	4.2.3	DatatypeProperty	DCTerms	date	date	
DK	NameOfChurchWhereChildWasBaptised	x	4.2.4	DatatypeProperty			text	
DK	DateOfBaptism	x	4.2.5	DatatypeProperty	DCTerms	date	date	
DK	PersonalIdentificationNumber	x	4.3.1	DatatypeProperty	ADMS-AP	Identifier:identifier	text	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
DK	PlaceOfRegistrationOfBirth	x	4.4.1	DatatypeProperty	CLV	Location:geographicName	text	
DK	BiologicalOrAdoptiveParentsFullNames	x	4.6.	DatatypeProperty			text	
LU	***LU-Birth***							
LU	AuthorityIssuingDocument			Class	CPOV	PublicOrganisation		
LU	SignatureAndSealOfDepository	x	2.1	DatatypeProperty			text	
LU	DocumentInfo			Class				
LU	PlaceAndCountryOfIssue	x	3.6.1	DatatypeProperty	CLV	Location:geographicName	text	
LU	BirthPerson			Class	CPV	Person		
LU	ParentA		4.7	Class	CPV	Person		
LU	Surname	x	4.1	DatatypeProperty	CPV	familyName	text	
LU	Forename	x	4.2	DatatypeProperty	CPV	givenName	text	
LU	Sex	x	4.5	DatatypeProperty	CPV	gender	code	values of 4.5.1-4.5.2
LU	Female	x	4.5.1					
LU	Male	x	4.5.2					
LU	DateOfBirth	x	4.3	DatatypeProperty	CPV	dateOfBirth	date	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
LU	PlaceAndCountryOfBirth	x	4.4	DatatypeProperty	CLV	Location:geographicName	text	
LU	ParentB		4.8	Class	CPV	Person		
LU	Surname	x	4.1	DatatypeProperty	CPV	familyName	text	
LU	Forename	x	4.2	DatatypeProperty	CPV	givenName	text	
LU	Sex	x	4.5	DatatypeProperty	CPV	gender	code	
LU	Female	x	4.5.1					
LU	Male	x	4.5.2					
LU	DateOfBirth	x	4.3	DatatypeProperty	CPV	dateOfBirth	date	
LU	PlaceAndCountryOfBirth	x	4.4	DatatypeProperty	CLV	Location:geographicName	text	
RO	***RO-Birth***							
RO	DocumentInfo			Class				
RO	BirthCertificateNo	x	3.8	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
RO	RegisteredAt	x	3.9	DatatypeProperty			text	
RO	BirthPerson			Class	CPV	Person		

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
RO	PersonalIdentificationNumber	x	4.6	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
RO	ParentsDetails		4.7	Class				
RO	FathersSurname	x	4.7.1	DatatypeProperty	CPV	familyName	text	
RO	FathersFirstName	x	4.7.2	DatatypeProperty	CPV	givenName	text	
RO	MothersSurname	x	4.7.3	DatatypeProperty	CPV	familyName	text	
RO	MotherFirstName	x	4.7.4	DatatypeProperty	CPV	givenName	text	
RO	Remarks	x	4A	Class				
RO	Remarks	x	4A.1	DatatypeProperty			text	
RO	NoRemarks	x	4A.2	DatatypeProperty			boolean	
SI	***SI-Birth***							
SI	DocumentInfo			Class				
SI	SerialNumberOfTheDocument	x	3.7.1	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
SI	BirthPerson			Class	CPV	Person		
SI	PersonalIdentificationNumber	x	4.3.1	DatatypeProperty	ADMS-AP	Identifier:identifier	text	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
SI	SurnameOfFather	x	4.6.1	DatatypeProperty	CPV	familyName	text	
SI	ForenameOfFather	x	4.6.2	DatatypeProperty	CPV	givenName	text	
SI	SurnameOfMother	x	4.7.1	DatatypeProperty	CPV	familyName	text	
SI	ForenameOfMother	x	4.7.2	DatatypeProperty	CPV	givenName	text	
SI	Nationality	x	4.8	DatatypeProperty	CLV	Jurisdiction:name	text	
SI	Notes	x	4.9	DatatypeProperty	vCard	note	text	
ES	***ES-Birth***							
ES	DocumentInfo			Class				
ES	CivilRegisterInWhichItIsEnteredvolumepag	x	3.8	DatatypeProperty			text	
ES	BirthPerson			Class	CPV	Person		
ES	TimeOfBirth	x	4.3.1	DatatypeProperty	CPV	dateOfBirth	Time	
ES	NationalIdentityCard	x	4.6	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
ES	DetailsOfParentA		4.7	Class	CPV	Person		
ES	Name	x	4.2	DatatypeProperty	CPV	givenName	text	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ES	Surnames	x	4.1	DatatypeProperty	CPV	familyName	text	
ES	NationalIdentityCard	x	4.6	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
ES	NameAndSurnamesOfParents	x	4.7.1	DatatypeProperty			text	
ES	PlaceOfBirthprovincecountry	x	4.7.2	DatatypeProperty	CLV	Location:geographicName	text	
ES	DateOfBirth	x	4.3	DatatypeProperty	CPV	dateOfBirth	date	
ES	MaritalStatus	x	4.7.3	DatatypeProperty	DPV	maritalStatus	code	
ES	Nationality	x	4.7.4	DatatypeProperty	CLV	Jurisdiction:name	text	
ES	Address	x	4.7.5	DatatypeProperty	CLV	Address:fullAddress	text	
ES	ProvinceAndCountry	x	4.7.6	DatatypeProperty	CLV	Location:geographicName	text	
ES	DetailsOfParentB		4.8	Class	CPV	Person		
ES	Name	x	4.2	DatatypeProperty	CPV	givenName	text	
ES	Surnames	x	4.1	DatatypeProperty	CPV	familyName	text	
ES	NationalIdentityCard	x	4.6	DatatypeProperty	ADMS-AP	Identifier:identifier	text	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ES	NameAndSurnamesOfParents	x	4.7.1	DatatypeProperty			text	
ES	PlaceOfBirthprovincecountry	x	4.7.2	DatatypeProperty	CLV	Location:geographicName	text	
ES	DateOfBirth	x	4.3	DatatypeProperty	CPV	dateOfBirth	date	
ES	MaritalStatus	x	4.7.3	DatatypeProperty	DPV	maritalStatus	code	
ES	Nationality	x	4.7.4	DatatypeProperty	CLV	Jurisdiction:name	text	
ES	Address	x	4.7.5	DatatypeProperty	CLV	Address:fullAddress	text	
ES	ProvinceAndCountry	x	4.7.6	DatatypeProperty	CLV	Location:geographicName	text	
ES	ParentsMarriage		4.9	Class				
ES	DateOfMarriage	x	4.9.1	DatatypeProperty	DCTerms	date	date	
ES	Place	x	4.9.2	Class				
ES	ProvinceAndCountry	x	4.7.6	DatatypeProperty	CLV	Location:geographicName	text	
ES	CivilRegisterInWhichItIsEnteredvolumepag	x	3.8	DatatypeProperty			text	
SE	***SE-Birth***							
SE	BirthPerson			Class	CPV	Person		

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
SE	Mother		4.6	Class	CPV	Person		
SE	DateOfBirth	x	4.3	DatatypeProperty	CPV	dateOfBirth	date	
SE	Citizenship	x	4.6.1	DatatypeProperty	CLV	Jurisdiction:name	text	
SE	Surname	x	4.1	DatatypeProperty	CPV	familyName	text	
SE	FirstName	x	4.2	DatatypeProperty	CPV	givenName	text	
SE	PlaceOfBirthAndCountryOfBirth	x	4.6.2	DatatypeProperty	CPV	Location:geographicName	text	
SE	NationalIdentificationNo	x	4.6.3	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
SE	Father		4.7	Class	CPV	Person		
SE	DateOfBirth	x	4.3	DatatypeProperty	CPV	dateOfBirth	date	
SE	Citizenship	x	4.6.1	DatatypeProperty	CLV	Jurisdiction:name	text	
SE	Surname	x	4.1	DatatypeProperty	CPV	familyName	text	
SE	FirstName	x	4.2	DatatypeProperty	CPV	givenName	text	
SE	PlaceOfBirthAndCountryOfBirth	x	4.6.2	DatatypeProperty	CPV	Location:geographicName	text	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
SE	NationalIdentificationNo	x	4.6.3	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
PT	***PT-Birth***							
PT	BirthPerson			Class	CPV	Person		
PT	TimeOfBirth	x	4.3.1	DatatypeProperty	CPV	dateOfBirth	time	
PT	Mother		4.6	Class	CPV	Person		
PT	Name	x	4.6.1	DatatypeProperty	CPV	fullName	text	
PT	Age	x	4.6.2	DatatypeProperty	FOAF	age	numeric	
PT	CivilStatus	x	4.6.3	DatatypeProperty	DPV	maritalStatus	code	
PT	PlaceOfBirth	x	4.6.4	DatatypeProperty	CLV	Location:geographicName	text	
PT	HabitualResidence	x	4.6.5	DatatypeProperty	CLV	Jurisdiction:name	text	
PT	Father		4.7	Class	CPV	Person		
PT	Name	x	4.6.1	DatatypeProperty	CPV	fullName	text	
PT	Age	x	4.6.2	DatatypeProperty	FOAF	age	numeric	
PT	CivilStatus	x	4.6.3	DatatypeProperty	DPV	maritalStatus	code	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
PT	PlaceOfBirth	x	4.6.4	DatatypeProperty	CLV	Location:geographicName	text	
PT	HabitualResidence	x	4.6.5	DatatypeProperty	CLV	Jurisdiction:name	text	
PT	SpecialRemarks		4.8*	Class				
PT	TheParentsAreForeignNationals	x	4.8.1	DatatypeProperty			boolean	
PT	CommentsOnTheBirthCertificate		4.9*	DatatypeProperty			text	
PT	MarriedNameOfSpouse	x	4.9.1	DatatypeProperty	CPV	fullName	text	
PT	MarriedOnDate	x	4.9.1	DatatypeProperty	DCTerms	date	date	
PT	DeathOfSpouseOnDate	x	4.9.2	DatatypeProperty	DCTerms	date	date	
PT	DivorcedOndate	x	4.9.3	DatatypeProperty	DCTerms	date	date	
PT	NonexistenceOfTheMarriageOndate	x	4.9.4	DatatypeProperty	DCTerms	date	date	
PT	AnnulmentOfTheMarriageOndate	x	4.9.5	DatatypeProperty	DCTerms	date	date	
PT	MarriageDeclaredNullAndVoidOndate	x	4.9.6	DatatypeProperty	DCTerms	date	date	
PT	LegalSeparationOndate	x	4.9.7	DatatypeProperty	DCTerms	date	date	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
PT	ReconciliationOfSpousesOndate	x	4.9.8	DatatypeProperty	DCTerms	date	date	
PT	ConversionOfLegalSeparationIntoDivorceOn	x	4.9.9	DatatypeProperty	DCTerms	date	date	
PT	ParentalResponsibilityEstablished		4.9.10	Class				
PT	Date	x		DatatypeProperty	DCTerms	date	date	
PT	Name	x		DatatypeProperty	CPV	fullName	text	
PT	GuardianshipEstablished		4.9.11	Class				
PT	Date	x		DatatypeProperty	DCTerms	date	date	
PT	Name	x		DatatypeProperty	CPV	fullName	text	
PT	DeclaredLegallyIncapacitated		4.9.12	Class				
PT	Date	x		DatatypeProperty	DCTerms	date	date	
PT	Name	x		DatatypeProperty	CPV	fullName	text	
PT	DeclaredLegallyIncompetent		4.9.13	Class				
PT	Date	x		DatatypeProperty	DCTerms	date	date	
PT	Name	x		DatatypeProperty	CPV	fullName	text	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
PT	ParentalResponsibilityExercisedBy	x	4.9.14	DatatypeProperty	CPV	fullName	text	
PT	NameChangedTo		4.9.15	Class				
PT	Date	x		DatatypeProperty	DCTerms	date	date	
PT	Name	x		DatatypeProperty	CPV	fullName	text	
PT	DiedOn	x	4.9.16	DatatypeProperty	DCTerms	date	date	
PT	BodyFoundOn	x	4.9.17	DatatypeProperty	DCTerms	date	date	
PT	DeclarationOfPresumedDeathIssuedOn	x	4.9.18	DatatypeProperty	DCTerms	date	date	
PT	PortugueseNationalityGrantedOn	x	4.9.19	DatatypeProperty	DCTerms	date	date	
PT	AcquiredPortugueseNationalityOn	x	4.9.20	DatatypeProperty	DCTerms	date	date	
PT	PortugueseNationalityWithdrawnOn	x	4.9.21	DatatypeProperty	DCTerms	date	date	

Table 12: Mapping of the attributes of the conceptual model for the Moving Abroad pilot use case 2 (extract of marriage certificate) to existing vocabularies

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ALL	***marriageForm-1.1***							
ALL	Header		0	Class				
ALL	Title	x	0.1	DatatypeProperty	DCTerms	title	text	
ALL	Country	x	0.2	DatatypeProperty	CLV	Location:geographicName	text	http://publications.europa.eu/resource/dataset/country
ALL	ImportantNotice	x	0.3	DatatypeProperty			text	
ALL	NoteForTheIssuingAuthority	x	0.4	DatatypeProperty	vCard	note	text	
ALL	AuthorityIssuingForm		1	Class	CPOV	PublicOrganisation		
ALL	Designation	x	1.1	DatatypeProperty	CPOV	prefLabel	text	
ALL	AuthorityIssuingDocument		2	Class	CPOV	PublicOrganisation		
ALL	Designation	x	1.1	DatatypeProperty	CPOV	prefLabel	text	
ALL	DocumentInfo			Class				
ALL	DocumentKind			Class				
ALL	DocumentFromCourtOrTribunal		3.1	DatatypeProperty			code	Values of 3.1.1 - 3.1.5
ALL	CourtDecision	x	3.1.1					
ALL	DocumentEmanatingFromAPublicProsecutor	x	3.1.2					
ALL	DocumentEmanatingFromAClerkOfACourt	x	3.1.3					

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ALL	DocumentEmanatingFromAJudicialOfficer	x	3.1.4					
ALL	Other	x	3.1.5	DatatypeProperty			text	
ALL	AdministrativeDocument		3.2	DatatypeProperty			code	values of 3.2.1-3.2.4
ALL	Certificate	x	3.2.1					
ALL	ExtractFromTheCivilStatusRegister	x	3.2.2					
ALL	ExtractFromThePopulationRegister	x	3.2.3					
ALL	VerbatimCopyOfCivilStatusRecords	x	3.2.4					
ALL	Other	x	3.1.5	DatatypeProperty			text	
ALL	NotarialAct	x	3.3	DatatypeProperty			boolean	
ALL	OfficialCertificateOnDocumentSignedByPerson	x	3.4	DatatypeProperty			boolean	
ALL	DocumentDrawnUpByDiplomaticOrConsularAgent	x	3.5	DatatypeProperty			boolean	
ALL	IssueDate	x	3.6	DatatypeProperty	DCTerms	issued	date	
ALL	ReferenceNumber	x	3.7	DatatypeProperty	ELI	number	text	
ALL	Marriage		4	Class	CPSV-AP	LifeEvent		
	DateOfMarriage	x	4.1	DatatypeProperty	DCTerms	date	date	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
	PlaceCountryOfMarriage	x	4.2	DatatypeProperty	CLV	Location:georgaphicName	text	
ALL	MarriageSpouseA		5	Class	CPV	Person		
ALL	Surname	x	5.1	DatatypeProperty	CPV	familyName	text	
ALL	Forename	x	5.4	DatatypeProperty	CPV	givenName	text	
ALL	DateOfBirth	x	5.5	DatatypeProperty	CPV	dateOfBirth	date	
ALL	Sex		5.6	DatatypeProperty	CPV	gender	code	values of 5.6.1-5.6.3
ALL	Female	x	5.6.1					
ALL	Male	x	5.6.2					
ALL	Undertermined	x	5.6.3					
ALL	SurnameBeforeMarriageOrRegPartnership	x	5.2	DatatypeProperty	CPV	familyName	text	
ALL	SurnameAfterMarriageOrRegPartnership	x	5.3	DatatypeProperty	CPV	familyName	text	
ALL	MarriageSpouseB		6	Class	CPV	Person		
ALL	Surname	x	5.1	DatatypeProperty	CPV	familyName	text	
ALL	Forename	x	5.4	DatatypeProperty	CPV	givenName	text	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ALL	DateOfBirth	x	5.5	DatatypeProperty	CPV	dateOfBirth	date	
ALL	Sex		5.6	DatatypeProperty	CPV	gender	code	values of 5.6.1-5.6.3
ALL	Female	x	5.6.1					
ALL	Male	x	5.6.2					
ALL	Undertermined	x	5.6.3					
ALL	SurnameBeforeMarriageOrRegPartnership	x	5.2	DatatypeProperty	CPV	familyName	text	
ALL	SurnameAfterMarriageOrRegPartnership	x	5.3	DatatypeProperty	CPV	familyName	text	
ALL	Footer		7	Class				
ALL	SurnameForenameOfficial	x	7.1	DatatypeProperth	CPV	fullName	text	
ALL	PositionOfOfficial	x	7.2	DatatypeProperty	vCard	title	text	
ALL	IssueDate	x	7.3	DatatypeProperty	DCTerms	issued	date	
ALL	Signature	x	7.4	DatatypePropert			text	
ALL	SealOrStamp	x	7.5	DatatypePropert			text	
BE	***BE-Marriage***							

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
BE	MarriageSpouseA			Class	CPV	Person		
BE	TitleOfNobility	x	5.3.1	DatatypeProperty	FOAF	title	code	EU Vocabulary Honorific
BE	PlaceAndCountryOfBirth	x	5.7	DatatypeProperty	CLV	Location:geographicName	text	
BE	MarriageSpouseB			Class	CPV	Person		
BE	TitleOfNobility	x	5.3.1	DatatypeProperty	FOAF	title	code	EU Vocabulary Honorific
BE	PlaceAndCountryOfBirth	x	5.7	DatatypeProperty	CLV	Location:geographicName	text	
BE	Witnesses		6A	Class				
BE	Witness1		6A.1	Class	CPV	Person		
BE	Surname	x	6A.1.1	DatatypeProperty	CPV	familyName	text	
BE	TitleOfNobility	x	(box 6A) 5.3.1	DatatypeProperty	FOAF	title	code	EU Vocabulary Honorific
BE	FirstName	x	(box 6A) 5.4	DatatypeProperty	CPV	givenName	text	
BE	DateOfBirth	x	(box 6A) 5.5	DatatypeProperty	CPV	dateOfBirth	date	
BE	PlaceAndCountryOfBirth	x	(box 6A) 5.7	DatatypeProperty	CLV	Location:geographicName	text	
BE	Witness2		6A.2	Class	CPV	Person		
BE	Surname	x	6A.1.1	DatatypeProperty	CPV	familyName	text	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
BE	TitleOfNobility	x	(box 6A) 5.3.1	DatatypeProperty	FOAF	title	code	EU Vocabulary Honorific
BE	FirstName	x	(box 6A) 5.4	DatatypeProperty	CPV	givenName	text	
BE	DateOfBirth	x	(box 6A) 5.5	DatatypeProperty	CPV	dateOfBirth	date	
BE	PlaceAndCountryOfBirth	x	(box 6A) 5.7	DatatypeProperty	CLV	Location:geographicName	text	
BE	Witness3		6A.3	Class	CPV	Person		
BE	Surname	x	6A.1.1	DatatypeProperty	CPV	familyName	text	
BE	TitleOfNobility	x	(box 6A) 5.3.1	DatatypeProperty	FOAF	title	code	EU Vocabulary Honorific
BE	FirstName	x	(box 6A) 5.4	DatatypeProperty	CPV	givenName	text	
BE	DateOfBirth	x	(box 6A) 5.5	DatatypeProperty	CPV	dateOfBirth	date	
BE	PlaceAndCountryOfBirth	x	(box 6A) 5.7	DatatypeProperty	CLV	Location:geographicName	text	
BE	Witness4		6A.4	Class	CPV	Person		
BE	Surname	x	6A.1.1	DatatypeProperty	CPV	familyName	text	
BE	TitleOfNobility	x	(box 6A) 5.3.1	DatatypeProperty	FOAF	title	code	EU Vocabulary Honorific
BE	FirstName	x	(box 6A) 5.4	DatatypeProperty	CPV	givenName	text	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
BE	DateOfBirth	x	(box 6A) 5.5	DatatypeProperty	CPV	dateOfBirth	date	
BE	PlaceAndCountryOfBirth	x	(box 6A) 5.7	DatatypeProperty	CLV	Location:geographicName	text	
BE	OtherHeadings		6B	Class				
BE	Divorce		6B.1	Class				
BE	Court	x	6B.1.1	DatatypeProperty			text	
BE	DateOfTheCourtDecision	x	6B.1.2	DatatypeProperty	DCTerms	issued	date	
BE	DateWhenTheCourtDecisionBecameResJudicat	x	6B.1.3	DatatypeProperty	DCTerms	issued	date	
BE	DateOfEntryInTheCivilStatusRegisterdateO	x	6B.1.4	DatatypeProperty	DCTerms	issued	date	
BE	CaseNumberOrDecisionReferenceNumber	x	6B.1.5	DatatypeProperty	ELI	number	text	
BE	MarriageAnnulment		6B.2	Class				
BE	Court	x	6B.1.1	DatatypeProperty			text	
BE	DateOfTheCourtDecision	x	6B.1.2	DatatypeProperty	DCTerms	issued	date	
BE	CaseNumberOrDecisionReferenceNumber	x	6B.1.5	DatatypeProperty	ELI	number	text	
DK	***DK-Marriage***							

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
DK	AuthorityIssuingDocument			Class	CPOV	PublicOrganisation		
DK	Address	x	2.1	DatatypeProperty	CLV	fullAddress	text	
DK	SpouseA			Class	CPV	Person		
DK	MiddleName	x	5.4.1.	DatatypeProperty	CPV	alternativeName	text	
DK	PersonalIdentificationNumber	x	5.5.1	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
DK	PlaceOfRegistrationOfBirth	x	5.5.2	DatatypeProperty	CLV	Location:geographicName	text	
DK	SpouseB			Class	CPV	Person		
DK	MiddleName	x	5.4.1.	DatatypeProperty	CPV	alternativeName	text	
DK	PersonalIdentificationNumber	x	5.5.1	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
DK	PlaceOfRegistrationOfBirth	x	5.5.2	DatatypeProperty	CLV	Location:geographicName	text	
LU	***LU-Marriage***							
LU	AuthorityIssuingDocument			Class	CPOV	PublicOrganisation		
LU	SignatureAndSealOfDepository	x	2.1	DatatypeProperty			text	
LU	DocumentInfo			Class				
LU	PlaceAndCountryOfIssue	x	3.6.1	DatatypeProperty	CLV	Location:geographicName	text	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
LU	SpouseA			Class	CPV	Person		
LU	PlaceAndCountryOfBirth	x	5.5.1	DatatypeProperty	CLV	Location:geographicName	text	
LU	Domicile (Place of residence)	x		DatatypeProperty	CLV	Location:geographicName	text	
LU	Profession (Job)	x		DatatypeProperty	schema.org	occupationalCategory	code	ESCO Occupation, BLS O*NET-SOC, ISCO-08
LU	Mariage précédent (Previous marriage)	x		DatatypeProperty			boolean	
LU	SpouseB			Class	CPV	Person		
LU	PlaceAndCountryOfBirth	x	5.5.1	DatatypeProperty	CLV	Location:geographicName	text	
LU	Domicile (Place of residence)	x		DatatypeProperty	CLV	Location:geographicName	text	
LU	Profession (Job)	x		DatatypeProperty	schema.org	occupationalCategory	code	ESCO Occupation, BLS O*NET-SOC, ISCO-08
LU	Mariage précédent (Previous marriage)	x		DatatypeProperty			boolean	
LU	DissolutionOfTheMarriage		new box 6A	Class				
LU	ReasonForTheDissolution		6A.1	DatatypeProperty			code	values of 6.A.1.1-6.1.1.3
LU	Divorce	x	6A.1.1					
LU	Annulment	x	6A.1.2					
LU	LegalSeparation	x	6A.1.3					

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
LU	DateOfTheCourtDecision		6A.2	Class				
LU	JudgmentOf	x	6A.2.1	DatatypeProperty	DCTerms	issued	date	
LU	AppealJudgmentOf	x	6A.2.2	DatatypeProperty	DCTerms	issued	date	
LU	Parent 1			Class	CPV	Person		
LU	Surname			DatatypeProperty	CPV	familyName	text	
LU	Forename			DatatypeProperty	CPV	givenName	text	
LU	Sex		4.5	DatatypeProperty	CPV	gender	code	
LU	Female		4.5.1					
LU	Male		4.5.2					
LU	Domicile (Place of residence)			DatatypeProperty	CLV	Location:geographicName	text	
LU	Profession (Job)			DatatypeProperty	schema.org	occupationalCategory	code	ESCO Occupation, BLS O*NET-SOC, ISCO-08
LU	Date of death			DatatypeProperty	CPV	dateOfDeath	date	
LU	Parent 2			Class	CPV	Person		
LU	Surname			DatatypeProperty	CPV	familyName	text	
LU	Forename			DatatypeProperty	CPV	givenName	text	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
LU	Sex		4.5	DatatypeProperty	CPV	gender	code	
LU	Female		4.5.1					
LU	Male		4.5.2					
LU	Domicile (Place of residence)			DatatypeProperty	CLV	Location:geographicName	text	
LU	Profession (Job)			DatatypeProperty	schema.org	occupationalCategory	code	ESCO Occupation, BLS O*NET-SOC, ISCO-08
LU	Date of death			DatatypeProperty	CPV	dateOfDeath	date	
RO	***RO-Marriage***							
RO	DocumentInfo			Class				
RO	MarriageCertificateNo	x	3.8	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
RO	RegisteredAt	x	3.9	DatatypeProperty			text	
RO	SpouseA			Class	CPV	Person		
RO	PlaceOfBirth	x	5.5.1	DatatypeProperty	CLV	Location:geographicName	text	
RO	PersonalIdentificationNumber	x	5.7	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
RO	ParentsDetails		5.8	Class				
RO	FathersSurname	x	5.8.1	DatatypeProperty	CPV	familyName	text	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
RO	FathersFirstName	x	5.8.2	DatatypeProperty	CPV	givenName	text	
RO	MothersSurname	x	5.8.3	DatatypeProperty	CPV	familyName	text	
RO	MotherFirstName	x	5.8.4	DatatypeProperty	CPV	givenName	text	
RO	SpouseB			Class	CPV	Person		
RO	PlaceOfBirth	x	5.5.1	DatatypeProperty	CLV	Location:geographicName	text	
RO	PersonalIdentificationNumber	x	5.7	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
RO	ParentsDetails		5.8	Class				
RO	FathersSurname	x	5.8.1	DatatypeProperty	CPV	familyName	text	
RO	FathersFirstName	x	5.8.2	DatatypeProperty	CPV	givenName	text	
RO	MothersSurname	x	5.8.3	DatatypeProperty	CPV	familyName	text	
RO	MotherFirstName	x	5.8.4	DatatypeProperty	CPV	givenName	text	
RO	Remarks		6A	Class				
RO	Remarks	x	6A.1	DatatypeProperty			text	
RO	NoRemarks	x	6A.2	DatatypeProperty			boolean	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
SI	***SI-Marriage***							
SI	DocumentInfo			Class				
SI	SerialNumberOfTheDocument	x	3.7.1	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
SI	SpouseA			Class	CPV	Person		
SI	PersonalIdentificationNumber	x	5.5.1	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
SI	PlaceOfBirth	x	5.5.2	DatatypeProperty	CLV	Location:geographicName	text	
SI	SpouseB			Class	CPV	Person		
SI	PersonalIdentificationNumber	x	5.5.1	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
SI	PlaceOfBirth	x	5.5.2	DatatypeProperty	CLV	Location:geographicName	text	
SI	Footer			Class				
SI	Notes	x	7.6	DatatypeProperty	vCard	note	text	
ES	***ES-Marriage***							
ES	DocumentInfo			Class				
ES	CivilRegisterInWhichItIsEnteredvolumepag	x	3.8	DatatypeProperty			text	
ES	Marriage			Class	CPSV-AP	LifeEvent		
ES	TimeOfCelebrationOfMarriage	x	4.3	DatatypeProperty	DCTerms	date	time	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ES	SpouseA			Class	CPV	Person		
ES	PlaceOfBirthprovincecountry	x	5.5.1	DatatypeProperty	CLV	Location:geographicName	text	
ES	NameAndSurnamesOfParentA	x	5.7	DatatypeProperty	CPV	fullName	text	
ES	NameAndSurnamesOfParentB	x	5.8	DatatypeProperty	CPV	fullName	text	
ES	CivilRegisterInWhichBirthIsEnteredvolume	x	5.9	DatatypeProperty			text	
ES	MaritalStatus	x	5.10	DatatypeProperty			text	
ES	Addressprovincecountry	x	5.11	DatatypeProperty	CLV	Address:fullAddress	text	
ES	Nationality	x	5.12	DatatypeProperty	CLV	Jurisdiction:name	text	
ES	NationalIdentityCard	x	5.13	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
ES	SpouseB			Class	CPV	Person		
ES	PlaceOfBirthprovincecountry	x	5.5.1	DatatypeProperty	CLV	Location:geographicName	text	
ES	NameAndSurnamesOfParentA	x	5.7	DatatypeProperty	CPV	fullName	text	
ES	NameAndSurnamesOfParentB	x	5.8	DatatypeProperty	CPV	fullName	text	
ES	CivilRegisterInWhichBirthIsEnteredvolume	x	5.9	DatatypeProperty			text	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ES	MaritalStatus	x	5.10	DatatypeProperty			text	
ES	Addressprovincecountry	x	5.11	DatatypeProperty	CLV	Address:fullAddress	text	
ES	Nationality	x	5.12	DatatypeProperty	CLV	Jurisdiction:name	text	
ES	NationalIdentityCard	x	5.13	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
SE	***SE-Marriage***							
SE	SpouseA			Class	CPV	Person		
SE	NationalIdentificationNo	x	5.7	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
SE	Citizenship	x	5.8	DatatypeProperty	CLV	Jurisdiction:name	text	
SE	PlaceOfBirth	x	5.9	DatatypeProperty	CLV	Location:geographicName	text	
SE	MiddleName	x	5.10	DatatypeProperty	CPV	alternativeName	text	
SE	ConfidentialPersonalData	x	5.11	DatatypeProperty			text	
PT	***PT-Marriage***							
PT	Marriage			Class	CPSV-AP	LifeEvent		

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
PT	TimeOfMarriage	x	4.1.1	DatatypeProperty	DCTerms	date	time	
PT	CommentsOnTheMarriageCertificate		4.3*	DatatypeProperty			text	
PT	DissolvedDueToDeathOfSpouseAbOn	x	4.3.1	DatatypeProperty	DCTerms	date	date	
PT	DissolvedDueToDivorceOn	x	4.3.2	DatatypeProperty	DCTerms	date	date	
PT	AnnulledOn	x	4.3.3	DatatypeProperty	DCTerms	date	date	
PT	MarriageDeclaredNullAndVoidOn	x	4.3.4	DatatypeProperty	DCTerms	date	date	
PT	DeclaredNonexistentOn	x	4.3.5	DatatypeProperty	DCTerms	date	date	
PT	LegalSeparationOn	x	4.3.6	DatatypeProperty	DCTerms	date	date	
PT	ReconciliationOfSpousesOn	x	4.3.7	DatatypeProperty	DCTerms	date	date	
PT	ConversionOfLegalSeparationIntoDivorceOn	x	4.3.8	DatatypeProperty	DCTerms	date	date	
PT	SpouseA			Class	CPV	Person		
PT	PlaceOfBirth	x	5.7	DatatypeProperty	CLV	Location:geographicName	text	
PT	HabitualResidence	x	5.8	DatatypeProperty	CLV	Jurisdiction:name	text	

MS	DE4A concept	Data Field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
PT	ChildOfA	x	5.9	DatatypeProperty	CPV	fullName	text	
PT	ChildOfB	x	5.10	DatatypeProperty	CPV	fullName	text	
PT	SpouseB			Class	CPV	Person		
PT	PlaceOfBirth	x	5.7	DatatypeProperty	CLV	Location:geographicName	text	
PT	HabitualResidence	x	5.8	DatatypeProperty	CLV	Jurisdiction:name	text	
PT	ChildOfA	x	5.9	DatatypeProperty	CPV	fullName	text	
PT	ChildOfB	x	5.10	DatatypeProperty	CPV	fullName	text	

Table 13: Mapping of the attributes of the conceptual model for the Moving Abroad pilot use case 2 (extract of death certificate) to existing vocabularies

MS	DE4A concept	Data field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ALL	***deathForm-1.1***							
ALL	Header		0	Class				

MS	DE4A concept	Data field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ALL	Title	x	0.1	DatatypeProperty	DCTerms	title	text	
ALL	Country	x	0.2	DatatypeProperty	CLV	Location:geographicName	text	http://publications.europa.eu/resource/dataset/country
ALL	ImportantNotice	x	0.3	DatatypeProperty			text	
ALL	NoteForTheIssuingAuthority	x	0.4	DatatypeProperty	vCard	note	text	
ALL	AuthorityIssuingForm		1	Class	CPOV	PublicOrganisation		
ALL	Designation	x	1.1	DatatypeProperty	CPOV	prefLabel	text	
ALL	AuthorityIssuingDocument		2	Class	CPOV	PublicOrganisation		
ALL	Designation	x	1.1	DatatypeProperty	CPOV	prefLabel	text	
ALL	DocumentInfo		3	Class				
ALL	DocumentKind			Class				
ALL	DocumentFromCourtOrTribunal		3.1	DatatypeProperty			code	Values of 3.1.1 - 3.1.5
ALL	CourtDecision	x	3.1.1					
ALL	DocumentEmanatingFromAPublicProsecutor	x	3.1.2					

MS	DE4A concept	Data field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ALL	DocumentEmanatingFromAClerkOfACourt	x	3.1.3					
ALL	DocumentEmanatingFromAJudicialOfficer	x	3.1.4					
ALL	Other	x	3.1.5	DatatypeProperty			text	
ALL	AdministrativeDocument		3.2	DatatypeProperty			code	values of 3.2.1-3.2.4
ALL	Certificate	x	3.2.1					
ALL	ExtractFromTheCivilStatusRegister	x	3.2.2					
ALL	ExtractFromThePopulationRegister	x	3.2.3					
ALL	VerbatimCopyOfCivilStatusRecords	x	3.2.4					
ALL	Other	x	3.1.5	DatatypeProperty			text	
ALL	NotarialAct	x	3.3	DatatypeProperty			boolean	
ALL	OfficialCertificateOnDocumentSignedByPerson	x	3.4	DatatypeProperty			boolean	
ALL	DocumentDrawnUpByDiplomaticOrConsularAgent	x	3.5	DatatypeProperty			boolean	
ALL	IssueDate	x	3.6	DatatypeProperty	DCTerms	issued	date	

MS	DE4A concept	Data field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ALL	ReferenceNumber	x	3.7	DatatypeProperty	ELI	number	text	
ALL	DeathPerson		4	Class	CPV	Person		
ALL	Surname	x	4.1	DatatypeProperty	CPV	familyName	text	
ALL	Forename	x	4.2	DatatypeProperty	CPV	givenName	text	
ALL	DateOfBirth	x	4.3	DatatypeProperty	CPV	dateOfBirth	date	
ALL	Sex		4.4	Sex	CPV	gender	code	
ALL	Female	x	4.6.1					
ALL	Male	x	4.6.2					
ALL	Undertermined	x	4.6.3					
ALL	DateOfDeath	x	4.5	DatatypeProperty	CPV	dateOfDeath	text	
ALL	PlaceCountryOfDeath	x	4.4	DatatypeProperty	CLV	Location:geographicName	text	
ALL	Footer		5	Class				

MS	DE4A concept	Data field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ALL	SurnameForenameOfficial	x	5.1	DatatypeProperty	CPV	fullName	text	
ALL	PositionOfOfficial	x	5.2	DatatypeProperty	vCard	title	text	
ALL	IssueDate	x	5.3	DatatypeProperty	DCTerms	issued	date	
ALL	Signature	x	5.4	DatatypeProperty			text	
ALL	SealOrStamp	x	5.5	DatatypeProperty			text	
BE	***BE-Death***							
BE	DeathPerson			Class	CPV	Person		
BE	TitleOfNobility	x	4.1.1	DatatypeProperty	FOAF	title	code	EU Vocabulary Honorific
BE	TimeOfDeath	x	4.3.1	DatatypeProperty	CPV	dateOfDeath	time	
BE	PlaceAndCountryOfBirth	x	4.5.1	DatatypeProperty	CLV	Location:geographicName	text	
BE	PlaceOfDiscoveryOfTheDeadBody	x	4.7	DatatypeProperty	CLV	Location:geographicName	text	
BE	DateOfDiscoveryOfTheDeadBody	x	4.8	DatatypeProperty	DCTerms	date	date	
BE	TimeOfDiscoveryOfTheDeadBody	x	4.9	DatatypeProperty	DCTerms	date	time	

MS	DE4A concept	Data field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
DK	***DK-Death***							
DK	DeathPerson			Class	CPV	Person		
DK	MiddleName	x	4.2.1	DatatypeProperty	CPV	alternativeName	text	
DK	PlaceOfRegistrationOfDeath	x	4.4.1	DatatypeProperty	CLV	Location:geographicName	text	
DK	PlaceOfBurial	x	4.4.2	DatatypeProperty	CLV	Location:geographicName	text	
DK	PlaceOfRegistrationOfBirth	x	4.5.1	DatatypeProperty	CLV	Location:geographicName	text	
DK	PersonalIdentificationNumber	x	4.5.2	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
DK	SurvivingOrPredeceasedSpousesFullName	x	4.7	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
DK	SpousesPersonalIdentificationNumber	x	4.7.1	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
LU	***LU-Death***							
LU	AuthorityIssuingDocument			Class	CPOV	PublicOrganisation		
LU	SignatureAndSealOfDepository	x	2.1	DatatypeProperty			text	
LU	DocumentInfo			Class				
LU	PlaceAndCountryOfIssue	x	3.6.1	DatatypeProperty	CLV	Location:geographicName	text	
LU	DeathPerson			Class	CPV	Person		

MS	DE4A concept	Data field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
LU	PlaceAndCountryOfbirth	x	4.5.1	DatatypeProperty	CLV	Location:geographicName	text	
LU	État civil (Civil status)	x		DatatypeProperty	DPV	maritalStatus	code	
LU	Domicile (Place of residence)	x		DatatypeProperty	CLV	Location:geographicName	text	
LU	Heure du décès (Hour of death)	x		DatatypeProperty	CPV	dateOfDeath	time	
LU	LastSpouse		4.7	Class	CPV	Person		
LU	Surname	x	4.1	DatatypeProperty	CPV	familyName	text	
LU	Forename	x	4.2	DatatypeProperty	CPV	givenName	text	
LU	Sex		4.6	DatatypeProperty	CPV	gender	code	values of 4.6.1-4.6.2
LU	Female	x	4.6.1					
LU	Male	x	4.6.2					
LU	Date of death	x		DatatypeProperty	CPV	dateOfDeath	date	
LU	Place of death	x		DatatypeProperty	CLV	Location:geographicName	text	
LU	ParentA		4.8	Class	CPV	Person		
LU	Surname	x	4.1	DatatypeProperty	CPV	familyName	text	

MS	DE4A concept	Data field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
LU	Forename	x	4.2	DatatypeProperty	CPV	givenName	text	
LU	Sex		4.6	DatatypeProperty	CPV	gender	code	values of 4.6.1-4.6.2
LU	Female	x	4.6.1					
LU	Male	x	4.6.2					
LU	ParentB		4.9	Class	CPV	Person		
LU	Surname	x	4.1	DatatypeProperty	CPV	familyName	text	
LU	Forename	x	4.2	DatatypeProperty	CPV	givenName	text	
LU	Sex		4.6	DatatypeProperty	CPV	gender	code	values of 4.6.1-4.6.2
LU	Female	x	4.6.1					
LU	Male	x	4.6.2					
LU	Person who declares the death			Class	CPV	Person		
LU	Name (Nom)			DatatypeProperty	CPV	familyName	text	
LU	Forename (Prénoms)			DatatypeProperty	CPV	givenName	text	
LU	Age (Âge)			DatatypeProperty	FOAF	age	Numeric	
LU	Relation with the dead person (Relation avec le/la défunt(e))			DatatypeProperty			code	

MS	DE4A concept	Data field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
LU	Date of the declaration (Date de la déclaration)			DatatypeProperty	DCTerms	date	date	
LU	Hour of the declaration (Heure de la déclaration)			DatatypeProperty	DCTerms	date	time	
LU	Other statements (Autres énonciations)			DatatypeProperty			text	
RO	***RO-Death***							
RO	DocumentInfo			Class				
RO	DeathCertificateNo	x	3.8	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
RO	RegisteredAt	x	3.9	DatatypeProperty			text	
RO	DeathPerson			Class	CPV	Person		
RO	PlaceOfBirth	x	4.5.1	DatatypeProperty	CLV	Location:geographicName	text	
RO	PlaceOfResidence	x	4.5.2	DatatypeProperty	CLV	Location:geographicName	text	
RO	PersonalIdentificationNumber	x	4.7	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
RO	ParentsDetails		4.8	Class				
RO	FathersSurname	x	4.8.1	DatatypeProperty	CPV	familyName	text	
RO	FathersFirstName	x	4.8.2	DatatypeProperty	CPV	givenName	text	

MS	DE4A concept	Data field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
RO	MothersSurname	x	4.8.3	DatatypeProperty	CPV	familyName	text	
RO	MotherFirstName	x	4.8.4	DatatypeProperty	CPV	givenName	text	
RO	Remarks		4A	Class				
RO	Remarks	x	4A.1	DatatypeProperty			text	
RO	NoRemarks	x	4A.2	DatatypeProperty			boolean	
SI	***SI-Death***							
SI	DocumentInfo			Class				
SI	SerialNumberOfTheDocument	x	3.7.1	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
SI	DeathPerson			Class	CPV	Person		
SI	PersonalIdentificationNumber	x	4.3.1	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
SI	DateOfBirth	x	4.5	DatatypeProperty	CPV	dateOfBirth	date	
SI	PlaceOfBirth	x	4.5.1	DatatypeProperty	CLV	Location:geographicName	text	
SI	LastPermanentResidence	x	4.7	DatatypeProperty	CLV	Location:geographicName	text	
SI	SurnameOfSpouse	x	4.8	DatatypeProperty	CPV	familyName	text	

MS	DE4A concept	Data field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
SI	ForenameOfSpouse	x	4.8.1	DatatypeProperty	CPV	givenName	text	
SI	PersonalIdentificationNumberOfSpouse	x	4.8.2	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
SI	Notes	x	4.9	DatatypeProperty	vCard	note	text	
ES	***ES-Death***							
ES	DocumentInfo			Class				
ES	CivilRegisterInWhichItIsEnteredvolumepag	x	3.8	DatatypeProperty			text	
ES	DeathPerson			Class	CPV	Person		
ES	TimeOfDeath	x	4.3.1	DatatypeProperty	CPV	dateOfDeath	time	
ES	PlaceOfBirthprovincecountry	x	4.5.1	DatatypeProperty	CLV	Location:geographicName	text	
ES	CivilRegisterInWhichBirthIsEnteredvolume	x	4.5.2	DatatypeProperty			text	
ES	NationalIdentityCard	x	4.7	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
ES	NameAndSurnamesOfParentA	x	4.8	DatatypeProperty	CPV	fullName	text	
ES	NameAndSurnamesOfParentB	x	4.9	DatatypeProperty	CPV	fullName	text	
ES	MaritalStatus	x	4.10	DatatypeProperty			text	

MS	DE4A concept	Data field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
ES	Nationality	x	4.11	DatatypeProperty	CLV	Jurisdiction:name	text	
ES	LastAddressprovincecountry	x	4.12	DatatypeProperty	CLV	Address:fullAddress	text	
ES	PlaceOfBurialprovincecountry	x	4.13	DatatypeProperty	CLV	Location:geographicName	text	
SE	***SE-Death***							
SE	DeathPerson			Class	CPV	Person		
SE	NationalIdentificationNo	x	4.7	DatatypeProperty	ADMS-AP	Identifier:identifier	text	
SE	RegistrationInNationalPopulationRegister	x	4.8	Class				
SE	Date	x	4.8.1	DatatypeProperty	DCTerms	date	date	
SE	County	x	4.8.2	DatatypeProperty	CLV	Address:adminUnitL2	text	
SE	Municipality	x	4.8.3	DatatypeProperty	CLV	Address:postName	text	
PT	***PT-Death***							
PT	DeathPerson			Class	CPV	Person		
PT	TimeOfDeath	x	4.3.1	DatatypeProperty	CPV	dateOfDeath	time	
PT	PlaceOfBurial	x	4.4.1	DatatypeProperty	CLV	Location:geographicName	text	

MS	DE4A concept	Data field	Position in form	Property type	Related existing vocabulary	Subclass/Subproperty of	Data type	Controlled vocabulary
PT	CivilStatus	x	4.7	DatatypeProperty	DPV	maritalStatus	code	
PT	PlaceOfBirth	x	4.8	DatatypeProperty	CLV	Location:geographicName	text	
PT	LastHabitualResidence	x	4.9	DatatypeProperty	CLV	Jurisdiction:name	text	
PT	ChildOfA	x	4.10	DatatypeProperty	CPV	fullName	text	
PT	ChildOfB	x	4.11	DatatypeProperty	CPV	fullName	text	

DISCLAIMER: We proposed some initial controlled vocabularies that can be reused to describe DE4A concepts by using commonly agreed list of values. We will further investigate the use of more possible controlled vocabularies in the next iteration and in case of different lists of values for each participating MS of the pilots, we will examine the description of concepts by using SKOS standard (skos:ConceptScheme). A more detailed representation of the suggested controlled vocabularies is mentioned at Annex IV.