*SC245DI07171*

D04.07 Report on policy support for e-Procurement   
*e-Procurement ontology*

Document Metadata

|  |  |
| --- | --- |
| **Property** | **Value** |
| Date | 2016-09-20 |
| Status | Accepted |
| Version | 1.00 |
| Authors | Nikolaos Loutas – PwC EU Services  Brecht Wyns – PwC EU Services  Stefanos Kotoglou – PwC EU Services  Dimitrios Hytiroglou – PwC EU Services |
| Reviewed by | Pieter Breyne – PwC EU Services  Natalie Muric – Publications Office  Cecile Guasch – European Commission, DG DIGIT  Vassilios Peristeras – European Commission, ISA Programme |
| Approved by | Natalie Muric – Publications Office |

# 

**This study was prepared for the ISA Programme by:**

*PwC EU Services*

**Disclaimer:**

|  |
| --- |
| The views expressed in this report are purely those of the authors and may not, in any circumstances, be interpreted as stating an official position of the European Commission.  The European Commission does not guarantee the accuracy of the information included in this study, nor does it accept any responsibility for any use thereof.  Reference herein to any specific products, specifications, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favouring by the European Commission.  All care has been taken by the author to ensure that s/he has obtained, where necessary, permission to use any parts of manuscripts including illustrations, maps, and graphs, on which intellectual property rights already exist from the titular holder(s) of such rights or from her/his or their legal representative. |

Contents

[1. Introduction 1](#_Toc462142475)

[1.1. Context 1](#_Toc462142476)

[1.2. Proposed solution 2](#_Toc462142477)

[1.3. Scope 3](#_Toc462142478)

[1.4. Structure of this document 3](#_Toc462142479)

[1.5. Common working terminology 3](#_Toc462142480)

[2. Process, Methodology and Technology 5](#_Toc462142481)

[3. Target Audience & Use Cases 9](#_Toc462142482)

[3.1. Target audience 9](#_Toc462142483)

[3.2. Use cases 9](#_Toc462142484)

[4. Related Ontologies/Vocabularies and Projects 20](#_Toc462142485)

[4.1. Data models and ontologies 20](#_Toc462142486)

[4.1.1. CEN WS/BII business term vocabulary and semantic models 20](#_Toc462142487)

[4.1.2. Open Contracting Data Standard 21](#_Toc462142488)

[4.1.3. Universal Business Language 25](#_Toc462142489)

[4.1.4. The European Single Procurement Document 27](#_Toc462142490)

[4.1.5. CEN Core Invoice 29](#_Toc462142491)

[4.1.6. e-Certis data model 29](#_Toc462142492)

[4.1.7. ISA Core Vocabularies 30](#_Toc462142493)

[4.1.8. The Public Procurement Ontology 32](#_Toc462142494)

[4.1.9. LOTED2 34](#_Toc462142495)

[4.1.10. The Linked Open Economy ontology 36](#_Toc462142496)

[4.1.11. Payments ontology 36](#_Toc462142497)

[4.1.12. Paraguayan procurement ontology 37](#_Toc462142498)

[4.1.13. SEDIA 38](#_Toc462142499)

[4.1.1. Common Data Model (CDM) of the Publications Office 38](#_Toc462142500)

[4.1.2. Standard forms for public procurement (TED) 39](#_Toc462142501)

[4.1.3. Other generic vocabularies that should be taken into consideration 40](#_Toc462142502)

[4.2. Reference data and codelists 40](#_Toc462142503)

[4.2.1. The Common Procurement Vocabulary 40](#_Toc462142504)

[4.2.2. The Named Authority Lists of the Publications Office 41](#_Toc462142505)

[4.2.3. Nomenclature of Territorial Units for Statistics 42](#_Toc462142506)

[4.3. Identification of reusable concepts 43](#_Toc462142507)

[5. Conclusion and Next Steps 44](#_Toc462142508)

[6. References 45](#_Toc462142509)

[7. Annexes 49](#_Toc462142510)

[7.1. Annex I: Classes of the LOE ontology 49](#_Toc462142511)

[7.2. Annex II: Example of classes in the Paraguayan procurement 51](#_Toc462142512)

List of Figures

[Figure 1: UBL "Invitation to Tender" process 26](#_Toc462142513)

[Figure 2: ESPD Data Model [16] 28](#_Toc462142514)

[Figure 3: Contract Class and subclasses [21] 32](#_Toc462142515)

[Figure 4: core classes of PPROC [21] 33](#_Toc462142516)

[Figure 5 Semi-Structured data extracted from TED 35](#_Toc462142517)

[Figure 7: The three different levels of NUTS [27] 42](#_Toc462142518)

List of Tables

[Table 1: Actors & roles 5](#_Toc462142519)

[Table 2: Process Overview 6](#_Toc462142520)

[Table 3: Methodology overview 7](#_Toc462142521)

[Table 4 Overview of technology to be used 7](#_Toc462142522)

[Table 5 Relevant actors for each use case 18](#_Toc462142523)

[Table 6 Examples of CEN BII Profiles 20](#_Toc462142524)

[Table 7 Main sections and objects in OCDS [11] 21](#_Toc462142525)

[Table 8: UBL "Call for Tenders" Document Schema 27](#_Toc462142526)

[Table 9 Example elements described in the Core Invoice data model 29](#_Toc462142527)

[Table 10 Example Classes form the ISA Core vocabularies 31](#_Toc462142528)

[Table 11: Classes of LOE ontology 49](#_Toc462142529)

[Table 12: Example of classes in the Paraguayan procurement 51](#_Toc462142530)

# Introduction

## Context

Public procurement represents around the 20% of GDP in Europe. This big buying volume offers a high economic potential to enhance efficiency of European procurement.

The EU is investing significantly on the digitalisation of the public procurement process (referred to as e-Procurement). This goes beyond simply moving to electronic tools; it rethinks various pre-award and post-award phases with the aim to make them simpler for businesses to participate in and for the public sector to manage. It also allows for the integration of data-based approaches at various stages of the procurement process[[1]](#footnote-2).

With e-Procurement, public spending should become more transparent, evidence-oriented, optimised, streamlined and integrated with market conditions. More specifically, e-Procurement offers a range of benefits such as:

* significant savings for all parties, both businesses and the public sector;
* simplified and shortened processes;
* reductions in red-tape and administrative burdens;
* increased transparency;
* greater innovation;
* new business opportunities by improving the access of enterprises, including small and medium-sized enterprises (SMEs) to public procurement markets.

To deliver the aforementioned benefits, e-Procurement is heavily based on the exchange of data between different systems supporting the procurement processes (i.e. achieving end-to-end interoperability of public procurement processes and underlying systems) and on the availability and dissemination of procurement data to the wider public (i.e. improving transparency and stimulating innovation and new business opportunities).

As stated in the Commission Implementing Regulation (EU) 2015/1986[[2]](#footnote-3), contracting authorities in the EU are legally required to publish notices above certain thresholds. Article 6 of that Regulation states that either the eNotices online application or the TED eSender systems should be used to electronically transmit notices to the Publications Office of the European Union. From a different angle, the implementation of revised PSI directive[[3]](#footnote-4) across the EU is calling for open, unobstructed access to public data in order to improve transparency and to boost innovation via the reuse of public data. Procurement data has been identified as data with a high-reuse potential[[4]](#footnote-5). Therefore, making this data available in machine-readable formats, following the data as a service paradigm, is required in order to maximise its reuse.

We hence see that data exchange, access and reuse become key requirements for efficient and transparent end-to-end public procurement. It is because of this, that we observe a focus shift from the definition of procurement process standards for system-to-system exchange, which have already gone a long way, to the development of data standards for publishing e-Procurement data in open, machine-readable formats (see Chapter 4 Related Ontologies/Vocabularies and Projects).

The key problem is that procurement data is available in different systems across the European Union while

* the relations between the different concepts in the procurement chain and data flow are not fully documented, therefore data and data relationships cannot be reused directly in a flexible and comparable manner;
* some data available has inherited formats from its paper origins leading to illogical business processes and incorrect conceptual models;
* different systems use different data formats therefore reuse of information is not always efficient; and
* taxonomies like CPV are often not correctly used which creates severe problems like making it very difficult for SMEs to find correct business opportunities.

Given the increasing importance of data standards for e-Procurement, a number of initiatives driven by the public sector, the industry and academia have been kick started in the recent years. Some have grown organically, while others are the result of standardisation work. The vocabularies and the semantics that they are introducing, the phases of public procurement that they are covering, and the technologies that they are using all differ. These differences hamper data interoperability and thus its reuse by them or by the wider public. This creates the need for a common data standard for publishing procurement data, hence allowing data from different sources to be easily accessed and linked, and consequently reused. The e-Procurement ontology (henceforth referred to as the ePO) introduced by this study aspires to play this role.

## Proposed solution

The ultimate objective of the ePO is to put forth a commonly agreed OWL ontology that will conceptualise, formally encode and make available in an open, structured and machine-readable format data about public procurement, covering it from end to end, i.e. from notification, through tendering to awarding, ordering, invoicing and payment.

It is not the intention of the ePO to reinvent the wheel by redefining existing terms or processes, but rather to unify all existing practices, thus facilitating seamless exchange, access and reuse of data.

Process, Methodology and Technology discusses in detail the open process and methodology that will be followed for developing the ePO.

## Scope

This report is not focusing on creating the specifications of the ePO neither in the form of a conceptual data model nor as an OWL ontology.

The scope of this report is to put together the necessary information for being able to proceed with the specification of the ePO, including a process and methodology to be followed for the development of the ePO. As such, the following activities are in scope of this work:

* Identify the target audience and the key use cases for the ePO;
* Document and analyse existing initiatives to discover overlaps and gaps, and identify which ones to reuse and with which ones to align; and
* Identify reference data and code lists that can be referenced to by the ePO.

## Structure of this document

This document is structured in several sections. After describing the context, scope and the proposed solution presented by this work in section 1, section 2 proposes a process and methodology to be followed and the technology to be used for the development of an e-Procurement Ontology. Section 3 identifies the main stakeholders that are impacted by the ePO or that should be involved in its development. Moreover, it describes the possible use cases that the ePO aims to address. In section 4, relevant existing data models and code lists are identified and analysed. This section aims to assess the extent to which existing works could be reused in the ePO. Section 5 concludes on the work and identifies the next steps that have to be taken for the further development of the e-Procurement Ontology.

## Common working terminology

|  |  |
| --- | --- |
| Term | Definition |
| Public procurement | The process by which public authorities, such as government departments or local authorities, purchase work, goods or services from companies [1]. |
| e-Procurement | e-Procurement is the conduction of the procurement process by means enabled by the internet [2]. |
| Call for Tenders | Procedure of asking for bids to be submitted for the awarding of a contract [3]. |
| Pre-award phase | e-Procurement process phases occurring up-until the award of the contract (e-Notification, e-Access, e-Submission, e-Evaluation, e-Awarding) [4]. |
| Post-award phase | e-Procurement process phases occurring after the award of the contract (e-Ordering, e-Invoicing, e-Payment) [4]. |
| Data standard | A structural metadata specification that describes or defines other data [ISO111179]. Structural metadata indicates how compound objects are put together [NISO]. It can consist of among others data models, reference data, and identifier schemas [5]. |
| Data Model | A data model documents and organizes data, how it is stored and accessed, and the relationships among different types of data. The model may be abstract or concrete [6]. |
| Conceptual data model | The conceptual model enables to understand the meaning of the data model. Generally, the conceptual data model is the most important. The conceptual model does not specify how properties and associations are technically represented[[5]](#footnote-6). |
| Ontology[[6]](#footnote-7) | A formal naming and definition of the types, properties, and interrelationships of the entities that exist for a particular domain. In the context of this report, an ontology should be expressed in OWL as this is the format used by the Common Data Model of the CELLAR, in which the ePO will be implemented. |

# Process, Methodology and Technology

The ePO will be developed following the ISA process and methodology for developing semantic agreements [7], which is an open consensus building process which engages a working group of experts. The process outlines the roles that the different actors in this process play, as summarised in Table 1, and the process steps that need to be taken in order to set up the working group environment. Table 2 outlines the consensus building process itself, which will deliver in the end the ePO.

Table 1: Actors & roles

|  |
| --- |
| **Actors & Roles** *Reaching consensus* |
| **Working Group**  The Working Group for building consensus on the eProcurement ontology comprises the following actors:   * Chair(s): the Publications Office will appoint one or several, usually not more than two, chairs who are responsible for leading the meetings of the working group, for ensuring that the process and methodology specifications are followed and that consensus is reached within the working group. * Editor(s): one or several, usually not more than two, editors will be appointed, who are responsible for the operational work of defining and documenting the ePO. * Working group experts: besides the chairs and editors, the working group will mainly consist of experts who are contributing knowledge and expertise required for the specification of the ePO. Members of the following groups and communities will be invited to join the working group as experts:   + Members of the multi-stakeholder expert group on eProcurement[[7]](#footnote-8) of DG GROW;   + Staff working on eProcurement from national, regional and local administrations in the EU Member States;   + Staff working on eProcurement from the EU institutions, including representatives of CEF Telecom and the Open Data Portal;   + Members of the CEN TC 440[[8]](#footnote-9) (Technical Committee on Electronic Public Procurement) and the CEN TC 434[[9]](#footnote-10) (Technical Committee on Electronic Invoicing);   + Members of the Core Vocabularies working groups;   + Members of the OpenSpending network, publicspending.net, the Open Contracting Partnership and related initiatives;   + Research and academia working on related initiatives (refer to Chapter 4 for an overview of related activities).   **Review Group**  A Review Group should be invited to provide an independent external review on the first full draft of the ePO. This will be done as part of the public comment period. The members of the Review Group will come from the same groups and communities as the members of the Working Group. Ideally, a member of the Working Group should not also be part of the Review Group. |

Table 2: Process Overview

|  |
| --- |
| **Process** *Reaching consensus* |
| 1. Identify stakeholders *(The Publications Office and a contractor)* 2. Form working group *(The contractor in agreement with the Publications Office)* 3. Identify chair(s) *(The Publications Office with input from a contractor)* 4. Identify editor(s) *(The Publications Office).* 5. Identify review group *(Chair(s) and Editor(s))* 6. Verify and secure IPR[[10]](#footnote-11) (Intellectual property rights) *(The Publications Office and the contractor as necessary)* 7. Establish working environment and culture *(Chair(s) and Editor(s))* 8. Publish drafts *(Chair(s) and Editor(s))* 9. Review drafts *(Working Group experts)* 10. Publish last call working draft *(Chair(s) and Editor(s))* 11. Review last call working draft *(Review Group)* 12. Gather evidence of acceptance *(Chair(s) and Editor(s))* 13. Submit for endorsement *(The Publications Office)* |

Once steps 1 to 7 of the process listed above are conducted, the Working Group can start its operational activities. Steps 8 and 9 in the process above – creating and reviewing drafts – are repeated to iteratively create the ePO specification. The technical methodology, describing the steps that must be undertaken in the development of a specification, is described in Table 3 below. Especially steps 5 and 6 in the methodology below, i.e. the creation of a conceptual data model, might require several iterations and drafts before consensus in the Working Group is reached. For the Chairs, editors and Working group to have a starting point (for points 1-3 below) the contractor will present a project charter, a further developed analysis based on this report of the methodology to be used. This will include:

1. how to reach the formal OWL ontology,
2. produce the conceptual model and information requirements

from the suggested use cases via

1. the reuse of existing data and services
2. suggesting synergies with other working groups in the domain of open data and/or public procurement.

The working group will agree on the methodology to produce the deliverables, adding and removing use cases as necessary whilst adapting the methodology as it finds fit.

Table 3: Methodology overview

|  |
| --- |
| **Methodology**  *Developing a specification* |
| 1. Review analysis of existing solutions (based on Chapter 4 of this report and analysis mentioned in paragraph above) *(Editor(s) and Working Group)* 2. Review analysis of existing data and services *(Editor(s) and Working Group)* 3. Define and agree on use cases (based on Chapter 3 and analysis mentioned in paragraph above) *(Editor(s) and Working Group)* 4. *Define methodology to be used (see analysis mentioned*  in paragraph above) 5. Identify information requirements *(Editor(s) and Working Group)* 6. Identify a meaningful set of Core Concepts *(Editor(s) and Working Group)* 7. Define and agree on terminology and create a conceptual data model *(Editor(s) and Working Group)* 8. Define naming conventions *(Editor(s) and Working Group)* 9. Define identifier conventions *(Editor(s) and Working Group)* 10. Draft the namespace document *(Editor(s))* 11. Specify conformance criteria *(Chair(s) and Editor(s))* 12. Perform quality assurance *(Chair(s))* |

There will be a number of technologies and tools used to create and underpin the ePO, the main of which are listed in Table 4 Overview of technology to be used below:

Table 4 Overview of technology to be used

|  |
| --- |
| **Technology & Tools** *Creating a model* |
| **OWL DL**  The OWL language is built upon the RDF standard. It is an ontology modelling language for describing RDF data. It allows for the strict definition of concepts and the complex relationships between them[[11]](#footnote-12). The eProcurement Ontology should be expressed in OWL since the Common Data Model of the CELLAR[[12]](#footnote-13) – in which the ePO will be implemented – is expressed in OWL.  **SPARQL**  SPAQL is a semantic query language. It is used to retrieve and manipulate data stored in RDF format[[13]](#footnote-14).  **PROTÉGÉ**  Protégé is an open source ontology editor developed and maintained by Stanford University[[14]](#footnote-15). |

# Target Audience & Use Cases

## Target audience

The target audience of the ePO comprises the following groups of stakeholders:

* Contracting authorities and entities, i.e. buyers, such as public administrations in the EU Member States or EU institutions;
* Economic operators, i.e. suppliers of goods and services such as businesses, entrepreneurs and financial institutions;
* Academia and researchers;
* Media and journalists;
* Auditors and regulators;
* Members of parliaments at regional, national and EU level;
* Standardisation organisations;
* NGOs; and
* Citizens.

## Use cases

The ePO is designed to meet specific needs of the aforementioned stakeholders. These needs are described in the use cases below. The use cases are organised around the following categories:

1. Transparency and monitoring
2. Innovation & value added services
3. Interconnection of public procurement systems

|  |  |
| --- | --- |
| 1 | Transparency and monitoring |
| 1.1 | **Public understandability**  *In order to increase understandability of the public procurement process, the parties who are involved in procurement processes as well as citizens, journalists and regulators should be able to easily access procurement data in structured and machine-readable format. Many stakeholders aim at gaining a quick understanding of the provided information rather than performing in-depth analysis of the published documentation. Currently, two main challenges exists. First, data coming from different e-Procurement systems are often fragmented, hence reflecting the silos between the source systems. Second, the data is available in different formats and representations, which are not always consistent and interoperable, and are therefore hard to connect and interlink. By providing a common view over e-Procurement data, the ePO will allow providers of procurement data to link their data and make it available in ways which will be easier for the non-technical consumer to interpret and reuse, in order to create a complete view of the public procurement process*  ***Example*** A watchdog is interested to understand how a public administration purchases goods and services. Their main goals are to understand the procedure and gain visibility of all the procedure steps. Procurement procedures often consist of complicated documents and processes, which are scattered on different platforms and websites, and are not always understood by the wide public. As all procurement data is now represented and made available using the ePO, the watchdog can easily bring it together and combine it with data from different sources, thus providing them with the necessary context for understanding the available information.  **Information requirements:**  In this case it would be required:   * Of the ePO to model all documents that result from any phase of the procurement process;   Of the ePO to model all metadata about elements of the procurement process, such as participating entities. |
| 1.2 | **Data journalism**  *The ever increasing amount of digitised information leads to new ways of producing and disseminating knowledge in society. Data journalism helps journalists to:*   * *identify information;* * *understand complex information;* * *identify complex data deriving from different sources; and* * *create compelling stories (e.g. through data visualisation techniques) which can be easily communicated and understood by the wider public.*   *By providing a common way to describe e-Procurement resources and data, the ePO will enable data journalists to identify, extract integrate and analyse relevant information coming from different sources.*  ***Example:***  A journalist in France is writing an article about the total number and volume (in Euro) of tenders in the domain of transportation by looking at different data sources in the country, and also by comparing the French data with data from neighbouring countries, such as Belgium and Spain. As all data has been modelled using the ePO, it is easy for the journalist to identify all the data that is related to procurement procedures and the resulting invoices. The journalist is then able to integrate and analyse the data related to transportation, and produce data visualisations based on the organisation and location data of the tenders.  **Information requirements:**  In this case, it would be required   * For the ePO to model data about economic operators, such as businesses (names, locations, contact details etc.); * The ePO to model calls for tenders; * The ePO to model invoices, moreover, it requires core, not private or sensitive data about invoices to be available as open data; * Link the data of the ePO with procurement data of other countries’ procurement systems. |
| 1.3 | **Monitor the money flow**  *In order to obtain an exhaustive and unified view of the flow of public money, from tax collection and budget over to procurement until spending, e-Procurement data should be integrated with other datasets such as budget, spending and location data. A common ontology such as the ePO is necessary in order to interlink such datasets, and help with the creation of a unified view over the flow of public money.*  ***Example:***  A procurement watchdog is analysing the flow of public money during an interval of two years. Using the ePO as the common model for representing data, allows the watchdog to find their way through the different sources that have to be consulted, e.g. budget dataset, calls for tender and procurement notices, and to interlink the data in order to identify the trails. Examples of the data to be interlinked by the watchdog, in order to discover the flow of money could be:   * the value of the contract; * the name of the awarded tender; * the location of the awarded tender; and * the department of the public administration that awarded the tender.   **Information requirements:**  In this case it would be required:   * Of the ePO to model all procurement process data e.g. calls for tenders, notices etc.; * Of the ePO to model economic operator data e.g. name, location etc.; * Of the ePO to model contract data e.g. contract value; * Of the ePO to model exclusion criteria etc.; * Of the ePO to link to other datasets e.g. budget datasets, spending datasets, tax information datasets. |
| 1.4 | **Detect fraud and compliance with procurement criteria**  *For assuring efficiency and transparency, and for detecting fraud and corruption in public administrations, EU institutions and contracting authorities, rigorous audits of procurement take place. In order to improve and further automate the audit process, different data should be made available in structured, machine-readable formats so different data sources can be referenced and integrated. The creation of the ePO will be a first step towards achieving such integration.*  ***Example:***  While auditing the evidences submitted by the tenderer who was awarded the contract, the auditor noticed that the supplier did not comply with the location criteria that were agreed during the signing of the contract. The payment evidence adduced, proved that besides the initial agreement, the supplier leased services outside the European Union to reduce the cost of the works. Publishing e-Procurement data in a structured, linked and machine-readable format, allows the interconnection of data on transactions, criteria, contracts and evidences from different sources, e.g. including also BRIS and ECRIS, thus facilitating cross-checking and automated fraud detection.  **Information requirements:**  In this case it would be required:   * Of the ePO to model the evidences, the contract, the procurement criteria, including the location criteria; * To link the data from the ePO to data in other datasets, such as procurement systems of different countries or the BRIS or ECRIS. |
| 1.5 | **Audit procurement process**  *In order to monitor the correct use of funds it is necessary to cross-check data from different sources. In the case of public procurement, when the payment and invoice data is represented as linked data through the ePO, it is possible to link it with budget data. In this way one can check if the amounts resulting from the invoices do correspond to the initially budgeted amounts.*  ***Example:***  A governing body wants to make sure that no payment through public procurement on any specific category exceeds the decided upon amount. For this the government body can easily organise all the invoice data of all procurements by category, combine it with budget data and cross-check if the numbers add up correctly.  **Information requirements:**  In this case it would be required:   * Of the ePO to model payments, contract terms; * Link the data of the ePO with budget data. |
| 1.6 | **Cross-validate data from different parts of the procurement process**  Representing all phases of procurement in a linked data format can allow for better cross-validation of the data of any part of the process.  **Example:**  After a contract has been awarded to a specific tenderer a watchdog wants to check if the criteria for the awarding of the contract are surely met. By having all parts of the process linked, the watchdog can by identifying the specific contract immediately identify the tenderer and the criteria of the contract. Through linking this data with data about the tenderer from other sources, such as his financial data, he can double check if the tenderer does actually fulfil the requirements.  **Information requirements:**  In this example it would be required:   * Of the ePO to model the contract awarded, the criteria of the contract, the details of the supplier; * Link the data of the ePO to data in other databases such as databases containing financial data about businesses. |

|  |  |
| --- | --- |
| ID | 2. Innovation & value added services |
| 2.1 | **Automated matchmaking of procured services and products with businesses**  *The initial stages of the e-Procurement process (e.g. e-Notification and e-Tendering) aim at matching the products and services of economic operators to the needs of contracting authorities. In order to automate matchmaking, i.e. automatically identifying matches between offered services and demanded needs, e-Procurement data should be made available in a structured, machine-readable format. The ePO is crucial for achieving this goal.*  ***Example*** An economic operator requires more information in order to find and decide on a trade partner. The economic operator is able to identify the ideal candidates by displaying the names of winners in different products or services against the value/cost of said products or services. Representing e-Procurement data following an ontology and making it available in a machine-readable format facilitates the automated mapping between the provided data about the economic operators and that about the economic activities.  **Information requirements:**  In this case it would be required:   * *Of the ePO to model economic operator’s details such as names, locations, contact details etc.;* * *Of the ePO to model procurement criteria;* * *To link the data of the ePO to data of other sources including material costs, labour costs etc.* |
| 2.2 | **Automated validation of procurement criteria**  *Economic operators that submit a tender are required to fulfil several criteria. In order for a contracting authority to automatically validate whether the criteria are met by an economic operator, data, both from the contracting authority’s side as well as from the economic operator’s side, should be cross-checked. In order to automate this process, both the data and the evaluation criteria should be made available in machine-readable formats.*  ***Example*** An economic operator submits a tender to DG Informatics of the European Commission. The offer is written based on the criteria defined by the contracting authority in the tender specifications. Through the semi-automated validation of the tender, the economic operator is notified whether the tender meets the procurements in terms of evidences required that check against financial and other exclusion criteria. Otherwise the tenderer is provided with a list of evidences that are further required to fulfil said criteria, and only after their submission does the process move on to the manual evaluation of technical requirements. Such preliminary automation allows for gains in speed and efficiency.  **Information requirements:**  In this example it would be required:   * Of the ePO to model tenders, notices, offers by tenderers, procurement criteria, evidences; * Of the ePO to model the relationship between offers and procurement criteria. |
| 2.3 | **Alerting services**  *Contracting authorities announce and publish the calls for tender to economic operators, citizens and third parties. Through the use of alerting services, economic operators are informed about published call for tenders that match their profile. In order to automate alerting services, e-Procurement data such as tenders and information about economic operators should be machine processable, so they can be integrated, matched, and the right data should be delivered to the right person (depending on their subscription to the alerting services).*  ***Example*** A Spanish public administration procures stationery and textbooks for the forthcoming year. The public administration publishes the call for tenders on an online platform. Since the call for tenders is published in a machine-readable format, following the structure of the ePO, third-party applications can process the call for tender and send alerts to interested parties who are subscribed in their client bases. Usually, such third party applications offer their clients the ability to define criteria for which they want to be automatically alerted.  **Information requirements:**  *In this example it would be required:*   * *Of the ePO to model the calls for tenders and the details within it.* |
| 2.4 | **Data analytics on public procurement data**  Although data is available in vast amounts, businesses and public administrations often fail to efficiently manage these data and extract useful and qualitative information from them. In the field of e-Procurement, applying data analytics could be advantageous for economic operators, contacting authorities and external parties such as journalists and watchdogs. Applying data analysis techniques to e-Procurement data allows stakeholders not only to better understand public procurement, but also to take better informed, evidence-based decisions. In order to fully exploit the potential data analytics in e-Procurement, data should be published in as machine-readable formats – in which the ePO plays a major role – and preferably linked open data. Linked Data allows for flexible data integration over the Web; this helps to increase data quality and fosters the development of new services.  **Example** The European Commission aims to leverage its decision making capability during a call for tenders in telecommunications by analysing all the data available about the potential suppliers and forecast a fair market price. The European Commission aims at securing that the contract will be awarded to the supplier that provides the best services at the best price. In order for the European Commission to conduct its analysis, e-Procurement data should be integrated with a large amount of data coming from different sources, such as data about fees and pricing, qualifications, technical specifications and cost of materials.  **Information requirements:**  In this example it would be required:   * Of the ePo to model economic operators and procurement criteria; * Link the data of the ePO with data from other sources providing data on fees, pricing, cost of materials etc. |

|  |  |
| --- | --- |
| ID | 3. Interconnection of public procurement systems |
| 3.1 | **Increase cross-domain interoperability among Member States**  *The European Union aims at providing a competitive economic environment for economic operators from different Member States. In order to achieve such a competitive environment, economic operators, public administrations, researchers and academia should be able to access and exchange procurement information coming from different sources around Europe, allowing them to participate in calls for tenders from procurers from different Member States. Similarly, contracting authorities should be able to access information about economic operators, which are based in different Member States, and submit tenders for procured services. Making e-Procurement data available in common well-structured and machine-readable formats enhances cross-domain and trans-European competiveness by allowing economic operators from any Member State to participate in public procurement in any other Member State.*  ***Example*** The VAT authority of a Member state wants to monitor the activity of a certain economic operator. By having all procurement data in all Member States published in a common and machine readable format, that data can be integrated into the systems of the VAT authority. This way it can instantly gain access to all data about any business conducted for public administrations by that economic operator in any other Member State.  **Information requirements:**  In this case it would be required:   * Of the ePO to model the whole procurement process and the details of each phase; * Of the ePO to use unique identifiers for the economic operators and contracting authorities and to use common reference data wherever required, such as NALs, NACE codes, CPV, common codes for products etc.; * Link the data of the ePO to a dataset containing information about economic operators.   In this example the VAT authority will simply have to gain access to the systems hosting procurement data of each Member State and it will instantly acquire all needed data. |
| 3.2 | **Introduce automated classification systems in public procurement systems**  *During the procurement procedure, especially upon the receipt of offers, procurers receive many documents from different sources. Improved and automated classification of these documents would facilitate and make more efficient their processing and archiving. The ePO will set the grounds for common ways and rules for classifying such documents.*  ***Example***  A contracting authority procuring agricultural products is receiving different types of documents and evidences from potential suppliers via its electronic submission platform. When uploading documents, suppliers are asked to complete core metadata coming from the ePO. For example, implementing the ePO facilitates the provision of the specifications of their products, the financial state and the contact details of the suppliers in a commonly agreed and structured way. The platform of the procurer can then automatically classify all received documentation, using machine learning techniques, based on different dimensions including, among others, the following:   * The price of the tender; * The category of the tenderer’s business; and * The extent to which the tenderer complies with specific criteria.   **Information requirements:**  In this case it would be required:   * Of the ePO to model all documents and evidences regarding tender offers; * Of the ePO to model procurement criteria; * Of the ePO to model details about the economic operators; * Of the ePO to model product categories. |

Table 5 Relevant actors for each use casebelow summarises the relationships between the identified actors and the uses cases.

Table 5 Relevant actors for each use case

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Actors  Use  case | Contracting authorities | Economic operators | Academia | Media-journalists | Auditors- regulators | Parliament | Standardisation organisations | NGOs | Citizens |
| **1.1**: Increase transparency and public understandability | X | X | X | X | X | X | X | X | X |
| **1.2**: Data journalism | X | X | X | X | X | X |  | X | X |
| **1.3**: Monitor the money flow | X | X | X | X | X | X |  | X | X |
| **1.4**: Detect fraud and compliance with procurement criteria | X | X |  | X | X | X |  | X |  |
| **1.5:** Audit procurement process | X | X |  | X | X | X |  | X |  |
| **1.6:** Cross-validate data from different parts of the procurement process | X | X |  | X | X | X |  | X |  |
| **2.1**: Automated matchmaking of procured services, products and businesses | X | X |  |  |  |  |  |  |  |
| **2.2**: Automated validation of procurement criteria | X | X |  |  |  |  |  |  |  |
| **2.3**: Alerting services | X | X | X | X | X | X | X | X | X |
| **2.4**: Data analytics on public procurement data | X | X | X | X | X | X |  | X | X |
| **3.1**: Increase cross-domain interoperability among Member States | X | X | X | X | X | X | X | X |  |
| **3.2**: Introduce automated classification systems in public procurement systems | X | X |  |  |  |  |  |  |  |

# Related Ontologies/Vocabularies and Projects

## Data models and ontologies

### CEN WS/BII business term vocabulary and semantic models

The CEN Workshop on business interoperability interfaces for public procurement in Europe (CEN WS/BII), established in March 2007, had the objective to provide a basic framework for technical interoperability in pan-European electronic transactions and it has delivered a complete set of profiles covering both the pre-award and the post-award phases of the public procurement. The existence of these profiles and their associated semantic data models has been key to allow disparate solutions to interoperate.

These profiles describe aspects throughout the whole procurement process such as the notifications, the call for tenders, the awarding and the contracting.

These profiles have been implemented in several projects in Europe: the European Commission has used them to build e-Prior[[15]](#footnote-16), their open source solution for electronic invoicing, ordering and now covering the pre-award phases; the PEPPOL[[16]](#footnote-17) community has used them to create their own BIS specifications, resulting in a national-wide deployment of electronic invoicing in countries such as Norway, Denmark or Sweden, and other public administrations in Europe are currently basing their IT infrastructure and electronic procurement policies on deploying these standards such as the National Health Service of England.

These profiles have been updated in 2015 and examples of such profiles are listed below in Table 6 Examples of CEN BII Profiles.

Table 6 Examples of CEN BII Profiles

|  |  |  |  |
| --- | --- | --- | --- |
| CWA[[17]](#footnote-18) | BII Profile | Transaction Information | UBL Syntax Binding |
| CWA3456-119 | BII54 Tendering | Submit Tender | CWA3456-218 |
| Tender Receipt Notification | CWA3456-205 |
| CWA3456-112 | BII47 Call for Tenders | Call for Tenders | CWA3456-212 |
| CWA5678-104 | BII06 Procurement | Order | CWA5678-301 |
| Invoice | CWA5678-305 |
| CWA2345-101 | BII10 Contract Notice | Contract Notice | CWA2345-201 |

These semantic models and their mappings to XML document exchange syntaxes, such as UBL and UN/CEFACT, should now be converted into knowledge to go one step further, promoting a whole set of new functionalities such as searching for opportunities to the sellers, comparing offers for the buyers, getting statistical data or improving the control and transparency in the electronic procurement procedures in the European Union.

In 2015, CEN established a new technical committee (TC) which aims at developing standards to support and facilitate the electronic exchange of information in public procurement [8]: CEN/TC 440. The technical committee will develop semantic data models, based on CEN/BII. TC/440 will closely collaborate with CEN/TC 434, a technical committee for the development of standards supporting European Electronic Invoicing [9]. The work of CEN/TC 440 and TC 434 is closely related to the development of the ePO. Therefore synergies between CEN TC/440, TC 434 and the ePO should be developed as far as possible.

### Open Contracting Data Standard

The Open Contracting Data Standard (OCDS)[[18]](#footnote-19) was developed for the Open Contracting Partnership (OCP) by the World Wide Web Foundation[[19]](#footnote-20). The OCDS enables disclosure of data and documents at all stages of the contracting process by defining a common data model. It was created to support organizations to increase contracting transparency, and allow deeper analysis of contracting data by a wide range of users [10].

The Open Contracting Data Standard is maintained using JSON Schema. Table 7displays the main sections and common objects used in the schema.

Table 7 Main sections and objects in OCDS [11]

|  |  |  |
| --- | --- | --- |
| Section | Object | Description |
| **Planning:**  Information from the planning phase of the contracting process. | Budget | The budget object has the following sub-elements:  Source, id, description, amount, project, project ID and URI.[[20]](#footnote-21) |
| Rationale | The rationale for the procurement provided in free text |
| Documents | A list of documents related to the planning process |
| **Tender:**  The activities undertaken in order to enter into a contract. | ID | An identifier for this tender process |
|  | Title | Tender title |
| Description | Tender description |
| Status | Current status on of the tender (value from codelist) |
| items | The goods and services to be purchased, broken into line items wherever possible. |
| minValue | The minimum estimated value of the procurement |
| Value | The total upper estimated value of the procurement |
| procurementMethod | Specify tendering method (value from codelist) |
| ProcurementMethodRationale | Rationale of procurement method |
| awardCriteria | Specifies the award criteria for the procurement (values from codelist) |
| awardCriteriaDetails | Any detailed or further information on the award or selection criteria |
| submissionMethod | Specify the method by which bids must be submitted (value from codelist) |
| submissionMethodDetails | Any detailed or further information on the submission method |
| tenderPeriod | The period when the tender is open for submissions |
| enquiryPeriod | The period during which enquiries may be made and answered |
| hasEnquiries | A Yes/No field to indicate whether enquiries were part of tender process |
| eligibilityCriteria | A description of any eligibility criteria for potential suppliers |
| awardPeriod | The date or period on which an award is anticipated to be made |
| numberOfTenderers | The amount (integer) of tenderers |
| tenderers | All entities who submit a tender |
| procuringEntity | The entity managing the procurement, which may be different from the buyer who is paying/using the items being procured. |
| Documents | All documents and attachments related to the tender, including any notices |
| Amendment | Amendment information |
| Milestones | A list of milestones associated with the tender |
| **Buyer:**  The buyer is the entity whose budget will be used to purchase the goods | Identifier | Unique identifier of the buyer[[21]](#footnote-22) |
| additionalIdentifiers | Alternative identifiers of the buyer |
| Name | Name of the buyer |
| Address | Address of the buyer |
| contactPoint | Contact point within the buyer entity, such as an E-mail address or a person |
| **Awards:**  An award for the given procurement. There may be more than one award per contracting process | Id | The unique identifier for this award |
| Title | Award title |
| Description | Award description |
| Status | The current status of the award (value from codelist) |
| Date | The date on which a decision to award was taken |
| Value | The total value of this award |
| Suppliers | The suppliers awarded this award |
| Items | The goods and services awarded in this award, broken into line items where possible |
| contractPeriod | The period for which the contract has been awarded |
| Documents | All documents related to the award |
| amendment | Amendment Information |
| **Contracts:**  Information regarding the signed contract between the buyer and supplier(s) | Id | The unique identifier for this contract |
| awardID | The award ID against which this contract is being issued |
| Title | Contract title |
| Description | Contract description |
| Status | Current status of the contract (value from codelist) |
| Period | The start and end date of the contract |
| Value | The total value of the contract |
| Items | The goods, services, and any intangible outcomes in this contract |
| dateSigned | The date the contract was signed |
| Documents | All documents and attachments related to the contract |
| Implementation | Information related to the implementation of the contract in accordance with the obligations laid out therein. |
| Amendment | Amendment information |
| **Language:**  Specifies the default language of the data |  |  |

The Open Contracting Data Standard cannot be directly reused in the ePO, because it is not an RDF vocabulary. It can however be used as an insight to all things to be considered during the modelling process as it is neatly structured and quite extensive. How it has developed its buyer URI could be further looked into in a more in-depth analysis

### Universal Business Language

The Universal Business Language (UBL)[[22]](#footnote-23) has been designated by the European Commission as one of the first consortium standards officially eligible for referencing in tenders from Public Administrations and is freely available to everyone without legal encumbrance or licensing fees.

The UBL is the result of an international effort to define a royalty-free library of standard electronic XML business documents, such as purchase orders and invoices.

It is designed to plug into existing legal, business, auditing and records management practices, eliminating the re-keying of data in existing fax and paper-based supply chains and being an entry point into e-commerce for SMEs [12]. It is also used by nations around the world for implementing cross-border transactions related to sourcing (e.g. tendering), procurement (e.g. electronic invoicing), replenishment (e.g. managed inventory) and transportation (e.g. waybills and status).

The standard is the foundation for several European Public Procurement frameworks, including EHF (Norway)[[23]](#footnote-24), Svefaktura (Sweden)[[24]](#footnote-25), OIOUBL (Denmark)[[25]](#footnote-26), e-Prior (European Commission DIGIT)[[26]](#footnote-27), and PEPPOL[[27]](#footnote-28) [13].

The Universal Business Language provides a list of business objects expressed as reusable data components (e.g. address and payment) and common business documents (e.g. order and invoice), schemas for reusable data components and schemas for reusable business documents. Business objects from UBL that relate to the procurement field, include *Invitation for Tender, Submission of Qualification Information* and *Awarding of Tenders*. UBL Document Schemas related to e-Procurement include, for example, *Call for Tenders*. An example of these objects and how the relate, is described below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Example***  **Business Object**  *Invitation to Tender*  Figure 1: UBL "Invitation to Tender" process  [Invitation to Tender Diagram]  In this Business Object, i.e. the *Invitation to Tender* process, the Document Schema *Call for Tenders* is used. The *Call for Tenders* Document Schema is described as follows:  **Document Schema**  *Call for Tenders*  Description: A document used by a Contracting Party to define a procurement project to buy goods, services, or works during a specified period.  Table 8: UBL "Call for Tenders" Document Schema   |  |  | | --- | --- | | Processes involved | [Tendering](http://docs.oasis-open.org/ubl/os-UBL-2.1/UBL-2.1.html#S-TENDERING) | | Submitter role | Contracting Authority | | Receiver role | Tenderer | | Normative schema | [xsd/maindoc/UBL-CallForTenders-2.1.xsd](http://docs.oasis-open.org/ubl/os-UBL-2.1/xsd/maindoc/UBL-CallForTenders-2.1.xsd) | | Runtime schema | [xsdrt/maindoc/UBL-CallForTenders-2.1.xsd](http://docs.oasis-open.org/ubl/os-UBL-2.1/xsdrt/maindoc/UBL-CallForTenders-2.1.xsd) | | RELAX NG schema | [rnc/versions/UBL-CallForTenders-2.1.rnc](http://docs.oasis-open.org/ubl/os-UBL-2.1/rnc/versions/UBL-CallForTenders-2.1.rnc) | | Document model (ODF) | [mod/maindoc/UBL-CallForTenders-2.1.ods](http://docs.oasis-open.org/ubl/os-UBL-2.1/mod/maindoc/UBL-CallForTenders-2.1.ods) | | Document model (Excel) | [mod/maindoc/UBL-CallForTenders-2.1.xls](http://docs.oasis-open.org/ubl/os-UBL-2.1/mod/maindoc/UBL-CallForTenders-2.1.xls) | | Document model (UML) | [uml/UBL-CallForTenders-2.1.html](http://docs.oasis-open.org/ubl/os-UBL-2.1/uml/UBL-CallForTenders-2.1.html) | | Summary report | [mod/summary/reports/UBL-CallForTenders-2.1.html](http://docs.oasis-open.org/ubl/os-UBL-2.1/mod/summary/reports/UBL-CallForTenders-2.1.html) | |

Since the UBL is the basis for many e-Procurement systems, as described above, it is considered to be a well-established standard. Therefore, it cannot be neglected when developing the ePO. Especially the UBL concepts related to procurement, such as *invitation for tenders, call for tenders,* etc.should be carefully looked into.

### The European Single Procurement Document

In January 2016, the European Commission adopted the European Single Procurement Document (ESPD)[[28]](#footnote-29), a document that aims to considerably reduce the administrative burden for companies, in particular SMEs who want to have a fair chance at winning a public contract.

To achieve this the ESPD maps out and replaces equivalent certificates issued by local public authorities or third parties involved in the procurement process, which can differ drastically between Member States.

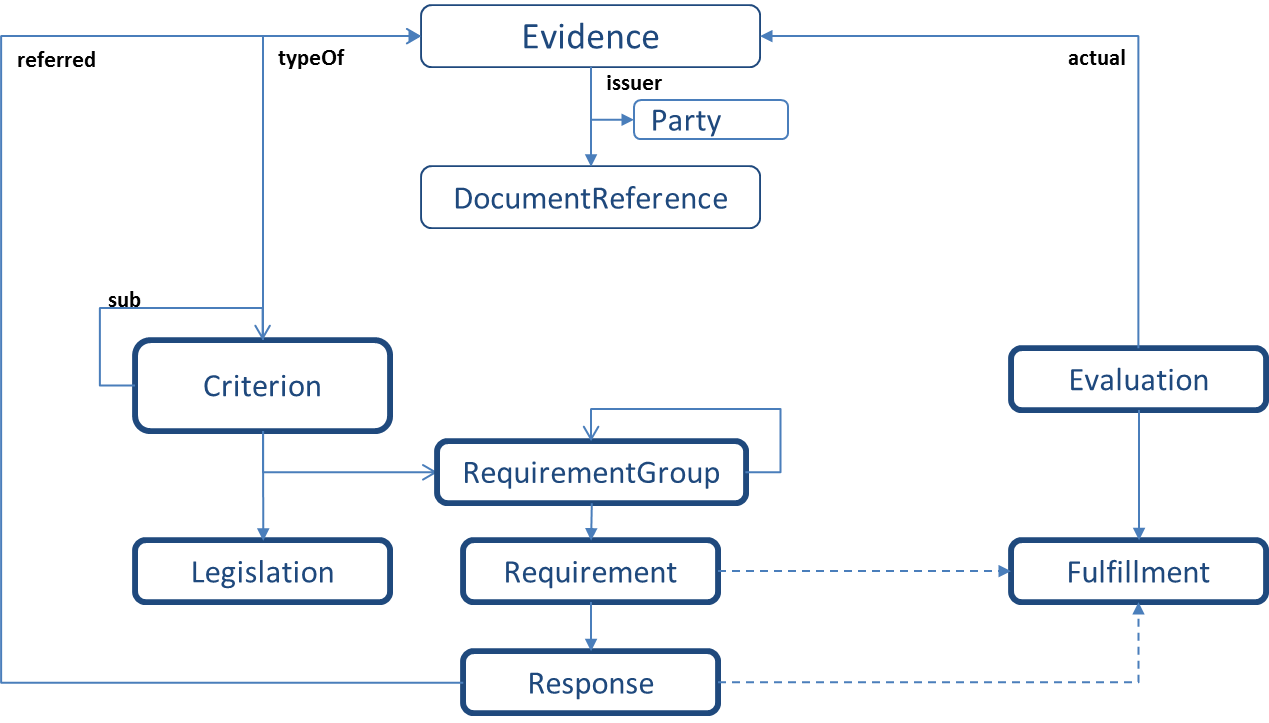
While some countries have already introduced some form of “self-declaration” of suitability, others require all interested parties to provide full documentary evidence of their suitability, financial status and abilities. The ESPD will allow businesses to electronically self-declare that they meet the necessary regulatory criteria or commercial capability requirements, and only the winning company will need to submit all the documentation proving that it qualifies for the contract [14].

In order to make full use of the ESPD concept, the European Commission will establish a service available for both suppliers and buyers, developing and providing the ESPD service free of charge to Member States and European Institutions. It will be provided as open source, so it can be implemented by service providers for their own use and to provide added value to buyers and suppliers [15].

With regard to technical requirements, the transmission will be done through e-Tendering solutions. As the service correlates with e-Certis[[29]](#footnote-30), business registers and e-Tendering solutions great care will be given that the semantic data model is harmonized. Development will be linked to e-SENS, the standardisation initiatives of by CEN, ISA Core Business Vocabulary and solution providers.

In conclusion, the main objective of the ESPD is to reduce the administrative burden for buyers and suppliers to participate in public procurement procedures. The ESPD service will reduce that burden by removing the need to produce a substantial number of certificates and documentation related to exclusion and selection criteria.

Figure 2: ESPD Data Model [16]



The ESPD is definitely worth a careful look. As it is an initiative that maps all the certificates and evidences needed for procurement in the different Member States, it does the ePO a great service, because this is something that will be necessary during the creation of the ePO.

### CEN Core Invoice

The Directive 2014/55/EU[[30]](#footnote-31) on electronic invoicing in public procurement states that Member States should ensure that contracting authorities and contracting entities receive and process invoices electronically.

The European Commission requested CEN, the European Committee for Standardisation[[31]](#footnote-32), to develop a standard semantic data model, including business terms and rules, representing the core content of an e-invoice. The development in CEN is based on the CENBII Core Invoice data model[[32]](#footnote-33) and it also takes other international standards into account [17]. Member States shall adopt, publish and apply the laws, regulations and administrative provisions necessary to comply with this Directive at the latest by 27 November 2018.

Table 9 below contains examples of elements described in the Cen Core Invoice data model.

Table 9 Example elements described in the Core Invoice data model

|  |  |
| --- | --- |
| Element Name | Rationale and use |
| Seller Name | A Core Invoice must contain the name of the seller. |
| Seller address line1 | A Core Invoice must contain the seller’s street name and number or P.O.box. |
| Delivery date | A Core Invoice may contain the actual delivery date on which goods or consignments are delivered from the seller. Also applicable for service completion date. |
| Paid amounts | A Core Invoice may contain the sum of all prepaid amounts that must be deducted from the payment of this invoice. For fully paid invoices (cash or  card) this amount equals the invoice total. |

The CEN Core Invoice model could be invaluable to the ePO as a source of complete and accurate invoice data.

### e-Certis data model

e-Certis[[33]](#footnote-34) is a free, online source of information to help companies and contracting authorities cope with the different forms of documentary evidence required for cross-border tenders for public contracts. e-Certis presents the different certificates frequently requested in procurement procedures across the EU [18]. In particular, e-Certis can help companies to find out which certificates issued in their country they need to include in tender files submitted to an authority in any partner country, or contracting authorities to establish which documents issued by a partner country to confirm the eligibility of a tender are equivalent to the certificates they themselves require.

e-Certis is a reference tool and not a service of legal advice. The information contained in the database is provided by the national authorities and updated on a regular basis [19].

e-Certis describes the documents using the following metadata:

* Document type set, e.g. “Certificate required to participate in public procurements”;
* Document type, e.g. “Proof of tender’s identity”, “Invoices from the service provider”;
* Country; and
* Available language.

e-Certis has a high reusability potential for our project, for it could be a valuable reference when creating the classes and properties describing the certificates that are needed in the procurement process.

### ISA Core Vocabularies

The ISA Core Vocabularies[[34]](#footnote-35) were created in collaboration by international working groups facilitated by the Interoperability Solutions for European Public Administrations (ISA) Programme of the European Union[[35]](#footnote-36). Their aim is to facilitate the exchange of information in the context of European Public Services and address interoperability problems such as the lack of commonly agreed data models and universal reference data.

Core Vocabularies are simplified, re-usable and extensible data models that capture the fundamental characteristics of an entity in a context-neutral fashion. Public administrations can use and extend the Core Vocabularies in the following contexts [20]:

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

The currently available vocabularies are the following:

* Core Person vocabulary: captures the fundamental characteristics of a person, e.g. the name, the gender, the date of birth, the location.
* Core Public Service vocabulary: captures the fundamental characteristics of a service offered by public administration.
* Core Business vocabulary: 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 Public Organization vocabulary: captures the fundamental characteristics of public organizations in the European Union.
* Core Location vocabulary: captures the fundamental characteristics of a location, represented as an address, a geographic name or a geometry.
* Core Criterion & Core Evidence vocabulary: describes the principles and means that a private entity must fulfil in order to be qualified to perform public services.

Of the above vocabularies, the Core Criterion & Core Evidence, Core Business,Core Public Organization and Core Person vocabularies can be especially useful for the eProcurement ontology, as they describe fundamental parties and elements of public procurement contracts. Also The Core Location vocabulary can provide a solution for describing any location data needed.

Table 10 Example Classes form the ISA Core vocabularies

|  |  |  |
| --- | --- | --- |
| Vocabulary | Class | Description |
| Core Criterion & Core Evidence | Criterion | A rule or principle that is used to judge, evaluate or test something. |
| Core Criterion & Core Evidence | Evidence | The Evidence class contains information that proves that a criterion requirement exists or is true, in particular an evidence is used to prove that a specific criterion is met. |
| Core Public Organization | Public Organization | The Public Organization class represents the organization. One organization may comprise several sub-organizations and any organization may have one or more organizational units. |
| Core Business | Legal Entity | Represents a business that is legally registered. |
| Core Business | Identifier | The Identifier class represents any identifier issued by any authority, whether a government agency or not. |

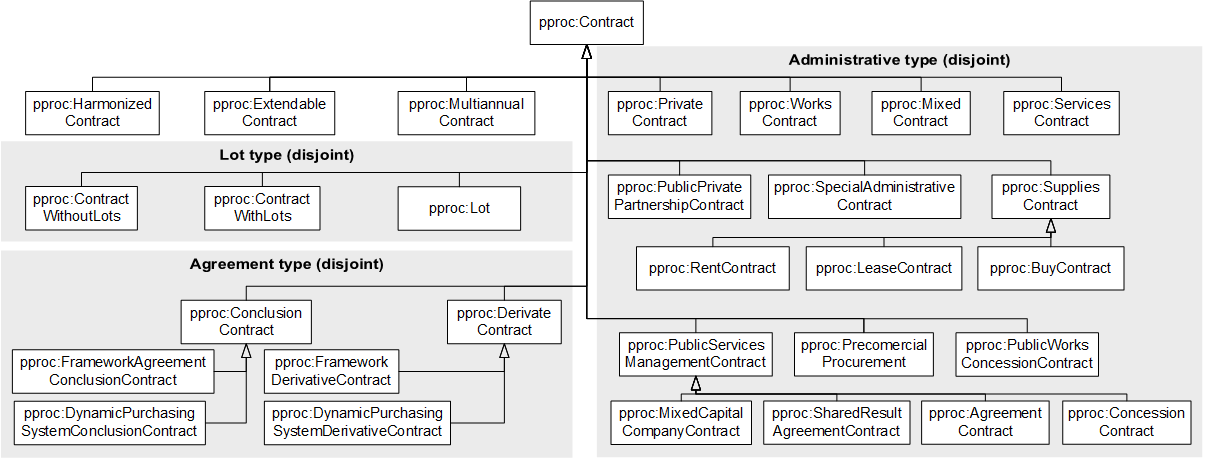
### The Public Procurement Ontology

The PPROC ontology[[36]](#footnote-37) has been developed under the *Public procurement optimization through semantic technologies* project (CONTSEM)[[37]](#footnote-38). This project is jointly undertaken by iASoft, the University of Zaragoza, ARAID (Government Agency of Aragon), the Government of Aragón, the Provincial Council of Huesca, and the town halls of Huesca and Zaragoza. The main purpose of the project is to add semantic technologies to the software used by public authorities in the procurement procedures in order to publish data about public contracts. More specifically, one of the core objectives is to describe semantically the information published in official procurement bulletins[[38]](#footnote-39) [21].

For this purpose CONTSEM participants have developed the PPROC ontology in accordance with Spanish laws and European laws in general.

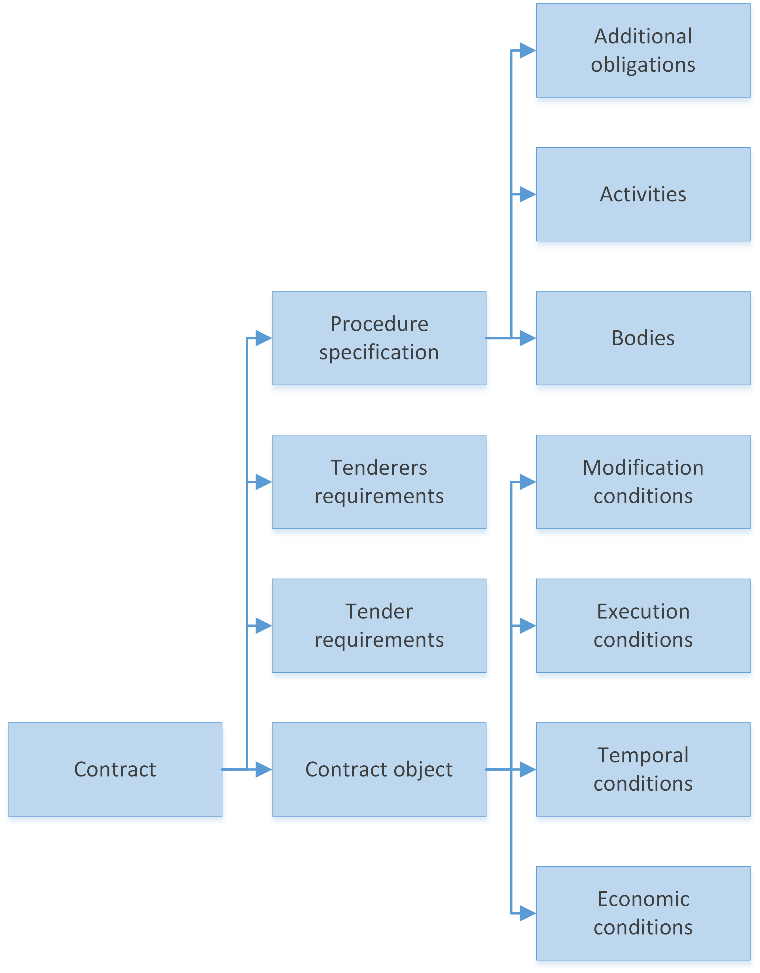
The PPROC ontology defines the necessary concepts needed to describe the public procurement process and its contracts by effectively extending the Public Contracts Ontology[[39]](#footnote-40). The main Class of the PPROC ontology is the pproc:Contract class, as the contract is considered to be the core concept of every procurement, as represented in Figure 3.

**Figure 3: Contract Class and subclasses** [21]



The other core Classes of the ontology which describe different aspects of procurement are the following represented in Figure 4: core classes of PPROC [21].

Figure 4: core classes of PPROC [21]



To describe all other concepts relevant to procurement contracts, the ontology reuses various ontologies and schemes. For example, the following solutions are reused: the Organization Ontology, the Schema.org scheme, the Simple Knowledge Organization System (SKOS) ontology, the Good Relations Ontology and the Dublin Core Metadata terms scheme.

The PPROC ontology is definitely worth looking into as a possibility for reuse in the ePO as it is extensive in its coverage, compatible with European procurement processes, well documented, and already extensively reuses existing established vocabularies.

### LOTED2

LOTED[[40]](#footnote-41) (Linked Open Tenders Electronic Daily) is an ontology for the representation of European public procurement notices developed by the Knowledge Media Institute[[41]](#footnote-42) of the Open University.

It was created following the initiatives around the creation of linked data-compliant representations of information regarding tender notices in Europe, with the aim to address a specific problem plaguing previous efforts.

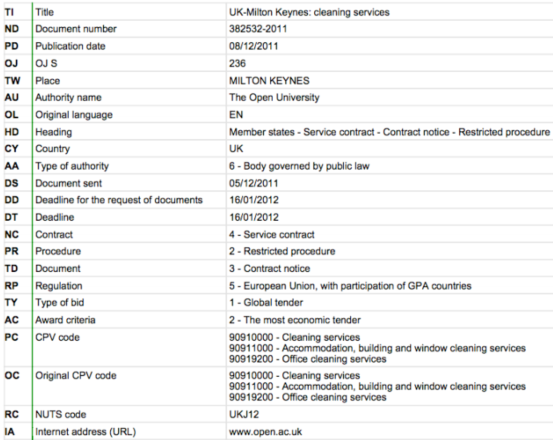
Until now projects developing legal ontologies have attempted to represent the legal concepts and the case-based reasoning behind them in linked data simply by mapping them in OWL. However due to the high level of detail and the nuances of legal reasoning, this approach resulted in extremely complex vocabularies. This is unwanted in semantic applications because in order for intelligence to arise from linking heterogeneous data, the datasets in question must be flexible enough to integrate effectively.

The LOTED2 model seeks to find a balance between accurately representing the complex legal concepts and the reasoning behind them while retaining the usability required for semantic applications. [22]

Specifically LOTED2 has been designed for the following purposes:

* to express the main legal concepts of the domain of public contracts notices as defined in legal sources (e.g. European Directives on public contracts);
* to support rich semantic annotation, indexing, search and retrieval of tenders documents, such as contract notices;
* to enable the integration with other ontologies and vocabularies about related domains; and
* to make possible the reuse of semi structured data extracted from the TED system, as shown in Figure 5 Semi-Structured data extracted from TED.

Figure 5 Semi-Structured data extracted from TED



LOTED2 is organized into the following 10 independent and reusable core modules which collectively represent 180 Classes:

* **Loted2-core** module: acts as the framework for the other modules;
* **Procurements Subjective Scope** module: describes the classes of legal persons who are empowered to issue a tender notice (e.g. contracting authorities, contracting entities);
* **Tender Documents** module: this module provides a full description of tender documents (e.g. The majority of tender documents available on the TED system are described following this structure);
* **Procurement Regulation** module: this module describes the legislative sources regulating public procurement domain;
* **Procurement Competitive Process** module: this module describes the competitive process of the procurement (e.g. type of competition, qualification process, award procedure);
* **Subjective Legal Situations** module: this module describes the roles played by agents in the procurement process (e.g. role of the tenderer, role of the awarding legal entity);
* **Proposed Contract** module: this module describes the details of the contract to be awarded;
* **Tender Bid** module: this module describes the tender bid;
* **Business Entity** module: this module describes the entities to whom the invitation to submit an offer for a proposed public contract is addressed; and
* **Top** module: this module contains abstract classes used to integrate LOTED2 with other core legal ontologies.

In the case of ePO, the LOTED2 vocabulary could be useful as a means of enriching the data represented by the ePO with more legal context. Also helpful is the fact that it is already designed with compatibility with TED data in mind.

### The Linked Open Economy ontology

The Linked Open Economy (LOE) ontology is developed for the purposes of the EU funded project YourDataStories.eu. It was created to address the problem of the poor quality of open economic data that is constantly becoming available, as more governments around the world open their data to the public.

The Linked Open Economy ontology is a top-level, generic conceptualization that aims to enrich and interlink the publicly available economic open data by modelling the flows incorporated in public procurement along with the market process to address complex policy issues.

The Linked Open Economy approach is a simple scalable model designed to describe data ranging from public procurement, budgets and spending to market prices. As such it can be easily tailored to a multitude of individual project needs. It also extensively uses existing vocabularies to make integration of heterogeneous data easier.

Table 11 in annex 7.1 summarizes Classes of the LOE ontology as used in the YourDataStories project[[42]](#footnote-43).

The Linked Open Economy model is an interesting case to look into for reuse as it is quite generic and depending on the possibility to tailor it to the needs of the ePO it could prove useful.

### Payments ontology

The Payments ontology[[43]](#footnote-44) was created in 2010 by the Local eGovernment Standards Body and the Local Government Group as a part of the UK government’s transparency drive, which requested all UK local authorities to publish detailed information on their spending.

The Payments ontology is a general purpose vocabulary for publishing organizational spending data. It is built on the Data Cube vocabulary[[44]](#footnote-45) as it aims to represent payment data, which is usually described as a multi-dimensional table.

The main concept of the ontology is that of a Payment, which is associated with a Payer, a Payee and a Date. The ontology then provides a number of optional properties to further describe the payment, such as the specific government department responsible or related expenditure line and also to structure the data Cube according to needs.

The following is an example of a payment:Payment instance:

<http://www.elmbridge.gov.uk/id/payment/HL00022825>

a payment:Payment ;

rdfs:label "Invoice HL00022825"@en ;

payment:reference "HL00022825" ;

payment:payer <http://www.elmbridge.gov.uk/id/elmbridge> ;

payment:payee <http://www.elmbridge.gov.uk/id/payee/a-j-oakes-partners> ;

payment:date <http://reference.data.gov.uk/id/day/2009-01-04> ;

payment:expenditureLine <http://www.elmbridge.gov.uk/public/finance\_line\_level\_data\_01042009-31032010/expenditure0> ;

payment:unit <http://www.elmbridge.gov.uk/id/department/leisure-and-cultural-services>.

<http://www.elmbridge.gov.uk/public/finance\_line\_level\_data\_01042009-31032010/expenditure0>

a payment:ExpenditureLine ;

rdfs:label "Expenditure Line 0"@en ;

qb:dataSet <http://www.elmbridge.gov.uk/public/finance\_line\_level\_data\_01042009-31032010> ;

payment:payment <http://www.elmbridge.gov.uk/id/invoice/HL00022825> ;

payment:netAmount 4000.0 .

The Payments Ontology can be considered for reuse in the post award stage of the procurement process to model the spending. Its suitability should be discussed however, as it is based on the Data Cube vocabulary, which although suitable for specific kinds of analysis, may prove less than ideal for integration with the rest of the data, probably modelled in a different format.

### Paraguayan procurement ontology

The DNCP[[45]](#footnote-46) (National Public Procurement Portal) of open data, set up by the government, was created to provide access to data of public procurement of Paraguay and promote the development of creative tools to attract and serve the citizens.

This initiative aims to promote transparency, efficiency, citizen participation and economic development by exposing the work done in the various institutions, showing how they are managed and how they invest public resources.

Table 12 in annex 7.2 lists all Classes used in the Paraguayan Procurement Ontology[[46]](#footnote-47).

Although the Paraguayan Procurement ontology aims to serve a similar purpose as the ePO, two problems with regards to its reuse were identified. First, the Paraguayan Procurement ontology is modelled completely in Spanish, which limits its reusability in the multilingual EU context. Secondly, the ontology is tailored to the local process. However the ideas behind the ontology could provide an interesting insight.

### SEDIA

The Single Electronic Data Interchange Area (SEDIA) is a major strategic initiative that aims to create a master data repository of external stakeholders making business with the European Commission, whether business means grants or tenders.

The goal of the SEDIA project to create a fully automated and integrated process for handling procurement and grants information, limiting to the strict minimum the manual input of data, and promoting the alignment and reuse of such data along the whole process. This requires the implementation of solutions based on interoperability of the different systems.

This is a process where the actors would not have to submit recurrent information over and over again, but would allow reuse of information previously submitted. Each piece of data that needs to be dealt with should be encoded only once, and then reused or updated according to the needs.

In order to achieve the envisaged interoperability a basic common understanding of the data dealt with is required. Therefore a common data model is to be created.

The SEDIA vocabulary is currently a work in progress. It started by mapping all relevant existing vocabularies and standards to ensure that it achieves its envisioned interoperability, and is in the process of creating a vocabulary.

In this vocabulary are described all concepts which are part of the procurement process and whose attributes are relatively static over time, as this is as mentioned above a vocabulary aiming to underpin a repository of stakeholders. Examples of such information are business and organization addresses, names, formal IDs, banking details etc.

The SEDIA vocabulary could be reused in the ePO to represent details about all kinds of stakeholders of the procurement process.

### Common Data Model (CDM) of the Publications Office

The Common Data Model (CDM) is the metadata model of the resources published by the Publications Office of the EU. The model is based on the FRBR[[47]](#footnote-48) model, being able to represent the relationships between the resource types managed by the Publications Office. Initially the focus was on metadata related to legal resources and general publications, in a later phase metadata for TED and CORDIS were added. The CDM includes different classes and properties that relate to e-Procurement[[48]](#footnote-49). The CDM wiki[[49]](#footnote-50) explains which classes and properties are defined in the CDM and how they relate to each other. For example, the CDM defines a **Public Procurement** class as *any of the works related to public procurement (Ted)*. The model also defines a **Prior Information Notice** class as a subclass of Public Procurement. The Public Procurement has, among others, the following properties:

* Submission date;
* NUTS original reference;
* CPV[[50]](#footnote-51) original title;
* eTendering URL;
* Document number in the Official Journal;
* Directive name;
* …

Besides defining classes and properties, the CDM also defines relationships between concepts, such as:

* Public procurement has original CPV concept;
* Public procurement has current CPV concept;
* Public procurement value expressed in a given currency;
* Public procurement notice published in official journal;
* …

The CDM can help us understand how different metadata concepts of e-Procurement relate to each other. The ePO will respect the naming and design rules of the CDM. Moreover, as the CDM is available in OWL, its elements can be reused by the e-Procurement Ontology wherever possible.

### Standard forms for public procurement (TED)

Following the adoption of the revised e-Procurement Directives[[51]](#footnote-52), a new set of standard forms for public procurement was introduced. With the new directives, the forms are meant to be used in an electronic format only, which allows for automatic checking for mandatory fields. Moreover, the clear structure of electronic notices ensure consistency with the European Directives and minimize the risk of encoding errors. The forms, which are available via SIMAP[[52]](#footnote-53), impose a structure for submitting the following information:

* Prior information notice;
* Contract notice;
* Contract award notice;
* Periodic indicative notice – utilities;
* Contract notice – utilities;
* Contract award notice – utilities;
* Qualification system – utilities;
* Notice on a buyer profile;
* Design contest notice;
* Results of design contest;
* Notice for changes or additional information;
* Voluntary ex ante transparency notice;
* Modification notice;
* Social and other specific services – public contracts;
* Social and other specific services – utilities; and
* Social and other specific services – concessions.

The standard forms for public procurement are very important for the development of the ePO, as they describe how public procurement data should be submitted for publication in order to comply with the public procurement Directives. Since the ePO has to be compliant to the same Directives, it should take into account the concepts, data structure and controlled vocabularies of the standard forms for public procurement. Moreover, in 2015, the Publications Office and the ISA Programme of the EU have conducted a study in order to elicit information and functional requirements from TED re-users [23]. The requirements identified by this study could be considered when developing the ePO.

### Other generic vocabularies that should be taken into consideration

|  |  |
| --- | --- |
| Vocabulary | Description |
| **FOAF** | **FOAF** (Friend Of A Friend) is a vocabulary defining a dictionary of people-related terms that can be used in structured data |
| **Dublin Core Terms** | The **Dublin Core Terms** is a set of vocabulary terms that can be used to describe web resources (video, images, web pages, etc.), as well as physical resources such as books or CDs, and objects like artworks. |
| **SKOS Core** | **SKOS Core** is a model and an RDF vocabulary for expressing the basic structure and content of concept schemes such as thesauri, classification schemes, subject heading lists, taxonomies, 'folksonomies', other types of controlled vocabulary, and also concept schemes embedded in glossaries and terminologies. |

## Reference data and codelists

### The Common Procurement Vocabulary

The Common Procurement Vocabulary (CPV)[[53]](#footnote-54) was created by the European Commission in order to facilitate the processing of invitations to tenders published in the Official Journal of the EU by means of a single classification system to describe the subject matter of public contracts. This classification endeavours to cover all requirements for supplies, works and services [24].

The CPV consists of a main vocabulary for defining the subject of a contract, and a supplementary vocabulary for adding further qualitative information. The main vocabulary is based on a tree structure comprising codes of up to nine digits associated with a wording that describes the supplies, works or services forming the subject of the contract.

For example, if a contracting entity wants to obtain a road transport service for a fragile high-tech device, it may be interested to look into the following codes:

* *60100000-9 Road transport services*
* *60110000-6 Public road transport services*

Another example could be if an entity is interested in buying general-purpose rolling machines and parts for them. In order to find the most suitable codes, it could look into the following codes:

* *42000000-6 Industrial machinery*
* *42930000-4 Centrifuges, calendering or vending machines*

The supplementary vocabulary may be used to expand the description of the subject of a contract. The items are made up of an alphanumeric code with a corresponding wording allowing further details to be added regarding the specific nature or destination of the goods to be purchased.

For example, specific metals may be designated with the supplementary vocabulary codes: AA08-2 (Tin) or AA09-5 (Zinc).

The use of the CPV is mandatory for all public procurement procedures in the European Union as from 1 February 2006 [25].

The CPV should be used in the case of the ePO as it is obligatory by directive[[54]](#footnote-55). Furthermore as it is a wide spread and well established standard, its inclusion will facilitate integration and reuse of published data. An update of these CPVs are also foreseen within the ISA action: European Public Procurement Interoperability Initiative which also covers the ePO

### The Named Authority Lists of the Publications Office

**The Named Authority Lists (**NALs)[[55]](#footnote-56) are harmonised code lists with multilingual labels used to facilitate data exchange. They are maintained by the Publications Office of the European Union[[56]](#footnote-57) in the Metadata Registry under the governance of the EU’s Interinstitutional Metadata Maintenance Committee (IMMC).

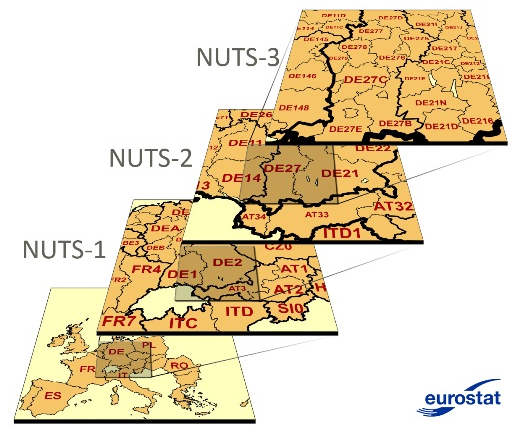
The use of common, high-quality reference data in information reuse can significantly reduce semantic interoperability conflicts. Available in different machine-readable formats and maintained by a trusted authority, the NALs are to be reused in many different information exchange contexts.

Some examples of NALs that could be used in the domain of e-Procurement are those on countries, currencies, documentation types, EU programmes and EU corporate bodies [26].

### Nomenclature of Territorial Units for Statistics

The Nomenclature of Territorial Units for Statistics (NUTS)[[57]](#footnote-58), is a geographical nomenclature subdividing the economic territory of the European Union into regions at three different levels: NUTS 1, 2 and 3 respectively, moving from larger to smaller territorial units, as it is shown in Figure 6.

Figure 6: The three different levels of NUTS [27]



The NUTS classification is a hierarchical system for dividing up the economic territory of the EU for the purpose of [27]:

* The collection, development and harmonisation of European regional statistics;
* Socio-economic analyses of the regions; and
  + NUTS 1: major socio-economic regions
  + NUTS 2: basic regions for the application of regional policies
  + NUTS 3: small regions for specific diagnoses
* Framing of EU regional policies.
  + [Regions eligible for support from cohesion policy](http://ec.europa.eu/regional_policy/how/coverage/index_en.cfm) have been defined at NUTS 2 level.
  + The [Cohesion report](http://ec.europa.eu/regional_policy/index.cfm/en/information/cohesion-report/)has so far mainly been prepared at NUTS 2 level. Despite the aim of ensuring that regions of comparable size all appear at the same NUTS level, each level still contains regions which differ greatly in terms of population. For further details, it also exists the [NUTS publication](http://ec.europa.eu/eurostat/documents/3859598/5916917/KS-RA-11-011-EN.PDF) 2013/EU-28[[58]](#footnote-59).

The NUTS classification should be used for the purposes of the ePO when describing localities as it is obligatory in the public procurement directives[[59]](#footnote-60).

## Identification of reusable concepts

**In projects such as the creation of the ePO, it is important to reuse and combine existing concepts to the extent possible. During this preliminary research into existing relevant works, a number of possible candidates for reuse have been identified.**

**RDF vocabularies are the easiest to reuse in the ePO as they are already in the required format. This means that providing classes and properties expressing elements which need to be described by the ePO can be reused directly with little or no modification needed.**

Specifically for the description of elements relating to **payments**, the Payments ontology can be reused. It already contains properties describing all basic parts of a transaction: the payer, the payee, the amount, the date.

In the case of **contracts**, the Public Procurement Ontology provides a ready model for describing a contract and connecting it to relevant elements. It offers a detailed breakdown of all types of contracts and of their parts, such as requirements and evidences.

The ISA Core vocabularies are perfect for describing the main **parties** of the procurement process. The Core Business vocabulary can be used to describe businesses competing for the contracts. The Core Public Organizations vocabulary can be used to describe the contracting authorities. The Core Evidence and Core Criterion vocabularies can be used to represent the criteria of the contracts and the evidences proving compliance with them. Finally the Core Location vocabulary can be used to describe any location data.

The LOTED2 vocabulary can be used to provide all elements and parties of the procurement process with the legal depth required, such as legal contract details and awarding implications.

The Linked Open Economy vocabulary, which is a rather generic model, could be used to tie together the rest of the vocabularies which are targeted to specific parts of the procurement process.

Codelists and named authority lists are also easy to and should be reused. Especially if they are widely used, their inclusion in the ePO will facilitate interoperability and reuse of the data described by it. Specifically, the Common Procurement Vocabulary, as it stands now or an evolutions of it, can be used to identify the subject matter of contracts and the Nomenclature of Territorial Units for Statistics classification can be used to encode locations. The Named Authority lists of the Publications Office can be used to define multiple things ranging from administrative entities, to currencies and to languages.

Other existing works, which are merely standards or non-RDF models, can be reused in the sense that they can provide useful information for the modelling of the ePO and inform on important things to consider during its creation.

# Conclusion and Next Steps

The objective of this deliverable was to collect the necessary information in order to be able to start the development of the e-Procurement Ontology, a commonly agreed OWL ontology that will conceptualize and formally encode information describing public procurement in a structured and machine readable format.

Towards this goal, this work has identified use cases for the ePO. The use cases demonstrate how the ePO can foster transparency and help monitor public procurement, how it can promote innovation, and how it can interconnect different public procurement systems. Moreover, the target audience of the ePO has been identified. The target audience includes, but is not limited to, contracting authorities, economic operators, regulators and the media.

Besides the target audience and use cases, a key objective of this work was to identify existing data standards and reference data which are relevant for e-Procurement. Moreover, an initial assessment was conducted to identify the extent to which these existing solution could be reused in the ePO. The analysis showed that many solutions can be directly reused, some may provide guidance for aligning, and some may be used for reference.

Following the ISA process and methodology for developing semantic agreements [7] as mentioned in chapter 2, a next step would be to set up an open working group. A call for participation will be sent to stakeholder communities, inviting them to take part in the work. Once the working group members have been identified, roles and responsibilities will be assigned. The working group chairs, editors and experts will execute the operational work for developing the specification. They will have to agree on the use cases proposed in this work or identify further use cases identify information requirements and propose a set of core concepts for the ePO, taking into account the analysis of existing initiatives as presented in chapter 4 and further in depth analysis. In order to support their work, a collaboration environment should be set up. The collaboration environment could be hosted on Joinup[[60]](#footnote-61), an online platform developed by the European Commission to help public administrations find, share, reuse and develop interoperability solutions. The platform will allow members of the working group to post and discuss issues, to share and review drafts of the ePO and to communicate with each other in an open and efficient manner. A key task of the working group when developing the ePO, will be to define naming and identifier conventions. A persistent Uniform Resource Identifier (URI) will have to be identified for the classes and properties that are defined in the ontology. A review group could be established to challenge and validate the proposals of the working group.

# References

|  |  |
| --- | --- |
| [1] | European Comission, [Online]. Available: http://ec.europa.eu/growth/single-market/public-procurement/. |
| [2] | European Commission, [Online]. Available: http://ec.europa.eu/growth/single-market/public-procurement/. |
| [3] | European Commission, [Online]. Available: http://ec.europa.eu/clima/tenders/index\_en.htm. |
| [4] | O. Bausa Peris, S. Kourtidis, K. Liljemo, N. Loozen, J. Rodrigues Frade and M. Snaprud, "e-Procurement Golden Book of Good Practice," European Commission, Brussels, 2013. |
| [5] | ISA Programme of the EU, [Online]. Available: https://joinup.ec.europa.eu/site/eia/EIRA/EIRA\_beta\_dev/HTML/elements/53d8df8a.html . |
| [6] | DataONE , [Online]. Available: https://www.dataone.org/best-practices/define-data-model. |
| [7] | ISA Programme of the EU, "Process and methodology for developing semantic agreements," 2013. [Online]. Available: https://joinup.ec.europa.eu/sites/default/files/Process%20and%20methodology%20for%20developing%20semantic%20agreements.pdf. [Accessed 29 04 2016]. |
| [8] | CEN, "CEN/TC 440 - Electronic Public Procurement," [Online]. Available: https://standards.cen.eu/dyn/www/f?p=204:7:0::::FSP\_ORG\_ID:1976650&cs=175E298F320429229DD35C9E22F4E8F76. [Accessed 28 04 2016]. |
| [9] | CEN, "European committee for Standardization - CEN, eBusiness," [Online]. Available: https://www.cen.eu/work/areas/ict/ebusiness/pages/default.aspx. [Accessed 28 04 2016]. |
| [10] | Open Contracting Partnership, [Online]. Available: http://standard.open-contracting.org/latest/en/. |
| [11] | Open Contracting Partnership, "Open Contracting Data Standard schema release," [Online]. Available: http://standard.open-contracting.org/latest/en/schema/release/. |
| [12] | T. Mcgrath, "OASIS Universal Business Language (UBL)," 18 March 2015. [Online]. Available: https://joinup.ec.europa.eu/asset/oasis-ubl/description. |
| [13] | OASIS, "Advancing open standards for the international society," 19 November 2014. [Online]. Available: https://www.oasis-open.org/news/pr/european-commission-approves-referencing-of-oasis-universal-business-language-ubl-standard. |
| [14] | E. Europa, "Commission further simplifies public procurement across the EU," 6 January 2016. [Online]. Available: http://ec.europa.eu/growth/tools-databases/newsroom/cf/itemdetail.cfm?item\_id=8611. |
| [15] | European Commission - DG GROW, "EUROPEAN SINGLE PROCUREMENT DOCUMENT SERVICE," [Online]. Available: http://ec.europa.eu/isa/documents/actions/more-about-action-2.16\_en.pdf. |
| [16] | ISA Programme of the EU, "ESPD data model," [Online]. Available: https://joinup.ec.europa.eu/catalogue/distribution/espd-exchange-data-model-v10. |
| [17] | M. M. Forsberg, "CEN BII: The BII post-award activities and deliverables. The path towards more efficient procurement in Europe," 2 December 2014. [Online]. Available: www.cenbii.eu. |
| [18] | European Commission - DG Internal Market and Services, "E-CERTIS," 30 July 2014. [Online]. Available: http://ec.europa.eu/markt/ecertis/login.do. |
| [19] | ISA Programme of the EU, "Joinup EC Europa," [Online]. Available: https://joinup.ec.europa.eu/sites/default/files/files\_epractice/sites/e-CERTIS%20End%20user%20guide.pdf. |
| [20] | "ISA Programme of the EU," [Online]. Available: http://ec.europa.eu/isa/. |
| [21] | J. F. Munoz-Soro, G. Esteban, O. Corcho and F. Seron, "PPROC, an Ontology for Transparency in Public Procurement". |
| [22] | I. Distinto, M. d'aquin and E. Motta. [Online]. Available: http://www.semantic-web-journal.net/system/files/swj678\_0.pdf. |
| [23] | ISA Programme of the EU, "D03.02.02 - Report on the pilot," European Commission, Brussels, 2015. |
| [24] | ISA Programme of the EU, "Common Procurement Vocabulary," [Online]. Available: https://joinup.ec.europa.eu/catalogue/asset\_release/common-procurement-vocabulary. |
| [25] | "SiMAP," [Online]. Available: http://simap.ted.europa.eu/cpv. |
| [26] | Publications Office of the EU, "Metadata Registry," 16 March 2016. [Online]. Available: http://publications.europa.eu/mdr/authority/. |
| [27] | European Commission - Eurostat, "NUTS," [Online]. Available: http://ec.europa.eu/eurostat/web/nuts/overview. |
| [28] | European Commission - DG MARKT, "e-CERTIS User Guide," [Online]. Available: https://joinup.ec.europa.eu/sites/default/files/files\_epractice/sites/e-CERTIS%20End%20user%20guide.pdf. |

# Annexes

## Annex I: Classes of the LOE ontology

Table 11: Classes of LOE ontology

|  |  |
| --- | --- |
| Class | Explanation |
| elod:AccountType | This class represents the Account Types |
| elod:AdministrativeDecision | Administrative Decisions (Financial & Non-Financial) |
| elod:Attachment | Attachments documents found in the Decisions |
| elod:BudgetCategory | Budget Categories |
| elod:BudgetItem | Budget of a Public Project |
| elod:BudgetKind | Budget Kind of a Decision |
| elod:CollectiveBodyKind | Different kinds of a Collective Body |
| elod:CollectiveBodyType | Different types of a Collective Body |
| elod:CommittedItem | Decisions having type B.1.3. |
| elod:Country | Countries |
| elod:CPV | CPV codes, a vocabulary which is used to characterize the products or services purchased by a contract. |
| elod:Currency | Currencies |
| elod:Decision | Decisions |
| elod:DecisionStatus | Status of the Decisions |
| elod:ExpenditureLine | Decisions that involve expenses |
| elod:ExpenseApprovalItem | Decisions that involve approval of expenses |
| elod:FinancialDecision | Financial Decisions |
| elod:Law | Law which is defined in a Decision |
| elod:NonFinancialDecision | Non Financial Decisions |
| elod:OfficialAdministrativeChange | Official Administrative Changes |
| elod:OpinionOrgType | Types of Opinion Organizations |
| elod:OrganizationalUnitCategory | Categories of the Organizational Units |
| elod:OrganizationCategory | Categories of the Organizations |
| elod:OrganizationDomain | Domains of the Organizations |
| elod:OrganizationStatus | Status of the Organizations |
| elod:Position | Positions |
| elod:PositionType | Position Types |
| elod:RegulatoryAct | Regulatory Acts |
| elod:SelectionCriterion | Selection Criteria of a Contract |
| elod:SpendingItem | Payments of a Public Project |
| elod:Subproject | Subprojects for each Public Project |
| elod:Subsidy | Public Projects which are Subsidies |
| elod:TimePeriod | Time Period |
| elod:VacancyType | Vacancy Types |
| elod:VatType | Vat Types of the Organizations |
| foaf:Agent | Entities that participate in actions |
| foaf:Organization | Organization. It is one of the four classes used for their modelling |
| foaf:Person | Physical Persons |
| gr:BusinessEntity | Organization. It is one of the four classes used for their modelling |
| gr:UnitPriceSpecification | A conceptual entity that specifies the price asked for a service or product. It specifies the price, the currency and whether the price includes VAT or not |
| org:Organization | Organization. It is one of the four classes used for their modelling |
| org:Role | Role that the Agent plays in a Membership relationship with an Organization |
| pc:Contract | Public contracts during all stages of their existence |
| rov:OrganizationalUnit | Organizational Units of Organizations |
| rov:RegisteredOrganization | Organization. It is one of the four classes used for their modelling. |
| vcard:Address | Address details of an agent. |
| elod:AidActivity | An official development assistance activity |
| elod:TradeActivity | The trade activity between two agents |
| elod:GroupNationalAgent | The country or region trading goods. |
| elod:Amount | The amount of money. |
| elod:ContractType | The types of the contract |
| elod:ContractingAuthority | The contracting authority |
| elod:CancellationReason | The cancellation reason |
| elod:VAT | The amount of VAT |
| elod:CorrectionDecision | The decision which corrects another one |
| gr:SomeItems | A placeholder instance for unknown instances of a mass-produced commodity |
| gr:Offering | An offering represents the public, not necessarily binding, not necessarily exclusive, announcement by a gr:BusinessEntity to provide (or seek) a certain item |
| pc:AwardCriteriaCombination | Class for description of criteria combination used for tender evaluation |
| pc:CriterionWeighting | Class for description of one criterion and its weight |
| elod:Transaction | Class representing all transactions |

## Annex II: Example of classes in the Paraguayan procurement

Table 12: Example of classes in the Paraguayan procurement

|  |  |  |
| --- | --- | --- |
| Classes | Translation of Classes | Translation of Description |
| [Planificacion](https://www.contrataciones.gov.py/datos/1/def/Planificacion) | Planning | The way in which the entity plans to carry out his bidding, budget contains data that can be linked to other systems and estimated dates of initiation |
| [Convocatoria](https://www.contrataciones.gov.py/datos/1/def/Convocatoria) | Call | The notice or competitive bidding containing basic information to determine supplier’s interest in participating |
| [Adjudicacion](https://www.contrataciones.gov.py/datos/1/def/Adjudicacion) | Allocation | Bidding result of which it is determined foreclosed suppliers and the amount awarded. There may be more than one awarded by procedure |
| [Contrato](https://www.contrataciones.gov.py/datos/1/def/Contrato) | Contract | Contract signed by the allocated supplier |
| [Modificacion de Contrato](https://www.contrataciones.gov.py/datos/1/def/Modificacion%20de%20Contrato) | Contract Modification | Changes of the contract |
| [Categoria](https://www.contrataciones.gov.py/datos/1/def/Categoria) | Category | Grouping tenders for goods and services by similar market categories |
| [Tipo de Procedimiento](https://www.contrataciones.gov.py/datos/1/def/Tipo%20de%20Procedimiento) | Procedure Type | The kind of the form or type of vendor selection procedure used |
| [Moneda](https://www.contrataciones.gov.py/datos/1/def/Moneda) | Coin | Type of currency used, e.g. Dollars, Euros, Guarani |
| [Estado](https://www.contrataciones.gov.py/datos/1/def/Estado) | State | It indicates in which phase of the lifecycle the procedure currently is |
| [Sistema de Adjudicacion](https://www.contrataciones.gov.py/datos/1/def/Sistema%20de%20Adjudicacion) | System Allocation | It allows you to split the object of the tender award items, in order to determine whether the bid can be allocated to one or more suppliers depending on the number of items or group of items in which it is divided. |
| [Tipo Garantia de Oferta](https://www.contrataciones.gov.py/datos/1/def/Tipo%20Garantia%20de%20Oferta) | Type of Warranty Offer | Type of document to be submitted by the offeror to ensure his proposal |
| [Forma de Pago](https://www.contrataciones.gov.py/datos/1/def/Forma%20de%20Pago) | Form of payment | Determines the way, mechanism, frequency, occurrence or event that indicates the completion of a payment resulting from the contract execution |
| [Fuente de Financiamiento](https://www.contrataciones.gov.py/datos/1/def/Fuente%20de%20Financiamiento) | Funding Source | Classification of the funding source. |
| [Unidad de Medida](https://www.contrataciones.gov.py/datos/1/def/Unidad%20de%20Medida) | Unit of measurement | Unit of measure used for quote |
| [Grupo de Items](https://www.contrataciones.gov.py/datos/1/def/Grupo%20de%20Items) | Group Items | Grouping Items to be requested by the convener, which are identified by a number and a name. |
| [Item](https://www.contrataciones.gov.py/datos/1/def/Item) | Item | One or more items requested by the convener, on which providers should submit their proposal |
| [Proveedor](https://www.contrataciones.gov.py/datos/1/def/Proveedor) | Providers | List invited to submit tenders in a procurement procedure or participants |
| [Documento](https://www.contrataciones.gov.py/datos/1/def/Documento) | Bidding Documents | Tender documents (bidding terms and conditions, addendums, clarifications) |
| [Licitacion](https://www.contrataciones.gov.py/datos/1/def/Licitacion) | Bidding | - |
| [Etapa Licitacion](https://www.contrataciones.gov.py/datos/1/def/Etapa%20Licitacion) | Bidding stage | - |
| [Convocante](https://www.contrataciones.gov.py/datos/1/def/Convocante) | Convener | - |
| [Parametro](https://www.contrataciones.gov.py/datos/1/def/Parametro) | Parameter | - |
| [Catalogo Nivel 4](https://www.contrataciones.gov.py/datos/1/def/Catalogo%20Nivel%204) | Catalog Level 4 | - |
| [Catalogo Nivel 5](https://www.contrataciones.gov.py/datos/1/def/Catalogo%20Nivel%205) | Catalog Level 5 | - |
| [Objeto de Gasto](https://www.contrataciones.gov.py/datos/1/def/Objeto%20de%20Gasto) | Object of Expenditure | - |
| [Capacitacion](https://www.contrataciones.gov.py/datos/1/def/Capacitacion) | Training | - |
| [Precio de Item](https://www.contrataciones.gov.py/datos/1/def/Precio%20de%20Item) | Price of Item | - |

1. <http://ec.europa.eu/growth/single-market/public-procurement/e-procurement/index_en.htm> [↑](#footnote-ref-2)
2. Commission Implementing Regulation (EU) 2015/1986 of 11 November 2015: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2015.296.01.0001.01.ENG> [↑](#footnote-ref-3)
3. PSI Directive: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32013L0037> [↑](#footnote-ref-4)
4. Report on high value datasets: <http://ec.europa.eu/isa/documents/publications/report-on-high-value-datasets-from-eu-institutions_en.pdf> [↑](#footnote-ref-5)
5. <https://en.wikipedia.org/wiki/Conceptual_schema> [↑](#footnote-ref-6)
6. <https://en.wikipedia.org/wiki/Ontology_(information_science)> [↑](#footnote-ref-7)
7. Multi-Stakeholders Expert Group on eProcurement: <http://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetail&groupID=3142> [↑](#footnote-ref-8)
8. CEN TC 440: <https://standards.cen.eu/dyn/www/f?p=204:7:0::::FSP_ORG_ID:1976650&cs=175E298F320429229DD35C9E22F4E8F76> [↑](#footnote-ref-9)
9. CEN TC 434: <https://standards.cen.eu/dyn/www/f?p=204:7:0::::FSP_ORG_ID:1883209&cs=1E81C9C833655EEDC7010C8D0A2FB786C> [↑](#footnote-ref-10)
10. This includes asking all who participated in the creation process to sign an agreement conceding any intellectual rights to the open licence. Example agreement: <https://joinup.ec.europa.eu/node/104627> [↑](#footnote-ref-11)
11. W3C OWL: <https://www.w3.org/2001/sw/wiki/OWL> [↑](#footnote-ref-12)
12. CELLAR: <https://www.w3.org/International/multilingualweb/luxembourg/slides/41-schmitz.pdf> [↑](#footnote-ref-13)
13. SPARQL: <https://www.w3.org/2001/sw/wiki/SPARQL> [↑](#footnote-ref-14)
14. PROTÉGÉ: <https://www.w3.org/2001/sw/wiki/Protege> [↑](#footnote-ref-15)
15. e-Prior: <https://joinup.ec.europa.eu/software/openeprior/description> [↑](#footnote-ref-16)
16. PEPPOL: <http://www.peppol.eu/> [↑](#footnote-ref-17)
17. CEN Workshop Agreement: <http://www.cen.eu/work/products/CWA/Pages/default.aspx> [↑](#footnote-ref-18)
18. OCDS: <http://standard.open-contracting.org/latest/en/> [↑](#footnote-ref-19)
19. World Wide Web Foundation: <http://webfoundation.org/> [↑](#footnote-ref-20)
20. This model has multiple levels. In this case we have the section “Planning”, within this section we have three objects “Budget, Rationale, Documents”. The Rationale and Documents objects each directly contain a value as described, but the Budget object contains further sub-elements “Source, ID, Description, Amount, Project, Project ID, URI” which in turn each contain a value. [↑](#footnote-ref-21)
21. A unique identifier is a string of characters, numbers and/or symbols; a code that is unique to the specific buyer within the model. To identify organisations, Open Contracting advises to use identifiers from official or well-established registers, such as opencorporates.com, state company registrars, VAT registers, etc. For more information about the use of identifiers in OCDS, refer to <http://standard.open-contracting.org/latest/en/schema/identifiers/>. [↑](#footnote-ref-22)
22. UBL: <https://www.oasis-open.org/committees/tc_home.php?wg_abbrev=ubl> ,

    <https://joinup.ec.europa.eu/asset/oasis-ubl/description> [↑](#footnote-ref-23)
23. EHF: <https://vefa.difi.no/ehf/> [↑](#footnote-ref-24)
24. Svefaktura: <http://www.sfti.se/standarder/bestallningsprocesssftisvehandel/svefaktura/svefakturabis5a20.2074.html> [↑](#footnote-ref-25)
25. OIOUBL: <http://oioubl.info/classes/da/index.html> [↑](#footnote-ref-26)
26. e-Prior: <https://joinup.ec.europa.eu/community/osor/case/e-prior-electronic-procurement-system-public-administrations> [↑](#footnote-ref-27)
27. PEPPOL: <http://www.peppol.eu/> [↑](#footnote-ref-28)
28. ESPD: <http://ec.europa.eu/growth/tools-databases/newsroom/cf/itemdetail.cfm?item_id=8611> & ESPD standard form: <http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32016R0007&from=EN> [↑](#footnote-ref-29)
29. e-Certis: <http://ec.europa.eu/markt/ecertis> [↑](#footnote-ref-30)
30. Directive 2014/55/EU on electronic invoicing in public procurement: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0055> [↑](#footnote-ref-31)
31. CEN: <https://www.cen.eu/Pages/default.aspx> [↑](#footnote-ref-32)
32. CEN BII Core Invoice data model: <http://www.cen.eu/work/areas/ICT/eBusiness/Documents/CWA_16356-1.pdf> [↑](#footnote-ref-33)
33. e-Certis: <http://ec.europa.eu/markt/ecertis/login.do> [↑](#footnote-ref-34)
34. ISA Core Vocabularies: <https://joinup.ec.europa.eu/community/semic/og_page/core-vocabularies> [↑](#footnote-ref-35)
35. The ISA Programme of the EU: <http://ec.europa.eu/isa/> [↑](#footnote-ref-36)
36. PPROC Ontology: <http://contsem.unizar.es/def/sector-publico/pproc.html>

    and paper: <http://www.semantic-web-journal.net/system/files/swj1030.pdf> [↑](#footnote-ref-37)
37. CONTSEM: <http://contsem.iasoft.es/> [↑](#footnote-ref-38)
38. Bulletins: Online announcement boards on public procurement, which can also work as platforms through which to conduct the process, such as TED (<http://ted.europa.eu/TED/main/HomePage.do>) or national e-Procurement platforms such as <https://eten.publicprocurement.be/etendering/home.do>. [↑](#footnote-ref-39)
39. Public Contracts: <http://lov.okfn.org/dataset/lov/vocabs/pc> [↑](#footnote-ref-40)
40. LOTED2: <http://loted.eu>/ [↑](#footnote-ref-41)
41. KMi: <http://kmi.open.ac.uk/> [↑](#footnote-ref-42)
42. YourDataStories: <https://github.com/YourDataStories/ontology> [↑](#footnote-ref-43)
43. Payments Ontology: <https://data.gov.uk/resources/payments/reference> [↑](#footnote-ref-44)
44. Data Cube Vocabulary: <https://www.w3.org/TR/vocab-data-cube/> [↑](#footnote-ref-45)
45. DNCP: <https://www.contrataciones.gov.py/> [↑](#footnote-ref-46)
46. Ontology website: <https://www.contrataciones.gov.py/datos/def> [↑](#footnote-ref-47)
47. FRBR – Functional Requirements for Bibliographic Records: <http://www.ifla.org/publications/functional-requirements-for-bibliographic-records> [↑](#footnote-ref-48)
48. An overview of all CDM classes and properties are listed at <http://publications.europa.eu/mdr/cdm/index.html> [↑](#footnote-ref-49)
49. CDM Wiki: <http://publications.europa.eu/mdr/resource/cdm/cdm_4.1.3/cdm.wiki> [↑](#footnote-ref-50)
50. CPV - Common Procurement Vocabulary: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=URISERV%3Al22008> [↑](#footnote-ref-51)
51. DIRECTIVE 2014/23/EU: <http://data.europa.eu/eli/dir/2014/23/oj>, DIRECTIVE 2014/24/EU: <http://data.europa.eu/eli/dir/2014/24/oj>, DIRECTIVE 2014/25/EU: http://data.europa.eu/eli/dir/2014/25/oj [↑](#footnote-ref-52)
52. SIMAP – Information System for Public Procurement: <http://simap.ted.europa.eu/standard-forms-for-public-procurement> [↑](#footnote-ref-53)
53. CPV: <http://simap.ted.europa.eu/cpv> [↑](#footnote-ref-54)
54. Directive on CPV use in procurement: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32014L0024> [↑](#footnote-ref-55)
55. NALs: <http://publications.europa.eu/mdr/authority/> [↑](#footnote-ref-56)
56. Publications Office: <https://publications.europa.eu/en/home> [↑](#footnote-ref-57)
57. NUTS: <http://ec.europa.eu/eurostat/web/nuts/overview> [↑](#footnote-ref-58)
58. NUTS publication 2013/EU-28 : <http://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-GQ-14-006> [↑](#footnote-ref-59)
59. Directives on public procurement:

    DIRECTIVE 2014/23/EU: <http://data.europa.eu/eli/dir/2014/23/oj>

    DIRECTIVE 2014/24/EU: <http://data.europa.eu/eli/dir/2014/24/oj>

    DIRECTIVE 2014/25/EU: <http://data.europa.eu/eli/dir/2014/25/oj> [↑](#footnote-ref-60)
60. Joinup: [http://joinup.ec.europa.eu/](http://joinup.ec.europa.eu/http) [↑](#footnote-ref-61)