Formalisation of Code Lists and their Values

The case of the ISO19152 Land Administration Domain Model

Authors: Abdullah Kara, Alexandra Rowland, Peter van Oosterom, Erik Stubkjær, Volkan Çağdaş, Erwin Folmer, Christiaan Lemmen, Wilko Quak, Laura Meggiolaro
Background and Affiliations

Alexandra Rowland
Kadaster & University of Twente
Linked Data and Semantic Web, Knowledge Graph, Interoperability

Abdullah Kara
Delft University of Technology
Land Administration, Property Valuation, Semantic Web

Co-authors affiliations:
- Peter van Oosterom: Delft University of Technology, Faculty of Architecture and the Built Environment, The Netherlands
- Erik Stubkjær: Aalborg University, Denmark
- Volkan Çagdas: Yildiz Technical University, Department of Geomatic Engineering, Turkey
- Erwin Folmer: Kadaster and University of Twente, Faculty of Behavioural and Management Sciences (BMS), The Netherlands
- Christiaan Lemmen: Kadaster International, FIG, OICRF and University of Twente
- Wilko Quak: Delft University of Technology, Section GIS Technology, The Netherlands
- Laura Meggiolaro: Land Portal Foundation, Italy
Overview

- What is code list? and code lists in LADM Edition I
- Land administration and Semantic Web
- Requirements for semantically enriched code list values
- A metamodel for refined code lists and their values
What is code list?

• ISO TC/211 and OGC standards generally uses the class diagram (static view modelling) of the UML.

• **UML class diagram** basically consists of **classes, their attributes, operations and relationships.**

• In this way of modelling, **data types** are assigned to **attributes** in order to specify the allowable characteristics of the attributes.

• One of the options to determine which values an attribute can have is to utilise **code lists.**

ISO 19152:2012 LADM – LA_Party Class
A code list is a simple list of values without any structure.

Code lists and their values can be considered as a supplement to the classes and associations within a standard and they provides initial examples for further structuring of the domain.

When modelling for actual systems to be implemented typically, the half of the efforts are devoted to the creation of the UML class diagrams as backbone of the structure. The other half of the efforts are spent on specifying the actual code list values.

However, the code lists in international standards (e.g. ISO and OGC) are generally just mentioned in the diagrams and present only a simple list of example values without any definition, reference to the source of a definition, multi-lingual alternative term support and semantic relationships (e.g. hierarchical, associative) in many cases.
This is also true in the case of **ISO 19152:2012 LADM** which specifies a number of code lists (e.g. LA_PartyType, LA_MortgageType, etc.) in the informative annex of the standard (Annex J).

LADM code lists only include example values, and **the specification of code lists is left to ‘User communities [who] have to define and manage their own values when implementing’ the standard.**

LADM is currently under the **systematic review of ISO** and adding more content, meaning and structure to its code list values has been considered taking a step forward in development of LADM.
There is growing interest in representing terms belonging to a particular domain using Semantic Web technologies (e.g. RDF, OWL, SKOS, SPARQL) and making them available on a registry (e.g. the ISO/TC 211 Multi-Lingual Glossary of Terms –MLGT–, alias Geolexica, OGC Definitions Server, INSPIRE code list register, Basic Register of Thesauri, Ontologies & Classifications -BARTOC-) on the Web. This interest is also the case in the domain of land administration.

The Cadastre and Land Administration Thesaurus (CaLAThe)

- **Terms from** LADM, OGC LandInfra, and several existing thesauri (e.g. GEMET, AGROVOC, and STW Thesaurus for Economics
- **Encoded with** SKOS
- The last version of CaLAThe includes code list and values of ISO LADM and OGC LandInfra that is made available through BARTOC and OGC Definitions Server
The Linked Land Governance Thesaurus (LandVoc)

- Includes concepts related to **land governance**. It is designed as a part of **FAO’s AGROVOC Linked Open Data set** and is maintained by the **Land Portal Foundation**.
- based on RDF, SKOS and Dublin Core definitions and can be consumed through AGROVOC SPARQL endpoint and RDF format.
- **LandVoc does not provide a specific solution for representing code list values.**
INSPIRE Code List Register

- The code list values defined in INSPIRE data themes (e.g. cadastral parcel) were structured in RDF format and made available through the INSPIRE code list register.
- The RDF representation of INSPIRE code list values does not include hierarchical relationships between the code list values and references to external code list values.
**Problem and Aim**

**Problem**: adding more meaning and content to code list values Semantic Web Technologies can be used, however code list values can be structured in a number of ways within the framework of the Semantic Web using various formalisms (format, vocabulary, registry).

To overcome this issue, **a joint understanding in structuring, extending and maintaining code list values** is required that may be achieved through an **agreed metamodel**.

**Aim**: creating a **metamodel for structuring, extending, and maintaining semantically enriched code list values** and implementing of the proposed framework.

To achieve this aim the **requirements for semantically refined code list values** should be firstly collected and/or determined.
When developing a new model, it is important to **reuse existing standards** as a foundation.

**ISO 19150-2:2015** — *Rules for developing ontologies in the Web Ontology Language (OWL)* standard, which ’defines the conversion of the UML static view modeling elements used in the ISO geographic information standards into OWL’

This standard proposes the use of SKOS for code lists.

- ‘SKOS has been broadly adopted for vocabulary formalization. SKOS supports the codelist requirements of membership and extensibility.’

**ISO 19150-2:2015 sets a number of requirements** for the conversion from UML code lists to SKOS:
- ‘A CODELIST shall correspond to a Class, a ConceptScheme, and a Collection.’
- ‘The Class shall be a subclass of skos:Concept.’
- The use of skos:broader, skos:narrower, and skos:related properties in order to specify the hierarchical relationships between values.
- The utilisation of skos:broadMatch, skos:closeMatch, skos:exactMatch, skos:narrowMatch and skos:relatedMatch properties are suggested to record the relationships between values of a code list.
Requirements for a semantically enriched code list values

ISO 19150-2 only focuses on conversion from UML code list values to SKOS but it does not specify requirements for structuring semantically enriched code list values, such as versioning, localisation (i.e. country profile), alternative values and maintenance.

• To identify the requirements for semantically enriched code list values several experts (from Kadaster, Geonovum, Universities) meeting were held.

• After several meetings with experts, thirteen requirements are identified. The selected thesauri and registries are evaluated against the identified requirements.
Requirements for a semantically enriched code list values

<table>
<thead>
<tr>
<th>Requirements \ Solutions</th>
<th>S1. CaLAThe</th>
<th>S2. LandVoc</th>
<th>S3. INSPIRE code list register</th>
<th>S4. Geolexica</th>
<th>S5. OGC Definitions Server</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1. Selection of code list values</td>
<td>OGC LandInfra, LADM,...</td>
<td>FAO’s Land Tenure Thesaurus, LADM,...</td>
<td>INSPIRE Data Theme</td>
<td>ISO standards</td>
<td>Terms defined by OGC or communities</td>
</tr>
<tr>
<td>R2. Identifier for code lists and their values</td>
<td>skos:ConceptScheme, skos:Concept, rdf:about</td>
<td>rdf:Description, rdf:about</td>
<td>rdf:Description, rdf:about</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>R3. Label (preferred and alternative) for code list values</td>
<td>skos:prefLabel, skos:altLabel</td>
<td>skos:prefLabel, skos:altLabel, skos:altLabel, skos:altLabel</td>
<td>skos:prefLabel, skos:altLabel</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>R4. Definition of code list values (and source of definition)</td>
<td>skos:definition</td>
<td>rdf:Description rdf:value</td>
<td>skos:definition</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>R5. Determining the values that belong to a code list</td>
<td>skos:inScheme, skos:broad</td>
<td>No</td>
<td>skos:inScheme</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>R6. Hierarchical and associative relationships between code list values</td>
<td>skos:broad, skos:narrower, skos:related</td>
<td>skos:narrower, skos:broad, skos:related</td>
<td>-</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>R7. Mapping relationships across different code list values</td>
<td>skos:exactMatch skos:closeMatch</td>
<td>skos:exactMatch skos:closeMatch, skos:closeMatch skos:closeMatch</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>R8. Versioning of code lists and their values (and concurrent versioning)</td>
<td>Partly yes</td>
<td>No</td>
<td>No</td>
<td>Partly yes</td>
<td>Partly yes</td>
</tr>
<tr>
<td>R9. Procedures for updating code list values (e.g. new, changed, deleted)</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>R10. Semantic web view of code lists</td>
<td>SKOS RDF/XML</td>
<td>SKOS RDF/XML, SPARQL Endpoint</td>
<td>RDF/XML</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>R11. Support for multiple languages (alphabets)</td>
<td>Yes, with labels</td>
<td>Yes, labels and skosxl:literalForm</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>R12. Support for national extension</td>
<td>Partly yes</td>
<td>Partly yes</td>
<td>Partly yes</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>R13. Selecting possible registries to publish and maintain code list values</td>
<td>Yes, through OGC Definitions Server, SKOMOS</td>
<td>AGROVOC</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The 10th Land Administration Domain Model Workshop, 31 March - 2 April 2022, Dubrovnik, Croatia
Proposed Metamodel for LADM Code Lists

LADM Code List Metamodel

- `skos:Concept`
- `skos:ConceptScheme`
- `CodeListValue`
- `CodeList`
- `skos:Collection`
Implementation and Demo Environment Links

To follow along in the overview of this metamodel and to see the demonstration version live (or to attend to interact with the model yourself) please make use of the following data stories:

- Summary implementation document (developed for the purpose of LADM Workshop): [https://data.labs.kadaster.nl/lexi-rowland/-/stories/summary-ladm-code-list](https://data.labs.kadaster.nl/lexi-rowland/-/stories/summary-ladm-code-list)
- Demonstration environment: [https://data.labs.kadaster.nl/experiment/-/stories/ladm-metamodel-Demo](https://data.labs.kadaster.nl/experiment/-/stories/ladm-metamodel-Demo)