Semantic Resources for the Geospatial Domain

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Key words: CaLAThe; Controlled vocabulary; LandVoc; Semantic resources; Semantic web

SUMMARY

Smart surveyors are aware of the potential of semantic resources. Within the FIG community, semantic representation often supplements geospatial representation, but you also find specific references to semantic technologies. For example, Mey et al (2020) among others introduce characteristics of the semantic web, including the notion of controlled vocabularies, which assist in providing interoperability among datasets in the surveying and the construction sector, and support a wider e-governance perspective.

Within the geospatial domain, such vocabularies have recently been developed and made available, namely the Geolexica of the ISO TC 211 Geographic information / Geomatics, as well as the OGC Definitions Server. The two standardization organisations have developed these resources to promote interoperability by providing easy access to the concepts and concept structures, which are applied in their standards.

These efforts are part of a more general trend, providing controlled vocabularies for the various domains of science. The AGROVOC of FAO, the GEMET - GEneral Multilingual Environmental Thesaurus, and the STW Thesaurus for Economics, are among the about 100 vocabularies collected in the Basic Register of Thesauri, Ontologies & Classifications (BARTOC).

For professionals and researchers, it may be difficult to explore these vast and diverse semantic resources. Therefore, domain-specific entry points have been made in terms of LandVoc - the Linked Land Governance Thesaurus, as well as the Cadastre and Land Administration Thesaurus (CaLAThe).

The purpose of the paper is to provide a review of the mentioned semantic resources and to illustrate their use, e.g. for student and research projects and for national management of code lists. Concepts and concept structures are the basic elements of science. A dedicated use of the presented semantic technology and semantic resources will stimulate the scientific base of the surveying profession.

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1. INTRODUCTION

The amount of data and information has increased exponentially over the past two decades, but semantic technologies help us define data and information and the relations they have with other data and other pieces of information. Surveyors, researchers, librarians, information specialists, but also policy makers and anyone who uses the web are more dependent on formal specifications of data structures to allow for discoverability and interoperability. Technologies increasingly support researchers and practitioners to save time and money overcoming traditional and less efficient ways of finding resources, as stated in Mons (2020) and Mey et al (2020). The precondition for this to happen is to publish structured, findable data on data, that is: metadata that helps users easily find their content of interest.

Semantic technologies, including Knowledge Organization Systems (KOSs) support the publishing of data in a relational, structured way. The notion of KOSs refers to tools that present the organized interpretation of knowledge structures, such as term lists, taxonomies, classification schemes, thesauri, and ontologies (Zeng and Chan, 2004, p. 377). They are also referred to as controlled vocabularies, structured vocabularies, value vocabularies, concept schemes, semantic assets, and classification by various standards (Golub et al., 2014). KOSs are primarily considered 'value vocabularies' that define resources used in metadata records (Zeng and Mayr, 2019, p. 2). Their representation and indexing functions are important also for the Semantic Web and its Linked Data implementations (Méndez and Greenberg, 2012, p. 237). KOSs now can be serviced as Linked (Open) Data through a W3C specification, Simple Knowledge Organisation System (SKOS) (W3C, 2009) which defines a common data model for sharing and linking KOSs via the Web. The functions of KOSs, however, include much more than the mentioned metadata descriptions. KOSs in the nutshell provide semantic road maps for the effective exchange of domain knowledge (Mayr et al., 2016, p. 205), as illustrated in Section 4.

This paper introduces various KOSs related to the geospatial sector (section 2), and provides an ad-hoc review of these semantic resources (section 3). The use of semantic resources is illustrated in terms of student and research projects (section 4.1) and the national management of code lists (section 4.2). The Conclusion (section 5) calls for further development of concept definitions of the domain of land administration and refers to corresponding advice.

2. An OVERVIEW of SEMANTIC RESOURCES for the GEOSPATIAL DOMAIN

This section provides a brief overview for available KOSs for the FIG community. The identification of these KOSs is facilitated by the cross-referencing provided through the Basic Register of Thesauri, Ontologies & Classifications (BARTOC).

Geolexica

The ISO/TC 211 Multi-Lingual Glossary of Terms (MLGT)[1] is a compilation of terminology clauses published in ISO/TC 211 standards. Its current version includes 1,302 entries (terms

[1] https://github.com/ISO-TC211/TMG

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and their definitions) in English and 8,706 translated entries in fourteen languages. The MLGT is available in an Excel spreadsheet edition, and can be accessible through an online edition called ISO/TC 211 Geolexica[2]. The online version is published thorough Glossarist, an open-source software for maintaining multi-language concept systems. The Glossarist also provide a base for a recently released OSGeo Glossary[3] (ISO 690) by the Lexicon Committee[4] of the Open Source Geospatial Foundation[5] (OSGeo).

OGC Definitions Server

The OGC Definitions Server is an online registry that allows for the management of resources such as terms, definitions, vocabularies and other related resources that are defined in OGC standards. The resources are recorded in registers that conform to Linked Data principles and are published through the definitions server. The definitions server is intended to facilitate semantic interoperability between different systems that use OGC standards (https://github.com/opengeospatial/NamingAuthority). It was announced in 2018 and is being extended to contain much of the knowledge incorporated in OGC documents as well as a single reference site for Coordinate Reference System (CRS) definitions, Discrete Global Grid Systems (DGGS), sensor models, and other specialized catalogues or ontologies (http://www.opengeospatial.org/blog/2922). Recently, the implementation was shifted to VocPrez (http://www.opengis.net/def/), a read-only web delivery system, licensed using the GPL v3 licence.

Cadastre and Land Administration Thesaurus

The Cadastre and Land Administration Thesaurus[6] (CaLAThe), is a thesaurus that presents and relates core concepts of the cadastral domain both from the legal and technical aspects in the SKOS format. Issued in 2011, it was originally intended as a core terminology, to alleviate terminological inconsistencies and support the development of a coherent and universal cadastral theory or cadastral ontology (cf. Çağdaş and Stubkjær, 2009). CaLAThe's initial version was based on the then draft version of ISO 19152 Land Administration Domain Model. However, it was including also terms from other thesauri, such as the AGROVOC, the GEMET with INSPIRE Spatial Data Themes, the STW Thesaurus for Economics, Cycorp's OpenCyc ontology, and United Kingdom's Integrated Public Sector Vocabulary. The current 4th version of CaLAThe includes almost 250 terms, organized through its top concepts that characterize the domain covered. The six top concepts of CaLAThe parts are: Activity, Information, Land, Law, Party, and Survey. CaLAThe is presently based on a dedicated web server, drawing SKOS-structured content from a MySQL database by means of php code. Moreover, term relations are depicted as graphs, provided through the GraphViz[7] visualization software.

LandVoc - the Linked Land Governance Thesaurus

LandVoc[8] is a thesaurus covering concepts related to land governance. It is built as a sub vocabulary of AGROVOC and is maintained by the Land Portal Foundation[9]. LandVoc consists of 310 concepts organized hierarchically under seven top concepts, namely land administration,

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[2] https://isotc211.geolexica.org

[3] https://osgeo.geolexica.org

[4] https://wiki.osgeo.org/wiki/Lexicon_Committee

[5] https://www.osgeo.org

[6] http://cadastralvocabulary.org

[7] https://www.graphviz.org

[8] https://landvoc.org

[9] https://www.landportal.org

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land equity, land governance, land management, land markets, land rights and land stakeholders. It is fully available in English, French, Spanish and Portuguese, and is presently translated into more languages (e.g. Khmer, Vietnamese, Burmese, Thai, Swahili, Hindi, Italian and Arabic). The content of LandVoc is updated periodically according to recommendations of the Community of Experts and in close coordination with the FAO AGROVOC editorial team. LandVoc thesaurus content is licensed under Creative Commons Attribution 3.0 IGO (CC BY 3.0 IGO). LandVoc is currently part of FAO's AGROVOC, which is aligned with other vocabularies like EUROVOC, Cadastre and Land Administration Thesaurus (CaLAThe), Chinese Agricultural Thesaurus (CAT), Aquatic Sciences and Fisheries Abstracts (ASFA), Linked Thesaurus fRamework for Environment (LusTRE), National Agricultural Library Thesaurus (NALT), United Nations Bibliographic Information System Thesaurus (UNBIS), General Multilingual Environmental Thesaurus (GEMET), etc. LandVoc can be explored through a SPARQL point and downloaded in Excel, CSW or RDF. (LandVoc.org)

LandVoc was created in 2012 and has been constantly developed since then. (Mey et al 2020). LandVoc builds on existing land glossaries, such as the FAO's Land Tenure Thesaurus (Ciparisse, 2003), the Land Administration Domain Model or the Global Land Indicators Initiative glossary. New concepts were added and translated to several languages. The full name for this set of land-governance related concepts is now called "LandVoc - the linked land governance thesaurus".

Basic Register of Thesauri, Ontologies & Classifications (BARTOC)
The Basic Register of Thesauri, Ontologies and Classifications[10] (BARTOC) is a general or reference terminology registry, developed by Basel University Library to describe KOSs in a uniform way, visualize them and to make them browsable for humans, foster interoperability and machine readability by utilizing Semantic Web standards. It provides academics, researchers, and practitioners with a multidisciplinary, multilingual tool that facilitates searching, finding, and browsing KOSs. Currently, BARTOC groups metadata of more than 2,800 KOSs and 87 other terminology registries in one place (Waeber & Ledl, 2018, p. 4-5).

AGROVOC Multilingual agricultural thesaurus
AGROVOC Multilingual agricultural thesaurus[11], shortly AGROVOC provides a vocabulary related to all areas of interest to FAO, such as food, nutrition, agriculture, forestry, fisheries, names of animals and plants, environment, biological notions, techniques of plant cultivation, etc. It was originally created to describe documents and other information resources for indexing and searching purposes, then linked to other multilingual knowledge organization systems. The AGROVOC includes about 38,000 concepts and 803,000 terms in 40 languages. Its concepts are organized under following top concepts: Activities, Entities, Events, Factors, Features, Groups, Location, Measure, Methods, Objects, Organisms, Phenomena, Processes, Products, Properties, Resources, Site, Stages, State, Strategies, Subjects, Substances, Systems, Technology, Time. The AGROVOC is available in RDF-SKOS format with various serializations of RDF (i.e. RDF/XML, N3, NQ, TRIX), and can be edited using VocBench 3, a web-based vocabulary management tool.

EuroVoc - the EU's multilingual thesaurus

EuroVoc[12] is a multilingual, multidisciplinary thesaurus managed by the Publications Office of the European Union (EU)[13] for processing the documentary information produced by EU institutions. The EuroVoc thesaurus is also based on SKOS. It's current version contains terms in 26 languages. EuroVoc concepts are organized under following top concepts: Politics; International Relations; European Union; Law; Economics; Trade; Finance; Social Questions; Education and Communications; Science; Business and Competition; Employment And Working Conditions; Transport; Environment; Agriculture, Forestry and Fisheries; Agri-Foodstuffs; Production, Technology and Research; Energy; Industry; Geography; International Organizations.

Other reference vocabularies include land related concepts, e.g., GEMET[14], STW Thesaurus for Economics[15], Agrisemantics Map of Standards[16], and the Agroportal[17] specifically developed for the agriculture and food domain.

3. EVALUATION of SEMANTIC RESOURCES

Soergel (2009) provides an exhaustive overview of the different types of KOSs, which among others presents functions of KOSs in design and decision making, collaboration, learning, scientific research, information retrieval, artificial intelligence, data modeling, interoperability, and natural language processing. He also presents a set of characteristics for the describing and evaluating KOSs including matters such as purpose of KOS, coverage of concepts and terms, conceptual analysis and conceptual structure, access and display, and update (Soergel, 2001).

Recently, Wilkinson et al. (2016) introduced FAIR Data Principles to improve Findability, Accessibility, Interoperability, and Reusability of digital assets. The notion of digital assets cover the algorithms, tools, workflows, analytical pipelines, technical specifications, standards, metadata, vocabularies, and ontologies (Zeng and Clunis, 2020, p. 97). The four foundational FAIR Data Principles are further detailed with 15 concrete and measurable guiding principles (Jacobsen et al., 2020). The Findability principle stipulates identification of (meta)data with unique and persistent identifiers, description of data with rich metadata records, and registration or indexation of data in a searchable resource. Accessibility requires a standardized communication protocol that allows the search of meta(data) by their identifier, and availability of metadata even when the data are no longer available. The third fundamental principle, Interoperability is about the representation of data. It recommends that (meta)data should be represented with a formal, accessible, shared, and broadly applicable language, and drawn on controlled vocabularies that follow FAIR principles. It also suggests that (meta)data should have qualified references to other (meta)data. Finally, the Reusability principle requires enrichment of meta(data) descriptions with accurate and relevant attributes, which enable assessment of the discovered resource is appropriate for reuse for a specific task.

Zeng and Clunis (2020), discuss FAIR Data Principles in the case of Linked Open Data (LOD) KOS vocabularies. They recommend that LOD KOS vocabularies follow the FAIR principles

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[12] https://op.europa.eu/en/web/eu-vocabularies

[13] https://op.europa.eu/en/home

[14] https://www.eionet.europa.eu/gemet/en/themes/

[15] https://zbw.eu/stw/version/9.10/about.en.html

[16] https://agrisemantics.org

[17] http://agroportal.lirmm.fr

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to improve findability, accessibility, interoperability, and to enable reuse of any digital assets owned. Additionally, a LOD KOS should be Functional, Impactful, and Transformable. Functionality means that the vocabulary is made available in ways that enhance its inherent purpose, while the Impactful refers to maximization of the impact of a LOD KOS vocabulary. Transformability is about expanding the functionality and impact through innovative adaptations (Zeng and Clunis, 2020).

The above-mentioned evaluation approaches and criteria suggest an exhaustive review for the KOSs being introduced in Section 2. However, in the following, we provide a modest review of the KOSs related to the FIG community (cf. Table 1, below). A more detailed evaluation based on the available scientific methodologies is postponed to further research.

We think that BARTOC provides a gateway to available KOSs, therefore it may be considered a 'semantic portal' to access more specific vocabularies within the land and geospatial domains. It supports initial investigation of a topic and reveals available semantic resources for further investigations. If the subject is about geospatial standards, then ISO/TC Geolexica and OGC Definitions Server should be consulted to get terms and definitions used in ISO and OGC standards, especially for the users at more advanced levels. Among the reviewed semantic resources AGROVOC is the most comprehensive thesaurus for land domain, focusing on agriculture and neighbor subdomains, including about 38.000 concepts and 800.000 terms in about 40 languages. The FAO community also provides valuable semantic resources about the food and agriculture domain, such as the Agrisemantics portal and the Agroportal. However, these resources will not be further detailed here. Finally, we have two more specific thesauri in the land domain, the LandVoc, and CaLAThe. The former, which is a subscheme of AGROVOC, is related to land governance; while the latter CaLAThe is related to the administrative, legal and geographical aspects of cadastre and land administration domain. These thesauri have some commonalities in terms of subject areas, yet with different levels of detail; therefore, they can support each other. LandVoc has a wider coverage and therefore may provide a road map to users having different expertise areas (e.g. agriculture, law, geography, spatial planning); while CaLAThe seems more convenient to the surveyors and lawyers working in the cadastre and land administration domain.

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Table 1. A comparison of KOSs related to the land and geospatial domains

Semantic resource	Type	Domain	Multilingually	Format	Graphical visualization	Mapping to other KOSs	User level	Definitions
ISO/TC211 Geolexica	KOS registry	Geospatial - ISO	Yes	SKOS RDF/XML, JSON	No	No	Advanced	Yes
OGC Definitions Server	KOS registry	Geospatial - OGC	No	SKOS RDF/XML, JSON	No	No	Advanced	Yes, partly
CaLAThe	Thesaurus	Land - Land administration	Yes, limited	SKOS RDF/XML	Yes	Yes	Advanced	Yes, partly
LandVoc	Thesaurus	Land - Land governance	Yes	SKOS RDF/XML, Excel, CSV	No	Yes	All levels	No
BARTOC	KOS registry	Multidisciplinary	Yes	SKOS RDF/XML, JSKOS	No	Yes	All levels	-
AGROVOC	Thesaurus	Land - Agriculture	Yes	SKOS RDF/XML	No	Yes	All levels	No
EuroVoc	Thesaurus	General	Yes	SKOS RDF/XML	No	Yes	All levels	Yes

4. USE of SEMANTIC RESOURCES

The above-mentioned semantic resources may be used occasionally, but consciousness of the vocabulary used in e.g. a project report supports the learning process, potentially increases the readability of the report, and hence advances merit. The following section therefore presents guidelines on how to develop a project-specific vocabulary by using open-source software tools and terminological resources. A subsequent section describes another use of geospatial semantic resources, namely how CaLAThe may be used as a general frame for national management of code list

4.1 Use of semantic resources for research and student projects

The guide sets out by presenting a set of concepts which applies to terminology work. This set of concepts is structured through the use of software, and the outcome is discussed. This approach may then be repeated for the project at hand.

Terminology applied for terminology work

Terminology work is work concerned with the systematic collection, description, processing and presentation of *concepts* and their *designation*. A *Concept* is a unit of knowledge created by a unique combination of characteristics. Concepts correspond to *Objects*. An *Object* is anything perceivable or conceivable; thus, objects can be material (e.g. 'engine', 'sheet of paper', 'diamond'), immaterial (e.g. 'conversion ratio', 'project plan') or imagined (e.g. 'unicorn', 'scientific hypothesis'). The *Designation* of a concept may be a symbol, e.g. a (pedestrian) traffic sign, or a *Term*, which represents the concept by linguistic means, or - in SKOS terminology - by lexical labels, including *prefLabel* for preferred term, and *altLabel* for e.g. synonymies. Moreover, SKOS applies the codes: *broader* and *narrower*, to indicate a hierarchical relation between two concepts, while *related* indicates an associative link between two concepts.

A *Definition* is a representation of a concept by an expression that describes it and differentiates it from related concepts. The *Source* of these definitions is ISO 1087:2019 (en) Terminology work and terminology science.

Terminology work results in a *Terminology resource*, a collection of terminological entries. A *Vocabulary* is a terminology resource that contains designations and definitions. A *Thesaurus* is a terminology resource in which concepts are represented by terms, organized so that relationships between concepts are made explicit, cf ISO 25964-1:2011(en) Information and documentation — Thesauri and interoperability with other vocabularies.

Use of semantic resources

Software tools for terminology work

A visual presentation of the above terminology terms and their relations may be provided by entering terms, definitions and relations, as well as URI for every concept into an excel sheet with a predefined structure, as described at Software tools for terminology work http://labs.sparna.fr/skos-play/. The Sparna SKOS Play (free) application transforms the excel file into a SKOS compliant format, which then can be visualized as a list with terms and definitions, etc., or alternatively as a graph.

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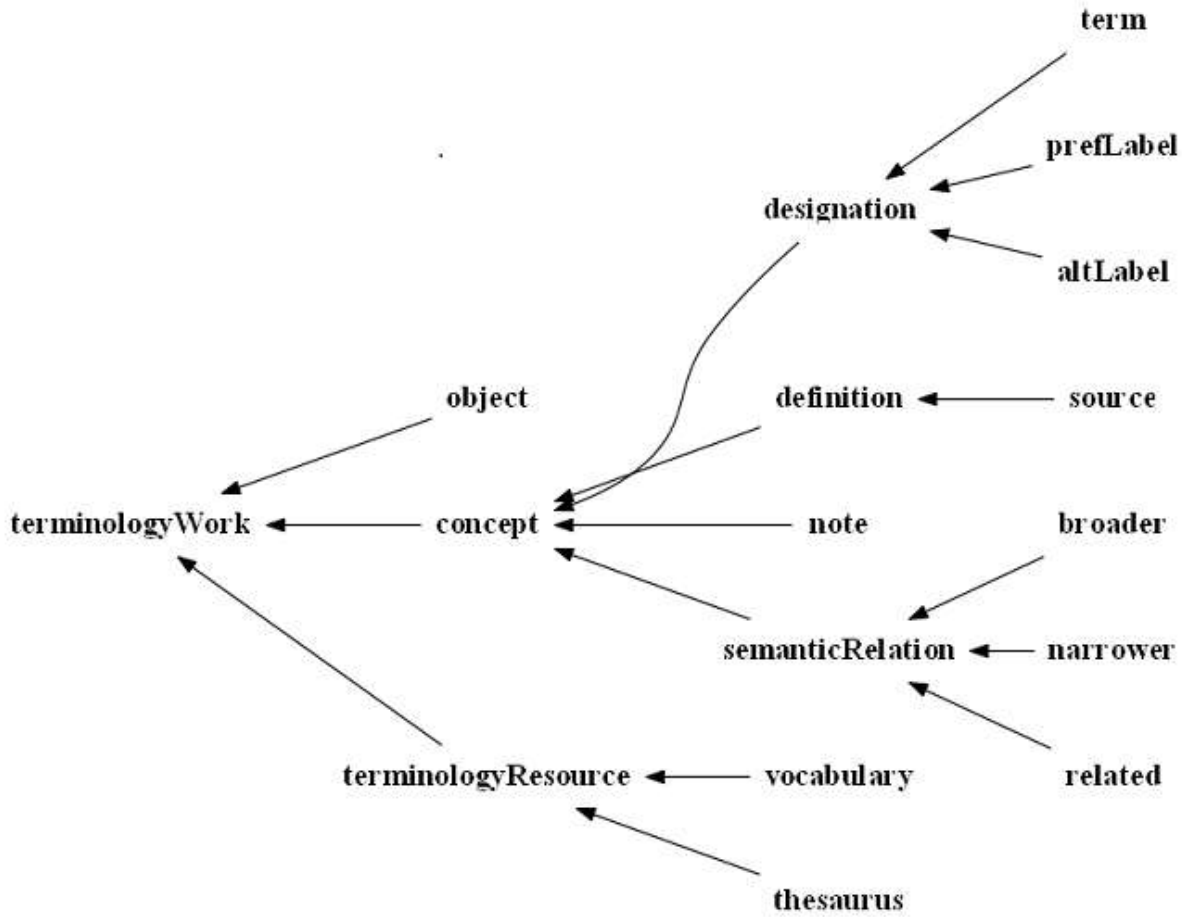
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Figure 1. Terminology Terms, visualized by means of GraphViz

Mention is made that concept relations may be depicted by the (free) GraphViz[18] software. However, an important difference between GraphViz and SKOS Play is that SKOS Play facilitates the rendering of an URI to every concept, in accordance with the principles of semantic web / linked data. These principles are now generally followed, when more permanent terminology resources are developed and curated.

In Annex A, more details are presented, including a link to the above-mentioned excel sheet with terms and definitions, etc.

4.2 Use of a domain thesaurus for the development of country profiles

The domain of Land Administration is reflected in two international standards: The ISO 19152:2012 Land Administration Domain Model (LADM), and the OGC Land and Infrastructure Conceptual Model Standard (LandInfra) (2016) with the corresponding OGC InfraGML Encoding Standard (2017). The Cadastre and Land Administration Thesaurus (CaLAThe) includes concepts from both standards, and thereby provides for a mediating platform (Stubkjær & Çağdaş, 2021). Both ISO LADM and OGC LandInfra include a number of code lists, which supplement the basic classes and relations of the standards. As of 2019 (version 4), CaLAThe includes the relevant code lists of LandInfra, and - as proof of concept -

the LADM code lists. The code lists are available through the BARTOC Skosmos Browser

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[18] https://graphviz.org

and the OGC Definition Server, cf Figure 2. LADM is presently being reviewed; when the new version is adopted, the remaining code lists will be included in CaLAThe.
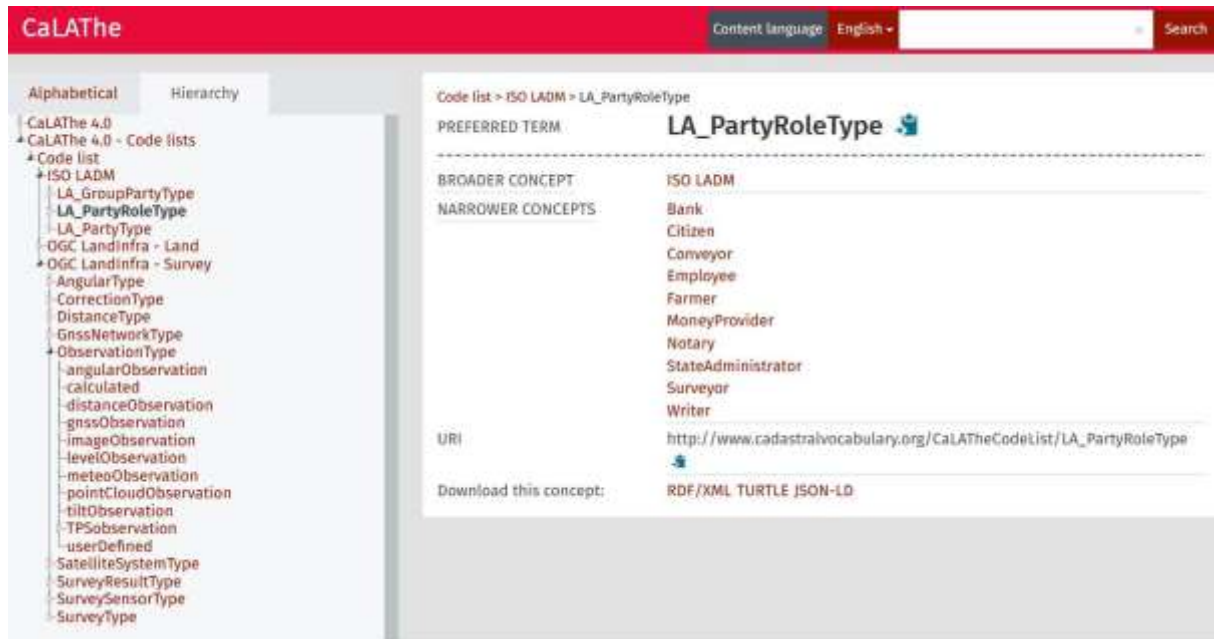

Figure 2. Screenshot excerpt of CaLAThe with code lists: LADM PartyRoleType and OGC LandInfra Survey ObservationType, as rendered by BARTOC Skosmos Browser. Clicking the black and white triangles enables navigation in the hierarchy.

While OGC LandInfra/InfraGML provides for encoding specifications, ISO LADM is a reference model, which has to be supplemented with country profiles. A methodology for development of country profiles is proposed (Kalogianni et al, 2019). Basically, the conceptual modelling starts by inheriting from LADM core classes the relevant country-specific classes, adding classes and attributes as needed, and extending the set of code lists of the informative Annex J of LADM with code list values as needed. The potential of semantic technologies is acknowledged, and specifically, CaLAThe is mentioned as a means, also for potential joint code list management (Kalogianni et al, 2019; Stubkjær et al, 2018; 2019).

The benefit of using semantic technology in terms of CaLAThe includes that code list values may be added directly to CaLAThe as ordinary concepts with semantic relationships broader and narrower, and with optional definitions, e.g. drawn from the ISO/TC 211 Geolexica vocabulary (Stubkjær & Çağdaş, 2021). This supports the development and use of a precise and shared terminology, with implications both for routine processes and for research in institutional arrangements within the domain.

5. CONCLUSIONS

Land is a topic that is debated in many languages, across different (academic) disciplines, and in all parts of the world. Furthering a collective agenda, sharing and learning from knowledge and perspectives from other contexts, or transitioning technological innovations from one country to the other is complicated by - among many other aspects - language and terminology barriers. Several Knowledge Organization Systems (KOSs) have been developed not only to eliminate the above-mentioned communication problems but also to enable Semantic Web and Linked Data implementations. This paper briefly documents and evaluates the content of KOSs

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which may be useful for the FIG community and more specifically for the people working in the land administration sector.

A brief review of the selected KOSs indicates that Basic Register of Thesauri, Ontologies & Classifications (BARTOC), which includes any kind of KOS from any subject area, in any language, any publication format, could be considered as a gateway to access available semantic resources. As for terms and term definitions used by the international geospatial standards issued by the International Organization for Standardization (ISO) and the Open Geospatial Consortium (OGC), people are referred to ISO/TC Geolexica and OGC Definitions Server. Semantic resources in the domain of land administration are represented by LandVoc - the linked land governance thesaurus, and Cadastre and Land Administration Thesaurus (CaLAThe). We think that LandVoc may serve a wider community covering experts from, e.g. agriculture, law, geography, spatial planning fields; while CaLAThe serves the professionals having surveying, law, and public administration background.

The above-mentioned review also showed that KOSs related to land administration, namely CaLAThe and LandVoc should be supported with concept definitions to fulfill their functions. ISO 704:2009 'Terminology work - Principles and methods' provides detailed specifications for concept definitions, and states that intensional definitions (also known as genus-differentia definitions) are the most explicit and precise method of concept definition (ISO, 2009, p. 22). An intensional definition consists of two parts. A basic part states the superordinate concept to which the concept belongs (genus), and a second part enumerates the delimiting characteristics (differentia), which distinguish this concept from its coordinate or related concepts (ISO, 2011, p. 26). The reader is also referred to Seppälä et al. (2017) for detailed guidelines about genus-differentia definitions. This paper thus concludes with a call for the development of genus-differentia definitions for the domain concepts to improve communication between parties and to provide a scientific base for further research and teaching in the domain of land administration.

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ANNEX A: STEPS in DEVELOPING a PROJECT-SPECIFIC VOCABULARY

Vocabulary development has to fit the development path of the project concerned. Many project models exist; here the project- and problem-based learning (PBL) approach applied at Aalborg University, supported by the UNESCO centre, is taken as reference. The development path of a semester project, performed by a group of say three to six B.Sc. or M.Sc. students, may have the following steps:

1. Select topic/ question/ issue/ contradiction to explore
2. Delimit through problem formulation
3. Decide on theories, methods, disciplines to apply (typically selected from semester/ study unit courses)
4. Identify literature to be read, and who reports reading of what to the group
5. Collect, analyse and structure evidence/ empirical data to obtain answer or solution to the stated problem.
6. Write project report on the above process, including critical assessment of the proposed path to solution, as well as literature review.
7. Add reflection on related problems/ social context and on the learning process

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The first four steps may be iterated, until (2) Problem formulation is decided definitively. Then is the time to establish the first word list. While reading (4) and analyzing (5), it makes sense to group the words into clusters or otherwise identify a structure/ network of word or concept relations. In the context of writing on theoretical issues (6), if not before, it is relevant to write the definitions of the central concepts of the project. General terminology resources (see section 2 of the article) support the linking of project terminology to terminology resources of the relevant scientific discipline(s).

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The terminology terms and definitions, mentioned in section 4.1., are available in an excel sheet at https://cadastraltrees.aau.dk/Temp/ProjVoc.xlsx, ready for exploring at the mentioned http://labs.sparna.fr/skos-play/

The corresponding file in the dot language, to be rendered by GraphViz is available at https://cadastraltrees.aau.dk/Temp/TerminologyTerms.gv

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BIOGRAPHICAL NOTES

Volkan Çağdaş is associate professor for cadastre and land administration at Yildiz Technical University, Department of Geomatic Engineering, Istanbul / Turkey. He has been teaching cadastre, immovable property law, land re-adjustment, real estate valuation, and land information management systems at undergraduate and graduate levels. His research interest focuses on the technical and the institutional aspects of cadastre and land administration.

Laura Meggiolaro is Team Leader at the Land Portal Foundation. Over the past 16 years Laura has been working mainly for the land governance sector specialising in information and data management for development with an increasing interest in Open Data, semantic technologies and open standards. She holds a master in communication science and master in economics for developments. Since 2011 Laura has been responsible for the overall management, implementation and expansion of the Land Portal contributing to the process that has seen the Land Portal evolving from a project into the independent organization that maintains the Land Portal website: the single one-stop-shop about land governance data and information and a vibrant convening and knowledge exchange platform that promotes transparency and modern open data ecosystems. Prior to coming to the Land Portal Foundation, she has been working with the Food and Agriculture Organization, ILC at the International Fund for Agricultural Development and ActionAid International, specialising in information and knowledge management for land rights.

Erik Stubkjær is emeritus professor, having served as professor of cadastre and land law at Department of Development and Planning, Aalborg University 1977 – 2008. He is engaged in standardization activities, contributing to the OGC standards LandInfra and InfraGML (2016/17). He graduated as land surveyor in 1964 and obtained his Ph.D in 1969. During 1979-1988, he was a member of the Tribunal of the Danish Association of Chartered Surveyors.

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