A Knowledge Organization System for the Development of an ISO 19152:2012 LADM Valuation Module

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SUMMARY

The challenge to develop interactive information services for new domains is supported by Knowledge Organization Systems and Services (KOS), which model the underlying semantic structure of a domain through classification systems, thesauri, gazetteers, or ontologies. The ISO 19152:2012 Land Administration Domain Model (LADM) is an international standard regarding the management of information about ownership, value and use of land. The current version of LADM addresses legal and administrative aspects; the standard revision starts in 2017, according to ISO's periodic maintenance procedure. A group of researchers have initiated the development of a valuation component of LADM in terms of a draft extension module. It concerns the fiscal parties involved in the valuation practices and fiscal real property units that are the objects of valuation (see Çağdaş et al., 2016). The present paper aims at supporting this initiative by providing a domain vocabulary and thesaurus. The presented Valuation Thesaurus is developed according to the ANSI/NISO Z.39.19-2005 'Guidelines for the Construction, Format, and Management of Monolingual Controlled Vocabularies' and includes terms derived from international valuation standards, such as European Valuation Standards (TEGoVA, 2012), International Valuation Standard (IVSC, 2013), Standard on Mass Appraisal of Real Property (IAAO, 2013a), Standard on Automated Valuation Models (2003), Standard on Ratio Studies (IAAO, 2013b). It is encoded through the Simple Knowledge Organization Systems (SKOS) specifications developed by World Wide Web Consortium (W3C) for standardized representation of structured vocabularies. The Valuation Thesaurus reveals the core semantic of the immovable property valuation domain, and therefore supports the identification of candidate classes, class attributes and relationships for the further elaboration of the mentioned LADM Valuation Module.

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1. INTRODUCTION

The ISO 19152:2012 Land Administration Domain Model (LADM) is an international standard regarding the management of information about the relationships (formal, informal and customary) between people and land. The current edition of LADM addresses geometry, surveying/mapping and legal/administrative aspects; the standard revision starts in 2017, according to ISO's periodic maintenance procedure. A recently initiated collaborative research aims at developing a LADM based international information model for one of the current 'LADM external' classes[1] (included in external databases), namely in terms of a Valuation Module.

The purpose of the mentioned research is to define the semantics of valuation information, and to extend the scope of LADM with a fiscal perspective to provide an information model that could be used to construct information systems for immovable property valuation.

The present paper aims at supporting this initiative by providing a knowledge organization system (KOS) for immovable property valuation, and represents it through a Simple Knowledge Organization System (SKOS), according the specifications developed by the World Wide Web Consortium (W3C). The main purpose is to reveal the semantic structure of a domain with the developed KOS which may assist the identification of candidate classes, class attributes and relationships for the further elaboration of LADM Valuation Module. The developed KOS includes terms derived from international valuation standards, such as European Valuation Standards (TEGoVA, 2012), International Valuation Standard (IVSC, 2013), Standard on Mass Appraisal of Real Property (IAAO, 2013a), Standard on Automated Valuation Models (2003), Standard on Ratio Studies (IAAO, 2013b).

The remaining part of the paper is organized as follows: Section 2 outlines types of KOSs and section 3 renders the adopted methodology for the development and representation of KOSs. Section 4 describes the developed Immovable Property Valuation Thesaurus, and the last section suggest further research and concludes the present paper.

2. KNOWLEDGE ORGANIZATION SYSTEMS

[1] LADM external databases may concern party data, address data, taxation data, land use data, land cover data, valuation data, physical utility network data, and archive data.

A knowledge organization system is a general term which refers to tools that present the organized interpretation of knowledge structures (Zeng, 2004, p. 377). It covers all types of schemes for organizing information and promoting knowledge management, such as (i) term lists, (ii) classifications and categories, and (iii) relationship lists (Hodge, 2000, p.4).

The first group of KOS, *term lists* comprises of *glossaries*, *dictionaries* and *gazetteers*. Glossaries and dictionaries are lists of terms with definitions. Dictionaries are more general in scope than are glossaries, and they may also provide information about the origin of a word, variants (by spelling and morphology), and multiple meanings across disciplines. (Miguel, 2009, p. 17). A gazetteer refers a list of place names (Hodge, 2000, p. 5). The second group of KOS, *classifications and categories* includes *subject headings* and *taxonomies* (Hodge, 2000, p. 6). These models are more complex than the first group of KOS, because of their hierarchical structure. A subject heading is a uniform group of words used to describe the subject of library materials, while a taxonomy is a controlled vocabulary consisting of preferred terms, all of which are connected in a hierarchy or polyhierarchy (ANSI/NISO Z39.19-2005, p. 18). The last group of KOS, *relationship lists* comprises of *thesauri* and *ontologies* (Hodge, 2000). A thesaurus was defined by ISO-2788 as a set of terms, formally organized so that the a priori relationships between these are made explicit. Relationships commonly expressed in a thesaurus include hierarchy (broader-narrower), equivalence (synonymy), and association or relatedness (Hodge, 2000, p. 6 ; see Clark and Zeng, 2012, for an update). The last type KOS, an ontology is an explicit formal specification of a shared conceptualization. It is used in information systems and in knowledge representation systems to denote a knowledge model, which represents a domain of interest (Gruber, 1993).

Among these KOSs, taxonomies, thesauri and ontologies are most commonly used schemas for modeling of knowledge domains (cf. Schwarz, 2005; van der Meer, 2008). A taxonomy is a rough modelling scheme because it only connects terms to each other with a hierarchical relationship, whereas a thesaurus is more specific, because it also offers equivalence and associative relationships. An ontology, however, is most precise because it defines the meaning of concepts by modelling properties that constrain the possible interpretations of a concept (Schwarz, 2005, p. 19). However the great size of the required models increases too much the complexity and cost of the ontology development process. Thesauri, on the other hand, provide a weaker semantics but they are simpler to create and bigger models are affordable (Miguel 2009, p. 13). They are also seen the core building block of ontologies (Ma *et al.* 2011, p. 1603). This research, therefore aims at constructing a thesaurus for the domain of immovable property valuation, and thereby further ontology building.

In the current version of the ISO LADM standard, there are sample values for the various code lists with types of rights, restrictions and responsibilities (LA RightType, LA RestrictionType, LA ResponsibilityType). Despite their importance, the code lists are in the informative part of the standard (and not in the normative part) and the values for the various types are just indicated by a single name (label) without definitions. An initial attempt to use sematic technologies, ranging from hierarchically structured code list to the RDF vocabulary

SKOS (see section 3.3), for structuring and maintaining LADM code lists was proposed ontologies (Paasch et al. 2015). The paper proposed the following rule: if ‘things’ are structurally different, i.e. different attributes/properties and/or different relationships, then adding a new class would be most appropriate, otherwise it is better to consider adding well-structured code list values (based on semantic technology). Adding refined meaning to the LADM code lists, covering both formal and informal registration of rights, restrictions and responsibilities, is a next step in the direction of international harmonization of the administrative/legal interests in land administration.

3. THESAURUS CONSTRUCTION

This paper follows the principles proposed by ANSI/NISO Z.39.19-2005 ‘Guidelines for the Construction, Format, and Management of Monolingual Controlled Vocabularies’, and organizes the thesaurus construction processes into the following stages: (i) Term selection, (ii) Identification of semantic relationships, and (iii) Specification of these relationships. The general content of these stages is summarized in the following sub-sections which will constitute the base for the methodology employed in Section 4.

3.1 Term selection

The first step of the thesaurus construction is the selection of a set of candidate terms. According to ANSI/NISO Z39.19-2005, the candidate terms could be selected by the committee method, the empirical method, or a combination of these methods (p. 91). In the committee method, domain experts draw up a list of key candidate terms and indicate the relationships among them, whereas in the empirical method extracts terms from documents, either manually by humans, or automatically by use of computers. Candidate terms could be derived from ‘prearranged standardized sources’ and ‘open-ended non-standardized sources’ (Soergel, 1974). Prearranged sources are already existing descriptor lists, classification schemes, thesauri, dictionaries, etc. On the other hand, open-ended sources consist of written sources and unwritten sources. The most traditional written sources are documents within a subject literature, where terms are selected from titles, abstracts, paragraphs, or the full-text (Schneider, 2004, p. 25-27).

3.2 Identifying semantic relationships

ANSI/NISO Z39.19-2005 defines three types of relationships used in controlled vocabularies: (i) Hierarchy, (ii) Equivalency, and (iii) Association (p. 42). A thesaurus includes all these relationships. This hierarchical relationship is represented using the notation BT (broader term) and NT (narrower term). There are three types of hierarchical relationship: the generic relationships, the instance relationships and the whole-part relationships. The *generic relationship* identifies the link between a class and its members or species, while *instance relationship* describes the link between a general category of things or events. *Whole-Part relationship* covers situations in which the meaning of one concept is inherently included in another one so that the terms can be organized into logical hierarchies, with the whole treated as a broader term (ANSI/NISO Z39.19-2005, 2005, p. 48-49).

In addition to hierarchical relationship, a thesaurus also includes equivalence and association relationships. The equivalence relationship is the reciprocal relation between preferred term (PT) and non-preferred terms (NPT) where two or more terms are regarded as referring to the same concept. It covers synonyms, lexical variants, near-synonyms, generic posting, and cross reference to elements of compound terms (ANSI/NISO, Z39.19-2005, p. 43). The other type of relationships included by a thesaurus is the association relationship. An association relationship covers associations between terms that are neither equivalent nor hierarchical, yet the terms are semantically or conceptually associated. The most common associative relationship used in thesauri is symmetrical and is generally indicated by the abbreviation RT (related term) (ANSI/NISO Z39.19-2005, 2005, p. 51).

3.3 Specification: Simple Knowledge Organization System (SKOS)

The Simple Knowledge Organization System is a common data model for expressing the basic structure and content of concept schemes such as thesauri, classification schemes, subject heading lists, taxonomies, and other similar types of controlled vocabulary. Since the SKOS data model is an application of the Resource Description Framework (RDF), it enables machine-readable representation of a KOS, and allows sharing and linking KOSs via the Web (Isaac and Summers, 2009; Miles and Bechhofer, 2009). Because of its simplicity and advantages relative to other KOS representation formats (cf. Pastor-Sanchez et al., 2009), nowadays the SKOS data model has been increasingly used in the encoding of existing KOSs e.g. GEMET (General Multilingual Environmental Thesaurus), AGROVOC (Multilingual Agricultural Thesaurus), and the Cadastre and Land Administration Thesaurus (CaLAThe).

The general content of the SKOS data model is summarized below based on W3C Specifications of SKOS (Simple Knowledge Organization System Reference, 2009; SKOS Simple Knowledge Organization System Primer, 2009).

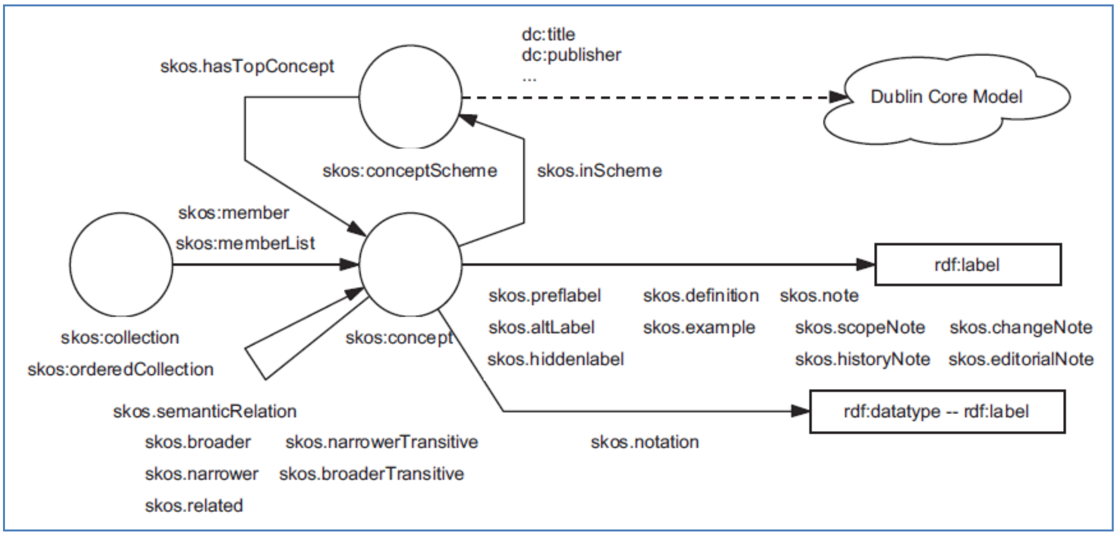

Figure 1. SKOS data model

The components and relationships between the components of the SKOS data model are summarized in SKOS Reference as following: *"Using SKOS,* ***concepts*** *can be identified using URIs,* ***labeled*** *with lexical strings in one or more natural languages, assigned* ***notations*** *(lexical codes),* ***documented*** *with various types of note,* ***linked to other concepts*** *and organized into informal hierarchies and association networks, aggregated into* ***concept schemes****, grouped into labeled and/or ordered* ***collections****, and* ***mapped*** *to concepts in other schemes."*

SKOS represents the elements of a KOS as *concepts*, provides them with various kinds of *labels* and *documentation notes*, and allows linking them together by three types of *semantic relations.* A SKOS concept, *skos:Concept* is the basic element of the SKOS data model, and it represent units of thought, ideas, meanings, or (categories of) objects and events. A SKOS concept scheme, *skos:ConceptScheme* is an aggregation of one or more SKOS concepts. These SKOS concept schemes and SKOS concepts are identified by URIs, enabling anyone to refer to them unambiguously from any context, and making them a part of the World Wide Web.

SKOS concepts can be labelled with any number of lexical strings in any natural language. SKOS provides three properties to attach labels to concepts, namely preferred term (*skos:prefLabel*), alternative term (*skos:altLabel*), and hidden label (*skos:hiddenLabel*). The first property is used for assigning a preferred lexical label to a concept, while the second one is used for alternatives of preferred label, e.g. synonyms. The last one is used in order to make concepts accessible by for instance misspelled variants of other lexical labels.

SKOS concepts can be **linked** to other SKOS concepts via semantic relation properties. There are two types of semantic relation properties: **hierarchical** and **associative**. A hierarchical link between two concepts indicates that one is in some way more general ("broader") than the other ("narrower"). An associative link between two concepts indicates that the two are inherently "related", but that one is **not** in any way more general than the other. The properties *skos:broader* and *skos:narrower* are inverse relations, and used to assert a direct hierarchical link between two SKOS concepts. While, the property *skos:related* is used to assert an associative link between two SKOS concepts.

There are seven documentation notes in SKOS for providing information relating to SKOS concepts. For instance, the *skos:scopeNote* supplies some information about the intended meaning of a concept. The *skos:definition* is used for giving a complete explanation of the meaning of a concept. The *skos:example* supplies an example of the use of a concept, and *skos:historyNote* describes changes to the meaning or the form of a concept.

SKOS concepts can be **mapped** to other SKOS concepts in different concept schemes. The properties *skos:broadMatch* and *skos:narrowMatch* are used to state a hierarchical mapping link between two concepts, while *skos:relatedMatch* is used to state an associative mapping link between two concepts. The *skos:closeMatch* is preferred to link two concepts that are sufficiently similar, while *skos:exactMatch* is used if two concepts are exactly matching.

4. A THESAURUS for the DOMAIN of IMMOVABLE PROPERTY VALUATION

In the research for this paper we adopted the committee method, more specifically 'prearranged standardized sources', as introduced in Section 3.1. In recent years, a number of standards have been developed by valuation organizations, namely

- Standard on Automated Valuation Models (IAAO, 2003)
- Standard on Mass Appraisal of Real Property (IAAO, 2013a)
- Standard on Ratio Studies (IAAO, 2013b)
- European Valuation Standards (TEGoVA, 2016)
- International Valuation Standard (IVSC, 2016)

In the first stage, the candidate terms for the immovable property valuation domain were derived by the empirical method mentioned in Section 3.1. The employed empirical method involves a manual term extraction process. In this process, total 522 terms which represents main valuation concepts and terms that represent factors affecting property values were derived from the glossaries and the main text of the international valuation standards. The manually extracted terms were analyzed and edited from a linguistic perspective, including elimination of repeated terms, control of the grammatical forms, spelling variants, singular and plural forms, abbreviations and acronyms, punctuation and capitalization (cf. Schneider, 2004, p. 28). Moreover, a number of terms which are mainly related to financing, land surveying, and statistics were eliminated from the vocabulary. During the next stage, the semantic relationships between the remaining 139 terms (i.e. hierarchical, equivalency and association relationships) were specified according to the principles explained in Section 3.2. Finally, the developed thesaurus was encoded through the SKOS formalism outlined in Section 3.3.

4.1 Description of the Immovable Property Taxation Thesaurus

This section presents a narrative description of the valuation domain with the terms of developed Immovable Property Valuation Thesaurus (IPVT).

Immovable property valuation or *Real estate appraisal* is performed by *Valuer* or *Appraiser* employed within a public or private organization to estimate *Value* of immovable properties for several public and private purposes, such as property taxation, expropriation, land use planning, real estate financing, investment analysis, insurance and further property transactions (see, Figure 2).

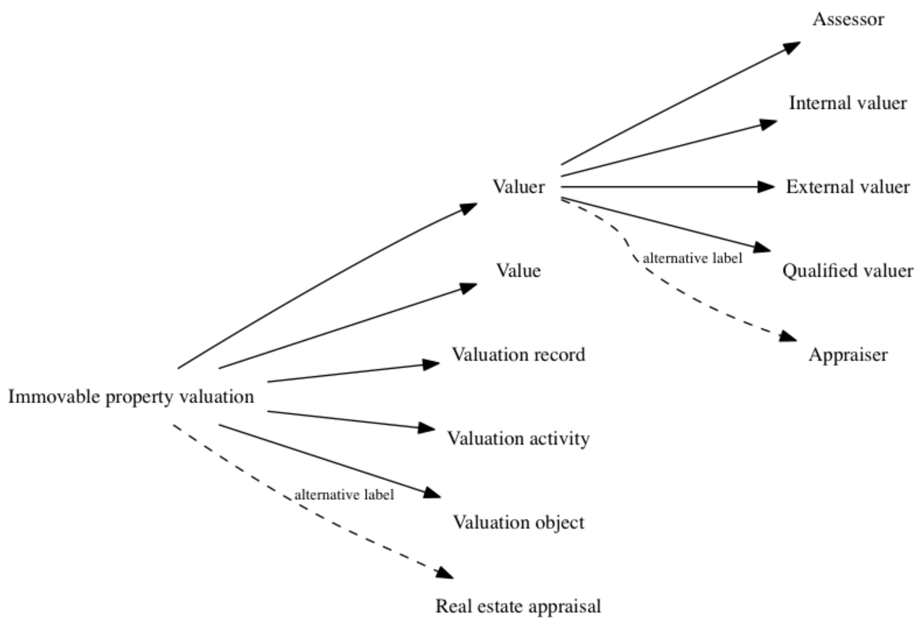

Figure 2. The Valuer concept

The term of *Value* refers to the relationship between an object desired and a potential owner (IAAO, 2013a; 2013b), and can be decomposed into several value types according to different legislations and requirements, such as *Acquisition value*, *Alternative use value*, *Appraised value*, *Assessed value*, *Base year value*, *Fair value*, *Hope value*, *Insurable value*, *Investment value*, *Market value*, *Mortgage lending value*, *Synergetic value*, *Net present value*, *Reconstruction value*, *Residual value*, *Reversionary value*, *Special value*, *Use value*, and *Plottage value* (see, Figure 3).

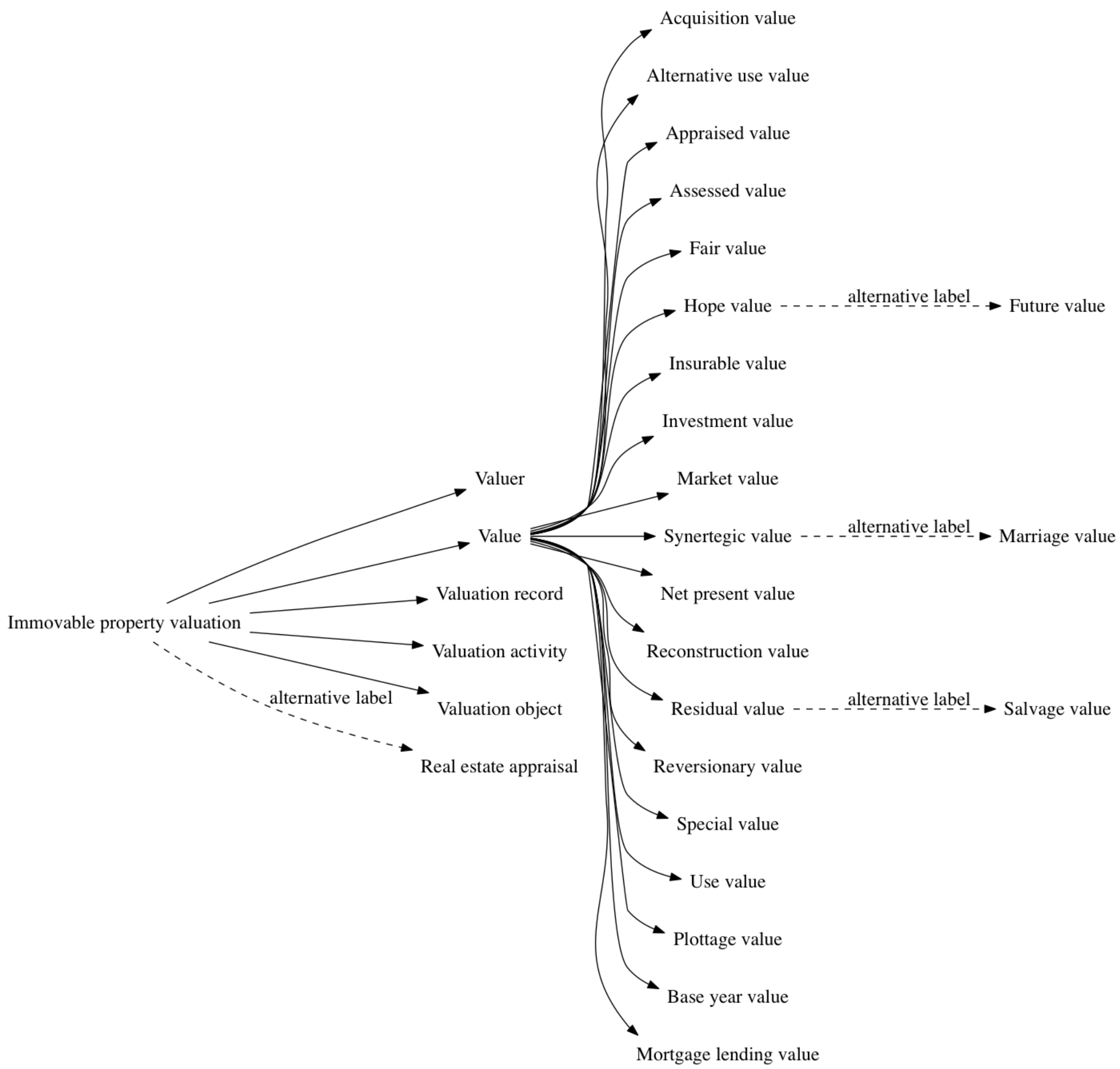

Figure 3. The Value concept

As illustrated in Figure 4, the object of valuation is the *Immovable property* or *Real estate* which consists of one or more *Parcel*(s) and the *Construction*(s) built on the *Parcel*(s). These objects have characteristics that should be considered the in *Immovable property valuation*, such as *Parcel area*, *Land use* and *Topography* for the *Parcel;* and *Chronological age*, *Size* and *Construction quality* for the *Construction*. Moreover, selection of the *Valuation approach* to be employed requires classification of the *Immovable property* according to its use, for instance *Residential property*, *Commercial property*, and *Mixed residential and commercial property* (cf. IAAO, 2013a).

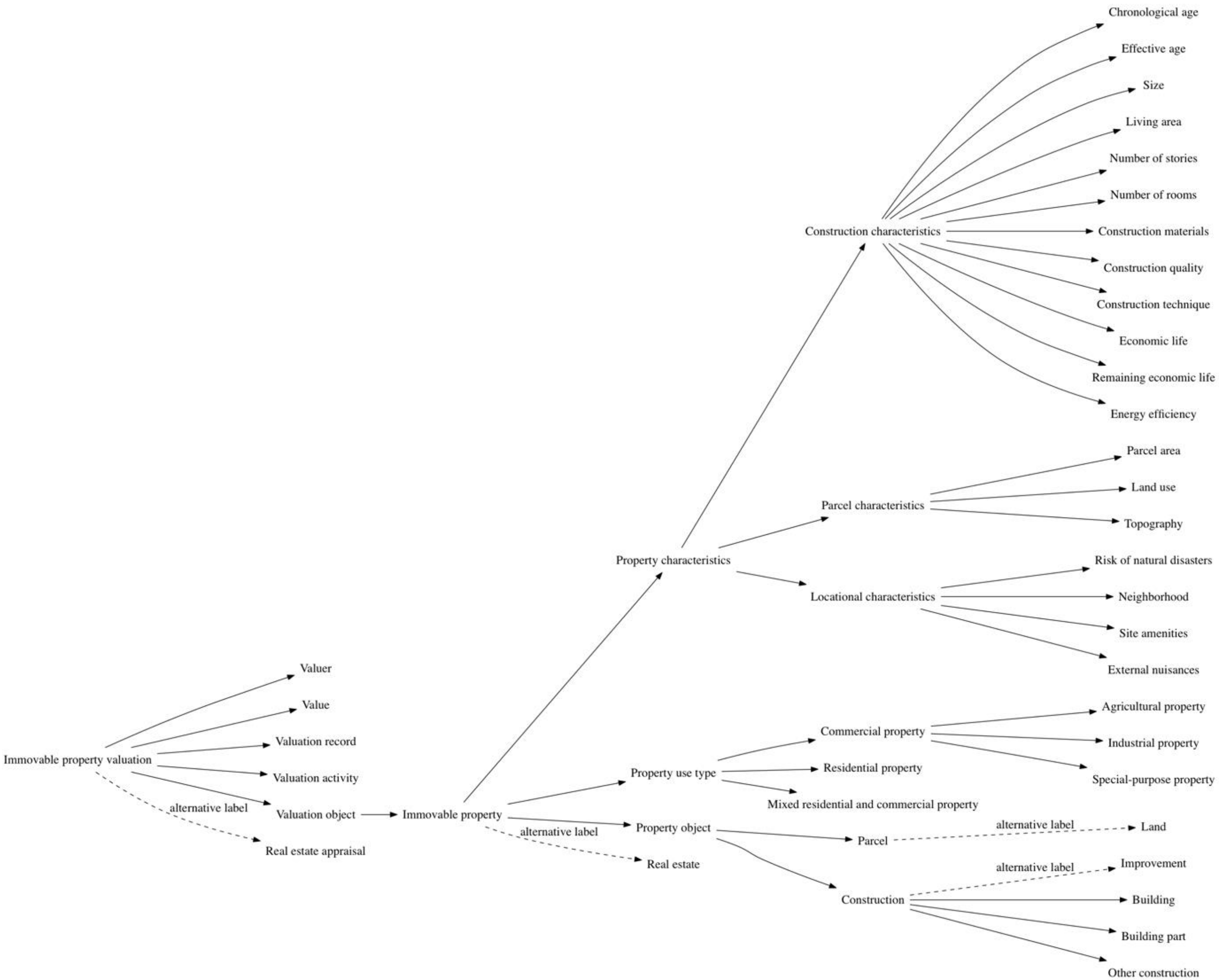

Figure 4. The valuation object concept

The *Valuation activity* term illustrated in Figure 5 covers *Valuation approach*es, *Single property appraisal, Mass appraisal* and *Valuation date*. The *Valuation approach* specifies the *Sales comparison approach,* the *Cost approach* and the *Income approach,* terms that represent the traditional valuation approaches or methods, used in both *Single property appraisal* and *Mass appraisal*.

The *Sales comparison approach* compares the subject property with other similar properties that have been recently sold which are termed as *Comparable sales*. It estimates the *Value* of the subject property by making *Adjustments* in the *Sale*s *price*s of the comparable properties in terms of their differences from the subject property. *Adjustments* are usually made for the *Sale date*, location and physical characteristics (e.g. *Parcel characteristics*, *Construction characteristics,* and *Locational characteristics*) (IAAO, 1999).

The *Cost approach,* which is also known as the *Summation approach,* provides an indication of the *Value* based on the economic principle that a buyer will pay no more for a property than the cost to obtain a property of equal utility (TEGoVA, 2016). According to this, the *Market value* of an improved parcel can be estimated as the sum of the value of the *Parcel* and the depreciated value of *Construction*s (Eckert et al., 1990, p. 205). A differentiated version of the *Cost approach*, the *Abstraction method* or *Residual method* can also be used for valuation of unimproved land in the absence of vacant land sales. The *Cost approach* requires estimation of the current *Cost* of *Construction* which covers expenses, direct and indirect, of constructing an improvement (IAAO, 2013a). Two types of *Cost* can be used: *Reproduction cost* and *Replacement cost*. The former refers to the current *Cost* of creating a replica of the asset, while the latter means the current *Cost* of a similar asset offering equivalent utility (IVSC, 2016). This method also requires determination the extent of *Obsolescence* occurred in the *Construction*. *Obsolescence,* which is also known as *Depreciation,* refers to loss in value of an object, relative to its *Replacement cost*, *Reproduction cost*, or original cost (IAAO, 2013a). It can be decomposed into *Physical obsolescence*, *Functional obsolescence,* and *External obsolescence* (IVSC, 2016).

The next, *Income approach* converts the present or prospective stream of income derived from property into capital value through *Direct capitalization* or *Yield capitalization* (Shugrue, 1963). The *Direct capitalization* can be applied with *Net income* and *Capitalization rate* or *Gross income* and *Gross rent multiplier.* The *Capitalization rate* is the ratio of net operating income to market value (IAAO, 2013a), while the *Gross income multiplier* represents the ratio of potential gross income or its effective gross income to market value. The second capitalization approach, *Yield capitalization* (*Discounted cash flow analysis*) is used to calculate the present value of anticipated future *Cash flow*s (IAAO, 2010). Future *Cash flow*s are converted to value through *Rate of return* (*Discount rate*) of the investment. A *Rate of return* is an amount of income (loss) and/or change in value realized or anticipated on an investment, expressed as a percentage of that investment (IVSC, 2016). It consists of *Internal rate of return*, *Risk free* rate and *Risk Premium. Internal rate of return* is the discount rate at which the present value of the future cash flows of the investment equals the acquisition cost of the investment. The *Risk free rate* is the rate of return available in the market on an investment free of default risk. The *Risk premium* is a rate of return added to a risk-free rate to reflect risk (IVSC, 2016).

Figure 5. The Valuation activity concept

Above outlined *Valuation approach*es are employed in both *Single property appraisal* and *Mass appraisal*. The *Single property appraisal* estimates value of a particular property on a given date, while the *Mass appraisal* values a group of properties on a given date and using common data, standardized methods, and statistical testing (IAAO, 2013a; 2013b). The term of *Computer aided mass appraisal* (c.f. IAAO, 2003; 2013a) is used when *Mass appraisal* is performed by means of computer-supported statistical analyses.

The main component of *Mass appraisal* is the *Mass appraisal model* which explains the relationship between *Value* and variables representing factors of supply and demand (IAAO, 2013a). *Model specification* and *Model calibration* are distinct steps in the modeling. *Model specification* is the formal development of a model in a statement or equation, based on data analysis and appraisal theory (IAAO, 2003; 2013a). Models may be specified for group of properties that have similar characteristics, in the form of *Additive model*, *Multiplicative model*, and *Hybrid model*. Grouping of properties according to the selected variable (e.g. location, size, age, and construction quality) is called as *Stratification* and can be realized with *Cluster analysis* (see, IAAO, 2003). The specified models are supplemented through the *Model calibration* stage, which according to IAAO (2003; 2013a) is the development of adjustments, or coefficients, based on market analysis, that identifies specific factors with an actual effect on market value. Several statistical techniques can be applied in this stage, such as *Multiple regression analysis*, *Adaptive estimation procedure*, *Location value response surface analysis*, *Time series analysis*, and *Artificial network analysis*. A *Mass appraisal* may further include a performance analysis stage, the *Ratio study,* to compare the appraised values with market values for determining the accuracy of the appraisal (Gloudemans, 1999). The *Ratio study,* which also termed as *Appraisal ratio study* or *Sales ratio study,* is a study of the relationship between appraised values and market values (IAAO, 2003; 2010; 2013a). A *Ratio study* estimates an *Appraisal ratio* which refers to the ratio of the appraised value to an indicator of market value (IAAO, 2013a; 2013b). Two aspects, *Appraisal level* and *Appraisal uniformity* are analyzed in the *Ratio study* in order to measure the accuracy of the *Mass appraisal*. The *Appraisal level* is an indicator that show the overall or typical ratio of the appraised values to the market values. It is ascertained by central tendency measures such as, mean, median, weighted mean. The second indicator, *Appraisal uniformity* defines appraisal consistency and equity between and within groups of properties. It could be expressed for instance, by the coefficient of dispersion, coefficient of variation, or price-related differential measures (Gloudemans, 1999).

Information used in or produced through the *Valuation activity* are represented or kept in *Valuation record*s. These records may be in the form of *Valuation report*s or in the form of *Valuation database*s, which records the *Locational, Parcel, and Construction characteristics* of *Valuation objects,* or provides *Sale statistics* about property market, such as the Purchase Price Collections in Germany, or the Sales Price Register in Slovenia (see Figure 5).

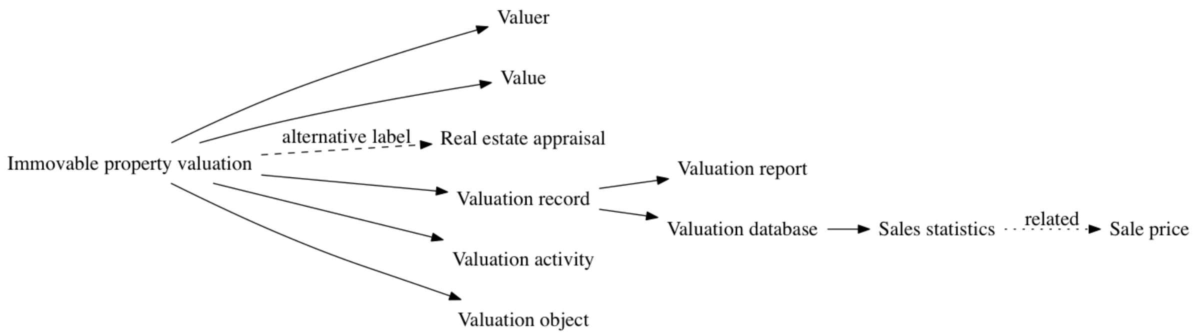

Figure 5. The valuation record concept

The SKOS encoding of above described Immovable Property Valuation Thesaurus is online accessible at http://cadastralvocabulary.org/IPVT.rdf. Table 1, below, provides an extraction from this SKOS encoding.

Table 1. The SKOS encoding of the *Immovable property valuation* term extracted from IPVT

```
<skos:Concept rdf:about="http://cadastralvocabulary.org/IPVT/ImmovablePropertyValuation">
<skos:prefLabel>ImmovablePropertyValuation</skos:prefLabel>
<skos:altLabel>RealEstateAppraisal</skos:prefLabel>
<skos:definition>(1) The process of establishing the value of an asset or liability; OR (2) The
amount representing an opinion or estimate of value (Source: International Valuation Standards
Counsil, 2016).</skos:definition>
<skos:changeNote>Established with version 1.0</skos:changeNote>
<skos:inScheme rdf:resource="http://cadastralvocabulary.org/IPVT"/>
<skos:narrower rdf:resource="http://cadastralvocabulary.org/IPVT/Valuer"/>
<skos:narrower rdf:resource="http://cadastralvocabulary.org/IPVT/Value"/>
<skos:narrower rdf:resource="http://cadastralvocabulary.org/IPVT/ValuationObject"/>
<skos:narrower rdf:resource="http://cadastralvocabulary.org/IPVT/ValuationActivity"/>
<skos:narrower rdf:resource="http://cadastralvocabulary.org/IPVT/ValuationRecord"/>
</skos:Concept>
```

5. CONCLUSIONS

This paper introduces a domain thesaurus for immovable property valuation, which has been developed according to the ANSI/NISO Z.39.19-2005 ‘Guidelines for the Construction, Format, and Management of Monolingual Controlled Vocabularies’, and represented through the Simple Knowledge Organization System (SKOS) formalism. The terms of the thesaurus are derived from international valuation standards issued by the International Valuation Standards Council, The European Group of Valuers' Associations, and the International Association of Assessing Officers.

The Immovable Property Valuation Thesaurus is an output of a collaborative research which aims at developing an international Valuation Information Model based on ISO 19152:2012 Land Administration Domain Model (LADM). It reveals the core semantic of the immovable property valuation domain, and therefore support the identification of candidate classes, class attributes and relationships for the further elaboration of LADM Valuation Module. It may also be used for classification and indexing of domain resources in a Linked Data environment.

Future research includes the refinement of the Immovable Property Valuation Thesaurus, as well as mapping its terms with the terms of the Cadastre and Land Administration Thesaurus (CaLAThe) and the ISO LADM, addressing also the code list issue mentioned at end of Section 2.

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