Representing Roles in Formalizing Domain Ontology for Land Administration

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Outline

• Background
• Objectives
• Formalization
• Role Representation
• Application
• Conclusions & Future Work
• various and large customers include surveyors, lawyers, government authorities, the public, landowners, etc.

• the customers are core to the portals and operations

• being able to identify user role intelligently will allow selected information to only be provided to relevant customers

Portals
• formal ontology offers logical facts and rules for automated checking on integrity and consistency of data
• a formal ontology that emphasizes roles helps intelligently identify user roles based on information received, for example:

\[ \text{Party}(?x) \land \text{possesses}(?x,?y) \land \text{SpatialSource}(?y) \land (\text{hasRRR}=0) \Rightarrow \text{Surveyor}(?x) \]

a party who possesses spatial source (e.g. certified plan) and does not have any related RRR can be inferred as a surveyor
Objectives

- to formalize domain ontology for land administration in OWL (Web Ontology Language)
- to add role representation, which captures user roles and their relationships, in the ontology
BAUnit and Party have a role relationship, but baunitAsParty is treated like other association relationships (e.g. unitRrr, suBaunit).

Role as CodeList:
1. limits the representation of role as context dependent;
2. assumes the conceptual structure of role is flat, but role structure is much complex.
Methodology

• to treat roles as a first class concept. Treating roles as concept allows flexible definition of role to be context dependent;

• BAUnit is treated as RolePlayer to relate to Party, which is a subclass of Role through hasRole relationship;

• Role is represented in hierarchy or ontology in its own.

• introducing three concepts: RolePlayer, Role and Context, and two relationships: hasRole, dependsOn
Overall Process of Formalization

Extracting Natural Texts from ISO 19152

Drafting the Functional Syntaxes

Building Ontology in Protege, an Ontology Editor

Web Ontology Language (OWL)

ISO 19152/ImplementationMaterial/LADMOntology.owl
Resulted Formal Ontology in OWL
Classes and Properties

- VersionedObject
  - BAUnit
    - BasicPropertyUnit
    - LeasedUnit
    - RightOfUseUnit
  - BoundaryFace
  - BoundaryFaceString
- Context
  - AdminSource
  - SpatialSource
  - Level
- Party
  - Citizen
  - Conveyancer
  - Employee
  - Farmer
- GroupParty
  - Association
  - BAUnitGroup
  - Family
  - Tribe
- MoneyProvider
  - Bank
  - Notary
  - StateAdministrator
- Surveyor
  - Writer
  - PartyMember
  - Point
- Role
  - Party
- RolePlayer
  - BAUnit
  - Group
  - NaturalPerson
  - NonNaturalPerson
- RRR
  - Responsibility
  - Restriction
  - Right
- Source
  - AdminSource
  - SpatialSource
  - SpatialUnit
  - SpatialUnitGroup
- containsOtherGroupParties
- dependsOn
- describesBFace
- describesBFaceString
- describesPoint
- describesSpatialExtent
- hasAdminSourceBAUnit
- hasAdminSourceParty
- hasAdminSourceRRR
- hasBASpatialUnit
- hasBAUnitAdminSource
- hasBAUnitRRR
  - hasBAUnitResponsibility
  - hasBAUnitRestriction
  - hasBAUnitRight
  - hasBAUnitSpatialSource
  - hasMortgage
  - hasMortgageRight
  - hasPartyMembers
  - hasRequiredRelationshipBAUnit
  - hasResponsibilityParty
  - hasRestrictionParty
  - hasRightParty
- hasRole
  - hasRRR
  - hasRRROnBAUnit
  - hasResponsibilityOnBAUnit
  - hasRestrictionOnBAUnit
  - hasRightOnBAUnit
  - hasSpatialSourceBAUnit
  - hasSpatialSourceParty
  - isRegisteredAs
  - isSupportedBy
Ontology available at LADM Wiki

http://www.isoladm.org/
Role Representation
Context Dependent Role

[Diagram showing relationship between different roles and entities, with a note on Land Surveyor Board registers]
Define Roles in Hierarchy

- certifiedSurveyor inherits all properties of Surveyor
- certifiedSurveyor (?x) -> Surveyor (?x) but not vice versa
- the hierarchy can be an ontology in its own with rules
“BAUnit plays the Role of Party”
Potential Application in Cadastral Processing

Consistency Checking, Data Integrity, User Role Inference

OWL
SWRL/RIF
Reasoning

LandXML

Knowledge Tier

Data Tier
Conclusions

- formalized domain ontology from natural language to OWL
- enhanced the ontology with the representation of user roles
- the role representation allows:
  - to describe roles as context dependent
  - to represent roles in hierarchy or ontology in its own
  - to treat the role relationship between BAUnit and Party more specific
Future Work

• temporal aspect was not considered in the ontology, temporal constraints and relationships should be added

• the role representation should be enhanced with more concepts and relationships and be supported with logical rules, using SWRL or RIF

• for further improvements, value the inputs from the LA community on the ontology at the LADM wiki http://wiki.tudelft.nl/pub/Research/ISO19152/ImplementationMaterial/LADMOntology.owl
Thank You!

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