Ontology Engineering for the Comparison of Cadastral Processes

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Agenda

1. Comparing Process Models
2. Ontology-based Comparison of Real Property Transactions
3. A Worked Example
4. Conclusions
Comparing Cadastral Processes

Comparative Analysis

- Enhanced understanding of the national processes
- Identification of commonalities and differences
- Basis for identifying the reasons for a different efficiency and transaction costs
- Basis for the development of a reference process
Cadastral Process Models

- Process Models
  - Textual description and activity diagrams of national cadastral transactions
  - Property transfer, property subdivision
  - E.g., Denmark, England / Wales by Vaskovich (2003)
  - No reference process!

Activity Diagram for Property Transfer (Vaskovich, 2003)
Comparison of Transaction

Buying a one-family house in Denmark works like this ...

And in England/Wales, it’s like this ...

Formal ontology-based comparison
Initial Comparisons

**Comparison by Activities**
- Activities performed during the subdivision process are mapped
- Actors are not considered

**Comparison by Actors**
- Actors involved in the subdivision process

<table>
<thead>
<tr>
<th>Denmark</th>
<th>England/Wales</th>
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</thead>
<tbody>
<tr>
<td>Initiation</td>
<td>Initiation</td>
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<tr>
<td>Investigation</td>
<td>Investigation</td>
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<tr>
<td>Check/Measurement</td>
<td>Consultation</td>
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<tr>
<td>Case Preparation</td>
<td>Case Preparation</td>
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<tr>
<td>Case Approval</td>
<td>-</td>
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<tr>
<td>Application for Registration</td>
<td>Application for Registration</td>
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<tr>
<td>Case Check</td>
<td>Case Check</td>
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<tr>
<td>Ownership Registration</td>
<td>Ownership Registration</td>
</tr>
<tr>
<td>Information Updating</td>
<td>-</td>
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</tbody>
</table>

Initial Comparison of Subdivision (Vaskovich, 2004)
Why a formal comparison?

- Comparison of different countries at the same level of detail
- Detailed knowledge on the degree of conformity
- Explain why a country A is more similar to a country B than to a country C

ontology-based comparison
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A Formal, Ontology-Based Approach

**Ontologies?**
- “explicit account of a shared understanding“ (Uschold & Grüniger 1996)
- vocabulary for a domain

**Ontological Modeling**
- Formal way of representing conceptual models
- in an ontology language
- Higher expressiveness than other approaches to conceptual modeling: restrictions, quantors, constraints, …

**Ontological Reasoning**
- Consistency check
- Subsumption, Equivalence
- Computation of correspondences between the national models
Ontology-based Comparison

Cadastral Top-level Ontology

Ontology Model for Property Transfer
Country 1

Activity Diagram

Textual Description of the Process

correspondences

Ontology Model for Property Transfer
Country 2

Activity Diagram

Textual Description of the Process

Hess, Schlieder: Ontology Engineering for the Comparison of Cadastral Processes
Cadastral Top-Level Ontology

Why using a top-level ontology?
- Concepts and properties used for the description of processes
- Ensures that all process models use the same terminology
- And the same criteria for comparison

The cadastral top-level ontology
- Uses terms defined in the Workflow Management Coalition’s (WfMC) glossary
- Extended with terms for the description of processes in the cadastral domain!
Processes and Activities

- **Process**
  - Formalized view of a business process, represented as a coordinated set of process activities (WfMC)
  - E.g., Property Transfer, Property Subdivision

- **Activity**
  - Description of a piece of work that forms one logical step within a process (WfMC)
  - E.g., sale contract signing

Activity Diagram for Property Transfer in England/Wales (Vaskovich, 2003)
Concepts for Describing an Activity

- **Function / Purpose**
  - The purpose of an activity

- **Result**
  - Signed document, e.g., sale contract
  - Oral agreement between the participants of an activity, e.g., sale agreement
  - Decision, e.g., decision on title registration

<table>
<thead>
<tr>
<th>Signing the sale contract (DK)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Function</strong></td>
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<tr>
<td><strong>Result</strong></td>
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</tbody>
</table>
Ontology Models

- Formalization of the Ontology Models
  - Literate UML models are represented in the ontology modeling language OWL
  - Use of the concepts defined by the cadastral top-level ontology
  - Example: DK_SaleContract-Signing
Ontological Reasoning

- Computes the type of the identified mapping: equivalence, specialization
- Reasoner, e.g., RACER
- Interpretation of the results by knowledge engineers and domain experts
- Example: Property Examination: EW ⊆ DK
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Comparing Property Transfer

**Compared Transactions**
- Denmark and England / Wales

**Approach**
- Ontological modeling and computation of correspondences in several iterations
- Differences with the domain experts’ intuition on correspondences?
- Explanation and refinement of the models

**Example Activities**
- Property examination
- Signing of the sale contract
Property Examination

- Equivalence?
- Specialization?
  - Correspondence of the type specialization
  - The examination of the physical state of the property is more formal in E/W than in DK

- Results are organized in a hierarchy according to increasing “professionalism” and level of detail.
Sale Contract Signing

Equivalence?

- Between DK_SaleContract-Signing and EW_Sale-ContractSigning?
- False!
- DK: Sale contract is signed and immediately legally binding.
- E/W: Sale contract is signed independently by both parties and is only legally binding after exchange.
- Sale contract exchange must be considered!
Sale Contract Signing 2

Aggregation

- To a new activity
- `hasPart` EW_SaleContractSigning and EW_SaleContractExchange
- Result is the result of the last subactivity
- New function corresponding to the function of the activity DK_SaleContractSigning
- Reasoner: EW_SaleContractSigningProcess ⊆ DK_SaleContractSigning

EW_SaleContractSigningProcess
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Approach and Results

- **Top Level Ontology**
  - Function and result: new focus on the activities which has not yet been analyzed
  - Extensible

- **Level of Detail**
  - Detailed enough → not everything is equivalent
  - Not too detailed → correspondences could be identified

- **Results of the Comparison**
  - Verification of the intuitions
  - Results conforming with the intuitions
  - More detailed knowledge about commonalities and differences
  - All relationships can be explained
Conclusion

■ Approach
  ▶ is applicable to the comparison of cadastral process models
  ▶ Sensible results
  ▶ Useable to the comparison of > 2 process models
  ▶ without modifying the approach and
  ▶ without a pair wise comparison

■ Not restricted to the cadastral domain
  ▶ Definition of a different top level ontology

■ Future Work
  ▶ Basis for the development of a reference process