Towards supporting business services discovery through the integration of organizational models with ontologies

Blanca Vázquez
Alicia Martínez
Hugo Estrada
Anna Perini
Mirko Morandini

Tuesday, April 9, 2013

XVI Ibero-American Conference on Software Engineering
In recent years, considerable attention has been paid to organizational modelling techniques. This interest is motivated by the need of achieving a better understanding of organizational knowledge, and to support the definition and implementation of suitable business processes.

The organizational model helps to detect:

- Relationships between stakeholders.
- Describes the social context, structure, processes and resources of an organization.
- Detects bottle-necks.
Actually, there are still some gaps and weaknesses in the global engineering process, for instance in:

- Discovery of business services.
- The integration between organizational models with ontologies.
- The addition of semantic information to existing models.

From a business process engineering perspective, ideally, we would like to derive the design and the discovering of business services from an organizational model.
The discovering of business services from the existent services has been poorly explored in requirement engineering.

However, several approaches apply general ontologies focused on:

- Recommendations for improvements of the organizational language to resolve ontological miss-interpretation [Guizzardi et.al. 2010]
- Improvement the domain-specific quality of UML class diagrams using domain ontologies [Poels et. al. 2010]
- The ONION tool permit the integration of ontologies [Mitra et.al. 2000]
- The used of a global ontology performad the integration of heterogeneous data sources. [Bergamaschi et.al. 1999]
We propose: An approach for integrating organizational visual models with general and specific domain ontologies.

We claim that the integration of an organizational model with an ontology can improve the performance in discovering business services from the existing services.

The idea is to identify domain concepts integrating different model elements could represent new business services to the organization.
Our proposed approach is based on visual models represented in:

<table>
<thead>
<tr>
<th>i* framework</th>
<th>Tropos</th>
<th>Service-oriented i*</th>
</tr>
</thead>
</table>

In order to integrate an visual model, we used:

**Semantic Web Ontologies (OWL / RDF)**
An explicit specification, a formal and shared conceptualization, based on the idea of a simplified conceptualization of the world. The ontologies are classified in: general, domain and application ontologies.

**OntoSem ontology**
(Ontological Semantics) is a theory of meaning in natural language. The most important feature of OntoSem is to be a practical general ontology.
Outline

1. Introduction / Motivation
2. Integrating visual models with ontologies
3. A case study
4. Conclusions
**Objective:** Integrate organizational models represented in the i* variants Tropos and Service-oriented i*, with a general or a specific domain ontology.
This process supports the development of a set of general and specific semantic annotation suggestions. The suggestions are the key to annotate the organizational models.

The **general suggestions** should be applied to domain ontologies in general. The **specific suggestions** are domain-dependent and instantiated in the OntoSem ontology.

- The annotation is carried out by the analyst first following the semantic annotation suggestions.
- The analyst should go in-deep in the selected ontology to find out the most appropriate domain concept for each model element.

**Example:**

\[
ME : \text{Goal} \xrightarrow{AB} SC : \text{mental - event} \land SC : \text{social - event} \land SC : \text{mental - object}
\]

This process extends the iStarML format to represent the annotated model with domain concepts.

iStarML is an XML-based proposal for i* models interchange, built taking in consideration several metamodels of i* variants.²

The extension consists of adding the XML attribute sannotation.

This attribute allows us to identify each element of the model with its respective semantic annotation.

```xml
<name="create new account" type="goal" sannotation="open-account"/>
```

- We use jUCMNav for organizational modelling.³
- Extension of an existing JUCMNav plug-in.

Generation of an annotated model represented in iStarML extended.

---


Phase 2: Integrating the organizational model with the ontology

**Architecture of TAGOOOn+**

**Inputs**
- Annotated Model [iStarML file]
- General Domain Ontology [OWL file]

**Automatic Parsing Module**
- Parsing iStarML file
- Parsing OWL file

**Automatic Mapping Module**
- Union of ontologies
- Mapping between ontologies
- Creating “is_a” links

**Automatic Linking Module**
- Processing the information from parser

**Automatic Documentation Module**
- Generating documentation

**Outputs**
- Organizational model ontology integrated with an ontology
- Documentation

**TAGOOOn+** integrated an i* models with general or domain ontologies.

**Automatic Parsing Module**

- Reading the iStarML and OWL files.

**Result:** Two arrays with information for further analysis.
Phase 2: Integrating the organizational model with the ontology

**Architecture of TAGOOOn+**

**TAGOOOn+** integrated an i* models with general or domain ontologies.

**Automatic Mapping Module**
- Performing the automatic transformation from an i* based model into an ontology.

**Result:** The organizational model represented as ontology.

http://tagoon.semanticbuilder.com
Phase 2: Integrating the organizational model with the ontology

**TAGOOn+**

Tool for the Automatic Generation of Organizational Ontologies and Integration

**Inputs**
- Annotated Model [iStarML file]
- General Domain Ontology [OWL file]

**Outputs**
- Organizational model ontology integrated with a domain ontology
- Documentation

**Automatic Linking Module**
- Mapping each instances of the model with one or more domain concepts.
- Creating the links of type “is_a” between the instance of the model with one or more concepts.

**Result:** An organizational model ontology integrated with a domain ontology represented in OWL.

http://tagoon.semanticbuilder.com
Phase 2: Integrating the organizational model with the ontology

**Architecture of TAGOOn+**

**Inputs**
- Annotated Model [iStarML file]
- Generator Domain Ontology [OWL file]

**Automatic Parsing Module**
- Parsing iStarML file
- Parsing OWL file

**Automatic Linking Module**
- Union of ontologies
- Processing the information from parser
- Mapping between ontologies
- Creating “is_a” links

**Automatic Mapping Module**

**Automatic Documentation Module**
- Generating documentation

**Outputs**
- Organizational model ontology integrated with an ontology
- Documentation

TAGOOn+ integrated an i* models with general or domain ontologies.

**Automatic Documentation Module**
- Searching the description of each domain concept in the ontology.
- Relating each instance with its semantic annotation.

**Result:** A text document representing each element of the model with its semantic annotation and description.

[http://tagoon.semanticbuilder.com](http://tagoon.semanticbuilder.com)
Outline

1. Introduction / Motivation

2. Integrating visual models with ontologies

3. A case study

4. Conclusions
In order to validate our approach, we used it on several case studies. In this paper we describe each phase of our approach using the smart card-based payment system case study [Liu 2004].
3 Case study

Testing of our approach

- We propose to use the demarking symbol “@” to add the semantic annotation.
- Each domain concepts selected need to be congruent with the description and adds information to the model element.
- The annotation avoid the ambiguity and to share a same knowledge.
- The annotation semantic process is manual.

Specific semantic annotation suggestions for type “goal” elements:

$$ ME : \text{Goal} \quad \rightarrow \quad SC : \text{mental} \land SC : \text{social} \land SC : \text{mental} \land \text{object} $$
3 Case study
Testing of our approach

A fragment of annotated i* strategic rationale model

Representation of i* model in iStarML format

- The semantic annotation for each model element is stored in the XML attribute `sannotation`
Case study

Testing of our approach

- Each model element related with one or more concepts should describe its meanings.
- This integration allows us to clarify and add additional information to the label of the model elements.
- A model element annotated with domain concepts taken from an ontology allows us to infer new knowledge missing when it have only a single label.
The discovery of new services inside the organization is achieved when one or more domain concepts are used within different model elements.

We envision that these domain concepts could represent a more general service Protect Information, like Paypal.

Paypal could represent a new business service, which allows a registered customer to use PayPal to pay its transactions, and its data are kept protected and privated thanks to this on-line payment processing service.

We consider that it is most feasible to infer new knowledge grouping different model elements than element by element, without any additional reference.
Outline

1. Introduction / Motivation
2. Integrating visual models with ontologies
3. A case study
4. Conclusions
4 Conclusions

Conclusions

- We presented an proposal to integrate an organizational model represented as ontology with a general or specific domain ontology.

- This integration process is based on the identification of elements that are common between the analysed business model and the domain concepts represented in ontology, and on their relationships.

- In order to carry out the integration process the TAGOOOn+ tool was presented.
Our approach addresses the problem of weaknesses of current business modelling techniques to define new business functionalities taking as base an organizational visual model. We consider that a domain concept that integrates different model elements is a strong indicator to implement a new business services inside the organization.

The advantages to add semantic annotation to i* models:

- Helps to discover hidden relationships.
- Collaborates with domain experts.
- Improves the understanding of the model.
- Eliminate ambiguity in labeling and thus facilitate to share knowledge.
4 Conclusions

Conclusions

➢ The integration proposed at instance level with domain concepts permit:
  ✓ The standardization of model elements according to similar situations or description.
  ✓ To facilitate the reasoning between model elements.
  ✓ To add additional information clarifying the description of each element.
  ✓ To facilitate a semi-automated OWL reasoning among the model elements for completeness and consistency checking.

➢ The illustrative example presented provides a preliminary evidence of the utility of our semantic annotation suggestions and the integration process of a visual model represented in the i* variants with a general ontology.

As a future work, we propose to use the proposed approach in the modelling of SemanticWebBuilder.
Thank you for your attention.

Contact: Blanca Vázquez
blancavazquez@infotec.com.mx
blancavazquez11c@cenidet.edu.mx