Collaborative modeling of processes and ontologies

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What is this about?

Develop a theoretical and practical framework that:

Supports the integrated modeling of Processes and Ontologies;

Fosters the collaboration between domain experts and knowledge engineers.

WHY?

need of a comprehensive model which requires the description of both the dynamic component (processes) and the static component (ontology);

need for an agile collaboration between domain experts and knowledge engineers. Need to actively involve the domain experts in the modeling process.
The research vision - architecture

Formal representation of integrated processes and ontologies

Architecture for collaborative conceptual modeling

Theoretical framework
Outline of the presentation

Formal representation of processes and ontologies

Architecture for collaborative conceptual modeling

The tool and some real usages
Integrating processes and ontologies

Roles / Organization
- Author
  - Read CFP
  - Write paper
  - Submit paper
- FC Chair
  - Publish CFP
  - Collect submissions
  - Assign reviewers
  - Collect reviews
  - Send notification
  - Collect final versions
  - Prepare proceedings
- Reviewer
  - Get review information
  - Prepare reviews
  - Submit reviews

Documents
- Paper
  - @To submit
  - @To read

Semantic Annotations
- @To send
- @To assign
- @To collect
- @To send
- @To collect
- @To submit
- @To prepare

Actions
Integrating processes and ontologies

Example of queries and reasoning that involves both ontological knowledge and process knowledge:

What are the activities performed by a certain role (e.g. PC Chair)?

Where are documents (e.g. reviews, notifications) produced?

What are the activities where something is published? What are the activities where something is sent out?

What are the activities an author perform right before submitting something?

Example of application exploiting semantically annotated business processes:

Managing Cross-cutting concerns in business processes.
Semantically annotated business processes are encoded into a logical knowledge base implemented in OWL.

Note: Business Process Diagrams (BPDs) are specified using the Business Process Modelling Notation (BPMN).
BPMN Ontology

Ontology provides a formalization in OWL DL of the structural part of BPMN.

Two parts:
1. is a taxonomy of all the BPMN elements;
2. attributes and properties which describe how to use these elements to compose a BPD.

A Start Event MUST NOT be a target for Sequence Flow.

sequence_flow ⊑ ∀ has_connecting_obj_target_ref (¬ start_event)
BPMN Ontology

Current version based on v1.1 of the BPMN specifications by OMG (to be update to v2.0)

It is not intended to model the dynamic behaviour of business process diagrams.

if there are multiple outgoing Sequence Flow then only one Gate (or the DefaultGate) SHALL be selected during performance of the Process.

There are a few documented properties which are not represented due to expressiveness limitation imposed by Description Logics.

all outgoing sequence flows connected to an inclusive gateway must have the same conditional expression attached

Available for download at:

Business Domain Ontology

Represents the (specific) business domain.

Used to annotate the elements of the business process diagram.

Can be composed of:

- Top level ontologies, such as DOLCE;
- Domain-specific ontologies.
BPD Instances

Represents the specific annotated business process diagram.
BPD Instances

Represents the specific annotated business process diagram.

Create an individual for each graphical element of the business process.

\[ s_1, s_2, s_3, s_4, t_1, t_2, g_1, g_2 \]
BPD Instances

Represents the specific annotated business process diagram.

**BPMN-type assertions**: for every graphical element $g$ of BPMN type $T$ occurring in the process, we add the assertions $T(g)$.

(sequence_flow($s_4$))
BPD Instances

Represents the specific annotated business process diagram.

**BPMN-structural assertions**: For every connecting object \( c \), going from \( a \) to \( b \), we add assertions of the form \( \text{source}(c, a) \) and \( \text{target}(c, b) \).

\[
\text{has_sequence_flow_source_ref}(s_1, g_1)
\]

\[
\text{has_sequence_flow_target_ref}(s_1, t_1)
\]
BPD Instances

Represents the specific annotated business process diagram.

Semantic assertions: For every graphical element $g$ of the process which is annotated with $C$ (where $C$ is a complex concept expression of the domain ontology), we add the assertion $C(g)$. 
Automatic OWL A-box generation

The transformation of an annotated Business Process Diagram into an OWL A-box is performed automatically.

Available for download at:

http://selab.fbk.eu/difrancescomarino/SemanticBPM/
Process Constraints

The framework also enables to define constraints for:

correct/incorrect annotation of business process graphical elements:

• A BPMN activity is annotatable only with actions of the domain ontology (and not e.g., with documents);

valid critical patterns:

• containment constraints: the activity of managing a shopping cart is a sub-process which contains an activity of removing products from the cart;

• precedence constraints: the activity of providing personal data is immediately preceded by an activity of reading the policy of the organization;

• exception handling constraint: the activity of reserving products in the On-line Shop pool has always to catch a “product unavailability” error event;

Using DL-reasoning we can:
Integrating processes and ontologies

Selected publications:


*Semantically-aided business process modeling* - C. Di Francescomarino, C. Ghidini, M. Rospocher, L. Serafini, P. Tonella - International Semantic Web Conference (ISWC’09)

*Reasoning on semantically annotated processes* - C. Di Francescomarino, C. Ghidini, M. Rospocher, L. Serafini, P. Tonella - International Conference on Service Oriented Computing (ICSOC’08)

Next steps: extension to the dynamics of executions
An architecture for collaborative conceptual modeling in wikis

1. **One element** ↔ **One page**
   
each element of the model is represented by a page in the wiki;

---

**Concept “Mountain”**

**Mountain**

A *mountain* is a large *landform* that stretches above the surrounding land in a limited area usually in the form of a peak. A mountain is generally steeper than a *hill*.

The highest mountain on earth is the *Mount Everest*.
An architecture for collaborative conceptual modeling in wikis

2. **Unstructured and structured descriptions**

   each page contains both structured and unstructured content;

```plaintext
Mountain
A mountain is a large landform that stretches above the surrounding land in a limited area usually in the form of a peak. A mountain is generally steeper than a hill.

The highest mountain on earth is the Mount Everest

Landform

¬Hill ∩ ¬Plain

∀madeOf(Earth ⊔ Rock)

∃height. ≥2500

Mountain(Mt.Everest)
Mountain(Mt.Kilimanjaro)
```

(unstructured content)  (structured content)
An architecture for collaborative conceptual modeling in wikis

3. Different views to access the model:

different views to support different modeling actors;

A mountain is a large landform that stretches above the surrounding land in a limited area usually in the form of a peak. A mountain is generally steeper than a hill. The highest mountain on earth is the Mount Everest.
Wiki-based modeling tool;

Supports the integrated modeling of Processes and Ontologies;

Provides modeling support both for domain experts and knowledge engineers, fostering the collaboration between them;

Based on the framework presented so far.
Different views for different roles

- Unstructured view
- Semi-structured view
- Fully-structured view
Different views for different roles
Further features

Graphical editing
Further features: key concepts extraction

Extract new concepts from textual resources

(Powered by *KX* - a Keyphrase eXtraction system)

Files

- Upload Files

Show uploaded files

Remove all uploaded files

Configure and Run

- Re-load Default Settings

Language: English  Domain: environment

Percentage of relevant concepts to return: 15

Take multiword expressions that occur at least:

- either 2 times in a document
- or 5 times in the corpus

Maximum length of multiword expressions: 4

Prefer key-concepts occuring early in the text: 

Prefer specific key-phrases: Medium Preference

Extract relevant concepts

Concepts Extracted

(The lists shown below are limited to the first 500 entries)

- **Concepts extracted (Ordered by Relevance)**
  - hayfever diary (2195.13)
  - pollen (1488.32) Already Defined
    - Wordnet
      - Synset Num: n#07991785
        - Wordnet Semfield: Chemistry
        - Sumo Entry: BodySubstance
        - Wordnet Definition: a fine powder produced by the anthers of seed-Is a: powder
    - Additional info
      - Source: Environmental dictionary
      - Option Num: 1
      - Add info entry: FINNISH TRANSLATION: siitepöly
      - Add info entry: SWEDISH TRANSLATION: pollen n, frömjöl n, ståndar
      - oild seed rape pollen (707.85) Already Defined
      - birch pollen (693.17) Already Defined
      - alternaria-mould spore (460.39)
        - flowering of grasses (393.18)
        - flowering of mugwort (363.68)
        - alder pollen (295.25) Already Defined
        - allergic complaints (196.28)
        - flowering of hazel (107.44)
        - pollen grain (87.5)
        - maple pollen (78.65) Already Defined
        - tree of heaven pollen (78.65) Already Defined
        - cultivated rye pollen (59) Already Defined
        - pollen levels (43.47)
        - grass flowering (41.94)
        - mugwort pollen allergy (25.92)
Usages of \textit{MoKi}
\textit{the Modelling Wiki ---}

\textbf{FP6 EU Project [48 months]}

**Purpose:** modeling of tasks/processes in an enterprise and of the topics related to that task

**Used by:**

- 4 SMEs
- 3 Universities
- several related summer schools and university courses
Purpose: build/revise an environmental ontology

Developed the new key concepts extraction functionalities

Used to automatically create part of the ontology (pollen)
**eContentplus EU Project [36 months]**

**Purpose:** build/revise an ontology of organic agriculture and agroecology

Used to foster collaboration between domain experts (FAO) and knowledge engineers

**Follow-up:** Organic.Lingua (FP7 Pilot Tipe B EU project [36 months])

   Extend MoKi to multilingua models and interface
Italian national project

**Purpose:** model processes for analysis/revision and dematerialization

Used by 5 (out of 7) Italian regions:

Puglia, Liguria 1, Trentino, Emilia Romagna, Liguria 2.

Medium size models produced in around 2 weeks.
eOnco FBK internal project
modeling of nurse activities in an oncology ward.

OncoCure project
modeling of clinical protocols for the breast cancer.

Italian private company
modeling email marketing domain;
Lessons learned

Wikis can be a powerful way to lower the entrance barrier for modeling tools and to share knowledge;

Real need to integrate processes and ontologies and to include organizational aspects in processes taken from a formal description (ontology);

Collaboration happens and is helpful;

Need to guide domain experts by providing schemata of representations; e.g., what is a document?
Current & Future Works

Develop ad-hoc templates to guide users in modeling activities

describing an artifact is different than describing a role

Support usage of ontology patterns

to speed up modeling activities, and limit modeling errors

Extend key concepts extraction functionalities

Support extraction / identification of semantic relation (e.g. “isA”) between concepts

Fully implement the formal framework for integrating processes and ontology
Publications and demos:

Released Open Source in July 2010 (version 1.2 – GPL2)

MoKi WebSite: http://moki.fbk.eu
On-line demos, code download, documentation, news, support…
Thank You!

Questions?

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