

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?

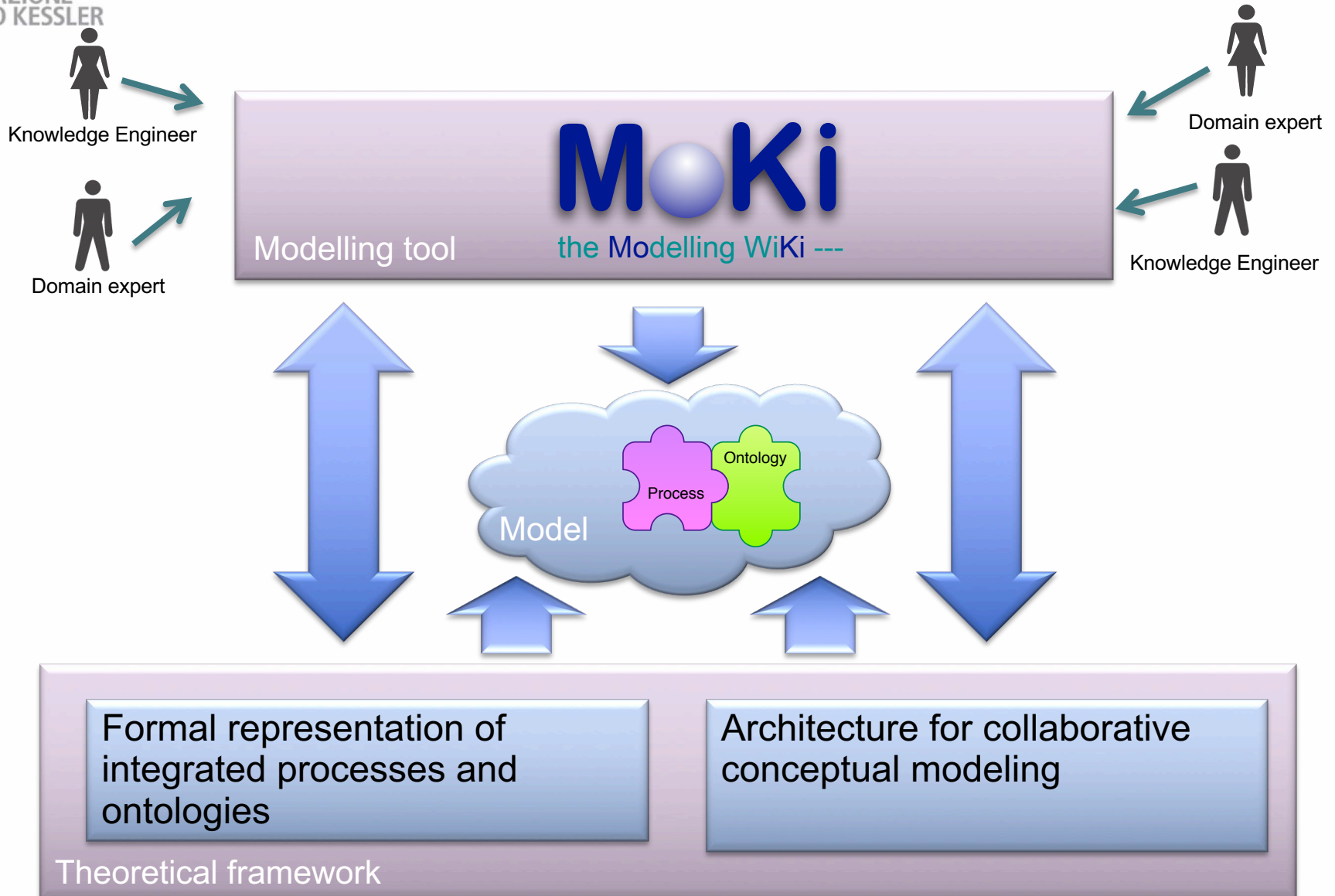
need of a comprehensive model which requires the description of both the dynamic component (processes) and the static component (ontology);

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



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The research vision - architecture



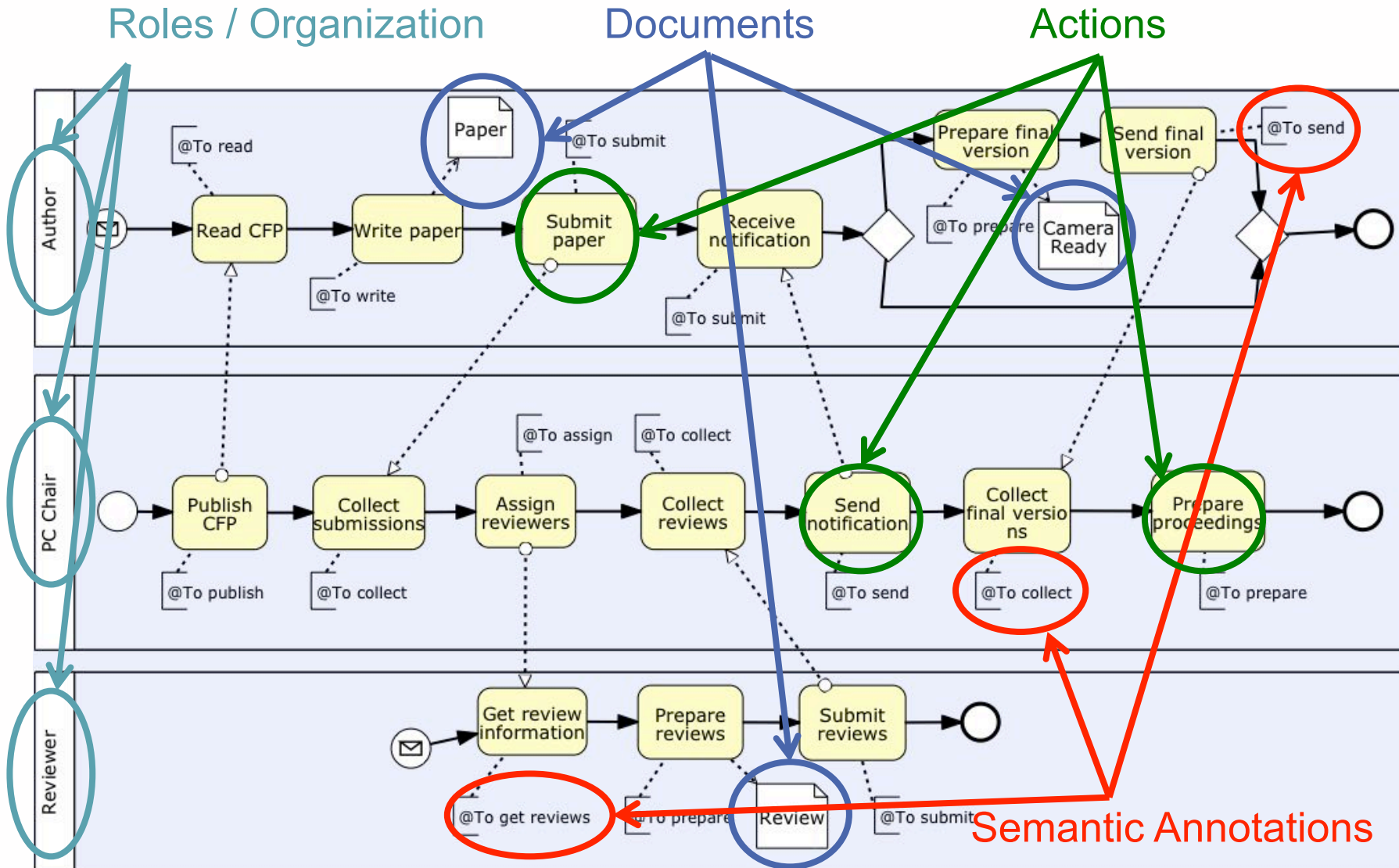
Outline of the presentation

Formal representation of processes and ontologies

Architecture for collaborative conceptual modeling

The tool and some real usages

Integrating processes and ontologies



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?

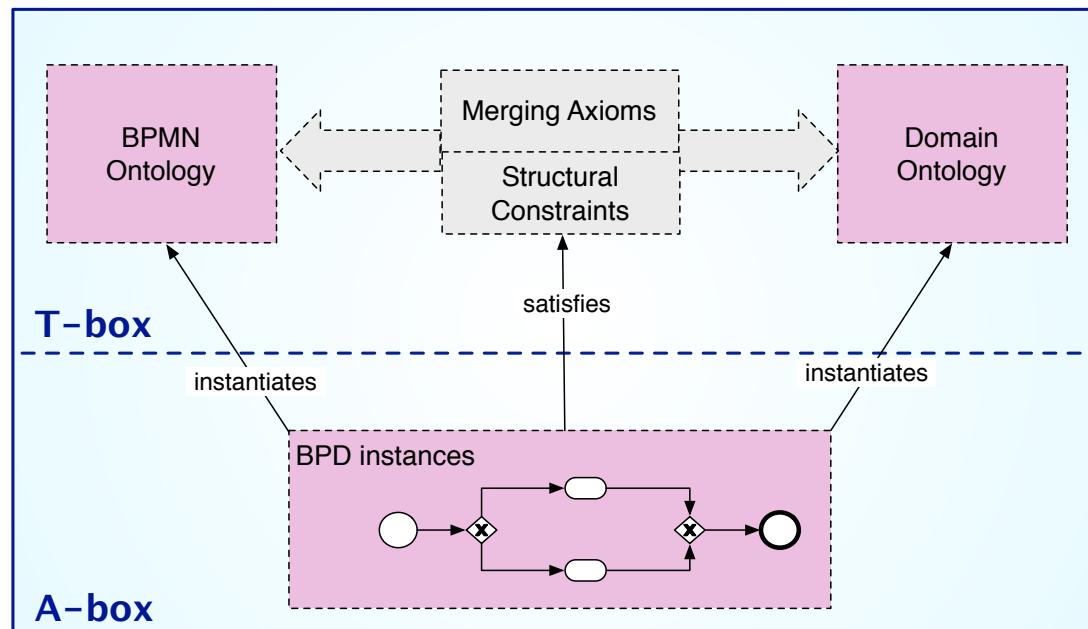
What are the activities an author perform right before submitting something?

Example of application exploiting semantically annotated business processes:

Managing Cross-cutting concerns in business processes.

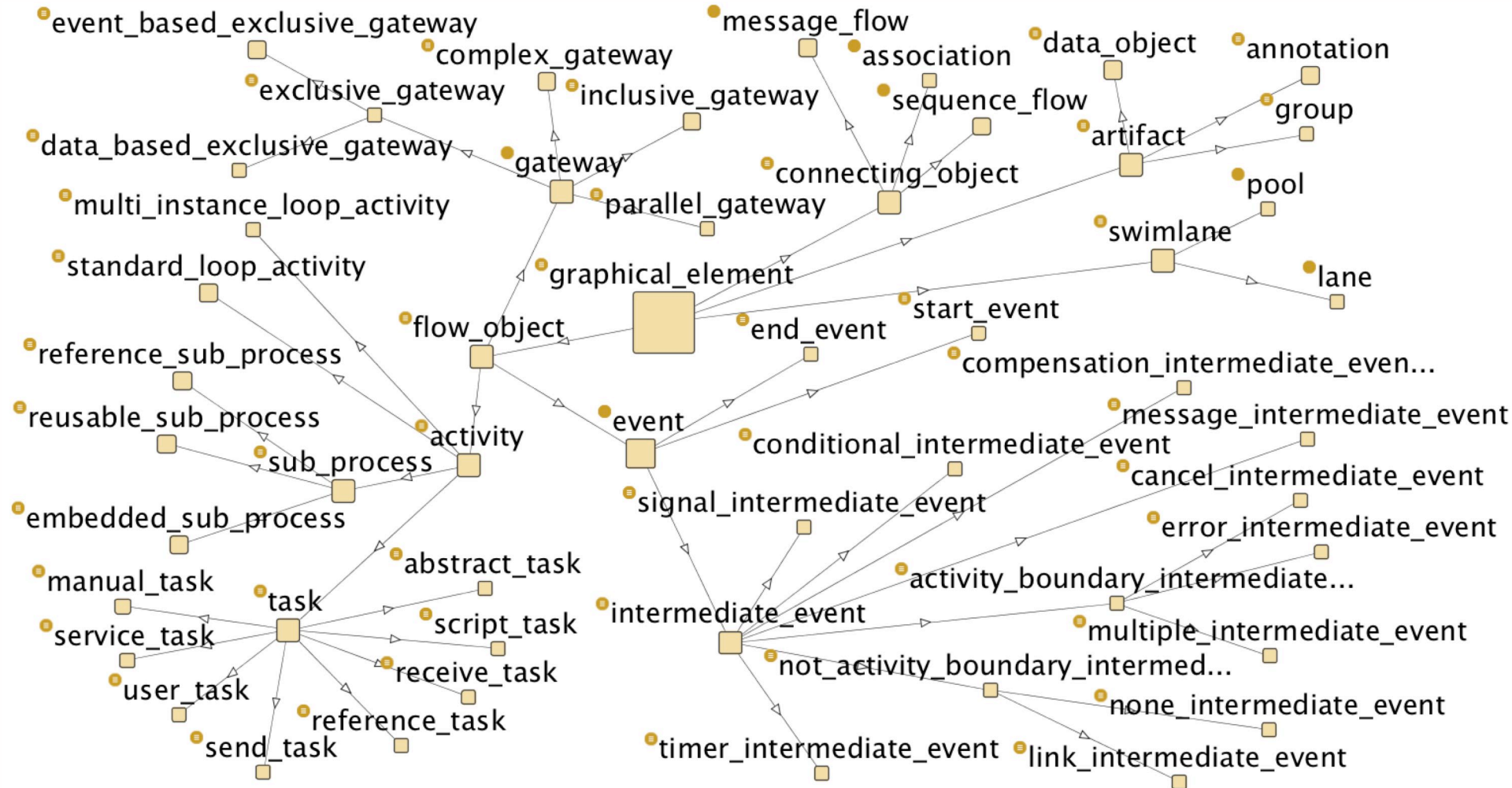
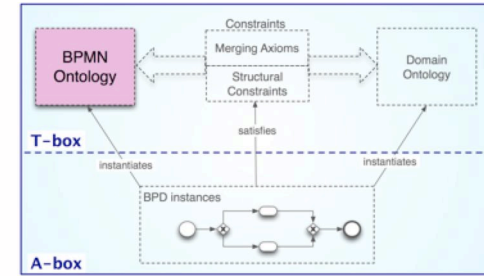
Semantically Annotated Business Processes

Semantically annotated business processes are encoded into a logical knowledge base implemented in OWL

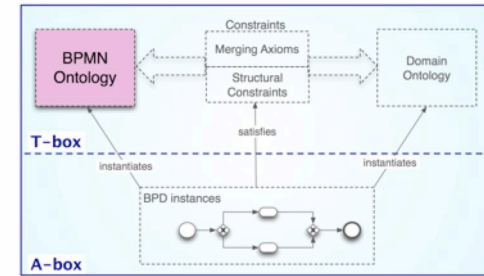


Note: Business Process Diagrams (BPDs) are specified using the Business Process Modelling Notation (**BPMN**).

BPMN Ontology



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.

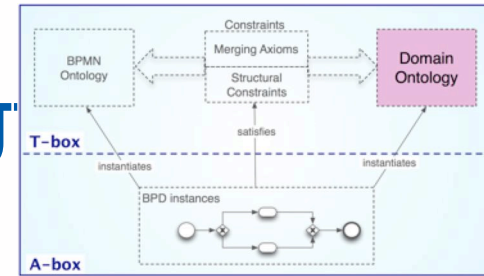
There are a few documented properties which are not represented due to expressiveness limitation imposed by Description Logics.

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

Available for download at:

http://dkm.fbk.eu/index.php/BPMN_Ontology

Business Domain Ontology



Represents the (specific) business domain.

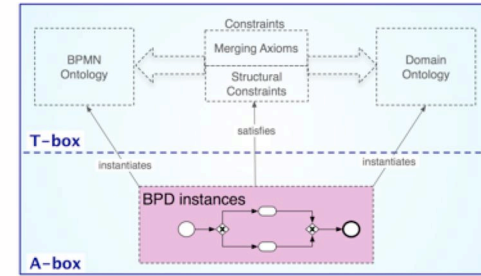
Used to annotate the elements of the business process diagram.

Can be composed of:

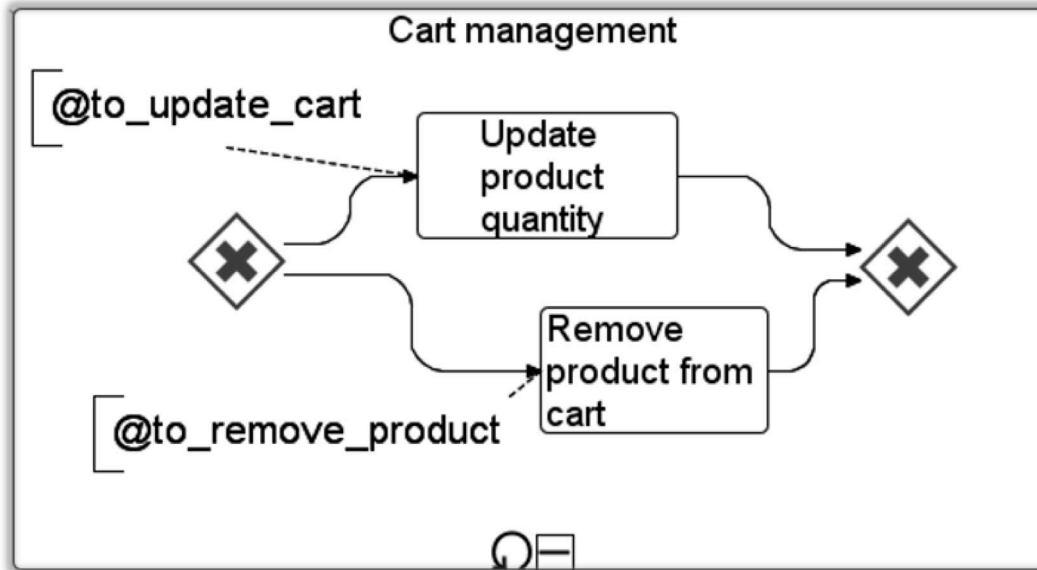
- Top level ontologies, such as DOLCE;

- Domain-specific ontologies.

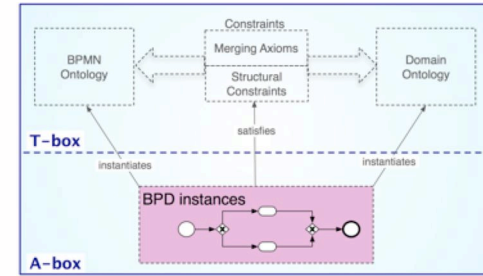
BPD Instances



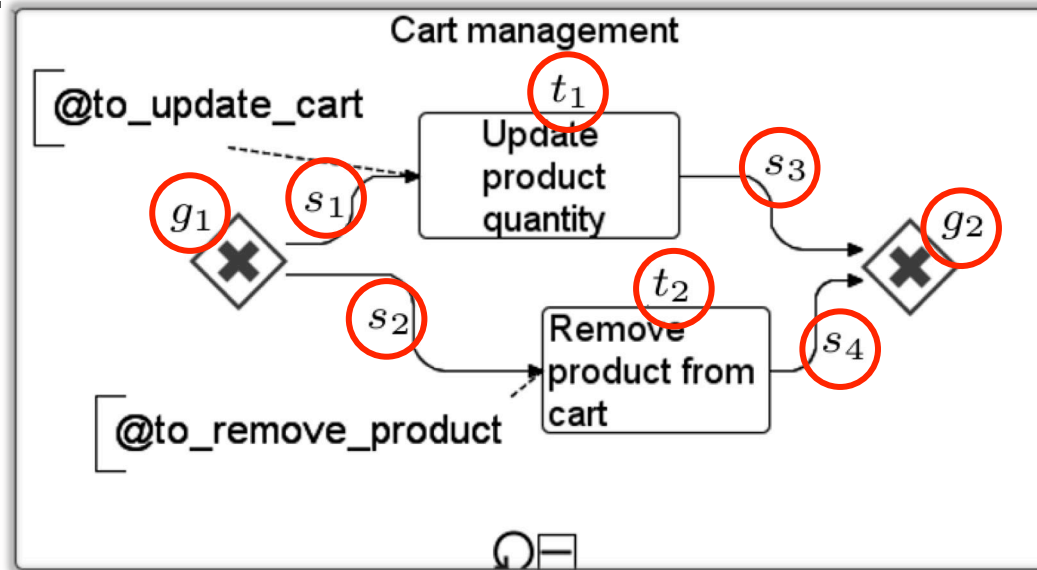
Represents the specific annotated business process diagram.



BPD Instances



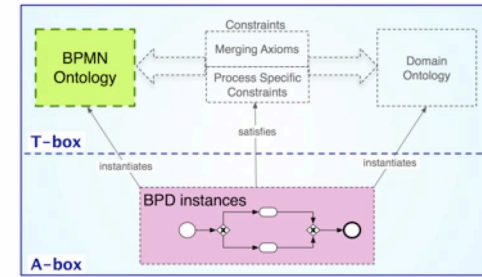
Represents the specific annotated business process diagram.



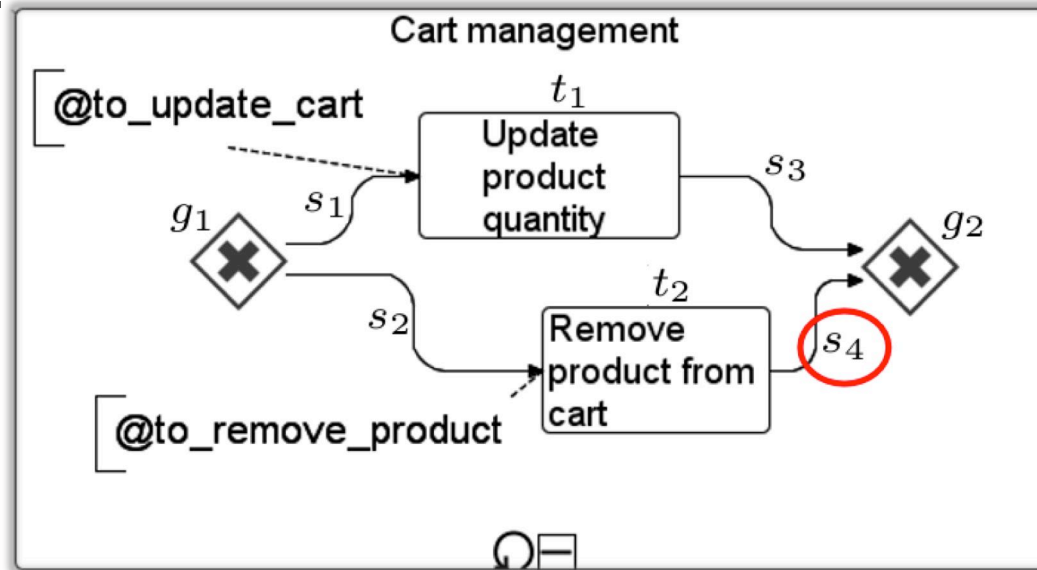
Create an individual for each graphical element of the business process.

$s_1, s_2, s_3, s_4, t_1, t_2, g_1, g_2$

BPD Instances



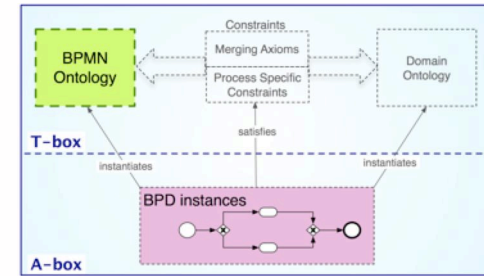
Represents the specific annotated business process diagram.



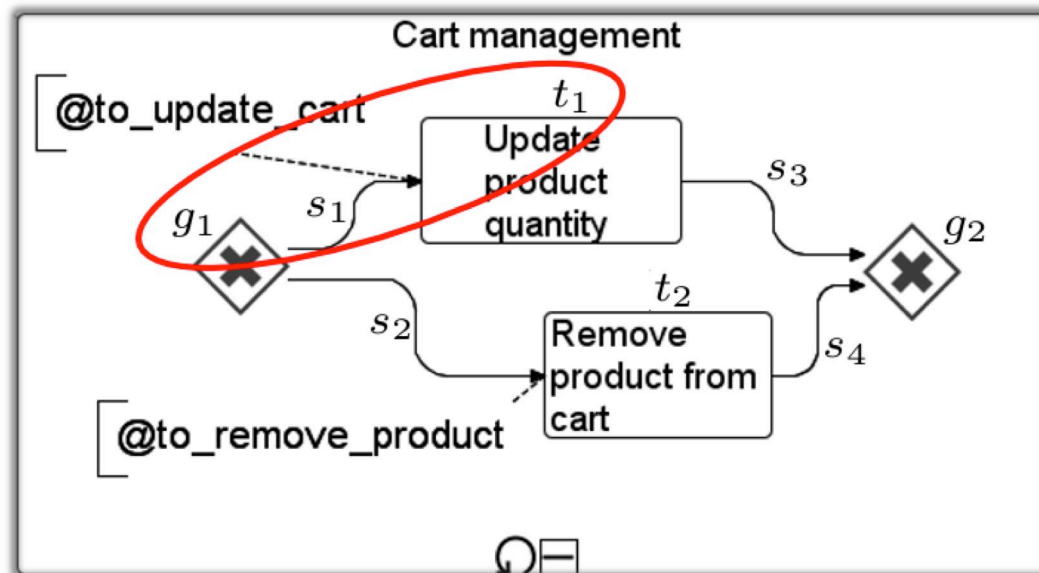
BPMN-type assertions: for every graphical element g of BPMN type T occurring in the process, we add the assertions $T(g)$.

sequence_flow(s_4)

BPD Instances



Represents the specific annotated business process diagram.

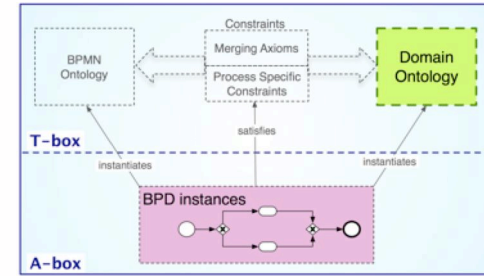


BPMN-structural assertions: For every connecting object c , going from a to b , we add assertions of the form $source(c,a)$ and $target(c,b)$.

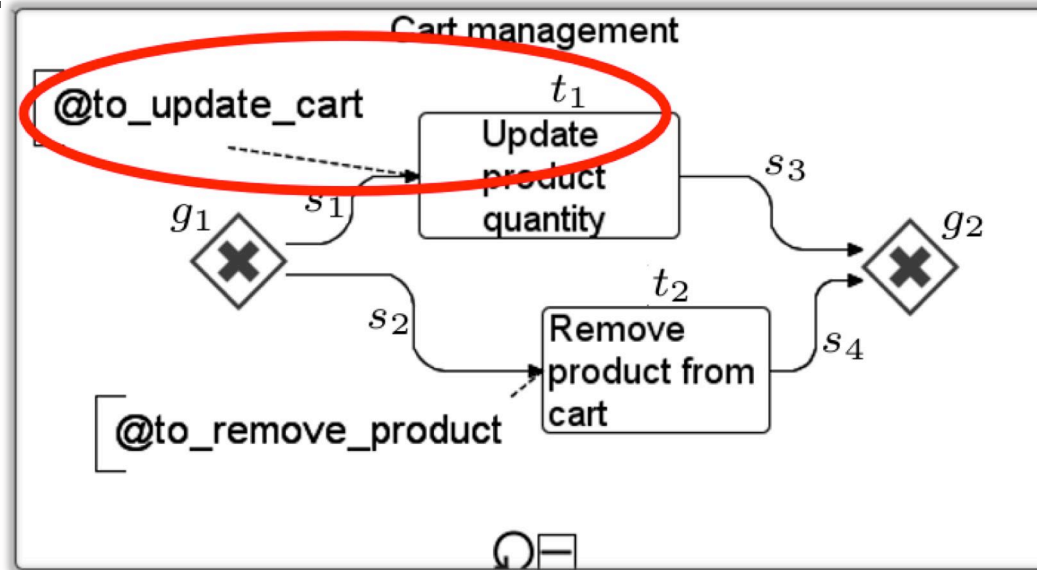
$has_sequence_flow_source_ref(s_1, g_1)$

$has_sequence_flow_target_ref(s_1, t_1)$

BPD Instances



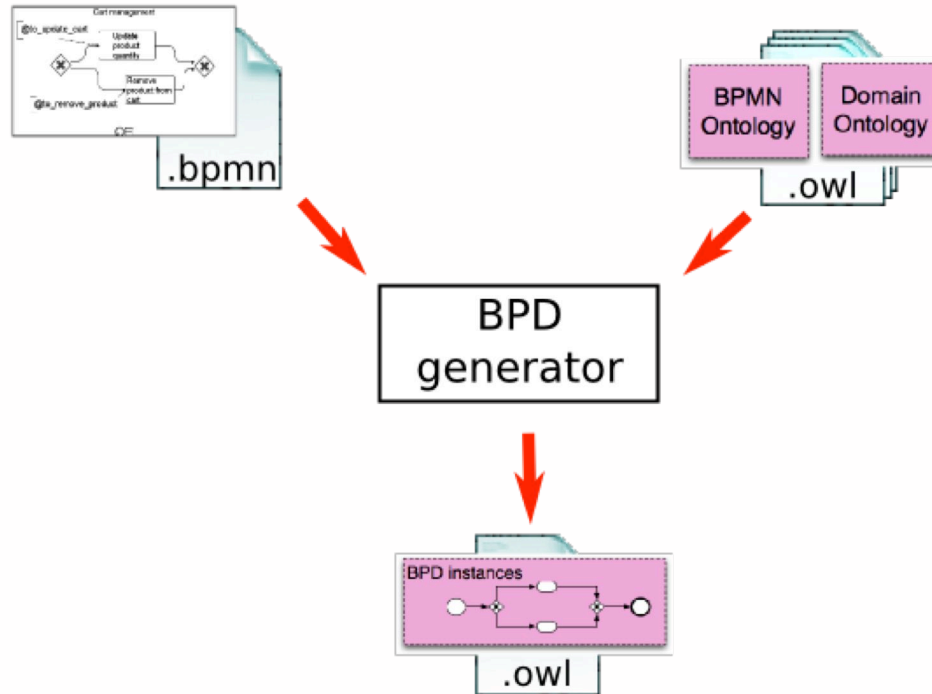
Represents the specific annotated business process diagram.



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

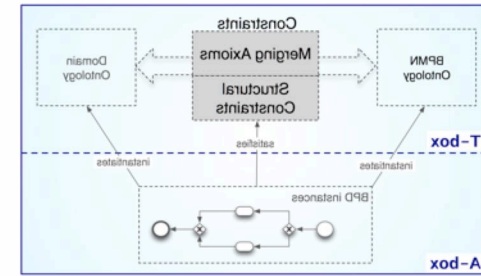
The transformation of an annotated Business Process Diagram into an OWL A-box is performed automatically.



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:

Selected publications:

Semantics based aspect oriented management of exceptional flows in business processes – C. Ghidini, C. Di Francescomarino, M. Rospocher, P. Tonella, L. Serafini - IEEE Transactions on Systems, Man and Cybernetics. Part C: applications and reviews (to appear)

A framework for the collaborative specification of semantically annotated business processes - C. Di Francescomarino, C. Ghidini, M. Rospocher, L. Serafini, P. Tonella - Journal of Software Maintenance and Evolution: Research and Practice

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

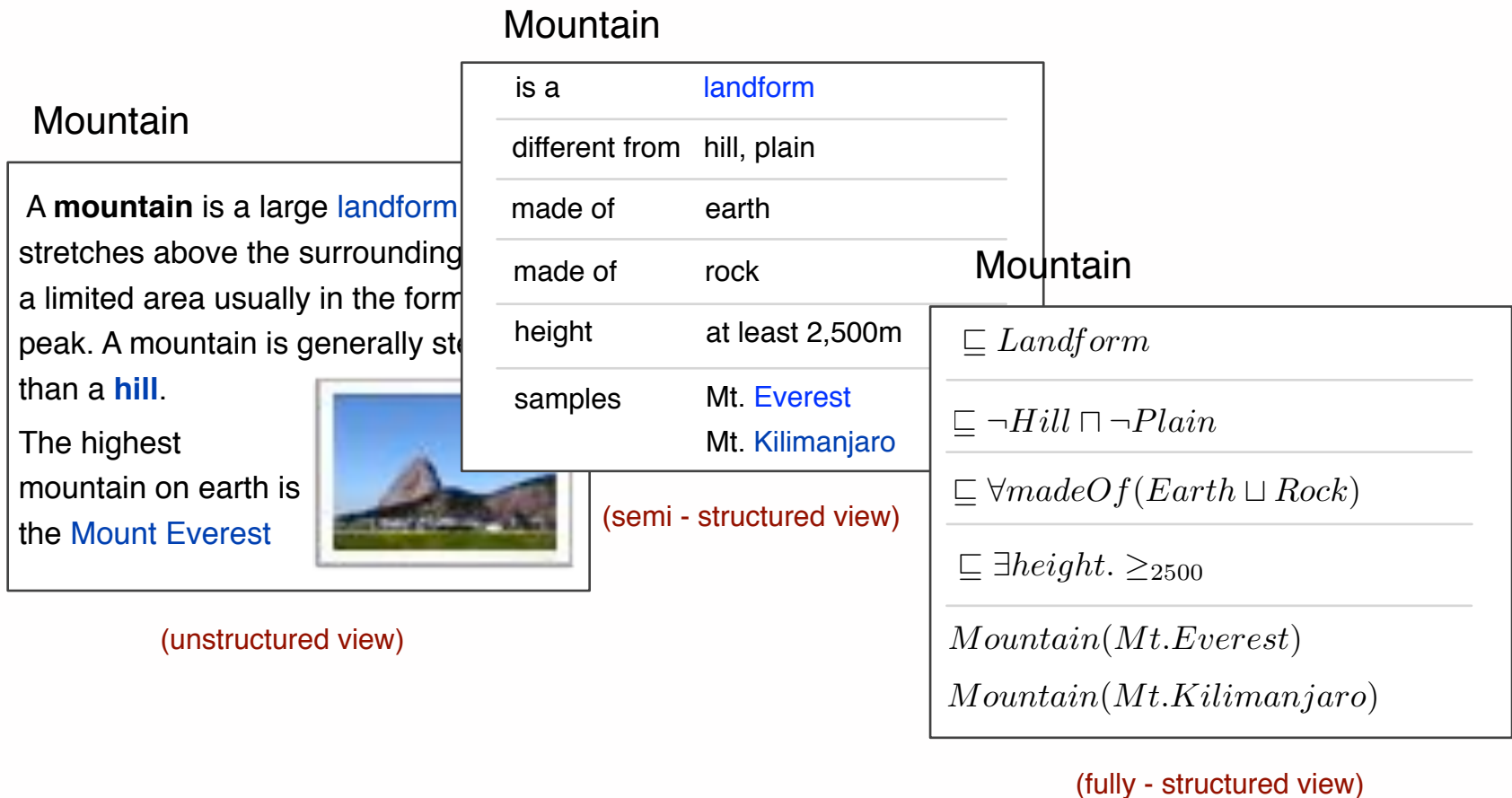
each page contains both structured and unstructured content;

Mountain	
<p>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.</p> <p>The highest mountain on earth is the Mount Everest</p> 	$\sqsubseteq \textit{Landform}$ <hr/> $\sqsubseteq \neg \textit{Hill} \sqcap \neg \textit{Plain}$ <hr/> $\sqsubseteq \forall \textit{madeOf}(\textit{Earth} \sqcup \textit{Rock})$ <hr/> $\sqsubseteq \exists \textit{height}. \geq 2500$ <hr/> $\textit{Mountain}(\textit{Mt.Everest})$ $\textit{Mountain}(\textit{Mt.Kilimanjaro})$
(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;



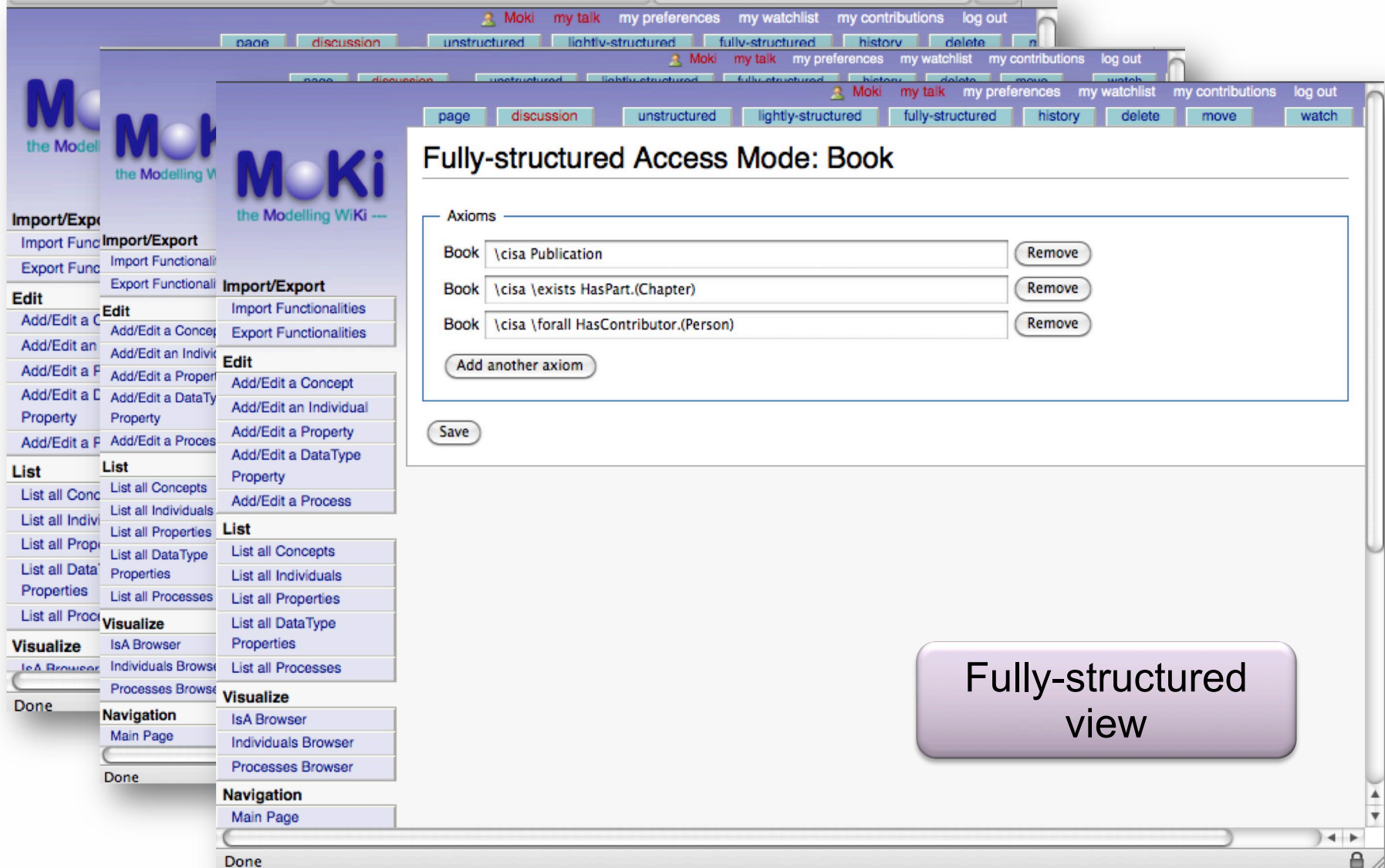
Wiki-based modeling tool;

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



The screenshot displays the Moki web interface in 'Fully-structured Access Mode: Book'. The top navigation bar includes user options: Moki, my talk, my preferences, my watchlist, my contributions, and log out. The main content area shows a list of axioms:

- Book \cisa Publication (Remove)
- Book \cisa \exists HasPart.(Chapter) (Remove)
- Book \cisa \forall HasContributor.(Person) (Remove)

Below the axioms list are buttons for 'Add another axiom' and 'Save'. The left sidebar contains a navigation menu with categories: Import/Export, Edit, List, Visualize, and Navigation. A callout box in the bottom right corner highlights the 'Fully-structured view'.

Different views for different roles

The screenshot illustrates the Moki web application interface, showing three overlapping browser windows. The top window is titled "Lightly-structured Access Mode: Hospital Administration". The middle window is titled "Lightly-structured Access Mode: Hospital Administration". The bottom window is titled "Fully-structured Access Mode: Hospital Administration" and displays a detailed BPMN diagram for a patient admission process.

The BPMN diagram in the bottom window shows the following process flow:

- Start Event:** A circle representing the start of the process.
- Task:** "Patient request admission to hospital".
- Exclusive Gateway (+):** Splits the flow into two parallel paths:
 - Path 1:** "Access Medical History database" (Task) → "Adequate facilities and funding" (Task).
 - Path 2:** "Access Insurance records" (Task).
- Exclusive Gateway (X):** Receives input from "Adequate facilities and funding" and "Access Insurance records".
 - Yes:** Leads to "Reserve Room for Patient" (Task).
 - No:** Leads to "Refer to other hospitals" (Task).
- Parallel Gateway (*):** Receives input from "Reserve Room for Patient" and "Alert consulting Doctor" (Task).
- Parallel Gateway (*):** Receives input from "Check in Patient" (Task) and "Alert consulting Doctor" (Task).
- End Event:** A circle representing the end of the process, reached from "Update Hospital Admission Records" (Task).

The diagram also includes a "Policy of access" document icon and various BPMN symbols like tasks, gateways, and events.

Further features

The screenshot displays the MOKi web interface for editing a class hierarchy. On the left, a navigation menu includes sections for 'Import/Export', 'Edit', and 'List'. The main content area shows a 'Browser IsA' view with a tree structure of classes: Thing, AcademicStaff, FacultyMember, and Lecturer. A 'Policy of access' box is linked to the MOKi logo. A diagram at the top illustrates relationships between 'Access Insurance' and 'Adequate facilities and funding'.

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: Domain:

Percentage of relevant concepts to return:

Take multiword expressions that occur at least:

either times in a document

or times in the corpus

Maximum length of multiword expressions:

Prefer key-concepts occurring early in the text:

Prefer specific key-phrases:

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

[oil 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)



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



STREP FP7 EU project [36 months]

Purpose: build/revise an environmental ontology

Developed the new key concepts extraction functionalities

Used to automatically create part of the ontology (pollen)



Organic.Edunet

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 Type 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:

ESWC2009, SemWiki2009, EKAW2010, ISWC2010,...

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?