FP7 ICT STREP Project

Deliverable D5.1

Models for Setting the Wiki

http://www.learnpad.eu

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Abstract

Deliverable D5.1 draws upon requirements identified in D1.1 and is derived from two running processes, namely the "Student Admission Process" and "SUAP". The "Student Admission Process" is a running process at FHNW and the "SUAP" is a running process at Marche Region.

We illustrate the functionalities that will be implemented in a mock-up for the two real processes.

The mock-up provides the golden threat throughout the document. The main artefact reported on in this deliverable is the Learn PAd ontology. Using ontology to represent information is widely accepted as it is machine understandable as well as cognitively adequate for humans.

We reused an existing ontology namely ArchiMEO that was developed by FHNW. In order to cover Learn PAd specific requirements the ontology was enhanced regarding concepts and relations defined in the Learn PAd Conceptual Meta Model (LCMM) and the Learn PAd Platform Independent Meta Model (LPIMM) which are developed in WP3.

We reassessed the ontology by posing competency questions in order to determine the formal terminology needed to meet the requirements. Since ontology development is considered an iterative process, the Learn PAd ontology represents a first version and will be continuously improved throughout the project.

Since the ontology is supposed to support process execution and learning the ontological representations were related to non-ontological representations, particularly to the models of various kinds (e.g. a process modelled in BPMN). Therefore, we mapped the classes of LPIMM to concepts of the Learn PAd ontology. With this approach we can provide the semantics to infer the context of a process, which we illustrated using again the mock-up for the two processes. In addition to the mapping between models and the ontology we defined a mapping between models and their representations in XWiki.

Furthermore, we introduced mechanisms for retrofitting modifications and annotations made in the wiki into their ontological representation.

Keyword list

Meta Model, Conceptional Meta Model, Platform Independent Meta Model, Model, Model Kind, Model Description Language, BPMN, BMM, CMMN, Model Driven Development, Ontology, Ontology Engineering, Ontology Mapping, Core Enterprise Ontology, ArchiMEO, Conceptual Model Ontology, LCMO, Platform Independent Meta Model Ontology, LPIMO, Competency Question, RDFS, Collaborative Content Management, Collaborative Workspace, Mock-up, Browsing Mode, Execution Mode, Context, Retrofitting Mechanism

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Glossary, acronyms & abbreviations

Item	Description
BIS	MSc in Business Information Systems
BMMO	Business Motivation Model Ontology
BMMo	Business Motivation Model ontology
BP	Business Process
BPMN	Business Process Model and Notation
BPMNo	Business Process Model and Notation ontology
CEO	Core Enterprise Ontology
CMMN	Case Management Model and Notation
CMMNo	Case Management Model and Notation ontology
CMMo	Competency Meta Model ontology
DKMo	Document and Knowledge Meta Model ontology
FHNW	University of Applied Sciences and Arts Northwestern Switzerland
KPIo	KPI Meta Model Ontology
LCMM	Learn PAd Conceptional Meta Model
LCMO	Learn PAd Conceptual Model Ontology
LCMO	Learn PAd Conceptual Model Ontology
LPIMM	Platform Independent Meta Models
LPIMO	Learn PAd Platform Independent Meta Model Ontology
OMMo	Organisation Meta Model ontology
SPARQL	SPARQL Protocol And RDF Query Language
SUAP	Sportello Unico Attivitá Produttive
TOL	Top Level Ontology
UC	User Case
UML	Unified Modeling Language

Table of Contents

List of Figures

1. Introduction

The Collaborative Content Management has two faces: the one the user sees and the one the "machine" sees. The first is implemented in XWiki, the latter in an ontology. The XWiki representation supports the user in a way she is used to whereas the ontology provides the semantic meta models for expressing a shared understanding of meaning and for automatic reasoning. Hence, we have two translations of models, i.e. of their objects and relations: one into XWiki pages, the other into the ontology.

Figure 1.1 depicts the context of the approach: on top left part of the graphical representation of a platform independent meta model (here: of BPMN) is depicted, below part of its ontological representation. On the right hand side a process model is shown expressed in BPMN. This model is translated into XWiki pages and into instances of the ontology.

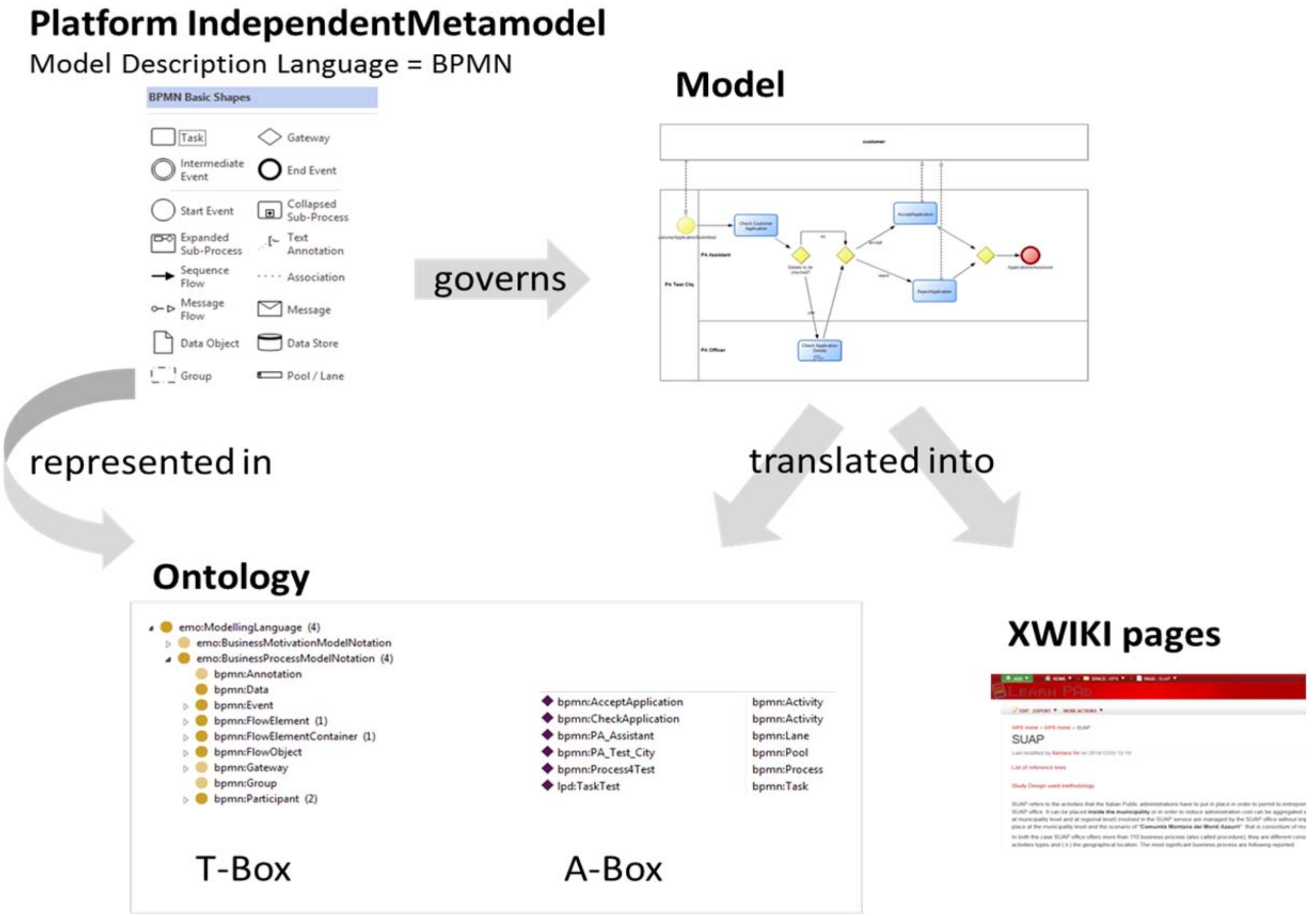


Figure 1.1 Context of Models

Therefore an export functionality is developed to translate all model elements and relations into XWiki pages and into the ontology. For each model its model elements and relations are translated into a XWiki structure and several XWiki pages are created including graphical representations and elucidations. The collaborative nature of the XWiki then allows that all process stakeholders can provide feedbacks, comments and suggestions. Same as models are translated into instances of the ontology, user contributions are also represented in it.

In this way the ontology builds the basis for creating, executing and monitoring business processes and information to be used for automatically providing services and information, guiding the learner in both online and offline learning, and measuring the success of learning via KPIs.

1.1. Objectives

Within task 5.1 the following objective are addressed and described:

- to create the ontologies needed to represent meta models, models and their relations in a machine understandable but cognitively adequate representation
- to determine the mappings between ontology and non-ontological data representations, as in XWiki
- to define the mechanism for retrofitting modifications and annotations made in the XWiki into the ontological representation of the correlating entities.

1.2. Related Tasks / Deliverables

Our work considers other work that is provided in already completed deliverables, see the list below:

- D1.1. Requirements Report. The document identifies requirements that build input for our deliverable.
- D2.1 Platform Architectural Description. The document provides sequence diagrams of Use Cases (UC) that are used to create a mock-up and to reassess the ontology.
- D3.1. Domain Analysis of Business Processes in Public Administrations. The document also analyzes the modeling notations and the practices in order to define a first list of concepts suitable to define the Learn PAd meta models and on these grounds the ontology.

There are also some deliverables due at M12 that are related to D5.1. These are mainly

- D3.2 Domain Analysis of Business Processes in Public Administrations. Within task 3.2 a high level Conceptional Meta Model (LCMM) is developed as well as a set of Platform Independent Meta Models (LPIMM) is defined, that capture and elaborate the previously identified elements (introduced in D3.1), which allow a reasonable description of the considered business processes and their context. The Learn PAd Conceptual Meta Model (LCMM) is elaborated in the Learn PAd ontology within task 5.1 and also the concepts and relations of the Learn PAd Platform Independent Meta Model (LPIMM) are represented in the ontology.
- D6.1 Simulation Environment: Specification and Design. Relation to our work is with respect to providing context information for setting up and monitoring simulation.
- D8.1 Demonstrators BP and Knowledge models. Work in task 8.1 permits to assess the applicability, acceptance and effectiveness of our approach within real working context. For our work we selected part of one process (called "SUAP") provided by WP8 to visualize our approach via a mock-up, to re-assess the ontology by asking competency questions.

1.3. Structure of the Deliverable

D5.1 is structured as follows: First the objectives we aimed to achieve within task 5.1 are explained in chapter 1. And then, in chapter 2 the methodology that we applied to reach the goals is described. In chapter 3 mock-up for two real processes, "Student Admission" and "SUAP" are described to illustrate the functionality that will be implemented. In chapter 4 we introduce the basis of the Learn PAd ontology followed by a description of the procedure of verification and enhancement of the ontology for Learn PAd. Chapter 5 is about translating models into XWiki pages and into the ontology, i.e. mapping ontological models to non-ontological models. Chapter 6 introduces retrofitting mechanisms for user annotations to models. The deliverable concludes in chapter 7.

2. Methodology

Our methodology for reaching the above mentioned objectives is based largely on the Design Science Research approach (amongst others Vaishnavi & Kuechler (2004)) that foresees the following five steps:

1. awareness, i.e. understanding the problem and deriving requirements
2. suggesting a draft for the solution
3. developing/implementing the solution
4. evaluating the solution
5. deriving general conclusions and insights

Figure 2.1 depicts the general methodology of the research design.

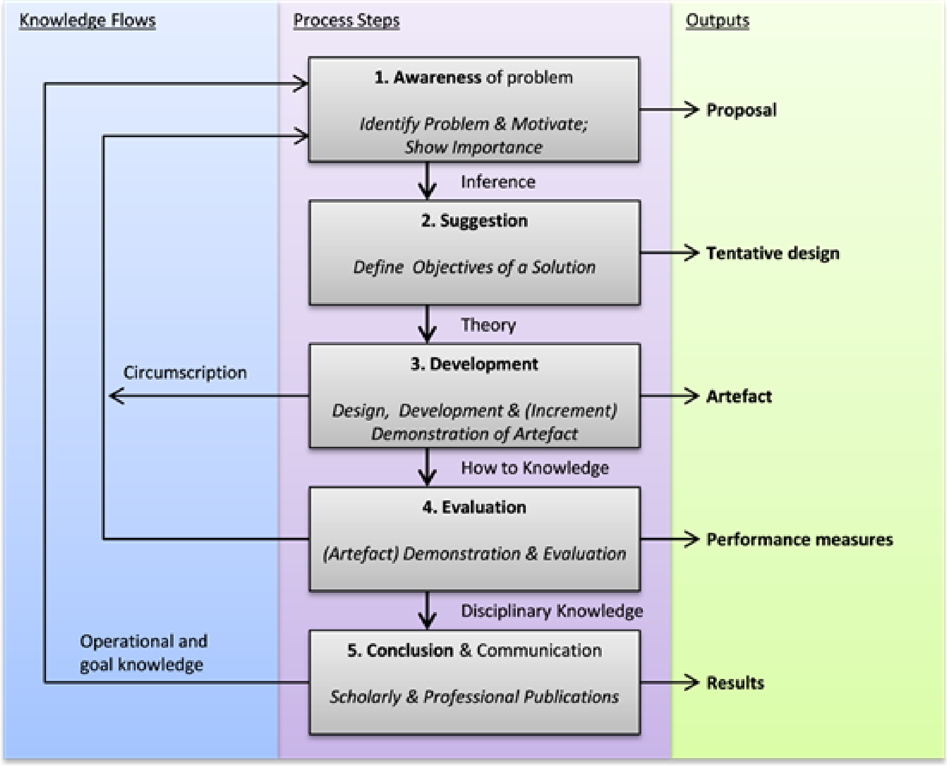

Knowledge Flows
Process Steps
Outputs
1. Awareness of problem
Identify Problem & Motivate; Show Importance
Proposal
Inference
2. Suggestion
Define Objectives of a Solution
Tentative design
Theory
Circumscription
3. Development
Design, Development & (Increment) Demonstration of Artefact
Artefact
How to Knowledge
4. Evaluation
(Artefact) Demonstration & Evaluation
Performance measures
Disciplinary Knowledge
Operational and goal knowledge
5. Conclusion & Communication
Scholarly & Professional Publications
Results

Figure 2.1 General Methodology of Research Design

Figure 2.1 is adapted from Vaishnavi & Kuechler (2004) and enhanced with elements from Peffers et al. (2008).

Since we are at a rather early stage of the project, only steps 1 and 2 are performed and they are explained in the following.

2.1. Analysis of the Problem

To gain awareness of the problem we applied the following methods.

- We analyzed the requirements and scenarios described in deliverable D1.1 and concretized them along two real processes, namely the "Student Admission Process" implemented at FHNW and the "SUAP", implemented at Marche Region. As we had the expertise and domain knowledge regarding the "Student Admission Process" within our team, we used this process to get a thorough and concrete understanding of the requirements and scenarios from D1.1. For the "SUAP" process we draw upon the knowledge provided in deliverable D8.1.

- We designed a mock-up of the collaborative workspace for both processes that reflect the use cases UC3.6, UC3.7 and UC3.10 and that show how users could interact with the collaborative workspace when learning and sharing knowledge. This includes both mechanisms for receiving knowledge in the form of context-sensitive recommendations and for sharing knowledge via annotations and other means. The mock-up serves as basis for a discussion with the application partners during a consortium meeting to reach a common understanding and clarify their requirements; we then adapted the mock-up accordingly. The result of these two steps is described in chapter 3.
- We applied the common approach in ontology engineering of answering competency questions to develop the Learn PAd ontologies. Fox et al. (1996, p 134) consider competency questions as "benchmarks in the sense that the ontology is necessary and sufficient to represent the tasks specified by the competency questions and their solution." This technique has been used to build the TOVE ontology (Fox et al. 1996) and since then been adopted amongst others by De Bruijn (2003), De Leenheer & Mens (2008) and Cardoso (2010). In general, competency questions are formulated in natural language to determine the scope and evaluate appropriateness of an ontology. Questions and answers lead to the required concepts and their properties, relations and axioms of the Learn PAd meta model, i.e. the Learn PAd ontology. Figure 2.2 shows the procedure for ontology design and evaluation as suggested by Grüninger & Fox (1995, p 3).

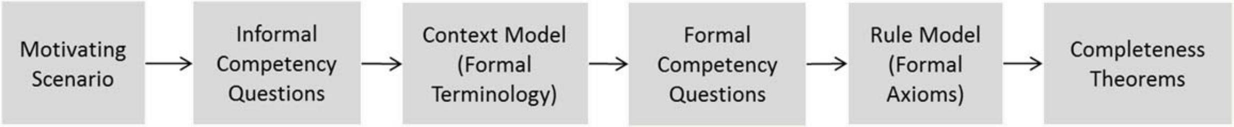

Motivating Scenario
Informal Competency Questions
Context Model (Formal Terminology)
Formal Competency Questions
Rule Model (Formal Axioms)
Completeness Theorems

Figure 2.2 Procedure for Ontology Design and Evaluation

Within the awareness phase the first two steps of the procedure were performed. For the "Motivating Scenario" we base on the "Student Admission Process" and the "SUAP scenario". The both scenarios were created after several meetings with people working in the real process at FHNW and in Regional Public Administrations of Marche Region. The procedure for ontology design and evaluation is described in chapter 4.4. Based on the motivating scenarios the information competency questions were elaborated, described in section 4.4.1.

Step three, development of the formal terminology, is part of drafting the solution as detailed below.

2.2. Suggestion for a Draft Solution

Within the second step of Design Science Research objectives of the solution were defined and a tentative design created.

To draft the solution

- we created a first iteration of the Learn PAd ontologies

    - since ontology engineering is a challenging task we followed Bertolazzi et al. (2001, pp 104-115) who argue that ontology engineering should not start from scratch but propose to use an already existing model, they call the Core Enterprise Ontology (CEO). A CEO should contain the most general business concepts, common to the majority of enterprises, independently of the specific activity field. The ArchiMate Standard developed by The Open Group is such a meta model comprising all enterprise objects needed to model an Enterprise Architecture. FHNW already developed an ontological representation of ArchiMate 2.1 (The Open Group 2012) enhanced by top level concepts (Thönssen 2013) and evaluated it within several projects like DokLife (Thönssen & Lutz 2012), APPRIS (Emmenegger et al. 2012). The ontology is called ArchiMEO (Hinkelmann et al. 2013). Due to its proofed shared use ArchiMEO ontology seems to be eligible to serve as a CEO
    - we took the Learn PAd meta models (LCMM and LPIMM) as described in D3.2 as basis for Learn PAd specific extensions of ArchiMEO, namely the Learn PAd Conceptual Model Ontology (LCMO) and the Learn PAd Platform Independent Meta Model Ontology (LPIMO)
    - we re-assessed the thusly developed Learn PAd ontology and added concepts and relations derived from the competency questions if needed
- we defined the mappings between ontology and non-ontological data representations, i.e. between models, respectively meta models, and representations in XWiki and the Learn PAd ontology
- we outlined the mechanism for retrofitting modifications and annotations made in XWiki into the ontological representation.

3. Mock-up of the Collaborative Workspace

To illustrate the functionality that will be implemented we introduced a mock-up for two real processes, "Student Admission" and "SUAP". The "Student Admission Process" is a running process at FHNW and the "SUAP" is a running process at Marche Region.

The mock-up for the "Student Admission" and "SUAP" process, respectively the knowledge intensive parts, we created is based on the Use Case Scenarios 3.6, 3.10 and 3.7 described in deliverable D2.1.

3.1. Mock-up of "Student Admission" Process

3.1.1. Short Description of the Process

The "student admission" process regulates the admission of applicants to the study program *MSc in Business Information Systems* (BIS) within the school of business at FHNW. The goal of the process is to decide whether a candidate should be admitted to the study program or not, based on the candidate's application documents and a face-to-face interview. There is a set of business rules that guides the final decision, involving e.g. a minimum grade in previously acquired diplomas (e.g. Bachelor grade) and a minimum amount of work experience.

Figure 3.1 shows an overview of the process. The process starts when a person makes an application to participate in the Master Program. The first step of the process is a check of the documents the student handed in. These documents comprise a motivation letter, a CV and certificates of previous education and proof of work experience. The check is a knowledge-intensive sub-process carried out by the MSc assistant and will be described in more detail below. The information collected in the first step is handed over to the program head (dean) who validates the findings. If formal requirements are met, the applicant is invited for an interview, otherwise she/he is rejected directly. The interview is conducted by a team of two professors who record a protocol that is, together with the formal documents, inspected by the admission commission. The commission makes the final decision about acceptance or rejection of the applicant.

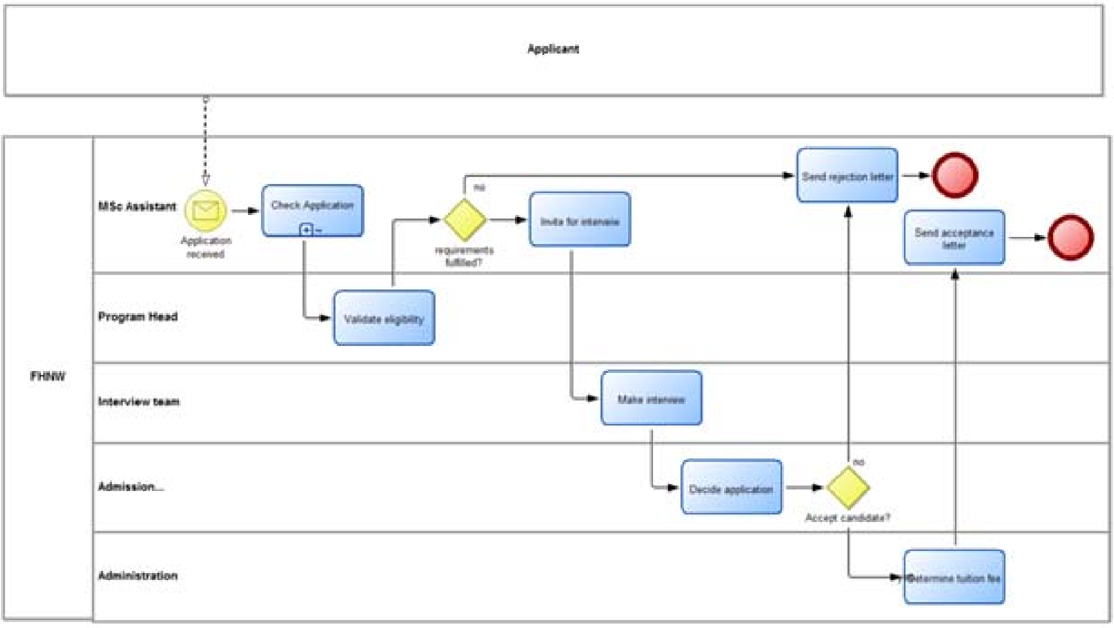


Figure 3.1 Overview of the Student Admission Process

For the illustration of learning support, we will concentrate on the knowledge-intensive sub-process "Check application". A CMMN model of this sub-process is shown in Figure 3.2.

The main challenge in this sub-process is that the educational record of the applicant may consist of unknown degrees acquired in institutions and within study programs with unknown accreditation and grading systems widely different from the Swiss grading system.

In order to be able to apply the business rules that guide the decision, the assistant needs to first translate the degrees, accreditations and grades into the Swiss system. The information for such translation can be found in various on-line or off-line resources (e.g. crus.ch) or by involving experts (e.g. colleagues from the respective country). For applicants who have studied in Switzerland before, another necessary activity in the sub-process is to retrieve the matriculation number – since Swiss students will always use the same matriculation number throughout their education and across all Swiss universities.

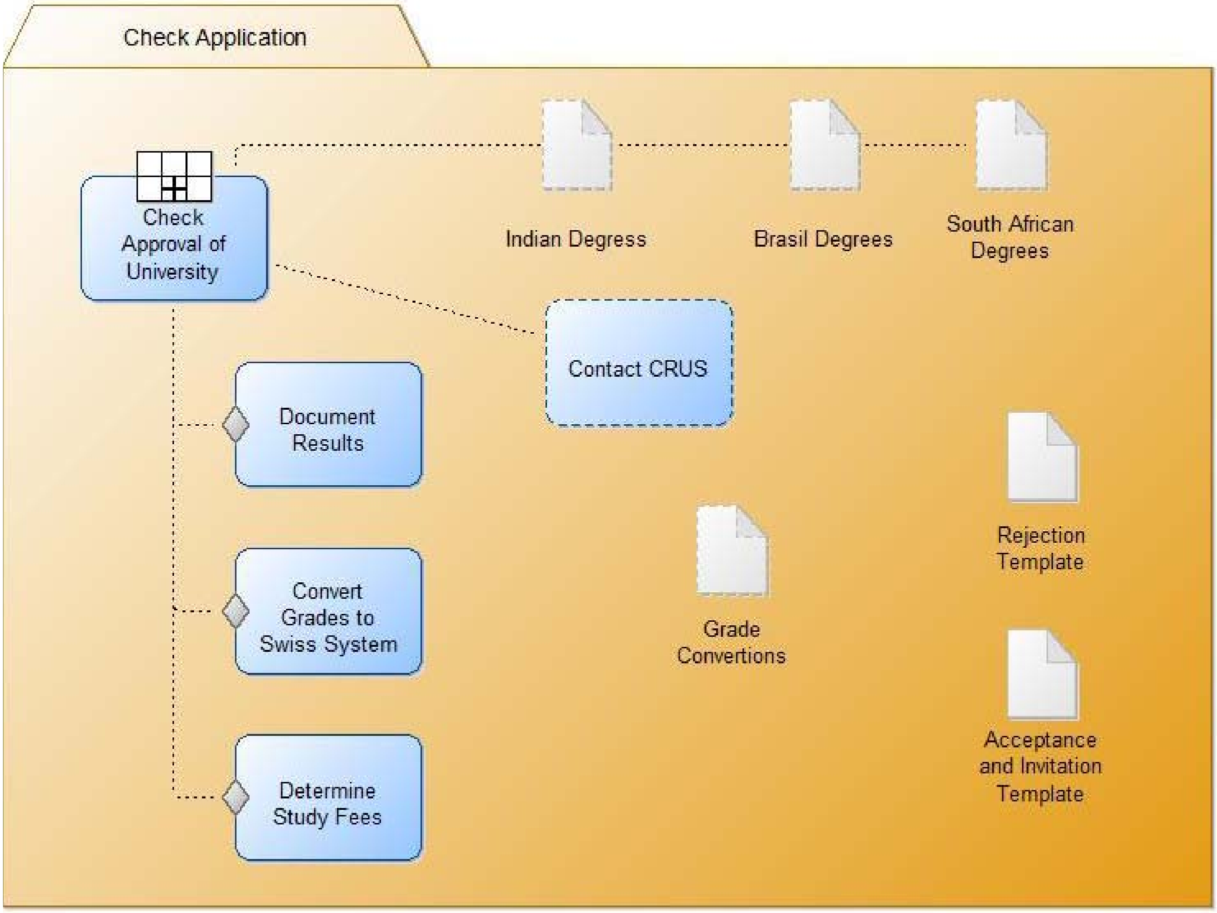


Figure 3.2 CMMN Model of the Knowledge-Intensive Sub-Process "Check Application"

3.1.2. Ways of Learning

As stated in the description of work Learn PAd considers learning and working strongly intertwined (learning while doing). The platform is intended to support both an informative learning approach based on enriched business process (BP) models, and a procedural learning approach based on simulation and monitoring (learning by doing). Therefore we distinguish learning is the following ways:

- Firstly, a civil servant can learn by browsing and reading documentation of a business process. This happens "off-line", i.e. there is no example case on which the learning is carried out. Or in other words, learning is performed on the model not on an instance of the model.
- Secondly, a civil servant can learn by solving a problem, i.e. while actually performing tasks (learning by doing). This can be done in a simulation setting where the problem is not real (it can be either a historical or invented case) as described in deliverable D6.1. Or it can be in a real setting while working on a real and current case.

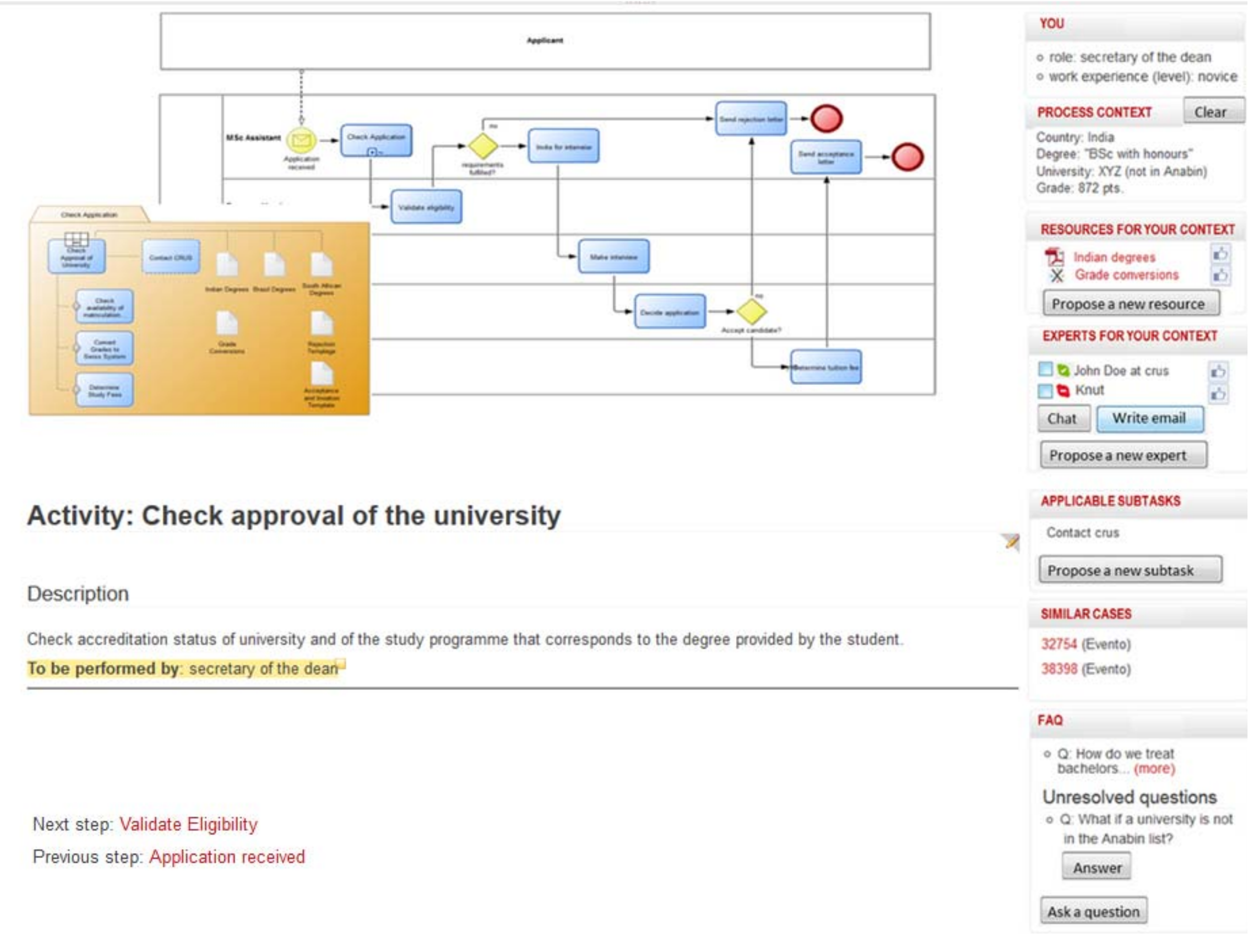
In the Wiki, we support the first way of learning (as described in the use case scenario UC3.6), but also the case of working on a current real case (see UC 3.10). Accordingly, there are two different *modes* in which the Wiki can be used:

- The **browsing mode** permits a user to browse pages describing objects of a business process, for example a task within the process. In this mode a process model (and related models like the organisational model) is displayed without the process (instance) specific context. Usually, the entry point to a browsing session is a page with a graphical overview of the business process. The user can choose an activity by clicking its representation in the graphic. After that the XWiki page describing the task is displayed, providing generic information about each task, including useful resources, subtasks and experts. Afterwards, the user can navigate freely between tasks, using the links that connect those tasks that follow each other in the BP model. In this mode user navigation is not restricted to the role she/he has in a process but to the tasks the role she/he has been assigned to.
- The **execution mode** supports a user in solving a real case. As in real life a learner learns by doing, that means, learns by executing a "real instance" of a process. This has two consequences:
    - Application data needed to get the context of a task must be provided. This can be done for example by uploading a form that was provided as an input to the business process (like the application of a student for admission at FHNW). The Learn PAd system uses this information to provide context-specific recommendations (as will be shown below).
    - The execution mode may be augmented with a "shallow workflow functionality" that actually guides a user through a process. Such a functionality might provide a lightweight integration with a productive business system that is to be used to deal with the task. That is, the wiki page representing the task either allows to call a legacy system (e.g. by clicking a hyperlink) or, simply by asking the user to switch to the legacy system, carry out the requested work step and later come back to the wiki to report the results. Thus, the wiki can become the system that one uses to walk through the process, providing links to productive (legacy) systems where the actual work is carried out. The shallow workflow will also take a user to the next activity. In the case of gateways, interaction may be required where the user decides which path to take. In those cases where the next activity has to be executed by another role the system would identify persons having assigned this role and involve them by sending an email. Refer to section x for a description how this is represented in XWiki.

In the following, we illustrate how the support of these learning modes may look like in a real system.

3.1.3. Mock-up for UC 3.6 and 3.10

Figure 3.3 shows a mock-up screenshot of the Learn PAd system that will support the MSc assistant in performing the "check application" sub-process with its main activity "Check approval of the university".



Activity: Check approval of the university

Description

Check accreditation status of university and of the study programme that corresponds to the degree provided by the student.

To be performed by: secretary of the dean

Next step: Validate Eligibility

Previous step: Application received

- role: secretary of the dean
- work experience (level): novice

Country: India
Degree: "BSc with honours"
University: XYZ (not in Anabin)
Grade: 872 pts.

- Q: How do we treat bachelors... (more)

- Q: What if a university is not in the Anabin list?

Figure 3.3 Mock-up Screenshot for "Check Approval of the University"

The screen is divided into two sections:

- The main section on the left supports UC 3.6 (see deliverable D1.1), i.e. the browsing mode: the graphical model of the entire business process is shown, along with the title and description of the activity (including the responsible role). With the links "previous step" and "next step", the user can navigate to similar screens that represent the predecessor and successor activities. Thus, the user can understand the position of the activity within the whole process and learn about the rough goal of the activity.
- A dynamically adapting "help center" is shown in the right screen section, which appears as a sidebar and supports the scenario described in UC 3.10, i.e. the

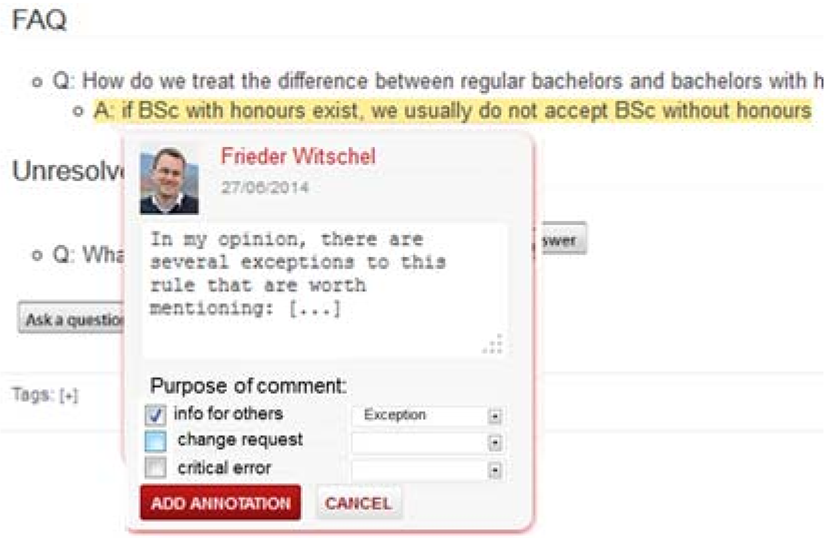
execution mode. The sidebar is divided into blocks that offer different kind of help: the first two blocks show the context in which the current process execution is taking place (note: here, we do not address the question of how the Learn PAd system learns about that context, this will become clear later).
In the example, the context is given by the role and work experience level of the user, plus the application data that is relevant for the current activity: the degree of the applicant, the country and university where that degree was acquired and the grade on the certificate. This context determines the content of all other blocks: the system recommends to the learner resources, experts and subtasks that fit the current context. For instance, the system proposes a document with help on Indian degrees – which fits because the applicant acquired her degree in India. In addition, the system shows similar cases from the productive system where applications and matriculations are managed (Evento) and a collection of frequently asked questions around the activity.

3.1.4. Mock-up for UC 3.7 (Dialogues for Commenting and Adding Resources)

In order to foster learning on a collaborative level, civil servants are also able to share their knowledge about the admission process, as described in UC 3.6 (see deliverable D1.1).

Knowledge sharing can take four forms:

- Firstly, a user can comment on items displayed on the screen – including both the static information in the left section and the recommended resources in the right section. The purpose of a comment can be to either make other users aware of a problem or an exception that should be taken into account in certain situations, to request a change in the way the process is modeled or even to report a critical error in the model. Commenting works by highlighting text on the page and pressing a combination of keys that will bring up the comment dialogue.
  An example of commenting is shown in Figure 3.4: it can be seen that the user has highlighted some text – in this case the answer that another user has provided for a question – and written some text relating to the highlighted content. At the bottom of the dialogue the user has classified the comment as "info for others", i.e. it will be shown to other users who look at this FAQ, but a change of the model is not considered necessary.



FAQ

- Q: How do we treat the difference between regular bachelors and bachelors with h
  - A: if BSc with honours exist, we usually do not accept BSc without honours

Unresolv

- Q: Wha

Ask a questio

swer

Tags: [+]

Frieder Witschel

27/06/2014

In my opinion, there are several exceptions to this rule that are worth mentioning: [...]

Purpose of comment:

☑ info for others Exception

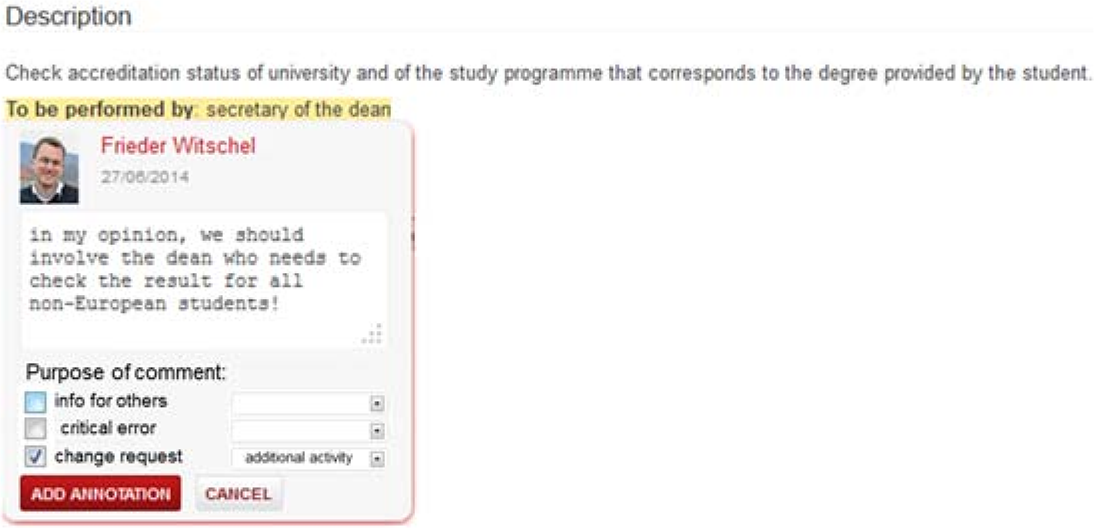
☐ change request

☐ critical error

ADD ANNOTATION CANCEL

Figure 3.4 Dialogue for Commenting

Figure 3.5 shows another example of the user suggests changing the model. The change request is additionally characterized as "additional activity". The semi-structured design of the commenting dialogue will facilitate the task of retro-fitting user annotations to the model (see chapter 6).



Description

Check accreditation status of university and of the study programme that corresponds to the degree provided by the student.

To be performed by: secretary of the dean

Frieder Witschel

27/06/2014

in my opinion, we should involve the dean who needs to check the result for all non-European students!

Purpose of comment:

☐ info for others

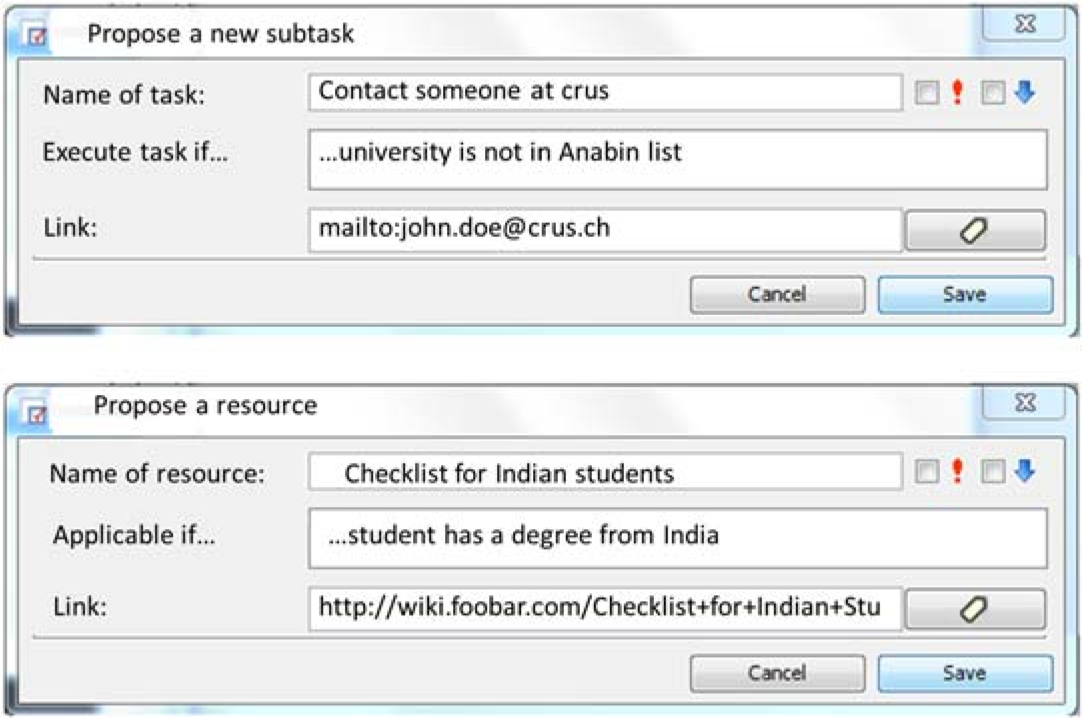
☐ critical error

☑ change request additional activity

ADD ANNOTATION CANCEL

Figure 3.5 Dialogue for Requesting a Model Change

- Secondly, a user can contribute knowledge about useful resources, experts or subtasks by clicking on the "Propose a new…" buttons in the right screen section (sidebar) in Figure 3.3. When clicking such a button, dialogues like the ones shown in Figure 3.6 will appear – here, we can see how a user proposes a new subtask and a new resource. The user needs to provide a name and a link; in addition, the user can provide a condition under which the resource should be recommended, e.g. a checklist for Indian students only needs to be recommended if the applicant has a degree from India. Again, this helps to retrofit the contribution to the model (see chapter 6).


Propose a new subtask

Name of task: Contact someone at crus

Execute task if... ...university is not in Anabin list

Link: mailto:john.doe@crus.ch

Propose a resource

Name of resource: Checklist for Indian students

Applicable if... ...student has a degree from India

Link: http://wiki.foobar.com/Checklist+for+Indian+Stu

Figure 3.6 Screens for Proposing a New Subtask and Resource

- Thirdly, a user can share an opinion and/or rating regarding the perceived usefulness of a recommended resource, expert or answer using the "Like" buttons (see the small icons 👍 next to resources and experts in Figure 3.3). Later, this simple mechanism may be refined by introducing "up" and "down" ratings or rating via a Likert scale. In this way, a community-based quality assessment of contributions can emerge.
- Finally, users can post or answer questions that will be listed in the FAQ block of the sidebar. They can do this by clicking the "Answer" or "Ask a question" buttons in the lower right corner of Figure 3.3, which will bring up a simple dialogue to enter text (an answer or a question, respectively).

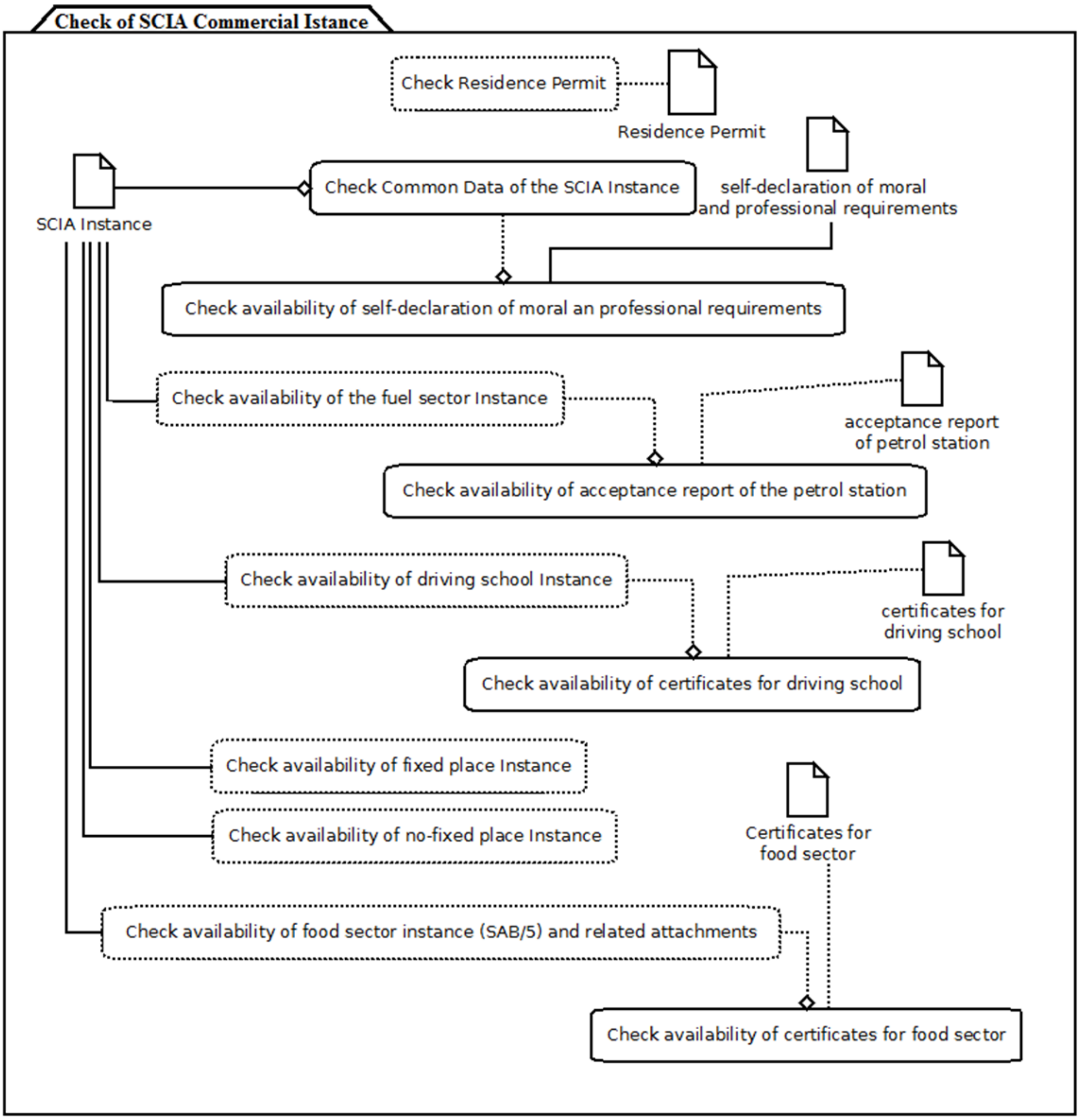
3.2. Mock-up of "SUAP" Process

3.2.1. Short Description of the Process

As introduced in deliverable D8.1 "SUAP" (Sportello Unico Attivitá Produttive, which in English means "business start-up certified notification") refers to the activities that the Italian PAs have to put in place in order to permit to entrepreneurs to set up a new company.

SUAP is a process introduced in the Italian law number 241/90 in the article 19 in which an entrepreneurs notifies to the municipality and third parties organizations the starting of a commercial business activity. It is the scenario considering an entrepreneur who self-certifies the starting of a business activity. This activity is in line with the general description, as described in deliverable D8.1. Figure 3.7 shows a CMMN model of the sub-process

"Check of SCIA commercial instance". This has to be done by the SUAP office; it can be both at municipality or mountain community level. The whole process is too complex to be shown here.



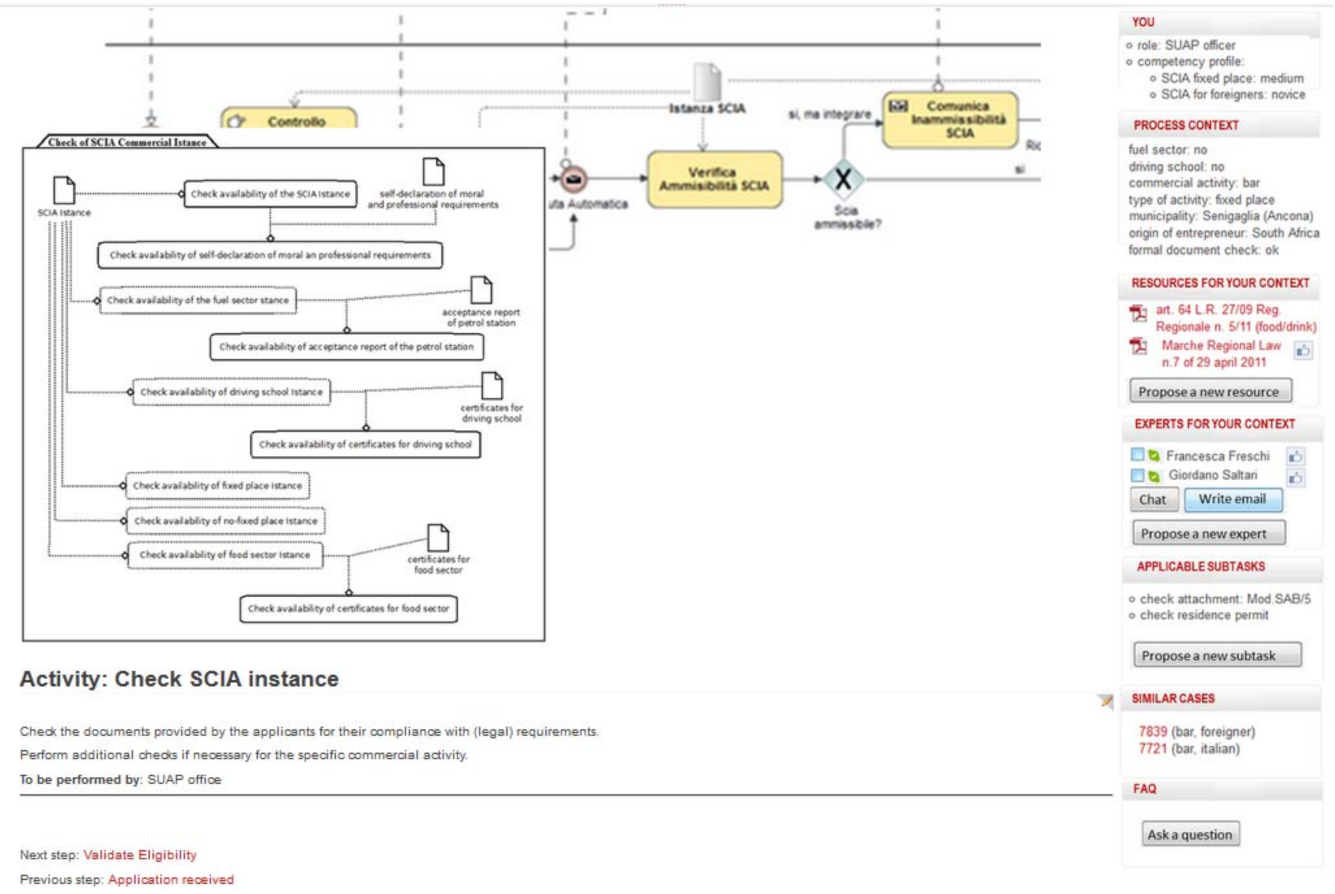
Check of SCIA Commercial Istance
Check Residence Permit
Residence Permit
SCIA Instance
Check Common Data of the SCIA Instance
self-declaration of moral and professional requirements
Check availability of self-declaration of moral an professional requirements
Check availability of the fuel sector Instance
acceptance report of petrol station
Check availability of acceptance report of the petrol station
Check availability of driving school Instance
certificates for driving school
Check availability of certificates for driving school
Check availability of fixed place Instance
Check availability of no-fixed place Instance
Certificates for food sector
Check availability of food sector instance (SAB/5) and related attachments
Check availability of certificates for food sector

Figure 3.7 CMMN Model of sub-process "Check SCIA Commercial Instance"

It can be seen that there is a large number of discretionary sub-tasks. The concrete selection of applicable sub-tasks depends mainly on the type of commercial activity – special cases are (e.g. opening a petrol station or a driving school) – whether it takes place in a fixed place and the origin of the entrepreneur. Each type of commercial activity requires specific attachments (data object) to be handed in by the applicant (and hence to be checked by the SUAP office) and is covered in different section of the law texts.

3.2.2. Mock-up for UC 3.6 and 3.10 (Our "Main Mock-up")

Figure 3.8 shows a mock-up screenshot of the Learn PAd system that will support the SUAP officer employee in performing the "Check of SCIA commercial instance" knowledge-intensive sub-process.


Controllo
Istanza SCIA
si, ma integrare
Comunica Inammissibilità SCIA
Verifica Ammisibilità SCIA
Scia ammissibile?
uta Automatica
si
Check of SCIA Commercial Istance
SCIA Istance
Check availability of the SCIA Istance
self-declaration of moral and professional requirements
Check availability of self-declaration of moral an professional requirements
Check availability of the fuel sector stance
acceptance report of petrol station
Check availability of acceptance report of the petrol station
Check availability of driving school Istance
certificates for driving school
Check availability of certificates for driving school
Check availability of fixed place Istance
Check availability of no-fixed place Istance
Check availability of food sector Istance
certificates for food sector
Check availability of certificates for food sector

Activity: Check SCIA instance

Check the documents provided by the applicants for their compliance with (legal) requirements.

Perform additional checks if necessary for the specific commercial activity.

To be performed by: SUAP office

Next step: Validate Eligibility

Previous step: Application received

YOU

- role: SUAP officer
- competency profile:
  - SCIA fixed place: medium
  - SCIA for foreigners: novice

PROCESS CONTEXT

fuel sector: no
driving school: no
commercial activity: bar
type of activity: fixed place
municipality: Senigaglia (Ancona)
origin of entrepreneur: South Africa
formal document check: ok

RESOURCES FOR YOUR CONTEXT

art. 64 L.R. 27/09 Reg. Regionale n. 5/11 (food/drink)
Marche Regional Law n.7 of 29 april 2011

Propose a new resource

EXPERTS FOR YOUR CONTEXT

□ Francesca Freschi
□ Giordano Saltari

Chat | Write email

Propose a new expert

APPLICABLE SUBTASKS

- check attachment: Mod.SAB/5
- check residence permit

Propose a new subtask

SIMILAR CASES

7839 (bar, foreigner)
7721 (bar, italian)

FAQ

Ask a question

Figure 3.8 Mock-up Screenshot for "Check of SCIA Commercial Instance"

As one can see, the general layout is the same as for the student admission process. This time, the graphical representation of the BP model looks different - this is attributable to the fact that it was modeled using MagicDraw (as opposed to the student admission process which was modeled with ADOxx). This just shows that different forms of graphical representation are possible for different public administrations, but the general concept and functionality remain the same.

Again, the Learn PAd system has captured relevant parts of the context which are shown at the top of the sidebar: in this example, the planned commercial activity consists in opening a bar. Another relevant piece of information is the origin of the applicant (South Africa). We also consider the municipality where the process was started. Finally, a needed precondition is referring to the checking from a formal point of view the correctness and completeness of the provided document.

Driven by this context information, the system is able to recommend discretionary sub-tasks that are applicable in that specific context: when applying for a commercial activity in gastronomy, applicants need to attach a special form (Mod SAB/5) – which needs to be checked by the SUAP officer. In order to support this check, the system recommends a relevant article of the law (art 64 L.R. n. 5/11) which covers aspects related to commercial activities offering food and drink, along with a more law text relevant for "Check of SCIA commercial instance" in general. Because the entrepreneur is a foreigner, the discretionary sub-task "check residence permit" is recommended.

In addition, the system can retrieve former historical cases which are similar to the current one in the sense that the same type of commercial activity (here: opening a bar) was applied for.

4. Learn PAd Ontology

As emphasized by Stuckenschmidt (2011) and others, re-use of an ontology is a huge asset. It means that modeling effort can be reduced, consistency of a domain's concepts can be ensured, etc. Learn PAd Ontology consists of several parts: the already existing Enterprise Ontology (ArchiMEO) which includes an Enterprise Upper Ontology and the Top-Level-Ontology. To represent Learn PAd particularities extensions are made derived from the Learn PAd Conceptual and Platform Independent Meta Models (refer to D3.2). In the following we will explain the several parts in more detail. The Learn PAd ontology will then be reassessed following the ontology development procedure introduced by Grüninger & Fox (1995) to ensure that all concepts and relations are represented to meet the Learn PAd requirements for supporting learning.

4.1. Basis of the Learn PAd Ontology

ArchiMEO is based on the ArchiMate standard, that is, all concepts and relations defined in ArchiMate 2.1 (The Open Group 2012) are formally represented in RDFS 3.0 (for details refer to section 4.5). Not considered are the two optional extensions of the ArchiMate language for motivation and implementation and migration (The Open Group 2012, p 216 ff).

Since ArchiMate does not provide general concepts, like location or time, ArchiMEO includes a Top Level Ontology (TOL) following Bertolazzi et al. (2001) who propose business independent ontologies. TOL comprises generic concepts of the world like `time`, `location` and `event` and can be considered best breed of. ArchiMEO also contains extensions derived from generalisable requirements from use cases of former projects. Figure 4.1 depicts the three origins of ArchiMEO.

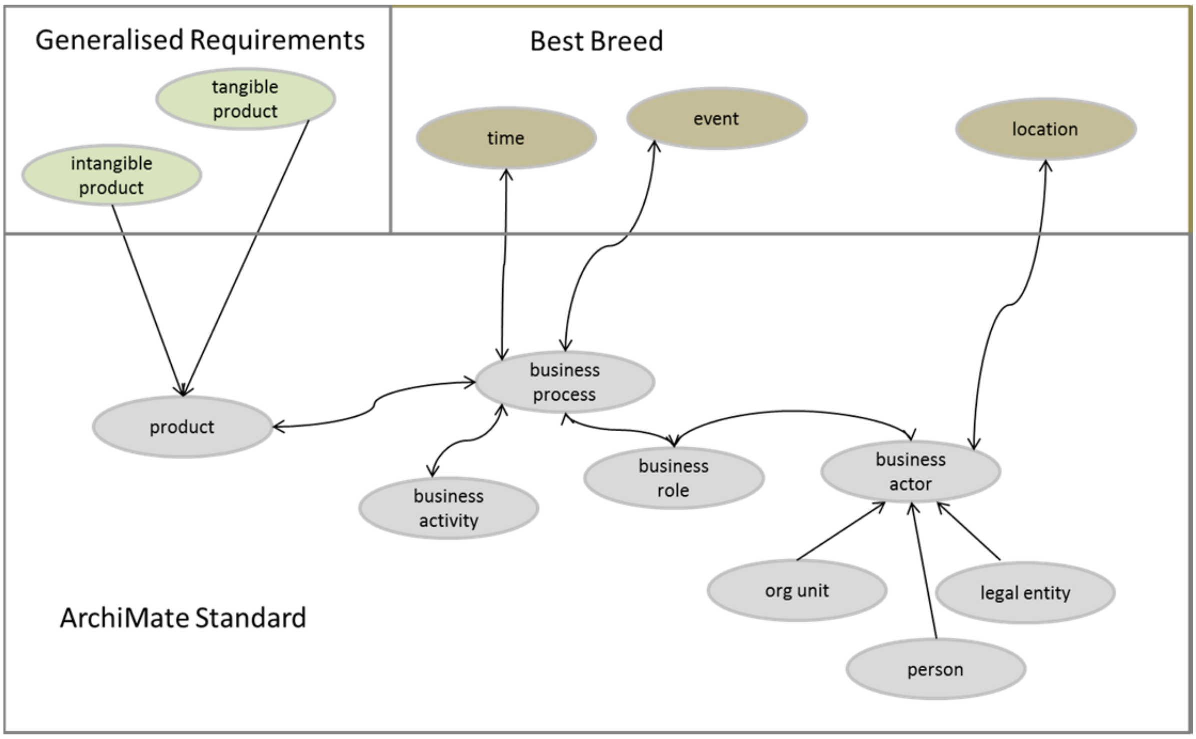


Figure 4.1 Origins of ArchiMEO

For Learn PAd we draw upon the ArchiMEO ontology. Therefore we can provide the semantics needed in Learn PAd, e.g. for recommendations. Semantics were defined in the ArchiMate 2.1 standard (The Open Group 2012) for example the concept of "Business Process" and its relations: "Business processes or business functions are assigned to a single business role with certain responsibilities or skills [competencies]. A business actor that is assigned to a business role ultimately performs the corresponding behavior. In addition to the relation of a business role with behavior, a business role is also useful in a (structural) organizational sense; for instance, in the division of labor within an organization" (The Open Group 2012, p 32).

For Learn PAd ArchiMEO is enhanced with respect to application independent concepts like the ones representing business motivation aspects (according to the Language Extensions proposed in ArchiMate 2.1 (The Open Group 2012)). Furthermore two application specific extensions are made: one for describing domain knowledge and the other for representing the meta models used by the users for modeling, i.e. for example BPMN 2.0 for modeling business processes. These two extensions were derived from Learn PAd Conceptual Meta Model (LCMM) and the Learn PAd Platform Independent Meta Model (LPIMM) described in D3.2.

In Figure 4.2 we show the Learn PAd Ontology. It consists two parts:

- Learn PAd Conceptual Meta Model Ontology (LCMO), which comprises ArchiMEO (that includes the ontological representation of ArchiMate 2.1 including language extensions, and top level concepts and relations) plus the extension for domain specific concepts and relations made for Learn PAd
- Learn PAd Platform Independent Meta Model Ontology (LPIMO), which is the other extension of ArchiMEO for the ontological representation of the meta models of the various model kinds used in Learn PAd.

LCMO and LPIMO reflect the modeling layers of LCMM and LPIMM as described in D3.2.

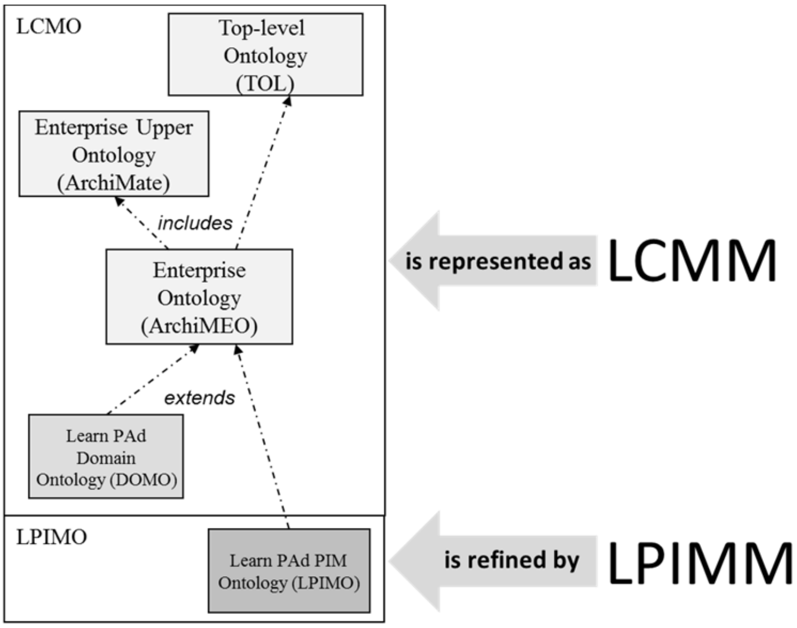

LCMO
Top-level Ontology (TOL)
Enterprise Upper Ontology (ArchiMate)
includes
Enterprise Ontology (ArchiMEO)
extends
Learn PAd Domain Ontology (DOMO)
LPIMO
Learn PAd PIM Ontology (LPIMO)
is represented as
LCMM
is refined by
LPIMM

Figure 4.2 Learn PAd Ontology Overview

Figure 4.3 shows the super concepts of the Learn PAd Ontology represented as an UML class diagram. It is a graphical representation of the ontology modeled with TopBraid in RDFS 3.0 (cf. section 4.5). In the middle the core concepts are depicted. From left to right: the super concept of the LPIMO (`LearnPAdPlatformIndependentMetaModel`), the super concept of the ontological representation of ArchiMEO (`EnterpriseObject`) including the ArchiMate concepts, and the super concept of the TOL (`TopLevelElements`). Below the `EnterpriseObject` concept the main concepts of ArchiMate are visible as defined in the standard: `ActiveStructureElement`, `BehaviourElement` and `PassiveStructureElement.`

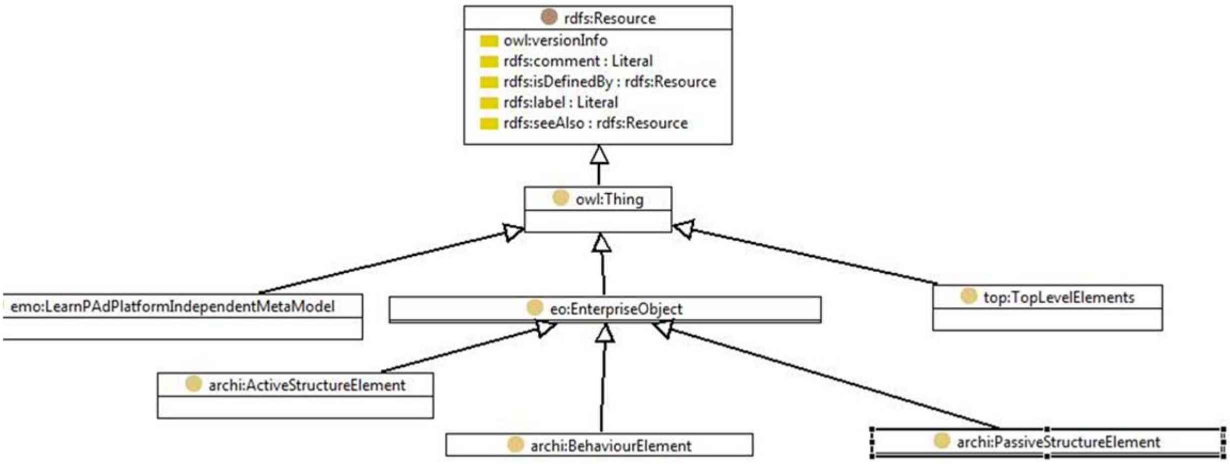

rdfs:Resource
owl:versionInfo
rdfs:comment : Literal
rdfs:isDefinedBy : rdfs:Resource
rdfs:label : Literal
rdfs:seeAlso : rdfs:Resource
owl:Thing
emo:LearnPAdPlatformIndependentMetaModel
eo:EnterpriseObject
top:TopLevelElements
archi:ActiveStructureElement
archi:BehaviourElement
archi:PassiveStructureElement

Figure 4.3 Top Level Concepts of the Learn PAd Ontology

Actually, the ontologies are logically separate but physically all concepts and relations are stored in one ontology - the Learn PAd Ontology. The distinction between the different ontologies is made based on different namespaces. The namespaces shown in Figure 4.3 has the following meaning (from left to right): `emo` = enterprise meta model ontology, `eo` = enterprise ontology, `top` = general top level concepts and `archi` = concepts of the ArchiMate 2.1 standard. Some more namespaces are used which will be introduced when needed.

In the following the details of LCMO and LPIMO were described. Note, that ontology development is an iterative process. Concepts and relations of LCMO and LPIMO presented below reflect the current knowledge and thus the ontology may modify as work is going on.

4.2. Learn PAd Conceptual Meta Model Ontology (LCMO)

The LCMO refines the concepts and relations of the Learn PAd Platform Independent Meta Model as described in D3.2 in order to provide semantics to the concepts and relations and allow for reasoning, as depicted in Figure 4.2. The ontological representations of the refinements of the LCMO, the concepts and relations, are considered Learn PAd specific enhancements of the existing ontologies.

Figure 4.4 depicts a snippet of the LCMO. On the bottom of the figure the LCMM and its relations is shown. To give an example of how the concepts are elaborated in the ontology for the LCMM concepts "organisation" and "motivation" the refined concepts of LCMO are depicted. The concepts and relations in LCMO *refine* the LCMM concept in a machine-understandable but cognitively adequate way.

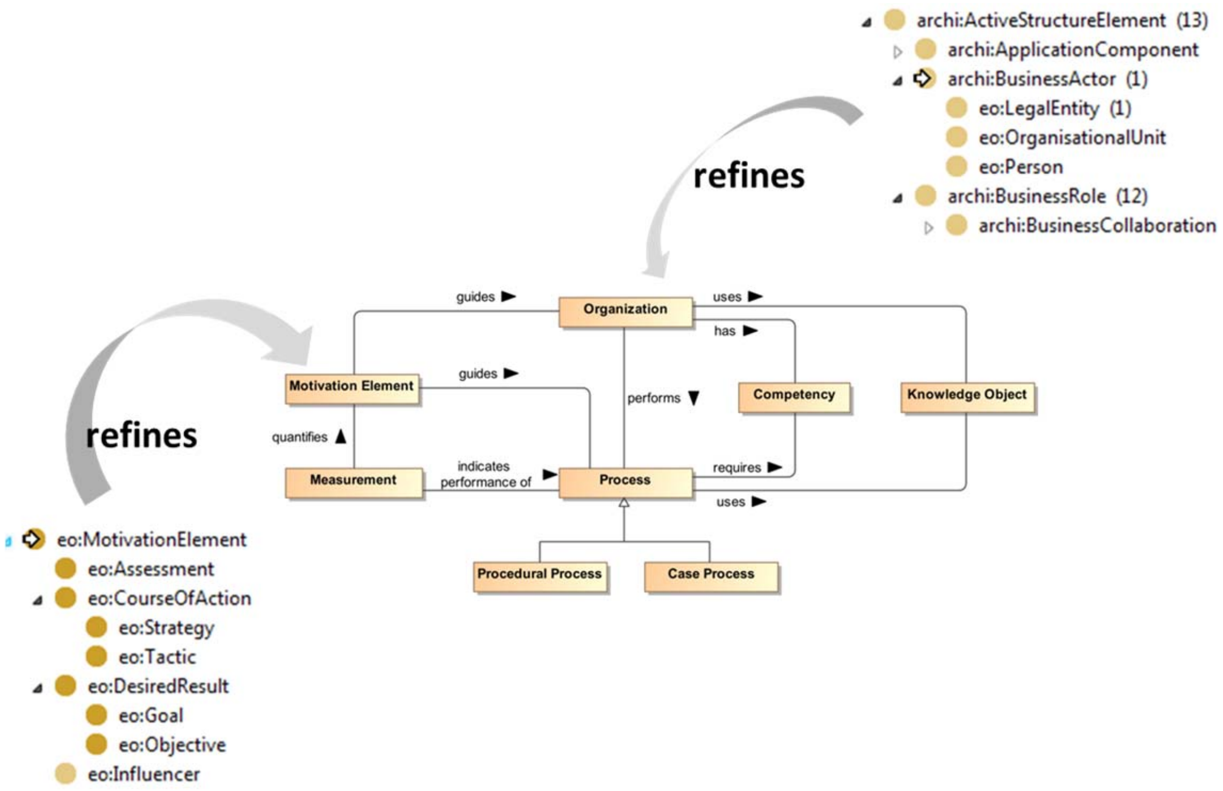
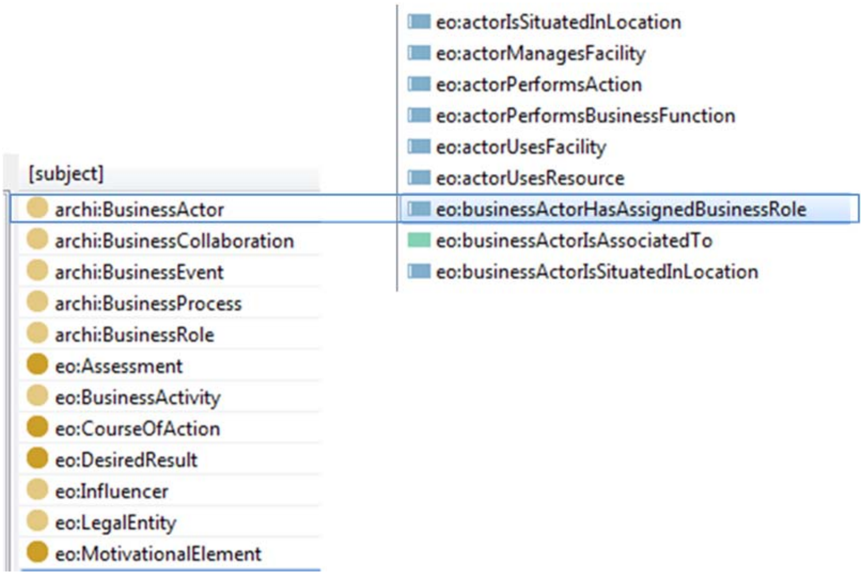


Figure 4.4 Snippet of the LCMM and LCMO

Note, that the refinements for "organisation" are already covered by ArchiMEO. For those LCMM concepts that cannot already be described with ArchiMEO new concepts and relations were created as it is the case for "motivation". With this approach we benefit from the already existing ontology (ArchiMEO) and hence from the semantics already modeled in the ontology since - for example - it is defined by the ArchiMate standard and could concentrate on Learn PAd specific enhancements were needed.

Furthermore, also many relevant data and object properties are already available in ArchiMEO. Figure 4.5 depicts some existing properties that have `BusinessActor` as domain. Note, that all properties shown have rectangle in light blue (for object properties) or light green (for data properties) in front indicating that they are not newly introduced for Learn PAd. However, if existing properties are used, i.e. needed or not depends on the results of the ontology re-assessment as described in chapter 4.4.



[subject]

- archi:BusinessActor
- archi:BusinessCollaboration
- archi:BusinessEvent
- archi:BusinessProcess
- archi:BusinessRole
- eo:Assessment
- eo:BusinessActivity
- eo:CourseOfAction
- eo:DesiredResult
- eo:Influencer
- eo:LegalEntity
- eo:MotivationalElement

- eo:actorIsSituatedInLocation
- eo:actorManagesFacility
- eo:actorPerformsAction
- eo:actorPerformsBusinessFunction
- eo:actorUsesFacility
- eo:actorUsesResource
- eo:businessActorHasAssignedBusinessRole
- eo:businessActorIsAssociatedTo
- eo:businessActorIsSituatedInLocation

Figure 4.5 Snippet of Properties for the Concept BusinessActor

In general the LCMO provides syntax and semantics for the various platform independent meta models, as for example for BPMN.

The following examples show the importance of the approach. BPMN 2.0 does not precisely specify the meaning of **pools**. "A Pool is the graphical representation of a Participant in a Collaboration. A Participant […] can be a specific Partner Entity (e.g., a company) or can be a more general Partner Role (e.g., a buyer, seller, or manufacturer)" (OMG 2011, p 76). Based on the Learn PAd ontology the modeled level of preciseness can be determined since information on partners and their roles can be specified. Based on this knowledge it can be inferred

- which partners may obtain the modeled role (e.g. serve as customer)
- which role a certain partner plays (e.g. another public administration)

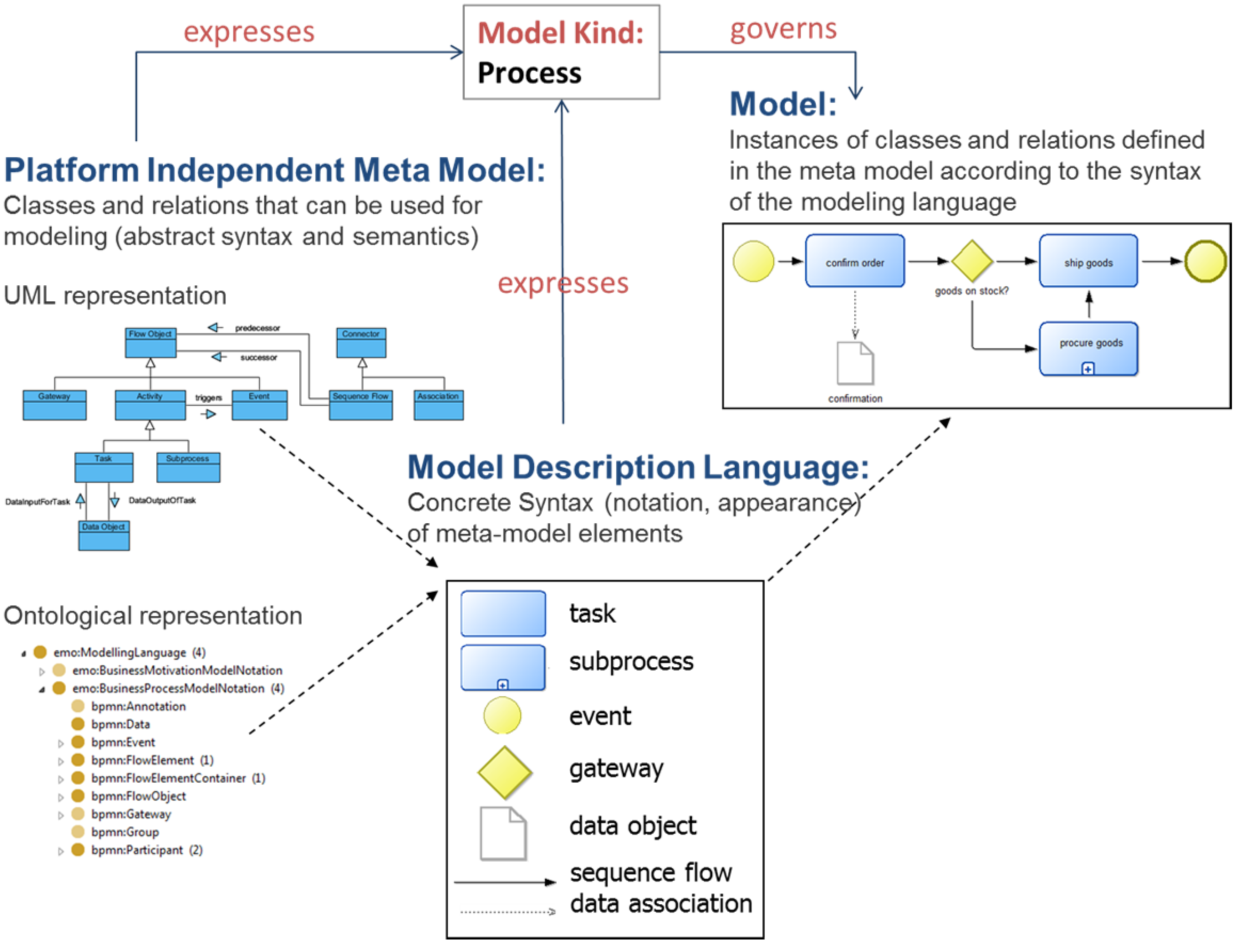
Furthermore, if need be information on products, e.g. requested by a customer or delivered by a supplier, can be inferred.

BPMN 2.0 also does not clearly define the usage, i.e. the meaning, of **lanes: "**Lanes are used to organize and categorize Activities within a Pool. The meaning of the Lanes is up to the modeler. BPMN does not specify the usage of Lanes. Lanes are often used for such things as internal roles (e.g., Manager, Associate), systems (e.g., an enterprise application), an internal department (e.g., shipping, finance), etc." (OMG 2011, p 336). Though, in order to provide the context of an activity to a user and to set up simulation for learner it is important to know whether an activity is to be executed by a role (the user may have or have not), a system (the user may have to interact with or is transparent to the user) or an organisation unit, consisting of various people performing various roles. To determine, if a lane in a model refers to a role, a system or an organisation unit the approach of "unique names assumption" is followed. The unique names assumption allows us to use the convention that the same name denotes the same individual. That is, if the name of a lane equals the name of a role it is assumed that the lane represents the organisational unit (and not a role or a system - provided that they don’t have the same name).

Details about the relations between concepts of LCMO and concepts of the LPIMO are provided for each model kind in the following sections.

4.3. Learn PAd Platform Independent Meta Model Ontology (LPIMO)

As depicted in Figure 4.2, besides the LCMO introduced above the Learn PAd ontology also comprises the concepts and relations defined in the Platform Independent Meta Models. Figure 4.6 depicts the correlation between Platform Independent Meta Model (represented as UML class diagram and as ontology), Model Kind (here: process), Model Description Language (here: BPMN) and a Model governed by the Meta Model.



expresses
Model Kind:
Process
governs
Model:
Instances of classes and relations defined in the meta model according to the syntax of the modeling language
Platform Independent Meta Model:
Classes and relations that can be used for modeling (abstract syntax and semantics)
UML representation
Flow Object
predecessor
successor
Connector
Gateway
Activity
triggers
Event
Sequence Flow
Association
Task
Subprocess
DataInputForTask
DataOutputOfTask
Data Object
expresses
confirm order
goods on stock?
ship goods
procure goods
confirmation
Model Description Language:
Concrete Syntax (notation, appearance) of meta-model elements
Ontological representation
emo:ModellingLanguage (4)
emo:BusinessMotivationModelNotation
emo:BusinessProcessModelNotation (4)
bpmn:Annotation
bpmn:Data
bpmn:Event
bpmn:FlowElement (1)
bpmn:FlowElementContainer (1)
bpmn:FlowObject
bpmn:Gateway
bpmn:Group
bpmn:Participant (2)
task
subprocess
event
gateway
data object
sequence flow
data association

Figure 4.6 Relations between Modeling Aspects

The Learn PAd Platform Independent Model Ontology (LPIMO) comprises concepts and relations for all model kinds used in Learn PAd as detailed below. Figure 4.7 depicts in the upper left side graphical representation of the model kinds of document, organisation and process that govern the Architecture Models. At the left hand side their ontological representation is sketched as well as the instances, derived from the models.

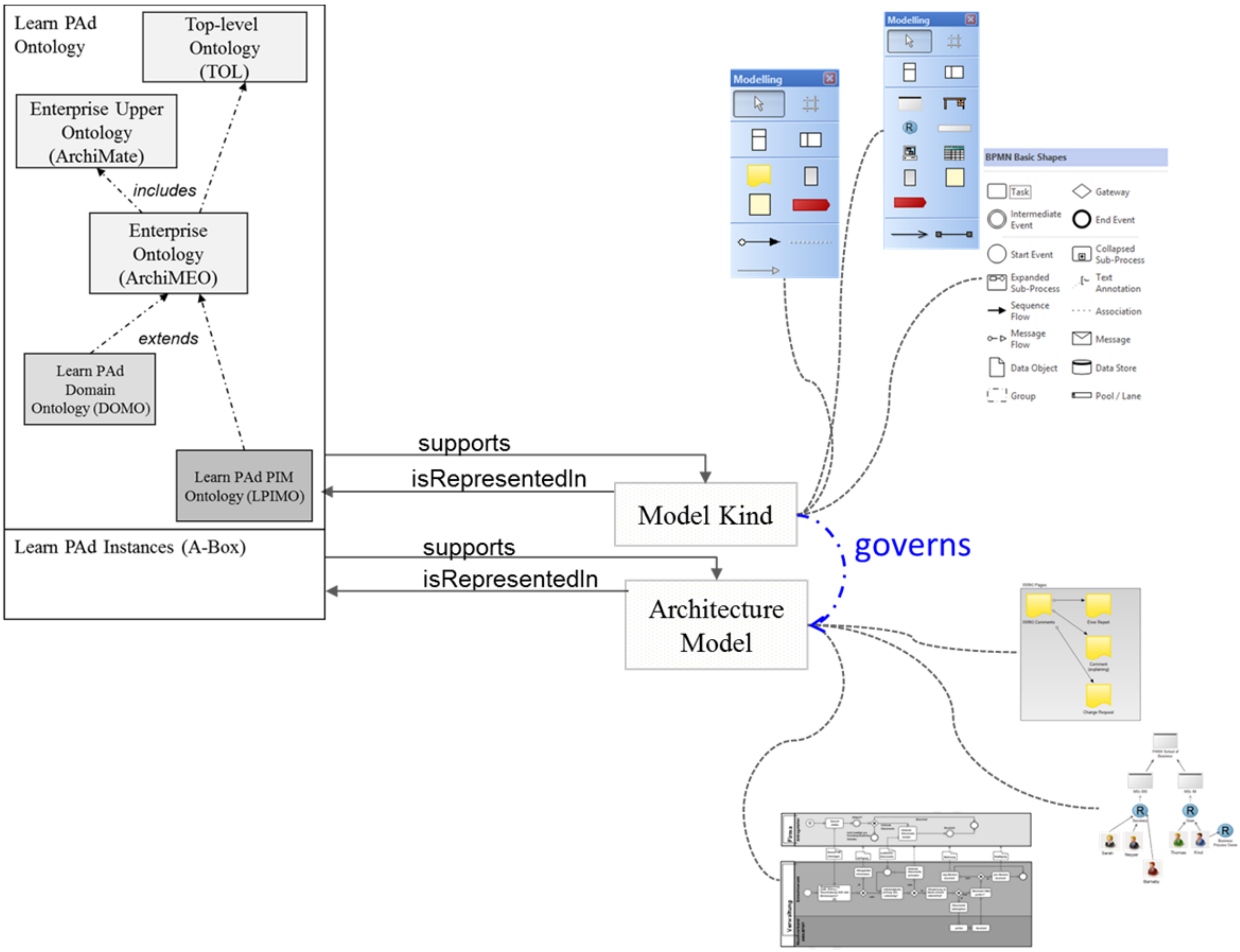


Figure 4.7 Relations between Learn PAd Ontology, Model Kinds and Architecture Models

Figure 4.8 shows a graphical representation of the main sub-concepts of the `LearnPAdPlatformIndependentMetaModel` concept as far as determined up to now. In case another Model Description Language should be used the LPIMO can be enhanced.

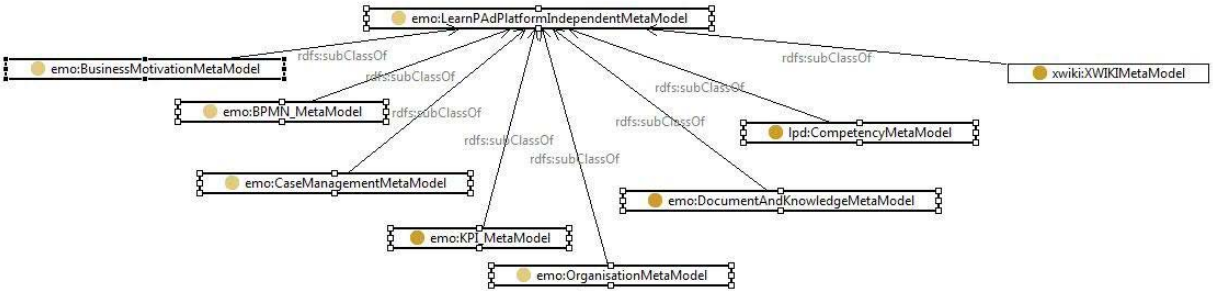
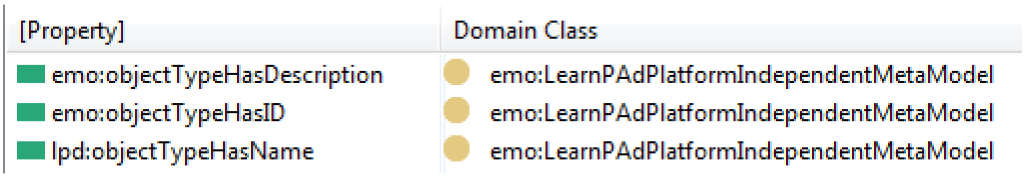


Figure 4.8 Main Concepts of the Learn PAd Platform Independent Meta Model Ontology (LPIMO)

For all concepts of LPIMO three generic data properties were defined as listed in Figure 4.9.



[Property]	Domain Class
🟩 emo:objectTypeHasDescription	● emo:LearnPAdPlatformIndependentMetaModel
🟩 emo:objectTypeHasID	● emo:LearnPAdPlatformIndependentMetaModel
🟩 lpd:objectTypeHasName	● emo:LearnPAdPlatformIndependentMetaModel

Figure 4.9 Top-level Data Properties

As described in deliverable D3.1 for learning are several model kinds needed: the process model, the case model, the business motivation model, the competency model, the organisational model, and the document and knowledge model. In D3.1 the model kinds were introduced to give an overview on what knowledge is needed to enable learning in Learn PAd.

The Learn PAd Platform Independent Meta Model (LPIMM) contains for all model kinds the relevant classes and relations as described in D3.2.

In D5.1 the details of the ontological representation of the LPIMM are provided in the following sections. Each sub-section is structured as follows: first the basis for the modeling is briefly explained, e.g. a standard a model is based on as it is the case for the process meta model. Then details on the ontological representation are given followed by section how the model, respectively its concepts, of the LPIMO relate to concepts of the LCMO.

Note iterative process of ontology development and hence, that the following data reflects the current status but may alter with the progress of the project.

4.3.1. Business Motivation Model ontology (BMMo)

4.3.1.1. Foundation

As already described in deliverable D3.1 the model description language used in Learn PAd for describing business motivation is the Business Motivation Model (BMM 1.2), an OMG standard that "provides a scheme or structure for developing, communicating, and managing business plans in an organized manner" (OMG 2014a)(OMG 2014a).

4.3.1.2. Ontological Representation

The ontological representation of BMM (BMMo) is derived from the standard and the LPIMM. BMMo contains, compared to its standard, an extension to the concept "KPI". Refer to D3.2 for details. Figure 4.10 depicts the main concepts of BMMo.

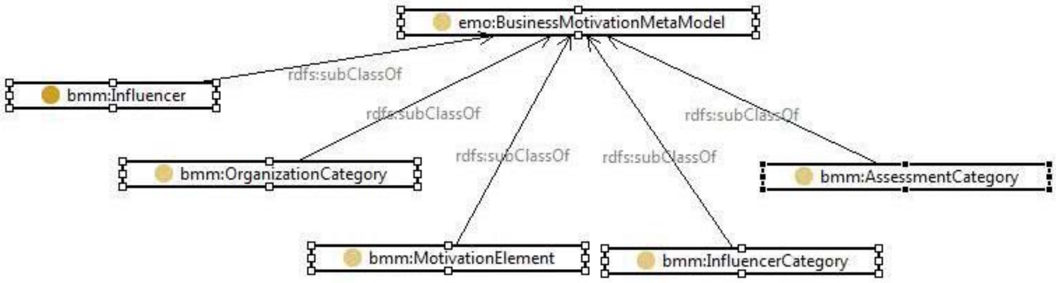
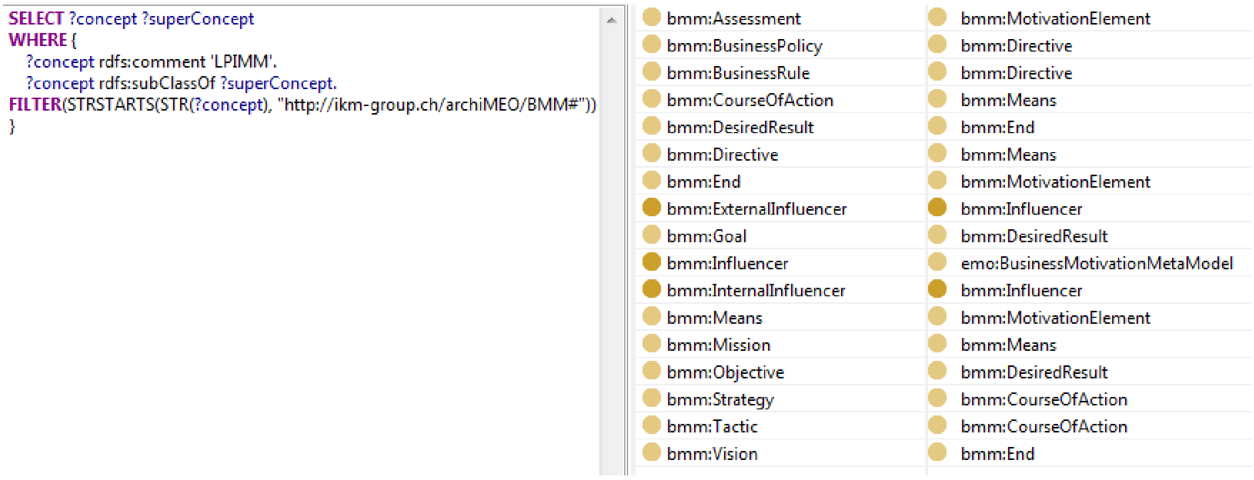


Figure 4.10 Core Concepts of BMMo

Figure 4.11provides the complete list of BMMo concepts. On the left of the print screen the SPARQL[1] query is shown, at the right the result set. The result set contains the concept (left) and its super-concept (right). Also all print screens of this kind shown in the following are constructed in the same way.



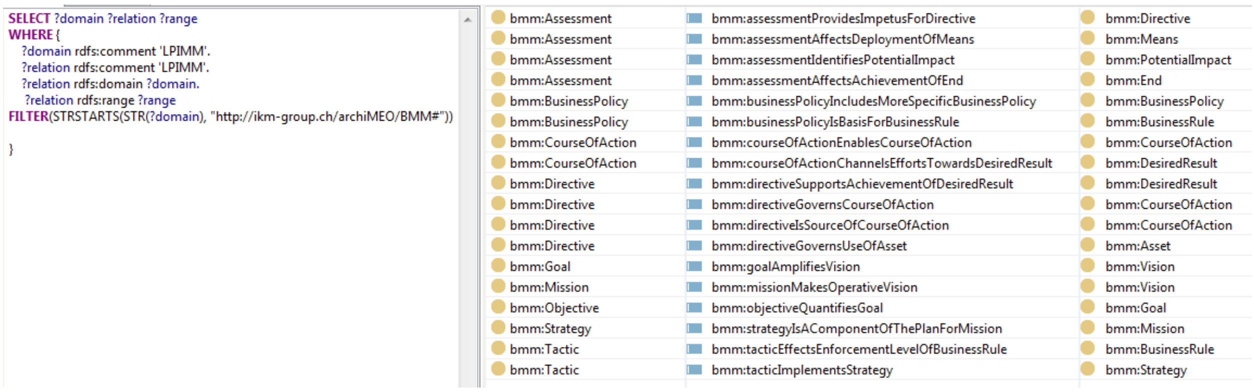
```
SELECT ?concept ?superConcept
WHERE {
   ?concept rdfs:comment 'LPIMM'.
   ?concept rdfs:subClassOf ?superConcept.
FILTER(STRSTARTS(STR(?concept), "http://ikm-group.ch/archiMEO/BMM#"))
}
```

bmm:Assessment	bmm:MotivationElement
bmm:BusinessPolicy	bmm:Directive
bmm:BusinessRule	bmm:Directive
bmm:CourseOfAction	bmm:Means
bmm:DesiredResult	bmm:End
bmm:Directive	bmm:Means
bmm:End	bmm:MotivationElement
bmm:ExternalInfluencer	bmm:Influencer
bmm:Goal	bmm:DesiredResult
bmm:Influencer	emo:BusinessMotivationMetaModel
bmm:InternalInfluencer	bmm:Influencer
bmm:Means	bmm:MotivationElement
bmm:Mission	bmm:Means
bmm:Objective	bmm:DesiredResult
bmm:Strategy	bmm:CourseOfAction
bmm:Tactic	bmm:CourseOfAction
bmm:Vision	bmm:End

Figure 4.11 List of Ontological Representation of BMM Concepts

4.3.1.3. Non-hierarchical Relations between concepts of the BMMo

Figure 4.12 lists the relations between concepts of the BMMo. Note, that inverse relations are not presented as they simply use the "other direction" of an object property, i.e. the inverse property of `bpm:goalAmplifiesVision` would be `bpm:visionIsAmplifiedByGoal`. Since SPARQL allows queries to go in any direction, which makes the use of inverse properties optional. Because of this reason, TopQuadrant (2011, p. 34) "generally discourage[s] users from specifying inverse properties".



```
SELECT ?domain ?relation ?range
WHERE {
   ?domain rdfs:comment 'LPIMM'.
   ?relation rdfs:comment 'LPIMM'.
   ?relation rdfs:domain ?domain.
    ?relation rdfs:range ?range
FILTER(STRSTARTS(STR(?domain), "http://ikm-group.ch/archiMEO/BMM#"))

}
```

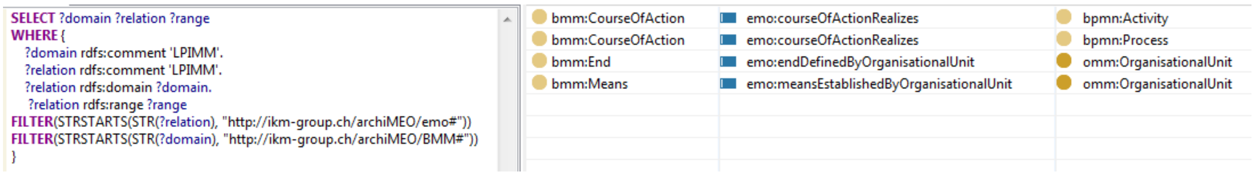
bmm:Assessment	bmm:assessmentProvidesImpetusForDirective	bmm:Directive
bmm:Assessment	bmm:assessmentAffectsDeploymentOfMeans	bmm:Means
bmm:Assessment	bmm:assessmentIdentifiesPotentialImpact	bmm:PotentialImpact
bmm:Assessment	bmm:assessmentAffectsAchievementOfEnd	bmm:End
bmm:BusinessPolicy	bmm:businessPolicyIncludesMoreSpecificBusinessPolicy	bmm:BusinessPolicy
bmm:BusinessPolicy	bmm:businessPolicyIsBasisForBusinessRule	bmm:BusinessRule
bmm:CourseOfAction	bmm:courseOfActionEnablesCourseOfAction	bmm:CourseOfAction
bmm:CourseOfAction	bmm:courseOfActionChannelsEffortsTowardsDesiredResult	bmm:DesiredResult
bmm:Directive	bmm:directiveSupportsAchievementOfDesiredResult	bmm:DesiredResult
bmm:Directive	bmm:directiveGovernsCourseOfAction	bmm:CourseOfAction
bmm:Directive	bmm:directiveIsSourceOfCourseOfAction	bmm:CourseOfAction
bmm:Directive	bmm:directiveGovernsUseOfAsset	bmm:Asset
bmm:Goal	bmm:goalAmplifiesVision	bmm:Vision
bmm:Mission	bmm:missionMakesOperativeVision	bmm:Vision
bmm:Objective	bmm:objectiveQuantifiesGoal	bmm:Goal
bmm:Strategy	bmm:strategyIsAComponentOfThePlanForMission	bmm:Mission
bmm:Tactic	bmm:tacticEffectsEnforcementLevelOfBusinessRule	bmm:BusinessRule
bmm:Tactic	bmm:tacticImplementsStrategy	bmm:Strategy

Figure 4.12 Relations between Concepts of the BMMo

[1] SPARQL is a query language for RDF provided by the W3C. Source: W3C Recommendation (2008). URL: http://www.w3.org/TR/rdf-sparql-query/ (retrieved: 28.1.2015)

4.3.1.4. Relations between BMMo and other Model Kinds of LPIMO

Figure 4.13 lists the relations between concepts of the BMMo and concepts of other model kinds. The result set shows the BMMo concept (domain), the relation and the concept of another model kind (range).



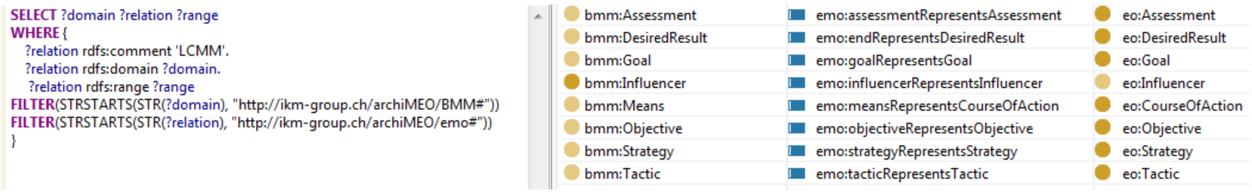
```
SELECT ?domain ?relation ?range
WHERE {
   ?domain rdfs:comment 'LPIMM'.
   ?relation rdfs:comment 'LPIMM'.
   ?relation rdfs:domain ?domain.
    ?relation rdfs:range ?range
FILTER(STRSTARTS(STR(?relation), "http://ikm-group.ch/archiMEO/emo#"))
FILTER(STRSTARTS(STR(?domain), "http://ikm-group.ch/archiMEO/BMM#"))
}
```

bmm:CourseOfAction	emo:courseOfActionRealizes	bpmn:Activity
bmm:CourseOfAction	emo:courseOfActionRealizes	bpmn:Process
bmm:End	emo:endDefinedByOrganisationalUnit	omm:OrganisationalUnit
bmm:Means	emo:meansEstablishedByOrganisationalUnit	omm:OrganisationalUnit

Figure 4.13 Relations between Concepts of the BMMo and Other Model Kinds

4.3.1.5. Relations between BMMo and LCMO

Find below Figure 4.14 the relations between BMMo concepts and the concepts of the LCMO. On the left of the print screen the SPARQL query is shown, at the right the result set, i.e. domain, relation, range. Also all print screens of this kind shown in the following are constructed in the same way.



```
SELECT ?domain ?relation ?range
WHERE {
   ?relation rdfs:comment 'LCMM'.
   ?relation rdfs:domain ?domain.
    ?relation rdfs:range ?range
FILTER(STRSTARTS(STR(?domain), "http://ikm-group.ch/archiMEO/BMM#"))
FILTER(STRSTARTS(STR(?relation), "http://ikm-group.ch/archiMEO/emo#"))
}
```

bmm:Assessment	emo:assessmentRepresentsAssessment	eo:Assessment
bmm:DesiredResult	emo:endRepresentsDesiredResult	eo:DesiredResult
bmm:Goal	emo:goalRepresentsGoal	eo:Goal
bmm:Influencer	emo:influencerRepresentsInfluencer	eo:Influencer
bmm:Means	emo:meansRepresentsCourseOfAction	eo:CourseOfAction
bmm:Objective	emo:objectiveRepresentsObjective	eo:Objective
bmm:Strategy	emo:strategyRepresentsStrategy	eo:Strategy
bmm:Tactic	emo:tacticRepresentsTactic	eo:Tactic

Figure 4.14 List of Relations between BMMo Concepts and LCMO Concepts

4.3.2. Business Process Model and Notation ontology (BPMNo)

4.3.2.1. Foundation

As detailed described in deliverable D3.1 the model description language used in Learn PAd for describing the process model kind is BPMN 2.0 (OMG 2011).

4.3.2.2. Ontological Representation

The ontological representation of BPMN 2.0 (BPMNo) is derived from the standard and the LPIMM. Figure 4.15 depicts the core concepts of BPMNo.

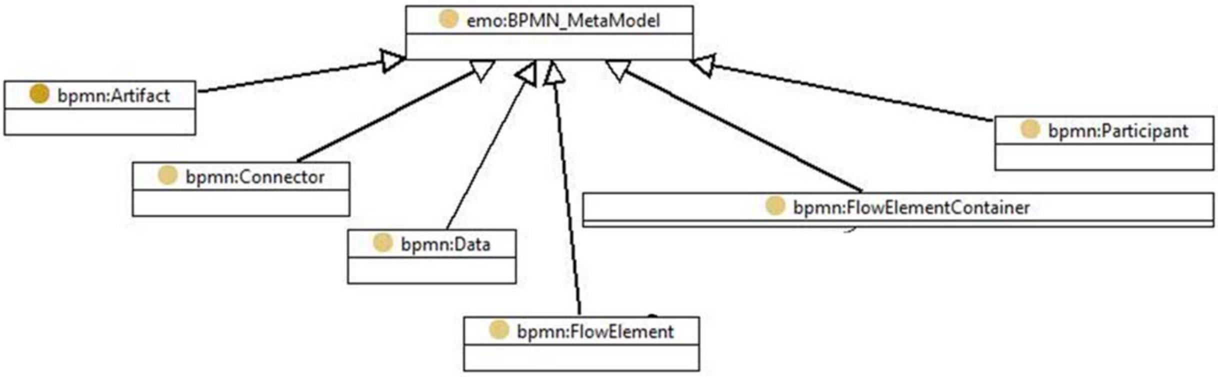
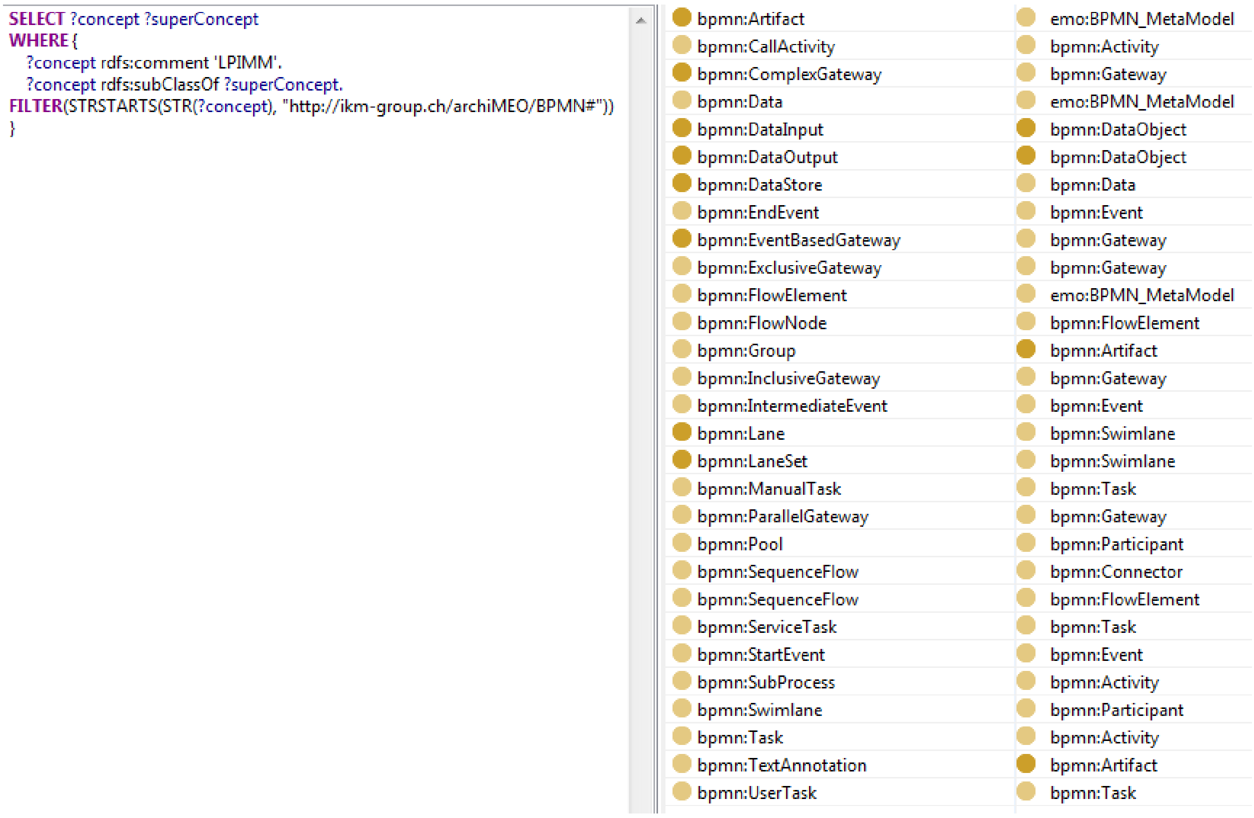


Figure 4.15 Core Concepts of BPMNo

Figure 4.16 provides the complete list of BPMN concepts in BPMNo.



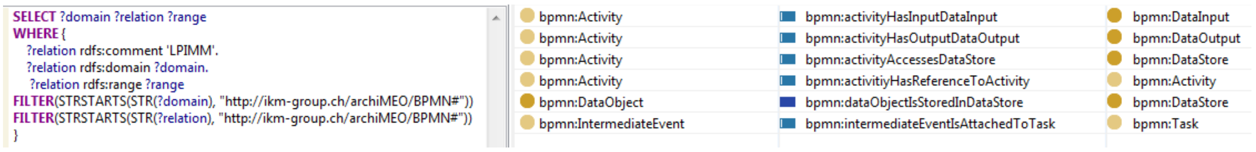
```
SELECT ?concept ?superConcept
WHERE {
   ?concept rdfs:comment 'LPIMM'.
   ?concept rdfs:subClassOf ?superConcept.
FILTER(STRSTARTS(STR(?concept), "http://ikm-group.ch/archiMEO/BPMN#"))
}
```

bpmn:Artifact	emo:BPMN_MetaModel
bpmn:CallActivity	bpmn:Activity
bpmn:ComplexGateway	bpmn:Gateway
bpmn:Data	emo:BPMN_MetaModel
bpmn:DataInput	bpmn:DataObject
bpmn:DataOutput	bpmn:DataObject
bpmn:DataStore	bpmn:Data
bpmn:EndEvent	bpmn:Event
bpmn:EventBasedGateway	bpmn:Gateway
bpmn:ExclusiveGateway	bpmn:Gateway
bpmn:FlowElement	emo:BPMN_MetaModel
bpmn:FlowNode	bpmn:FlowElement
bpmn:Group	bpmn:Artifact
bpmn:InclusiveGateway	bpmn:Gateway
bpmn:IntermediateEvent	bpmn:Event
bpmn:Lane	bpmn:Swimlane
bpmn:LaneSet	bpmn:Swimlane
bpmn:ManualTask	bpmn:Task
bpmn:ParallelGateway	bpmn:Gateway
bpmn:Pool	bpmn:Participant
bpmn:SequenceFlow	bpmn:Connector
bpmn:SequenceFlow	bpmn:FlowElement
bpmn:ServiceTask	bpmn:Task
bpmn:StartEvent	bpmn:Event
bpmn:SubProcess	bpmn:Activity
bpmn:Swimlane	bpmn:Participant
bpmn:Task	bpmn:Activity
bpmn:TextAnnotation	bpmn:Artifact
bpmn:UserTask	bpmn:Task

Figure 4.16 List of Ontological Representation of BPMN Concepts

4.3.2.3. Non-hierarchical Relations between concepts of the BPMNo

Figure 4.17 lists the relations between concepts of the BPMNo.



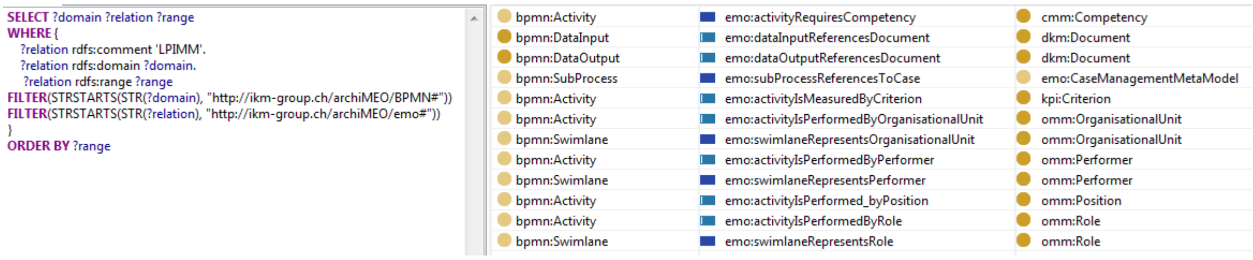
```
SELECT ?domain ?relation ?range
WHERE {
   ?relation rdfs:comment 'LPIMM'.
   ?relation rdfs:domain ?domain.
    ?relation rdfs:range ?range
FILTER(STRSTARTS(STR(?domain), "http://ikm-group.ch/archiMEO/BPMN#"))
FILTER(STRSTARTS(STR(?relation), "http://ikm-group.ch/archiMEO/BPMN#"))
}
```

bpmn:Activity	bpmn:activityHasInputDataInput	bpmn:DataInput
bpmn:Activity	bpmn:activityHasOutputDataOutput	bpmn:DataOutput
bpmn:Activity	bpmn:activityAccessesDataStore	bpmn:DataStore
bpmn:Activity	bpmn:activitiyHasReferenceToActivity	bpmn:Activity
bpmn:DataObject	bpmn:dataObjectIsStoredInDataStore	bpmn:DataStore
bpmn:IntermediateEvent	bpmn:intermediateEventIsAttachedToTask	bpmn:Task

Figure 4.17 Relations between Concepts of the BPMNo

4.3.2.4. Relations between BPMNo and other Model Kinds of LPIMO

Figure 4.18 provides the ontological representation of relations between BPMNo concepts and other model kinds.



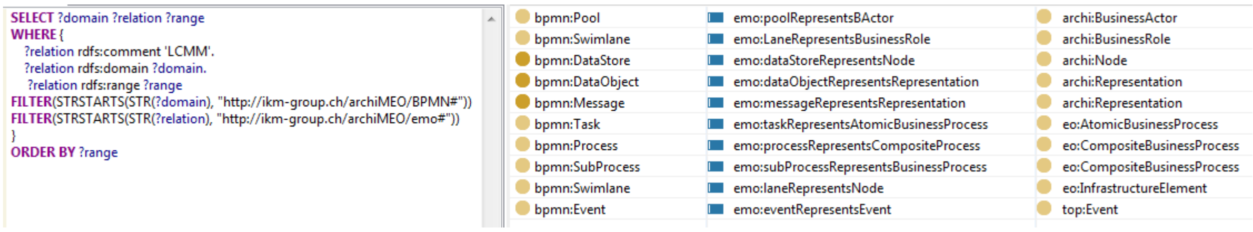
```
SELECT ?domain ?relation ?range
WHERE {
   ?relation rdfs:comment 'LPIMM'.
   ?relation rdfs:domain ?domain.
    ?relation rdfs:range ?range
FILTER(STRSTARTS(STR(?domain), "http://ikm-group.ch/archiMEO/BPMN#"))
FILTER(STRSTARTS(STR(?relation), "http://ikm-group.ch/archiMEO/emo#"))
}
ORDER BY ?range
```

bpmn:Activity	emo:activityRequiresCompetency	cmm:Competency
bpmn:DataInput	emo:dataInputReferencesDocument	dkm:Document
bpmn:DataOutput	emo:dataOutputReferencesDocument	dkm:Document
bpmn:SubProcess	emo:subProcessReferencesToCase	emo:CaseManagementMetaModel
bpmn:Activity	emo:activityIsMeasuredByCriterion	kpi:Criterion
bpmn:Activity	emo:activityIsPerformedByOrganisationalUnit	omm:OrganisationalUnit
bpmn:Swimlane	emo:swimlaneRepresentsOrganisationalUnit	omm:OrganisationalUnit
bpmn:Activity	emo:activityIsPerformedByPerformer	omm:Performer
bpmn:Swimlane	emo:swimlaneRepresentsPerformer	omm:Performer
bpmn:Activity	emo:activityIsPerformed_byPosition	omm:Position
bpmn:Activity	emo:activityIsPerformedByRole	omm:Role
bpmn:Swimlane	emo:swimlaneRepresentsRole	omm:Role

Figure 4.18 List of Relations between BPMNo Concepts and Other model kinds

4.3.2.5. Relations between BPMNo and LCMO

In order to reason about processes and their context, concepts of BPMN are related to concepts of the LCMO as briefly introduced in section 4.2. Figure 4.19 provides the relations between BPMNo concepts and the concepts of the LCMO in the Learn PAd ontology.



```
SELECT ?domain ?relation ?range
WHERE {
   ?relation rdfs:comment 'LCMM'.
   ?relation rdfs:domain ?domain.
    ?relation rdfs:range ?range
FILTER(STRSTARTS(STR(?domain), "http://ikm-group.ch/archiMEO/BPMN#"))
FILTER(STRSTARTS(STR(?relation), "http://ikm-group.ch/archiMEO/emo#"))
}
ORDER BY ?range
```

bpmn:Pool	emo:poolRepresentsBActor	archi:BusinessActor
bpmn:Swimlane	emo:LaneRepresentsBusinessRole	archi:BusinessRole
bpmn:DataStore	emo:dataStoreRepresentsNode	archi:Node
bpmn:DataObject	emo:dataObjectRepresentsRepresentation	archi:Representation
bpmn:Message	emo:messageRepresentsRepresentation	archi:Representation
bpmn:Task	emo:taskRepresentsAtomicBusinessProcess	eo:AtomicBusinessProcess
bpmn:Process	emo:processRepresentsCompositeProcess	eo:CompositeBusinessProcess
bpmn:SubProcess	emo:subProcessRepresentsBusinessProcess	eo:CompositeBusinessProcess
bpmn:Swimlane	emo:laneRepresentsNode	eo:InfrastructureElement
bpmn:Event	emo:eventRepresentsEvent	top:Event

Figure 4.19 List of Relations between BPMNo Concepts and LCMO Concepts

4.3.3. Case Management Model and Notation ontology (CMMNo)

4.3.3.1. Foundation

The Case Management Model and Notation is standard also provided by the OMG for "modeling and graphically expressing a Case, as well as an interchange format for exchanging Case models among different tools. The specification is intended to capture the common elements that Case management products use, while also taking into account current research contributions on Case management" (OMG 2014b).

4.3.3.2. Ontological Representation

The ontological representation of CMMN (CMMNo) is derived from the standard and the LPIMM. Figure 4.20 depicts the core concepts of CMMNo.

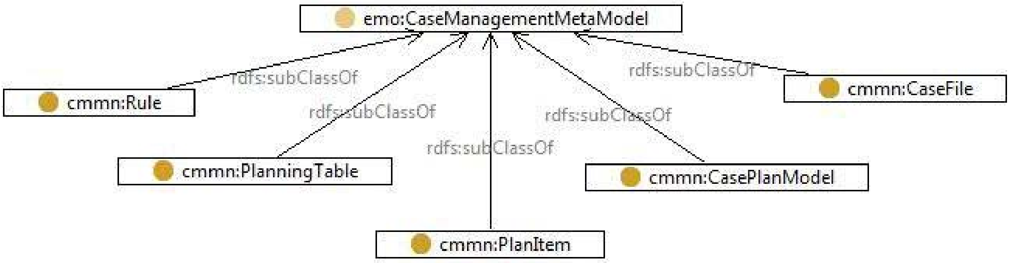
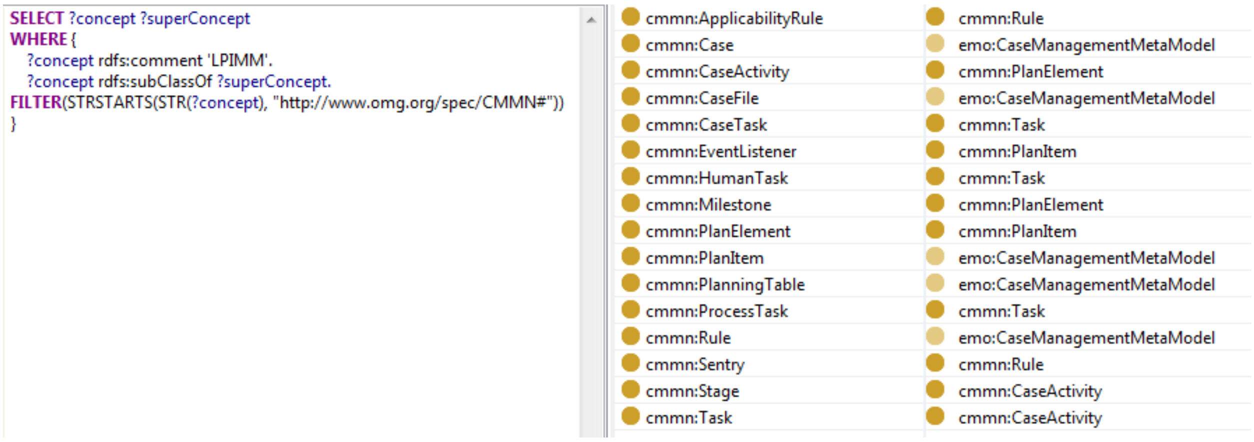


Figure 4.20 Core Concepts of CMMNo

Figure 4.21 provides the complete list of CMMN concepts in CMMNo.



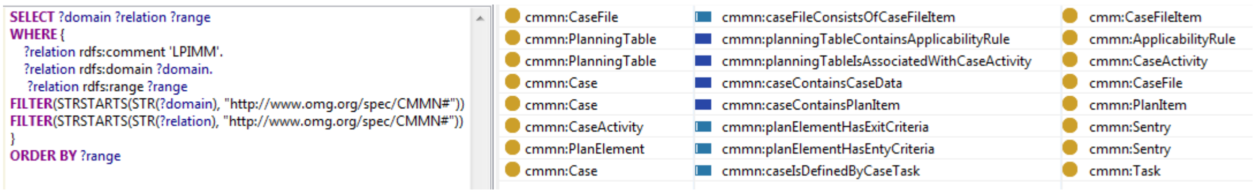
```
SELECT ?concept ?superConcept
WHERE {
   ?concept rdfs:comment 'LPIMM'.
   ?concept rdfs:subClassOf ?superConcept.
FILTER(STRSTARTS(STR(?concept), "http://www.omg.org/spec/CMMN#"))
}
```

cmmn:ApplicabilityRule	cmmn:Rule
cmmn:Case	emo:CaseManagementMetaModel
cmmn:CaseActivity	cmmn:PlanElement
cmmn:CaseFile	emo:CaseManagementMetaModel
cmmn:CaseTask	cmmn:Task
cmmn:EventListener	cmmn:PlanItem
cmmn:HumanTask	cmmn:Task
cmmn:Milestone	cmmn:PlanElement
cmmn:PlanElement	cmmn:PlanItem
cmmn:PlanItem	emo:CaseManagementMetaModel
cmmn:PlanningTable	emo:CaseManagementMetaModel
cmmn:ProcessTask	cmmn:Task
cmmn:Rule	emo:CaseManagementMetaModel
cmmn:Sentry	cmmn:Rule
cmmn:Stage	cmmn:CaseActivity
cmmn:Task	cmmn:CaseActivity

Figure 4.21 List of Ontological Representation of CMMN Concepts

4.3.3.3. Non-hierarchical Relations between concepts of the CMMNo

Figure 4.22 lists the relations between concepts of the CMMNo.



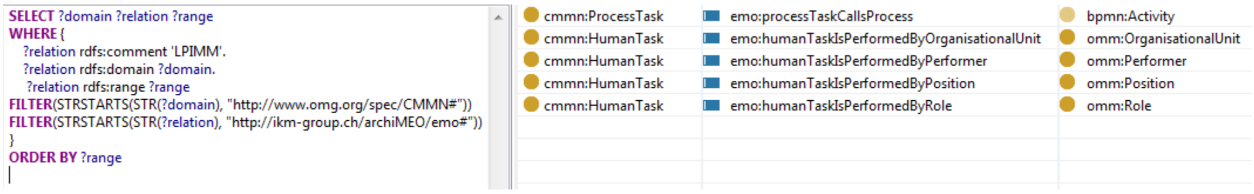
```
SELECT ?domain ?relation ?range
WHERE {
   ?relation rdfs:comment 'LPIMM'.
   ?relation rdfs:domain ?domain.
    ?relation rdfs:range ?range
FILTER(STRSTARTS(STR(?domain), "http://www.omg.org/spec/CMMN#"))
FILTER(STRSTARTS(STR(?relation), "http://www.omg.org/spec/CMMN#"))
}
ORDER BY ?range
```

cmmn:CaseFile	cmmn:caseFileConsistsOfCaseFileItem	cmm:CaseFileItem
cmmn:PlanningTable	cmmn:planningTableContainsApplicabilityRule	cmmn:ApplicabilityRule
cmmn:PlanningTable	cmmn:planningTableIsAssociatedWithCaseActivity	cmmn:CaseActivity
cmmn:Case	cmmn:caseContainsCaseData	cmmn:CaseFile
cmmn:Case	cmmn:caseContainsPlanItem	cmmn:PlanItem
cmmn:CaseActivity	cmmn:planElementHasExitCriteria	cmmn:Sentry
cmmn:PlanElement	cmmn:planElementHasEntyCriteria	cmmn:Sentry
cmmn:Case	cmmn:caseIsDefinedByCaseTask	cmmn:Task

Figure 4.22 Relations between Concepts of the CMMNo

4.3.3.4. Relations between CMMNo and other Model Kinds of LPIMO

Figure 4.23 provides the ontological representation of relations between CMMNo concepts and other model kinds.



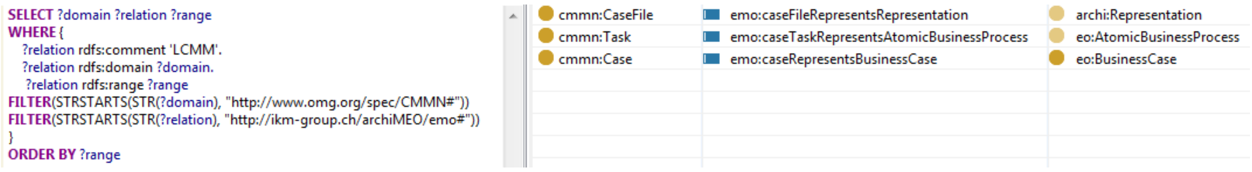
```
SELECT ?domain ?relation ?range
WHERE {
   ?relation rdfs:comment 'LPIMM'.
   ?relation rdfs:domain ?domain.
    ?relation rdfs:range ?range
FILTER(STRSTARTS(STR(?domain), "http://www.omg.org/spec/CMMN#"))
FILTER(STRSTARTS(STR(?relation), "http://ikm-group.ch/archiMEO/emo#"))
}
ORDER BY ?range
```

cmmn:ProcessTask	emo:processTaskCallsProcess	bpmn:Activity
cmmn:HumanTask	emo:humanTaskIsPerformedByOrganisationalUnit	omm:OrganisationalUnit
cmmn:HumanTask	emo:humanTaskIsPerformedByPerformer	omm:Performer
cmmn:HumanTask	emo:humanTaskIsPerformedByPosition	omm:Position
cmmn:HumanTask	emo:humanTaskIsPerformedByRole	omm:Role

Figure 4.23 List of Relations between Concepts of CMMNo and Other Model Kinds

4.3.3.5. Relations between CMMNo and LCMO

Find below Figure 4.24 the relations between CMMNo concepts and the concepts of the LCMO.



```
SELECT ?domain ?relation ?range
WHERE {
   ?relation rdfs:comment 'LCMM'.
   ?relation rdfs:domain ?domain.
    ?relation rdfs:range ?range
FILTER(STRSTARTS(STR(?domain), "http://www.omg.org/spec/CMMN#"))
FILTER(STRSTARTS(STR(?relation), "http://ikm-group.ch/archiMEO/emo#"))
}
ORDER BY ?range
```

cmmn:CaseFile	emo:caseFileRepresentsRepresentation	archi:Representation
cmmn:Task	emo:caseTaskRepresentsAtomicBusinessProcess	eo:AtomicBusinessProcess
cmmn:Case	emo:caseRepresentsBusinessCase	eo:BusinessCase

Figure 4.24 List of Relations between CMMNo Concepts and LCMO Concepts

4.3.4. Competency Meta Model ontology (CMMo)

4.3.4.1. Foundation

The Competency Meta Model created in Learn PAd is based on recommandations of the European Committee for standardisation, CEN WS-LT LTSO[2], driven by 9 international institutions and organizations involved in the standardization of E-learning technologies. Refer to D3.2 for a class diagram of the Competency Model of the LPIMM.

Competencies can be grouped as several competencies belong to a certain class of competencies, e.g. Speaking English, German, Italian etc. belong to the competency speaking foreign languages. Competencies can also be related to each other in order to define complex competencies, where a higher-level competency's definition mandates that certain lower-level competencies are met.

4.3.4.2. Ontological Representation

Figure 4.25 depicts the core concepts of CMMo.

[2] Learning Technology Standards Observatory / URL: http://www.cen-ltso.net/Main.aspx (retrieved: 14.9.2015)

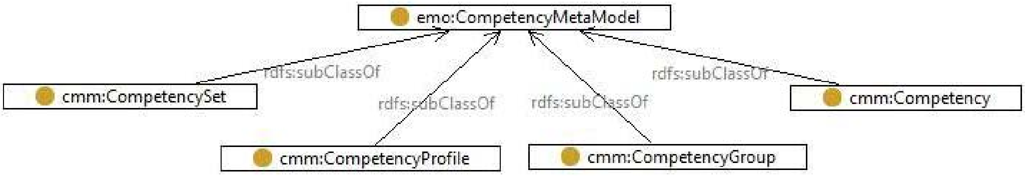
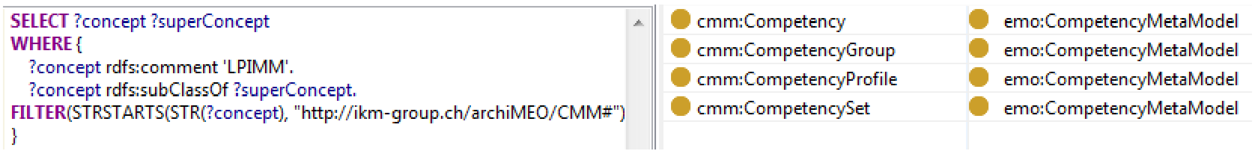


Figure 4.25 Core Concepts of CMMo

Figure 4.26 provides the complete list of CMM concepts in CMMo.

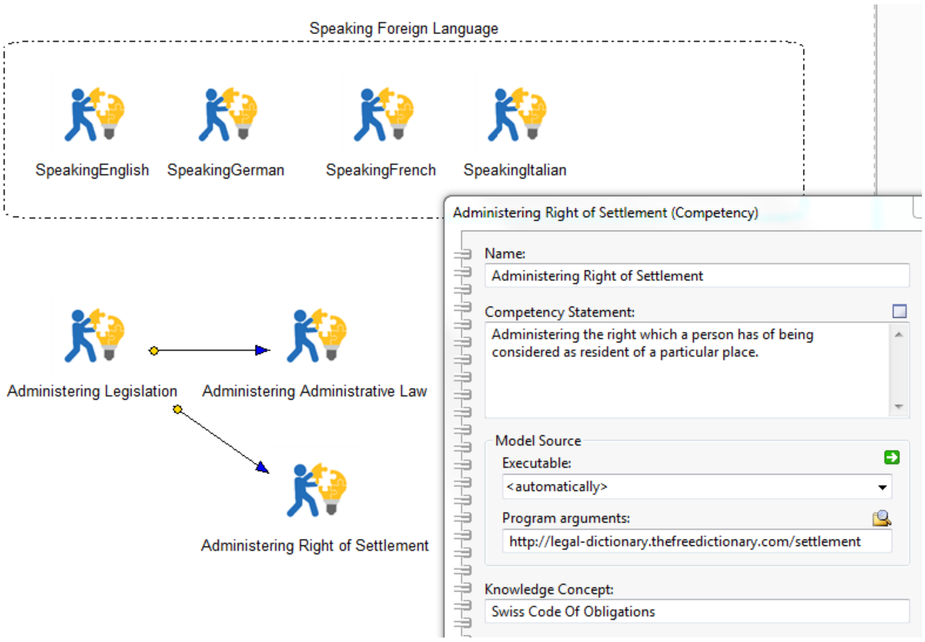


```
SELECT ?concept ?superConcept
WHERE {
   ?concept rdfs:comment 'LPIMM'.
   ?concept rdfs:subClassOf ?superConcept.
FILTER(STRSTARTS(STR(?concept), "http://ikm-group.ch/archiMEO/CMM#")
}
```

cmm:Competency	emo:CompetencyMetaModel
cmm:CompetencyGroup	emo:CompetencyMetaModel
cmm:CompetencyProfile	emo:CompetencyMetaModel
cmm:CompetencySet	emo:CompetencyMetaModel

Figure 4.26 List of Ontological Representation of CMM Concepts

Since the competency meta model isn't based on a widespread standard in the following an example is given. Figure 4.27 depicts a graphical representation of a competency model. On top of the figure competencies in speaking languages are depicted grouped by "Speaking Foreign Language". Below the competency "Administering Legislation" is modelled that requires the competencies "Administering Administrative Law" and "Administering Right of Settlement". For "Administering Right of Settlement" attributes are shown, like the name of the competency, a definition (attribute "Competency Statement) and the source (attribute "Model Source") and a knowledge concept the competency refers to.


Speaking Foreign Language
SpeakingEnglish
SpeakingGerman
SpeakingFrench
SpeakingItalian
Administering Legislation
Administering Administrative Law
Administering Right of Settlement

Administering Right of Settlement (Competency)

Name:
Administering Right of Settlement

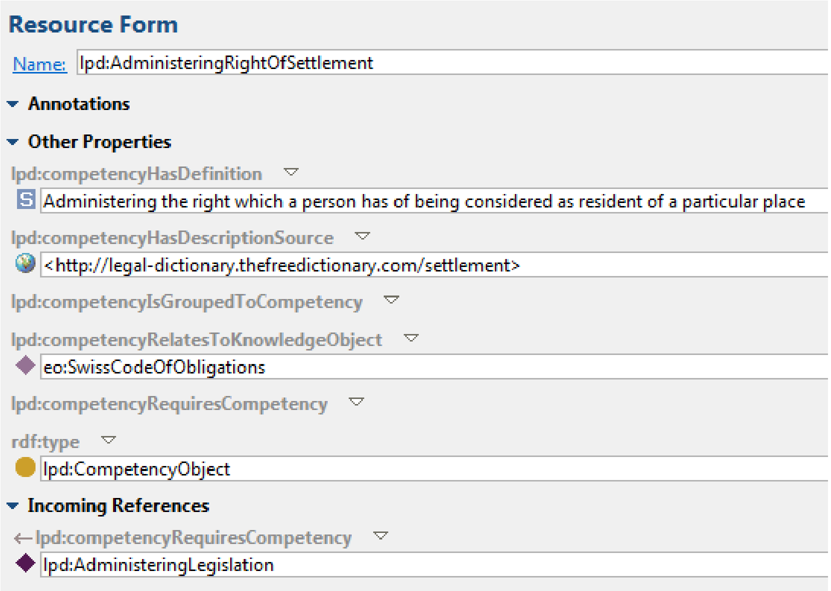
Competency Statement:
Administering the right which a person has of being considered as resident of a particular place.

Model Source
Executable:
<automatically>
Program arguments:
http://legal-dictionary.thefreedictionary.com/settlement

Knowledge Concept:
Swiss Code Of Obligations

Figure 4.27 Graphical Representation of a Competency Model

In Figure 4.28 below the ontological representation of the instance is depicted.



Resource Form

Name: lpd:AdministeringRightOfSettlement

Annotations

Other Properties

lpd:competencyHasDefinition

S Administering the right which a person has of being considered as resident of a particular place

lpd:competencyHasDescriptionSource

<http://legal-dictionary.thefreedictionary.com/settlement>

lpd:competencyIsGroupedToCompetency

lpd:competencyRelatesToKnowledgeObject

◆ eo:SwissCodeOfObligations

lpd:competencyRequiresCompetency

rdf:type

● lpd:CompetencyObject

Incoming References

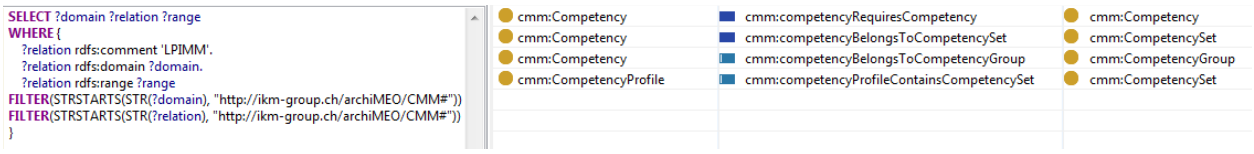
← lpd:competencyRequiresCompetency

◆ lpd:AdministeringLegislation

Figure 4.28 Ontological Representation of the Instance

4.3.4.3. Non-hierarchical Relations between concepts of the CMMo

Figure 4.29 lists the relations between concepts of the CMMo.



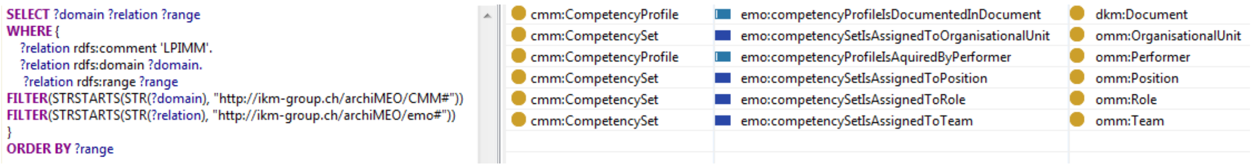
```
SELECT ?domain ?relation ?range
WHERE {
   ?relation rdfs:comment 'LPIMM'.
   ?relation rdfs:domain ?domain.
   ?relation rdfs:range ?range
FILTER(STRSTARTS(STR(?domain), "http://ikm-group.ch/archiMEO/CMM#"))
FILTER(STRSTARTS(STR(?relation), "http://ikm-group.ch/archiMEO/CMM#"))
}
```

● cmm:Competency	■ cmm:competencyRequiresCompetency	● cmm:Competency
● cmm:Competency	■ cmm:competencyBelongsToCompetencySet	● cmm:CompetencySet
● cmm:Competency	■ cmm:competencyBelongsToCompetencyGroup	● cmm:CompetencyGroup
● cmm:CompetencyProfile	■ cmm:competencyProfileContainsCompetencySet	● cmm:CompetencySet

Figure 4.29 Relations between Concepts of the CMMo

4.3.4.4. Relations between CMMo and other Model Kinds of LPIMO

Figure 4.30 provides the ontological representation of relations between CMMo concepts and other model kinds.



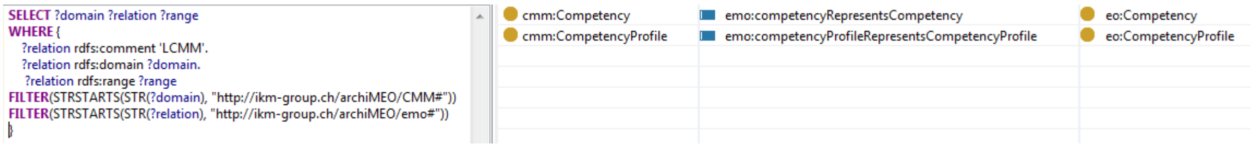
```
SELECT ?domain ?relation ?range
WHERE {
   ?relation rdfs:comment 'LPIMM'.
   ?relation rdfs:domain ?domain.
    ?relation rdfs:range ?range
FILTER(STRSTARTS(STR(?domain), "http://ikm-group.ch/archiMEO/CMM#"))
FILTER(STRSTARTS(STR(?relation), "http://ikm-group.ch/archiMEO/emo#"))
}
ORDER BY ?range
```

● cmm:CompetencyProfile	■ emo:competencyProfileIsDocumentedInDocument	● dkm:Document
● cmm:CompetencySet	■ emo:competencySetIsAssignedToOrganisationalUnit	● omm:OrganisationalUnit
● cmm:CompetencyProfile	■ emo:competencyProfileIsAquiredByPerformer	● omm:Performer
● cmm:CompetencySet	■ emo:competencySetIsAssignedToPosition	● omm:Position
● cmm:CompetencySet	■ emo:competencySetIsAssignedToRole	● omm:Role
● cmm:CompetencySet	■ emo:competencySetIsAssignedToTeam	● omm:Team

Figure 4.30 List of Relations between Concepts of CMMo and Other Model Kinds

4.3.4.5. Relations between CMMo and LCMO

Find below Figure 4.31 the relations between CMMo concepts (domain) and the concepts of the LCMO.



```
SELECT ?domain ?relation ?range
WHERE {
   ?relation rdfs:comment 'LCMM'.
   ?relation rdfs:domain ?domain.
    ?relation rdfs:range ?range
FILTER(STRSTARTS(STR(?domain), "http://ikm-group.ch/archiMEO/CMM#"))
FILTER(STRSTARTS(STR(?relation), "http://ikm-group.ch/archiMEO/emo#"))
}
```

● cmm:Competency	▬ emo:competencyRepresentsCompetency	● eo:Competency
● cmm:CompetencyProfile	▬ emo:competencyProfileRepresentsCompetencyProfile	● eo:CompetencyProfile

Figure 4.31 List of Relations between CMMo Concepts and LCMO Concepts

4.3.5. Document and Knowledge Meta Model ontology (DKMo)

4.3.5.1. Foundation

The Document and Knowledge Meta Model used in Learn PAd is based on long-term practical experiences the Learn PAd partner BOC has. Refer to D3.2 for a class diagram of the Document Model of the LPIMM.

4.3.5.2. Ontological Representation

Figure 4.32 depicts the core concepts of DKMo.

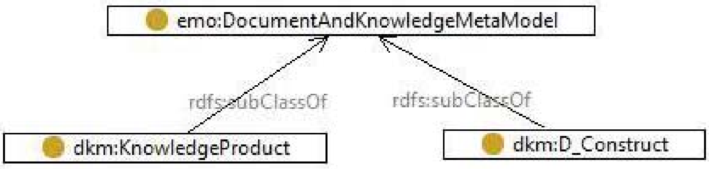
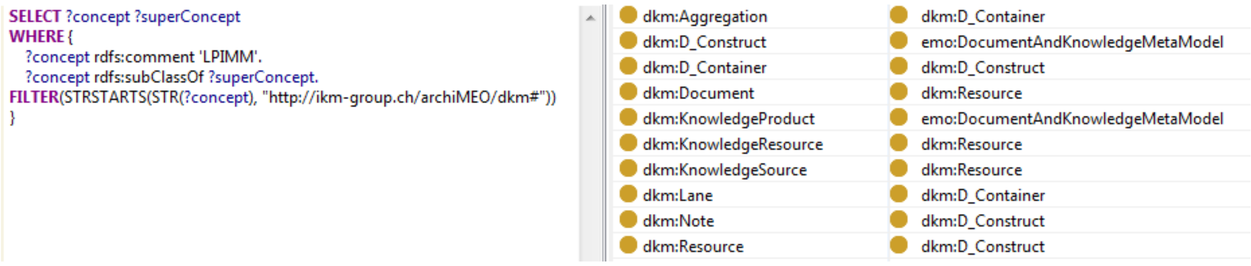


Figure 4.32 Core Concepts of DKMo

Figure 4.33 provides the complete list of DKM concepts in DKMo.



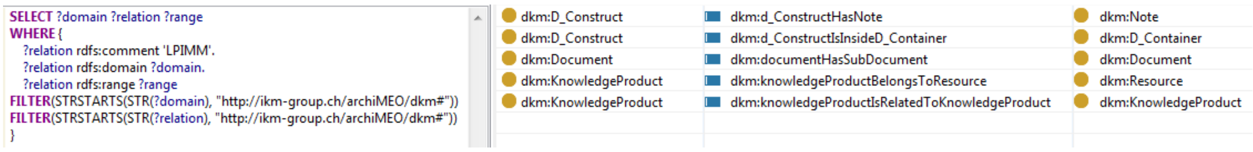
```
SELECT ?concept ?superConcept
WHERE {
   ?concept rdfs:comment 'LPIMM'.
   ?concept rdfs:subClassOf ?superConcept.
FILTER(STRSTARTS(STR(?concept), "http://ikm-group.ch/archiMEO/dkm#"))
}
```

● dkm:Aggregation	● dkm:D_Container
● dkm:D_Construct	● emo:DocumentAndKnowledgeMetaModel
● dkm:D_Container	● dkm:D_Construct
● dkm:Document	● dkm:Resource
● dkm:KnowledgeProduct	● emo:DocumentAndKnowledgeMetaModel
● dkm:KnowledgeResource	● dkm:Resource
● dkm:KnowledgeSource	● dkm:Resource
● dkm:Lane	● dkm:D_Container
● dkm:Note	● dkm:D_Construct
● dkm:Resource	● dkm:D_Construct

Figure 4.33 List of Ontological Representation of DKM Concepts

4.3.5.3. Non-hierarchical Relations between concepts of the DKMo

Figure 4.34 lists the relations between concepts of the DKMo.



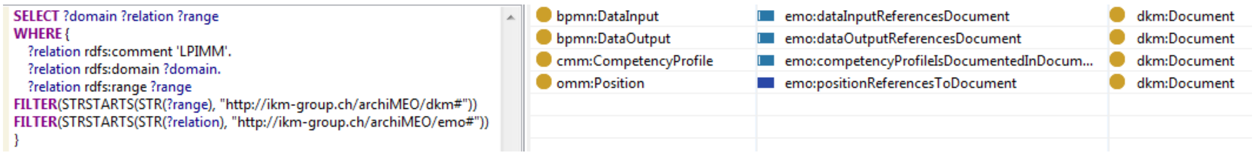
```
SELECT ?domain ?relation ?range
WHERE {
   ?relation rdfs:comment 'LPIMM'.
   ?relation rdfs:domain ?domain.
   ?relation rdfs:range ?range
FILTER(STRSTARTS(STR(?domain), "http://ikm-group.ch/archiMEO/dkm#"))
FILTER(STRSTARTS(STR(?relation), "http://ikm-group.ch/archiMEO/dkm#"))
}
```

● dkm:D_Construct	▬ dkm:d_ConstructHasNote	● dkm:Note
● dkm:D_Construct	▬ dkm:d_ConstructIsInsideD_Container	● dkm:D_Container
● dkm:Document	▬ dkm:documentHasSubDocument	● dkm:Document
● dkm:KnowledgeProduct	▬ dkm:knowledgeProductBelongsToResource	● dkm:Resource
● dkm:KnowledgeProduct	▬ dkm:knowledgeProductIsRelatedToKnowledgeProduct	● dkm:KnowledgeProduct

Figure 4.34 Relations between Concepts of the DKMo

4.3.5.4. Relations between DKMo and other Model Kinds of LPIMO

Figure 4.35 provides the ontological representation of relations between DKMo concepts and other model kinds. Since at the current state of the work no relations exists having a DKMo concept as domain Figure 4.35 provides a listing of relations having a DKMo concept as range.



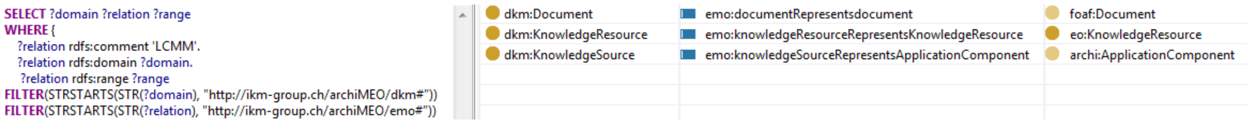
```
SELECT ?domain ?relation ?range
WHERE {
   ?relation rdfs:comment 'LPIMM'.
   ?relation rdfs:domain ?domain.
   ?relation rdfs:range ?range
FILTER(STRSTARTS(STR(?range), "http://ikm-group.ch/archiMEO/dkm#"))
FILTER(STRSTARTS(STR(?relation), "http://ikm-group.ch/archiMEO/emo#"))
}
```

```
bpmn:DataInput          emo:dataInputReferencesDocument            dkm:Document
bpmn:DataOutput         emo:dataOutputReferencesDocument           dkm:Document
cmm:CompetencyProfile   emo:competencyProfileIsDocumentedInDocum...  dkm:Document
omm:Position            emo:positionReferencesToDocument           dkm:Document
```

Figure 4.35 List of Relations between Concepts of DKMo and Other Model Kinds

4.3.5.5. Relations between DKMo and LCMO

Find below Figure 4.36 the relations between DKMo concepts and the concepts of the LCMO.



```
SELECT ?domain ?relation ?range
WHERE {
   ?relation rdfs:comment 'LCMM'.
   ?relation rdfs:domain ?domain.
    ?relation rdfs:range ?range
FILTER(STRSTARTS(STR(?domain), "http://ikm-group.ch/archiMEO/dkm#"))
FILTER(STRSTARTS(STR(?relation), "http://ikm-group.ch/archiMEO/emo#"))
```

```
dkm:Document            emo:documentRepresentsdocument                        foaf:Document
dkm:KnowledgeResource   emo:knowledgeResourceRepresentsKnowledgeResource      eo:KnowledgeResource
dkm:KnowledgeSource     emo:knowledgeSourceRepresentsApplicationComponent     archi:ApplicationComponent
```

Figure 4.36 List of Relations between DKMo concepts and LCMO concepts

4.3.6. KPI Meta Model ontology (KPIo)

4.3.6.1. Foundation

The KPI Meta Model used in Learn PAd is based on long-term practical experiences the Learn PAd partner BOC has. Refer to D3.2 for a class diagram of the Document Model of the LPIMM.

4.3.6.2. Ontological Representation

Figure 4.37 depicts the core concepts of KPIo.

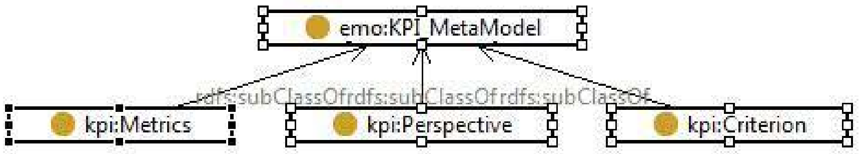
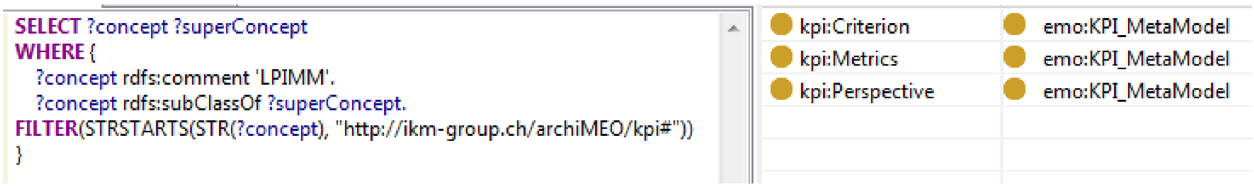


Figure 4.37 Core Concepts of KPIo

Figure 4.38 provides the complete list of KPI concepts in KPIo.



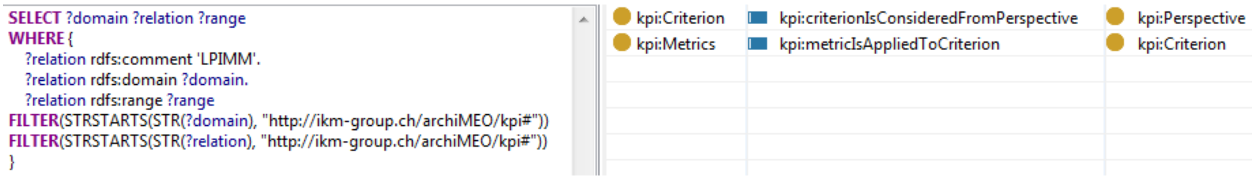
```
SELECT ?concept ?superConcept
WHERE {
   ?concept rdfs:comment 'LPIMM'.
   ?concept rdfs:subClassOf ?superConcept.
FILTER(STRSTARTS(STR(?concept), "http://ikm-group.ch/archiMEO/kpi#"))
}
```

● kpi:Criterion	● emo:KPI_MetaModel
● kpi:Metrics	● emo:KPI_MetaModel
● kpi:Perspective	● emo:KPI_MetaModel

Figure 4.38 List of Ontological Representation of KPI Concepts

4.3.6.3. Non-hierarchical Relations between concepts of the KPIo

Figure 4.39 lists the relations between concepts of the KPIo.



```
SELECT ?domain ?relation ?range
WHERE {
   ?relation rdfs:comment 'LPIMM'.
   ?relation rdfs:domain ?domain.
   ?relation rdfs:range ?range
FILTER(STRSTARTS(STR(?domain), "http://ikm-group.ch/archiMEO/kpi#"))
FILTER(STRSTARTS(STR(?relation), "http://ikm-group.ch/archiMEO/kpi#"))
}
```

● kpi:Criterion	▬ kpi:criterionIsConsideredFromPerspective	● kpi:Perspective
● kpi:Metrics	▬ kpi:metricIsAppliedToCriterion	● kpi:Criterion

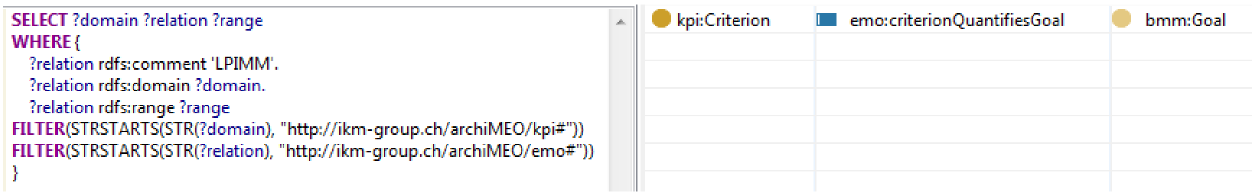
Figure 4.39 Relations between Concepts of the KPIo

4.3.6.4. Relations between KPIo and other Model Kinds of LPIMO

Figure 4.40 provides the ontological representation of the relation between a KPIo concept and a concept of BMMo. Note, that only those relations are depicted having a KPIo concept as domain. Have a look for example at the similar section for relations having BPMNo concepts as domain you will find the relation

`bpmn:activity - emo:activityIsMeasuredByCriterion - kpi:Criterion`,

having the KPIo concept as range.



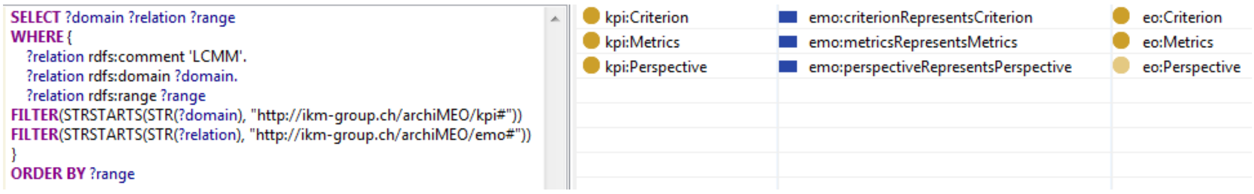
```
SELECT ?domain ?relation ?range
WHERE {
   ?relation rdfs:comment 'LPIMM'.
   ?relation rdfs:domain ?domain.
   ?relation rdfs:range ?range
FILTER(STRSTARTS(STR(?domain), "http://ikm-group.ch/archiMEO/kpi#"))
FILTER(STRSTARTS(STR(?relation), "http://ikm-group.ch/archiMEO/emo#"))
}
```

● kpi:Criterion	▬ emo:criterionQuantifiesGoal	● bmm:Goal

Figure 4.40 List of Relation between KPIo Concept and another LPIMO Concept (BMMo Concept)

4.3.7. Relations between KPIo and LCMO

Find below Figure 4.41 the relations between KPIo concepts and the concepts of the LCMO.



```
SELECT ?domain ?relation ?range
WHERE {
   ?relation rdfs:comment 'LCMM'.
   ?relation rdfs:domain ?domain.
   ?relation rdfs:range ?range
FILTER(STRSTARTS(STR(?domain), "http://ikm-group.ch/archiMEO/kpi#"))
FILTER(STRSTARTS(STR(?relation), "http://ikm-group.ch/archiMEO/emo#"))
}
ORDER BY ?range
```

kpi:Criterion	emo:criterionRepresentsCriterion	eo:Criterion
kpi:Metrics	emo:metricsRepresentsMetrics	eo:Metrics
kpi:Perspective	emo:perspectiveRepresentsPerspective	eo:Perspective

Figure 4.41 List of relations between KPIo Concepts and LCMO Concepts

4.3.8. Organisation Meta Model ontology (OMMo)

4.3.8.1. Foundation

The Organisation Meta Model used in Learn PAd is also based on long-term practical experiences the Learn PAd partner BOC has. Refer to D3.2 for a class diagram of the Organisation Model of the LPIMM.

4.3.8.2. Ontological Representation

Figure 4.42 depicts the concepts and relations of OMMo.

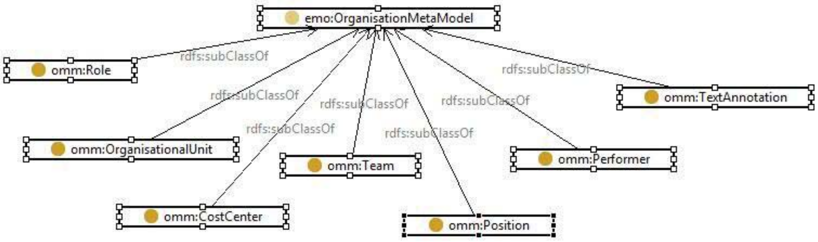
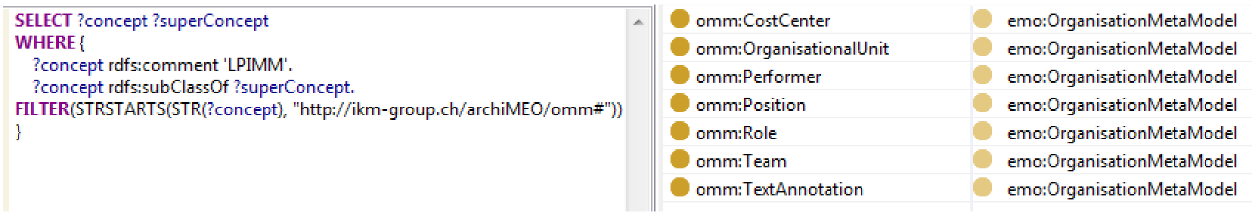


Figure 4.42 Main Concepts of OMMo

Figure 4.43 provides the complete list of OMM concepts in OMMo.



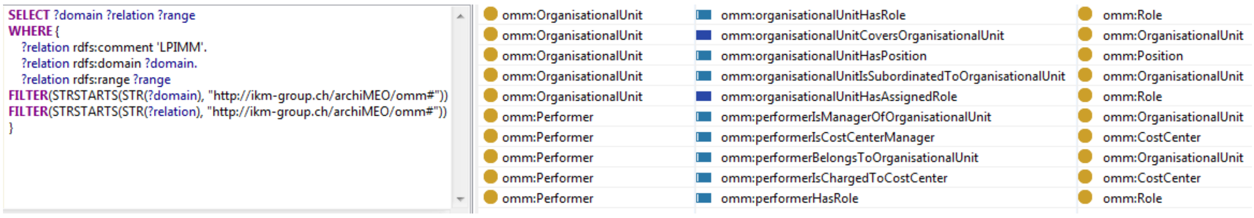
```
SELECT ?concept ?superConcept
WHERE {
   ?concept rdfs:comment 'LPIMM'.
   ?concept rdfs:subClassOf ?superConcept.
FILTER(STRSTARTS(STR(?concept), "http://ikm-group.ch/archiMEO/omm#"))
}
```

omm:CostCenter	emo:OrganisationMetaModel
omm:OrganisationalUnit	emo:OrganisationMetaModel
omm:Performer	emo:OrganisationMetaModel
omm:Position	emo:OrganisationMetaModel
omm:Role	emo:OrganisationMetaModel
omm:Team	emo:OrganisationMetaModel
omm:TextAnnotation	emo:OrganisationMetaModel

Figure 4.43 List of Ontological Representation of OMM Concepts

4.3.8.3. Non-hierarchical Relations between concepts of the OMMo

Figure 4.44 lists the relations between concepts of the OMMo.



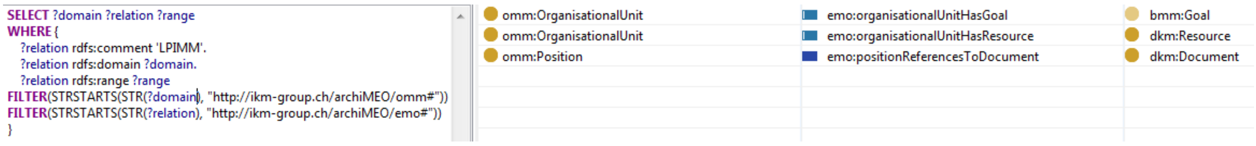
```
SELECT ?domain ?relation ?range
WHERE {
   ?relation rdfs:comment 'LPIMM'.
   ?relation rdfs:domain ?domain.
   ?relation rdfs:range ?range
FILTER(STRSTARTS(STR(?domain), "http://ikm-group.ch/archiMEO/omm#"))
FILTER(STRSTARTS(STR(?relation), "http://ikm-group.ch/archiMEO/omm#"))
}
```

omm:OrganisationalUnit	omm:organisationalUnitHasRole	omm:Role
omm:OrganisationalUnit	omm:organisationalUnitCoversOrganisationalUnit	omm:OrganisationalUnit
omm:OrganisationalUnit	omm:organisationalUnitHasPosition	omm:Position
omm:OrganisationalUnit	omm:organisationalUnitIsSubordinatedToOrganisationalUnit	omm:OrganisationalUnit
omm:OrganisationalUnit	omm:organisationalUnitHasAssignedRole	omm:Role
omm:Performer	omm:performerIsManagerOfOrganisationalUnit	omm:OrganisationalUnit
omm:Performer	omm:performerIsCostCenterManager	omm:CostCenter
omm:Performer	omm:performerBelongsToOrganisationalUnit	omm:OrganisationalUnit
omm:Performer	omm:performerIsChargedToCostCenter	omm:CostCenter
omm:Performer	omm:performerHasRole	omm:Role

Figure 4.44 Relations between Concepts of the OMMo

4.3.8.4. Relations between OMMo and other Model Kinds of LPIMO

Figure 4.45 provides the ontological representation of relations between OMMo concepts and other model kinds.



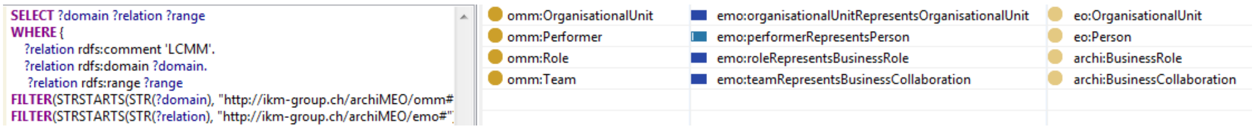
```
SELECT ?domain ?relation ?range
WHERE {
   ?relation rdfs:comment 'LPIMM'.
   ?relation rdfs:domain ?domain.
   ?relation rdfs:range ?range
FILTER(STRSTARTS(STR(?domain), "http://ikm-group.ch/archiMEO/omm#"))
FILTER(STRSTARTS(STR(?relation), "http://ikm-group.ch/archiMEO/emo#"))
}
```

omm:OrganisationalUnit	emo:organisationalUnitHasGoal	bmm:Goal
omm:OrganisationalUnit	emo:organisationalUnitHasResource	dkm:Resource
omm:Position	emo:positionReferencesToDocument	dkm:Document

Figure 4.45 Relations between Concepts of the OMMo and Other Model Kinds

4.3.8.5. Relations between OMMo and LCMO

Find below Figure 4.46 the relations between OMMo concepts and the concepts of the LCMO.



```
SELECT ?domain ?relation ?range
WHERE {
   ?relation rdfs:comment 'LCMM'.
   ?relation rdfs:domain ?domain.
    ?relation rdfs:range ?range
FILTER(STRSTARTS(STR(?domain), "http://ikm-group.ch/archiMEO/omm#
FILTER(STRSTARTS(STR(?relation), "http://ikm-group.ch/archiMEO/emo#"
```

omm:OrganisationalUnit	emo:organisationalUnitRepresentsOrganisationalUnit	eo:OrganisationalUnit
omm:Performer	emo:performerRepresentsPerson	eo:Person
omm:Role	emo:roleRepresentsBusinessRole	archi:BusinessRole
omm:Team	emo:teamRepresentsBusinessCollaboration	archi:BusinessCollaboration

Figure 4.46 List of relations between OMMo concepts and LCMO concepts

4.4. Ontology Reassessment Process

After determine the content of the Learn PAd ontology as described above the ontology was reassessed to ensure that all concepts and relations needed to serve the purpose of Learn PAd were represented.

Therefore we followed the approach of Uschold & Grüninger (1996), asking competency questions. One of the problems Stuckenschmidt (2011) identified when re-using an ontology is that most likely it does not (fully) meet requirements of a new application. Thus, to verify the Learn PAd ontology, i.e. ArchiMEO inclusive its extensions, competency questions can be used related to a "motivating scenario", as suggested by Uschold & Grüninger (1996). Uschold & Grüninger (1996, p 29) claim: "By specifying the relationship between the informal competency questions and the motivating scenario we give an informal justification for the new or extended ontology in terms of these questions". Figure 4.47 gives an overview of the ontology development procedure applied in Learn PAd.

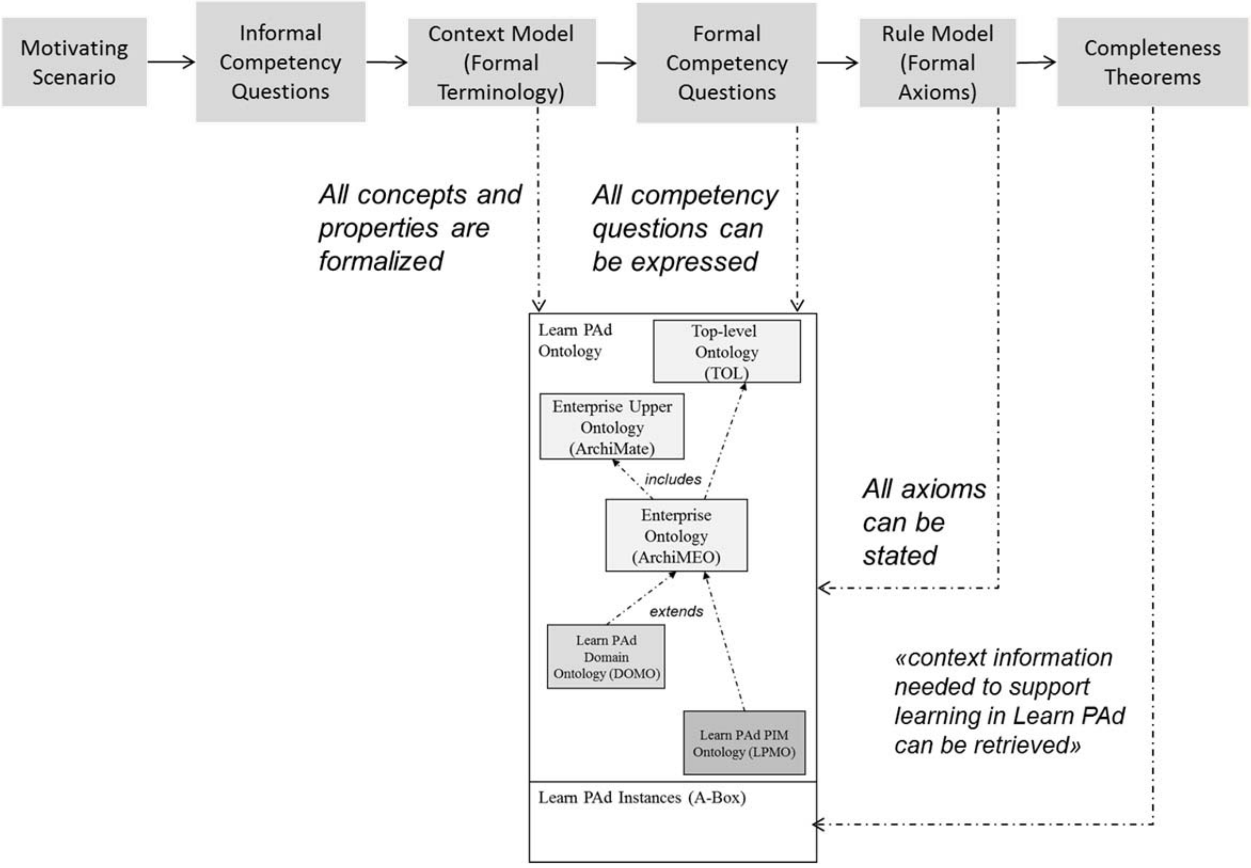
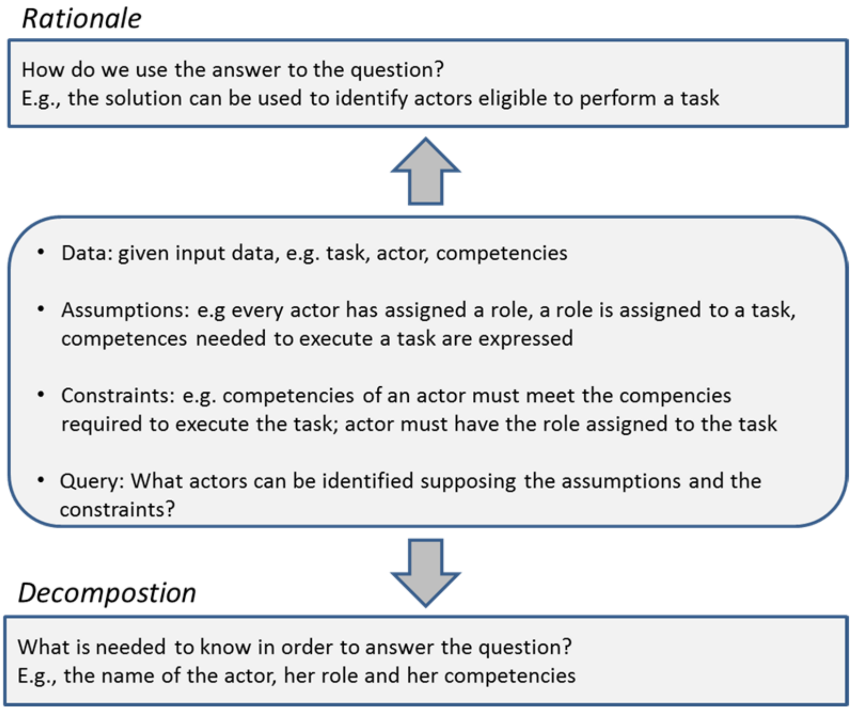

Motivating Scenario
Informal Competency Questions
Context Model (Formal Terminology)
Formal Competency Questions
Rule Model (Formal Axioms)
Completeness Theorems
All concepts and properties are formalized
All competency questions can be expressed
Learn PAd Ontology
Top-level Ontology (TOL)
Enterprise Upper Ontology (ArchiMate)
includes
Enterprise Ontology (ArchiMEO)
extends
Learn PAd Domain Ontology (DOMO)
Learn PAd PIM Ontology (LPMO)
Learn PAd Instances (A-Box)
All axioms can be stated
«context information needed to support learning in Learn PAd can be retrieved»

Figure 4.47 Ontology Development Procedure Applied in Learn Pad

For ontology capture, i.e. identifying and defining the relevant concepts and terms, in LearnPAd the two real processes, "Student Admission" and "SUAP", build the basis. Uschold & Grüninger (1996) call this the motivating scenario. The motivating scenarios are examples for requirements which are to be addressed with the ontology.

Given the motivating scenario(s), a set of queries can be framed which express the demands on the ontology. "We can consider these queries to be expressiveness requirements that are in the form of questions. An ontology must be able to represent these questions using its terminology, and be able to characterise the answers to these questions using the axioms and definitions" (Uschold & Grüninger 1996, p 35). These questions are called "informal questions" as they are expressed in natural language. By specifying the relationship between the informal competency questions and the motivating scenario an informal justification can be given for the new or extended ontology in terms of these questions (Uschold & Grüninger 1996). See Figure 4.48 about the structure of informal question.



Rationale

How do we use the answer to the question?
E.g., the solution can be used to identify actors eligible to perform a task

- Data: given input data, e.g. task, actor, competencies
- Assumptions: e.g every actor has assigned a role, a role is assigned to a task, competences needed to execute a task are expressed
- Constraints: e.g. competencies of an actor must meet the compencies required to execute the task; actor must have the role assigned to the task
- Query: What actors can be identified supposing the assumptions and the constraints?

Decompostion

What is needed to know in order to answer the question?
E.g., the name of the actor, her role and her competencies

Figure 4.48 Structure of Informal Question (based on Structure of Informal Question introduced by Uschold & Grüninger (1996) provided by Gomez-Perez et al. (2004))

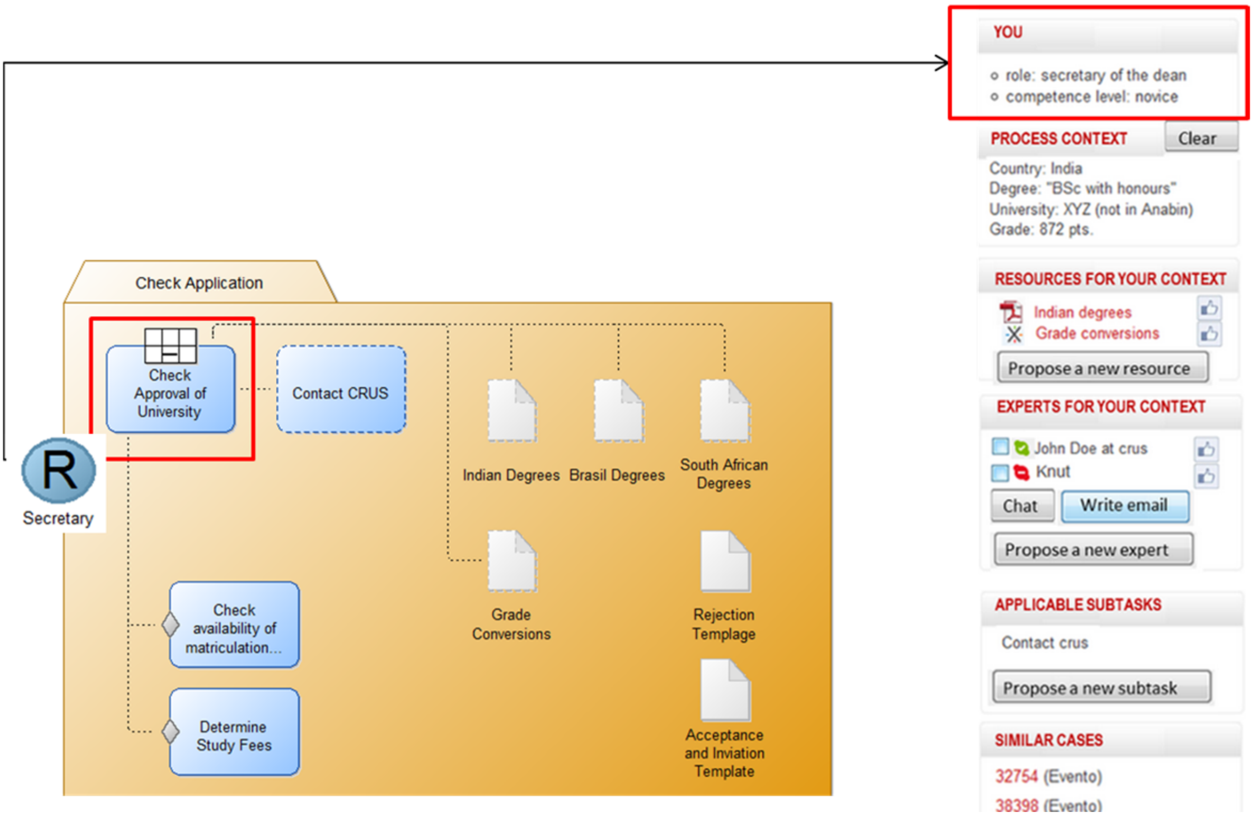
4.4.1. Informal Competency Questions

In the following, informal competency questions are phrased to determine what concepts and relations needed to be represented in the Learn PAd ontology. The questions were derived from the two real world processes and their mock-up as introduced in chapter 3.

4.4.1.1. Competency Questions related to "Student Admission Process"

Figure 4.49 depicts the context information provided for the tasks detailed in the mock-up. On top of the "context panel", that is the section displayed on the right side of the screen, information about the user who is logged into the Learn PAd system is displayed. Hence, the role (secretary of the dean) of the user - in the given task - and her level of work experience (novice) is to be retrieved from the Learn PAd ontology.

For all context elements the competency questions are given followed by the concepts and relations considered relevant. Note that in this phase of the ontology development process the formal terminology is finalized in the next steps.



YOU

- role: secretary of the dean
- competence level: novice

PROCESS CONTEXT Clear

Country: India
Degree: "BSc with honours"
University: XYZ (not in Anabin)
Grade: 872 pts.

RESOURCES FOR YOUR CONTEXT

Indian degrees
Grade conversions
Propose a new resource

EXPERTS FOR YOUR CONTEXT

□ John Doe at crus
□ Knut
Chat Write email
Propose a new expert

APPLICABLE SUBTASKS

Contact crus
Propose a new subtask

SIMILAR CASES

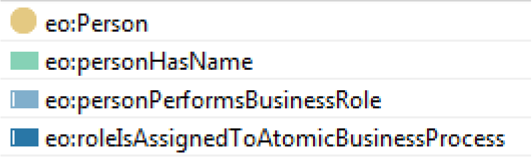
32754 (Evento)
38398 (Evento)

Figure 4.49 Context Information of the User

Informal Competency Questions are:

1. Given a user logged in to the Learn PAd system
   AND
   some constraints regarding tasks (e.g. the task the user is about to execute/simulate) what role the user has?
   a. *rationale*: the answer is used to provide context information about the role a user performs in the task.
   b. *decomposition*: the name of the user, user is an actor, an actor has a role, a role is assigned to a task.

The formal terminology is derived from the competency questions, see below:



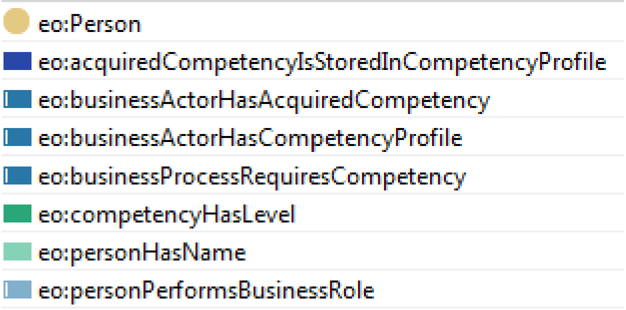
● eo:Person
🟩 eo:personHasName
▭ eo:personPerformsBusinessRole
▭ eo:roleIsAssignedToAtomicBusinessProcess

2. Given a user logged in to the Learn PAd system
   AND
   some constraints regarding the level of competencies (acquired competencies of the

actor and required competencies in the task).
what level of work experience the user has?

a. *rationale*: the answer is used to provide context information about the level of work experience a user has with respect to the task.
b. *decomposition*: the name of the user, user is an actor, an actor has role "employee" (explicitly assigned or inferred from "a role is needed in an organisational unit, hence, an actor is an employee), competencies are required to perform a task, an actor has competencies acquired, competencies are stored in the competency record of an actor, level of work experienced is defined by the difference of required and acquired competencies (could also be explicitly defined).

The formal terminology is derived from the competency questions, see below:

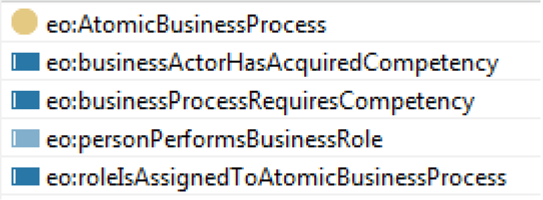


● eo:Person
▬ eo:acquiredCompetencyIsStoredInCompetencyProfile
▬ eo:businessActorHasAcquiredCompetency
▬ eo:businessActorHasCompetencyProfile
▬ eo:businessProcessRequiresCompetency
▬ eo:competencyHasLevel
▬ eo:personHasName
▬ eo:personPerformsBusinessRole

A more general question can be derived:

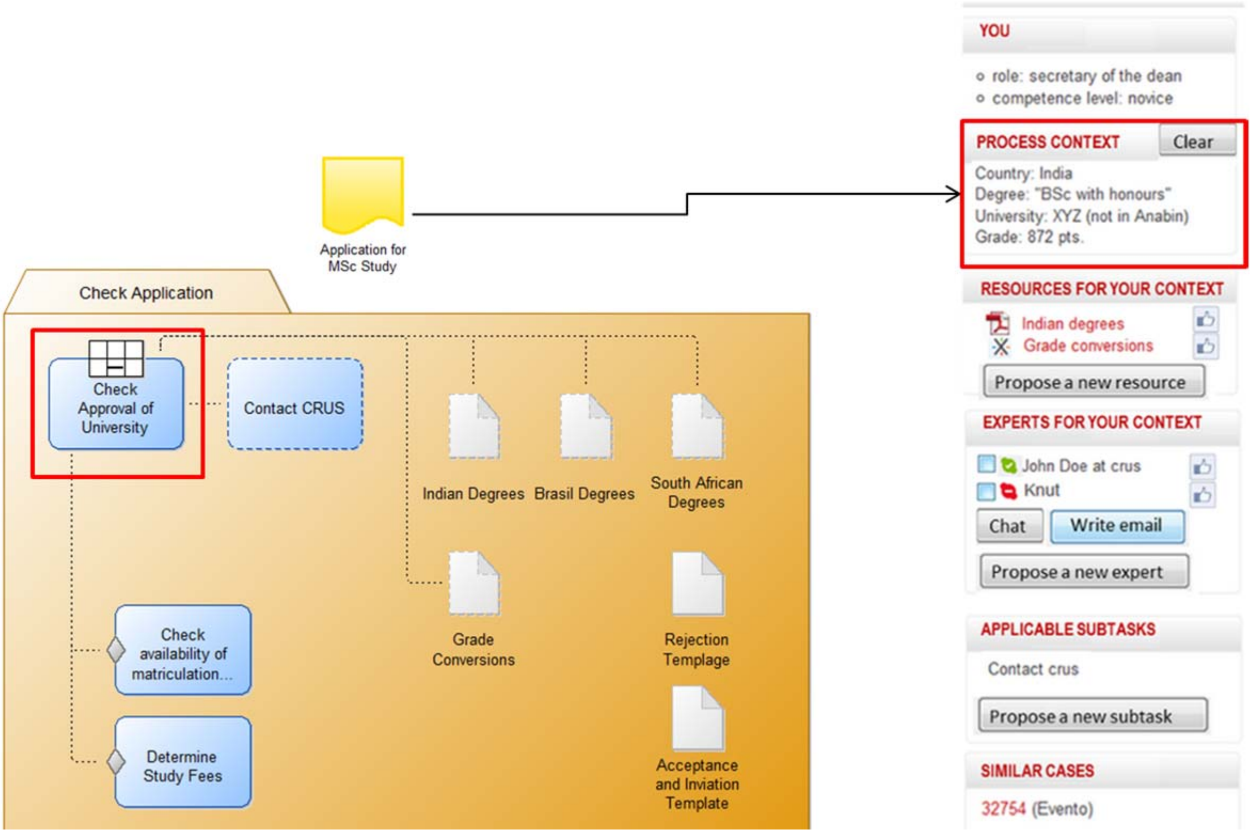
3. Given a task to be performed
   AND
   some constraints regarding role and competencies
   what actors are eligible to perform the task?
   a. *rationale*: the answer can be used to select actors, i.e. persons, that can perform the task as they have the required role and appropriate competencies (appropriateness is to be defined when setting up the system; it could be: acquired competency equals required competency, or differs not more than x on a pre-defined scale of competencies).
   b. *decomposition*: task, role needed to perform task, competencies needed within the task, role is assigned to an actor, an actor has acquired competencies.

The formal terminology is derived from the competency questions, see below:



● eo:AtomicBusinessProcess
▬ eo:businessActorHasAcquiredCompetency
▬ eo:businessProcessRequiresCompetency
▬ eo:personPerformsBusinessRole
▬ eo:roleIsAssignedToAtomicBusinessProcess

Figure 4.50 depicts the information from the application, e.g. from a form that a candidate has filled and submitted.



YOU

- role: secretary of the dean
- competence level: novice

PROCESS CONTEXT Clear

Country: India
Degree: "BSc with honours"
University: XYZ (not in Anabin)
Grade: 872 pts.

RESOURCES FOR YOUR CONTEXT

Indian degrees
Grade conversions

Propose a new resource

EXPERTS FOR YOUR CONTEXT

□ John Doe at crus
□ Knut

Chat | Write email

Propose a new expert

APPLICABLE SUBTASKS

Contact crus

Propose a new subtask

SIMILAR CASES

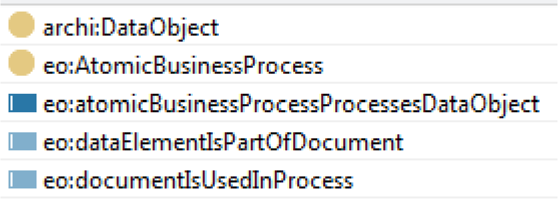
32754 (Evento)

Figure 4.50 Application Information

Informal Competency Question is:

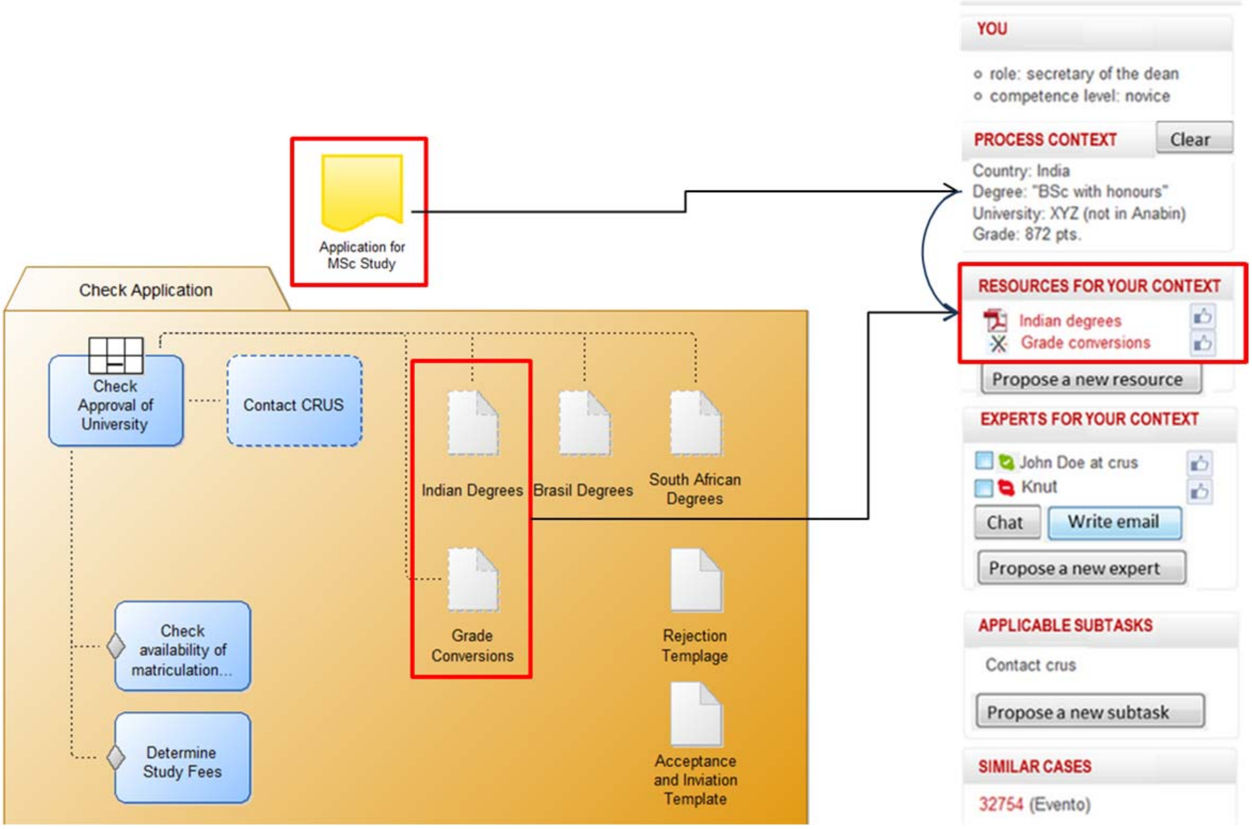
4. Given a task of a process
   AND
   some constraints regarding data objects (e.g. document as input, output of a task) what data is relevant to perform the task?
   a. *rationale*: the answer is used to provide application information that is relevant to perform the task.
   b. *decomposition*: the task, related data objects, data represented in the object (from an application database, database of historical case or test database).

The formal terminology is derived from the competency questions, see below:



● archi:DataObject
● eo:AtomicBusinessProcess
■ eo:atomicBusinessProcessProcessesDataObject
■ eo:dataElementIsPartOfDocument
■ eo:documentIsUsedInProcess

Figure 4.51 depicts the (information) resources that are recommended to use in a given context.



YOU

- role: secretary of the dean
- competence level: novice

PROCESS CONTEXT

Country: India
Degree: "BSc with honours"
University: XYZ (not in Anabin)
Grade: 872 pts.

RESOURCES FOR YOUR CONTEXT

Indian degrees
Grade conversions

EXPERTS FOR YOUR CONTEXT

□ John Doe at crus
□ Knut

APPLICABLE SUBTASKS

Contact crus

SIMILAR CASES

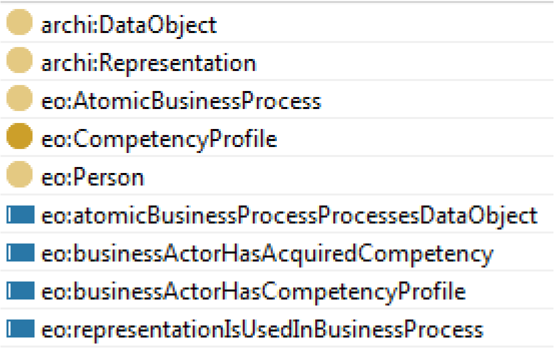
32754 (Evento)

Figure 4.51 Recommended Resources

Informal Competency Question is:

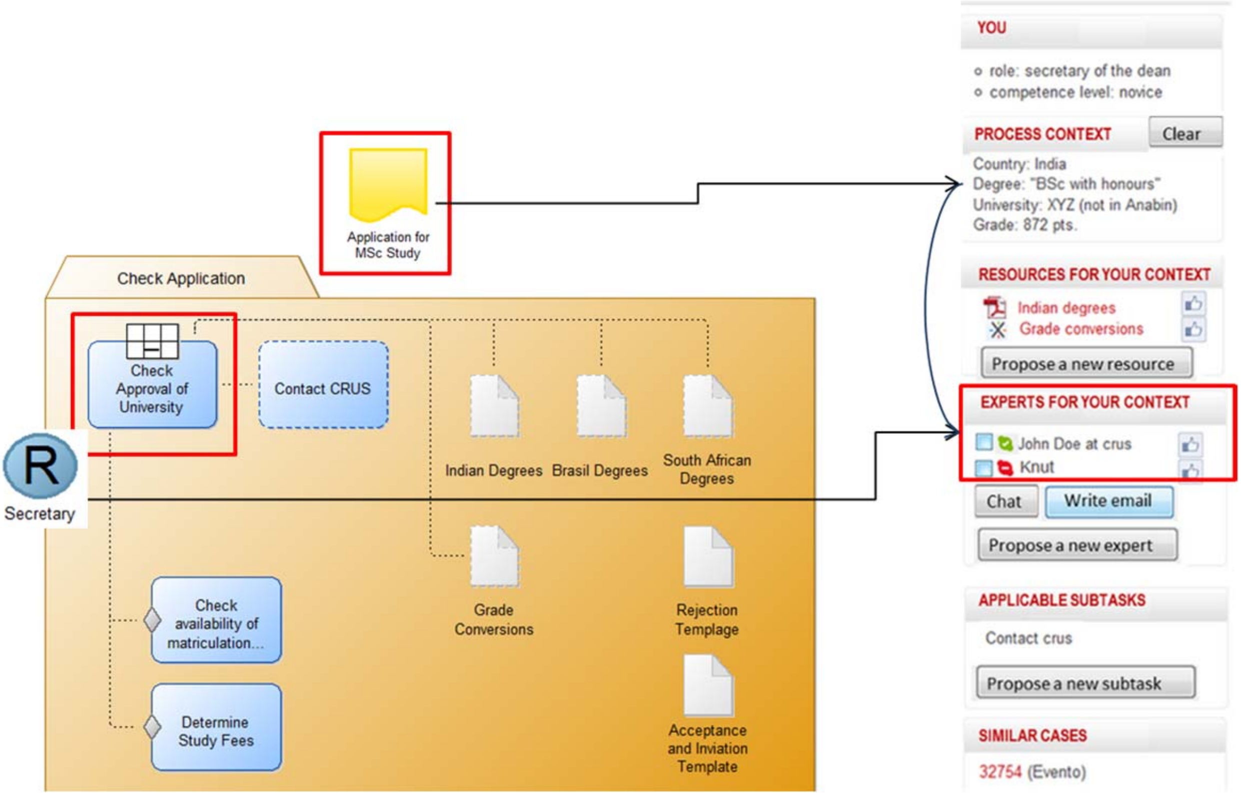
5. Given application data used to perform a task
   AND
   some constraints regarding level of work experience the user performing the task has what information resources (i.e. discretionary documents) are recommended?
    a. *rationale*: the answer is used to provide information resources (i.e. links to documents) that are relevant to perform the task while considering the level of work experience the user has.
    b. *decomposition*: the task, application data, discretionary documents, level of work experience of the user.

The formal terminology is derived from the competency questions, see below:



● archi:DataObject
● archi:Representation
● eo:AtomicBusinessProcess
● eo:CompetencyProfile
● eo:Person
▬ eo:atomicBusinessProcessProcessesDataObject
▬ eo:businessActorHasAcquiredCompetency
▬ eo:businessActorHasCompetencyProfile
▬ eo:representationIsUsedInBusinessProcess

Figure 4.52 depicts the resources (persons) that could support the execution of the task.



YOU
- role: secretary of the dean
- competence level: novice

PROCESS CONTEXT Clear
Country: India
Degree: "BSc with honours"
University: XYZ (not in Anabin)
Grade: 872 pts.

RESOURCES FOR YOUR CONTEXT
Indian degrees
Grade conversions
Propose a new resource

EXPERTS FOR YOUR CONTEXT
□ John Doe at crus
□ Knut
Chat Write email
Propose a new expert

APPLICABLE SUBTASKS
Contact crus
Propose a new subtask

SIMILAR CASES
32754 (Evento)

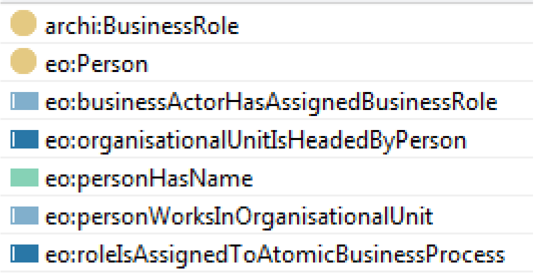
Figure 4.52 Task Execution Support Resources

Informal Competency Questions are:

6. Given role a user has in a task
   AND
   some constraints regarding the organisation (e.g. superiors are considered more experienced than subordinates, colleagues with high level of work experiences) what internal experts can be recommended?
   a. *rationale*: the answer is used to recommend experts from the organisation that may support the user if need be.

   b. *decomposition*: the name of the user, user is an actor, an actor has role in the task, role is associated with an organisational unit, organisational unit is part of organisational structure, organisational unit has head.

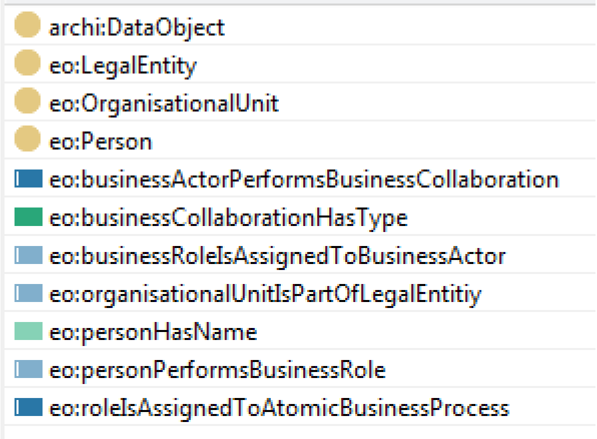
The formal terminology is derived from the competency questions, see below:



archi:BusinessRole
eo:Person
eo:businessActorHasAssignedBusinessRole
eo:organisationalUnitIsHeadedByPerson
eo:personHasName
eo:personWorksInOrganisationalUnit
eo:roleIsAssignedToAtomicBusinessProcess

7. Given application data used in a task
   AND
   some constraints regarding collaboration (e.g. an actor, i.e. a legal entity has a certain role, for example business partner of)
   what external experts can be recommended?
   a. *rationale*: the answer is used to recommend experts from legal entities a collaboration is established with who may support the user if need be.
   b. *decomposition*: application data, the name of the user, user is an actor, an actor has role in the task, role associated with an organisational unit, organisational unit belongs to a legal entity, legal entity has collaboration with (other) legal entity, collaboration between legal entities has type.

The formal terminology is derived from the competency questions, see below:



archi:DataObject
eo:LegalEntity
eo:OrganisationalUnit
eo:Person
eo:businessActorPerformsBusinessCollaboration
eo:businessCollaborationHasType
eo:businessRoleIsAssignedToBusinessActor
eo:organisationalUnitIsPartOfLegalEntitiy
eo:personHasName
eo:personPerformsBusinessRole
eo:roleIsAssignedToAtomicBusinessProcess

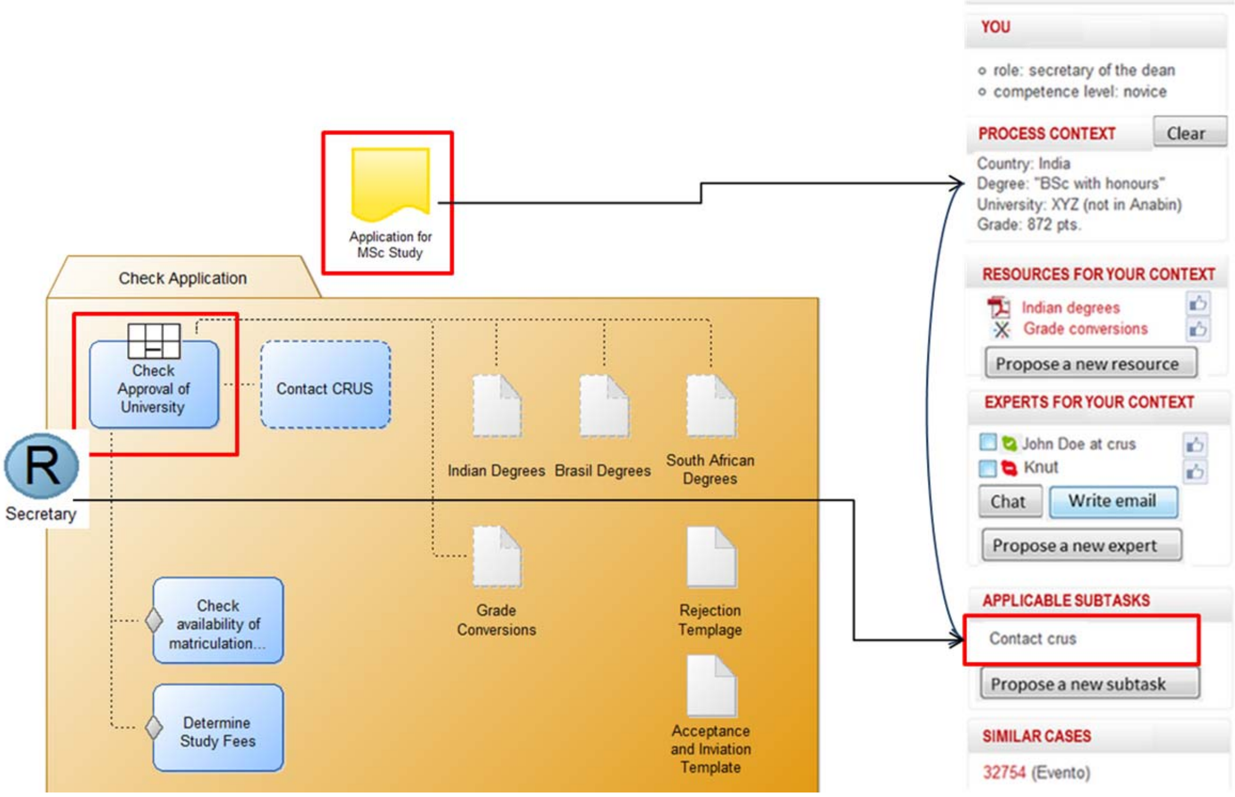
8. Given one or more experts recommended in a task
   AND
   some constraints regarding the level of work experience a user has
   what internal and external experts can be recommended in addition or should be omitted?

a. *rationale*: depending on the level of work experience a user has experts are added to or excluded from the recommendation.

b. *decomposition*: application data, the name of the user, user is an actor, an actor has role in the task, role associated with an organisational unit, organisational unit is part of organisational structure, organisational unit has head, organisational unit belongs to a legal entity, legal entity has collaboration with (other) legal entity, collaboration between legal entities has type.

Competency Question 8 can build on the answers/results of competency questions 6 and 7. Therefore the excerpt of the formal terminology is omitted.

Figure 4.53 depicts the subtasks, here only one subtask, that can be performed if need be.



- role: secretary of the dean
- competence level: novice

Country: India
Degree: "BSc with honours"
University: XYZ (not in Anabin)
Grade: 872 pts.

Figure 4.53 Subtasks Recommended to Perform

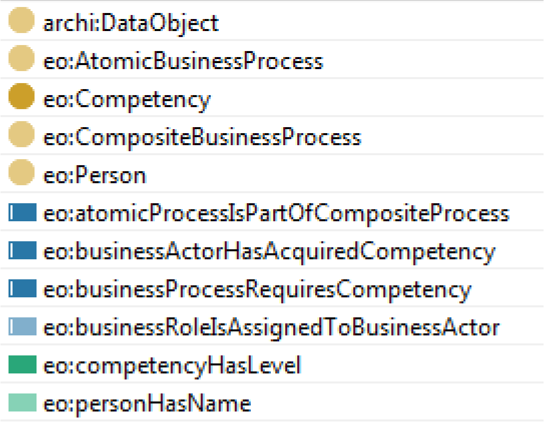
Informal Competency Questions are:

9. Given application data used in a task
AND
some constraints regarding competencies (e.g. level of work experience an actor, i.e. user logged in has)
what subtasks can be recommended?

    a. *rationale*: the answer is used to recommend subtasks, based on application data and competencies a user logged in has that can be performed if need be.

b. *decomposition*: application data, the name of the user, user is an actor, an actor has competencies (or: level of work experience), task is part of sub-process, competencies are required to perform the task.

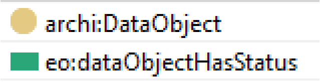
The formal terminology is derived from the competency questions, see below:



archi:DataObject
eo:AtomicBusinessProcess
eo:Competency
eo:CompositeBusinessProcess
eo:Person
eo:atomicProcessIsPartOfCompositeProcess
eo:businessActorHasAcquiredCompetency
eo:businessProcessRequiresCompetency
eo:businessRoleIsAssignedToBusinessActor
eo:competencyHasLevel
eo:personHasName

10. Given application data used in a task
AND
some constraints regarding historical cases (i.e. cases with similar application data that were performed in the past)
what subtasks can be recommended?
    a. *rationale*: the answer is used to recommend subtasks based on cases that were similar to the current one executed in the past.
    b. *decomposition*: application data, data of historical cases.

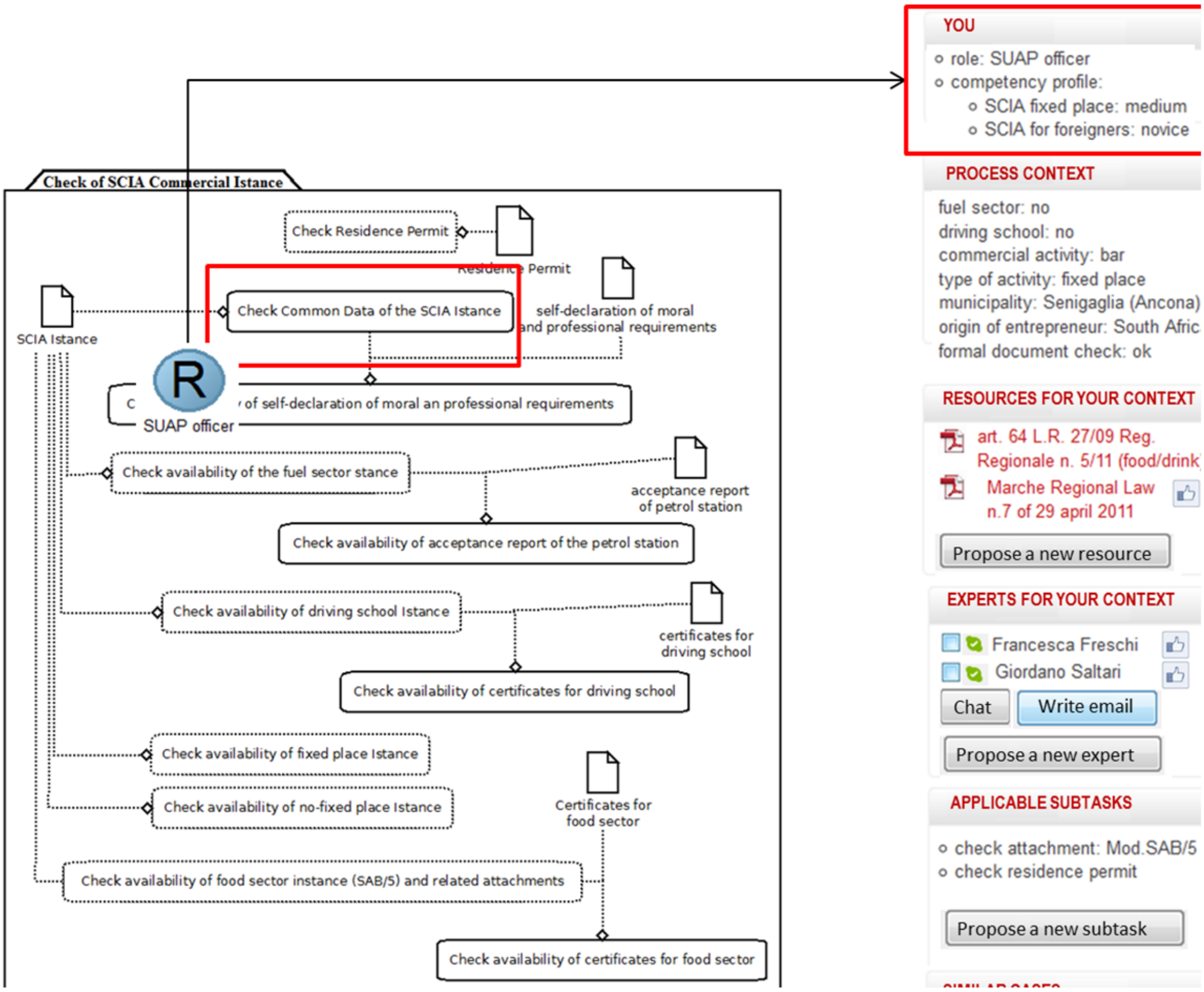
The formal terminology is derived from the competency questions, see below:



archi:DataObject
eo:dataObjectHasStatus

4.4.1.2. Competency Questions related to "SUAP"

In the following competency questions will be derived, respectively the developed questions presented above will be verified for the knowledge intensive sub-process of the "SUAP" process (cf. chapter 3.2).


Check of SCIA Commercial Istance
Check Residence Permit
Residence Permit
SCIA Istance
Check Common Data of the SCIA Istance
self-declaration of moral and professional requirements
R
SUAP officer
C
of self-declaration of moral an professional requirements
Check availability of the fuel sector stance
acceptance report of petrol station
Check availability of acceptance report of the petrol station
Check availability of driving school Istance
certificates for driving school
Check availability of certificates for driving school
Check availability of fixed place Istance
Check availability of no-fixed place Istance
Certificates for food sector
Check availability of food sector instance (SAB/5) and related attachments
Check availability of certificates for food sector
Chat
Write email
Propose a new resource
Propose a new expert
Propose a new subtask

YOU

- role: SUAP officer
- competency profile:
  - SCIA fixed place: medium
  - SCIA for foreigners: novice

PROCESS CONTEXT

fuel sector: no
driving school: no
commercial activity: bar
type of activity: fixed place
municipality: Senigaglia (Ancona)
origin of entrepreneur: South Afric
formal document check: ok

RESOURCES FOR YOUR CONTEXT

art. 64 L.R. 27/09 Reg. Regionale n. 5/11 (food/drink

Marche Regional Law n.7 of 29 april 2011

EXPERTS FOR YOUR CONTEXT

□ Francesca Freschi
□ Giordano Saltari

APPLICABLE SUBTASKS

- check attachment: Mod.SAB/5
- check residence permit

Figure 4.54 Task Context Information

Figure 4.54 depicts the context information provided for the tasks detailed in the mock-up. Same as in the "Student Admission Process" on top of the "context panel" information about the user who is logged in to the Learn PAd system is displayed. Hence, the role (SUAP officer) of the user - in the given task - and her competency profile is to be retrieved from the Learn PAd ontology.

Whereas the first part - identifying the role of the logged in user - is the same as for the "Student Admission Process" here not work experience of the user is to be displayed but a profile of the acquired competencies the user has. Hence only for this aspect a new competency question is asked:

11. Given a user logged in to the Learn PAd system
    AND

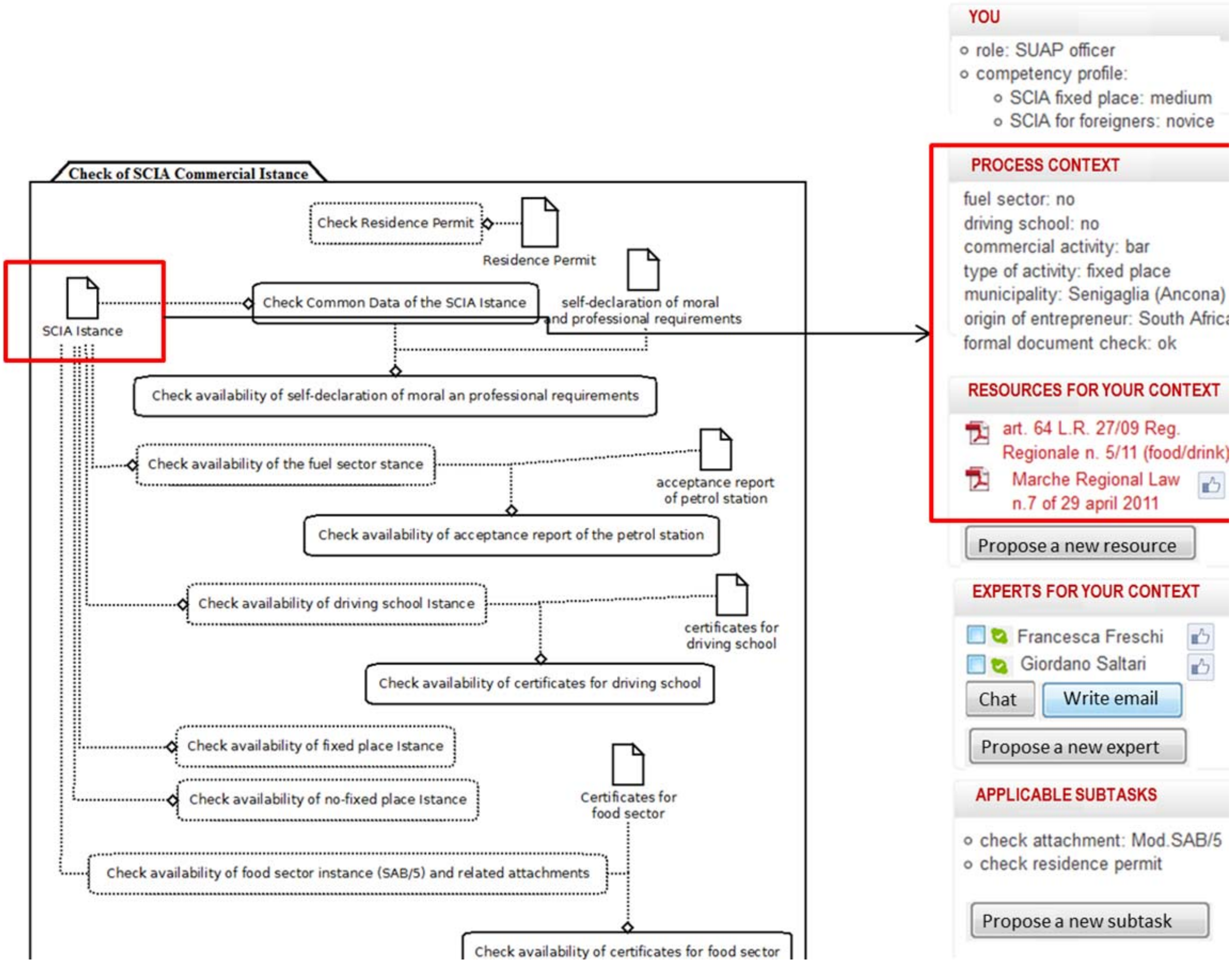
some constraints regarding the level of competencies (acquired competencies of the actor or required competencies in the task)

what competencies the user has (to acquire)?

a. *rationale*: the answer is used to provide context information about the competencies a user has acquired or are required with respect to the task.
b. *decomposition*: the name of the user, user is an actor, an actor has role "employee" (explicitly assigned or inferred from "a role is needed in an organisational unit, hence, an actor is an employee), competencies are required to perform a task, an actor has competencies acquired, competencies are stored in the competency record of an actor, level of work experienced is defined by the difference of required and acquired competencies (could also be explicitly defined).

Since competency question 11 can build on the answers for competency question 9 the derived formal terminology is omitted here.

Figure 4.55 depicts the process context and the resources for this context. Same as in the "Student Admission Process" process context is extracted from application data, e.g. from the form the applicant filled out. In the SUAP process it is the SCIA instance, depicted in Figure 4.55 as document. Whereas retrieving this context information is similar to the "Student Admission Process" here the resources proposed are not modeled explicitly (as discretionary documents) but deduced from background knowledge. Hence, for this aspect a new competency question is asked.


Check of SCIA Commercial Istance
Check Residence Permit
Residence Permit
SCIA Istance
Check Common Data of the SCIA Istance
self-declaration of moral and professional requirements
Check availability of self-declaration of moral an professional requirements
Check availability of the fuel sector stance
acceptance report of petrol station
Check availability of acceptance report of the petrol station
Check availability of driving school Istance
certificates for driving school
Check availability of certificates for driving school
Check availability of fixed place Istance
Check availability of no-fixed place Istance
Certificates for food sector
Check availability of food sector instance (SAB/5) and related attachments
Check availability of certificates for food sector

YOU

- role: SUAP officer
- competency profile:
  - SCIA fixed place: medium
  - SCIA for foreigners: novice

PROCESS CONTEXT

fuel sector: no
driving school: no
commercial activity: bar
type of activity: fixed place
municipality: Senigaglia (Ancona)
origin of entrepreneur: South Afric
formal document check: ok

RESOURCES FOR YOUR CONTEXT

art. 64 L.R. 27/09 Reg. Regionale n. 5/11 (food/drink)
Marche Regional Law n.7 of 29 april 2011

Propose a new resource

EXPERTS FOR YOUR CONTEXT

□ Francesca Freschi
□ Giordano Saltari

Chat | Write email

Propose a new expert

APPLICABLE SUBTASKS

- check attachment: Mod.SAB/5
- check residence permit

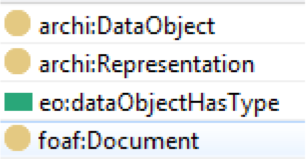
Propose a new subtask

Figure 4.55 The Process Context and its Resources

Informal Competency Question is:

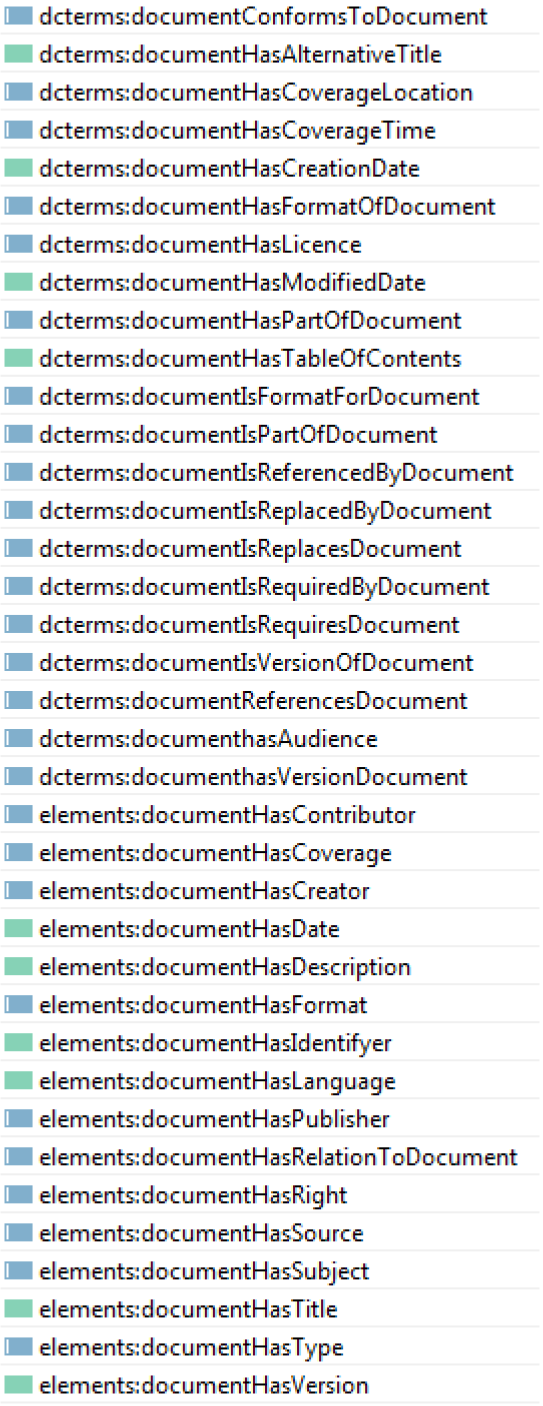
12. Given application data used to perform a task
    AND
    some constraints regarding application data
    what information resources (i.e. documents) are recommended?
    a. *rationale*: the answer is used to provide information resources (i.e. links to documents) that are relevant to perform the task while considering application data. Here: Since "commercial activity is bar" the document "art. 64 ..." is recommended and since "type of activity is fixed place" the document "Marche Regional Law ..." is proposed.
    b. *decomposition*: the task, application data, type of application data, document related to type of application data.

The formal terminology is derived from the competency questions, see below:



● archi:DataObject
● archi:Representation
🟩 eo:dataObjectHasType
● foaf:Document

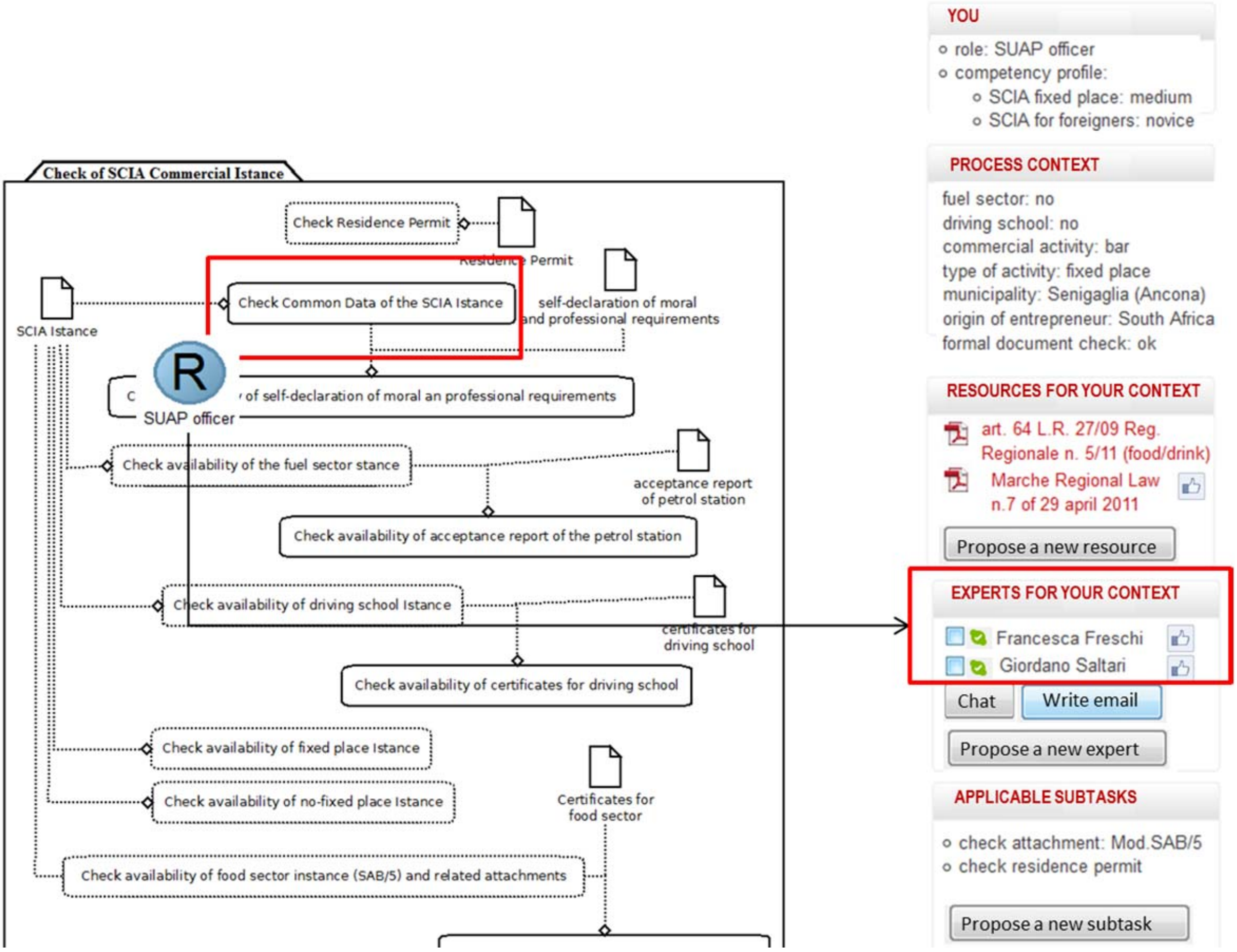
In addition to the terminology derived from competency question 12 in the following the Dublin Core[3] Meta Data Elements are depicted available to describe information resources.



- 🟦 dcterms:documentConformsToDocument
- 🟩 dcterms:documentHasAlternativeTitle
- 🟦 dcterms:documentHasCoverageLocation
- 🟦 dcterms:documentHasCoverageTime
- 🟩 dcterms:documentHasCreationDate
- 🟦 dcterms:documentHasFormatOfDocument
- 🟦 dcterms:documentHasLicence
- 🟩 dcterms:documentHasModifiedDate
- 🟦 dcterms:documentHasPartOfDocument
- 🟩 dcterms:documentHasTableOfContents
- 🟦 dcterms:documentIsFormatForDocument
- 🟦 dcterms:documentIsPartOfDocument
- 🟦 dcterms:documentIsReferencedByDocument
- 🟦 dcterms:documentIsReplacedByDocument
- 🟦 dcterms:documentIsReplacesDocument
- 🟦 dcterms:documentIsRequiredByDocument
- 🟦 dcterms:documentIsRequiresDocument
- 🟦 dcterms:documentIsVersionOfDocument
- 🟦 dcterms:documentReferencesDocument
- 🟦 dcterms:documenthasAudience
- 🟦 dcterms:documenthasVersionDocument
- 🟦 elements:documentHasContributor
- 🟦 elements:documentHasCoverage
- 🟦 elements:documentHasCreator
- 🟩 elements:documentHasDate
- 🟩 elements:documentHasDescription
- 🟦 elements:documentHasFormat
- 🟩 elements:documentHasIdentifyer
- 🟩 elements:documentHasLanguage
- 🟦 elements:documentHasPublisher
- 🟦 elements:documentHasRelationToDocument
- 🟦 elements:documentHasRight
- 🟦 elements:documentHasSource
- 🟦 elements:documentHasSubject
- 🟩 elements:documentHasTitle
- 🟦 elements:documentHasType
- 🟩 elements:documentHasVersion

[3] Dublin Core. URL: http://dublincore.org/documents/dces/ (retrieved: 29.1.2015)

Figure 4.56 depicts the resources (persons) that could support the execution of the task.



Check of SCIA Commercial Istance
Check Residence Permit
Residence Permit
SCIA Istance
Check Common Data of the SCIA Istance
self-declaration of moral and professional requirements
R
SUAP officer
C
of self-declaration of moral an professional requirements
Check availability of the fuel sector stance
acceptance report of petrol station
Check availability of acceptance report of the petrol station
Check availability of driving school Istance
certificates for driving school
Check availability of certificates for driving school
Check availability of fixed place Istance
Check availability of no-fixed place Istance
Certificates for food sector
Check availability of food sector instance (SAB/5) and related attachments

YOU

- role: SUAP officer
- competency profile:
  - SCIA fixed place: medium
  - SCIA for foreigners: novice

PROCESS CONTEXT

fuel sector: no
driving school: no
commercial activity: bar
type of activity: fixed place
municipality: Senigaglia (Ancona)
origin of entrepreneur: South Africa
formal document check: ok

RESOURCES FOR YOUR CONTEXT

art. 64 L.R. 27/09 Reg. Regionale n. 5/11 (food/drink)
Marche Regional Law n.7 of 29 april 2011

Propose a new resource

EXPERTS FOR YOUR CONTEXT

□ Francesca Freschi
□ Giordano Saltari

Chat | Write email

Propose a new expert

APPLICABLE SUBTASKS

- check attachment: Mod.SAB/5
- check residence permit

Propose a new subtask

Figure 4.56 Resources Supporting Task Execution

According to the description of the process (refer to deliverable D8.1) the scenario considers the SUAP office place at the level of the Senigallia Municipality and the "Comunità Montana dei Monti Azzurri" that is consortium of municipalities in a mountain area offering the SUAP for 13 municipalities in the surrounding area.

Informal Competency Question is:

13. Given a task
    AND
    some constraints regarding roles (internally, i.e. the role assigned to the task and externally, i.e. collaborators in a process)
    what experts can be recommended?
    a. *rationale*: the answer is used to recommend internal experts that have the same role as the user logged in (and assigned to the task) and external experts that collaborate, i.e. support process execution if need be.

b. *decomposition*: task, task is part of process, the name of the user, user is an actor, an actor has role in the task, same role is assigned to other actors, actor belongs to a legal entity, legal entity has relation to other legal entities, (other) legal entity has role, type of role can be collaboration, role may be related to an enterprise object (e.g. a product or process).

Since competency question 13 can build on the answers for previous competency questions, formal terminology is omitted here.

Since there are no specific in the SUAP process regarding applicable subtasks and similar cases competencies do not differ from the ones elaborated for the "Student Admission Process".

4.4.1.3. Competency Questions related to "Learning"

In the following we reassess the Learn PAd ontology regarding its ability to meet requirements particularly concerning the way of learning supported by Learn PAd.

Here the uses cases (refer to deliverable D2.1) figure as motivating scenarios. Since the use cases 3.6, 3.7 and 3.10 are basis for the mock-up (chapter 3.1.3 and chapter 3.1.4) some aspects are already addressed in the previous sections.

UC3.2 - Defines learning goals

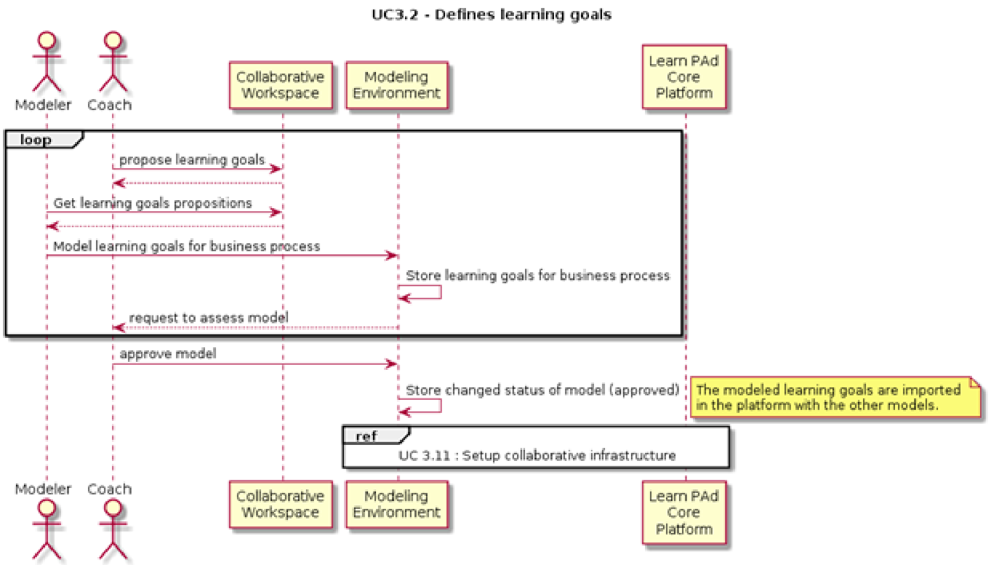

UC3.2 - Defines learning goals
Modeler
Coach
Collaborative Workspace
Modeling Environment
Learn PAd Core Platform
loop
propose learning goals
Get learning goals propositions
Model learning goals for business process
Store learning goals for business process
request to assess model
approve model
Store changed status of model (approved)
The modeled learning goals are imported in the platform with the other models.
ref
UC 3.11 : Setup collaborative infrastructure
Modeler
Coach
Collaborative Workspace
Modeling Environment
Learn PAd Core Platform

Figure 4.57 Sequence Diagram for UC3.2

Figure 4.57 depicts the sequence diagram for the use case UC 3.2. The following competency questions are derived from this.

Informal Competency Question is:

14. Given a user logged in to the Learn PAd system
AND

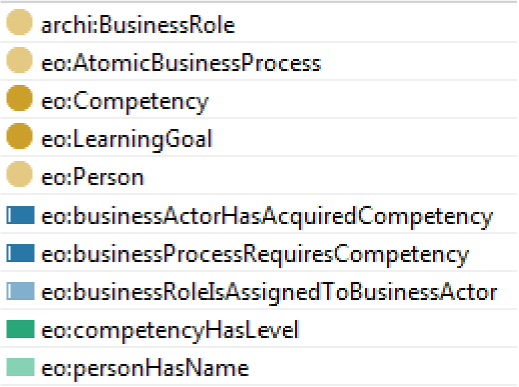
some constraints regarding role and activities to perform she has (e.g. PA officer, involved in the SUAP process)

what learning goals are suggested for a user?

a. *rationale*: the answer is used to provide suggestions for learning goals related to the role a user has and to the competencies she needed to perform tasks assigned to this role.

b. *decomposition*: the name of the user, user is an actor, an actor has a role, a role is assigned to a task, for a task competencies are required, an actor has competencies acquired, required and acquired competencies may differ, the difference can determine a learning goal.

The formal terminology is derived from the competency questions, see below:



- archi:BusinessRole
- eo:AtomicBusinessProcess
- eo:Competency
- eo:LearningGoal
- eo:Person
- eo:businessActorHasAcquiredCompetency
- eo:businessProcessRequiresCompetency
- eo:businessRoleIsAssignedToBusinessActor
- eo:competencyHasLevel
- eo:personHasName

UC3.6 - Supports Browsing Process Documentation

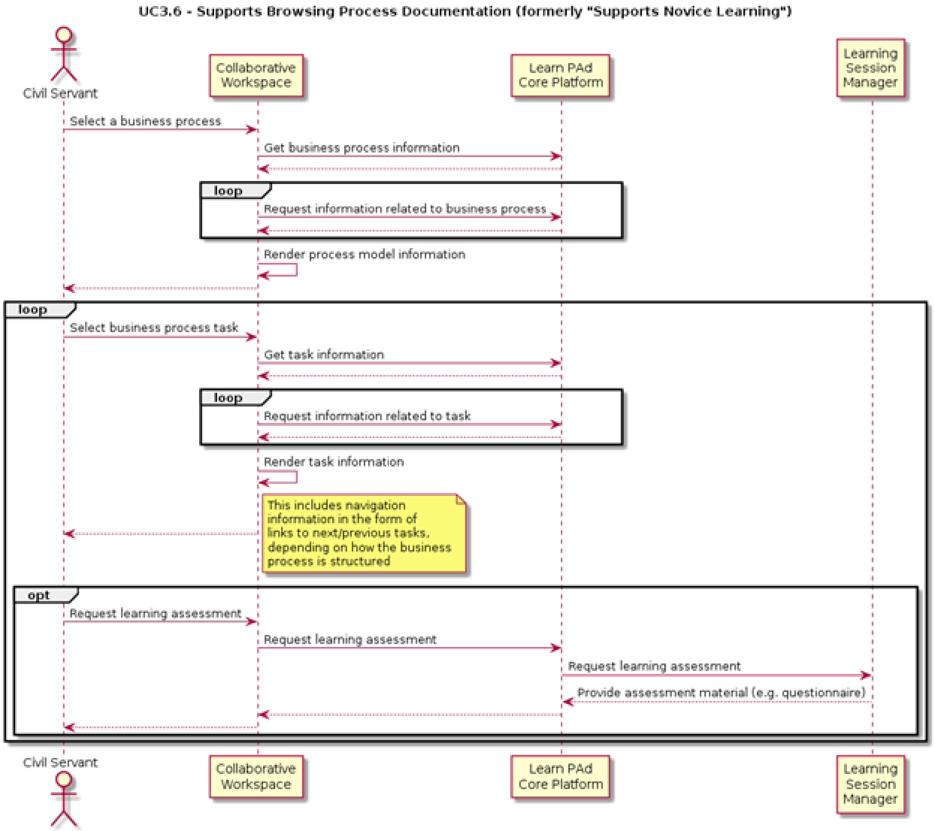

UC3.6 - Supports Browsing Process Documentation (formerly "Supports Novice Learning")
Civil Servant
Collaborative Workspace
Learn PAd Core Platform
Learning Session Manager
Select a business process
Get business process information
loop
Request information related to business process
Render process model information
loop
Select business process task
Get task information
loop
Request information related to task
Render task information
This includes navigation information in the form of links to next/previous tasks, depending on how the business process is structured
opt
Request learning assessment
Request learning assessment
Request learning assessment
Provide assessment material (e.g. questionnaire)
Civil Servant
Collaborative Workspace
Learn PAd Core Platform
Learning Session Manager

Figure 4.58 Sequence Diagram of UC3.6

Figure 4.58 depicts the sequence diagram of UC3.6. The following competency questions are derived from this.

Informal Competency Question is:

15. Given a user logged in to the Learn PAd system
AND
some constraints regarding role and activities to perform she has (e.g. PA officer, involved in the SUAP process)
what information, related to a process and tasks can be suggested?
    a. *rationale*: the answer is used to provide suggestions for information related to the role a user has and to the activities (and processes) the role is assigned to.
    b. *decomposition*: the name of the user, user is an actor, an actor has a role, a role is assigned to a task, a task is part of a process, to task and process information is related.

    Since competency question 15 can build on the answers for previous competency questions, formal terminology is omitted here.

The competency question might be elaborated to consider a user's competencies, too.

16. Given a user logged in to the Learn PAd system
AND
some constraints regarding competencies, role and activities to perform she has (e.g. PA officer, involved in the Student Admission Process, working experience Novice)
what information, related to a process and tasks can be suggested?
    a. *rationale*: the answer is used to provide customized suggestions for information related to the role and the working experience a user has and to the activities (and processes) the role is assigned to
    b. *decomposition*: the name of the user, user is an actor, an actor has a role, a role is assigned to a task, a task is part of a process, to task and process information is related, classification of information regarding relevance (e.g. for expert, novice) .

    Since competency question 16 can build on the answers for previous competency questions, formal terminology is omitted here.

UC3.7 - Shares Business Process Knowledge

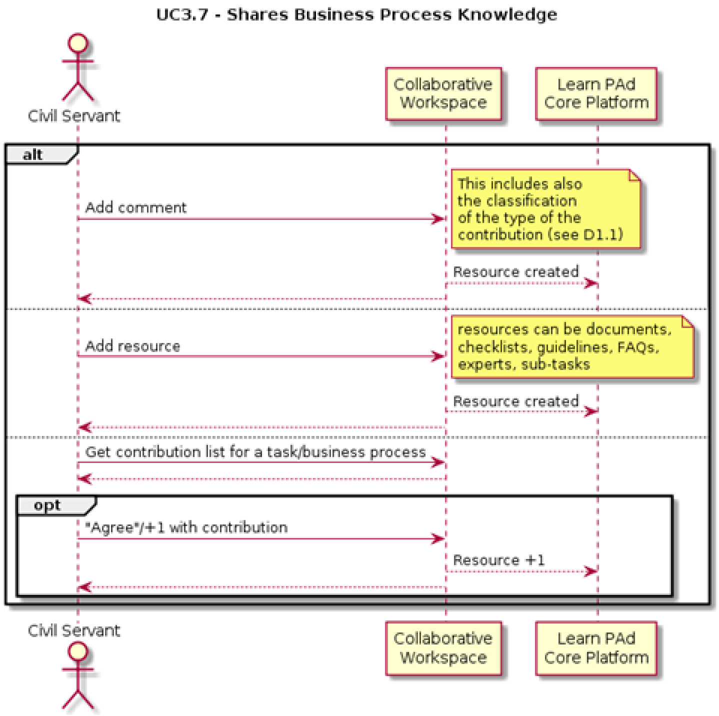

UC3.7 - Shares Business Process Knowledge
Civil Servant
Collaborative Workspace
Learn PAd Core Platform
alt
Add comment
This includes also the classification of the type of the contribution (see D1.1)
Resource created
Add resource
resources can be documents, checklists, guidelines, FAQs, experts, sub-tasks
Resource created
Get contribution list for a task/business process
opt
"Agree"/+1 with contribution
Resource +1
Civil Servant
Collaborative Workspace
Learn PAd Core Platform

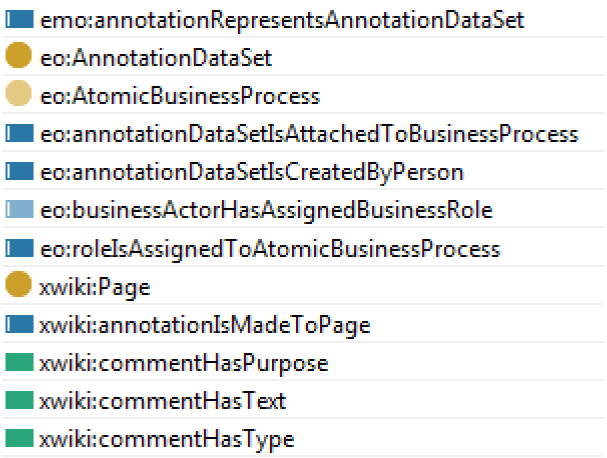
Figure 4.59 Sequence Diagram of UC3.7

Figure 4.59 depicts the sequence diagram of UC3.7. The following competency questions are derived from this.

Informal Competency Question is:

17. Given a user logged in to the Learn PAd system
    AND
    some constraints regarding role what contributions can be displayed?
    a. *rationale*: the answer is used to provide a list of contribution made to tasks/processes the role the user has is involved in, e.g. if the user has the role "PA officer" contributions to those tasks/processes are displayed he "works in"; if the user as the (additional) role "Modeler" contributions to those tasks/processes are displayed he is responsible for or that a new
    b. *decomposition*: the name of the user, user is an actor, an actor has a role, a role is assigned to a task, a task is part of a process, to task and process comments are made.

The formal terminology is derived from the competency questions, see below:



emo:annotationRepresentsAnnotationDataSet
eo:AnnotationDataSet
eo:AtomicBusinessProcess
eo:annotationDataSetIsAttachedToBusinessProcess
eo:annotationDataSetIsCreatedByPerson
eo:businessActorHasAssignedBusinessRole
eo:roleIsAssignedToAtomicBusinessProcess
xwiki:Page
xwiki:annotationIsMadeToPage
xwiki:commentHasPurpose
xwiki:commentHasText
xwiki:commentHasType

UC3.10.2 – Set Process Context

In order to increase readability first UC3.10.2 is considered before looking at UC3.10.1. UC3.10.2 is about setting the context, i.e. it is about providing the application data handled in a process.

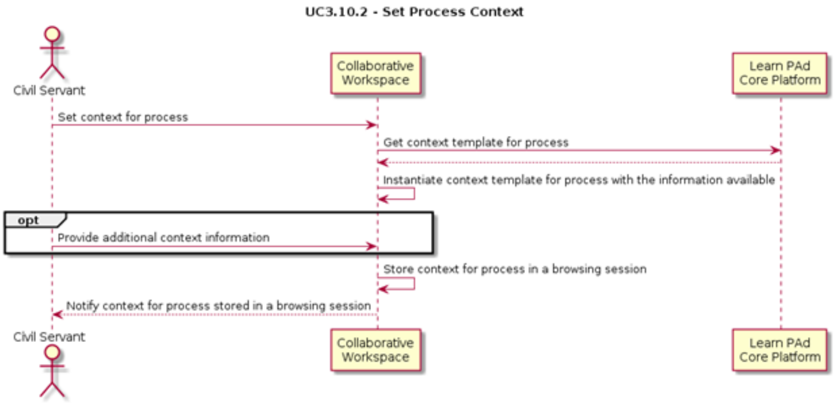

UC3.10.2 - Set Process Context
Civil Servant
Collaborative Workspace
Learn PAd Core Platform
Set context for process
Get context template for process
Instantiate context template for process with the information available
opt
Provide additional context information
Store context for process in a browsing session
Notify context for process stored in a browsing session
Civil Servant
Collaborative Workspace
Learn PAd Core Platform

Figure 4.60 Sequence Diagram of UC3.10.2

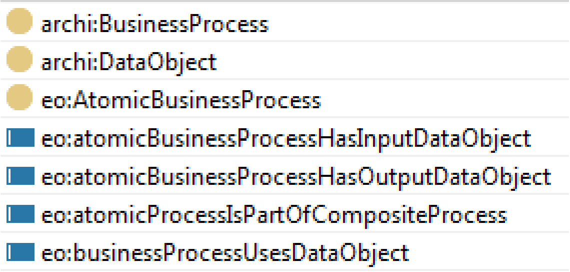
Figure 4.60 depicts the sequence diagram of UC3.10.2. The following competency questions are derived from this.

Informal Competency Question is:

18. Given a user logged in to the Learn PAd system
 AND
 some constraints regarding process and task she has to perform what application data is needed?
 a. *rationale*: the answer is used to provide the data needed within a process; be it automatically retrieved from an application system, e.g. a database containing data of an application or given by filling a form

b. *decomposition*: a process, tasks that are part of the process, data that is needed within the tasks (e.g. input, output or reference) and the process.

The formal terminology is derived from the competency questions, see below:



● archi:BusinessProcess

● archi:DataObject

● eo:AtomicBusinessProcess

▬ eo:atomicBusinessProcessHasInputDataObject

▬ eo:atomicBusinessProcessHasOutputDataObject

▬ eo:atomicProcessIsPartOfCompositeProcess

▬ eo:businessProcessUsesDataObject

UC3.10.1 – Provides Recommendations for Learning

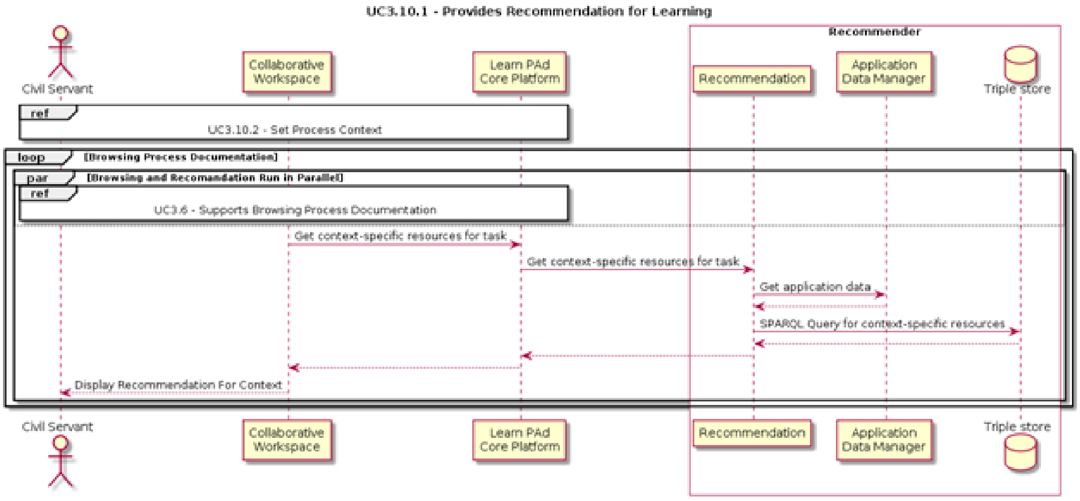

UC3.10.1 - Provides Recommendation for Learning
Recommender
Civil Servant
Collaborative Workspace
Learn PAd Core Platform
Recommendation
Application Data Manager
Triple store
ref
UC3.10.2 - Set Process Context
loop
[Browsing Process Documentation]
par
[Browsing and Recomandation Run in Parallel]
ref
UC3.6 - Supports Browsing Process Documentation
Get context-specific resources for task
Get context-specific resources for task
Get application data
SPARQL Query for context-specific resources
Display Recommendation For Context
Civil Servant
Collaborative Workspace
Learn PAd Core Platform
Recommendation
Application Data Manager
Triple store

Figure 4.61 Sequence Diagram of UC3.10.1

Figure 4.61 depicts the sequence diagram of UC3.10.1. Since this UC is an aggregation of what has been considered more detailed when looking at the two real life scenarios detailed above please refer to the competency questions in the previous sections.

UC3.14 – Improving business processes by feedbacks

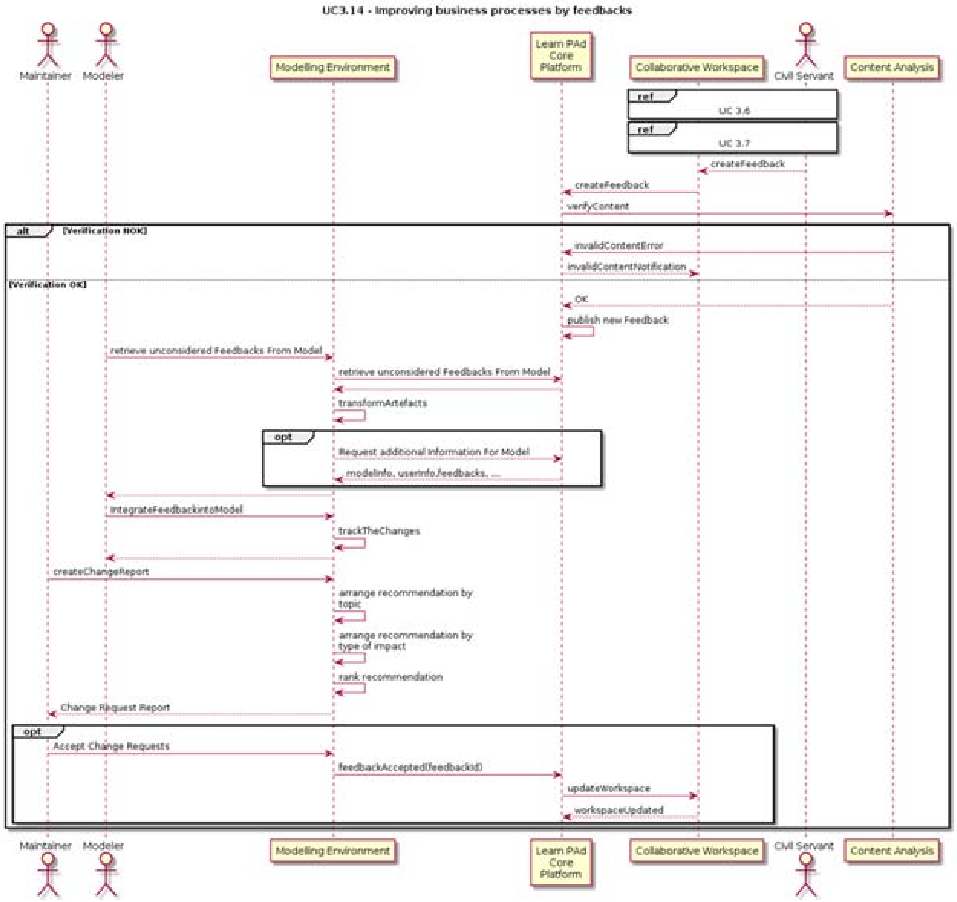


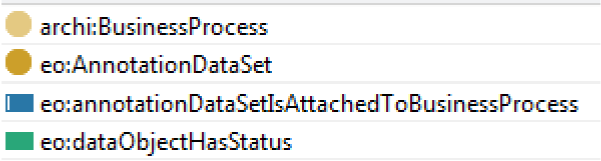
Figure 4.62 Sequence Diagram of UC3.14

Figure 4.62 depicts the sequence diagram of UC3.14. The following competency questions are derived from this.

Informal Competency Question is:

19. Given a modeler logged in to the Learn PAd system
    AND
    some constraints regarding status of comments (i.e. feedback from model) what processes, tasks and feedback should be displayed?
    a. *rationale*: the answer is used to provide a (list of) process(es), task(s) for which feedback has been given (comments were made) that were not handled yet
    b. *decomposition*: a process, tasks that have comments, comments have a status.

The formal terminology is derived from the competency questions, see below:



● archi:BusinessProcess
● eo:AnnotationDataSet
▬ eo:annotationDataSetIsAttachedToBusinessProcess
▬ eo:dataObjectHasStatus

UC3.15 – Enables monitoring of goal achievement

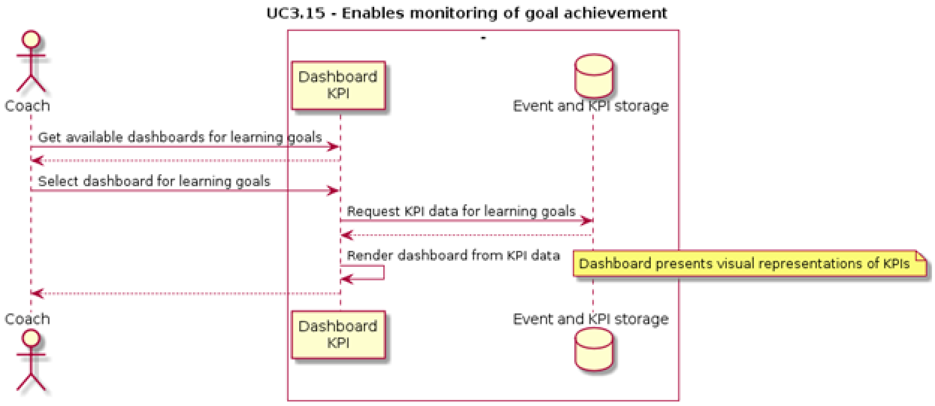

UC3.15 - Enables monitoring of goal achievement
Coach
Dashboard KPI
Event and KPI storage
Get available dashboards for learning goals
Select dashboard for learning goals
Request KPI data for learning goals
Render dashboard from KPI data
Dashboard presents visual representations of KPIs
Coach
Dashboard KPI
Event and KPI storage

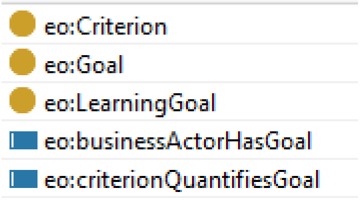
Figure 4.63 Sequence Diagram of UC3.15

Figure 4.63 depicts the sequence diagram of UC3.15. The following competency questions are derived from this.

Informal Competency Question is:

20. Given a coach logged in to the Learn PAd system
    AND
    some constraints regarding actor what learning goals should be displayed?
    a. *rationale*: the answer is used to populate the dashboard with learning goals and their KPIs.
    b. *decomposition*: actor (legal entity, org. unit, person), actor has learning goals, a learning goal is a goal, goals are related to KPIs.

The formal terminology is derived from the competency questions, see below:



● eo:Criterion
● eo:Goal
● eo:LearningGoal
▬ eo:businessActorHasGoal
▬ eo:criterionQuantifiesGoal

4.5. Ontology Representation Language

For ontology representation a language is needed that formally describes concepts and relations. UML can be considered as it is easy to understand but has the drawback of not being expressive enough for automatic reasoning.

The Semantic Web provides a number of modeling languages of different levels of expressivity. However, since there is no "right" language to formally define the Conceptual

Meta Model but "The choice of the language to use in a system or analysis will ultimately depend on what types of facts and conclusions are most important for the application" (Brachmann & Levesque 2004, p 43), we decided for a pragmatic approach. We considered what modeling requirements were to be met, i.e. how detailed constraints between classes, instances and properties should be expressed, how much reasoning is needed and how good the language supported by tools was.

Starting with the most basic requirement, that we want to be able to "say anything about anything" (Klyne & Carroll 2002) in a flexible but standardized way led inevitably to RDF. With RDF, which is called data model by Allemang and Hendler (2008, p 75), every relationship between any two data elements can be expressed explicitly, unambiguously and with great flexibility.

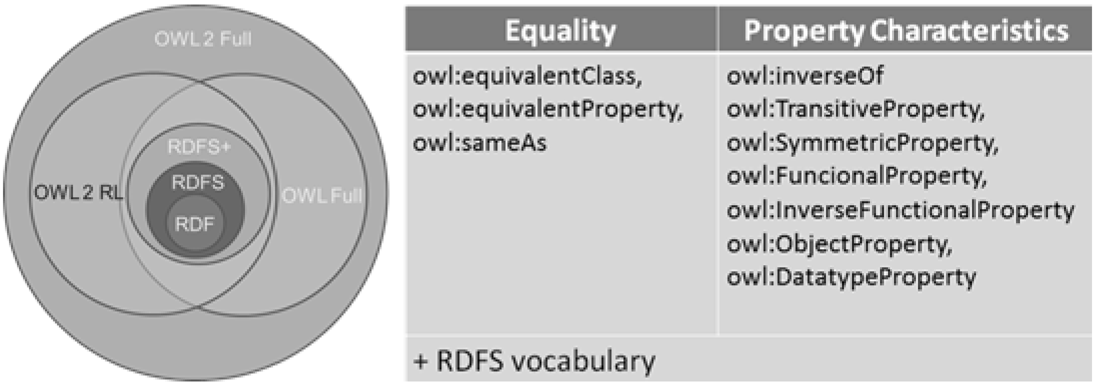
Clearly, RDF is not sufficient as it is "dumb data" as Allemang and Hendler (2008, p 79) put it, since only little information about the data model (i.e. the graphs) can be expressed (e.g. rdf:type, rdf:subject). The RDF Schema Language (RDFS) provides a way to *describe* the data, precisely: the data *sets*. This is important as it is the key to inferencing, i.e. from some given data, other related data can be determined as it would have been stated.

The few patterns RDFS provides can be combined to create more powerful patterns, which make it possible "to simulate certain logical combinations of sets and properties" (Allemang & Hendler 2008, p 122), like Set Intersection and Set Union (two ways of using the rdfs:subClassOf pattern) and Property Intersection and Property Union (two ways of using the rdfs:subProperty pattern).

All patterns RDFS supports are used in the Learn PAd ontology and hence, RDFS is necessary. The question is if it is sufficient.

It is common knowledge, that OWL (W3C OWL Working Group 2009) is the most expressive of the web ontology languages. "The W3C Web Ontology Language (OWL) is a Semantic Web language designed to represent rich and complex knowledge about things, groups of things, and relations between things. OWL is a computational logic-based language such that knowledge expressed in OWL can be exploited by computer programs, e.g., to verify the consistency of that knowledge or to make implicit knowledge explicit" (OWL Working Group 2012). Several OWL profiles are available. Each of them provide different expressive power and target different application scenarios (Grau et al. 2008), and therefore addresses (Su & Ilebrekke 2006, p 776) statement: "Which language to choose is dependent of the problem domain and modeling requirement, like how much reasoning support is needed".

A subset of OWL language constructs is called RDFS-*Plus* (Allemang & Hendler 2008, p 123) because they "see a trend among vendors of Semantic Web tools and Web applications designers for determining a subset of OWL that is at the same time useful and can be implemented quickly". Almost the same subset has been published by members of the W3C working group, which is called RDFS 3.0 (Hendler n.d.). The subset can be expressed entirely in RDFS, distinguished by the namespace `owl`. Figure 4.64 positions RDFS-Plus in relation to OWL.



Equality	Property Characteristics
owl:equivalentClass, owl:equivalentProperty, owl:sameAs	owl:inverseOf owl:TransitiveProperty, owl:SymmetricProperty, owl:FuncionalProperty, owl:InverseFunctionalProperty owl:ObjectProperty, owl:DatatypeProperty
+ RDFS vocabulary	

Figure 4.64 Positioning RDFS-Plus in Relation to OWL (Bao 2008)

RDFS plus can be regarded as an answer to OWL, which is a powerful language but hard to apply in real-world semantic technology projects due to its open-world assumption (Knublauch 2009). Another advantage of choosing RDFS Plus as a good tool support is shown in the W3C Wiki that lists a collection of tools for developing Semantic Web applications[4]. For Learn PAd we use the commercial tool Top Quadrant's TopBraid Suite, which is a collection of integrated semantic solution products[5]. A free version is available providing almost all functionalities needed in Learn PAd. An asset of the tool is that graphical representation of the concepts and relations is provided looking alike an UML class diagram (see Figure 4.65).

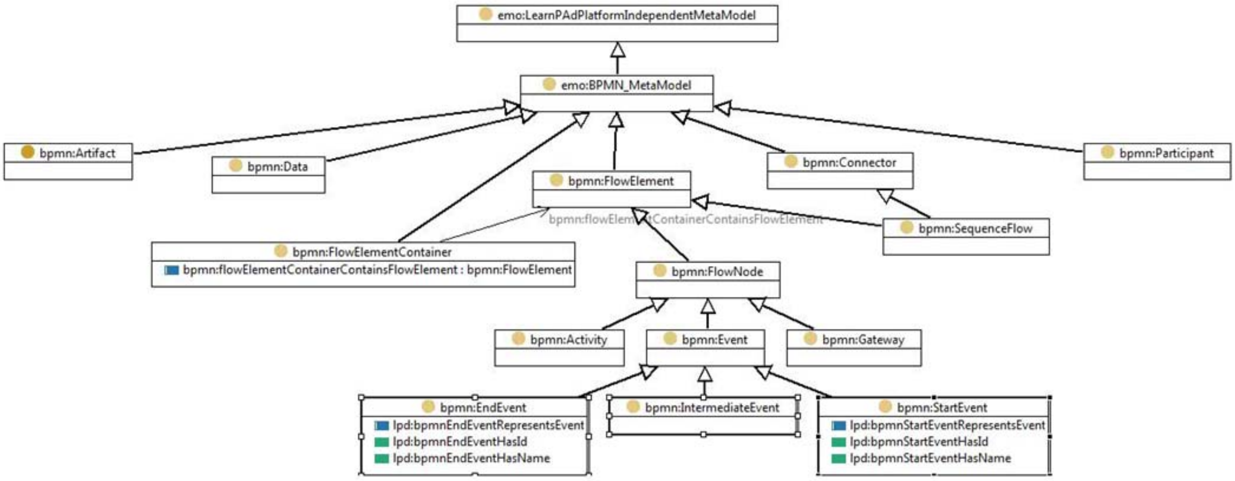


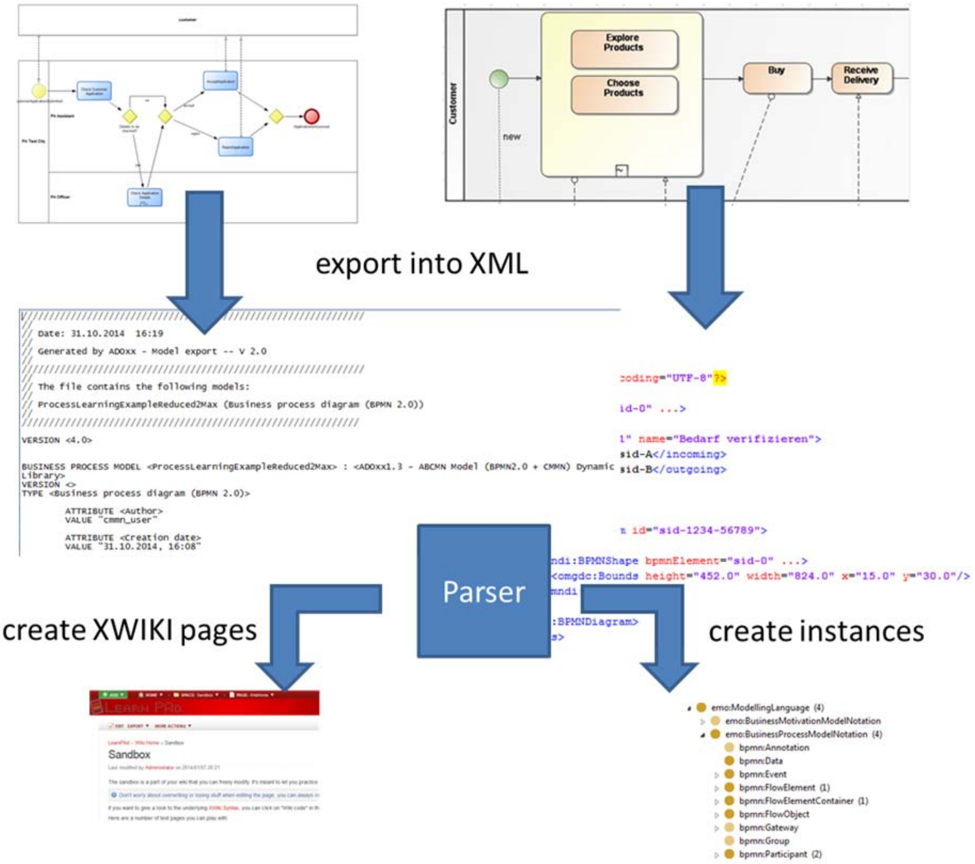
Figure 4.65 Representation of BPMN Concepts Modelled in RDFS

[4] W3C Wiki: Semantic Web Development Tools. URL: http://www.w3.org/2001/sw/wiki/SemanticWebTools) (retrieved: 28.12.2014)

[5] TopBraid. URL: http://www.topquadrant.com/tools/modeling-topbraid-composer-standard-edition (retrieved: 10.1.2014)

5. Mapping models to Wiki representation and Learn PAd ontology

As depicted in Figure 4.7 relations between Learn PAd ontology and Model Kind and Architecture Model models are governed by the model kind described in a certain Model Description Language, for example in (a subset of) BPMN 2.0. However, in order to exploit the knowledge represented in the Learn PAd Meta Model, e.g. in order to give recommendations, concepts and relations (T-Box of the Learn PAd ontology) must be populated with instances derived from the models. The general approach is depicted in Figure 5.1 After a model is created in a modeling tool it is exported into an XML file. Then the file is parsed in order to create XWiki pages and to create instances of the respective concepts in the Learn PAd ontology.



```
//////////////////////////////////////////////////////////////////////
//
// Date: 31.10.2014  16:19
//
// Generated by ADOxx - Model export -- V 2.0
//
//////////////////////////////////////////////////////////////////////
//
// The file contains the following models:
//
// ProcessLearningExampleReduced2Max (Business process diagram (BPMN 2.0))
//
//////////////////////////////////////////////////////////////////////

VERSION <4.0>

BUSINESS PROCESS MODEL <ProcessLearningExampleReduced2Max> : <ADOxx1.3 - ABCMN Model (BPMN2.0 + CMMN) Dynamic
Library>
VERSION <>
TYPE <Business process diagram (BPMN 2.0)>

        ATTRIBUTE <Author>
        VALUE "cmmn_user"

        ATTRIBUTE <Creation date>
        VALUE "31.10.2014, 16:08"
```

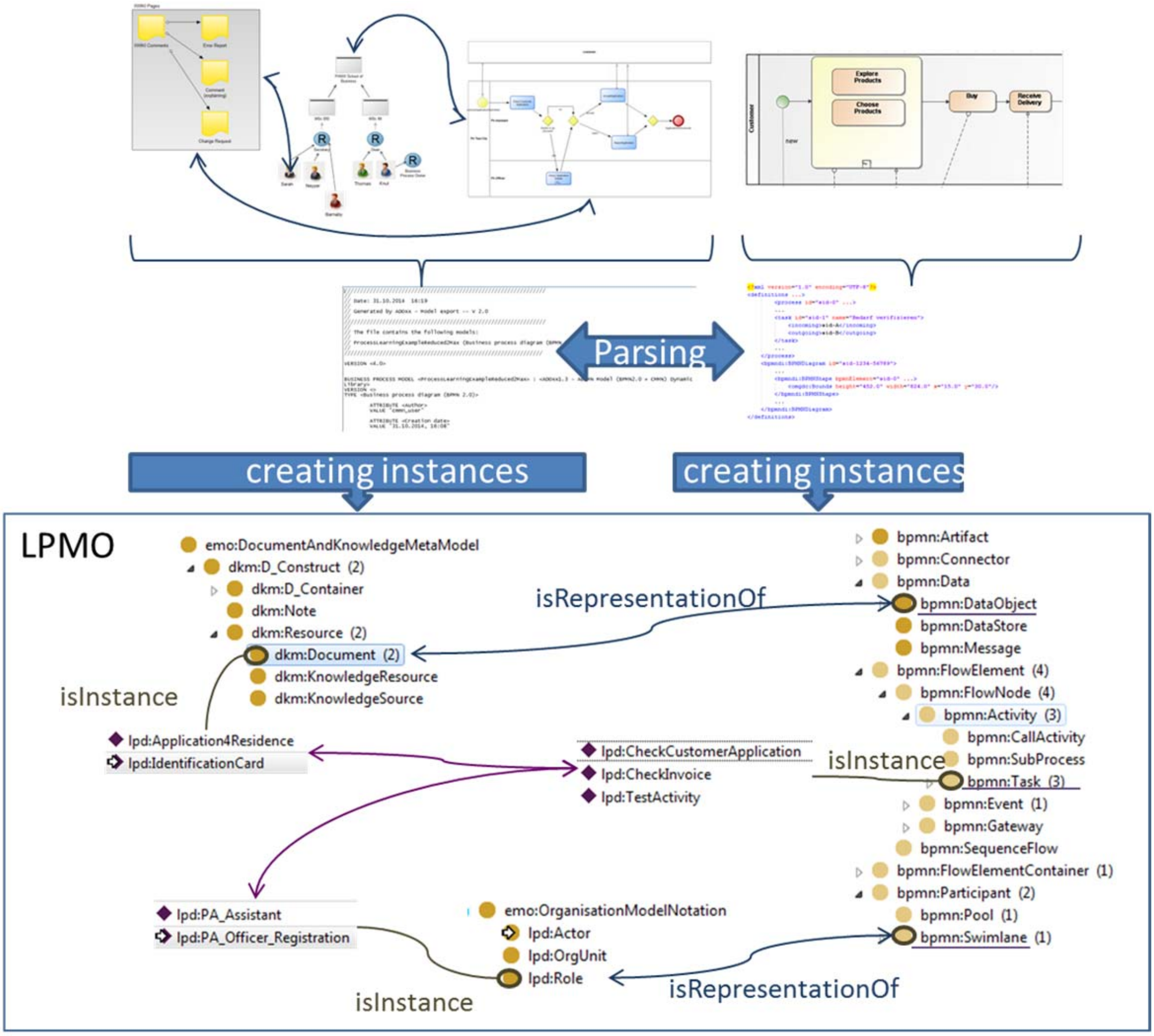
```
coding="UTF-8"?>

id-0" ...>

1" name="Bedarf verifizieren">
sid-A</incoming>
sid-B</outgoing>

n id="sid-1234-56789">

ndi:BPMNShape bpmnElement="sid-0" ...>
<omgdc:Bounds height="452.0" width="824.0" x="15.0" y="30.0"/>
mndi

:BPMNDiagram>
s>
```

Figure 5.1 From Models to XWiki Pages and Ontology Population

In the following sections both paths will be explained in detail. Section 5.1 describes how the parsed information is imported into the Learn PAd ontology to create instances of the respective concepts and, how they are related. Afterwards in section 5.2 describe how the models are transformed into XWiki pages.

5.1. From Model to Instances

Figure 5.2 depicts the overall procedure for populating concepts and creating relations in the Learn PAd ontology, i.e. in the LCMO.



```
//////////////////////////////////////////////////////////////////
// Date: 31.10.2014  16:19
//
// Generated by ADOxx - model export -- v 2.0
//////////////////////////////////////////////////////////////////
// The file contains the following models:
//
// ProcessLearningExampleReduced2Max (Business process diagram (BPMN
//////////////////////////////////////////////////////////////////
VERSION <4.0>

BUSINESS PROCESS MODEL <ProcessLearningExampleReduced2Max> : <ADOxx1.3 - model (BPMN2.0 + CMMN) Dynamic
Library>
VERSION <>
TYPE <Business process diagram (BPMN 2.0)>

      ATTRIBUTE <Author>
      VALUE "cmmn_user"

      ATTRIBUTE <Creation date>
      VALUE "31.10.2014, 16:08"
```

```
<?xml version="1.0" encoding="UTF-8"?>
<definitions ...>
    <process id="eid-0" ...>
        ...
        <task id="eid-1" name="Bedarf verifizieren">
            <incoming>eid-A</incoming>
            <outgoing>eid-B</outgoing>
        </task>
        ...
    </process>
    <bpmndi:BPMNDiagram id="eid-1234-56789">
        ...
        <bpmndi:BPMNShape bpmnElement="eid-0" ...>
            <omgdc:Bounds height="452.0" width="824.0" x="15.0" y="30.0"/>
        </bpmndi:BPMNShape>
        ...
    </bpmndi:BPMNDiagram>
</definitions>
```

Figure 5.2 Overall Procedure for Populating Concepts

In the upper part of Figure 5.2 overall graphical models of several model kinds are depicted, created with two different modeling tools. On the right hand side a BPMN process model is shown, on the left hand side also a BPMN process model is shown but also an organisational and a document model referred to in the process model. That is to show that Learn PAd supports as well models using only object types defined in BPMN as enhanced BPMN models having explicit relations to other meta models. The models can be exported into an XML file and are then parsed to extract values for populating the Learn PAd ontology, i.e. creating instances of the concepts.

In a next step these instances are automatically related to instances of concepts of LCMO. For this we utilize features that RDFS provides as that an instance can be of more than one type as described in chapter 4.3.1.2.

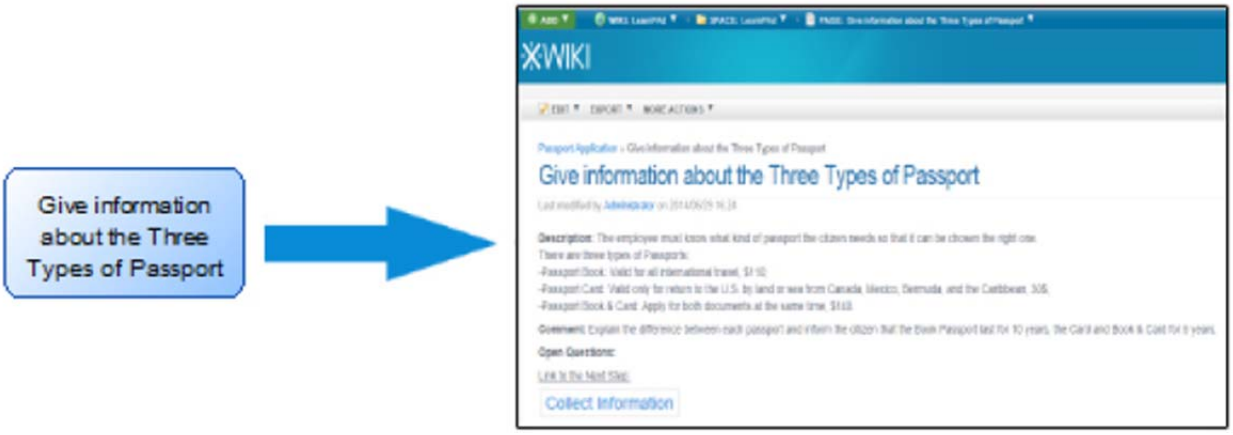
5.2. From Model to XWiki

In a first prototype we implemented the translation of process models, organisation models and document models into XWiki pages and structured information related to the pages. In particular, we used translated three model kinds: business process models, organisation models and document models as well as the relations between these model kinds. For the prototype, the models were created with the ADOxx modeling tool. A similar functionality will be provided for models created with MagicDraw. In the following the transformation is described. Details on how the XWiki is used are illustrated in section x.

It was the objective of the transformation is using the strength of a wiki, namely XWiki, to collaboratively manage information and knowledge. For creating the XWiki pages (and objects like links) an xml-file of a model is exported from the modeling tool which is parsed. The result is a transformation of objects, defined in the model into XWiki pages and structures. For example, for every activity of a business process a XWiki page is created. In the XWiki page the worker can see a description of the task and has links to the information associated with the task. If there are additional resources or applications assigned to the tasks they would be accessible via the wiki page, too.

The database model of XWiki helps in the translation process. XWiki can store structured data as classes (with properties) and instances of these classes (objects). Each element of a model will be translated in such objects in the wiki. For example, the XWiki database model will have a class, call it XTask, that describes a task. When a representation of a task of a process model is created in XWiki an instance of XTask is created. This instance will be attached to the page that represents the task and displayed to the user when she accesses the page. The same will be done with gateways, and any other model object that will be translated into XWiki, i.e. into the Collaborative Workspace.

In Figure 5.3 an illustration is given of the transformation of an activity into an XWiki page. The name of the XWiki page is the name of the activity so that the worker can easily recognize in which step of the process she currently is. At the bottom of each page there is a link to the next task, i.e. another page representing this task.


Give information about the Three Types of Passport
ADD ▾
WIKI: LearnPAd ▾
SPACE: LearnPAd ▾
PAGE: Give information about the Three Types of Passport ▾
XWIKI
EDIT ▾
EXPORT ▾
MORE ACTIONS ▾

Passport Application » Give information about the Three Types of Passport

Give information about the Three Types of Passport

Last modified by [illegible] on 2014/06/29 16:24

Description: The employee must know what kind of passport the citizen needs so that it can be chosen the right one.
There are three types of Passports:
-Passport Book: Valid for all international travel, $110
-Passport Card: Valid only for return to the U.S. by land or sea from Canada, Mexico, Bermuda, and the Caribbean, 30$
-Passport Book & Card: Apply for both documents at the same time, $140

Comment: Explain the difference between each passport and inform the citizen that the Book Passport last for 10 years, the Card and Book & Card for 5 years.

Open Questions:

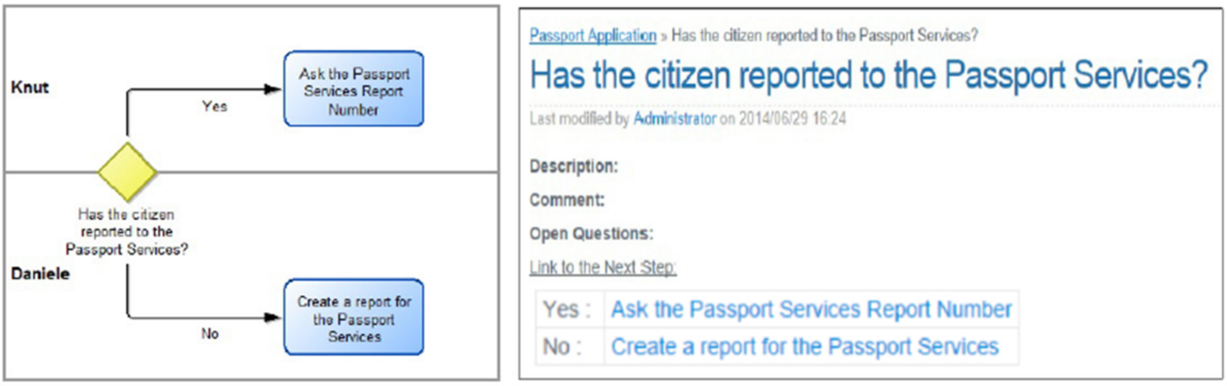
Link to the Next Step:

Collect Information

Figure 5.3 Illustration of the Transformation of an Activity into an XWiki Page

As sequence is not the only process flow possible also gateways, which represent branches of a process, are represented in XWiki. This means that the subsequent activities must be decided by user interaction. A gateway can be thought of as a question that is asked at a point in the process flow. It is represented as a wiki page, too. The page contains a question and multiple links to answer the question, i.e. taking the decision as depicted in Figure 5.4

Based on the answer the corresponding branch is taken. The answer is represented as a link to the next activity.


Knut
Yes
Ask the Passport Services Report Number
Has the citizen reported to the Passport Services?
Daniele
No
Create a report for the Passport Services

Passport Application » Has the citizen reported to the Passport Services?

Has the citizen reported to the Passport Services?

Last modified by Administrator on 2014/06/29 16:24

Description:

Comment:

Open Questions:

Link to the Next Step:

Yes :	Ask the Passport Services Report Number
No :	Create a report for the Passport Services

Figure 5.4 Representation of a Gateway in XWiki

If references from the process model to other models were made, e.g. from a task to the organisational model or the document and knowledge model then these relations are translated into XWiki representations, too. In the organisation model, the persons are assigned to the roles. This is used in the translation: The subsequent activity is to be performed by a different person, if it is assigned to a different lane than the current activity. In this case the transformation component looks in the organisation model which persons are assigned to the role corresponding to the lane. In the organisation model we represent for each person its email address. The link to the next task, which is included in the wiki page of a task as described above, now does not relate to the wiki page of the next task but to the email addresses of all people having the role assigned to the task.

Figure 5.5 depicts the process: From the export of the graphical models (1), over the import of the models into XWiki (2) to the execution as described above (3).

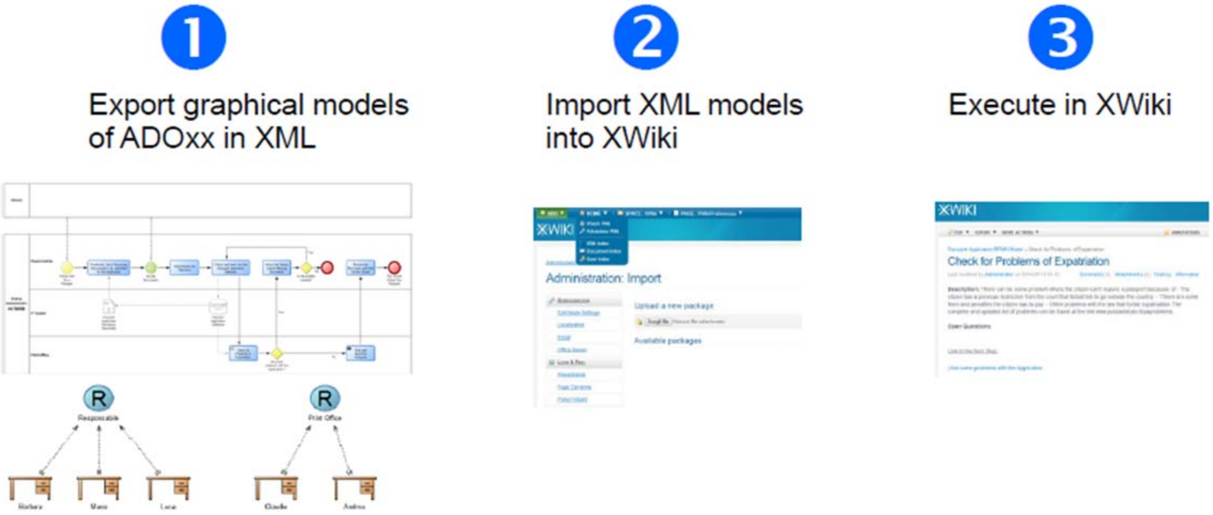

1
Export graphical models of ADOxx in XML
2
Import XML models into XWiki
3
Execute in XWiki
R
R
XWIKI
Administration: Import
XWIKI
Check for Problems of Expatriation

Figure 5.5 Process of Transforming Models into XWiki pages for Execution

5.3. Representation of XWiki pages in the Ontology

Figure 5.6 depicts the whole process of ontology population illustrated for one model object (task). On top left of the figure a BPMN process model is shown. As described above an export of the model (and if applicable related models) is made. Then, in a first step (1) the

LPMN is populated. In the example an instance of bpmn:Task is created for the activity "TestActivity". Also the properties were populated, e.g. emo:objectTypeHasID. After this a rule is triggered that automatically makes the instance also an instance of eo:atomicBusinessProcess (2). With this the concept of the LPIMO and of the LCMO are implicitly related as they share the same instance. Next (3) for XWiki objects, here Page, the respective concept of the LPIMO is populated, namely XWiki:Page. After that another rule is triggered that automatically creates the relation between the instance of the wiki page

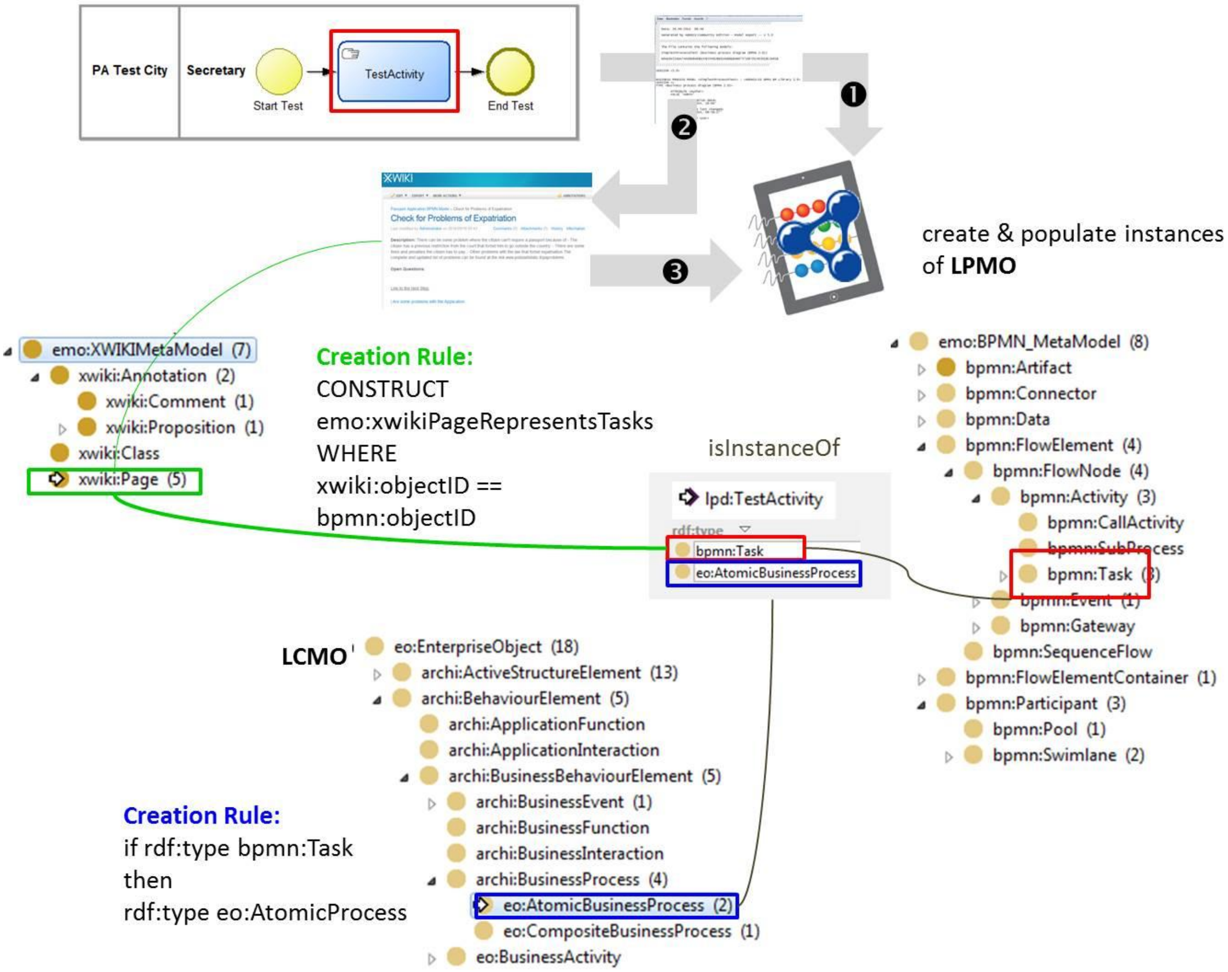


Figure 5.6 Linking XWiki instances to BPMNo and LCMM

With this approach it is possible to reason about models exploiting the semantics provided in the LCMO and thus retrieve the context of work as illustrated in the mock-up. Furthermore it builds the basis for implementing mechanisms for retrofitting annotations as described in the following section.

6. Mechanisms for retrofitting user annotations to models

In general two different ways of handling user modifications and annotations are possible:

1. models are updated automatically/semi-automatically and stored as "draft of new version"; this could be the case for suggested tasks, suggested documents and suggested experts.
2. models are updated manually based on human analysis of user's modifications and annotations; this could be the case for dealing with comments.

6.1. Automated Mechanism

Figure 6.1 gives an example of proposing a new resource. In addition to the both already suggested documents a new one is proposed by a user.

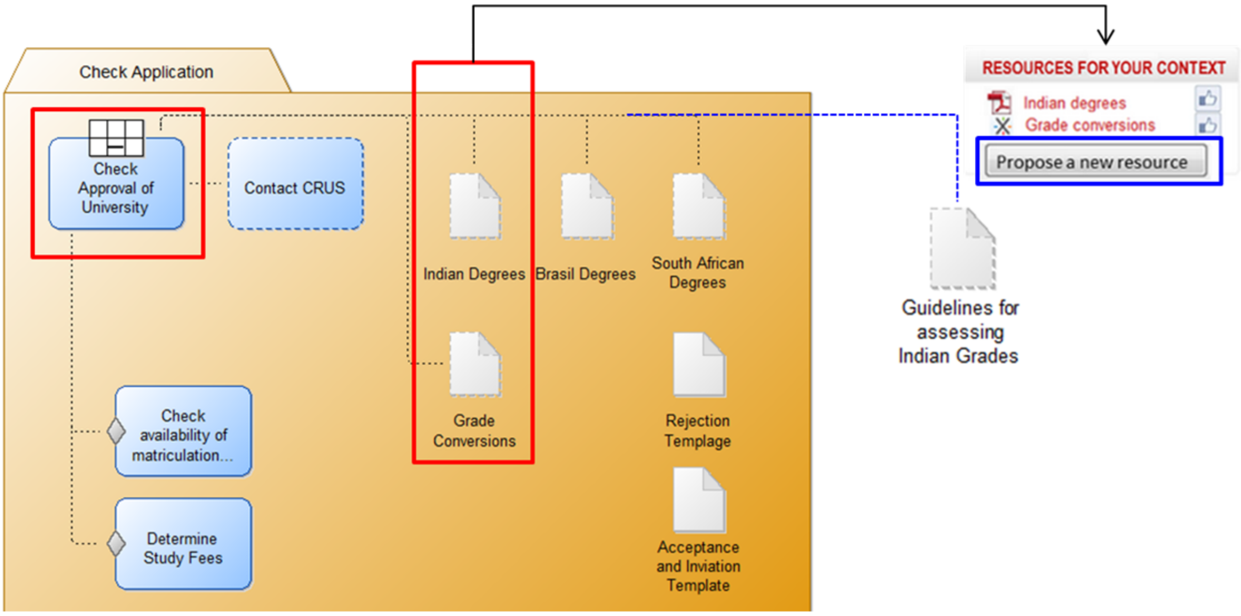


Figure 6.1 Proposing a New Resource

In this case a new version of the applied process model (status: "active") can be created with the status "drafted". The person(s) responsible for the model can be notified that an update was suggested. She can open the update and decide whether she accepts or denies the proposition and how she handles the constraints for example the proposed resource is applicable if a student from India asks for admission.

If the model expert accepts the suggestion further modeling activities may be necessary. For example, she can add an applicability rule for the resource or, in case of a new task can improve the model regarding the definition of conditions for execution or further enhancements such as additional documents to the new tasks.

After amendments are done the model's status can be changed to "ready for use". In the following depending updates can be made, e.g. updates of the Learn PAd ontology in order to make the new resource available for recommendations and updates of the XWiki representation.

6.2. Manually Performed Retrofitting

In case comments are made to models an expert needed to assess the proposal and the comments and then act as appropriate, e.g. updating models, updating the Learn PAd ontology and sending a reply to the one who issued the proposal or comment.

6.3. Ontological Representation

Annotations are made to XWiki pages. In Learn PAd two types of annotations are supported: comments and propositions. XWiki annotations and their meta data are represented as concepts in the Learn PAd LPIMO with relations to the LCMO and hence, annotations made to XWiki pages are represented as instances of the respective concepts in the ontology.

Figure 6.2 depicts the concepts and relations for representing annotations in the ontology. Two types of annotations are supported: commenting and proposing.

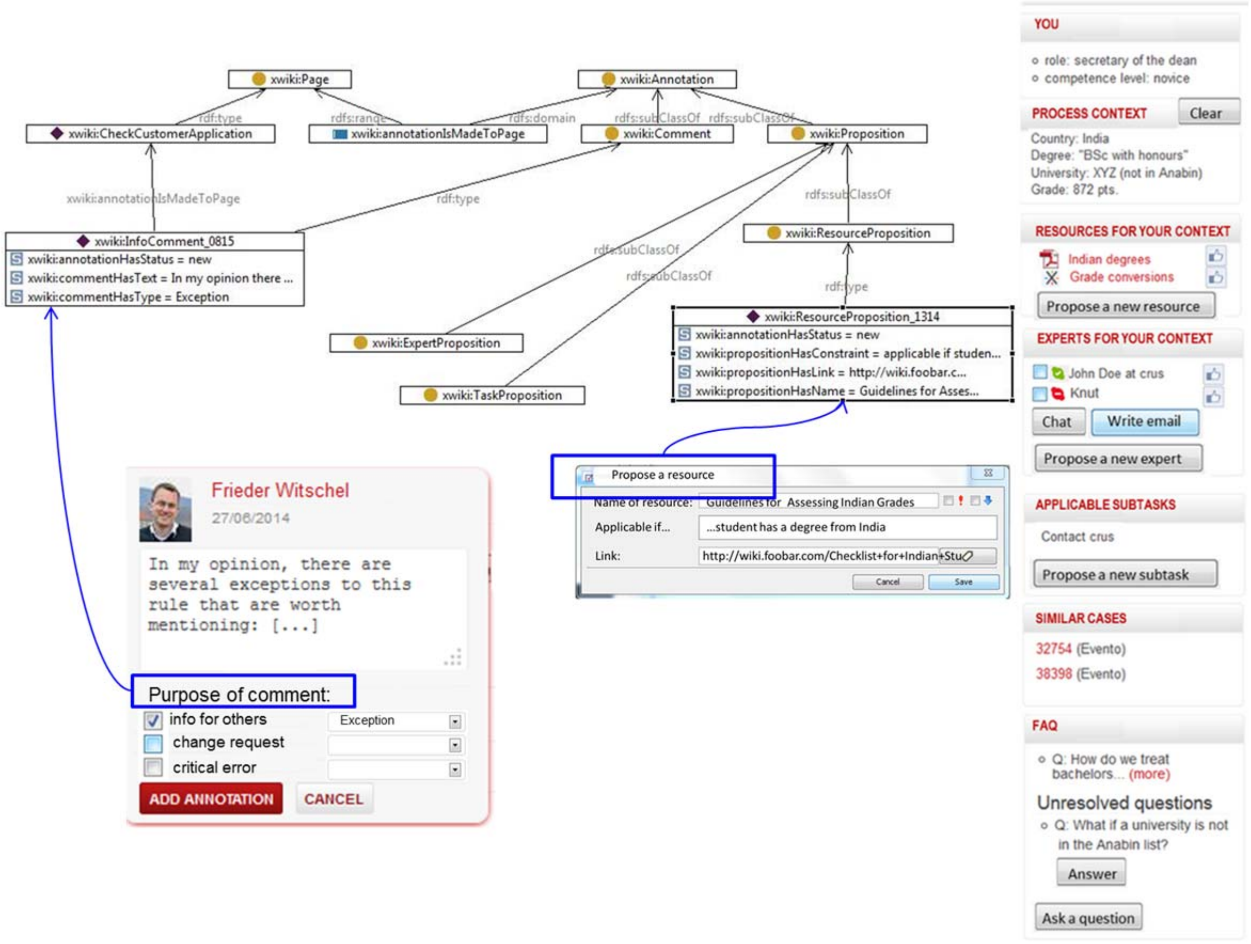

xwiki:Page
xwiki:Annotation
rdf:type
rdfs:range
rdfs:domain
rdfs:subClassOf
rdfs:subClassOf
xwiki:CheckCustomerApplication
xwiki:annotationIsMadeToPage
xwiki:Comment
xwiki:Proposition
xwiki:annotationIsMadeToPage
rdf:type
rdfs:subClassOf
xwiki:InfoComment_0815
xwiki:annotationHasStatus = new
xwiki:commentHasText = In my opinion there ...
xwiki:commentHasType = Exception
xwiki:ResourceProposition
rdfs:subClassOf
rdfs:subClassOf
rdf:type
xwiki:ExpertProposition
xwiki:TaskProposition
xwiki:ResourceProposition_1314
xwiki:annotationHasStatus = new
xwiki:propositionHasConstraint = applicable if studen...
xwiki:propositionHasLink = http://wiki.foobar.c...
xwiki:propositionHasName = Guidelines for Asses...
Frieder Witschel
27/06/2014
In my opinion, there are several exceptions to this rule that are worth mentioning: [...]
Purpose of comment:
☑ info for others Exception
□ change request
□ critical error
ADD ANNOTATION
CANCEL
Propose a resource
Name of resource: Guidelines for Assessing Indian Grades
Applicable if... ...student has a degree from India
Link: http://wiki.foobar.com/Checklist+for+Indian+Stu
Cancel
Save
YOU
role: secretary of the dean
competence level: novice
PROCESS CONTEXT
Clear
Country: India
Degree: "BSc with honours"
University: XYZ (not in Anabin)
Grade: 872 pts.
RESOURCES FOR YOUR CONTEXT
Indian degrees
Grade conversions
Propose a new resource
EXPERTS FOR YOUR CONTEXT
□ John Doe at crus
□ Knut
Chat
Write email
Propose a new expert
APPLICABLE SUBTASKS
Contact crus
Propose a new subtask
SIMILAR CASES
32754 (Evento)
38398 (Evento)
FAQ
Q: How do we treat bachelors... (more)
Unresolved questions
Q: What if a university is not in the Anabin list?
Answer
Ask a question

Figure 6.2 Representing Annotations in the Learn PAd ontology (LPIMO)

Again we took the mock-up as motivating scenario for ontology capture, respectively ontology reassessment to identify the relevant concepts and terms to meet the Learn PAd requirements. That is, to reason about annotations in order to make suggestions for model enhancements.

Informal Competency Questions are:

21. Given a type of an annotation (e.g. an informative comment)
    AND

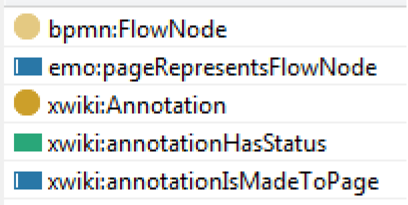
    some constraints regarding its status (e.g. new)

    what models and objects are affected?

    a. *rationale*: the answer is to identify and display models and objects, e.g. processes and activities for which annotations are made that are not addresses yet (i.e. "new")

    b. *decomposition*: annotation has status, annotation is made to an XWiki-page, page represents an object of a model (here: of BPMN).

The formal terminology is derived from the competency questions, see below:



● bpmn:FlowNode
🟦 emo:pageRepresentsFlowNode
● xwiki:Annotation
🟩 xwiki:annotationHasStatus
🟦 xwiki:annotationIsMadeToPage

22. Given an object type (e.g. process)
    AND

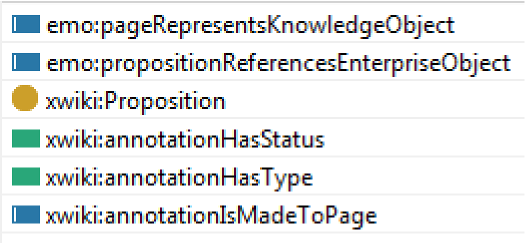
    some constraints regarding its status (e.g. drafted) and type of annotation (e.g. proposition)

    what model enhancements can be suggested?

    a. *rationale*: the answer is to identify and display processes and activities for which propositions have been made (e.g. for a resource, as task or an expert)

    b. *decomposition*: annotation is of certain type, annotation has status, proposition has reference to enterprise object (document, business activity, person), annotation is made to an XWiki-page, page represents a model object.

The formal terminology is derived from the competency questions, see below:



🟦 emo:pageRepresentsKnowledgeObject
🟦 emo:propositionReferencesEnterpriseObject
● xwiki:Proposition
🟩 xwiki:annotationHasStatus
🟩 xwiki:annotationHasType
🟦 xwiki:annotationIsMadeToPage

Model enhancements can then be made in the graphical model environment which and, for example, a new version of a process can be implemented. After that the model is translated back into the ontology as described in chapter 5.1.

7. Conclusion

Within this deliverable D5.1 we reported the defined ontologies to represent models and their relations in a machine understandable but humanly adequate way. Ontology development could be reduced since we followed the suggestion of Bertolazzi et al. (2001) by re-using an existing ontology, namely ArchiMEO developed by FHNW (Hinkelmann et al. 2013). In order to cover Learn PAd specific requirements the ontology was enhanced regarding concepts and relations defined in LCMM and LPIMM and then re-assessed by posing competency questions as proposed by Grüninger & Fox (1995). We will continue with Grüninger & Fox's (1995) procedure for ontology design and evaluation in the next project phases. Our approach for ontology development proved to be very efficient and praxis-oriented by illustrating the use of the ontology in the mock-up. Since ontology development is considered an iterative process, the Learn PAd ontology will improve with each following phase. However, to enhance the ontology to further Learn PAd specific needs we strictly stuck to the fitness-for-purpose principle, introduced by Chen et al. (2008); supported by the chosen modeling procedure based on the methodology of Uschold & Grüninger (1996) only these concepts, relations and rules which represent business requirements were modeled.

Since the ontology is supposed to support process execution and learning the ontological representations must be related to non-ontological representations, particularly to the models of various kinds (e.g. a process modelled in BPMN). We implemented this by populating the respected concepts in LPIMO. As concepts of LPIMO are mapped to concepts of LCMO, we are able to infer the context of a process with provided semantics (as illustrated in the mock-up). In addition to the mapping between models and LPIMO we defined a mapping between models and their representations in XWiki. Similar to the mapping between models and LPIMO we also have a mapping between XWiki and LPIMO.

Furthermore, mechanisms for retrofitting modifications and annotations made in the wiki into their ontological representation were introduced.

In deliverable D5.1 we focussed on (static) models for setting the Wiki. Within the next project phase we will

- improve and finalize the export functionality for models created with ADOxx
- develop the export functionality for models created with MagicDraw
- improve and finalize the transformation process to export files of both modelling tools, i.e. elaborate on
  - the parsing algorithm
  - the process for creating XWiki pages
  - the process for creating the corresponding instances in the Learn PAd ontology.

We will continue with the ontology development process by framing formal competency questions (derived from the ones stated in natural language in D5.1) and creating the rules, e.g. for automatically relating instances.

In Task 5.2 we concentrate on ontology supported learning and will therefore develop functionality to recommend information (be it for browsing, simulating or executing a business process and its context). Part of it has been already mocked-up in D5.1, for example for the provision of context.

With respect to learning all wiki articles are regarded as learning objects as they correlate one-to-one to model elements (e.g. a wiki-page to a task). Since the ontology does not only represent characteristics of the wiki content (derived from the meta models and the models as described in D5.1) but additionally contains profiles of the learners, i.e. the workers in the

PA, recommendations for learning can be generated. We will define inference rules that allow identifying relevant learning objects, exploit characteristics of the learner and her duties (i.e. based on the role(s) she has) and thus can guide the user to relevant content, i.e. learning objects.

In deliverable D5.2 we will report on defined semantic extensions of the wiki to identify relevant learning objects (the above mentioned reasoning) and how new learning objects can be added and modified as extension of wiki content.

8. Bibliography

Allemang, D. & Hendler, J., 2008. *Semantic Web for the Working Ontologist - Effictive Modeling in RDFS and OWL*, United States: Morgan Kaufmann.

Bao, J., 2008. OWL Full Semantics - RDFCompatible Model-Theoretic Semantics. Available at: http://tw.rpi.edu/wiki/Image:2008-09-06_OWL_FULL_Semantics.ppt.

Bertolazzi, P. et al., 2001. An Approach to the Definition of a Core Enterprise Ontology : CEO. In *International Workshop on Open Enterprise Solutions: Systems, Experiences, and Organizations - OES-SEO 2001*. Rome, pp. 104–115.

De Bruijn, J., 2003. *Using Ontologies - Enabling Knowledge Sharing and Reuse on the Semantic Web*, Galway, Ireland. Available at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.106.7278&rep=rep1&type=pdf.

Cardoso, Y.C., 2010. *Creation and Extension of Ontologies for Describing Communications in the Context of Organizations*. Universidade Nova de Lisboa.

Chen, D., Doumeingts, G. & Vernadat, F., 2008. Architectures for enterprise integration and interoperability : Past , present and future. *Computers in Industry*, 59, pp.647–659.

Emmenegger, S., Laurenzi, E. & Thönssen, B., 2012. IMPROVING SUPPLY-CHAIN-MANAGEMENT BASED ON SEMANTICALLY ENRICHED RISK DESCRIPTIONS. In *Proceedings of 4th Conference on Knowledge Management and Information Sharing (KMIS2012)*. Barcelona, Spain.

Fox, M.S., Barbuceanu, M., Grüninger, M., et al., 1996. An Organization Ontology for Enterprise Modelling. *Simulating Organizations: Computational Models of Institutions and Groups*, (AAAI/MIT Press), pp.131–152.

Fox, M.S., Barbuceanu, M. & Grüninger, M., 1996. An organisation ontology for enterprise modeling: Preliminary concepts for linking structure and behaviour. *Computers in Industry*, 29(1-2), pp.123–134. Available at: http://linkinghub.elsevier.com/retrieve/pii/0166361595000798.

Gomez-Perez, A., Fernandez-Lopez, M. & Corcho, O., 2004. *Ontological Engineering* 4th ed., Springer-Verlag London, UK.

Grau, B.C. et al., 2008. OWL 2: The next step for OWL. *Web Semantics: Science, Services and Agents on the World Wide Web*, 6(4), pp.309–322. Available at: http://linkinghub.elsevier.com/retrieve/pii/S1570826808000413 [Accessed July 23, 2011].

Grüninger, M. & Fox, M.S., 1995. Methodology for the Design and Evaluation of Ontologies. *Industrial Engineering (1995)*, 95, pp.1–10. Available at: http://ibict.phlnet.com.br/anexos/grninger95methodology.pdf.

Hendler, J., RDFS 3.0. Available at: http://www.w3.org/2009/12/rdf-ws/papers/ws31.

Hinkelmann, K. et al., 2013. ArchiMEO: Representing and Enhancing ArchiMate in RDFS 3.0. *Enterprise Modelling and Information Systems Architecture*.

Knublauch, H., 2009. Composing the Semantic Web. *A tool developer's blog on ontology development for the Semantic Web and beyond*. Available at: http://composing-the-semantic-web.blogspot.ch/2009/01/object-oriented-semantic-web-with-spin.html.

De Leenheer, P. & Mens, T., 2008. Ontology Evolution. In M. Hepp et al., eds. *Ontology Management - Semantic Web, Semantic Web Services, and Business Applications*. SpringerScience + Bsuiness Media Inc., pp. 131–176.

OMG, 2014a. Business Motivation Model. *BMM 1.2*, (May), p./. Available at: http://www.omg.org/spec/BMM/1.2/PDF/.

OMG, 2011. Business Process Model and Notation (BPMN V 2.0). *Business*, (January). Available at: http://www.omg.org/spec/BPMN/2.0.

OMG, 2014b. Case Management Model and Notation (CMMN V 1.0). , (May).

OWL Working Group, 2012. Web Ontology Language (OWL). Available at: http://www.w3.org/2001/sw/wiki/OWL.

Peffers, K. et al., 2008. A Design Science Research Methodology for Information Systems Research. *Journal of Management Information Systems*, 24(3), pp.45–77.

Stuckenschmidt, H., 2011. *Ontologien. Konzepte, Technologien und Anwendungen* 2nd ed. O. P. Günther et al., eds., Springer Berlin Heidelberg.

Su, X. & Ilebrekke, L., 2006. A Comparative Study of Ontology Languages and Tools. In L. N. in C. Science, ed. *Advanced Information Systems Engineering*. Springer Berlin / Heidelberg, pp. 765–777.

The Open Group, ArchiMate. *ArchiMate Standard*. Available at: http://www.opengroup.org/subjectareas/enterprise/archimate [Accessed January 28, 2015].

The Open Group, 2012. ArchiMate 2.1 Specification.

Thönssen, B., 2013. *Automatic, Format-independent Generation of Metadata for Documents Based on Semantically Enriched Context Information*. University of Camerino. Available at: http://ecum.unicam.it/429/.

Thönssen, B. & Lutz, J., 2012. *DokLife Project Description*, Olten.

Uschold, M. & Grüninger, M., 1996. Ontologies : Principles, Methods and Applications. *TECHNICAL REPORT- UNIVERSITY OF EDINBURGH ARTIFICIAL INTELLIGENCE APPLICATIONS INSTITUTE AIAI TR*, (191).

Vaishnavi, V. & Kuechler, B., 2004. Design Science Research in Information Systems. *January 20, 2004*.

W3C OWL Working Group, 2009. OWL Web Ontology Language Overview. *W3C Recommendation 10 February 2004*. Available at: http://www.w3.org/TR/owl-features/.