Process Oriented Training with ADOxx: A Model-Based Realisation in Learn PAd

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Abstract. Process Oriented Training can be applied in two different approaches: (a) processes describing the methodology of training and learning as well as (b) processes describing the organizational context that need to be learned. This paper introduces the results of the EU project Learn PAd that developed prototypes of modelling tools enabling the latter - the usage of business processes to describe the organizational context. Flexibility of business processes have been introduced with case management and knowledge artefacts had been integrated to provide a homogeneous modelling environment. The requirements of such a modelling environment had been collected and implemented with the meta-modelling platform ADOxx®. The meta-model approach has been used to implement the modelling language as well as the mechanisms and the algorithms. The architecture of the modeling tool is introduced and a use case feedback is provided.

Keywords: Meta modelling · Modelling method development · Process-Oriented learning

1 Introduction

This paper revisits the contents of [29] and extends it with findings of [6]. This paper elaborates application scenarios for process-oriented training and learning, derives relevant requirements for modelling languages and introduces how the Learn PAd modelling method can be implemented with ADOxx® [2].

In [29] process oriented learning is introduced, which(1) compares the business process with a curriculum, (2) exploit the so-called knowledge products within a business process to define the required knowledge and (3) the knowledge sources to identify the available knowledge. The end users are using the business processes and the corresponding description for learning, whereas the responsible trainers manage the training by appropriately configuring the business process models.

The EU project Learn PAd [19] applied this process-oriented training approach at two governmental use cases, first at a University and second in a municipality.

The technological infrastructure is introduced and some guidelines for the change towards process-oriented learning are highlighted.

This paper focus on the realisation of process oriented learning and training with ADOxx®, by discussing application scenarios, modelling method requirements,

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development tools, modelling features and their implementation and technical deployment of realized prototype. Use case expertise is reflecting based on [6]. Public results are introduced in form of proof of concept evaluation from the adoxx.org community [2].

In Sect. 2 we present the identified scenarios on process oriented training. Section 3 introduces the meta-modelling approach as a realisation technique. In Sect. 4 implemented Learn PAd modelling method is introduced. Possible deployment architecture is discussed in Sect. 5. Afterwards use case scenarios are briefly elaborated in Sect. 6. Finally, outlook and conclusion is reflected in the last section.

2 Application Scenarios

In this section we shortly revisit the five application scenarios identified [30].

2.1 Individual Training

Individual training will support novices. The assessment of trainings enables much better insights into training demands.

The education of new employees is time consuming, as new employee typically lacks the organizational context. Hence, many questions or knowledge gaps are the result of fundamentally missing baseline knowledge of the organization.

Individual training is supported by the definition of different learning goals for different skill profiles, so that a learner can continuously improve their own skills through executing the business process.

Learn PAd merges the training and working environments, so that changes to business processes affect both the working environment for the daily tasks and the corresponding training environment.

2.2 Organizational Evolution

This process-oriented approach can also be applied to the development of the whole workforce within an organization.

In order to organizationally evolve the business process, learning goals need to define which part of the business process is to be changed, and – by involving skill profiles of team members – analyse how certain skill profiles are to be educated.

In addition to changes in the sequence of a particular process, knowledge of existing business processes can also change. Here the situation is different to individual training as users are very familiar with the process and usually claim that they know exactly what to do. The challenge is therefore to increase sensibility to minor, but important, changes.

2.3 Business Process Support and Reflection

The use of business processes and their explanatory documents as learning objects forces the public administration to critically reflect the current way of working and enables the detection of error prone parts.

Learning goals are defined in order to support the performance and reflect on the current business processes, which part needs to be improved.

An honest reflection on business process performance is usually very difficult as employees ideally need to critically reflect on their daily business within a so-called "failure-culture" in the organization – a culture that appreciates the identification of failures instead of pseudo-blaming some responsible actors.

Performance analysis needs a guiding structure. Business processes are an ideal candidate for such a structure as they enable a step-by-step analysis of daily operations that must result in an efficient sequence of activities that achieve organizational goals.

2.4 Process Optimization and Improvement

Process optimization and improvements are closely linked to performance support and reflection, which rely on the existing competencies of team members.

In order to support continuous improvement and optimization of a business process, learning goals can be used to identify the organizational learning objectives and identify the corresponding measures.

In this scenario, the team members use the learning platform as a communication and collaboration portal. The intention is to use business process based collaborative learning not only for the initial identification of improvements, but also to use those improved processes when performing the aforementioned organizational learning scenario.

2.5 Citizens Transparency

This use case is not a traditional training scenario but is an add-on use case with the aim of addressing the citizen that interacts with the Public Administration.

Learning goals are defined in order to increase transparency for citizens, addressing the misunderstandings reduction, incorrect submitted documents or increase appreciation.

Under such special conditions, the collaborative process-oriented training platform can be provided to citizens who interact with the administration.

Of course, the process will not be represented in detail, but on a higher abstraction to only point out the relevant decisions for the citizens, as well as only including high-level information.

3 Realization Approach

3.1 Modelling Method Requirements

The five application scenarios on process-oriented training have been analysed using an open requirement harvesting approach [7]. Modelling method relevant requirements have been filtered, grouped and detailed to end up with the following high level list:

- Modelling Language requirements: (a) access rights on models, (b) filtered model view to simplify the usage of the modelling tool, (c) questionnaire modelling, (d) textual annotation of models to semantically lift the models (e) bar display to have a better overview on used and created knowledge, (f) people-like view to simplify the graphical representation for non-modelling experts and (g) realizing a meta model that integrates the different relevant standards like BPMN, DMN, CMMN and others.
- Mechanisms and Algorithms: (a) track changes to see enable collaborative modelling, (b) process simulation to check consistency, (c) role based process skeleton to identify role-specific tasks, (d) model validation check, (e) critical path analysis, (f) model exchange with collaboration platform, (g) verification component and (h) evaluation component using a dashboard.

In the following the realisation approach of aforementioned requirements is introduced.

3.2 Conceptual Modelling as an Instrument

Conceptual models belong to the family of linguistic models that use an available set of pre-defined descriptions to create a model, and enrich the pure textual models (such as mathematical formula) with diagrammatic notations [9].

Hence, targeting aforementioned process-oriented training scenarios with conceptual models, means that pre-defined diagrammatic concepts are available that have a specific meaning enabling to reconstruct relevant parts of the reality with these

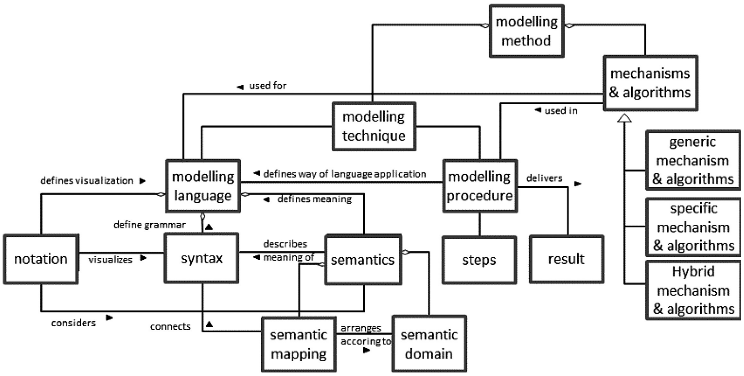

Fig. 1. Modeling method framework based on [11].

concepts in order to either (1) specify, (2) support execution, (3) represent knowledge or (4) evaluate the different dimensions of process-oriented training. The generic framework introduced in Fig. 1 enables the specification of conceptual models.

The framework identifies three building blocks: (1) the modelling language that is most prominently associated with conceptual models, as available concepts to be used for such models are pre-defined according their semantic, their syntax and their graphical notation, (2) the modelling procedure defines the stepwise usage of the modelling language and hence is not always available, this means there are modelling languages that have not a pre-defined way of usage but leave the modeller freedom in the sequence of modelling, (3) mechanisms and algorithms enable the computer-based processing of models and hence provide an IT support for the aforementioned modelling scenarios – specification, execution support, knowledge representation and evaluation.

3.3 Meta Models as Realization Approach

Meta modelling is introduced as a realization approach to develop domain-specific modelling tools and hence enable IT-supported concept modelling [11]. Based on [12, 15, 24] Fig. 2 introduces the different layers.

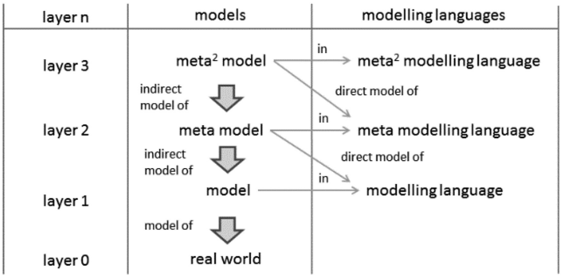

Fig. 2. Meta model layers.

Relevant parts of the real world – in our case the process oriented training – are seen as layer 0. Relevant concepts are provided in form of a modelling language and the corresponding mechanisms and algorithms to enable the creation of a model on layer 1. The modelling language is understood as the meta model, as it is a model of the concepts available for the model. This meta model is for example defined in a meta model language like ALL [2]. The specification of the meta model can again be defined by a model – the so called meta model or as a synonym meta^{2}model.

ADOxx® provides a meta^{2}model to simplify the development of modelling tools by using the provided meta^{2}model elements. Furthermore ADOxx® provides also an abstract meta model, which defines the context and functional behaviour of concepts, which can be used to inherit the own concepts.

The challenge is now to find the most appropriate abstract meta model classes to realise the modelling approach that covers aforementioned process-oriented training requirements.

3.4 Realization Technology with ADOxx®

This section introduces the development platform adoxx.org [2]. It is therefore seen as a short overview on how to implement an individual modelling solution for process-oriented training. Due to space restriction a brief overview is provided with the intension to raise the interest for detailed reading in the tutorial sections of adoxx.org.

The modelling tool is realized by configuring the meta modelling platform with a so-called application library. The model type is a package of modelling classes, enabling the separation of concerns within the meta model. Modelling classes are concepts of the meta model that are instantiated by the user while modelling. Each class is defined by its attributes, which are instantiated with attribute values during modelling. The user interface and interaction with the model concepts, are defined in the so-called notebooks class attribute “AttrRep”. In the class attribute Graphical representation (GraphRep), the graphical notation –with other words, the concrete syntax- of the class is defined. The semantic of a model class is defined by the inheritance from the pre-defined meta model.

3.4.1 Relevant Technology for Modelling Languages

The context, semantic as well as the functional behaviour of modelling classes are realised by inheriting the most appropriate pre-defined meta model class, and adapting the missing structural, semantical or functional elements. In the following the two ADOxx abstract meta models are discussed. First, the dynamic meta model realizes a directed graph and hence provides start, activity, decision, parallelism, merging, and graph-end. Additional to these elements with operational graph-based semantic, there are two classes with container semantic the aggregation and the swim lane that automatically groups elements that are inside. Beside these two groups of classes there are some additional objects.

The static meta model realizes an organizational structure with persons and resources. Similar to the above mentioned containers there are aggregations and swim lanes. A new meta model is developed, when inheriting from the pre-defined classes. In case graph-based algorithms are used, the concepts are inherited from the dynamic meta model. In case a tree-based algorithm is used the classes are inherited from the static meta model. In case no corresponding class is found an own class hierarchy must be implemented.

3.4.2 Relevant Technology for Mechanisms and Algorithms

In order to upgrade a simple model editor to a full fletched modelling tool, the previously defined modelling language is enriched with corresponding mechanisms and algorithms. Generic functionality is provided for (a) modelling, (b) query, (c) transformation and (d) simulation. Some features need no configuration like querying a model or running a path analysis, whereas some functionality needs domain specific configurations like the transformation of a model into another format.

Basic components and their configurations can be extended by a script language called AdoScript that provide more than 400 APIs in form of message ports for: (i) acquisition, (ii) modelling, (iii) analysis, (iv) simulation, (v) evaluation, (vi) import/export, (vii) documentation and (viii) query. Ports for user interfaces are

(i) AdoScript language, (ii) Core user interface and the (iii) Explorer, whereas APIs for manipulating the models are (i) the Core – the actual model representation, (ii) the data base and (iii) the user management. Finally the application API of the modelling tool is provided in form of (i) drawing and (ii) application. This set of APIs provides the functionality that can be implemented either within the modelling tool, or via APIs that are accessed from third party components.

In third party components interact, there are three concepts available: (1) file based communication that triggers the export in a specific format (e.g. XML), (2) batch mode, where an AdoScript is invoked from outside the application or (3) via a Web/REST-Service that enables the invocation of all AdoScript APIs. In this way also SOAP messages can be exchanged and the modelling tool can be integrated into a collaborative learning platform.

4 The Learn PAd Modelling Method

The Learn PAd modelling method applies business process management for process oriented learning, hence the core concepts focuses on business process management. As Learn PAd uses the business processes for learning aspects, the idea is to use also the model-based approach for learning related modelling and identify applicable relations between the business processes that represent the object under observation as well as the learning models that describe the Learn PAd approach.

Business processes and learning models are both representatives of concept models hence have a tight relationship with semantics. Therefore, the integration of so-called modelling utilities such as ontologies or more human oriented knowledge acquisition tools, seems appropriate.

This results in a hybrid modelling approach; combining (a) business process related, (b) learning management related and (c) so-called modelling utilities together.

Figure 3 depicts current high level conceptual architecture on the Learn PAd modelling method, indicating the conceptual environment of the Learn Pad modelling method.

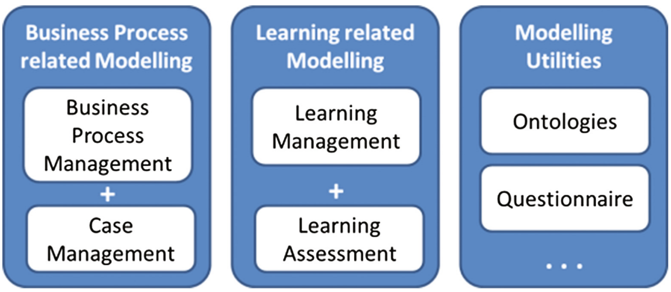

Fig. 3. High level building block of learn PAd modelling method.

Business Process Related Modelling: The major aspect in business process-oriented learning is the appropriate representation of a business process within the public administration. Beside the typical standard approach in using BPMN 2.0 for covering the business process management, Learn PAd additionally requires to specify relevant knowledge and skill profiles. In particular the business goals, strategies and business motivations, the organizational structure, the document and knowledge models are seen as the context of the business process model in Learn PAd.

In order to enable collaboration mechanisms for models on the Wiki platform, the corresponding concepts for such collaborative concepts need additionally to be reflected in the business process modelling language.

As Learn PAd deals with differently structure business process, ranging from well structure processes – that are typically covered in BPMN-like notations – but also weakly structured processes – that may be covered in Case Management Model Notation CMMN – there is the necessity to cover hybrid modelling within Learn PAd.

This conceptual concern is the basis of the Learn PAd modelling method.

Learning Related Modelling: deals with the specification of learning goals, definition of the learning content and the teaching path in presenting the content in the ideal way for each individual learner. Typical aspects are learning goal, curricula, skill profiles, teaching content and the packaging towards a learning management platform. Current state of research is to continuously asses the learning progress and hence combines the teaching path with assessment models that specify the goals that need to be achieved and also the assessment method.

Depending on the level of detail, the learning management will be performed using the ECAAD (Evidence Centred Design Methodology) [20, 21] method. Conceptual linkage is foreseen, so that Learn PAd business processes are seen as content packages of the ECAAD method, as well as different business processes models correspond to different phases of the learning process in ECAAD.

Modelling Utilities are modelling concepts that may or may not be used and hence can be flexibly added to the meta model. Current identified aspects are ontologies for semantically lifted log mining or questionnaires models for a model-driven development of tests.

Although those modelling utilities are not mandatory, the Learn PAd modelling method foresees as possible interaction, such as using the so-called "semantic lifting" approach to integrate ontologies, or to investigate a "graph rewriting" to export and transform relevant parts of the business process to questionnaire models.

Understanding the Learn PAd modelling method within its conceptual environment, it is now possible to distinguish between concepts that must be included into the Learn PAd modelling method (e.g. such as BPMN, CMMN, Roles and knowledge), concepts that are may be included as nice to have (e.g. such as business motivation, Key Performance Indicators, or skill profiles) and concepts that are not appropriate to be put into the Learn PAd modelling method (e.g. learning goals, learning assessment indicators, questionnaires).

Figure 4 introduces the conceptual Learn PAd Meta Model that introduces the high level concepts (a) process in both forms – procedural and case based processes, (b) organisation that are responsible in performing the processes, (c) the competency and required knowledge map appropriate organisations to processes, as well we as finally

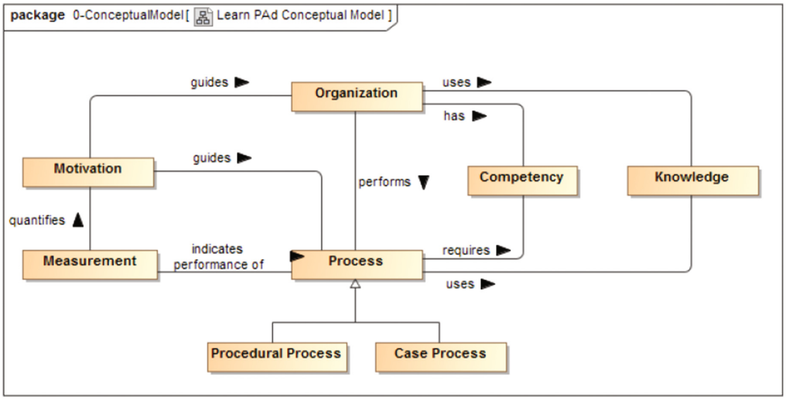

Fig. 4. The learn PAd meta model.

(d) the motivation and goals that guide the performance of processes and well as the corresponding measurement.

The next section introduces some selected parts of the method conceptualization in more detail.

4.1 Modelling Language

The modelling language has been developed following the meta model based approach and is described in detail in D3.2 [18].

The core domain is the business process model (using BPMN [22]) and the flexible case management (using CMMN [23]), which is linked to the business processes. Both are performed by workers, who are described in the organizational (structure) model. In order to perform skill-management, there is also a competence models, which details the traditional work place description of the organizational model.

Document and knowledge models provide the organizational knowledge in order to perform and execute the business processes and the cases.

In order to enable continues improvement, the business motivation model describes goals, intensions and rules, whereas the KPI (Key Performance Indicator) model, collects and aggregates measures and construct measurable indicators to assess the evolution of the learning organization.

Some other model types like the process map or the knowledge system model are introduced. Those model types do not carry own domain information but mainly act as a navigation support to navigate between the different aforementioned models.

A sub-set of BPMN 2.0 has been realized in Learn PAd focusing on those aspects which are relevant for human – learning – interaction, and leave out – technical – aspects, which are not relevant.

Although all concepts are specified in the BPMN 2.0 standard, its realization including abstract classes as well as references to other model types (– so called model type weaving.

More information on the BPMN realization is provided on the Learn PAd development space at ADOxx.org [1], as well as in [18].

The use of flexible case management, hence the description and collection of different cases introduces not only a flexibility into the business processes but also enables collaboration in form of discussions, recommendations and lessons learned in exceptional cases.

Due to the absence of appropriate standards that describe the organizational structure, Learn PAd used the meta model from the first and most successful community business process management tool ADONIS® Community Edition.

Organizational units describe the different departments, sections or the enterprises, hence define organizational boundaries. The roles describe the ideal representation of competences, whereas the performer describes the current workplace holder and hence describes the actual competences.

The Document and Knowledge Model type specification, that is interesting for learning and/or knowledge management models, traditionally, is a document pool, that lists all documents that are needed – either as input, as a resulting output, as a guidance or as a support document – when executing a business process. This traditional view is highly important in quality management scenarios or in keeping the business process documentation clear and simple.

In the context of learning, we enriched this model type with elements from the PROMOTE® modelling language [26]. A language that was first implemented in 2000 in a research project [25] and now founds its way into teaching and industrial projects.

Knowledge resources are described in three forms: (a) the document as an atomic knowledge carrier with a unique identifier, (b) the knowledge source that is – often a very large – container of documents, which collects, manages and encapsulates the big amount of documents like databases, document management systems or file directories, as well as (c) the knowledge resource, which represents not only complicated but also complex knowledge carries such as humans, or communities.

The difference between knowledge source and knowledge resource is that a knowledge source provided predictable results, hence a formal correct query into a database or file repository, will result in a predicable list of documents. Knowledge resource in contract, represent the complex knowledge resources and hence do not provide predictable results. The assessment of the opinion of an "expert community", the forming of a "committee" or the "impressions of an exhibition" may be valuable knowledge resources but in contract to a document by far not predictable. Hence those artefacts can be described in the knowledge resource.

When realizing a knowledge management or learning environment, the pure knowledge carrier like documents, sources or resources are often not relevant, but the so-called knowledge products. The knowledge product is a successful artefact that enables the consumption of knowledge in the similar way, like the consumption of any other non-physical good [27, 28].

It is based on implicit and explicit knowledge, hence can be distinguished in (a) information products that realize the internalization, (b) the service, that realizes the socialization and finally (c) the application that realizes the combination of external knowledge. For completeness reasons it is stated that (d) the externalization is not considered as it is a knowledge production and not a knowledge consumption.

Hence, typically a business process consumes knowledge products that are prepared for the use. Information products are mainly provided as documents, services as "responsible" colleagues and applications as "IT-resources" to be used.

As we consider the knowledge product as the essential carrier of knowledge and hence the essential artefact for learning, which is important to be observed, supported and measured, the consortium decided to include the knowledge product into the document and knowledge model type although this seems not obvious from a business process management point of view.

In that form, knowledge products can be integrated into the business processes and into cases, their responsibilities can be defined in the organizational structure and their quality and evolution can be measured with key performance indicators.

The full specification of the modelling can be downloaded in form of D3.2 [18] from the Learn PAd webpage. Additional material and specification on aforementioned modelling language implementation can be downloaded from the Learn PAd development space of ADOxx.org [1].

4.2 Mechanisms and Algorithms

Mechanisms and algorithms implement the model value by processing the models and by introducing features for modelling. Here, some relevant features are introduced.

4.2.1 People Oriented View

Business process models belong to the family of concept models, hence they consist of a graphical representation of concepts, which are often unintuitive to agents from public administration or to citizens. In order to ease the interpretation of business processes, so-called people oriented view has been introduced that enables the switch form a business process in the traditional graphical notation to a new graphical notation, where icons graphically describe the nature of the activity. Hence, instead of "blue boxes", an iconic representation of the action is provided, as shown in Fig. 5.

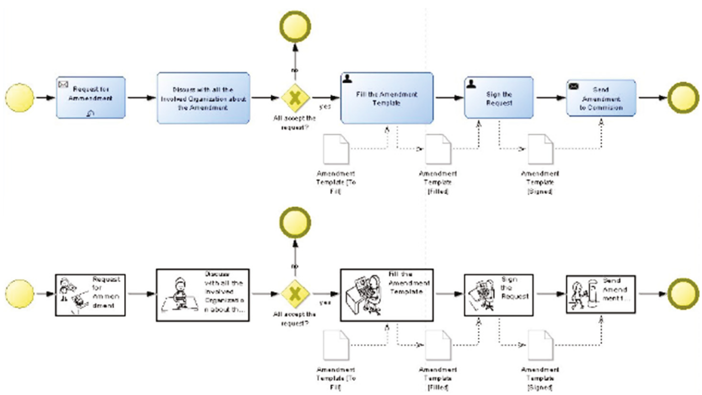

Fig. 5. Standard and people-like View of a business process.

This is achieved, by a so-called semantic lifting of each concept, hence the relation of a model object with an ontological description. A list of explanatory graphical icons is also annotated to the same ontological description. Hence, when switching into the people-like view, the images that are annotated with the model object are included in the new graphical description.

Current set of graphical description is based on the artefact types in the BPMN 2.0 specification. As the approach is open, other graphics can be included.

A detailed instruction of this feature is described in the Learn PAd development space in ADOxx.org.

4.2.2 Semantic Lifting of Business Processes

Semantic lifting is a form of a loose coupled model weaving, where concepts of a business process – e.g. tasks – are semantically lifted. This semantic lift is implemented by annotating the BPMN objects with an ontological concept [10].

There are different forms of semantic lifting, hence three cases that explain the different nature of semantic lifting are explained.

First, the direct lifting within the model is a simple copy/paste of the ontology URI into a generic or specially adapted attribute of the business process object. In this form, no changes in the modelling languages are necessary, but the usability is low and error prone is high.

The import ontological concept into the modelling tool and the selection of the semantic concepts within one modelling tool – e.g. via the former introduced pointer concept the so-called INTERREF – has the benefit that all concepts are safely managed in one repository and in one tool. As concept modelling and semantic have differences in the tool handling, it is likely that the ontology is maintained in the separate tool, which raises redundancies, requires replications and raises challenges in maintaining objects in the concept model repository. Therefore, this approach is not applicable if the ontology changes, but is required to stay stable.

The third approach is the invocation of an ontology management system out of the modelling environment. Hence, each model object of a business process, can access an interface of an ontology management system and can select one of the concepts, which are then stored in form of the URI in a special annotation attribute.

Finally, it has to be mentioned that there are many combinations of the introduced approaches, where the second and third approaches are combined to realize also complex scenarios and use the second approach as a pre-selection of stable part and the third approach for the identification of the concrete concept.

A discussion on the different implementations in more detail as well as the necessary development tools can be downloaded from the Learn PAd development space form ADOxx.org.

4.2.3 Business Processes in Collaboration Portals

The graphical representations of business processes is used to simplify the introduction of the business process tasks and link the corresponding description and attached document to the graphical representation. Although this form of process documentation is widely known and applied, the use within collaboration portals raises new challenges.

The simple export of graphical representations and model information is typically performed via Web-enabled APIs. In the ADOxx® case in form of Web-Services that deliver the (a) table of content, (b) model image, (c) model information and (d) model image map to enable click-able interaction in the Browser.

While user interface technology improves – e.g. Ext JS – the interaction possibilities improve. Former file based interaction, or static Web-API approaches are now exchanged by the attempt to continuously interact with a WIKI portal or realize Widgets that run within different Web-user interfaces.

Traditional Web-Service interaction and creation of WIKI pages can be downloaded from the Learn Pad development space from the ADOxx.org community. The mentioned Widget interaction is currently under development.

4.2.4 Business Process Verification

Business process design is an error prone process. The domain expert acting as modeler of the BP can easily introduce logical errors especially on complex and high collaborative business processes, which can results in failures at the execution time.

Verifying some quality properties over a Business Process in a formal and rigorous way is the safer way to avoid such kind of situations [5, 8].

The Learn PAd platform integrates a Formal Verification component in order to provide such kind of functionality. This component interact with the Learn PAd Modeling environment prototype through the Learn PAd platform in order to verify some properties like soundness or critical path existence, and visualize the results on the model.

The Fig. 6 is an example of the resulting of such interaction. In this case, deadlock presence is checked on a Business Process model and the found trace that lead to deadlock is shown on the model. Deadlock verification is only one of the supported properties that can be verified. For a complete list, please refer to the Deliverable 4.1 of the Learn PAd project.

The full support of this interaction scenario is under development. More details are available on the Learn Pad development space from the ADOxx.org community.

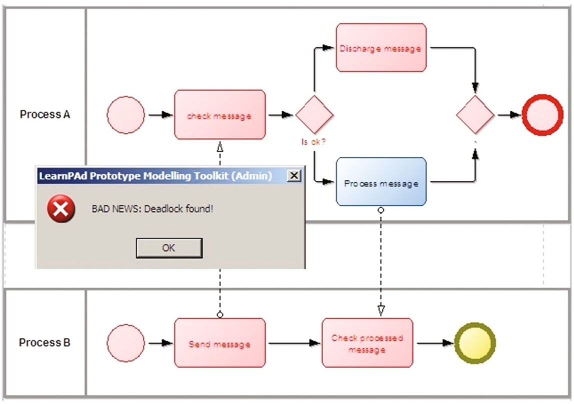

Fig. 6. Deadlock trace highlight on business process.

5 Process Oriented Learning Deployment

Process oriented Training and Learning has in principle two main categories with different technical realization:

- Process Oriented Training and Learning, where the process describes the training and learning method.
- Process Oriented Training and Learning, where the process describes the organizational content.

The technical realization in the first case can be realized by a process oriented training and learning methodology like ECAAD, (Evidence Centred Design Methodology) [20, 21] whereas the training and learning environment are Learn Management Systems like Moodle or Blackboard [3].

The technical realization of the second case can be realized by using business process modelling method like the extended BPMN 2.0 as developed in Learn PAd but then faces the challenge to be integrated into an existing legacy application.

Learn PAd dealt with the latter case and hence had to challenge the installation of this organizational learning-add on into existing legacy infrastructure.

5.1 High Level Reference Architecture

Learn PAd indicates functional capabilities for process oriented training and learning in organization, based on the knowledge management high level reference architecture.

Figure 7 indicates the major building blocks from the reference architecture: (1) Knowledge, Learning and Business Process Context that considers the complex and heterogeneous operative legacy systems of the end users organization, (2) Collaborative Business Process and Knowledge Based Learning that enables a process-oriented learning from knowledge workers, (3) Business Process and Knowledge Based Learning Modelling enables the definition of learning processes that are then realized in

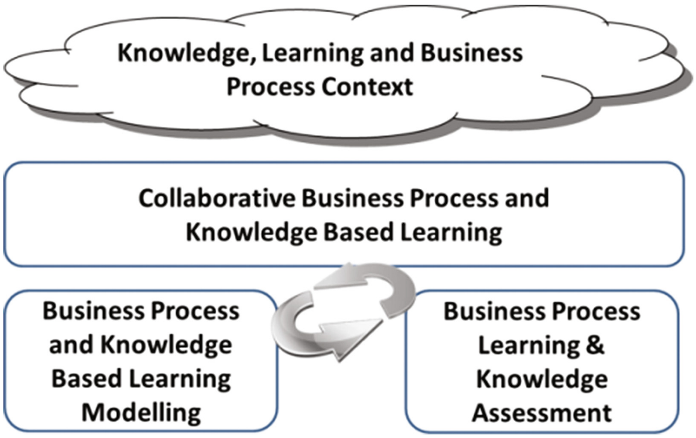

Fig. 7. Tools and applications for process-oriented learning.

the aforementioned execution environment, and finally (4) Business Process Learning and Knowledge Assessment introduces monitoring and dashboard functionality to identify improvements opportunities.

In the following the four building blocks are described:

- "Knowledge, Learning and Business Process Context": is a collection of relevant legacy applications that are necessary to execute the business process. In order to enable the seamless implementation of process oriented learning within an organization, the available IT infrastructure has to be considered as it is, and the process oriented learning framework has three choices to interact with the existing applications.
  First integration is a loose link from the learning system to the legacy applications. This is most likely the first choice, ideally if the legacy application is a Web-application. Hence, this will be a Hyperlink to the Web-interface of the legacy application
  Second integration is via an implemented API. This will be used if valuable learning or feedback information is required from the concrete legacy application. In the case where a social enterprise tool, enterprise wikis or similar are already in place, it may be worth implementing an interface. (e.g. KPI container).
  Third integration are learning system components that are added to the IT infrastructure, hence the integration is given by the use of the learning system.
  Pragmatically, a Wiki environment that describes how to access the legacy systems and providing the necessary links is the most appropriate way to start with a process oriented learning system.
- "Collaborative Business Process and Knowledge Based Learning": is a collaborative platform that is specially configured to support business processes. Traditional business process descriptions that are exported in collaborative Web-platforms are enriched with learning functionalities, such as stepping through a process, starting simulations, commenting on documents and knowledge as well as assessing learning progress.
  Business processes can be trained by the user either in a manual or automatic way. The manual way is performed by stepping through a business process, reading the documents and discussing with colleagues whether the decision that would have been taken is the correct one. Automatic training of a business process is understood as simulation, whereby the process is triggered and the trainees have to commit their decisions into the system. Collaborative Business Process and Knowledge Based Learning workspace provides all functional capabilities for a user-friendly entry point into the process documentation, the manual stepper and the automatic simulation. Business processes are presented graphically, the corresponding documents, the required skill level and the capability to provide feedback and comments in form of an intuitive Wiki are provided in the form of a collaborative environment.
  Process Simulation for Learning is used by the knowledge worker in order to learn how the process has to be executed. Depending on different skill levels the process is simulated in a form that the knowledge worker performs each step with the correlated content. Hence the process is not executed directly but simulated with the aim to derive findings from recorded clicks and links. Focus is the end users

interaction with the platform and with the process so that the user learns to perform the process in practice.

- "Business Process and Knowledge Based Learning Modelling": is used by trainers to design business process models for public administration. Typical conceptual and semantic modelling will be applied to define relevant conceptual artefacts that are processed for management and improvement. Modelling covers typical capabilities like (1) graphical visualization of models, (2) query and analysis features of models, (3) simulations of graphs as well as (4) transformation into different input and output formats. Depending on the platform and usage scenario the aforementioned generic modelling feature are differently grouped or detailed. Collaboration and Feedback transforms the previously made "Wiki-like" collaboration functionality into the modelling tool. Hence track changes, ratings or comments may be considered in this group.
- "Business Process Learning & Knowledge Assessment": is used by experts and trainers to analyses the use of the business processes and assess which part of the process is well supported and trained and which needs adjustments. A dashboard displays key performance indicators that enable the assessment of the maturity, skills and training levels of the process and its end users. It is seen as a cockpit for the trainer that represents KPIs for learning and knowledge maturity in a Scorecard like presentation.

The aforementioned grouping of high-level functional building blocks describes the major components, which can be added into an existing working infrastructure and the organization's site.

5.2 Modelling Tool Deployment

This section introduces the business process and knowledge based learning modelling tool, which can be downloaded in form of the first prototypes at the development space of ADOxx.org, or can be tested in the online version at advisor.boc-group.eu.

There are two prototypes: (a) the standalone rich client installation, which can be downloaded from the development space at ADOxx.org, as well as (b) the Web-based training and learning modeller on advisor provide modelling features, shown in Fig. 8.

The deployment of the full fletched rich client is in form of a local installation of the prototype. Export can be performed using the transformation features in order to generate special formats for learning simulation engines or collaborative portals. A server side installation may be required, in case the collaboration portal interacts with the modelling tool not via file exchange using the transformation features, but via the Web API. For such more complicated scenarios, additional effort is required to evolve the current prototype to an operational execution environment.

The deployment of the Web-based training and learning prototype in Learn PAd is a hosted deployment in form of a Web-application to flexibly instantiate modelling tools for different organizations. Cloud technology is available, in case such a service should be offered as SaaS.

In general, both modelling tools provide the basic concept modelling features, which can be extended on both prototypes.

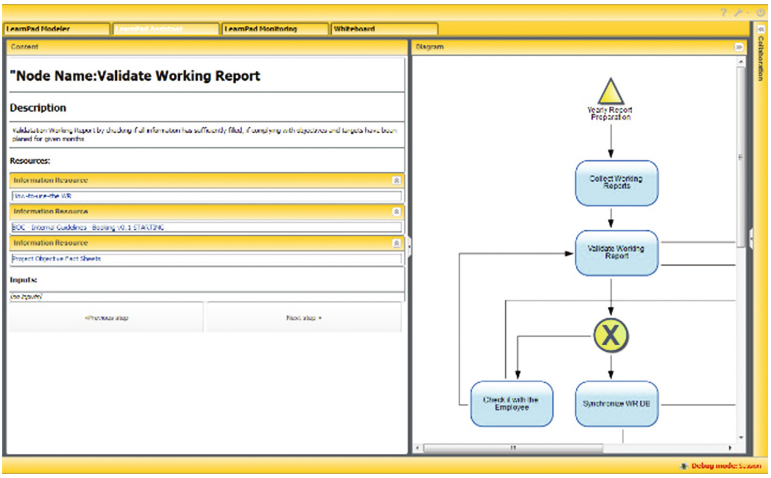

Fig. 8. Learn PAd prototype: modelling tool.

Modelling features are distinguished in: (a) model repository and access management, (b) Visualization, model management and graphical design, (c) Query, analysis and semantic inference of models as well as (d) Transformation from the model repository in requested output formats for documentation, execution or interchange.

Beside those generic functional capabilities, the feature details described in Sect. 3 are implemented in the standalone modelling prototype.

5.3 Use Case Realisation

The use case is the University of Camerino with strong background in BP modelling and software engineering. The team consists of on Learn PAd modeller and five so-called tellers who describe the organisational context and the processes.

The management of national and international research projects with the faculty was the use case scenario that starts when receiving an invitation to a project, and ends with archiving the finished project.

The processes deal with knowledge about research project form, the faculty council report, the consortium agreement and the grant agreement.

There are two sub-divisions that have been modelled according persons and their roles, hence each role described the required competence profile for executing the corresponding tasks within the business process.

This classification of skills had been distinguished in (i) analytical skills referring to selection and gathering of information, (ii) diagnostic skills referring to comprehension-evaluation of working activities and (iii) Implementation skills referring to accomplishment of tasks and transformation into results with appropriate quality.

For the successful evaluation, the European Quality Framework (EQF) has been used to formulate Key Performance Indicators that define the progress in individual and organisational learning.

After realising Learn PAd at the use case, the initial qualitative feedback is positive, hence further use cases are currently identified to be worked out during the final phase of the project and afterwards.

6 Conclusions

Process Oriented Training and Learning supports two approaches, one where process models are used to describe the teaching and one, where process model are used to describe the organizational context and content.

In Learn PAd the latter approach is applied for civil servants in five application scenarios: (a) individual training, (b) organizational evolution, (c) support and reflection, (d) process optimization and improvements as well as (e) citizens transparency.

The Modelling Method with its core languages has been introduced and some special features has been proposed, like the people oriented view, the semantic lifting and the business process verification. In the end the deployed architecture has been presented focusing on the high level architecture.

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