Integrating Learning Objects to Business Processes

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Abstract

The fast development of technologies requires specialized skills that need to be renewed frequently. For example, the semantic web technologies related to knowledge centric organizations require specialized skills of the employees. In this paper, we present how such skills can be achieved by learning processes that are integrated to the tasks of the business processes of a knowledge centric organization. The gains of such learning processes are that they are just-in-time, tailored to their specific needs, and ideally integrated into day-to-day work patterns. In order to illustrate our approach we present an overview of the BPMN and show how it can be used for attaching learning objects to the business process diagram. Then we show how we attach metadata to the learning objects, called guides, and to the business process tasks. In order to standardize the used metadata items we have developed ontologies that give the semantics for the metadata items (keywords). The gain of using standardized metadata items is that it facilitates automatic integration of the learning objects and reuse of the learning objects

1. Introduction

The role of continued education and lifelong learning is becoming still more important as the fast development of technologies requires specialized skills that need to be renewed frequently. E-learning adopts well for continued education as it can be done in parallel to other work. Hence, e-learning sets new requirements for organizations: they have to build global learning infrastructures, learning material has to be in digital form, and learning material has to be distributed. In addition, organizations need learning processes that are just-in-time, tailored to their specific needs, and ideally integrated into day-to-day work patterns.

A challenging situation for the learning processes in organizations is the introduction of new technologies such as the introduction of an ERP-system (Enterprise Resource Planning System) or the introduction of the knowledge centric organization. In particular, the introduction of knowledge centric organization is challenging as it incorporates semantic web technologies into every part of the work life cycle, including information production, presentation, analysis, archiving, reuse, annotation, searches and versioning.

In our project we are introducing semantic web technologies for e-government. In particular, we are introducing Internet-based workflow technologies [1] for automating and coordinating the business processes in e-government and developing appropriate ontologies for e-government. The introduction of these technologies significantly changes the daily duties of the employees in the organization. Therefore the most challenging aspect will not be the technology itself but rather changing the mind-set and the training of the employees.

For training the staff and ensuring the flexible introduction of the new business process, we are integrating appropriate learning objects to the tasks of the business processes. Ideally the integrated learning objects give the skills that are needed for performing the tasks. We believe that in this way we can optimally develop learning processes that are just-in-time and are tailored to their specific needs.

Basically, the integrated learning objects may be any digital or non digital entity that can be used for learning the skills related to the task of a business process. Due to this feature of these learning objects we call them *guides*.

We have also developed specific ontologies for the guides integrated with the tasks of the business processes. The aim of these ontologies is to standardize the metadata items attached to the guides. These in turn facilitate the reuse of the *guides* and automatic integration of the *guides* to business processes.

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The rest of the paper is organized as follows. First, in Section 2 we give an overview of the BPMN (Business Process Modelling Notation) [2] and illustrate how it can be used for modeling business processes for e-government. In particular we show how BPMN can be used in attaching guides to the business process diagram. Then, in Section 3, we present the ontologies developed for standardizing the metadata items attached to g*uides* and business process tasks. In particular, we present two ontologies: a content ontology and a Guidance ontology. The specifications of these ontologies by XML-based languages are also considered. Section 4 illustrates the principles how *guides* can be automatically integrated to the tasks of the business process. Finally, Section 5 concludes the paper by discussing the advantages, limitations and the costs of our approach for training new technologies.

2. Business processes in e-Government

E-government is the use of information and communication technology (ICT) to support government operations and provide government services [3, 4, 5].

From e-government point of view there are two important goals for the business processes: First, the notation used in modeling the processes should be readily understandable by the analyst that create initial drafts of the processes, and by the employees in the government who manage and monitor those processes. Second, the used notation should be easily transformed into a business process modeling language.

The Business Process Modeling Notation (BPN) is a standard for modeling business process flows and web services. Basically BPMN and the UML 2.0 Activity Diagram from the OMG [2] are rather similar in their presentation. However, the Activity diagram has not adequate graphical presentation of parallel and interleaved processes, which are typical in workflow specifications.

The BPMN defines a Business Process Diagram (BPD), which is based on a flowcharting technique tailored for creating graphical models of business process operations. These elements enable the easy development of simple diagrams that will look familiar to most analysts. In addition BPMN allows an easy way to connect documents and other artifacts to flow objects, and so narrows the gap between process models and conceptual models. Also, a notable gain of BPMN specification is that it can be used for generating executable BMEL4WS (Business Process Execution Language for Web Services) [6] code.

We now give an overview of the BPMN. We first shortly describe the types of graphical objects that comprise the notation, and then we show how they work together as part of a Business Process Diagram (BPD) [2]. After it, we give a simplified application process description using BPD.

In BPD there are tree Flow Objects: Event, Activity and Gateway:

- An Event is represented by a circle and it represents something that happens during the business process, and usually has a cause or impact.

- An Activity is represented by a rounded corner rectangle and it is a generic term for a task that is performed in companies. The types of tasks are Task and Sub-Process. So, activities can be presented as hierarchical structures.

- A Gateway is represented by a diamond shape, and it is used for controlling the divergence and convergence of sequence flow.

In BPD there are also three kind of connecting objects: Sequence Flow, Message Flow and Association.

- A Sequence Flow is represented by a solid line with a solid arrowhead.

- A Message Flow is represented by a dashed line with an open arrowhead and it is used to show the flow of messages between two separate process participants.

- An Association is represented by a dotted line with a line arrowhead, and it used to associate data and text with flow objects. We use Association to attach guides to activities.

In Figure 1, a simplified application process is described using the BPD. Note that Data Objects are a mechanism to show how data is required or produced by activities. They are connected to activities through Associations. In the figure there is a data object attached to each activity. Further each data object represents a guide. For example *Guide A* is attached to the activity Receive application.

In the next sections we describe what technologies we use for attaching metadata items to *guides* as well as for the activities of the BPD-diagram

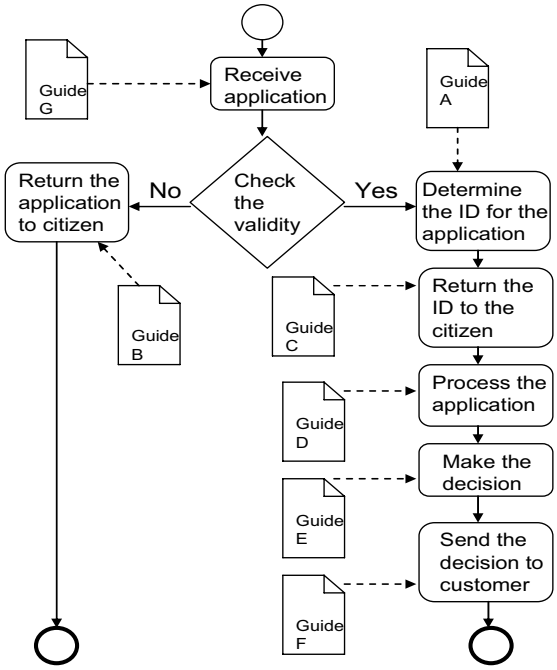

Figure 1. Integrating guides to a BPD.

3. Required ontologies

3.1. The goal of ontologies

Generally, an ontology is a general vocabulary of a certain domain [7], and it can be defined as "an explicit specification of a conceptualization" [8]. Essentially the used ontology must be shared and consensual terminology as it is used for in-formation sharing and exchange.

Ontology tries to capture the meaning of a particular subject domain that corresponds to what a human being knows about that domain [9]. It also tries to characterize that meaning in terms of concepts and their relationships. Ontology is typically represented as classes, properties attributes and values. So they also provide a systematic way to standardize the used metadata items.

Ontology languages provide representational entities without stating what should be represented, i.e., they do not commit to any particular domain [10]. For example the ER-model [11], RDFS [9], ODL [11], UML, DAML+OIL [9] and OWL [12], which define concepts such as entities or objects, attributes and relations, are ontology languages.

A salient feature of ontologies is that depending on the generality level of conceptualization, different types of ontologies are needed. Each type of ontology has a specific role in information sharing and exchange.

3.2. Attaching metadata items to guides

In general, the metadata of a *guide* describes any kinds of information of the guide, such as the author of the guide, the pedagogical features of the guide, the contents, special target groups, and the technical requirements of the guide [13]. In general, well-designed and sufficient metadata facilitates the employees in retrieving relevant *guides* and aids the organization to provide suitable information about their *guide* supply [14]. *Guide's* metadata is also needed for supporting the management of collections of *guides,* and for supporting the decision process of the employees in looking instructional resources.

To standardize *guides'* metadata we have developed specific taxonomies and ontologies. They give the semantics for *guides'* metadata, and so they provide a shared and common understanding of the used metadata items. Basically, they have a similar function as database scheme defined by data definition languages. A difference, however, is that ontology languages provide semantically richer means than database definition languages.

3.3. Content ontologies for guides

The purpose of the content ontology is to describe the concepts of the domain in which guiding takes place. So, the content ontology may for example describe the concepts related to administration (Figure 2) or to Programming (Figure 3). The ontology represented in Figure 2 is in fact a taxonomy which we consider as a weak ontology.

In general, taxonomy is a way to classify or categorize a set of things into a hierarchy [9]. It is a tree like structure consisting of a root and branches where each branching point (i.e., a node) is an information entity. In the context of information technology taxonomy is generally understood as the classification of information entities in the form of a hierarchy, according to the presumed relationship of real-world entities that they represent.

The logic behind taxonomy is that when one goes up the taxonomy toward the root, the information entities become more general, and respectively when one goes down towards the leaves the information entities become more specialized.

The ontology presented in Figure 3 captures the programming languages and their relationships. It is a typical ontology that can be represented by OWL.

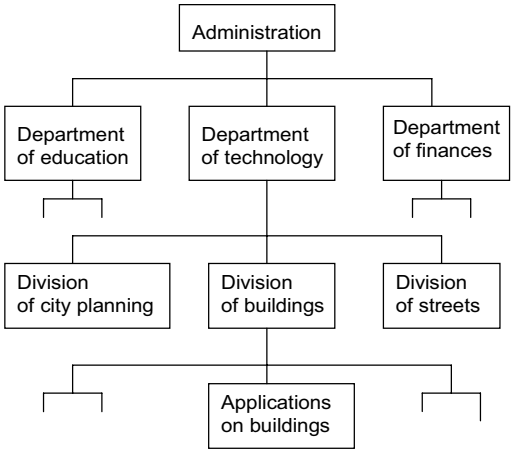

Figure 2. Taxonomy Administration.

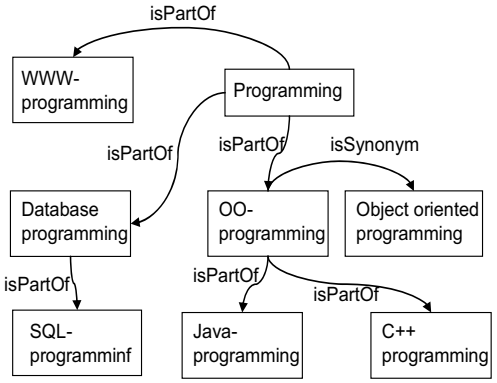

Figure 3. Content ontology Programming.

3.4. Guidance ontology

Our Guidance ontology captures learning objects that are related to guiding and their relationships. It has a similar function as database scheme defined by data definition languages. A difference, however, is that guidance ontology is presented by an ontology language OWL and thus it provides syntactically and semantically richer means than database definition languages.

In Figure 4, the Guidance ontology is presented in a graphical form. In the figure, a relationship (property in OWL terminology) related to the object (Class in OWL terminology) "guide" is "precedes". In OWL we can specify that this property is transitive. So, for example if *Guide A* precedes *Guide B* and *Guide B* precedes *Guide C*, then the system can infer that also *Guide A* precedes *Guide C*. This is one feature that can be defined in ontology languages but not in the data definition languages developed for databases.

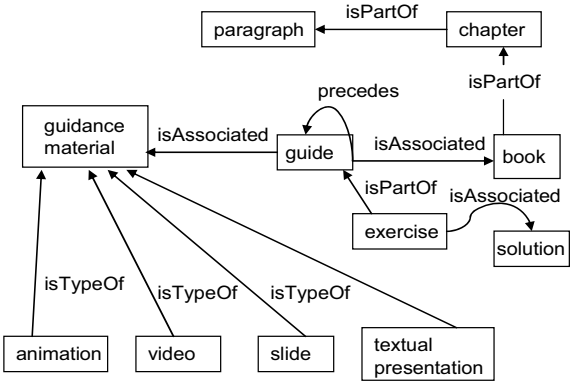

Figure 4. A Guidance ontology.

4. Integrating guides to business process tasks

As the tasks of the business processes may vary in many ways also appropriate *guides* may vary in many ways. For example, a *guide* may advise for using certain technology or tool (e.g., using an editor for producing valid XML-documents [15]), or it may instruct domain specific knowledge (e.g., instructs the use of new coding of applications). In addition some tasks may require many *guides* and some *guides* may be useful in many tasks as well.

In order to increase the reusability of *guides* and support the automatic integration of *guides* to business process tasks we attach metadata items on the business process tasks and to each *guide.* In order to standardize the used metadata items they we the same content and guidance ontology for annotating *guides* and business process tasks.

To illustrate this, assume that the *guides* (similar to other documents) in the organization are annotated by the used ontologies, e.g., according to the taxonomy of Figure 2. So, each document is annotated by picking one or more keywords of the taxonomy Administration. Further, assume that the tasks of the business processes are annotated in the same way and using the same taxonomy, e.g., the task "Process the application of building a house" may be annotated by the keywords (nodes) "Division of buildings" and "Applications of buildings".

Now, it is appropriate to integrate *Guide G* to Task T if they have similar keywords. Assume that *Guide G*

has *m* keywords and Task T has *m* keywords, then they have at most *min{m,n}* common keywords. So we can assume that the higher the number of the common keywords is the better the *Guide G* match for the Task T. Hence, we can order the *guides* of the Task T according to the number of their common keywords.

5. Conclusions

A challenging situation for the training and learning processes in organizations is the introduction of new technologies. As an example, the introduction of knowledge centric organization is challenging as it incorporate semantic web technologies into every part of the work life cycle, including information production, presentation, analysis, archiving, reuse, annotation, searches and versioning. The introduction of these technologies significantly changes the daily duties of the employees of the organization. Therefore the most challenging aspect will not be the technology but rather changing the mind-set of the employees and the training of the new technology.

The introduction of a new technology is also an investment. The investment on new ICT-technology includes a variety of costs including software, hardware and training costs. Training the staff on semantic web technology is a big investment, and hence many organizations like to cut on this cost as much as possible. However, the incorrect usage and implementation of a new technology, due to lack of proper training, might turn out to be more expensive in the long run.

We have proposed that training is carried out by the *guides* that are integrated to the tasks of the business processes. The gain of this approach is that learning processes are integrated in a natural way into day-to-day work patterns, and thereby minimize the extra time required for training. A drawback of this approach is that developing tailored learning material is rather expensive. However, it is obvious that in the long run such an approach is cost effective as the training material (i.e., *guides*) has to be developed only in the beginning of the change. In addition the ontology based descriptions of the learning material increase the reusability of the learning material, and thereby decreases the costs of developing the learning material.

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