E-learning – a Solution for Project Management Excellence

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Abstract

The paper presents an e-Learning platform in project management centred on the learner and based on advanced technologies, such as: ontology, competence standards, IMS Standards.

***Key words**: e-Learning, ontology, project management, competency management, ICB*

1. Introduction

The e-learning platform, named SinPers, is based on two new fundamental concepts: Learning object – LO and learner's model. These assume the structuring of the course content (knowledge) on several abstracting levels: domain ontology (concepts and relation between concepts), learning objects (support of the concepts), and metadata (objects attributes). Applying this for the project management domain imposes the adopting of a standard for the domain concepts and project managers competencies. This standard is ICB – International Competence Baseline of the IPMA – International Project Management Association.

The training material is structured on indexed learning objects (LO). For the specification of the relations and interdependencies between the elements, SinPers platform uses ontology; these allow the abstracting, definition and inter-correlation of the training domain concepts by relations like is_part_of, requires, and suggested order, for the link with LO. Learner models are created and maintained in SinPers. These models contain, mainly, the learner cognitive state and preferences (knowledge level, cognitive and perceptive abilities, relations with the actors of the learning process etc.).

In SinPers a course will be composed from a selected set of goals of the training (key concepts that the learner must learn) and from a learning path (a sequence of LOs that will be used for a learner in order to reach the goals). Once established these elements, begins the complete cycle of the learning-training process.

2. The Educational Content Management – an Ontology-based Learning Approach

2.1 Definitions

A learning ontology is an explicit formal specification of how to represent the learning objects, learning concepts (classes) and other entities and the relationships among them (Kanellopoulos et al., 2006). It describes the learning terms and the relationships between them and provides a clear definition of each term used. Ontologies are created using ontology editors, such as Protégé (2000). Protégé is a Java-based ontology editor which allows ontology implementation as an applet. Protégé provides the framework for a multiple usage of the ontology. An interesting guide to develop a learning ontology is given in Kanellopoulos et al. (2006). The proposed methodology for developing learning ontology include the following steps: identifying the purpose (why is the ontology being built), ontology capture mechanism (identifying all the key concepts and relationships), coding (representing the ontology in a formal language, using a suitable editor), refinement, testing and maintenance of the ontology.

A precise and formal description of the course content will be made by explicit references to the learning ontology, using semantic annotations. The modelling of an ontology-based course can be accomplished on two levels of knowledge organization (figure 1):

- the upper level: the concepts set of the course topic selected form the ontological domain concepts;
- the lower level: learning resources (books, web presentations, movies) associated with the upper level concepts; the ontology may be used as a semantic index for accessing the resources.

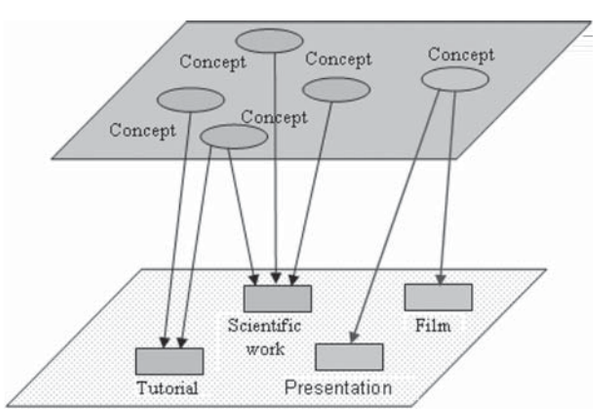

Figure 1: The content semantic annotation

In the course development phase, learning paths can be created at the conceptual level based on semantic relations between the concepts (figure 2a, b). In this phase, it is considered:

- a sequence of concepts obtained by browsing of the domain ontology, which give the access order to the learning objects
- the corresponding learning objects sequence, which is associated to the ontology concepts and which constitute the personalized course.

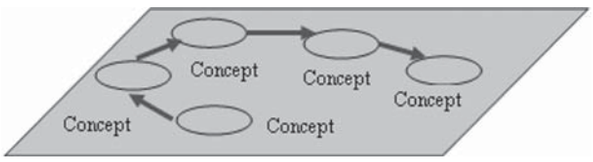

Figure 2a: The learning path at the conceptual level

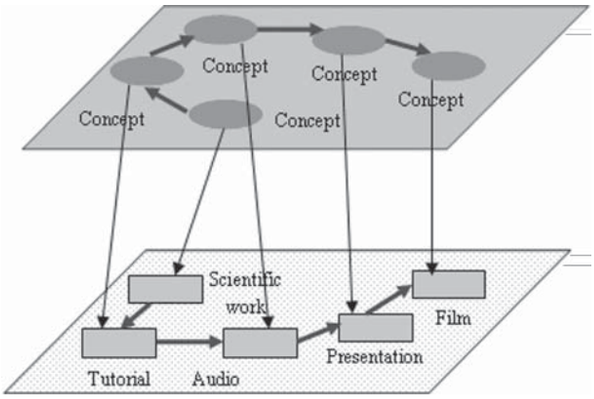

Figure 2b: A learning path with LO

At the conceptual level, the learning paths can be developed based on semantic relations between the concepts, on two dimensions: the horizontal dimension and the vertical dimension (figure 3a, b).

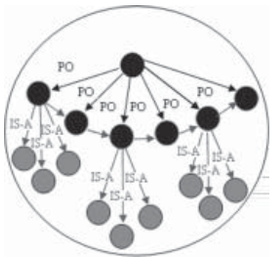

Figure 3a: The learning path development - horizontal dimension

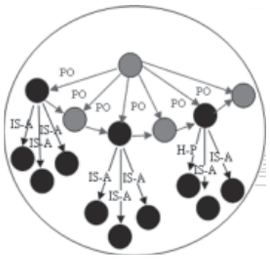

Figure 3b: The learning path development - vertical dimension

On the horizontal dimension, the learning sequence is established by moving from a given concept (the main subject), the ontology is browsed by following the decomposition relations (PO – Part Of relation). On the vertical dimension, the ontology is browsed on the specialized connections (the IS-A relationship) with different results base on the direction: from down to up (synthesis and topic completion) and from up to down (topics development).

2.2 Ontology-based Learning Systems - Some Examples

The following systems are based on ontologies and standards that have an important role in the representation of learning objects and repositories (Kanellopoulos et al., 2006):

- **CIPHER** (http://www.cipherweb.org): The system supports the exploration of national and regional heritage resources.
- **Connexions** (http://cnx.rice.edu): It is an open source project that provides learning objects, a repository, a markup language and a set of tools for authoring, composing modules into courses and navigating through these courses.
- **Conzilla** (http://www.conzilla.org/): Conzilla is being developed as part of the PADLR project as a means of accessing and annotating learning objects. It is a concept browser that allows the user to navigate through a space of context maps to access associated content. While the context maps are not reffered to as ontologies, they may be regarded as equivalent.
- **Edutella** (http://edutella.jxta.org): This project provides an infrastructure for Peer-to-Peer systems for exchanging educational resources. Edutella uses metadata based on standards such as IEEE LOM to decsribe resources.
- **EML (Educational Modelling Language)** (http://eml.ou.nl/introduction/explanation.htm): It is a notational system developed at the Open University of the Netherlands as a means of representing the content of a study unit and the students and teachers roles, relations, interactions and activities. It now forms the basis for the IMS Learning Design Specification. As with many XML based approaches ontologies are not mentioned. However, the study units, domain and learning theory models can be contructed as a set of ontologies.

2.3 Integrating the Ontology-based Learning with an Ontology-based Project Management Competency Management

The *competency ontology*, known as *competency catalogue* (Biesalski, Abecker, 2005; Schmidt, Kunzmann, 2006) defines the *employee competency profiles* (the actual competencies of the employees) and the *reference position competency profiles* (the list of competencies that are needed to fulfil the working requirements of the individual positions). The competency ontology should be in line with

the ICB competence standard. These two types of profiles allow afterwards a matching process to be done for the identification of a possible gap between the reference and the actual competency profiles and identification of the project management training requirements. An ontology-based project management learning approach allows to find the most suitable courses when there a similarity but do not an exact match between training offers and the competency gap.

The usage of competency ontologies have several benefits like:

- Competency groups or clusters can easily be defined since the competency ontologies are taxonomies. An hierachy can be easily exploited to aggregate competencies to a more abstract level and build up competency groups.
- An ontology component can be integrated from another information source (e.g. the domain ontology) using ontology mapping techniques.
- Similarity measures can easily be calculated to define the gap between the reference and the actual competency profiles.
- A similarity-based search of the most suitable trainings is possible. This can be used to recommend trainings that are similar but do not exactly close to the competency gap.

3. The SinPers Project Management Ontology

Applying the ontology learning approach for the project management domain requires adopting a standard for the domain concepts and project managers' competencies. This standard is ICB – International Competence Baseline of the IPMA – International Project Management Association.

The training material is structured on indexed learning objects (LO). For the specification of the relations and interdependencies between the elements, SinPers system uses ontology (Biesalski, Abecker, 2005; Garcia et al., 2003; Liu et al., 2003); these allow the abstracting, definition and inter-correlation of the training domain concepts by relations like is_part_of, requires, and suggested order, for the link with LO. Learner models are created and maintained in SinPers. These models contain, mainly, the learner cognitive state and preferences (knowledge level, cognitive and perceptive abilities, relations with the actors of the learning process etc.).

In SinPers a learning unit will be composed from a selected set of goals of the training (key concepts that the learner must learn) and from a learning path (a sequence of LOs that will be used for a learner in order to reach the goals). Once established these elements, begins the complete cycle of the learning-training process.

The ontology of the project management course contains 201 concepts and 3 types of relationship between concepts.

The following table presents concepts of ontology, in connection with ICB competence elements (IPMA, 2006):

ICB competence elements	SinPers concepts	ICB competence elements	SinPers concepts
Project management success	INT, PRJ, SCS, DSC, FSP, SUC	Assertiveness	CO4
Interested parties	MSP, MSE, PIN, RMS, ACO, QAD, AAN, SRP	Relaxation	CO5
Project requirements and objectives	ENT, ASI, STO, RST, OBV, OOB, DOB, OBP, OSA, NOB	Openness	CO6
Risk & opportunities	MRO, IER, ACA, MOC, PMM	Creativity	CO7
Quality	MCP, PCP, PPR, PCR, PCM, ASC, ADP, CO1, COA	Results orientation	CO8
Project organisations	SOP, ORG, OPR, RPR, PRP, MGP, CMP, STP, ASO, CER, FDP, CAM, MEP, COL, EPR	Efficiency	CO9
Teamwork	FEP, CEP	Consultation	C10
Problem resolution	MPR, CRD, PSO	Negotiation	C11
Project structures	GRP, CXP, STR, SPR	Conflict & crisis	C12
Scope & deliverables	SFC, REZ, WBS, WBI, SPA, CPA, RPA, IPA	Reliability	C13
Time & project phases	DIT, FPP, CVP, FZP, MTP, PLC, PJA, JAL, DGT, ADC, DRA, DEP, RDD, DRC, ALG	Value appreciation	C14
Resources	RES, NOR, ESR, ALR, MLR, OAR	Ethics	C15
Cost & finance	MCP, COS, TCO, CEN, FCO, ECO, BPR, MFP, SFP, PFN	Project orientation	OPP
Procurements & contract	ACC, NAP, SFR, NCO, DCA	Programme orientation	MPG, PGR, OPG
Changes	MSH, MSC, MSR, MSF	Portfolio orientation	MMP, GRU, LAN, CLP, MPP, POP, SPP, OPO, GPP, TPP
Control & reports	CCT, RPT, ACP, CRE, RCR, DUR, CCO, RPC, AEV, CFN, RAF, TMC, CTR	Project, programme & portfolio implementation (PPP implementation)	TIP, DIM, DSP
Information & documentation	IDP, SMD, SMP, SIP, BDP	Permanent organisation	ICO, DMP, MOP, COO, MMO, EMP
Communication	COP, STC, TIC, SWP	Business	IPR, INV, IDE, CRV, SPZ, ACB, AEC, ASZ, ARC, SWO
Start-up	DDI, DIP, PRO, CPR, DDP, EEP, ATP	Systems, products & technology	PTH
Close-out	TPR, DOF, APR, LIN	Personnel management	MGP, MGE, MGR
Leadership	CO1	Health, security, safety & environment	SSS
Engagement	CO2	Finance	AFC
Self-control	CO3	Legal	AJD

Table 1: Concepts of ontology, in connection with ICB competence elements

The following table describes the type of the relationship between concepts:

ID	Relationship type	Symbol
1	Has-Part	
2	Is-required-by	
3	Suggested-Order	

Table 2: The type of the relationship between concepts

Figure 4 presents an overall view of the ontology and figure 5 presents detailed views of the following parts of the ontology: project (5a), project management (5b) and project oriented organizations (5c).

Figure 4: The ontology of the project management course – a general view

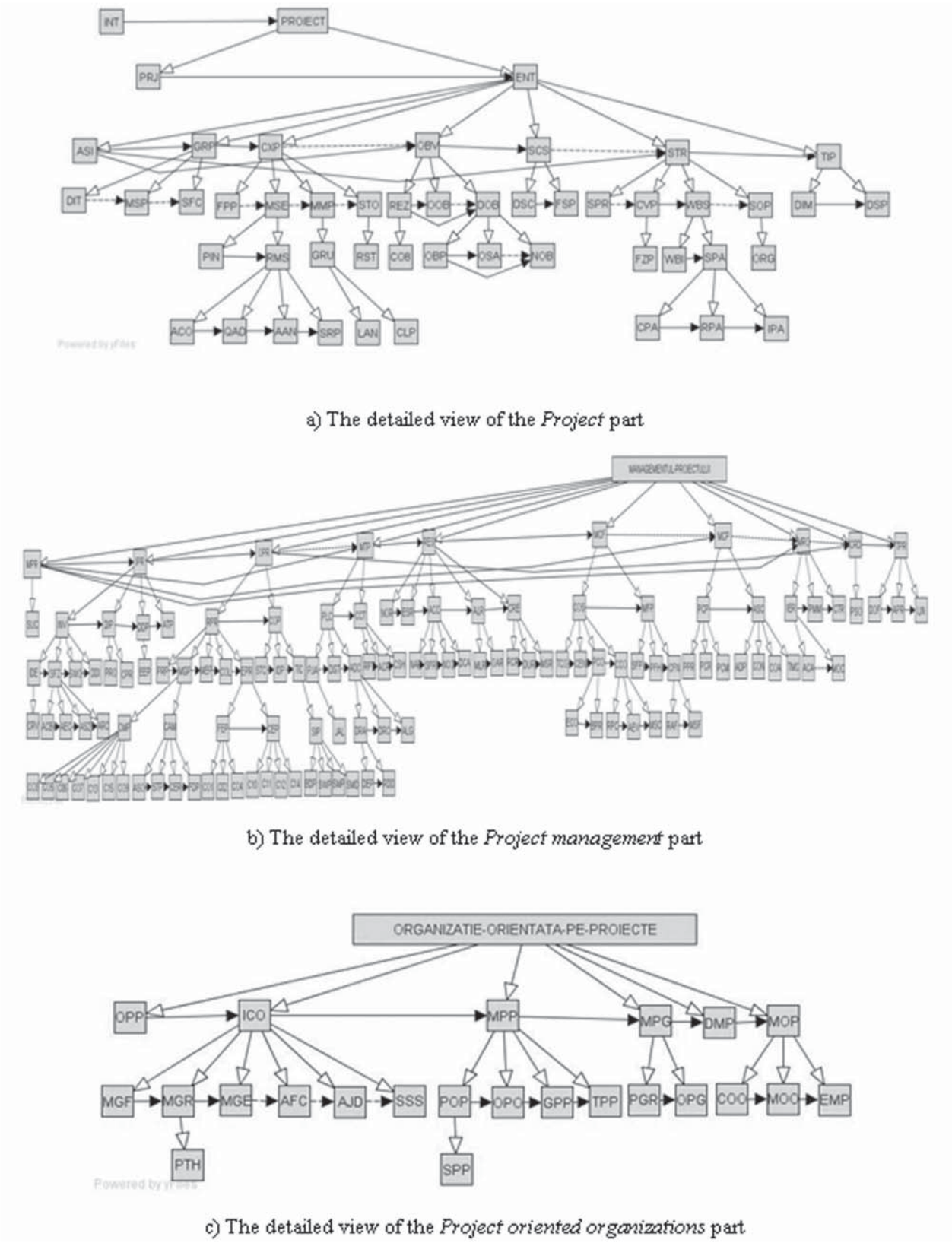

Figure 5: The ontology of the project management course – detailed views

Figure 6 shows the Protégé description of the project management course ontology and the figure 7 presents a fragment from the OWL code.

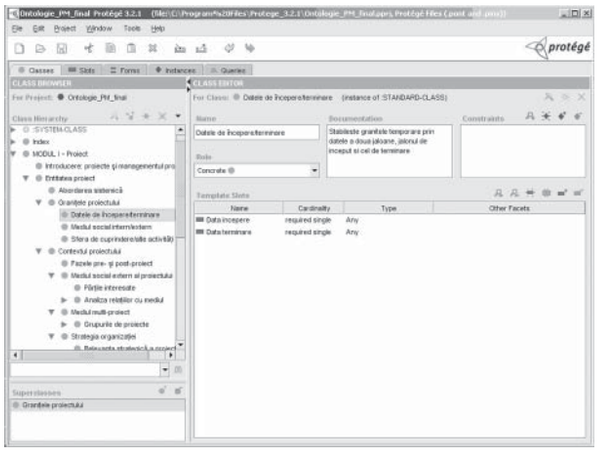

Figure 6: Protégé description of the project management course ontology – an extract

```
<?xml version="1.0"?>
<rdf:RDF
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema#"
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
  xmlns:owl="http://www.w3.org/2002/07/owl#"
  xmlns="http://www.owl-ontologies.com/unnamed.owl#"
 xml:base="http://www.owl-ontologies.com/unnamed.owl">
 <owl:Ontology rdf:about=""/>
 <owl:Class rdf:ID="Obiectivele_proiectului">
  <rdfs:label
rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
   >Obiectivele proiectului</rdfs:label>
  <rdfs:subClassOf>
   <owl:Class rdf:ID="Entitatea_proiect"/>
  </rdfs:subClassOf>
 </owl:Class>
 <owl:Class rdf:ID="Tehnici_de_stimulare_a_creativităţii">
  <rdfs:label
rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
   >Tehnici de stimulare a creativităţii</rdfs:label>
  <rdfs:subClassOf>
   <owl:Class rdf:ID="Generarea_ideii_de_proiect"/>
  </rdfs:subClassOf>
 </owl:Class>
 <owl:Class rdf:ID="Exprimarea_obiectivelor">
  <rdfs:label
rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
   >Exprimarea obiectivelor</rdfs:label>
  <rdfs:subClassOf rdf:resource="#Obiectivele_proiectului"/>
 </owl:Class>
 <owl:Class
rdf:ID="Asociaţii_profesionale_de_managementul_proiectelor">
  <rdfs:label
rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
   >Asociaţii profesionale de managementul
proiectelor</rdfs:label>
  <rdfs:subClassOf>
   <owl:Class
rdf:ID="Cariera_în_managementul_proiectelor"/>
  </rdfs:subClassOf>
 </owl:Class>
 <owl:Class rdf:ID="Manageri_de_produs_şi_de_proces">
  <rdfs:label
rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
   >Manageri de produs şi de proces</rdfs:label>
  <rdfs:subClassOf>
   <owl:Class
rdf:ID="Influenţe_constrângeri_organizaţionale"/>
  </rdfs:subClassOf>
 </owl:Class>
 <owl:Class rdf:ID="Consultare">
  <rdfs:subClassOf>
   <owl:Class rdf:ID="Consolidarea_echipei"/>
  </rdfs:subClassOf>
 </owl:Class>
 <owl:Class rdf:ID="Proceduri_de_negociere_a_contractelor">
  <rdfs:subClassOf>
   <owl:Class rdf:ID="Achiziţii_şi_contracte"/>
  </rdfs:subClassOf>
  <rdfs:label
rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
   >Proceduri de negociere a contractelor</rdfs:label>
 </owl:Class>
```

Figure 7: OWL description of the project management course ontology – an extract

4. Conclusions

The research project brings new conceptual approaches and technical solutions for three basic elements: the teaching-learning process (e.g. learning and support activities flow, delivery conditions, triggers - notifications or timed events), the learning content (e.g. domain ontology, learning object and metadata) and the actors-roles. The learning platform development process use state of the art IT technologies (metadata and ontology for knowledge manipulation, web services, learner model, and intelligent tutoring systems). The research project concentrates both market demands in e-learning for adults (mainly project managers from different industries), and the emerging concepts and technologies regarding Internet usage, man-computer interaction, multimedia technologies, knowledge management, according to the IST / FP6 and FP7 - Technology enhanced learning objectives.

The reaserch project team developed the first comprehensive project management course ontology based on ICB 3.0. The integration of the ontology-based learning with the competency management is proposed. The competency ontology should be in line with the ICB competence standard. The competency ontology allows the identification of a possible gap between the reference and the actual competency profiles and the identification of the project management training requirements. An ontology-based project management learning approach allows to find the most suitable training when there a similarity but do not an exact match between training offers and the competency gap.

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