Beyond contents and activities: specifying processes in learning technology

A. Rius Gavidia [*,1], **M.A. Sicilia Urbán**[2], **E. García Barriocanal**[2], and **G. Macarro Plazuelos**[2]

[1] UOC Open University of Catalonia, Department of Computer Science, Multimedia and Telecomunication, Rambla Poblenou, 156, 08018 Barcelona, Spain
[2] UAH University of Alcalá, Department of Computer Science, Ctra. Barcelona km 33,6, 28871 Alcalá de Henares, Madrid, Spain

Recent standardization efforts in eLearning technology have resulted in a number of specifications, however, the automation process considered basic in a Learning Management System (LMS) is a less explored subject. As learning technology becomes widespread and more heterogeneous, there is the growing need to specify processes that cross the boundaries of a single LMS or learning resource repository.

This paper proposes to obtain a specification oriented to automation that assumes the heterogeneity of systems and formats, and provides a language for specifying complex and generic interactions. The semantic conformance profiles, the BPMN diagram and its translation to BPEL seems to be suitable to achieve it.

Keywords automated specification processes; learning technology scenarios; Learning Management Systems

1. Introduction

IMS Digital Repositories Interoperability (DRI) specification [1] suggests recommendations for the interoperation of the most common repository functions. This specification acknowledges that a wide range of content formats, implemented systems, technologies, and established practices already exist; it is tied to IMS specifications on contents but it does not assume heterogeneity of systems and formats, and does not provide a language for specifying complex, generic interactions.

In order to achieve interoperability among systems and formats the eduSource Canada project has designed and implemented a standard communication protocol, ECL [2]. The ECL protocol is flexible with respect metadata schemas and repository contents and it allows new and existing repositories to communicate and share resources across a network. It conforms to IMS DRI specifications and implements its main functions, and, furthermore, it extends the IMS protocol with some definitions based on OAI harvesting protocol. Also conforming to IMS DRI specification, the PAWSEL project proposes an architecture that pretends to facilitate the heterogeneous conversational patterns among participants of the scenario [3]. The intermediary level provides the orchestration capabilities for the rest of components through services interfaces and the relation among learning services, their users and intermediaries are understood as scenarios. The SleD2 project presents another architecture that facilitates the integration of learning services instead of web services. The engines CooperCore as IMS LD service are integrated as workflow engine and satisfy the automation of scenarios but limited to the delivery of activities [4].

The term scenario, in the eLearning area, and the reutilization of learning objects as scenario-based approach were introduced in an attempt to present the learning objects metadata as required infrastructure to support some LMS functions [5]. Also, in relation with scenarios, it has been proposed to use the semantic conformance profile (SCP) towards the automation processes [6]. Having into account this

[*] Àngels Rius Gavidia: e-mail: mriusg@uoc.edu, Phone: +34 933263740

previous work [3, 5, 6], knowing the need to have a language for processes specification to describe the fundamental processes in the LMS and all the interactions among the participants, we propose BPMN as the most suitable one. Next, we state the main advantages that BPMN brings to the eLearning :

- It supports the Interchange formats between applications: The serialization of BPMN is done for XML interchange. A comparative study [7] about 15 different XML-based specifications for BPM concludes that BPMN and BPEL are the languages that satisfy the majority of the items that assure the interchange formats and the interoperability.
- It reduces heterogeneity among LMS: BPMN is accepted by the business community to describe the processes workflow. It can also be used in eLearning context as specification language in order to reduce the heterogeneity among the specification techniques and bringing interoperability between different systems [9]. The justification can be found in [8].
- It provides elements to specify complex and generic interactions: To achieve dynamic and adaptative LMS we need to specify their processes in a language that will be able :1) to describe in a standard graphical and understandable notation; 2) to define abstract modelling elements by means of a metamodelling notation; 3) to offer different techniques of modelling processes for processes of only one participant or more that are connected through the flow messages [9].
- It provides support to the generation of executable specifications: BPMN has an internal model that enables the generation of BPEL executable specifications with automated support. It contributes to reduce the number of errors introduced during the translation phase, decreasing costs of the development and increasing productivity. In a general sense, it can be considered in a normative way a bridge for the gap between business process design and process implementation [9, 10].

In this paper we propose to address the specification of learning technology processes. Taking a concrete scenario that is not present as an user case in the IMS DRI recommendations, we will describe the steps to obtain their executable specifications. The rest of the paper is organised as follows: The second section is about the specification of learning processes in BPMN and its mapping to BPEL, showing by an example the advantages to use it. The third section presents the integration of the BPMN processes with IMS DRI recommendations and other learning technology specifications and finally, section fourth, presents conclusions.

2. Specifying learning technology processes with BPMN

We will take as example the scenario-type of acquisition of a learning object. This scenario describes the automated or semi-automated purchase of a reusable learning object to full fill a given learning objective inside the LMS [6]. In order to transform this description in natural language in an oriented automation way, we decided to use the SCP; then analysing all the interactions between participants, the tasks to be performed, we describe the SCP in terms of BPMN and then we obtain its mapping from BPMN to BPEL. We want to note that the steps we propose are a particular case of the methodology to develop eLearning scenarios proposed by [11].

2.1. The semantic conformance profile

In order to analyse the acquisition scenario and specify it in a consistent way oriented to the automation, we generate the SCP [6]. So we have identified the precondition, the restrictions and the post conditions of the process, which are called required elements, idioms and runt-time commitments, respectively.

Table 1 Semantic Performance Profile of the Acquisition of a Learning Object process.

PRE (Required elements)	Characteristics of the LO we want to buy Identifier of the vendor system Buying conditions
Restrictions (Idioms)	The conditions of the purchase are accepted by the initial budget. The copyrights are met. The legal conditions will be satisfied The vendor system is available to carry out the transaction Thhe process of purchasing has been audited, both from the point of view of the LMS and the vendor system
POST (Run-time commitments)	Receipt of purchasing Vendor system running Availability of the learning object

2.2. BPMN diagram process.

The SCP has allowed us to identify the actors that participate in the process: 1) the repository or repositories that allocate the learning objects, 2) the LMS that wants to purchase the reusable learning object, and 3) the vendor system as a supplier of this. It is clear that we need to describe a collaborative process in a notation that easily permits understand the tasks that each participant has to perform and the interactions among them in order to achieve the goal of the acquisition process.

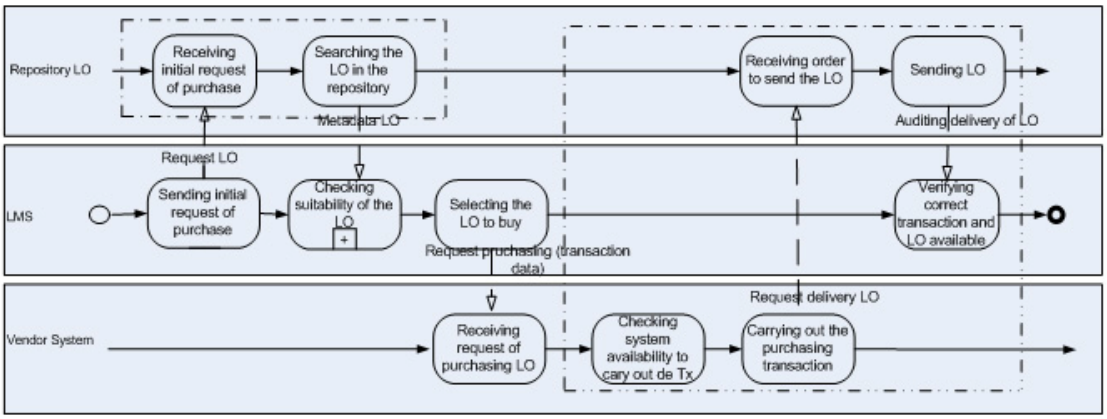

Fig1. BPMN diagram: the acquisition of a learning object (1st. level)

In Fig. 1 the BPMN diagram shows that the process begins when the LMS receives the initial purchasing request. This request includes the pedagogical characteristics of the learning object to buy, the buying conditions and the location of the vendor system. The LMS translates their request to the different repositories in order to do the search. Among the learning objects susceptible of being bought the LMS chooses one, the better option according to the buying conditions and other related issues. In order to carry out the purchase the LMS contacts with the vendor system, it sends its purchasing request, the business transaction is done and the vendor system sends to the suitable repository the corresponding order to deliver the learning object to the LMS. We see two groups marked: the search of the reusable learning object in the repositories and the purchase of this learning object. The first one corresponds to the Federator function of the reference information model recommended by IMS DRI specification, which could be considered another reusable scenario [5]. The second one is all the tasks or the sub processes related to the purchase action among all involved participants. One of them is the buying transaction; it is marked with double border. Also it is interesting to notice that there is a collapsed sub process that is detailed in a lower level where the suitability of each reusable learning object is evaluated and one of them is selected, the learning object to acquire.

2.3. BPEL implementation.

BPEL is focused on the orchestration of SOAP web services and based in XML, so it facilitates the interchange formats and brings interoperability. BPEL processes are grounded on the idea of peer to peer, purpose-based interactions between BPEL-orchestrator- processes and individual web services. According BPMN specfications [9], the BPMN mappings to BPEL cover only the mapping to a single executable private business process; called workflow processes. If the BPMN diagram depicts more than one internal process, then there will be a separate mapping for each on the internal business processes. Thus, the abstract sections of BPMN diagrams will be mapped to Web services specifications, such of abstract processes of BPEL, and the collaborative model sections of BPMN may be mapped to Collaboration models such as ebXML, BPSS, Rosetta-Net, etc.. Thus, in our example (see in Fig. 2) we identify some BPEL processes (the LMS, the vendor system and the Federator) and some web services (the repositories) for the implementation of the acquisition scenario.

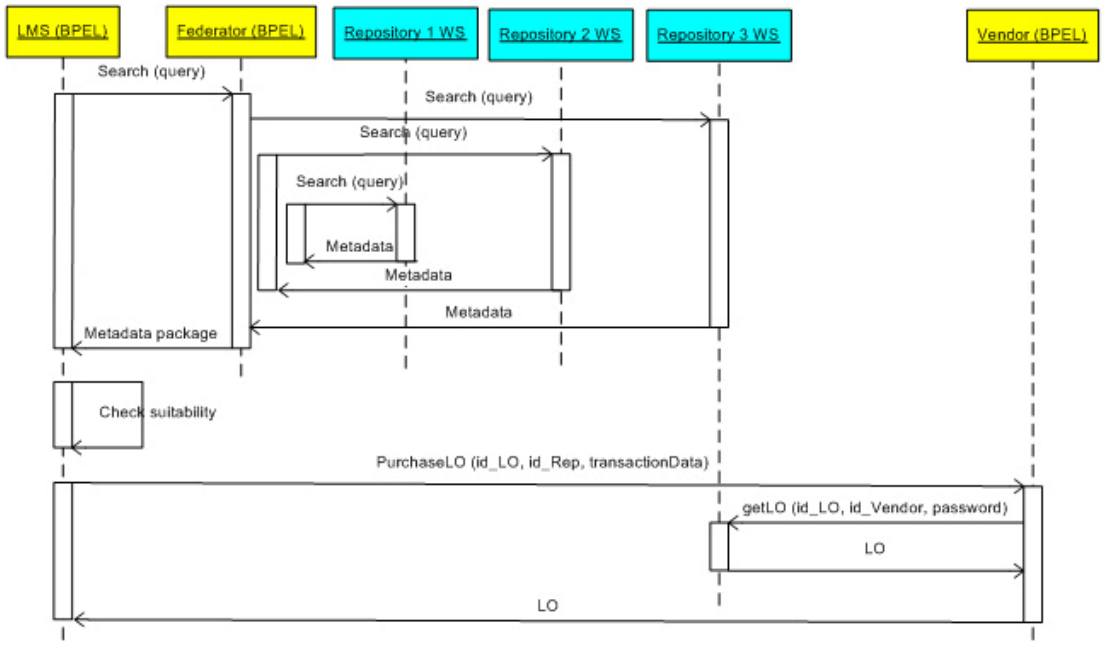

Fig 2. Sequence diagram: The acquisition of a learning object

The LMS process can be considered the orchestrator because it is the process that interacts with the other pools (the repositories and the vendor system). The Federator is another BPEL process because its function could be considered a sub process in the workflow and it has to interact with a lot of repositories. The vendor system could be another BPEL process and the collaboration model sections of BPMN may be mapped to Collaborations models such as ebXML, BPSS or RosettaNet. The repositories could be considered Web services because they are external services that need a common interface to interact with LMS and other processes. If we will apply the mappings according to [9], we will obtain executable specifications in BPEL, whose logic is declared in XML and interpreted by the BPEL engine.

3. Integrating BPMN with existing learning technology specifications

IMS DRI specification [1] is integrated in the acquisition scenario because we have it into account to communicate metadata among different actors in a distributed environment. The use of Federator function is a proof. Other eLearning specifications could be integrated too. LOM [12] could be used to annotate the learning objects and made the search more efficient. The LD [13] in order to design the

learning resources in a more general sense of learning object. The IMS QTI [14] if we consider the learning object as an evaluation test. And SCORM [15] if we use this specifications to pack the contents or the metadata application profile instead of LOM.

4. Conclusions

BPMN specification is attractive for the implementers, designers, vendors and clients of the LMS, because it promotes the interoperability and reduces the confusion among all kind of eLearning users [10].. BPMN promotes interoperability, accessibility and reusability of Web-based learning content and between systems and tools, promoting the sharing and reusing of learning objects.

In this paper we have presented three steps to specify learning processes with the aim of automate them. So we have based on the SCP and the scenario-oriented reusable learning object approach to achieve a consistent description of the process to be automated. Next, considering all the participants, their interactions, their workflow of activities and messages sent among them, we have obtain the BPMN diagram. Then, the recommendations of BPMN specifications guide us to translate BPMN diagram to BPEL code. Finally, we have considered the integration of the other specifications of the eLearning area

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References

[1] IMS Global Consortium, IMS Digital Repositories Interoperability- Core Functions Information Model IMS DRI, IMS Consortium, 2003
[2] T.Eap, M..Hatala, G.Richards, In Proc. of the 13th Intl. World Wide Web Digital Repository Interoperability, New York, NY, USA, pp 19-27 ISBN: 1-58113-912-8
[3] G.Macarro, S.Arroyo, MA Sicilia, R. Armas, 9th Intl Conf. on Interactive Computer aided Learning (ICL 2006), Villach, Austria, Setember 26-29, 2006. ISBN: 3-89958-195-4
[4] H.Vogten, H.Martens, R.Nadolski, C.Tattersall, P. Van Rosmalen, R. Koper, Integrating IMS Learning Design and IMS Question and Test Interoperability using CopperCore Service Integration, Proc. of Intl. Workshop in Learning Networks in Lifelong Competence Development, TENCompetence Conf, March 30th-31st, Sophia, Bulgaria
[5] MA.Sicilia, M.Lytras (2005). Intl Journal of Knowledge and Learning, 1(4), pp. 332-34, 2005.
[6] MA.Sicilia, C. Pagés, E. García, S. Sánchez-Alonso, S, A. Rius, Proc. of the 5th. Intl. Conf. on Information Technology Based Higher Education and Training. Istanbul. Turkey, May 31-June 2, 2004
[7] J.Mendeling, G.Neumann.,M.Nüttgens, Proc. of EMISA- Information Systems in E-Business and E-Government, Luxembourg, Luxembourg 6-8 October 2004
[8] D. Helic, J. Hrastmik, H.Maurer, An analysis Application of Business Process Management Technology in E-Learning Systems, 2005
[9] Object Management Group, Business Process Management Modelling Notation, OMG, 2006.
[10] A. Stephen, Introduction to BPM, White, IBM Corporation
[11] I. Hamburg, Th. Busse, M. Marin, 6th European Conf. on E-Learning, E-Business, E-Government, E-Work, E-Health, E-Democracy, E-Mediary, Virtual Institutes, On-Line, BB Services, ERA and their Influences on the Economic and Social environment, Bucharest, Romania, September 19-20, 2005.
[12] IEEE Learning Technology Standards Committee. Learning Object Metadata (LOM), IEEE 1484.12.1,2002.
[13] IMS Global Consortium, IMS Learning Design Information Model, Version 1.0, IMS Global Consortium, 2001.
[14] IMS Global Consortium, IMS Question and Test Interoperability, Version 2.1, IMS Global Consortium.
[15] Advanced Distributed Learning, Sharable Content Object Reference Model (SCORM) overview, ADL, 2004.