Using MDD to Extend the IMS LD Standard with Adaptability

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Abstract. A few e-Learning platforms propose a solution for ubiquity and context aware adaptability. Current standards, as Learning Design (LD), require an extension to propose context awareness. Based on previous related works, we define a fully interoperable and learner (ambient) context adaptable platform, by using meta modeling based approach mixing MDD, parameterized transformations, and models composition. The scope of this paper is to extend LD meta model as a first step. We use a concrete software engineering industrial product that was promoted by French Government.

1 Introduction

E Learning aims the delivery of a learning, training or education program by electronic and it involves the use of a computer or electronic device (e.g. a mobile phone), in some way, to provide training, educational or learning material. Concerning the architecture point of view, e Learning platforms gather two separated and distributed parts as: authoring tools (for pedagogical contents definition) and execution platforms. So, e Learning may: i) use several media and devices, ii) promote specific training according to learner skills, iii) send specific events to increase complexity of lessons and to assess learner reactions, …

Previous works allowed us to use Web services to get interoperability and flexibility to changes. But, we noticed the lack of adaptability, so, we extended Web services to introduce adaptability with aspects [12]. We noticed this very efficient and pragmatic solution was very technical. Recently, we have investigated a model driven approach and context awareness to provide developers mechanisms that allow them representing an application in abstract way (in a model) and, then, automatically generating the corresponding code [7], [8]. We aimed to explore adaptability and flexibility on a service platform using context with the benefits of an MDD (Model Driven Development) [9] development strategy. These benefits are related to productivity, quality, adaptability and maintenance.

Moreover, e Learning standards tend to extend their semantic to Web services standards [4]. We studied e-Learning standards metamodels, but, we noticed no semantics concerning context aware adaptability.

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We aim to propose a fully interoperable and learner (ambient) context adaptable platform. This paper studies e-Learning standard semantics to introduce context awareness metamodels. We focus here on Learning Design (LD) that helps to define a pedagogical scenario with its components (roles, activities, environment, and outcomes). LD proposes an entity for context in its metamodel but, according to us, this approach is too semantically poor.

We shall process as followed. Second section presents context and context awareness, aspect based services models and context aware metamodel. Third section discusses an extension of LD metamodel with models composition and a concrete industrial software engineering project. Fourth section presents some related works. Let us define now context awareness.

2 Context Aware Modelling

2.1 Context and Context Awareness

Context awareness is a quite new discipline in e Learning domain. For instance, in [6] [11], the authors noticed the context acts like a set of constraints that influence the behavior of a system (a user or a computer) embedded in a given task. They discussed the nature and structure of context but they notice the lack of representation of context in e Learning domain. The emergence of new technologies, in particular wireless communications and the increasing use of portable devices (smart phones, Personal Digital Assistants(PDA), laptops…), has stimulated the emergence of a new computing paradigm called: pervasive computing. In fact we have moved from the desktop computing paradigm to the mobile and ubiquitous computing paradigm. Pervasive computing refers to the seamless integration of devices into the user's everyday life. *"Appliances should disappear into the background to make the user and his tasks the central focus rather than computing devices and technical issues."*[13]. Computing applications now operate in a variety of new settings; for example, embedded in cars or wearable devices. They use information about their context to respond and adapt to changes in the computing environment. They are, in short, increasingly context aware. The context awareness of such applications is the subject of a recent field of studies in pervasive computing called: context-aware systems. This terminology was discussed in [10] and presented as *"software that adapts according to its location of use, the collection of nearby people and objects, as well as changes to those objects over time"*. Since then, there have been numerous attempts to define context-aware computing. In [10], [11], they define context-awareness as the ability of a program or device to sense or capture various states of its environment and itself. Referring to these latter definitions a context-aware application must have the ability to capture the necessary contextual entities from its environment, use them to adapt its behavior (run time environment) and finally present available services to the user. In this sense and to describe context-awareness independently from application, function, or interface, [11] proposes four features of context-aware application : (1) Contextual sensing which refers to the detection of environmental states and their presentation to the user; (2) Contextual adaptation refers to the adaptation of application behavior to the current context; (3) Contextual resource discovery is the use of context data to discover other resources within the same context; (4) Contextual augmentation in which the environment is augmented with digital data associated to a particular context. In [2], [3], the authors introduce another definition in which they insist on the use of context and the relevance of context information. The authors consider that: *"a system is context-aware if it uses context to provide relevant information and/or services to the user, where relevance depends on the user's task"*. They explain how to use context and propose a classification of the features of context-aware applications that combine the ideas of [10].

2.2 Model Driven Development (MDD)

At the beginning of this century, software engineering needs to handle software systems that are becoming larger and more complex than before. Object-oriented and component technology seem insufficient to provide satisfactory solutions to support the development and maintenance of these systems. To adapt to this new context, software engineering has applied an old paradigm, i.e. models, but with a new approach, i.e. Model Driven Development (MDD). In this new global trend, Model Driven Architecture (MDA) is a particular variant. MDA is based on standards from the Object Management Group (OMG) [9]; it proposes an architecture with four layers: meta metamodel, metamodel, model and information (i.e. an implementation of its model). MOF (Meta Object Facility) is a standard from OMG for metamodels specification. The development is based on the separation of concerns (e.g. business and technical concerns), which are afterwards transformed between them. So, business concerns are represented using Platform-Independent Model (PIM), and technical concerns are represented using Platform-Specific Model (PSM). Finally, it is well recognized nowadays that model transformation is one of the most important operations in MDA. In the context of the basic four levels Metamodeling architecture of MDA, various scenarios of model-to-model transformation have been identified. The most common scenario of these transformations, which is compatible with the MOF2.0/QVT standard includes the following elements. Transformation rules specify how to generate a target model (i.e. PSM) from a source model (i.e. PIM). To transform a given model into another model, the transformation rules map the source into the target metamodel. The transformation rules are based on a transformation language, such as the standard QVT. The transformation engine takes the source model, executes the transformation rules, and produces the target model as output.
Adaptable Service platforms have been proposed for the development of mobile context-aware applications. The development of such platforms involves a number of challenges from which we consider two main issues in the context of our approach of model driven development:

- The definition of a metamodel to describe the contextual domain in which a given application or service is defined.
- A mechanism to integrate the context into the business application using a model driven approach.

In [7], [8] we have discussed these two main issues. We have defined a context metamodel which identifies and adds the most relevant and generic contextual entities that will be held in account in modelling any mobile and context aware application. We have then proposed a parameterized transformation technique which allows merging context information with business logic at model level. We have investigated this type of transformation which is not explored and there is not a standard transformation language implementing it.

3 Extension of LD to Context Awareness

3.1 LD Model

A Learning Design (LD) is a description of a method enabling learners to achieve intended learning objectives and outcomes by performing predefined learning activities. More specifically, a learning design is a means allowing the Instructional designer to describe a learning scenario in terms of a set of activities that learners should perform according to the different roles that they may play within environments (i.e Run-time environment). Environments are described in terms of Learning Objects and Services that should assist learners during the Learning process. IMS-LD (Instructional Management Systems-Learning Design) [1], [5] specification provides for previously described concepts a meta-model (Figure 1) that was and is still used by LD authoring tools developers. According to IMS-LD specification, LD concepts must meet height requirements. We name the third one because it deals with personalization that is relevant to our work. The LD specification states that: "*The content and activities within a unit of learning can be adapted based on the preferences, portfolio, pre-knowledge, educational needs, and situational circumstances of users. In addition, the control over the adaptation process must be given, as desired, to the student, a staff member, the computer, and/or the designer*".

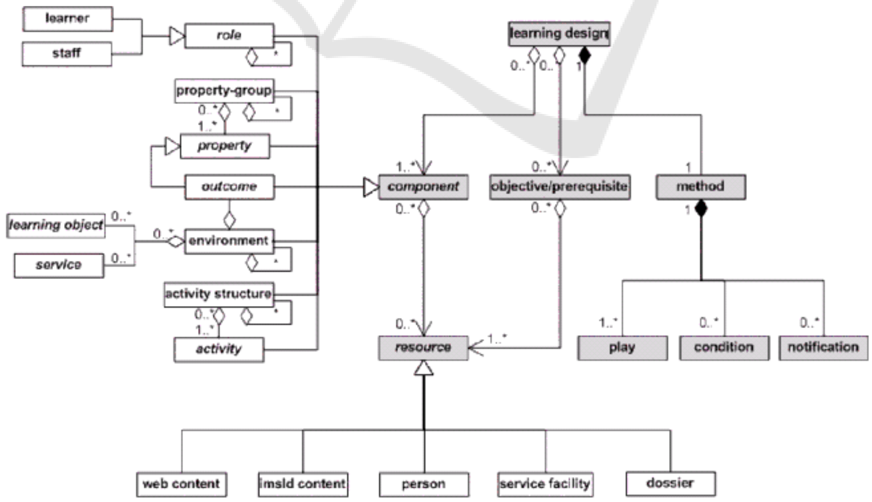

Fig. 1. The LD Specification.

However, IMS-LD provides neither means nor modeling solutions to take into account contextual data of mobile users for instance. We should stress that the contextual data, unlike those already defined for personalization, are dynamic and may depend on the user's external environment. We propose to extend this model with our context metamodel with composition mechanisms according to [14], [15] .

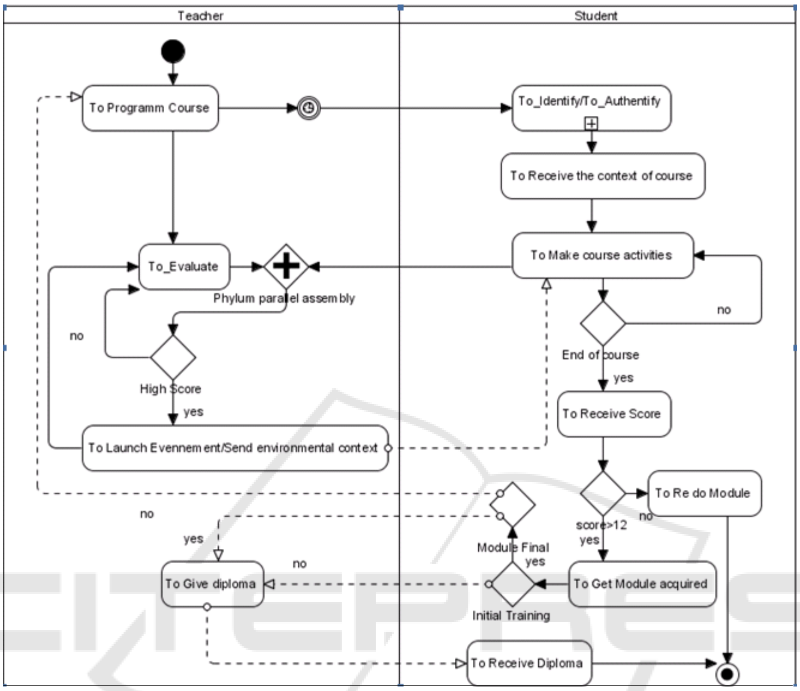

Fig. 2. Generic BPMN Process of the training.

3.2 Illustrative example and Model Composition

We worked for French government to implement a navigation and fishing e learning application. We proposed following metamodels coming from our research works. The application aims to train different kind of learners as: young students coming from fishery schools and adults working for fishery companies. In fine, the aim of the system is to train learners to be: fishery captain, fishing boat mechanic, sailor, port manager,…

During course, learner according to his skills receives a navigation and/or fishing scenario as " go to 100 miles from Saint Jean de Luz and fish tuna". So, the learner has to do obligatory tasks as: to check weather, to define the road, to check the fitted nets, to check mechanic,… The generic BPMN (Business Process Modeling) [16] process shows (Figure 2) the different tasks to do by the learner and the teacher. The teacher programs a course that will be received by the learner anywhere he is, via any media, … after identifying himself. The learner is assessed in real time and the teacher may send him events. At the end of the module, the diploma is delivered or not. The learner is in front of his laptop and receives the training. All the navigation tools (radar, sounder, GPS,…) are simulated. According to his skills, the teacher (human or system) can send to the learner desktop specific events as mist, rain,… and the learner has to react properly. Moreover, the system provides an estimation of learner skills in real time. The resulting composed model is formed by: i) training metamodel (that could be later formatted to e-learning standards), ii) a contextual model that was already composed to component class from LD. Another composition may also be done with fishery business metamodel. For each training module, a link may be done with specific business data. For instance, a training module about tuna fishery involves the choice of the fitted net. A mark is put on the required classes.

4 Conclusions

Other approaches aims to use metamodeling: i) to define e Learning interoperable and platforms independent system ii) and to extend standards as [1], [4], [5]. Some researchers introduce adaptability with Multi Agent System but we choose an hybrid approach based on software engineering and Artificial Intelligence. Previous works as [7], [8], propose solutions to model context. We use these approaches to extend them to eLearning according to our choices. We did not find any concrete and relevant related works concerning such an approach in e-Learning domain, but we are convinced our approach is pertinent because we got good results with fishing simulators and in other Web based application domains.

This paper proposes a metamodel approach to introduce (ambient) context awareness in LD model. It is based on our previous works about adaptability and models composition based MDD. We propose examples coming from a concrete industrial project. We aim: i) to define an independent platform model based on services, ii) to implement models transformations to link these models to implementation platform, iii)to promote automatic code generation… We propose now transformation rules via a technical platform based on services and supporting context awareness.

References

1. Boticario, J. Olga. C Santos: An open IMS-based user modeling approach for developing adaptive Learning managements systems. Retrieved from www-jime.open.ac.uk/2007/02/.
2. Chen, G., and Kotz, D. (2000). A survey of context-aware mobile computing research. Tech. rep., Dept. of Computer Science, Dartmouth College.
3. Dey, A. K. (2001). Understanding and Using Context. Personal and Ubiquitous Computing 5, 1, 4-7.
4. Dietze Stefan, Alessio Gugliotta, and John Marko Rosić Vlado Glavinić Branko Žitko: Intelligent authoring shell based on Web services : http://www.pmfst.hr/~bzitko/radovi/files/INES2004.pdf
5. Davinia Hernandez Leo, Juan I. Asensio Perez, Yannis A. Dimitriadis, "IMS Learning Design Support for the Formalization of Collaborative Learning Patterns" Advanced Learning Technologies, IEEE International Conference on, pp. 350-354, Fourth IEEE International Conference on Advanced Learning Technologies (ICALT'04), 2004.

6. Mary, B., and Patrick, B. (2005). Understanding context before to use it. In 5th International and Interdisciplinary Conference on Modeling and Using Context vol. 3554 of Lectures Notes in Artificial Intelligence, Springer-Verlag, pp. 29-40.
7. V. Monfort, S. Hammoudi, When Parameterized MDD Supports Aspect Based SOA , IJEBR 2010, International Journal of E-Business Research (To appear).
8. V. Monfort, S. Hammoudi, ICSOC, Towards Adaptable SOA: Model Driven Development, Context and Aspect The 7th International Conference on Service Oriented Computing, November 23-27 2009, Stockholm, Sweden.
9. OMG (Object Management Group). (2001). Model Driven Architecture (MDA), OMG document number ormsc/2001-07-01.
10. Schilit, B. N., and Theimer, M. (1994). Disseminating active map information to mobile hosts. IEEE Network 8 22-32.
11. Strang, T., and Linnhoff-Popien, C. (2004). A Context Modeling Survey. In First International Workshop on Advanced Context Modelling, Reasoning and Management, UbiComp.
12. Tomaz, R. F., Hmida, M. B., and Monfort, V. (2006). Concrete solutions for web services adaptability using policies and aspects. The International Journal of Cooperative Information Systems (IJCIS), 15(3):415– 438.
13. Weiser, M. (1991). The computer for the 21st century. Scientific American. PP 94-104.
14. J. Klein, L. Hélouet, and J. M. Jézéquel. -- Semantic-based weaving of scenarios. -- In Proceedings of the 5th International Conference on Aspect-Oriented Software Development (AOSD'06), Bonn, Germany, March 2006. ACM
15. Sten Lundesgaard, Arnor Solberg, Jon Oldevik, Robert France, Jan Oyvind Aagedal, Frank Eliassen, Construction and Execution of Adaptable Applications Using an Aspect- Oriented and Model Driven Approach, IFIP DAIS 2007, LNCS 4531, 76-89, 2007.
16. BPMN specification web site retrieved from http://www.bpmn.org/