CROSS-DOMAIN MAPPING: QUALITY ASSURANCE AND E-LEARNING PROVISION

Hilary Dexter, Jim Petch
The e-Learning Research Centre, University of Manchester186 Waterloo Place, Manchester, United Kingdom

Keywords: e-learning provision, quality assurance, checklist, process model, knowledge domain

Abstract: In order to ensure that a valid and robust model of e-learning provision is developed it has to be based on a thorough understanding of the e-learning provision domain. The fullest and most detailed articulations of the e-learning development process are found in quality checklists for e-learning development. The problem this paper addresses is that posed by the situation of having knowledge used for modeling in one domain represented by artifacts in another. Using a number of checklist sources, a composite list was developed for some aspects of the e-learning development process. The checks address the activities and their artifacts that should be monitored, and what the outcomes of the checks should be in terms of what actions should be taken and what changes made if the results do not meet quality criteria. A small worked example of this cross-domain mapping process is given.

1 CONTEXT

The stimulus for this study is the need to ensure quality service provision for e-learning in higher education, viz. the processes of planning, design, development and delivery of e-learning courses. Underlying the study is an approach to service provision based on enterprise models. The e-learning provision model is seen as part of an enterprise model that includes business processes and enterprise information model as well as the provision of e-learning by partner institutions (Figure 1).

The main premise of this study is that in order to ensure that a valid and robust model of e-learning provision is developed it has to be based on a thorough understanding of the e-learning provision domain. There are two challenges here. One is that there is no thorough articulation of the e-learning provision domain that is in any way comprehensive. The second is that there are very few published accounts of quality on which to base a model. Almost all Higher Education (HE) provision is in situations that are not adequately documented and the few available commercial sources are understandably thin.

In fact the fullest and most detailed articulations of the e-learning development process are found in quality checklists for e-learning development. It seems that a number of organizations and individuals have used this means of expression as a way of capturing and organizing knowledge about the domain (Scienter-MENON 2004,WCET 2000).

Studies of some of the most widely used and well known checklists (Hirumi 2003, Franklin, Petch, Armstrong and Oliver 2004) show clearly that the scope of these checklists differs substantially and that the nature of the checks themselves is not consistent. However it is possible to rationalize the available checklists (Petch 2003, 2004) so that a consistent and comprehensive description of the e-learning development and delivery process is achieved.

Recognizing that the development of checklists is an ongoing process, a set of published lists was used to develop a consolidated and harmonized list that could be used as the basis for developing an e-Learning Provision model. In this study the list does not cover the complete e-learning development cycle (Wilcox, Petch and Dexter, 2004) but is sufficient for the purpose of exploring the cross-domain mapping issues.

2 PROBLEM

The problem this paper addresses is that posed by having knowledge used for modeling in one domain represented by artifacts in another. It is the problem

Dexter H. and Petch J. (2005).
CROSS-DOMAIN MAPPING: QUALITY ASSURANCE AND E-LEARNING PROVISION.
In *Proceedings of the Seventh International Conference on Enterprise Information Systems*, pages 199-205

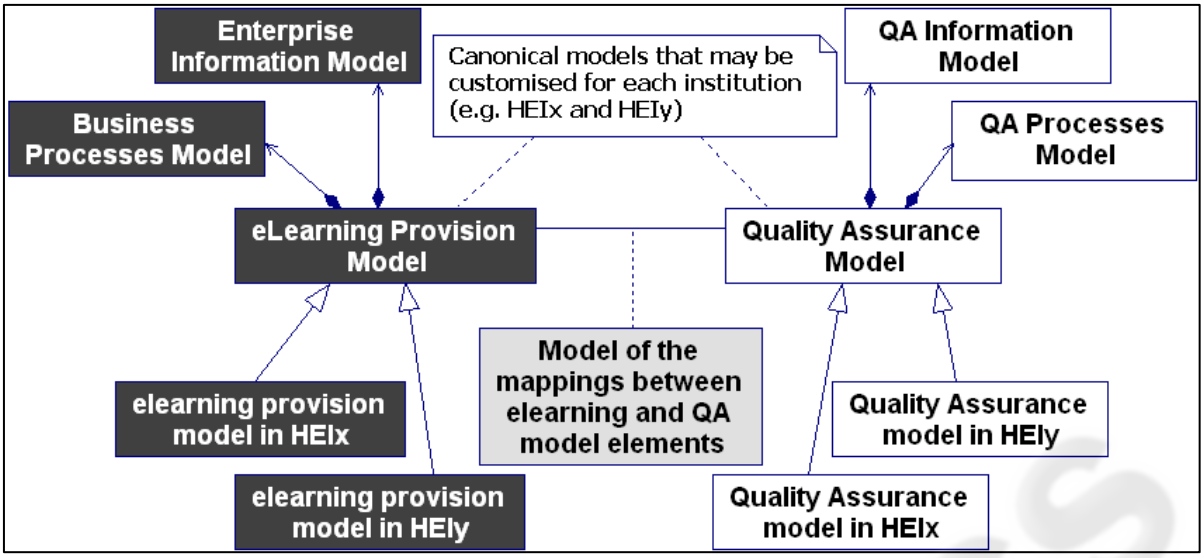

Figure 1: Modeling the Quality Assurance (QA) and the eLearning Provision domains

of cross-domain mapping. It is necessitated by the fact that the best available knowledge of the e-leaning process is in the Quality Assurance (QA) domain but the model needed to be developed is in the provision domain. In fact, in practice there are iterations of interaction between these domains, and in some organizations a reasonable expectation that they have been planned together, so that we may expect some alignment between them. However, there remains the problem for the modeler of developing a satisfactory meta-model and a valid model in one domain from knowledge based on the meta-model and model in another. There is no intention here of modeling the QA domain. The checklists are taken as given.

The problem of cross-domain mapping is put forward as a general one for domain modeling. It is suggested that the situation of asymmetric positioning of knowledge and model is commonplace. Indeed a cross-domain mapping approach may be a useful element of a modeling strategy in general.

3 APPROACH

A modeling approach has been adopted to tackle the transfer of knowledge between the two domains of interest. A modeling framework has been set up to provide an environment in which it will be possible to progress in iterations of modeling activity towards a complete and precise expression of all the people, processes and technology involved in the provision of e-learning services. The modeling framework includes an evolving well-defined vocabulary of modeling elements expressed in the Unified Modeling Language (UML).

A domain model describes the elements that can exist in the domain, their interrelationships and their types. Both the static and dynamic aspects of that domain need to be represented in the model, that is both the data and information entities and the business processes. The UML domain model comprising Classes, Relationships, Use Cases, Activities and States is equivalent to a formal ontology for that domain, taking the definition of an ontology as being “an explicit formal specification of how to represent the objects, concepts and other entities that are assumed to exist in some area of interest and the relationships that hold among them” (International DOI, 2005). UML may be extended by stereotypes and tagged values if required to define precisely concepts in the domain (Fuentes and Vallecillo, 2004) thus negating the need for a separate and different ontology language. The extended UML elements are packaged together into what is termed a UML profile. In this way an e-learning profile for UML can be constructed and added to as more information about the domain is gathered. This profile may then be applied to any modeling effort concerned with e-learning provision.

The domain model for e-learning provision being developed in this research program employs Class Diagrams, Activity Diagrams and Use Case

Table 1: Knowledge Areas Covered by Checklists

ORGANIZATION	**ACE:** American Council on Education 1997	**AFT:** American Federation of Teachers 2000	**ADEC:** American Distance Education Council 2004
INSTITUTIONAL GUIDELINES	o Organizational Commitment.	o Encourage experimentation	o Administrative & organizational commitment.
PROGRAM DESIGN AND CURRICULUM GUIDELINES	o Learning Outcomes o Technology	o Class size o Student assessment o Full programs o Evaluation of Coursework	o Technological and human infrastructure.
COURSE DESIGN AND PEDAGOGICAL GUIDELINES	o Outcomes o Content o Expectations o Interactions o Assessment o Complement Elements o Technology o Activities and assessments	o Potentials of medium o Personal interaction o Courses materials	o Outcomes and objectives o Learner engagement o Media Use o Learning environments o Learning experiences o Social mission
STUDENT AND ACADEMIC SUPPORT GUIDELINES	o Learner Support	o Student requirements o Advisement o Research opportunities	o Learner Support
FACULTY SUPPORT GUIDELINES		o Academic control o Faculty Preparation o Materials Control	

Diagrams as a useful subset of the range of tools available in the UML. The Activity Diagrams include the flow of artifacts in the domain, and their state at any stage in the process may be included in the model. In this way the lifecycles of significant artifacts, such as proposals, strategy documents, course materials etc, may be captured in the context of the activities that require or produce them. Concepts, such as monitoring and evaluation and response to events (see Figure 5) are often best represented in Class Diagrams where the elements concerned and their interactions can be depicted. The business rules such as those for determining the appropriate response to events or for decisions in workflows are captured as constraints.

4 CHECKLISTS

Checklists are the result of a non-formal synthesis of knowledge of the domain. Tables 1 and 2 based on Hirumi (2003), illustrate the knowledge areas some of the widely used checklists represent and show the variety in scope and nature of the checklist areas. These lists were developed by a variety of processes, few of which were fully documented but include surveys of practice, expert submissions, team brainstorming and formalizations of working practices. Using these major sources, a composite list was developed for some aspects of the e-learning development process. A sample of the composite is presented in Table 2. The style of checks varies significantly. Some are checks that represent points of principle, some are on approach, some on activities undertaken and some are instructions about what to do. The sample in Table 2, and the type used in this study are of the style that relate to activities undertaken and objectives achieved. In the composite checklist an attempt has been made to keep consistent checks that relate to activities and objectives.

The process of consolidating the various checklists consists of an iterative amalgamation and breakdown of the various activities represented by the checks. By iteratively cross-checking checks it is possible gradually to extend the scope of the subjects checked and to avoid repetition. By

iteratively considering groups of checks it is possible, on first principles, to assess the completeness of the scope and the continuity of the processes.

Table 2: Sample Section from Checklist for E-Learning Development, University of Manchester

QA Checklist for Project Management
Pre-Planning ▪ Has a structured approach been adopted? ▪ Have roles and responsibilities been defined? ▪ Has a communication protocol been agreed? ▪ Has documentation been agreed? Project Control ▪ Does the project have an external assessor? ▪ Has an evaluation, monitoring and feedback system been set up? ▪ Do you have a system for Change Management? Project Exit ▪ Have the deliverables been accepted? ▪ Have you decided how to measure whether the deliverables have been achieved? ▪ Are there any remaining to be achieved at a later stage? ▪ How will you assess what lessons have been learnt? ▪ How will the final costs be calculated? ▪ How will you assess if the benefits have been achieved?

Also by iterative composition, and based on cues in the original checklists, it is possible to develop a structure to the checking process that represents stages or components of a viable e-learning development process. For each of the checks and stages it is possible from some of the checks and from first principles to associate actions and artifacts elsewhere in the enterprise.

5 CROSS-DOMAIN MAPPING

There exists a two-way interaction between the QA domain and the e-learning provision domain that may also be captured by the evolving model. Processes in these two domains interact with each other and influence each other. QA may be viewed as an “Aspect” of the e-learning domain that may be modeled as a system running alongside and impacting on the e-learning provision system.

In turn, as the domain model for e-learning provision evolves, new checks will be discovered that may be added to the checks repository. Gaps not covered by checks may be identified in the QA process and redundancies may be highlighted. Other factors such as which checks are critical and whether there is any bias in the checks may also be illuminated by the act of modeling the e-learning provision domain and capturing practices.

Checklists tell us which things in each stage of a business process, activities and their artifacts should be monitored, and what the outcomes of the checks should be in terms of what actions should be taken and what changes made if the results do not meet quality criteria. This information allows us to build a model of the business process itself.

A small worked example of this cross-domain mapping process is given here using checks available from an internal source (Petch, 2003) and a few external sources (Frances and Bonora, 2004, Kelly, 2004, QAA 1999). Figure 2 shows the top level activity diagram for one section of the e-learning provision model process.

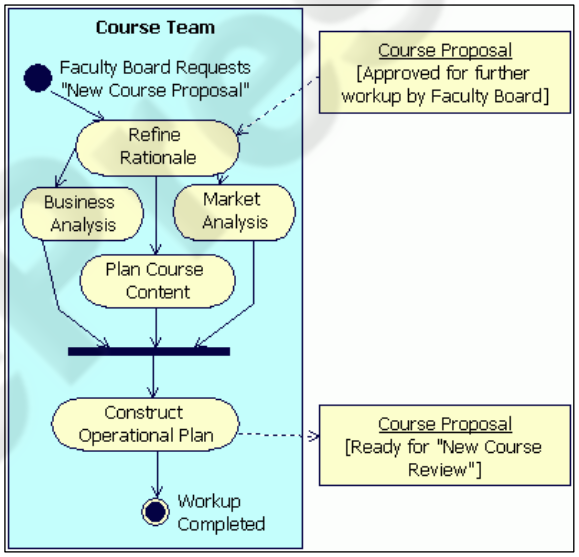

Figure 2: Activity Diagram for Preparing a New Course Proposal for Review.

This section covers the stages between a faculty board approving a preliminary proposal for a new course and requesting a detailed “New Course Proposal” in order to execute a “New Course Review” and the New Course Proposal being ready for that review. The group (role) responsible for carrying out these activities is referred to as the “Course Team”. A checklist appropriate for this stage in e-learning provisioning provided the knowledge about the existence of the role of an approving body. In many institutions this would be a faculty board but in others it may not. In the latter case the checklist may be indicating what roles

another body may have to take on in order to carry out the approval process. The checklists have also guided the sequencing of the steps and in some cases contain the prerequisites for activities.

The checks from multiple lists are managed in a repository where they are given a logical organisation based on the 15 identified practice areas within the e-learning lifecycle (Dexter and Petch, 2003).

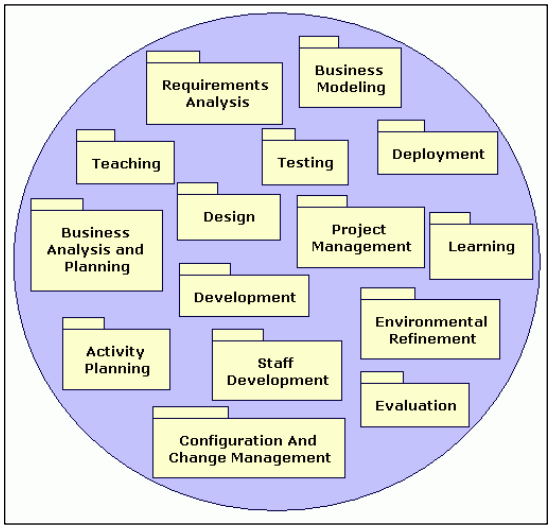

Figure 3: The Practice Areas in the e-Learning Lifecycle

Activities from these practices are executed at various times during the lifecycle of a product such as an "e-learning course". For management purposes, the whole lifecycle is divided into phases and each phase is divided into a number of iterations depending on the complexity of the product being developed. In each iteration there are a number of activities from the practices and the iteration produces a set of deliverables.

The checklist items for the activity Market Analysis, from the Activity Diagram in Figure 2, are found in the "Business Analysis and Planning" practice (Figure 3). Checks were modeled as Classes and Figure 4 shows the internal structure of a check (attributes and operations) and its relationship to the e-learning lifecycle.

There are two ways to build on the e-learning domain model from the checklists:

1. Adding a hierarchy of activities that matches the checklist items by using subactivity states, drilling down from the top level activity diagram and adding object flow states to link artifacts (documents, software applications, e-learning materials, technology) to the activities. These are artifacts required or produced by the activities.
2. Creating a Use Case for the activity. Each Use Case may then be expanded to describe the workflow and outputs in detail. The Use Case will also specify its preconditions, i.e. the activities that have to have been completed prior to its execution. Each Use Case may then be expanded to describe the workflow and the outputs in detail.

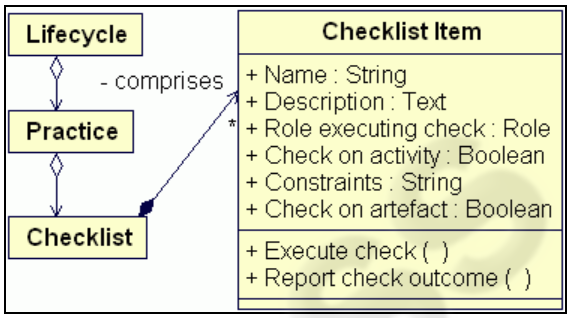

Figure 4: Structure of Checklist Item

The following table (Table 3) shows the activities discovered in checklists relating to "Market Analysis" that would be relevant to the stage in the process shown above, "Preparing New Course Proposal".

Table 3: Activities Identified for Market Analysis

Market Analysis Activity
Determine brand identity
Identify markets and the elearning segments
Determine the positioning of the course
Calculate the size of potential markets
Assess trends in potential markets
Assess ease of access to potential markets
Assess the nature of the competition
Determine the market share of other producers.
Create strategy for acquiring and analyzing market information
Set up system for monitoring and evaluating needs of students and alumni
Determine the long-term potential of the course
Identify the sales channels for the course.
Determine whether price is a determining factor
Discover which courses have done well recently and why (also poorly)
Review possible changes in government policy that may affect demand
Discover the key success factors in this market

When the course team reaches the stage in the preparation of the New Course Proposal of "Market Analysis" it will be able to see the expanded set of activities recommended. The team should execute the activities and then use a checklist from the

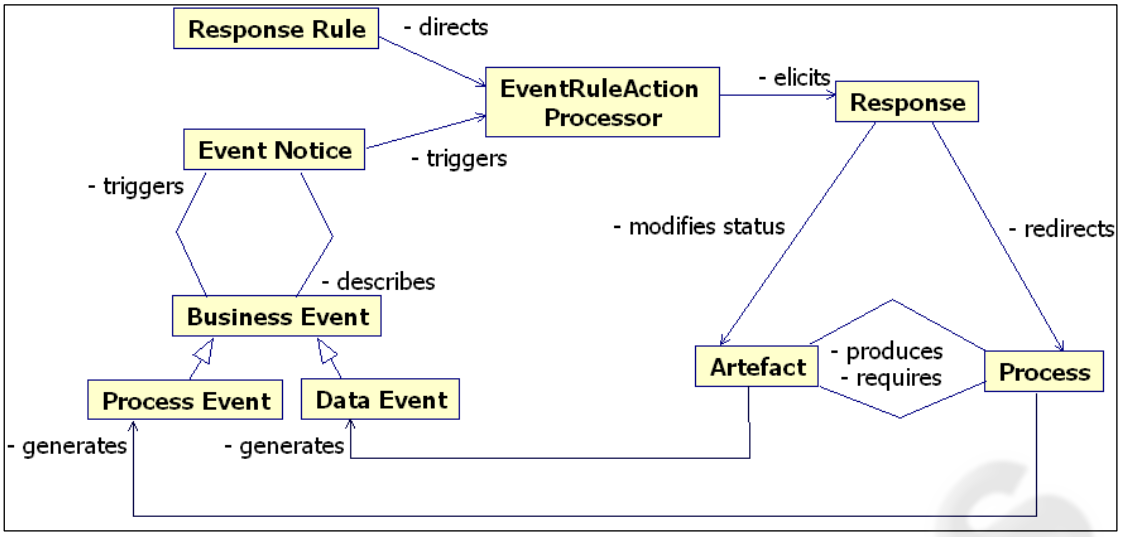

Figure 5: Events and Rules Governing Processes

repository to ensure that it has covered all the areas. The relevant checks are found in the checklist repository by the activity "Market Analysis" itself, by means of a subscription mechanism (see section 6). Each of the activities inside "Market Analysis" may also have subscribed to checks and these can be made available to the course team as they execute the activity Operationalization.

The model shown above (Figure 5) of the event response governing process is based on a simplified version of the event-driven process and data-event-driven process models provided in the EDOC UML profile (OMG, 2004).

This model decouples the events generated by an activity or artifact in the business process from the set of responses to that event by using a publish-and-subscribe mechanism. In this way any activity or artifact in the system can subscribe to a set of checks and respond to them appropriately. Any event in the system, generated by an activity or an artifact can publish, in an event notice, the need for a set of checks and these will be picked up by those processes that have subscribed to the event. Their response to the checks is contained in the "Response Rule". This response could be in the form of a new set of activities in a process and/or the repetition of activities that have already been executed.

This mechanism allows a reservoir of checklist items to serve multiple processes, with checklist items being used in different places in ways determined by the Response Rule which will be appropriate for the context.

6 E-LEARNING SERVICES PROVISION

e-Learning service provision can be driven by executable business process models by adopting mechanisms based on the Business Process Execution Language for Web Services (BPEL4WS) (Kath, Blazarenas, Born, Eckert, Funabashi and Hirai, 2004). Such mechanisms will collect the services and components in the environment, both technology-based and people-based, and choreograph them into a service aligned with the defined task.

In order to get closer to the quality of model required for such a venture we need to be able to acquire extensive, in-depth knowledge about the processes. The models must also be provided to institutions in a way that they may be customized for the organization. One means to improve the depth of knowledge in the domain model is shown to be by interacting with the QA domain and to learn from QA checklists.

7 CONCLUSION

We have argued that cross-domain mapping can form part of an enterprise modeling strategy for e-learning provision. We have demonstrated a proof of concept for the process of cross-domain mapping and have provided a model of a mechanism to operationalize the use of checklists for governing the provisioning process in e-learning.

The next steps in the work are a fuller development from the proof of concept to a rich e-learning model based on the combined checklist set. At the same time, the checklists should be refined as we are able to take a whole system view. The checklist operationalization mechanism should be implemented and tested over a range of situations where checks give rise to modified activities in multiple parts of the e-learning provision processes.

REFERENCES

Dexter, H., Petch, J., 2003. A Roadmap for e-Learning Service Provisioning, e-Learning Research Centre, research paper, http://www.elrc.ac.uk/publications/163/

Frances, V.L., Bonora, A.G., 2002. Methodology for the Analysis of Quality of Open and Distance Learning Delivered via the Internet (MECA-ODL) www.adeit.uv.es/mecaodl

Franklin, T, Petch, J., Armstrong, J., Oliver M., 2004. An Effective Framework for the Evaluation of E-Learning, eLearning Research Centre, research paper http://www.elrc.ac.uk /publications/153/

Fuentes, L., Vallecillo, A., 2004. An Introduction to UML Profiles, UPGRADE , European Journal for the Informatics Professional 5,2, http://www.upgrade-cepis.org/issues/2004/2/ upgrade-vol-V-2.html

Hirumi, A., 2003. In Search for Quality: An Analysis of e-Learning Guidelines and Specifications, submitted to the *Journal of e-Learning Administration*

International DOI (Digital Object Identifier) Foundation, 2005. Glossary, http://www.doi.org/ handbook_2000/glossary.html

Kath, O., Blazarenas, A., Born, M., Eckert, K.-P., Funabashi, M., Hirai, C., 2004. Towards Executable Models: Transforming EDOC Behavior Models to CORBA and BPEL, *Proceedings of the 8th IEEE Intl. Enterprise Distributed Object Computing Conference*

Kelly, B., 2004. *QA Focus Handbook*, JISC QA Focus Project www.ukoln.ac.uk/qa-focus/ documents/handbook

Object management Group (OMG), 2004. UML Profile for Enterprise Distributed Object Computing Specification, http://www.omg.org/ technology/documents/ modeling_spec_catalog.htm

Petch, J., 2003. Quality Assurance for New Courses, e-Learning Research Centre, working paper, http://www.elrc.ac.uk/publications/162/

Petch, J., 2004. QA Checklists, e-Learning Research Centre, briefing paper, http://www.elrc.ac.uk /publications/162/

Quality Assurance Agency for Higher Education (QAA), 1999. QA Distance Learning Guidelines www.qaa.ac.uk/public/dlg/contents.htm

Scienter-MENON Network (ed), 2004. *Sustainable Environment for the Evaluation of Quality in E-Learning* (SEEQUEL) http://www.education-observatories.net/seequel/SEEQUELTQM _Guide_for_informal_learning.pdf

Western Cooperative for Educational Telecommunications (WCET), 2000. Guidelines for the Evaluation of Electronically Offered Degree and Certificate Programs http://www.wcet.info/resources/accreditation/ guidelines.pdf

Wilcox, P., Petch, J., Dexter, H, 2004. A Foundation for Modelling e-Learning Processes, e-Learning Research Centre, working paper, http://www.elrc.ac.uk/publications/148/