A Management System for Model-Oriented Course Outlines

Olivier Gerbé
HEC Montreal
Montreal, Quebec, Canada H3T 2A7
olivier.gerbe@hec.ca

Jacques Raynauld
HEC Montreal
Montreal, Quebec, Canada H3T 2A7
jacques.raynauld@hec.ca

Abstract: Driven by requests from Internet-savvy students, a large number of universities and educational institutions have started to design, develop and use information and communication technology to create, share and disseminate instructional material. Commercial tools, such as Blackboard and WebCT, are available to offer basic course management functionalities. However, most of these tools are hindered by flaws that prevent sharing and publishing instructional material. For example, professors are generally provided with little assistance and deprived of models to develop the structure of their course outlines and they often prevent colleagues from sharing resources. Creating course outlines is indeed a laborious and complex task. The authors believe that a management system for electronic course outlines should be based on the management of models which enables users to create, adapt and modify course outline structures. This paper presents Course Zone, a model-oriented management system for course outlines developed at HEC Montreal.

1 Introduction

Driven by requests from Internet-savvy students, a large number of universities and educational institutions have started to design, develop and use information and communication technology (ICT) to create, share and disseminate their instructional material. Unfortunately, less than 40% of American universities and colleges have a Web portal dedicated to individual courses (Campus Computing Project, 2004).

Commercial tools such as WebCT (WebCT, 2003), Blackboard (Blackboard, 2004) and eCollege (eCollege, 2004), are now available to offer basic course management functionalities. Experimental tools such as Stellar from MIT (Massachusetts Institute of Technology) (Stellar, 2004) or The Sakai Project (Sakai, 2004), a 6.8 million dollar project, have also been developed. Generally, course management systems were designed for telelearning contexts. Many of these systems are hindered by flaws that prevent widespread use by teachers. These systems provide a number of tools to communicate with learners and assess their work, learning and knowledge although they offer little help for the activity that requires the most resources: the development of a course Website. Teachers have little or no help to structure their course outline Website and it is often impossible to share resources with colleagues. Consequently, the development of a course Website remains a long and complex process. In order to address these drawbacks, we believe that electronic course outline management systems should be based upon management models which allow users to create, adapt and modify course outline structures.

The Object Management Group (OMG) presented a new approach to developing information systems. It is called the Model Driven Architecture (MDA) (OMG, 2003a) (Bézivin & al., 2001). According to the OMG, the MDA provides a scalable approach that is platform-independent to address the challenges linked to rapid changing world of business and technology. According to the standards already stipulated by OMG, the MDA allows users to separate the business or applicative logic from the underlying platforms. This approach was applied to the solution proposed in this paper. A model for the management of electronic course outlines was developed, then, a new course outline management system was created in accordance with this model. In order to design this system, the authors organized numerous meetings involving teachers, students and administrative staff. This approach enabled the authors to develop a common vocabulary and helped them to discover the most efficient methods to manage course outlines.

HEC Montreal is a business management school located in Montreal, Quebec. The course catalogue includes about 1,500 courses. Two major challenges had to be addressed in order to publish online the course outlines: (1) the logistics problems associated with a course divided into with multiple groups taught by different professors; (2) controlling the dissemination of the instructional resources linked to the course outline.

Certain courses are taught to over 15 different groups, at different times, by different professors. For courses with multiple groups, a single professor is the designated Course Coordinator. The coordinator is responsible for the instructional content of the course. Before the development and use of the new system Course Zone, coordinators could manage the contents of a given course in one of two ways.

The first, and most simple method, was to manage a single Website which eventually included specific resources for each group. This approach generated frequent maintenance problems. Either, all of the professors who taught the course were authorized to update the Website, which was likely to hinder coherence, or, the coordinator was overloaded with too many documents to publish and fell behind, thus, the Website was never up-to-date. In this situation, professors from each course would send numerous emails to their respective students.

The second option was to create a different Website for each group. However, the coordinator had to send an email all professors to signal every single modification made to the common sections of the course outline. Afterwards, each professor had to update the site for his or her group(s).

The other issue mentioned above concerned the control of the information disseminated. At HEC Montreal, professors are encouraged to disseminate their instructional material at large. However, certain resources cannot be broadcasted to the entire WWW community. For copyrights or confidentiality reasons (e.g., a corporate balance sheet), certain resources must be reserved solely for the students who are officially registered for the course.
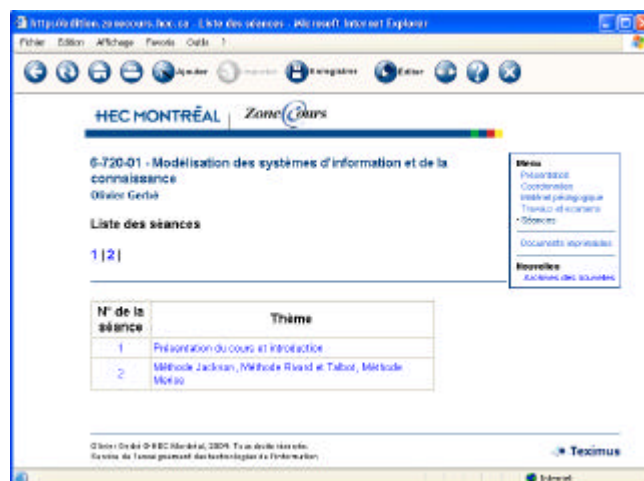

Figure 1: Screen shot

The development of the new electronic course outline management system was aimed to respond to these needs, while ensuring that users do not depend on a unique provider (Unsworth, 2004). For professors, lecturers, and support staff, Course Zone provides an environment for editing and publishing electronic course outline or course websites which:

- offers advanced functionalities while being user-friendly;
- requires no knowledge of HTML language;
- permits users to reuse and share instructional electronically formatted material;
- is adaptable for multiple groups;
- integrates advanced security features.

For students, Course Zone is an environment that supports their studies:

- it offers a unique access point to their various course Websites;
- it uses a unified interface;
- it allows rapid access to all instructional resource information required to succeed in their studies.

For the general public and the HEC Montreal community in particular, Course Zone is a gateway to a wealth of instructional resources in all aspects of management.

This paper is divided into three different sections. The first section describes the general architecture of Course Zone and a second section presents the underlying course model and security model of the application. Finally, a

third section provides the preliminary results obtained following the experimental implementation of the program.

2   Architecture

This section presents the general architecture of the application. Course Zone is composed of three modules: an editing module, a publishing module, and a storage module. Figure 2 illustrates this architecture.
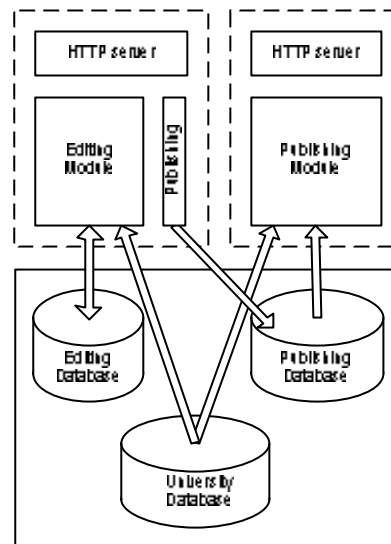

Figure 2. Course Zone architecture

2.1 The Editing Module

The most complex module is the editing module. Based upon course outline models and security models (presented in the following section), it manages all course outline material. It includes functionalities for structure, resource and security management.

Not only do the structure management functionalities allow professors to create new course outlines, or to modify or duplicate existing course outlines, they also allow them to define the very structure of the course outline (e.g. determine the quantity and types of sessions). For courses with multiple groups, professors who teach the same course can design a common course outline that includes the information and instructions valid for all groups. Each professor then merges this common course outline with another course outline that is tailored to each course.

Resource management functionalities allow users to link instructional resources to the course outline. The system manages different types of resources: bibliographies, external documents (PowerPoint presentations, Excel spreadsheets, Internet hyperlinks, etc.), internal documents (texts managed by the system), news, assessment activities, exercises, etc.

Security management functionalities allow professors to control the visibility of the resources and to provide editing rights to colleagues. They also allow a professor to join a team and share resources with the members of this team. The editing module was developed with Teximus Expertise (Teximus, 2004). This knowledge management tool allows users to develop model-oriented applications which offer advanced security features.

2.2 Publishing Module

The publishing module is responsible for storage and provides access to course outlines and their associated resources. It is composed of two submodules: a Generation Submodule and an Authorization Submodule.

The Generation submodule allows professors to generate different Web pages for the course Website according to the information stored in the editing module. Once a professor decides to publish the material, he or she can launch his or her course Website. The system will generate the various pages of the course outline according to the structure determined by the professor. The system also copies resources associated with the course outline.

All of the objects, HTML pages and resources are stored in a database to provide better access control. When publishing a course outline that is used by multiple groups, the system merges the information and resources for both the specific and the common course outlines. Therefore, publishing a common outline involves the publication of each specific course outline which is then meshed with the common course outline.

The Authorization Submodule is used to provide access to the course outline Websites. This submodule is responsible for managing access rights. Professors can prevent access to certain resources in the HEC Montreal community or decide that certain document can only be shared with students who are registered for the course. Course registration, which is managed by the university central system, is coupled with Course Zone, thus enabling them to verify the official registration lists before granting access to resources.

2.3 Database Module

The Database Module provides access to three databases: the Editing Database, the Publishing Database, and the University Database. The Editing Database manages the structure, resources and access rights. The Publishing Database manages the course outline Web pages, which are generated by the Publishing Module. For the purpose of this paper, suffice it to say that the University Database manages students' registration in various courses. It also contains information about the courses assigned to each professor.

3. A Course Management Model

This section presents Course Zone's modeling architecture, which is composed of two layers: the metamodel layer and the model layer. The metamodel layer contains the elements which allow users to define the system models. The model layer contains the types (e.g. a course or a semester), associations, instances and links used to describe the system.

3.1. The Metamodel Layer

The metamodel layer is relatively simple. It is derived from the entity-relationship formalism (CDIF, 2004), the MOF (Meta Object Facility), and the UML (Unified Modeling Language) modeling language metamodel (OMG, 2003 b). Figure 3 illustrates the six fundamental elements of the metamodel layer.
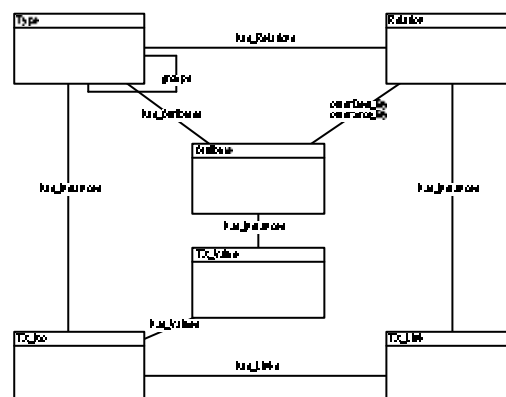

Figure 3: The metamodel layer

Types can have both attributes and relations which describe their instances. Type instances are knowledge object (TX_Ko). Relation instances are links (TX_Link) and the attributes instances are values (TX_Value). This metamodel includes the concept of unified types (groups). This concept differs from the classical inheritance notion as only relations are inherited by the types which participate in the union. This notion is better adapted to knowledge management than the heritage concept generally used, as it allows users to group objects which have different structures, but share common relations. In knowledge management, the common relations between objects are much more important than their structure. One interesting feature is the presence of the relations orderDest_By and orderSrce_By which allow to sort links between two knowledge objects according to the attribute values of these objects.

3.2. The Course Model

The Course Model defines the vocabulary used in Course Zone. Figure 4 illustrates this vocabulary. The central element, the course outline (CourseOutline), is divided (includes) into sessions. The system considers different types of sessions, such as classes, assignments, projects, laboratory experiments, etc. A course outline, or a session, can be associated with different resources (resource). This association is made through a representative (ProxyResource). The representative represents the resource context in the course outline. A single resource can appear in different course outlines or sessions with different characteristic (e.g., a single resource could bear different names, or it could be mandatory in one course, but optional for another). A resource appears under an entry (entry) in the course outline once it has been analyzed by its representative. The intellectual property related to the course outline and its resources are linked to a user according to an ownership (proprietor) relation.
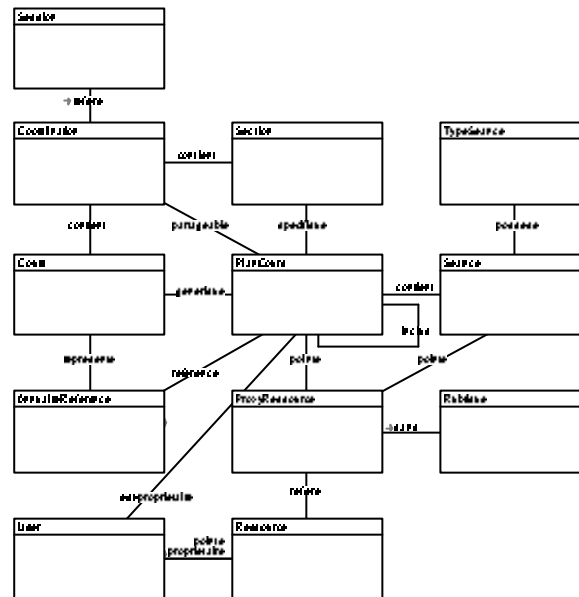

Figure 4. The course outline model

The remaining elements deal with organizational matters. A course outline can be either generic or specific. A generic course outline is assigned to a course (course); however, it is not assigned to a section (section). A generic course outline cannot be published; it is a working document which allows professors to prepare the official course outline before it is assigned to a section. A specific course outline is a document used during a semester; it is assigned to both a course and a section, and it can be published. A section, which represents a single group taking a course, therefore, each section is assigned to a professor who acts as the coordinator. The groups that share a common coordinator are assembled by the coordination portion of the program, enabling them to access the specific content of the course outline. Coordination is related to both a course and a semester (semester). It is possible to associate a common (shared) course outline through coordination of the program. The elements of this common course outline are meshed with the specific course outline associated through the coordination of the program. Finally, the last part of the model refers to a brief course description in the university catalogue (catalogue), which is the official course description, including its administrative characteristics

3.3. Security Models

There are two security models: the Editing Model and the Student Model. The Editing Security Model is used to control access to the editing mode, while the Student Security Model is used to control access to the course outline resources.
The Editing Security Model is based on the concepts of teamwork and contribution to team projects. Knowledge objects are saved in groups. Although they are saved in a single group, this cluster can be included in many other groups. Figure 5 illustrates the Editing Security Model.
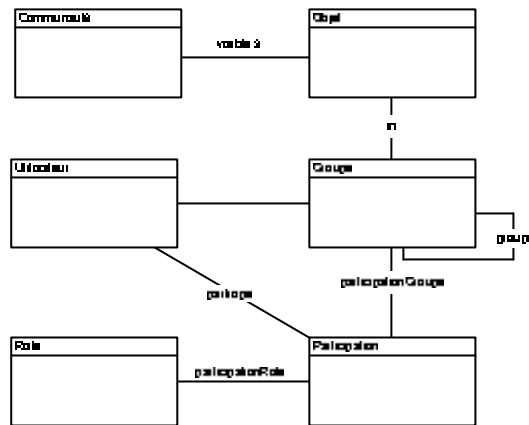
Figure 5. The editing security model

Object access is determined according to users' roles (role) and participation (participation) in groups (group). A certain number of roles have been determined: administrator, designer, author, user, guest, etc. By default, Course Zone creates a group for each user and each course. The course outline resources are saved in the group which belongs to the author of the course outline. A single resource used in numerous course outlines is stored in the group where it was first saved. Professors are assigned to the role of author in the groups containing their own course outline. The author has full editing rights over the objects included in their group. To provide editing rights to another group or another actor, an additional (group of) author can be added to the group. People who were granted user rights can access the objects that belong to the group; however, they cannot edit them. It is also possible to create work teams which share common resources. Moreover, professors are able to assign each object they publish to one of three levels of visibility.

Based upon resource visibility, the security model is rather straightforward. When creating resources, authors can indicate the community to whom the object will be visible. Up to now, three communities have been identified: the general public (i.e., the World Wide Web), the HEC Montreal community, and a group of students who are registered for a specific course and a given semester. The HEC Montreal community refers to the entire university community. This includes users who have access to the university servers, or anybody who provides credentials indicating that he or she is a HEC Montreal student, professor or staff member. The general public includes the HEC Montreal community, which, in turn, includes the students registered for a course. Figure 6 illustrates the elements included in the Student Security Model.
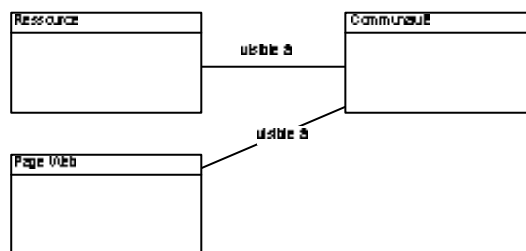

Figure 6. The Student Security Model

In the Publishing Module, resources differ from course Web pages. Publishing a page differs from publishing a resource. Resources are saved in a database with their associated visibility level (WWW, HEC Montreal or registered students). A different page is thereby created for a Web page that grants access to the selected resources. Thus, if a page contains solely WWW resources, with the exception of a single resource, which is reserved to registered students, two Web pages are created: one that contains the hyperlink which allows access to this resource, and another one that does not include this link. Thus, for people who are not registered for the course, the link does not appear on their screen as the resources have not been made available to them. When a Web page is requested, the system verifies the user's status in the community. Their status can be verified in one of two ways. First, the IP (Internet Protocol) address is authenticated. If the request originates from the school network, the system presumes that the user is a member of the HEC Montreal community. Second, users can log on to the system by providing their usernames and passwords (using LDAP, Light Directory Access Protocol). The system then uses the university database to verify the courses for which the student is registered, or the list of courses taught by a professor. This official list provides designated users with access to course outline resources in a fast, efficient and secure manner.

4. Preliminary Results

4.1.   Implementation Context

This project was launched in January 2003, after it was determined that the variety of formats and technology used by professors to develop their course Websites was confusing for students, professors and the administrative staff. Moreover, due to a plan to migrate, in April 2004, towards the administrative management system PeopleSoft, an important security feature used by professors to protect files on their course Websites would be lost. Two important conditions were thus the catalyst for developing a new system that would address these needs.

Following a thorough analysis of the different electronic course outline by professors from different departments at HEC Montreal, a series of meetings were organized between professors, lecturers and the administrative staff of the school, to explain the objectives of the project, but more importantly to gather their comments regarding the framework for the prototypes that the Course Zone team would develop. These meetings confirmed that the proposed features responded to the genuine needs expressed by the users (even more so for courses with multiple sections), thus the parties involved cooperated in an atmosphere where people were very receptive to change. These meetings also allowed researchers to present preliminary interfaces to the users.

4.2.   Initial Prototypes

The first functional prototype was developed during the summer of 2003 and it was tested with a dozen users during the fall (2003) semester. This first experiment received a very positive response concerning the general structure of the model, yet it also revealed certain weaknesses regarding the data input interfaces. In the winter of 2004, a second version of the prototype was investigated. About 20 users, participants compiled of professors, members of the administrative staff, and a more significant number of students than for the first experiment, took part in the study. In this second version, the data input interfaces underwent major changes, which later turned out to be an important component favouring a more widespread use of Course Zone.

4.3.   Going Online

Due to the migration towards the administrative management system PeopleSoft, a functional, online version of Course Zone was released in time for the summer 2004 semester. This deployment involved about a hundred courses. The HEC Montreal summer semester starts in early May, thus, in April 2004, training workshops were organized for professors and the administrative staff. Meeting with the heads of the different departments at HEC Montreal were organized to plan the transition. A dozen students from the electronic pedagogy team (who are available to assist professors and administrative staff) were assigned the task of converting existing course outlines to the new Course Zone system.

The conversion work continued through the summer, in order to prepare for a fall 2004 deployment for the entire HEC Montreal community. Supplementary training workshops were also offered at the end of August. Thus, at the beginning of September, when classes started, the system was fully operational, in both the publishing and editing modes. Moreover, the performance of the publishing mode was particularly impressive, allowing students rapid access to their course material, even during peak periods.

In the fall semester, out of 595 courses offered by the various HEC Montreal programs, nearly 70% (n=411) of them had their course outlines accessible through Course Zone. As for the individual groups of students (a single course can be offered to multiple groups of students), statistics show that over 70% (860 out of 1,218) of all groups used Course Zone.

The centralized approach of Course Zone allows administrators to compile statistics rapidly. So far, over 8,842 documents were published through Course Zone. This includes 3,364 Word documents, 1,319 PDF files, 3,012 Power Point presentations, 606 Excel spreadsheets and 241 zipped files.

Conclusion

This paper presented an electronic course outline management system called Course Zone. Developed at HEC Montreal, this system addresses specific needs (courses with multiple groups and restricted access to resources) while favouring the dissemination of instructional resources developed by professors to the general public.

Based upon a model, this system is easily scalable and flexible. Separating the editing module from the publishing module allows users to work on course outlines until the moment they are ready for publication. The application includes an elaborate system to restrict access to resources. This favours the broadcasting of instructional resources to the general public and reassures professors who wish to protect certain documents, as it is no longer necessary to reserve all instructional material solely for the students registered in the course.

According to preliminary statistical results obtained after the implementation, Course Zone is a successful system. Without any obligation whatsoever, right from the first semester, 70% of HEC Montreal courses had a Website in Course Zone. Simple, user-friendly editing interfaces which are identical to the published version are certainly responsible for this success.

The system is undergoing further developments which will be integrated in the near future. The authors are currently working on a system to manage reference lists. Indeed, courses often have long reference lists which are repeatedly keyed in. Eventually, Course Zone will support queries from the library information system thereby allowing a more efficient, centralized management of references. Future components also offer a management system for course packs (i.e., a collection of documents used in a specific course and semester, prepared by professors and acquired by students at the beginning of the semester). Integrated with Course Zone, this system will allow professors to use bibliographic references to create course packs that will be sent automatically to the printing shop.

Finally, two research projects were launched to encourage the dissemination of instructional resources to the general publish and the business world. The first project deals with the integration of ontologies in the field of management. These ontologies will provide access to resources linked to a specific domain. The second project aims to develop a competency model that will provide access to resources associated to a specific skill a user wishes to acquire. These projects will allow the general public to follow the latest advances in the realm of management and to acquire the necessary knowledge pertaining to their professional development.

References

Bézivin and O. Gerbé. (2001). Towards a Precise Definition of the OMG/MDA Framework. In the Proceedings of the 16th Conference on Automated Software Engineering, pages 273–280, San Diego, CA, November 2001. IEEE Computer Society Press.

Blackboard Inc. (2204).. The Blackboard Learning System. 2004. Website: www.blackboard.com

Campus Computing Project. (2004). The 2004 National Survey of Information Technology in US Higher Education. 2004. Available at www.campuscomputing.net

CDIF Technical Committee. (1994) CDIF: Case Data Interchange Format: Framework for Modeling and Extensibility. July 1994. Electronics Industry Associate. Interim. Interim Standard EIA/IS-107.

eCollege.com. (2004) AU+ Course Management System. 2004. Website: www.eCollege.com

Object Management Group and R. Soley. (2000). Model Driven Architecture. November 2000. OMG document available at www.omg.org

OMG. (2003a). MDA Guide Version 1.0.1. June 2003. Document number: omg/2003-06-01.

OMG. (2003b) Meta Object Facility (MOF) 2.0 Core Specification. October 2003. ptc/03-10-04.

Sakai Project. (2004). Sakai Help Guide. 2004. Available at www.sakaiproject.org

Stellar Course Management System. (2004). Website: stella r.mit.edu.

Teximus Technologies Inc. Teximus Expertise 2.2. (2004). Available at www.teximus.com

Unsworth, J.M. (2004). The Next Wave: Liberation Technology. The Chronicle of Higher Education, 50(21), 2004.

WebCT Inc. (2003). WebCT: Learning without Limits. 2003. Website: www.webct.com