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Title : E-Learning in the academic world: a survey

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Abstract

E-Learning refers to the use of Internet technologies to deliver learning experiences. Since 1995, an ever-growing number of universities has chosen the Internet medium for teaching and learning. How these universities launched their "e-program" and to what purposes? Answers to these two key questions are tentatively addressed in this survey by peering more than 20 universities. While the list of these universities is far from being exhaustive (nearly all universities have now some form of e-Learning culture), it represents a sampling of the most "visible" cases at the time of this writing. This list includes North American, European, Asiatic and Australian universities. Swiss universities are not included in this survey, as the swiss e-Learning landscape has recently been extensively drawn up by the Università della Svizzera italiana (Lepori and Succi 2003). In addition to this peering, two major e-Learning initiatives, the MIT open courseware and the virtual open university of Catalonia, are presented in the details. Furthermore, a section describing the e-Learning standards currently used in the learning community is also included so that this survey is as much as possible self-contained.

Contents

1 Introduction

Learning and teaching using technology is increasingly cited in the academic world[1]. This mode of learning is referred as "e-Learning", a word that designates learning in the context of the Internet and associated Web-based applications as the delivery medium for the learning experience. In Switzerland, the importance of e-Learning has been recognized at the political level since 1999 when the parliament approved the Swiss Virtual Campus (SVC). Through this program, the Swiss universities received 30 million francs for the years 2000-2003. The European community has also recently recognized the importance of e-Learning. The EU Council has recently approved the 2004-2006 e-Learning Program, in which 44 million euros will be invested in providing incentives for the twinning of schools, the development of virtual campuses and the promotion of digital literacy. The "e-Learning Europe" program is currently establishing a directory of the existing resources in the universities and are interested in disseminating the "best practices" in Europe[2]. In U.S.A, the incentives for promoting e-Learning in the higher education are in line with those found in Europe. However, the actions undertaken by the universities are made independently, without clear state programs for unifying their individual efforts.

What the literature indicates is that the introduction of e-Learning activities in higher education has increased very fast over the last years. Thanks to the SVC, Switzerland is well positioned in this race (Lepori and Succi 2003; ICNEE 2003). However, the SVC program is due to end in 2007, which makes essential to build lasting e-Learning centres. The success of such centres will crucially depend on resource sharing of e-Learning material, and on the development strategy of the university for modernizing teaching activities based on these new educational technologies. Inspiration from other universities, as those presented in this document, should help identify the key elements that are needed to sustain the development of such e-Learning centres.

1.1 Scope of the survey

Most of the universities are developing, at least in some areas, e-Learning activities. Indeed, the conception of e-Learning is very broad, encompassing different kinds of educational offers, ranging from simple activities like placing course material on the web, to blended learning based on distant interactive classes, or using virtual environments, to cite but a few. Thus, it would be utterly ambitious to claim that this survey represents an exhaustive study of the academic world. Rather, this survey attempts to identify and analyse the main trends in e-Learning. It is not the aim of this study to assess which strategy is best, or which technology complies best with the pedagogical goals. Statistics are still too sparse for getting a clear picture of the achievements in e-Learning. The survey thus will concentrate on how the universities use e-Learning, what are their priorities, their target public, their choice in the technologies, how they finance and organize their support centres, and what general strategy they pursue. A second aspect presented in this survey bears on the e-Learning standards, which are increasingly used by the academic world as a way to share resources. Again, only the most frequently cited standards are described, and the list is likely to evolve in the near future.

[1] By "world", it is meant the industrial world *and* the developing countries as well. As it will become clear in this document, for the developing countries such a technology represents a unique chance to access knowledge using the current infrastructure they own (e.g. cyber-cafe).

[2] In October 2003 I have been contacted by the staff in charge of this program.

1.2 Outline of the survey

The core of this survey is composed of four sections. The first, Section 2, describes the general strategies followed by universities in a variety of countries. This is a convenient starting point as strategies determine the orientations and trends of the e-Learning programs, which generally have a large impact on the choice of the technology. More than twenty universities are considered. It is followed by two case studies in Section 3, one related to the open courses and another concerned with virtual universities. The e-Learning standards are then presented in Section 4. The survey concludes in Section 5 with some general considerations and perspectives on e-Learning.

2 Strategic choices in e-Learning

2.1 Introduction

Why have an e-Learning strategy? One sensible answer is to state that a strategy is needed to deal with the complexities of the interactions existing between e-Learning and the organisation, and to take care of the difficulty in changing people's attitudes about a new learning approach. Clearly, for institutional change to be effective, there is a need to be led from the top, starting with a vision of what the new organization is to be like (Brown 2002). The more pieces of the foundation that are supporting, rather than hindering, e-Learning initiatives, the greater the likelihood that these initiatives can be sustained.

Because e-Learning is not a value for itself, the crucial question an organization has to ask is "What do we want to use e-Learning for?". Seufert and Euler (2003) identified 5 dimensions for a sustainable implementation of e-Learning: learning/teaching, culture, technology, organization, and strategy. If one were to define a hierarchy in these dimensions, strategy would without doubt be placed on top of the others. It is the strategy that determines the e-Learning scenarios, sets the incentives for innovative teaching environment, establishes the central support structures, puts the requirements on technology, sets up a funding plan, defines external cooperation, etc. Identifying such strategies deployed by various universities for performing e-Learning is the focus of this section.

2.2 Overview

Following Rosenberg (2001), a strategic foundation for e-Learning must do more than just build and deliver high-quality training on the Web. It should also include the following critical elements[3]:

- The adoption of an organizational (and business) model that supports rather than limits the growth of e-Learning;
- The creation of an organizational environment that encourages learning as a valuable activity of the university;
- The use of the organisation's technological capabilities to deliver and manage e-Learning;
- The coordination of e-Learning with the rest of the university's learning efforts;
- The establishment of a knowledge management that provides informational databases and assessment support tools.

[3]This list, originally established for business needs, has been adapted to the academic world.

Concrete examples of strategy implementations are now provided. This overview covers North America, Europe, Asia, Australia, as well as one example of an African e-Learning site. Most of the e-Learning initiatives presented in this overview are recent, less than five years old. The initiative status corresponds to what is available on the source web sites in December 2003.

2.2.1 University of Alberta, Canada

URL: www.ualberta.ca/WEBCT

Like many e-Learning projects in higher education, the university program was originally targeted toward faculty for purposes of enhancing the classroom experience. The program then evolved toward the distribution of static content, such as syllabi, schedules, announcements, and lecture notes, as well as the access to interactive tools such as discussion threads, whiteboards, live chat, and online assessments. Faculty find that using the technology allows more time for critical thinking, and makes use of virtual guest lectures to offer students exposure to experts. The whole e-Learning program is based on a standard learning management system (webCT).

The university proposes a campus-wide support unit, the Academic Technologies for Learning (ATL), which is available to assist faculties, departments, corporate and academic researchers, professors, sessionals and graduate students for consultation on innovative learning environment research, design and architecture. A team of experts supports the development of best practice teaching and effective learning environments through the exploration of alternative instructional delivery methods and the blending of technologies and pedagogical approaches. To minimize the barriers of time, money and skill associated with developing online learning resources, the ATL proposes Online Learning Resources.

More than 16 faculties are "online", offering hundreds of courses through the webCT platform. Furthermore, the e-Learning services include Web-4M, a suite of communication and collaboration tools, and a learning objects repositories[4]. In each room users can audio conference, chat, share graphics via a whiteboard, and view slides through an interactive slide show. Instructors can conduct live polling and assessments during a conference session. Conferences can also be recorded for later review. Access to these resources is restricted to campus students.

2.2.2 University of British Columbia, Canada

URL: www.e-Learning.ubc.ca/home

This university focuses on improving the overall learning experience by strengthening and coordinating support networks and providing appropriate tools and infrastructure for using technology in innovative and effective ways. A guiding role is provided by a "pan-university" group comprising professional representatives from units engaged in IT, educational technology, instructional support and teaching and learning within faculties and central units. The e-Learning course design support for the faculty is not provided by a centralized group, but by members within each school or department group, who are themselves members of an e-Learning community. The main e-Learning strategies of the university are:

[4]Learning objects are stand-alone packages of information and learning closely related to pedagogy and repository. They must be digital, efficient, self-sustained, sharable, reusable, and have instructional objectives. They can be as simple as short video clips, a chapter of a textbook, or a map, or as sophisticated as a virtual tour of a museum, an interactive learning experience such as a flight simulator, a chemistry experiment, or assessments. A recent document treating of the learning objects standards (S3 Working Group 2003) is to be found on the web site of the Masie Center (www.masie.com). This centre sponsors an e-Learning consortium, a collaboration of major corporations, government agencies and e-learning providers that focus on the future of e-learning. The consortium is intended to be a community of practice which provides an information network and data on e-learning practices and technology.

I. Develop learner-centred undergraduate curricula that incorporate research, international, interactive and interdisciplinary components;

II. Fully integrate information technology with instruction in all areas;

III. Renovate and upgrade classroom and laboratory spaces and equipment, to support a research-based, interactive learning environment;

IV. Ensure that faculty members and staff are appropriately prepared to function effectively in a learner-centred environment

V. Develop alternative ways of delivering credit and non-credit programs to students unable to attend classes at regular hours or on campus. Create new programs that address the life-long learning needs of citizens in a knowledge-based society. Expand the continuing higher education programs at the graduate level and in professional upgrading, to provide unique distance learning opportunities throughout the province.

Funding comes from the "Teaching and Learning Enhancement Fund", a program the University created to take 3.5% of student tuition and set it aside for a competitive process among faculty to create sustainable learning enhancements. Hundreds of online courses (more than 40 themes) are available through the webCT platform. Access is restricted to students (those who paid the tuition).

2.2.3 Canadian Virtual University

URL: www.cvu-uvc.ca

The Canadian Virtual University (CVU) is a partnership of universities across Canada, committed to delivering university-level programs that can be completed from anywhere in the country or beyond. This partnership regroups 10 Canadian universities[5] offering over 250 programs, representing 2000 courses to chose from, available through the Internet or by distance education.

The programs are offered using a variety of distance-education methods to help the students complete a degree (university degrees, diplomas, and certificates) according to their schedule, no matter where they live. They may work with printed material that they receive in the mail or using electronic material they receive via the Internet. Some courses may include computer conferencing, audiotapes, videotapes, television, and radio programs. Some programs are completely online. Others use a combination of these methods. Some courses have specific start dates; others may be started any month of the year.

Each university is committed to allowing transfer credits, as long as the credits fit the students' program requirements. Students can enrol using an online application form at the university offering the program. The CVU does not grant degrees. Only one of the partner universities, the one considered as the "home" university, can grant a degree, certificate, or diploma. By paying regular tuition fees, it is possible to audit a distant course, without having to complete assignments and exams. Adult learners from around the world may enrol in many, but not all, CVU programs. According to the CVU, people who earn a degree through distance education are usually working adults who are juggling family schedules and work commitments with the need to advance their education. But the typical 20-year-old university student is also starting to look at online courses. For instance, on-campus students who wish to fast-track

[5]Athabasca University, British Columbia Open University, Laurentian University, Memorial University of Newfoundland, Royal Roads University, Télé-université du Québec, Université de Moncton, University College of Cape Breton, The University of Manitoba, and University of New Brunswick.

their education or who find that the course they want is not conveniently scheduled can create their own schedule by selecting a distance education course offered by any of the participating universities. In terms of fees, distance education allows students to save money when they take courses from partner universities[6].

Attending distant courses does not ask for any particular computing skills. Many of the programs are delivered via print materials students receive in the mail. They communicate with their tutor through the phone, e-mail, or mail. In some courses, keyboard, word-processing, and web-navigation skills are required.

CVU is also part of an emerging alliance of universities and colleges working with Industry Canada to provide programming complementary to the Canada's Campus Connection initiative (www.campusconnection.net), a pilot project of Canada's Schoolnet (www.schoolnet.ca). Schoolnet provides a gateway to the online courses of 60 Canadian universities and colleges and promotes these courses to large, national and international learner markets.

2.2.4 University of North Texas, U.S.A.

URL: www.unt.edu/distanceed.htm

This university established the Centre for Distributed Learning (CDL) as a service to assist faculty with the development and delivery of online courses. The CDL combines technology resources with expert consultation and staff in an effort to provide faculty with a "one-stop" guide to technology-based courses. A portion of the students' tuition, those who take classes online, ensures funding. A side-effect of the delivery of online courses is that fewer classrooms are required, which makes possible to reduce and even eliminate the need to construct new classrooms.

Courses are accessible through webCT for registered students. About 15 themes are proposed, representing several hundreds courses. Some course sections may require face-to-face meetings. Students are assisted by the CDL to learn how to use the e-Learning platforms. A "Course Information Database" (CID) has been created to help to provide accurate, up-to-date information to students about their course and is being used by the CDL to market distance education courses in a variety of ways.

2.2.5 University of Central Florida, U.S.A.

URL: distrib.ucf.edu

The e-Learning initiative of this university began in 1996 and since that time, it became an integral part of the campus culture. The strategic plan follows "The Pathways to Prominence". This plan offers a framework for the university to realize, by means of distributed learning technologies, its vision of becoming the "nation's leading metropolitan research university recognized for its intellectual, cultural, technological, and professional contributions and renowned for its outstanding programs and partnerships". The strategic planning council has identified twelve strategic initiatives, using three pathways:

I. Pathway One: Enhance the university's academic mission

   (1) Promote excellence in undergraduate education
   (2) Increase prominence in graduate studies
   (3) Foster excellence in research and creative activities

[6]Most Canadian universities charge higher fees for non-Canadian students. Each university has its own policy and fees.

(4) Promote visual and performing arts

II. Pathway Two: Serve the central Florida metropolitan region

(5) Contribute to regional economic development

(6) Expand access to educational excellence

(7) Enhance collaboration

(8) Expand partnerships with schools

III. Pathway Three: Strengthen the university's services and processes

(9) Increase operational excellence

(10) Enhance the university community

(11) Increase visibility

(12) Enhance university resources

To realise these strategic initiatives, three specialized units have been developed: (1) The Centre for Distributed Learning, which coordinates program development and marketing, and provides administrative support for online courses; (2) The Course Development and Web Services unit, which provides course development, and some technical support for online students; (3) The Research Initiative for Teaching Effectiveness, which conducts ongoing assessment, regularly surveying both student and faculty populations, and also supports research projects in the area of online learning.

The Centre for Distributed Learning (CDL) includes instructional delivery technologies such as video tape, interactive television and Web-based instruction that provide services to non-traditional, distant, and campus-based students. The university has developed 16 programs of totally Web-based degree, degree-completion, and certificate programs, representing several hundreds of courses. The CDL encompasses the use of computer resources to extend and enhance traditional classroom instruction. Students desiring to attend these courses must pay a fee.

Online@UCF (online.ucf.edu), which belongs to the CDL, consists of upper-division and graduate level courses and programs offered via the World Wide Web. Students at a distance can complete many of these courses and programs. The online courses are provided on the webCT delivery platform. The university offers 4 undergraduate degree completion programs, 6 graduate degree programs and 5 graduate certificates, plus a hundred courses every semester from all academic areas. The academic credits are the same as credits received for face-to-face classes held on the various campuses. All programs and most courses require that students be admitted to the University. Admissions information and applications are available online at the admissions web site.

2.2.6 Florida State University, U.S.A.

URL: online.fsu.edu

At this university, html editors and course management systems formed the seed of the e-Learning activities. Keys to the spread of e-Learning rested on (1) the availability of an "one button publishing" for class material, with a common template and syllabus for classes, and (2) the integration of library resources into the e-Learning system, allowing the faculty to concentrate on teaching and learning. The university edited a handbook to help instructional

faculty and graduate teaching assistants who are interested in being more effective teachers (online.fsu.edu/learningresources/handbook/instructionatfsu). It offers strategies used by experienced instructors and presents instructional methods and techniques based on four components of instructional design:

- Course Planning;
- Lesson Delivery;
- Student Testing and Grading;
- Course Revision and Evaluation.

Blackboard is the predominant software used to set up Florida State University's (FSU) distance learning and distributed classes. Web-Mediated CourseAssistant (Web-MC) is a template created for faculty to provide web support for courses offered at FSU. Courses are only available to registered students who pay their fees.

2.2.7 The State University of New York, U.S.A.

URL: sln.suny.edu

The State University of New York (SUNY) Learning Network allows students to study and take classes at any time and from any place. The SUNY Learning Network (SLN) is supported by the Alfred P. Sloan Foundation and SUNY System Administration. The SLN is a growing consortium, currently with 56 campuses in the SUNY System, who have joined together to offer graduate and undergraduate online courses. The SLN is an Asynchronous Learning Network (ALN). An ALN is a new approach to teaching and learning that is student centred. It eliminates the constraints of time and location that higher education normally places on students. ALN also emphasizes innovative instruction and learning. The activities of a traditional class are the same – students read course materials, write papers, do research, and communicate with their instructor and fellow students. The students, and the faculty, use technology to accomplish these tasks. The course design facilitates these activities through a computer network. The learning is both interactive with faculty and collaborative with other students. Faculty and students can also leverage the wealth of resources available through the Internet to support this instruction.

The ALN gives access to 60 complete online degree and certificate programs, representing 3000 online college courses annually. Many of the SUNY campuses offer complete degree programs through the SLN. Only registered students have access to the ALN (Tuition costs vary depending on campus, course level, and residency status). To work online, students need to have a modem connection, a web browser, a valid email address, and a word processing software that has the capability to save files in the Microsoft Word 6.0 or RTF file format. In an online college course the instructor and students are connected to each other through the Internet. Using the Internet, students can at any time receive instruction, compose and submit assignments, ask questions of the instructor and other students, discuss issues and actively participate in the class all from their home, their office, or the nearest campus computer lab. Depending on the faculty member and the discipline, courses may also incorporate other web based materials, textbooks, application software, simulations, and even learning activities outside of the Internet like experiments, observations, or other projects.

2.2.8 Stanford University, U.S.A.

URL: aboutcoursework.stanford.edu

From the beginning, interoperability and collaboration have been two key concepts that drove this university. Stanford is a founding member of the Open Knowledge Initiative (OKI). This initiative aims at specifying standards to support innovative learning technology. OKI came out of discussions between Stanford and the Massachusetts Institute of Technology (MIT) that focused on e-Learning platform scalability, flexibility, stability and interoperability. The result of the collaboration is "CourseWork", an open and extensible architecture that specifies how the components of an educational software environment communicate with each other.

CourseWork is Stanford University's course Web site development and distribution system. It is a simple-to-use, robust, scalable system for faculty to develop and present online course materials. It allows simple site management, faculty control student registration. Faculty can create class lists or allow students to register online. Students can submit any type of document for a problem set, essay assignment, or project. Web-based quizzes with multiple choice and short answer questions can be easily created, distributed, scored, and returned. Management tools include an Email/Web announcement system, and simple file uploads for class handouts, syllabi, images, articles, and other course materials.

Using CourseWork, instructors can set up a course Web site that displays announcements, online readings, a dynamic syllabus and schedule, online assignments and quizzes, a discussion forum for students, and a grade book. CourseWork is designed both for faculty with little Web experience, who can use CourseWork to develop their Web site quickly, and for expert Web-users, who can use it to organize complex, Web-based materials and link them to Web communication tools. CourseWork has several Web-based tools for developing and displaying the components of a course Web site. Instructors can select from a list of tools, adopting those that provide the features they want for their site. This list of tools will expand with the continuing development of the CourseWork system. CourseWork supports over 350 courses. It is restricted to registered students.

Stanford University announced the Open Source release of its course management system CourseWork. With the Open Source release, the code is now available for any school to install and customize the system, enabling it to provide instructional web sites for all its courses. Institutions adopting CourseWork can modify its tools to better fit their teaching mission, or add new tools for different functionality. Stanford University intends to continue development of CourseWork as a modular, standards-based framework for course management. Stanford is currently developing the Assignment and Assessment Manager, an addition to CourseWork that will be released next year, providing sophisticated tools for online assignments and exams. CourseWork uses APIs (Application Program Interface) developed as part of the Open Knowledge Initiative (OKI) project.

2.2.9 Harvard Business School, U.S.A.

URL: e-Learning.hbsp.org

The Harvard Business School (HBS) has a completely technology-enabled environment, in which everyone takes full advantage of IT to meet his or her goals. Through this environment, the community is surrounded with IT in all aspects of life – academics, career planning, student life, operations and administration, etc. This e-Learning environment offers both interactive programs and performance support tools. In the former, learners actively engage in scenario-based cases, make decisions that affect the case outcome, and then receive customized feedback. Learners can also use interactive tools online and receive customized feedback. In the latter

(performance support tools), the student is offered just-in-time help – quick answers to immediate problems – right when a manager needs it. Most of the content is chunked into learning elements that require only 10 minutes to complete. This allows learners to flexibly go where their interest and needs lead them. Program learning elements include: interactive real-world case studies, expert feedback, practical tools, Harvard Business Review resources, and performance support tools. To emphasize learning-from-others and personalize the programs further, learners are encouraged to interact with other students who knows the support tools well. Each branch and outcome ends with customized feedback about the choices made. The programs are developed to help corporations educate their managers with the best content just-in-time where it is needed. While no credit is offered for the online programs, certain professional associations have adopted several of the courses as part of their continuing education credit programs. To access these teaching modules, the student must pay a fee.

The e-Learning system was built in several small, incremental steps, rather than using few giant leaps. Such an approach allowed following short cycle times for early testing and improvement, which has the benefit to add value throughout the life of a project, and to create a climate of growth, change, experimentation, and learning. The e-Learning system is also based on modular, reusable platforms, tools, and templates. This infrastructure has been conceived of by the HBS IT Group, which has grown from a small team to nearly 100 full-time employees, working in three general areas: (1) technical support for faculty, staff, students, facilities, networks and infrastructure, and other systems, (2) software development, comprising software and systems engineers, multimedia designers and producers, content specialists, database administrators, and business analysts, and (3) client services to define and meet each group's technology needs. Homemade e-Learning tools at the HBS include course platform, polling application (JavaPoll), collaborative learning environments, videoconferencing and Webcasting, etc.

2.2.10 Nanyang Technological University, Singapore

URL: www.ntu.edu.sg/cce

The Nanyang Technological University (NTU) is another interesting case. While the culture of the university demanded face-to-face (F2F) courses, the university's president was very supportive to challenge the faculties to have blended learning as the primary mode of delivery for lectures. This effort was nourished by the goal of realizing a national digital knowledge economy in Singapore. Initially, the University adopted a de-centralised e-Learning approach where individual professors and departments fragmented their efforts for distributing online courses. Faced with an increasing demand, they finally had to opt for a more scalable approach based on a centralization of the resources. This e-Learning operation centre is able to bear more attention to the software and hardware requirements of the system and to ensure focus on security, authentication, and the ability to integrate with the other administrative systems on the campus. Much attention was given to facilitating, equipping, and enabling faculty to create and enhance content.

Currently, a centre for continuing education within the university is delivering a large range of online courses. These courses are streamlined to suit the needs of the A level students as well as Diploma graduates who have the intention to pursue a degree. NTU professors who have many years of experience in teaching the subjects offered have adapted the contents from the main academic syllabus and restructured it as revision tools. These courses, which are available against a fee, are useful in laying the foundation for the various disciplines in Engineering, Science and Business studies.

2.2.11 University of Adelaide, Australia

URL: www.adelaide.edu.au/ltdu

This university considers e-Learning as an enhancement to on-campus student learning and as a provider of access to resources. The program focuses on the needs of both students and faculty with the idea of making learning easier and more efficient. It aims at enhancing, but not replacing, existing F2F teaching. The e-Learning centre is able to offer free online courses through a portal[7] (student registration is necessary). Historically, this university began its own online learning programs armed with grant money from various research projects. This financial plan prompted a debate within he university on decentralized versus centralized e-Learning infrastructures. However, with the establishment of a centrally supported course management system, the university saw immediate cost savings. This centre now hosts several learning object repositories established with the aid of federal funds.

The Learning and Teaching Development Unit (LTDU) assists the university community to improve student learning and staff teaching through development programs and research. The LTDU manages four programs: Academic Staff Development, Student Development, Evaluation, and Online Learning and Teaching Development. The staff of the LTDU work with all faculties, supporting the implementation of innovations in learning and teaching ranging from, for example, individual assistance with small group teaching to the introduction of new teaching methods based on multimedia technologies, the development of schemes for student assessment, curriculum review, and approaches to student learning. Academic services include advice and assistance with course design, language and learning matters, teaching methods, assessment, and evaluation of learning and teaching. This technology for distributing courses is available on the university portal (www.adelaide.edu.au/myuni).

Short courses, seminars and workshops are offered throughout the year, including an introductory program in university teaching. LTDU staff also produce materials addressing specific aspects of university teaching and policy, participate in research projects with academic staff, and provide consultancy services to universities and outside organisations. The LTDU has been successful in influencing change in and providing support for the University's policies and practices with respect to learning and teaching.

2.2.12 Open Polytechnic of New Zealand

URL: www.openmindonline.com

The Open Polytechnic of New Zealand (www.topnz.ac.nz), a government-owned and funded school, accredited to deliver courses throughout New Zealand and internationally, is one of New Zealand's leading institutions in e-Learning. This university offers full online study in selected degree and diploma programs, along with general online support for all students. The Internet delivery program for this university is called "Open Mind Online". Open Mind Online offers the opportunity to study for an Executive Level Graduate Diploma, Bachelor of Business, Bachelor of Applied Science, or an associated Diploma. The programs, which cover 11 areas of study representing about 60 courses, are delivered in distance mode to students around the world.

The Executive Level Graduate Diploma, Bachelor of Business, Bachelor of Applied Science and associated Diplomas have been designed in consultation with a range of academics and industry groups to ensure their relevance to today's workplace. They are accredited by the New Zealand Qualifications Authority, and are monitored by internationally recognised academics. Open Mind Online offers personalised tutoring and student support, both one-to-one and to

[7] A portal is a website that acts as a 'doorway' to the Internet or a portion of the Internet, matching a person's needs to available offerings.

groups of learners. Students are expected to participate in electronic discussions with the other students and the lecturer in their course. A wide range of resources is proposed for the online courses. Students are expected to purchase items such as textbooks, to support their learning. General online support is available to all students once they have enrolled. Services include library access and study resources, access to course forums, Web pages specific to the attended courses, assessment hints, web resources, staff information, online quizzes and tutorials, past examination papers, and learning support information including exam preparation. Fees are variable depending the student's geographical position, and range from $50 (Australian students) to $120 (European students) per course.

2.2.13 University of Cambridge, U.K.

URL: www.ucel.ac.uk

This university is partners of the Universities' Collaboration in e-Learning (UceL), which is a multi-institutional collective to collaboratively produce high quality interactive multimedia resources for health-professional education. Its six founding partners, the Universities of Cambridge, Nottingham, Manchester, East Anglia, Wolverhampton and Peninsular Medical School, offer a wide range of subjects which UCeL resources support: medicine, nursing, pharmacy, behavioural sciences, sports science and health studies to name but a few. UCeL was founded to create cost-effective resources, in the form of reusable learning objects (RLO). The underlying UCeL message is "you can't replace face-to-face", and thus e-Learning forms just one part of the learning mix.

The UCeL production learning objects consist of an online collection of core documents and is being developed to guide content creators, peer reviewers and developers, and evaluators. Besides, it provides a large collection of images and movies. UCeL has taken the pragmatic step of clearly defining a learning object as "an interactive web-based resource based on a single learning objective and comprising a stand-alone collection of 4 components: presentation, activity, assessment, and links". The fact that a RLO is based on a single-Learning objective is deemed as important by the UceL because it is much more likely to be small, self-contained, stand alone, and therefore reusable. Typically, "families" of RLOs can be linked to form larger chunks of learning.

2.2.14 Oxford University, U.K.

URL: www.online.ox.ac.uk

The e-Learning activities at this university are taken in charge by the Learning Technologies Group (LTG) (www.oucs.ox.ac.uk/ltg), recently created by Oxford University Computing Services in response to a growing demand for advice and support related to the use of ICT in traditional teaching, learning and research. The LTG is mainly charged with:

- Developing computer-based teaching and research packages in collaboration with Oxford staff and external bodies;
- Researching the latest developments in the use of ICT in traditional university teaching and student learning;
- Disseminating information about the use of ICT via website publications, workshops and conferences;
- Providing access to specialized learning and teaching applications, and multimedia equipment.

Another major section within the LTG is the IT Learning Program. This covers all courses ranging from introductory courses, through training graduates in information skills, right up to advanced courses for lecturers in how to integrate ICT into their teaching.

Four Oxford University Continuing Education courses use the Internet as their main means of delivery:

I. The part-time courses in Computing and Local History, both taught at undergraduate-level;

II. The part-time masters course in Human Rights Law, a distance course with e-mail communication between tutors and students;

III. An online short course in Immunology, which gives a sound introduction to the principles of immunology and latest therapeutic developments for Continuing Professional Development of science professionals;

IV. The Alliance for Lifelong Learning, a new, not-for-profit "distance learning" venture between Oxford, Stanford and Yale Universities. The mission of the Alliance is to provide online courses and other educational offerings in the arts and sciences.

The courses are open to all but do not offer any qualifications however. Fees are variable according to the course. For instance, the annual tuition fee for the Undergraduate Diploma in Computing via the Internet is $1500 for home and EU resident students, and $4000 for students deemed to be non-EU for fees purposes.

The Oxford Digital Library (ODL) is a key-component of the e-strategy of Oxford University Library Services. It has been established to create the intellectual framework and to develop the technical infrastructure for an enhanced service, providing online access to the vast scholarly library collections of the University. ODL will have a major role in co-ordinating and stimulating digitisation activities in the University.

2.2.15 The Open University, U.K.

URL: www.open.ac.uk

The Open University (OU) is Britain's largest university, with more than 200,000 people studying its courses. Since its establishment by Royal Charter in 1969, it has opened the door to higher education for more than 2 million people. OU courses are designed for students studying in their homes or workplaces, in their own time, anywhere in the UK, Ireland, throughout Europe and often further afield. Courses use a range of teaching media – specially produced textbooks, TV and radio programs, audio and videotapes, computer software and home experiment kits. Personal contact and support comes through locally-based tutors, a network of 330 regional study centres in the UK and overseas and annual residential schools.

Undergraduate courses are open to all regardless, of educational qualifications. The OU takes special responsibility for making higher education accessible to people with disabilities; currently more than 7,000 of its students belong to this category. The majority of OU students are working towards a BA/BSc degree. Taught and research higher degrees are also available. Apart from those studying for degrees, many OU students follow courses related to professional development. These often lead to certificate or diploma qualifications. Others just study individual courses to update their qualifications or fulfil personal ambitions.

The OU offers more than 360 undergraduate and postgraduate courses in arts, modern languages, social sciences, health and social welfare, science, mathematics and computing, technology, business and management, education and law. It is possible to achieve a degree with

the OU in three years, studying full time, but most undergraduates combine part-time study with work or family responsibilities. The average time taken for a degree is six years, at an average cost of about $7000. Their employers sponsor many students.

More than 150 OU courses are using IT to enhance learning in various ways, including virtual tutorials and discussion groups, electronic submission (and marking) of assignments, multimedia teaching materials and computer-mediated conferencing. Around 160,000 OU students read more than 170,000 email and computer conference messages each day. Fourteen OU courses are delivered via the Internet. OU researchers have developed new applications of IT for learning: the "virtual field trip" for level one science students, and an internet stadium capable of hosting mass audience events with up to 100,000 participants.

To promote distant learning, the OU launched the International Centre for Distance Learning (ICDL), an internationally recognised centre for research, teaching, consultancy, information and publishing activities. However, because its external funding has come to an end on April 2003, the ICDL ceased most of its activities. Its database of distance-Learning courses and institutions remains online (www-icdl.open.ac.uk) but 'frozen in time' as it will no longer be updated and will be phased out in due course (ICDL's literature database will continue and be maintained).

2.2.16 Clyde Virtual University, U.K.

URL: cvu.strath.ac.uk

Clyde Virtual University (CVU) was founded in 1995 as Europe's first virtual university, with funding from the Scottish Higher Education Funding Council to develop and deliver Internet-based teaching materials to students registered at five institutions in the West of Scotland. CVU combines the academic and technical strengths of Glasgow, Strathclyde, Glasgow Caledonian and Paisley Universities together with the Glasgow School of Art. It has become the central repository for learning material for these institutions, and is a test bed for exploring, developing and evaluating techniques for delivering learning materials and assessment over the Internet.

About 20 themes are available online. Courses are actual modules being run through CVU which are restricted in access to those who are enrolled through a traditional university. They may include online notes, assessment and discussion. It costs students nothing to use the resources. So long as the students have access to a WWW browser then they have access to all the courseware available from CVU. The installation, maintenance and updating of the material is dealt with centrally, by CVU staff on the CVU server.

2.2.17 University for Industry, U.K.

URL: www.ufiltd.co.uk

The British government has appropriated $68 million to open the University for Industry. This initiative aims at offering workers training in business or home settings in information technologies, multimedia, and basic skills. Learning services are delivered through a multimodal program called "learndirect", the largest publicly-funded online learning service in the UK, which provides citizens access to courses, 80% of them online. The university wants to reach one million learners, including 400,000 private and public sector employees a year in organisations of all sizes by 2005, generating significant and profitable revenue from commercial engagement with large employers. The strategic objectives include the willingness to be:

- A nationally recognised and relevant brand in the learning market, synonymous with widening and increasing participation in learning;

- The vocational e-Learning choice for the workforce and for individual citizens;
- A lead in vocational e-Learning through the use of innovative and appropriate ICT solutions for all learners;
- A viable and financially robust organisation, an employer of choice delivering value for money to its customers and stakeholders.

It is to be noted that the university is using a home-made course management system.

2.2.18 The FernUnivesität of Hagen, Germany

URL: www.fernuni-hagen.de

This virtual university is the first and only distance teaching university in the German-speaking countries. It offers degree programs at the undergraduate and graduate levels as well as research-oriented academic education. There are six faculties: (1) computer science, (2) economics, (3) education, social sciences and humanities, (4) electrical and information engineering, (5) mathematics, and (6) law. Given higher education provided by universities requires continual re-orientation, the FernUniversität is cited as being already today a university of the future for a world of tomorrow. In its basic structure the virtual university FernUniversität does not differ from conventional universities. The university's special feature is its way of teaching. There are no lecture halls and the study contents are conveyed through printed study units, computer-based learning programs, audio and videocassettes as well as using up-to-date information and communication technologies on the World Wide Web. The FernUniversität has phrased its response to society's demands for more flexible education and new models of lifelong learning. About 80% of the FernUniversität's students are working. Access is restricted to registered students.

2.2.19 University Paris III, France

URL : www.tele3.univ-paris3.fr

Distant higher education teaching service, "Télé 3" targets the population with no possibility to regularly attend university courses for professional, geographical, health, and other reasons. Télé 3 is attended by:

- Those who wish to prepare national diplomas, or to obtain a university certification;
- Those who wish to follow university courses as open training without certification;
- Non-bachelors who, whatever their age, wish to prepare a diploma to access higher education, a diploma equivalent to a bachelor.

The courses of the University Paris III Sorbonne Nouvelle are designed such that they are at the same time theoretical (presentations, synthesis), practical (exercises, training, homework), documental (text), and methodological (bibliographies, research techniques). Beside the training exercises and assessment works, Télé 3 proposes collaborative work, telephonic support with teachers, and individual tutor sessions. This pedagogical framework makes possible for the students to study at their own pace, according to their availability.

The courses are dispensed on paper or recorded (cassettes, CD-ROM). The Télé 3 Internet site represents a communicating and working environment for students, where virtual classes can be created to link them to teachers and tutors – and between themselves through the network,

for instance using a forum available for students through the webCT platform. The site also proposes to visitors or students who want to register regularly updated information.

2.2.20 Università degli Studi di Milano, Italy

URL: ariel.ctu.unimi.it

This university offers an e-Learning portal, named "Ariel", through which registered students can access hundreds of courses. An online medical campus is also offered through this portal.

Ariel is the platform software of the e-Learning centre of the university. The virtual classrooms keep the students informed on the innovations and on the teaching activities, online laboratories for the learning of the languages and the exercise of the philosophical writing, etc. This portal also let the student perform self-evaluations tests, practice didactic materials, etc. In addition to online courses, the e-Learning centre has a library dedicated to multimedia and electronic libraries for the consultation of books, reviews, and CD-ROM.

2.2.21 Politecnico di Milano, Italy

URL: www.laureaonline.it

The Politecnico di Milano offers an online computer engineering degree is an entirely distance learning study program carried out via the Internet. The course is exactly on a par with the traditional one, with the same subjects, training credits, workload, exams and recognition as the degree taken "in person" and is even held by professors at the Politecnico di Milano. Additionally, the online teaching format gives students the opportunity to:

- Specialise in ICT, directly using ICT equipment and methods for their studies;
- Personalise their study timetable and methods without the constraints of attending lectures;
- Choose a personal study route according to the workload they are able to take on;
- Communicate directly with tutors and lecturers via the Internet and email;
- Easily and frequently get together with other students in their virtual class.

The online computer engineering degree aims to train engineers with a wealth of knowledge, able to develop and use the computing and automation methods and equipment and apply them to a vast range of situations. The resulting professional profile is claimed to be one of the most sought after (and one of the most modern) on the market. Graduates are exposed to a wide cultural background, characterised by the ability to solve new problems, but also to tackle some traditional ones through the use of information technology, telecommunications and multimedia. Access to these online courses is restricted to registered students.

The Politecnico di Milano and Somedia, a private company that has been committed over the years to the organisation and management of training courses, both traditional and online, have set up the Online Degree Course. Online Degree students are asked to participate in a virtual class activity with around 20-25 other students followed by a lecturer and a tutor for each subject. The main activities proposed for the classes are:

- Individual study, developed according to the speed suggested by the lecturers, based around CD-ROM (which contain the base contents of each taught part in multimedia version), online material (self-study software, guided exercises), and specific resources made available online by lecturers throughout the course (slide, explanations, notes, etc.);

- Learning and online collaboration, together with other students, tutors and lecturers using unsynchronised instruments (forum, e-mail, etc.), and synchronised instruments (live sessions);
- Periodical online progress tests in each subject.

At the end of each semester, students must sit an exam in person at the Politecnico di Milano campus.

2.2.22 African Virtual University, Kenya

URL: www.uva.org/french

The African Virtual University (AVU) is a distant teaching program using satellite transmission for dispensing scientific and technical training. The AVU has the objective of training a new generation of scientists, engineers, technicians, and business people so as to incite and sustain economical development in various African countries.

Since its inception in 1997, the AVU has aimed to provide internationally recognised computer science and business programs to the African continent. Since that time, the AVU has developed into an independent organisation comprising 30 universities in French and English-speaking African countries with students and professionals in 18 African countries receiving over 3,000 hours of interactive instruction. More than 24,000 students have completed semester-long courses in technology, engineering, business and the sciences and over 3,500 professionals have attended executive and professional management seminars on topics such as strategy and innovation, entrepreneurship and e-commerce. The AVU currently provides education programs at undergraduate and postgraduate levels. Access to online educational materials includes an online digital library with over 1,000 full text journals.

By 2007 the AVU aims to be recognised as a highly professional organisation providing:

- Quality academic services throughout the world;
- Equitable access to affordable quality education at tertiary level for all people;
- Access within Africa to high-quality educational resources of global standards including learning programs, a digital library and an online portal.

AVU academic programs are delivered by distance education via a mixed mode approach, which incorporates live video classes, online (Internet based) classes (based on webCT), CD-ROM, print and other multimedia technologies. The program includes Computer Science and Computer Engineering, Electrical and Mechanical Engineering, Public Health, Teacher Training, and Business and Management. The Computer Science Degree is a 4-year program offered by the Royal Melbourne Institute of Technology (RMIT) in Australia. Business Studies are expected to be delivered and accredited by Curtin University of Technology in Perth, Australia, from January 2004, working with the University of Addis Ababa and delivered to five sites, which are to be competitively selected. Students are required to pay fees to the local Partner Institution. Fees usually cover registration, tuition, books and other learning materials. Details of fees can be obtained at the local Partner Institution.

2.3 E-Learning institutions

With the development of the e-Learning in the academic world, a growing number of e-Learning institutions appears on the web. The activity of these institutions is more focused on the gathering of information, relevant links to e-Learning resources, than on the design and diffusion of

courses. The main particularity of these institutions is that they are non-profit organisations, and are generally dedicated to the support of the continuing professional development of individuals and the transformation of organisations who wish to enter into the knowledge economy and society. To give a hint of what are these institutions, two examples are provided below.

2.3.1 European Institute for e-Learning

URL: www.eife-l.org

The creation of the European Institute for e-Learning (EIFEL) is a response to the expectations of professionals and organisations, buyers and training providers, users and learning resources providers, who seek greater transparency and high standards in the services provided. The Institute will be the premier source of information concerning the developments of e-Learning in Europe and elsewhere, offering

- A personal portal;
- Weekly electronic newsletter (to be followed by a journal);
- A library and documentation centre;
- Exhibitions, conferences and regional seminars.

EIFEL will deliver training and certification in partnership with universities and awarding bodies, on the basis of standards of e-Learning competence that will be established at its creation. It will provide access to a variety of resources to support and validate members' development.

In order to keep abreast of evolutions in the world of technology and learning and to promote best practice, EIFEL will conduct research and studies on the development of e-Learning, working in concert with appropriate partners in Europe and beyond. Examples of domains investigated will be virtual universities, corporate universities, and the impact of ICT on work and training systems. Recognising the importance of opportunities to experiment with new technologies for the ongoing development of competences, EIFEL will, wherever possible, integrate them into its own services and test platforms: knowledge management tools, learning management systems, e-commerce, etc. EIFEL will also offer certification of the quality of distance learning systems and technology-based learning programs.

2.3.2 UNESCO's e-Learning site

URL: www.unesco.org/education/portal/e_learning

The Unit for Special Projects (CI/USP) of the Communication and Information Sector has taken the initiative to create a pilot learning site, developed in cooperation with the education sector, as well as other external partners. The ultimate objective of the e-Learning portal is to increase and facilitate access to education resources in different regions of the world in different languages while stimulating professional cooperation to improve the quality of education and learning. This site contains many links to relevant e-Learning resources for different educational levels, including about 50 e-Learning institutions and associations, and to numerous e-Learning tools and sources of information. It also contains a forum on e-Learning. Moreover, material is provided for lifelong learning purposes, especially in the field of information and communication technologies.

3 Case studies

In this section, two case studies are considered. The first is about free open courses dispensed by a famous university. The fact that it is entirely free makes the case interesting enough to be separately covered. The second case study is about a virtual European university, one of the first in the world to propose such a model. It is generally considered as being the European example of what should be a virtual univeristy.

3.1 Open courseware at the Massachusetts Institute of Technology

URL: ocw.mit.edu

Of all the universities cited in the Section 2.2, none offers free online courses. This is what makes the Massachusetts Institute of Technology (MIT) OpenCourseWare (OCW) initiative particularly interesting: this initiative aims at making MIT course materials that are used in the teaching of almost all undergraduate and graduate subjects available on the Web, free of charge, to any user anywhere in the world. It is a collection of genuine MIT course materials, some highly current, others maybe one or two years old. It is not however a way to get credits, teacher contact or classroom participation. It is thus not a distant formation. Rather, this initiative reflects the idea that scholars and teachers want to share freely the knowledge that they generate through their research and teaching. In the following sections, the strategy, organisation, evaluation and technology behind this OCW initiative are described.

3.1.1 Strategy

MIT publishes free course materials. How is it so? One cited argument is that MIT OCW wants to advance technology-enhanced education at MIT, and serves as a model for university dissemination of knowledge in the Internet age. The OCW uses open licensing terms that encourage others to build on its materials with "derivative works" while forbidding resale.

Of course, all this takes money. MIT is aided by grants in the tens of millions from well-heeled national foundations (estimated costs per year: between $7.5 and $10 millions). MIT OCW is a large-scale, Web-based electronic publishing initiative funded jointly by the William and Flora Hewlett Foundation, the Andrew W. Mellon Foundation, and MIT. MIT OCW's goals are twofold:

I. Provide free, searchable, access to MIT's course materials for educators, students, and self-learners around the world;

II. Create an efficient, standards-based model that other institutions may emulate to openly share and publish their own course materials.

In 1999, MIT Provost Robert A. Brown asked the MIT Council on Education Technology to provide strategic guidance on how MIT should position itself in the distance/e-Learning environment. The resulting recommendation – the idea of MIT OCW – is in line with MIT's mission: *to advance knowledge and educate students in science, technology, and other areas of scholarship that will best serve the nation and the world in the 21st century.* This initiative continues the tradition at MIT, and in American higher education, of open dissemination of educational materials, philosophy, and modes of thought, and will help lead to fundamental changes in the way colleges and universities utilize the Web as a vehicle for education.

MIT OCW is possible through the support and generosity of the MIT faculty who choose to share their research, pedagogy, and knowledge to benefit others. The OCW initiative expects MIT to reach a steady state by 2008. They target the publication of materials from virtually all

of MIT's undergraduate and graduate courses. They will be continually evaluating the access, use, and impact of MIT OCW over the course of the next five years. With 500 courses published in September 2003, the OCW initiative is still in an early stage. Indeed, not all lecture notes are yet available online (and depending on the kind of course might never be?). However, the plan is to have 500 new courses each year until the course materials from virtually all of MIT's subjects, undergraduate and graduate, are available to the world.

3.1.2 Organisation

By preparing their materials for public display, and also by having easy access to the materials of others, faculty members will inevitably improve course quality. However, generally the faculty are already over-committed with teaching and research obligations. Thus, they have concerns about any additional burden that publishing their materials to the MIT OCW Web site would place on them. Therefore, specific resources have been deployed and organised according to three main components:

I. The Core Team, composed of 20 people ensuring the production, the faculty liaisons, and intellectual property;

II. The Department Liaisons (one for each Faculty) who work directly in the MIT academic departments with faculty, helping them publish their courses online;

III. The Advisory Committees who give feedback and guidance to the leadership and staff of MIT OCW.

OpenCourseWare has thus an organizational structure and relationships with academic departments. The OCW staff work to make it easy for faculty to participate to the publication of their courses and reports to the Office of the Provost at MIT.

3.1.3 Evaluation

A thorough and continuous evaluation and feedback strategy is an integral part of the MIT OCW effort. Evaluation is important for two essential reasons:

I. By measuring the use and by demonstrating the impact of MIT OCW and the course materials MIT offers through it, other colleges and universities can be inspired to consider sharing their intellectual property and making the investments necessary to make their materials available to others;

II. Tracking the usefulness and usability of MIT OCW, as well as the internal efficiency, will help to set future direction and also to make incremental improvements to MIT OCW features and services and how to implement them, all of this assuring the future relevance and cost effectiveness of this MIT initiative.

Program evaluation focuses on MIT OCW's outputs – course materials, supplementary publications, and services – and the outcomes that result. These outcomes include:

- Access: Who is accessing MIT OCW, what are their profiles (educator, student, self-learner, other), what are their disciplines (or other interests), and where are they located?
- Use: How do users use MIT OCW, and is MIT OCW designed appropriately to facilitate that use? To what extent, and in what ways, are MIT course materials adopted for teaching purposes?

- Impact: What benefits are being realized through the use of MIT OCW?

Process evaluation focuses on MIT OCW operations and how the goals are accomplished. MIT OCW operations can be thought of as having five dimensions: organization, process, technology, communications, and planning/evaluation. In each of these dimensions, the effectiveness (how well and at what level of quality and participant satisfaction the processes are performed) and efficiency (how much does it cost to operate, and are there ways to improve the ratio of production outputs to resource inputs) are planned to be assessed.

3.1.4 Technology

The MIT OpenCourseWare Web site is published using flat HTML, so that users are able to easily utilize and integrate MIT OCW material in their own teaching or learning Web sites (see Figure 1). For the "proof of concept" pilot, launched in September 2002, the Web pages of the MIT OCW site were built by "brute-force HTML." Utilizing Web content editors such as DreamWeaver, a team of programmers from MIT and Sapient Corp., a business and development-consulting firm, designed and built the first 32 subjects. However, that model was not scalable for 500 courses, so MIT OCW has implemented a Content Management System (CMS) in order to achieve MIT OCW's long-term publishing goals.

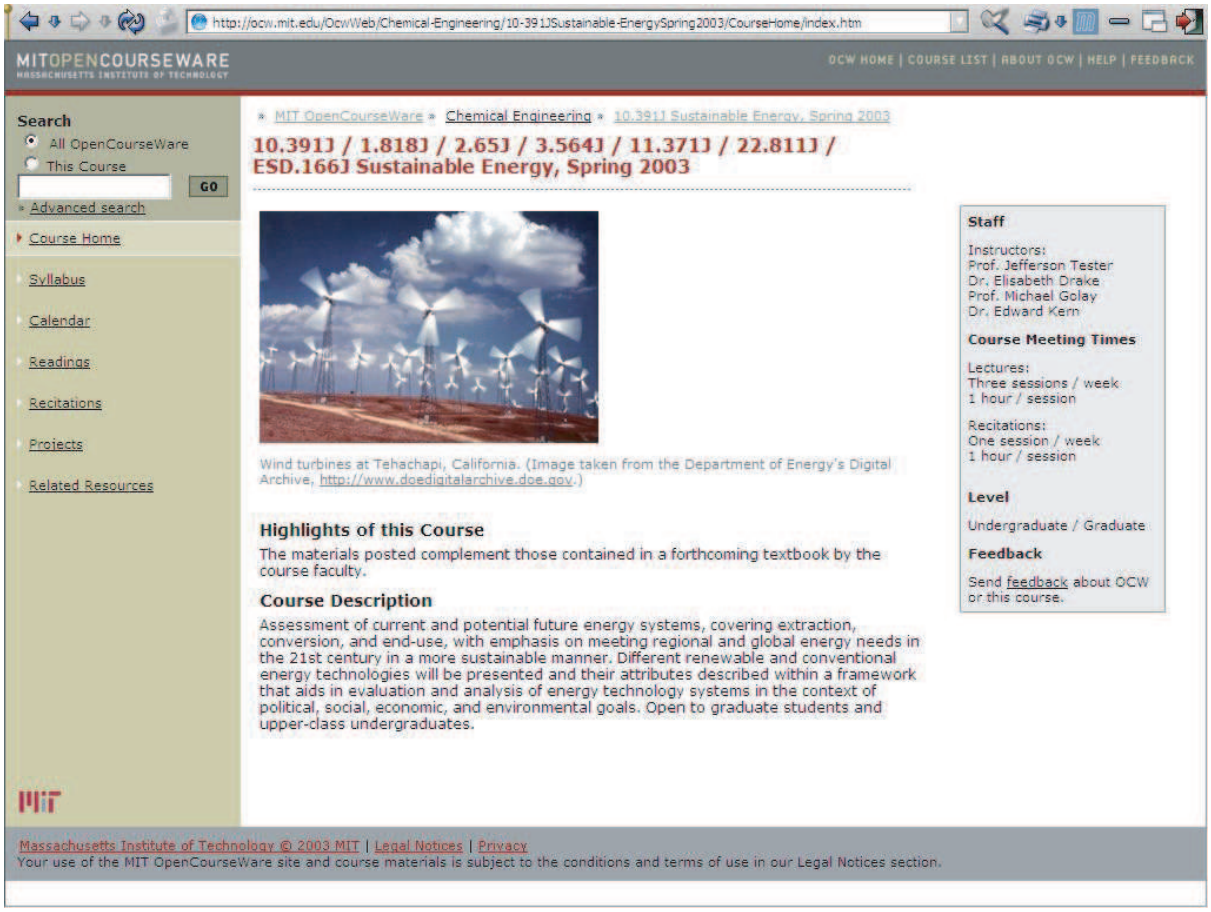

Figure 1: Examples of OCW at MIT.

The CMS that has been used since the beginning of 2003 is a customized implementation of Microsoft Content Management System 2002. The entire MIT OCW Web site is now published

dynamically from the CMS. Embedded in the course sites are a number of file types, including Adobe Acrobat PDF files, Java Applets, Shockwave, Real Player, Java, and MATLAB. All of these applications can be downloaded from the MIT OCW Technical Requirements page.

A frequently asked question is whether MIT OCW is an open-source project. The answer is that MIT OCW is committed to open systems and will share its approach with those who may want to launch similar efforts. Why then did they go with a commercial CMS (Microsoft CMS 2002)? Because, it seems, at the time they needed to implement a CMS system, there wasn't a viable open source solution that could meet their capacity and implementation timeline requirements. Microsoft made a serious commitment to the MIT OCW project, the total cost of ownership of Microsoft CMS 2002 was significantly lower than the other vendors then in consideration, and the Microsoft product offered a high-level of usability for the end-users (that is, MIT OCW's faculty liaisons and MIT's faculty).

For other institutions considering implementing their own "opencourseware" there are several open-source CMS options. At this point, MIT OCW is monitoring six: Zope, Red Hat, Midgard, OpenACS, OpenCMS, and Bricolage. By 2004, most experts agree that one CMS provider will become the clear, open-source leader in this industry sector. MIT OCW will track the progress of key open-source CMS providers during this accelerated maturation. This will contribute to MIT being able to share its experience and understanding of these CMS options with other institutions. Their hope is that utilization of open-source model CMS products could lead to less expensive implementations of opencoursewares on other campuses. Stanford joined with MIT and other leading institutions in the Open Knowledge Initiative (OKI) to create, test, and distribute open source educational software. This initiative represents a potent solution for reducing development effort and encouraging development of specialized modules that can integrate into larger systems.

3.2 Virtual Open University of Catalonia

URL: www.uoc.edu/web/eng

The Open University of Catalonia was one of the pioneers in the provision of higher education based on a virtual campus (public university for nonpresential teaching). Believing that by the end of the 20th century information technology would have to be heavily used to effectively support higher education (around communications technology, personal computers and multimedia), after a year in design, the Open University of Catalonia (in Catalan, Universitat Oberta de Catalunya, or UOC) launched the idea of the virtual online university in the fall of 1995. The UOC was initiated in 1993 with a very clear vision: to open up the possibility of higher education at a cost all Catalans could afford, by offering distance learning that maximizes the use of ICTs. It was co-financed by the Catalan government to create a private university with a public mission. This initiative is an example of a successful, publicly funded, privately managed system. There are now 25,000 students and 600 faculty and staff in the virtual university, and the program's portal receives more than 9 million visits per month. The university has currently six faculties.

3.2.1 Strategy

The UOC represents a new concept in university education, a new way of experiencing education, and is capable of offering answers to an emerging world-wide and universal knowledge society. This new society is currently in need of learning models that permit to people the widest possible access to knowledge throughout their lives, and to do so in a continuous, convenient, and simple manner, regardless of the geographical area where they may be. Teaching offer in Spanish is not only addressed to the Spanish state, but includes Latin America as well. By means of the

construction of a network of alliances – currently more than one hundred – the UOC is also present in Europe, Latin America and Asia with other universities and educational and research institutions in the national, regional and local spheres of each country.

UOC management has taken a very global approach in its strategic planning. The virtual University targets a working, upwardly mobile professional with high Internet and IT literacy, and it serves an additional 5,000 corporate customers a year who take short courses to improve skills and knowledge. In an effort to improve the quality of learning, a project was begun to speed up a student's progress through the degree program through continuous assessment. The project has already resulted in a 15% improvement in the time it takes a student to get a degree. All course materials are designed at the UOC by seventy full-time professors. In addition, 800 consultants and tutors work on contractual part-time basis.

UOC administers the public resources with austerity and efficiency. In this respect, it endows itself with the organisation that is strictly needed to achieve the objectives assigned to it. There are two teaching divisions, each with its own financial policy: the Catalan division, subsidized by regional government to offer low-cost education for residents of Catalonia, and the Iberoamerican division, which includes Spain, Portugal, and Latin America, for the rest of the students, who pay three-times as much. In order to guarantee full feasibility to its educational project, the UOC seeks to obtain alternative sources of finance, such as the profitability of its assets in distant teaching.

The UOC is running the research project "Metacampus", which involves several European universities and is financed by the European Commissions ICTs Program. It aims to create a protocol that will make possible the interoperability of educational intranets, with a single user account and customizable appearance. This attempt to interconnect campuses throughout the world started in March 2001 with a pilot project with Latin America. Several campuses in Iberoamerica, which by 2001 had started their online programs using the platform of the UOC, will be integrated into the "Metacampus" project.

3.2.2 Student's organisation

While the virtual university is organized in such a way that students do not need to be present to attend courses, their presence on the campus is necessary in at least two situations.

First, in Web-based learning, continuing evaluation is essential. The success of the process often depends on how well students understand evaluation criteria, the importance of following these guidelines and of maintaining a proper rhythm of study in order to reach objectives. UOC's students can choose between continuous or final forms of evaluation, both of which require final exam in presence form. The three 'pillars' of UOC's pedagogical model are: teaching materials, tutorial action and continuous evaluation. Didactical materials are in multimedia and paper form and/or Web-based, according to which is more appropriate and efficient for specific content.

Second, face-to-face meetings bring students and teaching staff together at the beginning and at the end of each semester. The academic program of meetings, consisting of the counselling and tutoring sessions, registered a stable attendance (38% of the total number of students matriculated). Tutorial action implies a three-tier faculty body involved in the teaching process:

I. Tutors, who are simultaneously a guide for the student, envoy of the university and personal coach;

II. Consultants, who are specialists in particular subjects and motivate and support students in their study and continuous evaluation;

III. Professors, who do not participate in direct teaching/learning, but who develop the course program, ensure the quality and state-of-the-art of didactic materials and coordinate the work of consultants and tutors.

The program of complementary activities, made up of workshops and cultural activities, receives a good reception. Each presentation meeting mobilises some 8,000 people, and each synthesis meeting, 7,000 (data include students, counsellors, tutors and lecturers). The organisation of these meetings entails the mobilisation of a team of between 40 and 50 people in one day. To these, it must be added the management staff that on that day takes an active part in the events. So the total adds up to 125 people who attend personally all students present at the meeting.

3.2.3 Technology

The Virtual Campus platform allows interactive, mainly asynchronous, communications between students and teachers, and between students and students. By means of an intensive use of the new technologies, the UOC manages to break down the barriers of space and time and is able to offer an educational model based on the Internet. In this model, and through the Virtual Campus, students obtain from any location easy access to a dynamic learning environment, and become the centre of a personal educational process assisted by an accredited teaching team and by innovative didactic resources and services.

The technology infrastructure for UOC was built from scratch, rather than being built around a commercial learning management solution. Seeing the requirement for scalability from the beginning, UOC chose to build the system around open architectures and e-Learning standards-based products and services from industry providers such as Sun Microsystems[8]. Now in its fifth release, the technology is thoroughly embedded in the pedagogical model. Furthermore, the platform has reached the level of modularity and stability at which UOC management is comfortable that they can scale indefinitely their vision of becoming the reference point on the Internet for the distribution of knowledge.

The total cost of UOC is also well below the average cost of other universities in Spain. Equally important to note is that UOC is realizing additional improvements to its bottom line through server consolidation, economies of scale, and increased efficiency. UOC plans to invest in the design and implementation of new online fields of study and hiring additional faculty.

The Internet Interdisciplinary Institute (IN3), EduLab and other departments conduct numerous research projects on the information society and e-Learning. The "Methodological Resources Assistant" program developed at UOC provides faculty with guidelines and tools for creating effective software-based courseware.

3.2.4 E-Library

The UOC library forms part of the Virtual Campus and is designed so that users, from their homes, can access the library and a series of services offered at any university library. It is a library with no walls which can be consulted from anywhere in the world. People using the UOC library have at their disposal the following services:

I. The library's digital database, which can be accessed through different applications or different services. It is made up of: educational material in different formats, complementary material (articles, conferences, software, etc.), digital newspapers, specific subject databases, official publications, general or specialised reference books (encyclopaedias, dictionaries, etc.) and Internet resources related to subjects taught at the UOC, as well as other subjects that are part of the University's speciality in distance education;

[8]For the success of establishing this virtual campus, Sun named UOC a Sun Centre of Excellence in e-Learning in May 2003.

II. The UOC library catalogue is a combination of documents in physical and digital support. For the management of physical documents a range of applications has been developed that allows the user to make online document loan requests, to book documents in advance and to cancel previously-made requests, as well as to view the state of these requests. It is also possible to consult the electronic summaries and abstracts of these documents using the library reference in order to obtain additional information. From the catalogue it is also possible to access the digital documents directly in all their possible formats and typologies;

III. The Virtual Library has developed a range of library and documentary services for the virtual community: students, professors, management staff and other groups of people related to the University. These services are: online document loan, document request and inter-library loan, documentation service, and access to full text online databases.

4 Standards in e-Learning

4.1 Introduction

The degree to which educational content can be reused and re-purposed depends on how it is stored, made available, and delivered to the academic user community. Existing learning technology interoperability standards are designed to ensure the reusability of educational content within different authoring environments, content repositories and delivery platforms. Emerging learning technology interoperability specifications, for instance IMS Simple Sequencing and IMS Learning Design (see Section 4.2), provide pedagogical frameworks which enable significantly more effective use of learning resources. For many, these frameworks constitute the only hope to reduce the costs engendered by the delivery of online courses, and thus, represents the only viable long-term solution.

Over thirty different standards and guidelines that affect the creation of online learning software can presently be counted. Most of these standards are under construction and only now begin to be used by the e-Learning community. However, this section limits itself to describe the most cited standards and content repositories, which, ideally, should be based at least on the four following criteria (see Section 4.3 for other criteria):

I. Accessibility, so that instructional components can be accessed from one remote location and delivered to many other locations;

II. Interoperability, so that instructional components developed in one location, with one set of tools or platform, can be used in another location, with a different set of tools or platform;

III. Reusability, so that instructional components can be incorporated into multiple learning experiences[9];

IV. Durability, so that using instructional components continues without redesign or recoding in spite of technology changes.

4.2 IMS

URL: www.imsproject.org

[9] A learning experience consists of activities that are supported by electronic or non-electronic learning resources.

The IMS Global Learning Consortium[10] is a worldwide non-profit organization that includes more than 50 contributing members and affiliates for developing and promoting the adoption of open technical specifications for interoperable learning technology. IMS is concerned with standards for learning servers, learning content and the enterprise integration of these capabilities. Several IMS specifications have become worldwide de facto standards for delivering learning products and services. The IMS members come from every sector of the global e-Learning community. They include hardware and software vendors, educational institutions, publishers, government agencies, systems integrators, multimedia content providers, and other consortia.

IMS came into existence in 1997 as a project within the National Learning Infrastructure Initiative (NLII) of EDUCAUSE[11]. The scope for IMS specifications, broadly defined as "distributed learning," includes both online and off-line settings, taking place synchronously (real-time) or asynchronously. This means that the learning contexts benefiting from IMS specifications include Internet-specific environments (such as Web-based course management systems) as well as learning situations that involve off-line electronic resources (such as a learner accessing learning resources on a CD-ROM). The learners may be in a traditional educational environment (school classroom, university), in a corporate or government training setting, or at home. For example, the IMS learning resources meta-data specification benefits the learner looking for information with a meta-data aware search tool both when the search is of Web-based resources and when the search is made through a CD-ROM or DVD-ROM encyclopaedia. Content developers who have implemented the IMS learning resources meta-data specification will contribute to ease the work of people doing the search to find the resources they want, since meta-data allows users to be much more specific in the search terms they can specify.

IMS has undertaken a broad scope of work. Specification requirements are typically gathered through meetings, focus groups, and other sources around the globe to establish the critical aspects of interoperability in the learning markets. Based on these specifications, IMS develops draft specifications outlining the way software must be built in order to meet the requirements. The draft specification is formally approved by the IMS Technical Board and then released to the public. IMS specifications are made available free of charge to the general public, regardless of whether or not they are members of IMS. There are presently 11 IMS Learning Resource Metadata specifications: Accessibility, Competency Definitions, Content Packaging, Digital Repositories, Enterprise, Learner Information, Learning Design, Meta-data, Question and Test Interoperability (QTI), Simple Sequencing, and Vocabulary Definition Exchange. The description of these specifications is to be found on the IMS web site (see above). To illustrate the essence of these specifications, two of them, often cited, are:

I. The IMS Simple Sequencing specification, which defines a method for representing the intended behaviour of a learning experience such that any learning technology system can sequence discrete learning activities in a consistent way. The specification defines the required behaviours and functionality that conforming systems must implement. It incorporates rules that describe the branching or flow of instruction through content according to the outcomes of a learner's interactions with content. The specification was released to the public in March 2003;

II. The IMS Learning Design specification, which supports the use of a wide range of pedagogies in online learning. Rather than attempting to capture the specifics of many pedagogies, it does this by providing a generic and flexible language, described through a set of three documents: (1) IMS Learning Design Best Practice Guide, (2) IMS Learning Design Information Binding, and (3) IMS Learning Design Information Model. This language

[10] IMS is the acronym for Instructional Management Systems

[11] EDUCAUSE is a non-profit American association whose mission is to advance higher education by promoting the intelligent use of information technology.

is designed to enable many different pedagogies to be expressed. The approach has the advantage over alternatives in that only one set of learning design and runtime tools then need to be implemented in order to support the desired wide range of pedagogies. The language was originally developed at the Open University of the Netherlands (OUNL), after extensive examination and comparison of a wide range of pedagogical approaches and their associated learning activities, and several iterations of the developing language to obtain a good balance between generality and pedagogic expressiveness.

IMS is not building a software product per se. It is defining **technical specifications** (as those listed above) that developers and creators of products and services can incorporate so that they work together. **These specifications are the primary IMS deliverables**. Such technical specifications aim at changing the habits of conceiving instructional management systems where each actor implements their functionality (e.g. usage tracking, user profile information, performance reporting, to cite but a few) in proprietary ways. For developers and publishers of content products, such a conception means that development costs are generally higher as developers must create separate applications for various management systems in order for their content to work consistently across different platforms. Furthermore, creators of management systems must often invest in creating their own content authoring tools in order to facilitate the development of content that works appropriately with their system[12].

Examples of toolkits provided by IMS contributing members to create learning resources that use IMS standards are the followings:

4.2.1 Sun Microsystems

Working with SRI International's Center for Technology in Learning, Sun created a toolkit for the creation of XML documents that conform to the IMS Meta-data Specification standard. This toolkit uses Java technology, and is freely distributed to IMS members and to the educational and training community. The toolkit simplifies and increases the speed at which developers can provide content that complies with the IMS Meta-data Specification. This product is available at: imsproject.org/tools

4.2.2 Microsoft Corporation

The Learning Resource Interchange (LRN) toolkit provides a comprehensive view of the IMS content packaging specification and SCORM reference implementation (for a description of SCORM, see Section 4.7 below). LRN provides the tools required to create LRN compatible online learning content. In addition to the essential tools and documentation, several LRN-based content samples are available. This product is available at: www.microsoft.com/eLearn

4.2.3 Joint Information Systems Committee

The Joint Information Systems Committee[13] (JISC) has financed[14] the design of the product RELOAD, a graphical tool for creating and previewing valid IMS Content Packages. The content package editor and viewer support all aspects of the latest and previous versions of IMS Content Packaging, including IMS Meta-data with IEEE LOM (Learning Object Metadata[15])

[12]Generally, developers do not have the opportunity for sharing development costs across vendors and they also limit their market to consumers who have committed to their specific product line.

[13]The Joint Information Systems Committee (JISC) provides strategic guidance to UK higher education in the use of Information and Communications Technology (ICT) to support teaching, learning, research and administration. JISC is funded by all the UK post-16 and higher education funding councils.

[14]RELOAD is funded by JISC under the X4L program (see Section 4.14.2), and is being carried out at Bolton Institute in partnership with the University of Strathclyde.

[15]Standard based on the IEEE 1484.12.1 LOM, see Section 4.4.

vocabulary. It enables content to be aggregated into different structures and tagged with metadata for exchange between systems and delivery to learners. A package viewer is incorporated to enable both authors and learners to interact with packages produced. Metadata records can also be created for the content. The package editor supports reusable SCORM 1.2 objects and the SCORM 1.3 that includes IMS Simple Sequencing, allowing designs to respond to the learner's actions and to change sequences of content. The software is freely available under the MIT Open Source License[16] and is written in Java. The RELOAD editor has been designed with maximum flexibility to allow the use of local metadata profiles and customised user interfaces. This product is available at: www.reload.ac.uk

4.3 ADL

URL: www.adlnet.org

The Advanced Distributed Learning (ADL) Initiative, sponsored by the Office of the Secretary of Defense (OSD), U.S.A, is a collaborative effort between government, industry and academia to establish a new distributed learning environment that permits the interoperability of learning tools and course content on a global scale. ADL's vision is to provide access to the highest quality education and training, tailored to individual needs, delivered cost-effectively anywhere and anytime.

By working with industry and academia, the Department of Defense (DoD) is promoting collaboration in the development and adoption of tools, specifications, guidelines, policies and prototypes that meet the following functional requirements:

- Accessibility from multiple remote locations through the use of meta-data and packaging standards;
- Adaptability by tailoring instruction to the individual and organizational needs;
- Affordability by increasing learning efficiency and productivity while reducing time and costs;
- Durability across revisions of operating systems and software;
- Interoperability across multiple tools and platforms;
- Reusability through the design, management and distribution of tools and learning content across multiple applications.

The ADL Initiative was designed to accelerate large-scale development of dynamic and cost-effective learning software and systems to stimulate an efficient market for these products in order to meet the education and training needs of the Military Services and the nation's workforce of the future. ADL targets the achievement of these goals through the development of a common technical framework for computer and net-based learning that foster the creation of reusable learning content as "instructional objects." The ADL Initiative is evolving the development and implementation of ADL specifications and guidelines, such as the Sharable Content Object Reference Model (SCORM), which is described in Section 4.7.

[16]The "classic" licenses approved by the Open Source Initiative (OPI, http://www.opensource.org) are GPL, LGPL, BSD, and MIT.

4.4 IEEE

URL: ltsc.ieee.org/wg12

The standard IEEE 1484.12.1 LOM, a working group of the IEEE Learning Technology Standards Committee, specifies the syntax and semantics of Learning Object Metadata (LOM), defined as the attributes required to adequately describe a Learning Object. Learning Objects are defined here as any entity, digital or non-digital, which can be used, re-used or referenced during *technology supported learning*. Examples of technology supported learning include computer-based training systems, interactive learning environments, intelligent computer-aided instruction systems, distance learning systems, and collaborative learning environments. Examples of Learning Objects include multimedia content, instructional content, learning objectives, instructional software and software tools, and persons, organizations, or events referenced during technology supported learning. The Learning Object Metadata standards focus on the minimal set of attributes needed to allow these Learning Objects to be managed, located, and evaluated. The standards aim at accommodating the ability for locally extending the basic fields and entity types, and the fields can have a status of obligatory (must be present) or optional (maybe absent). Relevant attributes of Learning Objects to be described include type of object, author, owner, terms of distribution, and format. Where applicable, Learning Object Metadata may also include pedagogical attributes such as: teaching or interaction style, grade level, mastery level, and prerequisites. It is possible for any given Learning Object to have more than one set of Learning Object Metadata. The standard will support security, privacy, commerce, and evaluation, but only to the extent that metadata fields will be provided for specifying descriptive tokens related to these areas. The standard will not concern itself with how these features are implemented. IEEE expects these standards will conform to, integrate with, or reference existing open standards and existing work in related areas. For example core attributes of Learning Objects will be coordinated with or may simply defer to, the efforts to standardize content objects in general.

Other IEEE working groups are briefly described in the next four sections (see the Web site ltsc.ieee.org for more details on the topic).

4.4.1 Architecture and Reference Model

This standard specifies a high level architecture for information technology-supported learning, education, and training systems. It covers a wide range of systems, commonly known as learning technology, education and training technology, computer-based training, computer assisted instruction, intelligent tutoring, metadata, etc., while being pedagogically neutral, content-neutral, culturally neutral, and platform-neutral. This standard has the following features:

I. Provides a framework for understanding existing and future systems;

II. Promotes interoperability and portability by identifying critical system interfaces;

III. Incorporates a technical horizon (applicability) of at least 5-10 years while remaining adaptable to new technologies and learning technology systems.

4.4.2 Digital Rights Expression Language

The Digital Rights Expression Languages (DREL) workgroup within the IEEE Learning Technology Standards Committee is gathering requirements that a standardized DREL must meet to support learning, education, and training. Such DREL standardization efforts are supported

by large industry groups (multimedia, consumer electronics, telecommunications, the IT industry, etc.) As it is assumed that such languages will be incorporated into technology in this decade, the goal of this working group is not to create another DREL standard but to ensure that existing standards can be effectively used by the educational community.

4.4.3 Computing Managed Instruction

Today Computer Based Training (CBT) is being written by a diverse number of parties using very diverse tools or authoring systems. Many of these CBT lessons can complement and work well with other lessons developed in different locations with different tools by different people. There is a need to allow these complementary lessons to be brought together and used in a single course. However, this cannot be done without defining a standard set of CMI (Computer Managed Instruction) functions and a matching set of CBT functions. Consequently, the proposed standard covers:

I. Describing what is in a course;

II. Organizing and sequencing individual lessons in a single course;

III. Launching or starting assignable units with course management software (CMI software);

IV. Communicating information between software managing a group of lessons(i.e. CMI system) and the lessons themselves;

V. Describing objectives in a course and relating them to lessons and groups of lessons;

VI. Reporting student performance information, and relating performance to objectives.

4.4.4 Reusable Competency Definitions

This standard specifies the mandatory and optional data elements that constitute a Competency Definition as used in a Learning Management System, or referenced in a Competency Profile. This standard is intended to satisfy the following objectives:

I. Provide a standardized data model for reusable Competency Definition records that can be exchanged or reused in one or more compatible systems;

II. Reconcile various existing and emerging data models into a widely acceptable model;

III. Provide a standardized way to identify the type and precision of a Competency Definition;

IV. Provide a unique identifier as the means to unambiguously reference are usable Competency Definition regardless of the setting in which this Competency Definition is stored, found, retrieved, or used. For example, metadata that describe learning content may contain a reference to one or more Competency Definition records that describe the learning objectives for the content;

V. Provide a standardized data model for additional information about a Competency Definition, such as a title, description, and source, compatible with other emerging learning asset metadata standards;

VI. Provide a controlled vocabulary to express how competency definitions are semantically related.

4.5 PAPI

URL: edutool.com/papi

The Public and Private Information (PAPI) for Learners (PAPI Learner) Standard describes "portable" learner records. The PAPI Learner Standard is a data interchange specification, used for communication among cooperating systems. The data is exchanged: (1) via external specification (only PAPI Learner coding bindings are used while some other data communication method is mutually agreed upon by data exchange participants), (2) via control transfer mechanism to facilitate data interchange, or (3) via data and control transfer mechanisms.

An important feature of the PAPI Learner Standard is the logical division, separate security, and separate administration of several types of learner information. These types of information are also known as "profile information" and "learner profiles". The PAPI Learner Standard may be integrated with other systems, protocols, formats, and technologies. The PAPI Learner Standard is based on IEEE specifications (see above), particularly 1484.2.1 to 1484.2.6 and 1484.2.21 to 1484.2.26.

4.6 AICC

URL: www.aicc.org

The Aviation Industry CBT Committee (AICC) develops guidelines for the aviation industry in the development, delivery, and evaluation of Computer Based Training (CBT) and related training technologies. These guidelines, which are concerned with the hardware and software aspects, represent the oldest e-Learning standard in CBT (founded in 1988).

The AICC certifies training products that comply with AICC Guidelines and Recommendations (AGR's) via its independent test labs. The AICC currently offers certification testing for the following AGR's:

- AGR-006: Computer Managed Instruction (File-based);
- AGR-010: Web-based Computer Managed Instruction (CMI).

The types of products that can be certified compliant to AGR-006/AGR-010 are as follows:

- Assignable Units: Computer-based pieces of learning content "launchable" and "trackable" from an AICC/CMI system;
- CBT Courses: A groups of assignable units bundled with an AICC/CMI course structure;
- CMI Systems (also called LMS): Systems that manage and launch Assignable Units (AU's) and track student progress;
- CMI Application Service Provider (ASP): A CMI System installed at a central data centre provided by an organization. This organization offers CMI system "services" to multiple customer organizations rather than licensing/selling CMI system software;
- Courseware Generation / Assessment Systems: Content creation/delivery systems that can either communicate with a CMI system directly as an AU or generate AU's such that some (or all) of AICC communication data is automatically set or inspected by the system (and not directly by the content designer). Examples of such systems are test bank systems, simulation systems, courseware engines, and courseware generators;

- Authoring Systems: Learning content creation/delivery systems that allow content designers to directly control the inspection and setting of all AICC communication data in the design of (AU's).

More than 20 vendor participants are compliant with these guidelines (among them Macromedia and IBM[17]).

4.7 SCORM

URL: www.adlnet.org/index.cfm?fuseaction=scormabt

The Sharable Content Object Reference Model (SCORM) is a collection of specifications adapted from multiple sources (Aviation Industry CBT Committee – see Section 4.14.1, IMS – see Section 4.2, IEEE – see Section 4.4, ARIADNE – see Section 4.14.1, ALIC[18], and others) to provide a comprehensive suite of e-Learning capabilities that enable interoperability, accessibility and reusability of Web-based learning content. The SCORM is issued from the ADL Initiative (see Section 4.3 above), and is **a reference to the IMS Learning Resource Metadata Information Model**, which itself is based on the IEEE 1484.12.1 LOM (Learning Object Metadata) standard. Since the LOM standard possesses a rather complex data model consisting of over 60 metadata entries, designing a tool for searching SCORM metadata had required to overcome several challenges to boost run-time performance and efficiency, and to be user-friendly (through the use of a GUI – Graphical User Interface).

ADL released a draft version of SCORM in 1999, SCORM Version 1.0 in 2000, SCORM Version 1.1 and 1.2 on 2001. The SCORM continues to update and expand the scope of the specifications through cooperation with industry, government and academic participants. It is intended to standardize how to launch and track directed learning experiences, and to define the logic of complex learning experiences so content can be reused, moved, searched for, etc. Future versions are expected to expand the initial scope of the SCORM as technology further develops. The ADL Technical Team has now released SCORM 2004 (formerly known as SCORM Version 1.3), which reflects the work of the ADL Technical Team to refine SCORM Version 1.3 Working Draft 1 and the approval of various e-learning standards. The most significant change from SCORM Version 1.2 to SCORM 2004 is the addition of learning content sequencing capabilities as defined by the IMS Simple Sequencing specifications (see below) to address the needs for dynamic presentation of learning content based on prescribed sequencing strategies and learner performance.

The SCORM is a reference model that defines the interrelationship of course components, data models and protocols so that learning content objects are sharable across systems that conform with the same model. This model is written primarily for vendors and toolmakers who build LMS and learning content authoring tools. The SCORM, which includes aspects that affect LMS, content authoring tool vendors, instructional designers, content developers, training providers and others, contains fours parts:

4.7.1 The SCORM Vision

The SCORM Vision is intended to represent the next generation of learning architecture. It will focus on the learner information profiles, assessments, data models, and other Application Program Interfaces (API), including protocols such as SOAP.

[17] IBM Lotus LearningSpace 5.0 is based on this standard. However, the new IBM Lotus LMS follows the SCORM standard instead of the AICC.

[18] ALIC (Advanced Learning Infrastructure Consortium Pamphlet) is a Japanese standard to promote standardization in learning infrastructure from primary and secondary school to higher education, training and "Life-long Learning". ALIC works in cooperation with the Information Processing Society of Japan.

4.7.2 The Content Aggregation Model

The Content Aggregation Model specifies the way to assemble learning content so it can be moved and reused. The first specification in the Content Aggregation Model is LOM, a dictionary of tags that are used to describe learning content, including metadata[19], in a variety of ways. Typically, metadata describes what the content is, who owns it, what are the technical requirements, educational purposes, etc. The second specification is concerned with the way to code the tags in XML (XML binding). Finally, the third specification is the IMS Content Packaging specification. This defines how to package together a collection of learning objects, their metadata, and information about how the content is to be delivered to the user. More concretely, packaging consists of "zipping" all relevant files together with an XML "manifest" that defines all of the contents and their relationship to one an other. The "manifest" thus describes the structure (i.e. the hierarchy), or organisation, of the overall learning experience.

4.7.3 The Run-Time Environment

The Run-Time Environment is used for launching learning objects and track the learner's progress. It is made of two parts: (1) an API, and (2) a data model. The first component was defined to provide a standard way of communicating with an LMS, regardless of what tools are used to develop the content. The second component specifies what to communicate, and is described accordingly to a data model. Such a data model thus standardizes how LMS track learners.

4.7.4 Sequencing

Sequencing and navigation of content objects are crucial to representing complex behaviors of learning experiences (such as remediation branching, which is an important cognitive aspect of a learner as this determines his/her progress in learning) in a standardized way. While sequencing was not available in the preliminary versions of SCORM, since 2001 an ADL working group, in collaboration with the IMS Global Learning Consortium, has worked on the development of a specification for sequencing of learning content. This work, based on use cases, was introduced in the SCORM Version 1.3 (version known as SCORM 2004).

4.8 MPEG-7

URL: www.chiariglione.org/mpeg/standards/mpeg-7/mpeg-7.htm

MPEG-7, formally named "Multimedia Content Description Interface", provides a rich set of standardized tools to describe multimedia content. This standard has been developed by experts representing broadcasters, electronics manufacturers, content creators and managers, publishers, intellectual property rights managers, telecommunication service providers and academia.

Both human users and automatic systems that process audiovisual information are within the scope of MPEG-7. MPEG-7 offers a comprehensive set of audiovisual Description Tools (the metadata elements and their structure and relationships, that are defined by the standard in the form of Descriptors and Description Schemes) to create a set of instantiated Description Schemes and their corresponding Descriptors, which form the basis for applications targeting efficient access (search, filtering and browsing) to multimedia content.

Why using MPEG-7 in e-Learning? Because this standard has the following features:

- Has a multimedia description interface;

[19] Developping and applying metadata to learning resources is a new concept, and so far, no common usage of metadata has yet emerged.

- Is robust for metadata;
- Is a standard for metadata;
- Has semantic interoperability (important feature);
- Can be interfaced to portals;
- Is compliant with learning object repository.

MPEG-7 addresses many different applications in many different environments, which means that it needs to provide a flexible and extensible framework for describing audiovisual data. Therefore, MPEG-7 does not define a monolithic system for content description but rather a set of methods and tools for the different viewpoints of the description of audiovisual content. Having this in mind, MPEG-7 is designed to take into account all the viewpoints under consideration by other leading standards such as, among others, TV Anytime[20], Dublin Core (see next section), SMPTE Metadata Dictionary[21], and EBU P/Meta[22]. These standardization activities are focused to more specific applications or application domains, whilst MPEG-7 has been developed as generic as possible. MPEG-7 uses also XML as the language of choice for the textual representation of content description, as XML Schema has been the base for the DDL (Description Definition Language) that is used for the syntactic definition of MPEG-7 Description Tools and for allowing extensibility of Description Tools (either new MPEG-7 ones or application specific). Considering the popularity of XML, usage of it will facilitate interoperability with other metadata standards in the future.

4.9 Dublin Core

URL: dublincore.org

The Dublin Core Metadata Initiative is an open forum engaged in the development of interoperable online **metadata standards** that support a broad range of purposes and business models. It is an organization dedicated to fostering the widespread adoption of interoperable metadata standards and promoting the development of specialized metadata vocabularies for describing resources to enable more intelligent resource discovery systems. The first Dublin Core Series Workshop took place in Dublin, Ohio in 1995. On its web site, a list of tools for managing metadata (creating, producing, converting, etc.) is available. Web pages are one of the most common types of resources to utilize the Dublin Core's descriptions, usually within HTML's meta tags. However increasingly there are many digital archives of physical objects that are starting to make use of the Dublin Core. For instance, Dublin Core metadata is being used as the basis for descriptive systems by several community interest groups such as educational organizations, libraries, government institutions, scientific research sector, Web page authors, businesses requiring more searchable sites corporations with vast knowledge management systems, etc.

[20]TV-Anytime Forum Inc. is an international consortium in charge of developing the TV-Anytime Metadata Specification. This specification includes attractors/descriptors used e.g. in Electronic Program Guides (EPG), or in Web pages to describe content, a set of metadata for describing user preferences, representing user consumption habits, and defining other information (e.g. demographics models) for targeting a specific audience, as well as segmentation metadata used to edit content for partial recording and non-linear viewing.

[21]Standard issued from the Society of Motion Picture and Television Engineers and covering the use of metadata for video, audio, and data in their various forms.

[22]TV standard of the European Broadcasting Union

Both the Dublin Core and RDF[23] (Resource Description Framework) communities have a number of members in common, and have evolved side-by-side. The Dublin Core community provided much of the basic requirements that were used to design RDF. In turn, the development of RDF provided the Dublin Core community with a much more formal underlying data model that has helped it to determine best practices and universal solutions for many of the detailed problems that were encountered during the deployment process. The Dublin Core Metadata Element Set (DCMES) was created to provide a core set of elements that could be shared across disciplines or within any type of organization needing to organize and classify information. Dublin Core projects are found in a variety of domain, e.g. art and humanities, business, education (for instance EdNA, see Section 4.13.1), mathematics, medicine, science and technology, etc.

4.10 CanCore

URL: www.cancore.ca

CanCore, with the support of Athabasca University and the eduSource project[24], has developed three open-source software components for the access and manipulation of LOM/CanCore metadata. The CanCore Initiative, which is based on and fully compatible with the IEEE Learning Object Metadata standard (Section 4.4) and the IMS Learning Resource Metadata specification (Section 4.2), has been funded through the CANARIE[25]-sponsored BELLE[26] and POOL[27] projects, the Netera Alliance, Industry Canada, and through Alberta Learning, TeleEducation NB and the Electronic Text Centre of the University of New Brunswick. Released under the Free Software Foundation's LGPL License, the three components of CanCore have the potential to greatly simplify the challenging task of developing learning object repositories, all without adding in any way to development costs. These components take the form of interfaces, APIs (Application Program Interfaces), or schemas for working with LOM (Learning Object Metadata) or LOR (Learning Object Repository) data and functions.

The first component, a LOM interface or API, is written in Java, and takes the form of a LOM "Java Binding". This binding can be used by Java programmers for representing and manipulating LOM data objects in software systems. As an API, this component also provides a way of facilitating interoperable communication between a LOM data object and external third party software. The second component, a LOR interface or API, is also written in Java, and it allows LOM records to be stored and made accessible in an interoperable manner in a networked environment. This LOR API makes it possible to access LOM data in ways comparable to

[23]The Resource Description Framework (RDF) is a W3C Recommendation. The basic layer of RDF can be understood as collection of simple sentences (assertions), that is, they have a subject, a predicate and an object. In case another sentence is talking about the same subject, they are glued together at the level of a subject node. Generally such geometric/semantic objects are called labeled directed graphs. This feature is basic to RDF and forms the basis of its potential. More details can be found on the web site http://dublincore.org/documents/2002/04/14/dcq-rdf-xml.

[24]The eduSource project aims at creating a testbed of linked and interoperable learning object repositories across Canada and provides leadership in the ongoing development of the associated tools, systems, protocols and practices that will support such an infrastructure.

[25]The CANARIE Learning Program, a $25 million shared-cost funding initiative, was launched in September 1999 with funding support from Industry Canada to encourage the development and use of broadband networks in education and training.

[26]BELLE (Broadband Enabled Lifelong Learning Environment) is a $3.4 million shared-cost project funded under the CANARIE Learning Program. BELLE's objective is to develop a prototype educational object repository.

[27]POOL (Portal for Online Objects in Learning) is a project to develop a prototype national repository and portal for learning objects, particularly for post-secondary, workplace training and continuing education markets, using a Web-based approach. The project leader is TeleLearning Network Inc., Vancouver, BC.

the functions specified in the IMS Digital Repositories Interoperability Specification (i.e. via "harvest", "search", and "submit") The third component, a "LOR-LDAP" implementation, stores LOM records using simple and popular LDAP (Lightweight Directory Access Protocol) server software. This component takes the form of a specific LOR API implementation built using a custom LDAP schema developed specifically to store and expose LOM data.

4.11 The Sakai Project

URL: www.sakaiproject.org/sakaiproject

The University of Michigan, Indiana University, MIT, Stanford, and the uPortal consortium are joining forces to integrate and synchronize their educational software into a pre-integrated collection of open source tools. This joint force aims at yielding three outcomes for sustainable economics and innovation in higher education:

I. A framework that builds on the recently ratified JSR 168 portlet standard and the OKI (see Section 2.2.8) open service interface definitions to create a services-based, enterprise portal for tool delivery;

II. A re-factored set of educational software tools that blends the best of features from the participants' disparate software (e.g., course management systems, assessment tools, workflow, etc.);

III. A synchronization of the institutional clocks of these schools in developing, adopting and using a common set of open source software.

The products of this project will include an Enterprise Services-based Portal, a complete Course Management System with sophisticated assessment tools, a Research Support Collaboration System, a Workflow Engine, and a Tool Portability Profile as a clear standard for writing future tools that can extend this core set of educational applications. The modular, pre-integrated tools will greatly reduce the implementation costs of one or more of these tools at any institution. The Sakai Project Core universities are committing over $2 million per year to launch and support this two year project. The core universities are also committed to implementing these tools at their own institutions starting in Fall 2004 through the duration of the project. The commitment of resources and adoption is set on strict timeline to swiftly integrate and synchronize the educational software at the core institutions. This effort should demonstrate the compelling economics of "software code mobility" for higher education, and it should provide a clear roadmap for others to become part of an open source community.

The Sakai project is also developing an Educational Partners Program that includes resources for community development, training, shared best practice, and early access the Tool Portability Profile (TPP) and Sakai applications. Presently, it costs $10K per year (minimum 3 years) to become a member of the Sakai project. Among others, a member benefits from an early access to pre-release code, of exchange of partner-developed tools, developer training for the TPP, and access to the knowledgebase.

4.12 ULF

URL: www.saba.com/standards/ulf/Overview/Frames/overview.htm

In the commercial products, the Universal Learning Format (ULF) is a modular set of XML-based formats developed by Saba Software Inc. for capturing and exchanging various types of

e-Learning data, including online learning content, catalogues of learning resources, certification libraries, competency libraries, and learner profile information.

ULF is based on various standards for exchanging learning data in a web environment (including ADL, IMS, LRN, IEEE LTSC, Dublin Core, and vCard) and brings together the key elements of these standards into a comprehensive and fully integrated solution. ULF is fully compatible with its constituent standards and provides a two-way path for conversion and reconversion. This ensures that data described in ULF is universally portable across all systems and taxonomies that are designed to support virtually any recognized industry standard. It also means that the ULF will shadow new developments in its constituent standards, thus providing a direct path for future extensibility.

4.13 Learning Object Repositories

Learning Object Repository (LOR) contains standardised learning materials ready to be used in teaching. More than 20 such repositories have been inventoried by the University of Texas (San Antonio), with their URL address available on their web site (http://elearning.utsa.edu/guides/LO-repositories.htm). To give a flavour of what can be found in such LOR, four of them are presented in this section.

4.13.1 EdNA Online

URL: www.edna.edu.au/edna/go/pid/1

EdNA Online is a service that aims to support and promote the benefits of the Internet for learning, education and training in Australia. It is organised around Australian curriculum, its tools are free to Australian educators, and it is funded by the bodies responsible for education provision in Australia, all Australian governments. As an information service, EdNA Online provides two key functions: (1) a directory about education and training in Australia, (2) a database of Web-based resources useful for teaching and learning.

The EdNA Metadata Standard is based on the internationally recognised Dublin Core Metadata Element Set (DCMES, see Section 4.9). The work of maintaining the EdNA Metadata Standard is conducted by an EdNA Metadata Standard Working Group. The purpose of the EdNA Metadata Standard is to support interoperability across all sectors of education and training in Australia in the area of online resource discovery and management. Adoption of the standard aims at assisting people across education and training engaged in the production and use of well-described digital content. The standard will also support the technical requirements for well-structured coding of this content to exchange and serve up data on request. The principal application of the standard at present is to facilitate the aggregation of metadata about educational resources, from all states and territories, and all sectors of education and training, for EdNA Online.

4.13.2 Merlot

URL: www.merlot.org

MERLOT, the acronym for Multimedia Educational Repository for Learning and Online Teaching, is as a collaborative effort of a consortium of higher education institutions. It is a free and open resource designed primarily for faculty and students of higher education. Links to online learning materials are collected there along with annotations such as peer reviews and assignments. The collection includes art, business, education, humanities, mathematics, science and technology, and social sciences. Each item within a collection has an URL that points to

the web site where the material is to be found. Material can be applets for providing animated explanations on specific topics (e.g. how a transistor is fabricated on a silicon wafer), web pages, evaluation sheets, etc. This kind of resource is to be compared to what can be found on the Swiss Virtual Campus site.

Merlot can be viewed as a huge directory containing the URLs that point to material provided by contributors who wish to share their tools. Because the quality of the web sites is variable, a rating, obtained through a peer review, is added next to each material listed in the different collections. The list of the contributors also includes private companies, which means that the information is obtained at the price of advertisements!

Peer reviews are performed by evaluation standards that divide the review into three dimensions: quality of content, potential effectiveness as a teaching tool, and ease of use. Each of these dimensions is evaluated separately. In addition to the written findings established by the reviewers, there is a rating for each of the three dimensions (1-5 stars, 5 being the highest). A review must average three stars (or textual equivalent) to be posted to the MERLOT site. The primary purpose of these reviews is to allow faculty from any institution of higher education to decide if the online teaching-learning materials they are examining will work in their course(s). Peer reviews are performed by peer users of instructional technology, and not necessarily by peer authors of instructional technology. This choice is dictated by the emphasis on the user's perspective to use MERLOT.

In view of the huge number of material listed in the database, search tools are also provided on the MERLOT site. These tools greatly help in the search for specific resources, specially in view of the fact that the search can be applied onto other database such as EdNA Online (Education Network Australia, see Section 4.13.1) and SMETE (see Section 4.13.3). As such, MERLOT is a powerful knowledge tool for education. This consortium has a partner alliance with the EDUCAUSE National Learning Infrastructure Initiative (NLII, see Section 4.2), which organizes annual meetings.

4.13.3 SMETE

URL: www.smete.org

The SMETE Digital Library is a dynamic online library and portal of services by the SMETE Open Federation for teachers and students. The SMETE Open Federation was formed to promote the teaching and learning of science, mathematics, engineering and technology at all levels. The Federation was built with funding by the National Science Foundation[28], National STEM Education Digital Library program[29] and partnerships with nationally recognized professional educational organizations, academic institutions and private e-Learning companies. The SMETE Open Federation community fosters the ongoing collaborative development among partner organizations, provides tools and services to support collection and service providers, and ensures stability, sustainability and scalability of the Federation's programs and projects.

On their Web site, it is possible to access a wealth of teaching and learning materials. For students, it opens access to resources that can help them prepare for a class or exam. For

[28]The National Science Foundation (NSF) is an independent agency of the U.S. Government, established by the National Science Foundation Act of 1950. Its mission is to promote the progress of science, to advance the national health, prosperity, and welfare, and to secure the national defence.

[29]The National Science Digital Library (NSDL), funded by the NSF, provides educational resources for science, technology, engineering and mathematics education. The NSDL mission is to both deepen and extend science literacy through access to materials and methods that reveal the nature of the physical universe and the intellectual means by which we discover and understand it. The National STEM Education Digital Library program aims to establish a national digital library that will constitute an online network of learning environments and resources for science, technology, engineering, and mathematics (STEM) education at all levels.

teachers, it allows to find learning materials ready to be used in their classroom.

4.13.4 Wisc-Online

URL: www.wisc-online.com

Wisconsin's digital library was developed with the collaboration of content-expert faculty and instructional technology specialists. It is a searchable database where more than 1000 of reusable learning objects can be found.

Most of the learning objects have been developed using Macromedia Flash 6.0. Flash was selected for its functionality when publishing to the web. Some objects contain animated characters which are created in a software called "Poser", which creates three dimensional, animated human figures quite effectively. Video is rarely used, but when it is, they use a software package called "Sorenson Squeeze" to optimize video for the Web. A large number of objects includes a dynamic E-mail function, which allows any student to send interactions to any instructor. A section of the site makes available templates that allow instructors to create Flash-based learning objects for instructors with the possibility of releasing and editing objects without technical support.

Another related object repository is GEODE (Global Education Online Depository and Exchange) of the University of Wisconsin, which propose electronic course materials specialized in Culture and Community, Communication, Information and Technology, Environment, Health and Science, Economics and Development, Politics, Security and Justice. More details can be obtained on their Web site http:// www.uw-igs.org/search

4.13.5 Gateway to Educational Materials

URL: www.thegateway.org

The Gateway to Educational Materials (GEM) is a consortium effort to provide educators with quick and easy access to thousands of educational resources found on various federal, state, university, non-profit, and commercial Internet sites. GEM is sponsored by the U.S. Department of Education. Teachers, parents, administrators can, at no costs, search or browse the GEM and find thousands of high quality educational materials, including lesson plans, activities, and projects. Browsing (based on the Inktomi software) can be made through lists organized by subjects, keywords, or grade level.

4.14 European Initiatives

4.14.1 ARIADNE

URL: www.ariadne-eu.org

ARIADNE is a project of the European Union focusing on the development of tools and methodologies for producing, managing, and **reusing** computer-based pedagogical elements and telematics-supported training curricula. To this end, they are involved in related technical specifications efforts, most notably in the area of meta-data. Interestingly, ARIADNE and IMS have jointly developed a meta-data specification (the IMS Learning Resources Meta-data Specification) for submission to IEEE.

The ARIADNE Foundation was created to exploit and further develop the results of the ARIADNE (and in a second phase ARIADNE II) European Projects, which created tools and methodologies for producing, managing and reusing computer-based pedagogical elements and

telematics supported training curricula. Validation of the tools and concepts took place in various academic and corporate sites across Europe. This work received financial support from the European Union and from the Swiss Government (OFES).

The ARIADNE Foundation seeks to increase the awareness of Europe's (and beyond) learning citizen of existing ICT-based training channels, convince and guide new potential users from the academic community, and to assist new users from the corporate world, where training and re-training is increasingly necessary. The following educational technologies and methodologies are available to members:

- Learning objects multilingual indexation;
- Learning objects capitalization, sharing and reuse;
- Learning objects authoring (courseware-type-specific authoring);
- Capture of socio-geographical learners' data;
- Design of socio-geographically targeted curricula;
- Learning objects selection and assembling in targeted curricula;
- Design of web distributed distance courses;
- Best practices in the use of interactive communication technologies;
- Best practices in management of small, medium and large distant learning courses.

4.14.2 X4L Program

URL: www.cetis.ac.uk/members/x4l

The UK Exchange for Learning (X4L) Program is exploring the re-purposing of existing and forthcoming content, funded by JISC (Joint Information Systems Committee - see Footnote 13, page 28), suitable for use in learning. The program also encompasses content created by other bodies and agencies active in learning where intellectual property rights allow for educational use. Part of this activity is to explore the process of integration or "plugging-in" of usable objects into online learning such as Virtual Learning Environments (VLEs) and Managed Learning Environments[30] (MLEs).

Through the production of a suite of software tools for authoring and delivery standard-compliant learning objects incorporating comprehensive user guides and exemplar resources, the X4L program has the potential to:

- Increase the range and number of materials accessible for use in learning and teaching (with focus on pedagogical outcomes);
- Facilitate the creation, sharing and reuse of learning objects and services;
- Make available exemplars and case studies of re-purposing electronic materials for learning and teaching;

[30] According to the JISC, the term VLE refers to the components in which learners and tutors participate in "online" interactions of various kinds, including online learning (and is thus a broader definition than LMS). Furthermore, the term MLE is used to include the whole range of information systems and processes of a college (including its VLE if it has one) that contribute directly, or indirectly, to learning and the management of that learning.

- Explore the potential for re-purposing existing electronic materials to meet new learning objectives;
- Establish mechanisms for tagging content as learning objects, and the mechanisms for interaction between local provision and national repositories, e.g. the National Learning Network (NLN) repository;
- Build upon the JISC MLE programs to demonstrate the potential for use and re-use of standards or specifications for learning objects within VLEs and MLEs;
- Build on relationships with content providers (including commercial suppliers) to provide learning focussed exemplars and sample materials which demonstrate applicability of content for learning.

One realization[31] is the application RELOAD (see Section 4.2.3) that builds directly on tools and systems delivered by several earlier JISC projects (such as PackageIt and the Colloquia VLE), and which integrate SCORM.

4.14.3 CEN/ISSS

URL: www.cenorm.be/isss

CEN/ISSS was created in mid-1997 by CEN (European Committee for Standardization) as the focus for its Information and Communications Technologies activities. ISSS (Information Society Standardization System) provides an open process combining the tried and tested backing of the formal standardization environment with a fast, market-driven approach. CEN/ISSS attempts to bridge the gap between formal and informal standardization, combining the rapid process of informal specification with the security offered by the formal open consensus of traditional standardization.

Since February 1999, the CEN/ISSS provides a workshop in the learning technologies. Its objective is to encourage the effective development and use of relevant and appropriate standards for learning technologies for Europe. Specifications, agreements, guidelines or recommendations are developed in this kind of workshop, particularly when no initiative addressing the identified requirements is in place yet or when global solutions developed elsewhere need to be localized to European requirements.

4.14.4 PROMETEUS

URL: www.prometeus.org

PROMETEUS (PROmoting Multimedia in Education and Training in EUropean Society) was launched in March 1999 under the sponsorship of the European Commission with the aim of promoting multimedia access to education and training throughout European society, and has evolved since then to encompass the whole range of technology-assisted learning. The main objectives of the PROMETEUS are:

- To improve the effectiveness of the co-operation between education and training authorities and establishments, users of learning technologies, service and content providers and producers within the European Community including the Commission of the European Communities (the Commission);

[31] Issued from current developments of the Valkenburg Group at the Open University of the Netherlands (OUNL), the EML (Educational Modeling Language) and the associated IMS Learning Design Specification.

- To foster the development of common European and international standards for digital multimedia learning content and services;
- To give a global dimension to their co-operation, and to having open and effective dialogues on issues relating to learning technologies policy with policy makers in other regions of the world, while upholding Europe's cultural interests and specificities.

5 Conclusions

5.1 E-Learning motivations

Web-based learning, whether totally on-line courses or blended with classroom learning, is becoming a significant part of the institutional culture on many campuses. From the university peering reported in this document, the main incentives for developing the e-Learning culture can be summarized by stating that e-Learning

- Improves the quality of learning;
- Facilitates access to resources;
- Promotes remote exchanges and collaboration.

This e-Learning culture is deemed by the students as being natural and necessary. Students are, in many cases, more satisfied with the blended learning model than traditional face-to-face instruction (Harley *et al.* 2003). For instance, the University of Central Florida indicates that students are 14% more satisfied with blended learning than classroom learning, while fully online courses have slightly lower success rates and higher withdrawal rates than either their face-to-face or web-enhanced counterparts (see web site pegasus.cc.ucf.edu/∼rite for statistics).

If from the point of view of the students the motivation for promoting e-Learning is clear, one of the big challenge is to convince faculty of becoming engaged into it. Among the variety of reasons that explains this lack of engagement (reviewed for instance in Hagner and Schneeback 2001), one is that some professors are computer illiterate or firmly believe that traditional models are superior. On the contrary, those who are computer experts and strongly motivated, often initiate e-Learning programs without long-term university development strategy. However, according to many of the institutions presented in this report, the ability to scale these early initiatives, in retrospect, prove to be one of the major critical success factors in ensuring their on-going viability. Once students use the system, either for blended learning or totally on-line offerings, they pressure faculty and administrators to support more and more courses. This pressure puts a greater burden on getting the late-adopting faculty trained, as well as scaling the hardware and software to support the reliability and availability demands of a growing constituency of expectant learners. Often the campuses have to upgrade their delivery infrastructure significantly, adopting a centralized e-Learning approach to be more efficient, facilitate creativity, and reduce the costs (Hartman and Truman-Davis 2001). The ultimate objectives of these e-Learning centres can be summarized as being able to enable faculty and students to concentrate on teaching and learning instead of technology.

5.2 Hyper-University

At another scale, universities strengthen and coordinate support networks with the aim of providing appropriate tools and infrastructure for using technology in innovative and effective ways (Millichap 2003). For instance, the University of British Columbia provides a guiding role with respect to e-Learning through the Faculty Alliance for Technology in Education (FATE).

FATE is a pan-university group comprising professional representatives from units engaged in IT, educational technology, instructional support and teaching and learning within faculties and central units who work together to ensure that e-Learning initiatives get proper recognition and executive attention. Another example is the Open Knowledge Initiative (OKI), a collaboration among leading universities (e.g. MIT and Stanford University) and specification and standards organizations to support innovative learning technology in higher education. Another example of large-scale initiative is the "MetaCampus", a concept developed by the Open University of Catalonia in collaboration with Sun. The idea is to achieve a "hyper-university" where a student will be able to enrol in the subjects they prefer and at the university of their choice, provided that they have previously subscribed to the hyper-university project. The hyper-university will permit the studying of careers and other type of joint learning since, in the not-too distant future, all universities will possibly have their own Virtual Campus. The aims of all these initiatives are to:

- Create a standard for learning technology;
- Provide stability, reliability, and a smooth migration path;
- Support a range of teaching and learning requirements;
- Encourage easy sharing of learning content and technology;
- Lower long-term cost of software ownership.

5.3 Funding

E-Learning requires huge investments at the beginning, specially for the creation of multimedia materials. If tutoring is present, costs will also increase as the number of students increases, albeit at a slower rate than for presence teaching. Return on investment can however come from the fact that blended learning makes classroom utilization more efficient and offers potential cost savings because it allows administrators the opportunity to eliminate the need for some classroom construction. The rationale is that as students number increases, on line courses have lower cost per student than presence teaching (for a review on teaching costs, see Bates 1999).

Even though large amount of money is saved in the human resources area by centralizing system support, the running costs of the e-Learning centres (including the software and licences) ask for proper funding. While the initial funding can sometimes come from state programs, in the long term the universities must organise themselves to assume the costs. In U.S.A., several universities have opted for the solution consisting to take a part of student tuition to finance the e-Learning infrastructure. Other universities, in the context of the continuing education or of professional upgrading, or of a virtual university, manage to finance the e-Learning programs by asking the students to pay a fee for each attended course.

There is one interesting exception in the funding strategy of the universities considered in this survey: the MIT. Funded jointly by two private foundations, and MIT itself, the politics of the school is to freely distribute all courses to the whole world. This initiative is presented as being the tradition at MIT, and in American higher education, of open dissemination of educational materials, philosophy, and modes of thought. Another point of view could be that it is a reaction to the fear that the traditional providers of higher education will not be able to compete with the private sector regarding the use of ICT, and thus by freely distributing courses they will be able to withstand competitive pressures. Whatever the reasons, it is not yet clear how in the long term the other universities that sell their courses are going to pursue their politics, given one of the most prestigious university is already distributing freely high quality courses.

5.4 Technology

The word e-Learning encompasses different kinds of educational programs and uses of technology, ranging from straightforward distance courses and curricula to blended learning or hybrid courses (which combine presence and distance) to the use of technology to support or to improve presence teaching for campus students. Consequently, there are a large number of software tools for e-Learning. According to their function, they may be divided into four areas:

I. Course content, which can be offered in using various formats (html, ppt, doc, pdf, mpeg, ram, avi, etc.);

II. Communication using videoconference, webcasting, collaborative learning environments, chats, forums, and so on;

III. Management for monitoring students' access to the different course items, enrolling students, splitting a class into different groups, giving different access rights to different kinds of users (learners, professors, tutors, evaluators, administrators, etc.);

IV. Student's assessment.

The market offers many products, called Learning Management Systems (LMS), which try to integrate all four functions accordingly to specific standards, as presented in Section 4. Universities proposing e-Learning activities can choose either to adopt a LMS (most use WebCT), which integrates the main tools needed for the courses and their management, or to develop an ad-hoc solution (homemade platform, dedicated Website, mixing of different tools, etc.). For scalability reasons, university that started with an ad-hoc solution often switch to commercial LMS. The advantages of using such LMS include:

- The reliability and cross platform compatibility (due to the standards used);
- Bug fixing, developing and updating is ensured by the provider;
- No technical competence is required to use it.

Besides Internet technology, some virtual universities use a range of teaching media, such as specially produced textbooks, TV and radio programs, audio and videotapes, CD-ROM, computer software and home experiment kits. Such "low-technology tools" should not be neglected as long as they have the capacity to enrich courses.

As a side note, it should be stressed that while open teaching platforms become fashionable, no "open pedagogical knowledge" is yet available. There is certainly a need to build a "knowledge community" able to identify the real knowledge of teachers. To achieve this task, a few issues will have to be solved:

- New forms of knowledge representation must be found;
- Process of representing and sharing practice must be elaborated;
- Resources to take advantage of new media and new technology must be collectively built.

All these issues should help to take advantage of new technology in effective teaching. This means that e-Learning staff must devise new means of conveying faculty's teaching knowledge, develop tools and resources, and build on-line multimedia knowledge-bases and forums.

5.5 Perspectives

At this moment, it is rather unclear whether e-Learning based education (using specific courseware, combining traditional learning and on-line learning, etc.) is efficient or will be efficient in practice in the near future. What can be observed is the growing demand for education and differentiation of educational needs. An increasing proportion of undergraduate students is working and thus might have difficulties in attending lectures. Moreover, a university degree has become a desirable goal for many people already in employment. Thus, the typical full-time campus student will no longer be the only target public for tertiary education in the future.

Another factor in favour of e-Learning based education is the introduction of the Bologna model. This model could, at least in the long term, increase student mobility and competition between European universities, which will try to attract students from outside, especially for their master courses. These trends may have a strong impact on the organisation of the higher education sector, as well as on the position of each individual institution.

If universities become part of broader networks or consortia (internationalization and marketization of higher education), this may have a considerable impact on the internal organisation. According to de Boer *et al.* (2002), it may well be that the unity of functions that have been considered ultimately connected under the roof of the university cannot be persevered. This will also rise the question whether it will be tenable to have an organisation in which all staff members can perform the broad range of teaching and research activities. While it was not the purpose of this review to address these questions, it is clear enough from the university peering presented in this document that e-Learning will play a dominant role in the diversification of the educational needs and social functions of the university.

6 Relevant web sites

In addition to the URLs of the universities provided in the text, several relevant web sites found in the course of the overall web exploration are cited in the following table. These URLs are regrouped according to three domains: (1) libraries of learning objects, (2) teaching of instructional design, and (3) specific e-Learning institutions.

URL	Description
www.imsglobal.org/metadata	IMS Learning Resources Meta-data Specification
www.merlot.org	Multimedia Educational Resource for Learning and Online Teaching
ekb.mwr.biz	E-Learning Knowledge Base
www.smete.org/smete	SMETE Digital Library, dynamic online library
moats.arizona.edu	Module Organizer And Teaching System, Univ. of Arizona
lester.rice.edu	Learning Science and Technology Repository
www.imsproject.org	e-Learning standards-based technology
eml.ou.nl	Educational Modelling Language
www.dublincore.org	interoperable online metadata standards
web.mit.edu/OKI	The Open Knowledge Initiative
www.cancore.ca	Canadian Core Learning Object Metadata Application Profile
en.wikipedia.org/wiki/SCORM	Sharable Content Object Reference Model
www.educause.edu/nlii	National Learning Infrastructure Initiative
www.lsal.cmu.edu	Learning Systems Architecture Lab, Carnegie Mellon
www.edna.edu.au	Education Network Australia
cdws.ucf.edu	Course development web service, UCF
www.electroniccampus.org	Electronic marketplace for courses, programs and services
pegasus.cc.ucf.edu/∼rite	Research Initiative for Teaching Effectiveness, UCF
antioch.rice.edu/etrac/techctrbr	Centers for Advanced Technology in Higher Education, Rice Univ.
www.educause.edu/nlii	National Learning Infrastructure Initiative
www.atl.ualberta.ca	Academic Technologies for Learning, Univ. of Alberta
www.elearningeuropa.info	European e-Learning site
www.swissvirtualcampus.ch	Swiss Virtual Campus
www.scil.ch	Swiss Centre for Innovations in Learning

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