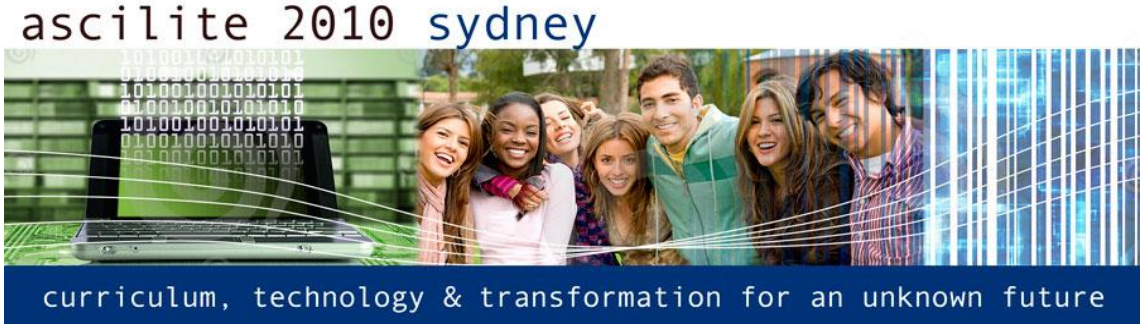

Enterprise architecture roadmap for the development of distance online learning programs in tertiary education

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When universities are trying to convert their existing face-to-face courses to distance online learning programs at a project level, faculty members usually have to commit extra time other than their normal teaching and preparation hours to prepare the e-learning course content because their original face-to-face course materials are not fully compatible with the online learning settings. If universities are going to convert their face-to-face courses in a large scale on an ongoing basis, there is a clear need for us to re-design the enterprise architecture to lower the cost of the e-learning development and make the process more efficient. This paper will use two case studies to highlight the issues that the faculty members have been experiencing when they participate in the e-learning development, and to point out good practices. Then based on the Zachman Framework, a "To-Be" Enterprise Architecture is proposed, which enables academic staff to start contributing to the e-learning development at an early stage such as at the time when they are preparing for the face-to-face courses.

Keywords: Enterprise Architecture, E-Learning Development, Zachman Framework, Tertiary Education

Introduction

Many universities in the world are converting their normal face-to-face courses into online resources that include lecture recordings, lecture notes, assignments and the solutions, project tasks and examples, etc. These materials are usually hosted by a dedicated repository website operated by the universities or by other third party services such as iTunesU. While this conversion process seems not complex as long as the academics are able to send the materials to relevant technical personnel, it does not create active learning experiences for audiences. We cannot call the audiences students because these resources are not specially designed as e-learning courses or programs. To make use of the resources from the faculty members, some universities invest in setting up an e-learning development team to work with the lecturers and develop professional distance online learning programs (Gordon, He, & Abdous, 2009; Leacock, 2005; Lee & Reigeluth, 2009). These programs may offer free access for the public to participate (e.g. USQ – http://ocw.usq.edu.au, OU – http://openlearn.open.ac.uk, etc.). Some may serve as continuing education programs, which may charge students a fee, such as Harvard Medical School's online continuing education programs http://cmeonline.med.harvard.edu. However, the process of converting existing face-to-face university courses into this kind of online learning programs is typically complex, and the associated costs vary depending on a combination of factors such as the media and technologies chosen, the materials and equipments, the staffing costs, the e-learning development process and the enterprise architecture within the universities (Bates, 2000; Rumble, 1998, 2001). In this paper, we will discuss how to use the techniques of enterprise architecture design to make such a complex process more streamlined and economically efficient.

A typical e-learning development process involves a collaboration of several specialists such as subject-matter experts, instructional designers, and technicians in a team environment. The e-learning projects usually go through several phases such as initiation, planning, execution, quality assurance, revision, etc. (Chao, Saj, & Tessier, 2006; Lynch & Roecker, 2007). This process usually requires faculty members to allocate extra time (other than their normal teaching and preparation hours) to obtain certain e-learning design skills and to prepare the course content just for the e-learning programs. Some universities even require the academics to finish a one-semester educational technology course before they can formally get involved in the e-learning development (Leacock, 2005). This practice is apparently time-consuming and there is space for optimisation. If universities would like to participate in the process of transforming their courses in a large scale, there is a need for them to redesign their enterprise architecture to enable the academics to start contributing to the e-learning development while they are lecturing their normal courses (i.e., no need for them to spend considerable extra time to work with the educational designers over a few months just for the e-learning programs).

Methodology

At the enterprise level, to optimise the process of developing e-learning programs, an enterprise architecture redesign methodology is recommended. Enterprise architecture addresses the challenge of increasing e-learning development efficiency while continuing educational innovation. Universities can use enterprise architecture frameworks to manage system complexity and align normal face-to-face teaching and e-learning design resources. Enterprise architecture frameworks provide a set of building blocks and how these blocks fit together. These frameworks serve as documentation and component-specification tools, and facilitate enterprise planning and problem solving (Shah & Kourdi, 2007). There are a number of existing enterprise architecture frameworks available for developing the roadmap, such as the TOGAF framework (The Open Group, 2009), the Federal Enterprise Architecture Framework (The Chief Information Officers Council, 1999), the Zachman Framework (Zachman, 1987), etc. Different frameworks are designed for different purposes and for use in different contexts, but most of them share a similar line of reasoning: business needs drive changes in information systems, which require changes in workflow, data, personnel, IT infrastructure, governance, etc.

In this paper, based on two case studies, the Zachman Framework is adapted to propose a concise roadmap for universities to convert their normal face-to-face courses into e-learning programs in a large scale. The roadmap aims to help resolve the issues emerged in the case studies. The Zachman Framework has 5 perspectives which cover all the participants involved in the whole system of the e-learning development: (1) Scope, (2) Enterprise, (3) System, (4) Technology, and (5) Representations. Each of these perspectives should be defined using 6 dimensions: (1) Data (What?), (2) Function (How?), (3) Network (Where?), (4) People (Who?), (5) Time (When?), and (6) Motivation (Why?). The 5 perspectives and the 6 dimensions form a table that will provide us with a strategic overview.

Case Study 1

Sydney Medical School, University of Sydney, is developing an online self-pace continuing education program on Anxiety Disorders targeting GPs, nurses, Psychiatric trainees and medical students. The e-learning project involves a group of 28 academics who are specialised and noted in a particular area of Anxiety, 6 of whom serve as unit coordinators. The e-learning project is funded externally by the Centres of Clinical Research Excellence (CCRE) Scheme, and it supports a one-year effort in developing 13 units of e-learning resources that consist of 52 modules. In order to make the modules consistent in terms of instructional design throughout the whole e-learning program, all the content experts are required to prepare each module's raw content following the same instructional model designed by an instructional designer, which was adapted from the 4MAT Cycle (McCarthy & McCarthy, 2006). Each of the 13 units consists of 4 sections: (1) Introduction, (2) Lectures (Modules), (3) Assignments and (4) Summary (see Table 1). They received a document specifying the instructional design strategies and e-learning possibilities for different sections of each unit. For example, for the "Connect" step, the unit coordinators were told to "connect students directly to the concept in a personal way and capture students' attention by

initiating problem-solving activity before delivery of instruction…" By doing this, the time and effort to be spent on revision and modification on the submitted content would be reduced.

Table 1: Instructional model adapted from the 4MAT Cycle

Section	Step	Goal	Content Design
Introduction	Connect	Concrete Experience → Reflective Observation	Unit Coordinator
	Attend		
Lectures (4 modules)	Image	Reflective Observation → Abstract Conceptualisation	Lecturers
	Inform		
Assignments	Practice	Abstract Conceptualisation → Active Experimentation	Unit Coordinator
	Extend		
Summary	Refine	Active Experimentation → Concrete Experience	Unit Coordinator
	Perform		

The content experts do not need to manipulate any e-learning software or learning management systems. All they need to do is to supply PowerPoint slides with speech scripts, video materials (e.g., doctor-patient interview), quizzes, discussion forum topic/questions, glossary, assessment questions, reading lists, etc. All the required files from the content experts are described within a specification document. Once the content experts have finished designing and writing all the required raw content and materials, the e-learning development team will start to develop the content into interactive e-learning courseware using rapid e-learning authoring software and a learning management system. Where necessary, the e-learning development team will also assist in filming the doctor-patient interviews that will be used in the introduction, lecturers, and the assignments. If the suitable patients who are willing to participate are not found, actors/actresses are hired to perform the interview with the doctors.

While the content experts find the guidelines of course design useful for keeping the whole course consistent, they have been experiencing the following issues:

- **Video materials:** firstly, the doctor-patient interviews could have been arranged prior to the e-learning project. Otherwise, the academics find it difficult to identify suitable patients for filming within a comparatively short timeframe. Secondly, some of the academics have already had some video materials that they filmed previously, but the filming consent forms that the patients singed indicate the video recordings are for other research/educational purposes, not for this particular e-learning program.
- **PowerPoint slides:** some academics have existing PowerPoint slides for their face-to-face lectures. They find it time-consuming to adapt the original slides for the e-learning project. If they had the e-learning guidelines when they designed the slides for face-to-face, they could prepare the materials for both purposes at the same time.
- **Copyright:** the e-learning project's copyright guidelines are stricter than those for face-to-face lectures because the e-learning courseware will not completely fall into the university teaching scope and the use of some copyright materials require extra licensing procedure. It would be easier for them to arrange the copyright clearance at an earlier stage when the materials were developed for face-to-face teaching.
- **Assessment:** the original assessment materials for the face-to-face course are unsuitable for self-paced online programs, so the content experts have to re-design the assessment questions with objective answers and feedback. The assessment for the e-learning program can include video/audio materials while the original assessment papers for face-to-face courses cannot. The process of re-design the assessment requires them to review all the course materials.

The above issues have been driving the need for enterprise architecture re-design. The aim of this re-design would be establishing a system to support a parallel development of face-to-face courses and their corresponding distance online learning programs.

Case Study 2

The Surry campus of Simon Fraser University, Canada, has created a sustainable e-learning development culture where a central resource pool has been set up to support individual e-learning development clusters (see Figure 1).

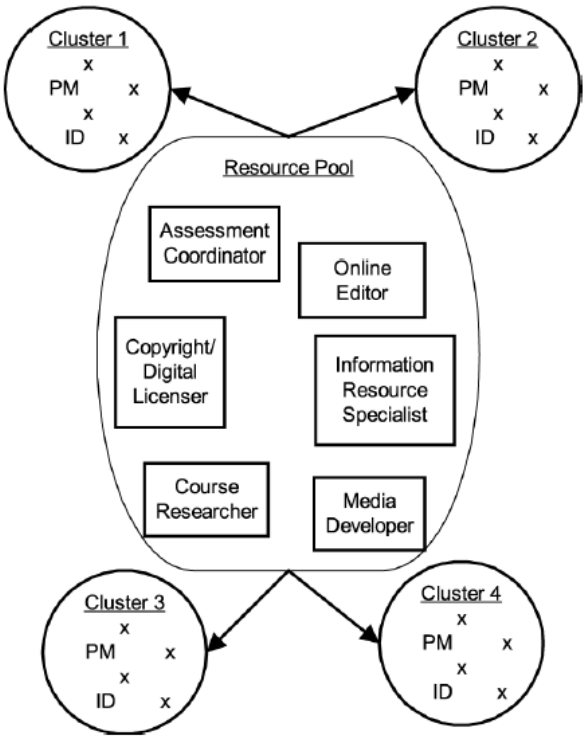

Figure 1: Structure of development clusters (Leacock, 2005)

Leacock (2005) has reported that this enterprise architecture design can facilitate the e-learning process and significantly increase productivity over a short timeframe. This structure was designed to support e-learning development for a brand new campus. At the time when the e-learning development occurred, the campus was not yet open and there were no students, so the involved faculty members could allocate most of their time to participate in the e-learning project where they were required to take a one-semester educational technology course. However, it is still unclear how these clusters can be operated smoothly on an on-going basis when the faculty members' available time decreases and/or when new academics staff come in, who do not have enough e-learning design skills, but Simon Fraser University's experience does demonstrate how important a central resource pool is, so this experience should be adapted into the proposed enterprise architecture roadmap.

Enterprise Architecture roadmap

Based on the two case studies, to make the e-learning development more efficient, it is recommended that the academics prepare the e-learning content in the acceptable format for e-learning development while they are teaching the normal face-to-face courses, instead of allocating separated time to participate in the e-learning development. Table 2 illustrates the enterprise architecture roadmap for this change based on the Zachman Framework (Zachman, 1987). Each cell within the table represents a small work unit in the enterprise architecture design process, which should be supported by detailed planning documentations. This proposed roadmap features the introduction of enterprise-wide e-learning guidelines and course content submission system:

- **E-Learning guidelines:** these guidelines are to be developed by e-learning designers and be used university-wide. They will specify every aspect of the e-learning development such as educational principles, instructional strategies, standard e-learning course structure, technical possibilities, course content specifications, copyright compliance, e-learning development workflow, responsibilities of the involved department/personnel, etc. The guidelines must be promoted via multiple channels such as academic staff orientation/training, university policy, etc., so that the academics will be aware of the requirements for the e-learning development and the limitations of online learning even when they are still preparing for their face-to-face courses.
- **Course content submission system:** this system is managed in a central e-learning development centre and mainly serves as a portal for academic staff to submit their course content for e-learning development in the basic format (e.g., Word documents, PowerPoint slides, filming scripts, etc.). The system should be able to help the academics conduct a brief check to determine if the content to be submitted complies with the e-learning design guidelines. This system becomes the communication channels for the academics and the e-learning development team. The system should display the process of the e-learning development (e.g., submitted, accepted, alpha version, beta version, final release, etc.). Before the raw content is accepted, it is to be reviewed by reviewers other than the original authors and revised and finalised by the course coordinators and the authors. The authors and reviewers are invited to review the courseware in the alpha stage.

Table 2: The To-Be Enterprise Architecture

	What	How	Where	Who	When	Why
Scope	To convert face-to-face courses to e-learning programs	Face-to-face course delivery and e-learning program development	Faculties, e-learning development centres at faculty level and/or at enterprise level	Faculty members and e-learning developers	When a face-to-face course becomes stable and mature	To make the most use of the existing educational resources from the academics
Enterprise	E-learning programs on offer	E-learning programs are developed using the resources from face-to-face courses, and are released to the public	Dedicated e-learning websites	IT technicians, student administrators, marketing staff	When the e-learning programs have been fully developed and passed through a quality assurance process	To promote the university's courses, to expand the approaches for students to receive education
System	Course content submission system and learning management system	Course content submission system to facilitate the data communication between academics and e-learning developers; learning management system to support the e-learning production	Course content submission system built within the existing staff area of the university learning and teaching system; learning management system for self-paced e-learning programs to be separated from other learning management systems for normal university courses.	IT technicians, programmers, system engineers, faculty administrators, teaching assistants, educational designers, etc.	When the IT infrastructure becomes ready to support the course content submission system and the learning management systems	To improve the communication efficiency between the content experts and the e-learning developers; to host, develop, test and manage the e-learning programs

Technology	Normal office software, industrial software, e-learning authoring and multimedia production software	Academics to use normal office software and industrial software to prepare the course content; e-learning developers to use advanced e-learning authoring and multimedia production software and equipments to develop the e-learning programs	Normal office software and industrial software at Faculties; e-learning authoring and multimedia production software at e-learning development centres	Academics, teaching assistants, e-learning developers, and multimedia producers	When the academics are familiar with the process of using the normal office software and industrial software to prepare the course content in the acceptable format, when the e-learning development team has the expertise to manipulate the professional e-learning software	To minimise the unnecessary effort that academics have to make to learn advanced and complex e-learning development skills
Representations	Self-developed multimedia materials, published copyrighted materials, e-learning design guidelines	At the time when face-to-face courses are being prepared and designed, filming and copyright clearance are done for both face-to-face courses and e-learning programs under the supervision of e-learning design guidelines	Dedicated repository for self-developed video materials, and copyrighted materials with copyright clearance; printed e-learning design guidelines distributed to faculties and academic staff orientation and training organisers	Actors/actresses, publishers, printing service, staff training, faculty administrators, e-learning designers	When the exact requirements for multimedia materials and published copyright materials and their availability have been confirmed.	To enrich the e-learning program and to make them more interesting and easier to learn, to maintain the consistency through the whole e-learning program and across different e-learning programs

Conclusion

Although e-learning programs can be developed smoothly within individual projects where subject-matter experts are required to commit dedicated effort to the course content design, the issues associated with the repetition of similar work for the subject-matter experts' normal face-to-face teaching is becoming obvious as the projects are going. This paper has used the Enterprise Architecture techniques to provide a roadmap for those universities who are interested in converting their face-to-face courses into e-learning programs in a large scale. The roadmap highlights 5 perspectives and the 6 dimensions of the "to-be" enterprise architecture that enables academic staff to start contributing to the e-learning development at an early stage such as at the time when they are preparing for the face-to-face courses. This is not to support a process where the academics do not need any extra effort for the e-learning delivery. Comparing to the preparations for face-to-face courses only, the dual delivery mode does require extra time; otherwise the face-to-face delivery would be compromised. However, the optimised workflow can significantly reduce the unnecessary repetitive work required when the e-learning programs are developed completely separately. Besides, the architecture also supports collaboration of a group of academics for the same online programs. Nevertheless, the feasibility of the proposed enterprise architecture design has not been thoroughly investigated, so further empirical studies on the effects and issues of executing this roadmap are highly recommended.

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