COVER SHEET

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ELEARNING MODULES – INCREASING KNOWLDEGE OF COLLABORATION TOOLS FOR CONSTRUCTION MANAGEMENT

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ABSTRACT

Web based collaboration software, such as Optus inCITE and IFC compliant construction management software, offers the opportunity for construction project teams to design and communicate more cost effectively, to plan construction more efficiently, and manage costs throughout the project life cycle. However, a general lack of knowledge of the benefits of the software within the industry has resulted in the underutilisation and slow uptake of such collaborative systems. The challenge is to disseminate information on collaboration and construction management software to the wider construction industry. An initiative to address this at the Queensland University of Technology has been to expand the undergraduate curriculum to include developing eLearning modules on document management and construction management processes. These modules will ultimately be offered in an eLearning format that will be made available to the construction industry. The novel aspect of this initiative is that the development of the prototype eLearning content was prepared by construction management students and will be used by industry for CPE. to train an innovative, competitive workforce, and assist the industry strategic excellence and competitive advantage, and ensure systemic change, innovation, and sustainability.   The issues that arose as part of this initiative are outlined with some recommendations for future work.

Keywords: Collaboration software, Optus inCITE, Construction Management software, Automation of business processes, eLearning, CPE

THE PAPER

1.0 Overview

1.1 Web based collaboration software, 3D CAD software using industry foundation classes (IFC), and nD construction management software are now commercially available. They present the opportunity for construction project teams to design more cost effectively, plan construction earlier, manage costs throughout the life cycle of a construction project and provide a central asset management register for facilities managers. Coupled with this, information and communications technology (ICT) is rapidly changing the way large construction companies are approaching their operations.

1.2 CRC CI Project No 2005-022-E (Betts) eLearning Modules for Building Construction seeks to achieve the following:

- To show industry how to organise design teams and supply chains to work together collaboratively to increase productivity;
- To reveal how life cycle costs can be reduced to enhance the competitiveness of Australian Construction and Integrated Engineering enterprises in a global market; and
- To demonstrate how information for the life of a project and future projects can be captured and used.

1.3 An effective education strategy could be described as a 2 step process:

- To compare traditional paper-based processes to the automation of each construction management process, for example eDocument Management, eTender, ePurchasing,and eEstimating; and
- To educate the industry on the benefits of using interoperable construction management software and the benefits of the Building Information Model concept.

1.4 Current work within the CRC provides for the development and dissemination of eLearning modules for CPE and university programs as follows:

Table 1 - eLearning CPE Training modules

	eLearning Module	Module Content
1	Collaboration Software	Covers web-enabled collaboration software used for communications, business process workflows and storage of documents within a project.
2	Building Information Model (BIM)	Describes the concept as an electronic representation of a building embedded with information that details initial site condition studies and schematic designs through to design development decision making, specifications and detail documentation, working drawings, as-builts, maintenance procedures, and performance records. With cross platform software for interoperability, the BIM database can be readily used at any time by the architect, owner, engineers, fabricators, and constructors. The database tracks the contributions, decisions and approvals of each part of the building life cycle: design to construction to operation. At each phase information is updated and added to the model.

		(http://www.aia.org/static/bim/bim.cfm)
3	Industry Foundation Classes (IFC)	Emphasises the importance of IT standard definitions that have been developed by the International Alliance for Interoperability (IAI) to electronically represent all elements of a building. The relationship between these elements support the design, construction, maintenance and operations processes during the building lifecycle.
4	Automated Estimating	Describes traditional estimating, the current processes and future vision for estimating. Automated estimating adopts electronic tools to measure and store the quantities of materials from a set of construction drawings, and a database of rates to apply to the measured quantities. A user interface manages the generation of these estimates. Model-based estimating automates a bill of quantities from the BIM and produces a cost estimate. 5D reporting uses the construction model as the link between cost and time. Cost loaded schedules are produced for financial analysis. Scheler describes the opportunity to compare fast cost estimates for design to actual construction cost.
5	Automated Scheduling	Outlines traditional methods of scheduling are outlined. 4D sequencing software tools linking scheduled alternatives, can automatically prepare the construction schedules. Once linked, schedule alternatives can be analyzed then communicated and virtual reality models can be created to provide a visual checking aid for client/project team members (Dynaproject).
6	Facilities Management	Focuses on the facility manager and eFM software to improve efficiencies to manage a completed built asset.
7	Automated Code Checking with DesignCheck	Analyses working drawings to ensure they meet the Disability Act and relevant standards prescribed by the Building Code of Australia.
8	Environmental analysis with LCADesign	Focuses on the detailed environmental assessment measures for different materials, products and designs automatically from a 3D CAD drawing to meet sustainable criteria.

2.0   KEY ISSUES

The need for eLearning modules on these emerging technologies is emphasised by the construction industry's current inefficient management practices. Once these collaboration tools are understood and harnessed by the construction industry the benefits can be realised.

2.1   On a large construction project only a fraction of the business processes are automated and much of the information about a building is not interoperable. This results incompatible and redundant information. Currently, architects pass the drawings off to design engineers who add their work but no integration of the data occurs.

2.2   The vision is to adopt tools which can define a building project and automate the construction management business processes in an integrated way. A software interoperability solution where standard objects are interlinked will result in lower expenditures for stakeholders and provides the opportunity for the industry to work together to meet their respective targets This is value adding from the clients' perspective and most importantly, will reduce project life cycle costs for all.

2.3   As all information about a building is contained within a single Building Information Model (BIM) and accessible through a model server on the web,,It is possible to

analyse a BIM, make changes automatically, and hand over a model of the building to the facility manager at the end of construction of the project.

3.0   Current Research

Research presently underway encompasses the investigation of how web-based collaboration tools are being used on live projects to maximise the perceived efficiencies of communication and automating workflows among key stakeholders. To accompany these new work practices, a legal framework is needed to ensure electronic transactions are conforming to contractural requirements.

3.1   Web-Based Collaboration Software

Project Number: 2005-022-E IT Enabled Business Strategies aims to present data that will contribute to a better understanding of current day best practice with respect to life cycle ICT strategies in Australia. It seeks to showcase how flagship Thiess John Holland Joint Venture projects such as *EastLink* and *Lane Cove Tunnel* are utilising web-based collaboration software in their day to day operations and demonstrate to the construction industry their benefits.

From this project, ideas about how to create eLearning modules on collaboration extranets including the benefits achieved at Lane Cove and EastLink will be trialled by (John Holland Group) JHG staff during their induction processes prior to widespread dissemination to industry.

3.2   eTendering and eContracting

Despite the Federal Government's *Electronic Transaction Act* of 1999 confirming the general principle that there is no impediment to a person entering contracts via electronic communication, the basis and protocols for working electronically remain underdeveloped. As the construction industry adopts web-based collaboration tools, organisations will increasingly be required to trade electronically. Hence, the basis for legally compliant electronic trading needs to be established. In particular, the negotiation and establishment of contracts, together with the required and appropriate software tools is to be investigated.

CRC Project No's 2002-067-A (Betts) eTender, and 2005-025-A (Christensen) Electronic Contract Administration – Legal and Security Issues, will change the way we operate in the construction industry. They examine the legal and security issues for the formation and administration of building and construction contracts wholly within an electronic environment.

The research will focus on several aspects of electronic contracting and administration:

1. The process of electronic contract formation;
2. The processes encompassing contract administration; and
3. Contract retention and archiving.

A crucial part of the research will be a case study of JHG's Southbank project. The Southbank project is using the Optus InCITE collaboration platform to administer the contract and the case study will focus on the legal and security issues (both real and perceived) of electronic contract administration as outlined above.

Through the JHG case study the research aims to support further research into eContracting and contract administration in the building and construction industry by:

1. identifying the legal and security issues, risks and barriers for both large enterprises and SMEs within the building and construction industry;
2. explaining in plain English the legal and security framework (including best practice examples) necessary for eContracting and contract administration within the construction industry; and
3. providing critical success factors for legally compliant and secure electronic contracting and contract administration within the construction industry.

eTender and eContracting eLearning modules will disseminate outcomes to industry and give industry confidence in using online environments which are legally compliant.

3.3   eLearning Module Development

Project Number: 2005-022-E IT Enabled Business Strategies seeks to develop eLearning modules for CPE for industry as listed in item 1.4 above. After trialling on QUT students and small industry groups within the construction industry, eLearning modules will be disseminated through industry organisations.

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Cost of Developing eLearning Content

The range of estimates for the development of eLearning content varies, from small financial resources required to huge financial commitment (Mayer, 2003). Estimates with regard to the development time required to develop one hour of content vary considerably. Blomeyer (2002) estimates that the effort required to develop material typically ranges from 50 to 150 man hours of development for one hour of instruction with in some cases up to 2,000 hours of development for one hour of instruction. Baker (2002) explored the cost of development of eLearning content and found that times range from 200 hours to 700 hours of development for one hour of finished development. Horton (2000) suggests that estimates of development for one hour of development between 100 to 600 hours of development are common. Bersin (2003) in a survey of eLearning trends in the United States identified that the costs of developing content typically range from $200 to $5,000 per hour of content development. These cost estimates were a key consideration in the development of the resources and influenced the development strategy adopted.

Methodology in developing eLearning Modules

The undergraduate curriculum for two class groups at QUT included a requirement to produce material for eLearning modules based on a number of topics dealing with collaboration tools.

The students involved were enrolled in the Bachelor of Applied Science in Construction Management. These were a second year group in Applied Computing (CNB 227) and a final year group in Current Construction Issues (CNB 420). Of the 138 students who participated, 108 students were from CNB 227 and 30 students were from CNB 420.

The methodology adopted for developing the eLearning modules was for the students from CNB 227 to create the first draft which was then passed on to the students from CNB 420 for review and comment. Once the version from the CNB 227 students was accepted, the CNB 420 students finalised the module by incorporating a strategic vision for their topic. This development methodology is outlined below in figure 1.

Figure 1 Development Methodology
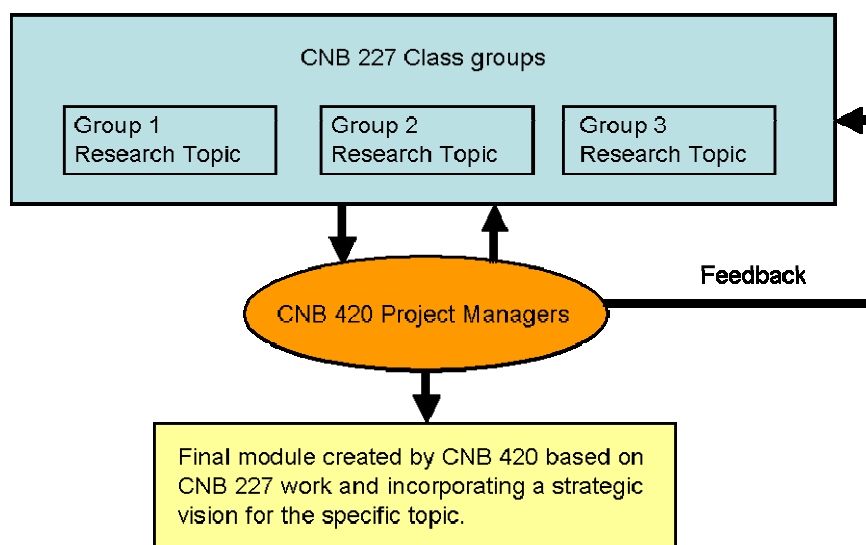
Students were self-allocated on a first come first served basis to each of the topic areas for both CNB 227 and CNB 420. The CNB227 class was divided into groups of 3 or 4 students who were required to prepare initial learning material on the topic assigned to the group. A review of the initial draft of the material by CNB 420 took place during weeks 4 and 5 of the semester. Following on from this review, the groups were expected to revise the work undertaken in light of the feedback given and to continue to develop the material. This cycle was to be completed by week 11. The CNB 420 group project managers were to offer advice, information and motivate the groups assigned to them. When the work was completed at the end of week 11, CNB 420 were to review the material for the topic area they were responsible for and to create one overall module based on their assessment of the three CNB 227 groups. They were also required to include a strategic element in the content they developed. This was to be submitted by the end of week 13.

Results

The evaluation of the eLearning modules is currently been undertaken. Initial feedback would indicate that this was a very worthwhile exercise. From the students perspective the CNB 227 group found the development of content in specific domains very beneficial in understanding the reasons for adopting web-based collaboration tools and eLearning module content. However, while it was anticipated that the students' learning material developed would be integrated into a dedicated eLearning framework hosted by an external provider, this proved to be too ambitious an undertaking in the time available. Notwithstanding this, all the content is now captured in a digital format such as MS PowerPoint, web links, digital images and typed transcripts to use when developing a voice over for the content.

Using final year students as project managers was not as successful as originally anticipated. While they offered some guidance to the CNB 227 group they did not engage actively enough in the project management of their assigned groups. The reasons for this may be related to the pressure of time commitments as all these students were working in industry, and the fact that in terms of the overall module there were a relatively small percentage of the marks assigned to this exercise.

4.0   Future Directions

4.1   The eLearning modules will be designed to educate the building industry on how to manage construction data through the life cycle of a building and hence reduce life cycle costs. To gather the material for the module, a Building Information Model (BIM) model server will be set up and implemented that will track a real building through the design construction phase and used to manage the building. This process is envisaged to be conducted in parallel with traditional construction methods so that the monitoring of benefits provided by these tools is clearly measurable to the project staff. As well as using this experience to develop the eLearning modules, "how-to guides" will also be created for use by the construction industry .

4.2   To create a post project 'knowledge centre' to provide a consultancy service for construction industry eTrading and eContracting. The knowledge centre will also contribute to developing industry-wide standards in electronic contract administration.

4.3   To hold workshops and seminars to disseminate research outcomes within industry partners and the construction community.

5.0   Conclusion

Once the legal and security aspects of eTendering and eContracting are established, we expect to see a rapid decrease in paper based contracting with most parties preferring an electronic alternative.

Current project management reveals inefficiency in using traditional methods of processing information. An effective education strategy is urgently needed to demonstrate to industry how we can better use information and automate construction management processes. A software interoperability solution where standard objects are interlinked will result in lower expenditures for stakeholders and an opportunity for industry to work together simultaneously on all aspects of construction management. This adds value for clients and most importantly will reduce life cycle costs for all. If all the information about a building is contained within a single BIM and accessible through a model server on the web, it is possible to visualise all data on that building, analyse the BIM, make changes automatically, and hand over a model of the building at the end of construction to the facilities manager.

In order to realise the benefits of emerging technologies, the construction industry needs to increase the level of knowledge about these web-based collaboration tools. An education program which provides industry examples will help to raise the confidence level of all parties involved in a project's lifecycle. Using electronic methods to communicate this knowledge means it will reach a maximum audience, due to ease of access via the internet.

Involving students in the formulation of eLearning modules aims to ensure the concepts of web-based collaboration tools are understood before and during the students entry into the construction industry.

6.0 REFERENCES

Baker K. *E-Learning Myths and Realities for the IT Professional* available to download at
      http://knowledgemanagement.ittoolbox.com/document.asp?i=1768 accessed 18th
      March 2003

Blomeyer R. *Virtual Schools and E-Learning in K-12 Environments: Emerging Policy and
      Practices North Central Regional Educational Laboratory Policy Issues* April 2002
      pp1-12

CRC CI. (2005) 2005-002-E (Betts) It Enabled Business Strategies – Lane Cove Case Study Cooperative Research Centre for Construction Innovation, April 2005 (Confidential).

CRC CI (2005) CRC CI 2005-002-E (Betts) It Enabled Business Strategies – EastLink Case Study, Cooperative Research Centre for Construction Innovation, May 2005 (Confidential)

CRC CI (2005) CRC CI 2002-067-A (Betts) eBusiness – Security and Legal Issues, Cooperative Research Centre for Construction Innovation, January 2005 (Confidential)

CRC CI (2005) CRC CI Electronic Contract Administration – Legal and Security Issues, Cooperative Research Centre for Construction Innovation, December 2005 (Confidential)

Electronic Transaction Act of 1999 (Cth)

Horton W. *Designing Web-Based Training* 2000 Wiley

OPUTS inCITE (2005), Optus inCITE, the construction industry trading exchange, http://www.optusinCITE.com

Taylor, C. (2005) Web-based collaboration tools for the construction industry: the John Holland Experience CRC CI International Conference, 25-27 October 2004, Surfers Paradise, Australia Proceedings of Clients Driving Innovation International Conference 2004