



The Knowledge Exchange Testbed March 2005 to March 2006:

Summary of Findings

The Knowledge Exchange: *An Open Architecture Testbed for a Third Party Elearning Supply Chain (3PEL)*

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One cannot see the way up a mountain, it can only be climbed by trial and error. The intellectual mountaineer makes false starts, gets stuck, gets into blind alleys and cul-de-sacs, finds himself in untenable positions, has to backtrack, has to descend and to start again. Slowly and painfully with innumerable errors and corrections, he makes his zigzag way up the mountain. It is only when he reaches the summit, or the height he desires that he will see that there was a royal road to it. In publications he takes his readers along this royal road, but this bears no resemblance to the crooked tortuous process by which he constructed a path for himself. (Hermann von Helmholtz, 1866, as cited in Sacks, 1997:167)

Executive summary

The above quotation was used in the final chapter of a book published in 2004 on elearning¹. While the research that led to the book may have helped bring the 'royal road' into focus it did not help other climb this road.

The Testbed was established by The Institute for Working Futures Pty Ltd (acn: 22 054466769) (Working Futures™) to help organisations navigate the 'royal road' and safely look around the blind corners associated with adopting elearning technologies. The testbed was borne from the frustration commercial and community clients felt over the noise and general lack of informed debate occurring on the introduction of information and communication technologies to assist with learning, knowledge transfer and capability development. The testbed provided not only insights into how technology could be used, but also a safe environment for users to test and challenge their assumptions.

This is the report of findings from the testbed's first year of testing and development. The report builds on and incorporates the existing papers outlining the establishment of the *Testbed Overview Paper* (November 2004) and the *Interim Research Report* (June 2005) that confirmed the initial findings from the testbed.

Supply chain view of elearning

The testbed was established to provide a supply chain view of how the deployment of information and communication technology (ICT) could enable learning, at all stages from production through to end use.

The supply chain view was taken to directly challenge the supply-push view taken by educational institutions and many learning technology vendors. The testbed's operational point-of-view was from the end-users perspective back up the supply chain. While not wanting to enter into the debated, tautological world of many transport academics and professionals, the testbed was not just about the supply chain, but the logistics of learning. **Logistics management** centres on the process of analysing, planning, implementing and improving the efficient, cost-effective flow and storage of materials, inventory items, completed goods, and supporting data and information from origin to satisfy the end-users' requirements. Logistics today is enabled by development of ICTs to realise its potential as a 'value adding', strategic business activity. This view of learning is woefully inadequate at both an academic and professional level. In fact, often rightly, this view is alien to many educators who often perceive such views to be a threat to the social and personal contributions of learning.

Supply chain management is about managing the activities which support the movement of a product from a firm's supplier to a firm's customers. Supply chains can be simple (producer–shipper/supplier–customer) or very complex with multiple parties involved serving different end-customers. For a modern business, managing the supply chain revolves around addressing the challenges faced in the planning and management of supplies, manufacturing, inventory and distribution. The aim is to create a **value chain** where all activities create value. This occurs when all activities operate in a coordinated, integrated manner whereby they contribute to customer-related outcomes at each stage and culminate with the optimal satisfaction of the end-customer's needs and preferences.

¹ Bowles, M 2004, *Relearning to E-learn*, Melbourne University Press.

Value as it applies to a supply chain resides at two levels. The plain meaning of value is something for which the customer is willing to pay; a product or service has value defined by the marketplace. This focuses on the marketplace and satisfying and expanding customers' demand for a company's product or service. Value is also created by being able to not only meet customer demand, but through ownership of capital assets—human (people and their productive capacity), social (relationships and networks), structural (processes, systems and procedures) and financial—able to sustain an organisation's competitive advantage. Value is therefore created not only by products and services that the supply chain can take to market, but also through how well the supply chain supports and enhances this activity.

The aim of the testbed set by Dr Marcus Bowles was to establish a commercial model as exists in the logistics and supply chain marketplace for elearning for **3PL** (*Third Party Logistics*) companies; a third-party company that performs all or part of the corporate logistics activities on behalf of the freight owner or shipper, such as transportation, storage, inventory management and data and information management and reporting.

The testbed sought to provide a *showcase of third-generation open architecture technologies capable of spanning an end-to-end, knowledge and learning object management supply chain.*

If all the components of the testbed were validated, then together their viability could be holistically ascertained by establishing a commercial-level proof of concept and proof of market for a complete business to business (B2B) learning object and knowledge exchange business model (called the Knowledge Exchange, this is a *third party elearning provider* solution or **3PEL**).

The foundation concepts

The testbed's high-level findings are listed below under 9 themes.

1. Value resides in managing the whole supply chain

The highest value proposition for a corporation lies not in content, or learning outcomes, but in their deployment in a supply chain that maximises value as part of a strategic business activity.

2. Learning is an investment in knowledge creation

Learning is a process that has an impact beyond a learning outcome. Learning is a social process of knowledge transfer. Why then not extend the paradigm beyond learning as a cost centre to being an investment in knowledge capital growth that an organisation can track to its bottom-line through making visible knowledge capture, transfer and growth in non-learning forms of outcomes. These outcomes include improvements to performance, talent development (future potential), compliance, the human capital asset pool, and overall knowledge capital.²

3. Standards-based operations

A standards-based approach to content authoring, storage, discovery and access (IEEE-LOM, ADL-SCORM, IMS QTI, CORDRA, OKI, etc.) maximises interoperability, access, reuse and distribution.

4. Service-oriented operations

Individuals' needs should drive ICT implementation. Being service oriented has dual relevance at both the functional and technical design level. Functionally, being service oriented suggests that technology enablement of learning must focus on customers/users of that activity, and satisfying the end-customers' needs and preferences. This means automating what individuals cannot technically adopt with existing skills-sets and optimising workflows to fit functional needs, not technology limitations.

² While this debate is touched on in this report it is covered in full in print Dr Marcus Bowles and Heather Schoenheimer, *Human Capital*

Development: Forging the link between Human Resource Development and Knowledge Management (title to be confirmed).

Secondly, Service-Oriented Architecture (SOA) is a formal architectural style. It focuses on the customers and end-users of the service-shaping requirements and inter-operation of component applications. This links with the use of open standards (Point 5, following).

5. Open standards

Technologies can be designed and built to promote interoperability and a service-oriented approach. In an SOA environment, applications undertaking activities or managing nodes within a network can make resources available to other participants in the network as independent services that the participants access in a standardised way. SOA is a paradigm shift away from traditional object-oriented approaches. This affects how applications (technologies) operate to avoid creating 'closed' networks, single applications that create application-specific interoperability and 'standards'. The aim is to recognise that workflows, supply chains and networks will vary in their construction. This means applications should be able to interoperate or 'mix and match' to maximise customer outcomes. For instance, you should not buy a new application to run content, but ensure that all applications can play content that conforms to rules (an analogy is not buying a new CD player every time you want to play a new CD).

6. Uncouple the LMS

If the core business or organisational function is education, then making the Learning Management System (LMS) the 'hub' of the business processes (workflows) and the system architecture may be justifiable. The optimal value proposition and workflows for a business deploying an LMS, whether proprietary or open standards, occurs when it is not the hub. Clear evidence illustrates that specific functions have to be uncoupled from the LMS to achieve strategic and knowledge capital outcomes, including separating content authoring and assembly from delivery, learning object storage and content presentation; learning and assessment object authoring; and reporting of learning and business related outcomes.

7. Uncouple from fixed Internet paradigms

Not all elearning will be Web-based and have learning environments tied to an LMS. Mobile learning, in particular, illustrates why browser-based, online all the time, or learning within the LMS will 'burden' network connections and hinder the effectiveness of learning outcomes. Work-based learning, just-in-time knowledge transfer, and use of manuals, technical documentation, compliance reporting, and such like often make the LMS role redundant. Often the most viable solution involves uncoupling the LMS and avoiding Web-based, browser-based content presentation. Equally, data reporting from the learning may be through data packages reported back to the LMS or other business systems (performance, compliance, etc.) through multiple network options. Such data transfers may occur as a synchronised, rather than online all the time, connection.

8. Manage assessment objects as you do learning objects

Assessment objects hold equivalent status to learning objects. Fundamentally, considering assessment objects as a component of a learning object fails to enforce rigour or improve the efficient and effective authoring, storage, discovery, reuse or presentation of assessment. Equally, assessment objects can be designed for multiple uses and outcomes beyond learning. These may include performance management, assessment of potential, compliance, maintenance, and such like.

9. Pay-on-use, or demand-driven service models for end-to-end learning technology

The testbed has provided strong indication that a pay-on-use, or demand-based model is viable for provision of an ASP-type elearning service model. While the full commercial model did not go to market during the life of the testbed, commercial use of elearning technology and architecture occurs where the whole supply-chain can be accessed and users can 'mix and match' the open, standards-based technologies with their own or other

companies' solutions. They only pay on use and for the components used, as they use them, configured to their brand, permissions and requirements. In addition, this model can provide a market exchange for content providers (authors) to interact with system users seeking access to objects, content or qualifications (recognition).

The testbed did not meet all its goals. The testbed fundamentally fell short of actually seeing The Knowledge Exchange testbed model in the marketplace. Nevertheless, the model researched and developed in the testbed has been spun off and taken to market by a testbed partner, UXels – see www.tke.com.au.

The inability to achieve the higher order outcome resides mainly with the difficulty of slaying the sacred cow belief that the learning management system (LMS) has some pre-ordained position at the hub of any elearning supply chain, and that software engineers and developers of an LMS have an omnipotent, papal-type power to direct how everyone develops systems.

Uncoupling the learning management system (LMS) from the 'hub' of the system required much more effort and involved lengthy delays. Integration of LMS with the learning object repository (LOR- Hive® from HarvestRoad), took significantly more time than anticipated, as the LMS had to be reconfigured to search and publish to the LOR instead of using its own content management capability. The involvement of software engineers to develop specific solutions such as the QTI authoring tool and the conversion capability (Redoit™) involved more cost and delays than anticipated.

As is the nature of a testbed, the principles and foundation concepts were confirmed or denied based on hard experience and lessons learnt. The most important finding was that if an existing LMS vendor is to be used breakthroughs will only be possible if the LMS as the temple at which all users must worship is removed. It must be replaced with a more secular, user-oriented and business-oriented solution.

Next steps—Testbed 2006–2007

Findings from The Knowledge Exchange™ testbed suggest that further research and development is required. Working Futures™ will be continuing the elearning testbed in 2006 (March 2006 to March 2007). At least three major corporations and four smaller education and content providers have expressed an interest in joining the 2006 elearning testbed.

In 2006, Working Futures will be scaling-up beyond research and initial development with the option for partners to test larger installations or even graduate to undertaking full implementation. In effect, 2006 will be about giving companies examining their options for large-scale initiatives access to applied solutions that leverage off research on the best technologies and business approaches. These solutions will not be in a 3PEL model, but in a more typical stand-alone hosted or purchased solution.

The testbed will be titled '**uni-in-a-box**'; the provision of a complete end-to-end elearning solution able to create a complete virtual learning presence across all levels of learning, and interfacing directly into corporate HR, performance and knowledge management systems.

Uni-in-a-box™ will enable organisations to not only determine their future options without entering into licenses but also then, if they choose, to take on a limited license to confirm certain solutions within the controlled testbed context, and then purchase outright some or all of the applications from the vendor(s).

Following on from research in 2005, the research priorities in the 2006 testbed will be:

- large-scale content conversion and authoring into standards-compliant packages (i.e. the Redoit™ solution);
- authoring standards-compliant assessment objects able to be integrated into SCORM packages and distributed as part of Web-based and mobile learning;

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- design and implementation models for a virtual corporate university (managing multiple content suppliers and learning providers across multiple educational sectors, locations and business activities) (i.e. Test the uni-in-a-box™ solution);
- extending the open, standards-based approach to learning management systems (LMS) that can integrate with a .NET corporate architecture; and
- enhancing the LMS role in assessment and reporting beyond learning outcomes to compliance and HR requirements.

As always, Working Futures™ will select testbed partners based on their commitment to advancing elearning. The testbed is not intended to be a pure research facility nor an open facility for anyone to use. Working Futures™ is a private company. As such, Working Futures'™ costs for running the testbed (licenses, agreements, administration and facilitation) is scaled according to three levels of testbed participation.

In 2006, three levels will exist at which testbed partners may engage or graduate through:

1. Level 1—Testbed access and exploration (30 days). Level 1 partners nominate a few individuals to access the testbed technologies and systems under Working Futures™. Training is available for such participants at cost and no other fees are usually required.
2. Level 2—The Testbed is configured and set up to enable Level 2 partners to run their own trials (usually, 90 days). Fees will vary with commitments made by the organisation (Working Futures™ can leverage better deals with vendor/license owners based on the nature or test and mix of technologies in use). Fees are usually incurred for:
 - training of key personnel (depending on technologies in use, this is usually run for a maximum of 15 personnel at cost; usually \$3,000 for a one- to two-day program).
 - Individual per user and student. (Depending on numbers involved, the usual trial has in the past had 200–300 people on the system for one course and fees have been set at around \$45.00 per person.)
 - configuration and set-up. (Depending on the level of secure access, integration to existing corporate technologies and systems, and branding fees were not more than \$2500 in the earlier trials.)
 - content conversion. (This can vary and usually participants use the tools provided to convert existing content or author content to SCORM packages.)
3. Level 3—The testbed allows participants to graduate to two access solutions:
 - a. the Knowledge Exchange (www.tke.com.au), which is a commercial offering from UXels. This company was part of the initial testbed and has developed a user-pays service based on the 2005-2006 testbed. This commercial version offers a model where candidates can avoid licenses and instead subscribe as a client of an ASP-type service which holds all the licenses and access to the best-of-breed technologies.
 - b. purchase of licenses for the relevant technology and adoption as part of their preferred corporate solution.

Prior to entry into the testbed all participants have to agree to a research and reporting process on key areas of mutual interest with Working Futures™. Obviously, some areas will remain commercial in confidence while other research findings can be reported in public case studies. Working Futures™ intends to make more research available to the public in this next round of testbed initiatives than was the case with the 2005 testbed.

In 2006, the core LMS will be built using .NET and have the compliance reporting requirements sought by corporate clients. The system selected will be the Competency and Compliance Management System (www.ccm-solutions.com).

Working Futures™ will only provide access to the testbed and cannot provide more than limited support to testbed partners. In 2006, the testbed will be a self-service model rather than Working Futures™ initiating 'controlled' discovery. The aim is to promote action research and self-directed use of the testbed capacity and collaboration only on specific, agreed outcomes. Any extended support commitments required from Working Futures™ may require resourcing at a cost to the testbed participant.

Introduction

Best-of-breed approach

The testbed leveraged off real problems and advanced best-of-breed technologies. Its perspective directly resulted from the involvement of Director of Working Futures™, Dr Marcus Bowles³, with real customers implementing some of the largest Australian elearning procurements in 2004–2005, and leadership of an international research project on overcoming barriers to elearning (the *Learning to Elearn* project sponsored by the Commonwealth Bank of Australia through the Unitas Knowledge Centre).

The testbed also sought to examine the commercial and technical realities of an elearning supply chain that encompassed not just open standards but also Service Oriented Architecture (SOA). As an architectural style, SOA focuses on the customers and end users of the service shaping requirements and interoperation of component applications. In an SOA environment, nodes on a network make resources available to other participants in the network as independent services that the participants access in a standardised way³. This is a distinct departure from traditional object-oriented architectures where data and functionality are tightly bound together in application services. Businesses can harness SOA to rapidly evolve technology and systems to satisfy emerging customer imperatives. SOA enhances how businesses manage complex IT systems; achieve integration across multiple interfaces and different programmes; and still achieve not only technology but process integration consistent with core business requirements.

Open source (often free to download and share) is not the same as open standards. Open source systems do not necessarily use open standards. Open source systems may be based on proprietary specifications and not operate with each other, or with commercial systems that may be based on open standards.

The testbed graduated from research activities in March 2005, to undertake development and refinement of the model from March 2005 to March 2006. Stage 1 of the testbed concentrated on bedding down the systems and processes, and Stage 2 the further development of applications and new practices relating to the refined end-to-end, knowledge and learning electronic supply chain. Stage 2 also represented the commercialisation of the overall model and testing by commercial entities of the technology and processes.

Establishing the testbed

The vision set for the testbed was:

to provide a testbed to showcase third-generation open architecture technologies capable of spanning an end-to-end, knowledge and learning object management supply chain.

A core mission was also set. This was:

to provide Working Futures™ clients and like-minded developers, learning providers (university and registered training providers), and corporate users with access to a complete, fully integrated testbed. Access to the secure environment was free. Partners were granted access to conduct research, development, testing and evaluation activities that together spanned the complete elearning supply chain, including:

- content design and development;
- instructional design;
- standards-compliant authoring or packaging;
- management of learning objects, learning assets, components and assessment tools;
- conversion, branding and packaging of content while maintaining alignment to qualifications;

³ http://en.wikipedia.org/wiki/Service_Oriented_Architecture and see http://www.service-architecture.com/web-services/articles/service-oriented_architecture_soa_definition.html

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- delivery of objects for knowledge or learning transfer;
- alignment of content to qualifications or 'recognised' outputs;
- intellectual property, copyright, rights and authorisation management;
- ecommerce systems; and
- reporting and recordkeeping.

The testbed components

The components of the elearning testbed are represented diagrammatically in Figure 1 below. The testbed sought to test technologies, processes and practices as part of an integrated solution: not just to know how the components worked, but how they impacted upon all aspects of the elearning supply chain.

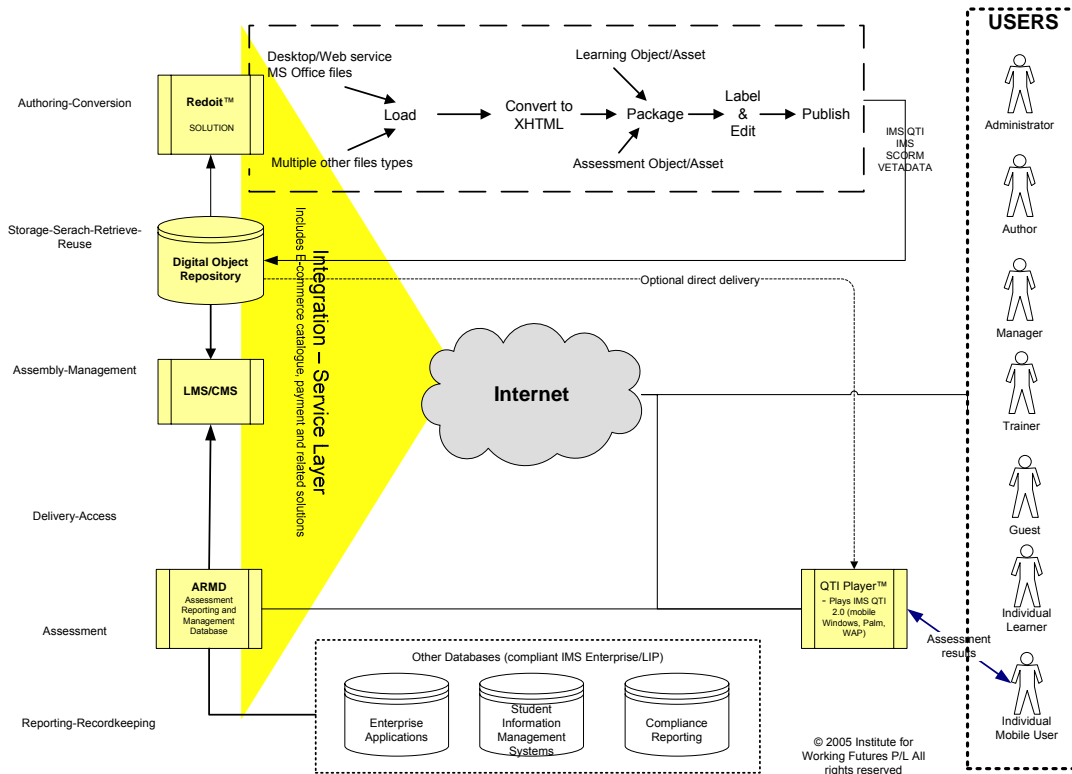


Figure 1 Working Futures™ The Knowledge Exchange testbed components

The role of Working Futures™

The testbed and all Working Futures™ effort remained vendor neutral.

Working Futures™ approached vendors with best-of-breed component technologies that could be constructed into an elearning end-to-end supply chain. Vendors initially became involved out of significant goodwill and in pursuit of opportunities to share in research outcomes. By January 2005 it was clear that the costs of running and maintaining the testbed required a technology partner able to hold licenses and manage the vendors signed up to be included in the testbed. Working Futures™ chose to work with UXels (User eXperience eLearning solution). Working Futures™ is not, and has no desire to become, a technology vendor or service provider. It is a research and consultancy company leveraging a supply agreement with UXels for the advantage of its clients and research partners.

UXels committed to supply (under license), host and support a range of technologies that Working Futures™ believes represent the best-of-breed second generation and, with regards to the learning object repository and authoring tools, third generation elearning technologies. The advantage for UXels is that if the mix of technologies is commercially sustainable, they can 'take the solution' to market.

The life of The Knowledge Exchange testbed was set from March 2005 to March 2006.

Throughout the testbed implementation, Working Futures™ remained free from commitment to any one technology provider or mix of solutions. Its only commitment is to solutions that work for corporate and community organisations and learners.

Action research

There are eight major themes associated with research undertaken on the testbed. Individually, these projects have their own research methodologies and approaches.

It is important to note that all research has leveraged off major projects that had been undertaken by the UNITAS Knowledge Centre (UKC). The UKC is a collaborative body (co-laboratory) founded by the Commonwealth Bank of Australia, the University of Tasmania and the State Government of Tasmania in 2002. It provides a collaborative framework and infrastructure for leading private organisations to research, test and advance the implementation of learning and knowledge. A number of research partners also joined with the UKC to complete in 2003–2004 a major international Learning to E-learn research project that resulted in complete re-evaluation of elearning practices in corporate and community settings. The research was published in case studies, a research report and an elearning process manual (<http://www.portal.unitas.com.au/elearn/elearnindex.asp>). The non-commercially sensitive research and findings were also published in a book (Bowles, 2004) *Relearning to E-learn* (<http://www.mup.unimelb.edu.au/ebooks/0-522-85130-4/>). Interestingly, this was the first publication in Australia to follow a tri-publication process (hardcopy, digital-book (online), and e-book (downloadable by chapter)).

The research foundations have distinctly shaped each project in the testbed. However, all projects share a common research theme in the sense that they are focused on applied outcomes.

Action research has been and is actively used in this project. This is the best form of research when the aim is to both encourage ownership and ensure the process of research and planning generates a sustainable result. Action research, as used by the Working Futures™ team and partners, involves the participants of the research in the development and outcomes of the project in a spiralling set of steps that integrate action and research into one process. Team members have evolved their approach from the theory promoted by Kemmis and Grundy (1997), Burns (1994), Reason and Bradbury (2001), and Australian action research resources such as those listed by Southern Cross University online at <http://www.scu.edu.au/schools/gcm/ar/arhome.html>.

Action research is an appropriate vehicle to achieve the outcomes of this project: it has the capacity to discover not only the issues impacting upon individuals in their specific context, but can also incorporate the influence of contextual features in the process of the research. It assumes this involvement to be inevitable, and that research should aim to improve the situation of the participants.

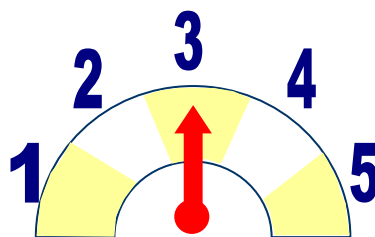
When managed by those familiar with the principle of 'spiralling improvement', action research can build and test processes and systems, while securing collaborative involvement in the planning, implementation and evaluation of each project. More importantly, the methodology permits different motivators and causal factors to be isolated and compared between different projects or participant groups.

Consistent with the central tenet of action research, case studies do not just report occurrences. They are used to investigate and report practices and problems. The research therefore builds a comparative framework for analysis and action that achieves improvements to both practice and systems (Avison, et al. 1999, p. 96).

Part I—Testbed intent

Intent of the Testbed

The following sections outline the intent of the testbed 2005. The rating scale used to indicate attainment of the intended outcomes is outlined below and a rating given for each section of each stage.



- 1 = No advancement in applied understanding or practice
- 2 = Moderate investigation, no specific contribution to understanding, practices or commercial solutions
- 3 = Positive contribution to understanding and practices but limited use in new practices and no commercial proof of product
- 4 = Positive contribution to understanding and development of field tests that advance new practices to a point where initial proof of product exists
- 5 = Significant advancement of understanding and practices to the point where proof of product is achieved and initial proof of market determined

Business intent

Working Futures™ sought to remove all the noise and hype, and make visible and freely accessible to its development partners and its clients the technology, processes and recognition frameworks that can enable efficient and effective elearning.

Commercial

At a commercial level, Working Futures™ wishes to provide proof of concept and market for a complete B2B learning object and knowledge exchange business model (The Knowledge Exchange—a third-party elearning provider solution, or **3PEL**).

Working Futures'™ intention is to provide an environment where it can leverage its own content and capabilities to advance existing research and practice. It will then turn this expanded know-how into accelerated adoption of elearning, especially with Working Future's corporate and community clients.

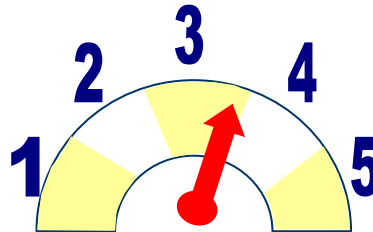
UXels has been appointed to provide, manage and administer commercial license agreements. UXels' involvement is critical to assist achievement of the commercial imperative for Working Futures™, which, as a private company, needs some commercial return from its investment. This approach frees the testbed from commercial constraints and permits its projects to concentrate on research with outcomes that are driven by market need.

Research

Working Futures™ views the testbed as an investment. The testbed research activities are not revenue generating. The Knowledge Exchange is intended to be an applied research testbed with the capacity for research partners to engage on three levels:

- the Developer's Zone, for providers of learning objects, applications and supporting technologies;
- the Learning Provider's Zone, for partnering accredited providers; and
- the Client's Zone, for Working Futures™ customers and business partners.

Individuals, companies and learning providers may use publicly accessible content made available by Working Futures™ on the site for their own commercial return. However, students who 'enrol' to access and use all associated elearning systems and technologies associated with the testbed can only do so through partnering learning providers or through commercial relationships with UXels. The overall rating for his outcome has been set at 3.5; significant progress but not a major breakthrough.



See projects in Part 2:

TKE05.1 Streamlined workflows

TKE05.7 The real value

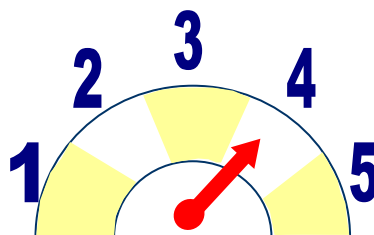
TKE05.8 The Knowledge Exchange commercial model and service layer

Elearning supply chain intent

Working Futures™ sought to test the operational and financial viability of a supply chain solution that can achieve the specified user and end-consumer outcomes.

Supply Chain Components	Description (specified user and end-consumer outcomes)
Authoring and conversion tools	<ul style="list-style-type: none"> • Support the assembly and authoring of content using agreed templates to specified compliance standards (i.e. SCORM/QT1/AICC compliant) • Maximise multiple modes of delivery/publishing (print, CD ROM, online, etc.) • Conversion and repackaging of legacy content under SCORM regime/repository • Automate conversion of Microsoft Office files, especially Word and PowerPoint, into SCOs and thence into an online format
Assessment engine	<ul style="list-style-type: none"> • Generate QTI V2 assessment tools • Author and publish assessment tools • IMS QTI compliant and IMS and SCORM LOM compliance (integrated packaging and labelling; explore sequencing integration) • Tie learning objects (multiple or single) to assessment (objects) • Import or export assessment objects • Tie assessment outcomes to recognition points (qualifications)
Learning Management System	<ul style="list-style-type: none"> • Administer training • Define training courses and programs • Plan and report development and learning paths and resources • Deliver, track, assess, store and report capability, competency and compliance-related results for courses/content • Set-up training costs • Define training requirements • Plan training budgets for your organisation • Administer course sessions • Enrol and waitlist students • Track student training • Track training costs • Career, succession and development planning • Individual learning and development plans • Compliance auditing and reporting • Data analysis and reporting
Learning Content Management System/ Digital Object Repository	<ul style="list-style-type: none"> • Link directly to content/courses • Store, source, manage rights and track learning objects/content; provide object usage reporting • Deliver, track, measure, store and report usage of learning objects/materials • Manage digital/ learning object assets

	<ul style="list-style-type: none"> • Improve the consistency of taxonomy, classification and knowledge management • Maximise access to third-party content • Establish, manage and report digital rights, rules and requirements for learning objects/content being sourced and deployed • Manage examination and test banks • Enhance deployment of content across multiple modes (print, online, CD ROM, etc.) • Report digital rights and intellectual property value • Deliver objects direct to students, not via LMS
Hosted online environment	<ul style="list-style-type: none"> • Chat • Forums • Support one-way and two-way staff communication • Permit virtual classrooms • Support learning communities • Provide help and search functions • Provide integrated reporting
Content	<ul style="list-style-type: none"> • Pre-packaged content at strategic points of the learning pathways • Integration of IMS and SCORM requirements in packaging, labelling and sequencing (especially for objects relating to assessment, mobile learning and to meet accessibility requirements) • Use of automated templates and style sheets • Publishing of content to LMS and Web as an integrated, automated activity • Mobile learning and exploration of players for podding and QTI assessments
Ecommerce	<ul style="list-style-type: none"> • Pay, banking and processing facilities • Service and administration layer for end-to-end activities



See projects in Part 2:

TKE5.2 Redoit packager and converter

TKE5.3 Development of the assessment tools QTI Creator and QTI Player

TKE5.5 Promoting m-learning and accessibility

TKE5.8 The Knowledge Exchange commercial model and service layer

User-oriented, open, standards-based intent

The argument for moving towards open standards in elearning technologies is convincing and pervasive. Initial work in the testbed confirmed working with open standards systems has:

- accelerated development of data transfer between systems;
- improved capacity to integrate technologies;
- conformed with Open Knowledge initiative (OKI) principles and practices; and
- promoted the move away from object-oriented, standardising learning technologies to service-oriented architectures.

Open standards versus open source from the enterprise perspective

Open source has achieved many success stories in global IT, for instance, the adoption of Linux® and Apache®. Nevertheless, an on-going debate about the testbed amongst technicians and educators has been the enterprise-side business and value proposition gained from the use of open source learning technologies. Given cost and accessibility, much analysis and discussion occurred on the replacement of the Fourpoint™ LDS with an open source solution. Extensive research and analysis had already been completed in previous

research by the UNITAS Knowledge Centre (UKC) on the value and attributes of such 'free' Course Management Systems (CMS) or LMS' as:

- Moodle™ (<http://moodle.org>)
- ATutor™ (<http://www.atutor.ca>)
- Wordcircle™ (<http://sourceforge.net/projects/wordcircle/>)
- OpenLMS® (<http://openlms.sourceforge.net/>)
- Claroline® (<http://www.claroline.net/>)
- DoceboLMS™ (<http://www.docebolms.org/>)

Challenges to the claim that open source learning applications are 'free' have been well documented. The risk of adopting such technologies and converting and maintaining them involves eventual costs usually equivalent to the purchase price of mid-range commercial learning technologies.

It is worthwhile noting the strengths of Moodle™ and Atutor™ beyond their technical design. The existence of user groups that span the globe and share experiences and solutions, endorsement by major international bodies (e.g. WorldBank for Moodle™ and Commonwealth of Learning for Atutor™), the development of multi-language support, and the emergence of technical support companies (in over 90 countries in Moodles' case), all suggest adoption is growing.

On the other hand, some experts hold negative views. Many consider the open source LMS/CMS solutions very rudimentary. These views are best summarised by Paul Wilson from Knowledge Patterns (<http://www.knowledgepatterns.com/>). Comments he made during the research phase can be extrapolated as follows:

The very unformed design and build for these applications seems to stem from learning practitioners with programming skills possibly having a poor awareness and understanding of the broader ICT field. Even a cursory evaluation of the systems {as listed above} suggest they do not understand the other options that exist for achieving the 'learning' functionality they require. This may be traced back to considering 'learning systems' as something unique and different from other computer-based activities, and therefore requiring different systems. This paradigm is like requiring a specific word processor custom-designed for teaching materials, whereas the overall design of word processors is already streets ahead of any custom design that might be desired, and a standard word processor would work perfectly anyway. It would seem more useful to think of any learning system as one application of Knowledge/Content Management Systems technologies. If this is valid, it suggests the following:

- *Developing dedicated learning systems may not be useful because they can be quickly outgunned by dedicated enterprise and Content Management Systems which will tend to have existing user bases, existing corporate investment/infrastructure, and higher potential for linking with existing/emerging corporate systems (even lower priced LMS/CMS, which certainly appear more polished, are not necessarily highly advanced, and would be at risk when faced with such competitors); and therefore,*
- *Designing an open source LMS independent of existing proven systems seems flawed.*

Boiled down to a pretty raw level of detail, the whole situation seems like an industry-wide dilemma and perhaps a poor decision regarding a technology 'buy or build' decision ... Given the rate of change that tends to occur in IT, and that each new innovation tends to open many new doors, it seems likely that already significant technology lag is likely to get more severe over time. In effect the competitive hurdle, and attractiveness of bypassing dedicated LMS solutions, is likely to increase to the point where it becomes necessary.

The above comments relate to the comparative advantages associated with the use of both open source and lower cost enterprise applications that are more sophisticated. In many cases the LMS and student management activities can be added to these systems, or already exist to some extent within such systems. For larger organisations, the implications of Paul While turning back time is not an option, Wilson's comments are perhaps worth placing into a future context. It is not the initial cost of the systems or their rudimentary design that is the core issue. Acknowledging Paul Wilson's information systems expertise and focus on knowledge and content management systems that exist in the market, his concern centred on how well open source LMS within an enterprise environment could:

- Scale-up within known risk and cost parameters;
- maintain the required pace of innovation and change all that ICTs face when deployed;
- integrate with other applications; and
- comfortably fit within a cost effective organisational maintenance and systems development regime.

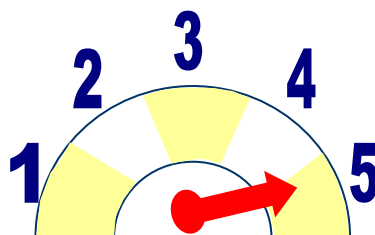
Criteria for selection of technologies

The vendors selected to provide each type of technology in the testbed were evaluated against the following criteria.

- Standards compliance (i.e. SCORM 2004, IMS, IMS QTI, IMS Enterprise, IMS LIP, IEEE, LOM)
- Best-of-breed solution in its specific area of the elearning supply chain
- Evidence of interoperability
- Ease of adoption as measured by length of time for a novice to achieve proficiency of use
- Consistent pricing and total cost of a license
- Extensibility either through open source, programming interfaces or 'bolt-on' applications
- Functional separation, for instance ability to distinguish authoring, content storage and management, presentation, assessment and reporting activities
- Capacity to manage multiple clients in a secure environment on the same installation.

At a deeper analysis level, the short-listed technologies were then collectively reviewed for user functions such as:

- Discovery
- Authoring
- Assembly
- Personalisation and customisation to individual client organisations and users
- Meta Tagging
- Content Management
- Digital Rights Management
- Integration and Interoperability
- Manuals and help functions
- Support



See projects in Part 2:

TKE5.01 Stream line workflows

TKE5.2 Redoit packager and converter

TKE5.3 Development of assessment tools QTI Creator and QTI Player

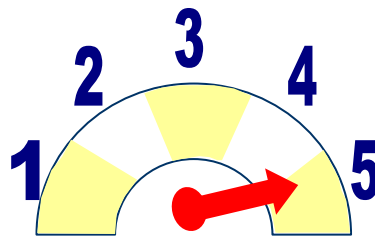
TKE5.5 Promoting m-learning and accessibility

TKE5.8 The Knowledge Exchange commercial model and service layer

Accessibility and mobility intent

The testbed had a primary desire to explore the capacity of making any elearning supply chain maximise the channels to users (to market) and enhance access. This revolved around exploration of two critical aspects that ensured the supply-chain could produce content and ICT capabilities that:

- could be accessed by people with a disability; and
- were not restricted by the network or receiving device (i.e. mobile beyond fixed Internet connected desktop computers)



See projects in Part 2:

TKE5.01 Stream line workflows

TKE5.5 Promoting m-learning and accessibility

Technology providers

The following technology providers partnered with UXels to provide Working Futures™ with the technology necessary to complete testbed activities. While these partners have access to specific research activities and obviously be able to source findings that affect their products and services, they are independent of Working Futures™ and the funding and management of the testbed.

Company	Product
UXels	Web hosting and service provider spanning all technology providers. UXels is a service company. It provides Web hosting and is a commercialisation company specialising in transition of innovations from proof of product to the market. They also have Web hosting and services to facilitate development of research and commercialisation of 'electronic' products.
EtechGroup Pty Ltd	The FourPoint™ Learning Delivery System. EtechGroup specialises in collaborating with educational clients to offer flexible, adaptable software solutions, primarily in the Web and/or education, HR and training arenas. http://www.etchgroup.com.au/ .
Harvest Road Pty Ltd	Testbed gained a license for The Harvest Road Hive®. The Hive is an independent, federated digital repository system that manages sharing and reuse of any form of content in any online learning environment across any number of locations or countries and integrates with any Learning Management or ERP System. http://www.harvestroad.com.au/
Intelitec Pacific Pty Ltd	Intelitec Pacific is a technology engineering consultancy specialising in software and electronics design and build http://www.intelitec.com.au/

Timelines

No.	Critical action	By when
1.	Consolidate Web servers, infrastructure requirements and support relationships	November 04
2.	Capacity to author, convert and edit or update or digitise standard content (Microsoft Office files) into SCORM-compliant materials able to be distributed in multiple digital forms.	November 04
3.	Availability of LMS to back content delivery to an initial population of 300 students	Nov. 04
4.	Commence publishing online modules for a graduate unit (13 chapters) and a Diploma level course (13 units).	Nov/Dec. 04
5.	Establish user's Zones with security controls to permit up to 15 users access to Working Futures™ Testbed as 'teachers/authors' to author, edit, or convert content or assessment tools.	Dec. 04/ Jan. 05
6.	Design and deploy full Working Futures™-branded Web presence able to be reskinned and customised to multiple partners and individual users (including ecommerce functionality)	Jan. 05
7.	Availability of LCMS/Object Repository to back content delivery to an initial population of 300 students	Jan. 05
8.	Formally commence all research projects.	Feb. 05
9.	Secure access to an online assessment generator/engine	Feb. 05
10.	Capacity to reskin Working Futures™ capacity under agreement with UXels.	Feb. 05
11.	Load all FLM materials and at least two full Graduate Units, assessment tools and conduct acceptance testing of site	Feb. 05
12.	Load full Diploma, three short courses, and one unit of a Graduate Certificate of Management (GCM) level course.	March 05
13.	Commence formal relationships and 'turn on testbed' for public access and trials. (Includes download page for Beta QTI Creator™ and Redoit™ applications.)	11 April 05
14.	Load at least three other vocational qualifications, four units of a Grad. Cert. level course and one unit of a GCE.	April 05
15.	Scale system solution to commence testing of end-to-end aspects of UXels third-party elearning solution.	July 05
16.	Scale system solution to commercial offering with a student population of 1000 and up to 150 concurrent users	Nov. 05
17.	Write up findings and wind up testbed	March 06

Structure

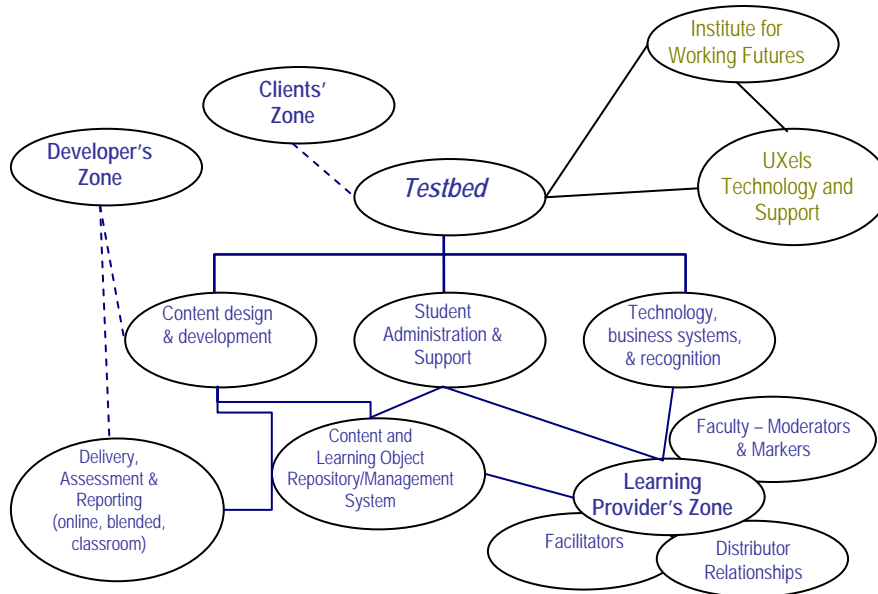


Figure 2 Testbed structure of relationships

Testbed Architecture

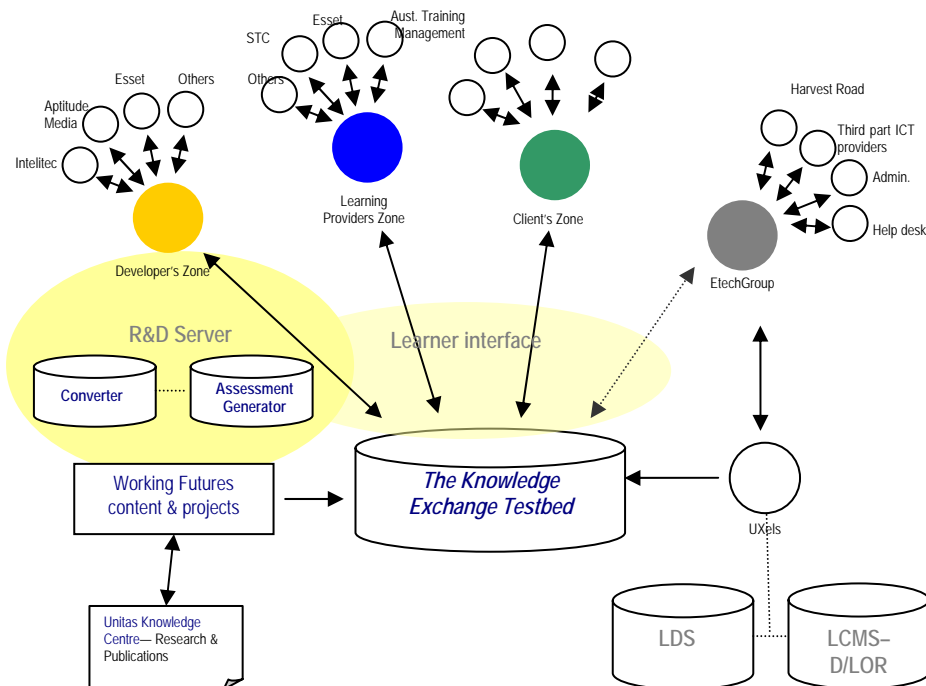


Figure 3 High-level view of testbed architecture

Arrows represent testbed relationships and interactions.

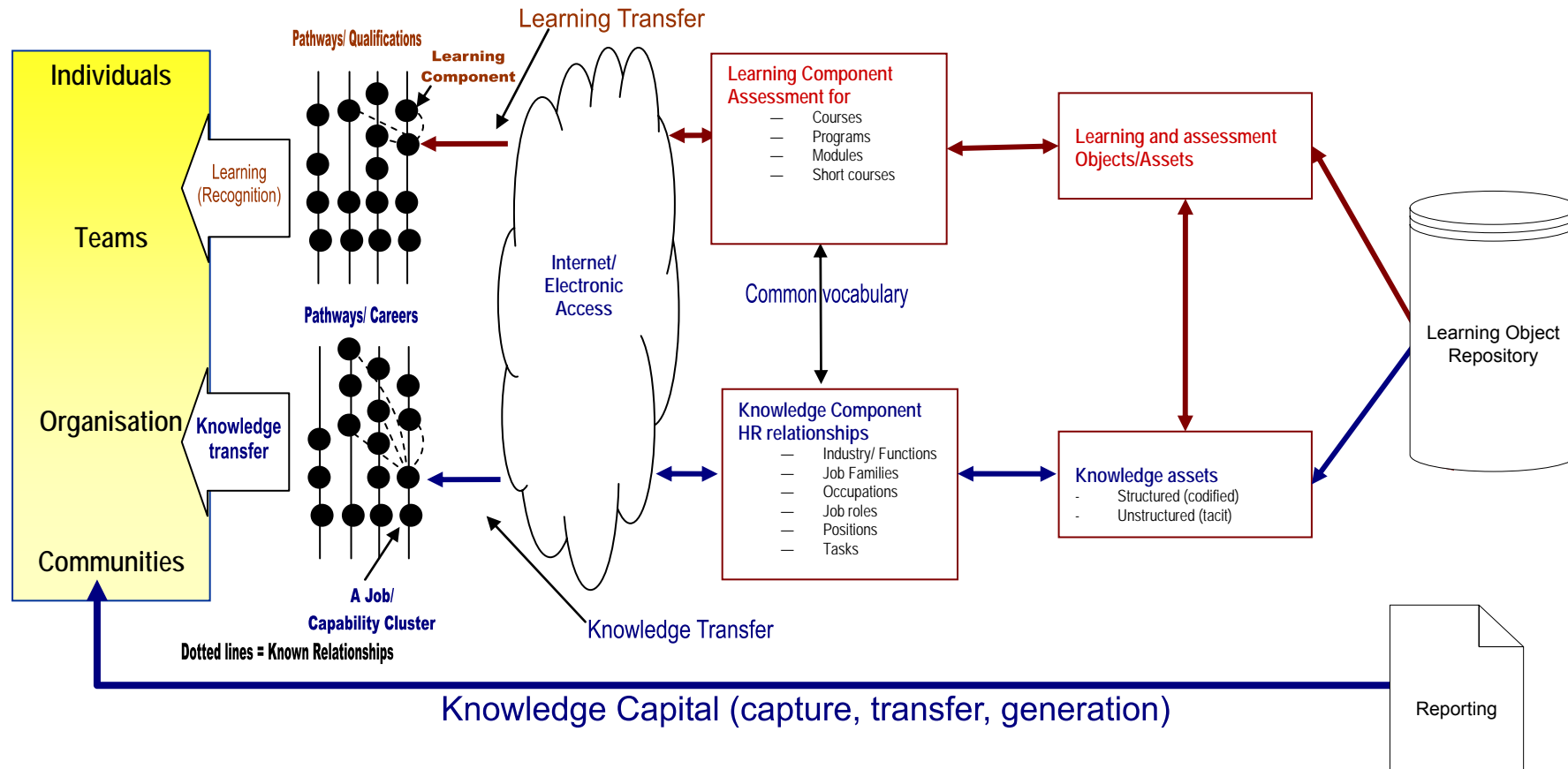
UXels = User eXperience eLearning solution (License holding and technology services company)

ICT = Information and communication technology

LDS = Learning Delivery System

LCMS-D/LOR = Learning Content Management System; Digital/Learning Object Repository

Figure 4 Working Futures™ Open Architecture Testbed for A B2B Knowledge and Learning Objects Exchange



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Blue lines represent knowledge transfer – No assessment, but immediate transfer of required knowledge to meet performance capabilities. Measured transfer by human capital management system = growth in Knowledge/Intellectual Capital of people and the organisation.

Brown lines represent the learning transfer process. Assessment is essential to tie learning objects to a learning component associated with a course and qualification. Objects can be repackaged, converted or customised and still be attached to a qualification.

Net result is UXels is the first disintermediation organisation in the global learning and knowledge transfer space. Corporations, learning institutions and individuals can download the objects they want for learning or knowledge purposes (see iTunes, Napster or eBay as B2Bs in different media e-markets). UXels also can become an aggregation point for objects that developers cannot sell because they lack a marketplace or an ability to aggregate against higher value propositions to the customer (qualifications or careers).

Part II—Testbed Outcomes

Part 2 - Research projects

The following section reports on all the projects listed in The Knowledge Exchange project plan for 2005.

TKE05.1 Streamlined workflows for instructional design and content authoring or reuse

Description

The workflow to streamline instructional design and authoring relating to producing content from desktop applications into SCORM-compliant content ready for delivery off an LMS or online environment. The research tested how to control repackaging, rebranding and reuse while preserving links to assessment and qualifications. This included integrating production of content so it can be distributed in multiple blended forms of delivery (including classroom; self-paced flexible and distance learning packages based on print and CD ROM; online; and mobile learning). Content developed for courses included two short courses from the Certificate III in Multimedia, Certificate IV in Records Management, Diploma of Business (Frontline Management), Diploma of Training and Assessment, Graduate Certificate of Management, and a Vocational Graduate Certificate of Education unit.

Research and Development Partners

- Aptitude Media
- Australian Maritime College⁴
- Esset Australia
- Australian Training Management
- Australian Flexible Learning Framework (QTI m-Player project)

Results

Research on workflows relating to the authoring, storage, assembly, delivery and reporting relating to elearning using the testbed has illustrated the following:

- TKE05.2.1. Optimal value in content authoring is achieved where content is in a format that can subsequently be assembled into any one or mix of standards, Web-based delivery, print, computer-based, or LMS-based learning modes;
- TKE05.2.2. Optimal workflow efficiency occurs where content is authored in a format able to be communicated or accessed off any communication network; fixed terrestrial, wireless and cellular, satellite or similar.
- TKE05.2.3. Integration and management across learning technologies and between the learning supply chain and other enterprise systems is desirable and can best be done through an overall 'service layer';
- TKE05.2.4. As data carries its own metadata on packaging, sequencing and a 'book end' supply chain process is emerging whereby the Learning Object Repositories (LOR) reside at one end (knowledge an entity can control) and assessment resides at the other end (confirms knowledge transfer and utility);
- TKE05.2.5. Content, presentation, assessment and reporting should be separated and able to occur without being locked into an exclusive relationship with one LMS; and
- TKE05.2.6. Workflows that concentrate on learning and content emphasise costs and overlook the reality that they are part of an investment in knowledge capital where value creation may occur through performance, capability growth, and related HR activities.

⁴ AMC involvement was through Working Futures™ work on course development, and in one case, course delivery.

TKE05.2 Redoit™ packager and converter—Microsoft Office conversion and IMS QTI/SCORM packaging application

Description

To streamline the authoring of content from standard Microsoft desktop applications into compliant SCORM and IMS packaging, sequencing or QTI regimes and thence to LMS or Internet-ready (XHTML) formats. This project reported on issues relating to the transfer of 'legacy' content and objects from multiple previous sources, into standards-compliant objects that can be accessed, stored, discovered, harvested and transferred under a federated repository of learning objects or metadata describing such objects. Effort included exploring the links to the TKE05.3 QTI project.

This project was intended to produce a more feature-rich application able to replace the Reload™ application and test content delivery under Australian VETADATA and VLORN project requirements.

Research and Development Partners

- Intelitec Pacific
- Aptitude Media
- Esset Australia
- UXels
- Delfi Software (Redoit™ Solution development)

Results

The Redoit™ project and the QTI Creator™ project (see the next project description) were merged in late 2005. As a result of the failure to obtain a 'stand-alone' QTI Creator™ from the contracted software engineering company, the related Redoit™ activity could not commence. While the projects were always seen as linked, they commenced as separate development projects. The QTI Creator™ was intended to create IMS QTI 2.0 assessment packages, and Redoit™ would convert or author content from standard Microsoft desktop applications or files in image or movie formats into compliant content that can be loaded into preconfigured or Internet-ready formatted (XHTML) content and/or be packaged into SCORM 2004.

Late in 2005, both projects were without key enabling technologies, despite extensive investment and effort producing a pre-beta desktop version of the QTI Creator™.

Nevertheless, it was apparent that SCORM 2004 and IMS developments, especially in QTI 2.0 (amendments proposed in late 2005), suggested development could and should progress under a merged solution. Very fortunately, Working Futures™ started exploring options of working with Delfi Software—a Berlin-based software development and integration company (<http://www.delfi-software.com/en/>). Working Futures™ proposed combining its know-how and research into an enhancement to the Delfi product called Lersus™. The end result is the Redoit™ Solution.

Redoit™ Solution is a combined QTI2.0 authoring tool that can also convert or author content into standards compliant SCORM 2004 packages. The Redoit™ solution also, for the first time in a market-ready product, permits QTI 2.0 assessments to be created then re-imported into a learning asset that can then be exported into a single SCORM 2004 package.

By the conclusion of the testbed this project was also integrating findings on workflows and content design to ensure all content could be packaged not just as SCORM 2004 (or IMS, or VETADATA), but into a selection of CSS templates that can alternatively be ready for Web-based Learning, W3C-compliant menu systems, delivery onto mobile devices, and rapid re-branding for different companies or design styles.

Now organisations can convert 'legacy' content and objects from multiple previous sources into standards-compliant objects that can be accessed, stored, discovered, harvested and transferred under standard compliant regimes. Content was not locked into any one LMS. This has relevance to learning and assessment or beyond to include the digitisation and better management of workforce documents, compliance tools, and such like.

TKE05.2.1. Conversion of legacy content can occur through a single application and solution;

- TKE05.2.2. Conversion and authoring of content can occur independent of the LMS but with the option to choose to export the content as standard compliant, Web-ready, or into designs (didactic modes) that permit QTI, W3C, mobile, or other specific options;
- TKE05.2.3. Generating standards-compliant content with all the metadata and options can occur without the user being expert in standards, meta-data or technical requirements all the time while using their preferred desktop applications (i.e. MSWord®);
- TKE05.2.4. Content can be produced and stored so it can be imported or exported into and out of compliant LMS without hindrance;
- TKE05.2.5. Content 'locked into' an LMS can be converted and uncoupled from that LMS;
- TKE05.2.6. Assessment objects can be generated in QTI 2.0 and packaged for use on the Web, or in an LMS as part of a standard SCORM 2004 package (without a special rendering capability), or on the QTI m-Player™ (QTI2.0 player for mobile devices); and
- TKE05.2.7. Standards compliant content no longer needs to 'lock' assessments into it so they lose their ability to be discovered or accessed as an object.

TKE05.3 Development of assessment tools QTI Creator™ and QTI Player™

Description

To develop a user-friendly application able to author 20 standard typologies of assessment tools. The QTI Creator™ was intended to author tools to QTI 2 compliance, play them on mobile or other technologies and report data. The research will also test how to manage assessment objects under both IMS, SCORM and VETADATA schedules, within a compliant repository and across multiple compliant LMS' or reporting databases.

Critical to this project will be confirmation of how to manage QTI assessments as an object able to be packaged at a SCO, resource/component, activity and stand-alone assessment object level within an LMS. The QTI Player for mobile devices will provide a means to play, synchronise and report QTI reports.

Research and Development Partners

- Intelitec Pacific (technical lead)
- Aptitude Media (accessibility issues)
- Esset (User issues)
- Australian Training Management (User issues)
- Australian Flexible Learning Framework (QTI m-Player project)
- TAFE Tasmania (QTI m-Player project)
- Department of Education and Training NSW (QTI m-Player project)
- Department of Health and Housing (QTI m-Player project)

Results

For the past two years Working Futures™ has been lobbying and actively advocating for the treatment of assessment as an object that is able to be packaged and managed independent of other objects (i.e. a learning resource or content package). This was considered essential for management of assessment where it was tied to compliance or holistic requirements that spanned more than one learning activity (i.e. a module, course, etc.). While still in its very early days, this requirement is now possible.

QTI Authoring tool

It is also important to note that assessment under QTI® requirements also offers attractive ways to complete knowledge assessment; maintenance, performance and compliance tests; and information surveys. For commercial and enterprise systems administrators, QTI® compliance can integrate learning assessment with pay, performance and human capital reporting. Delivery can also move beyond fixed Internet networks to encompass mobile networks. It provides a means to conduct both knowledge and learning transfer in a manner that does not 'burden' the existing, often overburdened internal networks. It also can be done in a manner that does not compromise security, commercial and privacy concerns. Additionally, there is no need for the LMS to actually reside inside the enterprise's own network. Data can be interchanged in XML from the mobile device to the learning providers' systems and thence, through a

very secure, narrow 'tunnel' to the HR, learning, knowledge and related enterprise data management systems.

The first major delay in the IMS QTI project occurred when the decision was made in January 2005 to be the first adopters and users of the QTI2.0 standards. These standards were a massive leap beyond the previous QTI 1.02 standards.

Despite great strides and excellent results, the QTI 2.0 Creator™ was not developed beyond a pre-beta demonstration desktop version. Nevertheless, in December 2005, effort switched to modification of an existing application to achieve QTI2.0 authoring. The result was moved into the Redoit™ solution and tested in February to March 2006 with great success. The resulting tool authors QTI for seven of the most common of the twenty intended instruments. It can be further developed to cover all other instruments.

QTI m-Player™

Working Futures™ undertook to expand the critical mass behind the QTI effort by applying for a national New Practices Project under the Australian Flexible Learning Framework (<http://www.flexiblelearning.net.au/flx/go/home/projects/2005/pid/54>). TAFE Tasmania acted as prime for the application with Working Futures™ managing the project that included many of the testbed partners. The new application (QTI m-Player™) was built by Intelitec Pacific, the software engineering company working on the QTI Creator™.

The QTI m-Player™ for mobile devices was initially operate on any handheld mobile device with Microsoft® Windows® mobile™ to play any QTI 2.0 compliant instrument. The aim is to prove the software can also access the Internet (whether wireless, cellular, satellite, cable or terrestrial), and synchronise or link with any compliant Learning Management System (LMS) or Learning Content Management System/Learning Object Repository (LCMS/LOR). Palm®, iPod®, and MIDP (Nokia®, etc) editions of the player could be developed beyond this project.

The report, research and evaluation reports, technical specification, sample QTI 2.0 assessments ready for use on a mobile device, case studies (note the overlap with the testbed research agenda and initiatives) and the QTI m-Player™ or a Windows® mobile™ device can be downloaded from <http://www.marcbowles.com/newqti/qtimplayer.html>. The Website has been designed by Aptitude Media to reflect not only accessibility issues, but also access and usability by someone using a mobile or small screen device. Again, a fold-back on wider testbed research and trials.

The site and all the digital content will be made available for free under an appropriate Australian Flexible Learning Framework site, and form the basis for a CD Rom or similar digital distribution package in April 2006. If you seek this information, register your interest at the AFLF site.



Figure 5 QTI m-Player(tm) Project Website

Overall findings from the QTI project area:

- TKE05.3.1. Authoring and conversion of Microsoft® Word® or QTI 1.02 instruments into fully compliant QTI 2.0 requirements can occur through a single solution;
- TKE05.3.2. Workflow analysis suggests the creation (authoring) or conversion of assessment objects to IMS QTI 2.0 is most likely to be adopted and completed with a high degree of efficiency and effectiveness where the author can do this on their own desktop and save instruments to a central repository;
- TKE05.3.3. Reporting of outcomes from use of an IMS QTI 2.0 assessment object is possible where it can be synchronised back to a data management system, including, but not necessarily exclusively, an LMS. In a mobile environment this especially prevents the need to be online, all the time;
- TKE05.3.4. It is not necessary to wait for LMS to adopt QTI 2.0 assessments for QTI 2.0 to be produced in a manner where they can be rendered on the Web, rendered on a mobile player (the QTI m-Player™), or packaged into SCORM 2004 and used on compliant LMS;
- TKE05.3.5. Assessments should be created and managed separate to learning objects and while still carrying the metadata that permits them to be managed just as with any other objects or SCO (i.e. Assessment should not just be embedded within a learning object at the point of authoring, but may be when learning assets are assembled);
- TKE05.3.6. It is possible to have multiple activities or SCOs tied to one assessment object;
- TKE05.3.7. QTI 2.0 assessment objects must be able to be labelled, edited and incorporated into packages using various elearning standards regimes (i.e. SCORM, or national variations such as VETADATA—Vocational Education and Training Metadata Application Profile and VLORN project requirements—www.flexiblelearning.net.au) to maximise their reuse, accessibility, discoverability, durability and interoperability;
- TKE05.3.8. Most importantly, all data reported from assessment can be managed in XML to security and privacy requirements, across fixed, wireless, cellular, satellite, or cable networks; and
- TKE05.3.9. Further development work must occur to ensure assessment report packages (QTI results data packages) can move seamlessly in a format compatible with IMS Enterprise or IMS Learner Information Package (LIP) reporting that encompassed non-learning outcomes such as HR reporting (performance and personnel profiles), compliance, and enterprise human capital accounting.

TKE05.4 Promoting accessibility and personalisation of elearning

Description

Personalisation of learning to maximise individual access (accessibility), testing of useability and accessibility for content and all technologies, and customisation of the learning environment (intelligent agents)

Research and Development Partners

- Aptitude Media (accessibility)

Results

Merged with Project TKE05.5. A focus was removed from Intelligent Agents and instead focused on avatars and the accessibility of the content for the individual user, especially those with learning or visual disabilities.

TKE05.5 Promoting m-learning access (retitled Promoting mobility and accessibility)

Description

Examining the extension of content design to promote storage, delivery, assessment and reporting across multiple mobile devices, global locations and networks consistent with W3C requirements

Research and Development Partners

- Aptitude Media

- Delfi Software
- Australian Maritime College
- Department of Education (NSW)

Results

This project merged with the TKE05.4 project and was retitled Promoting Mobility *and* Accessibility.

The results of the testbed in this project area have produced some quite significant incremental advances on current practice and approaches. Through the involvement and effort of Aptitude Media, these developments have found rapid acceptance in national and international work in the field. A number of key findings have been confirmed:

- TKE05.5.1. It is possible to convert and author content into a format (XHTML/CSS template) that can not only be preconfigured prior to packaging into SCORM 2004, it can be done in a manner that is:
 - a. able to carry different brands and styles;
 - b. W3C compliant and with menus able to be used by people with visual or learning disabilities; and
 - c. Mobile-ready in the sense that the content can scale and configure automatically to suite the screen size (PC, smart Phone/PDA, or even digital projector).
- TKE05.5.2. Content can be produced for mobile devices at no additional cost to standard content production that is compliant with SCORM 2004 or QTI 2.0 or W3C requirements;
- TKE05.5.3. While it is conceptually possible to solve, the testbed confirmed that serious restrictions remain over presenting learning and assessment objects to people with visual disabilities on mobile devices until such devices can carry all the adaptive technologies and screen reader applications available on desktop computers;
- TKE05.5.4. Guarantees of content conformance to achieve the above does not mean that the content can necessarily render on an LMS with the same efficiency (i.e. LMS design and configuration lags behind the content authoring and rendering advances);
- TKE05.5.5. The most effective mobile learning environments uncouple content delivery and reporting from the LMS and therefore don't need to be online all the time or restricted to certain network connection modes;
- TKE05.5.6. Avatars, or so-called 'talking heads', are able to be produced to use different languages (even an Australian accent), and be deployed to not only enhance learning engagement, but the presentation of text for those with visual or learning disabilities; and
- TKE05.5.7. Text-to-speech capabilities—as used with avatars or for people with visual disabilities—can be used to capture text for reuse in podcasts or as audio learning objects.

Findings specific to designing accessible content

Initially, Aptitude Media and Working Futures™ collaborated to create HTML-based courses that could maximise accessibility (W3C-strict or level 3 compliant) and use on small screen mobile devices.

This led to developing and utilizing the Ultimate Drop Down Menu 4.45 by [Brothercake](http://www.brothercake.com) (<http://www.brothercake.com>). This menu is both mouse- and keyboard-accessible. Disabled users—especially vision impaired users—don't use a mouse. Further, in the quest to make content accessible, design and development work focused on the importance of making our courses both W3C- **and** elearning standards-compliant. Development moved from HTML, tabled layouts to XHTML Strict with CSS (CSS for both style and positioning). This move enables content to be accessible on the widest range of devices, and accessible to the largest audience.

A better explanation of the benefits of CSS and XHTML can be found at <http://www.aptitudemedia.com/resources.htm> (CSS benefits for accessibility and all XHTML benefits).

The development was tested in a number of courses that were loaded onto the testbed for partners to access, use, re-assemble and present.

The development of the Diploma of Business (Frontline Management) and Diploma of Training and assessment and MBA units for the Australian Maritime College into a fully online, accessible form that could also be packaged into SCORM 2004 provided some important lessons. These included the following:

- Content that does not use Flash® or bandwidth-hungry animations does not have to be boring. The course was developed to be used for blended delivery. This means it is an online version of the

course notes and all resources that supplement face-to-face delivery. It is not intended to be interactive content. Nevertheless, it has some important design features that maximise its utilisation:

- Content is 'chunked' into easy-to-complete blocks.
 - Each block relates to a stand-alone sub-topic within a larger topic area.
 - Each topic area has its own reflective quiz and supporting presentation that give an overview of all the sub-topics.
 - Navigation is accessible and can take the learner to specific related components of learning.
 - Content is reflective of, but not necessarily presented exactly the same as, hardcopy student notes.
 - Content is packaged into SCORM or IMS at the 'block'/sub-topic level to maximise tracking, reuse and student access.
- Moving content into accessible form on a CSS is best achieved when the MSWord® document is also produced in a parallel template with all Alt Tags on images and heading formats set.
 - Content does not have to be difficult to produce in accessible form (W3C level 3). The development of the course was achieved through rigorous trial and error that resulted in the development of an accessible CSS template(s). This template can be reused for other courses and modified to achieve different design features or outcomes. The important add-on work such as ALT labels for images were resolved by the original author, ensuring paragraphs leading into a table or figure fully explain the figure.
 - Navigation solutions exist. The problems with navigation were resolved through international research that led to a number of solutions that have specifically been designed to resolve how people with visual or learning disabilities navigate online learning content. These products were tested and the best solutions licensed or built into the templates being used.
 - Aptitude Media's James Newton, and Adam Maxwell (March, 2005) identified a checklist to ensure accessibility is achieved:
 - Use standard markup; HTML 4.01 or XHTML (transitional or strict).
 - Use CSS to separate styles from the content.
 - 'Caption' pictures with the alt attribute; in a visual browser this looks like a 'tool tip' when you mouseover an image; a screenreader reads the alt text to the user. Make sure the text is meaningful.
 - Ensure that text can be resized. For users who are not blind, but have visual impairments, this is vital. Not everyone is a 20-year old designer with perfect eyesight and a 21-inch monitor!
 - Don't rely on JavaScript. There's no problem with JavaScript, but don't rely on it for navigation, because screen-readers, PDAs etc. don't understand it.
 - Ensure your forms are Accessible, otherwise the user won't be able to contact you, sign up for your newsletter or buy your wonderful product. There's an article by Rachel Andrew 'Forms and Accessibility', at DNzone.
 - Use a tab index to ensure that the user can tab through fields in a logical order.
 - Use Accesskeys. They're supported in all modern browsers, allowing the user to press a designer-determined key to open links. You can use a CSS class to underline the letter of the Accesskey to let users know which key you have assigned (like the underlining sign for the shortcut key in 'Format' in the Microsoft Word menu, for example).
 - Ensure Accessible navigation: Don't use drop-down menus for navigation without a 'go' button to confirm the selection. Such navigation is impossible to use without a mouse. Also, warn users before spawning new windows, or they might be trying in vain to use the 'back button' when actually they're in a new window.
 - Put the most important content at the top of a page. Sighted users can 'scan' a page for the main body of content; a person with a disability must listen to a screenreader read the site from top to bottom, and could be listening to a lot of links, and logos before hearing the main content that they care about. If you can't do that, make the first item on the page a link 'skip to main content' and make it invisible by having the same colour font as the background colour. Your sighted users will never know it's there; blind users will hear it on their screenreaders and thank you for it!
 - Test your pages for Accessibility. When you've finished, check the page. By all means use UsableNet's LIFT tool, the Bobby or Cynthia Says validators, but they are only machines. View your site in the Lynx browser or, better still, download a speech synthesiser and then check out your site with the monitor turned off and the mouse unplugged.

Mobile learning

Mobile learning offers an extended capability beyond delivery of elearning using terrestrial communication networks and the World Wide Web. As stated by Bowles (2003:12; & 2004:15):

The emergence of mobile, wireless and satellite technologies is already impacting on elearning. New Internet technologies are being used to support small-screen mobile and wireless devices. Satellites and mobile wireless devices can use TCP/IP (Transmission Control Protocol and Internet Protocol) to communicate on the Internet. In a field marked by such rapid evolution, we cannot assume that the Web as we know it today will remain the primary conduit for Internet-based elearning.

The promise of m-learning is challenging paradigms that have underpinned online learning. This especially relates to the design of content and the need for educators to become more familiar with the technical differences associated with mobile information and communication technologies. This is encapsulated in the following observation from Nokia:

Yet despite the many benefits of mobility, no one today seems content with the state of corporate content (the various forms of on-line information)—especially the rendering of existing PC-oriented formats on handheld devices. Workers using smaller devices with their smaller screens often get frustrated attempting to access available information. And once connected, they can get even more discouraged trying to navigate the “full screen” nature of email messages and attachments ... (Nokia, 2004:1)

In spite of the hurdles associated with m-learning, mobile networks and devices have long been considered a major opportunity through which enterprises may learn to expand how they communicate and transfer knowledge. The networks also extend beyond fixed Internet to offer employees on-demand access to the data, information, knowledge, and learning the company can access. This means that value for the company resides not only in the improved performance such networks can generate, but also in an increased utilisation of existing knowledge assets in a manner that tangibly expands the organisation's operational capabilities.

From an m-learning perspective, this suggests that an investment in content and systems for learning purposes has a value that does not reside solely in the learning outcomes. Rather, it resides in the ability to manage the personalisation and delivery of knowledge assets in a way whereby it is possible to report the affect that this knowledge transfer has had beyond individual learning. This effect includes recording and reporting data that confirms improvement in individual performance, customer satisfaction, and the expanding value resident in the origination possessing the capacity to deliver knowledge assets in a way that increases their intrinsic capital value.

The attributes of m-learning identified in research include:

- **ubiquity of access**—just-in-time, immediate and independent access anytime, anywhere, multiple networks;
- **convenience**—time and space constraints are removed and people can access applications according to their time and preferences;
- **security**—use of means such as Security Socket Layer (SSL) to provide personal security, privacy of communications, and data integrity above that available in fixed Internet environments;
- **localisation**—merging capabilities and sharing costs between retailers or a region wishing to ‘push’ or promote mutual services and products;
- **instant connectivity**—access to applications on demand using multiple technologies and more network options; and
- **personalisation**—use of multiple technologies to receive what you want, to set preferences, and how you want, while allowing the provider to place content and brand directly to the user in their context (positioning control, targeting and culturally sensitive).

Many limitations of m-learning that were addressed included:

- automatic change to menus and content presentation consistent with using small screens;
- application of SCORM and QTI standards to content presented on mobile devices;
- slow convergence of functionality between mobile Internet over mobile phones, handhelds and mobile computers;

- slow appreciation of Australian satellite broadcasters on the market for digital learning beyond fixed connections (TV and cable);
- limited roll-out of higher bandwidth mobile networks and devices (i.e. 3G networks and wireless broadband networks are predominantly located in cities);
- sunken costs in 'old' wireless and broadband infrastructure;
- technology constraints of mobile devices (memory, processing power, display capabilities, input methods);
- security of data when moved between some mobile and wireless networks; and
- too many choices for business investment in hardware and infrastructure.

Creating Mobile Learning Environments (MLE)

The prevailing assumption has been that m-learning requires both content be accessed and assessment be reported back to an LMS. Therefore, designers of m-learning must consider how to splice any learning activity on a mobile device with a link to the LMS. The concept of an MLE devised by Bowles (2004:155) suggests that learning must be optimised by balancing the competing requirements of lower bandwidth while still enhancing interactivity and engagement. The addition of an LMS functionality to the portable computing device, whether through a storage card (SD Card) or via online links, mitigates against both ease of use and bandwidth issues.

Uncoupling mobile learning content from the LMS is at the heart of creating an MLE. Being online is also discouraged in favour of synchronisation; a solution widely deployed in m-commerce but still relatively embryonic in m-learning deployments.

As illustrated in Figure 6 below, delivery of content and assessment of outcomes can be completed in an MLE separate from the LMS. Equally, the learner need not be online all the time if the content can be pre-loaded or downloaded onto the mobile device and assessment or other tracking data synchronised back to a database.

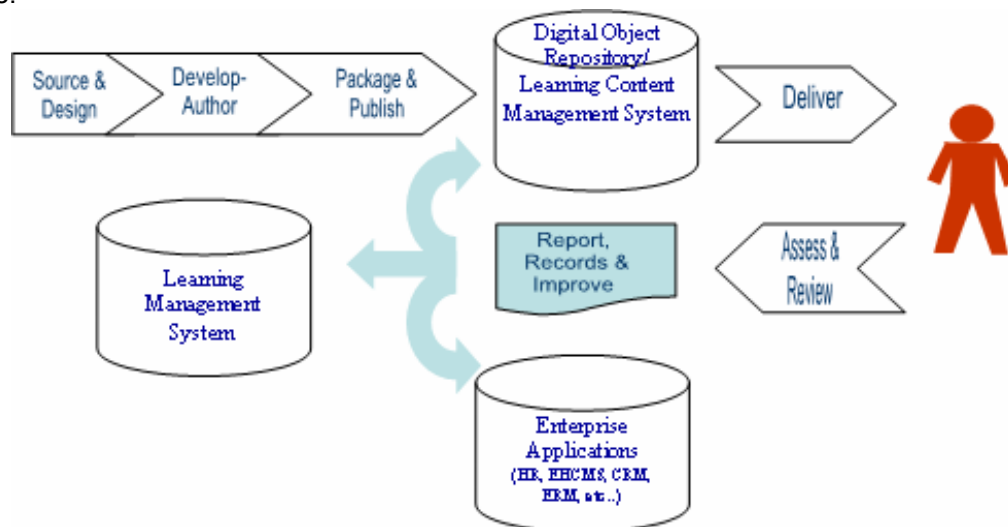


Figure 6 Uncoupling the LMS from m-learning solutions

The above hypothesis is reinforced by the examination of mobile assessment. While research has confirmed that learning objects need to be better managed beyond the LMS, it has also presented a tantalising insight into the benefits of integrated results reporting beyond the LMS. The value generated by a LOR beyond learning (i.e. Knowledge asset value, content management, etc.) has to be matched by better management of the data resulting from learning completion.

In the first instance, Stage 1 of the testbed confirmed how LORs offer distinct value propositions in terms of their contribution beyond earlier learning content management systems (LCMS). LORs, such as Hive®, are able to manage granular digital objects for reuse in learning (and other contexts), and do so in a federated manner across multiple authoring and delivery environments. Typically, LCMS assumed integrated

authoring and usually directly embedded this functionality with an LMS; no granularity and certainly no federation.

While some 'out of the box' LMS can and do interface well with enterprise applications, value is increased significantly where data can move across any compliant database. As depicted in the first part of Figure 7 below, mobile workers (including assessors) report results back to the organisation online or via synchronisation within the corporate secure network. The data reported from each activity is directed to each relevant application. To share data one application must integrate with the other application. Integration across the whole network is costly and often very difficult. For instance, assessment results go into the LMS, but reporting the assessment as a pay-on-use service outcome requires an interface be built between the HRMIS and the CRM.

In the second evolution (see the second part of the figure), the mobile network is in effect the Internet accessed anywhere, at any time. For mobile assessors, the data they capture can be synchronised back to a central enterprise server and database. If this central database was, for instance, compliant with IMS Enterprise standards, it could report learning information into fields that could then directly report or share data with any compliant application in the enterprise network. In such a scenario, assessment results, once keyed/captured, will direct data to any relevant enterprise application.

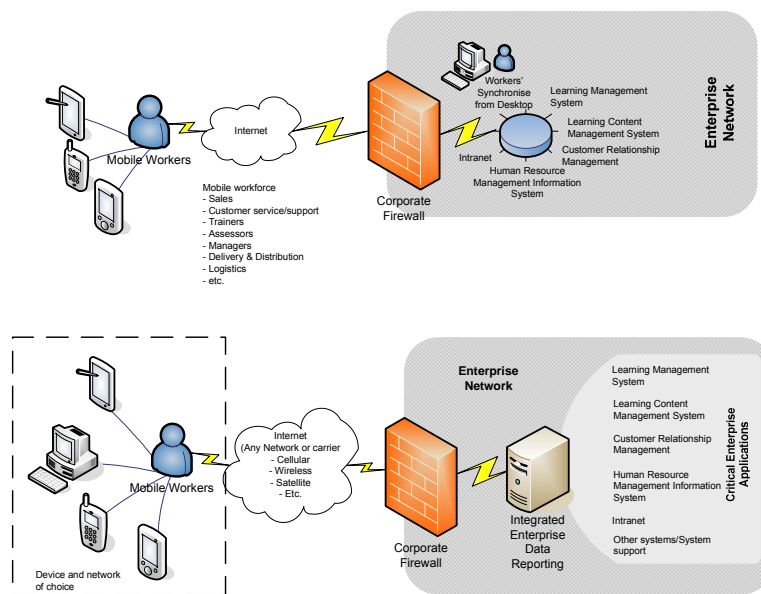


Figure 7 Evolving data integration and reporting from mobile assessment

Use of avatars

The QTI m-Player™, while compliant with QTI requirements, is not supported by a QTI 2.0 assessment creation tool that can develop non-text instruments. Use of Macromedia products will permit Flash™ and such-like instruments to be developed and linked with assessments. But QTI permits the rendering of visual and audio within the assessment itself. This may overcome some of the accessibility problems inherent in Flash®.

One of the ways around this situation being explored by Aptitude Media is to develop avatars that convert text to speech. The speech engines can also capture text for reuse in podcasts and simple audio learning objects. As audio files, the objects can be incorporated into QTI 2.0 assessments, but this opportunity is still to be realised.

The Aptitude Media website illustrates that adaptive technologies can be complimented by audio and visual avatars and instruments. Adaptive technologies may not be installed on PDAs and the current generation of Smart Phones. However, QTI can support audio and visual file formats. This suggests that the use of Flash® and restrictions in how we render certain assessments (and learning content) can be addressed.



Figure 8 Aptitude Media website and audio and visual avatars

TKE05.6 Quality and compliance management systems for a Knowledge Exchange

Description

Development of overall procedure and quality systems to cover complete Knowledge Exchange. Systems to encompass ISO 9002, university and Australian Quality Training Framework compliance.

Research and Development Partners

- UXels
- Esset Australia

Results

Project withdrawn.

TKE05.7 The Real Value—Measuring the management of learning objects and content as part of corporate knowledge capital management systems

Description

Set benchmarks and systems to measure how learning and knowledge interventions enhance service, brand value, performance, and HR activities

Research and Development Partners

- HarvestRoad™
- UXels
- Foundation work for Unitas Knowledge Centre and Commonwealth Bank of Australia

Results

The concept of Return on Investment or, more accurately, the value proposition for elearning, has built on the seminal work undertaken by the Unitas Knowledge Centre on this topic. The initial report on findings and research was tested in The Knowledge Exchange.

The work in this area also was subsumed into Dr Marcus Bowles' work with the Transport and Logistic Centre, Web gateway project (the Transport Integrated Learning and Information Service or TILIS; see www.talc.com.au).

The core findings and a more detailed explanation of some of the findings are listed below.

- TKE05.7.1. The Learning Object Repository lies at the heart of an elearning value proposition for a commercial entity. The organisations' investment and ROI is not in training and reuse of learning objects; it is in managing and valuing digital objects and then reporting their utility value. This enables the multiplying of reporting both intellectual property, human and knowledge capital value while, as a parallel exercise, actually confirming the increased value that enterprise data has when tied to a purpose (i.e. a dynamic audit).
- TKE05.7.2. Somewhat counter-intuitively to educational institutions, value creation in a business setting actually increases proportionally to how well we enable the LMS to play a virtual role, not a controlling role, in the elearning supply chain;
- TKE05.7.3. The investment in an elearning supply chain, or part thereof, is maximised the more people can access it (Metcalf's Law) and as standards permit objects to be searched, discovered, accessed, reused, and reported (i.e. as for OKI and CORDRA initiatives);

Expanding the network utility and value

The above ideas and current research strongly mitigate against standards and specifications regimes standardising how applications and technologies interoperate. It also strongly supports our Stage 2 development work that seeks to maximise how systems or applications deployed in an elearning supply chain can communicate with, but operate independent of, any LMS or LOR.

Metcalf's Law states that the utility or value of a network grows by the square of the size of the network (i.e. number of users - $n(n - 1)$, or $n^2 - n$). While this equation may overestimate the overall value every connection or additional function contributes, it does give an excellent guide to the value of adding users to a network. Conceptually, the application of Metcalfe's Law to all learning management and related systems suggests that, as with any IT system, the more functions offered, the more useful and value-adding learning technologies can be. Therefore, it seems that learning systems that can integrate with existing IT systems and add functions on offer to users, while also enabling data reporting that can contribute to multiple enterprises' activities beyond learning, will consistently out-perform the value of dedicated learning systems in the market. In effect, Metcalfe's Law works against the dedicated LMS developer and regimes that seek to standardise how learning applications and technologies interoperate in isolation from other systems. However, for developers who actively seek to build efficient, responsive, and service-oriented solutions, Metcalfe's Law starts working in their favour.

OKI™

The need to ensure that data can move freely between different platforms and applications is a major issue for all elearning standards regimes. The OKI™ (Open Knowledge Initiative) is a Massachusetts Institute of Technology-led initiative to improve interoperability among applications and the enterprise system (<http://www.okiproject.org/>). The initial focus has been on higher education and elearning, but the initiative's service-oriented architecture is applicable outside these domains. OKI™ provides Open Services Interface Definitions (OSIDs): contracts between service consumers and providers. The OSIDs are well-defined integration boundaries that leave flexibility in the hands of developers. The OSIDs are neutral with regard to programming language⁵ and implementation detail. Nevertheless, the Repository includes interfaces for integration among applications (consumers) and repository content (providers) (MIT, 2005:1). It also defines objects such as a Repository Manager, Repositories, Assets, and their metadata as well as methods for managing object lifecycle, data maintenance, and searching.

The OKI™ work also compliments work in IMS Enterprise to ensure educational data management systems can not only interface better, but also do so with enterprise HR and related data management systems. IMS work and OKI™ also strongly influence Learning Technologies Systems Architecture (LTSA) work (<http://ltsc.ieee.org/wg1/files/ltsa-400.html>).

Applications use the OSID to gain access to content in a manner that hides the technical detail by which that content is provided. This allows the application to integrate simply with a wide range of content providers without including the complexity inherent in supporting heterogeneous means of communication and data

⁵ The programming language-neutral form of an OSID is called an XOSID. There are bindings of the XOSIDs for Java™, Objective-C, and PHP. Other languages bindings are in development.

exchange. The application is also insulated from technology changes made by providers which leads to a longer useful lifetime for an application and thereby a greater return on investment (MIT, 2005:1–2).

With regards **OKI™**, the testbed has leveraged off the work by two of its technology suppliers in the international arena. HarvestRoad (Hive®) has worked on **OKI™** with Apple Educational Marketing and MacLearningEnvironments.org (MLE.org). One joint plan was to have MLE.org build a Mac OS X application (SearchParty) that could search content in the HarvestRoad Hive®, a content store⁶. EtechGroup® (Fourpoint) has also been working with Apple Educational Marketing and HarvestRoad, who provide a standards-based learning management system to create the Global Learning Object Repository Initiative (GLORI). GLORI is a real-time global learning exchange based on elearning standards and has several primary and secondary schools and universities involved as initial elearning members.

The promise of OKI™ is worthwhile and seriously important given the findings of Stage 1 of our research. It suggests specific architectures and application interface designs can be accommodated through use of meta architecture. In simple terms, rather than building an interface or application to ensure data management systems can ‘talk’ with each other, the aim is to build into all data management systems and data the means to connect and communicate. This confirms the move towards service-oriented architecture, rather than fully integrated, stand-alone proprietary systems. This is also consistent with major international project work funded and supported by the Joint Information and Systems Committee (JISC) in the UK. These projects include the Elearning Framework (ELF) (<http://www.elframework.org/>), the implications for distributed learning explored in the Hull University DeL eTools—ASSIS (Assessment and Simple Sequencing Integration Services) (<http://www.hull.ac.uk/esig/assis.html>), or the Distributed National Electronic Resource (DNER) project (http://www.jisc.ac.uk/index.cfm?name=dner_adding_value).

CORDRA

CORDRA is the Content Object Repository Discovery and Registration/Resolution Architecture (<http://cordra.lsal.cmu.edu/cordra/cordra/introduction/>). It is a project engaging profound international interest run in the US out of the Learning Systems Architecture Laboratory, Carnegie Mellon University. It is an open, standards-based model for how to design and implement software systems for the purposes of discovery, sharing and reuse of content (especially learning and compliance documents) through the establishment of interoperable federations of learning content repositories. Uniquely, the CORDRA model recognises that multiple repositories or content management systems may be linked under a single, federated repository. Access to one ‘connected’ repository or through a central gateway can permit content to be accessed directly from the repository or, more likely, from content stored on the original owner’s own learning object repository or other form of content repository. The owner at all times uses the repository’s workflow management to determine who and how much access is granted to others. All rights and permissions are digitally tracked and reported.

A CORDRA repository has enormous potential for promoting all aspects of content sharing and knowledge management. This is depicted in Figure 7 below. At the time of writing the Transport and Logistic Centre, Web gateway project (TILIS) had become the start point for the national Australian Department of Education and Training and ADL Co-laboratory collaborative effort to create the first non-US based CORDRA iteration.

⁶ The goal was to show the application and Hive® working together. MLE.org chose to develop a native Mac OS X application, written in Objective-C, rather than a cross-platform application written in Java™. While the Java application would work on both Mac OS X and Windows, Objective-C programs can leverage the Cocoa developer frameworks native to Mac OS X, thus speeding development time, allowing more focus on the user experience and the application functionality. SearchParty was to use a proprietary API provided by HarvestRoad (Java Hive API—JHAPI). This effort had an aggressive timetable and required some Objective-C/Java bridge work, but was not perceived to have a high degree of technical risk.

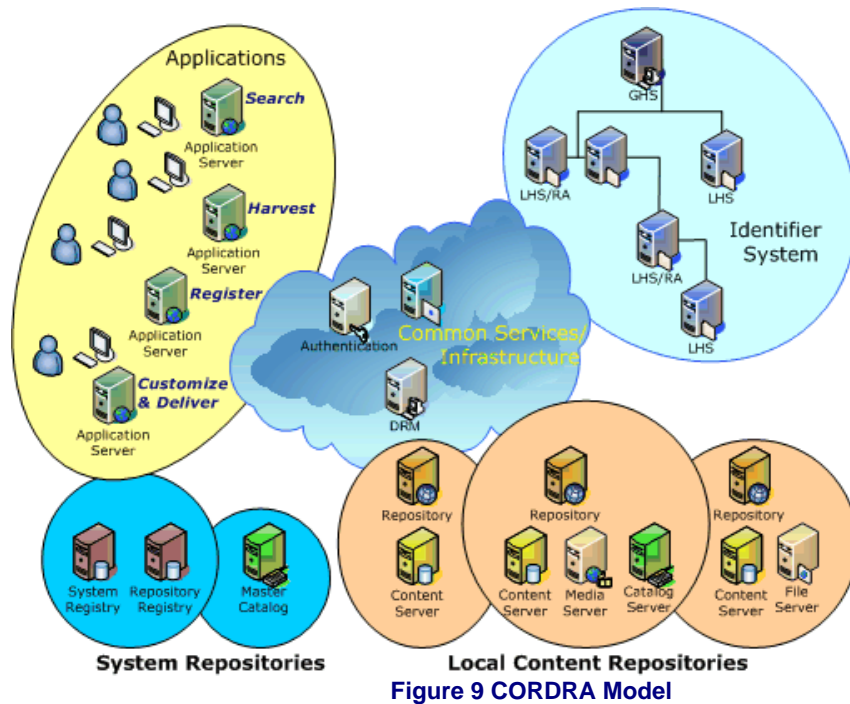


Figure 9 CORDRA Model

(Source CORDRA: Technical Introduction and Overview, <http://www.isal.cmu.edu/isal/expertise/projects/cordra/intro/intro-v1p00.html>)

TKE05.8 The Knowledge Exchange commercial model and service layer

Description

An end-to-end model or framework to guide the implementation of integrated learning and knowledge strategies. This model will establish the commercial value of a B2B learning object and knowledge exchange business model (a third-party elearning-provider solution, or 3PEL). Includes developing a service layer with ecommerce and integrated database for the overall system.

The aim of this project was to bring together a single interface where individuals could enter the exchange and every component technology in the end-to-end supply chain. The features of the service layer are:

- common identity and permissions management;
- single integration layer thus creating an interoperability 'hub' for multiple technologies (and others that are added or used to replace existing components);
- ecommerce and catalogue;
- log on (LDAP) and configuration of appearance to different user requirements;
- brand management;
- a 'shop front'; and
- guest facilities.

Research and Development Partners

- UXels

Results

The UXels development and integration of the Service Layer to span all aspects of the elearning supply-chain as envisioned and implemented in the testbed 2005 is still being finalised. The finalisation relates to the commercial release of the service layer. The build has been done with all the specified components.

TKE05.8.1. The implementation of a service layer assumes that all vendors seek to maximise interoperability and movement of data, content and users or user groups (identity management) across the whole supply chain;

TKE05.8.2. The service layer should be built independent of the LMS while still supporting data import and export from the LMS;

- TKE05.8.3. The single identity and log-on issues take longer to resolve as multiple vendors and their applications may be involved in confirming the technical design, testing the development prior to release, and ensuring ongoing functionality;
- TKE05.8.4. Having different applications on different servers to optimise individual performance resulted in sub-optimal performance of the service layer;
- TKE05.8.5. Applications not designed to work with other applications (stand-alone LMS solutions) could not respond to the creation of an LDAP solution with the same speed or efficiency as applications designed to work within complex IT systems (i.e. an LOR);
- TKE05.8.6. Problems occurred with synchronisation of data and discontinuities between applications if one is updated, and this affects the overall service layer;
- TKE05.8.7. Scalability and reduction in the cost of roll-out are enhanced enormously when a single service layer can be placed over multiple technologies;
- TKE05.8.8. While it is conceptually possible to 'mix and match' LOR and LMS solutions once a service layer exists, testing of open-source, free-to-download learning management and course management systems with rudimentary programming and design configurations consistently proved the most expensive to reconfigure to be part of a 'service layer' or interoperate within an 'end-to-end' elearning solution;
- TKE05.8.9. For both workflow and data management efficiencies, it is desirable for reporting to reside in the service layer; and
- TKE05.8.10. Further investigation is required to develop a standards-complaint reporting solution (LIP, IMS Enterprise, etc.) that can reside in the service layer and uncouple reporting from the LMS.

This development proved the most vexed and time-consuming of the whole TKE Testbed. In effect, the Learning Object Repository (LOR), HarvestRoad Hive® was able to deal rapidly with new authoring or assessment generation tools being 'bolted' onto it. Equally, delivery of content in standards-based format or any regime could be managed within the same 'bureau' within the repository.

The reality was that EtechGroup's Fourpoint Learning Delivery System proved difficult working in an end-to-end elearning supply chain where interoperability and uncoupling of the LMS from certain functions was essential to maximise ROI and operational efficiency. Problems were not insurmountable but the solution rapidly required reconfiguration of how the LMS was designed, especially as it was not very suitable in its standard form for corporate learning contexts.

Keeping the LMS an 'out of the box' solution to optimise help desk and support of the product proved impossible. The principle of the LMS not being the hub for the elearning supply chain is inconsistent with current software programming work on the LMS tested. The desire to avoid proprietorial solutions meant open, standards-based LMS solutions tested and EtechGroups'® Fourpoint Learning™ system implemented in the testbed had to be reshaped to:

- suite corporate hierarchy and terminology;
- interface with a repository (HarvestRoad Hive®);
- integrate reporting into the service layer;
- integrate log-on, identity and permissions management with the service layer; and
- manage all forms of standards-compliant content/object.

Evidence in the testbed suggests that LMS designers still 'don't get it! The separation of content and presentation is an essential feature for value creation and efficient technical operation in the elearning supply chain. At the very least it must be a consideration: LMS companies should expect to have to address this issue. Nevertheless, the open, standards-based platforms accessed in the testbed all tried to consolidate content management onto their platforms or failed to provide for a two-way interface with content management systems. More critically, only a few were IMS, SCORM 1.2 or SCORM 2004 compliant and able to publish this content off the platform once it had been 'authored', assembled or stored on the system.

Most systems also prevented workflows where the delivery was to occur independently of the LMS. For instance, many corporations like to only have the LMS as an 'invisible' backdrop to learning completed in Web courses or mobile learning environments. In such a configuration the learner logs on, views their course lists in the 'splash page' and moves directly to the chosen course. The splash page and the 'home' page of the Web courses give the student access to the LMS if they require but it is not the primary learning environment. Reporting and assessment still link back to the LMS. This is in contrast to how schools and

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universities will use the LMS as the primary vehicle for content presentation. It is also not unusual for them to author and embed content in the LMS.

With massive and growing sales in the schools sector globally, the imperative to reduce the functions 'locked into the LMS' and adopt a 'supply-chain view' on the role played by the LMS seems to have been counter-intuitive to the short-term imperatives of the LMS developers.

Nor could the open, standards-based (SCORM 2004 compliant) LMS' in the testbed be integrated with ease into an environment where the business systems and other components of the elearning supply chain (authoring tools or reporting databases) were currently operating in a 'Microsoft Shop' environment; approaches based on .Net and/or Windows Server 2003 architecture.

Detail

UXels is a start-up company specifically designed to take end-to-end elearning solutions to market. Its core offering is The Knowledge Exchange (TKE), a conceptual model derived in the testbed⁷. UXels is the sponsor organisation; TKE is the online learning and object exchange service (see Figures 10 and 11). TKE is a cluster of best of breed elearning technologies drawn from the Working FuturesTM testbed and provided as a service on a user-pays basis. This means that a user can configure the system to their company's needs without having to pay license fees for each component or the overall system. They pay for each student who accesses the service on a course-by-course basis. Designers and developers of content can also provide content or learning objects via the object repository and make them available for reuse by learning providers, under terms they set.

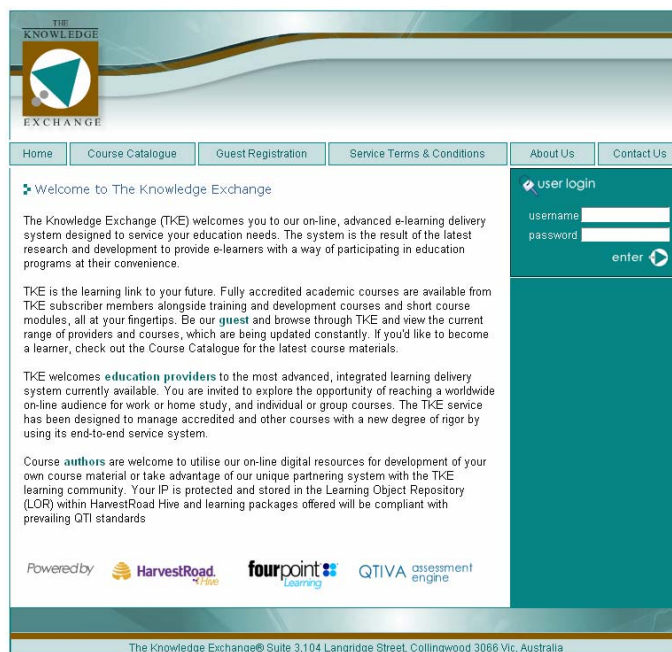


Figure 10 The TKE site

All content and objects are protected and stored in the HarvestRoad Hive® Learning Object Repository (LOR). Preference is for all content to be in compliant specifications as set by IEEE, ADL Colab's SCORM or IMS Global Consortium's standards, including IMS QTI standards. The LMS is the eTechGroup Fourpoint LearningTM learning delivery system. Authoring tools can vary but the predominant solution is the conversion and authoring tool Redoit®, by the Delphi Group.

⁷ UXels has worked with The Institute for Working Futures research testbed to refine the TKE model and the applications it uses. Working FuturesTM is a partner in the New Practices QTI m-PlayerTM project.

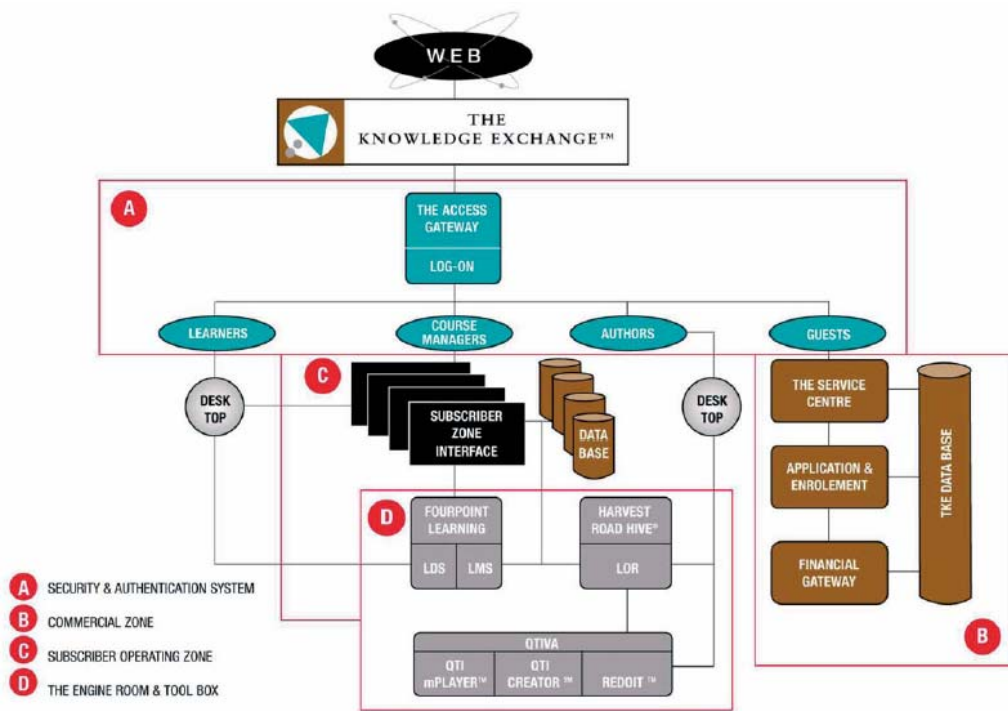


Figure 11 The TKE end-to-end model

As of March 2006, UXels is completing final user acceptance testing and independent audit on the full offering before a full rollout is undertaken in the third quarter of 2006.

Terms, acronyms, glossary and standards organisations

Terms and acronyms

This section is intended to remove some of the 'noise' associated with some of the terms used in this application.

QTI is the **Question and Test Interoperability** specification developed by **IMS** Global Learning Consortium, an international, industry sponsored project. QTI describes how tests and their results can be described in XML. QTI version 2 was released in 2004. QTI is essential in detailing how to achieve interoperability of assessment instruments and all aspects of data reporting off mobile devices.

IMS Metadata is a specification that provides a way to format the **Institute of Electrical and Electronics Engineers'** (IEEE) Learning Object Metadata (**LOM**) standard in XML (**eXtensible Markup Language**). IEEE has a key role in setting international standards for electro and information technologies and sciences.

IMS Packaging is also a commonly used specification that sets out to describe objects aggregated into packages (i.e. like SCORM).

IMS Simple Sequencing is a specification that details navigation paths and relationships between objects and collections of resources. This can be coupled with **IMS Learning Design** that establishes how learning objects fit within a learning strategy. Related to this is the **IMS Learner Information Package (LIP)**, a specification that addresses the interoperability of internet-based Learner Information Systems with other systems that support the Internet learning environment. As such, servers that are compliant can exchange data that is mutually defined and has the appropriate permissions to enable it to be shared.

SCORM is the **Shareable Content Object Reference Model**. SCORM was developed under the **Advanced Distributed Learning (ADL)** initiative, a joint academic and Department of Defence initiative chartered to address a late 1990s US Federal Government directive to address learning content sharing and management. ADL introduced SCORM 1.0 in 2000, and a series of iterations and enhancements that have now resulted in SCORM 2004. SCORM is not a standard or a specification, but a reference model. It mainly covers labelling for describing data (**metadata**), the packaging of content to specific enterprise application, a messaging and communication system that enables the content to exchange data with enterprise systems or other content objects, and a way to organise content objects into larger assemblies. In 2004, the key content component became the **Activities and Sharable Content Object (SCO)**. SCORM is therefore essential in guiding how we source develop, manage and distribute content.

Globally, the combination of SCORM 2004, with IMS QTI version 2.0 (released March 2005) and metadata and packaging specifications has created four profound and new opportunities to:

- design, deploy and manage assessment objects that fit multiple strategies, rather than having to limit strategies if SCORM was used;
- treat assessment as a SCO (not part of some other object), and have multiple activities tied to one assessment object;
- design, develop and manage QTI assessment instruments (assessment objects) in relation with SCORM, thus maximising their reuse, accessibility, discoverability, durability and interoperability (including across multiple enterprise applications such as LMS); and
- most importantly, manage all data reported from assessment in XML to the highest security and privacy requirements, across fixed or mobile networks.

For commercial and enterprise systems administrators, QTI compliance and roll-out over mobile networks is now extremely attractive. It provides a means to conduct both knowledge and learning transfer in a manner that does not 'burden' the existing, often overburdened internal networks. It also can be done in a manner that does not compromise security, or commercial and privacy concerns. Additionally, there is no need for the LMS to actually reside inside an enterprise's own network. Data can be interchanged in XML from the mobile device to the learning providers' systems and thence, through a very secure, narrow 'tunnel' to the HR, learning, knowledge and related enterprise systems.

Packaging relates to:

- aggregating 'chunks' of content or objects into larger components; and
- formatting the objects to confirm how they are to be used.

Packaging can confirm not just how content is to be designed and built, but also how it can be accessed (CD ROM, fixed PC connected to the Web, PDA, mobile device, etc.), and how it will be presented.

Labelling relates to the use of metadata; in effect, deployment of LOM and SCORM in assessment and learning objects that are packaged.

AVETMISS is the Australian Vocational Educational and Training Management Information Statistical Standard. AVETMISS data reporting is required for VET funded by the government. It requires that data be collected on enrolment and on completion of training against standard fields. Applications that do this reporting (i.e. VETTrak) also can be used by providers to generate strategic data and specific reports required by state authorities and agencies.

AICC = Aviation Industry Computer-based learning Committee

CMS = Content Management System (Most often used by the educational sector instead of LMS)

LMS = Learning Management Systems

LDS = Learning Delivery System (LMS with authoring capabilities)

LOR = Learning Object Repository

LCMS = Learning Content Management System

EHCMS = Enterprise Human Capital Management System

CRM = Customer Relationship Management system

ERP = Enterprise Resource and Planing

HR = Human Resource

Glossary

Analogy (Analogue)—signal that is received in the same form as it is transmitted, while the amplitude and frequency may lose quality with each generation.

Application Service Provider (ASP)—company that provides access to applications on a subscription basis. MediaSeek and LearningStation.com are examples of ASPs.

Application sharing—allows more than one person to use a software application. Multiple users can add and delete items from the document. The application is launched from one person's computer and that person is the gatekeeper who can determine which users can make changes to the document and which can only view it.

Asynchronous—communication in which interaction between parties does not take place at the same time.

Asynchronous Collaborative ELearning (ACEL)—term coined to indicate asynchronous, but also collaborative, experience. The collaboration does not occur in real time, however.

Asynchronous learning—learning in which interaction between teachers and students occurs intermittently with a time delay (as opposed to synchronous learning). Examples are self-paced courses taken via the Internet or CD-ROM, Q&A mentoring, email, listservs, audiocassette courses, videotaped courses, correspondence courses and Internet courses.

Authoring software/tools—allow users to create and adapt content for the Web for use in an online course. Assists in creating elearning courses. High-level computer programs designed for creating computer-based training, interactive presentations and multimedia. Commands are often presented as simple terms, concepts and icons. Authoring software translates these commands into programming code (e.g. Authorware, WebCT, Director).

Authoring systems—the software specially designed to let people create online learning modules that include all of the key learning elements: text presentations, graphics, questions (links to appropriate learning material based on learners' responses) and tracking of student performance. See authoring software/tools.

Bandwidth—information-carrying capacity of a communication channel. The greater the bandwidth, the greater the carrying capacity. Often used in reference to Internet access.

Bluetooth—short-range (10–100) metres low-power radio technology available for a range of mobile and fixed devices: enables devices to communicate with each other via local area networks (LANs) for small offices, etc. wirelessly.

Broadband—high-speed data transmission. The specific speed used to define broadband is subjective; the word often implies any speed above what is commonly used at the time.

Browser—application program that provides a way to look at and interact with all the information on the World Wide Web, for example, Mosaic, Internet Explorer, Netscape Navigator. See also search engine.

Capability—combination of knowledge assets in the form of competence attributes (skills and knowledge) plus identity attributes (culture, roles, behaviours and traits) that support individual and collective performance.

Certificate or certification—form of recognition of achievement for a defined set of learning outcomes (for a module/program or a course) by a credential not linked to formal qualifications (i.e. vendor- or company-endorsed credential).

Channel—aggregation of content with a common theme, made available by a content provider.

Chat (Internet Relay Chat or IRC)—real-time, interactive online conversations on the Internet, allowing Internet users to join theme discussions or post comments on their screen at the same time as other participants. Chatting can also include communication in virtual reality environments using avatars (the virtual representation of the user by a 2-D or 3-D character).

Chat room—real-time text-based conversation with other learners over the Internet. Whatever a user types is displayed on the other users' screens as it is being typed.

C-learning—classroom learning; the traditional form of learning in which learners attend class at a specific location, at a set time and with a learning advisor.

Competencies—specification of the knowledge and skills and the application of that knowledge and skill to the standard of performance required in a level of employment.

Computer-Assisted Instruction (CAI)—teaching process in which a computer is used to enhance the learning environment by assisting students to gain mastery over a specific skill.

Computer-Based Training (CBT)—umbrella term for the use of computers in both instruction and management of the teaching and learning process. CAI (computer-assisted instruction) and CMI (computer-managed instruction) are included under the heading of CBT. Some people use the terms CBT and CAI interchangeably. Both involve training materials and content delivered via software applications that are installed on the learner's computer.

Computer-Managed Instruction—see computer-based training.

Content—see learning content.

Content Service Provider (CSP)—company that provides data and information for inclusion on the Web. Encyclopaedia Britannica, McGraw Hill and Oz New Media are examples of CSPs.

Convergence—increased unity of service across TV, computer, Internet, telephony, video and other media.

Course—sequence of modules that leads to a credential being issued to provide formal recognition through a qualification or professional accreditation.

Credit transfer—establishes the value or credit a person may receive in recognition of prior experience, current competence or completed training or education when seeking to transfer into a formally recognised course or program of learning. This credit can be applied towards a qualification.

Curriculum—formal document that structures and packages criteria, learning outcomes or competencies into a learning 'package', such as a course, module or program.

Data—the basis for forming information.

Delivery—any method of transferring offerings to learners. Variants are instructor-led training, Web-based distance learning, online laboratory, CD-ROM and books.

Digital—electrical signal that varies in discrete steps in voltage, frequency, amplitude, location, etc. Digital signals can be transmitted faster and more accurately than analog signals. Digital does not lose quality in duplication or quality over distance.

Discussion list—discussion board/threaded discussions—online conversation in which one person sends a question or comment to a list of people who have signed up for discussions on that topic (hence the name discussion list). Respondents view the messages at their convenience and send replies to everyone on the discussion list. A form of asynchronous online communication. (Users can also send private messages.) See asynchronous.

Distance education—learning situation in which the instructor and students are separated by time, location, or both. The interaction between a learner who strives to acquire knowledge or skill by instruction or study with a remote knowledge source: one that is physically separated from the learner. Education or training courses are delivered to remote locations via synchronous or asynchronous means of instruction, including written correspondence, text, graphics, audio- and videotape, CD-ROM, online learning, audio- and videoconferencing, interactive TV, radio and facsimile. Distance learning does not preclude the use of the traditional classroom. The definition of distance education is broader than and encompasses elearning. Elearning is a subset of distance education and training.

Distance learning—the desired outcome of distance education.

Ebusiness—conducting business on the Internet.

Ebusiness services—services comprising consulting, design, integration, support, management and outsourcing, associated with the development, deployment and management of Internet sites.

Ecommerce—electronic commerce or the conduct of transactions over the Internet.

Elearning—covers a wide set of applications and processes such as Web-based learning, computer-based learning, virtual classrooms and digital collaboration. It includes the delivery of content via Internet, intranet/extranet (LAN/WAN), audio- and videotape, satellite broadcast, interactive TV and CD-ROM.

Electronic mail (email)—messages sent from one computer user to another.

Elibrary—wealth of digital resources for learners to use for learning purposes. Elibrary companies help find, organise and mine the content for learners.

Etest—ability to provide assessment and evaluation over the Internet.

Experiential learning—learning through short, structured and targeted exercises where individuals learn through performance and investigation. Unlike action learning the tasks may not necessarily be related to the workplace but learning opportunities are structured to combine competency, cognitive and emotional aspects of an individual or team's experience in a manner that promotes learning.

Extranet—World Wide Web-like network available only to people chosen by the organisation, including people outside of it (hence, the term 'extra').

File Transfer Protocol (FTP)—protocol that allows files to be moved from a distant computer to a local computer using a network such as the Internet.

Firewall—security barrier between a company intranet and the larger Internet to protect systems from viruses and other unwanted digital intrusions.

Flash—multimedia technology developed by Macromedia to allow much interactivity to fit into a relatively small file size.

Floor control—feature in a synchronous learning environment that allows one person to know what is going on with all the participants. The person with floor control can look at other learners' screens, control the whiteboard and run the class. The learning advisor is typically the one with floor control, but control can be transferred to other learners. The term is probably taken from television directing, floor director.

Formal (national) qualification—consistent and portable credential recognising an individual's attainment of all the competency units nominated as requirements for competency to be recognised at a given level on the Australian Qualifications Framework. This may be through the completion of a course, direct assessment or a combination.

Fully interactive video—two sites interact with audio and video as if they were located in the same place (two-way interactive video).

Graphical User Interface (GUI)—interface that incorporates a variety of media, especially text and graphics. Often graphical user interfaces have icons that represent actions that the system can perform and that make extensive use of visuals. Windows and the Mac Operating System (OS) are examples of programs that have a graphical user interface.

Groupware—software that promotes synchronous and asynchronous online collaboration, by letting users send email, share work files, conduct online chats, and similar activities. See application sharing.

Host—(from *whatis.com*) in Internet protocol specifications, any computer that has full two-way access to other computers on the Internet. A host has a specific 'local or host number' that, together with the network number, forms its unique Internet Protocol (**IP**) **address**. If you use **Point-to-Point Protocol** to get access to your access provider, you have a unique IP address for the duration of any connection you make to the Internet and your computer is a host for that period. In this context, a 'host' is a **node** in a network.

Hot link—see Hyperlink.

Hyperlink—on the Web or other hypertext systems, hyperlink is a synonym for both link and hypertext link. Possibly, the term originated because 'link' was not felt to be specific enough. And it's shorter than 'hypertext link'.

Hypermedia—derived from hypertext, extends the notion of the hypertext link to include links among any set of multimedia objects, including sound, motion video and virtual reality. It can also connote a higher level of user/network interactivity than the interactivity already implicit in hypertext.

Hypertext—any text that can be chosen by a reader which allows another document to be retrieved and displayed.

Hypertext Transfer Protocol (HTTP)—set of rules for exchanging files (text, graphic images, sound, video and other multimedia files) on the World Wide Web. Relative to the Transmission Control Protocol (TCP)/ Internet Protocol (IP) suite of protocols (which are the basis for information exchange on the Internet), HTTP is an application protocol.

Identity—the sum of cultural attributes, roles, traits and behaviours. It involves the sense of past experiences, current capabilities and a trajectory towards a desired future.

Individualised Education Plans (IEP)—learners can design how, when and what they want to learn. The Internet simplifies this process by offering a variety of choices and learning options.

Information—data + meaning.

Information object—any digital resource that can be used to support a learning object (see Knowledge Nugget; Learning Object).

Instructor-Led Training (ILT)—training in which learners are taught by an actual person, or instructor, usually in a classroom setting, synchronously or asynchronously.

Intellectual capital—See knowledge capital.

Interactive communication—interactive communication brings people together, speeds up information dissemination and learning processes, and enables users to interact in real time without distance being an obstacle. Today, two people can develop a product from opposite ends of a continent, benefit from another person's expertise even though they are thousands of kilometres apart, use multimedia elements such as sound, video or fixed image and text, share software, and much more.

Internet—system of linked computer networks that facilitates communication and transfers information among users.

Internet Service Provider (ISP)—company that provides the facilities necessary for individuals or organisations to access the Internet via dial-up or dedicated lines.

Intranet—private network that links a group of computers, usually within a company. Functions like the Internet but is not available to the public. It involves a (Local Area Network) LAN or Wide Area Network (WAN) that can transport information. See also WAN.

IP address—multi-digit number that relates to a website.

IP multicast—transmission of information from services to clients where the information is broadcast to clients who have subscribed to the service.

IP telephony—use of IP networks such as the Internet to provide telephony services. Known as Voice Over IP (VOIP).

Knowledge—data + meaning + purpose (also may be embedded and migratory, tacit and explicit, embrained and encultured, focal, etc.).

Knowledge assets—capabilities and knowledge or information components accessible by an individual group or organisations.

Knowledge capital—total capabilities available to an organisation in pools of knowledge resources including social capital, human capital and infrastructural capital. Together, the pools of capital resources determine knowledge capital, which has a value through the potential for productive capacity and agility. The term is also used to encompass intellectual capital.

Knowledge management—capturing, organising, and storing knowledge and experiences of individual workers and groups within an organisation and making it available to others in the organisation.

Knowledge nugget—can be used to delineate a ‘chunk’ that is an original knowledge asset, information object or learning object that is a component of a more extensive learning program but no longer maintains its formal relationship to a learning outcome or a course or short course.

Learning content—best thought of as knowledge assets packaged into materials, activities and supporting resources to support learning components. They enable a learner to complete learning to the outcomes attached to a learning component. They may include case studies, challenges, assessment tools, experiments and so on.

Learning Management Systems—software that tracks student progress in a course and indicates completion. At minimum, learning management systems track individual student progress, record scores of quizzes and tests within an online learning program, and track course completion. Learning management systems may also transfer this information to other record management software, such as PeopleSoft, so that permanent educational records reflect progress in online learning. Although originally sold as separate software that worked in conjunction with authoring tools, many authoring tools now include learning.

Learning nugget—can be used to delineate a ‘chunk’ that is an original knowledge asset or learning object; this chunk maintains its ability to credit transfer an individual’s learning towards an agreed outcome that is linked to a course or short course.

Learning object—this has been defined as a modular digital resource, uniquely identified and meta-tagged, which can be used to support learning. Learning objects have the potential to provide learning customised for each specific learner at a specific time, taking into account their learning styles, experience, knowledge and learning goals. In addition, they can be disaggregated to permit the same objects to be used for different courses, or be reusable in how different individuals access the same content.

Learning organisation—in a learning organisation, the individual within the organisation, and the organisation as a whole, has to commit to learn, to continually seek to change existing practices through knowledge acquired by learning, and to respond to the sources of information that stimulate new knowledge and learning.

Learning portal—any website that offers learners or organisations consolidated access to learning and training resources from multiple sources. Operators of learning portals are also called content aggregators, distributors or hosts.

Learning Service Provider (LSP)—specialised Application Service Provider (ASP) offering learning management and training delivery software on a hosted or rental basis.

Link—electronic connection between two websites (also called ‘hot link’, hotlink or hyperlink).

Listserv—email program that automatically sends messages to all subscribers, creating an online discussion.

Message boards and discussion threads—asynchronous communication tool that allows learners to post comments and questions to a common location on the Internet. Learners and learning advisors can read the messages and post responses at their leisure.

Metadata—method to organise data into ‘nuggets’ so that the user can locate, evaluate, access and manage online information.

Meta-tag—tags affixed to learning objects to explain what’s inside: its content, objectives, author, language, date, version, level, assessment, and more.

Modem—equipment that allows computers to interact with one another via telephone lines by converting digital signals to analog for transmission along analog lines.

Module—stand-alone unit of learning that offers credit transfer into a program or formally recognised course.

Multimedia—any document that uses multiple forms of communication such as interactive text, images, sound and colour. Multimedia can be anything from a simple PowerPoint slideshow to a complex interactive simulation.

Multipoint—communication configuration in which several terminals or stations are connected. This differs from point-to-point, where communication is between two stations only.

Network—series of points in different locations connected by communication channels.

Nugget (of information)—delineates a ‘bite-sized’ component of learning that is a component of a module or program of learning but no longer maintains its formal relationship to a learning outcome that is linked to a formal course.

Nugget (of learning)—delineates a ‘bite-sized’ component of learning that is a component of a module and maintains its ability to credit transfer an individual’s learning towards an agreed outcome that is linked to a formal course or certificated short course.

Off-the-job training—training, education and development that is structured and conducted outside the ‘normal’ workplace situation and performance of tasks related to job completion. This may include lectures, classroom activities, case studies, self-paced learning, games, simulations, programmed instruction and special training sessions within a workplace context structured outside normal job/task completion.

On-the-job training—training, education and development that is structured and conducted in the workplace and based on activities completed as part of a student’s normal workplace activities and job. This usually includes learning by ‘doing’, coaching, skills tests and learning completed as part of normal job/task completion.

Organisational learning—while organisations are not usually built to learn they do organise functions and processes to complete transactions between individuals within and outside their structure. Such transactions stimulate relationships that can be deliberately managed to encourage organisational learning through the capture, transfer and generation of knowledge. This knowledge has the potential to advance individual, group and organisational outcomes.

Page—all websites are a collection of electronic ‘pages’. Each Web page is a document formatted in HTML (HyperText Markup Language) that contains text, images or media objects such as RealAudio player

files, QuickTime videos or Java applets. The 'home page' is typically a visitor's first point of entry and usually features a site index. Pages can be static or dynamically generated. All frames and frame parent documents are counted as pages.

Performance—application or deployment of capabilities to achieve an outcome. It may also include the composite outcomes or end results which emerge when an individual, group or organisation pursues actions that may be measured to determine if they are optimal (minimised or maximised).

Point-to-Point—form of access. See Host.

Portal—location on the Web that serves as a central source for information and content targeted to a specific group. Serves as a gateway to information and elearning from a variety of different sources. Although the term was initially used to refer to general purpose sites, it is increasingly being used to refer to vertical market sites that offer the same services, but only to a particular industry such as banking, insurance or computers.

Program—tertiary-level training segment. Sequence of modules that does not result in a qualification but offers credit transfer into a course (i.e. multiple modules but less than a course).

Qualification (formal, national)—consistent and portable credential recognising an individual's attainment of all the criteria, learning outcomes or capabilities nominated as requirements for recognition at a given level of accreditation (i.e. the Australian Qualifications Framework). This may be through the completion of a course, direct assessment or a combination.

Real time—processing of information that returns a result so rapidly that the interaction appears to be instantaneous. Telephone calls and videoconferencing are examples of real-time applications. Real-time information not only needs to be processed almost instantaneously, but also needs to arrive in the exact order it is sent. A delay between parts of a word, or the transmission of video frames out of sequence, makes the communication unintelligible. See Synchronous.

Recognition of Current Competency (RCC)—the formal process of mapping competencies held by an individual against benchmark competency standards, or competencies that compose formal qualifications. RCC is closely related to RPL, but distinct, especially when associated with determining actual performance capacity as opposed to learning held; i.e. as in performance reviews.

Recognition of Prior Learning—RPL is the formal process and means by which workers can gain formal recognition for skills and competencies they already possess, through life experiences, or learning elsewhere, without having to undertake further training.

Repository—a database of learning objects. An LCMS can deliver these as required by a specific situation.

Search engine—(from whatis.com) on the Internet, a search engine is a coordinated set of programs that includes:

- A spider (also called a 'crawler' or a 'bot') that goes to every page or representative pages on every website that wants to be searchable and reads it, using hypertext links on each page to discover and read a site's other pages
- A program that creates a huge index (sometimes called a 'catalog') from the pages that have been read
- A program that receives your search request, compares it to the entries in the index, and returns results to you.

Self-directed learning—process of learning in which the individual takes full responsibility for diagnosing needs, priorities, learning goals, the structuring and completion of study to meet learning needs, and follow-up evaluation of the progress they have made through study.

Self-paced learning—offering in which the learner determines the pace and timing of content delivery.

Server—machine that makes services available on a network to client programs. A file server makes files available.

Sharable Content Object Reference Model (SCORM)—set of standards that, when applied to course content, produces small, reusable learning objects. A result of the US Department of Defense's Advance Distributed Learning (ADL) initiative, SCORM-compliant courseware elements can be easily merged with other compliant elements to produce a highly modular repository of training materials.

Short course or session—refers to a stand-alone module or sequence of training that does not offer credit transfer into a course but may result in certification.

Streaming—live radio, audio and video—this 'continuous' broadcast mode, called streaming, can be found on the Internet and intranets to process data (display images or video, or play sounds or music) before it is fully downloaded or uploaded. The information is compressed at the source, usually in MPEG format, and then decompressed by the user. Several users can simultaneously view or listen to the posted files. Streaming technology allows the user to listen to, view and even interact with (while viewing or listening) multimedia files. The streaming mode is essential for listening to conferences and radio or television programs live or in delayed broadcast, although the video broadcast quality is entirely dependent on the telecommunication network and the user's hardware (modem, processor, etc.).

Synchronous—through modern technology, the learners log into class at a regularly scheduled time and date and engage in real time with the learning advisor and other learners, much like a real classroom. Assignments are given, questions are asked and answered, and exams and pop quizzes are taken.

Synchronous Collaborative ELearning (SCEL)—term coined to indicate that the experience was synchronous—two-way—but also collaborative. Common forms of synchronous learning include video conferencing, audio conferencing and computer conferencing and/or chats.

Teleconferencing—two-way electronic communications between two or more groups in separate locations via audio, video and/or computer systems.

Videoconferencing and desktop videoconferencing—using video and audio signals to link participants at different and remote locations. There are two kinds of videoconferencing: personal (or face-to-face) via personal computers, and group (person or persons talking to a group of persons) using a dedicated videoconference system via monitors or televisions. Desktop videoconferencing occurs through use of a personal computer.

Video teleconferencing—teleconference including two-way video.

Virtual classroom—online learning space where students and instructors interact.

Voice Over IP—see IP telephony.

WAN—Wide Area Network—(from whatis.com) geographically dispersed telecommunications network. The term distinguishes a broader telecommunication structure from a local area network. A wide area network may be privately owned or rented, but the term usually connotes the inclusion of public (shared user) networks.

Web-Based Training (WBT)—training that occurs using the Internet. Learners must connect to an intranet or the Internet to access the information.

Web page—file written in a programming language that enables it be read on the World Wide Web. See also Page.

Website—collection of one or more Web pages linked together.

Whiteboard—in an elearning situation, application that allows documents and content materials to be posted on the screen for all learners to see. The learning advisor can then make changes to the document or post additional information, just as with a traditional blackboard. It is used in a synchronous learning situation. The learners see the information being changed on their screens in real time.

Whiteboarding—term used to describe the placement of shared documents or material on an on-screen 'shared notebook' or 'whiteboard'. Desktop videoconferencing software includes 'snapshot' tools that enable one to capture entire windows or portions of windows and place them on the whiteboard. The user

works with familiar tools to mark up the electronic whiteboard much as with a traditional wall-mounted board.

World Wide Web (WWW)—hypermedia system (digital data, audio, video and other media used as hypertext elements) that facilitates searches for information on the Internet. The information available on the Web is presented as Web pages; a set of Web pages constitutes a website. A Web page can contain text and still-frame images, animations, video, sounds, etc., and links to other pages. Those links allow users to explore information in a specific order (or randomly) and to interact with the contents of the Web page. Documents on the WWW are published in HTML (hypertext markup language) and other protocols (dynamic HTML, stream, Java, etc.). See also HTML, hypermedia, hyperlinks, etc.

Elearning standards organisations

Web address	Organisation	About the organisation
www.adlnet.org	Advanced Distributed Learning (ADL)	The Advanced Distributed Learning (ADL) Initiative, sponsored by the US Office of the Secretary of Defense (OSD), is a collaborative effort between US 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.
www.aicc.org	Aviation Industry CBT Committee (AICC)	An international association of technology-based training professionals. The AICC develops guidelines for aviation industry in the development, delivery, and evaluation of CBT and related training technologies.
www.alic.gr.jp/eng/index.htm	Advanced Learning Infrastructure Consortium (ALIC)	Established to bring cooperation in industry, the government and academia, and contribute to the development of learning infrastructure including learning technology standards. ALIC also follows up the global standardisation in ISO/IEC JTC1, which started a subcommittee on learning technologies in March 2000 to promote system interoperability and content reuse.
www.ansi.org	American National Standards Institute	A private, non-profit organisation that administers and coordinates the US voluntary standardisation and conformity assessment system. Its mission is to enhance both the global competitiveness of US business and the US quality of life by promoting and facilitating voluntary consensus standards and conformity assessment systems, and safeguarding their integrity.
www.ariadne-eu.org	Ariadne	The ARIADNE Foundation was created to exploit and further develop the results of the ARIADNE and ARIADNE II European Projects, which created tools and methodologies for producing, managing and reusing computer-based pedagogical elements and telematics supported training curricula.
www.cenorm.be/issw/Workshop/lt/	CEN/ISSW Workshop Learning Technologies (WS-LT)	The Workshop's objective is to encourage the effective development and use of relevant and appropriate standards for learning technologies for Europe.
www.cleolab.org	Customized Learning Experiences Online (CLEO Lab)	The Customized Learning Experience Online (CLEO) Lab is a research collaboration between Cisco Systems, IBM, Microsoft and Thomson-NETg. The CLEO Lab goal is to conduct focused, applied research on technical and pedagogical issues related to the ADL Sharable Content Reference Model (SCORM), an important compilation of elearning interoperability specifications.

The Knowledge Exchange Testbed Findings Report

Web address	Organisation	About the organisation
www.dublincore.org/	Dublin Core Metadata Initiative	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. DCMI's activities include consensus-driven working groups, global workshops, conferences, standards liaison, and educational efforts to promote widespread acceptance of metadata standards and practices.
www.ebxml.org	e-business XML	Provides an open XML-based infrastructure enabling the global use of electronic business information in an interoperable, secure and consistent manner by all parties.
www.edna.edu.au	Education Network Australia	EdNA 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 a communications service, EdNA Online aims to promote collaboration and cooperation throughout the Australian education.
www.eicaonline.com	Energy Industry CBT Alliance (EICA)	Encompassing professionals from both energy companies and vendors, the EICA is the energy industry's largest network of technology-based training (TBT) professionals. It is an industry specific consortium that pools the technology-based training resources and knowledge of the largest energy companies to create new cost savings, widen each company's training resources, strengthen relationships with suppliers, and increase each company's ability to compete on a national and international basis.
www.hr-xml.org/channels/home.htm	HR-XML Consortium	The HR-XML Consortium is an independent, non-profit organization dedicated to the development and promotion of a standard suite of XML specifications to enable e-business and the automation of human resources-related data exchanges.
ltsc.ieee.org	IEEE Learning Technology Standards Committee	The Learning Technology Standards Committee (LTSC) is chartered by the IEEE Computer Society Standards Activity Board to develop accredited technical standards, recommended practices and guides for learning technology. The LTSC coordinates formally and informally with other organisations that produce specifications and standards for similar purposes. Standards development is done in working groups via a combination of face-to-face meetings, teleconferences, and exchanges on discussion groups.
www.ietf.org	The Internet Engineering Taskforce (IETF)	A large open international community of network designers, operators, vendors, and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet.
www.imsglobal.org/	IMS Global Learning Consortium	Involved in developing and promoting open specifications for facilitating online distributed learning activities such as locating and using educational content, tracking learner progress, reporting learner performance, and exchanging student records between administrative systems. IMS has two key goals: defining the technical specifications for interoperability of applications and services in distributed learning, and allowing distributed learning environments and content from multiple authors to work together.
www.iso.ch/iso/en/ISOOnline.frontpage	International Organisation for Standardization (ISO)	ISO is a non-governmental organization established in 1947. The mission of ISO is to promote the development of standardization and related activities in the world with a view to facilitating the international exchange of goods and services, and to developing cooperation in the spheres of intellectual, scientific, technological and economic activity.
jtc1sc36.org	Information technology for learning, education and training (ITLET)	Develops international standards in information technology in the areas of learning, education, and training.

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Web address	Organisation	About the organisation
www.ja-sig.org	Java Architectures Special Interest Group (JA-SIG)	The Java Architectures Special Interest Group (JA-SIG) is an independent organization promoting the use of Java technologies and architectures within the higher education community. JA-SIG supports the development and adoption of low-cost, flexible, open source solutions that adhere to best practices and open standards.
www.oasis-open.org/home/index.php	Organization for the Advancement of Structured Information Standards (OASIS)	OASIS is a not-for-profit, global consortium that drives the development, convergence and adoption of e-business standards. Members themselves set the OASIS technical agenda, using a lightweight, open process expressly designed to promote industry consensus and unite disparate efforts. OASIS produces worldwide standards for security, Web services, XML conformance, business transactions, electronic publishing, topic maps and interoperability within and between marketplaces.
web.mit.edu/oki/	Open Knowledge Initiative	The Open Knowledge Initiative is defining open architectural specifications to support the development of educational software. Its architecture will provide a modular and extensible development platform for building both traditional and innovative educational applications while helping institutions leverage existing infrastructure. It is designed for broad adoption in the university setting, and aims to simplify the methods of assembly, delivery and access to educational technology resources, while creating a large collaborative community.
prometeus.org/	Promoting Multimedia access to Education and Training in European Society (PROMETEUS)	Amongst its activities, PROMETEUS aims 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), to foster the development of common European and international standards for digital multimedia learning content and services.
http://www.sakaiproject.org/index.php?option=com_frontpage&Itemid=1	SAKAI: Collaboration and learning environment for education	The Sakai Project is a community source software development effort to design, build and deploy a new Collaboration and Learning Environment (CLE) for higher education. The Sakai Project has its origins at the University of Michigan and Indiana University, where both universities independently began open source efforts to replicate and enhance the functionality of their existing CMSs. Soon after, MIT and Stanford joined in and, along with the Open Knowledge Initiative (OKI) and the uPortal consortium, and a generous grant from the Mellon Foundation, they formed the Sakai Project.
www.sifinfo.org	Schools Interoperability Framework	The Schools Interoperability Framework (SIF) is an industry initiative to develop an open specification for ensuring that K-12 instructional and administrative software applications work together more effectively. SIF is not a product, but rather an industry-supported technical blueprint for K-12 software that will enable diverse applications to interact and share data seamlessly, now and in the future.
www.sisostds.org	Simulation Interoperability Standards Organization	The Simulation Interoperability Standards Organization (SISO) originated over ten years ago with a small conference held April 26 and 27, 1989, called, "Interactive Networked Simulation for Training". The original conference attracted approximately 60 people. The group was concerned that there was activity occurring in networked simulation, but that it was occurring in isolation. The group believed that if there were a means to exchange information between companies and groups that the technology would advance more rapidly. The group also believed that once the technology begins to stabilize then there would also be a need for standardization. The technology and the consensus of the community would be captured in the standards as networking or simulation technology matured.
www.unece.org/cefact/	United Nations Centre for Trade Facilitation and Electronic Business	UN/CEFACT is the United Nations Centre for Trade Facilitation and Electronic Business. It deals with UN/EDIFACT and ebXML in its work.

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Web address	Organisation	About the organisation
www.w3.org	World Wide Web Consortium (W3C)	The World Wide Web Consortium (W3C) develops interoperable technologies (specifications, guidelines, software, and tools) to lead the Web to its full potential. W3C is a forum for information, commerce, communication, and collective understanding.
www.webdav.org	Web-based Distributed Authoring and Versioning	WebDAV.org is developing DAV, a specification for collaborative work over the Web. It has submitted its work to IETF for open standardisation.
xml.org	xml.org	XML.org provides XML information and XML schemas and is maintained by OASIS.

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Websites

Aptitude Media	http://www.apitudemedia.com
O.K.I.	http://www.okiproject.org
Apple Education	http://www.apple.com/education
eduSource Canada	http://www.edusource.ca
EtechGroup	http://www.etchgroup.com.au
Giunti Interactive Labs	http://www.giuntilabs.com
CORDRA	http://cordra.lsal.cmu.edu
HarvestRoad	http://www.harvestroad.com
IMS Global Learning Consortium	http://www.imsglobal.org
Institute for Working Futures	http://www.workingfutures.com.au
Institute of Electrical and Electronics Engineers (IEEE)	http://www.ieee.org/portal/site
Intelitec Pacific	http://intelitec.com.au
Joint Information Systems Committee (JISC)	http://www.jisc.ac.uk/
Mac Learning Environments	http://www.maclearningenvironments.org
The Knowledge Exchange	http://www.tke.com.au
TKE Testbed	http://www.marcbowles.com/tke/about.htm
Sakai	http://www.sakaiproject.org

Attachments

Attachment 1 Workflows report

[Attachment 1-Workflows.doc](#)