The Knowledge Exchange (TKE) Testbed
Workflows Analysis and Initial Findings

Internal Report to Research Partners
In Confidence 14 March 2005

Responsible Manager: Dr Marcus Bowles Director The Institute for Working Futures Pty. Ltd. (mbowles@workingfutures.com.au)

Technical Manager: Adam Maxwell, Director Aptitude Media (www.aptitudemedia.com, adam.maxwell@aptitudemedia.com)

Contents

Purpose

This is an internal briefing paper outlining outcomes from the initial research in the TKE Testbed from December 2004 up to March 2005.

Note: As this paper covers the worst of the acronyms and terms a short description and explanation section is added in the last section.

Context

One of the first research projects undertake in the testbed has concentrated on workflows associated with content assembly and/or conversion and authoring. The objectives that have been validated in the period to March 2005, include determining if it is possible to:

- Streamline assembly, authoring, creation, conversion, and loading of Microsoft Office developed files into SCORM compliant SCO able to be loaded onto LMS or The Web.
- Convert and repackage legacy content into SCORM and thence manage it on a LCMS /LOR;
- Automate the assembly and/or conversion, and authoring of content using agreed templates that meet compliance standards (i.e. SCORM/IMS QTI);
- Maximise multiple modes of delivery/publishing for content developed consistent with (a), (b) and (c) above
- Enable the assembly and/or conversion, and authoring of content and objects consistent with accessibility needs;
- Enable the assembly and/or conversion, and authoring of content for use across small screen devices;
- Take QTI Assessment development processes outside an LMS where assessment is embed within learning objects/resources/activities, and specifically ensure:
    - QTI assessments can be treated as any an ‘assessment object’;

  - Multiple (more than one) learning object/resource/activity can be tied to one or more QTI assessments and progress in learning made contingent upon successful assessment;
  - Can be imported into learning object/resource/activity
- Ensure QTI Assessments could be accessed on mobile devices connected to the Internet, browser or non-browser based;
- Establish link between knowledge (IP) value captured by an enterprises managing and reporting digital rights, and setting rules and requirements for learning objects/content being sourced and deployed off a single federate digital object repository.
- Integrate data reporting into the LMS with data reported to other enterprise applications (eg. Oracle/Peoplesoft, CRM, EHCMS, ERP, etc.)

The workflows also confirm the need for applications development in the three areas already advanced, including:

- The Redoit™ converter and packager (See later section);
- The QTI Creator™; and
- QTI Player™.

The workflows also confirm additional important developments may be required to fully evidence and exploit an integrated, end-to-end e-learning service embodied in The Knowledge Exchange. These are:

(1) A QTI Admin™ (R&D name only):

This is a proposed database development that will reside outside the LMS. The database development span across:

- E-commerce functionality and the 'service layer' of TKE;
- The QTI Creator™ front end to tie instruments to people and reporting outcomes; and
- The QTI Player™ where data is synchronised and reported into the database.

The database is also intended to capture and report data into enterprise applications, as well as LMS/CMS'. It would also have major advantages in that:

- It can move data on very secure networks/ systems;
- It will move data outside the overburdened internal enterprise networks;
- Data feeds can occur into other databases;
- Data can be linked to AVETMISS (as per discussions with VETTrak) reporting requirements; and
- The LMS does not have to be 'purchased' or reside within the enterprises architecture/firewall.

(2) A Vocabulary for LOM that deals with competencies/capabilities

This development is a suggested extension to the existing IEEE Learning Object Metadata (it has a corporate library extension and does permit additional libraries). As proposed this would mean all objects can be tied to not just learning metadata but to other frameworks such as performance, learning and compliance reporting. This reinforces existing work already done by Working Futures™ on capabilities and the Standards-Based Performance and Learning System (S-B PALS) and again with Intelitec Pacific and Unitas, on the S-B PALS derived Capability Mapping and Tracking (CMT) application.

As integrated reporting occurs it would be possible to actually source the relevant tags to ensure the HR systems capture competency, compliance and performance issues, the EHCMS report knowledge capital value, and the LMS the learning recognition. All the same content and data but, ultimately, packaged to an individual's learning or knowledge acquisition needs.

Content assembly and/or conversion, and authoring

The following workflows indicate the existing processes and then models the revised processes. Note that the major issue has been the ability of Working Futures™ client's to capture, convert or write content using standard Microsoft Office applications (especially MSWord® and PowerPoint®) and Macromedia applications (i.e. Flash® and Director®).

Of major concern was the costs and delays associated with using third parties to author, edit, approve, assemble and convert content. The costs associated with training staff to use LMS and CMS applications was time consuming and prohibitively expensive. In professional organisations many have opted to either outsource these activities or engage specialists to do this activity. It is common for experts to author in their usual applications (i.e. MSWord) and work closely with the technical and instructional design (ID) coordinators. As evidenced in the workflows it is possible to develop applications that centre the workflow with the expert and ensure they develop content consistent with e-learning standards and requirements. This does not however, suggest ID assistance or other help may not be sourced on an as required basis. It does however suggest significant efficiencies are introduced and very significant cost and time savings are resulting from the effectiveness of revised work flows.

Conversion, packaging and labelling (metadata)

This has been the area where findings with the most profound international importance have been made. Suffice to say in this document it looks possible to integrate:

- SCORM 2004;
- IMS packaging and sequencing;
- IMS QTI 2.0; and
- Potentially other organisational/industry-level vocabularies/fields.

As stated earlier the methodology adopted regarding LOM in the QTI Creator and Redoit packager will mean we can make a serious and, hopefully, successful effort to integrate SCORM and IMS content packaging and sequencing (see the later QTI Assessment R&D section). Image using an automated process to take Word and PowerPoint through to an integrated package, being sure all labelling meets multiple compliance requirements, and link data to enterprise/organisational-specific tags. We know we can already do this with an Macromedia or MS Explorer generated files. All this can accordingly be produced, edited, accessed, found, stored and therefore managed as an intellectual property (IP) asset off Hive. As use is tracked and capital value reported, so the value of the objects (IP) increases.

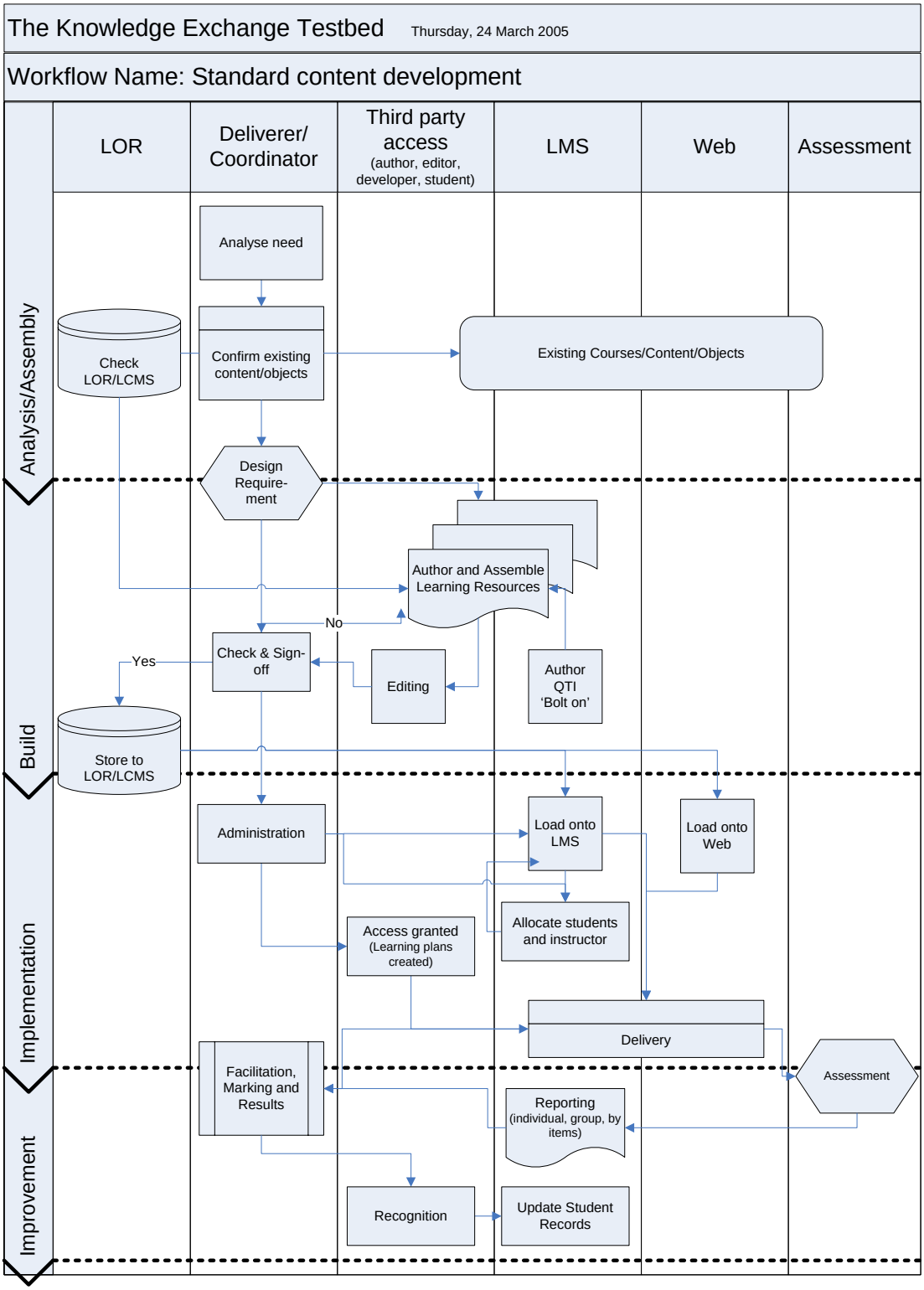
Content storage, assembly, publishing and management

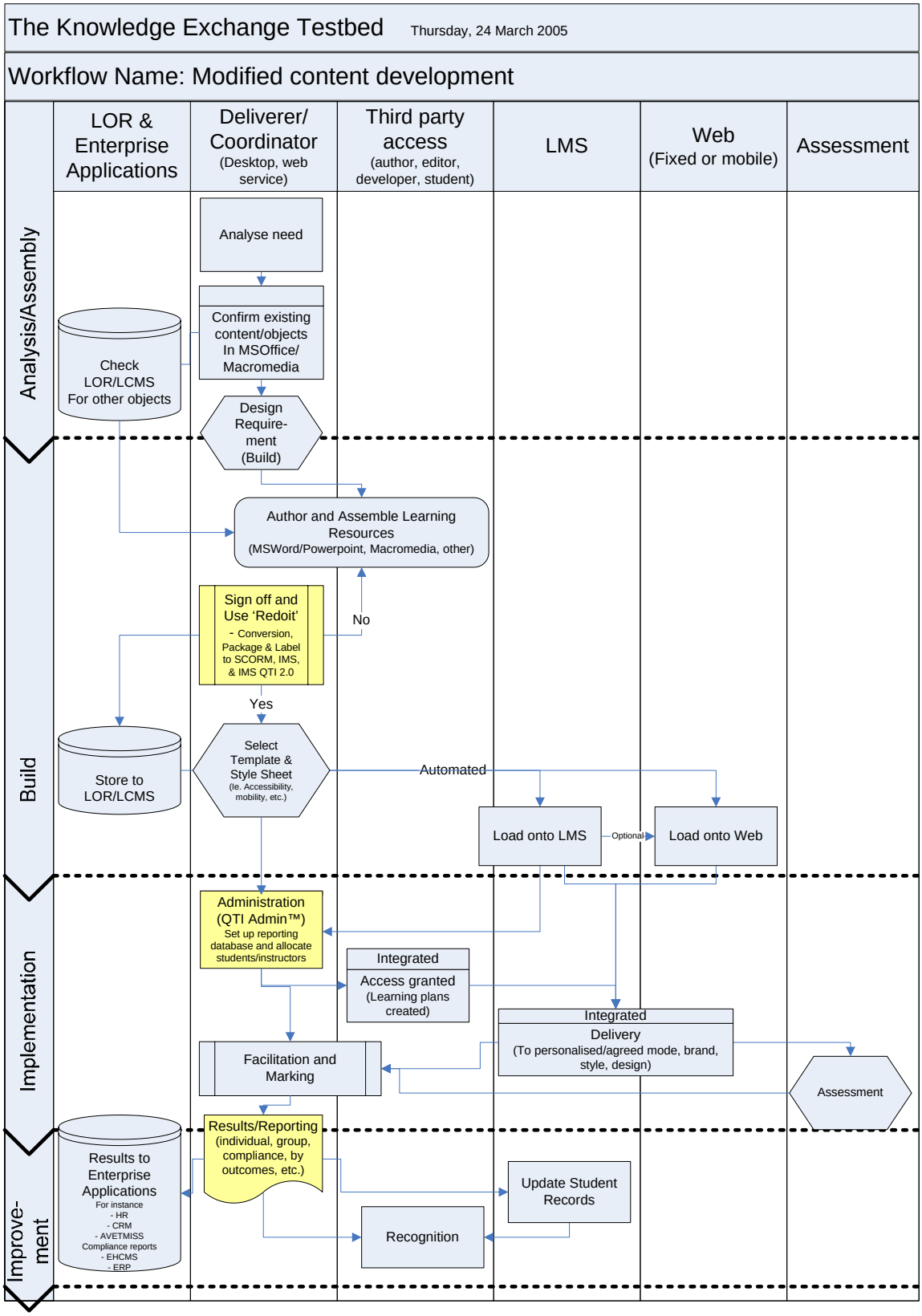
The workflows (both for content and QTI) confirm the ability to use repositories very early in the process. This suggests the use of the applications under development – especially the Redoit and QTI Creator – can quickly take existing content and place it into Hive as a SCO, or at very least for QTI as a QTI/IMS package.

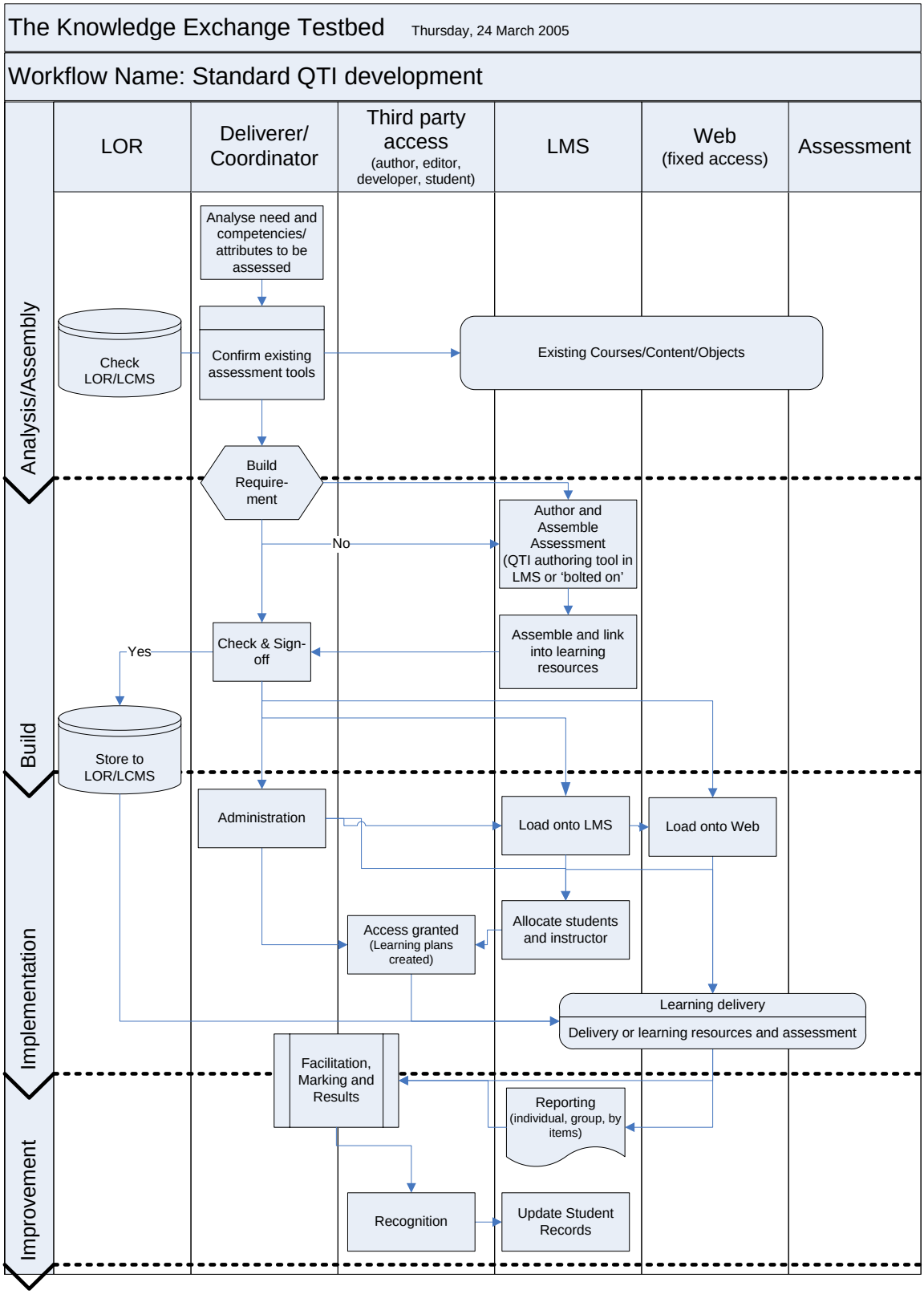
Trends to note

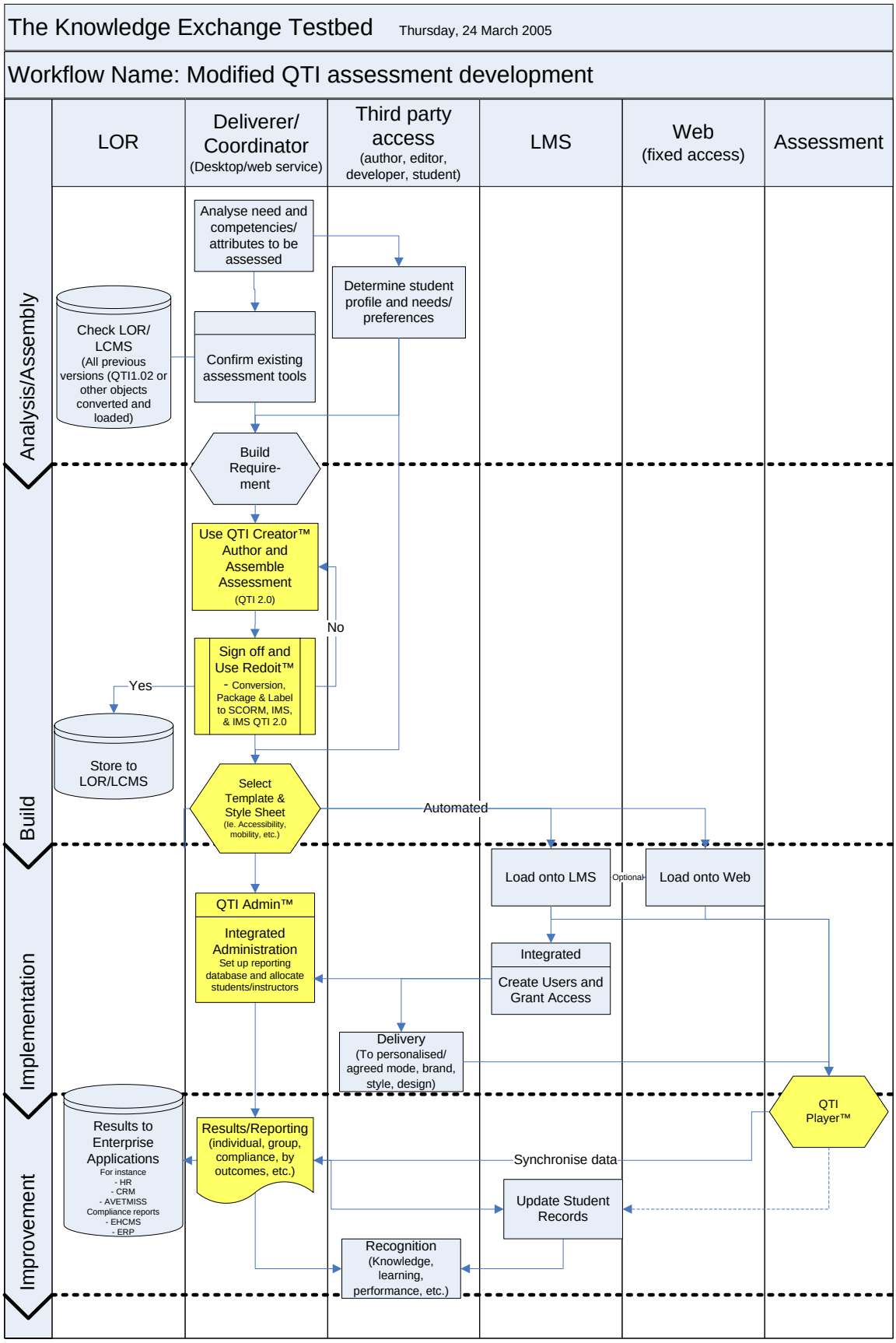
From our work it is possible to note some important underpinning trends:

- Options for value creation increase the less the LMS is involved;
- The data management can best be done at the overall ‘service layer’ level;
- We are seeing a ‘book end’ process with LOR at one end (knowledge an entity can control) and assessment at the other end (confirms knowledge transfer and utility);
- Development work in applications build is only intended to ‘prove the case’ but the QTI Admin or related database capability will need to be available to fully test all possible workflows and where value can be created; and
- 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 use (multiplier of reporting both human and knowledge capital value and reconfirming the increased value enterprise content has when tied a purpose).


The Knowledge Exchange Testbed
Thursday, 24 March 2005
Workflow Name: Standard content development
LOR
Deliverer/ Coordinator
Third party access (author, editor, developer, student)
LMS
Web
Assessment
Analysis/Assembly
Build
Implementation
Improvement
Analyse need
Check LOR/LCMS
Confirm existing content/objects
Existing Courses/Content/Objects
Design Require-ment
Author and Assemble Learning Resources
No
Yes
Check & Sign-off
Editing
Author QTI 'Bolt on'
Store to LOR/LCMS
Administration
Load onto LMS
Load onto Web
Access granted (Learning plans created)
Allocate students and instructor
Delivery
Facilitation, Marking and Results
Assessment
Reporting (individual, group, by items)
Recognition
Update Student Records

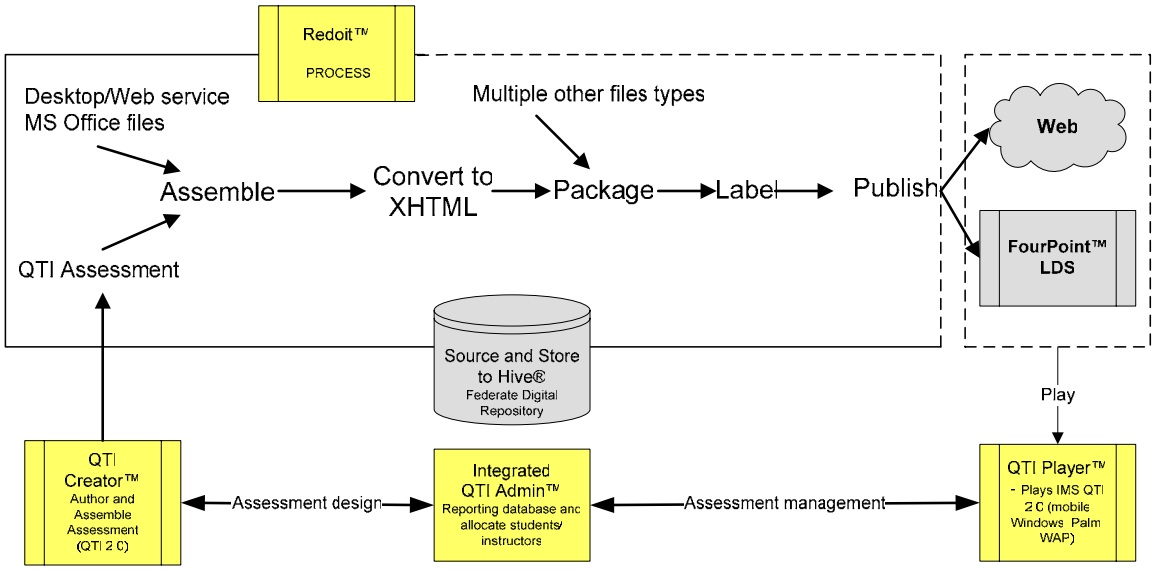

The Knowledge Exchange Testbed
Thursday, 24 March 2005
Workflow Name: Modified content development
LOR & Enterprise Applications
Deliverer/ Coordinator (Desktop, web service)
Third party access (author, editor, developer, student)
LMS
Web (Fixed or mobile)
Assessment
Analysis/Assembly
Build
Implementation
Improve-ment
Analyse need
Confirm existing content/objects In MSOffice/ Macromedia
Check LOR/LCMS For other objects
Design Require-ment (Build)
Author and Assemble Learning Resources (MSWord/Powerpoint, Macromedia, other)
Sign off and Use 'Redoit' - Conversion, Package & Label to SCORM, IMS, & IMS QTI 2.0
No
Yes
Store to LOR/LCMS
Select Template & Style Sheet (ie. Accessibility, mobility, etc.)
Automated
Load onto LMS
Optional
Load onto Web
Administration (QTI Admin™) Set up reporting database and allocate students/instructors
Integrated
Access granted (Learning plans created)
Integrated
Delivery (To personalised/agreed mode, brand, style, design)
Facilitation and Marking
Assessment
Results/Reporting (individual, group, compliance, by outcomes, etc.)
Results to Enterprise Applications
For instance
- HR
- CRM
- AVETMISS Compliance reports
- EHCMS
- ERP
Update Student Records
Recognition


The Knowledge Exchange Testbed
Thursday, 24 March 2005
Workflow Name: Standard QTI development
LOR
Deliverer/ Coordinator
Third party access (author, editor, developer, student)
LMS
Web (fixed access)
Assessment
Analysis/Assembly
Build
Implementation
Improvement
Analyse need and competencies/ attributes to be assessed
Check LOR/LCMS
Confirm existing assessment tools
Existing Courses/Content/Objects
Build Require-ment
No
Author and Assemble Assessment (QTI authoring tool in LMS or 'bolted on'
Assemble and link into learning resources
Check & Sign-off
Yes
Store to LOR/LCMS
Administration
Load onto LMS
Load onto Web
Access granted (Learning plans created)
Allocate students and instructor
Learning delivery
Delivery or learning resources and assessment
Facilitation, Marking and Results
Reporting (individual, group, by items)
Recognition
Update Student Records


The Knowledge Exchange Testbed
Thursday, 24 March 2005
Workflow Name: Modified QTI assessment development
LOR
Deliverer/ Coordinator (Desktop/web service)
Third party access (author, editor, developer, student)
LMS
Web (fixed access)
Assessment
Analysis/Assembly
Build
Implementation
Improvement
Analyse need and competencies/ attributes to be assessed
Determine student profile and needs/ preferences
Check LOR/ LCMS (All previous versions (QTI1.02 or other objects converted and loaded)
Confirm existing assessment tools
Build Require-ment
Use QTI Creator™ Author and Assemble Assessment (QTI 2.0)
No
Sign off and Use Redoit™ - Conversion, Package & Label to SCORM, IMS, & IMS QTI 2.0
Yes
Store to LOR/LCMS
Select Template & Style Sheet (Ie. Accessibility, mobility, etc.)
Automated
Load onto LMS
Optional
Load onto Web
QTI Admin™
Integrated Administration Set up reporting database and allocate students/instructors
Integrated
Create Users and Grant Access
Delivery (To personalised/ agreed mode, brand, style, design)
QTI Player™
Results to Enterprise Applications For instance - HR - CRM - AVETMISS Compliance reports - EHCMS - ERP
Results/Reporting (individual, group, compliance, by outcomes, etc.)
Synchronise data
Update Student Records
Recognition (Knowledge, learning, performance, etc.)

QTI Assessment Research and Development

The Redoit™ (R&D name) process is outlined below.



The Redoit™ process will bring together previously separate workflows (and expenses) relating to packaging QTI assessments and SCORM and IMS content packaging, labelling and sequencing specifications. The use of IEEE Learning Object Metadata (LOM) standards has advanced to such a point the Testbed partners can undertake development to ensure IMS, QTI and SCORM are integrated. This means we can maximise:

- Interoperability between LMS/CMS';
- Reuse of content on different LORs/LCMS';
- Interchange, assembly and disassembly of objects;
- Package and publish into templates and modes that can be changed to suite user needs (i.e. accessibility), mode of delivery (i.e. Mobile), location or deliverer (i.e. different branding), and pedagogies (i.e. adaptive approaches);
- Reporting across multiple applications and systems within an enterprise or across the learning supply chain;
- Recognition while removing the need to re-keying data relating to recording learning, knowledge, performance, compliance, and other HR or related requirements; and
- Value of intellectual property through labelling of all objects in a relationship to their use and knowledge capital value to the organisation.

Working Futures™ content development under trial

During the past three months TKE Testbed activity has centred on developing new courses or converting and updating content relating to the following courses and content.

Content	CSS/templates	Word to SCORM to LMS/Web*	Accessibility	Mobility	QTI integration*
Diploma of Business (Frontline Management) (BSB51004)	✓	✓	✓	✓	✓
Diploma of Training and Assessment (TAA50104)	✓	✓	(✓)	(✓)	✓
Graduate Certificate of Management					
• Transformational Leadership	✓	✓			✓
• E-commerce	✓	✓		✓	✓
• Knowledge Management and HRD	✓	✓			✓
• Building the High Performance Organisation	✓	✓			✓
Graduate Certificate of Education					
• Learning & technology	✓	✓	✓	✓	✓
• VET quality and policy	✓	✓	✓		✓
• Assessment	✓	✓	✓		✓
• Work based learning	✓	✓	✓		✓
Cert III in Multimedia (CUF30601)			✓	✓	✓
Short course in e-business/e-tailing (WRRO11A-14A)	✓	✓	✓	✓	✓

** Ongoing work. To be retested with Redoit™ and QTI Creator™ when available in late March 2005.*

Acronyms, terms and other matters

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

QTI is the **Q**uestion and **T**est **I**nteroperability specification developed by **IMS** Global Learning Consortium, an international, industry sponsored project. QTI described how tests and their results can be described in XML. QTI version 2 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 (e**X**tensible **M**arkup **L**anguage). IEEE has a key role in setting international standards for electro and information technologies and sciences.

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

IMS Simple Sequencing is a specification 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.

SCORM is the **S**hareable **C**ontent **O**bject **R**eference **M**odel. SCORM was developed under the **A**dvanced **D**istributed **L**earning (**ADL**) initiative, a joint academic and Department of Defence initiative chartered to address a late 1990's 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 **S**harable **C**ontent **O**bject (**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.
- QTI assessment instruments (assessment objects) can be designed, developed and managed in relation with SCORM thus maximising their reuse, accessibility, discoverability, durability and interoperability (including across multiple enterprise applications such as LMS').
- Most importantly, all data reported from assessment can be managed 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 no compromise security, commercial and privacy concerns. Additionally there is no need for the LMS to actually reside inside the enterprises' own network. Data can be interchanged in XML from the

mobile devise 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 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 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