e-Learning standards
and technical specifications

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Internet has enabled a proliferation of customised and timely educational tools that improve the dissemination of knowledge. e-Learning solutions facilitate these processes by making it possible to provide the right knowledge and skills to the right people at the right time. e-Learning is changing the way organisations organize and manage training and education. Large investments are now being made in e-Learning, IT technology, e-Learning applications and e-Learning content. Lately, e-Learning standards have been brought into the spotlight. But what are these “standards,” and what do they mean to the people designing and implementing e-Learning initiatives? Today, it may seem confusing, but in the future, this work should give e-Learning the flexibility we take for granted in other applications and systems. e-Learning standards are the vehicle that will bring flexibility to contents and infrastructures. They open the door for more sensible and coherent ways to package learning content and resources for learners, educators and developers alike.

Standards often feel remote and abstract, yet they have impact on our lives every day. For the Internet, the common standards of TCP/IP, HTTP and HTML are essential and well known to most people. Electricity, telephones, cars and traffic systems are all examples of other systems based on standards that we now tend to ignore but these systems would not work without them. However, we freely accept this situation in our e-Learning solutions. Content prepared for one system cannot be transferred easily, if at all, to another. If a company licenses a third-party library, they find that the content is not only made for a specific delivery system but also is dependent upon a specific interface requiring its own log-on and other requirements. Little wonder that e-Learning activities remain more fragmented and less convenient than they should be.

This text will attempt to provide an overview of the various initiatives on e-Learning standards and their inter-relationship. You have already met three acronyms above. You will meet more. The e-Learning standards world seems to be full of them.

**Standards vs. specifications**

Strictly speaking, there are NO e-Learning standards. Not yet, at least. Instead, there are several groups developing specifications. A specifications group is an organization with common interests and purposes that works to develop protocols (agreements) which can be supported by the community.

In e-Learning, the Instructional Management System (IMS) Metadata committee is one such specification group. This group has been clarifying issues such as the metadata tagging of e-Learning content, mandatory fields and the communication of such information. Once the specifications group compiles its work, it submits the proposed protocols to an official sanctioning body for standardisation. This is similar to the process used in drafting then ratifying a law. Once the bulk of the work has completed the committee stage, a formal legislative body must make it official. This may seem like a messy and inefficient process, but remember that the key to successful specifications is acceptance. If no one uses your specification, it has failed. A specifications group should therefore be viewed as an intelligent input system as well as a consensus-building vehicle. This stage of
specification development vs. standardisation describes current progress in the process of e-Learning standard definition.

Once created, standards have subtle points of distinction. They may be de facto or formal. They have varying operational application levels, sections and subsections. Their circulation and use differ. A first distinction lies in de facto, as opposed to formal, standards. De facto means that the specifications have been widely adopted before they are officially standardized. For example, the Aviation Industry Computer Based Training Committee (AICC) developed a system whereby a learning management system (LMS) could run a course and receive tracking and scoring information for CBT courseware. For years it was the best and only approach available. Today, this approach acts as a de facto standard for these functions, but it is not really suitable for web-based learning systems. The Lingua Franca of e-Learning standards – XML, eXtended Markup Language, itself a de facto technology standard – is gaining wide acceptance in Web-based applications as a means by which platforms can share information. It will be the single most relevant standard in e-Learning and it is the best way to maintain the value of corporate learning content in the medium or long term. XML acts at a lower technical level. XML is to e-Learning specifications what language is to vocabulary. XML enables communication but does not guarantee that communication will actually occur. There is wide variation in the terms and phrases used by different industries and in the way that different industries seek to organize their content. Unless common categories and terms are adopted, it will be difficult to aggregate content from different sources. XML gives us a way to create and maintain structured documents in plain text that can be rendered in a variety of different ways. A primary objective of XML is to separate content from presentation.

The advantages of a standard

There are four major advantages of standard development and use:

1. Durability – no need for modification as versions of system software change.
2. Interoperability – operability across a wide variety of hardware, operating systems, web browsers and Learning Management Systems.
3. Accessibility – indexing and tracking on demand.
4. Reusability – possible modification and use by many different development tools.

For systems to interoperate they need to understand the data structures they share. Without a standardized specification each “data supplier” or “tools developer” would expect others to conform to its own data structure. This would be like each town using its own proprietary road signs, or each web site requiring a different web browser, or trying to speak English in China.

Convergence between different initiatives

Everyone will benefit directly or indirectly from having a standard. These specifications open new learning markets for e-Learning. Publishers can sell well-proven learning packages - Purchase the best learning material from content producers - Good items can be sold, exchanged and traded - Helping us to deliver good and fair assessments - Items and assessment can be authored in one
system and delivered via another - Customers can choose the “best of breed”. Development-literate software will interoperate with complementary systems. The market will start to demand e-Learning standard-compatible systems as content publishers release new content. The distinction between “Authoring”, “Delivery” and “Reporting” systems allows for focus and specialization.

**E-Learning standards initiatives**

So what about the different initiatives? There are several acronyms (be warned!), organizations, and initiatives. How do they differ? Are there similarities? Even a degree of convergence? There are three major American initiatives with well-known names whose purposes and differences may be less obvious.

1. **AICC** - The Aviation Industry CBT Committee was originally designed to standardize instructional material for aircraft manufacturers and buyers. AICC covers the way in which content units (learning objects) communicate with learning content management and LMS.

2. **IMS** - The Instructional Management System has been working as a group for four years. The oldest section covers metadata tagging i.e. the tagging and identification of content. Other specifications include enterprise, content packaging, user profiles and question and test. The IMS Metadata specification may soon have the distinction of being the world’s first official e-Learning standard since it has also been included in the IEEE and ISO standardization process.

3. **SCORM** - The Shareable Courseware Object Reference Model is a standard developed by the United States Department of Defense. More details about these three initiatives and others will be given later.

There is some overlap between the work of these different groups. However, in June 2000, leaders from all of these groups met and agreed to begin to reconcile their differences and areas of conflict. At a second meeting in September 2000 in Sedona, Arizona, USA, all of the above organizations plus IEEE met and agreed to pool their efforts. In December 2000 IMS released a Public Draft of its Content Packaging specification version 1.1, which the Advanced Distributed Learning Co-Laboratory (ADL Co-Lab) will include in its next version of the Shareable Content Object Reference Model (SCORM). The Content Packaging Public Draft contains several changes that were suggested by ADL participants in the IMS Working Group. IMS and ADL are also collaborating with representatives from IEEE and ARIADNE to harmonize SCORM and IMS Meta-data with the IEEE 1484.12.1 Learning Objects Metadata 1.0 standard as it approaches the formal approval stage.

**A closer look at various initiatives**

**IMS**

In 1997, the IMS Project, part of the non-profitmaking EDUCOM consortium (now EDUCAUSE) consisting of US institutions of higher education and their vendor partners, joined forces to develop open, market-based standards for online learning, including specifications for learning content meta-
data. While IMS began with a focus on American higher education, specifications published to date as well as ongoing projects address requirements in a wide range of learning contexts including, of course, K-12 schools and corporate and government training. Today the IMS Global Learning Consortium, Inc. (IMS) is developing and promoting open specifications with a view to 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 acts to promote the widespread use of specifications that will allow distributed learning environments and content from multiple authors to work together, to interoperate.

The IMS organisation now consists of a staff servicing the different workgroups. It is based in Burlington, Massachusetts, USA. IMS represents a number of large and small educational institutions, training organisations and software vendors who are interested in incorporating e-Learning resource meta-data into their software products. IMS conducted a survey of these institutions and organisations to determine which meta-data elements from the IEEE LOM Base Document were more fundamental than others. IMS then adopted a Core set of meta-data elements chosen from the survey responses gathered from the IMS community in the U.S., Australia, Asia and Europe. Several countries have set up IMS Centres to gain input from local users. Local IMS Centres can be found in the UK, Singapore and Australia. In January 2001, IMS Europe was launched as a special branch within IMS. It is currently focusing on language issues and mobile learning, aka m-Learning.

So-called Contributing Members may participate in the workgroup jointly involved in different parts of the IMS standard. LUVIT is an IMS Contributing member. The contributing members of IMS include academic, corporate, non-profitmaking and government organisations.

The standard is open and everyone can use it. The different parts of the standard can be downloaded from the IMS organization homepage (http://www.imsglobal.org). The specifications are free for everyone to use and do not include any accreditation or compliance processes.

The IMS standard is defined by a number of DTD’s (Document Type Definition) or Schemas. These DTD’s or Schemas describe the mandatory and optional elements in an XML file. The XML file is validated against the DTD file to check that the file complies with the standard. Data is also stored in the XML file and can be imported by other, IMS-compliant applications. The XML file is the implementation of the DTD. The IMS standard only covers data structures and ignores anything related to design etc. IMS promises that future versions of the standard will be backward compatible which means that the standard can already be implemented without risk.

The IMS standard consists currently of the following subparts: **Meta-data** (the core elements of Learning material) **Content and Packaging** (packaging of courses or parts of courses), **Question&Tests** (quizzes), **Profiles** (different users of the material) and **Enterprise** (which covers personal data and group management, and is a part which will merge with Profiles). All these components are interlinked through a **Metadata** specification. There are emerging groups working on e-commerce as well as skills profiles, digital repositories and m-learning.
ADL/SCORM

Advanced Distributed Learning, ADL, is a program created by the US Department of Defense and the White House Office of Science and Technology to develop the guidelines needed for widescale development and implementation of efficient and effective distributed learning. It is a forum which provides the mandatory input for the IMS specification process. ADL uses IMS specifications. ADL’s Sharable Courseware Object Reference Model (SCORM 1.1) is the current result of their work.

The SCORM reference model comprises three major elements:

 Metadata - Mapping and the recommended usage of IEEE LTSC metadata elements for the defined SCORM categories. SCORM refers to the IMS 1.0 Meta-data specification when describing the IEEE LOM elements in XML, thus SCORM and IMS Content Packaging are in agreement on the encoding of metadata.

 Runtime Environment - A definition of a runtime environment that includes a specific launch protocol to run executable Web-based content, a common content-LMS API and a data model defining the data that is exchanged between an LMS environment and executable content at runtime. The IMS Content Packaging specification does not explicitly address the requirements of a runtime environment, but fully supports the description and interchange of content that implement SCORM runtime features.

 Course Structure Format - An XML-based representation of a course structure that can be used to define all of the course elements, structure and external references required to move a course from one LMS environment to another. The SCORM Course Structure Format (CSF) and IMS Content Packaging Specification overlap significantly and this is currently an area of convergence and harmonization which will be completed when the next version of SCORM is released.

 ADL is also scheduled to provide, in the very near future, a SCORM Version 1.1 Conformance Test Suite, enabling organizations to perform self-testing on Learning Management Systems, Sharable Content Objects, Content Structure Format XML documents and SCORM Meta-data XML documents. The Test Suite Version 1.1 will help organizations to test and determine their compliance with SCORM Version 1.1. ADL also provides XML DTDs and Schemas, as well as compliance tests.

AICC

The Aviation Industry CBT Committee (AICC) develops technical specifications for the management of computer-based training (CBT) course modules within the aviation training community. The AICC guidelines apply to a traditional type of computer-managed instruction (CMI) representing one instance of the many learning models supported by the IMS specifications. The IMS specifications also extend beyond the AICC model by addressing security and the integration of management systems into larger corporate learning environments. IMS is working with tool vendors who have announced AICC support to ensure that content complying with the AICC specification will operate on a server complying with the IMS specifications. (However, it is possible that IMS-compliant content will not necessarily run on an AICC-compliant server.) The AICC specifications
cover nine major areas, including CMI Systems (aka LMS), Assignable Units (aka learning objects) and CBT Courses (aka learning tracks or program). The term "AICC Compliant" means that a training product complies with one or more of the nine AICC Guidelines and Recommendations (AGRs). Since there are nine different AGRs, the broad claim of AICC compliance needs further clarification.

Other initiatives

ARIADNE
Alliance of Remote Instructional Authoring & Distribution Network for Europe, ARIADNE. This is a European Union project focusing on the development of tools and methodologies for the production, management and re-utilization of computer-based teaching material and telematics-supported training curricula. The project has now ended but it lives on within the ARIADNE Foundation which is involved in related work on technical specifications, most notably in the area of meta-data. As part of a memorandum of understanding, ARIADNE and IMS have jointly developed a meta-data specification (the IMS Learning Resources Meta-data Specification) for submission to IEEE. ARIADNE operates mainly within the higher education area within Europe.

CEN/ISSS
European Committee for Standardization/ Information Society Standardization System (CEN/ ISSS). CEN is an international association formally recognised by the European Community, which manages cooperation amongst the national standards bodies of the 15 EU states and the countries of Iceland, Norway, Switzerland and the Czech Republic. ISSS was formed to focus specifically on "Information Society" standardization requirements and has established a number of open workshops. IMS is a participant in the CEN/ ISSS Workshop on Metadata for Multimedia Information. In addition, IMS is involved in work on a Memorandum of Understanding with CEN/ ISSS and other organisations to build consensus for educational technology, thereby improving access to lifelong learning across Europe.

Dublin Core
The Dublin Core group has established a widely accepted technical specification for meta-data for the content of digital libraries. Originally designed for author-generated descriptions of Web resources, it has attracted the attention of formal resource description communities such as museums, libraries, government agencies and commercial organizations so that they, too, can find the electronic resources they need. The work within the Dublin Core group has influenced the work within IEEE. Moreover, the IMS Learning Resources Meta-data Specification incorporates major aspects of the Dublin Core by defining extensions that are appropriate specifically for educational and training materials. DCMI's activities include consensus-driven working groups, global workshops, conferences, standards liaison and educational work to promote widespread acceptance of metadata standards and practices.
IEEE  
Institute of Electrical and Electronics Engineers (IEEE). IEEE is highly influential in many areas and the acronym is generally well known. Several of the e-Learning standards initiatives are also collaborating and/ or have the same people involved in both. The work within IEEE is also influenced by the work in the various initiatives. IMS specifications may be utilised by the IEEE to foster the development of ANSI or ISO standards, which will increase international consensus and recognition. The IEEE LTSC has also recently initiated the move of this work to the full International Standards Organization (ISO) standards by establishing ISO Joint Technical Committee 1 (JTC1) Sub Committee 36 (SC36) on Learning Technology. IEEE 1484 is the major standard on Learning Management Systems and learning material. Its main sectors of interest are Learner-related, content-related, data and metadata as well as management systems and applications.

ISO  
The International Standardizations Organization, ISO, is also well known. Within ISO it is JTC1 (Joint Technical Committee 1) which is concerned with the relevant e-Learning issues. JTC1 is a joint committee of ISO and IEC, the International Electrotechnical Commission. JTC1 focuses on information technology standardization. Within JTC1, SC36 (Sub-Committee 36) is collaborating with several standards and specification development organizations, such as IEEE LTSC, CEN/ISSS/ LT-WS, AICC, ARIADNE, IMS, PROMETEUS and ADL SCORM. SC36 will be extending its collaboration with other international, regional and national organizations, such as DCMI (Dublin Core Metadata Initiative) and W3C (World Wide Web Consortium).

LRN  
LRN 2.0 (Learning Resource iNterchange 2.0) is a Microsoft initiative, designed to create SCORM and IMS compatible online learning content. Similar in many ways to SCORM, LRN 2.0 has adopted the IMS Content Packaging format and prescribes a format for browser toolbars and tables of contents. This can be useful where a company wants to present a consistent look when using content from multiple vendors but currently requires Microsoft Internet Explorer 5.01 or higher. Microsoft Corporation is providing the Learning Resource iNterchange (LRN) Toolkit free of charge.

PROMETEUS  
PROMETEUS: PROMoting Multimedia Access to Education and Training in EUropean Society is another example of the application and integration of the IEEE LTSC. The learning standards based on the European PROMETEUS projects are part of the 5th frame EU programme. Looking to apply not only the IEEE LTSC standards, the various PROMTEUS Special Interest Groups (SIGs) work to integrate these into the Europe context and cultures. The major issues the project tries to address are reusability and interoperability, metadata for learning content, quality compatible with ISO 9000, legal issues (intellectual property rights, privacy, liability, accreditation), multilingualism, multiculturalism and accessibility issues.
W3C
The World Wide Web Consortium (W3C) establishes specifications for the web. It is responsible for specifications such as HTML, XML and RDF (Resource Description Framework). It is not accredited but its specifications constitute industry standards. W3C creates specifications at a lower level than IMS. For example, all e-Learning uses XML as a language for representing meta-data, profiles and other structured information. The XML-based standard is still emerging.

Conclusion
The world of e-Learning standards and specifications may seem inhospitable at first sight. However, upon closer inspection, ways through it become visible. The first question most people ask is why there are so many initiatives and organisations. They then wonder how these initiatives and organisations relate to each other.

The first question is not easy to answer, but some tentative explanations can be given. First of all, learning is very much culture-based. Secondly, there are differences between the American and European ways of doing standardization work. The American way is often more market-driven and pluralistic, while the European way is often based on governmental work within the European Union or is instigated by institutions. Thirdly, there are many ways of doing this and until the widespread use of XML, there was no common language. We will therefore most likely see a convergence between the different initiatives. Indeed, such convergence has already become apparent. The specifications for several of these standards are complete enough to allow for use at this juncture. This is demonstrated by the growing use of these specifications by many of the consortiums and alliances including ADL, IMS and PROMETEUS.

What can you do as a buyer of e-Learning services? Find out enough about learning-related standards to enable you to ask vendors and partners the following questions. What level of involvement do they have with the various standards activities? Are they members of these working groups? What have they contributed? What are their plans (if any) for the use of, and compliance with, accredited standards and specifications as and when they emerge?

What can you do as an e-Learning service provider? Find out enough about the different initiatives to enable you to choose your specific area of work. It is not an easy task to implement e-Learning specifications in products or content, but it will certainly be necessary in the future. Currently the collaboration between IMS, ADL-SCORM and LRN makes this combination very promising for the future but the puzzle is not yet complete. On the other hand, nobody has ever claimed that the world is a complete entity, with no room for change or improvement.
Figure 1. The different e-Learning initiatives and their relationships. The lower square to the left contains American initiatives while the upper square contains European projects. The rectangle to the right indicates “more” international initiatives.