ECP 2007 EDU 417008

ASPECT

Report on the Advantages and Issues Associated with the Large-Scale Implementation of Selected Standards

Deliverable number	*D5.5*
Dissemination level	*Public*
Delivery date	*March 2011*
Status	*Final*
Author(s)	*Lars Ingesman,*
Internal reviewers	*Jim Ayre (EUN), Ingo Dahn (KOB), Elena Shulman (EUN), David Massart (EUN)*

e*Content*plus

This project is funded under the *e*Content*plus* programme[1],
a multiannual Community programme to make digital content in Europe more accessible, usable and exploitable.

[1] OJ L 79, 24.3.2005, p. 1.

Summary

The aim of deliverable D5.5 is to report on the work related to the implementation of standards and specifications carried out by content providers as part of the ASPECT project. The aim of this deliverable, however, is not simply to detail what was done during the project; its primary goal is to report on experiences and issues as they relate to standards and specifications recommended by work packages 2 and 3, as well as issues related to standardization as such and the large-scale implementation of standards and specifications.

The main part of the report covers a number of standards and specifications around which ASPECT partners have aimed to develop best practices and the issues raised by content providers trying to implement these standards and specifications. Key specifications covered are OAI-PMH, IEEE LOM, ADL SCORM, IMS Common Cartridge, IMS LODE ILOX and IMS QTI. The LRE Metadata Application Profile version 4.X (http://lre.eun.org/node/6) is also discussed as a profile of IMS LODE ILOX.

As this report will make clear, potential benefits or functionalities of a given specification or standard are not the only factors to consider. A series of other factors play important roles, such as: costs; organizational issues; different needs of end users; the maturity of the standard in question and the level of support required from experts; and documentation and validation services.

For organizations that start the process from scratch, being able to implement a selection of best-practice guidelines and standards may be of enormous benefit. A number of organizations, however, are in a very different situation in that they already have a more or less well-developed system and changing components in these systems can be costly. Many organizations wishing to implement ASPECT best practices, therefore, will most likely need to simultaneously change many aspects of their systems. They will be faced with changing how they evaluate and select specifications as well as the way they proceed with evaluating and selecting – and perhaps even developing – new tools to work with those specifications. The processes for developing and providing training and support to users and in setting up new workflows will also be subject to changes. In such circumstances, organizations will inevitably have to establish new workflows.

Available tools present another set of issues. A number of tools are not compliant with the specifications in question. This is particularly the case in connection with new specifications such as the IMS Common Cartridge specification. Tool compliance is uneven even for old specifications like ADL SCORM. Other tools do not provide the functionality required by content producers. The availability of standards compliant tools and validation tools, therefore, are serious issues in connection with emerging standards.

Finally, a number of content providers also see it as an issue that some specifications include profiles of other specifications that cover only parts of the original specification. This is the case in connection with the IMS Common Cartridge specification that includes a profile of the QTI 1.2 specification that is restricted to a subset of the full QTI specification.

As this deliverable makes clear, the ASPECT project, by gathering valuable input from both content providers and experts involved in standardization bodies, has functioned as a mechanism to expose and resolve some previously unidentified problem areas.

Contents

1 Introduction

ASPECT is a Best Practice Network that aims to improve the adoption of learning technology standards and specifications in two important areas. One is the area of content use where we have been working with key specifications relating to *content packaging and use*. The other area is related to what has been termed *content discovery* or *search and retrieval*. Specifications in this area relate primarily to metadata and harvesting.

The aim of deliverable D5.5 is to provide a report on work related to the implementation of standards and specifications carried out by the content providers as part of the ASPECT project. This deliverable does not simply detail work done in the course of the project. Rather, we aim to report on the experiences and issues we see in relation to the standards and specifications recommended by work packages 2 and 3. This report is also intended to describe issues surrounding standardization as such and large-scale implementation of standards and specifications.

Content providers in ASPECT come from both the private and public sectors and each organisation has its own specific context and business model. Given such a spectrum, their experiences and views will naturally differ to some extent. These differences are also important issues to take into consideration in any discussions about standards and standardization across a range of organizations and a large number of countries.

In the deliverable we try to present the experiences, or the 'lessons learned', as well as a number of key issues that we see in relation to the implementation and use of standards and specifications. Findings and experiences described in this deliverable are based primarily on a number of reports written by content providers at the end of the project and on various status reports provided throughout the project.

2 Content discovery: specifications and standards

Specifications and standards in relation to content discovery are one key issue in ASPECT. In this connection we are primarily concerned with the following specifications:

- OAI-PMH
- IEEE LOM and IMS LODE ILOX
- Others: ZTHES, SKOS, IMS VDEX

2.1 OAI-PMH

OAI-PMH, which stands for the *Open Archives Initiative Protocol for Metadata Harvesting*, is a key specification in that all content providers have implemented it in order to establish their connection to the *Learning Resource Exchange* (LRE) from European Schoolnet.

Harvesting based on the OAI-PMH specification was recommended by WP2 as a best practice for supporting a harvesting-based federation of repositories. The reason for preferring harvesting instead of federated search (for example using the *Simple Query Interface* - SQI) is that harvesting is a more robust approach to federated discovery than federated searching.

There are a number of advantages to OAI-PMH: it is a reasonably straightforward specification to read and understand and implementation of the protocol is facilitated by the availability of freely available libraries for a number of different development environments and programming languages. A number of the content providers already had a working OAI-PMH connection to the LRE before the start of the ASPECT project, whereas others needed to implement the LRE connection from scratch or update their existing connections.

One of the organizations that implemented an OAI-PMH connection from scratch despite the fact that they had an existing LRE connection (based on *SQI*) was the University of Ljubljana (UL). After undertaking the process they have no hesitation in recommending harvesting with the OAI-PMH specification as a best practice for connecting repositories:

> We are not really experienced in this area but we find this protocol simple and efficient and therefore we are recommending it as a best practice to connect your repositories.[2]

Their description of the implementation process illustrates why they recommend this protocol as a best practice:

> We chose a PHP platform on an Apache Web server to act as a harvesting target together with a MySQL database to store metadata records (popular LAMP platform). At first we studied the official protocol documentation and found out that everything was very clear and easy to understand, since the protocol was very simple. We also found the guidelines at http://www.openarchives.org/OAI/2.0/guidelines.htm extremely helpful. We found that one PHP implementation of the protocol was in existence but it lacked documentation. On the other hand, there was plenty of existing documentation for Java

[2] University of Ljubljana: from an intermediate report sent by email on 08/12-2009

developers, since most of the existing software was Java-based. Most work was then put into binding the server with the database, especially creating a database schema to fully support the needed functions (sets, times, resumption tokens, different metadata formats).

Both quotes are from an intermediate report sent by mail on 08/12-2009. The relative ease of implementation described by UL is corroborated by the experiences of other content providers.

We have had no reports about specific problems or issues in connection with the actual implementation of an OAI-PMH target.

2.1.1 Conclusions

From a content provider standpoint, the advantages of the OAI-PMH specification are that:

- The specification is simple to read and understand;
- There are freely available libraries for a number of different development environments and programming languages that make the implementation of the protocol reasonably easy.

2.2 Metadata specifications – IEEE LOM, IMS LODE ILOX, and the LRE Metadata Application Profile

The Learning Resource Exchange (LRE) is an infrastructure that federates repositories of learning content for schools in Europe. As such, the LRE provided an ideal tool to test and validate best practices related to specifications for content discovery and ASPECT content providers were asked to connect their repositories to the LRE.

At the beginning of the ASPECT project, LRE content was described using the LRE Metadata Application Profile version 3 (LREMAPv3), a profile of the *IEEE Learning Object Metadata* (LOM) specification. However, LOM is not well suited to describing packaged content and particularly does not allow for describing a learning resource available in more than one format (e.g., SCORM and Common Cartridge), two major requirements for ASPECT. Developed as part of the IMS Learning Object Discovery and Exchange (LODE) specification, the Information for Learning Object eXchange (ILOX) data model was created to address these issues[3]. In ASPECT, a 4th version of the LRE Metadata Application Profile (LREMAPv4) was produced by combining ILOX with IEEE LOM. The LRE was then upgraded to support this new version of the LREMAP. An ASPECT transformer service was also developed to automate the migration of metadata from the LREMAPv3 to the LREMAPv4 format and integrated with the LRE harvesting infrastructure. The LREMAPv4 was presented to content providers at a WP5 workshop in Munich in May 2009 where they were asked to use it to expose their learning resources.

[3] ASPECT is the main contributor of IMS LODE working group where it leads the development of the IMS LODE specification. The latter implements most of the project findings in the field of learning content discovery and exchange.

The reactions to the new profile were rather mixed. One concern came from the fact that all content providers, even the ones already connected to the LRE, had to support the new metadata profile. However, this step was absolutely necessary in order to allow them to expose learning resources available in multiple formats. In the meantime, thanks to the integration of the transformer service to the LRE infrastructure, no legacy metadata was lost.

There was also some unease because, at first sight, the LREMAPv4 appeared rather complex and difficult to understand. However, after having implemented export mechanisms to extract and convert metadata from their 'internal' metadata formats to the new profile, a number of content providers came to see how the LRE profile and the underlying ILOX specification could solve some of their own known problems with different versions, formats, licenses and locations for the same learning resource.

2.2.1 Understanding and implementation

WP5 partners have rather different views as to the understanding and implementation of the IMS LODE ILOX and IEEE LOM specifications and their profiling in the LREMAPv4. Some content providers felt that the profile was easy to implement and that the documentation provided at the beginning of the project was sufficient. Others felt that this documentation was sufficient, but complex.

On the whole, however, the content providers apparently found it relatively easy to implement the ILOX wrapper around their existing LOM export format. Moreover, thanks to the feedback received from these early adopters (i.e., the ASPECT content providers), it was possible to greatly improve the following versions of the text[4].

There are some general issues in connection with the adoption of the LRE Metadata Application Profile that are worthwhile mentioning because they reflect common problems faced by those attempting to map from one application profile to another. With each content provider serving a different community, we can expect some divergence in the controlled vocabularies they may use for educational metadata elements. For example, CNDP uses a French profile of the IEEE LOM specification along with customized controlled vocabularies. AS CNDP commented:

> The main problem we were facing was the creation of crosswalks between our controlled vocabularies and the LRE ones. Some recommended elements of the LRE profile are not used by the CNDP one and some vocabulary terms used by CNDP have no obvious equivalent in the LRE vocabularies. As a result, some information was lost during the conversion.

Another issue emerged about documentation as the LRE profile evolved in response to feedback and testing. As the Open University (OU) developer noted:

> LRE profile updates mean we have to go over everything again to make sure the decisions made earlier are still correct. It would be very helpful if they could provide a change log so we don't have to go through this again!

There was also some frustration expressed by the OU regarding the small differences in notation between specifications that draw on LOM metadata:

[4] The current version of the LRE Metadata Application Profile is available at http://lre.eun.org/node/6.

> In doing so I was reminded about the subtly different ways in which various IMS specifications have used LOM: IMS CC, CP and SCORM all treat fixed vocabulary fields slightly differently, they all define the language used differently, and they all have different upper/lower case conventions for vocabulary values. So where I ought to have a single simple function that outputs a LOM <metadata> string, it is instead full of switches to work out how to handle all the variations, making it much harder to get right.

These are perhaps small issues, but nevertheless they complicate implementation of standards and specifications. As our OU developer also observed: "Consistency would be nice!"

2.2.2 Views on the specification

As mentioned earlier, some content providers do see positive elements in the combination of IEEE LOM and IMS LODE ILOX in the new LRE metadata application profile. CNDP, for instance, reported:

> It was very rich to discover and study the possibilities offered by the LODE ILOX model. The model can respond to some information management problems we face. For example, we could see in the LREv.4 how ILOX allows for the organization of multiple metadata records and descriptions of multiple technical formats in one metadata record.

FWU also saw a lot of potential in the new IMS LODE ILOX specification:

> The ILOX data model might be even more useful in future for some "traditional" problems in describing different technical formats of resources. FWU productions, especially audiovisual media, are provided to the users in different formats like "wmv" or "flv". Looking at our product portfolio, similar descriptive problems occur concerning offline and online instances (DVDs vs. "Web DVDs") Both EAF[5] and LOM do not provide an elegant way of using only one description for productions that differ in their technical representation, but are identical in their intellectual content.

2.2.3 Conclusions

According to the ASPECT content providers, by combining IMS LODE ILOX with IEEE LOM, the LREMAPv4 offers a number of advantages. As a metadata container, ILOX effectively addresses some of the information management problems content providers face such as how to handle packaged content, different technical formats and versions of the same resource. Their major complaint was that, as beta testers of a specification under development, they had to deal with documentation that was incomplete and evolving.

2.3 Other specifications: ZTHES, SKOS, VDEX

ZTHES describes an abstract model for representing and searching thesauri, though it may be used for other types of vocabularies. It is represented as an xml format. In the ASPECT project it was used by CNDP as an exchange format to import some vocabularies into the Lexaurus editor in order to better visualize the structure and content of the vocabularies.

SKOS is the *Simple Knowledge Organization System*, an RDF vocabulary for representing semi-formal knowledge organization systems (KOSs), such as thesauri, taxonomies,

[5] EAF stands for Extended Exchange Format and is a metadata specification that has been developed by the German states and a large number of media centres.

classification schemes and subject heading lists. These representations are machine-readable and can be exchanged between software applications and published in the Linked Data Cloud. CNDP analysed this vocabulary and the model to transform its vocabularies and prepare them for a semantic web use.

The VDEX specification is being implemented by KlasCement as part of their cooperation with Dutch partners.

2.3.1 Conclusions:

Although these specifications are fine for encoding and exchanging simple vocabularies (no ASPECT content providers reported or commented on particular issues in connection with these specifications), the work that European Schoolnet did with the Vocabulary Management Group for importing the LRE thesaurus into the Vocabulary Bank of Education (VBE), showed that none of these three specifications is suitable to encode a full-fledged, multi-lingual thesaurus structured with micro-thesauri.

2.4 General issues concerning metadata standards

When discussing specifications and standardization across borders and organizations, it is important to remember that enhancements in the descriptive potential of metadata, discoverability of resources and interoperability are not the only things that matter for the uptake of a specific standard or specification. There are other factors such as; costs; organizational issues; different needs of end users; the maturity of the specification in question and the required level of support from experts; and documentation and validation services.

For organizations that start the process from scratch, being able to implement a selection of best-practice guidelines and standards may be of enormous benefit. As DGIDC notes in their report on the situation in Portugal:

> Coming relatively late to the creation a national educational repository has its drawbacks but it also has its definite advantages. One of the advantages was the coincidence of the start of the ASPECT with the beginning of the development of the repository of the Schools Portal. This made things so much easier, namely the adoption of the standards that were recommended in the project and the support we received as partners in the project.

Instead of having to go through a costly process of examining a number of different standards and specifications, DGIDC has been able to short-circuit the process and rely on the recommendations of experts involved in the ASPECT project.

Others, however, were in very different circumstances. As CNDP reports, there are clear advantages in using the new IMS LODE ILOX as a container for IEEE LOM, but also huge costs involved in its implementation. So although, as they recognized, the specification held out significant promise to improve the management of metadata:

> Nevertheless, the implementation of the whole model in our information system needs a *huge effort*, first because the CNDP needs to *change its development technologies* to

> handle this kind of model and second because, behind the technologies, there are *users* and it is necessary to apply a strategy to *support and train these users*.[6]

As is clear from these comments, there are many issues to consider. Improved functionality is not the only factor involved in best practices for the adoption of standards. CNDP needs to rethink and change its development technologies. They and others have also noted a need to set up a strategy for supporting and training users. As CNDP noted:

> Standards can be appropriate to use but sometimes it is complicated to implement them in a real-life system, where experts are needed to implement and where end-users need to be trained and supported.

The report from FWU comes to a similar conclusion:

> Implementation of specific features like metadata or packaging standards will always be part of a larger process of innovation. A central lesson to keep in mind is that an implementation will not succeed if it is not prepared with a clear view of its use and is not supported by workflows embedding it.

Apart from costs and different needs, there are also issues such as the maturity of a given standard. As we saw earlier, the OU developer had some problems with a profile in evolution. The more mature a specification is the more support one can get, in terms of access to experts, up-to-date and correct documentation, validation tools etc.

2.4.1 Conclusions

There are a number of issues to take into consideration when discussing metadata standards and their uptake:

- Benefits are not the only thing that matters for the uptake of a specific standard or specification.
- Organizational issues relating to workflow, tools and training and support of users may in many cases be equal to or even more important than benefits.
- There may be very different needs based on the business model of each individual organization and its specific area of content.
- Most organizations prefer standards that are reasonably stable and have reached a certain level of maturity.

3 Content use: specifications and standards

Specifications and standards in relation to content use are the second key issue in ASPECT. In this connection we are primarily concerned with the following specifications:

- ADL SCORM
- IMS Common Cartridge
- IMS QTI

[6] Author's emphasis.

3.1 SCORM and IMS Common Cartridge

SCORM and IMS Common Cartridge are two rather different content packaging standards. SCORM has been around for a number of years and is a relatively accepted and, in certain areas, widely used packaging standard. IMS Common Cartridge, on the other hand, is a 'newcomer' and is suggested as a relevant specification for packaged content in educational environments where blended learning is more relevant than self-paced individualized learning. The differences between the two are significant. As Ingo Dahn from the University of Koblenz describes it in a short note, "Common Cartridge is not SCORM":

> Common Cartridge targets a usage different from that of SCORM: While SCORM mainly addresses computer-based training, where a learner is learning on her own interacting with a computer, Common Cartridge addresses blended learning scenarios where a teacher (or a community) plans a course.[7]

For these reasons, in the ASPECT project, we have focused almost exclusively on the IMS Common Cartridge specification. This focus allows us, on the one hand, to obtain feedback from content providers on the technical issues around Common Cartridge. On the other hand, we have also been able to receive feedback from teachers in designated pilot schools on the usability of Common Cartridge packaged content in a school environment.

3.2 SCORM

Although we have, as mentioned above, focused on the Common Cartridge specification, a number of content providers have worked with SCORM and this has provided an opportunity to carry on a number of discussions on the uses of SCORM. Most of the work was done in connection with the conversion task required by deliverable "D5.2 A critical mass of content (at least 200 SCORM packages in Mathematics, Science and Technology) to which the Common Cartridge specification have been applied."

As part of this process, we used a conversion utility SCORM2CC developed by ASPECT partner Icodeon on behalf of Microsoft and provided through the Microsoft CodePlex open source hosting. This utility re-packages the resources of a SCORM zip-file as a Common Cartridge zip-file, removing or disabling whatever SCORM-specific functionality the original package contained.

3.2.1 Issues: complexity and non-compliance

In the process of developing the conversion utility, most of the content providers involved also had a close look at the SCORM specification as well as at validation tools and different SCORM players. We observed how different SCORM-packaging tools created somewhat different, and not always valid, SCORM packages. This inconsistency in SCORM packages also undermined the functionality of the conversion utility.

Variability in the way the SCORM specification was implemented by different tools resulted in a number of problems. Yet another issue that emerged from this work was that some

[7] Ingo Dahn, "Common Cartridge is not SCORM", available from the ASPECT website, http://www.aspect-project.org/sites/default/files/Common%20Cartridge%20is%20not%20SCORM.pdf

systems do not support all features of complex specifications such as SCORM. For example, Moodle supports SCORM 2004, but not the features of sequencing and navigation.[8]

One conclusion to draw from this may be that the complexity of the SCORM specification is one of the greatest issues when talking about standardization and general acceptance. If a specification is difficult to implement, different tools providers may very well end up implementing slightly different versions of the specification – and no one will actually reap the benefits of working with an accepted standard.

However, reducing complexity in most cases also means reducing power, as can be seen from the Common Cartridge discussion below. One way of coming to terms with this issue can be the introduction of stricter conformance testing for tools.

The attempt to achieve simplicity and clarity is perhaps one of the most important driving forces behind the Common Cartridge specification. As we shall see later, this may lead to other problems from the point of view of developers and content providers.

It is noteworthy that few of our content providers actually use SCORM-specific functionality such as sequencing, navigation and LMS interaction. Most use the SCORM specification as a form of IMS Content Packaging. As FWU explains in their report:

> As a result of the service described above, the user will be provided with a SCORM zip-file. Concerning our current needs, it would have been sufficient to create "IMS Content Packages" instead of SCORM packages, as only the structure and its elements need to be described and organized, but not specific SCORM elements.

All the OpenLearn SCORM packages are really just IMS Content Packages although they are presented as SCORM packages and rendered by the Icodeon SCORM player when they are accessed through the ASPECT portal.

There may be various reasons for this. One explanation, as mentioned by some project partners, is that creating SCORM-packaged learning resources utilizing some of the advanced features of SCORM requires a great deal of work both in the design and the development phase. Another reason may be that the tools available are not user-friendly enough to allow instructional designers to easily create packages that use these features. And last, but not least, we have found that large-scale implementation with different output formats is neither easy nor not cost effective when dealing with highly tailored learning resources.

3.2.2 Views on SCORM content packaging

A number of ASPECT content providers have strong views concerning the use of packaged content. In some cases these views are based on learning theory and the learning models adopted by the content provider. The views are primarily related to SCORM and its history.

As expressed by ANSAS (formerly Indire), content packaging – and here they are primarily thinking of SCORM in its traditional form, i.e., a highly-structured, self-paced and often controlled approach to learning – does not match their socio-constructivist view of learning:

> A special consideration is made about content packaging. Given our e-learning model…, we have never used SCORM for our courses. In an article of ANSAS former Director, Dr. Giovanni Biondi, Chair of European Schoolnet, titled "La dittatura dei Learning

[8] According to the online Moodle documentation: http://docs.moodle.org/en/SCORM

> Object" (*translation:*. The dictatorship of Learning Objects), the author says that the SCORM model refers to a model of "transmissive", passive way of learning, made by pre-determined paths where content is central, not the learner. […]

Seen from this point of view, SCORM is a packaged format with a built-in pedagogical viewpoint where the focus is on instruction and design of instruction rather than learning and learning processes. Instructional design is very much concerned with breaking up and presenting information according to the views of the designer. In many cases its focus is on individualized learning, based on highly structured information presentation, rather than on – more than information processing. If the special features of SCORM are used, such as navigation and sequencing, the learning designer is seen as attempting to control the learner and the learning process. In terms of learning theory there is, on the whole, a bias towards behaviorist theories in such approaches.

If you are 'training' highly motivated people in specific skills, this can be a very effective approach, particularly if the individual receiving the training is able to contextualize and process the information provided in relation to previous experiences. In this case, higher-level learning is allowed to take place.

SCORM has some benefits in terms of interoperability: if you are using an LMS and SCORM packages that support tracking of the individual learner, SCORM provides a 'standardized' approach to passing information from learning application to the LMS and back. This is a huge benefit – but only if you actually use and value those features.

If you do not use an LMS and the SCORM-specific features, the only advantage is in the ease of distribution. This may not be that much of an advantage though, as you need to incorporate a SCORM player in your environment, and complex packages may be rather slow and require a lot of bandwidth.

3.2.3 Conclusions

According to the ASPECT content providers, the issues and advantages in relation to SCORM are:

- Many tools produce non-compliant SCORM packages.
- A number of tools only implement parts of the SCORM specifications.
- Few content providers use SCORM-specific functionality such as sequencing and navigation.
- SCORM packages provide benefits if users rely on presentations and tracking by means of an LMS.
- To many people SCORM is still closely associated with individualized, self-paced learning based on behaviorist instructional design principles.

3.3 IMS Common Cartridge

As mentioned above, the major part of our work on content use has been focused on IMS Common Cartridge. Because this was also a new specification for most of the content providers involved in the project, many were particularly interested in exploring the possibilities and restrictions of that format.

3.3.1 Understanding and implementation

The vast majority of content providers were involved in some work with the Common Cartridge format. Some have implemented only minor packages as part of their preparation for the teachers' summer school piloting. Others included – or examined – large-scale implementations of the specification as part of their ordinary workflow.

The general view is that the Common Cartridge specification is an interesting specification. There are a number of reasons for this interest. First, there are simple tools available to help developers get started. Second, it is easy to create packages using these tools. Finally, validation tools such as the IMS Online Validator service are available.

The ease of implementation is illustrated by Educatio, which is one of the organizations that decided to use the Common Cartridge format as one of the possible formats supported by their Sulinet portal:

> As a part of ASPECT project we implemented the Common Cartridge standard that gave us the opportunity to publish our content in a way that we did not offer before to our users. The development of this service ensures that schools will be able to use the SDT content in their own learning content management systems. The implementation of Common Cartridge was an easy process and we did not meet serious problems.

The general impression is that, with the Common Cartridge Builder, a drag and drop tool developed and provided for free by *Learning Components, Inc*[9], and a simple 10-15-page tutorial, anyone can create a Common Cartridge package without any great technical skills. Thanks to the ease of implementation, one can rapidly develop a script-based and automated packaging process for larger numbers of resources.

3.3.2 Views and issues

Tools issues

As the IMS Common Cartridge is a relatively new specification, there are a number of issues. The key issue according to Global Grid for Learning (GGfL) centers on the availability of tools:

> The most significant lesson learned by Global Grid for Learning throughout ASPECT is that there is currently a significant shortage of authoring tools on the market that are standards' compliant.
>
> We have found that there are many tools that claim to be standards' compliant which are not fully compliant, or that are not compliant with the most current version of the standard.

GGfL sees the lack of standards' compliant tools as the most serious issue at the moment. To achieve complete compliance with the specification, GGfL had to carry on a great deal of manual editing of XML files generated by various tools.

Another problem noted by GGfL is that available tools lack required features:

> We have found that many of the authoring tools that have achieved standards' conformance are not yet capable of creating the quality of content that we require as publishers. AContent/ATutor, for example, is one of only two Common Cartridge

[9] Download address: https://www.learningcomponents.com/download.php

> authoring tools currently listed as conformant by the IMS (the full list is here: http://www.imsglobal.org/cc/statuschart.html). It does not yet have the capacity to incorporate images, which is an intrinsic part of our quiz content.

Restrictions built into the specification

Another issue raised by GGfL is the limitations placed on, for example, LOM and QTI within the Common Cartridge specification:

> We found that the limitations placed on the use of supplementary standards (such as LOM and QTI) within the Common Cartridge specification made the standard more difficult to use. Specifically:
>
> - Only six of the question types specified in QTI 1.2 are available in Common Cartridge
> - Most of the fields specified in LOM are disallowed in Common Cartridge

These restrictions were inexplicable from GGfL's point of view and they:

> Found that the restrictions increased the time and effort required to create fully conformant content as our workflows were originally designed around meeting the full specification requirements, not a subset.

So, although IMS added these restrictions in order to achieve a higher degree of simplicity in the Common Cartridge specification, to some this actually adds to the complexity of the internal workflows.

The same approach to achieve simplicity and thus a higher degree of acceptance and compliance is also an issue for Young Digital Planet (YDP), whose highly interactive learning resources require a tailored player and LMS/backend system. YDP finds it difficult to produce Common Cartridges that match the type and quality of the learning resources they currently produce.

Large-scale implementation

The right balance between simplicity and restrictions was also of concern for those working on large-scale implementations. The Open University has developed a complex workflow that allows them to provide their courses in a number of different output formats such as HTML, PDF, SCORM (IMS Content Packaging), Moodle backup, and Common Cartridge. The costs involved in large-scale production put restrictions on the features that can be used in the learning resources:

> There is no individual work required to generate the export formats and no extra effort in authoring beyond that targeted at the OpenLearn website itself. This is the only way in which it is possible for us to generate the wide range of export formats that we make available across all our existing content and anything we plan to release in future.
>
> Because this workflow matches standard course production, there is no additional cost in supporting OpenLearn content creation. However, the XML and automatic export creation approach lack flexibility to individually tune output either for a specific unit or perhaps within a specific export format.

Although it is a somewhat different issue, because it involves large-scale implementation of a particular specification and not the functionality of the specification as such, the results are the same: learning resources are simplified and standardized to reduce production costs.

Relevance of content packaging

Another key issue for a number of our content providers is that they do not consider content packaging relevant – to their users, to their view of learning, for the resources they provide, and the distribution models they have chosen so far.

Although some content providers recognize that IMS Common Cartridge is an 'improvement' over SCORM, the views relating to SCORM-packaged content continues to color their attitude towards the Common Cartridge format. As expressed by ANSAS:

> Certainly, in our view, the Common Cartridge standard is more adequate to the education world compared to the SCORM one, but it still does not correspond to our socio-constructivist view.

Others share these views. The perception persists that packaged content is somehow more 'closed' and not quite relevant to their model of learning and distribution:

> SCORM is a widely disseminated standard when it comes to packaged content. It is clearly useful for organizations that espouse a structured, behaviorist transmission of knowledge, from teacher or trainer to student or trainee.
>
> Common Cartridge originates from a different approach to learning and teaching and is thus closer to a constructivist view of education as a whole.
>
> These two standards may be useful for enterprises that want their content to be "sealed". However, for a Ministry of Education such as the Portuguese one, what seems to make sense is to open content available on its portal to everyone who may, in one way or another, benefit from its use.[10]

Distribution

Non-adoption of or lack of interest in content packaging is not just a question of learning models. Some see it primarily as a question of the distribution mechanism selected:

> Currently, the French ENT's (VLEs) do not deal with packaged content. The content packaging standards are not very well known in the school context. The content provided by public institutions is available on the institutions' websites.

In cases when content providers offer access to their learning resources from a website as web pages, packaging content does not add any value – neither for the content provider nor the user. Value is added only if users want to – and the content providers will allow them to – integrate a copy of that content in lessons delivered by means of a 'local' LMS. If that is the case, i.e., if you are distributing complex learning resources to the local environment of the user, packaged formats provide some 'ease of distribution'. For example, it is much easier and faster to import a Common Cartridge package into one's Moodle system than importing

[10] DGIDC, from the "Report on content Packaging. The point of view of content providers", https://docs.google.com/Doc?docid=0AYLgVgqFWn46ZGhyYmI4a3JfNGRzbWZkcTVn&hl=en

perhaps two hundred individual resources into the LMS or having to import and set up a complex structure of resources on your web-platform.

Supporting systems

Another barrier to Common Cartridge packaged content is the need for a special player or runtime environment if one does not have an LMS/portal that supports the format. The KlasCement portal has an integrated SCORM player, but still needs a Common Cartridge player:

> At the moment we have not yet managed to implement a real Common Cartridge-player on our portal. Since the SCORM-player is already a success, we hope a (free) CC-player will become available soon.[11]

3.3.3 Conclusions

According to the ASPECT content providers, the issues and advantages in relation to Common Cartridge are:

- The specification is relatively easy to understand.
- It is relatively easy to create a script-based packaging process.
- Currently there are too few tools that produce fully compliant Common Cartridge packages.
- There is one simple drag-n-drop tool that is free and easy to use.
- Tools do not support all Common Cartridge functionalities.
- There is a freely available online validator for testing cartridges.
- The Common Cartridge specification imposes restrictions on LOM and QTI used as part of a Common Cartridge package.
- The user needs a Common Cartridge compliant LMS or environment in order to run packages.

3.4 IMS Question & Test Interoperability Specification

The *IMS Question & Test Interoperability Specification* (QTI) has been recommended as a key specification for those content providers that integrate questions and question banks in their Common Cartridge learning resources.

On the whole, rather few content providers have shown much interest in QTI, but two in particular, Global Grid for Learning and Young Digital Planet, have been looking very carefully at QTI and the Common Cartridge 'integration' of the QTI specification.

Currently, the IMS Global Learning Consortium is working on a revision and update of the QTI specification, moving it to a version 2.1. However, the current Common Cartridge specification (version 1.0) uses a subset of version 1.2, which, in the opinion of some, is an obsolete version of QTI. Global Grid for Learning also voiced concerns, similar to those

[11] Ibid.

noted above, regarding the limitations placed on QTI (and LOM) within the Common Cartridge specification.

> We found that the limitations placed on the use of supplementary standards (such as LOM and QTI) within the Common Cartridge specification made the standard more difficult to use. Specifically: Only six of the question types specified in QTI 1.2 are available in Common Cartridge…

3.4.1 Issues

These limitations impacted workflows and raised costs. According to GGfL, restrictions have

> Increased the time and effort required to create fully conformant content as our workflows were originally designed around meeting the full specification requirements, not a subset.

Tools are another serious problem also noted earlier by GGfL:

> We have found that there are many tools that claim to be standards' compliant which are not fully compliant, or that are not compliant with the most current version of the standard. This is especially true of QTI, as many tools have been built to cater to QTI 2.0 and QTI 2.1, both of which have been retracted by the IMS in favor of QTI 1.2.

Apart from the compliance issue mentioned here, illustrated in the long list of tools and their shortcomings presented in the GGfL report, there is also another concern. In the IMS consortium there was some disagreement as to the status of the specification:

> In early 2009, the IMS Global Learning Consortium withdrew QTI 2.1, stating that "Adequate feedback on the specification has not been received, and therefore, the specification has been put back into the IMS project group process for further work." The most recent version of QTI that is fully endorsed by IMS GLC is v1.2.1.[12]

To developers and organizations interested in implementing standards, it is vital that organizations involved in developing specifications and trying to further standardization can be sure of stability for whatever specification they develop.

Young Digital Planet (YDP), another of the commercial content developers and providers in the ASPECT project, has looked closer at the functionality and use of QTI in Common Cartridge packages. Their main concern and issue is one of functionality:

> They [interactive exercises] can be described only by means of the obsolete QTI 1.2.1 data format (constrained even further by the CC specification), …so the content producer has really limited possibilities with regard to the choice of exercises and the way they are presented to the student. In fact – despite the CC specification claims that it can handle 6 exercise types – they are just two distinct exercise types to choose: multiple choice (in 3 simple variants) and fill-in-blanks. And even these two types have important limitations that limit their use to only really simple cases.[13]

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[12] From Wikipedia article: "QTI", http://en.wikipedia.org/wiki/QTI, accessed on November 19, 2010.

[13] Jaroslaw Dziedzic, "Conversion of the YDP learning content to Common Cartridge packages", paper prepared for the Se@m 2010 conference, June 15, 2010. See http://CEUR-WS.org/Vol-681/paper08.pdf.

After having looked closely at the specification and converted a number of their existing resources to Common Cartridge packages, YDP comes to the conclusion that the gain in simplicity was made at the expense of quality.

3.4.2 Conclusions

According to the ASPECT content providers, the issues and advantages in relation to the IMS QTI specification are:

- The specification is fairly complex.
- There are few tools that are fully compliant with the specification.
- There are two partly competing versions of the specification: 1.2, which is used in the Common Cartridge specification, and 2.x, which is currently being developed.
- There are restrictions as to how questions can be presented. Some content providers want a better integration of questions, exercises and actual content presentation.

4 Conclusion

This deliverable provides a summary the key experiences of content providers involved in the ASPECT project. It also details a number of issues they have seen in terms of large-scale implementations of a number of the standards and specifications recommended by ASPECT work packages two and three.

Although most of the standards and specifications recommended for use in the project have been favorably received by the content providers and have been considered interesting in terms of possible future developments, the general impression is that there are a number of conditions that need to be met before content providers in Europe can agree on a set of common standards.

The main conditions that have been identified are:

- The availability and quality of tools for producing compliant content and metadata;
- The availability and quality of tools to test for compliance;
- The availability of solutions adapted to the different needs of the different categories of content providers;
- Benefits of standardization are not adequate on their own. Organizations need to consider the needs of their customers or end-users, training and support, availability and costs of tools, workflow issues, etc.

By bringing together a wide spectrum of content providers and expert involved in standardization bodies, ASPECT has provided a collaborative forum to evaluate tools and standards. Their positive and negative experiences both serve to provide valuable insights to inform best practice guidelines for future development and implementation of content standards and specifications in Europe.

Appendix A: Nomenclature

ADL	Advanced Distributed Learning
ENT	Environnement Numérique de Travail
IEEE	Institute of Electrical and Electronics Engineers
ILOX	Information for Learning Object eXchange
IMS	IMS Global Learning Consortium Inc.
LMS	Learning Management System
LODE	Learning Object Discovery & Exchange
LOM	Learning Object Metadata
LRE	Learning Resource Exchange
OAI-PMH	Open Archives Initiative – Protocol for Metadata Harvesting
PDF	Portable Document Format
QTI	Question and Test Interoperability
SCORM	Sharable Content Object Reference Model
SKOS	Simple Knowledge Organisation Systems
SQI	Simple Query Interface
VDEX	Vocabulary Definition Exchange
VLE	Virtual Learning Environment
Zthes	Zthes specifications for thesaurus representation, access and navigation