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ASPECT

Final Evaluation Report

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Summary

This document contains the final evaluation report of the ASPECT project. It provides recommendations reflecting the experience of partners in the ASPECT Best Practice Network.

Contents

Introduction

This is the final evaluation report of the ASPECT Best Practice Network. Work package 7 continuously monitored the project and provided suggestions for improvements.

The report documents four facets of the evaluation of the project work carried out by work package 7:

1. The first facet comprises an internal evaluation of the project, which includes an analysis of the success indicators for the project as a whole and a detailed examination of the first four work packages.
2. The second facet examines the feedback from three categories of project stakeholders:
    a. Content providers (Work Package 5),
    b. Teachers (Work Package 6), and
    c. Policy makers.
3. Recommendations stemming from the ASPECT project's experience make up the third facet.
4. The fourth facet documents an experiment to test whether benefits' management techniques are applicable for projects such as ASPECT.

1 Approach and methodology

Evaluation consisted of three main phases: In the design of the evaluation, all stakeholders in the project have been involved in creating and evaluating objectives. The result of this phase is documented in *evaluation plan D7.1*. The evaluations of the first 15 months of the project were reported in the first evaluation report D7.3.1.

In this final evaluation report, we continue the work of D7.3.1 – the main aim is to monitor the project success, to follow up on suggestions for improvements made in D7.3.1 and to provide recommendations and lessons learned from the project.

The approach and methodology of this evaluation report was first described in depth in D7.3.1.

For the purpose of this evaluation, quantitative and qualitative methods are combined and utilised as a complementary design. The purpose of combining qualitative and quantitative methods is to use the results from one method to elaborate, enhance, or illustrate the results from the other.

Data collection

ASPECT data collection was done in several phases, using a variety of methods.

The data concerning the awareness and feedback of the consortium as well as on the dissemination impact was collected using both quantitative and – for most aspects – qualitative methods linked to ASPECT partner workshops and meetings. For the events evaluation, we designed a survey questionnaire divided into two parts. The first part was composed of structured questions and the second open questions. For the second period in the project, 6 events were surveyed: 3 Dissemination workshops (Lisbon, Paris and London), 1 Summer School (Lisbon) and two consortium meetings (Lisbon & Ljubljana). During these events, all participants were asked to complete the evaluation form provided. The same form was used to systematically collect data at all events.

Quantitative data was also collected during three workshops for teachers involving practitioners from Belgium (Flemish community), Lithuania, Portugal and Romania. The teacher trials are explained in more depth in ASPECT Deliverables D6.4 and D6.5. Highlights of the results from these school pilot trials are presented in Section 3.2 of this document.

This set of data was complemented by a (qualitative) case study approach. This involved interviews with content providers and policy makers. The first interviews took place during the ASPECT content providers' workshop in Munich in May 2009. Additional content providers were interviewed using video conferencing, so that all interviews were recorded. A second round of content provider interviews was carried out during the Ljubljana consortium meeting in September 2010. Further feedback to complement these interviews was also requested later by email. Work package 7 also interviewed most of the Ministries of Education involved in the project. These interviews were carried out from August to November 2010.

2 Internal Evaluation

2.1 Success Indicators

Table 1: ASPECT success indicators.

Indicators	Year 1 *(expected)*	Year 2 *(expected)*	Year 3 *(expected)*	May 09	Nov. 09	Jun. 10	Apr. 11
1. Translations of metadata	1 000	2 000	2 000	15 000	641 571	641 571	641 571
2. Additional learning objects from Europe and rest of world	5000	15 000	20 000	8 000	19 463	20 092	37 952
3. Additional learning assets from Europe and rest of world	10 000	40 000	50 000	12 000	69 324	71 212	91 507
4. Number of vocabularies in the vocabulary bank (a translation is counted as a separate vocabulary)	200	250	260	42	185	380	694
5. Number of participants at ASPECT technical events, codebashes and plugfests (including technical webinars)	50	100	100	24	42	75 (63 +12 web)	265 (75 + 190 web)
6. Number of participants at workshops and conferences (including webinars)	50	200	200	26	56	155 (155 + 0 web)	925 (886 +39 web)
7. Number of unique	1000	5000	6000	3 146	1 829	6 720	13 664

users of ASPECT web site							
8. Number of references to ASPECT activities and deliverables	*50*	*200*	*500*	*38*	*95*	*285*	*724*
9. Number of external European experts, professionals, policy makers joining / actively supporting the BPN	*50*	*100*	*150*	*12*	*34*	*71*	*197*
9. bis Number of external European experts, professionals, policy makers visiting the LTSO website	*not mentioned*	*not mentioned*	*not mentioned*	*/*	*541 108*	*969 214*	*1 502893*
10. Number of CEN Workshop Agreements (subject to approval by the CEN/ISSS WSLT)	*1*	*2*	*2*	*0*	*1*	*1*	*3*
11. Number of IMS GLC specifications (subject to approval by the IMS TAB)	*0*	*0*	*1*	*0*	*0*	*0*	*1*
12. Number of ENs submitted to TC353	*0*	*1*	*2*	*0*	*0*	*0*	*2*
13. Number of contributions (i.e., articles, presentations) to relevant conferences and events	*30*	*45*	*60*	*38*	*95*	*133*	*143*

14. Number of high-quality, scientific papers accepted for leading, internationally recognised conferences or journals	*0*	*3*	*4*	*1*	*3*	*6*	*10*
15. Number of newsletters	*1*	*3*	*6*	*0*	*1*	*2*	*6*
16. Number of new national portals connected to the LRE	*0*	*1*	*2*	*0*	*0*	*1*	*2*

As shown in Table 1, as far as success indicators are concerned, the project met all its objectives and in most areas has exceeded the original success targets.

Some of the indicators and their significance are self-explanatory (e.g., indicator 15: number of newsletters). Others require some elaboration.

Indicator 1: Translation of metadata. While the original success indicator called for 2000 translations, the final indicator shows more than 600 000. The explanation for this incongruity is as follows: The successful integration of the LRE automatic metadata translator meant it was possible to translate the entire set of LRE metadata without extra effort. This explains the much larger number of translations.

Indicators 2 and 3: Number of new resources and assets in the LRE. As the project evolved, it was clear that quantity of metadata records was not a goal per se. The ultimate objective was to provide a quality service to users. When eliciting feedback from teachers using the LRE, it became clear that they were not well served by a high umber of broken URLs that have entered the LRE as records were aggregated from various content providers. In response, ASPECT developed a mechanism to check for and remove records with broken URLs. The indicators reflect the number of records after removal of records containing broken URLs. The starting point (at the end of the

MELT project) for the number of learning resources and assets in the LRE was 32 000 and 110 000 respectively.

Indicator 4: Number of vocabularies in the vocabulary bank. While the indicator projected 260 vocabularies and translations, the final number is 694 not only because new LRE vocabularies were developed, but also because all vocabularies were systematically translated into 24 languages: all the official languages of the European Union (EU) and the languages of the non-EU countries member of European Schoolnet.

Indicator 8: Number of references to ASPECT activities and deliverables. This indicator requires further explanation. By reference we mean the number of times outcomes and papers from the ASPECT project were cited or mentions online.

To calculate the number of references to ASPECT's outcomes we performed some queries in Google. The queries performed retrieve the number of back links to ASPECT outcomes. These queries were in the format of *link:target_url*. The meaning of columns in Table 2 are as follows: **outcome** refers to the ASPECT outcome mentioned/cited; **query,** is the search term for this particular outcome; **number of references** is the number of search results obtained; and **date** is the day on which the search was performed.

Table 2: References to ASPECT's outcomes.

Outcome	Query	Number of references	Date
www.aspect-project.org	link:aspect-project.org	134	12th April 2011
lreforschools.eun.org	link:lreforschools.eun.org	157	12th April 2011
Cen-ltso.net	link:cen-ltso.net	25	12th April 2011
Application Profile	link:apr.vocman.com	0	12th April 2011

Registry			
VBE	link:aspect.vocman.com/vbe/	7	12th April 2011
LORRy	link:lreregistry.eun.org:5984/registry/_design/registry/index.html	0	12th April 2011
ARIADNE Collection Registry	link:ariadne.cs.kuleuven.be/ariadne-registry/	0	12th April 2011
ARIADNE Validation Service	link:ariadne.cs.kuleuven.be/validation Service/	3	12th April 2011
Transformer Service	link:lrecoreprod.eun.org:6080/mtdTransformer/	0	12th April 2011
Automatic Translation Service	link:lrecoreprod.eun.org:6080/oaitarget/OAIHandler?verb=Identify	0	12th April 2011

To calculate the number of references to ASPECT's papers we performed some queries in Google. Only papers published in international journals were considered. The format of queries consists of the exact title of a particular paper plus the number of its authors. The search results show the different web pages that reference a particular paper. We take this number as the number of references to a paper. The meaning of columns in Table 3 is as follows: **paper**, is a given paper under consideration; **query**, is the search terms that were inserted in the search box; **number of references,** refers to the number of search results that were obtained; and **date** is the day on which the search was performed.

Table 3: References to ASPECT papers.

Paper	Query	Number of	Date

		references	
S. Ternier, D. Massart, M. Totschnig, J. Klerkx, and E. Duval. The Simple Publishing Interface (SPI). D-Lib Magazine, 16(9/10), 2010.	"The Simple Publishing Interface (SPI)" Ternier Massart Totschnig Klerkx	80	12th April 2011
D. Massart, E. Shulman, N. Nicholas, N. Ward, and F. Bergeron. Taming the metadata beast: ILOX. D-Lib Magazine, 16(11/12), November/December 2010.	"Taming the metadata beast: ILOX" Massart Shulman Nicholas Ward Bergeron	38	12th April 2011
Roberto Perez-Rodriguez, Manuel Caeiro-Rodriguez, Luis Anido-Rifon, Martin Llamas-Nistal *Execution Model and Authoring Middleware Enabling Dynamic*	"*Execution Model and Authoring Middleware Enabling Dynamic Adaptation in Educational Scenarios Scripted with PoEML*" Perez-Rodriguez Caeiro-Rodriguez	10	12th April 2011

Adaptation in Educational Scenarios Scripted with PoEML. Journal of Universal Computer Science (J.UCS), September 2010	Anido-Rifon Llamas-Nistal		
K.I. Clements, J.M. Pawlowski *User-oriented quality for OER: Understanding teachers' views on re-use, quality and trust.* Journal of Computer Assisted Learning (JCAL), 2011 (waiting to be published)	"User-oriented quality for OER: Understanding teachers' views on re-use, quality and trust" Clements Pawlowski	0	12th April 2011

Victor González Barbone, Luis Anido Rifon, "From SCORM to Common Cartridge. A Step Forward" Computers and Education. Elsevier (2010), Vol 54,pps	"From SCORM to Common Cartridge. A Step Forward" "Anido Rifon" "Gonzalez Barbone"	193	12th April 2011

88-110.			
Rubén Míguez, Juan M. Santos, Luis Anido: Las TIC como soporte para la mejora de la calidad en la educación infantil. TICs Aplicadas para el aprendizaje de la Ingeniería (TICAI), edited by IEEE, Education Society, Spanish Chapter (IN PRESS)	"Las TIC como soporte para la mejora de la calidad en la educación infantil. TICs Aplicadas para el aprendizaje de la Ingeniería (TICAI)" Miguez Santos Anido	0	12th April 2011
Roberto Pérez Rodríguez, Manuel Caeiro Rodríguez, Luis Anido Rifón (2009) "Hacia una arquitectura para sistemas de e-learning basada en PoEML" IEEE-RITA 4(3), pp. 230-238	"Hacia una arquitectura para sistemas de e-learning basada en PoEML" Perez Caeiro Anido	17	12th April 2011
Munoz-King, P., Gras-Velazquez, A.	"Proyectos Europeos para la	3	12th April 2011

& Joyce A.(2009) Proyectos Europeos para la enseñanza de ciencias, matemáticas y tecnologías Boletín das Ciencias Enciga Ano XXII, Nº 68, pp,121-123. novembro 2009	enseñanza de ciencias, matemáticas y tecnologías" Munoz-King Gras-Velazquez		
Kurilovas, E. (2009). Interoperability, Standards and Metadata for e-Learning. In: G.A. Papadopoulos and C. Badica (Eds.): Intelligent Distributed Computing III, Studies in Computational Intelligence 237, pp. 121–130. Springer-Verlag Berlin Heidelberg 2009. ISSN 1860-949X	"Interoperability, Standards and Metadata for e-Learning" Kurilovas	48	12th April 2011

Manuel Caeiro-Rodríguez, Luis Anido-Rifón, Martín Llamas-Nistal (2010) "Challenges in educational modelling: expressiveness of IMS Learning Design". Educational Technology & Society (Accepted for publication)	"Challenges in educational modelling: expressiveness of IMS Learning Design" Caeiro-Rodriguez Anido-Rifon Llamas-Nistal	9	12th April 2011

Indicator 10: Number of CEN Workshop Agreements. The three specifications corresponding to this indicator are:

- Simple Publishing Interface (accepted as CWA 16097);
- Social Data; and
- Interoperability of Registries.

Indicator 11: Number of IMS GLC specifications. The specification corresponding to this indicator is the IMS Learning Object Discovery and Exchange (submitted).

Indicator 12: Number of European Norms submitted to TC353. The three specifications corresponding to this indicator are:

- Curriculum Exchange Format (endorsed)
- Simple Query Interface (submitted)
- Simple Publishing Interface (submitted)

Indicator 14: Number of high-quality, scientific papers accepted for leading, internationally recognised conferences or journals. This indicator was revised to only take into account journal papers. Conference proceedings were counted as part of indicator 13.

Indicator 16: Number of new national portal of Portugal and KlasCement (Belgium).

2.2 Work Package 1

Evaluation objective: work package _EO_1.1 to assess whether time and budget are kept

Evaluation performed: During months 16-28, work package 1 monitored the budget and progress of work by gathering periodic reports at the end of months 22 and 25. In the original plan it would have been months 22 and 27, but work package 1 decided to anticipate the latter in order to ensure that the last months of the project's spending would be anticipated early enough. Progress reports, financial reports and work package leader reports were gathered from all partners and work package leaders. Work package 7 also monitored the progress of the project management in Executive Task Force Flashmeetings every other week; these meetings included the work package leaders who gave their updates on work package activities.

Reacting to recommendations from the Evaluation report 1:

- Work carried on much in the same manner as during the first 15 months of the project. Some adjustments for project management were made. They included introducing a 'Google Document'-based file every two weeks where all work package leaders updated their progress for the whole consortium to check. In this document, the consortium also provided updates on coming events as well as progress on success indicators to which they still needed to contribute. Project management also paid closer attention to the communication between content providers and technology providers and also the progress of dissemination activities.

Findings:

- Some partners were still under-spending in September 2010. This issue was addressed by the project management and funds were transferred from those partners who did not require as much funding as originally anticipated to activities that were seen crucial at the last stage of the project.

- In September 2010 a change in work package 4's leadership took place that transferred work from EIfEL to the University of Vigo. The change provided an opportunity for the project to make an increased effort on dissemination activities that had fallen behind their targets in the first 2 years of the project. Efforts of all partners were directed towards dissemination during the last six months of the project, resulting in significant successes in gathering attendees to ASPECT dissemination events including plugfests and a new series of webinars.

Evaluation performed: work package 7 monitored the process of systematic review of deliverables by following the status on the ETF Flashmeetings every two weeks as well as by regularly analysing a table with delivery dates and reviewers' names provided by work package 1.

Reacting to recommendations from the Evaluation report 1:

- Work on deliverables was started considerably earlier than in the first period of the project and ETF Flashmeetings were used to prepare needed input for each deliverable.

- Work package leaders took the lead on dividing the required work among partners.

Findings:

- Reviewing the deliverables improved after the first period of the project; all deliverables were peer-reviewed and some were reviewed by external experts (e.g., D2.6 Infrastructure and services v2.0). Comments from partners were gathered and deliverables were edited and improved based on recommendations.

- All deliverables were reviewed by the project coordinator (EUN).

Evaluation objective: work package _EO_1.3 to assess whether content/quality monitoring of the tasks is performed

Evaluation performed: Work package 7 evaluated the quality of the project tasks in several events, gathered feedback from consortium meetings and developed a quality assurance plan. Quality assurance was on-going process that looked at both the quality of the work on each project task and the quality of the content provided by content providers. Work package 7 interviewed key ASPECT partners to identify problems within the project tasks.

Reacting to recommendations from the Evaluation report 1:

- More time was given to cross-work package meetings in the full consortium meetings. Generally, partners were more satisfied with the consortium meetings' presentations in comparison to the first period of the project.

- A 'benefits framework' was developed to help stakeholders better understand ASPECT project and the standards it focused on. The benefits of standards and specifications were presented to the end users in series of webinars as well as during dissemination events in 2010.

- Project self evaluations were carried out in consortium meetings in Lisbon (03/10) and Ljubljana (09/10).

Findings:

Feedback related to the arrangement of the consortium meetings was positive throughout the project and was slightly more positive during the second half of the project. Many said that the consortium meetings were the most fruitful part of the project and hoped that the communication between partners could be maintained after the project ends. Many ASPECT partners also felt that the most significant findings of the project were discovered during the international summer school with teachers, where the teachers tested SCORM and IMS CC packages in hands-on activities. Many publishers felt that working especially with IMS CC was the highlight of the project for them as they learned

a lot in the process (e.g., about the differences of the specifications). Many also welcomed the opportunity to test tools.

Some consortium members expressed a desire to see a more clear delegation of tasks as well as a more active dissemination component. (This feedback was gathered in September 2010, in Ljubljana, after which dissemination was emphasized and carried out successfully).

Evaluation objective: work package _EO_1.4 to assess whether finance monitoring is performed through regular reports (seasonal reports)

Evaluation performed: For months 16-28, work package 1 gathered periodic reports at the end of months 22 and 25. They also asked all partners to estimate their costs for the last months of the project in order to make sure the project was properly aligned with the budget. Progress reports, financial reports and work package leader reports were gathered from all the partners and work package leaders accordingly.

Reacting to recommendations from the Evaluation report 1:

- Work was carried on as before as per recommendations in evaluation report 1 with the addition of estimating forwards at the end of the project.

Findings:

- Work package 1 successfully gathered and prepared the needed financing monitoring and regular reports throughout the second period of the project.

2.3 Work Package 2

Evaluation objective: work package _EO_2.1 to assess the clarity and feasibility of the provided best practice documents

Evaluation objective: work package _EO_2.2 to assess whether the best practice documents support content providers in connecting to the ASPECT LRE infrastructure and therefore enable discovery of their own and other resources through ASPECT LRE.

Evaluation performed:

Work package 7 interviewed both the technology providers and the content providers in order to evaluate their experiences when working with the best practice documents. Extra information was also gathered by observation during meetings and additional documents provided by work package 2.

Reacting to recommendations from the Evaluation report 1:

- Work package 2 began a more intense monitoring of the standards' adoption process after the first period of the project. One of these procedures included the addition of an RSS feed on top of the harvesting service. Server administrators can subscribe to this feed to see if everything worked out well during harvesting or if something failed. For example, if metadata records did not pass conformance tests, they are not harvested but the administrators can take action to solve these conformance issues.

- The validation service tests if metadata records conform to the LRE Metadata Application Profile. However, work package 2 also wanted to know how the different content providers make use of optional metadata elements that are not mandatory but, if they are used, the metadata of those providers is richer and in turn, their educational material will be easier to find by end users. A number of visualizations (i.e., heat maps, tree-maps, stack graphs) have been created to analyze how the different metadata elements are used. The heat map in Figure 1

and Figure 2 illustrates the usage of optional metadata elements of the LRE Metadata Application Profile. Columns present ASPECT content providers; rows present the metadata elements in question. The column 'Total' contains the complete ASPECT metadata set. The values inside the different cells capture the average number of metadata elements in the row that sare added to one metadata instance that describes a learning object. For example, if you look at the values for the metadata element 'lom.general.coverage', the value for provider CNDP is 2.08. This means that, on average, every metadata instance of CNDP contains at least two values for that element. The meaning of this field explains the time, culture, geography or region to which this learning object applies. There are only two providers in ASPECT that describe their objects with this element. Colors in the heatmap encode the same value and make it easier to spot outliers: White cells contains average numbers of 0 to 0.2; light yellow contain averages from 0.2 to 1.0; light green from 1.0 to 2.0; and dark green contain average values that are higher then 2.0. Another example that one can see is that, on average, ASPECT metadata instances contain at least 6 keywords (lom.general.keyword). EduC even has more than 12 keywords added per instance.

- Additional training and technical guides to use the best practice documents were also provided to assist the content providers.

TOTAL	CNDP	CUP	DGIDC	EduC	EDUCATIO	FWU	INDIRE	OpenLearn	SIVECO	UL	XTEC	YDP	Path
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	lom
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	lom.general
0.28	1.0	0.0	0.0	1.0	0.0	1.0	0.0	1.0	1.0	0.0	0.0	0.0	lom.general.aggregationlevel
0.22	2.08	0.0	0.0	0.0	0.0	0.0	0.96	0.0	0.0	0.0	0.0	0.0	lom.general.coverage
1.22	1.0	1.0	1.01	1.96	1.0	0.51	1.0	1.0	1.0	1.0	1.0	0.0	lom.general.description
2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	lom.general.identifier
6.09	0.56	6.73	3.62	12.48	5.09	8.56	0.0	6.41	7.63	3.66	6.28	3.0	lom.general.keyword
1.01	1.04	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.04	1.0	lom.general.language
0.61	0.0	1.0	1.0	1.0	1.0	1.0	0.0	1.0	1.0	0.0	0.0	0.0	lom.general.structure
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	lom.general.title
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	lom.lifecycle
1.62	3.4	1.0	1.73	1.0	1.0	2.0	2.99	2.0	2.0	1.29	1.99	2.0	lom.lifecycle.contribute
0.89	3.4	1.0	1.68	1.0	1.0	0.0	0.0	0.0	0.0	1.0	1.99	2.0	lom.lifecycle.contribute.date
0.88	1.94	1.0	1.68	1.0	1.0	0.0	0.0	0.0	0.0	1.0	1.99	2.0	lom.lifecycle.contribute.date.datetime
1.63	3.4	1.0	1.73	1.0	1.0	2.0	2.99	2.0	2.0	1.48	1.99	2.0	lom.lifecycle.contribute.entity
1.62	3.4	1.0	1.73	1.0	1.0	2.0	2.99	2.0	2.0	1.29	1.99	2.0	lom.lifecycle.contribute.role
0.4	0.0	0.0	0.0	1.0	0.0	1.0	0.0	1.0	1.0	0.0	1.0	0.0	lom.lifecycle.status
0.26	0.0	0.0	0.22	0.53	0.0	1.0	0.0	1.0	1.0	0.0	0.77	0.0	lom.lifecycle.version
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	lom.metametadata
2.25	4.0	2.0	1.0	1.4	2.0	2.99	2.0	2.0	3.0	4.32	4.12	2.0	lom.metametadata.contribute
2.14	3.0	2.0	1.0	1.0	2.0	2.99	2.0	1.0	3.0	4.32	4.12	2.0	lom.metametadata.contribute.date
1.82	4.0	1.0	0.0	1.0	1.0	2.99	2.0	2.0	3.0	4.32	4.12	2.0	lom.metametadata.contribute.entity
1.93	4.0	1.0	1.0	1.4	1.0	2.99	2.0	2.0	3.0	4.32	4.12	2.0	lom.metametadata.contribute.role
2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	lom.metametadata.identifier
2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	lom.metametadata.identifier.catalog
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	lom.metametadata.language
0.26	1.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	lom.metametadata.metadataschema
0.25	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.25	0.0	lom.technical
0.25	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.25	0.0	lom.technical.format

Figure 1: Heatmap on the ASPECT content providers' use of non-mandatory metadata elements in the LRE 4.0 application profile (part 1).

1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	lom.educational
1.34	0.21	1.0	0.33	1.62	1.0	1.37	0.0	1.0	2.0	0.64	4.51	1.0	lom.educational.context
0.11	1.98	0.0	0.0	0.38	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	lom.educational.description
0.14	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	1.0	lom.educational.difficulty
0.95	1.44	0.0	1.34	1.0	1.0	1.81	0.0	2.0	2.0	0.8	3.01	1.0	lom.educational.intendedenduserrole
0.02	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	lom.educational.interactivitylevel
0.02	0.0	0.0	1.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	lom.educational.interactivitytype
0.25	0.0	0.0	0.0	0.0	1.0	1.0	0.0	1.0	1.0	0.0	0.0	0.0	lom.educational.language
1.03	1.11	1.0	1.3	1.0	1.0	1.07	1.0	1.0	1.0	1.1	1.19	1.0	lom.educational.learningresourcetype
0.01	0.0	0.0	0.66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	lom.educational.semanticdensity
0.76	0.0	1.0	1.0	1.0	1.0	1.0	0.0	1.0	1.0	0.6	1.0	0.0	lom.educational.typicalagerange
0.13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	lom.educational.typicallearningtime
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	lom.educational.typicallearningtime.description
0.13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	lom.educational.typicallearningtime.duration
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	lom.rights
1.0	0.97	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	lom.rights.copyrightandotherrestrictions
1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	lom.rights.cost
1.0	0.95	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	lom.rights.description
0.07	1.08	0.0	0.0	0.0	0.2	0.0	0.0	3.49	0.0	0.0	0.0	0.0	lom.relation
0.07	1.08	0.0	0.0	0.0	0.2	0.0	0.0	3.49	0.0	0.0	0.0	0.0	lom.relation.kind
0.07	1.08	0.0	0.0	0.0	0.2	0.0	0.0	3.49	0.0	0.0	0.0	0.0	lom.relation.resource
0.03	0.71	0.0	0.0	0.0	0.0	0.0	0.0	3.49	0.0	0.0	0.0	0.0	lom.relation.resource.description
0.25	1.08	0.0	0.0	0.0	1.06	0.0	0.0	3.49	0.0	0.0	0.0	0.0	lom.relation.resource.identifier
1.11	3.96	0.64	0.0	1.0	1.13	0.77	1.0	1.04	2.0	1.0	2.0	0.0	lom.classification
0.24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	lom.classification.description
0.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.97	0.0	0.0	0.0	0.0	lom.classification.keyword
1.11	3.96	0.64	0.0	1.0	1.13	0.77	1.0	1.04	2.0	1.0	2.0	0.0	lom.classification.purpose
1.11	3.96	0.74	0.0	1.0	1.13	0.77	1.0	0.42	2.0	1.0	2.0	0.0	lom.classification.taxonpath
1.11	3.96	0.74	0.0	1.0	1.13	0.77	1.0	0.42	2.0	1.0	2.0	0.0	lom.classification.taxonpath.source
3.97	10.11	0.74	0.0	1.0	1.13	0.77	7.1	0.78	2.0	1.64	14.21	0.0	lom.classification.taxonpath.taxon
0.09	0.0	0.0	0.0	0.37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	lom.annotation
0.09	0.0	0.0	0.0	0.37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	lom.annotation.date
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	lom.annotation.description
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	lom.annotation

Figure 2: Heatmap on the ASPECT content providers' use of non-mandatory metadata elements in the LRE 4.0 application profile (part 2).

A major advance is that content providers' resources are available now for sharing and reuse with other providers (e.g., they can be found now through the ARIADNE Moodle bridge in the LMS that has been customized for ASPECT). ASPECT also provided a number of documents on how the content providers could connect their repositories, including wiki pages. The interviews with the content providers showed that these documents provided enough information for some but not all of these partners to connect to LRE. However, for those needing more assistance, technical workshops were also organized to explain harvesting (OAI-PMH) and the application profile. Content providers found these workshops useful. Additional support was also provided by hands-on guidance, which the content providers could request. The content providers were asked if they found the best practice documents useful. For some providers connecting, "would not have been possible" without the best practice documents. Other found that:

> The wiki was helpful for when we needed to set up the server for harvesting… Yes… there was a lot of useful data… official specifications were the most useful ones.

Many of providers noted that they received help from the technical team to solve their problems when required via email, skype or phone connections. One provider explained that:

> We received some information from the ASPECT website and from the people working at the LRE and people working at the more technical level of the ASPECT project. So it was good, it was very good.

Many other providers expressed a similar satisfaction with the technical support they received:

> I was pleased with the support from the EUN, because most of the issues we can just communicate via email, and the response was quite fast, no delay there.

Technology providers suggested that language barriers were responsible for some of the problems encountered by content providers. Even when faced with a problem in making their metadata compatible with the LRE Metadata Application Profile, the content providers rarely offered feedback on the best practice documentation meant to support their tasks. Some providers did not engage in any communication even when they needed support to continue their work. Technology providers did not insist on maintaining active communication with content providers until they were made aware of a problem. Some of the content providers never consulted the deliverables and instead, as one provider explained, "Only checked the standards and maybe some email that was technical email. But I did not look at the deliverables." Despite these difficulties, ASPECT content providers felt that the work package 2 activity of adapting their metadata to LOM and the LRE Metadata Application Profile improved their publishing scheme. *As one provider explained,* "I think having IEEE LOM in our system was a good thing. Our portal is quite well known now because of its search functionalities. Part of that is thanks to the ASPECT project". For providers new to standards, participating in ASPECT offered clear benefits. As another provider explained:

> The fact is, when we joined this project, we were at a very early stage of our repository. So joining it was very helpful, in the sense that we've adopted a lot of standards and specifications that are helpful in the way of interoperability for example.

At the end of the project, all the content providers stated that using metadata standards is useful for their content publishing operations.

All except two said that they will use IEEE LOM standard, two will use Dublin Core metadata standard and one will use the ONIX metadata schema in the future. 70% of the publishers saw metadata creation as mainly intended to make their resources discoverable; half of them had a dedicated staff member performing this task. Eighty percent also said that using metadata standards is vital for their future publishing operations in order to be compatible with other repositories, tools and learning management systems inside their country and abroad.

2.4 Work Package 3

Evaluation objective: work package _EO_3.1 Evaluation of the content providers', technology providers' and teachers' awareness of standards and specifications

Evaluation performed: Throughout the project, work package 7 interviewed content providers, technology providers and teachers. Additional data was gathered using questionnaires during several events. Some issues were clarified after the interviews by email. In particular for the content providers, work package 7 assessed their awareness and skills in a longitudinal study that was conducted throughout the project to determine the long-term effect.

Reacting to recommendations from the Evaluation report 1:

- ASPECT continued, as recommended in D7.3.1, to provide awareness raising workshops as well as advanced expert activities to improve awareness on all levels.

Findings:

In principle, technology and content providers are aware of standards and have increased their awareness and knowledge during the project.

Technology providers' awareness

During the interviews, it became obvious that technology providers' awareness of standards and specifications is very high, because they need to deal with the standards in their daily work. This group of stakeholders in the ASPECT project has advanced expertise in the development and implementation of standards and specifications. They provide tools based on standards and have no trouble understanding how standards impact the full content production chain.

The content providers' awareness

This group of stakeholders in ASPECT project is quite aware of standards but in most cases the usage depends on the benefits provided to their business (and customers) by adopting standards (e.g., ease of development, re-use possibility). However, the level of awareness in this group is heterogeneous. As part of our study, we have classified the awareness and behaviour of content providers in an attempt to identify usage and awareness types that can be used in future settings. We identified three categories of content developers in ASPECT: 1) the coincidental adopter, 2) the experimenter and 3) the strategist adopter among contents providers (see Section 3.1.2) that are distinguished by their previous knowledge and work with standards and specifications. During ASPECT, all the content providers went through the process of experimenting with standards and specifications that increased their knowledge and awareness. Many of them had little knowledge on these standards before, but during ASPECT they learned about their benefits and interoperability. At the end of the project, they are able to distinguish the advantages and drawbacks

of each standard in term of the business value, adoption steps, convenience, and pedagogical implications.

Table 4 shows that, at the start of the project, only a small number of providers were aware of the SCORM packaging format; however, after the ASPECT trials, most were considering the production of either SCORM, IMS Common Cartridge formats or both. This finding demonstrates that ASPECT was successful in creating awareness among content providers of these standards. This table is based on data gathered from interviews with content providers' interviews at the consortium meeting in Ljubljana, September 2010.

Table 4: Content providers willingness to adopt content packaging standards.

Content provider	Content packaging before ASPECT	Tried during ASPECT	Future plan for Content packaging
University of Ljubljana	SCORM	SCORM + CC	SCORM + CC
ITC	None	SCORM + CC	No policy, the teachers can decide: SCORM/CC
Educatio	Their own format	CC	(CC)
YDP	SCORM	SCORM + CC	SCORM (+ possibly CC)

Siveco	None	SCORM + CC	CC
KlasCement	SCORM	SCORM+CC	SCORM + CC
FWU	None	SCORM+CC	SCORM
Indire	None	SCORM + CC	None
CNDP	None	SCORM+CC	None
DG	None	SCORM+CC	No policy, the teachers can decide: SCORM/CC
OUUK	SCORM+CC	SCORM+CC	SCORM+CC

Evaluation objectives work package _EO_ 3.2 / 3.4: Evaluation of the demonstrator, the process of creating guidelines and recommendations for the use of specifications

Evaluation performed: Work package 3 developed a demonstrator (i.e., a web-based portal describing a range of tools and how to use them in various scenarios). Work package 7 interviewed content providers about their use of the demonstrator.

Reacting to recommendations from the Evaluation report 1:

- The recommended cooperation with work package 6 and 7 to improve work with end users was taken up immediately. By this, the knowledge and awareness as well as the usage of tools was increased and improved.

- The recommendation to provide more support materials was taken up successfully; the use of web-based materials and webinars were especially successful.

Findings:

Most content providers initially found, that the demonstrator helped them in the process of packaging their content, and helped them to get familiar with the packaging procedures and process. They were able to make both SCORM and Common Cartridge packages with the demonstrator's help and could convert SCORM packages into Common Cartridge packages. The following comment illustrates our findings:

> Well, we needed to create some Common Cartridges, so it was helpful because we had to get in touch with the tools needed, with the validation services and everything.

The detailed process of demonstrator and guideline usages gave us insights into how content providers take up standards and difficulties encountered in this process. As an example, one content provider commented:

> With the CC, documentation was enough, but when we tried to test packages, […] there was a little bug in the tester. It cannot read XML files. When you have a wide order mark in the beginning of the XML file, it is three bytes. [Moreover], all the testers said it's wrong and I have to ask what is the problem. […], they said we have to remove this WOM and it worked. (One content provider commented)

The above quite specific and detailed comment highlights that the demonstrator helped guide content providers through the overall content packaging process. However, some of them also needed extra help from the technology team behind the tools, which was also successfully provided. This was particularly the case if small technical issues arose, which are very context-dependent. Our interviews also showed that all content providers were able to test creating SCORM and CC content packages and for many this process was guided by the demonstrator.

However, some of the tools provided in the demonstrator were initially not mature enough to provide the intended service and the content providers required help from the technology providers in order to be able to use them effectively. It seems very clear that a (human) expert should be involved to provide additional guidance in the process, especially for inexperienced users. This was successfully done in ASPECT. For this purpose, however, support structures need to be absolutely clear; based on our interviews, it was sometimes unclear for the content providers who should they turn to if they had a problem. Some turned towards the work package 5 leader and some towards the technology providers in charge of the tools.

Generally, the support provided through guidelines, the demonstrator and personal guidance was very successful and can be used as a good practice.

Evaluation objective: work package _EO_3.3 Evaluation of the enforcement process of the licensing model

Work package 3 introduced the LRE access control, which is described in D3.2 (Best Practice Report for Content Use). The licensing model enforcement process started with several meetings focused on improving the understanding of licensing schemes in order to raise awareness and start the discussion among the content providers. Work package 7 monitored the discussion. Credit-based access was tested during the teachers' summer school (7th of May 2010) and interviews took place with content providers on the different licensing schemes.

Reacting to recommendations from the Evaluation report 1:

- As recommended in D7.3.1, the testing process for the licensing models in practical situations was taken up.

Findings:

See recommendation **R-CP.7** in Section 0.

Evaluation objectives work package _EO_3.5 / 3.6: Evaluation of the ASPECT set of tools and the new tools to test metadata for compliance with standards

Evaluation performed: Work package 7 gathered feedback by interviewing the content providers on their use of ASPECT tools and also interviewed technology providers about the process behind developing the tools. This report summarizes testing findings from workshops in Munich (May 2009), Aarhus (November 2009) and the second round interviews of content providers conducted during the ASPECT consortium meeting in Ljubljana (September 2010).

Reacting to recommendations from the Evaluation report 1:

- The tools were, as planned in the description of work, developed further and improved for the needs of users.

- Workshops (with teachers and content providers) were held to provide hands-on experiences as recommended.

Findings: ICODEON's SCORM player, Common Cartridge Platform as well as the CC Builder were very attractive tools and functioned well. Content providers identified no critical problems in using them. In addition, the ASPECT LRE service centre tools were intensely used and appreciated by all the categories of content providers (see Table 7 for detailed analysis). However, for strategist adopters, who are very experienced in standards and technologies in general, some members of this group are very

reluctant to adopt some tools. These strategic developers preferred to use their own tools (that they had developed themselves) for the tasks.

Evaluation of the new tools to test metadata for compliance with standards

Regarding the new tools to test metadata for compliance with standards, the content providers' comments reflect their level of experience described in Section 3.1. For the less experienced coincidental and experimenter adopters, the new tools helped them in the process of compliance; except for some minor complications they were satisfied.

Strategist adopters, who are more advanced than the previous group, did not use many of the tools. They kept their in-house procedures, and publishing mechanism, based on XML that allows them to convert into a wide range of different interchange formats. This is because they believe that there is no need to change their existing process that worked well. Furthermore, they believe that the quality of the new tools would be lower than their own tools.

To summarize, we can conclude that the tools were very suitable for content providers, especially for the less experienced users and assisted the process of standards' adoption. The tools were adopted more successfully in the second half of the project when the tools became more mature and familiar.

2.5 Work Package 4

Assessing the level of awareness of ASPECT

Evaluation performed: The extent to which there was general awareness of the ASPECT project was evaluated by analysing the website statistics as well as by collecting feedback from several dissemination events organized for the stakeholder community. Web statistics have also been analyzed for the LTSO in D4.4.2.

Findings

An initial version of the ASPECT project web site was provided before the start of the project in September 2008. Monitoring of a more developed version of the site started in January 2009 after some of the initial dissemination actions (e.g., promotion of a first BETT workshop). Data has been collected since then through December 2010. We also assessed the traffic of the website from December 2009 until December 2010 to compare the findings with the first reporting period (from January 2009 to November 2009). We did a comparative analysis of both periods. Work package 7 distinguished two types of visits - referred and direct visits. A referred visit is one that starts from any source website or what we call referring sites.

Year 1

 In the first year of the project (starting from January 2009 to November 2009), a total of 152 referring sites sent 1,829 visits to aspect-project.org (see Figure 3). Table 5 presents the site usage details.

Table 5: Site usage (source Google analytics).

Visits	Pages/Visit	Avg. Time on Site	% New Visits
1,829	2.33	00:01:36	57.96%
% of Site Total:	Site Avg:	Site Avg:	Site Avg:
41.65%	2.87	00:02:16	59.05%
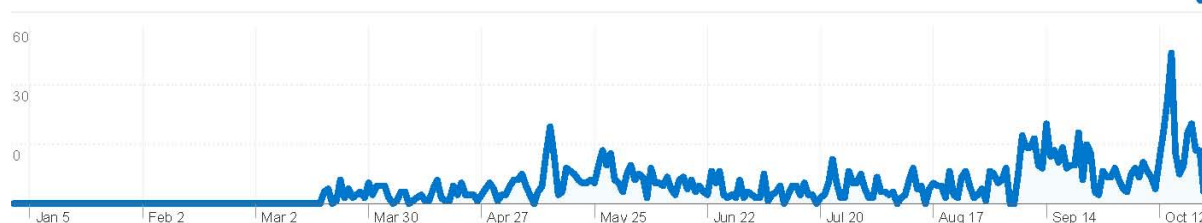
Figure 3: aspect-project.org referring sites (source: Google analytics).

Direct visits means that a visitor knows already the address of ASPECT website and just types this directly in his/her browser. By combining all the traffic sources, direct, referring and search engines, we obtain a total of 4,598 visits (See Figure 4).
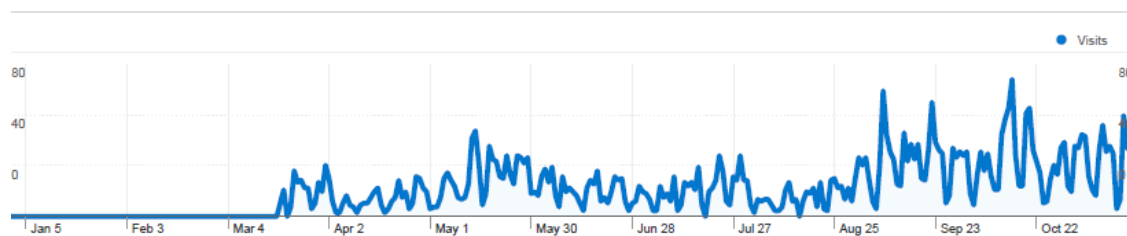
Figure 4: Traffic sources overview (Source: Google analytics).

Figure 5: All traffic sources sent a total of 4,598 visits (Source: Google analytics)

Year 2

During year two, we witnessed a considerable improvement in most indicators (see Section 2.1). From January 2010 to November 2010, a total of 4,221 referring sites sent 11,383 visits to aspect-project.org (see Figure 6). Table 6 shows the site usage details.

Table 6: Site usage (source Google analytics).

Visits	Pages/Visit	Avg. Time on Site	% New Visits
11,383	2,94	00:02:44	54.95%
% of Site Total: 45.45%	Site Avg:	Site Avg:	Site Avg:

Figure 6: Traffic sources overview of year 2 (source: Google analytics).
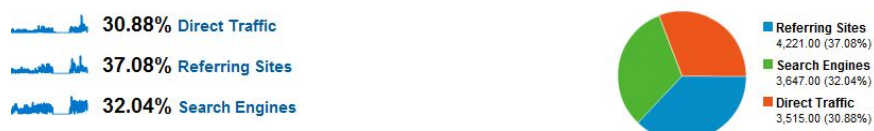
Figure 7: All traffic sources (source: Google analytics).

Comparative Analysis

 When comparing the two periods, we see that the site visits had significantly increased; compared to the previous year 2009, visitors were also spending more time in the portal and they were spending more time on the site. The percentage of new visits had decreased, but this can be seen as natural and indicates that an interested community was returning to the site to check up on what was going on. A detailed analysis of the ASPECT project site showed that the visits have considerably increased after September 2010 and the replacement of EIfEL by the University of Vigo as leader of work package 4. VIGO has particularly leveraged the Learning Technology Standards Observatory (LTSO) to invite external partners to ASPECT events.

- The whole consortium also took the additional disseminations actions in autumn 2010 including organizing a series of on-location events as well as webinars and individual contacts with potential Associate Partners. These webinars are described in detail in D4.4.2. The Report on ASPECT Workshops, Plugfests and Conferences N2 & 3.

- A successful series of webinars were arranged in co-operation with standards experts within ASPECT consortium and some were so popular that they had to be repeated in order to accommodate the demand. In our opinion, the webinars were successful for two reasons:

  o The topics were carefully chosen and contained hands on demonstrations showing how standards can be used in practice,

  o Webinars in Autumn 2010 were marketed via community forums, especially through the LTSO contacts.

Feedback from the community

Generally, ASPECT dissemination events proved very useful for many participants. For example, one participant explained that:

> This event helped me rethink some data structures and architecture issues in my repository.

Another participant felt that:

> This event had an impact on my work; we are developing a new approach to manage and use vocabularies.

Participants were able to take back what they learned for "recommending content packaging standards to our Ministry of Education". Others:

> Learned about architecture and how to implement standards. I have also learned about strategy for updating vocabularies between different systems.

Evaluation objective: work package _EO_4.3 Evaluate the number of professionals who are directly and indirectly linked to the ASPECT BPN

Evaluation performed: Work package 7 monitored the success indicator regarding professionals joining and linked to the ASPECT BPN.

Findings:

- During the first 15 months of the project, the project was slow to attract Associate Partners. Part of the reason for this is that significant project results only started to emerge in summer 2010. The large increase in the number of Associate Partners can also be explained by the strong, strategic effort put into dissemination towards the end of the project following the change of the work package 4 leader.

- The total number of professionals linked to ASPECT grew particularly rapidly in the last couple of months of the project as over ten dissemination events were planned for January-February 2011 as well as the final event. The list of Associate Partners can be found on the project website: http://aspect.eun.org/node/29

- Associate Partners include a diverse range of organizations and individuals from universities, schools, publishers, commercial companies and projects, eLearning associations and standardization bodies. The fact that Associate Partners are spread across five continents underlines the global reach of the project.

Evaluation objective: work package _EO_4.4 Evaluate the level of cooperation with other projects

Evaluation performed: The cooperation activities and agreements have been closely observed by work package 7 as these co-operations are a key activity of a BPN.

Findings:

- We found that ASPECT has an active level of cooperation with related projects including: ICOPER, OpenScout, ICSOFT, eLearning Forum 2009, Nordlet, and CATE. A significant dimension of cooperation with each project is to create synergies. A successful example is the cooperation between ASPECT and ICOPER where information has been exchanged regularly.

- ASPECT is also sharing some of its LRE Service Center services with ICOPER and has also co-organized events with ICOPER.

Evaluation objectives: work package _EO_4.6 Evaluate the service centre use and sustainability; work package _EO_4.7 Evaluate that the services provided through the service centre are compliant with state-of-the-art SSLTs

Evaluation performed: The service centre use and sustainability evaluation assessment was done via the content provider interviews round 2 during the last ASPECT consortium meeting in Ljubljana, Slovenia.

Findings:

- We found that most content providers had at least tried most of the ASPECT LRE Service Centre tools.

- Overall, their opinions on the tools varied (see Table 7, Section 3.1.3).

- Many of the content providers raised concerns regarding the availability of the service centre beyond the end of the ASPECT project.

3 Feedback from ASPECT Stakeholders

3.1 Content Providers

This section describes the results from interviews with content providers in the project.

Reacting to recommendations from the Evaluation report 1:

In the first evaluation report D7.3.1 (p.37), work package 7 made a series of recommendations to improve the effective involvement of content providers. In response to these recommendations, the ASPECT consortium organized with the work package 5, the Aarhus workshop in November 16, 2009 (See event report N0.8) in Denmark to address the needs of all content providers. In addition, more specific hands-on support was provided to content providers based on their individual needs. The workshop mainly focused on the Common Cartridge (CC) standard and associated tools, specially the SCORM2CC Converter, the Common Cartridge test tools, the Common Cartridge Builder and the Common Cartridge Platform (player). Along with the content providers' technical staff, two technology providers from work package 3 (Icodeon and University of Koblenz) took part in the workshop. After the workshop, work package 5 in collaboration with work package 2 and work package 3 continued to provide support to content providers.

3.1.1 Readiness to implement standards

Evaluation performed: work package 7 conducted a sequence of interviews and surveys to collect the content providers' experience and concerns after the first evaluation report. These interviews and

surveys were done during both the Aarhus workshop and the Ljubljana consortium meeting. In addition, we also drew information from a benefits' questionnaire completed by content providers and additional information was gathered from work package 5 reports.

To better understand the content standardization process and its underlying decision-making dynamics, we interviewed both senior management and technical staff from each content provider (both commercial and public sector providers) who were respectively responsible for deciding and recommending which standards and specifications the organisation should adopt.. We asked the following key questions:

- Could you describe the content conversion process you went through in ASPECT?

- How did the tools proposed by work package 2 and work package 3 support you in applying standards and specifications to your content?

- Describe your overall experience during this process of content conversion.

- Explain how the adoption of ASPECT best practices will impact your business model.

- Would the adoption of standards help to reach new types of customers?

- Has or might your current business model changed? If not, what will change in particular if you decide to adopt ASPECT best practices specifications?

The interviewees' experiences suggest that the standardization process follows a juncture model, based on increasing experience, willingness, and complexity in the standardization effort.

3.1.2 The Four Junctures of e-Content Providers' Standards Adoption

Content providers had differing interests in the standardization work. Some were only interested in metadata, while others were interested in both metadata and content packaging standards. Content providers also had widely differing needs in terms of tools and types of standards depending on their familiarity with e-learning standards. We also found that the content providers' diverged in their opinion regarding the usefulness of the tools provided by work package 2 and work package 3.

In the following, we introduce the Standardization of Electronic Content (SEC) model derived from our evaluation.

SEC distinguishes four classes of adopters:

- **Class 1 - The Coincidental Adopter**: No prior experience, just encountering standards while putting in place their e-content repositories.

- **Class 2 - The Experimenter Adopter**: Experimenting with standards on an ad hoc-basis.

- **Class 3 - The Strategic Adopter**: Trying standards with the goal of achieving strategic and competitive advantage, economy of scale, and their e-content management mechanism are mature.

- **Class 4 - Full Adopter**: Leveraging standards and specifications.

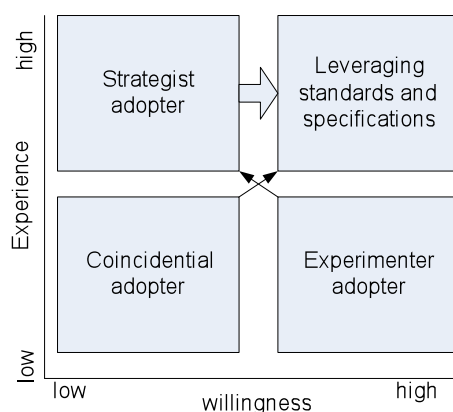The relationship among the component the juncture is described in Figure 8.

**Figure 8: Experience versus willingness
to use standards and specifications**

3.1.2.1 Class 1: The Coincidental Adopters

In this class, the content providers have no prior experience and knowledge of standards. They just embraced the standards and specifications process while struggling to begin work on standards and this coincided with their e-content development strategy. For this type of adopter it was natural to use the tools proposed because they are the only tools they know and are aware of and come with support. For the most part, this class of adopter is made of ministries of education and public sector content providers. These ministries clearly realise the necessity of organizing electronic content in a re-usable way but lack the knowledge to do so. Therefore, initiatives such as ASPECT are seen as an opportunity to acquire best practices in order to reach their goals. This approach is clear in the comments provided by a ministry representative:

> The fact is, when we joined this project, we were at a very early stage of our repository. So joining it was very helpful, in the sense that we've adopted a lot of standards and specifications that are helpful in the way of interoperability for example. So it was really exciting to be here...

It is important to stress that all ministries of education are not equal when it comes to knowledge or attitudes towards standards and specifications.

For some ministries of education, adopting standards and specifications enables them to exchange resources with other ministries of education and content providers in general. This is of critical importance for those ministries of education because they lack the necessary financial resources to either develop or acquire digital resources. Therefore, it was essential for this group of stakeholders to fully utilize coincidental opportunities presented by the ASPECT project.

Other ministries of education in this class are truly and fully coincidental adopters, and as such they are willing to make a move toward leveraging the full potential of standards. However, policy level decisions are a major constraint. If the policy maker does not see the usefulness of packaging content standards for his area of influence (national, regional), it is likely that ministry of education will just select standards and tools to solve specific needs and will not adopt the full standards and specifications.

Our interviews made clear that this group of coincidental adopters can achieve huge gains from their decision to adopt standards and specifications but this requires decisions to be taken at a policy level. Thus, awareness of standards issues by policy makers is crucial for a successful step towards standards adoption.

Surprisingly, this group with very few experiences of adopting standards took a huge step forward within the ASPECT project.

3.1.2.2 Class 2: Experimenter Adopters

The group of experimenter adopters, although not beginners, do not possess an advanced knowledge of standards, specifications, and content packaging processes. These content providers have their own established processes; in some cases those processes are governed by country specific legislation. Perhaps, this is why they adopted the experimenter role. Like the class of coincidental adopters, this class of content providers is also mostly made up of ministries of education.

Experimenter adopters used the proposed tools as an experiment to gain knowledge for future needs. In some cases, they do not intend to disrupt their existing practices; perhaps, until a new government policy is enforced. Experimenter adopters face a number of challenges in the process of standards and specification adoption and perhaps the foremost of these relates to how government policy is implemented. In some participating countries, repositories and content distribution are initiated and directly administered by policy makers. This means that decisions are taken at the policy level and implemented at the national or regional levels. In others countries, e-content strategies are more decentralized. Initiatives are first taken by repository or e-content managers (e.g., individual schools, universities, etc.) and then recommendations are made to the policy level. In both cases, the main responsibility and decisions about standards and reusable digital content remain with the policy makers.

A potential problem for this class of adopters comes from the fact that the approach they want to experiment with can contradict the

approach already in place. In response, some experimenters developed a secondary process where their experimentation was took place solely within the ASPECT project independent from their existing practice.

Furthermore, when they made a decision to adopt a standard, they were very selective in their choices of standards and tools proposed by work package 2 and work package 3.

3.1.2.3 Class 3: The Strategist Adopters

Strategist adopters use standards and specifications as a strategic means for their operations. They have decided to utilize standards as part of their business model to achieve (future) competitive advantages. This class mainly consists of commercial content providers. Most of these commercial content providers use proprietary specifications or standards that are out of the ASPECT project's scope. In addition, their business models, as well as associated supply chain, add more complexity to their decisions regarding which standards to adopt. The major constraints for many commercial content providers are their current business models as well as the maturity of relevant standards.

Commercial content providers' decision to adopt a particular standard is primarily driven by the market demand. In addition, it is also driven by strategic market advantages. Furthermore, commercial content providers may adopt standards when they are seen as supporting possible innovative business models that the organisation them to reach new customer segments.

Commercial content providers are very advanced in terms of knowledge of standards, specifications, and content packaging. They are very selective about the standards they use, especially,

when the selected standards enable them to manage e-content or repositories in innovative ways. In some cases, they found the standards proposed by the ASPECT project too immature to be used in the course of their businesses. Their preference tends to be to staying with the solutions they already developed and are reticent to adopt new standards unless they clearly offer opportunities for competitive advantages, as indicated in comments from one such Strategist adopter:

> We are still using our own publishing mechanism, moving from an XML format that we have and converting into a wide range of different interchange formats... We already had an existing process that worked well for us, that we were able to develop and modify to fit in with the range of different export formats that we needed.

As commercial operators, the strategist adopters may easily become full adopters of a standard if it opens the door to new market opportunities.

3.1.2.4 Class 4: Full Adopters

Full adopters have broad knowledge of standards and specifications. They consider all possible solutions and adopt those they determine to be suitable.

Conclusion

The first two classes (i.e., coincidental and experimenter adopters) are the most likely to directly adopt the best practices developed in ASPECT. The other categories will only selectively adopt best practices that arguably improve existing processes or complement their business models.

3.1.3 Assessment of the procedures and tools proposed/developed by ASPECT technology providers

Evaluation performed

Through our evaluation, we assessed how the procedures and tools proposed/developed by work package 2 and work package 3 helped content providers in applying standards and specifications to their content. We found that most tools proposed by work package 2 and work package 3 successfully helped content providers. The following table describes which tools were used the most by content providers.

Table 7: Assessment of ASPECT tools and services.

TOOLS / CONTENT PROVIDERS	Educatio	EDUC (KlasC)	CNDP	Camb.U.Press	CUP	DGIDC	FWU	INDIRE	ITC	SIVECO	OU	Uni-Lubiljana	YDP
Common Cartridge tools													
MIR Microsoft Platform	Π	Π	Π	Π		Π		Π			Π		
IDE Authoring Tool	Π		Π	Π		Π		Π			Π		
Common Cartridge Builder	Π	Π	Π	Π		Π		Π			Π		
IMS Common Cartridge testing tool	Π	Π	Π	Π		Π		Π			Π		
ICODEON Common Cartridge Platform	Π	Π	Π	Π		Π		Π			Π		
MS Semblio (once Grave)	Π	Π	Π	Π		Π		Π			Π		
SCORM		Π									Π		
ADL SCORM 2004 RELOAD Editor	Π	Π	Π			Π		Π			Π		
MOS SOLO	Π	Π	Π			Π		Π			Π		
Learning Essentials for MS Office	Π	Π	Π			Π		Π			Π		
SCORM2CC	Π	Π	Π			Π		Π			Π		
ADL Test Suite for SCORM2004 4th Edition	Π		Π			Π		Π			Π		
SCORM Test Track	Π		Π			Π		Π			Π		
ICODEON SCORM Player	Π	Π	Π			Π		Π			Π		
ASPECT service center tools													
Identity service (based on the handle)	Π		Π			Π		Π			Π		
Metadata translation service	Π		Π			Π		Π			Π		
Metadata transformation service	Π		Π			Π		Π			Π		
Metadata validation service	Π		Π			Π		Π			Π		
Vocabulary Bank for Education			Π			Π		Π			Π		
Learning Object Repository registry (early prototype)	Π		Π			Π		Π			Π		
Harvesting back service	Π		Π			Π		Π			Π		

As Table 7 shows, content providers were selective about the tools they use. Some tools were widely adopted, others not. Some tools were at an experimental stage (e.g., the first conformance tests) and intended to beta testers rather than aimed at all ASPECT participants.

3.1.4 Assessing interoperability

Evaluation performed: work package 7 evaluated improvements in interoperability by interviewing the content providers about their work in applying standards and specifications with the help from the tools provided by work package 2 and work package 3.

Findings: Most content providers were able to apply standards and specifications to their content and expose metadata records using the LRE's architecture for federating metadata using the LRE Metadata Application Profile 4.X. The IEEE LOM standard (see ASPECT service centre above) and IMS ILOX specification improved interoperability between partners' own databases and the LRE. However, content providers have varied backgrounds and this determines how they perceived the process of interoperability. Some content providers were able to easily accommodate their existing process and to comply with the requirements for interoperability; others reported that, "it was quite complicated to do this process." Some found the recommended tools to be "inadequate for our needs. Either the tools were non-conformant, or they had output that did not create content of a quality that we would put our name on as a publisher with a reputation to maintain".

In general, we found that the tools and services did increase interoperability and enable process changes particularly in less experienced organizations. As a next step, those tools can be

improved so that they can also meet the more specific needs of experienced organizations.

3.2 Teachers

3.2.1 Working with teachers:

The ASPECT project held three workshops for teachers described in deliverable D6.2 "Protocol of National Experimentation". Initially, national workshops were held in the four countries participating in the ASPECT pilots (Belgium, Lithuania, Romania and Portugal) in Autumn 2009. The national workshops mainly covered issues related to content discovery. The second workshop was carried out online in March 2010 also covering content discovery as well as the functionalities of the ASPECT version of the Learning Resource Exchange portal. The third workshop was a joint summer school for all teachers held in May 2010. The third workshop concentrated on assessing teacher responses to content access control mechanisms and content packaging. The evaluation instruments in the workshops included direct observation, interviews and questionnaires. These instruments and activities are detailed in deliverable D6.5. Data about teachers and feedback elicited from teachers per country is presented in deliverable D6.4.

Total number of participants for each workshop:

Workshop 1 (National): 44 teachers

Workshop 2 (Online): 47 teachers

Workshop 3 (International): 45 teachers

To understand user needs, we selected teachers who tended to have a high proficiency and experience in using computers and online materials in carrying out their work related tasks. These advanced users tend to be early adopters of new techniques and technologies. By understanding their preferences and experiences, we sought to

identify promising directions for further developments by standards' organizations and to identify problem areas that would invariably impact all teachers using new systems and e-learning tools.

Three main activities were envisaged for teachers in the ASPECT pilots.

1. Assessing the potential added value of Common Cartridge: A key focus in ASPECT was to explore how emerging specifications such as IMS Common Cartridge could be applied to both 'open' and commercial SCORM compliant educational resources. A preselected group of ASPECT teachers identified as likely "early adapters" were asked to test and compare features and the usability of IMS Common Cartridge content, SCORM content, and non-packaged web content when building lesson plans. The aim was to assess to what extent the IMS Common Cartridge and SCORM specifications provide real added value over non-packaged resources in terms of the usability and re-usability of the learning resources to which the packaging had been applied. This activity also involved examining how the packaged resources improve import and re-use of content within Learning Management Systems (LMS) being used by some of the pilot schools.

2. Testing of an Access Control mechanisms: The main objective of the Access Control mechanisms supported by the LRE is to provide all the necessary components to support as many business and distribution models as possible. What was unknown was how teachers would respond to the presentation of results when Access Control mechanisms are in effect. The validation phase with schools

enabled the project to evaluate teacher responses to different models of presenting protected content. Teachers searching for content were asked to provide feedback on a number of scenarios when they:

   a. Were only presented with results corresponding to resources that they were entitled to use;

   b. Were presented with all results matching their search criteria but only allowed to have access to a subset of them

3. Participating teachers were asked to test and provide feedback on a Learning Resource Exchange (LRE) demonstrator, also called the ASPECT LRE throughout this deliverable. To assess the usefulness and impact of specifications for educational content discovery on users, we carried out user testing that tracked search behaviours and the preferences of teachers by comparing their use of and satisfaction with the ASPECT LRE vs. Google in discovering relevant resources.

During the workshops the teachers had to:

• Fill in questionnaires describing their backgrounds, their attitudes towards learning resources, protected content, sharing of resources, packaged content and ways they already worked with digital learning resources more broadly.

• Carry out user tests on search behaviours and user satisfaction to understand how early adopter teachers work with the ASPECT LRE, a portal tailored to support the discovery of learning resources, vs. Google.

- Carry out user testing on the presentation of Access Control mechanisms.

- Carry out user testing on packaged content and teachers preferences for learning resource use and reuse in building lesson plans.

3.2.2 Main Findings and Observations

The ASPECT LRE portal employs standards and specifications to provide for cross-border reuse of content and interoperability between European learning object repositories. It also relies on standards and specifications to provide search and retrieval functionalities customized to meet the needs of educators. As part of the ASPECT project, seeking to understand and evaluate the impact on users of standards and specifications, we asked preselected groups of Maths, Science and Technology teachers to assess and compare the search and content qualities of the ASPECT LRE portal results versus one of the best known search portals: Google. We also conducted testing and surveys to understand teachers' opinions and use of packaged content as well as their reactions to the presentation of protected content using Access Control mechanisms. This work with the end users is a way to bridge the gulf between educational communities and standards organizations and to understand whether best practices for standards and specifications were meeting the needs of end users.

The user groups were made up of teachers from Belgium (Flemish community), Lithuania, Portugal and Romania (ten to eleven per country). Teachers taught mainly Science and Maths subjects at primary and secondary school levels (their students' ranged from 7 to 21 years of age). The teachers who participated in the series of ASPECT tests were 60% female and 40% male. Most were 40

years of age and older with over ten years of experience in math and science education. All participants had a working knowledge of English. This group of teachers were regular users of computers and the Internet. Up to 90% of teachers participating in the ASPECT tests used a PC at least one hour per day. We know from other studies of European teachers over 50 years of age, that such regular use makes the ASPECT teachers above the norm for their cohort in terms of ITC proficiencies. More than 70% of teachers participating in the ASPECT tests were quite experienced in making, using, sharing and editing resources that they found online. Over 60% had also given some feedback to other teachers on their materials. It came as no surprise that all teachers in our group used Google at some point.

Thus, our group can be considered as advanced users of ICT. Given their comfort and enthusiasm for innovation and new technologies we suggest that they are "early adopters", that is they are most likely among their peers to explore and adapt new techniques and technologies for use in the classroom and to share these experiences with other teachers.

To carry out the evaluation, a number of tests were designed and implemented during three workshops: The first phase of testing consisted of four national workshops (taking place in each of the four countries during consecutive weekends), the second phase consisted of an online workshop. The final phase was a workshop (also known as international summer school) where all the teachers met together and carried out the final tests at the same time. The tests evaluated the teachers' familiarity with learning resources and portals, their use patterns and preferences, their reactions to content in different packaging formats, and reactions to finding protected resources. The tests were complemented with online questionnaires,

open discussions and personal interviews. In addition, the teachers received a short training on Moodle and on the use of packaged content, both standalone resources and when integrated into a LMS.

The experimentations per country (Lithuania, Belgium, Portugal, and Romania) can be found in deliverable D6.4. The present deliverable provides a summary and evaluation of overall results.

Given the small size of the group and the methodology in preselecting the teachers for participation in these tests, we do not claim that our results are representative of European teachers as a whole. However, these results are an important first step in building feedback mechanisms into best practice developments and overcoming the gulf between standards' organizations and end users. The findings also highlight areas for further investigation in future research projects.

3.2.3 Teacher Search Behaviours and User Satisfaction

Teachers selected for user testing in the ASPECT project were already using and often adopting materials they gathered online as well as sharing materials with others as seen in Figure 9.
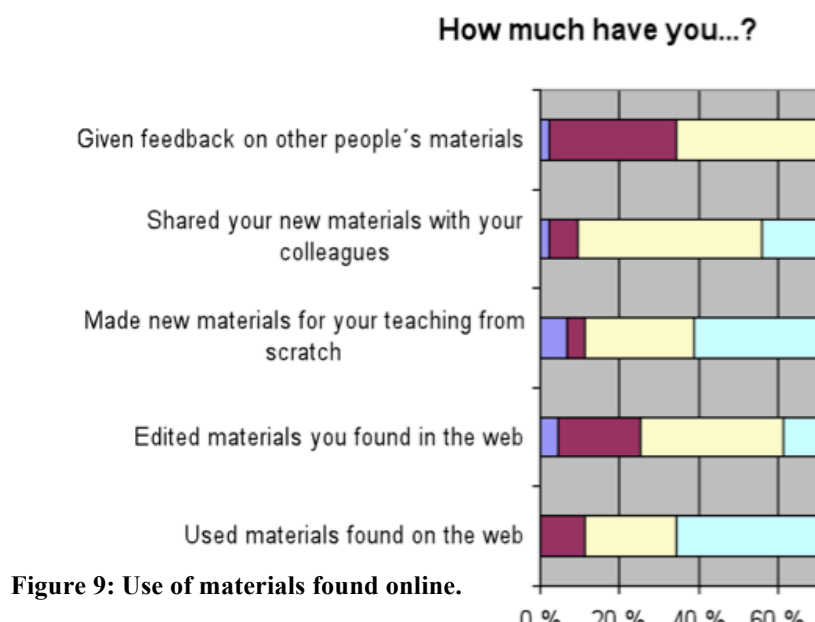
Figure 9: Use of materials found online.

This familiarity and comfort level with using resources found online also helped inform teachers' opinions on ways project tasks could be assisted as a result of improvements in the available tools and portals (90% of teachers were not yet familiar with the ASPECT LRE portal when answering this question). When asked what would better support their tasks, more than 80% thought that search tools they normally found in portals would benefit from further improvements.   They were also hoping to see more resources available that were easily adaptable to their needs with more than 80% indicating this preference as seen in Figure 10.

What sort of function would help you use materials more often?
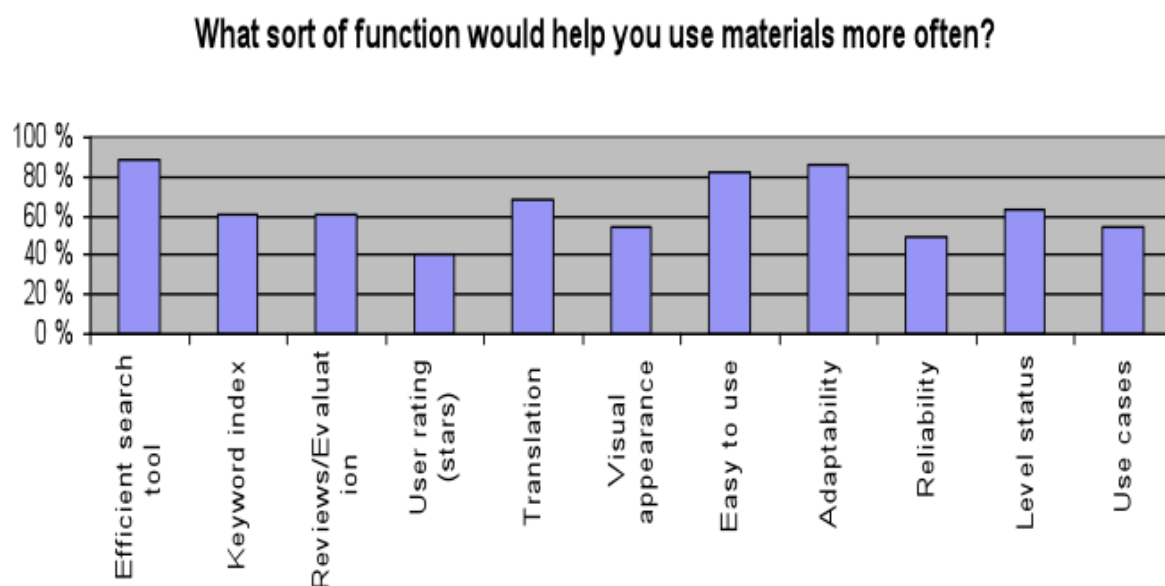
Figure 10: Portal functionalities relevant for the teachers.

Figure 11 illustrates search behaviours employed by participating teachers once they began using the ASPECT LRE portal. The ASPECT LRE portal was a clone of the LREforschools portal that was further developed during the project. The LREforschools portal allows for searching by keyword, subjects, and age ranges to support the needs of educators in discovering learning resources. By far the most common behaviour was to initiate searches using keywords and then followed by a preference to search by subject. When using the ASPECT LRE portal, teachers reported highest satisfaction when searching for images to fit their lesson plan requirements with 65% reporting finding appropriate images. More than a third of the teachers were also satisfied with their ability to discover appropriate simulations, interactive animations and animations for activities and tests.
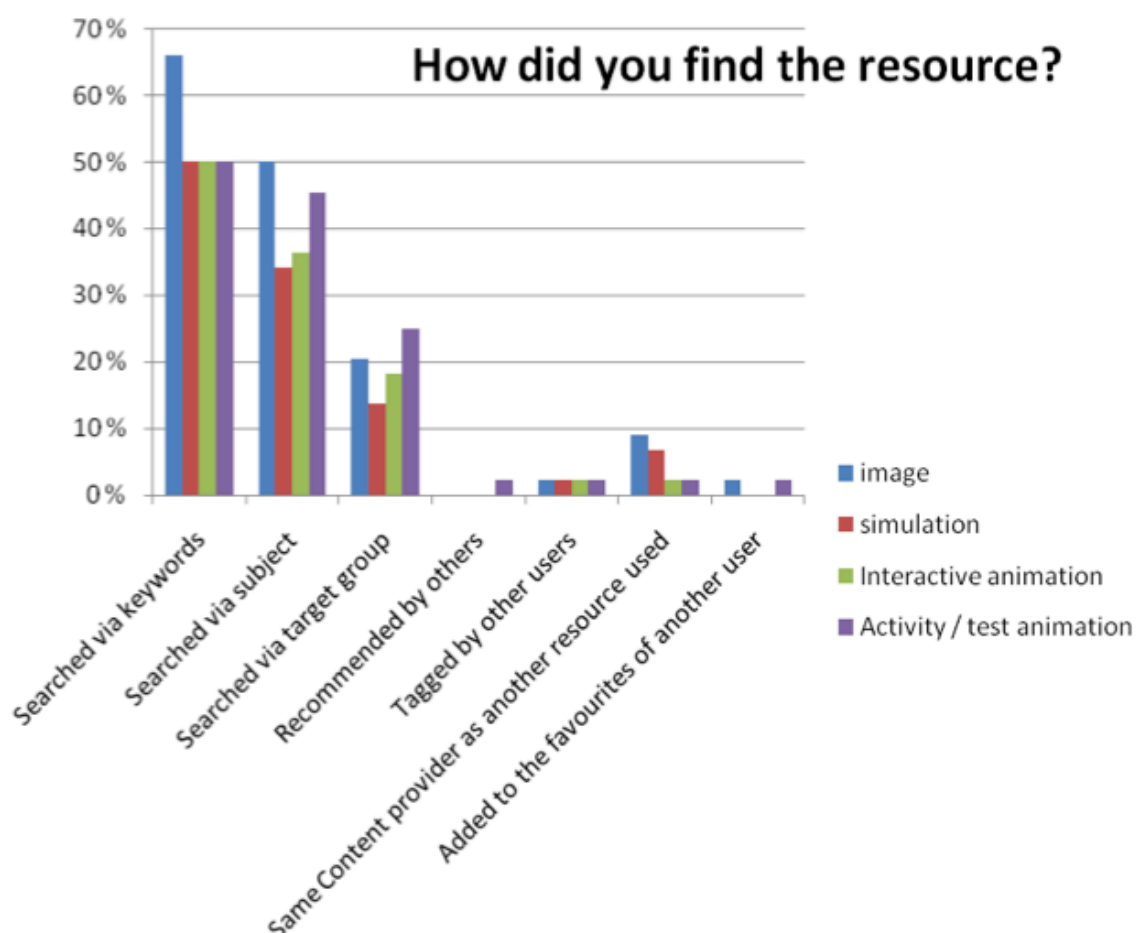
Figure 11: Teachers' search behaviour.

During the course of the workshop, teachers were asked to search for learning resources using the ASPECT LRE portal and Google. We timed how long it took teachers to find resources to create lesson plans with both search engines. We also assessed their satisfaction with the functionalities of the search and their satisfaction with discovered learning content.

There was little difference in the average time needed by the teachers to create a lesson plan with four resources from Google (1h 31') and the ASPECT LRE (1h 36'). The teachers' preferred

search method was to search by keywords in both the ASPECT LRE portal and Google. This familiarity and comfort with only searching by keyword, something known as the "Google effect", meant that other search functionalities tailored for educators in the ASPECT LRE went underutilized initially (such as rating, tags from other users, etc). We noted that teachers who knew about the ASPECT LRE before the beginning of the tests found resources using the ASPECT LRE portal faster than with Google. Although initially teachers treated the portal much as they would any non-education specific search engine, exposure to its features through the workshop resulted in continued interest among them. Five months after being introduced to the ASPECT LRE portal, up to 40% of participating teachers were using it at least once a month to look for resources. We conclude that a large-scale study of teachers involving observations, interviews and analysis of usage logs is highly desirable for improving such services for the education community.

User Trust

Being able to find resources more rapidly did not impact teachers' confidence about the quality of found content. This scepticism held for results coming from searches with Google and with the ASPECT LRE. Workshops that included search exercises also provided an opportunity for us to understand how teachers initially approached digital learning resources they may find and attitudes toward resource sharing across national and linguistic borders. As seen in Figure 12, teachers apply their own "trust" criteria to all resources online. Resources from well-known and authoritative sources and those with high ratings from other educators were most trusted by teachers. It also appears that some teachers trust the

evaluation of others slightly more than their own, which illustrates their preference to validate resource quality as a collaborative activity. The availability of resources in their native language had a relatively minor impact on their assessment of its trustworthiness. This comfort level suggests that teachers are rather open to using resources from other educational and national systems.
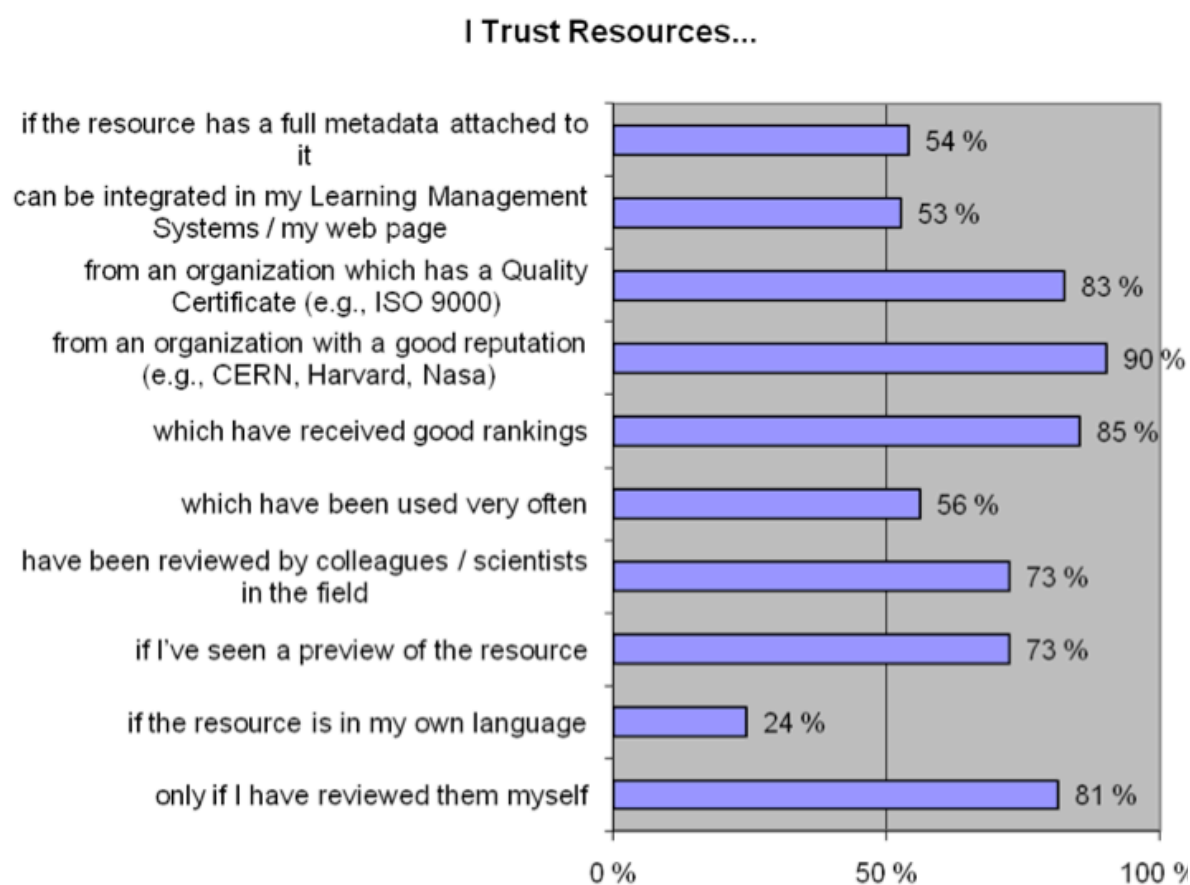
I Trust Resources...

if the resource has a full metadata attached to it — 54 %

can be integrated in my Learning Management Systems / my web page — 53 %

from an organization which has a Quality Certificate (e.g., ISO 9000) — 83 %

from an organization with a good reputation (e.g., CERN, Harvard, Nasa) — 90 %

which have received good rankings — 85 %

which have been used very often — 56 %

have been reviewed by colleagues / scientists in the field — 73 %

if I've seen a preview of the resource — 73 %

if the resource is in my own language — 24 %

only if I have reviewed them myself — 81 %

0 %   50 %   100 %

Figure 12: Teachers' "trust" criteria for content quality.

Teachers often referred to their interest in "quality" learning resources. We asked them to define what "quality" meant for them. As seen in Figure 13, over 70% strongly agreed that quality meant that resources were scientifically accurate and more than 60% strongly agreed that quality meant that the resource had an impact on learners. Given that the groups of teachers were all science teachers, this strong preference for scientific accuracy is not surprising. Further studies of teachers in other subject disciplines will likely demonstrate a different emphasis.

Figure 13: Meaning of "quality" for teachers.
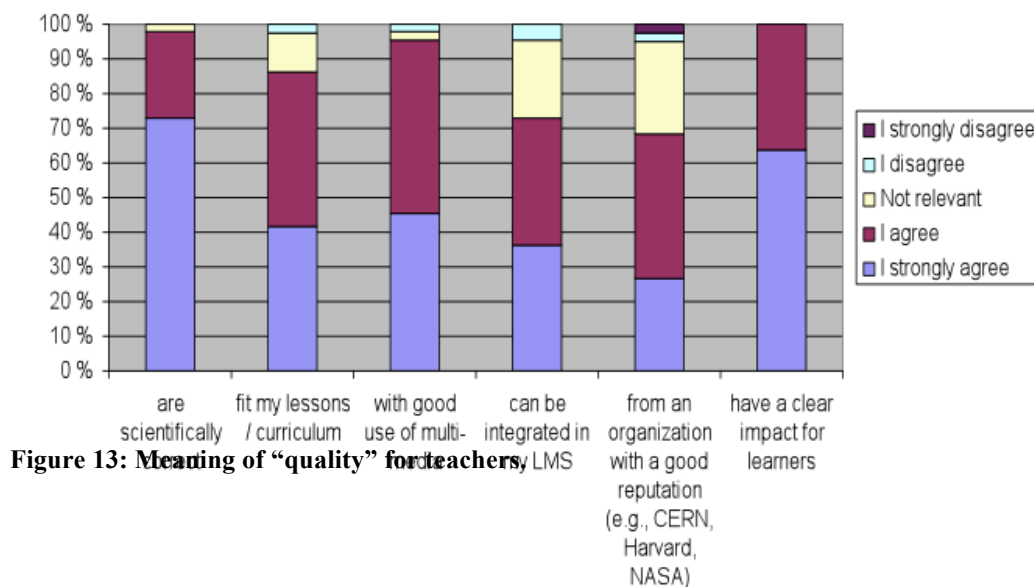
3.2.4 Building Lesson Plans in Moodle: IMS Common Cartridge vs. SCORM

Teachers' reactions and use behaviour patterns with IMS Common Cartridge and SCORM were elicited during a workshop organised in May 2010 in Lisbon, Portugal that brought all the teachers together. User testing focused on the integration of resources into Learning Management Systems (LMS) and content packaging, in particular exploring how different types of "content packaging" can add value to the learning experience. The LMS used was Moodle.

The teachers underwent a training session on the use of Moodle and the integration of packaged resources in the LMS. Teachers who had not experience with Moodle were provided with a basic training session in its use. Once all were familiar with this platform, we asked them to create the same lesson plan four times: 1) normal lesson plan using the Moodle learning platform in a "traditional" way, i.e., by combining different resources; 2) using a resource on the same topic that had been 'packaged' by ASPECT content developers using the SCORM standard; 3) using a resource

on the same topic that had been 'packaged' by ASPECT content developers using the IMS Common Cartridge standard; and, finally, 4) just embedding parts of the IMS Common Cartridge. After accomplishing the tasks, teachers completed questionnaires. (The questionnaires and tests are fully described in the Annex for each of the three workshops).

Figure 14 illustrates teachers' opinions on the level of difficulty they encountered when creating lesson plans with the resources in the four formats. While these teachers (a group accustomed to using digital resources for lesson plan design) were most comfortable with using resources found on web pages there was an overall high acceptance rate for packaged content and in using parts of packaged content, with more than half indicating they found all of the formats either really easy to use or reasonable to use in creating lesson plans.
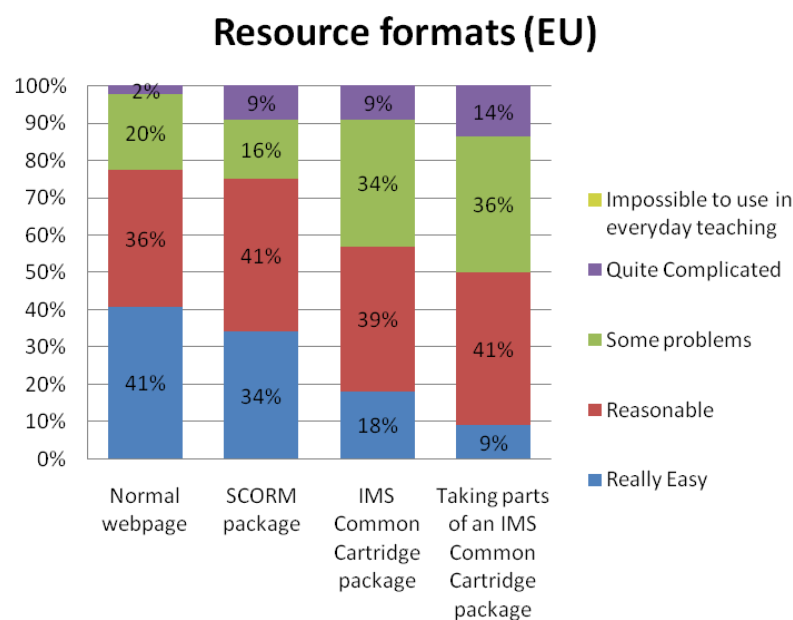
Figure 14: Difficulty creating a lesson plan with the same resource in the different packaging formats.

As part of this usability test, we also asked teachers to create an individual component (a questionnaire) for their lesson plans in Moodle using:

- The Moodle features to create questionnaires (Normal webpage)
- The questionnaire already integrated in the SCORM package
- The questionnaire already integrated in the IMS CC package
- Extracting the questionnaire from the IMS CC package

As shown on Figure 15, in spite of already having the questionnaire made in the packaged resources, the teachers initially had some problems. One in five reported some problems using SCORM and IMS CC packages while one in four had some problems extracting questionnaires from IMS CC packages to embed independently in Moodle. Thus, using packaged content was not perceived as more difficult than using a normal webpage. We consider this as a plus for packaged content given the other advantages provided by content standards like interoperability and platform independence.
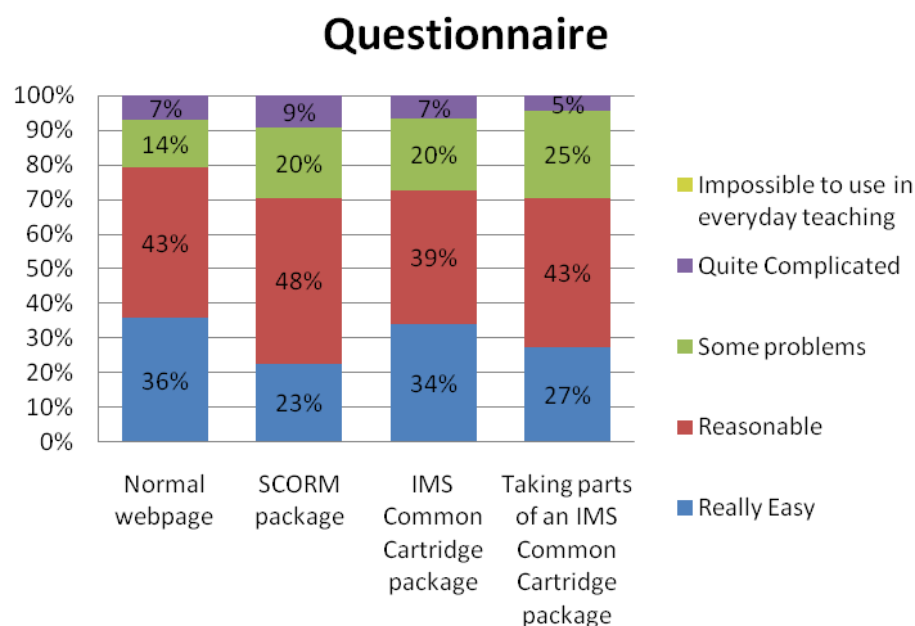
Questionnaire

Figure 15: Difficulty creating a questionnaire using resources packaged in different ways.

Having worked with the different content packages, we asked teachers if packaged resources had potential benefits for teaching and learning. As shown on Figure 16, over 90% of the teachers found they could see the benefits of all four formats in a number of cases, although only the potential of using non-packaged resource in Moodle was seen as extremely beneficial by 50% of teachers, followed closely by the IMS CC packaged resource. Teachers were most skeptical about the wide applicability of SCORM packages with 66% indicating that they would consider these useful only in limited cases.

How big of a benefit do you see when...
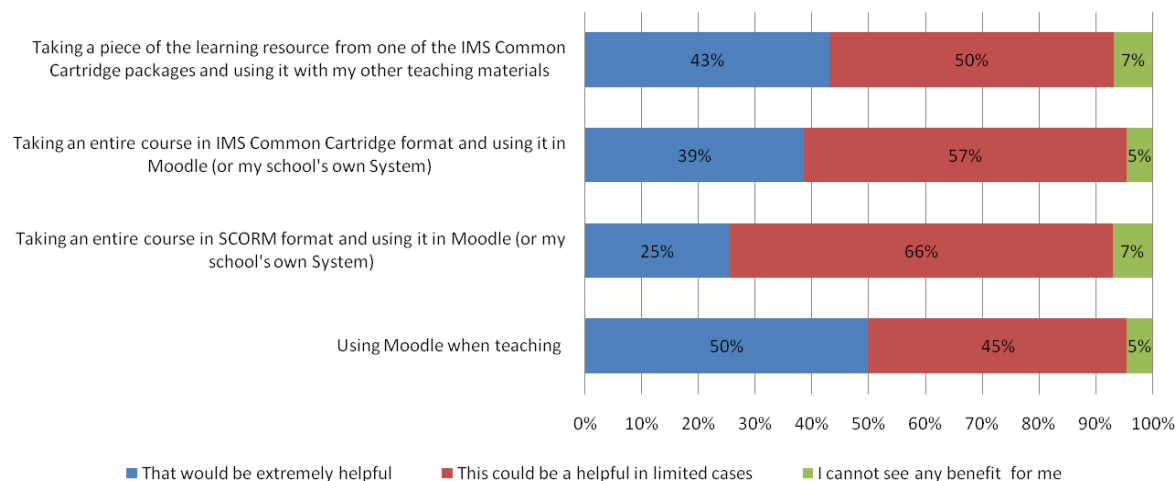
Figure 16: Benefits found by teachers of using resources differently packaged.

In Figure 17 we show the teachers' opinions of using SCORM packaged resources in a LMS like Moodle. Combining the answers "it would save time because one can upload all the parts of the resource at once" and "after some training, it would save time", as they are not mutually exclusive, one can see that about 80% of the teachers from all countries agree they would need some training to use SCORM packages but afterwards it would definitely save them time when preparing their lessons.

I think that using SCORM packages in Moodle...
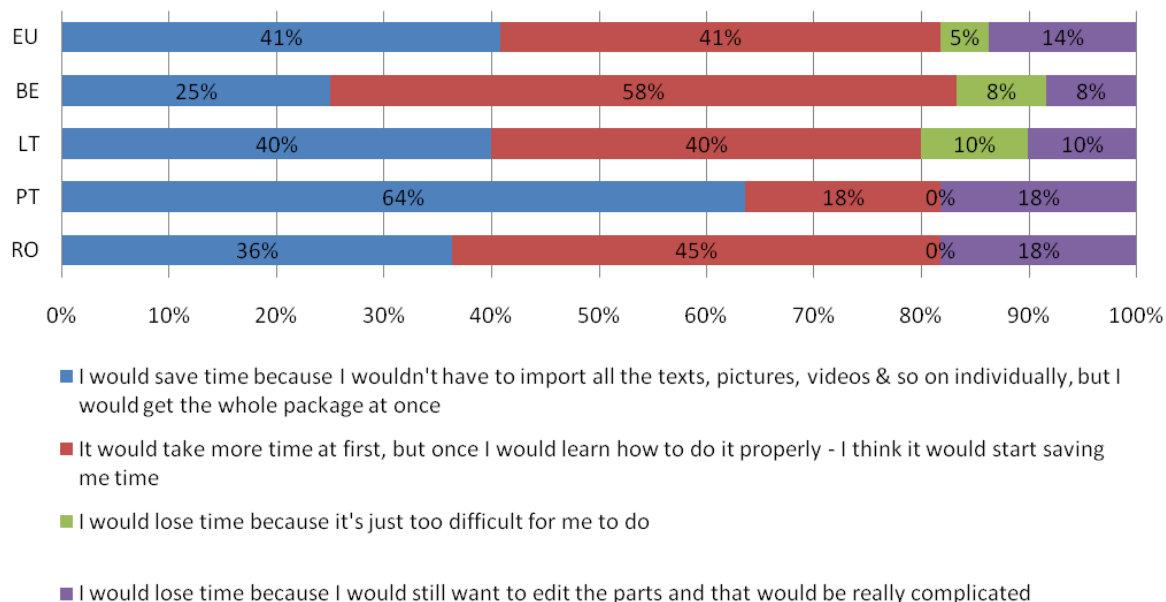
Figure 17: Use of SCORM with Moodle.

In Figure 18 we show the same question but using IMS CC packages in Moodle, also on average and according to the teachers from each country. Combining once more the time saving and the need for some training but finding it useful nevertheless, we see that over 95% of the teachers found IMS CC packages would save them time. Responses were somewhat more positive than for the SCORM packages but, given the small number of respondents (45 for this workshop) it should not be viewed as an overwhelming endorsement from teachers for one format over another.

I think that using IMS CC packages in Moodle…
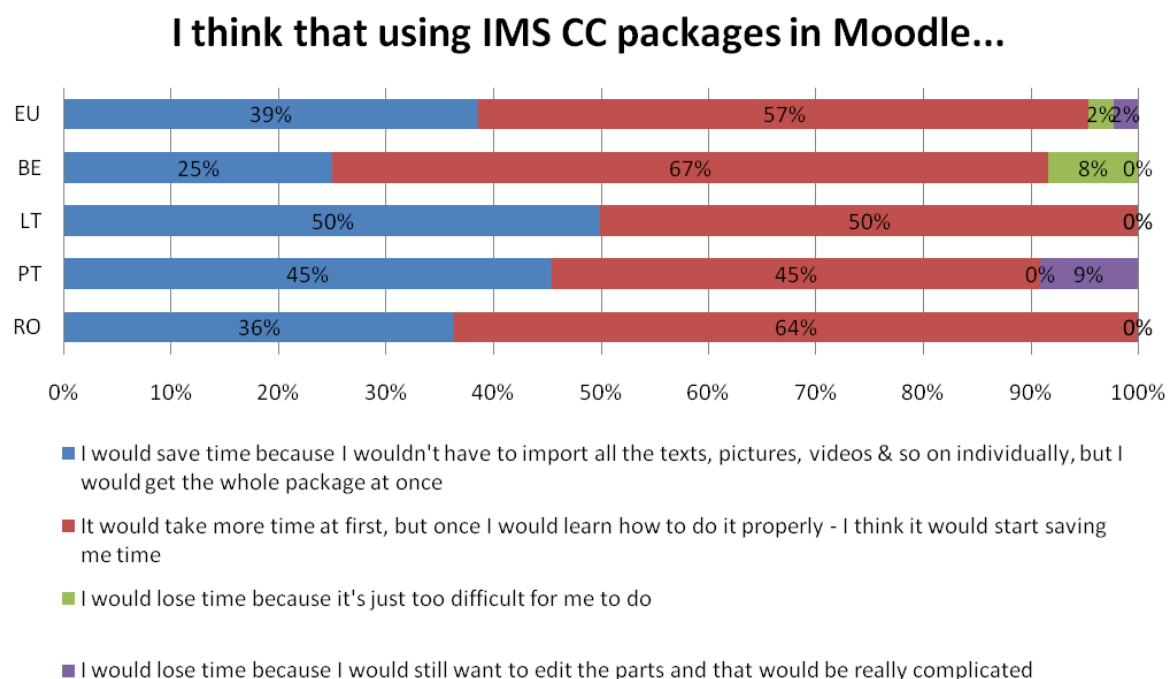
Figure 18: Use of IMS Common Cartridge packages in Moodle.

To control for any bias that may have stemmed from the features of Moodle, we also administered a final questionnaire that elicited opinions on packaged resources used independently of any Learning Management System. In this case the resources were rendered using the Icodeon SCORM player and the Icodeon Common Cartridge platform.

After having used features of different packing formats both in Moodle and other platforms, we asked teachers to indicate their preferences and to explain how they would use packaged content. In Figure 19, we see teachers' preferences when comparing resources in different viewing formats shown throughout the day:

- As a web page
- Using a SCORM player
- Using an IMS CC player
- Integrating the SCORM package in an LMS like Moodle

- Integrating the IMS CC package in an LMS like Moodle
- Whichever format, as they are all similar

Format preference was directly linked to the type of activity the teacher intended to conduct. When teachers intended to use resources for in-class demonstrations, one in three teachers would use a resource on a website, while one in four had no format preferences. However, when creating an online course or setting up homework assignments, they preferred the IMS Common Cartridge packaged resource. We hypothesized that they expressed this preference because features of Moodle, such as a grade book, made it possible to integrate resources and simultaneously track student responses and progress in the same LMS. This issue should be explored in future research projects with a larger group of teachers and using a variety of Learning Management systems.

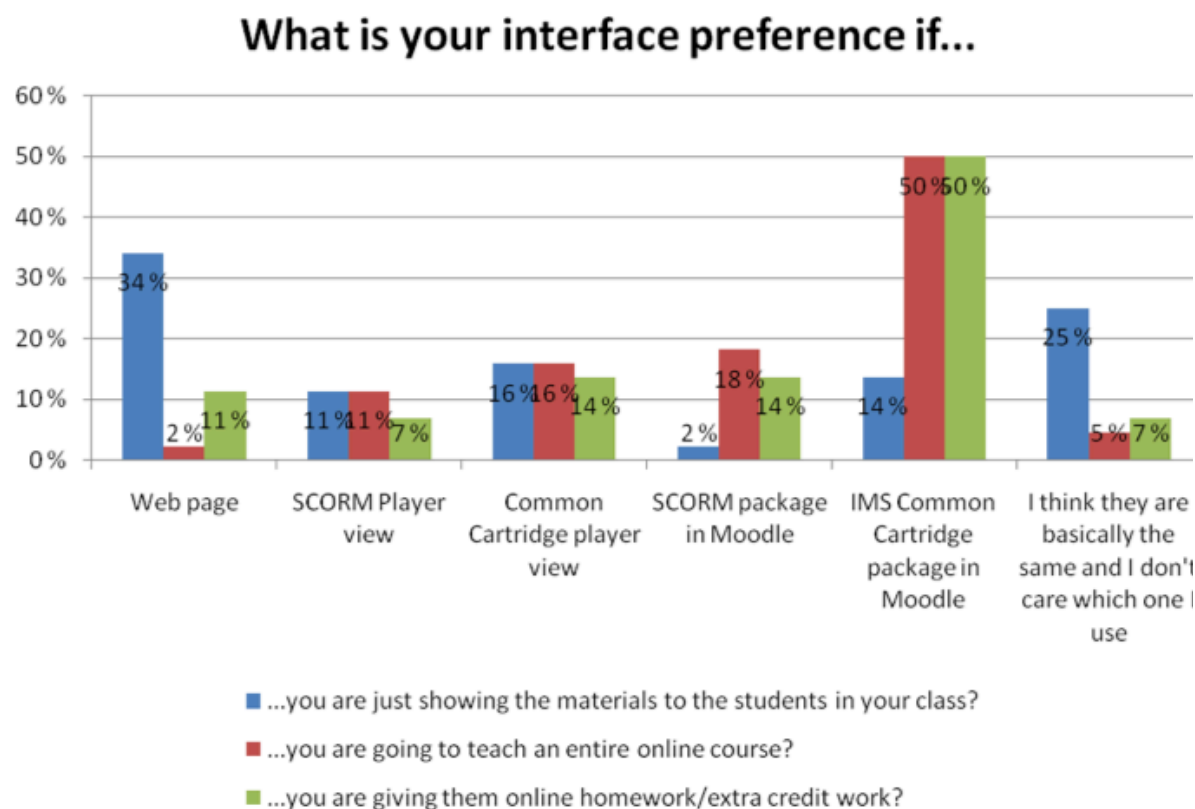## What is your interface preference if...

Figure 19: Interface preferences for different features.

A majority of teachers indicated a preference for learning materials they could adapt to their own needs. Sixty-nine percent of teachers indicated that they preferred using bits of materials that they found on the web and mixing them with other materials (flexible material) over using a packaged course or lesson plan and teaching according to the structured materials. Teachers also expressed enthusiasm for any packaging format and platforms that allowed them to control a wide array of functionalities and features as seen in Figure 20. The question requiring further study is whether teachers that are less comfortable with technology and innovation than the ASPECT 'early adopters' teacher group, would express this preference for working with materials to mix and match or whether they would be

more prone to favour structured material requiring less investment of their time to master.

How important is the following content packaging issue to you?
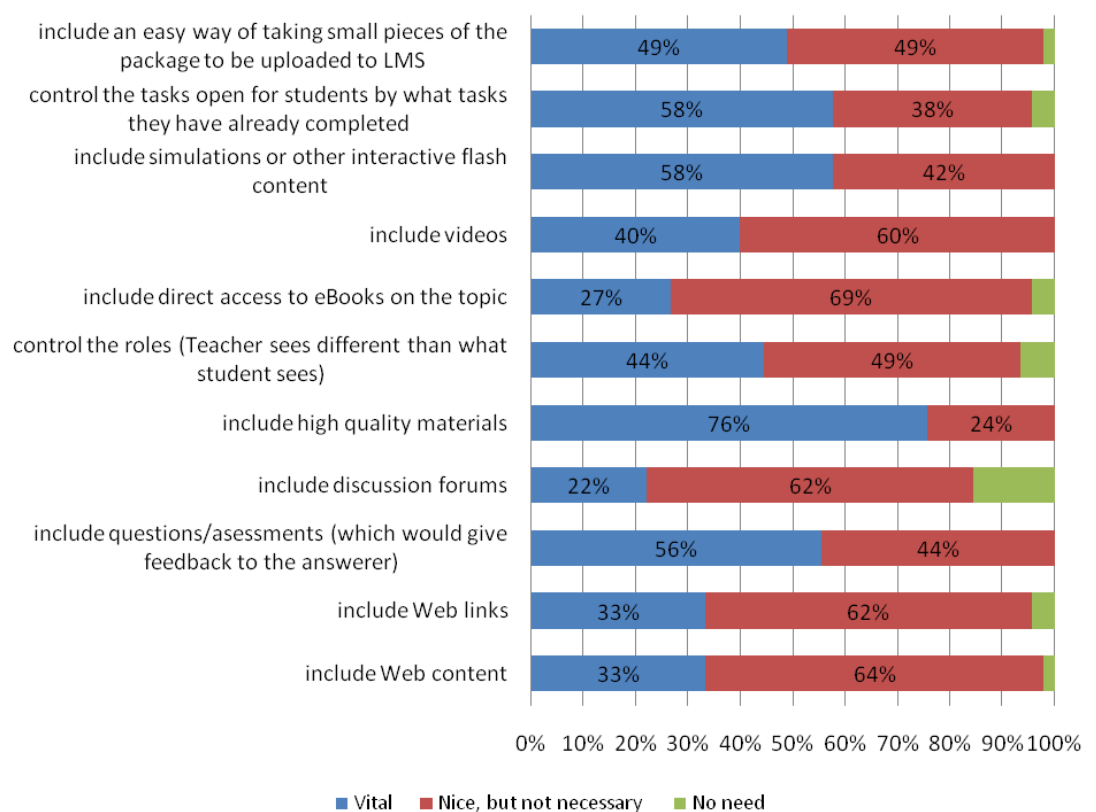

Figure 20: How important is the following content packaging issue for ASPECT teachers?

Ultimately, teachers indicated a strong preference for flexible packaging with many possible features that they could easily modify or fully edit over structured materials that could only be marginally manipulated. This preference explains their willingness

to invest time into learning to work with packaged content in IMS Common Cartridge format. This format allowed for easy reuse of materials in Moodle. They were highly satisfied with functionalities offered by Icodeon's IMS CC platform making it possible to embed parts of the package into blogs, social media, web pages, etc.

3.2.5 Conclusion

Teachers expressed a willingness to use resources packaged in either format, provided there was a sufficient pool of high-quality resources in these packaging formats to choose from. In most cases, a ready-made resource package is not directly suitable for a teacher's lesson. However, if it can be modified to some extent, then the package can become more useful.

Teachers evaluated the functionalities of content packages and regarded the following to be most vital:

- High quality material

- Controlling the tasks open for students by what tasks they have already completed (sequencing)

- Questions/assessments which would give feedback to the answerer (e.g., QTI questions, where the learner immediately gets told by a pop up window whether the answer was right or wrong and perhaps even gives the explanation why)

- Including simulations and other interactive content

- Including an easy way of extracting small parts from the package to be uploaded to a Learning Management System, blog or social networking site

The following functionalities were considered useful, but not vital by most:

- Including Web content

- Including Web links

- Including discussion forums

- Including videos

- Including direct access to eBooks on the topic

- Controlling the roles (e.g., Teacher has their own area and students have their own. Teacher's area contains functionalities where he/she can post tasks for students, whereas the students can only complete the tasks and have no access to edit the content within the LMS.)

Teachers were particularly interested in resources that are flexible and easily remixed.

3.3 Policy Makers

Work package 7 conducted a series of interviews with policy makers from eight countries: Denmark, Belgium, France, Germany, Italy, Lithuania, Portugal, and Slovenia. Our interviewees were personnel who are participating in policy-making related to educational content as well as staff with more in-depth technical knowledge of learning platforms, content repositories, authoring tools, educational resources, and metadata.

Findings:

Ministries expectations from ASPECT

The ministries of education representatives we interviewed expected, from any EU project in general and ASPECT in particular, that the result of these projects be tangible, executable and ready to use. Some would like clear best practices. Others would like to see a good example of ASPECT best practices implemented in a EU country, as one representative from a ministry of education explained, "[I]t is my experience that we can learn a lot from observing and listening to the other European countries." The same interviewee was also interested in publishers' reactions to these standards.

ICT strategy

Policy makers were asked if they had an ICT strategy. The representative of Portugal explained:

> We had a plan that was called the technology plan for education. This started in 2007, and it had three main axes: equipment, training and content. So there was a clear policy for ICT in Portugal. This plan is finishing, and we'll have another one from 2011 onwards, but we are still waiting for the policies to be assured here.

Another representative remarked:

> The strategy is central. Our ministry will provide free learning objects to our secondary school, secondary education. And this state-run content must be free for all students and teachers. It must be from the Internet. ... The ministry supports initiatives from the bottom in the creation of resources. The ministry will support teachers who can create their own resources and teachers who want to share with others.

When asked if they had a policy regarding digital resources or open education resource, one representative explained:

> Yes, we have. As I said, there is a plan, a technology plan for education, and one of the axes is content. This means resources. We've got a schools portal, and the schools portal has got a repository. And what we're doing at the moment is trying to upload as much content as we can into the repository, and also to disseminate to teachers the resources which are there.

The Danish representative explained:

> Yes, at the moment, based on the analysis that was performed last year, UNI-C is working on a ICT strategy for those schools in the K10 to 12 sector. These months we are, together with a consultancy firm, we are and, they are visiting schools in that sector to form the ICT strategy. Both for administrative and pedagogical use. So within a short time period there will be a strategy for that area. At the same time we are investigating whether they could include the K0 to 10 area as well in that strategy and I'm, I can't give you the status on that. But that's also in the, that's in the consideration. So you can have a total ICT strategy for all the educational institutions in Denmark. So there's actually going a lot on, in that are as well. And that will include digital educational material as well, and.. So, the idea is to enhance the use of those… in collaboration with the schools. So. but I don't know what, I don't know, how should I put it. I don't know how precise the strategy will be formulated, 'cause that depends on the result on this work. But it's certainly an area that's in the focus for this work. So we'll see, in a short while we would be able to answer that question but at the moment the work is going on.

The content distributed to the teachers/schools

In general, the content distributed to teachers or schools is free. The problem is that this free content is not sufficient. Therefore, some ministries combine free and commercial content from publisher. As illustrated by the comment below, in some countries, commercial publishers influence the content used by teachers.

It depends on the size of the market. For instance you can have a specific education within the vocational area that there's so few students, that they have to, the schools by themselves have to make the educational materials. Whereas others are as big that they actually form a business model for the professional publishers. And the strategy is that if the areas are, if they are big enough to be a business opportunity, then in general there won't be central or free content published by the ministry. Then it will be the business, the publishers who address that sector. So in some areas you have to produce digital or in other ways, educational material for free. And again in, and that's actually in, especially in the large areas for the K0 to 12, they are big enough to actually be a business for the publishers. So they are doing that, so from our, from […] we have this [B] portal, which contains lots of free material for the teachers and for the students as well. But they will always be for inspiration or to set an example, they will never be the total material that you have to use for the fourth grade in mathematics. The portal will have examples that could be used, and they are always for free, but there won't be enough anyway.

4 Recommendations

The recommendations below reflect the experience of partners in the ASPECT Best Practice Network and are grouped by the different categories of stakeholders involved in the project: content providers and repository owners, tools providers, federation and discovery service builders, and standards organizations. Given that end-users should benefit from standards and specifications rather than be concerned with issues related to their implementation and adoption, they are not addressed as a category of stakeholders.

The general recommendations are those that are applicable to all the categories of stakeholders. Policy making decisions should be informed by recommendations in all the categories.

4.1 General Recommendations

R-G.1: Use standards and specifications.

There are four core reasons to use standards and specifications:

1. They avoid dependency on single vendors (vendor lock-in);
2. Their use facilitates interoperability;
3. Their use lowers costs by making it possible to build higher-level services on top of proven and standard compliant systems;
4. They represent best-practice solutions to known problems even when interoperability is not at issue.

R-G.2: Check conformance.

Standards and specifications are of little value when implemented poorly. Systematic conformance testing permits for verifying that a

specification is implemented correctly and ensures (at least) syntactical interoperability.

R-G3: Select appropriate standards.

Given the profusion of standards available, it is critical to identify the existing standards of communities with which you want to interoperate. When a standard exists that addresses a certain requirement, using it, even if it is complex or incomplete – is often better than creating a new specification. Keep in mind that trying to create a new standard, when existing standards are already available, guarantees failure to interoperate with existing practices!

Do not abuse data elements: Using a data element for content for which it has not been foreseen leads to semantic interoperability problems that are particularly hard to detect. Instead, consider inserting additional elements at extension points foreseen in a specification (see also R-G5).

R-G4: Don't profile without consent.

Interoperability is jeopardized when standards and specifications are customized (profiled) without consent of the target community; in particular when data providers and data consumers use incompatible profiles. Therefore, as much as possible, try to use standards and specifications 'as-is'. A profile must always have a clearly defined scope and purpose for the target community whose needs it should meet. If no formal consensus can be reached in this community, it is recommended to meet the needs of its common practice.

Providing tools that help community members in achieving conformance with profiles can greatly ease the establishment of informal consensus.

R-G5: When profiling, preserve interoperability.

When profiling is unavoidable, keep any customization as limited as possible and profile in a way that preserves interoperability with the original specifications. For example, do not make mandatory elements optional or do not remove terms from an existing controlled vocabulary. If new elements must be introduced, do it only at the extension points foreseen in the specification. Several standardization organizations have created guidelines for application profiles. Examples of lists of dos and don'ts can be found at http://www.imsglobal.org/ap/index.html and http://www.cen-ltso.net/main.aspx?put=922.

R-G6: Combine standards and specifications consistently.

Most solutions call for combining several specifications in a domain profile. Ensure that the standards to be combined work together in a precisely defined way. Moreover, ensure that this combination is compatible with the practices of the target communities. The ASPECT Integrated System, described in ASPECT deliverable D5.4, is an example of how to combine specifications, such as OAI-PMH, IMS ILOX, IEEE LOM, IMS VDEX, in a consistent way.

R-G7: Use a progressive strategy.

Adopting a complete solution can be expensive but interoperability can be built gradually. Build interoperability in stages by adopting specifications most pertinent to your immediate requirements and progressively add other complementary specifications. For instance, adopt first the most common protocol specification in a community for exposing metadata and then add other protocols to address other needs. Always be frank: Describe explicitly which specifications or profiles are fully supported in your application.

4.2 Content Providers and Repository Owners

4.2.1 Interoperable Content

R-CP.1: Only use content specifications when required

If content is always to be used only on a single platform, providing it in a format which this particular platform can process most efficiently is usually more efficient than using a standard format. Nevertheless, the correct functioning of the content in all variants of the target platform should be carefully tested.

R-CP.2: For learning assets, stick to web-standards

When the intention is to make simple learning assets (i.e., images, videos, texts, sounds) widely available, employ web-standard formats, i.e., standards that can be directly rendered in a web browser or only require popular plug-ins such as pdf. For example, in the Learning Resource Exchange (LRE), high-quality images in encapsulated postscript (EPS) format and thus could not be rendered in a browser, were not used before they were made available in JPEG format despite their lower quality. Keep in mind that Adobe Flash is not supported by some mobile systems.

R-CP.3: Learning assets (i.e., single file content) should not be packaged

Web standards are sufficient to make learning assets interoperable and they should not be packaged. Collections of content objects should be packaged as zip files, if the structure of the collection is only used to resolve internal references.

R-CP.4: The distribution of complex content requires packaging

The distribution of complex content requires packaging because such content consists of multiple components that should be rendered in specific ways. Packaging specifications determine how complex content can be rendered. It allows the importing system to infer the intended role of each content object. The IMS Content Packaging specification should be the first choice for describing multi-faceted hierarchically structured content collections. The IMS Question and Test Interoperability (QTI) standard was designed to support the distribution of assessments.

R-CP.5: Use content package specifications used by your intended audience

Packaged content can only be rendered on platforms that support it. Use specifications supported by the platforms commonly used by your intended audience. Contact the developers of the target platforms and request precise information on the formats they can process, i.e. about the read profiles of the target platforms. Ask

them for tools to test whether your content conforms to their requirements.

4.2.2 Open Content

R-CP.6: "Creative Commons" maximizes reuse

If you plan to use open content to maximize reuse, opt for a Creative Commons license.

For example, the LRE specifically encourages Creative Commons Attribution.

4.2.3 Commercial Content

R-CP.7: Make sure the distribution of interoperable content does not conflict with your business model.

There are two main categories of scenarios for accessing content. Either the content is delivered to the user or a list of links is given to the user and the content remains on the content providers' server. Since Digital Rights Management (DRM) solutions are not supported in the technology-enhanced learning domain, controlling content access requires another combination of licensing regimes and technical solutions.

When content is delivered to an institution and delivered through a learning management system (LMS), an appropriate license agreement can be enforced by the LMS's access control mechanism. When content remains on the content provider's server, that server can control access by requesting credentials or by identifying the calling system through its IP address.

The IMS Common Cartridge and Basic LTI specification define ways to control content access. It should be checked whether these features are supported by the target systems.

4.2.4 Describing Content

R-CP.8: Make metadata creation easy and, where possible, try to generate metadata automatically.

Metadata is necessary for effectively managing, finding, and assessing the usefulness of learning resources. However, creating quality metadata is a challenging activity. Most users don't like to describe learning resources and usually produce poor or incomplete descriptions while professional indexers are expensive and not always consistent over time. Many metadata elements either already exist in one form or another and can be reused or can be produced in an automatic or semi-automatic way from the resource itself or its context. Moreover, tools exist for automatic metadata creation (such as the Simple automatic metadata generation Interface – SamgI). Therefore, each time it is possible and relevant, put in place tools and services to automate the generation of metadata. The LRE Service Centre provided by ASPECT offers examples of such tools and services such as:

- The LRE automatic metadata translator that allows for systematically translating English metadata into 6 additional languages.
- The ASPECT metadata transformer that, in a fully automated way, extract metadata from a common cartridge package, generates the corresponding metadata record in a specified standard, and exposes it using OAI-PMH.

R-CP.9: Combine as many sources of information as possible about the resource.

Descriptive metadata provided by content providers is only one of the possible sources of information about a learning resource. It can be complemented by other valuable information such as:

- Usage data, such as the number of times a resource is retrieved;
- Explicit feedback from users, such as ratings and annotations (Web 2.0 tools and practices);
- Third-party metadata provided by aggregators or reviewers.

This type of information provides feedback to enhance searching by users and ranking and feedback helps providers better understand issues related to the quality and usage of their content.

4.2.5 Exposing Content

R-CP.10: Expose metadata and content in as many ways as possible.

Each specification supports a different way of exposing metadata (e.g., metadata harvesting with OAI-PMH, search with SQI, metadata publication with SPI). These specifications make possible the development of different types of specialized discovery services. Although such services offer high degrees of precision in searches, it is important to recognize that a significant number of users rely on a different set of discovery tools. These include web search engines, social web services, full text indexing, etc. Therefore it is important to expose metadata and content in ways that make them accessible by these tools.

R-CP.11: Register your repository to ensure its discoverability.

Learning object repository registries, such as the ones developed in ASPECT, allow content aggregators to easily discover and access repositories. Properly describing a repository in such a registry

ensures that its content will be made available in the federations that use this registry.

R-CP.12: Describe each re-usable part of content

If content can be disaggregated, as in the case of Common Cartridges, describe each re-usable part with appropriate metadata so that it can be easily found. Metadata for parts can be inherited from metadata of the package but their validity needs to be checked.

4.3 Tools providers

R-TP.1: Build tools that support all features and options in a specification.

Some specifications (for example IMS Common Cartridge, IMS LODE, IMS QTI) define core profiles reflecting common practice.

Tools producing data should allow use of all features of these core profiles and they should have a mode disabling all features beyond those defined in the respective core profile. Tools consuming data should be capable of reading all data conforming to the core profile. They should at least tolerate additional data provided at specified extension points.

R-TP.2: Support content specifications best adapted to the type of learning scenarios a platform supports.

ADL SCORM is best suited for self-paced learning, IMS Common Cartridge is best suited for blended learning, IMS Question and Test Interoperability for assessments. Tools' providers might

support one or more of these content specifications depending on the type of learning activities provided by their learning platforms.

4.4 Federation and Discovery Service Builders

R-DS.1: Minimize the cost of joining a federation.

If the barriers to joining a federation are too high, the infrastructure will not be used. Means to lower such barriers to entry include:

- Only requiring simple metadata application profile(s);
- Making appropriate tools available for joining (e.g., metadata generator, conformance tests, transformer services, metadata translators, identifier service, metadata enrichment service);
- Supporting multiple ways to join the federation both as content provider and consumer (i.e., supporting as many protocols as possible);
- Providing reference implementations for the main protocols (both server and client side);
- Providing mechanisms for sharing usage data and feedback on content within the federation.

R-DS.2: Offer persistent management of learning resources and metadata.

The following set of services and tools are recommended for this purpose (Note that the order does not impose a priority):

- A *Collection Registry* for learning object repositories is needed for providing up-to-date information on the repositories in their network. It provides interoperability between numerous LORs and other collection registries.
- An *identifier service* should be provided for maintaining persistent unique identifiers for learning objects.
- A *validation service* must be provided that checks both the syntactic and semantic validity of metadata instances against multiple standards, specifications and their application profiles.

- o A broken link checker must be provided to ensure the availability of the learning objects referenced in metadata.
- o It cannot be expected, nor is it necessary, that all content providers over the world should support one and the same metadata standard or application profiles. Therefore, a *transformation service* should be provided that converts metadata from one format, for instance Dublin Core or IEEE LOM, into another format, for instance IMS ILOX.
- o An *enrichment service* must be used to enrich incoming metadata from content providers in order to enable better discovery rates of resources. Examples of enrichments are automatic translations of titles, descriptions, etc.
- o An *application profile registry* is recommended for storage of descriptive information about application profiles conforming to a specified schema. It should be connected with links to the formal documentation of the application profile required for validation and with links to the validation tools mentioned above. Moreover the application profile registry should provide information whether a profile in the registry is a restriction of another one.
- o A *vocabulary bank* should be used in which controlled vocabularies can be published and disseminated in a range of standardized interchange formats.
- o A client tool such as a *harvester* should be used to semi-automate the process from harvesting metadata from content providers to making it available in the broker network.

R-DS.3: Establish good communication channels between the different stakeholders of a federation.

A good communication between the different stakeholders of a federation is key to ensure federation service quality. For example, communication with content providers requires that:

- Clear training documentation for content providers must be provided to successfully publish materials in a federation.
- Content providers must be able to subscribe to news-feeds that inform them whether a harvesting cycle (harvesting, identification, validation, etc.) succeeded or not.

- Request for Change tools such as TRAC are deployed to enable people to report problems with services, tools, etc.

R-DS.4: Use already existing best practices and tools when setting up a federation.

The ASPECT project and others have produced many recommendations, tools, and best practices for efficiently managing federations. All these tools and services are available on the LRE service centre provided by ASPECT.

4.5 Standards Organizations

R-SO.1: Support the development of free and user-friendly tools to edit, deploy, re-arrange, and play educational content.

These tools should have open interfaces following open specifications. Coordinate the development of these tools. Leverage the potential of open source development in Europe.

R-SO.2: Provide community-based conformance competence forums, supporting stakeholders which apply open educational standards. These centers should be freely accessible for all. They should allow for open discussions of practical interoperability issues.

No specification can foresee all potential issues. Authorize a specification management group to rapidly provide preliminary recommendations on how newly emerging issues should be handled until the specification is updated.

R-SO.3: Support the development of application profiles and domain profiles of existing standards reflecting what is used in common practice.

Provide tools helping software developers and content authors to become fully compliant with these profiles. Develop a culture where the end user can rely that *all* features described in these profiles are implemented in any product that claims conformance. Only release standards and profiles that have been fully implemented and tested.

R-SO.4: Maintain backward compatibility

Whenever possible, data conformant to one version of a specification should remain conformant when the specification is updated. This builds trust into the specification, avoids re-engineering costs prevents slow-down of specification take-up.

R-SO.5: Do not encode controlled vocabularies in bindings.

Controlled vocabularies evolve rapidly to meet changing requirements and must often be available in multiple languages. Terms and their definitions must also be documented. The management of controlled vocabularies is optimized when they are encoded using specifications such as VDEX, ZTHES, or SKOS and stored in a bank (such as the ASPECT Vocabulary Bank for Education) independent of a binding. The binding can then refer to these external vocabularies. This comes at the price of an extra look up for resolving an identifier into the corresponding vocabulary term in a given language. However, the benefits (e.g., better management of controlled vocabularies, support for

multilingualism – see R-SO.6) are worth this extra cost. Moreover, in order to lower this cost, ASPECT has developed an array of tools to integrate binding and vocabularies. These include the ASPECT transformer service, the ASPECT Application Profile Registry, the ASPECT Vocabulary Management Tool, the ASPECT Validation Services. When using changing vocabularies, make sure content is conformance tested using the latest version of the vocabularies in use.

R-SO.6: Uniquely identify each controlled vocabulary and controlled vocabulary term and only use identifiers in metadata records.

Because identifiers are language neutral tokens, they can be associated with multiple translations of the same term. Using tokens in metadata records makes it possible to display in a given language a metadata record created in another language provided that both languages are available in the vocabulary bank.

Note that this recommendation is applicable to all organizations developing controlled vocabularies, not just standards organizations.

5 Benefits Management Experiment

Benefits management techniques where introduced in ASPECT to explore whether it was possible to demonstrate the benefits of specifications and tools for various stakeholders.

Benefits management consists of establishing a taxonomy of benefits (e.g., improved search and discovery of educational resources) and a taxonomy of features and capabilities (e.g., a given specification such as OAI-PMH or a tool such as a harvester). The technique involves the establishment of causal links between the two taxonomies in an attempt to ascertain if a given capability contributes in a positive or negative way to one or more concrete benefits for the stakeholders.

Figure 21 is a diagram of the ASPECT benefits taxonomy, features and capabilities taxonomy, and their causal links.
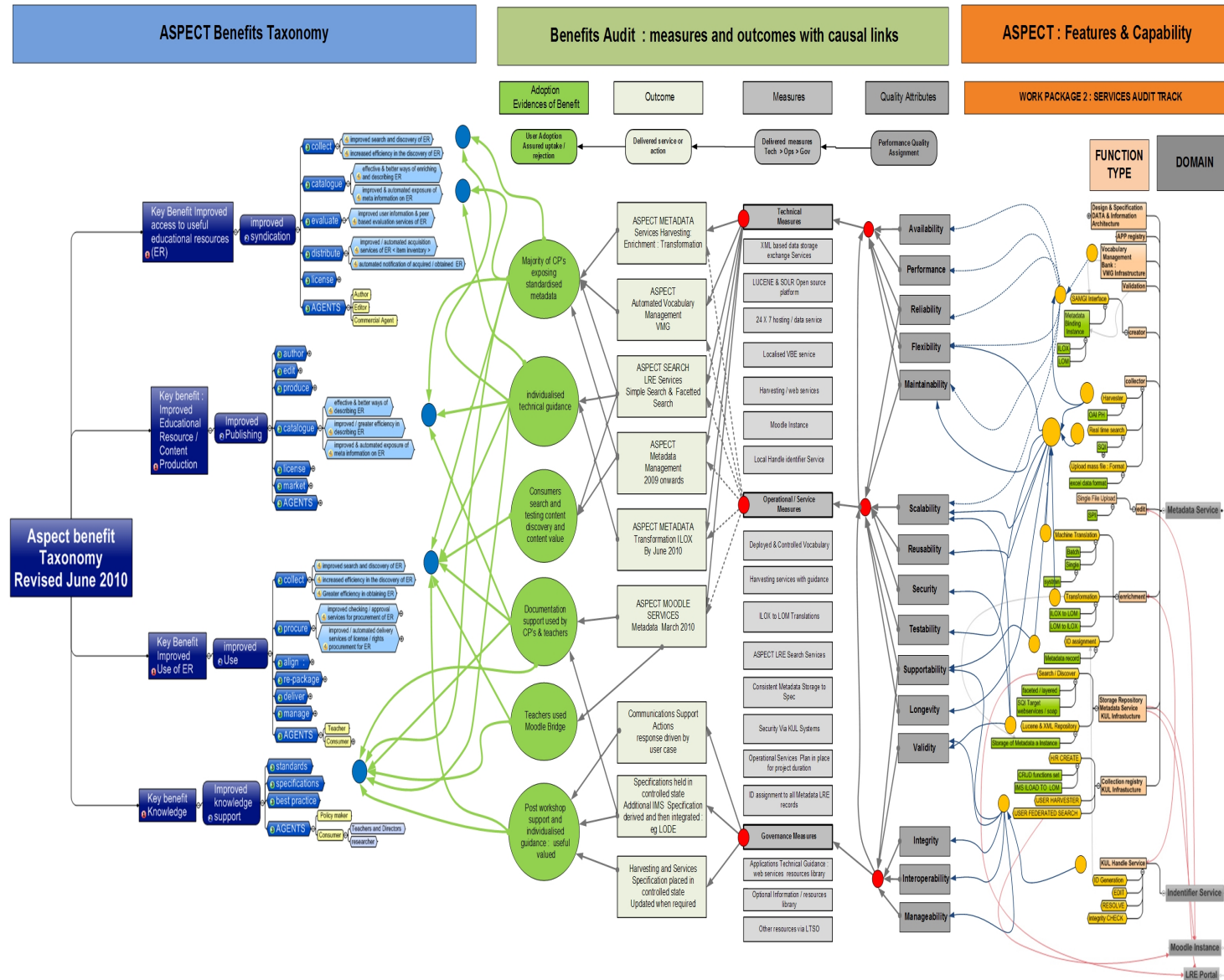
Figure 21: The ASPECT benefits taxonomy, features and capabilities taxonomy, and their causal links.

Some of the most salient findings of this exercise were:

1. The effective deployment of a standard based metadata harvesting service contributes to:
    a. An increased efficiency in the discovery of educational resources;
    b. Effective & better ways of enriching and describing educational resources;
    c. An improved & automated exposure of meta-information on educational resources.

2. The effective deployment of SCORM and Common Cartridge toolkits and suites contributes to:
    a. Better ways of modifying educational resources.
    b. An improved playability of educational resources.

3. The Icodeon SCORM and Common Cartridge players contributes to:
    a. An easier integration / interoperation of ER in a user technical environment.
    b. An automated or improved content delivery services into LMS / Content Player tools.

4. The effective deployment of metadata machine enrichment services contributes to:
    a. An effective & better ways of enriching and describing educational resources.

The results of this experiment demonstrates that this technique is not well-suited for a project such as ASPECT because, despite the amount of effort involved to carry out this experiment, it was only possible to demonstrate a limited subset of the actual benefits afforded to the ASPECT stakeholders.

6 Conclusion

As a Best Practice Network, ASPECT successfully fulfilled its objectives. The main gaps that were identified in the first evaluation report (D7.3.1) were effectively addressed during the second half of the project.

ASPECT productively compared how a range of standards and specifications can be applied to a diverse range of learning resources from both commercial and public sector providers. In particular the project successfully:

- Evaluated how the implementation of standards and specifications can enhance interoperability of educational resources and the systems that are used to develop, discover, transfer, and use that content.
- Efficiently carried out practical implementations of a range of content standards and specifications considered to be of strategic importance for the school sector by ministries of education and commercial developers.
- Demonstrated how to improve support for multilingualism in metadata.
- Established the Learning Resource Exchange as an example of best practices for combining existing specifications into a complete solution that addresses the needs of the school community in Europe in terms of discovery, exchange, and reuse of learning resources.
- Provided dissemination events that promoted consensus building and raised awareness related to standards for educational content and reached a larger and broader audience than originally envisioned at the start of the project.
- Offered recommendations on how combined standards and specifications can be taken to scaled and adopted.
- Helped shape the direction of standardization activities and outcomes by directly contributing to the development of nine new specifications.