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ASPECT

Release 2 of the integrated system

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eContentplus

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¹ OJ L 79, 24.3.2005, p. 1.

Summary

Deliverable D5.4 provides an overview of the integrated system that has been developed as part of the ASPECT project.

ASPECT is a Best Practice Network that aims to improve the adoption of learning technology standards and specifications in the areas of content use and content discovery. As part of its activities, the ASPECT project produces recommendations and best practices for the efficient use of these standards and specifications as well as an integrated system that demonstrates how the use of specifications and standards enables interoperability in terms of content use and search and retrieval of learning resources.

The integrated system is broken down into a sequence of processes related to specific stages in the following value chain: creating and validating packaged content; applying metadata specifications to content; making resources available through the harvesting process; and finally, searching and using resources.

In the first part on creating packaged content, we describe the key processes involved in using specifications for content packaging using the IMS Common Cartridge specification as our key example. We look at the tools and processes involved in packaging content and stress the importance of testing packages for compliance with the specification used, and finally we look at one of the tools that have been made available for runtime testing of packages as part of the ASPECT project.

In the section on metadata, we focus on the tools and processes set up to ensure ease of implementation as well as compliance with metadata standards and specifications. The two major tools we look at are the ARIADNE Validation service and the ASPECT Test System.

In the third section we look at what could be described as the core of our integrated system. Here we integrate a wide variety of essential tools and services in a complex, almost completely automated process of harvesting, validating, converting, translating and enriching metadata. We look at the workflow involved and the roles played by various elements of the integrated system.

In the fourth section, we illustrate the tools integration we have carried out to make life easier for the end-user. We illustrate the way in which Icodeon tools have been integrated into the LRE to allow users to run SCORM and Common Cartridge packages directly from the LRE search results page. We also describe another kind of integration where LRE search functionality is accessed directly from within a Moodle LMS. And we show how Common Cartridge packages found through the LRE search interface can be imported directly into a Moodle course and rearranged to suit the purposes of a specific lesson plan.

Contents

SUMMARY.....	2
1 INTRODUCTION.....	4
2 CONTENT PACKAGING	6
2.1 INTRODUCTION	6
2.2 PROCESSES AND TOOLS	6
2.2.1 Packaging resources.....	7
2.2.2 Validating packages	8
2.2.3 Running packages.....	14
2.3 SUMMING UP.....	14
3 METADATA.....	16
3.1 INTRODUCTION	16
3.2 PROCESSES AND TOOLS	16
3.2.1 Validation tools.....	17
3.2.2 Metadata Transformation	19
3.3 SUMMING UP.....	19
MAKING RESOURCES AVAILABLE.....	20
3.4 INTRODUCTION	20
3.5 ASPECT AUXILIARY SERVICES.....	20
3.6 THE GLOBAL VIEW OF HARVESTING	21
3.7 SUMMING UP.....	22
4 SEARCH, RETRIEVAL AND USE	23
4.1 INTRODUCTION	23
4.2 SEARCH AND RETRIEVAL.....	23
4.2.1 Automatic translations in interface.....	23
4.2.2 Metadata enrichment	24
4.2.3 Other advanced search features.....	24
4.3 TOOLS INTEGRATION AND CONTENT USE.....	25
4.3.1 LRE to external tools	25
4.3.2 Moodle: integrated search and retrieval.....	27
4.4 SUMMING UP	31
5 CONCLUSION	32

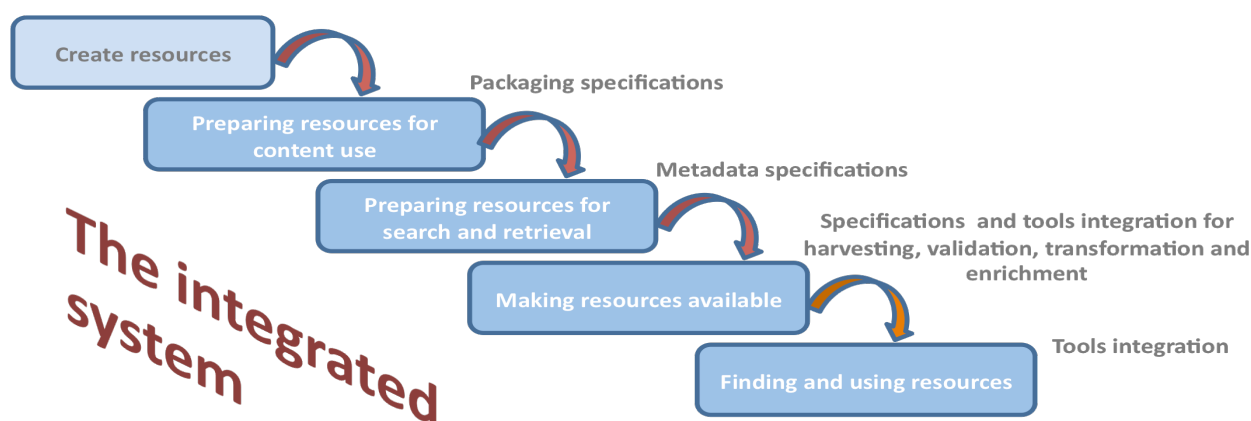
1 Introduction

ASPECT is a Best Practice Network that aims to improve the adoption of learning technology standards and specifications in two important areas: we are concerned with *specifications relating to content use* and *specifications relating to content discovery*. In the area of content use we have so far been looking primarily at content packaging specifications. In the area of content discovery we have been working with a whole range of specifications relating to, among other things, metadata, vocabularies, protocols, and registries.

As part of its activities, ASPECT produces recommendations and best practices for the efficient use of these standards and specifications. However, ASPECT also provides a number of essential components, primarily tools and services from different partners, for supporting the practical use of the standards and specifications. And last but not least, ASPECT integrates these components with the LRE, the Learning Resource Exchange of the European Schoolnet, so that the recommendations of the project can be tested and validated in a real-world setting.

This document describes the second release of the *integrated system*. As the integrated system represents the essence of more or less all activities and deliverables undertaken in the project, we will have to repeat some of the information provided in other deliverables, but we will avoid going into technical details that are explained elsewhere. We aim to provide an overview of the integrated system that will illustrate how all parts of the ASPECT project are related.

For the sake of simplifying matters, we break down the system in a sequence of processes that we group according to what we could consider ‘related functionalities’ or stages in the value chain from content developer/provider to end-user:



- **Preparing for content use** by applying content packaging specifications. This section will cover the issues of packaging tools as well as compliance and runtime testing of packages.



- **Preparing for search and retrieval** by applying metadata specifications. This section will cover issues and processes relating to metadata, primarily tools for validation and conversion of metadata.
- **Making resources available** by applying specifications for harvesting. In this section we will describe the processes involved in moving metadata instances from local repositories into the LRE. This includes tools and services built around the ARIADNE harvester, validation, RSS, email status of harvesting etc., as well as all the processes and tools involved in metadata enrichment, translation and indexing that are part of the final processing before the metadata are retrievable through the ASPECT LRE portal.
- **Search, retrieval and use.** In this section we will illustrate how resources can be located and displayed in various ways, depending on the resource type. Most resources are web-based and will be displayed directly in a browser window. Packaged resources, however, need a somewhat more complex environment such as the Icodeon SCORM player, the Icodeon Common Cartridge Platform, or a Moodle LMS. Here we will show how those platforms have been integrated.

2 Content packaging

2.1 Introduction

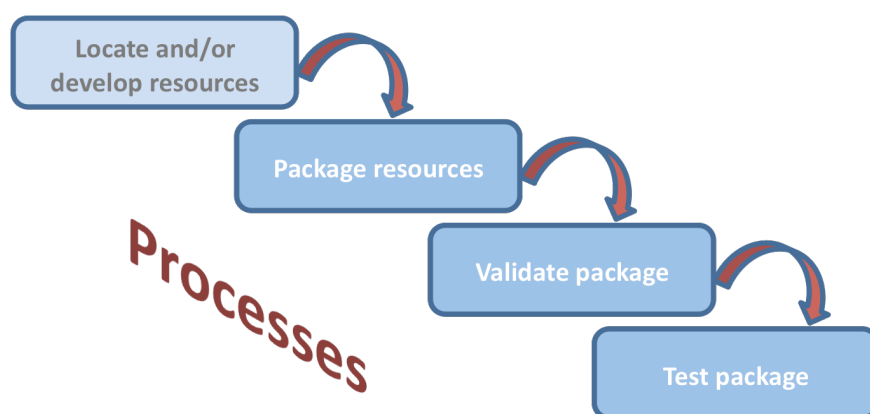
Most web-based or online learning resources are not packaged according to a generally accepted standard or specification. Nevertheless, content packaging plays a central role in the ASPECT project due to the benefits that the application of standards and specifications to content can provide to both producer and user of online learning resources.

We have worked primarily with two different sets of specifications for packaged content: SCORM and the IMS Common Cartridge. SCORM has been around for a long time and has been generally accepted in certain areas due to its focus on individualized, self-paced learning. The IMS Common Cartridge is a relatively new specification that aims to address some of the issues that may have made SCORM a less obvious choice for schools and some Ministries of Education in Europe. The IMS Common Cartridge specification is intended and designed for learning resources that will be used in blended learning environments.

As SCORM is a relatively well-known format, the primary concern of ASPECT was to explore to what extent content providers and users would perceive the IMS Common Cartridge format as an improvement over SCORM and a better example of a best practice specification than the SCORM format. For this reason, in this deliverable we will focus primarily on Common Cartridge examples and tools to illustrate the packaging processes.

2.2 Processes and tools

The workflow when packaging content based on the SCORM and IMS Common Cartridge specifications involves the following processes:



The only process that ASPECT is not concerned with is the very first process where the content provider locates or develops the resources to be used in the package.

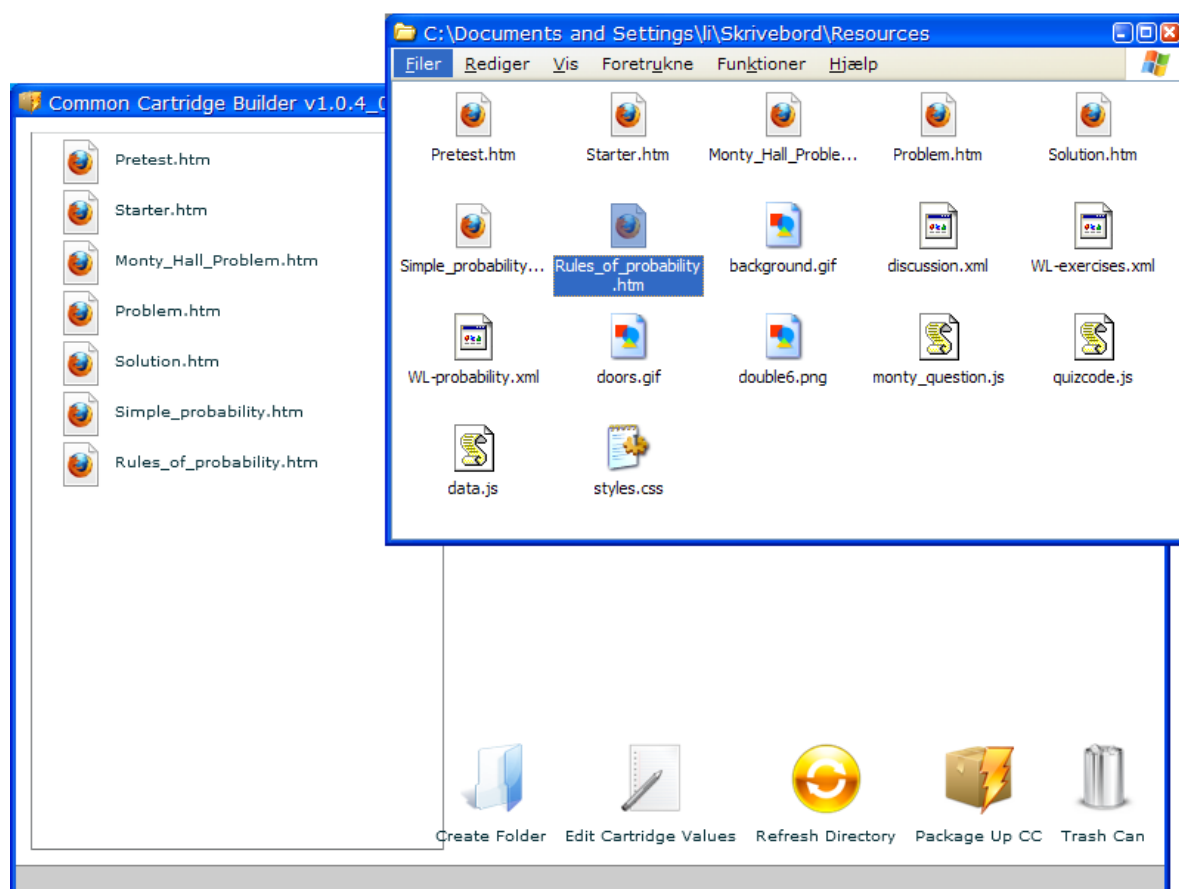
2.2.1 Packaging resources

Currently there are not all that many tools for creating Common Cartridge packages, although the number is growing. In the ASPECT project we have explored the following tools in particular:

- *MIR* – an open source reference implementation of the IMS Common Cartridge Specification. Users can author, import and launch cartridges. The project is a joint effort between IMS, Microsoft and LearnGauge.
- *Common Cartridge Builder* – an Adobe AIR application that allows you to easily and quickly assemble a Common Cartridge by dragging and dropping files from your file system onto the application window. The Common Cartridge Builder, which is currently a beta application, is provided for free by Learning Components Inc.

We illustrate the first step in content packaging by sketching the steps in the process using the *Common Cartridge Builder* and a set of resources that were developed for the ASPECT workshop on Common Cartridge that was held in Aarhus in November 2009.

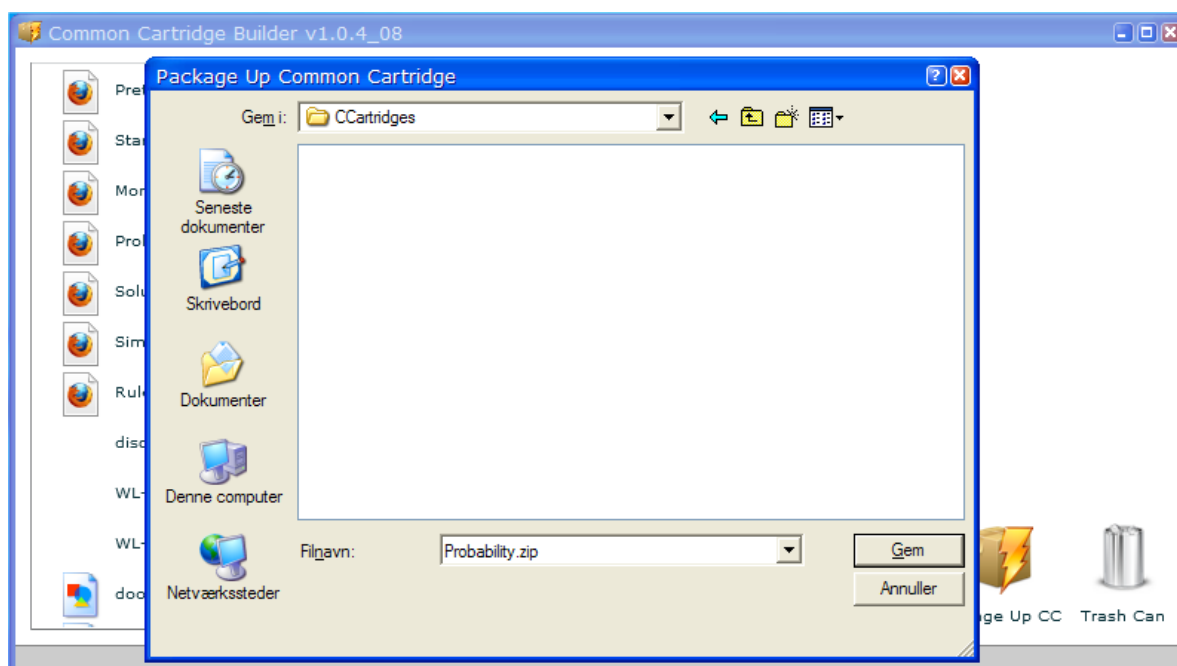
In the Resources folder we have all the resources that are needed for our Common Cartridge package. As you can see, there are a number of HTML-pages, a couple of images (.png and .gif), a stylesheet file (styles.css) and some JavaScript files:



In order to create a Common Cartridge package, we simply drag the files into the Common Cartridge Builder window and drop them there. Once we have dragged all files into the window, we can change the order, we can make some files invisible so that they aren't shown as menu items when the package is displayed, and we can add metadata and keywords or change the types of special resources such as discussions and web links. We have all the basic functions related to creating Common Cartridge packages.

The details of how you do these things have been described in the *Common Cartridge Tutorial* that was written as a supplement to the Aarhus workshop mentioned earlier – and they have also been presented at other workshops and webinars. As the tutorial is available on the ASPECT website (http://aspect-project.org/sites/default/files/docs/ASPECT_D5p4.pdf), we will not go into more detail here.

All one needs to do to create the actual package is click the button *Package up CC*. This will open a standard file save dialog where you specify the name of the zip-file and the folder to save it in. In the example, we have named the cartridge *Probability.zip*:



This is all there is to our first step. We now have a package that we are ready to take to step two: the validation or compliance testing of the package.

2.2.2 Validating packages

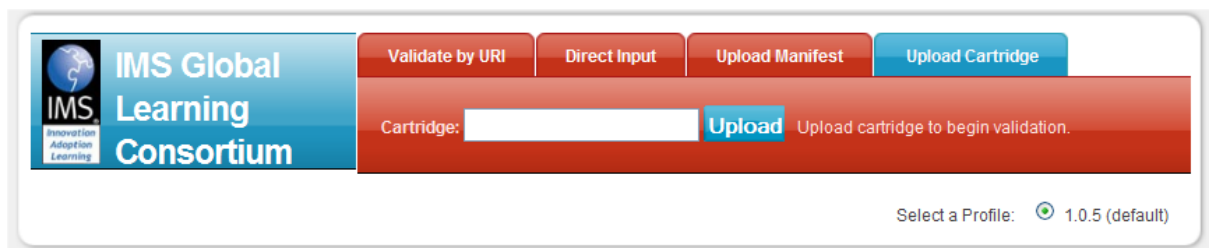
When working with standards and specifications one needs to be sure that one actually adheres to the requirements and constraints of the standards and specifications one uses. For this reason, we have used a number of tools to test compliance and to make compliance with the specifications easier.

If we were developing a SCORM package, we would be using the *ADL Test Suite*, which is the official test environment for validating SCORM packages. As we have a Common

Cartridge package, we use the *IMS Common Cartridge Test Tool*. The tool was developed by the University of Koblenz-Landau, an ASPECT partner, for the IMS Common Cartridge Alliance. Originally, it was a stand-alone application that was available for free to all members of the IMS Common Cartridge Alliance. IMS has, however, recently made the test system available free of charge to everyone as an online test system. As IMS now recommends using the online test system, we shall illustrate both systems.

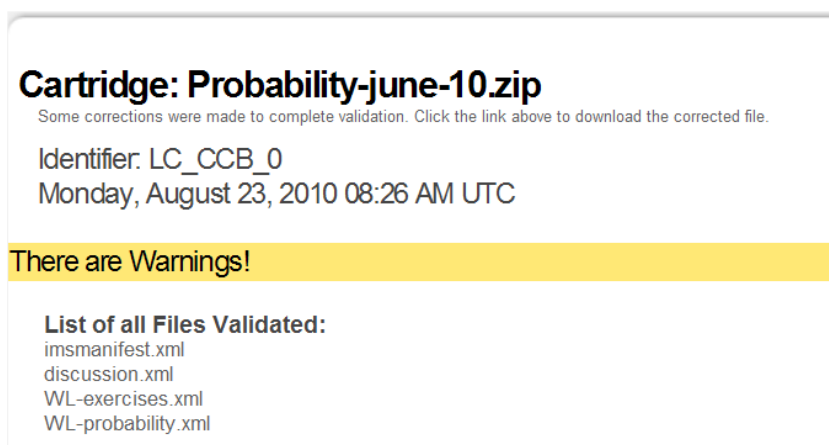
The IMS Common Cartridge Test System

The online validator can be found at the address: <http://validator.imsglobal.org/>. You can use the validator in a number of different ways:



The options are: *Validate by URI*, where you provide a URI to an ims manifest file; *Direct Input* where you copy and paste the contents of an ims manifest file into the input field; *Upload Manifest* where you upload an ims manifest file to be validated, or *Upload Cartridge* where you upload an entire common cartridge to be validated. Finally you can also access the validator as a webservice.

To validate a complete package, you simply click the Upload button and locate the package to be validated. Once the package is uploaded, the validation process starts, and after a brief period of time, you get a results' page:



One of the useful features of the online validator is that you can download a copy of your package with the correction suggested by the validator. In this case, the validator provides a copy with changes, as one can see from the message just below the headline: “Some corrections were made to complete validation. Click the link above to download the corrected file.”

The results of the validation are presented according to the different areas covered by the validator:

- Resource Validation Results
- Schema Location Results
- Schema Validation Results
- Schematron Validation Results

In our case there are a number of schema location messages:



Schema Location Results

Schema locations are valid.

Warnings (0)

Errors (0)

Fatal Errors (0)

Exceptions (0)

Messages (6)

discussion.xml : #2001: xsi:schemaLocation attribute is missing. The validator will use IMS schemas mappings.

discussion.xml : #2007: Mapped "http://www.imsglobal.org/xsd/imsdt_v1p0" to "http://www.imsglobal.org/profile/cc/ccv1p0/derived_schema/domainProfile_6/imsdt_v1p0_localised.xsd"

WL-exercises.xml : #2001: xsi:schemaLocation attribute is missing. The validator will use IMS schemas mappings.

WL-exercises.xml : #2007: Mapped "http://www.imsglobal.org/xsd/imswl_v1p0" to "http://www.imsglobal.org/profile/cc/ccv1p0/derived_schema/domainProfile_5/imswl_v1p0_localised.xsd"

WL-probability.xml : #2001: xsi:schemaLocation attribute is missing. The validator will use IMS schemas mappings.

WL-probability.xml : #2007: Mapped "http://www.imsglobal.org/xsd/imswl_v1p0" to "http://www.imsglobal.org/profile/cc/ccv1p0/derived_schema/domainProfile_5/imswl_v1p0_localised.xsd"

If we save the corrected copy of the package, the references listed will be inserted into the documents in question.

We also get a number of warnings concerning the schematron validation:

**Schematron Validation Results**

The document is valid but contains some warnings.

Warnings (3)

imsmanifest.xml : Assertion failed for pattern_8. For Discussion Topic Resources the Resource object must contain a single File object which references the Discussion Topic descriptor XML file which conforms to the http://www.imsglobal.org/xsd/imsdt_v1p0 schema. It must not have any href attribute.(#S06) (not (./@type='imsdt_xm1v1p0') or (count(/imsc:file)=1 and count(/@href)=0))

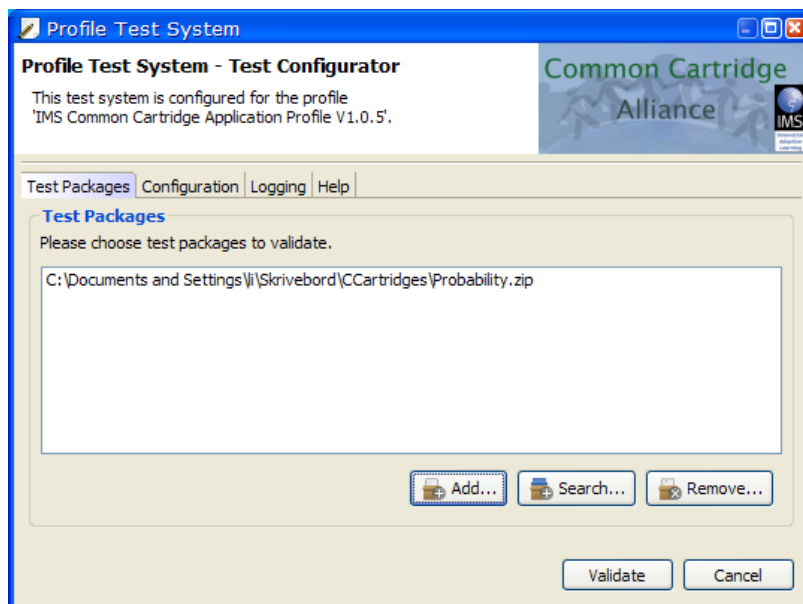
imsmanifest.xml : Assertion failed for pattern_9. For Web Link Resources the Resource object must contain a single File object which references the Web Link descriptor XML file which conforms to the http://www.imsglobal.org/xsd/imsdl_v1p0 schema. It must contain neither Dependency objects nor an href attribute.(#S07) (not (./@type='imsdl_xm1v1p0') or (count(/imsc:file)=1 and count(/imsc:dependency)=0 and count(/@href)=0))

imsmanifest.xml : Assertion failed for pattern_9. For Web Link Resources the Resource object must contain a single File object which references the Web Link descriptor XML file which conforms to the http://www.imsglobal.org/xsd/imsdl_v1p0 schema. It must contain neither Dependency objects nor an href attribute.(#S07) (not (./@type='imsdl_xm1v1p0') or (count(/imsc:file)=1 and count(/imsc:dependency)=0 and count(/@href)=0))

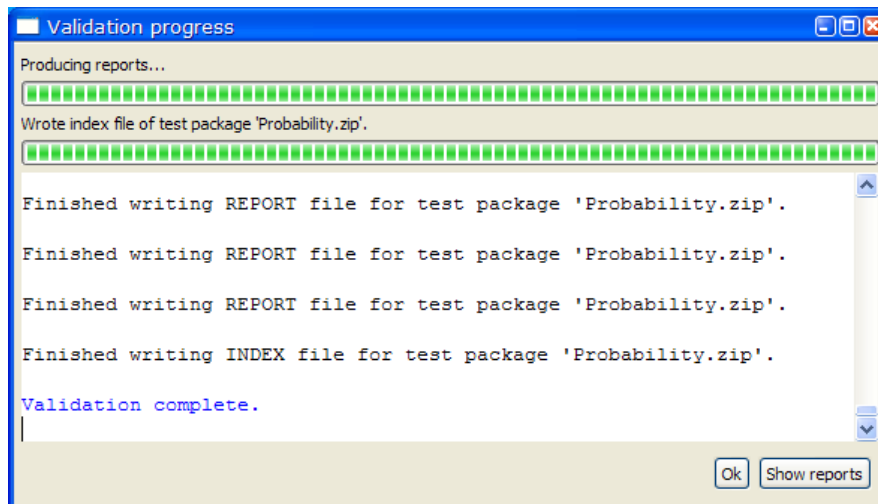
At first sight the warnings appear rather complex and difficult to understand, but they simply refer to an href attribute that is not allowed in connection with discussion topics and web links.

The stand-alone Validator

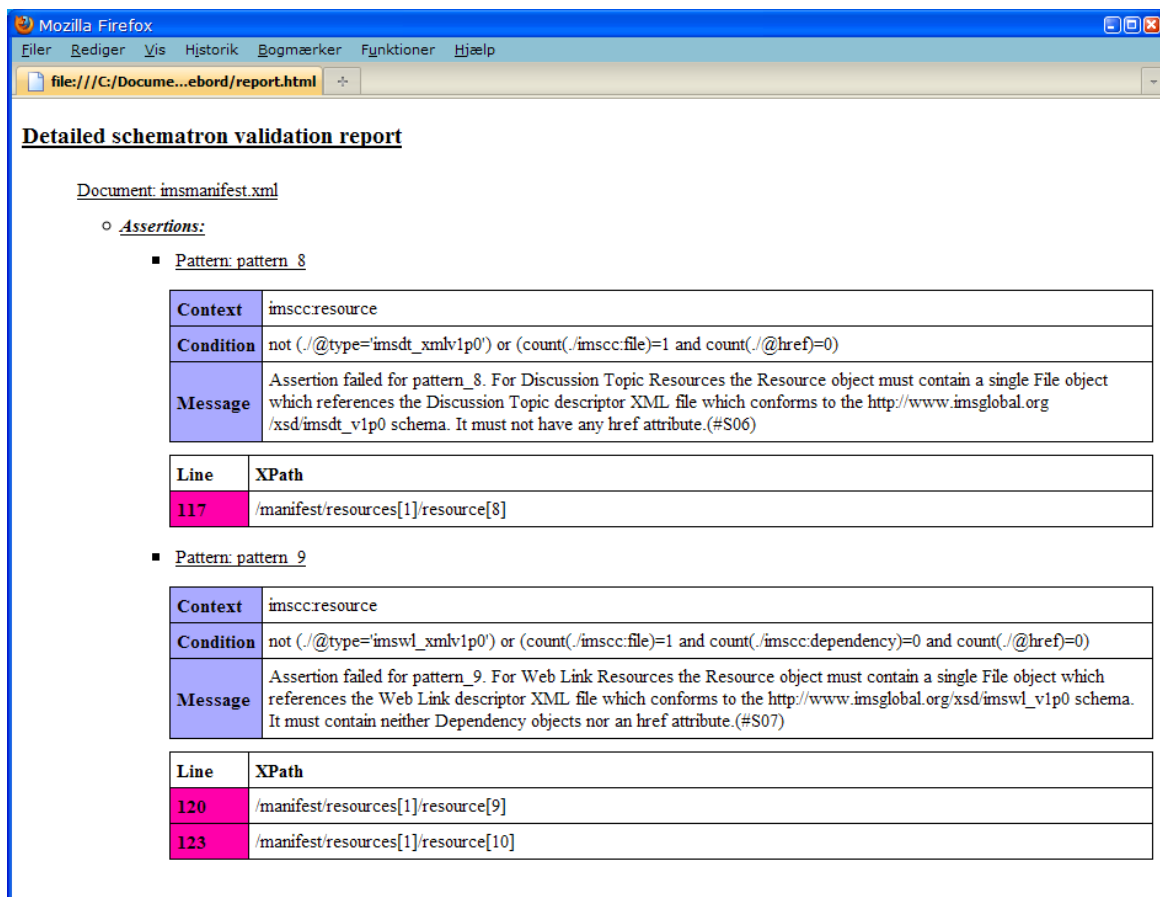
When you start the Validator application, all you need to do is click the *Add*-button, locate the package that you want to validate, and then click the *Validate*-button.



Once the validation is done, you get a status of the validation by choosing *Show reports*.



The reports will tell you if anything in the package is not fully compliant with the IMS Common Cartridge specification. Then you can go back and edit the `imsmanifest.xml`, if that is where the problems are, save the new version, and run a new validation to see if you have solved all problems.



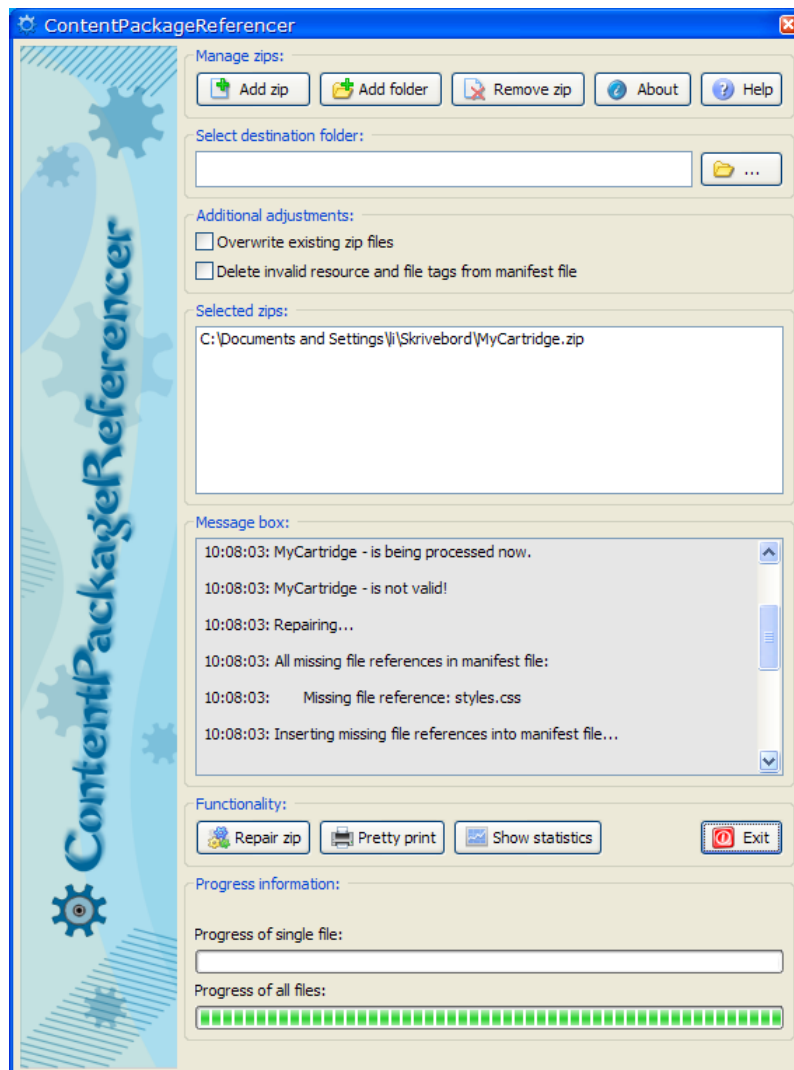
As we can see from the report, the ASPECT tool, the *Common Cartridge Builder*, does not adhere completely to IMS Common Cartridge specification. The error that is found is a small

error, actually one that the Icodeon Common Cartridge platform being used in ASPECT ignores, but nonetheless an error and as such something that other implementations of the IMS Common Cartridge specification might decide not to ignore. So for the sake of cross-platform interoperability, such errors should be removed.

It is also a very simple thing to handle. The validator tells us which lines to look at: 117, 120, and 123 – and it provides us with a description of the error. All we need to do here to comply with the specification is to remove an ‘href-attribute’ from the objects that describe the three resource elements listed in the report.

The Content Package Referencer

In some cases it can be cumbersome and difficult to check and repair missing and invalid file references. The University of Koblenz-Landau has developed another tool to help solve this problem, the so-called *ContentPackageReferencer*. This tool is used to test content packages for wrong references. It will insert missing file references in a content package manifest file; and it will warn the user if a file exists in the references of the manifest file but not in the content package.



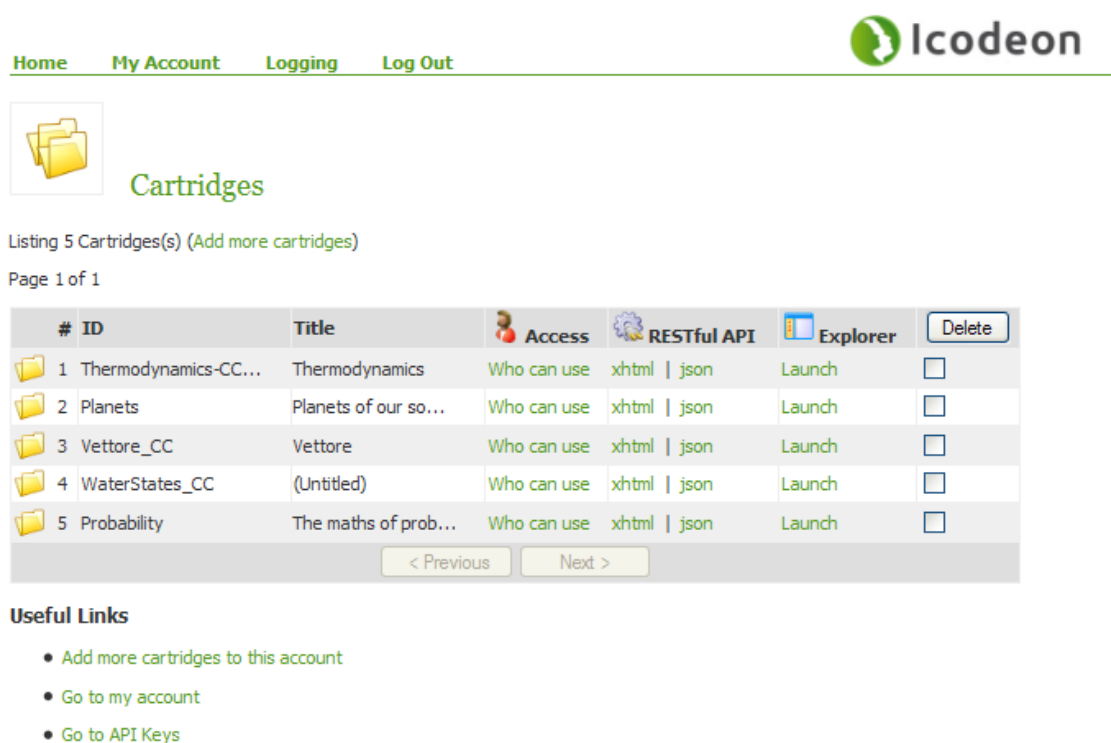
In the above example I have a missing reference in the manifest to the file *styles.css*. As one can see from the message box, the *ContentPackageReferencer* locates the missing reference and inserts it into the *imsmanifest.xml*.

2.2.3 Running packages

At the end of the validation process we have a package that is fully compliant with the IMS Common Cartridge specifications. This, however, does not necessarily mean that it will run exactly the way you expect it to run. So before we add the package and the corresponding metadata to our local repository, we need to test it.

For the runtime testing of packages we have been using primarily the Icodeon SCORM player and the Icodeon Common Cartridge platform, but we have also been using some of the other platforms available, such as MIR and ReLoad, and recently the Moodle LMS.

Icodeon Ltd., which is a tools' provider and ASPECT partner, have provided all ASPECT partners with access to a special Common Cartridge platform for testing purposes:



The screenshot shows the Icodeon web interface for managing cartridges. At the top, there are navigation links: Home, My Account, Logging, and Log Out. The Icodeon logo is in the top right. Below the navigation bar, there is a section titled "Cartridges" with a folder icon. It indicates "Listing 5 Cartridges(s)" and provides a link to "Add more cartridges". Below this, it says "Page 1 of 1".

#	ID	Title	Access	RESTful API	Explorer	Delete
1	Thermodynamics-CC...	Thermodynamics	Who can use	xhtml json	Launch	<input type="checkbox"/>
2	Planets	Planets of our so...	Who can use	xhtml json	Launch	<input type="checkbox"/>
3	Vettore_CC	Vettore	Who can use	xhtml json	Launch	<input type="checkbox"/>
4	WaterStates_CC	(Untitled)	Who can use	xhtml json	Launch	<input type="checkbox"/>
5	Probability	The maths of prob...	Who can use	xhtml json	Launch	<input type="checkbox"/>

Below the table are navigation buttons: "< Previous" and "Next >".

Useful Links

- [Add more cartridges to this account](#)
- [Go to my account](#)
- [Go to API Keys](#)

2.3 Summing up

ASPECT is about testing and developing recommendations for best practice standards and specifications. Everything that we do contributes to that overall objective. In the ASPECT project we are exploring standards and specifications for content use primarily because of the potential benefits we see in terms of interoperability, ease of distribution and ultimately ease of use.

In this section we have described and illustrated some of the work that we have done preparing online resources for use by applying specifications for content packaging to the



resources. We have stepped through the key processes involved in using specifications for content packaging using the IMS Common Cartridge specification as our key example. We have looked at the tools and processes involved in packaging content, and stressed the importance of testing packages for compliance with the specification used, and finally we have looked at one of the tools that has been made available for runtime testing of packages as part of the ASPECT project.

Although strict adherence to specifications may not always seem that important and in some cases it may perhaps even be seen as a nuisance, our experiences in ASPECT highlight the value in fully adhering to standards. As a result of converting some two hundred SCORM packages from a number of different content providers to the IMS Common Cartridge format, we have clearly identified the problems involved when tools' providers and content providers implement a given specification in different ways – and not always according to the exact requirements of the specification.

3 Metadata

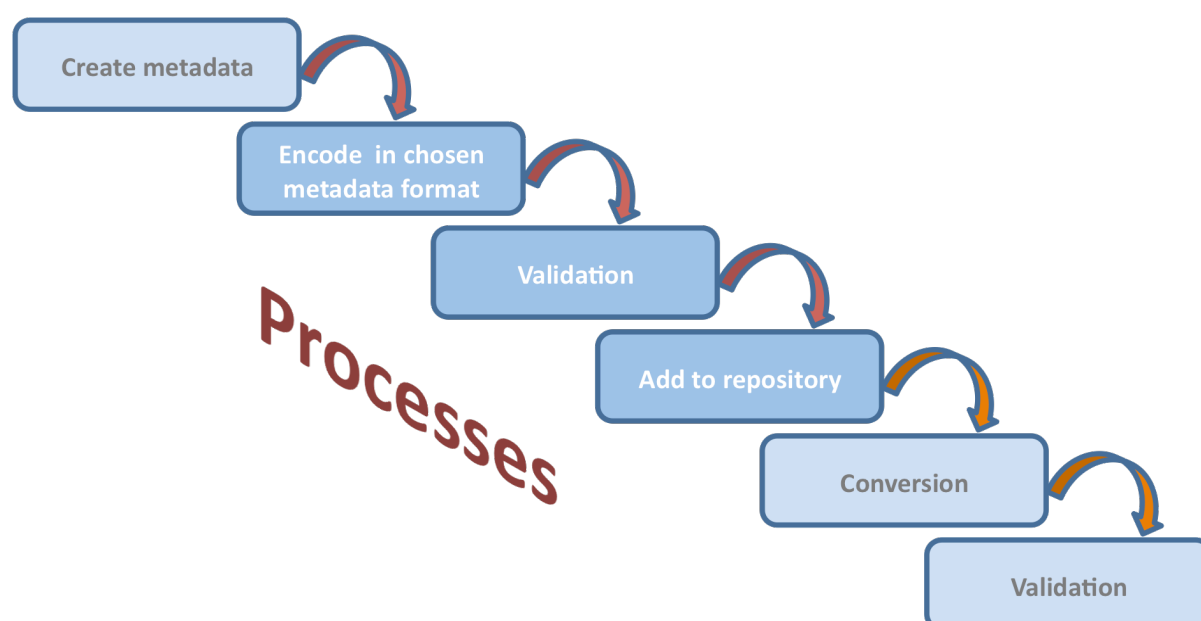
3.1 Introduction

The stage described above focuses on the area described in the ASPECT work plan as *content use*. Content use at this stage refers primarily to the preparation of content for use by applying content packaging specifications to online resources. The next stage is concerned with metadata, i.e. data describing different aspects of the learning resource. Basically this can be described as preparing resources for later search and retrieval.

In the framework of ASPECT, the primary function of metadata is to enable the seamless search and retrieval of resources across language barriers once the metadata have been harvested and added to the Learning Resource Exchange. A considerable number of the tools and services created or developed further as part of the ASPECT project relate specifically to metadata issues.

3.2 Processes and tools

In many ways the processes involved in connection with metadata are rather complex. They are certainly not as straightforward as the processes described in connection with content packaging. There are a number of different metadata standards in use; some may be more or less unique to the individual content provider, while others are either a profile or a strict version of a standardized metadata format like the IEEE LOM or Dublin Core. However, as each metadata instance will ultimately be harvested and added to the LRE database, it is essential that the metadata can be converted into the format used by the LRE.



The specific processes involved will of course depend on the system and workflow of each individual content provider. In most cases, content providers will have created an interface to

the database storing their repository so that entering, encoding, validating and adding data to the repository appear as one process to the user. And depending on the internal metadata format used, there may be no need for a conversion and another validation of converted metadata instances.

3.2.1 Validation tools

As the area of metadata specifications is complex and may require quite a lot of work, we have provided a number of tools to help content providers with the issues of metadata management. At this stage we are primarily interested in validation, i.e. in making sure that our metadata complies with the specifications of the chosen metadata format.

Compliance plays an important role. For one thing, compliance makes it easier for us to convert automatically between different metadata formats; for another, compliance makes it easier to implement some of metadata enhancements that will be applied to all metadata later in the process.

For validation purposes we have the following tools²:

- The *ARIADNE Validation Service*, which is an online tool
- The *ASPECT Test System*, which is a standalone application

The ARIADNE Online Validation Service

The ARIADNE online validation service is a complex service that can be used at different stages of the workflow and for different purposes. Here we will restrict ourselves to describing the validation options.

The validation service allows you to validate both single instances of metadata records and all records in a given repository (OAI-PMH target). And it allows you to validate based on a large number of different validation schemes as you can see from the example below:

² Note that both tools have been integrated with the Vocabulary Bank for Education (VBE) on which they rely as the source of controlled vocabularies to be enforced.

ARIADNE Validation Service

Validation About [Found a Bug ?](#)

Scheme URI :

LOM record from

If, for instance, you have a metadata instance in the LRE MAP v.4.5 format that you would like to validate, you simply paste the record into the window, select the validation scheme and click the validate button:

Validation Scheme URI :

Directly retrieve the first LOM record from an OAI-PMH target :

OR manually paste your LOM record here :

```

1 <expression xmlns="http://www.imsglobal.org/xsd/imsloisltitm_v1p0"
2   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
3   xsi:schemaLocation="http://www.imsglobal.org/xsd/imsloisltitm_v1p0 http://fire.eun.org
4   /lode/imsloisltitm_v1p0.xsd">
5   <identifier>
6     <catalog>hdl</catalog>
7     <entry>10494/29848</entry>
8   </identifier>
9   <identifier>
10    <catalog>expression-cmr-id</catalog>
11    <entry>29848</entry>
12  </identifier>
13  <identifier>
14    <catalog>OpenLearn</catalog>
15  </identifier>
16</expression>

```

Position: Ln 1, Ch 1 Total: Ln 282, Ch 9193

☒ Toggle editor

After pasting the metadata record and pressing "validate", you will get a small report explaining which parts of the metadata can be improved in order to be compliant with the ASPECT application profile. In this case we get the following message from the validator:

Schematron Validation Exception :

(Rule vocab) "roleValues"/"creator" is a not allowed source/value combination in
//lom:lom/lom:metaMetadata/lom:contribute/lom:role.

(Rule vocab) "ASPECTv1.0"/"provider" is a not allowed source/value combination in
//lom:lom/lom:metaMetadata/lom:contribute/lom:role.

As you can see from the message, there is a problem with the vocabulary, i.e., some of the values entered are not allowed by the specification. If you decide not to change the values, this may cause problems at a later stage when the integrated system attempts to do an automatic translation of the metadata record based on the contents of the vocabulary bank.

The ASPECT Test System

The ASPECT Test System is essentially the same system as the one that was used to validate Common Cartridge packages. Here it just validates based on another profile, viz. the LRE Metadata Application Profile version 4.5. The procedure, therefore, is the same as the one described above. You point out an XML-file that contains the metadata record and click the validate button. The results of the validation will be presented in your browser.

3.2.2 Metadata Transformation

Due to the many different metadata specifications being used, metadata transformation plays an important role. In the ASPECT project we have developed a number of metadata transformers. The transformer services are based on a set of Java libraries that can turn metadata instances of an application profile into instances based on another application profile. The libraries can be:

- used for standalone applications
- deployed as online services, or
- integrated with other applications such as the ARIADNE Harvester.

Currently, the following transformations are supported:

- From LREv3.0 (lom) to LREv4.5 (ilox)
- From LREv4.5 (ilox) to IEEE LOM loose:
- From LREv4.5 (ilox) to LREv3.0 (lom):
- From LREv4.5 (ilox) to CMRv3.0 (LRE internal format):

3.3 Summing up

In this section we have described and illustrated part two of our integrated system, i.e. the second step involved in preparing online resources for later search, retrieval and use. The key issue is the use of metadata specifications. Again we have focused on the tools and processes set up to ensure ease of implementation as well as compliance with standards and specifications. The two major tools we have looked at are the ARIADNE Validation service and the ASPECT Test System. For more technical details of the tools we refer you to the deliverables of WP2.

Making resources available

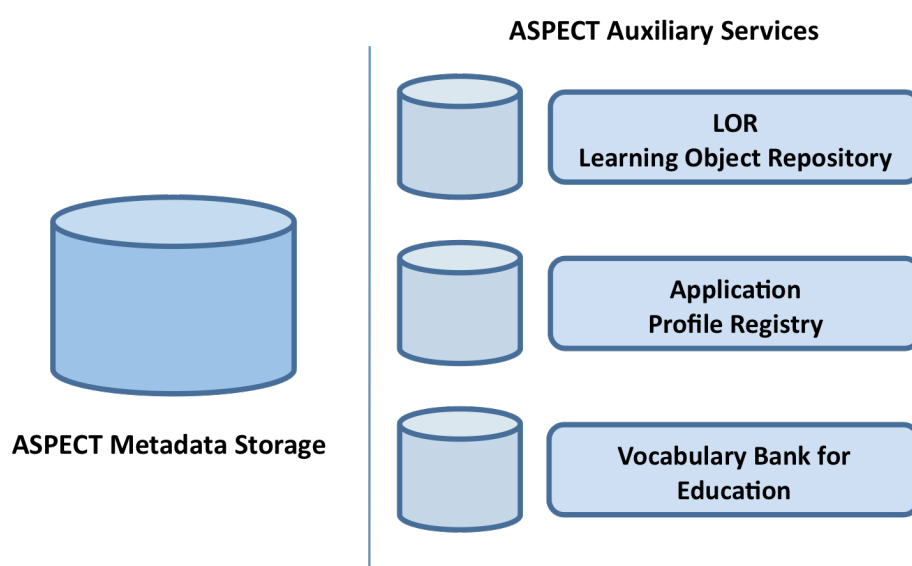
3.4 Introduction

In this section we approach what could be seen as the core of our integrated system. Here we integrate a wide variety of essential tools and services in a complex process of harvesting, validating, converting, translating and enriching metadata. We can differentiate between two kinds of services: some are directly involved in the processing of metadata one way or another, whereas others could be described as general enabling or auxiliary services, i.e. services that are used by one or more of the other services.

In order to make it easier to understand this part of the ASPECT integrated system, we will try once again to break it down into stages and related functionalities.

3.5 ASPECT Auxiliary Services

The integrated system relies heavily on what we have termed auxiliary or enabling services. We have three sets of services: the *Learning Object Repository*, the *Application Profile Registry*, and the *Vocabulary Bank for Education*:



The key function of the Learning Object Repository is to allow content providers, i.e. owners of repositories, to register their repository as part of the Learning Resource Exchange federation of repositories. The registry is basically a directory service, i.e. a directory of all repositories in the federation. The registry makes it easy for repositories in the federation, such as the EUN LRE, to locate and harvest metadata from other repositories in the federation. A federation of registries will also enable us to find resources, located in repositories that are part of other federations such as GLOBE, ARIADNE, etc.

The Application Profile Registry is a registry describing the metadata application profiles used by the repositories that are registered in the LOR. The Application Profile Registry can

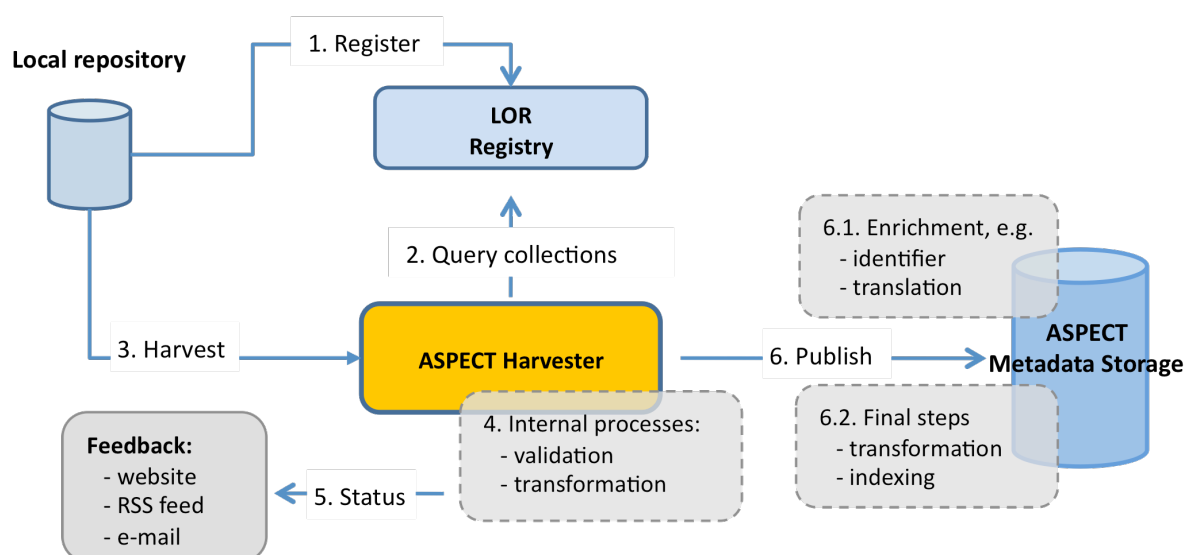
be used, not just by developers who may need to map between metadata elements in different repositories, but also by software processes or services that need to be able to process metadata in various ways depending on the specific application profile used to describe those metadata. Actually, uniquely identifying metadata application profiles is a key service for tools that handle multiple metadata formats and need to refer to them. Such tools include validation services, transformer services, and vocabulary registries such as the Vocabulary Bank for Education.

The Vocabulary Bank for Education is a specialized database that provides both a browsable and searchable web application for users to locate, view and download terminology, as well as standards-based machine-to-machine interfaces. The benefit of the vocabulary bank is that it facilitates all work related to the construction of vocabularies and the mapping between vocabularies, something that is extremely useful in a multi-lingual environment such as the LRE federation of repositories.

Although the services mentioned may be used in more than one way, we will focus on the role they play in the integrated system that is responsible for making resources from local repositories available in the LRE (or other repositories that harvest metadata).

3.6 The global view of harvesting

A key issue in the integrated system is to allow as many processes as possible to be handled automatically. In some cases, this is done by using the services described above. The global view of the flow and the processes involved in harvesting and publishing can be presented in the following way:



Local repositories register in the registry of Learning Object Repositories. The ASPECT/ARIADNE Harvester queries the registry and gets all the relevant information about the repository and can now initiate a harvesting process. As part of the harvesting process, the ASPECT Harvester uses a number of the services provided to validate the metadata and transform it if necessary. Based on the results of this validation, the Harvester provides



automated feedback to the people responsible for the local repositories, so that they can take action and handle any errors that may interfere with the automated workflow of the integrated system.

Once the ASPECT Harvester has done all the groundwork, the metadata are moved into the LRE, which also involves a number of processes such as metadata enrichment and transformation into the LRE internal metadata format. Once this is done, the metadata instance is available for search and retrieval to all users with access to the LRE.

3.7 *Summing up*

In this section we have looked at what could be described as the core of the ASPECT integrated system. Here we integrate a wide variety of essential tools and services in a complex, almost completely automated process of harvesting, validating, converting, translating and enriching metadata. We have looked at the workflow involved and the roles played by various elements of the integrated system. In-depth information on the internal workings of these services and tools can be found in the deliverables of WP2.

4 Search, retrieval and use

4.1 Introduction

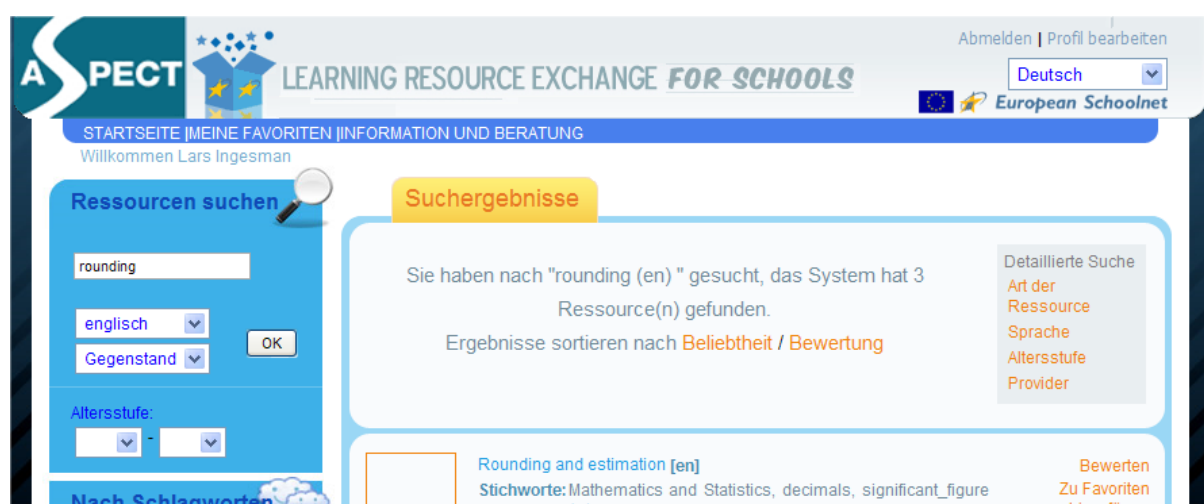
We have now come to the last step in our description of the integrated system where we address the user perspective and look at search, retrieval and use of the learning resources. In this section we will illustrate how resources can be located and displayed in various ways depending on the resource type. Most resources are web-based and will be displayed directly in a browser window. Packaged resources, however, need a somewhat more complex environment such as the Icodeon SCORM player, the Icodeon Common Cartridge Platform, or a Moodle LMS. Here we will show how those platforms have been integrated to improve the user experience.

4.2 Search and retrieval

A key issue in the ASPECT project has been to determine to what extent the use of metadata specifications improves search and retrieval seen from the point of view of the user. To show some of the functionality provided by the metadata specification which the content providers have implemented, we will provide a few simple examples of searches that take advantage of some of the ASPECT enrichment services such as automatic translation and controlled vocabularies.

4.2.1 Automatic translations in interface

Let us assume that we have a German user who is interested in finding something on the mathematics topic of rounding in English. If the user knows the English word 'rounding', he can add it to the search box and click the OK button:



At the moment, this search will give our user three hits. If his understanding of English math terms is not that good, he can click the *[de]* at the bottom of the metadata instance and get a translation of the entire record that he has located:


Aufrunden und Schätzung [en]

Diese Metadaten wurden automatisch übersetzt.

Stichworte: Mathematik und Statistiken, Dezimalstriche, significant_ (...)

Alter: >18 **Art der Ressource:** Text

Beschreibung: Wissenschaftliche Rechner sind eine wundervolle Erfindu (...)

Creative Commons Licence: 

Ansicht in:
[\[el\]](#) [\[en\]](#) [\[es\]](#) [\[fr\]](#) [\[it\]](#) [\[pt\]](#)

Bewerten

Zu Favoriten

hinzufügen

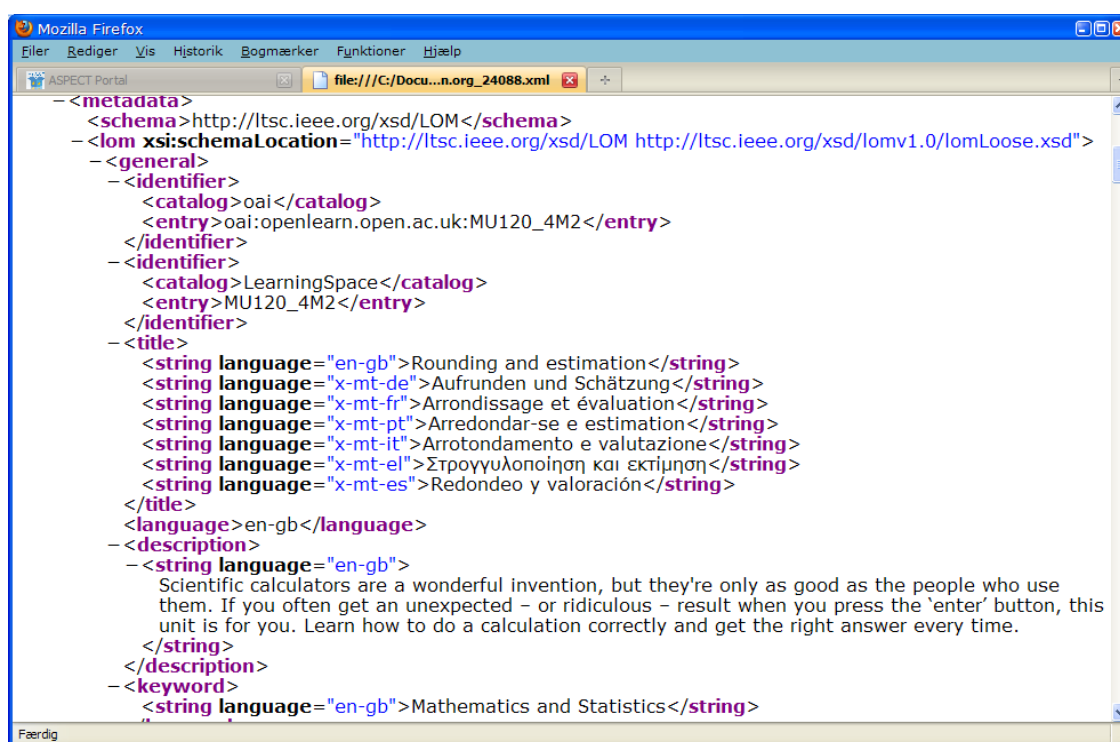
Problem

melden

Automatic translations, however, are not restricted to this. Our user could also have searched entirely in German using the German word ‘Aufrunden’. Due to the automatic translation of certain parts of the metadata, the user can search, as it were, across languages.

4.2.2 Metadata enrichment

The reason why we can do this is hidden in the metadata enrichments. Below we have a part of the metadata record for this particular learning resource. As you can see, the title exists in a number of different languages. The same goes for the description and most of the keywords:



```

- <metadata>
  <schema>http://ltsc.ieee.org/xsd/LOM</schema>
  <lom xsi:schemaLocation="http://ltsc.ieee.org/xsd/LOM http://ltsc.ieee.org/xsd/lomv1.0/lomLoose.xsd">
    <general>
      <identifier>
        <catalog>oai</catalog>
        <entry>oai:openlearn.open.ac.uk:MU120_4M2</entry>
      </identifier>
      <identifier>
        <catalog>LearningSpace</catalog>
        <entry>MU120_4M2</entry>
      </identifier>
      <title>
        <string language="en-gb">Rounding and estimation</string>
        <string language="x-mt-de">Aufrunden und Schätzung</string>
        <string language="x-mt-fr">Arrondissement et évaluation</string>
        <string language="x-mt-pt">Arredondar-se e estimação</string>
        <string language="x-mt-it">Arrotondamento e valutazione</string>
        <string language="x-mt-el">Στρογγυλοποίηση και εκτίμηση</string>
        <string language="x-mt-es">Redondeo y valoración</string>
      </title>
      <language>en-gb</language>
      <description>
        <string language="en-gb">
          Scientific calculators are a wonderful invention, but they're only as good as the people who use them. If you often get an unexpected – or ridiculous – result when you press the 'enter' button, this unit is for you. Learn how to do a calculation correctly and get the right answer every time.
        </string>
      </description>
      <keyword>
        <string language="en-gb">Mathematics and Statistics</string>
      </keyword>
    </general>
  </lom>
</metadata>

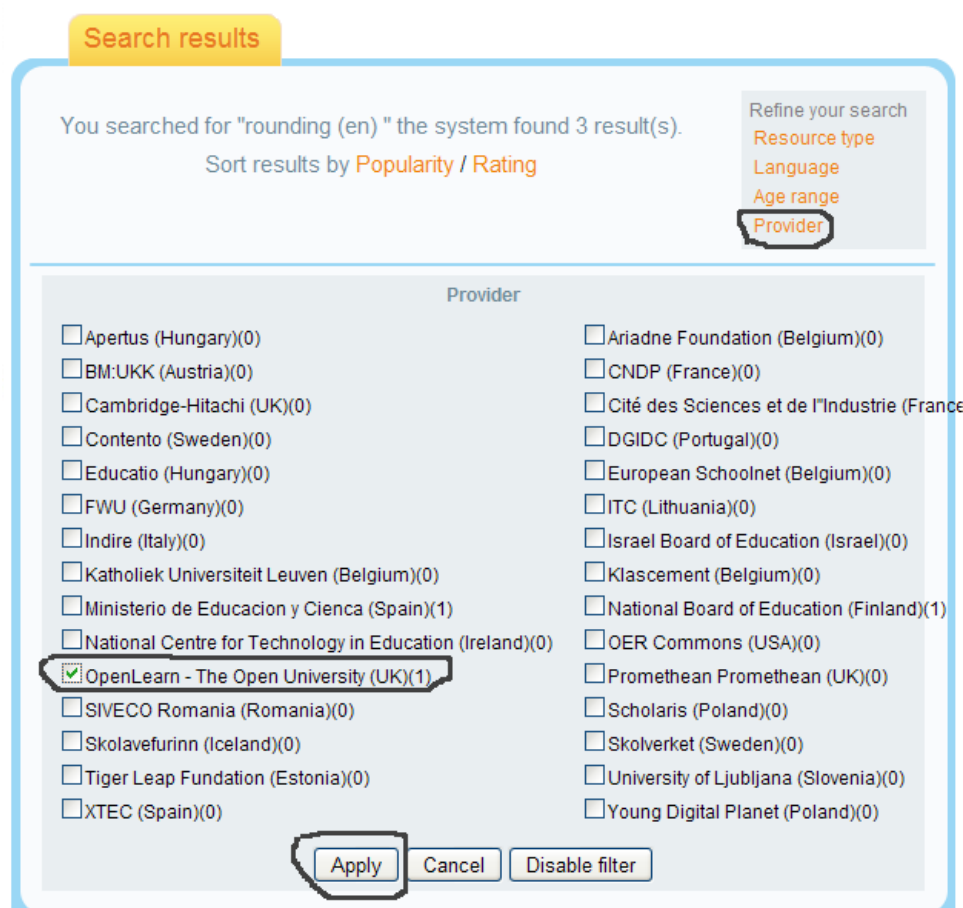
```

The enrichment based on free text translation is done on the contents of the fields *title*, *description* and *keywords*.

4.2.3 Other advanced search features

Based on the metadata that our content providers have used to describe their resources, the LRE has some more advanced search features such as provider, language, resource type and age range. If we are interested in locating resources from the Open University’s OpenLearn

resources, we can restrict the search results to those of just one provider. This we do by clicking Provider, selecting OpenLearn and finally Apply.



The screenshot shows the 'Search results' interface. At the top, it states 'You searched for "rounding (en)" the system found 3 result(s)'. Below this, it says 'Sort results by Popularity / Rating'. On the right, there is a 'Refine your search' section with options: Resource type, Language, Age range, and Provider. The 'Provider' option is highlighted with a red box. Below this, a list of providers is shown, each with a checkbox and a count in parentheses. The provider 'OpenLearn - The Open University (UK)' is selected, indicated by a green checkmark and a red box. At the bottom, there are three buttons: 'Apply', 'Cancel', and 'Disable filter'. The 'Apply' button is highlighted with a red box.

Provider	
<input type="checkbox"/> Apertus (Hungary)(0)	<input type="checkbox"/> Ariadne Foundation (Belgium)(0)
<input type="checkbox"/> BM:UKK (Austria)(0)	<input type="checkbox"/> CNDP (France)(0)
<input type="checkbox"/> Cambridge-Hitachi (UK)(0)	<input type="checkbox"/> Cité des Sciences et de l'Industrie (France)(0)
<input type="checkbox"/> Contento (Sweden)(0)	<input type="checkbox"/> DGIDC (Portugal)(0)
<input type="checkbox"/> Educatio (Hungary)(0)	<input type="checkbox"/> European Schoolnet (Belgium)(0)
<input type="checkbox"/> FWU (Germany)(0)	<input type="checkbox"/> ITC (Lithuania)(0)
<input type="checkbox"/> Indire (Italy)(0)	<input type="checkbox"/> Israel Board of Education (Israel)(0)
<input type="checkbox"/> Katholiek Universiteit Leuven (Belgium)(0)	<input type="checkbox"/> Klascement (Belgium)(0)
<input type="checkbox"/> Ministerio de Educacion y Ciencia (Spain)(1)	<input type="checkbox"/> National Board of Education (Finland)(1)
<input type="checkbox"/> National Centre for Technology in Education (Ireland)(0)	<input type="checkbox"/> OER Commons (USA)(0)
<input checked="" type="checkbox"/> OpenLearn - The Open University (UK)(1)	<input type="checkbox"/> Promethean Promethean (UK)(0)
<input type="checkbox"/> SIVICO Romania (Romania)(0)	<input type="checkbox"/> Scholaris (Poland)(0)
<input type="checkbox"/> Skolavefurinn (Iceland)(0)	<input type="checkbox"/> Skolverket (Sweden)(0)
<input type="checkbox"/> Tiger Leap Fundation (Estonia)(0)	<input type="checkbox"/> University of Ljubljana (Slovenia)(0)
<input type="checkbox"/> XTEC (Spain)(0)	<input type="checkbox"/> Young Digital Planet (Poland)(0)

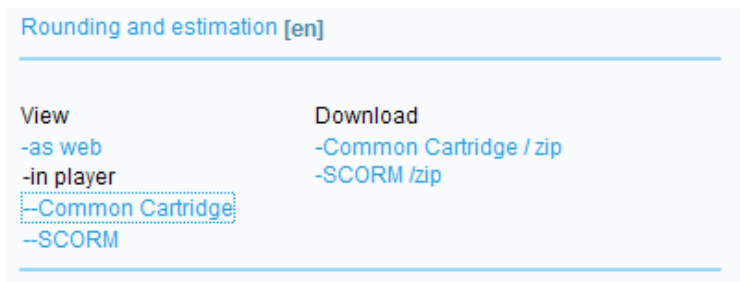
This restricts our list of hits to just one resource, as one can also see from the number in parentheses after OpenLearn – The Open University (UK).

Now that we have demonstrated some of the search functionality that is based on the metadata with which the learning resources have been described, we shall look at the tools' integration that we have done in this part of the ASPECT project.

4.3 Tools integration and content use

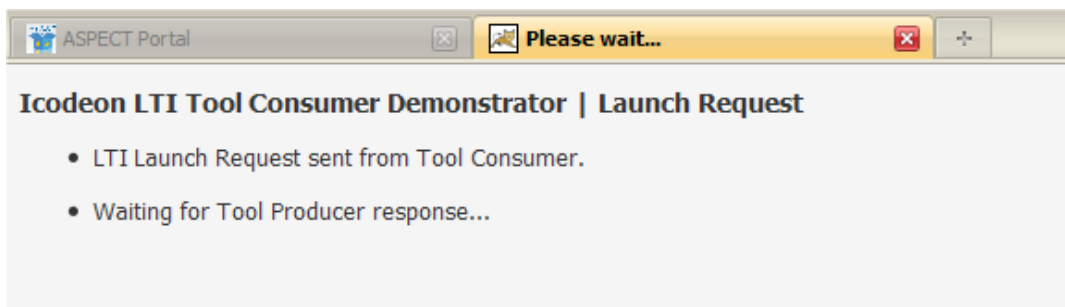
4.3.1 LRE to external tools

We have just located a resource. If we now click the title of the resource: *Rounding and estimation*, we get a list of the various formats in which we can get access to the learning resource:

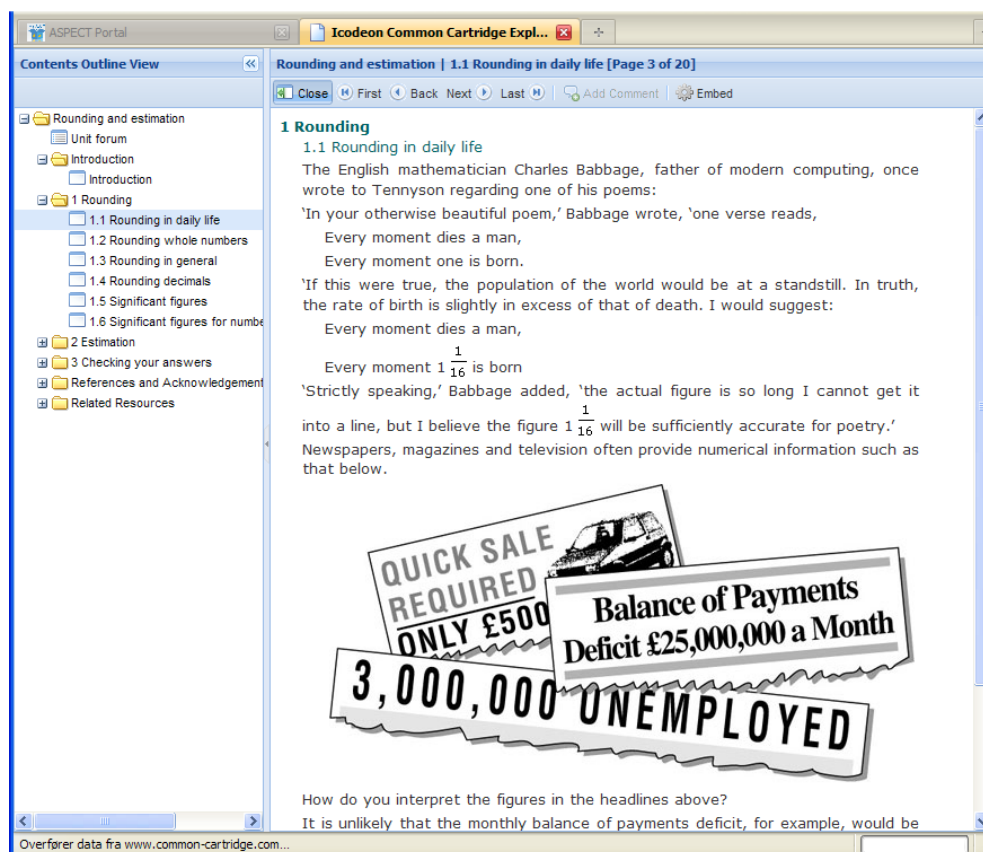


As you can see from the illustration, we can view it *as web*, which just means that we access the resource directly on the OpenLearn web site. We can also decide to download the resource as either a Common Cartridge or a SCORM package. And last but not least, we can access the resource *in player*. This means that we will access it in one of the Icodeon environments that have been integrated into the LRE. We have two options here, either the Icodeon SCORM player or the Icodeon Common Cartridge environment.

If we choose the Common Cartridge format *in player*, the LRE will send a *LTI (Learning Tools Interoperability) Launch request* to the Icodeon Common Cartridge environment:



Once the request has been processed, the Icodeon Common Cartridge environment will be launched with the contents of the OpenLearn package:



The screenshot shows the ASPECT Portal interface. On the left is a 'Contents Outline View' with a tree structure. The main content area is titled 'Rounding and estimation | 1.1 Rounding in daily life [Page 3 of 20]'. It contains text about Charles Babbage and a cartoon illustration of a car with a large deficit. The footer shows a URL: 'Overforer data fra www.common-cartridge.com...'.

Contents Outline View

- Rounding and estimation
 - Unit forum
 - Introduction
 - 1 Rounding
 - 1.1 Rounding in daily life
 - 1.2 Rounding whole numbers
 - 1.3 Rounding in general
 - 1.4 Rounding decimals
 - 1.5 Significant figures
 - 1.6 Significant figures for number
 - 2 Estimation
 - 3 Checking your answers
 - References and Acknowledgement
 - Related Resources

1 Rounding

1.1 Rounding in daily life

The English mathematician Charles Babbage, father of modern computing, once wrote to Tennyson regarding one of his poems:

'In your otherwise beautiful poem,' Babbage wrote, 'one verse reads,
Every moment dies a man,
Every moment one is born.
'If this were true, the population of the world would be at a standstill. In truth, the rate of birth is slightly in excess of that of death. I would suggest:
Every moment dies a man,
Every moment $1\frac{1}{16}$ is born
'Strictly speaking,' Babbage added, 'the actual figure is so long I cannot get it into a line, but I believe the figure $1\frac{1}{16}$ will be sufficiently accurate for poetry.'

Newspapers, magazines and television often provide numerical information such as that below.

QUICK SALE REQUIRED ONLY £500

Balance of Payments Deficit £25,000,000 a Month

3,000,000 UNEMPLOYED

How do you interpret the figures in the headlines above?
It is unlikely that the monthly balance of payments deficit, for example, would be

Overforer data fra www.common-cartridge.com...

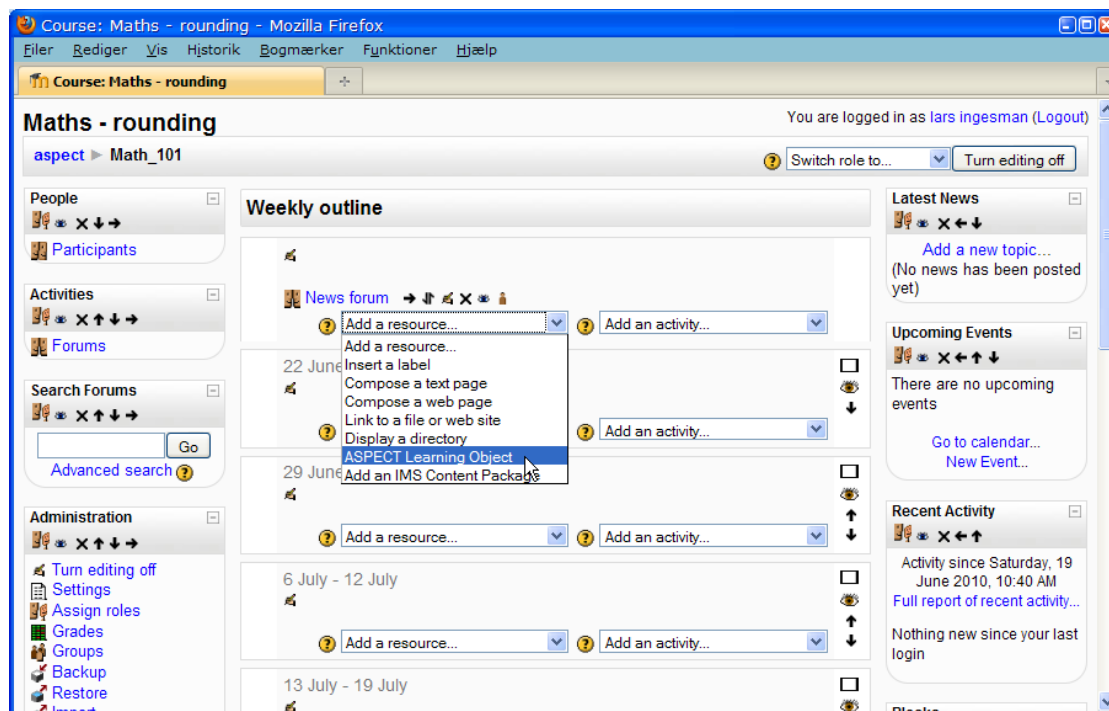
The integration of the Icodeon SCORM player and Common Cartridge environment into the LRE is one way in which we have integrated tools to provide a better user experience. Without this integration, the user would have had to download the zipped package to his computer, log on to another system such as MIR, Moodle or the Icodeon platform and then perform a manual upload of the package.

Most content providers will probably also see this kind of integration as a great advantage in that the user will not get, as it were, free access to the package, and therefore not be able to redistribute it. The package is sent from one trusted system to the other.

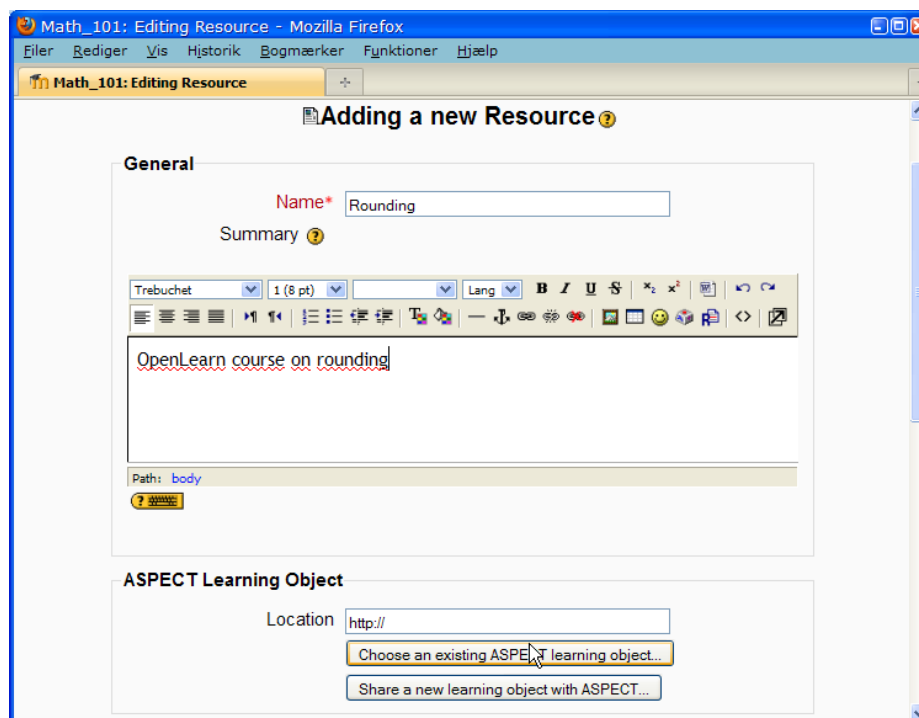
4.3.2 Moodle: integrated search and retrieval

The integration shown above is not the only example of a user-oriented tools' integration that we have in the ASPECT project. We have also customized an ARIADNE plug-in between the Moodle learning management system and a Learning Object Repository for the ASPECT project. This plug-in now allows the users of a Moodle system to search and retrieve packages directly from the LRE from within their Moodle system.

To demonstrate how this integration works, we will import the same OpenLearn package on rounding that we used in the example above. The process is as follows. First we go to the Moodle course to which we want to add the resource. We may of course also choose to create a new course to which we want to add the resource. Once this is done, we turn editing on for the course and click the *Add a resource* drop-down box:



In the list of options we select *ASPECT Learning Object*. First we can add a name and perhaps a description for the new resource. Then we click the button labelled *Choose an existing ASPECT learning object...*



This opens a special search box, where we enter *Rounding* as our search keyword:

Search for learning objects ?

GLOBE learning objects

Enter search keywords*

Search in ☒ ASPECT ☐ GLOBE repositories

There are required fields in this form marked*.


At first we get four hits, but from the list of search results we can refine the search and restrict our search to a specific provider – just as we did earlier when searching the LRE.


Results 1 to 2 of 2 for 'Rounding'
(Provider: learningspace)

Refine your search

By language

By provider [Remove filter](#)

- 1 [Rounding and estimation](#) (en-gb) 


 Indexed 5 months and 1 weeks ago


By: Open University

Keywords: Mathematics and Statistics (en-gb)

Description: Scientific calculators are a wonderful invention, but they're only as good as the people who use the (...) (en-gb)

Age: 18+ **Context:** higher education **Learning time:** PT5H





[More details](#)
- 2 [Developing countries in the world trade regime](#) (en-gb) 





 Indexed 5 months and 1 weeks ago

By: Open University

Keywords: Society (en-gb)

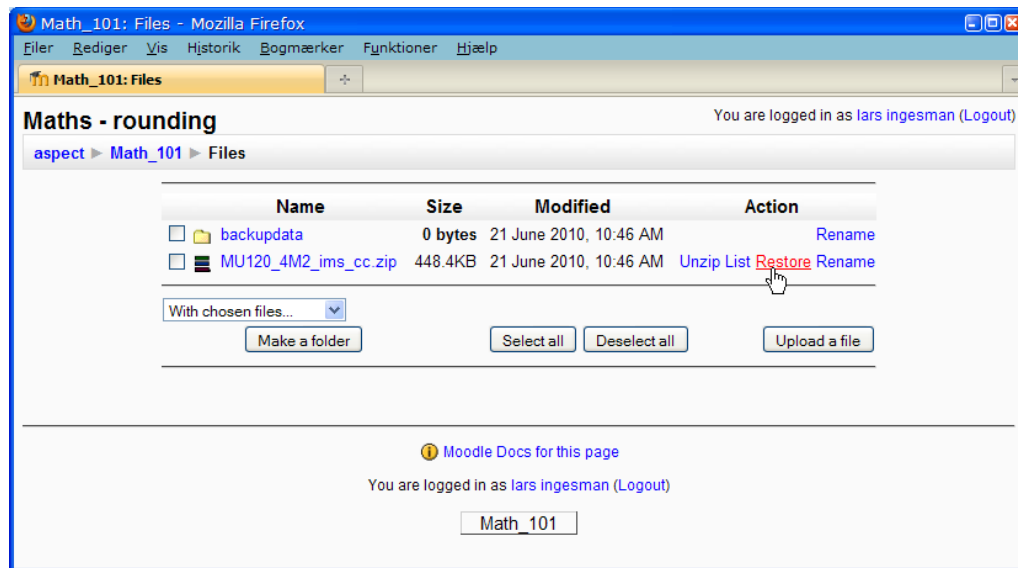
Description: Free trade or fair trade? This unit will help you to analyse the relationship that exists between de (...) (en-gb)

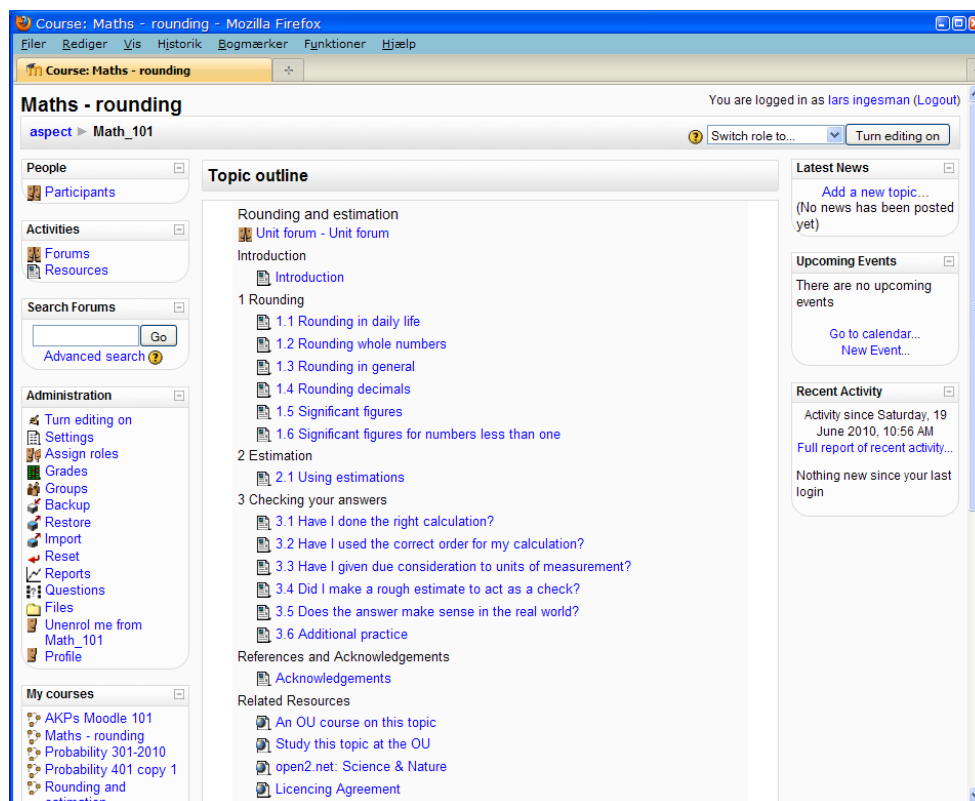
   

From the description we can see that the package we are interested in is the one called *Rounding and estimation*. In the right-hand side of the search results list there are three icons for each hit. The third icon is the *Import to Moodle* icon. All we need to do is click this icon and the package will be imported into Moodle directly from the LRE.

Once we have the package imported, we return to the course and click the *Files* option and then select *Restore* from the various options listed:





















This unpacks the package and imports all parts into the current course. At this stage one may also decide to create a completely new course based on the contents of the package.



Once the package is imported, we can turn editing on if we want to move the imported resources around within our course. We may remove parts of the package or add new parts to our course if we wish to do so.

In just some five minutes we can rearrange items in a weekly format:

Rounding and estimation	
 Unit forum - Unit forum	
22 June - 28 June	<input type="checkbox"/>
 Introduction	
1 Rounding	
Introduction	
 1.1 Rounding in daily life	
 1.2 Rounding whole numbers	
 1.3 Rounding in general	
 1.4 Rounding decimals	
 1.5 Significant figures	
 1.6 Significant figures for numbers less than one	
29 June - 5 July	<input type="checkbox"/>
2 Estimation	
 2.1 Using estimations	
6 July - 12 July	<input type="checkbox"/>
3 Checking your answers	
 3.1 Have I done the right calculation?	
 3.2 Have I used the correct order for my calculation?	
 3.3 Have I given due consideration to units of measurement?	
 3.4 Did I make a rough estimate to act as a check?	
 3.5 Does the answer make sense in the real world?	
 3.6 Additional practice	
References and Acknowledgements	
 Acknowledgements	
Related Resources	
 open2.net: Science & Nature	
 Licencing Agreement	

4.4 Summing up

In this section we have illustrated the final stage of the ASPECT integrated system where we have different kinds of tools' integration intended to make life easier for the end-user. We have illustrated the way in which Icodeon tools have been integrated into the LRE to allow users to run SCORM and Common Cartridge packages directly from the LRE search results page. We have also described in some detail an example of another kind of integration where LRE search functionality is accessed directly from within a Moodle LMS. And last but not least, we have seen how Common Cartridge package found through the LRE search interface can be imported directly into a Moodle course and rearranged to suit the user's purposes.



5 Conclusion

This deliverable describes the status of the work on the integrated system approximately six months before the end of the project. As one can see from the elements described above, we have already achieved a considerable amount of systems integration based on the use of specifications and standards as well as a wide variety of tools and services.