

Dutch Exam Profile v4.0

Functional overview

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1. Introduction

High stake summative, officially prescribed, exams are an important part of the Dutch educational system. At several points in their career, pupils and students are tested and scored. This starts at elementary school and continues all the way up to secondary, pre-vocational, vocational and academic education. Besides summative exams there are also diagnostic tests (in this document the word "exam" refers to both summative exams and diagnostic tests).

Traditionally this has always been done using paper. In 1999, the Dutch government started to administer some central exams as Computer Based Training (CBT). At that time, the Cito product ExamenTester was used. In 2011 the Dutch exam board (College voor Toetsen en Examens - CvTE) started developing a new open source system, that would be platform independent and compliant with Open Standards. This resulted in a working system, called Facet, in 2012. The first real computer-based exams administered using Facet were in 2013. In 2014 Facet was used at 190 schools and full use is planned for 2017.

If we compare computer and paper based exams, there are some important pros and cons to consider:

Pros	Cons
The ability to introduce adaptive testing (which makes it more specific for the candidates and leads to less exposure of items)	It takes a greater organizational effort
Less marking effort	Technical issues
The processing of data (results, etc.) is much easier	Organising computer based exams is more complex
Items can be re-used	Hacking must be prevented
Contents can be enhanced with, for instance, audio or film	Different devices must be supported
It allows for a format where the candidate sees only one item at a time	It is more expensive (at least for now)
Answers are typed in, not written, and are therefore always legible	More responsibility for the exam board

Although paper-based exams will not disappear in the near future, the share of computer-based exams is expected to grow over the years. Given the impact an exam result can have on a student's career, a stable and reliable system is a necessity.

An important part of such a computer-based exam system is the ability to specify the exams unambiguously and transport them reliably between different components. For instance, an exam provider/developer must know how, in which form, it should pass the exam to the distribution and delivery system. What question types are supported, how to encode these questions, how to make sure the presentation and layout is right, how to influence the final score computation, when is this exam due, etc. A standard, a specification, for doing this is needed.

Such a standard, for specifying and transferring exams between parts of a computer-based exam system, is called the DEP: the Dutch Exam Profile. Although originally developed for use with the Facet system, it is now positioned as a generic standard.

This document contains the functional overview of the DEP. It has two parts:

- It starts by providing a context for the DEP. This part is meant as a general introduction and does not require a technical background (pg. 4).
- After this it describes the DEP on a functional level: how is it structured, what is in it, what constitutes the DEP. This is meant as an introduction for the technical users (pg. 6).

The full set of the DEP documentation consists of several documents. An overview of these can be found in documentation overview section below (pg. 2).

Important remark: When creating content using the DEP, you will always do this for a specific delivery platform (e.g. Facet). Be aware that the description of the DEP alone will most probably be insufficient. The DEP is a generic standard/vocabulary and does, for instance, not describe the limits the player of the delivery platform imposes on the contents. You still need to know which interaction types are supported, which options/attributes, etc. This delivery platform specific information is not part of the DEP documentation. Please consult the supplier and/or documentation of your delivery platform if you need more information about this. For Facet, this information can be obtained from DUO (helpdesk Facet).

1.1. DEP Documentation Overview

The DEP v4.0 June 2, 2015 documentation set consist of several documents. References to other documents are always in square brackets, e.g. [DEP-MER]. The following table provides an overview:

Document:	Title:
[DEP-DRG]	Dutch Exam Profile v4.0 - Documentation Reading Guide
[DEP-FO]	Dutch Exam Profile v4.0 - Functional Overview
[DEP-MER]	Dutch Exam Profile v4.0 - Manifest Extensions Reference
[DEP-EDR]	Dutch Exam Profile v4.0 - Extension Documents Reference
[DEP-QAR]	Dutch Exam Profile v4.0 - QTI Adaptations Reference

1.2. Copyright Notice

This document contains extracts from or derivatives of the IMS Global Learning Consortium specifications listed below and are available from the IMS Global Learning Consortium at <http://www.imsglobal.org>:

- IMS Question and Test Interoperability Specification, Version 2.1

<http://www.imsglobal.org/question/>

Copyright © 2012

- IMS Content Packaging Specification, Version 1.2

<http://www.imsglobal.org/content/packaging/>

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2. The DEP in context

The Dutch Exam Profile or DEP is a standard for transporting exams/tests between parts of an exam delivery system. It is an *interface standard*, that is, it describes the transport format. How applications handle the exams internally is up to the applications themselves.

The most important requirements for the DEP are:

- Use open standards, according to the Dutch government ICT architecture.
- Facilitate proper item display, as "pixel perfect" as possible. Research has shown that the way an exam question is presented to the student can be of grave influence on how it is perceived and answered. So controlling the lay-out is important.
- Be as complete as possible, especially include all (meta)data required by all systems concerned. This means that not only information about the test/exams must be present, but also all sorts of administrative data.
- Support extensions using external modules (e.g. in HTML5).

The DEP, as its name already implies, is a *profile*, a specialization, of several existing open standards, most notably IMS QTI (Question and Test Interoperability), an open standard for defining questions and tests. Other standards used are IMS CP (Content Packaging) and the more basic ones like XML, HTML, CSS, etc.

The DEP both limits and extends these standards. For instance:

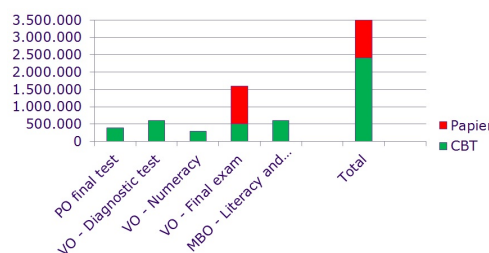
- It limits the content packaging standard by prescribing some strict rules for the important manifest file.
- It extends questions by specifying a way to add additional (meta) data to them in so-called extension documents.

The DEP is an evolving standard. It started with the release of V1.0 in 2012. This documentation (set) is for v4.0 dated June 2, 2015. More releases are scheduled, so be aware that this documentation (set) might be outdated. However, new versions usually mean the addition of features, so most information should still be correct.

Besides the rules imposed by the DEP, content developers and/or developers of DEP compliant systems must also be aware of the limits imposed by the final delivery system, the player. Since QTI is a very complex standard, not all interaction types and features will probably be supported. For Facet, please consult DUO (helpdesk Facet) if you need more information about this.

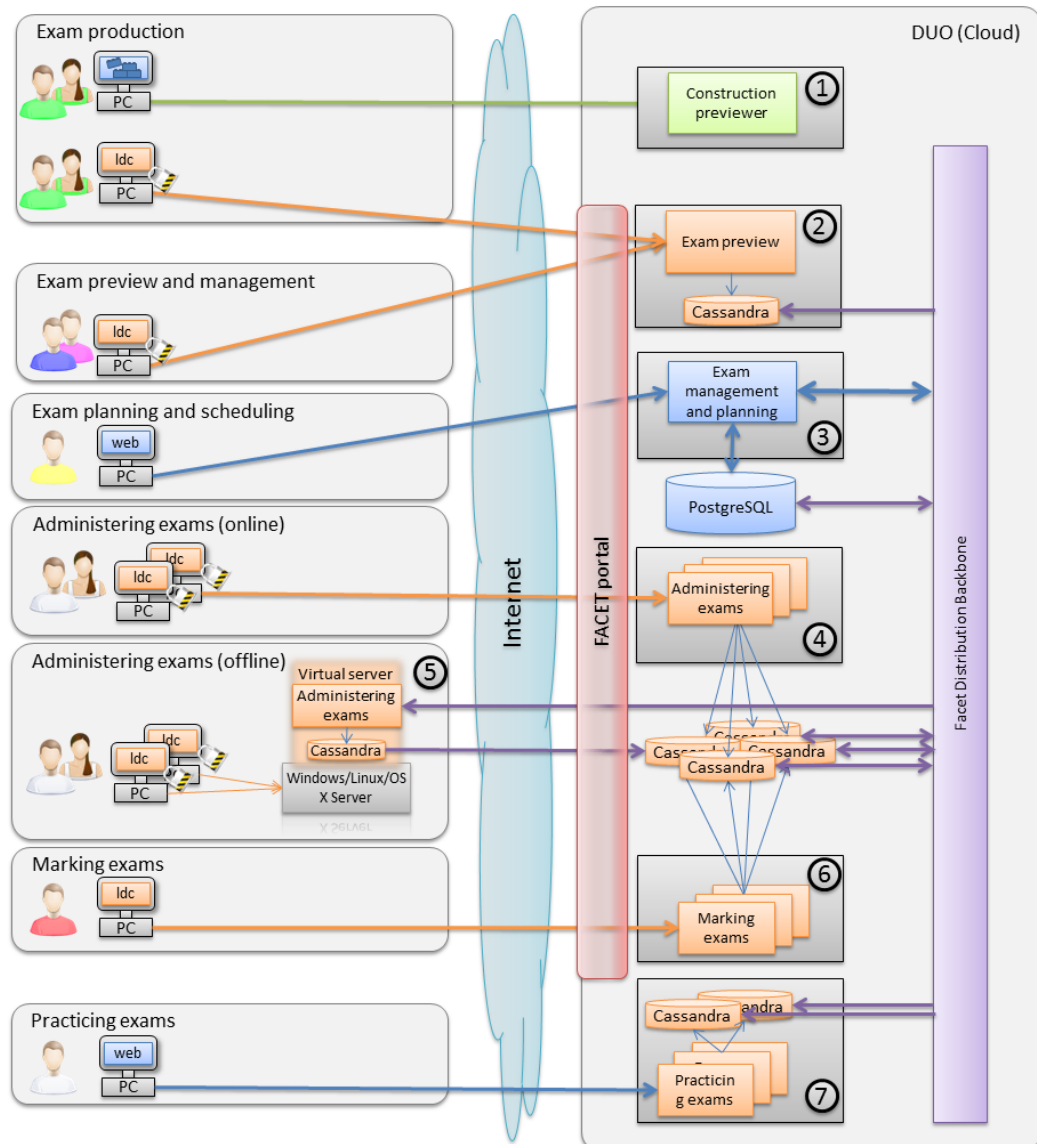
2.1. Usage example: Facet

In 2008, the Dutch government started working on a new computer-based exam system. This resulted in a working system, called Facet, in 2012. All computer based central exams and tests will be delivered in Facet by 2017. For 2020-2021 it is expected that almost 2,5 million exams will be done computer-based:



Expected computer-based exams using Facet in 2020-2021

Facet facilitates the full exam process chain, from determining the exams, administering them to passing on the results. The next figure provides an overview:



Overview of Facet

1. Exam production. Exam providers use their own environment and deliver the exams according to the DEP standard.
2. Exam preview and management
3. Exam planning and scheduling
4. Administering exams (online)
5. Administering exams (offline)
6. Marking exams
7. Practicing exams

Starting between the exam production (1) and preview/management (2), but also in several other places in the process chain (marked orange), exams must be transported between parts of the system. An exam contains a lot of information: Not only the questions themselves, but also assets, metadata, etc. All this information must be described and packaged in a uniform way, so all parts of the system know what to expect and are able to handle it. This calls for a standard to unambiguously describe the exams and combine all accompanying information. For Facet, this standard is the DEP.

3. Functional Description

The DEP is a standard for specifying and transporting complete exams between parts of a computer-based exam system. For instance, between exam producer and the central storage, between storage and player, etc.

This chapter dives deeper into the DEP. It provides a functional and technical breakdown of its parts and how it all fits together.

3.1. Underlying standards

This chapter will shortly introduce the standards underlying the DEP. For details we refer to the standards themselves.

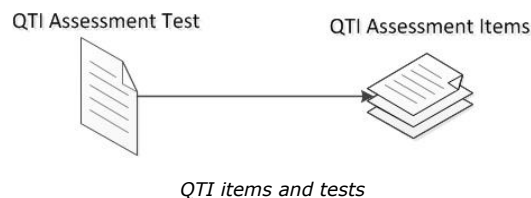
3.1.1. IMS Question & Test Interoperability (QTI)

Version: v2.1 Final (31 August 2012)

More information: <http://www.imsglobal.org>

The IMS Question & Test Interoperability (QTI) specification describes a data model for the representation of questions, tests and accompanying information. The specification enables the exchange of this information between systems like authoring tools, item banks, test constructional tools, learning systems, assessment delivery systems, etc. Its data model is described abstractly, however, for interchange between systems an XML binding is provided.

QTI's main structure consists of assessment items that are grouped together in assessment tests:



On both levels, QTI provides a lot of functionality:

- Assessment items (or in short, items) are the basic building blocks of QTI. An item can consist of an arbitrarily complex combination of text (with markup), multiple questions of different types, side information panels, multimedia objects, and more. It also defines its own result and response processing—when the answer is considered correct, scoring, and feedback. Some 20 different types of interactions are supported, like multiple choice, drag-and-drop, fill in the blanks, various graphic based types, etc.
- Assessment tests bind the individual items together. You can specify things like (sub)sections, random question drawing, time limits, adaptive tests, score computation, feedback, etc.

The DEP both limits and extends the basic IMS QTI standard:

- Consistent rendering and processing are important for formal exams. The DEP needs more information for this than standard QTI allows. Unfortunately QTI does not support any direct extensions for this in the items and tests themselves. Therefore the DEP specifies so called Extensions Documents that can hold this information. The Extension Documents are linked to the tests and items by the content packaging manifest (see [DEP-EDR]).
- Defines an API for so called Custom Interaction: Interactions that provide more functionality than basic QTI can provide. These interactions are written in HTML5 or Flash.
- Defines a number of custom operators for use in results processing, e.g. for comparing textual answers without considering accents on characters.
- Defines a specific way to make the tests adaptive (on top of the QTI test adaptivity features)

QTI is a complex standard and not all of its features will be supported by the software that will show the contents to the student (the delivery platform). What of QTI is supported and what not is not part of the DEP standard.

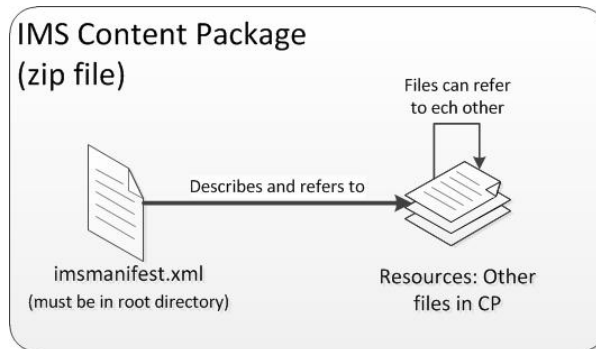
3.1.2. IMS Content Packaging (CP)

Version: v1.2 Public Draft 2 (March 2007)

More information: <http://www.imsglobal.org>

A meaningful unit of educational content almost always consists of more than one file. You have the individual questions and tests (in XML documents) but also the accompanying image, video and sound files. Since we want to transfer such an aggregation of files as a single unit, we need a way to package it, to keep it together. This is the subject of the IMS Content Packaging (CP) standard. IMS CP describes the data structures that can be used to exchange data between systems that wish to import, export, aggregate, and disaggregate packages of content.

In practice, an IMS Content package is a standard zip file with all the files that must be grouped together inside. The root of the zip file always contains an XML *manifest file*, called `imsmanifest.xml`. This manifest describes what's in the Content Package by providing metadata, structure information and references to all the contained files.



Schematic drawing of a Content Package

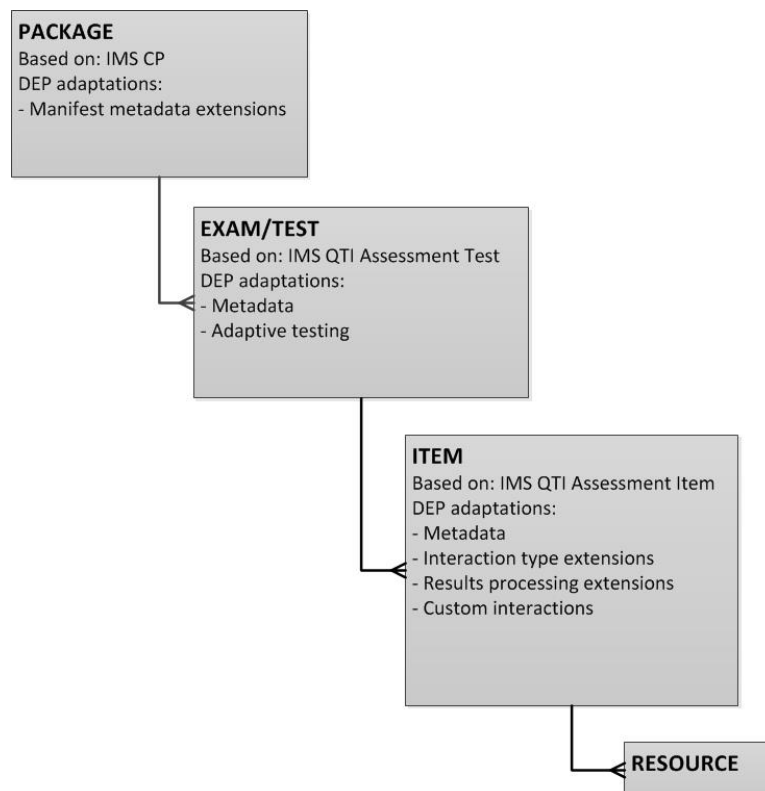
The manifest groups files in so-called *resources*. For instance, for the DEP a single item combined with its Extension Document is a single resource.

The DEP both limits and extends the CP manifest:

- The manifest is extended with DEP specific metadata, both on the package and resource level. This metadata is both in metadata sections and in DEP specific attributes. More information about this in [DEP-MER].
- Any information the DEP does not prescribe is ignored.

3.2. Functional breakdown

A DEP package contains a lot of interrelated data on various levels of detail. The figure below shows a functional breakdown of this:



Functional breakdown of the DEP

3.2.1. Package level

The DEP prescribes that the information must be packaged according to the IMS Content Packaging (IMS CP) standard. This means that:

- A DEP package with all its information is contained in a single zip archive
- This zip archive always contains, in its root, a so called manifest document. This manifest summarizes the contents of the package.

The unit of a DEP package is a group of exams/tests for a specific school type, subject and school year (e.g. HAVO, geography, 2014-2015).

DEP specific adaptations:

- Manifest metadata extensions: The manifest is extended with DEP specific information, for instance, its identifier, validity, exam year, etc. (see [DEP-MER]).

3.2.2. Exam/Test level

An exam/test specifies:

- The sequence of individual items (questions, information pages, etc.) the exam/test consists of
- How the individual item scores must be assembled into an overall exam/test score (results processing)
- Some exams/tests are adaptive (following questions depend on the answers given to previous ones). An exam/test can contain rules about this.

Exams/Tests must be specified as IMS QTI Test documents.

DEP specific adaptations:

- Metadata: An exam/test has metadata about, for instance, minimum screen resolution, maximum score, item numbering, etc. This metadata is in two locations:
 - Some metadata is in the package manifest (see [DEP-MER]).
 - Some metadata is in a special extension document, alongside the QTI Test exam document (see [DEP-EDR]). The manifest links the extension and the test document together.
- Adaptive testing: The DEP supports exams that are adaptive (following questions depend on the answers given to previous ones) (see [DEP-QAR]).

3.2.3. Item level

Items contain the actual contents of the exams. This will be questions, but also general information pages, etc.

Items must be specified as IMS QTI Assessment Item documents. DEP specific adaptations:

- Metadata: An item has metadata about, for instance, maximum score, usage of additional tools, etc. This metadata is in two locations:
 - Some metadata is in the package manifest (see [DEP-MER]).
 - Some metadata is in a special Extension Document, alongside the QTI Assessment Item document (see [DEP-EDR]). The manifest links the item and its extension together.
- Interaction type extensions: On top of the standard QTI interactions, the DEP specifies several extensions. These are not completely new interaction types, but specific "patterns" to be used in existing interactions that will elicit special, non-standard, behavior (see [DEP-QAR]).
- Results processing extensions: Results processing is what happens when an item is answered and the result is processed. For this the DEP adds several special operators, for instance to compare an answer without regarding diacritics (see [DEP-QAR]).
- Custom interactions: The DEP allows for special custom interactions that go beyond what the QTI standard can provide. These interactions must be written in HTML5 or Flash. They must interact with the rest of the environment in a specific way, for instance to pass the pupil's answer (see [DEP-QAR]).

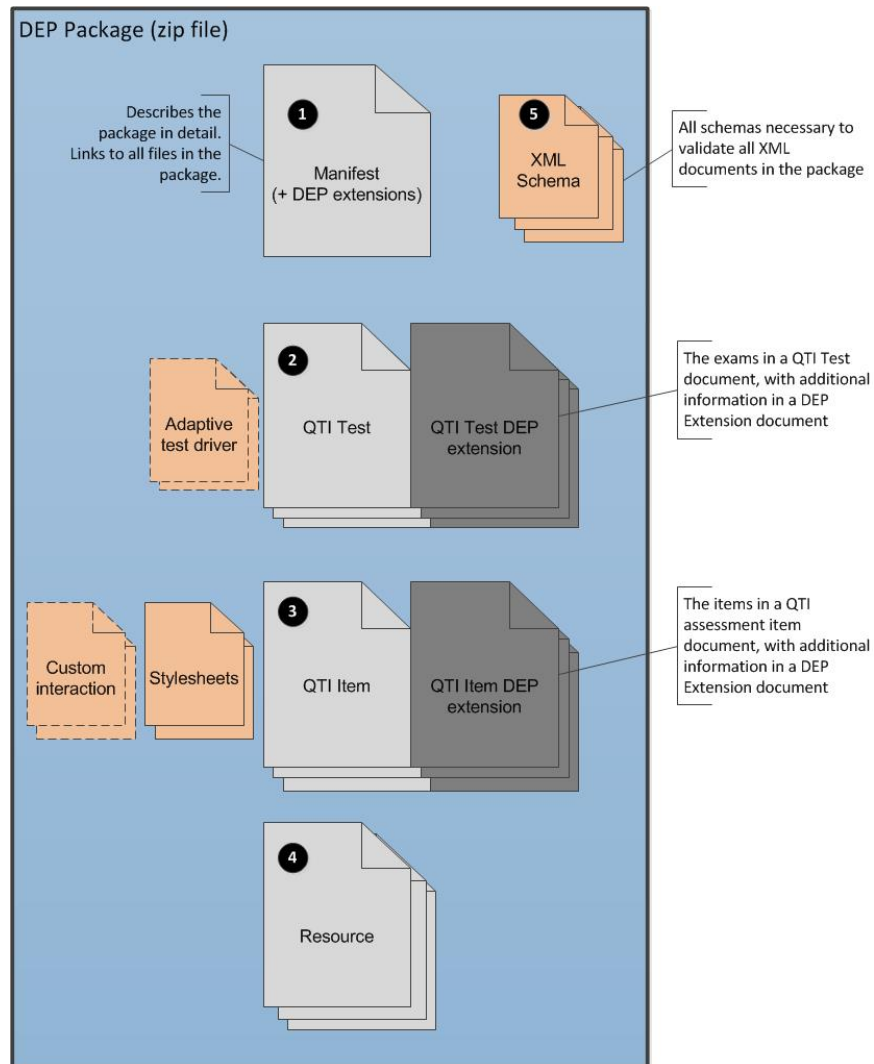
3.2.4. Resource level

Resources are things like images, movies, sound, etc. All resources referenced must be part of the DEP package.

Which resource types are supported is (for the DEP v4.0) not part of the DEP but a feature of the player.

3.3. Technical breakdown

A DEP package is technically a zip file (with other files inside). The following figure depicts the contents of a DEP package:



Technical breakdown of the DEP

1. Starting point for interpreting a DEP package is the manifest. This is always located in the root directory of the zip file and called `imsmanifest.xml`.
A manifest is an XML document that follows the IMS CP manifest schema. This schema is extensible and the DEP has defined an extension schema for metadata and linking to the test/item DEP extension documents (see [DEP-MER]).
2. All exams/tests are specified as IMS QTI Assessment Test documents. A test document can be accompanied by a (single) DEP extension document, containing additional metadata for the specific test (see [DEP-EDR]). When the test uses any adaptive test drivers these must also be present (see [DEP-QAR]).
3. All items are specified as IMS QTI Assessment Item documents. An item document can be accompanied by a (single) DEP extension document, containing additional metadata for the specific item (see [DEP-EDR]). Stylesheets and other additional documents referenced by the items must also be present. When the item uses any custom interactions (see [DEP-QAR]), these must also be present.
4. All resources referenced must be present.
5. It is good engineering practice (but not mandatory) to include all schemas for all XML documents in the package and reference these from the XML documents.