The ECDL test development and validation process

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THE ECDL TEST DEVELOPMENT AND VALIDATION PROCESS

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The ECDL Test Development and Validation Process

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Abstract
The European Computer Driving Licence (ECDL) is the leading end-user desktop certification programme, running in over 100 countries with more than 100,000 students enrolling monthly. The ECDL Syllabus is regularly monitored to ensure it meets current needs. This paper looks at the steps taken in developing the test process for the latest Syllabus release to ensure the testing procedure provides a fair and accurate assessment of candidate’s abilities.

ECDL test development is based on industry standard development techniques, with clearly defined steps involving:

- Syllabus Definition

General / Soft Test Characterisation
- Criticality / Core Item Identification Exercises
- Model Test Grids
- Cut Score Exercise
- Test Blueprint / Characterisation Test Template (CTT)
- Item / Test Development
- Evaluation and Validation
- Pilot Testing
- Empirical Evidence Evaluation
- Ongoing Maintenance of Tests

Criticality is considered by Subject Matter Experts (SMEs) in ECDL Core Item Identification exercises under European Computer Driving Licence Foundation (ECDL-F) supervision and evaluation. The Characterisation Test Template (CTT) is the test blueprint for ECDL tests. The CTT defines the test format, the cognitive level at which the test operates, the number and type of
questions, the required Syllabus coverage, the test duration and the cut score. The CTT is the embodiment of the previous exercises in a formalised document. Once implemented tests are subject to continual review to ensure they are fair and meet the agreed criteria.

Additional abbreviations:
ICDL – International Computer Driving Licence
A/MTE – Automated / Manual Test Evaluation
CEPIS – Council of European Professional Informatics Societies
UCISA – Universities and Colleges Information Systems Association
MCC – Minimally Competent candidate
OUCS – Oxford University Computing Services

Background
The European Computer Driving Licence (ECDL) is the world’s leading computer end-user skills certification programme. Outside the European Union it is known as the International Computer Driving Licence (ICDL), using a common syllabus and methodology with ECDL. The validity and reliability of the ECDL certification examinations is an issue of fundamental importance for the ECDL. ECDL certificate holders must be confident that their certificate is a valid proof of their computer competency and that this is recognised by the community at large, by employers and by educational institutes. The ECDL consists of seven modules: Module 1 is a theoretical test of computing knowledge at a general level and Modules 2-7 are practical skills tests (see Appendix A).

New syllabus
Nothing stands still in computing – neither the software, hardware or expected knowledge of a basic user of IT. For this reason the ECDL syllabus is periodically reviewed to ensure that it meets the current working practices and incorporates new technology. The introduction of a new syllabus allows for all aspects of the certification to be reviewed in the light of experience, lessons to be learned and development processes to be enhanced. The aim within ECDL is a reliable and valid test administration which accurately tests a candidate’s ability as a competent user of IT throughout the learning objectives defined within the ECDL Syllabus. The new Syllabus publication offers a further opportunity to enhance and evolve the processes around test development.

Test Development Process Steps
ECDL Test development is based on industry standard development techniques. The process is based on clearly defined steps involving:

1.2 Syllabus Definition
1.3 General / Soft Test Characterisation
1.4 Criticality / Core Item Identification Exercises
1.5 Model Test Grids
1.6 Cut Score Exercise
1.7 Test Blueprint / Characterisation Test Template (CTT)
General / Soft Test Characterisation
Within ECDL the Soft Test Characterisation is the general characterisation agreed by the experts drawn from the community of computing societies, national operators and participants within the programme about what the general characteristics for an ECDL test are. This provides an important guiding backdrop against which all tests are developed. Some of the elements of the ECDL soft test characterisation are as follow:

- Authentic test experience
- Sustains the metaphor of the driving licence
- Unthreatening test experience
- Ample time to complete
- High pass mark consistent with a competency based test
- No trick questions
- Coherent document outputs

The ECDL soft test characterisation provides an important basis and reference point for test development as it provides the context for what the tests should be like and is an important part of the general test construct.

Test characteristics
One of the underlying soft-test characteristics of an ECDL test is that ample time is provided for the Candidate in which to complete the test. In order to ensure this was in fact the case statistics need to be gathered by the various national operators. Shown below is the time taken across a sample of more than 33,000 tests spread across the seven modules of the qualification using 45 minute tests. The outcome of this type of exercise is to illustrate that there was sufficient time for all Candidates in which to complete the test.
Figure 1: Completion times

Whilst these figures show that the time required, on average, is only about half the allowed time they do not show whether the time has an impact on the success or failure of a candidate. For this we needed to look at the length of time taken by each candidate and whether this time restriction had a significant effect in their passing. If we had found for instance that there was a steep increase in failure by those taking right up to the allowed time then there could be a rationale to make the tests longer to allow them to complete.

Time for completion

A further evaluation of over 25,000 candidate results shows that there is ample time for the Candidates undertaking the test, we note that an increasing number of Candidates fail as time progresses, suggesting item at this point time is not a factor for the Candidate who will succeed in the test.
Figure 2: Sample of pass/fails against time
Reduction in achievement over time
Looking at this data in a comparison of passes and fails as a percentage within each time interval gives the following graph, which reinforces the concept that sufficient time has been allowed. From this we can see that both the number completing in the later time periods decreases (Figure 2) and the ratio successfully completing is falling (Figure 3).

Figure 3: Sample of pass/fails as a percentage per time interval
Syllabus Definition:
The Syllabus defines the facts to be known and the skills to be mastered. It specifies the skills analysis for IT competency which is refined by expert and professional opinion. Items are expressed in a precise and unambiguous way, and elaborated to a level of detail and precision to define a single (or a cohesive set) measuring point for testing. The following diagram illustrates a general view of the Syllabus Definition process:

**Figure 5 Syllabus Definition Process**

Criticality / Core Item Identification Exercises
Once the Syllabus has been established and refined over many iterations and the general or soft test characterisation expressed, the criticality of items in the given Syllabus modules has to be decided. The next step in the development process is core item identification. In any test it is not feasible to cover the entire syllabus with all of the nuances of the software. Measuring point criticality is the degree to which a Syllabus measuring point may be meaningful and discriminating for an item in a test given the test domain under consideration. For this reason a group of Subject Matter Experts (SMEs) reviewed the syllabus items and chose the areas which differentiate between whether a candidate has an understanding of the core concepts required for that module. The core items are the items of the Syllabus that are generally agreed to be critical to competency in the module domain. The panel of SMEs each voted on their critical items and these votes were then aggregated. Items scoring a sufficient number of votes become part of the
core item framework, and other items which had a significant vote were debated to allow SMEs to amend their choice.

In this way a coherent set of items were chosen from within the syllabus as being the core items for test construction.

Shown below is part of the core item grid showing the syllabus items for the Word Processing module. Items marked as NE are regarded as trivial in a testing context so not examinable in their own right, but necessary for completeness of the syllabus.

<table>
<thead>
<tr>
<th>SKILL SET</th>
<th>REF.</th>
<th>TASK ITEM</th>
<th>ITEM STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1.1 First Steps with Word</td>
<td>3.1.1</td>
<td>Open (and close) a word processing application.</td>
<td>NE</td>
</tr>
<tr>
<td>Processing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1.1 First Steps with Word</td>
<td>3.1.2</td>
<td>Open one, several documents.</td>
<td>Option</td>
</tr>
<tr>
<td>Processing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1.1 First Steps with Word</td>
<td>3.1.3</td>
<td>Create a new document (default template).</td>
<td>Core</td>
</tr>
<tr>
<td>Processing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1.1 First Steps with Word</td>
<td>3.1.4</td>
<td>Save a document to a location on a drive.</td>
<td>Option</td>
</tr>
<tr>
<td>Processing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1.1 First Steps with Word</td>
<td>3.1.5</td>
<td>Save a document under another name.</td>
<td>Core</td>
</tr>
<tr>
<td>Processing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1.1 First Steps with Word</td>
<td>3.1.6</td>
<td>Save a document in another file type such as: text file, Rich Text</td>
<td>Core</td>
</tr>
<tr>
<td>Processing</td>
<td></td>
<td>Format, HTML, template, software specific file extension, version number.</td>
<td></td>
</tr>
<tr>
<td>3.1.1 First Steps with Word</td>
<td>3.1.7</td>
<td>Switch between open documents.</td>
<td>Option</td>
</tr>
<tr>
<td>Processing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1.1 First Steps with Word</td>
<td>3.1.8</td>
<td>Use available Help functions.</td>
<td>Option</td>
</tr>
<tr>
<td>Processing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1.1 First Steps with Word</td>
<td>3.1.9</td>
<td>Close a document.</td>
<td>Option</td>
</tr>
<tr>
<td>Processing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1.2 Adjust Settings</td>
<td>3.1.2</td>
<td>Change between page view modes.</td>
<td>Core</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1.2 Adjust Settings</td>
<td>3.1.3</td>
<td>Use magnification/zoom tools.</td>
<td>Option</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1.2 Adjust Settings</td>
<td>3.1.4</td>
<td>Display, hide built-in toolbars.</td>
<td>Option</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1.2 Adjust Settings</td>
<td>3.1.5</td>
<td>Modify basic options/preferences in the application: user name, default</td>
<td>Option</td>
</tr>
<tr>
<td></td>
<td></td>
<td>directory/folder to open, save documents.</td>
<td></td>
</tr>
<tr>
<td>3.2.1 Insert Data</td>
<td>3.2.1</td>
<td>Insert text.</td>
<td>Core</td>
</tr>
<tr>
<td>3.2.1 Insert Data</td>
<td>3.2.2</td>
<td>Insert special characters, symbols.</td>
<td>Core</td>
</tr>
</tbody>
</table>

**Figure 5: Core item grid**

**Model Test Grids:**
The SMEs are then asked to prepare four model tests. An instruction is given to the Expert Group who are asked to reflect on the soft test characterisation: the notion that ECDL tests should be non-threatening, coherent, be based on developing meaningful outputs, with no trick questions etc. and then to create a test based on the largest number of items they think possible to include within the test duration and reflecting an agreed proportion of the core items identified in the core item identification exercises and present these in a series of Model tests.
The criticality dimension is important here for the SMEs. A minimum of two-thirds of the content in the core items must be selected in each test and then the SME is asked to collate up to a maximum number of agreed items that will be contained within what is deemed to be a ‘good’ test. The coverage profile elaborated within Core Item identification is very helpful in managing difficulty level expectation etc. The results are analysed to reflect the expert opinion and they are balanced to give a set of 4 streams of meaningful tests.

Cut Score Exercise:
Angoff Method cut score analysis exercises are then undertaken. A Group of SMEs ascribe a probability value, High, Moderate or Low to the Borderline or Minimally Competent Candidate’s (MCC) chances of succeeding in a particular test item. The MCC is the Candidate who will know just enough to pass the test. This exercise ascribes an index to outcomes for the MCC in respect of test items undertaken. All the results of the Experts are collated and averaged to produce an analysis. This is discussed to arrive at a cut score.

Anticipated Question Item Outcome Difficulty level
Anticipated outcome difficulty levels for questions are ascribed by SMEs to Syllabus measuring points to assure congruency with Syllabus in output question items developed. The questions themselves were divided into three levels (High, Moderate and Low) dependant upon anticipated outcome probability for the minimally competent or borderline student.

Characterisation Test Template (CTT) Development
The Characterisation Test Template (CTT) is the test blueprint for ECDL tests, it defines the form of the test and test construct. The CTT defines the test format, the cognitive level at which the test operates, the number and type of questions, the required Syllabus coverage, the test duration and the cut score. The CTT expresses what practicing professionals and Subject Matter Experts (SMEs) have agreed as reflecting the ECDL Syllabus and the general or soft characterisation for the test.
Item/Test Development
The ECDL-Foundation manages the process for test development and publishes guidelines for development against four nominally parallel test streams with relevance to Syllabus Item, language, fairness and precision. Test items are engineered to meet the ECDL CTT standards, whole tests are assembled then reviewed and validated by an expert group for accuracy and test experience.

ECDL-F Expert Review and Validation
The ECDL Foundation Automated Test Evaluation Systems (ATES) Evaluations Group have responsibility for evaluation of test items, tests and systems. The following review criteria are applied in the evaluation of question items and tests.

- Syllabus Congruence
- Syllabus Coverage
- Compliance with CTT
- Appropriateness of Item format
- Technical Accuracy
- Language & Clarity
- Text Content

Where Multiple Choice Question (MCQ) formats are used question items are evaluated under the following criteria. Note the following extract from ECDL-F ATES (Automated Test Evaluations Systems) Annex 2:

- Technical Accuracy
- Language / Clarity
- Question Stem
- Distracters
- Correct Answer / Question Stem
- Correct Answer / Distracters
- Distracters - Plausibility
- Distracters - Consistency
- Distracters - Logical Presentation
- Distracters - Weighting

Pilot Testing
Pilot testing is undertaken for all ECDL tests. The pilot process involves statistical evaluation of tests performance which includes quantitative and qualitative indicators in respect of the tests evaluated. Monitoring of the test results then takes place to ensure consistency over the long term by the ATES evaluations group. Benchmark certification industry statistical indicators are used to evaluate reliability and validity of the tests.

Review of Pilot Test Results
Pilot Test results are reviewed by the ATES Evaluations Group. Any changes requested in the tests based on Pilot testing are then undertaken before the live certification tests are administered.
Empirical Evidence Evaluation
ECDL Tests are evaluated and monitored on an ongoing basis by the ATES Evaluations Group using recognized psychometric measurements.

Ongoing Maintenance of Tests
ECDL tests are monitored on an ongoing basis by the ECDL Foundation ATES Evaluations Group. Tests are updated in line with Syllabus revisions and also where test results or empirical evidence indicates that items or tests are not functioning in line with anticipated test behaviour parameters.

Conclusion
The testing regime for ECDL throughout the world is based on sound, recognised testing methodologies. The empirical information established throughout the pilot testing carried out together with the test development processes provide a solid foundation upon which to base the tests.

Acknowledgements
Thanks to ECDL licensees for statistics, to ECDL Foundation ATES WG for discussions, and to our employers for allowing time to produce this paper.
## Appendix A

### ECDL Modules

<table>
<thead>
<tr>
<th>Module 1: Concepts of Information Technology (IT)</th>
<th>Knowledge of main concepts of IT at a general level. Make up of a personal computer in terms of hardware, software, storage &amp; memory. General knowledge of communications, networking, software applications, health &amp; safety issues, security, protection and legal issues.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module 2: Using the Computer and Managing files</td>
<td>Ability to use a computer and its operating system. The skills to adjust settings, use help, restart from failure, operate in desktop environment, organise files and folders. Use text editing, print management, compression and virus protection software.</td>
</tr>
<tr>
<td>Module 3: Word Processing</td>
<td>Ability to use a word processing application for every day tasks creating, formatting and finishing small sized documents. Copying &amp; moving, using tables, pictures &amp; images and mail merge tools.</td>
</tr>
<tr>
<td>Module 4: Spreadsheets</td>
<td>Ability to use a spreadsheet application. Developing, formatting, modifying a spreadsheet of limited scope understanding the concepts. Generating and applying formulas and using graphs/charts.</td>
</tr>
<tr>
<td>Module 5: Database</td>
<td>Ability to use a database application and understand the main concepts. Create &amp; modify tables, queries, forms &amp; reports and prepare outputs. Relate tables, manipulate and retrieve information using query and sort tools.</td>
</tr>
<tr>
<td>Module 6: Presentation</td>
<td>Ability to use presentation tools on a computer. Create, format, modify and prepare slide layouts for presentation. Ability to create simple drawn objects and create charts. Manipulate text, pictures and images and animate a presentation.</td>
</tr>
<tr>
<td>Module 7: Information and Communication</td>
<td>This module is divided into two parts. The ability to use the Internet, understand the basic concepts and appreciate security issues. Use search engine tools for common browsing and information retrieval tasks. Completing a web-based form, using bookmarks and printing pages. The ability to use e-mail and understand the basic concepts including security issues. Create, send, receive, reply to &amp; forward e-mail, handle attachments and organise message folders in e-mail.</td>
</tr>
</tbody>
</table>

106