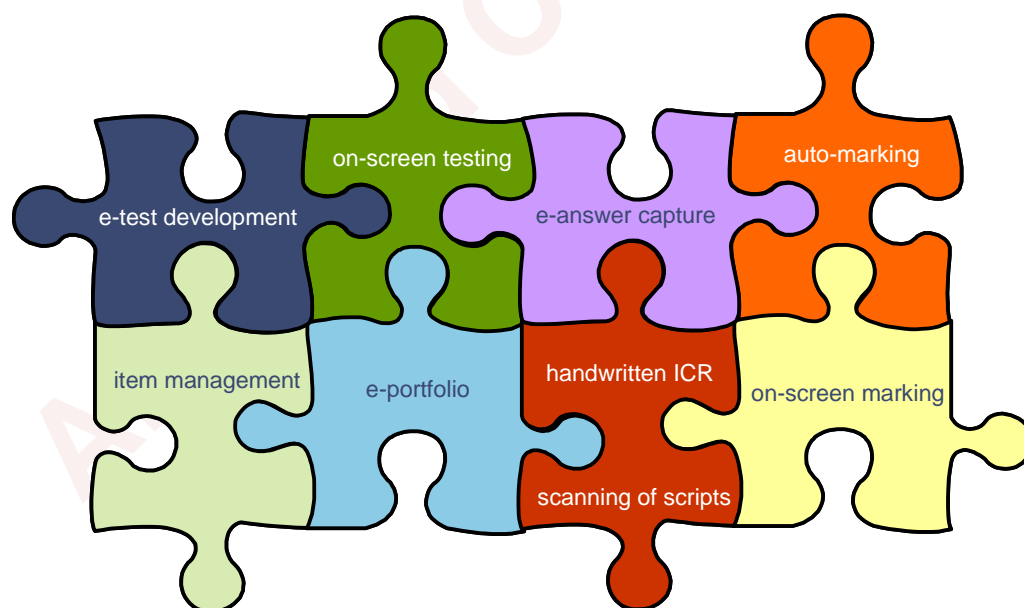


QCA

Review of e-assessment process models



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Executive Summary

In our review of the e-assessment process models of four Awarding Bodies (ABs), we have found that the awarding bodies offer a variety of different elements or components that can each be seen as electronic assessment. The awarding bodies offer different combinations of these components and this may further vary according to the particular qualification being assessed.

We have identified the following components:

1. on-screen testing;
 - i. *paper translation*
 - ii. *modifications not replicable on paper*
 - iii. *transformational*
2. e-test content item management
3. e-portfolio
4. on-screen marking
5. automated marking
 - iv. *automated multiple-choice marking*
 - v. *closed and short answer question marking*
 - vi. *process based marking*

The model used by most awarding bodies is on-screen testing, that is, for the duration of the test the candidate is not directly connected to the awarding body's server; only at the beginning and end of the test is live connectivity established through the centre's server. An alternative delivery model is provided by all awarding bodies: removable media which can be used to load the test on to standalone workstations.

The most basic form of on-screen testing; typically multiple choice style or 'paper translation' tests, has been offered for at least two years by awarding bodies, especially in the commercial and adult education sectors.

All of the awarding bodies are proceeding with an incremental approach to development and trial of components of e-assessment.

A common interim solution comprises paper scanning of scripts (digitisation) in order to enable implementation of on-screen marking which is soon to go live at two of the awarding bodies.

We have also found that awarding bodies are developing various elements that can be used in e-assessment systems such written short-answer character recognition, on-screen answer capture and auto marking capability slightly beyond basic objective tests.

The development of more sophisticated 'transformational' e-testing, which exploits the interactive and intelligence capabilities of IT, is still in its infancy with a few early tests in the piloting stage.

At the high level considered in this study, the e-assessment process for a given service/qualification and e-delivery model differs little between awarding bodies – any differences are in the detail of the service features/components and the consequent back office processing.

The impacts on the operational process of e-assessment are significant. The process map of the end-to-end system looks significantly changed as new processes are introduced, the order of processes is altered and other process become redundant. The key impacts on the system are:

1. Changes in system lead times
 - (i) On-demand testing (lead-time reduction) can be achieved through the implementation of e-assessment.

- (ii) Rapid results generation: through the use of pre-set pass marks and automated marking.
- 2. Changes in system phases
 - Introduction of the phase 'Internal verification / moderation' incorporating activities in centres connected with coursework, candidate portfolios and internally marked assessment.
 - Candidate registration now takes place after resourcing rather than before.
- 3. Changes in the allocation of overall system effort, refocusing it on different activities. Total effort may also sometimes be reduced depending on the complexity of the e-assessment.
 - (i) Reduction in post-exam operations
 - (ii) Increased effort required at front-end: in the test development stage
- 4. Changes to key 'players' in the system
 - Logistics suppliers are therefore no longer shown as a key player in the system.
 - A new key player in the e-assessment system is the technology supplier or developer (this may be an external party or an in-house operation).
- 5. Increased number of 'routes' through the system: any single qualification may have a unique route or routes through the system depending on:
 - which e-assessment components it uses;
 - different elements within the assessment;
 - transitional nature of some routes i.e. digitisation / scanning.
- 6. The ability to use e-assessment is dependent on the widespread technical and connectivity standards of centres, results in several additional processes for both centres and awarding bodies.
- 7. Some processes for example, Special Arrangements Requests or Appeals, are not yet properly developed and may not be robust enough to support e-assessment as it becomes more widespread and used for high stakes examinations.

Introduction

Background

The Assessment Policy and Development Programme team (APDP) in QCA commissioned PricewaterhouseCoopers LLP (PwC) to review and report on the business process models of selected awarding bodies offering e-assessment.

The review will inform the QCA's understanding of the range of e-assessment activities and development taking place currently in the sector and give an indication of the direction in which the advancement of e-assessment is heading.

The primary output from this review is a process model representing the high level e-assessment system and commentary to support the model.

Approach

The QCA selected the four awarding bodies for review. We gathered information from the awarding bodies by conducting interviews and reviewing any process and procedure documentation that they were able to provide. This has enabled us to identify:

- key e-assessment components;
- a summary of the key characteristics of the e-assessment system and the main changes and impacts on the end-to-end process model;
- the operational processes that comprise the e-assessment system;
- future development plans, implementation issues and an overview of the supporting technology; and
- a summary of the approach adopted for managing risk.

Overview of e-assessment

Key e-assessment components

We have identified seven key components of the e-assessment system. Any one individual qualification, which can be classed as being delivered by an e-assessment process model, may use one or more of these components.

1. *On-screen testing – ‘paper translation’*

At its most basic level, computer-based assessment is the replication of a paper test on a computer screen. This on-screen test typically entails questions being presented via a delivery system onto the student's workstation screen with little or no change to its appearance on paper.

The answers are captured electronically, but can be either:

- (i) marked manually as before (except for multiple-choice tests which are currently optically scanned and automatically marked); or
- (ii) marked automatically by the system.

This method has been an early ‘quick win’ solution in the evolution of e-testing, as it provides some delivery benefits from eliminating the test paper printing and physical distribution, without requiring any change of test design or question setting (hence the paper tests can also still be offered by the awarding body at the same time). This component allows flexibility of location and time of testing¹.

2. *On-screen testing – ‘modifications not replicable on paper’*

These tests still use closed tasks for which there is a known and pre-specified solution to the task, but may now incorporate modifications which would not be easily replicable on paper, for example video or audio clips, drag and drop actions, adaptive testing, or oral language capture. Adaptivity analyses a candidate's response to tasks to demonstrate what they can do; it then profiles the candidate's performance and presents further tasks which match their level. Other modifications may include the use of guidance which prompts candidates to complete missing questions and tasks or gives them ‘clues’ to tasks which they are struggling with.

3. *On-screen testing – ‘transformational’*

At the other end of the spectrum is the transformational e-test which exploits the capabilities of IT interactivity and data / media significantly beyond what is possible in a paper-based test. These are radically different from current assessment techniques, use scenario-based environments with a ‘virtual world’ data set available for the candidate to use, and include open tasks which have no known or pre-determined solution. Transformational e-tests are rules based, requiring the candidate to demonstrate their ability through process evidence as well as delivering particular outcomes. There may be many valid contributors and routes to achieving success in these tests.

Due to difficulties in assessing the comparability of *transformational* tests with existing tests, transformational testing is applicable only to new qualifications / or new ways of assessing current specifications.

¹ It should be noted however that on-demand testing can be achieved even with paper-based assessment, providing the test can be electronically transmitted to / downloaded by centres and printed locally as and when required.

Clearly the more sophisticated presentation of this e-test requires considerable development of the test software and environments, and requires different skills for task setting and marking than the traditional paper question-setter may currently possess.

4. *content item management / banking*

e-assessment generates three main implications for item management:

- (i) item-banking is required in order to support delivery of tests and assessments over larger time-windows. As tests become available to candidates beyond a one-off bounded time slot (at the extreme to fully on-demand 24 hours a day 7 days a week) questions and tasks must be selected from a large bank of items to avoid the potential for duplication, familiarity with questions, and communication of questions between candidates.
- (ii) systems must be established for test version control so that centres and candidates cannot predict the content of the test. Randomised selection may be from a bank of whole papers, or randomised selection of items to construct a paper for a centre or candidate. The latter involves more complex challenges for awarding bodies in ensuring comparability and the standards of individual items as well as entire papers.
- (iii) as e-assessment moves away from simple replication of a paper-based test, new types of question and tasks are required to make use of the different capabilities of the test environment. This now starts to blur the boundary between the question setting role of the examiner, and the software development role of the technical solution supplier. The nature of the test item 'task' design may now be radically different from a paper-based question or task.

The compatibility of different e-test solutions may be encouraged, but not guaranteed, by the emergence of the voluntary Question and Test Interoperability (QTI) standard in the computer aided assessment industry. In essence, e-test items and data can be managed separately from the presentation / delivery software, to retain the ability to develop 'question' / item banks independently of the software, and interoperability between subsystems becomes more feasible.

5. *Management of internal verification / assessment through e-portfolio management systems*

Another key e-assessment component deals with the management and verification or moderation of coursework portfolios and other learning evidence which is non time-bounded and primarily internally assessed.

At the basic level, this consists of the submission and marking of e-coursework (electronic based portfolios) written in computer / multi-media format and the subsequent issuing of results. At a more sophisticated level, the service can offer the ongoing recording and management of a learner's e-portfolio of modules and coursework to track progress towards an overall assessment or maintain a personal learning record, and enable access to the portfolio by assessors and verifiers. Evidence may include a wide range of media including digital pictures, sound and video as well as documents and spreadsheets.

Currently, a considerable number of suppliers, several of whom are small / niche players, offer a range of web-enabled portfolio services.

6. *On-screen marking*

On-screen marking comprises the presentation to external markers on computer of submitted work or answer sheets. The work is stored and circulated electronically whether it was originally created by an e-test or by the scanning / digitisation of a paper script. In either case, marks are associated electronically to the candidate's responses down to item / question level.

On-screen marking provides the key benefit of eliminating the majority of paper distribution to and from the centres, markers, moderators and awarding body. It also gives rapid access to scripts, holds more detailed information, and allows easier monitoring and quality assurance of the marking process. Typically markers access the candidate responses online, in a secure system, and enter the marks to a specially designed system.

On-screen marking enables scripts to be distributed in different ways to markers, e.g. no longer do scripts have sent to a marker batched by centre. Scripts can also be split by question and batches of individual questions apportioned to markers; allowing specific items to be sent to different types of marker (clerical, graduate/post graduate student, trained and standardised assistant examiners etc.) which is not possible with the paper-based system.

As well as scripts, other items can be distributed electronically to external markers such as oral responses. An additional benefit is that marks can be automatically summed removing the risk of arithmetic errors.

7. Automated marking

The automation of marking is performed in the test software or awarding body central marking system (either continuously or once the test is completed) following electronic capture of candidates' responses or actions and using a pre-determined mark scheme or rules base. This eliminates the requirement for numerous markers to be employed post-test and allows the immediate, or very rapid, generation of results.

There are three forms of automated marking:

- (i) in its simplest form, auto-marking is already widely used for multiple choice on-screen tests;
- (ii) automated marking may also be used to mark closed and short-answer questions, perhaps through the use of character recognition software;
- (iii) process-based marking requires increasing intelligence in the marking engine and redesign of tests to make tasks and candidate's responses more amenable to auto marking. A current challenge is in the developing application of auto-marking for transformational e-tests where task performance, rather than output, is marked.

Main e-assessment delivery models / solutions

In our review we have encountered the following e-assessment delivery models, as described in QCA's guide "On screen delivery of qualifications" March 2004. In every case, where results must be securely attributed to a registered individual, there is an initial layer of student registration and allocation of a unique identification number and password which the candidate then requires to initiate the e-test.

1. Delivery Model Type 1

- a) on-line test with candidate continuously online to an awarding body's server throughout the test, usually via a server located in the centre; or
- b) on-line test with candidate online at the start and end of the assessment session only (test download and answers upload).

Model 1 is dependent on high availability and reliability of internet connectivity, and consequently it is used primarily for low-stakes assessments such as progress tests, practice tests, and commercial applications.

2. Delivery Model Type 2

Assessments are encrypted and delivered to the centre in advance using the internet or removable media (such as CDs and rewriteable memory devices) and loaded to the exam or test centre's server. The assessment is then loaded to workstations via the centre's network. Following the end of the test, answers are uploaded back to the centre's sever and forwarded to the awarding body for marking and the results are returned within an agreed timetable.

Model 2 is more robust as it is only briefly dependent on internet connectivity and relies instead on the centre's network. It is used for some statutory tests.

3. Delivery Model Type 3

Test software is loaded manually to stand-alone workstations by removable media. Following the end of the test, answers are copied back to the removable media and returned to the awarding body. Assessments are not loaded onto the centre's server. Removable media is the only means of implementing on-screen assessment where internet links are unavailable.

Model 3 is the most robust as it can operate without internet access, but it does involve additional time and effort from centre staff and a few days lag for distribution of media. Sometimes model 3 is co-supplied to centres as a contingency option for model 2.

The above three delivery models address the actual test delivery environment for candidates.

Other sections of the end-to-end system are based on the following delivery models:

4. e-Test content item management

An item bank is a repository of question objects from which assessments can be assembled. An item bank will normally be organised at either the qualification or item level. The significant advantage of item banking is the potential for question re-use and therefore saving of development time, although this will only be realised after an initial investment peak in preparation of enough items to reach critical mass. Access to the item bank allows for assessments to be assembled for a particular qualification at an appropriate level for a specific outcome or assessment purpose. This could be for any diagnostic, formative or summative purpose.

There are a variety of different formats for item banks ranging from a series of text documents to a specially designed electronic item management system.

5. *e-portfolio*

e-portfolio delivery systems comprise two main delivery models:

- (i) *internet-based*: online management systems for the assessment and verification of competence based qualifications (products available include eNVQ, Quickstep NVQ, Digitalbrain). The system is hosted on and accessible via the Internet at any time from any location. Students can submit and store evidence (vocational qualifications), coursework and assignments (general qualifications), view their portfolio, receive feedback from their assessor as well as request guidance and support from their assessor between visits. As well as the internal verifier, access can usually also be given to the awarding body, line manager and external verifier. The systems also allow candidates and teachers to communicate with one another.
- (ii) *non internet-based*: standalone software can be loaded onto a laptop or workstation as an alternative for candidates or assessors who require access to the e-portfolio system whilst not online – e.g. in the field. Any data on standalone software is then usually synchronised when the assessor next has network or internet access. This portable solution may also involve capture of evidence on CD Rom so that it may be circulated for internal or verification / e-moderation.

Key operational differences of the e-assessment process model

See the attached process map for an overview of the operational process in the e-assessment system.

Although some process are unchanged for paper-based and e-assessment, there are many new processes and changed processes as well as several processes that become redundant with the implementation of e-assessment.

Overarching changes to the assessment process model

The key impacts on processes of changing from a paper-based to an e-assessment system are:

1. Changes in system lead times

- (i) *On-demand testing (lead-time reduction)* can be achieved through the implementation of e-assessment. A key feature of e-testing is the potential for users for more convenient access. As limitations caused by the physical requirements of printing and distribution of paper diminish, testing and examinations are able to move away from a series-based focus to wider time windows and on-demand assessment. e-test registration on-line can be instigated only days or even hours before a test is required, rather than many weeks or months.
- (ii) *Rapid results generation: moving towards e-assessment* reduces the post-test / exam processes involved thus reducing the timescale between a candidate sitting an exam or test and receiving the results. Instead of several months, this time delay may now be reduced to a few minutes or even seconds. Many of the qualifications that are being implemented through e-assessment allow for immediate auto-marked results. This is dependent on pre-determined pass marks / levels being established. Pre-set pass marks can be achieved only when pre-testing, previous use or expert judgement can establish the psychometric properties of the items. In some cases e-tests are automatically marked, and sometimes manually verified, by the awarding body system (rather than locally at the test centre); even in these cases results turnaround is usually only a few days.

2. Changes in system phases

Two key changes to the process model phases have been identified:

- Introduction of the phase '*Internal verification / moderation*', highlighting increasing emphasis on internal marking of coursework / portfolios and the introduction of e-portfolio systems to manage these processes.
- *Candidate registration* now usually takes place after resourcing rather than before. This reflects the shortened timescales required for candidates to register for an exam or test, in some cases registration may be immediately prior to the test. The paper-based system requires significant lead times (several months) so as to allow the correct quantities of exam materials to be ordered, printed and distributed, and sufficient markers to be recruited and trained.

3. Changes in overall system effort

- (iii) *Reduction in post-exam operations:* On-demand testing and automated marking both require a significant shift in the effort and timescales required in different phases in the overall system. Currently much effort in the paper-based system is focused on the post-test stages such as in marking, moderation, re-marking, awarding and results processing, and less upfront in test development. Over the two-years elapsed timescale of an assessment, most of the effort is squeezed into the last few months. Both automated marking and on-screen marking reduce the major 'back-end' logistical effort in managing answer sheets and scripts (movements between markers, moderators and awarding bodies). Auto-marking removes the dependence on high volumes of markers and removes processes such as marker recruitment, standardisation, and awarding, and eliminates the need for question paper printing, distribution to and collection from centres.

(iv) *Increased effort required at front-end:* more effort is needed in the test development stage (pre-testing, analysis, production of an item, establishing the quality, standards and comparability of individual items) so that the awarding body knows how the test will perform before it is 'live' as there will be no chance for performance to be adjusted later through the awarding process.

4. **Changes to key 'players' in the system**

Some printing and distribution processes are still required in an e-assessment system (guidance, manuals, notices, materials for learners etc). However, the large scale printing and despatch of exam papers and accompanying materials to centres, and the subsequent collection, distribution to markers and moderators, storage and retrieval are mostly eliminated. Logistics suppliers are therefore no longer shown as a key player in the system.

A new key player in the e-assessment system is the technology supplier or developer (or in-house function). This group now takes up a very significant role in the system and there is heavy reliance on mostly external (to awarding bodies) software development skills.

Examiners, markers and moderators remain as a distinct player in the end-to-end system as they remain significantly involved in many processes, either in their role as question setters, or in the new processes of on-screen marking. Some elements of electronic tests are not suitable for automated marking and are likely to remain so.

5. **Increased 'routes' through the system**

Any single qualification may have a unique route or routes through the system depending on:

- which e-assessment components it uses, e.g. on-screen testing, e-portfolio, immediate automated marking;
- different elements within the assessment which use different e-assessment components e.g. one assessment may comprise four different elements: multiple-choice, short answer, voice capture and essay-type responses, each of which may follow different automated and non-automated marking routes;
- some routes are transitional, e.g. an assessment that is currently paper-based may use scanning in order to digitise the candidate's response, thereby enabling on-screen marking to be used. However, the operational processes followed by a particular qualification may migrate over time.

Although each individual route may be simpler than the paper-based system, there is more complexity overall in the system due to combination of e-assessment components and the increased process options.

6. **New processes to ensure technical standards**

The ability to use e-assessment is dependent on the widespread technical and connectivity standards of centres. This results in several additional processes for both centres and awarding bodies such as centre approval, technical set-up and regular review of a centre's technical capabilities to ensure that the requirements are still being met.

7. **Processes not yet well established**

Some processes are not yet properly developed and may not be robust enough to support e-assessment as it becomes more widespread and used for high stakes examinations. Many processes such as centre compliance diagnostic checks, requests for special arrangements, appeals, and enquiry about results are yet to be formalised and standardised.

New quality assurance processes are also emerging as awarding bodies develop different ways of ensuring the quality of digital rather than paper information. These processes have not yet reached steady state and currently there is a tendency for more quality assurance points than may be necessary to be introduced into the system to err on the side of caution.

Summary of Issues

A number of e-assessment issues have been highlighted during our review and are summarised here. These include both general factors which affect the speed and extent of awarding bodies' adoption of e-assessment, and issues that affect the operational system and its processes.

Issues for both QCA (as regulator) and Awarding Bodies

1. Comparability

Transformational e-assessment introduces significant change to the method and design of assessment, which impacts considerably on comparability over time, across qualification and between awarding body.

This is of particular significance for statutory and high-stakes assessments, and therefore these qualifications may be more challenging to transfer from a paper-based to an electronic-assessment model. Therefore the difficulty of ensuring comparability presents a considerable barrier to the speed of innovation and implementation of e-assessment in the sector.

2. Pre-testing

The development of e-assessment is linked to the growth of the pre-testing / trialling phase of the assessment system. This phase becomes increasingly important as assessment moves towards immediate results production; item evaluation and an understanding of the assessment performance prior to the live assessment is necessary so that pre-set pass marks can be used. Historically, the sector has been uncomfortable with pre-testing of high-stakes examinations due to security concerns.

As the volume of assessments requiring pre-testing grows, new methods of pre-testing may need to be developed (e.g. using statistical probability) as the current methods may be constrained by cohort size.

3. Specific e-assessment code of practice / standards

Awarding bodies identified the need for a code of practice, guidelines and industry standards that will guide, and to some extent control, the development of e-testing and ensure industry inter-operability. Although convergence is of benefit, especially to avoid centres having to use many different systems, there is a risk that it may stifle innovation and therefore the quality and speed of expansion of e-assessment.

4. Imperfect market and industry risk

Proliferation of e-assessment solutions and suppliers

There are an increasing number of awarding bodies and suppliers who are developing e-tests and delivery solutions. This may lead to a potential proliferation of incompatible products. Some delivery solutions are subject to exclusivity agreements with a single awarding body, others are not "compatible" for content (i.e. test items are written for one supplier's software only), or are not interoperable (i.e. e-answers not compatible between every e-test, scanner and auto marking engine). Although a few awarding bodies are building their own delivery capability in-house, most are seeking to buy in delivery services.

There is an industry-wide risk of many awarding bodies fuelling the proliferation of products and 'backing the wrong horse', with a subsequent industry shakedown to a small number of the most successful solutions/ suppliers, leaving some awarding bodies with a vulnerable solution and some

centres offering qualifications that can not longer be assessed.

The emerging, voluntary Question & Test Interoperability (QTI) standard is not yet mature or fully adopted by all in the UK, and we understand that it may not guarantee full interoperability. Other standards BS 7988 (minimum requirements for any organisation that uses computers to make assessments) and standards governing data security, face similar challenges.

Smaller or 'adopter' awarding bodies and test development agencies moving into the e-assessment market will not know which commercial standard, or product to back. There is no emergence as yet of a national "preferred" delivery system, and small awarding bodies lack sufficient resources to invest in their own bespoke development/technology to the same extent as the big players.

Conversely, wariness of the emerging market may lead awarding bodies to move only slowly into transformational e-testing. Some express concern that regulatory requirement for interoperability, or a preferred national system, will be retrospectively imposed to the costly disadvantage of the market front runners.

Proliferation of e-portfolio solutions and suppliers

There are already a significant number of e-portfolio service providers, many of which are small firms that offer a range of different unique web-based or electronic service solutions.

There is considered to be some risk of shakedown in this market in the next year or so as small players are sidelined or taken over by large players (who are reported to be increasingly active); which may leave some awarding bodies and centres with obsolete solutions.

Awarding bodies are waiting for the e-portfolio market to mature and an industry standard to emerge, before developing their own in-house next generation solution for e-portfolio management and moderation or verification.

Business Continuity

Investment is required by awarding bodies and their suppliers to ensure business continuity. Failure to address business continuity may give some organisations a cost advantage but may in turn introduce additional risk to the market.

5. Limitation to centre and candidate choice

Assessment centres will not want the burden or cost of running and supporting multiple delivery channels / formats. In some cases significant IT or ISP enhancement may be required. The cost and effort required to implement the e-assessment delivery solution for one awarding body may therefore result in the centre only choosing qualifications offered by that awarding body so as to reduce the complexity and cost of administering more than one delivery solution. The choice of awarding body and assessments may therefore become constrained by software and delivery system requirements rather than by perceived educational value. Centres will increasingly require guidance on their choice of awarding body qualifications and e-assessment services, especially resource-constrained schools.

Centre requirements may therefore drive standardisation (between awarding bodies and between qualifications) or consolidation in the sector.

6. Technical capabilities of centres

Insufficient technical capabilities of centres will prevent e-assessment becoming the sole delivery mechanism for any high stakes / statutory assessments. However, if awarding bodies continue to operate both paper-based and electronic assessment systems in parallel for qualifications then delivery costs and complexity will rise.

While the reliability of centres' internet connectivity may currently be constraining the use of direct online e-testing, a more robust delivery model is proving popular based upon e-test download and control from a centre server.

Another restriction to the implementation of e-assessment and its impact on the timing of test sessions is the number of workstations and the level of invigilation resource available to centres.

7. Who should be regulated for e-assessment?

Many aspects of test method / design, usability, marking design, comparability issues, are being considered jointly by awarding bodies and their technology partners and suppliers. This may require clearer definitions of roles and responsibilities between awarding bodies and their suppliers or partners.

We have identified the following distinct e-assessment system parties:

- Awarding body;
- e-test design supplier;
- e-test IS supplier/host;
- e-portfolio service provider/host;
- technical support;
- scanning bureau; and
- testing centres.

Actions of all of these players have the potential to impact on the final assessment for candidates. Currently awarding bodies are held accountable for the actions of their suppliers. As e-assessment develops, the number of different organisations involved, and the complexity of their actions and responsibilities increases.

8. Accessibility

New issues arise regarding accessibility for learners with special needs, for example visual impairment, and equality of opportunity (centre restrictions due to physical limitations and cost). E-assessment provides new opportunities to meet the needs of learners with special needs, although the cost of development sometimes constrains development.

e-assessment also enables change in the location where a test may be taken. Use of lap-tops to enable tests to be sat outside the normal controlled centre environment, especially for vocational/adult qualifications (for example in the workplace or in the field), introduces the need for new rules to control this without inhibiting innovation and choice.

9. Impact on assessment models for the future

Further advances in transformational e-testing may enable the simultaneous testing of different subjects for example a candidate's use of English language could be tested at the same time as the pupil writes essays for a history exam.

10. Lack of common terminology

e-assessment introduces many new terms into the assessment sector, and the language used to describe the different components of e-assessment is not fully established nor entirely understood. There are many different terms to describe similar activities or functions and no single glossary of definitions. In many cases it is not obvious whether terms refer to the same thing, or what the differences are between what is being described. E-assessment itself may also be referred to as e-testing, computer based assessment, computer aided testing, online assessment, on-screen assessment, computerised assessment, computer based testing, internet based assessment, or computer assisted assessment.

The lack of common terminology makes it difficult to define and understand the many new operational processes in the e-assessment system.

Issues for Awarding Bodies

1. New skills required

New skills and capabilities are required in several different areas including:

- *question / task writing;*

The more sophisticated presentation and marking regimes of e-assessment requires different skills for question / task and mark scheme setting than the traditional paper question setter may currently possess. Question setters now need to also understand software capabilities and development and statistical performance of items.

Further developments in e-assessment will require significant advances in capacity, particularly with regard to skills and training.

Question / item settings may also require training in the use of formal item authoring software to allow question setters to create screens that will be used for the test, rather than written questions in a word document.

- *management of the new operational processes;*

Awarding bodies' understanding and development of operational processes varies partly depending on the level of outsourcing to a technical partner.

- *technology / software development (or supplier management) skills;*

A key issue for awarding bodies is management of the migration of operations from one key player (logistics companies) to another type of supplier (technical partners).

- *pre-testing of assessment and item banking skills; and*

The use of pre-set pass marks creates new responsibilities for awarding bodies. The performance of assessments must be closely monitored over time and if selection of items from an item bank is used, then analysis must be at item level rather than at paper / test level.

- *provision of new support services to centres (system set up, IT trouble shooting).*

Centres have significantly greater needs and expectations of the type and level of support provided to centres by awarding bodies for e-assessment. This may be provided by the awarding body itself or outsourced to a third party, again introducing a new set skills for awarding bodies to develop.

2. Inability to conduct manual "re-marking" / appeals with software automated marking.

Re-marking of an automatically marked assessment is no longer a valid activity as the mark will not vary provided the delivery system and software has functioned correctly.

As the marking regime becomes more complex in order to enable automated marking of assessments (other than objective tests), the transparency of the marking is reduced. There is less direct visibility for teachers of answers and mark schemes when the marking is embedded in the software or system.

Awarding bodies face several key issues:

- proving credibility of the marking regime for teachers / trainers / candidates;
- explaining a candidate's results to teachers without being able to physically produce a script with the examiners handwritten marks and comments; and
- dropping the appeals process and therefore leaving centres with no right of recourse for results that they wish to challenge.

3. Marker acceptance, competence and technical requirements

There are many issues and uncertainties about markers' and examiners' response to wide-spread roll out of on-screen markers, for example.

- markers may require some familiarisation and adjustment when moving to on-screen marking;
- the on-screen software must be deployed to all markers;
- markers must have IT capabilities that can support the specialist on-screen software;
- markers may require different terms and conditions as e-assessment may necessitate them marking in a different way and to shorter timescales; and
- there may be significant cultural barriers in the marker population to overcome.

4. Changes to centre's technical set-up

Following the initial check as part of the centre approval processes, the main problems that awarding bodies may experience are unplanned changes to a centre's technical set-up. Therefore some awarding bodies now run an automated diagnostic check on the centre's IT, or request that centres must undertake a 'dummy test' after any technical setup/ hardware changes have been made, to enable issues to be highlighted and resolved prior to the delivery of the next live test session.

5. Registration and entry process

There is a tension between the centre's desire for unnamed registration for assessment in order to provide them with greater flexibility, and awarding bodies need for firm numbers and candidate names at an earlier stage to facilitate planning and security.

6. Applicability of transformational e-assessment to more subjects

Much of the current e-assessment is centred on key and basic skills, ICT, vocational skills and English for speakers of other languages. Applicability of the transformational computer-based testing and auto-marking model to other logical / structured subjects is not yet proven. Extension to subjective / creative subjects is even more challenging.

7. Auto-marking requires further sophistication and development

Further sophistication is required for auto-marking for more complex answer relationships during compound task processes i.e. enhancing the auto marking intelligence for a transformational e-test.

8. Developing the software in-house / use off-the-shelf solution / external software supplier

Awarding bodies' approach to software development depends on a number of factors including size of awarding body and market share, capacity for risk, funds available for investment, internal skills and capabilities, capacity for innovation and view of the future for e-assessment.

Risk management

We found that the awarding bodies all have relatively robust risk management processes in place for the development of new e-assessment services.

In each case, the risks are captured in a project risk log and managed with the involvement of key stakeholders both internal and external. However, there is some variability around the extent of detail of risks recorded in risk logs, and consequently of visibility of the depth or quality of underlying risk analysis.

There are clearly many new risks that are introduced to the end-to-end system with e-assessment. These risks are fundamentally different to those that the sector is used to managing in the paper-based system. E-assessment therefore requires new controls to be incorporated into the processes for example: revised guidelines to centres on handling IT preparation, outages/problems and invigilation during e-tests; and more thorough processes for checking centres' technical capabilities.

However, e-assessment also enables in some cases a better level of risk control by automating certain processes for example:

- continuous / frequent backup of electronic answer / log files during e-test execution;
- audit logs recorded by the system of centre and student logons and key actions; and
- basic system reconciliation of number of files processed.

The awarding bodies report that there may not yet be comprehensive understanding by either themselves or the regulator of the evolving e-risks. They note that some risks are mitigated by the design of the system while others require new controls to be incorporated into new operational procedures. New controls and procedures are necessary to ensure integrity and file management along the e-test process / interfaces, especially at centres, for both automated and manual (contingency) steps.

For example, some new controls incorporated in the e-process include approval of exam centres to confirm their ability to conduct assessments to the appropriate standards.

Those awarding bodies that are using the internet have confirmed that they use the 'industry standard' to distribute the tests – that is, they use compressed encrypted test files and use encryption to communicate passwords and data. Some awarding bodies have said that the main perceived security risk is not from the use of the internet, but rather from fraudulent centres and / or invigilators.

New risks that are introduced to the system include:

- *technological risks*
 - although the extent of this risk depends on how the awarding bodies undertake the development of e-assessment systems for example whether they rely on outsourced IT skills, and the experience of the developer in the assessment system.;
 - interoperability regulations imposed after build which require costly development;
- *centre risks*
 - lack of technical capacity or knowledge;
 - lack of control over invigilation environments where tests can be taken on laptops, outside of the usual setting;
 - centres restricted from making choice and purchase decisions freely through technical limitations, additional cost or regulatory environment;
- *standards and comparability*
 - risk that the assessment does not perform as anticipated, but opportunity for adjustment of grade boundaries is diminished due to use of pre-set embedded pass marks in e-assessment system;
 - lack of question / item setters with appropriate skills;

- lack of appropriate skills and competencies within awarding bodies (both at a subject level and also in terms of operational skills, resulting in business benefits lost in poor integration with other systems and business processes);
- *credibility* – target market may not understand, or believe in, the value of the new approach;
- *market risk*
 - technology suppliers control market rather than awarding bodies, or regulator;
 - anti-competitive behaviour of regulator (i.e. introduction of a single platform from QCA / NAA) stifles innovation;
- *regulation*
 - non-compliance with regulation due to poor practice or lack of knowledge of operational staff;

Cost Indicators

No quantitative indication of absolute or relative e-assessment costs was available from the reviewed awarding bodies. The general consensus was that no significant cost savings have yet been gained overall due to high initial investment costs (in the order of several hundred thousand pounds) in the development and delivery of e-assessment. Some state that some high volume e-tests (especially paper translation) could realise some cost saving in the future.

Some cost drivers have been identified by the awarding bodies as follows:

- additional test design and software development effort required up-front which cancels the downstream savings that may be reaped for auto-marked and transformational e-tests;
- existing multiple choice tests have already automated many of the “easy wins” of e-testing;
- further savings will be driven by e-assessment economies of scale, i.e. expansion in take-up;
- e-assessment will often lead to value added services (e.g. on-demand and immediate result capabilities) rather than a cheaper commodity; and
- no costs can be saved overall while paper tests are continued in parallel with e-tests. Currently most awarding bodies still offer both paper tests and e-assessment to avoid the disenfranchisement of a particular community.

Further analysis would be required to determine whether it is feasible to realise any cost saving for exam centres through switching to e-assessment.

Cost savings are not felt to be the key factor driving implementation of e-assessment; other factors such as quality of assessment method and service improvement are seen to be more important.

Appendix A. *Process details: end-to-end e-assessment system*

See accompanying document for process map of the e-assessment system.

e-assessment system phases

The end-to-end e-assessment system comprises the following main phases:

1. Develop and teach syllabus
2. Internal verification / moderation
3. Develop assessment / e-tests
4. Resourcing
5. Candidate registration
6. Take test
7. External marking
8. Results processing
9. Certification

The previous process mapping exercise of the paper-based General Qualification assessment system identified the following phases:

1. Develop and teach syllabus
2. Develop exam papers
3. Candidate entries
4. Resourcing
5. Take exam
6. Marking
7. Results processing
8. Certification

The main differences in system phasing are:

- Introduction of the phase 'Internal verification / moderation' highlighting increasing emphasis on internal marking of coursework / portfolios and the introduction of e-portfolio systems to manage these processes.
- Candidate registration now takes place after resourcing rather than before. This reflects the shortened timescales now required for candidates to register for an exam or test, in some cases registration may be immediately prior to the test. The paper-based system requires significant lead times (several months) so as to allow the correct quantities of exam materials to be ordered, printed and distributed, and the correct number of markers to be recruited and trained.

Other differences include:

- A row is now shown for the software developers – highlighting the importance of this function in e-assessment.

- The row for logistics suppliers has been removed from this process model reflecting the reduced reliance on production and movement of papers and scripts in the system.

Changes to processes

The table below summarises the main process changes arising from e-assessment for each assessment system phase. It highlights those processes which are new or changed, and those paper-based processes that have become redundant. It should be noted that whether processes are introduced, changed or become redundant is dependent on which e-assessment components are implemented.

Phase 1. Develop & Teach Syllabus

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| Changed processes | <ul style="list-style-type: none"> ▪ Develop syllabus & associated materials: this process may vary as new assessment specifications are required for e-assessment. This may involve software developers at this early stage of the process. Process-based tests may require specifications which include guidance for teachers regarding what kind of process indicators would be evidence of a particular requirement. ▪ Centre Approval: centres must apply to awarding bodies for approval / registration to offer that awarding body's assessments. For e-assessment, a check on the technical capabilities of the centre is now involved in this process. Application for accreditation can be made either online or using a paper form depending on the awarding body and / or the centre's preference. The awarding body will usually check the centre's IT capabilities and environment at this stage e.g. workstations, local network, server, internet bandwidth). ▪ Candidate Registration: The process for registering candidates for e-assessment now becomes two-fold (similar to the current process for GNVQ / VCEs). <i>Registration</i> refers to the initial registration stage of a candidate for a particular qualification (scheduling is the second part of this process and involves the requesting of an assessment during a particular session or assessment window). The time interval between the two registration stages varies according to the awarding body and the delivery model being used. |
|-------------------|---|

Phase 2. Internal Verification / Moderation

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|---------------|---|
| New processes | <ul style="list-style-type: none"> ▪ Evidence capture and workflow through e-portfolio system: candidate's progress and evidence is now captured through an on-line or stand-alone e-portfolio system. ▪ Progress monitoring and tracking: both candidates and internal verifiers or moderators can use the e-portfolio system to record and monitor the candidate's progress against the requirements of the qualification. ▪ Assess candidate's work and evidence: candidates' coursework and evidence is digitised and distributed to assessors either through the e-portfolio system itself if it incorporates a workflow tool, or by removable media such as CD. ▪ Verification of internal assessment: candidates' coursework and evidence is digitised and distributed to verifiers either through the e-portfolio system or on removable media. ▪ Send sample via e-portfolio system to external moderator: some e-portfolio systems support electronic transmission of digitised evidence and candidate records to external moderators or verifiers. ▪ Submit results to awarding body: results may be submitted to awarding bodies electronically either through the internet based e-portfolio system or through the internet direct to the awarding body. |
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Phase 3. Develop Assessment / e-Tests

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| New processes | <ul style="list-style-type: none"> ▪ Training in the design of innovative items: designing and writing transformational e-tests requires different skills which may not be automatically possessed by traditional |
|---------------|---|

paper-based question setters. As e-assessment becomes more prevalent, training for question-setters in the design of items suitable for use in electronic assessment will become a more established and essential process.

- **Develop test specification / requirements:** depending on the complexity of the e-test, development of specifically designed test tasks, rules base, marking algorithms will be required and must therefore be included in the test specification. Training and support materials will also be needed to accompany the e-test. The test specification will also identify whether the test will be created by selection of items from an item bank, whether it is an adaptive test etc. Design of the assessment and mark schemes is fundamentally changed to exploit on-screen transformational capabilities that have no equivalent in paper e.g. multi-media interaction, simulation, adaptivity, auto-marking – this may now require combining the activities of subject experts and software developers.
- **Develop and implement e-test software and delivery system:** awarding bodies must procure or build e-test software and a delivery system, which must be developed, tested, trialled and approved.
- **Testing of delivery software – alpha trials & beta trials:** the test and software are developed as software code and the test software is tested.
- **Design e-test content: items / tasks, rules base, marking algorithms:** much more effort is involved in this process, either in building up stores of items for item / paper selection or in the identification of the many different variants in responses that candidates may give to a task-based assessment. Task writers have to understand the rules base, what evidence they are trying to elicit and how to write the marking algorithms – preparation, authoring and calibration. This may also include creation of a managed environment ('virtual world') and relevant data sets to allow the candidate to evidence the processes and tasks that are being assessed.
- **Build e-test content: items / tasks:** e-test content items are implemented through software development. Training and support material includes teaching notes, system manual, familiarisation tool / practice tests, centre setup and administration instructions, invigilation and IT support guidelines.
- **(Install software &) run pre-test piloting / testing in centres:** this will become an increasingly larger and more important process in the assessment system. Pre-testing will be required to establish the quality, standards and comparability of individual items and whole assessments so that the awarding body knows how the test will perform before the test is taken by candidates. The performance of each version of an assessment needs to be monitored over time and, if necessary, appropriate changes need to be made to the pass mark. If the items are drawn on-demand from a bank to create each complete assessment, the monitoring of the performance of scores also needs to take place at the item level.
- **Trial e-test with selection of candidates:** the e-test will be trialled with a sub set of candidates to establish the performance of the test and individual items or tasks.
- **Review trial outcomes / data and assessment refine design:** following the trials the design of test, content or delivery system may need to be refined. This may be an iterative process and if required the trial may be run again. General feedback from centres and candidates from the previous year's assessment may also be documented, reviewed and findings used to inform current test design.
- **Finalise e-test assessment:** the test may comprise a set of software – the test itself, plus associated environment and management functions.
- **Store and manage items in item bank:** items and data can be managed separately from the test presentation / delivery software. This allows awarding bodies to develop 'question'/ item banks independently of the software development.

Redundant processes

- **Print exam materials**

Phase 4. Resourcing

- | | |
|---------------------|--|
| New processes | <ul style="list-style-type: none"> ▪ Despatch software and guidance: the system software is sent to the exam / test centre, together with secure key / certificate. ▪ Receive or download software and guidance: the centre may either download the e-assessment system software directly from the awarding body's website, or receive it on removable media. ▪ Set-up and administer system, assign users and rights: the centre performs an initial one-off system setup and administration to facilitate the delivery system. The centre must assign staff to particular roles and give them the appropriate access rights. The system must be configured to meet the centre's requirements e.g. automatic or manual transfer of files and communication with the awarding body's server. ▪ Input workstation information: the centre must input information about the centre's technical set up and the number and location of workstations that are available for e-assessment. ▪ Import / upload candidate details from centre MIS: candidate details must be entered into the system. Awarding bodies vary in their ability to automatically import data from the centre's management information system. The QCA imports school and pupil data from the school's annual PLASC file. ▪ Centre compliance: prepare workstations & run server diagnostic check: a diagnostic check is run (either automatically or manually) to verify that the centre's IT environment and technical capabilities (local network, server, internet bandwidth etc.) are sufficient to support the delivery solution and to run the e-assessment to a satisfactory performance level. The awarding body may also require centres to meet different requirements in terms of the responsibilities of invigilators and exams officers. |
| Changed processes | <ul style="list-style-type: none"> ▪ Despatch test support documentation to centres: centres will still receive exam materials (for example invigilation instructions, notices for exam room walls) however a key change will be that centres will no longer receive exam papers and accompanying materials (marker envelopes, address labels etc) that require checking, counting and storage in a secure room. Training and support materials may include teaching notes, system manual, familiarisation tool / practice tests, centre set up and administration instructions and IT support guidelines. ▪ Marker recruitment and training: on-screen marking will require the training of markers in the use of marking software. ▪ Receive exam materials, plan rooms, resource invigilation: planning exam rooms will now also require not only matching the candidates to appropriate room sizes and set-ups, but will require consideration of IT equipment suitability and availability. Invigilation may now also require training of invigilators to ensure they are briefed about what to do in the cases of failure workstations, power failures, fire alarms etc. As well as invigilators, centres may also need to arrange for a technician to be available during the assessment. |
| Redundant processes | <ul style="list-style-type: none"> ▪ Despatch exam materials to centres ▪ Despatch exam materials to markers ▪ Calculate number of marker required (for auto-marked tests) ▪ Examiner & moderator recruitment (for auto-marked tests) ▪ Produce marker training materials (for auto-marked tests) ▪ Examiner / moderators receive exam material (for auto-marked tests) ▪ Examiners / moderators trained and standardised (for auto-marked tests) ▪ Apportionment (for auto-marked tests) |

Phase 5. Candidate Registration

- Changed processes
- **Make test available for selection by centres:** the e-test distribution of centres depends on which delivery model is in use by the awarding body / centres. In most cases (where a type 2 delivery model is in operation) the awarding body pre-sets a time-window of availability for each test. The centre is then able to choose this test for its candidates.
 - **Download e-test set to centre server / work-stations:** the centre selects and downloads the e-test to its server and / or workstations via the centre server or removable media. This may be done automatically by the e-assessment system.
 - **Download practice / familiarisation tests:** the centre can download practice / familiarisation tests for its candidates. These are often true on-line tests (Type 1).
 - **Take practice / familiarisation tests:** candidates are often encouraged to undertake practice tests in order to familiarise themselves with the equipment, e-test process, features of the delivery system and the e-test environment.
 - **Scheduling of candidates for e-test session:** Scheduling refers to the second part of the candidate registration process whereby the centre requests an assessment during a particular session or assessment window. The centre schedules the candidate to take the test; this now makes available the test for download by that particular candidate. Registration may be performed much closer to the test date as the process becomes less constrained by the lead-time required for paper logistics. In some cases registration may be simultaneous with scheduling and the actual assessment delivery as the electronic assessment of a qualification becomes truly on demand. The lead time for registration/entries may depend on the delivery model to be used for the assessment: no notice is required for Type 1a, 24 hours for Type 1b and 2, Type 3 will require a lead time of at least a few days.
 - **Enter pupil specific data:** pupil specific data may be required for the e-test for example
 - (i) teachers may be asked for their expectations of levels before the candidates take the test. This helps to identify what level the e-test should start at for each pupil (level of difficulty e.g. openness of tasks). Indirectly it also helps to pre-empt which teachers may query their students' results because outcomes have not met expectations.
 - (ii) centres will also be required to submit details of special requirements. The alterations needed may be different from the paper-based system due to the change in testing environment e.g. candidates with special needs may require special screens, special computer settings and / or other equipment to enable them to access their assessments.
 - **Generate candidate IDs & passwords:** the system generates unique candidate IDs and passwords for each e-test. To prepare an e-test session, the centre initiates on the system the generation of user names and passwords / tokens for the registered candidates and distributes them securely.
- Redundant processes
- **Submit late entries:** this process is more streamlined and can be done closer to the date of the test as it is less constrained by the lead-time required for paper logistics. In effect this process will merge with the candidate scheduling process.

Phase 5. Take Exam / Test

- New processes
- **Select e-test paper for candidate / centre using item bank:** create or select randomised e-test paper for candidate / centre using item bank.
 - **Activate e-test package within pre -set time window:** the test is made available to centres usually from the awarding body's server (unless it is being distributed by removable media) to registered / approved centres to select and schedule. A time-window of validity is set for test execution, which could be anything from continuously on-demand to one-off event. An e-test is automatically activated for use by the awarding body when its window of validity starts (anything from a single event to continuously available). Time windows are used to run on-demand or multi-session timetabled exams and to accommodate multiple sessions (e.g. limited workstations or

re-runs due to IT outages).

- **Workstations and server diagnostic check:** Prior to each assessment session, it is recommended that centres check the server(s) and workstations to confirm that they remain compliant with the awarding body's technical specification. Most awarding bodies offer support for the checks, but forms vary. Most provide checklists; one has a core utility that will conduct diagnostic evaluation and provide printed advice on required actions. It is recommended that the diagnostic sheets, completed checklist and reports of actions taken are filed with the master manuals and update logs.
- **Download / distribute e-test to workstations:** Once the e-test is activated, registered centres can then securely access the e-test and download / distribute it to workstations as required.
- **Input ID & password:** test downloaded & un-encrypted: At test execution, the centre's invigilator issues session tokens / passwords to candidates. Candidates access the test at the required time using their unique ID and password which allows the test to be unencrypted and initiated.
- **Take test on-screen. Log files generated automatically:** the candidate takes the e-test. Often the e-assessment system allow for continuous backup / creation of log files: these can be used to check for copying (all actions are time-stamped), retrieval of tests that have been suspended e.g. due to a power failure, and to provide audit information. The centre may now also have to manage staggered start times for its candidates or 'hot-desking' (due to scheduling limitations of workstation availability). The centre also needs to consider the availability of technical help in the event of IT problems experienced during the test session.
- **Monitor test. Test encrypted & despatched electronically from centre server:** the centre invigilator(s) monitor the test progress through the e-assessment system as well as through their physical presence with the candidates. Once the test is completed, the answer / work files and any audit log files are compressed and encrypted and uploaded (automatically or manually) by the centre back to the awarding body. The test and answer files are then deleted from workstation. The post-assessment workload required of invigilators varies considerably from one awarding body system to another. A minority require the invigilator to collate candidates' responses and submit them to the awarding body. Most only require the invigilator to monitor the process.
- **Capture items for auto-marking:** in some cases the e-test itself does not contain pre-set marks and the candidate's responses must be captured and returned to the AB where they will be automatically marked by the awarding body's central system.
- **Dismantling of paper scripts, scanning & digitisation:** scanning of paper scripts may be done either by (i) a specialist high volume scanning centre, or in some cases (ii) by a local scanner at the centre itself. This process also involves dismantling and reassembly of scripts. Where the scanning is off-site from the centre, the process 'collect and despatch completed scripts' will still be required.

Redundant processes

- **Collect and despatch completed scripts**
- **Submit post exam returns**

Phase 7. External Marking

New processes

- **Immediate automated marking:** the e-test software (at the test centre itself) performs the marking of the electronic answers / work.
- **Automated marking:** automated marking may also be performed by the awarding body's central server/system.
- **On-screen marking:** digitised files of answers / work are electronically distributed to markers. If answers were originally generated on paper, then these are first scanned into electronic format and the marks are transmitted automatically from markers to the awarding body. Markers use the on-screen marking system to capture marks and annotations.

- **Automatic monitoring of marker performance** (coherence, Std Dev, mean): some on-screen marking systems incorporate automated monitoring by the system of marker performance. When the performance consistently deviates beyond an acceptable range, the marker is advised. If this performance continues to deviate, senior markers are notified.
- Changed processes
 - **Apportionment of tests / items to external markers:** in more sophisticated systems, the workflow (script allocation and delivery) to markers and moderators is an electronic flow and is managed by the system and replaces physical movement of papers (except for the initial journey which may remain from centres to a high volume scanning centre). Apportionment no longer requires batching of scripts from centres to a particular marker.
 - **Standardisation:** where on-screen marking is in place, it may be possible to hold virtual standardising meetings, eliminating the need for considerable travel by markers to attend standardising meetings.
 - **Monitoring and intervention by senior examiners if required:** on-screen electronic marking systems allow instant access to candidate responses for checking, sampling, moderation and re-marking.
 - **Remuneration of markers:** this process can now be automated rather than involving manual input of volume data in order to calculate payments due to markers.
- Redundant processes
 - **Capture mark sheet data, check and store scripts:** in some cases some elements of these activities still remain e.g. paper scripts still require storage but much earlier on in the process (i.e. immediately after scanning). Mark sheet data will be captured automatically by the system rather than manually input and checked.
 - **External marking, re-marking, standardising and moderation:** these processes become redundant if automated marking is used.

Phase 8. Results Processing

- New processes
 - **Receive results immediately:**
 - (i) for tests with a pre-set pass mark (mostly those that are closer to on-demand) results can be issued immediately to the candidate following completion of the test;
 - (ii) results may be received electronically by centres and candidates; and
 - (iii) it may be possible to also provide macro data about efficiency and appropriateness of methods of working (e.g. how quickly the pupil found data, or how many times he/she had to revisit something to finish it.
 - **Moderate auto-marking:** Standardisation for automated marking may involve making adjustment to the rules base / marking algorithms to accommodate valid responses not identified prior to candidates taking the test. Following adjustments, the marks can be rapidly re-processed by the awarding body's system (bulk automated re-marking).
 - **Evaluate performance of items from bank:** once the test has been run, items used in the test can be evaluated and the results of their performance fed back into the item bank. At this stage certain items may be identified for withdrawal or amendment.
 - Changed processes
 - **Receive results via centre server:** results that are not immediately automatically marked by the e-test system will be processed by the awarding body and then returned to the centre (and candidate) usually electronically. The time lag for auto-marked results will be significantly shorter (a few days) than those that have been marked by an external marker (perhaps several weeks or months).
 - Redundant processes
 - **Awarding:** the awarding process may be redundant for auto-marked tests which contain pre-set pass marks.
 - **Appeals / EAR:** automated marking does not typically accommodate appeals or re-marking of individual answers / work. Appeals concern the consistent application of the marking rules to a candidate's script; auto-marked process based assessment with the predefined rules built into the test engine will apply those rules with 100% consistency.

- **Access to Scripts**
- **Evaluate / grade quality of markers** this is not required if candidate responses are automatically marked by the system.

Phase 9. Certification

No changes are envisaged for e-assessment.

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Archived Content

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