



Report for JISC

Roadmap for e-assessment

June 2006

Document Information

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Document History

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0.88	5	Updating literature review and lessons learned from case studies. Bibliography finished. All summaries to sections completed
0.89	4	Section on polices in UK completed

1 Executive Summary

1.1 E-assessment key policy and strategic drivers

Pedagogy and learner needs are the main drivers for change in e-assessment through out the United Kingdom. Scotland also makes explicit that it will also contribute to their Quality Assurance provision. Northern Ireland has led the way with summative assessment with their paperless exams project and Wales sees the future in investing in an ICT literate society. England differs from the other countries in that the QCA have stated that e-assessment will be rolled out in post-16 education by 2009. A more personalised learning agenda is being advocated in all the e-Learning strategies and e-assessment is one route to achieve this vision.

1.2 Current practice in e-assessment

The principal facilitators for effective implementation of e-assessment include active institutional support from senior management with strong staff development, pedagogical and technical support for tutors from central services. The role of pedagogically sound, imaginative design for e-assessment on the part of tutors is often a significant factor in its success. There is evidence of both summative and formative e-assessment taking place and that the main drivers for the introduction have been to improve student learning with faster feedback.

Drivers for adoption of e-assessment included perceived increases in student retention, enhanced quality of feedback, flexibility for distance learning, strategies to cope with large student/candidate numbers, objectivity in marking and more effective use of virtual learning environments.

The introduction of a VLE can act as a double edged sword. On the one hand it can encourage tutors to build e-assessments using the quiz function but it can also cause lone champions to lose support. This is unfortunate when bespoke systems have been developed to address specific pedagogical needs.

The principal barrier to development of institution-wide e-assessment remains one of academic staff time and training. Dissemination of pockets of innovative e-assessment practice across an institution can be hampered by organisational structures that favour autonomous academic departments, and limited centralised support.

The variety of applications of e-assessment reported and their innovation and general effectiveness indicate the potential of e-assessment to significantly enhance the learning environment and the outcomes for students, in a wide range of disciplines and applications.

1.3 Vision for 2014

A pedagogically driven model for e-assessment was called for rather than a technologically and standards led framework dominating future developments in this area. The consequences of systems being built that address pedagogical needs is interesting. Experts believe that students will take more control of their own learning and become more reflective. On demand testing will assist students to realise their own potential and e-portfolios can help them to present themselves and their work in a more personalised manner. This notion is also supported by the DfES agenda to

promote “personalised” learning. In fact there is perhaps a more stronger move towards andragogical (Knowles 1970) rather than pedagogical principles than first anticipated by the experts that were consulted in this study. The tutor’s role will inevitably change in this new regime and a study of how this change can be managed through training and work experience needs to be considered.

1.4 Barriers and challenges for implementing e-assessment

The experts’ visions provided a fair match to the policy documents. However participants were sceptical of the 2009 target. There appear to be a growing group of small commercial companies which can assist with meeting the 2009 target. However there are real concerns about standard compliance by these companies and one of the major challenges for the examination boards to employ these small businesses is to forecast whether they will still be operational in the future.

The vision and barriers to the practice of e-assessment in 2014 emphasise the role of research in progressing issues bound by both the technical and pedagogical level. There were real concerns about plagiarism detection and invigilation issues and 82% of the experts agreed that for the implementation of policy at the Awarding Body level for FE and HE there needs to be accessible secure and reliable systems in place. Further challenges include a change in current production methods to achieve high quality test items. Accessibility was an issue; together with the reliability and validity of high stakes assessments. User identity must not be an issue and accessible, reliable and valid assessments are the standards by which user confidence will be measured. The recommendations which can be found in section 9 of this report have been made with these objectives in mind.

	Superorganistical	Organisational	Personal
Vision	GCSE, A Level, Vocational examinations all to have an e-assessment component by 2009. for England and Wales. e-portfolios also included in the assessment procedures. On-demand testing available Self reflective learners identifying their own learning needs. All mention more learner autonomy.	FE preparing for policy changes e.g. COLA Project, Scotland, Equine Studies at Warwickshire, e-portfolio use etc. HE using more e-assessment influenced by VLE adoption. Pockets of bespoke systems that have been pedagogically driven will be available More worthwhile use of e-portfolios seen..	Teachers are addressing pedagogical problems through e-assessment Making better use of class time e.g. LSE and Strathclyde. Researchers developing new systems to move away from MCQs. Increased interest in student modelling, Latent semantic Assessment and Plagiarism detection devices.
Barriers	More regulation required than anticipated as vision will only be achieved through more reliance on external/ Commercial input. More widespread exam centres with good technical backup needed.	HE restricted by VLE investment in some cases. Staff need more training in designing and programming good questions. Tutors in HE only willing to use for high stakes assessment with first year students only. Spreading the enthusiasm of the e-assessment champion through an HE establishment is difficult. Lack of funds and staff recognition for working in this area is slowing progress	Can't test enough learning outcomes. Plagiarism, invigilation problems, HE and FE sectors need to invest in new assessment practices.
Facilitators	.e-learning continuing to improve in FE sector (see BECTA ICT Research 2005) More e-assessment plans being made explicit in HE e-learning strategy documents.	Increased retention, attendance and achievement. Tracking accreditation through a number of different routes through a qualification.	Good free text recognition of student responses. Formative assessment embedded so that tutors can track more easily student progress. Freeing time with automated feedback to students so that they can concentrate more on dealing with misconceptions and working with individual students.
Strategies	New process to ensure technical standards are recognised. More pre-testing of systems and questions required. Code of practice needed with guidelines and industry standards. New skills required. More training for markers.	Clear e-assessment policies and investment in staff training realised.	More funded research for automated test recognition. Software systems that will support interactive questions. Convincing and thorough evaluations of the effectiveness of e-assessment required. Fund development of pedagogically pertinent open-source products

Table 1: Summary of literature review and case studies data that relates to the roadmap themes

	Superorganisational	Organisational	Personal
Vision	DfES vision will be realised however hiccups will occur and consumer confidence will need to be boosted. Any time, anywhere testing freely available.	Ubiquitous e-assessment with automated essay marking. e-Portfolios will play a larger role in the documentation of the life long learning process. A few institutions will emerge as leaders or champions of e-assessment and will lead future developments	Central facet of education from cradle to the grave. e-Portfolios playing a large role here. Diagnostic e-assessments will improve teaching and learning cycle. A more personalised learning journey will be achieved with any time, anywhere testing. Tutors will no longer mark paper scripts.
Barriers	If systems are not piloted with respect to quality, accessibility, reliability and security, then there will be lack of confidence in e-assessments. Institutional and individual practitioner culture needs to be confident with e-assessment. Lack of knowledge by senior managers in schools and colleges about the potential and practice of e-assessment. Test centres need to be fully equipped and in place	Champions/pioneers are not supported enough financially or academically for their efforts. Resistance to change from tutors. No cost benefit. Lack of time to develop systems due to competing pressures from other sources such as the RAE. Problems if a wide range of pilot studies are not taking place. Lack of good item banks. Lack of assessment centres with appropriate hardware and software.	Workload on academic staff will not be adopted if rewards to staff are limited. Lack of technical skills being available to subject specialists. Lack of training provided to teachers/tutors in developing effective e-assessments. Failures with the exam boards at AS and A Level to deliver good e-assessment will affect confidence and reduce uptake in HE and FE.
Facilitators	Better quality assessment is the goal of awarding bodies. Some believe e-assessment will deliver a return on their investment. Growing body of expertise in public and private sectors	Champions can be found in both FE and HE sectors. Demand for tracking accreditation is rising. More interest in eportfolio usage	Leverage of mobile technologies eg most students have a mobile phone. Staff training available and recognised officially in some establishments. Automatic text marking is accruing more interest and urgency
Strategies	Policy makers continue to set timed targets for future developments. More pilot studies systematically evaluated and findings disseminated more widely	More e-assessment systems that are pedagogically driven made available. Encourage open source development of such tools	Fund research into automatic text recognition. Leverage know how of e-assessment champions into the wider community by appointing them as mentors to other institutions.

Table 2: Summary of experts' views from the survey

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3 Background

3.1 The Project

This project, based at the Open University, set out to review current policies and initiatives relating to e-Assessment across the UK, as documented by the funding councils, examination boards and accrediting bodies. Strategic priorities, projects and research activities were identified to assist with the recommendations for future coherent development in this field. This was achieved through not only suggesting ways to implement such policy documents as the DfES Harnessing Technology report, but also by adding value to the teaching and learning sector, through the advice of known experts gained during the development of the roadmap. This outcome was progressed through a modus operandi which selected a number of facets from a range of roadmap methodologies collected by Glenn and Gordon (2003).

e-Assessment for the purposes of this project has been defined in its broadest sense, where information technology is used for any assessment-related activity. e-Assessment has been considered here to include formative, summative and diagnostic testing. In this sense the definition encompasses those from e-Assessment Glossary and Wikipedia as discussed below. The e-Assessment Glossary which was commissioned by JISC and the Qualification and Curriculum Authority (QCA) offers the following definition for e-assessment. It states “The end to end electronic assessment processes where ICT is used for the presentation of assessment activity and the recording of responses. This includes the end to end assessment process from the perspective of learners, tutors, learning establishments, awarding bodies and regulators, and the general public.” (<http://www.jisc.ac.uk/assessment.html>) e-Assessment can be used to assess cognitive and practical abilities. Cognitive abilities are assessed using e-testing software, while practical abilities are assessed using e-portfolios or simulation software (Wikipedia) <http://en.wikipedia.org/wiki/e-assessment>

A number of the e-assessment activities described in this report are included in the above definitions but it should be noted that our definition embraces not only assessment of learning but also assessment for learning.

3.2 Roadmapping practice

In general the aim of a technology roadmap is to provide a consensus view or vision of the future landscape available to decision makers. The roadmapping process should provide a way to identify, evaluate, and select strategic alternatives that can be used to achieve a desired science and technology objective (Kostoff and Schaller 2001). In the case of this roadmap, the science and technology objective can be summarised as ‘effective implementation of e-Assessment within the post-16 and higher education sectors’. This roadmap seeks to present a vision of the future landscape that will help organisations and individuals in the post-16 and higher education sectors to make decisions about their future plans with respect to e-Assessment.

A chapter on science and technology roadmapping (Gordon, 2003) in an extensive survey of futures research methodologies (Glenn & Gordon, 2003) states:

“Since a roadmap is a diagram of interconnected nodes, it is necessary to consider what a node and the interconnections – that is the lines connecting the nodes – represent.

A node is a milestone on the road being mapped. It can be an element quantitatively determined (e.g. a document which is cited, a patent which is represented by other patents as a precursor) or subjectively defined (e.g. a future technology at some level of performance). When the node is quantitative, the definition can be “looked up” in some data base; when it is qualitative, usually the node is determined by expert opinion.”

Roadmaps are used for both retrospective and prospective studies in time, the link vectors can assume forward and backward directions in time. Construction of a roadmap, thus, requires identifying the nodes, specifying the node attributes, connecting the nodes with links, and specifying the link attributes.

There can be many approaches to developing such a roadmap. However surveys of approaches (e.g. Gordon, 2003; Kostoff & Schaller, 2001) indicate that what is required in for considering future directions is a *prospective roadmap* i.e. a map to help find out where we are going, as opposed to a *retrospective roadmap* which is intended to tell how we got to our present position. Kostoff and Schaller identify two extremes of prospective roadmap

- (1) Requirements-pull roadmaps (which start with desired end products and fill in the remainder of the roadmap to identify the R&D necessary to arrive at these products)
and
- (2) Technology-push roadmaps (which start with existing research projects, and fill in the remainder of the roadmap to identify the diversity of capabilities to which this research could lead).

For this project, we required a method that takes account of both requirements-pull and technology-push because we recognise that the development of this roadmap must consider political, pedagogical and business drivers for e-Assessment technology in addition to R&D showing how technology can be appropriated and used to support assessment. Factors influencing the choice of methods included

- Duration and budget of the project
- Availability of expertise outside the project team
- Reports and policies specified to be relevant by JISC.

The methods used are described in detail in section 2.3. Additionally, we recognise that in general, science and technology roadmapping is difficult, in particular where fundamental research is involved as Gordon points out:

“On complexity, most topics of interest are ultimately found to be fractal, that is, the more detailed the analysis, the more detail is left to discover. When the subject is fundamental research, the identification of nodes is particularly difficult since the nodes will inevitably include discoveries not yet made. As a roadmap is constructed, there comes a time when the analysts must say, enough. The balance between depth and superficiality is crucial but often hard to achieve.” (Gordon, 2003, p 9).

3.3 Methodology

3.3.1 Introduction

The project divided into three main stages, as illustrated in figure 1. The methods used within each stage are described in the next three sections.

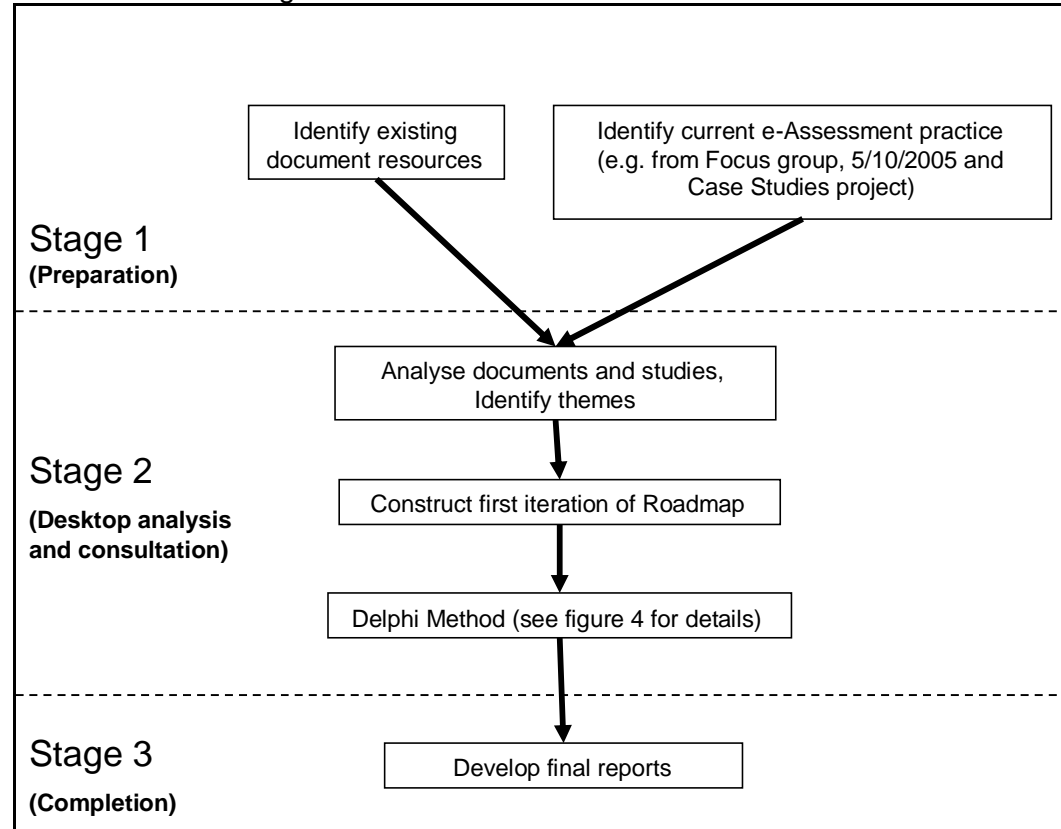


Figure 1: Graphical representation of the stages in the project

3.3.2 Stage 1 : Preparation phase

Stage 1, the preparation phase set out to achieve two goals.

1. identifying key documents
In consultation with JISC a number of UK organisations considered to be important players with respect to assessment in general and e-Assessment in particular were identified. Policy and other documents which described the plans and policies of these organisations with respect to e-Assessment were identified and obtained, together with published academic papers, about the role of standards, development of automated marking systems and pedagogical drivers to adopt e-assessment. (See references for list of key documents identified).
2. identifying current e-assessment practice
Sources of information about the current state of the art in practice, and the future plans of leaders in the field, were identified. This database of current e-Assessment practice was compiled through close co-operation with the JISC e-Assessment Case Studies project (Case studies of effective and innovative practice in the area of e-assessment) which also involved members of the Open University's roadmap team. We were also able to seek advice about

current and future e-Assessment practice from the JISC e-Learning Programme online experts meeting which was held from the 30th September to 7th October 2005. A summary of this event can be found in Appendix 5.

3.3.3 Stage 2 : Desktop analysis and consultation

An analysis of the key documents and the database of current e-Assessment practice identified in Stage 1 was carried out, to identify the strategic issues and challenges and benefits of e-Assessment together with the institutional, operational and pedagogic enablers and barriers to the effective use of e-Assessment. This analysis led to the development of a framework for constructing a first iteration of the roadmap.

3.3.3.1 Roadmap framework

The outcome of the literature review and the analysis of the database of current e-Assessment practice inspired the framework shown in figure 2. This framework consists of two axes, 'Status' and 'Scope' each consisting of three cells. The cells along the 'Status' axis (i.e. 'Vision', 'Barriers' and 'State of the Art') represent the current status ('State of the Art'), a vision of a desirable future status ('Vision'), and barriers which will need to be crossed to reach this desirable vision from the current status.

The cells along the 'Scope' axis (i.e. 'Superorganisational', 'Organisational' and 'Personal') represent the organisational scope to which the roadmap nodes within the cells of the map will apply. 'Personal' scope means e.g. the scope of individual academics or students. 'Organisational' scope means e.g. the scope of academic or commercial organisations involved in e-Assessment activities. 'Superorganisational' scope means e.g. the scope of those bodies which represent the interests of more than one organisation. Examples of 'Superorganisations' include government departments (e.g., DFES), funding bodies, and examining bodies. In figure 2 the text in each cell gives an example of the nature of the nodes which will occur in each cell. Figure 3 extends the framework shown in figure 2 to include an indication of the linkages which this form of map will show. These linkages are representative of strategies and facilitators that will help overcome the barriers and facilitate organisation, superorganisations and people change their status from their current state to the desirable vision.

Scope Status	Superorganisational	Organisational	Personal
Vision	What the superorganisational policy documents are aiming for in terms of e-assessment.	What organisations are aiming for in terms of e-assessment (make use of case studies?)	What individuals are aiming for in terms of e-assessment? Teaching staff, students, researchers, others?
Barriers	Misalignments between policies of various superinstitutions.	Misalignments between superorganisational policies and capabilities and/or policies of organisations.	Barriers which prevent (or reduce effectiveness of) individuals becoming involved in e-assessment.
State of the Art	Current situation in 2006	Current situation in 2006	Current situation in 2006

Figure 2: Roadmap framework

Scope Status	Superorganisational	Organisational	Personal
Vision	What the superorganisational policy documents are aiming for in terms of e-assessment.	What organisations are aiming for in terms of e-assessment (make use of case studies?)	What individuals are aiming for in terms of e-assessment? Teaching staff, students, researchers, others?
Barriers	Misalignments between policies of various superinstitutions.	Misalignments between superorganisational policies and capabilities and/or policies of organisations.	Barriers which prevent (or reduce effectiveness of) individuals becoming involved in e-assessment.
State of the Art	Current situation in 2006	Current situation in 2006	Current situation in 2006

Figure 3: Roadmap framework showing linkages between nodes and cells

The purpose of table 1 is to clarify the framework by describing the meaning of facilitators, strategies and barriers within each scope category.

	Superorganisational	Organisational	Personal
Vision	What the superorganisational policy documents are aiming for in terms of e-assessment.	What institutions are aiming for in terms of e-assessment (make use of case studies?)	What individuals are aiming for in terms of e-assessment? Teaching staff, students, researchers, others?
Barriers	Misalignments between policies of various superorganisations.	Misalignments between superorganisational policies and capabilities and/or policies of institutions.	Barriers which prevent (or reduce effectiveness of) individuals becoming involved in e-assessment.
Facilitators	Alignments between policies of superorganisations. E.g. systems not directly related to e-assessment, but the existence of which facilitates e-assessment.	Alignments between superorganisational policies and capabilities and/or policies of institutions.	Actions and processes which promote individuals involvement and/or gains from e-assessment.
Strategies	Suggestions about how to move through the barriers towards the vision.	Suggestions about how to move through the barriers towards the vision.	Suggestions about how to move through the barriers towards the vision.

Table 1 **Table intended to clarify the Roadmap framework**

3.3.3.2 Survey

The main test instrument was a survey sent to a group of experts, comprising of academics, commercial producers and personnel working for Government agencies such as SQA, Becta etc. This survey was an adaptation of the Delphi Method (Gordon, 2003) which makes use of a panel of experts and aims to build consensus over a range of issues. 40/50 returned the survey, a good response rate.

The survey (<http://kn.open.ac.uk/workspace.cfm?wpid=5977>) was designed after a literature review was undertaken and key issues identified. Although termed 'Survey' it was more of an electronic consultation as the experts were asked to give their opinions and to write free text responses for 13/16 questions.

The survey probed experts' opinions on the following issues:

- (a) The timings of policy implementation i.e. their realisation in HE and FE (2009 deadline by QCA, not so in Scotland)
- (b) The way in which e-assessment can make a significant contribution to cutting the burden of quality of assessment
- (c) Ways in which e-assessment will make a significant contribution to improving quality of e-assessment
- (d) The implications for the vision set by the policy documents (some maybe unforeseen)
- (e) Visions for the future

The Steering Group and Advisory Group formed the basis of the group of experts for this consultation phase of the project. Please find current list of participants in Appendix 4. The Delphi method was used to test the project team's initial conception of the roadmaps, and to identify factors that may have been omitted. Findings from the Delphi survey will contribute to the development of the roadmaps in Stage 3.

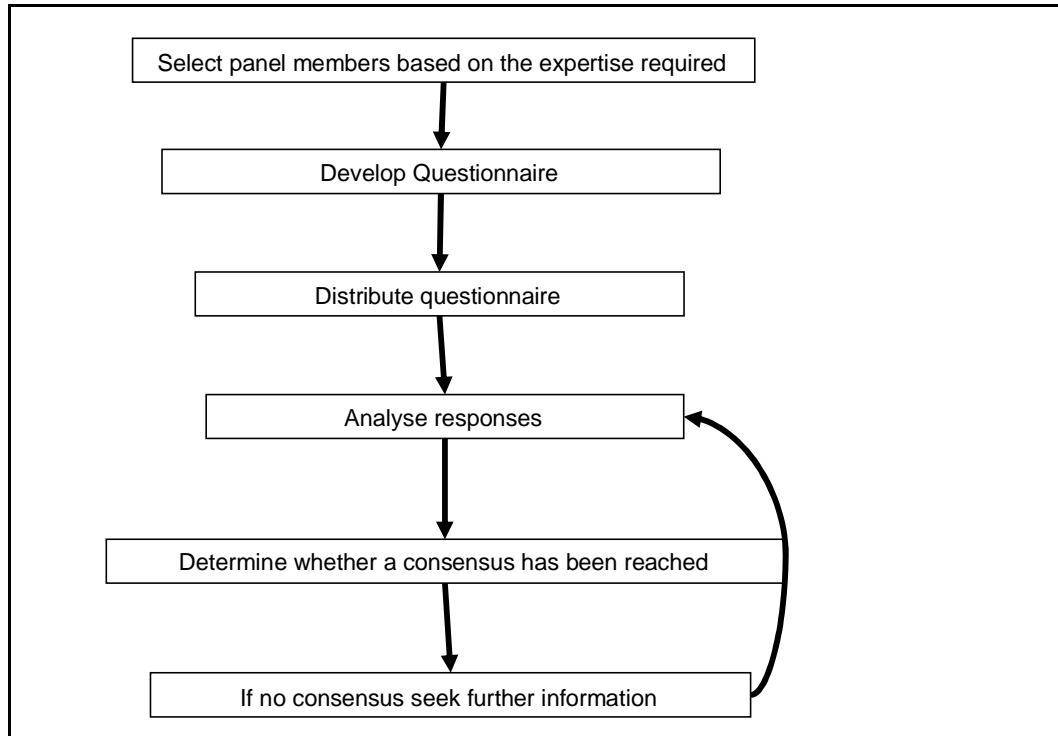


Figure 4 Illustration showing how the Delphi Method was used

3.3.4 Stage 3 : Completion phase

Analysis of the results from the Delphi Survey and the literature review enabled the production of a roadmap that illustrates the planning of future e-Assessment developments and strategic drivers and initiatives relating to e-Assessment.

This includes a visual representation of the roadmap which was produced and implemented using a graphic design tool

4 Overview of key policies and strategy drivers for e-assessment in Scotland, Northern Ireland, England and Wales,

This section of the report presents an overview of the key policies that are driving e-assessment in the four regions of the United Kingdom. It also highlights a number of projects that have been funded by the curriculum bodies and responses to these initiatives when evaluations have been undertaken.

4.1 Developments in Scotland

The first major policy document was produced by the Joint SFEC/SHEFC e_Learning group in 2003. It provided a ten year vision for learning and strongly emphasised the role of pedagogy. This emphasis is underlined by Roger McClure, the then chief executive of the Scottish Funding Councils, in his foreword to this report. He states very clearly that with this vision;

‘learning is what matters; the technology is or should be subordinate’

This vision includes the salient notions of both flexible and personalised learning. The goals of flexible learning emphasise just in time learning which can occur at any time and in any place. Systems also need to be developed to facilitate more personalised learning where the students can follow their own learning pathways.

What is the role of assessment then in this vision? The report suggests that these goals will be achieved through the feedback gained via assessment procedures which will be:

‘relevant and well designed’. They will ‘receive rapid feedback on their learning progress and pointers to remedial study to address shortcomings’

Technology will have a role to play here facilitated by increased use of broadband, MLEs, e-portfolios and other e-assessment systems which will be developed.

The SFC (established in October 2005) then reviewed this e-learning policy and reported in 2006 to the Council the following:

- Technology is increasingly part of mainstream teaching and learning and the main driver should be to improve the delivery of teaching and learning services to learners
- New technological literacies are emerging such as mobile learning. These assist the personalised learning agenda and the demands of learners need to be met to assist in the development of UK and global markets for learning
- E-learning should be embedded within core institutional processes for quality

This document again stressed that pedagogy and learner needs are the main drivers for change and institutional transformation practice in this area would be supported with a £6M investment. These e-learning transformation projects will report in 2007 and a further review will be conducted in the light of the project outcomes.

Six projects have been funded and are managed by the JISC e-Learning programme. They include:

BlendEd - Collaborative Transformation of Course Delivery - www.Blend-Ed.ac.uk

CELLs - Collaborative e-Learning in the Life Sciences - www.cellsproject.org

ECTP - e-Construction Transformation Project -
<http://www.learndirectandbuild.com/Transformation/course5.htm>

ISLE - Individualised Support for Learning through e-Portfolios -
<http://isle.paisley.ac.uk>

TESEP - Transforming and Enhancing the Student Experience through Pedagogy -
<http://extranet.lauder.ac.uk/tesep>

REAP - Re-engineering Assessment Practices - www.reap.ac.uk

All these projects match the SQA objectives of improving student learning with a shift to more student learning methods through a sustainable model of effective FE/HE collaboration.

The implementation of these policies is largely undertaken by the SQA and other national agencies such as JISC, the HE Academy and SFEU. As illustrated by the examples above. Therefore it is by an examination of the work of these agencies that the effects of policy decisions can be monitored directly with respect to e-assessment.

The SQA (Scottish Qualifications Authority) has an e-assessment strategy (2005) but has not set deadlines for its implementation, as is the case with QCA. For the SQA e-assessment has a very specific meaning within the implementation of CAA. It is used to describe the aspects of CAA that are experienced directly by the candidate and included the use of e-portfolios. The SQA vision of e-assessment is that it should add value to the student and provide a foundation for future study. In order to implement this vision SQA are monitoring the following parameters:

- Manageability
- Cost effectiveness
- Scalability
- Future proofing of technological developments

They are concentrating on the particular issues of a delivery platform, staff training and developing a business model for e-assessment and have been involved in a number of e-assessment projects. These include PASS-IT (Project on Assessment in Scotland-using Information technology) and the SOLAR Project. The Pass-IT project created and evaluated different forms of online assessments for HNC computing as well as for NABs in Mathematics, Chemistry, French, Music and English. It has produced a good practice guide and a demonstration of Pass-IT questions can be found at www.pass-it.org.uk.

The Solar project was SFEFC funded and is developing online summative assessments to support SQA's programme of HN modernisation. These assessments are being produced by subject specialists from the FE sector in Scotland and examples can be found at : solar@sqa.org.uk

4.2 Developments in Northern Ireland

The Northern Ireland Council for the Curriculum, Examinations and Assessment have taken the lead in the UK with respect to piloting summative e-assessment. Their action was in compliance with the Northern Ireland's Department of Education document 'A Strategy for Educational Technology' (1997) p.14. Discussions with Edexcel began in 2000 and were followed by a phase 1 pilot study known as the paperless examination (see CCEA/Edexcel 2001, Paperless Examinations project Phase 1 report <http://www.ccea.org.uk>). Phase 2 of the project began in 2002 where a computer-based mock examination in the three sciences, Biology, Chemistry and Physics together with another discipline, namely Geography was undertaken. The recommendations from these studies ;

- Guidelines are needed for item development
- Training is required in the development of e-assessment questions
- Provision for the widest range of item styles is required
- Accessibility issues need to be addressed at the beginning of any development
- A greater use of reference material to be used for questions eg. the periodic table.

These findings have influenced the development of other summative tests by awarding bodies (see section 5.2 with respect to Chapman's paper).

Further developments in Northern Ireland include the publication of a consultation document entitled e-learning Strategy for the Further Education sector: A learning Revolution (<http://delni.gov.uk/index/consultaion-zone/elearningforfesector.htm>) Again the emphasis is on a more personalised learning agenda which can be assisted with the use of new technologies.

4.3 Developments in England

The e-assessment agenda has been made more explicit in the England than elsewhere in the United Kingdom. The 14-19 Education and Skills White Paper presented to Parliament by the secretary of State for Education and Skills in February 2005 states

"In the medium term we expect e-Assessment to make a significant contribution to cutting the assessment burden and to improving the quality and usage."

E-assessment will contribute to more learner control and choice through introducing on-demand testing as described in the DFES document 'Harnessing Technology: Transforming learning and children's services' (Department for Education and Skills, 2005). This document states that 'Using technology to streamline assessment procedures and enable online assessment on-demand is a long term objective' (paragraph 86).

While Paragraph 93 (ibid.) states 'It is crucial that we fully examine the potential for technology to modernise the curriculum and its assessment. ICT supports assessment playing a more formative role – assessment for learning, not just for judging. And we want to see pilots of a wide range of applications of e-assessment: immediate feedback to learners and teachers, online tests, personalised diagnostics, online assessment and accreditation of e-skills and inclusion of e-skills in the assessment of all curriculum topics. QCA has the lead role in ensuring that we develop a curriculum which prepares learners for life and work in the 21st century.'

QCA have actively pursued this policy in their 'Blueprint for e-Assessment' by specifying that by 2009

- e-Assessment will be rolled out in post-16 education by 2009
- e-Assessment will make a significant contribution to reducing the assessment burden and improving the quality of assessment
- e-Assessment field trials should be taking place in at least two subjects per awarding body during 2005
- 75% of key and basic skills tests will be delivered on screen by 2005
- All new qualifications will include an option for on-screen assessment
- All Awarding Bodies should be set up to accept and assess e-portfolios

The sub text to these initiatives are that test sites, new procedures by the awarding bodies, piloting of new systems, the engagement of sub contractors to build and deliver some of this testing will be in place in time. Also that there will be more control given to the learner who will be able to practice and obtain feedback from the types of testing that will be available to students in high stakes examinations. However the effect of students studying at their own rate may very well result in higher grades but could also engender a lack of confidence in the standards for GCSE and AS/A levels. Should the number of re-sits be regulated? Will schools and colleges be able to dictate the pace of change? One could envisage a scenario where the most able students are studying distance learning degree courses whilst still at school.

Other questions relating to how e-assessment will affect pedagogical practices and how current research into text recognition which includes latent semantic analysis will facilitate the automatic marking of text based responses to a range of e-assessment tasks have also been raised with respect to the QCA targets. These are all issues that merit further investigation and should be considered as research items for inclusion in the Roadmap

4.4 Developments in Wales

The policy for e-learning in Wales has been embedded in the 2001 document entitled 'The Learning Country'. In April 2006 'The learning Country 2: delivering the Promise' was published, (<http://new.wales.gov.uk/docrepos/>) The Department for Training and Education (DfTE) are currently reviewing the e-learning document published by ELWa in 2003 and is due to publish an 'enhanced e-learning strategy' However in July 2006 'Towards e-Wales : A consultation on exploiting the power of ICT in Wales' was published by the Minister for Enterprise, Innovations and Networks The vision here is to ensure that all citizens are ICT literate to produce an economically vibrant country with a skilled and motivated workforce. E-learning will play its role also in promoting the culture of Wales and the e-assessment case studies project funded by JISC illustrate pockets of innovative activity in Wales. (see section 5 of this report)

5 Review of current practice in e-assessment

5.1 Introduction

The e-learning policies produced within the United Kingdom (as discussed in Section 4) envision the development of support structures that will nurture self reflective learners, who will in turn be able to have more choice about when, where and how many subjects they study for public examination. One of the main strategies that will be adopted to achieve these goals will be e-assessment. However, do the major providers and researchers of e-assessment have the same priorities as the policy makers? One way to assess the most current state of thinking about e-assessment is to review the proceedings of the 10th International Computer Assisted Assessment Conference. This set of proceedings has been chosen since it offers the most up-to-date opinions about e-assessment. It was hosted by Loughborough University in July 2006. Myles Danson, the Conference Director, states in his forward that his CAA Conference “continues to attract, develop and host the largest body of continuous research into e-assessment”. His opinion is supported by the number of diverse contributions from Awarding Bodies, Higher Education, Research Committees, National Projects, together with international initiatives from America, Canada, Holland, Poland and the Republic of Macedonia.

5.2 Issues of concern highlighted by the 2006 CAA Conference

The positive effects of immediate feedback to the student with e-assessment was stressed by over half of the papers presented at the CAA Conference. Practitioners who were advocates of e-assessment are well aware of the advantages of feedback in student learning. One of the papers, presented by David Nicol, directly addressed the notion of learners’ self regulation with the use of formative assessment. It draws attention to the role feedback can give to enhance self reflective learning and is in keeping with the concerns of policy makers. A key message from this work is that a set of robust formative assessment principles which have been derived from research are being tested. It is the cross fertilisation of ideas from the researchers of design communities that will enhance progress in this field and Nicol believes this will augment the student experience and benefit them in future study.

Ashton and Thomas (2006) meanwhile highlight issues that need to be addressed to narrow the gap between teaching, learning and assessment. These include:

- Assessment of what has been learnt rather than what is easy to assess
- The use of identical software tools throughout the education process
- Assessment of the application of knowledge rather than its acquisition

There was also an emphasis in the proceedings upon on the development of software applications and their use in particular subject domains such as mathematics, veterinary science, medicine, microbiology etc. A number of issues arose from these papers which were also emphasised in others. These included item banking and standards and new forms of delivery technologies for e-assessment. Accessibility too was a concern, together with staff training and automated text marking. Sclater et al (2006) report one strategy that the Open University is using to address these issues. It is adopting Moodle as a core component of its Virtual

Learning Environment. It is currently enhancing the Moodle Quiz engine and integrating it with other OU systems. This development will be in tandem with similar work taking place within the global open source community and it will be interesting to monitor how expertise is shared and what the challenges are in developing software in this way.

A number of short papers were presented from the commercial sector with Eric Shepherd from Questionmark Computing explaining and demonstrating some of the new technologies that will assist teachers to author and deliver assessments easily and securely. The emphasis was on quickly finding, updating and managing large item banks. It also addressed the concerns of the reporting mechanism of this tool and how staff could keep track of students' progress. McAlpine and van der Zanden's paper elaborated upon the proposed item banking infrastructure that SQA is currently developing. One of the major advantages of item banking is the increased quality assurance it affords and these authors suggest that populating the bank may need a more sophisticated approach than what is offered presently with content grids. Wynne and Lopes (2006) paper also stresses the usefulness of management information received from computer based testing. This can help to improve both the test and the feedback to candidates about to how to progress their learning. They stress the importance of the testing infrastructure for the rapid growth of assessment programmes. This infrastructure needs to be reliable and scaleable and "is the glue that sticks the test development, delivery, financial services, registration and scheduling and information management together".

A further seminal paper, (Chapman, 2006), from the commercial sector reported on a follow-up study undertaken to explore the acceptance and usage of e-Assessment for UK Awarding Bodies. 38% of the Awarding Bodies surveyed (N.B.81% of all awarding Bodies responded) use e-Assessment to deliver up to 60% of their assessment programme. The key benefits are ease of administration and time flexibility, together with improved accessibility for students. However candidate authenticity is still an important issue but seven out of ten respondents believed that e-Assessment will deliver on their Return on Investment (ROI). Hence the disadvantages traditionally associated with e-Assessment such as cost and technical issues have decreased in importance as usage has increased.

Warburton reported that the uptake of e-assessment in UK Higher Education has lagged behind the expectation of e-assessment specialists. His research was undertaken to understand the reasons for this difference. Practitioners often went for a "quick win" where they saw the production of a large item bank resulting in the reduction of assessment load. However he also suggests that where tutors were unsupported in achieving this aim, things could go wrong and the tutors would then be discouraged from ever using e-assessment again. One example given was where student data was lost during an invigilated exam. Warburton also described the phenomena of a "slow burn". Here the aim of the tutor was to implement pedagogical improvements through a stage approach. This lower risk strategy was effective and he emphasises that success occurs where tutors are well supported by learning technologists and software developers.

The seven principal mechanisms identified by Warburton were:

- Poor publicity from colleagues
- Ineffective dissemination of practice
- Ineffective procedural risk mitigation
- Fragmentary approach to physical risk mitigation

- Lack of a co-ordinating strategy for uptake
- Lack of resources
- Widely published concerns about “dumbing down” in National Press

Warburton’s descriptive model offers a way of differentiating different patterns of e-assessment practice and highlights the current concerns of practitioners who are developing assessment for learning tools which are robust and will inspire user confidence.

This paper also opens the question of how to describe effective practice in the e-assessment domain. This latter challenge was taken up by a JISC funded project which set out to identify a set of e-Assessment Case Studies of Effective and Innovative Practice in both the HE and FE sectors. The findings identified from this study are discussed below.

5.3 Findings from e-Assessment Case Studies of Effective and Innovative Practice

The aim of the e-assessment Case Studies project was to extend the understanding of what e-assessment meant to both users and producers in Higher and Further Education. A case study methodology was employed to identify and report upon best and current practice within this field of inquiry. Three further case studies were incorporated from outside the HE and FE sectors which included contributions from the most recent British Citizenship Test, a continuing professional development application for nurses at Chesterfield Royal Hospital and a study of the Cambridge University’s online admissions test, developed by Cambridge Assessment. Key personnel from twenty different sites were interviewed. These included the academic champion, the strategic supporter, tutors, students, developers and technologists.

Applications of e-assessment studied included:

- Large scale summative assessment
- University-wide formative e-assessment
- Confidence based testing
- e-Assessment in the Science and Mathematics domain
- e-Assessment being offered to large numbers of distance learners
- Mobile technology input to e-portfolio
- e-Assessment for continuing professional development
- Large scale e-assessment for the general public i.e. British Citizenship test
- University entrance test produced by a public examination board

Sites of interest relating to these themes are illustrated in Table 3 below.

Case Study	Domain Example documented in each case study	Application
1. Derby HE England	Large scale summative assessment using the TRIADS assessment engine Radiography course	TRIADS coded in Authorware (Macromedia) Web ,LAN or CD delivered

2. The Open University HE England	Numerous bespoke products including OpenMark and OpenMentor Maths for Science, Philosophy course	OpenMark. In house development coded in C++ and Java. Internet delivery
3. Birkbeck HE England	Assists part time students where English is not their first language. Feedback essential feature. Molecular Cell Biology	TRIADS with hyperlinks provided via the VLE
4. Warwickshire FE England	Assessment at work for the equine industry Health and safety training for the equine industry	Formative WebCT Summative TRIADS
5. West Suffolk FE England	Mobile technology used to collect photographic evidence for e-portfolios on a Chef's course. Chef's course	Paperfree systems Ltd. National learning Network
6. Dundee HE Scotland	Staff development for quality in the delivery of e-assessment on a university-wide basis Chemistry, Architecture	Questionmark™ Perception™
7. COLA Project FE Scotland	FE staff developed e-assessment questions for a repository used throughout Scotland Initial phase , computing IT and Business Studies	VLEs
8. Cardiff HE Wales	Formative e-assessment in oral pathology Oral pathology	TRIADS assessments delivered vis LAN-based executables
9. Coleg Sir Gar FE Wales	Formative and summative assessments IT for Business course developed and accredited by Edexcel	VLE
10. Ulster HE Northern Ireland	Questionmark™ Perception™ used to supplement traditional notes and lectures Biochemistry, Clinical Physiology, Bioscience, Radiography	Questionmark™ Perception™
11. East Antrim FE Northern Ireland	e-Assessment in process of becoming established throughout the Institution Business studies	Blackboard's MCQ tool
12. Southampton, Plymouth, Loughborough HE England	Commercial systems employed university wide throughout these three Universities School of Nursing- Dosage calculations, Global Tectonics	Questionmark™ Perception™
13. UCL & Glamorgan HE England	Confidence based testing employed to encourage reflective practice for learners Physiology, Computer Science	Javascript , Visual Basic
14. Heriott-Watt/Surrey HE Scotland/England	Specialists in numeric and algebraic assessments also offer partial credits for answers Mathematics and science courses	MATHML delivered via HTML technology. INS-QTI v1.2
15. Cambridge Assessment Public Exam Board	Development of University of Cambridge entrance test	Java application. QTI format
16. British Citizenship Online Examination e-Assessment for general public	Government product produced by commercial company British Citizenship	Calibrand Test

17. Chesterfield Royal Hospital Professional	Continuing professional development in medicines administration for nurses	TRIADS
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Table 3: e-Assessment sites investigated by the project

The e-assessment practices investigated, at all of the sites, were considered to be wholly or partially distinct from traditional paper and pencil tests with the majority of cases highlighting that they had broken new ground, either from a technical perspective or in their design to solve a learning or learning distribution problem. Four of the applications studied were new to the learning community. The majority of sites reported that they had seen an improvement in student results with their e-assessment applications, whilst over half declared an improvement in retention rates, with the introduction of new e-assessment practices.

Many of the applications were developed to address a known pedagogical need. The role of formative assessment and its effect upon teaching and learning was raised by a number of interviewees

Participants in e-assessment practices are well aware of the advantages and a number of institutions mentioned that its adoption can affect retention and motivation of students. However there are some disadvantages listed by students when they are working at home alone. These include:

- The questions are still rather limited i.e. essays are not open to e-assessment
- Feedback can be limited especially if you do not understand the question
- e-Assessment should not be relief upon as the only form of revision

One recommendation from this study would be to pass on lessons learnt from students using e-assessment as a set of guidelines for other students to use, both in HE and FE.

5.4 Case Study examples

Two case studies are summarised below to illustrate the sort of work that has been done with respect to e-portfolios (West Suffolk College) and the production of formative assessments by a consortia in Scotland (COLA Project). These exemplars highlight issues that merit attention in the development of a roadmap.

5.4.1 West Suffolk College: Case Study exemplar one (this Case Study is reported as part of the JISC funded e-Assessment Case Studies Project by the Open University and the University of Derby)

- **Background**

West Suffolk College offers over fifty full-time and 250 part-time courses which are designed to assist students to either move into Higher Education or one which assists them in securing a job. They also offer a number of courses franchised by Anglia Polytechnic University (APU). They specialize in work based learning and it is the Chef's Course that is the focus of this case study. The College is in the early stages of providing e-assessment across the curriculum but does offer key skills and initial assessment of learners via e-assessment

- **Drivers for adoption of e-assessment**

The main driver is to assist learners who find written assignments a barrier to reaching their full potential. This is particularly apparent in the vocational courses where students' skill performance is excellent but to produce written evidence for their portfolios is problematic.

- **Assessment Design**

The assessment which is primarily photographic evidence has been designed to meet a pedagogical need which is to assist students to construct a set of evidence about their practical skills for an e-portfolio. Photographs are 'blue toothed' back to the College via their tutor's laptop where they are assessed and commented upon. These files are also shared around the class when the relevant underpinning theory is discussed.

- **Design for usability and accessibility**

Tutors carry an iPAC pocket PC to record stills, sound and video of students' work which takes place mostly in the workplace. Students use their own mobile telephones and they are proficient users. No training is needed. They record their own work in this way. They have not experienced any issues of usability or accessibility with this course. There are specialists in the College to assist with any difficulties as they arise.

- **Enablers**

Small pump priming funds enabled through the identification of a pedagogical need. There has also been an e-learning staff development programme and support from the Vice Principal.

- **Barriers**

Some difficulties with student access to Broadband or a computer at home. There has been a lot of support to overcome these technical and equipment barriers particularly at Vice Principal level.

- **Evaluation**

The Course has been able to demonstrate an increase in retention and achievement since using this form of e-assessment.

- **Student's perceptions**

The students had no previous experience of e-assessment before this course. One student found it easy to use and a fast and effective form of assessment. She received speedier feedback that was constructive and useful from the tutor. This increased motivation. There were no financial difficulties with using the mobile in this way since uploading the file to the tutor's computer was via Bluetooth and that was free.

- **Tutor's perceptions**

It has increased student motivation and retention. This type of evidence capturing has broken down barriers experienced by students who have reading and writing difficulties.

Figures 5-6 show photographic evidence of food preparation or skills for the Chef Apprentice Programme course on the Modern Apprenticeship in Hospitality and Catering at West Suffolk College that can be taken and saved into the student's e-portfolio.



Figure 5: Evidence of food preparation for e-portfolio, Modern Apprenticeship in Hospitality and Catering, West Suffolk College



Figure 6: Evidence of food preparation skill for e-portfolio, Modern Apprenticeship in Hospitality and Catering, West Suffolk College

Recommendations

- Availability issues with respect to Broadband and computer access at home for students needs to be considered
- Using e-Portfolios to rethink assessment for disadvantaged students is an important consideration and hence the e-Portfolio tool needs to be flexible enough to address these issues illustrated by the Case Study above
- Utilising mobile telephones, iPods and technologies that students use regularly, should be able to interface with the e-Portfolio systems for the next generation

5.4.2 The COLA Project: Case Study exemplar two (this Case Study is reported as part of the JISC funded e-Assessment Case Studies Project by the Open University and the University of Derby)

• Background

The COLA Project is part of the work of COLEG (Scottish Colleges Open learning Exchange Group, started 2000) in which every college in Scotland except for three, operate as a consortium to develop and share learning content. The Scottish Further Education and Funding Council funded two rounds of this project from 2003 to cover the development of formative assessments with the objective of building a databank of questions suitable for e-delivery (COLA).

• Drivers for adoption of e-assessment

The Funding Council had provided funds for all colleges to buy virtual learning environments (VLEs) and there was a general view that online assessment would encourage staff to make more use of them.

• Assessment Design

The 18 subject networks whose practitioners work quite closely together were surveyed to select the choice of disciplines for the initial phase of question development. Not unexpectedly, the results indicated that computing, IT and business studies ranked highly whilst there was an under-representation of disciplines that do not have a culture of objective testing or where assessments are normally of a more discursive nature.

A launch event was organized to disseminate information and gain volunteers for question writing. The Project was managed by a project Steering Group with a wide representation from within the sector and other Partner Agencies and technical Advisory Group was created.

Word templates were used to write the questions. The templates were based on a project in Southampton University (e3en) established to create a bank of questions for use in HE Engineering courses. Workshops employing experts were held to inform writers of best practice techniques for constructing objective questions. These stimulated a lot of debate.

Writers were then commissioned to construct the questions within an agreed timescale. All assessments were peer-reviewed then sent to COLEG for proof reading and review from the learner's perspective whereupon they were either validated or returned for modification. The content of the questions was mapped to the Scottish Qualifications Framework. Each assessment contained between ten and twenty questions with some writers using the feedback as a learning tool more than others.

The next challenge was to convert the questions into a format that could be delivered by the four different VLEs then in use in FE colleges (Blackboard, Granada Learnwise, Teknical's Virtual Campus and WebCT). The project promised that the assessments could run on these systems and the IMS-QTI interoperability format was chosen for this reason. However it soon became clear that the four platforms were variably compliant with the standard and this posed a restriction on the question types that could be used.

The final formats were:

- Multiple Choice Question (MCQ)
- Multiple Response Questions
- True/false
- Matching Questions

Fill the gap questions were difficult to implement across the different VLE's and were abandoned early in the project. The colleges were then encouraged to use the assessments for their teaching.

- **Design for usability and accessibility**

The databank contains the questions in a QTI standard format. The screen layout is largely controlled by way in which an individual VLE renders the questions and thus issues of accessibility are variable depending on the functionality built into the VLE.

- **System architecture and delivery issues**

The delivery of the test is highly dependent on the functionality of the VLE rendering engine. There were problems with user-tracking in the different VLEs combined with the way in which each VLE handles the scoring. Different question formats have different problems in each VLE. Negative results were created for matching questions in some. Multiple response questions had the problem that by clicking on all possible answers the maximum score could be gained because there was no mechanism for penalizing the incorrect answers. Scoring issues could only be identified by test in the live environment.

- **Enablers**

Many hundreds of formative assessments have now been available for over a year and colleges are encouraged to use them in their teaching programmes. Tutors who have used the assessments regard them very highly. (see Section 10)

- **Barriers**

The variable level of compliance of the VLEs with the interoperability standard posed a restriction on the question styles that could be used. For example Teknical's Virtual Campus VLE does not display the matching questions in a conventional layout with a mismatch of instructions and layout.

Staff development is required to overcome cultural issues and promote confidence in the technologies. In common with many e-assessment initiatives, slow progress may result from the time taken for curriculum changes and frontloaded e-assessment design temporarily increasing the workload of academic staff when changing modes of assessment. However the general response from those that replied was positive and it is to be hoped that both the standards compliance of VLEs and take-up will improve over time.

Some of the apparent technical barriers may relate to lack of technical support within the colleges and this should not detract from the very large resource that is made available to tutors through this project.

- **Evaluation**

The project has moved forward the understanding of the technical issues round the VLE use and a better understanding of interoperability. The COLA project has with the TOIA project (www.toia.ac.uk) influenced the debate about standards in JISC and is an interesting feasibility study into the IMS-QTI standards compliance of four VLE's and the restrictions that they impose on pedagogic design.

The project had a significant impact on the writers (100 authors) understanding of objective testing online or offline and it has raised new issues about how small pieces of work are managed and quality assured. The need for a more automated process was identified.

The technical advisory group has worked well. It has brought together technical expertise from around Scotland. The awareness of technical issues has been raised and shared. The project was a good opportunity to introduce staff to e-learning. Question writers indicated that taking part in this e-learning process had boosted their confidence even if they did not have significant IT skills. COLEG has learned a lot about quality assurance of online content.

- **Student's perceptions**

Students from a law module at one college used the assessments after they had finished their exams and were really enthusiastic about them. They found them useful in reinforcing the learning and as a revision tool.

- **Tutor's perceptions**

- Tutors perceptions of the COLA material have been obtained for this study from two colleges:

- *Joan Archibald at Reid Kerr College, Paisley (www.reidkerr.ac.uk)*

COLA assessments are used by full time students in a range of subjects including Hospitality, Business and Management, Health & Safety and Marketing & Economics. Between 15 and 20 tutors are using the assessments. The tutors regard the content of the assessments as of very high quality and the students receive immediate feedback. Problems of uploading the assessments to the VLE and student access to the VLE when it is not used for any other part of their course can create a barrier to the full use of the assessments. However this has now been resolved by appointing an administrative member of staff in charge of the VLE. Once on the system and students have accounts there are few problems reported. The assessment results are evaluated and if all students answer a question incorrectly a class review and discussion of the question would ensue. The college runs a number of online courses. The assessments have made a big impact on these distance learning courses and the students' progress can be easily monitored. There was always a delay in returning the results from the old paper version. This enhances learning because students do not have to wait for result. The full impact can be evaluated properly by the end of the year.

- *Morag Robertson, Cardonald College, Glasgow (www.cardonald.ac.uk)*

Morag Robertson is a lecturer in Computing and is using the COLA assessments of programming for formative and summative (25%) purposes. About half the computing department staff are using COLA assessments in their courses. Morag found the assessments easy to set up and values them for the immediate feedback delivered to students and their use in preparing students for formal examinations. It also encourages the students to take

responsibility for their own learning. The original delivery issues have been resolved by an upgrade of the VLE. Morag is a COLA assessment author and had the support of the Webmaster to upload the assessments into the VLE but finds the question creation process quite laborious.

The screenshot displays a VLE assessment interface. On the left, a box titled 'Induction' contains user information: Name: David Archibald, Start time: February 24, 2006 10:56am, Time allowed: 15 minutes, and Number of questions: 6. Below this are 'Finish' and 'Help' buttons. The main question area shows 'Question 1: (1.00 points)' and asks 'Which of the following could result from induction not being carried out for new employees?'. It lists six options: a. Mistakes, b. High Morale, c. Lack of teamwork, d. Loss of production, e. High reputation, and f. Accidents. At the bottom of the question area are 'Save answer' and 'Next Question' buttons, and a 'Finish' button. On the right, a 'Time Remaining' section shows 14:43 (min:sec). Below that, a 'Question Status' section shows 'Unanswered' (yellow circle), 'Answered' (blue checkmark), and 'Answer not saved' (red exclamation mark). A progress bar at the bottom of the status section shows 6 questions, with the first one answered and the others unanswered.

The question is an example of a COLA assessment used at the *Reid Kerr College, Paisley*. It is a Multiple response Question used in one of their modules.

Recommendations

- This is a good model to encourage take up of e-assessment and also production of large banks of questions
- Accessibility issues need to be considered as these were variable in this project and depended upon the functionality built into the VLE which was used
- Raise awareness through this study of IMS-QTI standards compliance of four VLEs and the restrictions that they imposed upon pedagogical design.

This research also uncovered different ways of employing confidence level testing. Glamorgan in their MCQ tests, require the students to indicate the level of confidence in the correctness of their answer they have selected. This gives the tutors some way of identifying misconceptions which can then lead to pedagogical changes. Another use has been identified, at UCL, for the classes in medical diagnosis. Here the aim is to assist the students in building their 'aura of confidence' with their professional expertise.

5.5 Institutional Issues raised by the Case studies Project with respect to Practice

The studies illustrate that the principal facilitators for effective implementation of e-assessment include active institutional support from senior management with strong staff development, pedagogical and technical support for tutors from central services. The role of pedagogically sound, imaginative design for e-assessment on the part of tutors is often a significant factor in its success. There is evidence of both summative and formative assessment taking place and that the main drivers for the introduction have been to improve student learning with faster feedback.

Drivers for adoption of e-assessment included perceived increases in student retention, enhanced quality of feedback, flexibility for distance learning, strategies to cope with large student/candidate numbers, objectivity in marking and more effective use of virtual learning environments.

This project has revealed that the introduction of a VLE can act as a double edged sword. On the one hand it can encourage tutors to build e-assessments using the quiz function but it can also cause lone champions to lose support. This is unfortunate when bespoke systems have been developed to address specific pedagogical needs.

The principal barrier to development of institution-wide e-assessment remains one of academic staff time and training. Dissemination of pockets of innovative e-assessment practice across an institution can be hampered by organisational structures that favour autonomous academic departments, and limited centralised support.

5.6 Issues relating to student and staff perceptions

The previous section described the institutional issues that arose with respect to e-assessment practice but what have been the effects on teaching and learning with the introduction of these systems? The overwhelming response from tutors has been that the feedback from formative assessments has supported student learning. There is a strong move towards assessment for Learning as opposed to assessment of Learning. More importantly the feedback to tutors from the results of the assessments is also changing their teaching.

This feedback is acting as a diagnostic tool for the identification of student misconceptions. Direct help can be given to students on a particular topic. In fact a more constructive teaching and learning dialogue is being supported with the introduction of e-assessment. The next question then is how is this taking place? One of the activities that has promoted this change has been tutors viewing their subject from a different perspective, with the introduction of e-assessment. This is because the different question formats present a new challenge and the introduction of more interactivity into the tests requires a rethink of old practices. A second has been the use of simulations to extend students' experience of their subject. For example at Birkbeck, Caselt! is used to expand student exposure to a number of science techniques and to perform procedures that would be difficult or impossible to schedule in the already crowded teaching schedule. It has broken down some barriers experienced by students. For example at West Suffolk College it has assisted students on the chef's course who have reading and writing difficulties.

The fact that evaluations are starting to show that e-assessment is improving student performance as illustrated by the findings from Dundee University and is encouraging tutors to persist with this 'new dialogue' especially when feedback is given to students more quickly than with paper and pencil exercises. Tutors have also reported that one of the main benefits of e-assessment has been to enhance the engagement of the students in the subject and to broaden their experience of the domain.

Of course a dialogue involves two partners and although the findings from the tutors suggest that a different type of teaching and learning dialogue is taking place, what is happening from the students' perspective? The e-assessments help them to reflect

upon and become aware of the limitations of their knowledge. One of the students from Birkbeck says:

'These tests help you to reflect upon what you don't know'

This in turn promotes questioning not only with the tutor but also within the peer group.

Another aspect related to 'encouraging thinking' was made the students from Warwickshire College who believed that the e-assessment question styles helped them to concentrate on the main task which was the question content rather than 'on the writing'.

The students also said they found the assessments aided revision and so we see students taking more control of their own learning and become more reflective. With respect to the SToMP system, students reported that the e-assessment had taught them to be more accurate and to use MS-Excel for calculations. There was however anxiety found across the whole spectrum of studies and a lack of confidence in the assignments when a server failure occurs.

Tutors are gaining more confidence in designing e-assessments but all mentioned the overwhelming training needs of staff. Tutors are concerned that the time needed to prepare questions is not recognised and rewarded especially in research dominant environments.

5.7 Recommendations

Staff training is a real concern that merits further attention from such bodies as the JISC and Becta who could organise independent training workshops. These could bring together the experts in the field to conduct the training sessions and perhaps act as mentors to colleagues who have attended the course.

Staff also require recognition for their work in this area as they would if spending time on research.

More confidence and support is required for high stakes testing. Derby is one of the Universities which has taken the lead in successful summative e-assessment and there are lessons to be learned from their good practice.

A students' guide to e-assessment could be produced drawing upon the experience of students interviewed in the Case studies project. The guide would provide hints and tips about preparing for and sitting e-assessments for new students to further and higher education.

The variety of applications of e-assessment studied and their innovation and general effectiveness indicate the potential of e-assessment to significantly enhance the learning environment and the outcomes for students, in a wide range of disciplines and applications.

6 Checking out current practice and policy with a group of experts

6.1 Introduction

The purpose of the electronic consultation was to clarify whether the visions and directives issued by the policy makers in the UK were viewed, by a group of experts in the field, as realistic and matched current progress in the HE and FE sectors. The experts' opinion was also prompted about whether there were any unforeseen or undesirable consequences to the vision promulgated by the Superorganisations. Our group of experts were also asked to comment upon their own visions of the future and to articulate any barriers that they envisaged would deter or prevent educational institutions from piloting e-assessment applications. These personal visions and barriers will be discussed in sections 7 and 8 of the report, while this section reviews the following:

- The timings of policy implementation i.e. their realisation in HE and FE (2009 deadline by QCA,)
- The way in which e-Assessment can make a significant contribution to cutting the burden of quality of assessment
- Ways in which e-Assessment will make a significant contribution to improving quality of e-assessment
- The implications for the vision set by the policy documents (some maybe unforeseen)

6.2 Predicted timings of e-learning/assessment measures taken from HEFCE strategy for e-learning document (2005)

The majority of the experts (75%) believed ICT will be commonly accepted into all aspects of the student experience of higher education within the next five to ten years. Interestingly, 20% of the experts were convinced that ICT was currently prevalent throughout the whole student experience.

The next question the experts addressed was whether the students would be able to electronically access information, tutor support, expertise and guidance. Furthermore they were asked to consider whether they could effectively communicate with each other wherever they were..

30% of the experts understood this was happening already, while 50% believed it would be achieved within the next 2-4 years. 20% of the experts considered this would take longer and only be achieved within a 10 year time span. However this group were from the FE and HE sectors and held organisational responsibilities for e-assessment also they are not at the cutting edge or champions of e-assessment development. In addition the fact that they are involved with the effects of the implementation of VLEs which may well make them more sceptical.

The experts were then asked to address the question of when a suite of tools would be available to tutors to assist them to provide better support to their students. 30%

of the experts thought this was already present and 44% believed this facility would be available within 2-4 years. Again, it was only a small minority (17%) from an HE organisation level who believed it would take longer, i.e. between 5-7 years.

6.2.1 Recommendations to be addressed at the organisational level and sector agencies such as JISC, BECTA and the HE Academy

- Increase awareness of managers in HE and FE of potential restrictions imposed by VLEs on e-assessment tools and components

6.3 How can the use of technology be encouraged to facilitate electronic assessment?

The experts agreed about the following facilitators:

- Encourage e-assessment strategies to be developed in HE and FE establishments
- Promote good assessment design through research and training and sharing of question banks
- More buy-in at the strategic level in HE and FE
- Provide learners with the means to self and peer assess on demand for any aspect of their course
- e-Assessment to fit with mobile technology usage
- Examples of good practice required
- The development of any generic e-assessment engine should be free or low cost, robust, flexible and designed from a pedagogical standpoint
- Funding needs to be available to implement facilitative strategies

6.3.1 Recommendations to be addressed at Superorganisational level

- Fund research to provide evidence about:
 - Learning objectives that can be tested rigorously with e-assessment
 - The effect of e-assessment on students taking control of their own learning
 - Understanding whether e-assessment promotes reflective learning
 - Piloting on demand testing for a number of courses
 - Gauging the emotional pressures of such a system as well as the cognitive gains

To be addressed by sector agencies:

- Promote awareness of latest developments with tools and case studies at the organisational levels of HE and FE
- Provide a set of guidelines about e-assessment from best practice to date

6.4 Ways in which e-assessment can make a significant contribution to cutting the assessment burden

85% of the experts agreed with the claim made by the 14-19 Education Skills White Paper (2005) that “In the medium term we expect e-assessment to make a significant contribution to cutting the assessment burden and to improving the quality and usage of assessment”. Only six disagreed. The majority view was that the assessment burden could be reduced by:

- Production of essay marking tools
- Students able to self assess their own learning with the assistance of automated feedback
- On demand testing
- Integrate assessment more within the learning cycle. Avoid assessment driving the learning shift to assessment of learning
- Need consortia developed assessment resources
- Consider guidance developed by TechDis and BECTA re accessibility issues
- Reduce marking time and increase teaching time
- Introduction of technological change can facilitate reflection upon old practice and encourage a significant revision
- Appropriate assessment – modus operandi and construction of questions requires change
- Create efficiencies in results processing, transparency in grading, develop criterion referenced exams
- Introduce formative assessment – encourage user control of learning
- Assists with larger class sizes
- Faster feedback to both students and tutors

6.4.1 Recommendations

- Integrate formative e-assessment into the learning cycle – to be addressed by organisational level
- Follow SQA lead into building question banks and course assessments from within the teaching community – to be addressed at Superorganisational and by sector agencies

6.5 Ways in which e-assessment will make a significant contribution to improving quality of assessment

95% agreed that:

- A wider range of subjects should be available for testing by e-assessment to encourage student mastery
- e-Assessment forces assessors to produce clearly defined objectives that enhance student learning
- Offers more realistic assessments such as problem solving scenarios (for medical students etc.)
- Better regular feedback from both formative and summative assessment should help students who under-perform

- Quality will improve for individual learners who are able to progress at their own pace
- More improvement will be seen in the vocational sphere
- Evidence organisation will be improved for review by assessors.
- Better reporting and data gathering should make it easier to determine standards from year to year.
- Anonymity of marking is assured.

Only 5% of the experts were sceptical about e-assessment improving the quality of assessment.

6.5.1 Recommendations

To be addressed by organisational and sector agencies:

- Empirically test the impact of the quality and type of feedback to
- Build a wizard to assist with organising and presenting evidence in e-portfolios. This type of help could be based on an ELIZA type system as first produced by Wiezenbaum

To be addressed by superorganisational and sector agencies:

- Investigate whether e-assessment will assist with determining standards for high stakes examinations
- Fund research and development into widening the area of topics that can be meaningfully tested with e-assessment

6.6 The ways in which e-assessment will make a significant contribution to improving the usage of assessment

The claim that “In the medium term we expect e-assessment to make a significant contribution to cutting the assessment burden and to improving the quality and usage of assessment” was made in the 14-19 Education and Skills White Paper (2005). Our experts who belonged to the superorganisational group agreed upon the following:

- Assessment on demand would make assessment more flexible for the learner. This also would shift the burden of responsibility and control away from the tutor and onto the student
- e-Assessment offers greater opportunity to test a range of skills that are outside the remit of paper and pencil tests such as those that can be found in the vocational sphere of education

There was however agreement from all sectors that increased usage of formative assessment would improve take up. The champions of e-assessment, who are actively designing and working to use e-assessments to fit a pedagogical need, all agreed that “Well designed e-assessments are significantly better assessments than many non-e. This was because the nature of the medium forces assessors to produce clearly defined objectives for their assessments and to structure them in ways that enhance student learning. These are not the characteristics associated with most types of traditional assessment.”

6.6.1 Recommendations

Empirical evidence should be obtained about the following and hence studies should be commissioned at superorganisational and agency levels:

- Check e-Assessments match learning objectives.
- Check formative assessments match pedagogical needs.
- Check feedback to tutors from formative assessments changes teaching strategies to match learners needs.
- Encourage Skills testing that are outside the remits of paper and pencil tests.
- Explore whether more learner control is obtained through this type of assessment which leads to more learner confidence.

6.7 The implications for the vision set by the policy documents

The development of e-assessment 2004 to 2014 report (2005) suggests a vision for e-assessment for 2014 that includes e-testing, e-marking, e-portfolios as a standard method for compiling assessment, e-vivas via mobile technologies and e-presentations for assessment in the performing arts. The experts were asked their opinions about the implications of this vision. The following responses were made:

- 73% of the experts agreed that self assessment as part of a personalised learning agenda will contribute to the student's final mark by 2014. The experts who disagreed came from all sectors except the commercial arena
- The experts were split 50/50 when asked whether they believed the effect of students studying at their own rate will result in higher student grades and a lack of confidence in the standards for GCSE and AS/A Levels. However, there was a majority view (75%) that the overuse of re-sits for on demand testing will not always increase student grades
- Perhaps not surprisingly, 82% believed that the number of re-sits should be regulated
- 60% agreed that the QCA are more likely to oversee a lifelong learning record of each students' qualifications from Key Stage to external examinations
- Only 57% agreed that schools and colleges will dictate the pace of change in e-assessment. These experts belonged to the super organisational and organisational groups whereas the dissenters came from the commercial sector and were also personal champions of e-assessment in the HE area
- 72% of the experts believe that e-assessment test sites will be open 24/7. All the experts from the super organisational group agreed with this statement
- 75% agreed that Higher Education would benefit from e-assessment as students will have more depth and breadth to their learning (this finding agrees with the experts' opinion about vocational assessments and increases to the range and type of assessments that would be carried out in 2014
- 65% of the experts agreed that one consequence of on demand testing could be that more students would study university courses whilst still at school
- 65% agreed that the consequences of such a system could mean that parents will over pressurise children to take examinations too early

6.7.1 Recommendations

- Clarify issues surrounding the number of resits that can be taken by students and whether they will be declared on examination certificates – to be addressed as superorganisational issue

To be addressed by superorganisational and agency:

- Resolve the question of who will oversee the students' lifelong learning records
- Pilot a study to investigate whether student grades improve, if they study at their own rate

To be addressed by sector agencies:

- Determine whether universities are considering offering their courses to students who are still at school
- Set up a number of focus groups to understand whether:
 - Students will be over pressurised by the new regime
 - Parents will force children to take examinations
 - More students will seek extra tuition from commercial tutorial companies
 - More able students will want to broaden their examination range –

6.8 The cost implications of high stakes assessment in the HE and FE Sectors

Experts from across the sectors agreed that the following issues need to be considered taking into account costs may be offset by longer term benefits in student achievement and satisfaction:

- Technical infrastructure with local skills need to be in place and will be costly to implement
- Large scale testing sites need to be in place
- Training at all levels. Students, tutors, technical staff etc.

6.8.1 Recommendations

To be addressed by sector agencies:

- Carry out a cost benefit analysis of training needs
- Devise training plan

To be addressed by superorganisational

- Devise a plan for the citing and staffing of large scale testing sites in the public and private sector

6.9 Do experts agree with the recommendations suggested by the CCEA and Edexcel to realise paperless examinations?

- 85% of experts agreed that authors of the test items should be given training that would count towards a recognised qualification
- Only 38% agreed that these authors should have the same technical skills as their technology partners. Many of the experts who agreed with this statement were assisting academics with putting their questions into an electronic form within a VLE or other such system

- There was overwhelming agreement (100%) that research into the development of different question types is sorely needed
- 100% of experts agreed that research into automatic marking should be encouraged
- 100% of experts agreed that expertise and accessibility issues needs to be introduced earlier into the test item phase
- Only 55% believed that authors should use an agreed software development tool to ensure consistent look and feel of the items together with consistency in upload functionality. Champions working both in HE and FE agreed with this statement whereas experts from the super organisational and organisational sectors disagreed with this statement
- 75% of experts believed it would be better if markers worked from home on their own screens
- Only 40% believed a mobile mark centre such as bus with a wireless LAN would assist with secure marking of the examinations
- 89% accepted that thorough testing using structured procedures and in multiple environments is required at every stage of the development process

6.9.1 Recommendations for progression of these issues

- Ensure more development continues and that one software tool is not adopted at this stage – to be addressed by organisational and agencies

To be addressed by superorganisational and agencies:

- Funding best practice and then disseminating the findings through bodies such as BECTA, TechDis and JISC should be continued.
- Public acceptance of high stake assessments needs to be achieved through dissemination of key findings using press releases, TV and press editorials and PR techniques.
- Findings from pilot studies published and a roll out plan made available through JISC and BECTA – to be addressed by agencies

6.10 The implications of all AS and A Level examinations being available on screen by 2009 for University admission policies or job recruitment

- 30% of the experts believed that the universities were ignoring the initiative.
- 90% of experts from the super organisational group wanted this to mean that learners “are able to apply for jobs or university places with their results already known”.
- 40% of the experts believed that if confidence fell in the new AS/A Levels, then both employers and universities would run their own admissions tests which would fragment the current system.

6.10.1 Recommendations

- Publish a report on the implications of changes to AS and A level examinations for the HE sector, notify the universities and obtain feedback

on implementation or non compliance as advised – to be addressed by superorganisational

- DFES to be informed of the opinion of the experts with respect to advance notice of results preferred by the learners and of the expected results of a lack of confidence in the new AS/A Levels – to be addressed by agencies

6.11 Using technology to streamline assessment procedures

- 72% believed on demand e-assessment will be available within the next 10 years. Only 8% believed it would take more than 15 years however they came from the organisational and personal groups.
- On demand testing will reduce problems associated with student illness e.g hay fever sufferers
- The most important aspects to be streamlined were:
 - Marking
 - Analysis
 - Feedback
 - Increase in formative assessment
 - Assessment of vocational courses
- Administrative advantages

6.11.1 Recommendations

DFES, QCA, SQA to be informed for further action – to be addressed via agencies

6.12 Summary

Most of the experts agreed that the timings set by QCA to achieve their e-assessment targets were relatively reasonable. There was however a need for change in current production methods to achieve high quality test items. Accessibility was an issue, together with the reliability and validity of high stakes assessments.

A pedagogically driven model for e-assessment was called for rather than a technologically and standards led framework dominating future developments in this area. The consequences of systems being built that address pedagogical needs is interesting. Experts believe that students will take more control of their own learning and become more reflective. On demand testing will assist students to realise their own potential and e-portfolios can help them to present themselves and their work in a more personalised manner. This notion is also supported by the Government's agenda to promote "personalised" learning. In fact there is stronger move towards andragogical (Knowles 1970) rather than pedagogical principles than declared by the experts that were consulted in this study.

The tutor's role will inevitably change in this new regime and a study of how this change can be managed through training and work experience needs to be considered.

6.13 Recommendations Summary

6.13.1 Superorganisational

Fund research to provide evidence about:

- Learning objectives that can be tested rigorously with e-assessment
- The effect of e-assessment on students taking control of their own learning
- Understanding whether e-assessment promotes reflective learning
- Piloting on demand testing for a number of courses
- Gauging the emotional pressures of such a system as well as the cognitive gains
- Investigate whether e-assessment will assist with determining standards for high stakes examinations
- Fund research and development into widening the area of topics that can be meaningfully tested with e-assessment
- Clarify issues surrounding the number of resits that can be taken by students and whether they will be declared on examination certificates – to be addressed as superorganisational issue
- Resolve the question of who will oversee the students' lifelong learning records
- Pilot a study to investigate whether student grades improve, if they study at their own rate
- Determine whether universities are considering offering their courses to students who are still at school
- Set up a number of focus groups to understand whether:
 - Students will be over pressurised by the new regime
 - Parents will force children to take examinations
 - More students will seek extra tuition from commercial tutorial companies
 - More able students will want to broaden their examination range –
- Ensure more development continues and that one software tool is not adopted at this stage
- Funding best practice and then disseminating the findings through bodies such as BECTA, TechDis and JISC should be continued.
- Public acceptance of high stake assessments needs to be achieved through dissemination of key findings using press releases, TV and press editorials and PR techniques.

- Findings from pilot studies published and a roll out plan made available through JISC and BECTA – to be addressed by agencies
- Publish a report on the implications of changes to AS and A level examinations for the HE sector, notify the universities and obtain feedback on implementation or non compliance as advised

6.13.2 Organisational

- Integrate formative e-assessment into the learning cycle
- Empirically test the impact of the quality and type of feedback to
- Build a wizard to assist with organising and presenting evidence in e-portfolios. This type of help could be based on an ELIZA type system as first produced by Wiezenbaum

6.13.3 Sector Agencies

- Increase awareness of managers in HE and FE of potential restrictions imposed by VLEs on e-assessment tools and components
- Promote awareness of latest developments with tools and case studies at the organisational levels of HE and FE

- Provide a set of guidelines about e-assessment from best practice to date
- Follow SQA lead into building question banks and course assessments from within the teaching community
- Check e-Assessments match learning objectives.
- Check formative assessments match pedagogical needs.
- Check feedback to tutors from formative assessments changes teaching strategies to match learners' needs.
- Encourage Skills testing that are outside the remits of paper and pencil tests.
- Explore whether more learner control is obtained through this type of assessment which leads to more learner confidence.
- Determine whether universities are considering offering their courses to students who are still at school
- Set up a number of focus groups to understand whether:
 - Students will be over pressurised by the new regime
 - Parents will force children to take examinations
 - More students will seek extra tuition from commercial tutorial companies
 - More able students will want to broaden their examination range
- DFES to be informed of the opinion of the experts with respect to advance notice of results preferred by the learners and of the expected results of a lack of confidence in the new AS/A Levels – to be addressed by agencies

7 Visions of e-assessment for 2014

The experts have a coherent vision that e-assessment can assist learning and expect more formative e-assessment to be available to students. The effect of this development will be to encourage students to check their understanding of a given topic more frequently. The experts do not expect unassisted practice alone will aid learning but the quality of feedback given to the students will encourage reflection and enhance learning. There are difficulties in producing high quality test examples, especially with respect to free test entry and there are some differences of opinion about the timing and instantiation of these visions, which are described in section 9. The experts predictions are reported in terms of where and how e-assessment will be delivered. The research and development needed to meet the vision together with the effects of these visions on teachers and learners.

7.1 Delivery of E-Assessment 2014

7.1.1 Superorganisational

The experts agreed that on-demand testing will be available for AS and A levels. They were less confident that this would be the case throughout the HE sector. They suggested that:

- Large scale testing sites would be available as now organised for the theory driving test.
- Testing sites could be located in schools, colleges, universities and possibly supermarkets.
- Test sites will also administer paper and pencil tests for the subjects which are not totally electronic.
- e-assessment prevalent from primary school through to university and vocational qualifications. Not forgetting the Driving Test Theory exam and the British Citizenship examination
-
- High quality item banks of questions will be available.
- Setbacks will occur to reduce confidence, progress slower than expected
- High stakes assessments still available in traditional forms such as final examination in HE
- e-Assessment so integrated into a number of strategies that we will no longer refer to it as e-assessment
-

7.1.2 Organisational

- E-portfolios will play a large role in the assessment of courses delivered at FE and HE institutions.
- Formative and self assessment and e-portfolios will make up a core of assessment tools
- Personal Measurement of competence will occur at random intervals rather than as takes place now as a series of discrete controlled events. This means that education will fall in step with the vocational competency process
- Confidence in e-assessment will be declared by the following groups:
 - Teaching profession
 - Funding councils

- Awarding bodies
- Students
- General public

7.1.3 Personal

- e-Portfolios exchanged maybe as microchips in a business card
- e-assessment will replace everything except practical assessments
- e-assessment seamlessly integrated into day to day learning/work environments

7.2 Research and Development

7.2.1 Superorganisational

- Guidelines will be available to ensure the quality, accessibility, reliability and security of e-assessment.
- Development of standards should not dominate the research agenda or slow down development of systems driven by pedagogical need.

7.2.2 Organisational

- Development of quality training programmes for teachers, developers and invigilators will be delivered electronically.
- Development of e-assessment for group work
- Development of peer e-assessment.
- Adaptive systems that respond to students misconceptions will be available for A few institutions will emerge as leaders or champions in the use of e-assessment
- AS/A Level students in subjects such as mathematics, science and geography.
- Automated essay marking software will be improved Some subjects will be streets ahead with formative and summative e-assessment which will provide the students with excellent feedback
- Some subjects will struggle to ensure integrated e-assessment
- Use of virtual reality technology to increase authenticity of assessment
- More unusual uses of technology will be prevalent to assist with learning that is more personal

7.3 Implications of the Vision for Teachers

- Implications of the Vision for Learners Summative assessment will be based on electronically produced outputs rather than tests that have limited authenticity i.e. moving towards vocational competence
- There will still be a mixed economy of digital and paper assessment
- We will be working with assessment FOR learning rather than learning for assessment
- all modules/programmes will be using some form of e-assessment
- New skills will be acquired by both tutors and students for working in an integrated manner
- e-Assessment will inform tutors about the students' progress and they will adapt/tailor their teaching and learning plans to student needs

- Teachers will have reduced marking load and can spend more time supporting learners
- Vocational competence will be measured and developed by assessment led learning
- Central part of education from primary schooling to CPD, staff will be skilled, enthusiastic and freed from their current burdens to work better
- More use of diagnostic e-assessments
- Tutors in HE and FE will no longer marking paper scripts

7.4 Implications of the Vision for Learners

- Assessment on demand means learners will be working at their own pace.
- Learners will be able to alter preferences for presentation of their assessments i.e. accessibility issues will be addressed in this manner, if not alternative provision will always be available
- e-assessment seen as an integral part of learning which means course exams will be less of a shock to the students. More self and peer testing available
- There will still be a mixed economy of digital and paper assessment
- On demand testing will lead to greater personalisation of education
- New skills acquired by both tutors and students for working in an integrated manner
- Ubiquitous as the text books the students rely on now
- Assessment should inform students about their learning and their progress
- Adaptive e-assessment playing a major role in providing feedback to students who can take more control of their own learning
- Students/pupils will use different types of e-assessments throughout their whole learning experience
- Exams will be taken when the student feels ready to take them as opposed to set dates in the educational calendar
- e-assessment woven into CPD programmes for all professions where it is fit for purpose
- Assessment driven by pedagogical need and not technological imperative. This means a more bespoke service for students
- Improved accessibility and support for a diverse range of learners
- e-assessment part of personal learning journey. Intelligent and skilled use of e-assessment will be an integral part of education

7.4.1 JISC pedagogical experts' data

Visions of e-assessment

The face to face and online meetings that we have organised with the kind assistance of JISC to understand participants' visions for e-assessment have resulted in the following predictions:

- Complete shift from paper exams
- More use of mobile technologies for exams
- Much clearer use of online participation and reflection upon learning
- Acceleration of evidence gathering tools for assessment e.g. e-portfolios
- Video assessment of key skills for NVQs

- Movement away from text entry
- School teachers will work with paperless assignments
- More training needed for school teachers
- Exam boards will move to paperless exams and machine marking
- Machine marked tests for entry to different courses
- Real life simulations to test medics and lawyers at University
- Professional bodies will change to e-Assessment
- Better plagiarism detection

These visions provide a fair match to the policy documents and to the views given by the other experts. However participants were sceptical of the 2009 target. There were real concerns about plagiarism detection and invigilation issues, although the e-Vigilator, a commercial spin off from the University of Sussex, are actually trialling their system with the BCS in January 2006.

There appear to be a growing group of small commercial companies which can assist with meeting the 2009 target. However there are real concerns about standard compliance by these companies and one of the major challenges for the examination boards to employ these small businesses is to forecast whether they will still be operational in the future.

7.5 Summary

All experts from this group believed in e-assessment becoming integral to teaching and learning in 2014. Although some scepticism about the timing of progress was evident the feeling from this group can be summarised by one member who said:

“I do share the vision expressed in the DfES report – I have done so all my working life really and despite the frequent experience of seeing hopes for the greater use of e-learning deferred, I really do think that ICT in society has now crossed a rubicon and rapid progress is inevitable.”

8 What are the barriers to these visions?

The expert group contributed a variety of issues which may hinder development and adoption of e-assessment. These are reported in the following sections, and are grouped into those that will

- hinder the initial research and development of e-assessment systems, and
- others which will affect the wide spread adoption of proven systems (i.e. systems which have been proved to work in pilot studies).

The nature of these barrier issues is discussed below, where they have been grouped according to the scope that they are most appropriate to (i.e. Superorganisational, organisational, personal). Where appropriate they have been further grouped into categories (e.g. technical issues, staff attitude), but because of the qualitative nature of the descriptions of individual barriers, some of the barriers reported could have been entered under several different categories.

8.1 Barriers to research, development and piloting

8.1.1 Superorganisational

- Customer attitude
 - Lack of public confidence in e-assessment
 - Negative stories in the media about e-assessment
- Lack of integration of policies
 - Policies of superorganisations should integrate to ensure that key criteria of quality, accessibility, reliability and security are evaluated within pilot activities

8.1.2 Organisational HE and FE

- Lack of funding to encourage institutions to engage in pilot and/or R&D activities
- Lack of other encouragements (e.g. Contributions to RAE style approval) achievable through participation in pilot and/or R&D activities
- Institutional attitude
 - Lack of public confidence in e-assessment engendering institutional inertia
 - Institutions may be conservative in policy with respect to engagement in the piloting of unproven technology
 - Lack of confidence can mean FE heads of school unwilling to pilot A Levels and Highers etc
 - Fear of action under DDA
 - Fear of technical failure during pilots of high stakes assessments
- Availability of resources
 - Lack of suitable infrastructure to pilot e-assessment for courses with many students
 - Lack of pre-existing item banks

8.1.3 Personal

- Staff Attitude
 - Lack of funding to encourage individual practitioners to engage in pilot and/or R&D activities
 - Lack of other encouragements to individual practitioners (e.g. Contributions to RAE style approval) achievable through participation in pilot and/or R&D activities

- Work pressures on academic staff (insufficient time to give to developing potential of e-assessment)
- Availability of resources
 - Lack of suitable infrastructure to pilot e-assessment for courses with many students
- Lack of ICT skills in a pilot project's target student population

8.2 Barriers to adoption

8.2.1 Superorganisational

- Reformation of methods
 - Establishing the equivalence between paper based assessment items and e-assessment items. How can the equivalence of e.g. multimedia questions and questions that have been used for many years be established?
 - Belief that existing assessment methods are good because they have been around a while
 - Lack of sharing of best practice
 - Difficulty of promoting genuine accessibility
- Customer¹ attitude
 - Lack of confidence in awards accredited using e-assessment systems by stakeholders - e.g. employers, students
 - Major faults with e-assessment pilots
 - A belief that current systems are doing a good job therefore do not need anything new.
- Training/development issues
 - ICT skills need to be widespread through the population
- Availability of resources (Venues, hardware, software, etc.)
 - Access to appropriate technology for all learners within and without educational institutions as required
 - Appropriate technical infrastructure needs to be in place
- Technical
 - Commitment required to achieve interoperability of systems (both technological and human) across institutions
 - the readiness of institutional networks to manage the security, authentication and network robustness required is currently questionable, although in schools the Key stage 3 testing is having a positive impact on readiness
 - standards and specifications for interoperability are potentially the biggest barriers to a coherent NATIONAL e-assessment system. Awarding Bodies need guidance on standards to use when developing their assessments; they would benefit from access to a unique learner ID, they need to have their own authentication and security mechanisms in place; their servers need to be able to cope with demand
 - Authentication issues e.g. learner identity, plagiarism

¹ 'Customers' are those who make use of certifications based upon an assessment. Examples include Universities, employers, etc.

- Regulatory framework
 - Institutions must understand the necessary regulatory frameworks such as the Disability Discrimination Act 2005 (DDA 2005).

8.2.2 Organisational HE and FE

- Institutional attitude
 - Institutional buy in (not just in a strategy document) is essential.
 - culture shift needed to change planning and business processes to fit new assessment practices e.g. involving multi-window/continuous testing, contingency planning etc.
 - Institutional inertia
 - Lack of relevant knowledge and/or vision of senior management
- Training/development needs
 - Lack of skills and expertise on the part of staff at points of assessment design and moderation (e.g. setting fit-for-purpose questions and IT skills)
 - lack of staff knowledge of available assessment technologies
 - providing training needed for parts of the student population
- Customer attitude
 - Lack of confidence in awards accredited using e-assessment systems by other stakeholders - e.g. employers
 - Lack of confidence in awards due to opportunities for students to take exams on demand e.g. if students can resit many times how confident will the employers be in the qualifications?
- Availability of resources (Venues, hardware, software, support etc.)
 - Availability of sufficient and appropriate technology in educational institutions that can be properly incorporated into online assessment
 - e-assessment methodologies can offer high value but at a cost e.g. adaptive testing is immensely consuming of authoring and delivery resources
 - Requirement for skilled staff to support e-assessment technology on an ongoing basis to ensure reliability
 - Requirement for skilled staff to support users (staff and students) of e-assessment technology
 - Venues e.g. lack of suitably equipped venues to accommodate the biggest courses in an institution
- Reformation of methods
 - Adopting e-assessment can be time consuming, and academic staff may need assistance during the transition phase. Aspects of this include time needed to integrate e-assessment and learning with face to face components of course design and delivery, and the need for appropriate item banks
 - a culture shift is needed to move thinking and business processes (e.g. multi-window/continuous testing) within some academic institutions and awarding bodies
 - Some smaller awarding bodies may have difficulty raising up-front capital for item production and a change in business processes
- Technical
 - Lack of the robust technology and necessary infrastructure. Failures of server or network infrastructure (or breaches of security) could prove very detrimental.

Empirical evidence should be obtained about the following:

- E-assessments match learning objectives.
- Formative assessments match pedagogical needs.
- Feedback to tutors from formative assessments changes teaching strategies to match learners needs.
- Skills can be tested that are outside the remits of paper and pencil tests.

- More learner control is obtained through this type of assessment which leads to more learner confidence. .

8.2.3 Personal

- Staff Attitude
 - Work pressures on academic staff (insufficient time to give to embedding e-assessment, provision of individual learner support)
 - Resistance to change in some individuals within exam boards and academic institutions
 - Inertia amongst teaching staff who question whether changes to existing teaching, learning and assessment practices are necessary
 - Fear of the impact on traditional job roles
- Training issues
 - Lack of skills and expertise on the part of staff (e.g. designing assessments, setting fit-for-purpose questions, IT skills, knowledge of available systems)
 - Lack of necessary IT skills in some portions of the student population
- Learner attitude
 - Lack of confidence in security of results as handled by e.g. awarding bodies
 - Lack of learner value of awards for which there are opportunities for other learners to take exams on demand e.g. resitting many times
 - Learner scepticism that e-assessment can be a valid way of assessing from key/basic skills to post degree level
 - Some learners may prefer assessment by conventional methods, either formative and/or summative
- Reformation of methods
 - Electronic assessment may be inappropriate in some subject areas because of the nature of the subject
 - Inclusion of e-skills in the assessment of all curriculum topics has the potential to muddy the waters about what is being assessed
 - Different subject areas have different requirements for assessment, e.g. there are big differences between systems requirements for arts and science faculties. This can lead to differing demands on IT services departments that supply and run the systems.
 - Lack of sharing of best practice
 - Aiming for government targets with respect to e-assessment may encourage some academics to develop mcqs, which may reduce the effort put in to more innovative practice.

9 Recommendations

In order to construct a set of recommendations using the roadmap framework adopted by this study then both the facilitators and strategies at the Superorganisational, Organisational and Personal levels are first discussed. The recommendations are grouped with respect to research and development and actions that will affect the more widespread adoption of e-assessment practices.

9.1 Facilitators and strategies

The vision and barriers to the practice of e-assessment in 2014 emphasise the role of research in progressing issues bound by both the technical and pedagogical level. In fact 82% of the experts agreed that for the implementation of policy at the Awarding Body level for FE and schools there needs to be secure and reliable systems in place. User identity must not be an issue and accessible, reliable and valid assessments are the standards by which user confidence will be measured. There are a number of activities taking place which are facilitating these goals and are described below.

9.2 Superorganisational: Facilitators

- There is a growing expertise among a group of commercial providers of salient e-assessments and software systems to deliver them to the Awarding Bodies.
- The most successful providers are in step with the standards issues and are active members in this community, together with the Awarding Bodies
- There is a more recent awareness of the role of psychometrics in the assessment process by the awarding Bodies (Thompson 2006)
- Groundswell of opinion that more needs to be done with question types and predominance of multiple choice questions is not gaining user confidence
- The awarding bodies report (Thompson 2006) that the risks associated with data security and technology infrastructure have fallen. This suggests more confidence in e-assessment systems
- 7 out of 10 awarding bodies believe (Thompson 2006) that e-assessment will deliver a return on their investment
- A desire for a better quality of assessment is driving the awarding bodies who are currently delivering e-assessment
- QCA targets are facilitating the uptake of e-assessment

9.3 Superorganisational: Strategies

- Clear policy directives with designated timelines e.g. England and Wales 2009 deadlines for e-assessment will continue to drive the initiative
- Government agencies need to continue to support the on-demand testing agenda
- QCA's clear directions and deadlines to the awarding body are welcomed but a standard system for e-assessment would not be acceptable to the awarding bodies (Thompson 2006)
- Awarding bodies should be encouraged to produce their own e-assessment system but standards for such a system need to be spelt out by the QCA

- Initiatives that encourage the sharing of expertise, both technically and pedagogically, between awarding bodies both at school, FE and HE need to be introduced
- Recognition of training for academics in developing e-assessment with a move towards accreditation of such training
- Funding and expertise to be made available to both the FE and HE sectors to set up on demand testing centres. Lessons can be learned from work already in place for the Theory Driving Test and the British Citizenship test which is available to members of the public
- A conference organised to discuss the role of test centres for on demand testing with key stakeholders
- Policy makers to list the evidence they require about current e-assessment systems to plan for the future. The research community can then plan and execute the studies required by the policy makers which are more tightly focused and investigate the areas of interest with substantial numbers of participants
- Strong encouragement of open source licensing models
- Funding bodies who sponsor research into e-assessment should insist that seminars/workshops are given and that these should be co-ordinated by BECTA or JISC and not left to happen in an ad hoc manner
- Adaption of existing standards regarding security (BS7799), quality (ISO 9000), test delivery (BS7988) and item production (QTI). Commercial developers will need to subscribe to these independently existing standards without the need for costly intervention by the state, thus hindering innovation and stagnating the already-existing competitive market.
- An agreed level of interoperability based on national standards. There always needs to be a reliable exit strategy available to enable services to continue and develop when, not if, a commercial supplier fails to provide what is required.

9.4 Organisational: Facilitators

- Champions in both FE and HE
- Adoption of open source VLEs will facilitate sharing and development of more sophisticated e-assessment components
- Electronic formative assessment initiatives being set up in both HE and FE establishments e.g. The Open University and spin-offs from the COLA Project
- Increased retention and attendance have been documented (see Case Studies Project) with the introduction of e-assessment
- Introduction of e-portfolios both in FE and HE assist with tracking accreditation
- Seminars given about new developments in e-assessment

9.5 Organisational: Strategies

- Tools which assist tutors with course design that support electronic assessment and feedback to students need to be developed, refined and piloted within the learning community

- Increased awareness of such tools at the directors of teaching and learning level in the HE and FE communities. This strategy could be facilitated by JISC and BECTA
- Examine the role that VLEs are having on the use of tools for e-assessment so that they do not become a barrier
- Provide a set of guidelines based on best practice about e-assessment to assist the directors of e-learning both in HE and FE
- Facilitate reflection upon old assessment practices and encourage a significant revision in current practice, taking advantage of the benefits of good e-assessment practice
- Integrate formative e-assessment into the learning cycle
- Follow SQA's lead with encouraging the community to build shared question banks
- Publication of good practice and pedagogical benefits of high stake assessments such as those conducted at the University of Derby with the TRIADS system will assist public acceptance of e-assessment
- Fund a maximum of four in-depth case studies from the FE and HE sectors i.e. a much more ethnographic study of e-assessment roll out throughout the organisation
- JISC and BECTA to advertise seminars about new developments and progress with e-assessment
- Fund and evaluate development of self and peer assessment systems that can be used on demand for any aspect of a course
- Strong encouragement of open source software licensing models.

9.6 Personal: Facilitators

- Champions in both FE and HE sectors adopting role of mobile technologies to assist e-assessment
- Champions building systems that address known pedagogical needs
- Awareness of administrative advantages
- Benefits of student progress already capitalised on where tutors are now using the results of formative assessment to change their face to face teaching sessions i.e. addressing known student misconceptions in a much more direct manner
- Training available in some educational establishments. University of Dundee offers training and a qualification
- Research is taking place to automatically mark free text entries of students

9.7 Personal: Strategies

- Policy makers to advise funding bodies that research into automated text recognition systems should be funded
- Provide a set of guidelines based on best practice about e-assessment to assist tutors working both in FE and HE
- Fund a series of focus groups where the pedagogical champions of e-assessment discuss their experiences. The outcomes should be strategies for new developments, a cost benefit analysis of systems to date, planning more challenging evaluation studies, sourcing volunteers to take part in strategic evaluation studies

- Provide not only training for subject specialists to build good e-assessment questions, but also recognise the time spent on this work
- Make directors of e-learning aware of these problems and one way forward would be to credit academic staff with some qualification in this area
- Provide tutors with computer labs which are big enough for high stake assessment
- Assist e-assessment champions to convince their individual institutions to provide enough technical support to introduce both formative and a high stakes e-assessment
- Fund studies that investigate changes in traditional job allocations and resources if e-assessment is prevalent, together with studies that pinpoint successful change in both staff, culture and attitudes towards e-assessment
- Appoint mentors who are champions of e-assessment to other institutions. This will need to be funded and organised by institutions such as JISC and BECTA who can then disseminate the findings more widely from these appointments

9.8 Research and development

- Examine the role of VLEs on the uses of tools for e-assessment
- Fund research to provide evidence about:
 - Learning objectives that can be tested rigorously with e-assessment
 - The effect of e-assessment on students taking control of their own learning
 - Understanding whether e-assessment promotes reflective learning
 - Piloting on demand testing for a number of courses
 - Gauging the emotional pressures of such a system as well as the cognitive gains
- Empirically test the impact of the quality and type of feedback to students given during formative and summative
- Build a wizard to assist with organising and presenting evidence in e-portfolios. This type of help could be based on an ELIZA type system as first produced by Wiezenbaum
- Fund research and development into widening the area of topics that can be meaningfully tested with e-assessment.
- Set up a number of focus groups to understand whether:
 - Students will be over pressurised by the new regime.
 - Parents will force children to take examinations early.
 - More students will seek extra tuition from commercial tutorial companies.
 - More able students will want to broaden their examination range.
- Pilot a study to investigate whether student grades improve, if they study at their own rate.
-

9.9 Promote adoption and confidence in e-assessment practices

- Increase awareness at HE and FE organisational level of e-assessment tools and how they can be embedded within a VLE

- Promote awareness of latest developments with tools and case studies at the organisational levels of HE and FE
- Provide a set of guidelines about e-assessment from best practice to date
- Integrate formative e-assessment into the learning cycle
- Follow SQA lead into building question banks and course assessments from within the teaching community
- Clarify issues surrounding the number of resits that can be taken by students and whether they will be declared on examination certificates.
- Resolve the question of who will oversee the students' lifelong learning records
- Determine whether universities are considering offering their courses to students who are still at school.
- Carry out a cost benefit analysis of training needs
- Devise a plan for the siting and staffing of large scale testing sites in the public and private sector.
- Identifying best practice and then disseminating the findings through bodies such as BECTA, TechDis and JISC should be continued.
- Findings from pilot studies published and a roll out plan made available through JISC and BECTA
- Public acceptance of high stake assessments needs to be achieved through dissemination of key findings using press releases, TV and press editorials and PR techniques.
- Publish a report on the implications of changes to AS and A level examinations for the HE sector, notify the universities and obtain feedback on implementation or non compliance as advised.
- DFES to be informed of the opinion of the experts with respect to advance notice of results preferred by the learners and of the expected results of a lack of confidence in the new AS/A Levels.
- New technologies for e-assessment such as iPods, mobile phones etc merit attention
- Accessibility issues to be drawn attention to the whole community and continued support and training given to the HE and FE sectors

9.10 Summary

The vision and barriers to the practice of e-assessment in 2014 emphasise the role of research in progressing issues bound by both the technical and pedagogical level. In fact 82% of the experts agreed that for the implementation of policy at the Awarding Body level for FE and schools there needs to be secure and reliable systems in place. User identity must not be an issue and accessible, reliable and valid assessments are the standards by which user confidence will be measured

Therefore priorities for action include the following:

- Sort out authentication and plagiarism issues
- Train staff to devise e—assessments see case study of e-assessment exemplar the University of Dundee
- Build good test item banks following the lead of SQA
- Pass on good practice tips from current cohort of students to new learners using e-assessment for the first time
- Make more testing sites for summative assessment available and pass on good practice
- Support more research into automatic marking of e-assessment
- Address accessibility issues directly through superorganistical directives

- Public acceptance of high stake assessments needs to be achieved through dissemination of key findings using press releases, TV and press editorials and PR techniques.

10 Visualisation and model

10.1 Modelling the Findings

The roadmap framework which was described in section 3.3.3.1 is shown in table 5 below; this framework highlights the barriers and facilitators that can promote a vision for e-assessment for 2014.

In section 10.2 the findings from the JISC funded e-assessment case studies project together with the literature review which influenced the development of the roadmap are present in summary form and within this roadmap framework (table 6).

In section 10.3 the findings that emerged from the consensus of e-assessment experts are presented in summary form and within the roadmap framework (table 7).

Finally, in section 10.4 a visualisation of the roadmap is presented.

	Superorganisational	Organisational	Personal
Vision	What the superorganisational policy documents are aiming for in terms of e-assessment.	What institutions are aiming for in terms of e-assessment (make use of case studies?)	What individuals are aiming for in terms of e-assessment? Teaching staff, students, researchers, others?
Barriers	Misalignments between policies of various superorganisations.	Misalignments between superorganisational policies and capabilities and/or policies of institutions.	Barriers which prevent (or reduce effectiveness of) individuals becoming involved in e-assessment.
Facilitators	Alignments between policies of superorganisations. E.g. systems not directly related to e-assessment, but the existence of which facilitates e-assessment.	Alignments between superorganisational policies and capabilities and/or policies of institutions.	Actions and processes which promote individuals involvement and/or gains from e-assessment.
Strategies	Suggestions about how to move through the barriers towards the vision.	Suggestions about how to move through the barriers towards the vision.	Suggestions about how to move through the barriers towards the vision.

Table 5: Summary of roadmap themes

10.2 Themes that emerged from the literature review and e-assessment case studies

Findings suggest that in England and Wales it is policy pressure which is a main driver and is affecting more of the FE sector than HE sector. HE has more control over the rate and uptake of e-assessment in their institutions as they award their own

degrees. However, there is a recognition in HE that with larger classes and less tutorial time, tutors can keep track of their students' progress through e-assessment systems. They can adjust their lectures accordingly after they have picked up the misconceptions of a cohort through e-assessment feedback. At a personal level teachers/enthusiasts are addressing pedagogical problems through e-assessment.

The barriers identified at a superorganisational level are that of regulation, confidentiality and testing of these systems before they go across the UK. Also there is more reliance than expected on the private sector and small commercial businesses to achieve the vision. Providing e-assessment systems is expensive and some institutions have invested heavily in particular VLEs. They in turn have their own 'e-assessment systems'. In practice some of these are little more than quizzes and do not meet the aspirations of institutions who want to pursue interactive assessment systems which also provide instant feedback to students.

Teachers themselves are not convinced that e-assessment can test enough learning outcomes. They are also concerned about plagiarism and require more training to use and develop questions.

The main drivers at a superorganisational level are to move towards a new generation of self reflection learners who will be able to identify their own learning needs. One of the major drivers for institutions to adopt e-assessment practices is that of student retention. HE and FE also see benefits with respect to attendance and achievement. Accreditation can also be tracked through e-assessment systems.

Tutors want to use e-assessment especially formative e-assessment as diagnostic tools to understand how their students are learning especially in larger groups. They can then adjust their teaching accordingly and we have noted changes in pedagogical practice with the introduction of e-assessment (case studies project). There is a recognition at University level that more research funding is needed for e-assessment especially in the area of text recognition and automated feedback. In a sense more joined up thinking is needed at superorganisational level where there should be more of a push to ensure technical standards are in place and that there is a code of practice developed with guidelines at industry standards. Institutions are developing but need to make more explicit their e-assessment policies and invest in staff training. Individual champions and teachers would like more recognition of their work by the VLEs and other commercial software production houses because they are developing systems that address their own particular student needs. They would like these rolled out instead of trying to match their needs to a generic system. In one sense pedagogical needs are hampered by straight jacket software systems and this is where JISC funding can support local champions to build and then develop open-source products. This seed funding in turn fosters take up and further development by other institutions of these pedagogically pertinent systems.

	Superorganistional	Organisational	Personal
Vision	GCSE, A Level, Vocational examinations all to have an e-assessment component by 2009. for England and Wales. e-portfolios also included in the assessment procedures. On-demand testing available Self reflective learners identifying their own learning needs. All mention more learner autonomy.	FE preparing for policy changes e.g. COLA Project, Scotland, Equine Studies at Warwickshire, e-portfolio use etc. HE using more e-assessment influenced by VLE adoption. Pockets of bespoke systems that have been pedagogically driven will be available More worthwhile use of e-portfolios seen..	Teachers are addressing pedagogical problems through e-assessment Making better use of class time e.g. LSE and Strathclyde. Researchers developing new systems to move away from MCQs. Increased interest in student modelling, Latent semantic Assessment and Plagiarism detection devices.
Barriers	More regulation required than anticipated as vision will only be achieved through more reliance on external/ Commercial input. More widespread exam centres with good technical backup needed.	HE restricted by VLE investment in some cases. Staff need more training in designing and programming good questions. Tutors in HE only willing to use for high stakes assessment with first year students only. Spreading the enthusiasm of the e-assessment champion through an HE establishment is difficult. Lack of funds and staff recognition for working in this area is slowing progress	Can't test enough learning outcomes. Plagiarism, invigilation problems, HE and FE sectors need to invest in new assessment practices.
Facilitators	e-learning continuing to improve in FE sector (see BECTA ICT Research 2005) More e-assessment plans being made explicit in HE e-learning strategy documents.	Increased retention, attendance and achievement. Tracking accreditation through a number of different routes through a qualification.	Good free text recognition of student responses. Formative assessment embedded so that tutors can track more easily student progress. Freeing time with automated feedback to students so that they can concentrate more on dealing with misconceptions and working with individual students.
Strategies	New process to ensure technical standards are recognised. More pre-testing of systems and questions required. Code of practice needed with guidelines and industry standards. New skills required. More training for markers.	Clear e-assessment policies and investment in staff training realised.	More funded research for automated test recognition. Software systems that will support interactive questions. Convincing and thorough evaluations of the effectiveness of e-assessment required. Fund development of pedagogically pertinent open-source products

Table 6: Summary of literature review and case studies data that relates to the roadmap themes

10.3 Themes that emerged from the consensus of e-assessment experts

There was more acceptance of on-demand testing in the FE than the HE sector by 2009. However where will the testing sites to be located and how will they be staffed? The experts all agreed that secure and reliable e-assessment systems need to be in place. There were concerns about how we can ensure that the candidate taking the test is the person they purport to be and how cheating can be detected, particularly for high stakes e-assessments. If biometric data is available together with real time cameras and microphones at test centres will this overcome the problem? An overview of state of the art invigilation systems together with the cost of such installations should be commissioned to provide guidance for both the HE, FE and school sectors.

QCAs clear directives are welcomed but the awarding bodies and HE institutions do not want to see a standard e-assessment system imposed upon them. The adoption of VLEs also prevents certain systems functioning and being supported .

Experts agreed that the benefits of e-assessment are more than just administrative gains but they were more concerned to ensure that new developments were pedagogically driven rather than pushed forward by technological innovation. This means more research into question types and automatic marking of free text responses.

Devising good e-assessment is a time consuming exercise and academics wish to have this type of work recognised and also to be rewarded for it.

	Superorganisational	Organisational	Personal
Vision	DfES vision will be realised however hiccups will occur and consumer confidence will need to be boosted. Any time, anywhere testing freely available.	Ubiquitous e-assessment with automated essay marking. e-Portfolios will play a larger role in the documentation of the life long learning process. A few institutions will emerge as leaders or champions of e-assessment and will lead future developments	Central facet of education from cradle to the grave. e-Portfolios playing a large role here. Diagnostic e-assessments will improve teaching and learning cycle. A more personalised learning journey will be achieved with any time, anywhere testing. Tutors will no longer mark paper scripts.
Barriers	If systems are not piloted with respect to quality, accessibility, reliability and security, then there will be lack of confidence in e-assessments. Institutional and individual practitioner culture needs to be confident with e-assessment. Lack of knowledge by senior managers in schools and colleges about the potential and practice of e-assessment. Test centres need to be fully equipped and in place	Champions/pioneers are not supported enough financially or academically for their efforts. Resistance to change from tutors. No cost benefit. Lack of time to develop systems due to competing pressures from other sources such as the RAE. Problems if a wide range of pilot studies are not taking place. Lack of good item banks. Lack of assessment centres with appropriate hardware and software.	Workload on academic staff will not be adopted if rewards to staff are limited. Lack of technical skills being available to subject specialists. Lack of training provided to teachers/tutors in developing effective e-assessments. Failures with the exam boards at AS and A Level to deliver good e-assessment will affect confidence and reduce uptake in HE and FE.
Facilitators	Better quality assessment is the goal of awarding bodies. Some believe e-assessment will deliver a return on their investment. Growing body of expertise in public and private sectors	Champions can be found in both FE and HE sectors. Demand for tracking accreditation is rising. More interest in eportfolio usage	Leverage of mobile technologies eg most students have a mobile phone. Staff training available and recognised officially in some establishments. Automatic text marking is accruing more interest and urgency
Strategies	Policy makers continue to set timed targets for future developments. More pilot studies systematically evaluated and findings disseminated more widely	More e-assessment systems that are pedagogically driven made available. Encourage open source development of such tools	Fund research into automatic text recognition. Leverage know how of e-assessment champions into the wider community by appointing them as mentors to other institutions.

Table 7: Summary of experts' views from the survey

10.4 Visualisation


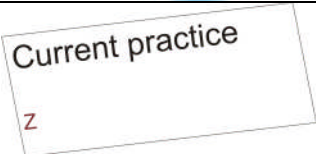
This graphic in figure 7 is a map of factors affecting the development and uptake of e-assessment in the UK post-compulsory education sector. The **scope dimension** (shown horizontally) represents the organisational scope of the map.

‘Personal’ scope means e.g. the scope of individual academics or students. ‘Organisational’ scope means e.g. the scope of academic or commercial organisations involved in e-assessment activities. ‘Superorganisational’ scope means e.g. the scope of those bodies which represent the interests of more than one organisation. Examples of ‘Superorganisations’ include government departments (e.g., DFES), funding bodies, and examining bodies.

The **time dimension** (shown vertically) indicates the order of occurrence of events in the map.

There are four time zones shown: the current state of the art, a research development and piloting zone, an adoption zone, and a vision (of the future) zone. Numbers are shown on the time axis and other areas of the map to indicate sections of the document containing details relevant to these time zones.

Nodes on the map are: indicators of the current state of the art (e.g. case studies, policies), and barriers that will have to be crossed to reach the future vision. The optimum order for approaching barriers in each time zone will vary from organisation to organisation and person to person and this infinite variety cannot be shown on this visualisation which illustrates the types of barriers that will have to be addressed in most cases. Each barrier node shows two or more page numbers: the left hand number(s) is the section in which the barrier is described, the right hand number(s) is the section(s) in which appropriate facilitators and strategies to overcome this barrier are described. Section numbers for vision, case studies, and policies nodes appear on appropriate areas of the graphic to indicate where these are described in more detail. The icons used to represent nodes are explained in this table:

Explanation	Example Icon
<p>Barriers This icon represents a barrier to development in the zone in which it occurs. Each barrier icon includes two numbers. These are represented in this example by X and Y. X is the section number of this report on which the barrier is described, Y is the section number on which appropriate facilitators and strategies to overcome this barrier are described.</p>	
<p>Current practice This icon represents a case study or other example of current practice which is described in more detail in the section number represented by Z.</p>	

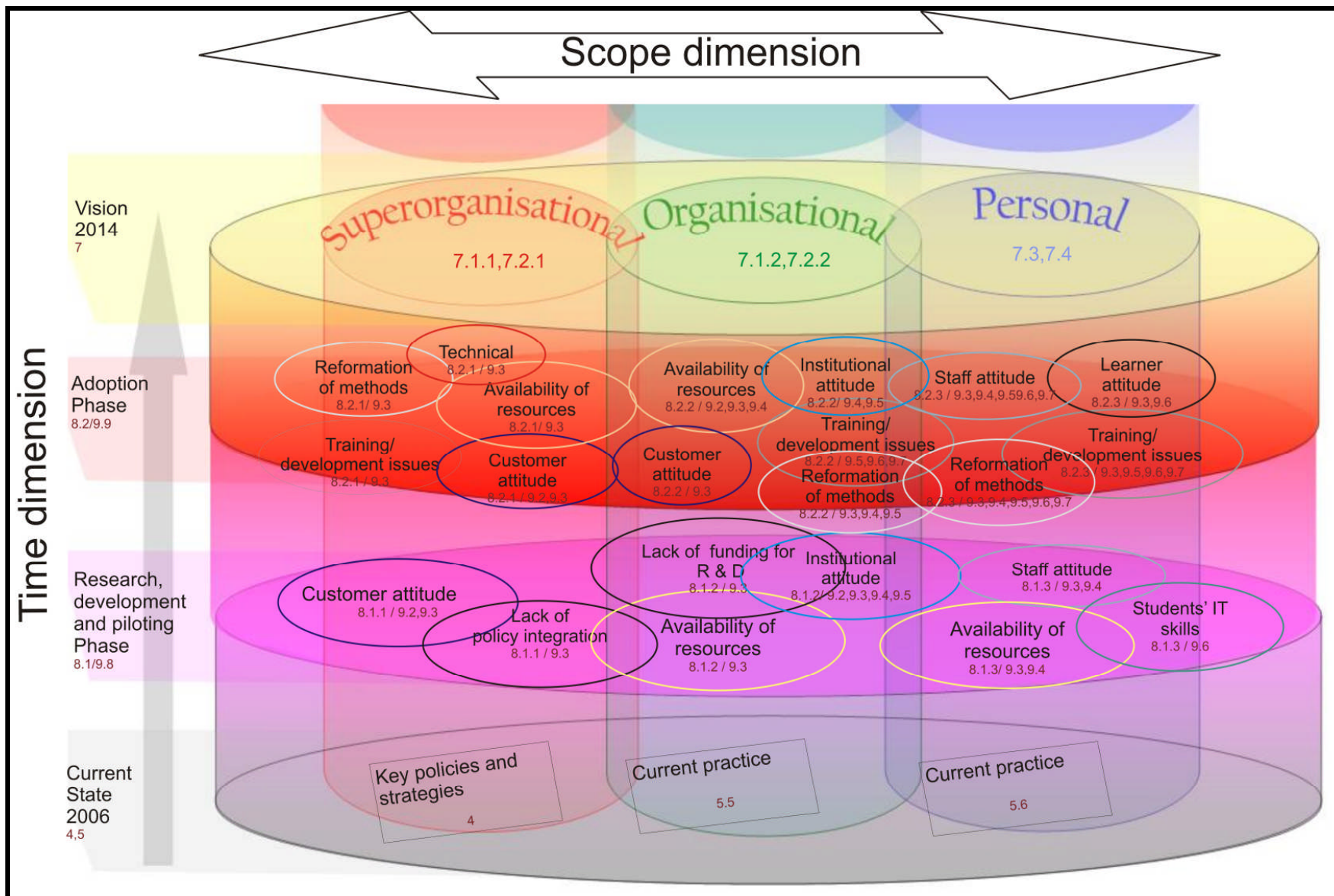


Figure 7 Roadmap visualisation

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APPENDIX I

Steering Group for eAssessment Road Map

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APPENDIX 3

First Road Map face to face consultation exercise CSET workshop 6 October 2005

Aims

- To identify more pockets of e-assessment practice that enhance learning
- To canvass opinion about the institutional, operational and pedagogic enablers and barriers to using e-assessment
- To capture delegates vision for e-assessment
- To identify future research strands that can enable that vision.

Findings:

Theme 1: Developments that can enhance e-assessment use

- New detection system for plagiarism
- Enables assessment of tasks with Interactive tools
- Better system/network reliability
- Models of good practice
- A recognition in different institutions that assessment is part of the learning process

Theme 2: Barriers to e-assessment use

- Belief that e-assessment cannot test enough learning outcomes specified on courses
- Plagiarism
- Problems with invigilation /proctoring
- No access to student identity through handwriting
- Universities need to invest and develop new assessment practices
- Restrictions in developing new practice by imposition of and investment in a particular VLE

Theme 3: Vision for e-assessment

- More learner flexibility, any time anywhere testing
- Good free text recognition of student responses
- Machine marking
- Machine marked dissertations
- Robust scaleable ways of checking candidates ID
- Formative assessment so embedded with good feedback to tutors that there will be no surprises at summative assessment
- E-Assessment tools for collaborative learning
- E-Assessment tools for collaborative learning
- E- tools for peer assessment
- Broader range of electronic submissions, varying media
- E-portfolios commonplace
- Blog your life away!
- E-assessment will be driven by professional bodies more

- More student control and onus on student to prove level in expertise in new reporting media such as portfolios.
- Diffuse assessment- more people assessing ,but less formal assessment as we know it
- Talk your answers into your mobile device

Theme 4: Research that can facilitate the Vision for e-assessment

- Student modelling research needs to be revisited
- Development of latent semantic algorithms
- Development of semantic web techniques
- Development of adaptive systems
- Sense-making tools needed to mine e-portfolios to determine level/quality
- Investigate changing media of assessment i.e. text to audio could be an enhancement to some but a barrier to others
- Accessibility issues