

Electoral pilot scheme evaluation

Overall report

May 2007

Executive summary

Pilot description and objectives

This report presents Ovum's overall technical evaluation of the electoral pilot schemes incorporating electronic counting technology in Bedford, Breckland, Dover, South Bucks and Stratford-upon-Avon & Warwick (the latter being a joint venture between the two authorities) at the elections on 3 May 2007. This evaluation summarises the key issues arising across these pilot schemes to inform the Electoral Commission's statutory evaluation criteria:

- the scheme's success or otherwise in facilitating voting or the counting of votes, or in encouraging voting or enabling voters to make informed choices at the elections
- whether the turnout of voters was higher than it would have been if the scheme had not applied
- whether voters found the procedures provided for their assistance by the scheme easy to use
- whether the procedures provided for by the scheme led to any increase in impersonation or other electoral offences, or in any other malpractice in connection with elections
- whether those procedures led to any increase in expenditure, or to any savings, by the authority.

Authorities covered and brief description

This report addresses those pilots with a technical component, incorporating electronic counting technology, that were evaluated by Ovum.

To deliver a number of the technical pilot solutions, the DCA contracted with technology suppliers as part of a framework agreement.

Ovum evaluated the following pilots:

Local Authority	Supplier	Description
Bedford Borough Council	Indra	Bedford Borough Council conducted an election pilot including electronic counting of votes. Voting took place in all 18 wards for the Mayor and one Borough Councillor (one ward elected two councillors to fill a casual vacancy). Parish Council elections took place in 4 wards. This was Bedford's first election pilot involving a technological innovation. Bedford selected Indra as the supplier of its technical solution from the DCA list of approved contractors. Indra provided a bespoke electronic counting solution based upon established modules within their e-democracy suite of applications.

Breckland District Council	Indra	<p>The focus of Breckland Borough Council's pilot scheme was to use an electronic counting system that would record and count ballot papers for both district and parish elections on 3 May 2007. The innovations included in the scheme were:</p> <ul style="list-style-type: none"> • Redesign of the ballot paper, to include barcode provision. • An electronic counting software solution that would capture ballot images • Provision of hardware, including commercial off-the-shelf scanners, • Operation of the system by trained Breckland Borough Council staff.
Dover District Council	Opt2Vote	<p>Dover District Council's pilot scheme used an electronic counting system to record and count ballot papers for both district and parish elections. The requirement was for a fully auditable solution.</p> <p>Dover was instrumental in selecting its preferred supplier, Opt2Vote. The innovations included in the scheme were:</p> <ul style="list-style-type: none"> • Redesign of the ballot paper, to include barcode provision, and a 2D barcode official mark. Also, the words "Do not fold" was printed on the back of the paper. • An electronic counting software solution that captured ballot images and provided a complete solution from verification through to the final result. • Provision of hardware, including commercial off-the-shelf scanners. • Projected displays. • Operation of the scanners, registration, verification and adjudication PCs by trained Dover District Council count staff.
South Bucks District Council	ES&S	<p>The solution procured by South Bucks District Council (SBDC) from ES&S (the only supplier to respond to the ITT from SBDC) piloted:</p> <ul style="list-style-type: none"> • Redesign of the ballot paper, to include barcode provision, and a 2D official mark • An electronic counting software solution that captured ballot images and provided a complete solution from verification through to the final result and then merge those results with those from the electronic voting system to provide the full result for the District and Parish Elections • Provision of hardware, including commercial off-the-shelf scanners. • Projected displays.
Stratford-on-Avon District Council and Warwick District	Consortium of Software AG and Dominion Voting	<p>The pilot scheme application, submitted jointly by Warwick District Council and Stratford District Council included:</p> <ul style="list-style-type: none"> • group working – using the same suppliers, namely Software AG as project managers and Dominion Voting Systems to provide the technical and electoral expertise

Council (joint application)	Systems	<ul style="list-style-type: none"> • e-counting of paper ballots at two sites, each counting some of the partner authority's wards or parishes • progress and declared results to be displayed on electronic displays, both in the counting venue and remotely over the internet.
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Recommendations for future pilot schemes

Pilot strategy

Share knowledge and learning between authorities. There are now several authorities that have successfully undertaken electronic counting pilots, and who have substantial, valuable knowledge to impart. It is recommended that the learning from all of the pilots is consolidated in to a manual on how to stage and manage an e-counting process, using authority staff. In addition, it is recommended that a comprehensive checklist is created that lists the essential tasks and actions that *must* be undertaken during the course of the project, and certainly during the count itself.

Encourage authorities to become more involved in the overall management of the technical part of the pilot, and so be more directly responsible for their pilot's performance. Ensure authorities are made aware of those requirements that suppliers are expected to fulfil under their contractual obligations, for example by taking them through the DCA's Statement of Requirements, and the Framework Agreement. In this way, it is expected that authorities will be less complacent and less accepting of their suppliers' capabilities and experience, and more rigorous in ensuring adequate testing and configuration is undertaken.

There also needs to be an end-to-end view of the system and the project. A checklist will help. But in the hectic period that always precedes an election, the list might still not be checked consistently. An independent resource who can remain detached from the pressure, but understands both the technology and the practice could prove a huge help. This would be a proactive and directive role, and it is a resource that could be shared among two or three pilots (depending on how ambitious the pilots are).

Encourage authorities to actively undertake operational aspects. For example, operation of scanning equipment is straightforward, and where authority staff are available, they can be effectively deployed. As part of this, training programmes need to be well managed and conducted, to include cross-role training for contingency purposes.

Pilot selection and procurement

Although participation in pilot schemes is subject to an application and selection process by the DCA, it is recommended that those authorities having successfully undertaken pilots are allowed to participate in future pilot programmes in order to further capitalise on their learning and build further capability through such schemes. Clearly should an authority decide not to continue participating in the pilot programme they should have that option.

Start the procurement process much earlier to improve the likelihood that the most appropriate supplier is selected for the authority. Ensure there is sufficient time for tight working relationships to develop, for effective project management procedures to be put in place and also for software to be further developed where improvements can usefully be made. In particular, it is highly recommended that suppliers have electoral experience in the UK, and further that such suppliers are essential partners for less experienced authorities.

Build a technical QA process into the procurement process (as well as the document and process review that was undertaken by the DCA). Generally, the technologies in use were tried and tested.

But there should still be some provision made for proper QA and testing of the systems in new situations, such as in the UK when suppliers have been used to working in other markets. Suppliers and their solutions should be fully accredited by a central body such as the DCA before being recommended to the local authorities for selection.

E-counting

Assess issues of scalability: more machines can be deployed, but human resources are limited. Encourage Local Authorities to take a more operational role. Number of staff required for a (successful) electronic count is less than for a manual count, so scalable services should be achievable.

Improve candidate/agent technical interfaces, and ensure they are adequately tested with other equipment prior to the count e.g. count progress display systems – the stakeholders' (enhanced) experience will count for much.

Comprehensive testing within a certain time period prior to the count with actual ballots should be mandatory. If testing is not achieved within this timeframe, a thorough risk assessment must be conducted before allowing the pilot to proceed.

Collaboration

Exploit the learning of those authorities who have undertaken successful pilot schemes. Have representatives of those authorities work in partnership with inexperienced authorities who wish to participate in future pilot schemes. For example, Westminster, Lewisham and Dover have significant knowledge and understanding of best practice they can pass on to others.

Redesigned ballot papers

Ensure ballots are printed with ample time to test sample batches with the electronic counting system. Ensure printers are used, perhaps through an additional framework agreement, that have the capability to produce high quality ballots incorporating barcodes, official marks and accurate orientation marks.

Ensure the packaging as well as the design of the ballots are compatible with the electronic counting system to be used, for example whether papers may be cleanly torn from pads, or whether lines or content is likely to extend beyond the print area accepted by the scanner.

1 Introduction

Under the Representation of the People Act (RPA) 2000, any local authority in England and Wales can submit proposals to the Secretary of State for Constitutional Affairs to carry out an electoral pilot scheme. Electoral pilot schemes can involve changes to when, where and how voting at local elections is to take place, how the votes cast at the elections are to be counted, or candidates sending election communications free of charge for postage. The Electoral Commission has a statutory duty to evaluate and report on any pilot scheme approved by the Secretary of State.

A total of 312 local authorities in England held elections in May 2007. In October 2006, the Department for Constitutional Affairs (DCA) and the Electoral Commission issued a joint prospectus to local authorities inviting applications for electoral pilot schemes at the May 2007 elections. In January 2007 the Secretary of State for Constitutional Affairs announced that he had approved 12 pilot schemes in a total of 13 local authority areas. A full list of all the authorities which held electoral pilot schemes in May 2007 is available on the Commission's website at www.electoralcommission.org.uk.

This report presents Ovum's technical evaluation of the electoral pilot schemes incorporating electronic counting technology in Bedford, Breckland, Dover, South Bucks and Stratford & Warwick (the latter being a joint venture) at the elections on 3 May 2007. This evaluation summarises the key issues arising across these pilot schemes, and take account of the Electoral Commission's statutory evaluation criteria:

- the scheme's success or otherwise in facilitating voting or the counting of votes, or in encouraging voting or enabling voters to make informed choices at the elections
- whether the turnout of voters was higher than it would have been if the scheme had not applied
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- whether the procedures provided for by the scheme led to any increase in personation or other electoral offences, or in any other malpractice in connection with elections
- whether those procedures led to any increase in expenditure, or to any savings, by the authority.

Authorities covered and brief description

This report addresses those pilots with a technical component, incorporating electronic counting technology, that were evaluated by Ovum.

To deliver a number of the technical pilot solutions, the DCA contracted with technology suppliers as part of a framework agreement. In addition to the DCA-funded pilots, pilot authorities were able to implement other innovations at their own expense.

Ovum evaluated the following pilots:

Local Authority	Supplier	Description
Bedford Borough Council	Indra	Bedford Borough Council conducted an election pilot including electronic counting of votes. Voting took place in all 18 wards for the Mayor and one Borough Councillor (one ward elected two councillors to fill a casual vacancy). Parish Council elections took place in 4 wards. This was Bedford's first election pilot involving a technological innovation. Bedford selected Indra as the supplier of its technical solution from the

		DCA list of approved contractors. Indra provided a bespoke electronic counting solution based upon established modules within their e-democracy suite of applications.
Breckland District Council	Indra	<p>The focus of Breckland Borough Council's pilot scheme was to use an electronic counting system that would record and count ballot papers for both district and parish elections on 3 May 2007. The innovations included in the scheme were:</p> <ul style="list-style-type: none"> • Redesign of the ballot paper, to include barcode provision. • An electronic counting software solution that would capture ballot images • Provision of hardware, including commercial off-the-shelf scanners, • Operation of the system by trained Breckland Borough Council staff.
Dover District Council	Opt2Vote	<p>Dover District Council's pilot scheme used an electronic counting system to record and count ballot papers for both district and parish elections. The requirement was for a fully auditable solution.</p> <p>Dover was instrumental in selecting its preferred supplier, Opt2Vote. The innovations included in the scheme were:</p> <ul style="list-style-type: none"> • Redesign of the ballot paper, to include barcode provision, and a 2D barcode official mark. Also, the words "Do not fold" was printed on the back of the paper. • An electronic counting software solution that captured ballot images and provided a complete solution from verification through to the final result. • Provision of hardware, including commercial off-the-shelf scanners. • Projected displays. • Operation of the scanners, registration, verification and adjudication PCs by trained Dover District Council count staff.
South Bucks District Council	ES&S	<p>The solution procured by South Bucks District Council (SBDC) from ES&S (the only supplier to respond to the ITT from SBDC) piloted:</p> <ul style="list-style-type: none"> • Redesign of the ballot paper, to include barcode provision, and a 2D official mark • An electronic counting software solution that captured ballot images and provided a

		<p>complete solution from verification through to the final result and then merge those results with those from the electronic voting system to provide the full result for the District and Parish Elections</p> <ul style="list-style-type: none"> • Provision of hardware, including commercial off-the-shelf scanners. • Projected displays.
Stratford-on-Avon District Council and Warwick District Council (joint application)	Consortium of Software AG and Dominion Voting Systems	<p>The pilot scheme application, submitted jointly by Warwick District Council and Stratford District Council included:</p> <ul style="list-style-type: none"> • group working – using the same suppliers, namely Software AG as project managers and Dominion Voting Systems • centralised postal vote opening, verification and management • e-counting of paper ballots at two sites, each counting some of the partner authority's wards or parishes • progress and declared results to be displayed on electronic displays, possibly remotely.

Evaluation methodology overview

The Electoral Commission briefed the pilot evaluators on its requirements, and a technical evaluation framework was developed. This framework incorporated a requirement for evaluators to set up a relationship with each allocated local authority, with evaluators making a number of calls and visits to the authority and the supplier(s) of each pilot scheme.

The scope of the project did not require a full-scale technical audit of the pilot systems, with formal quality assurance to be undertaken by other suppliers contracted by the DCA. Ovum therefore applied the following principles for the technical evaluation exercise:

- **Reviewing documentation:** we reviewed the available documentation on the pilot systems, including requirements, design, testing and security documents. This allowed us, where documentation was provided, to understand the intended functionality and attributes of the systems.
- **Interviewing:** we liaised with key technical and managerial staff within the technology service provider and the local authority, to examine the application of defined procedures.
- **Observation:** we observed key events where access was given, such as go-live testing and user acceptance testing, as well the Count itself. These observations allowed us to verify the functioning of the systems, for comparison against our expectations based on reviewing documentation and the interviews.

All evaluators followed the frameworks and the results were used to develop the individual pilot evaluation reports.

2 Technology evaluation

E-counting overview

The electronic counting solutions deployed by four different suppliers in five pilot schemes had all been developed by organisations with electoral experience, and as such, and on the basis of their tender submissions, were judged to be suitable candidates to undertake the pilot projects.

All suppliers deployed standalone networks, and used commercial off-the-shelf scanning equipment.

Bedford and Breckland

Indra provided a bespoke electronic counting solution in Bedford and Breckland, based upon established modules within their e-democracy suite of applications. The solution was installed on standard Windows XP PCs, and Windows 2003 server. All operators used the Windows domain login procedure. A proprietary and COTS algorithm, Read Soft Eyes and Hands was used for the Optical Character Recognition (OCR) and Intelligent Character Recognition (ICR) recognition of marks on the ballot paper. Indra applications interfaced with Kodak i600 scanners.

The scanning software worked by taking an image of each ballot paper, then detecting marks in the voting areas and elsewhere on the ballot paper. Marks in the voting areas were validated, and only valid marks were counted as votes, the rest being referred to adjudication.

The main problem encountered by the image recognition software was that it could not recognise the template on ballot papers that had the counterfoil still attached (a problem faced by both pilots, indicating a problem with the design of the ballot paper). Such ballots had to be referred to second level adjudication, and had to have bar codes manually re-keyed from the scanned images, which in turn caused problems due to the resolution of the image.

Indra's Security Plan produced by the supplier was cross referenced to a Project Responsibilities Matrix which met ISO 27001 requirements.

Following the election, Bedford and Breckland stated that they had the required DVDs containing copies of all the ballot papers images and that these were in secure storage. Indra stated that the server disks had been erased and re-formatted (although this was not confirmed by Breckland), and that they had lodged a sealed copy of the run time software and related logs with their lawyers in Spain.

Each ballot paper carried a unique identifier in the form of a bar code. At the polling station the elector's registration number was written against the appropriate number on a separate list of unique identifiers; known as the corresponding number list. This list was kept separate from the cast votes. Numbers were not written on the counterfoils of ballot papers, the counterfoil being purely a by-product of the stapling process to keep ballot papers together prior to use. The use of unique identifiers on the ballot papers protected the integrity of the vote. The unique identifier had to be recognised by the system for the vote to be counted. This made it impossible to count a vote twice or count votes spuriously scanned.

Dover

Opt2Vote's technical solution is designed to emulate existing manual processes where possible, in order that continuity is maintained, and legislated procedures are adhered to. The Opt2Vote e-counting application is a relatively mature, commercially available software application, using standard core EML, that required relatively little customisation for the Dover pilot scheme. Additional functionality was supplemented, however, according to Dover Electoral Services request.

The image recognition functionality works by scanning in a template version of each ballot contest in order to identify the areas that need to be read. These areas are then highlighted as zones. When the actual ballot papers are scanned in, the software records where a change has been made in those zones identified. If the mark is an X, and if it lies within an accepted zone of the template, it will be accepted as a valid vote. 25,000 types of X have been pre-programmed into the image recognition software.

The main problem encountered by the image recognition software was that the quality of printed ballot papers was inconsistent between postal ballot papers, and polling station ballot papers. Such differences caused 'ghosting' on the scanned images, which was addressed by the technician tweaking the template on the server for that contest. Unfortunately, there were hundreds of ballot papers requiring adjudication as a result of printer inconsistencies, meaning first level adjudication became more onerous than it might otherwise have been.

Opt2Vote has undertaken a comprehensive programme of systems and software testing, with a focus on security and risk management issues that could potentially impact on the pilot scheme.

The software provided the facility to maintain an account log of key processes, including login, batch and barcode numbers, adjudication and counting etc. On count night itself, Dover manually checked the first few sets of results against the account logs to ensure the results were as they would have expected. These were seen to be safe wards and no shift expected in the results.

Opt2Vote's process is designed to ensure that any electoral assets (including information assets) are retained in a secure manner for the duration of the statutory period following completion of the election / pilot scheme. All information assets were returned to the Deputy Returning Officer in the agreed format, i.e. one copy on DVD and one on Memory Stick. Unfortunately, the server did not have a DVD-R drive since this requirement had not been flagged. The data was therefore transferred via memory stick to the technician's laptop, and thereafter burnt onto DVD. This meant once the data was stored on the removable media, it had to be deleted from two units, the server and the laptop using the delete function within SQL Server.

The procedure undertaken varied slightly from that set out in OPT2VOTE's process document, in that the data was handed over to the Deputy Returning Officer after it had been deleted from the system (although the files had been checked for integrity on the removable media through a restore and redelete process).

South Buckinghamshire

The solution procured by South Bucks District Council (SBDC) from ES&S (the only supplier to respond to the ITT from SBDC) was to use 3 commercial scanners to scan the manually cast ballots and then merge those results with those from the electronic voting system to provide the full result for the District and Parish Elections.

From a system architecture perspective the solution was divided into two discrete components with no physical connection between each component, the "air gap" being a DCA requirement to ensure the highest level of security for the count.

On the night it was the server, built only days before the election and not tested in a live environment, that proved to be a problem, resulting in a corrupt XML file being created.

Results consolidation was handled by a standalone laptop which took a CD containing XML files from both the e-Voting system and the e-Counting system and merged the results to create the final results of the election. The results were then printed out and handed to the Returning Officer to be announced. This part of the solution lacked the ability to announce results from one contest whilst others were still being counted.

The solution appeared to be scalable with there simply being the need to add more scanners and more adjudication stations as the size of the electoral population increased. Each additional scanner

requires two additional staff. Similarly each additional adjudication station requires two additional staff. There is no reason for these staff not to be suitably trained council employees.

The official mark was on the front of the ballot, and on the reverse a single barcode and a reference number. The barcode was unique to the ballot paper and contained details of the contest, the polling station and the sequence number for the ballot paper.

Each scanned ballot was created as a unique EML file. EML version 460 was used. EML was seen by ES&S as the natural choice for this application as it offered interchangeability, easy 3rd party integration and is an approved industry standard.

The EML files, and the converted XML files were held on dedicated “clean” computers which after the election were cleaned to military specification (overwriting with zeros seven times). Copies of the data were burnt to CD and stored by SBDC in the same way that paper ballots are stored.

Stratford and Warwick

The e-counting system was supplied by a consortium headed by Software AG, with Dominion Voting Systems of Canada delivering the technology – Democracy Suite – and expertise. The technology includes a ballot designer. In addition to laying out candidate details, this designer also places orientation marks around the edge of the ballot paper, to facilitate scanning. It also encodes details of the contest and ward in the orientation marks along the bottom edge. The back of the ballot paper contains a unique barcode, used to verify the ballot paper.

The system includes a publishing mechanism sending XML encoded results data to a Flash application on a web server. A text-only version was developed at the request of the councils, to ensure accessibility.

A feature of Dominion’s technology is the way it keeps an audit trail of ballot interpretation decisions, as part of each ballot image. The scanned image is suffixed with the interpretation of voting marks, as identified by the software. If an image is put forward for adjudication, the changes to the interpretation made by the adjudicator are also suffixed. This means that a ballot image retains a complete audit trail of interpretations in a single TIFF image file.

Prior to adjudication, Dominion staff ran a query to check for duplicates, which were then brought to the attention of the returning officer. This query, however, was not enforced by the system and could easily be forgotten.

Based on statistics from the Stratford count, it appears some 24% of ballots were put forward for adjudication, most of them because the OCR software did not recognise a proportion of hand-written crosses as valid X marks.

There is a slight change with regard to the official mark, by which ballot papers are validated. The official mark was pre-printed: the combination of a unique barcode on each ballot, with special under-printing on all ballot papers. Therefore, all ballot papers were pre-validated and could, in principle, be completed and placed in a ballot box without further validation.

Within the e-counting system there was scope for error, and potentially fraud. Specifically, this system did not enforce the rule that a ballot paper must be counted only once. Although there was a database query that could identify duplicates, the system did not run it automatically and it was, on occasion, forgotten. However, before declaring the result, the returning officer would compare the number of ballots reported by the system, with the total of the ballot box accounts for the relevant ward. In Stratford, where on two occasions the system was around 100 ballots short, the returning officer postponed the declaration until missing batches had been found and adjudicated. If the system had been 100 ballots over, the returning officer would similarly have called for an enquiry.

Accuracy and Efficiency

In Dover, Bedford and South Bucks, testing and the count itself demonstrated that accuracy and (relative) efficiency were achieved. The Returning Officers and Electoral Services staff were satisfied with the outcome, and the process as witnessed by the Commission appeared to have delivered a successful outcome. In South Bucks, whilst not quicker than a manual count, there were no recounts called or challenges to results. Also, the clear (and primary) benefit to the Authority was the ability to conduct the count with a much reduced number of council employees. Whilst the count in Bedford took longer than anticipated for an electronic count, it was still considered to have been quicker than a manual count involving Mayoral, Council and Parish elections.

The Bedford and Breckland pilot schemes were illustrative of how differences in management and environment can impact on the successful delivery of an accurate count. Whilst the system did facilitate the counting of votes, and apart from some issues in Bedford, did provide that Authority with an acceptable (albeit slower than expected) outcome, in Breckland there were a number of significant failings within the system and with the process overall that challenged the integrity of the process. Subject to satisfactory resolution of these issues, then vote counting could potentially run smoothly and quickly, and provide a high degree of accuracy. In its present form, however, this was not the case.

In Warwick, the breakdown of the system meant accuracy and efficiency were not achieved. In Stratford, scanning of ballots was slower than expected by a factor of three to four.

Testing and Auditing of the System

Depth and rigour of testing too varied between Local Authorities. Opt2Vote in Dover had a comprehensive programme consisting of several sessions of full scale testing and training. At the testing and training session on 29th March, Opt2Vote used 10,000 ballot papers that were created by Opt2Vote personnel and temporary staff. In addition, a substantial number of ballot papers (2 x 1000 district ballot papers and 4 x 500 parish ballot papers) were marked up by Dover District Council, with additional ones being marked by DCA and Commission representatives, where the outcome was already known by the Dover Executive. Dover District Council also documented its user acceptance test (UAT) requirements, which were tested and passed by 23rd April. An additional stress test involving 52,872 ballots was undertaken during the weekend of 30th March.

In addition, Opt2Vote has undertaken a comprehensive programme of systems and software testing, for example:

- Opt2Vote use the services of security expert Peter Ryan, Professor of Computing at Newcastle University. Professor Ryan consults with Opt2Vote's development department, and reviews key processes, providing advice on how the supplier can improve services
- Opt2Vote contracted with Sopra Newell & Budge, who provided Opt2Vote with a Risk Management Report on the Dover electronic counting system.
- Other independent companies such as SQS perform stress testing and penetration testing on Opt2Vote's systems.

At the other extreme, limited testing was undertaken in Warwick and Stratford where, with user acceptance testing only taking place on 2nd May in Warwick and 3rd May in Stratford. In both cases, it was clearly too late for electoral officers not to accept the system or to suggest any changes. The testing session in Warwick seemed more successful in ironing out last minute issues around manual processes, than in thoroughly examining the functionality, capacity or security of the system. What was not tested was how tolerant the system was of various shapes of X. In the event, some 24% of ballot papers were put forward for adjudication, the majority because the system had failed to recognise a cross as an X. This took both the suppliers and the councils by surprise. This test should have been done much earlier in the lifecycle of the project, but had not been done at all.

At Bedford and Breckland, testing was delayed due to a lack of test ballot papers being delivered in time from the printers, but adequate testing was undertaken. Due to the failure of Print UK to deliver to Breckland, the ballots were subsequently supplied by Indra, and the acceptance test was carried

out at a date prior to the count. The testing was stated by Breckland and Indra as successful, with testing of approximately 10,000 ballots.

The acceptance test in Bedford on 24th April was observed by the Ovum Evaluator, where approximately 7,000 ballot papers split disproportionately between the three elections were used. The plan had been to use 10,000 ballot papers but the printer failed to deliver these papers. Consequently Bedford printed the test ballot papers in-house to allow the test to continue as scheduled. The test was useful in highlighting that a high number of ballots were likely to go to adjudication if electors only selected one choice rather than two on the Mayoral contest. Subsequently, on the Council's instructions, Indra re-configured the software to accept under votes where the voter marked their first preference with the valid mark (the numeral 1).

Ultimately, the major problem suffered by Bedford and Breckland at the Count itself was due to the absence of testing on the actual ballots that were to be used.

South Bucks conducted an acceptance test which involved the processing of 12,000 paper ballots. The system passed this with no problem. The issue with this test, however, was that it did not identify the problem of the system not being designed to easily allow the announcement of results whilst the count was still in progress. No independent tests were conducted on the e-Counting side of the Pilot.

Use of resources

Efficient use of resources depended on the strengths of the project managers and the successful (or not) deployment of workflow planning. In Dover, competent council staff were used to operate registration, scanning, verification and adjudication PCs. This worked well, though scanning staff often had periods with nothing to do. A readjustment in task allocation helped smooth things on the night, although it is worth considering whether nine scanner operators are too many for the number of ballots anticipated. Six or seven might have been just as effective.

Council staff were also used in Breckland to operate scanning equipment. Whilst again this was undertaken diligently, because of the problems experienced, more staff had to be drafted in to cover scanning

In Bedford Indra staffed the scanners and servers. Bedford provided all other staff, including personnel who carried out the adjudication, and handled the ballot boxes. Level of resources seemed sufficient in this instance, as it did in South Bucks, where ES&S also provided scanner operators with council staff undertaking adjudication. Indeed, an objective of the latter pilot scheme was to find new ways of resourcing the count due to difficulties encountered at previous counts of recruiting enough personnel to cover requirements.

In Stratford and Warwick the scanners were operated by Dominion and Software AG staff (mainly supplied by the former) The adjudication process was to be performed by the council's own staff, one at each location. When the problems arose the number of adjudicators was increased to 12 and these were trained "on the job" when the count at Warwick resumed on the Friday.

Training

In South Bucks, the training was adequate but with hindsight some issues arose in the process on the night that could perhaps have been addressed through training (or changes to the process).

Indra trained all the scanner staff in Bedford and had a hand in training Adjudication staff but Bedford decided on the rules to be used by Adjudicators. Indra also trained the Observers' Assistants.

Indra also took responsibility for training Breckland staff on the technical electronic counting system. It was undertaken as a series of sessions in the week prior to the count. On the actual count day, staff appeared at ease with the overall process, and with the operation of the scanners, which appeared straightforward and intuitive, and Indra staff provided continual support in the event of any issues that

arose, e.g. around loading process. Training documents were written in a straightforward, clear manner.

On the count day additional Breckland staff were brought in, after problems began to occur with scanned ballots. These staff did not appear to have been trained in use of the scanners, but were instructed by Indra and subsequently seemed at ease with the technology.

In order to address a bottleneck that was occurring on count day following the issues that arose with the scanners, some scanner operators were reallocated to first level adjudication duties. This was a good decision in order to try and alleviate the bottleneck. However, it was unclear whether these operators had been trained on that task beforehand. There was uncertainty about which boxes to check, and which reason to give for referral to RO adjudication. Some were also seen accepting ballots incorrectly. For example, adjudicating a ballot which contained three crosses (the required number), but accepting on two (based on the system prompt).

There was a similar situation in Dover, where scanner operators were promoted to first level adjudication. After a certain amount of familiarisation, the process worked well. However, it would have been better if personnel had had previous additional contingency training for just such an event. Overall, however, the training programme put in place by Dover was comprehensive and detailed, with plenty of chance for staff to practice operations.

In Warwick and Stratford, scanners were operated by Dominion and Software AG staff, who were given a half-hour demonstration on the afternoon of the 3rd of May and then given an hour's time to practice, using a small batch of sample ballots. A sheet of instructions was prepared at that time. The required operations were quite simple, the hardest part being a small amount of manual administration – adding up the number of ballots in the several scanned batches that made up a ballot box, and reconciling this sum with the ballot box account. Exceptions were handled by experienced Dominion staff.

Adjudication was performed by council officers – twelve of them, when the Warwick count resumed on Friday afternoon. Most of these were being “trained on the job”. On the night itself, there was one adjudicator at each site. At best they had a five minute explanation of how to operate the adjudication process, but again, this individual process is fairly simple. Experienced Dominion staff prepared the list of batches representing the ward or parish to be adjudicated and, in Stratford, got this wrong on two occasions. More automation, rather than more training might have prevented this.

3 Analysis of findings, key issues, & learning points

Technical supplier procurement

Key issues and findings

Procurement schedule

The DCA issued its formal Statement of Requirements (SOR) for the Pilot process in October 2006 allowing potential suppliers of electronic electoral solutions to submit responses to enable them to be selected for inclusion in the DCA's Framework Agreement. In parallel with this local authorities were allowed to submit applications to the DCA to participate in the Pilot.

The timing of the process meant that it was not until the end of January 2007 that the suppliers had been advised about whether they had been included in the Framework Agreement and the Local Authorities advised of their selection for inclusion in the Pilot process. This meant there was just 3 months before the elections for the Local Authorities to select a supplier, and plan for and implement their preferred solution.

All of the suppliers and Local Authorities felt that this was simply too short a time period. Whilst not openly admitted, it is clear that the short time frame available meant that the selection process by Local Authorities and the project implementation was rushed, leading to corners being cut. This was particularly an issue where new solutions (and in some cases commercial partnerships) were being trialled for the first time.

Clearly this was the first occasion for use of suppliers in the current Framework Agreement, which lasts until 2010. Going forward it can be expected that the suppliers will be able to better plan and prepare for forthcoming elections.

Procurement process

The actual procurement process, both for the Framework selection and the Councils' own supplier selections followed established public sector procurement practices. The issue for the Local Authority procurements was again one of time. In South Bucks, where they were undertaking both an electronic voting and electronic counting pilot, only ES&S submitted a response to the invitation to tender from South Bucks, perhaps because they were the only supplier in the Framework that was offering both solutions and other suppliers were unwilling (at such short notice?) to start creating consortia for this particular pilot. South Bucks were therefore restricted to a choice of one for their supplier

Framework agreement / SOR

In general the Framework approach seems to have worked well, allowing Local Authorities to undertake a rapid procurement of a supplier, essential given the short amount of time available. However it was clear that the establishment of the Framework and the inclusion of suppliers within it resulted in a level of trust by the Local Authorities that the suppliers and their solutions had been assessed by the DCA, in part this was influenced by the ministerial statement announcing the pilots, which declared:

To support those pilots that will be utilising electronic services, we have undertaken a rigorous procurement exercise and have established a framework of suitable suppliers for the piloting authorities to use.¹

¹ House of Commons, Hansard, Ministerial Statements for 29 January 2007 (pt0001)
<http://www.publications.parliament.uk/pa/cm200607/cmhansrd/cm070129/wmstext/70129m0001.htm#0701295000003>

“Rigorous procurement exercise” and “suitable suppliers” strongly suggest that detailed evaluation, perhaps even testing or accreditation, was part of this process. The approach of the councils to their suppliers suggests they took it in this spirit.

It is therefore unsurprising that the councils relied very much on their suppliers to deliver a managed service, meeting the requirements detailed in the DCA SOR and further scoped by their joint PID (project initiation document) and respective supplier contracts. Council officers seemed to take it for granted that those requirements had been understood and would be delivered. Meetings were concerned more with logistics – who would be doing what, when – than with the functionality and capacity of the pilot systems, which were assumed to be adequate, tested and proven.

It became very apparent during the pilots that, whilst some assessment had been done, it was not as comprehensive as some Authorities had assumed, especially on the technical side where some solutions were only being run live for the first time at the acceptance test. In addition, it is unclear whether the DCA understood that some of the solutions were to be modified to address the specific issues of the Local Authority, and if they did, whether they relayed that understanding to the Authority.

The DCA had taken a great deal of time to prepare a comprehensive SOR for the Framework and this was clearly essential. However the SOR assumed a certain level of understanding of the way in which UK elections are conducted, both with regard to the voting process but also the counting element. Several of the suppliers who were successful in being included in the Framework were essentially overseas suppliers and as a result most of their technical staff were not experienced in the UK election process. This led to some procedural issues with solutions at the count.

In particular at the South Bucks count it was a total surprise to the supplier (ES&S) that the Returning Officer was expecting to declare results of contests where the count had been completed, while other contests were still being counted. The ES&S software had not been designed to allow this and the attempts by ES&S on the night to deliver a work around were slow and tortuous. It is hard to blame either ES&S or South Bucks for failing to notice this omission as the SOR does not specifically require the solution to have this facility. South Bucks should also have ensured that their acceptance testing process included this element of the process.

Likewise the ability to provide a two stage adjudication process (which effectively mimics a manual count whereby blank and over-voting ballots are extracted and ignored at the initial ballot sorting stage) was not a specific requirement and not all suppliers provided such a facility. This resulted in an excessively large number of ballots being passed to the Returning Officer for adjudication in some counts. Whilst it could be said that the councils should of looked for such features in their procurement and planning process, it must be recognised that for many this was their first time using technology in an election and they had limited guidance on what was regarded as best practice both at an operational level and also with regard to software features and functionality.

The apparent lack of suppliers able to offer a both an electronic voting and an electronic counting solution (only ES&S had both solutions) is an issue for Local Authorities wanting to conduct pilots in both areas. The ability and willingness of different suppliers to work together across the full election process should be looked at further to ensure Local Authorities have more than one choice of supplier in the future. Had several councils been permitted to pilot both eVoting and eCounting it is doubtful that ES&S could have coped.

Trust in suppliers selected

As already mentioned above the framework procurement process and SOR assumed a level of intimate knowledge regarding the way in which counts are conducted in the UK, which was lacking amongst some of the suppliers, especially those where the technical team was not UK based.

The presence of the Framework agreement (and the limited time to select a suitable supplier) perhaps led Councils to be less intense in their procurement process, especially the technical component, as it had been assumed that the DCA has undertaken much of the basic groundwork in assessing the suitability of the supplier and their solutions.

Many of the solutions being offered by the suppliers were, in effect, unproven. Either this was the first time they had been used at all or this was the first time that they had been used in a form that made them suitable for a UK election, especially one involving different types of election (District, Parish and Mayoral) in a single count. The suppliers' ability to deliver working solutions based on the requirements of the SOR, was taken as read and not tested properly in many cases until the Acceptance Test process. This trust proved to be misplaced as many of the Acceptance Tests uncovered challenges, and further issues were encountered at the count itself.

DCA Certification; LA responsibility?

The whole procurement process should have been conducted over a longer period with suppliers being required to demonstrate working solutions to the DCA as part of the process. The Local Authorities cannot however absolve themselves of all responsibility and they too should have been more focussed on the technical component of the solutions being offered. Having said that, to be of use in anything other than a limited pilot, systems need to be tested, audited, certified, frozen and verified (to still be the same). Local Authorities have neither the skill nor the inclination to do this. They expect - and are right to expect - to buy a certified system or service. Certification is a specialist job that is best done centrally, e.g. through the agency of the DCA.

Going forward both suppliers and Local Authorities have learnt a great deal so that a future exercise will undoubtedly run much more smoothly, assuming the same suppliers and authorities are involved, and many of the issues encountered here will be avoided. Key here is continuity, with the exception of Dover none of these authorities had used technology in an election before and as a result they had to climb a very steep learning curve, being able to build on that learning is key if the pilot process is to deliver the best possible outcome for all the parties involved. It is notable that Dover had the fewest problems of any of the councils piloting an eCounting option.

Pre relationship (Dover and Opt2Vote) versus new relationship (Warwick/Stratford and Software AG / Dominion)

Where there was a previous working relationship between supplier and council the process seemed to be that much smoother. This was evident with Dover and Opt2Vote .

Clearly those authorities with prior experience of using technology in the voting environment are at a significant advantage to those trying it for the first time. South Bucks, undertaking a pilot for the first time, mentioned that it would have been very useful if there had been a practical guide available based on the experiences of those who had conducted trials previously.

Competing suppliers working together

In the pilot aspects of the trials there were no competing suppliers working together (although Opt2Vote was providing the signature/DOB checking elements in Warwick and Stratford), however there were consortia delivering the solution. As with any consortium it is important that each party understands its role clearly and is truly adding value to the overall solution. The experience in Stratford and Warwick would suggest that the role of Software AG was not truly defined and their lack of experience in managing a project of this type (that is, an election) was evident.

Learning points

More time, 6 months at least, is required for the Local Authorities to plan for and select their supplier for an e-counting electoral pilot scheme.

The suppliers did not all have close to finalised working solutions at the time they were advised that they were to be included in the Framework Agreement. Unfortunately they then had limited time to complete the working solution prior to the election, with no time for the development of any improvements following testing.

Most of the Councils did not fully appraise themselves of the technical and operating features of the solutions they were procuring. In part this was due to the lack of time, or because the solution was still being developed, but there was also an element of belief that the Framework process had already addressed this.

If Local Authorities are to be allowed to conduct joint electronic voting and counting exercises then there needs to be a greater choice of suppliers. ES&S struggled with two pilot schemes, and might have failed had they had more to cope with, unless more resource was brought in from the US.

The SOR assumed a level of knowledge and experience which was lacking in some (overseas) suppliers. It needs to be tighter and include, for instance, the need for results declaration whilst other contests are being counted. If overseas suppliers are to be permitted to participate in the process then they need to demonstrate their understanding of the UK election process and associated law.

A longer period between procurement and implementation would also allow the authorities and suppliers to be more familiar with the requirements and functionality of the process and solution. A longer period would also allow time for changes to be made to solutions in a measured way and with sufficient time to test the changes.

Electronic counting

Key issues

Technology

In general, the core software systems provided by the suppliers for the pilot schemes were considered to have been the result of established and acceptable development processes, engineered by recognised professional software companies. Bespoke systems were built on top of standard Microsoft Operating Systems (Windows 2003 for the Server, and XP for PCs). Proprietary and COTS algorithms were used for the optical character recognition, or image recognition aspects of the technology solution provided.

Whilst Dominion in Warwick/Stratford was perhaps less of a known entity, particularly in the UK market, its partnership with Software AG lent it credibility and trust.

What was more worrying was the enormous variation in the apparent level of 'readiness' of the different systems and whether they were fit for purpose for the task they were to undertake in their respective pilot schemes. In Dover, for example, the system had been tried and tested, not only in simulated situations, but also recently in a live local Referendum, with Dover's Electoral Services Manager, and was finalised in Dover early enough to test before deployment. Other systems such as Dominion's in Stratford/Warwick and Indra's final version in Bedford were not frozen until late in the day, meaning final operating versions had not been adequately tested. Indeed, in the case of the Dominion, substantial reconfiguration of the system took place actually in the midst of the election count process itself. The fact that there was also live data in the system at the time meant it could not be trialled with appropriate test data before hitting a live situation.

A key area of concern was that, where there was limited understanding of the **context** in which the software was to be deployed, there was a higher risk of the software not delivering optimum results, simply because it hadn't been configured in the most appropriate manner for the situation at hand. For example, Dominion did not realise the importance of the software being set up to refuse a ballot from being counted twice, or that an acceptable voter mark was a cross, rather than any mark as in Canada; ES&S did not realise it would be beneficial for declarations to be made throughout the course of the count, rather than right at the end; Indra did not realise the software would permit two different results of a rescan being recorded on the system, and allow the RO to accept the wrong one; Indra also hadn't programmed the software to prevent re-adjudication of the same ballot, as was observed in Bedford. Opt2Vote has been involved in the UK election sector for a number of years, and therefore had a much better understanding of what was required, as well as the experience of actually implementing systems in the UK environment.

All pilot schemes deployed commercial off the shelf (COTS) hardware, such as scanners, PCs and servers. Although suppliers' own scanners were used in 2006, it would have been perhaps desirable to have compared proprietary against COTS in a single election situation, from the perspective of speed, efficiency, usability and also cost whether in a live election or as a separate exercise. Indeed, ES&S would have preferred to use their own proprietary scanners, but were not permitted to do so as a result of the DCA Order.

The scanners that were used were all supplied by recognised, major companies such as Canon, Xerox, Böwe Bell+Howell and Axiome. On the whole, the main problems suffered with the hardware part of the scanning process was caused by paper jams, resulting from different sized ballot papers, or inconsistencies such as tears or folds. In Bedford, where Xerox scanners were used, it was noted that the operator had to keep a finger lightly pressed on the pile of ballots to feed into the scanner to ensure smooth transit. This was not the best or most efficient use of the operator's time, who could have been sorting and preparing the next batch for scanning. The key issue here is that limited testing of finalised ballot papers meant suppliers were unaware of the potential problems that may be caused by those papers on the equipment being used.

The speed of the scanners was likely to have been a consideration in their selection. However, it is perhaps ironic that the faster they were supposed to be (100 pages per minute in Warwick), the slower the actual throughput due to problems. Opt2Vote in Dover said at the outset of their pilot that they selected Canon models capable of 60 pages per minute as these were considered more robust at taking uneven inputs than faster models. Scanning accuracy is preferable to speed as it is the adjudication process which is the bottle neck in the whole count.

The main strain placed on the systems themselves during the count was the sheer volume of adjudications – caused predominantly by print discrepancies, but also by software that was perhaps oversensitive to voter mark variations. In Warwick, Stratford and Breckland, it was seen that perfectly good Xs were being thrown up for adjudication, simply because the software was not sophisticated enough in its image or character recognition capability, or because the recognitions threshold had been set too severely. In Dover, 25,000 different Xs had been programmed in, which alleviated this issue. But, a high number of ticks were sent for adjudication as this mark had not been programmed in as acceptable to the system (a conscious decision made by Dover and Opt2Vote at the outset of the pilot).

Different suppliers dealt with the challenge of high numbers of adjudications in different ways. Some tried to reconfigure the software and hardware on the fly – something which should not have been attempted in a best practice environment. Others modified processes and workflow, sometimes more successfully than others, but which is considered a lower risk approach. Stratford opted for a partial manual count early on, continuing with electronic counting only for multi-seat wards – a risk-averse approach that was more successful than Warwick's as a result.

Testing

It is the criticality of adequate testing that is one of the keys to success. The lateness of the procurement programme, compounded by printer problems in getting finalised ballot samples, but also by a lack of adequate planning led some of the pilot schemes to go live with too many unknowns as to how success would be achieved. There was also a high degree of variation in the pilot with regard to how much development work was required to deliver a suitable solution. At one extreme Dover had only limited work required whilst at the other Dominion had to undertake extensive development to adapt their proven Canadian solution to the requirements of a UK election. Where systems have a high proportion of new features and/or functionality having sufficient time for testing, and just acceptance testing, is critical.

User acceptance testing is the final test that needs to be made – and not the day before or even on the day, but with at least a week's grace so that modifications or reconfigurations may be made as required, or if that is impossible, then at least so that other contingency measures might be put into place. In Stratford, user acceptance testing was not conducted until 7pm on the evening of the count itself. Even then, it was unclear if the results of the test were actually acceptable.

Of course, the pilot scheme is in itself a test situation, but one in which participants should be pretty confident of at least a 99% success rate. The service availability and reliability requirements set down by the DCA, for example, mandate that "The e-counting service shall have an availability level, excluding services outside the control of the Service Provider, exceeding 99.95%, during the hours specified by the Returning Officer." It was highly debateable that this would be the case, based on the last minute testing in less than ideal conditions.

Again, best practice was demonstrated by Dover District Council and Opt2Vote. Extensive testing was carried out (with evidence provided), the LA was instrumental in defining the criteria they required to be implemented by the system, and they witnessed the capability of the system to do so, and formally provided their acceptance of that system.

Candidates and agents – interface with technology

It has been noted in previous years that disengagement of agents and candidates with regard to their involvement in the process was a danger with electronic counting technologies. It is considered desirable by all parties to address this issue and provide innovations that provide at least the same transparency (and perhaps excitement) as is the case with manual counts. All Local Authorities provided some mechanism such as a projected display to feed information to onlookers about the progress of the count, and/or to witness adjudications. However, none of the progress displays provided a satisfactory solution at the end of the day. In Dover, a progress screen was considered as a desirable innovation, but the system never really got up and running. It hadn't been properly tested prior to the count, and it is likely it was considered a 'nice to have' rather than a 'need to have' with other more urgent issues taking priority.

In Breckland, the progress display worked at first, until rescans of ballots were fed into the system, at which point there was seen to be a mismatch between what was being scanned and what was being displayed. Again, inadequate testing had not brought this issue to light. In Warwick, the progress screen was working (at least, on the Thursday), but as it was situated out of the main count area, candidates and agents found themselves too far removed from the real action.

On the whole, adjudication screens did work well (or at least as well as when candidates and agents used to crowd around the RO adjudicating a piece of paper). Minor improvements could be made for future election situations, such as the complexity of the interface used, the speed with which adjudications are made, and the positioning of the screen for optimum visibility in a crowded count hall.

Key to gaining and maintaining the buy-in of candidates and agents to an electronic count is trust, transparency and confidence. All local authorities were keen to optimise transparency, as discussed. But it is felt that suppliers were further removed from the need to please third parties. Their concern was with the system itself and its performance. It is an internally focused role, and as such their awareness of what would enhance the experience for other observers was, perhaps understandably, more limited. The gap between running a smooth operation, and configuring that system in such a way that it is understood and accepted by third parties needs closing.

Security and fraud

In all cases, the systems used were standalone, local area networks. That is, they were not connected via external links or to the Internet. This, together with other measures in place, meant that the integrity of the data to be handled was more protected than it otherwise would have been, and less open to malicious attack by third parties. In addition, critical servers were securely stored prior to the count, and generally protected from observers at the count itself

The DCA Quality Assurance audit was thorough in as far as it went. It was generally a paper-based exercise, however, where judgement of system adequacy was based on existing documentation. No technical testing was undertaken as part of this exercise. Nevertheless, the Auditor was stringent and meticulous in his questioning, and one would expect the process for professionally recognised software vendors would be sufficient. However, there were too many unknowns remaining. Despite the auditor's rigour, some suppliers were generally lax in providing relevant documentation for review (indeed, in some cases, it was unclear if such documentation even existed), or evidence that the systems were robust and secure. Others such as Dover, whilst still tardy in responding to requests for documentation, did eventually provide detailed evidence of best practice, for example, that their software solution had been tested and subjected to rigorous risk analysis by independent third party auditors. Time was a big problem here. The Audit took place only a couple of weeks before the election when suppliers and local authorities were extremely busy. Whilst suppliers should have been aware of the requirements on them from the Framework Agreement with the DCA, the local authorities were fairly surprised at the process, and felt they had had little warning of what was required.

All systems were either seen to be, or claimed to be clean at the outset of the counting process. That is, there was no data residing on the system before the scanning commenced. Certainly, the ROs or Deputy ROs were satisfied in this regard. Clearing down the systems at the end of the count was not so visible in all cases. In Breckland, for example, there was no evidence of this having been

undertaken before Indra departed for Spain. Suppliers in Stratford/Warwick declared they were unaware of this requirement, but in Stratford did manage to delete their data.

In future pilot exercises, whether for voting or counting, it might be appropriate for the DCA to prepare a standard form that requires sign off by the relevant parties at various stages of the process to confirm that key processes (such as zeroing registers, synchronising clocks and data deleted securely) have been undertaken. The return of this completed form to the DCA would be fundamental part of the election process and be required in order for the election to be declared valid.

User authentication procedures were in place, although some policies were seen to be more stringent than others. In Dover, the password allocation and policy procedures were considered weaker, with users selecting their own name and password, but given no guidance on robustness of the password, compared to Breckland, where individual passwords were generated by the system on the morning of the count.

Integrity of the data once scanning had commenced was maintained adequately in South Bucks, Bedford and Dover. However, as the problems in Warwick/Stratford and Breckland grew, security declined and the potential for serious compromise of the data became a much higher risk. In Warwick, supplier staff were seen copying and transferring data files from one PC to another; also, the system underwent a major reconfiguration whilst live data was resident in the database. In Stratford, trust in the system was impacted when votes appeared to go missing following adjudication. In Breckland, the decline in physical security of the count area meant it might have been relatively easy for an interloper to access the server area. As new staff were drafted in, so it would have been more difficult to judge who was authorised to be there. Later, barriers had been removed altogether, and the Sports Hall doors were left wide open.

Cost

The following table shows the comparative costs of the 5 pilot schemes.

	Bedford⁵	Breckland⁶	Dover	South Bucks⁷	Stratford & Warwick⁸
Supplier	Indra	Indra	Opt2Vote	ES&S	SAG/Dominion
Original Bid ¹	£165,792	£148,831	£166,300	£57,647	£270,555
Final Cost ²	TBA	£148,831	£166,300	£66,910	TBA
Difference ³		Nil	Nil	£9,263	
Manual Count Equivalent ⁴	Nil	£25,763	£13,000	£6,800	£6165
Number of ballots counted	82,889	40,080	45,000	21,955	109,700

- Notes:
- 1 This is the price quoted by the supplier to the council in the original proposal from the supplier.
 - 2 This is the price actually charged to the council by the supplier and reclaimed by them from the DCA.
 - 3 The difference reflects the increase or reduction in the cost of the pilot as actually charged to the council and the original bid by the supplier.
 - 4 This is the cost (labour) which would have been incurred by the council had they undertaken a manual count.
 - 5 The final cost for the Bedford pilot is still the subject of discussion between the supplier and the authority following the issues encountered with the solution. Because Bedford would have conducted a manual count during the course of a normal council day they would of not incurred any costs as staff would of simply been redeployed from their normal job. Had the count taken place outside the normal working day then a cost of up to £40,000 has been estimated.
 - 6 The final cost for the Breckland pilot is still the subject of discussion between the supplier and the authority following the failure of the solution and the need to undertake a manual count.
 - 7 In South Bucks the Project Management costs were combined with those for the eVoting pilot and therefore these figures exclude this component. The number of ballots counted does not include those extracted from the eVoting system.
 - 8 The final cost for the Stratford & Warwick pilot is still the subject of discussion between the supplier and the authority following the failure of the solution and the need to undertake a

manual count. The figure for the Manual count reflects the actual cost incurred in undertaking the manual count.

As the above table shows there was wide variation in the costs of the solutions provided by the different suppliers. It is also pertinent to note, as shown by the two solutions from Indra, that cost is not directly impacted by the number of ballots counted. The key cost is getting the system set-up and the provision of specialist scanning hardware, whether off-the-shelf or a supplier's own equipment.

Because problems were encountered with many of the counts at the time of submitting this report the final costs of the solutions being charged to the councils has not been agreed.

The introduction of technology, especially on the basis of a pilot, was never going to save money compared to a manual count. Were electronic to be introduced on a more widespread basis then it would be expected that the cost per council would fall significantly, especially if the councils were buying solutions whose costs could be spread over a number of years (and elections) and they took over the operation of the solutions themselves rather than relying on the suppliers often expensive staff to undertake the role.

The costs charged by the suppliers for the basic hardware (PCs, printers, servers etc) in many cases seem to be high (often close to our estimate of the actual purchase cost – for instance the desktop computers attached to the scanners in South Bucks were charged at £995 each) given that the equipment was in many cases only actually used for the count itself and the supplier has retained the equipment for its own use. In future pilots it might be more appropriate for the council or DCA purchase the equipment directly to a specification agreed with supplier so that they retain ownership and can then either retain it for future use in other elections or make it available for redeployment within the council or DCA.

Learning points

Experience of UK election processes on the part of the technology supplier is crucial in delivering an efficient and effective electronic count. Suppliers entering into the UK election market for the first time would do well to hire a local expert on UK electoral law and practice as a consultant. The Software AG / Dominion consortium, as well as the ES&S team, were taken by surprise by a number of features of UK elections that a local expert could have warned them about.

Minimum testing requirements must be undertaken within a defined period prior to the election. Undertaking this task a day or two before the count (or even on the same day) is too high risk. A large scale test using actual ballot papers should be undertaken. This means that those papers must be printed earlier – a requirement that may need a change in the deadline for candidate nominations and withdrawals.

In addition, technology solutions have to be *seen* to be fit and ready for purpose. Local Authorities should be very certain of success, and not be persuaded that it will be 'alright on the night'. Whilst election officials have to take a certain amount of advice on trust from their expert technical supplier, if the system's operation has not been successfully demonstrated to them and tested in real-life conditions with realistic numbers of ballot throughput, then Plan B should be implemented (assuming Plan B exists, which LAs need to ensure).

The gap between supplier and Local Authority is often too wide. There is limited experience on the part of the Authority as to what really is technically feasible, or what the risk of different strategies might be. As a result, one or two Local Authorities were persuaded by the supplier to carry on, or when it would have been prudent to refuse. It is, of course, in the supplier's interest to persevere for as long as possible, in order that contractual payment is not forfeited. There is a need, therefore to determine who should be managing such a technical programme. The Authority, with limited technical experience, or the supplier with conflicting commercial interests and often limited electoral process management skills? A close collaborative approach, such as Dover's would be the optimum solution, but this is arguably a rare case, and not easy, though not impossible, to replicate in the commercial,

competitive marketplace. The DCA would need to decide if it were viable only to accept suppliers with UK election knowledge, and pre-existing working relationships with the local authority. This may not be feasible in a public sector tender situation determined by OJEU rules. In any case, lack of domestic capacity may well require that systems and suppliers are sourced internationally.

Local Authorities (and indeed suppliers) are faced with many unknowns and uncertainties. Further guidance is needed. Not only to help them make mission critical decisions, but also to provide a checklist of actions they must undertake before, during and after the count to ensure best practice is followed.

Even with such a checklist, there remains an unavoidable degree of opacity in the whole situation. Local Authority representatives may indeed witness the zeroing of the system at the outset and clearing down at the end, etc. But ultimately, they are watching a process that has been explained to them by the supplier, without really having any visibility or understanding over what goes on inside the software, the application or in the database. Indeed, in Warwick, even the supplier lost sight of what was happening inside the system during the count. Local authorities have little choice but to trust the system. Therefore, in any application beyond a limited pilot, it is crucial to deploy only fully audited, certified systems that are verified after any change.

Contingency planning and rigorous risk analysis are key on part of both technical supplier and local authority. Again, there was uncertainty over where responsibility for this aspect lay. With the option of a manual count to fall back on, this aspect has not perhaps been as fully addressed as it should. But the detrimental impact caused in particular by Warwick, Stratford-upon-Avon and Breckland counts illustrate the importance of such planning and analysis.

Displays and screens for the benefit of onlookers such as candidates and agents are seen to be beneficial to aid transparency, provide information, and involve interested parties. For the most part, screens for adjudications worked well, with some minor adjustments required to optimise their use. However, major work is needed with regard to progress reporting displays, which need to be tested prior to use.

Project and relationship management

Key issues and findings

Prior to the election, evidence of good practice was seen in most of the pilot schemes, with project plans, project initiation documents, weekly, minuted meetings and structured teams in place. Dover in particular was seen to have robust processes in place keeping the project on an even keel, maintaining risk logs and addressing risk management issues in a timely and analytical fashion. Bedford too was a tightly run process with strong project management observed on the part of the Local Authority, as well as the supplier. South Bucks management was seen as adequate but attention to the electronic counting aspects of the pilot scheme were felt to be marginalised in favour of the more complex electronic voting issues. As a result, oversight of this element, whilst adequate, was lacking a firm hand, thus opening itself up to risk. Indeed, the ES&S project manager was not even present at the South Bucks count venue until 3am, some 5 hours after the start of the count when the process started to deteriorate. Had he been there from the outset, potentially the crisis could have been averted or minimised.

Breckland too was seen to have good project management capability prior to the election. Where it started to unravel, as it did in Stratford/Warwick, was in the lack of contingency planning when problems were encountered with user acceptance testing processes. The DCA Audit emphasised the need for contingency planning, but either the suppliers did not take it seriously enough, or they ran out of time to address it adequately.

Communication is key to good project management. Electoral services managers are experienced at running elections and ensuring everyone knows what they are doing. Unfortunately, by adding the technical element to the pilot schemes, this took many of the LAs out of their comfort or experience zone. There was an understandable gap in their knowledge about the technology, but also about the required changes to processes in deploying that technology. For example, perhaps it wasn't emphasised to presiding officers in Bedford and Breckland *why* ballot papers should not be roughly torn from counterfoils, or *why* counterfoils should not remain attached to the paper. (Namely, because such papers would not go through the scanner, or would be misread by the software.) It was imperative that POs should adhere to this process, but communication was insufficient to ensure it.

As mentioned above, the suppliers' remit was to cover the technical aspects of the pilot. They had limited visibility of the perspective of candidates and agents. It was therefore up to the Local Authority to maintain their links with those observers, keeping them aware of what was happening and why. As all pilots suffered their challenges, those candidates and agents were too often ignored or kept in the dark. This may have been because the Authority personnel themselves didn't understand the issues occurring with the technical system, or they were too tied up with recovery procedures to address it.

With the exception of Dover, where supplier and authority personnel had previously worked together, and had an understanding of the issues faced by each other, there remains a huge gap between experiences and expectations of suppliers and those of electoral personnel. This gap was instrumental in the complete breakdown of the Breckland pilot, where both sides seemed to abdicate responsibility, as it was not clear to them where technology and election process crossed over and responsibilities met.

Some of the Local Authorities assumed too much from the DCA procurement process (Dover aside, who researched their shortlisted suppliers), and as a result were too complacent with respect to how much their suppliers knew about the requirements of running a UK election. Some of the technical suppliers assumed too easily that the development and operation of a system for a UK local election would mirror that in other markets.

More understanding was required by all parties about the robustness of the solution to be offered, given the scale of voting and the time required to achieve a count that would satisfy the stakeholders. Such an understanding is difficult to achieve in the absence of testing on a real life scale. Putting through a few thousand ballots as part of the test is insufficient, instead the whole process needs to be fully tested as it would be on the night, including attempts to commit fraud (eg duplicate or fake

ballots and attempts to penetrate the systems) and simulation of power failures so that all parties have confidence that the system being used is as robust as is possible.

Management of workflow varied from pilot to pilot. Again, in Dover and in Bedford it was strong, but with scope for a few adjustments to improve on efficiency and speed required. When planning workflow, it is important that the suppliers understand issues such as the benefits of having a continuous flow of declarations throughout the count period. ES&S in South Bucks were unaware of this aspect of UK elections, and had not built it into their process. Also, workflow here did not follow the established procedure of a manual count due to unfamiliarity with the UK system

Learning points

Strong project management is obviously needed in such a complex event as electronic counting of an election. But more needs to be done to address the experience gap between the technical and the electoral process management. Some authorities adhered to Prince II management procedures via their suppliers, and strengths were witnessed as a result. It is crucial that a Communications Plan is developed and followed, with responsibilities and roles being clearly defined, including what to do in the event of a crisis. Someone, the Returning Officer or the Electoral Services Manager, needs to have an end-to-end overview of the whole process and system. The abdication of responsibilities in Breckland is a key learning point for other authorities to take note of, to ensure it doesn't happen to them.

Contingency planning has been mentioned in the technical context already. But it is essential that sophisticated alternatives are in place in the event of a crisis, and that this is clearly documented for all parties to adhere to. Contingency planning for different scenarios is recommended. For example, all pilots suffered extremely high numbers of adjudications for various reasons, but this was not really anticipated or adequately catered for on the part of most authorities.

Overall, there is merit in rigour, and the presence of a comprehensive electronic counting 'manual' incorporating a succinct checklist would be of benefit to authorities and suppliers alike.

Where a Council is using both electronic voting and electronic counting, both they and the supplier (assuming a single supplier) should have separate Project Managers for voting and counting to ensure that there is equal focus on each part.

Collaboration (Stratford/Warwick)

Key issues

Collaboration between Warwick and Stratford District Councils generally worked well. Each council operated a count centre on the night of the election, but to emphasise the collaborative aspect of the pilot, each counted two wards or parishes of the other. Geographically, these swapped wards were closer to the other council's count centre.

Relationships between the parties were good, and the division of responsibilities between the two councils appeared to work well. Having a joint weekly meeting with suppliers, instead of two separate ones, was more efficient although there are no measurements to say *how much* more efficient.

In the division of labour between Stratford and Warwick councils, Stratford prepared the risk register for the pilot. It followed a long-established pattern, recognising risk events that had occurred historically and describing actions to be taken to limit the impact, such as contingency arrangements. Only in a few cases did it specify actions to *reduce the likelihood* of a risk event occurring – training being the most common strategy.

Only a single line was devoted to the new risks posed by the e-counting pilot: "Counting machines fail." The contingency plan was obvious: "Reserve machine required." Redundancy of equipment was provided for in the contract with Software AG. The ultimate contingency plan was to revert to a manual count. E-counting uses physical ballot papers, so this plan is feasible and, in the event, it was invoked and executed.

Learning points

Joint ventures between councils can work and offer economies of scale. Close communication is key.

The electronic count was marginally more successful in one partner authority than the other – arguably due to the different decisions made, the risk approach taken and the lower volume of ballot papers.

Redesigned ballot papers

Key issues

In conducting an electronic count the ballot papers need to be very precise and consistent in their design and also in the quality of printing in order that they can be processed by the system. It was evident from the pilot that the design and printing of the ballot papers was a weak link in the process and a cause of a number of issues.

Ballot papers were of different sizes, depending on the number of candidates, and had both an Official Mark and a unique identifier in the form of a bar code

In the course of the Pilot the following issues relating to the ballot papers were identified:

- Printing Quality
- Mixing of ballot paper size
- Damage to ballot papers, caused by poor perforating
- Impact of paper colour on mark recognition
- Checking of Official Mark

Printing Quality

It is an unfortunate fact in the election process that it is only possible to print ballot papers once the nomination process has closed, typically some 3 weeks prior to the election. The time available to print the ballot papers is very tight as they need to be sent out in advance to those people voting by post. In a non electronic election the printing process can be undertaken with limited regard to quality and thus it can be done quickly. With an electronic count the papers need to be printed with a much higher degree of accuracy and they also need additional security and alignment information.

In several of the pilots it proved difficult for the printers to print the ballot papers to the required level of quality so that they could be processed by the system. This seemed in part to be down to lack of experience by the printers in this process. Several of the pilot suppliers expressed a desire to handle the printing at their own (offshore) facilities but for a variety of reasons councils or the suppliers chose or were required to use a UK based facility.

In Bedford they had to supplement ballot papers for postal votes in one ward because the printer had not delivered enough. These ballot papers were printed internally and the alignment crosses were 1mm out of alignment with those from the printer leading to them being rejected by the e-counting system.

Mixing of ballot paper size

In some of the elections voters at a single polling station were voting in more than one contest (ie both district and parish) and dependent upon the number of candidates in each contest the ballot papers may have been either A3, A4 (more than 5 candidates in a contest) or A5 (up to 5 candidates in a contest) in size. The scanning machine was designed to process both and worked reasonably well providing all ballot papers, regardless of size, were in a "portrait" orientation. In a small number of instances a voter had placed the A5 ballot paper in the ballot box in a "landscape" orientation which resulted in the ballot being rejected and sent for adjudication.

A further and more serious issue with mixed ballot paper sizes in South Bucks was the need to ensure all of the ballots were aligned to a common corner so that they would be picked up by the wheel on the scanner. Whilst the ballot papers were aligned to a common top edge, using a "shaker" some A5 ballots were aligned to the left edge of the A4 ballots, some to the right and some in between leading to a large number of scanning issues and significant delays in the scanning process. The scanner operators at South Bucks took it upon themselves to manually sort the ballots so only A4

or A5 ballots were being scanned at any one time on a scanner, but this introduced significant delay in the scanning process.

The easiest solution to this problem would be to insist all ballots for a particular polling station (assuming multiple contests such as district and parish) were of a single standard size either A3, A4 or A5, depending on the needs of the contest with the largest number of candidates so there were no ballots of different sizes in the same ballot box. Alternatively different ballot boxes should be used to prevent mixing of ballot papers.

Damage to ballot papers

In several pilots there were issues with damaged ballot papers causing issues with the scanning machines. The primary causes of the damage were either the automated envelope opener used for opening postal ballots or careless tearing out of ballot papers in the polling station

The problem caused by the envelope opener is relatively simple to resolve by either not using such a device, by ensuring the ballot is shaken clear of the envelope edge to be opened or by opening A5 envelopes along the shorter edge thus avoiding the folded edge, which was being cut.

In a number of the pilots the ballot papers had been bound into books as has been a requirement for UK elections before the passing of the Electoral Administration Act 2006. However either through thicker paper being used, insufficient perforations, careless tearing out by the polling station staff or a combination of these the ballots were being torn, leading to feeding problems with the scanner. This was a major problem in Bedford and Breckland. In South Bucks this was not an issue as the ballot papers were not bound into books but instead left loose. But even in Dover, where a similar system to that in Bedford/Breckland was used, papers were torn cleanly from the pad, indicating a better design was deployed, and/or polling station staff took more care.

Impact of paper colour on mark recognition

In Dover a comment was passed by the supplier that there had been some issues leading to ballots being passed to adjudication, caused by the colour of the ballot and the scanner finding it hard to recognise the mark due to insufficient contrast, although this did not cause an issue with determining the voter's intentions on screen. Analysis of the ballots being sent for adjudication in South Bucks also showed that a higher number of ballots required adjudication from the Parish elections where the paper was pale yellow rather than white. Whilst this was not seen as major issue it one that needs to be considered in the development of future pilots and may be something that can be resolved through adjustments to the scanner's sensitivity or ensuring that the pens used in polling stations are black to maximise the contrast between paper and voter mark.

Checking of official marks

Ballot security is a key concern, especially where technology is being deployed. As a general rule the ballot papers used in the eCounting pilot study had three sets of marks on them, a barcode (usually on the reverse) uniquely identifying the ballot, an official mark designed to demonstrate the authenticity of the ballot and one or more alignment marks used by the scanning software to aid the matching of the ballot with the image recognition software. A variety of official marks were used from simple printed marks which were claimed to be hard to copy to more complex ideas with photo-sensitive ink.

	Bedford	Breckland	Dover	South Bucks	Stratford & Warwick
Supplier	Indra	Indra	Opt2Vote	ES&S	SAG/Dominion
Official Mark	Photo-sensitive ink stamped on rear of ballot	Only the barcode on the reverse of the ballot. For postal ballots bore the Breckland mark which had been printed in thermo-chromatic ink, which would deter fraud as it could not be photocopied, and would disappear when pressed	Dot matrix 2D square barcode in the top left corner of the paper	Grey stripe on top left corner of ballot	Barcode and underprinting
Basis of Security	Unique mark added at the time the ballot is issued to the voter	Unique barcode and tamper proof mark for postal ballots with duplicate ballots identified	Barcode checked for presence and system designed to identify ballots with duplicate ID numbers	Easy to print and supposedly could not be photocopied	Underprinting could not be photocopied
Copyable?	Yes if you had access to the ink and a stamp (official or forged)	Barcode could be copied. Postal ballot mark could not	Yes, but software checks and identifies location of duplicated ballots	Proved possible to scan, but as ballots were not made available until after the election not possible to confirm whether the ballot would have been accepted by the scanner. Also test ballots were printed in a laser printer showing that the mark could be printed without special equipment	No
Checked?	Yes, by scanner but there were issues as some ballots were stamped on the front not the rear of the ballot leading to an increase in adjudications	Barcode checked as an integral part of the scanning process	Yes, by scanner at time of scanning	Yes, by scanner at time of scanning	Yes, by the scanner and ballots were passed to adjudication due to issues with validating the official mark

Where the official mark was put on at the time the ballot was printed there were no issues, although clearly this was a less secure approach as it would be open to public scrutiny as soon as the postal ballots were dispatched and potentially replicated with faked ballots. Where the official mark was put

on at the polling station there were issues (at Bedford) due to the scanner expecting the mark to be on the reverse side of the ballot whilst in some case the polling clerk had placed it on the front side. This later issue could perhaps be resolved if there was a clearly designated area on the ballot paper where the official mark was to be stamped by the polling clerk.

Security and fraud

No issues were encountered in the pilots with regard to security or the attempt to fraudulently submit ballots. Given that the councils were in the main simply following their established manual procedures this was not too surprising. As discussed above the primary form of security was the official mark and there were clearly upsides and downsides to the approaches adopted. It was unfortunately not possible to test the true security of the mark put on at the time of printing and the claim that it could not be copied because the Council would not release ballot papers to the evaluation team until after the count at which point the scanners were no longer on site.

Learning points

Printing arrangements for ballot papers need to be set up well in advance and the printer needs to work closely with the equipment supplier. The printer should not be allowed to then sub-contract the work out to a third party (as happened in South Bucks) without that third party demonstrating that they too can meet the agreed specification.

Adequate time needs to be allowed for testing the ballot papers before the election commences. In an ideal world there would be greater time in the election process to allow the printing and testing of ballot papers. In reality this is not going to be the case and therefore the printing process needs to well though out in advance and there is nothing to stop the printer printing a controlled number of dummy ballots in advance so that all aspects of the ballot design, its compatibility with the scanner and the printer's ability to print to the required quality standard can be checked in advance.

It is inadvisable for ballot papers of different sizes, which are to be counted in a single pass of the scanner, to be in the same ballot box.

Care has to be taken to ensure ballots are not damaged prior to scanning

Consideration has to be taken regarding the colour of the paper and the sensitivity of the scanning machine as contests which used coloured paper seem to have a greater tendency to have ballots which required adjudication compared to those using white paper. It may be that printing a coloured border, different for each contest type, on white paper is a better option, providing it meets with the issues relating to accessibility, as all marks would then be black on white.

Any marks on the ballot that are critical to the process and added after printing, such as an official mark, needs to be placed with the same care as a voter indicating their preference.

End to end design: the printer needs to understand how papers will be manipulated in order to incorporate best design features for the job. This should not be done remotely, but during face-to-face interaction.

4 Recommendations for future pilot schemes

Pilot strategy

Share knowledge and learning between authorities. There are now several authorities that have successfully undertaken electronic counting pilots, and who have substantial, valuable knowledge to impart. In collaboration with the Electoral Commission, have them produce a manual on how to stage and manage an e-counting process, using authority staff. In addition, it is recommended that a comprehensive checklist is created that lists the essential tasks and actions that *must* be undertaken during the course of the project, and certainly during the count itself.

Encourage authorities to become more involved in the overall management of the technical part of the pilot, and so be more directly responsible for their pilot's performance. Ensure authorities are made aware of those requirements that suppliers are expected to fulfil under their contractual obligations, for example by taking them through the DCA's Statement of Requirements, and the Framework Agreement. In this way, it is expected that authorities will be less complacent and less accepting of their suppliers' capabilities and experience, and more rigorous in ensuring adequate testing and configuration is undertaken.

There also needs to be an end-to-end view of the system and the project. A checklist will help. But in the hectic period that always precedes an election, the list might still not be checked consistently. An independent resource who can keep detached from the pressure, but understands both the technology and the practice could prove a huge help. This would be a proactive and directive role, and it is a resource that could be shared among two or three pilots (depending on how ambitious the pilots are).

Encourage authorities to actively undertake operational aspects. For example, operation of scanning equipment is straightforward, and where authority staff are available, they can be effectively deployed. As part of this, training programmes need to be well managed and conducted, to include cross-role training for contingency purposes.

Pilot selection and procurement

Although participation in pilot schemes is subject to an application and selection process by the DCA, it is recommended that those authorities having successfully undertaken pilots are permitted to continue with their respective programmes in order to further capitalise on existing learning and build further capability through such schemes.

Start the procurement process much earlier to improve the likelihood that the most appropriate supplier is selected for the authority. Ensure there is sufficient time for tight working relationships to develop, for effective project management procedures to be put in place and also for software to be further developed where improvements can usefully be made. In particular, it is highly recommended that suppliers have electoral experience in the UK, and further that such suppliers are essential partners for less experienced authorities.

Build a technical QA process into the procurement process (as well as the document and process review that was undertaken by the DCA). Generally, the technologies in use were tried and tested. But there should still be some provision made for proper QA and testing of the systems in new situations, such as in the UK when suppliers have been used to working in other markets. Suppliers and their solutions should be fully accredited by a central body such as the DCA before being recommended to the local authorities for selection.

E-counting

Assess issues of scalability: more machines can be deployed, but human resources are limited. Encourage Local Authorities to take a more operational role. Number of staff required for a (successful) electronic count is less than for a manual count, so scalable services should be achievable.

Improve candidate/agent technical interfaces, and ensure they are adequately tested with other equipment prior to the count e.g. count progress display systems – the stakeholders' (enhanced) experience will count for much.

Comprehensive testing within a certain time period prior to the count with actual ballots should be mandatory. If testing is not achieved within this timeframe, a thorough risk assessment must be conducted before allowing the pilot to proceed.

Collaboration

Exploit the learning of those authorities who have undertaken successful pilot schemes. Have representatives of those authorities work in partnership with inexperienced authorities who wish to participate in future pilot schemes. For example, Westminster, Lewisham and Dover have significant knowledge and understanding of best practice they can pass on to others.

Redesigned ballot papers

Ensure ballots are printed with ample time to test sample batches with the electronic counting system. Ensure printers are used, perhaps through an additional framework agreement, that have the capability to produce high quality ballots incorporating barcodes, official marks and accurate orientation marks.

Ensure the packaging as well as the design of the ballots are compatible with the electronic counting system to be used, for example whether papers may be cleanly torn from pads, or whether lines or content is likely to extend beyond the print area accepted by the scanner.