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CONSULTING

Electoral pilot scheme technical evaluation

Bedford Borough Council

June 2007

Introduction

This report is presented to the Electoral Commission to inform the statutory evaluation of the electoral pilot scheme in Bedford Borough Council at the elections on 3 May 2007.

The Electoral Commission is required to submit its evaluation report to the Secretary of State and any of the local authorities involved in the pilot scheme, and those local authorities are required to publish the evaluation report within three months of the election. This report is the technical evaluation report presented to the Commission on 25 June 2007 to inform their statutory evaluation.

In preparing this report, Ovum has drawn on its own observation and assessment of the pilot scheme, as well as on the views expressed to us by a number of other stakeholders. We would particularly like to thank the Returning Officer, and the electoral services department of Bedford Borough Council for their assistance in undertaking this evaluation and for supplying us with the information and data to support the technical evaluation.

Pilot objectives

The objective of the pilot as agreed with the DCA was to evaluate the extent to which the use of electronic counting technology contributed to the running of an efficient and effective combined election using first past the post and preferential voting arrangements.

Bedford's application to the DCA asked for approval for:

- Electronic counting for all the elections.
- Non-electronic advanced (early) voting for all the elections.
- For the Mayoral election only, the opportunity for the electorate to select "None of the above"
- For the Mayoral election only, the opportunity to use only one column for marking preferences with a 1 and a 2 instead of two columns.

Bedford's objective was to achieve an effective and speedy count which maintained the familiar look and feel of the election from the electors' point of view. Bedford also wanted to evaluate the speed of an electronic count compared to its accuracy.

Bedford specifically told the DCA in its application that the pilot scheme would enable them to:

- Improve the accuracy of the vote count
- Increase the efficiency of the administration procedures and the processes of the count.
- Improve the information using a visual aid to track voting progress.

Bedford applied for the pilot expecting that the electronic count would save time. They cited Lewisham in 2006 which had saved 3½ hours. "The verification instrument within the counting machine meant that both batches were electronically counted at the same time thus reducing the administrative costs of separating the ballot sheets." The 2002 Mayoral election in Bedford had taken 10 hours to count. Counting the second preference votes had been painstaking to avoid errors. Bedford hoped that electronic counting would simplify and remove the scope for errors during the consolidation of the second preference votes. Bedford stated in its Project Plan (Draft 1 19/03/07) that they expected the count to conclude in 6 hours from commencement.

Pilot scheme technical description

Electronic Counting

Bedford Borough Council was successful in gaining DCA approval for an election pilot scheme 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 is a Spanish Information Technologies and Defence Systems company, with revenues of over 2 billion Euros and 19,500 employees.

In the Mayoral election voters were asked to use a supplementary vote indicating only their first and second preferences in one column. The innovation of expressing only two preferences in one column only using a 1 or 2 rather than a double column representing both preferences with an 'X' was one of the non-electronic elements in the pilot.

In the Borough Council election and the Parish Council elections electors were asked to vote for up to the required number of candidates using crosses.

Electors were issued with two or three ballot papers of different colours and designs and asked to vote using the system of voting and marks specified. They then placed those two or three ballot papers into the same ballot box.

The electronic counting software had to be able to read both numbered preferential votes and crosses. It had to send to adjudication any ballot paper showing too many or no votes, Mayoral ballot papers with incorrect preferential votes and marks outside the square, and Borough and Parish Council ballot papers which used inadmissible marks. The software had to count valid votes and only count adjudicated votes once they were deemed valid.

Management of the pilot scheme

Project management

The project was sponsored by Bedford Borough Council's Service Manager (Registration and Administration) Mr Keith Simmons. Mr Simmons also acted as Deputy Returning Officer. The electronic counting pilot and the election were managed by Bedford as two separate projects.

A Project Initiation Document was drawn up by Bedford which defined Bedford's approach to the whole project including the technical elements of the project and included a section on Stakeholder Management, a Quality Plan, Acceptance Criteria, Project Controls, Risks, Issues, Highlight Reporting, Exceptions Reporting and reporting of lessons learned.

Indra drew up a Project Initiation Document and a Project Plan using Prince2 methodology. They generated complete documentation on the operation of their application including a manual of procedures to be used on the Count Day.

Training

Indra trained all the scanner staff 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.

Training in the operation of the equipment was provided by Indra's training officer.

Division of responsibilities

Indra supplied the hardware and software to deliver Bedford's requirement. Indra provided a project manager, training officer and four technical staff, and hired temporary staff in Bedford to operate the scanners and help pack up their equipment for return to Spain. Indra specified that temporary staff should have technical knowledge.

Indra's senior project manager oversaw the project in Bedford and a similar project at Breckland District Council. Bedford supplied the staff to carry out the first and second level adjudication.

The solution delivered in Breckland was said to be similar to that delivered in Bedford, though there were some differences in the requirement. Indra said that this provided them with the opportunity to cross-fertilise between the teams on issues which arose during the implementation.

Relationship management

The relationship between Bedford as client and Indra as suppliers remained collaborative throughout. Bedford was consistent and clear in defining its requirements. Indra was responsive to Bedford and did their best to deliver their requirements. They were also quick to alert Bedford to issues requiring their decision.

Bedford designed the user acceptance test and marked the ballot papers so they knew the 'result' of each of the elections to be electronically counted. They supplied staff to move the ballot boxes, sort the ballot papers, to carry out first and second level adjudication and to act as Returning Officer. For the testing, Indra staffed the scanners and supervised the scanner operators. The technical team of four monitored proceedings, supported the operation of the software and managed the servers.

On count day itself, Indra again staffed the scanners and servers. Bedford provided all other staff including personnel who carried out the adjudication, and handled the ballot boxes. The Bedford Chief Executive was in command as Returning Officer. The Bedford Service Manager (Registration and Administration) ran the operation as Deputy Returning Officer.

Indra drove the changes required to the ballot paper and liaised with the printer to ensure that the system was compatible with the layout of the ballot papers as printed.

Indra had a hand in drawing up the layout of the counting centre maintain the required balance between external scrutiny of the progress of the system and security.

Indra maintained contact with its sub-contractor Kodak who supplied the scanners. Bedford had no contact with Kodak. A Kodak technician was present at the acceptance tests and on count day.

Communications were frequent and effective. During the early stages of the project the project board met every two weeks, but from 18 April until the election on 3 May there were daily meetings between Indra and Bedford.

Bedford Borough Council accepted that Indra were deploying a bespoke electronic counting solution based upon established modules within their e-democracy suite of applications. Bedford recognised its responsibility to make sure that Indra adapted the solution to reflect the requirements of a British election.

There was no perceived conflict of interest between Indra providing a commercial service and the local authority where public service took precedence.

Process management

The process of handling the arrival of the ballot boxes and their management can be considered in two parts:

- The evening of the vote, when the boxes arrived and the ballot papers were sorted
- The day of the count

Thursday 3 May Evening of Election Day

When each box arrived, it was taken to the sorting desk allocated for that ballot box. The box seals were broken and the papers distributed to the table team for sorting into piles, according to the ballot. Each table had a team leader, who had been more fully briefed on process than the team. A sample of team members were queried by the Ovum evaluator. This revealed that all had been trained and knew the basic process. However, some additional guidance was provided by the team leader during the early stages of sorting.

Different teams employed different approaches to 'cleaning' excess stub from the papers (not cleanly torn along the perforations). Some teams cleaned the papers very well, others partially and some did not seem to bother.

Boxes were taken to the Ballot Verification station and the record of the number of issued ballot papers, based on counterfoil numbers recorded by the polling station officer, was entered into the electronic count system.

The distribution of boxes, resealing and removal of boxes to overnight storage was overseen and undertaken by council staff. Overnight storage, in the main count hall, was well ordered by ballot box number.

Friday 4 May Count day

At the start of the count, one ballot box was taken to the first scanning station. The process of opening, retrieving the papers, showing the open, empty box to observers and the full scanning process was stepped through slowly to ensure that the process was understood and clear to all the scanning operators. Subsequently, ballot boxes were taken to the scanning stations by council staff, the seals broken and the process handed over to the scanning staff who had been recruited by Indra and were very effectively supervised.

Once all the papers for a Ballot Box were scanned, the number scanned was checked against the Ballot Account. If the number tallied the images were released to the system. If not the Returning Officer could either accept the number scanned or order a re-scan. If a re-scan was ordered the system had to be re-set to clear all previous images for that election for that Ballot Box from the system. The system never deletes an image for audit proposes. If a re-scan was ordered the system renamed old images for that particular Ballot box before scaning it again.

Once released to the system the system counted the votes as programmed but sent to First Level Adjudication those which it could not count. The process of counting was invisible to observers within the count centre. The Returning Officer was the only person able to see the progress of the count.

Attention then focussed on the First Level Adjudication. Adjudicators were able to accept or reject a ballot image. This decision could be queried by observers who could see the Adjudicator's screen on a monitor. If accepted the Adjudicator marked the elector's votes onto the system and the votes were counted.

If the image was sent to second level adjudication the process was repeated but the determination was made by a higher level official, the Deputy Returning Officer or the Returning Officer.

Once Second Level Adjudication was complete the Returning Officer was able to see the final result. If satisfied he was able to inform the candidates and agents of the result he proposed to declare. If they accepted the result he was able to declare the result.

If the Returning Officer was not satisfied or the candidates or agents were not satisfied he was able to deal with the issues raised, resolve them and move to a declaration.

Contractual Relationship

This was conducted in accordance with procedures laid down within the DCA Framework Agreement. The contract was in the form of an Order from Bedford to Indra which referred to the technical specification included in the Indra proposal to Bedford.

The Bedford project manager, Mr Simmons, was responsible for the contract.

Risk and contingency management

Bedford, in its Project Initiation Document (PID) identified the key risks as:

- One or more aspects of the pilot prevent the delivery of an accurate result
- Customer quality expectations are not delivered

Customer quality expectations were identified as:

- That information about the electronic counting system is published and accessible by the electorate and other stakeholders.
- The count venue is set up in time for the start of the count.
- The scanners and hard wired mini-network provided by Indra operates properly
- The system accurately identifies the total number of ballot papers for each election and provides comparison with the ballot paper account concerned.

- Valid ballot papers are accurately identified and adjudication of doubtful ballot papers is accommodated by the system
- Valid ballot papers (including those originally marked doubtful and then adjudicated as valid) are counted with votes allocated accurately to the candidate(s) marked by the voter (and as determined by adjudication if necessary).
- Information on the progress of the counts is displayed for candidates, agents and other observers, including an accurate pictorial image of the allocation of votes to the candidates in the election.
- The stored electronic data is provided back to the Council for safe keeping with the ballot papers
- The count concludes within a timeframe of 6 hours from commencement.

Bedford's back up plan in the case of a major failure was to conduct a manual count. This was considered by the Returning Officer at 12 noon on count day but not felt necessary. By this time the Returning Officer was aware that the count was running slower than anticipated. This was the last time at which it was practical to call staff over from the Town Hall to commence a manual count in view of the impending Bank Holiday weekend.

The political agents asked for a manual count at midnight on count day because they believed the count would not be completed electronically that night, but this was refused by the Returning Officer. He deemed the integrity of the count sound and judged that that the electronic count could be completed within a few hours of that time (it was completed within two hours).

A second centre in south Bedford was available as a stand-by if counting had to continue on Saturday 5 May or Tuesday 8 May.

Indra maintained a Risk Register throughout the project. The Count Centre had its own back-up power supply in the event of mains power failure. Indra provided UPS to the servers, which provided about 15 minutes of power to allow systems to be shut down securely maintaining the integrity of the data.

Indra's contingency included

- Backup arrangements for the system
- Personnel back up arrangements
- Resilience and elimination of single points of failure
- Sufficiency of capacity for the expected volume and stress on the system
- Protection against electronic attacks
- Protection against loss of power to the Count Centre
- Plans for ensuring security of the service in case the Count Centre had to be temporarily abandoned.

Three servers were provided. One running the main processes, one with data and one with an image of both as backup in case of server failure.

Indra claimed that their servers would run at 20% load maximum but real time graphics observed during the count indicated much higher loads.

The electronic counting system operated on a local area network with no external or Internet access. There were no redundant security links.

Spares of laptops and printers were held but only basic spares were held for the scanners. All scanners appeared brand new. A Kodak technician was on site throughout. It was explained that even if spares were held it would take too long to install during the count. Indra had a scanner available for backup.

Availability issues

Sufficient hardware was available on the day of the count and during the acceptance tests. The printer supplier failed to supply test ballot papers for the first and second acceptance tests. On both occasions test ballot papers printed in house by Bedford had to be used.

Equipment supplied by Indra was only used for the purposes of electronic counting.

Testing approaches

The acceptance test on 24 April was observed by the Ovum Evaluator, who was also present for a re-test on 30 April. The re-test involved a limited number of ballot papers for three elections in one ward.

In the full scale acceptance test on 24 April 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.

All the ballot papers tested performed as expected. That is, valid papers displaying the required number of votes using valid marks were counted. All papers which did not conform to definition of a valid paper were sent to adjudication.

However, an unexpectedly high number of Mayoral test papers were sent to adjudication because they were marked with only one vote. Bedford explained that it was anticipated that a lot of electors would express only their first preference vote. They wished to test this option. The outcome was that the system did recognise these as a valid vote but sent it to adjudication because it was an undervoted ballot and thus an unexpected number of papers were sent to adjudication.

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). Under votes where the voter expressed only one preference but used an invalid mark (for example a X or * or a numeral other than 1) were sent to adjudication.

In the test:

- Of 4,631 Mayoral papers scanned 38% were sent to adjudication.
- Of 2,858 Borough Council papers scanned, 17% were sent to adjudication.
- Of 718 Parish Council papers scanned 39% were sent to adjudication.

Following the test it was agreed that voters would be supplied with black biros with which to make their mark rather than pencils to improve the clarity of the scanned image. This issue arose, typically, where the vote had been marked lightly or had been erased and remarked for another candidate.

At the re-test ballot papers had been prepared for the three elections in one ward. These test papers had been printed by Bedford in-house. Bedford marked the test papers according to a template list of doubtful papers supplied by the DCA. All the valid papers were counted. All the doubtful papers went to adjudication. All the under votes were correctly dealt with by the system. The machine gave the result exactly as expected by Bedford. That is, each test candidate got the number of votes marked on the test papers. The test was declared valid.

At the re-test a discussion took place about the means available to verify that the system had correctly allocated second preference votes. Indra informed Bedford that if this was an issue at the count a print-out could be provided of all first and second preference votes. It was, of course, always possible for a manual count to take place to check the result delivered by the system.

At both tests the software demonstrated that it could correctly identify characters and marks, and recognise characters out of sequence.

Technology

Hardware and technical layout

Indra applications interfaced with Kodak i600 scanners. Four scanners were initially proposed but Bedford requested that six be provided.

Three servers were used, operated by four Indra technical staff. Scanner operators had laptop computers providing a control panel for operating the scanner. Adjudicators and the Returning Officer used laptop computers supplied by Indra which provided password controlled access to the system. Observer screens were provided at the scanner and adjudication stations.

Two large digital displays projected onto screens within the Count Centre displayed information on the progress of the count.

Overall, the hardware seemed to work well. The scanners experienced some jams, but these were fairly minimal, and both the Indra team and the Kodak representative were on hand to address any issues with scanning. The scanning of perforated ballots, which had been torn at the polling station, caused problems with the scanning equipment. This is described further below.

Process operation

System Zeroed

At the outset the system was zeroed. A series of reports were printed and signed off by the Deputy Returning Officer. This verified that no ballot papers or votes were held in the system. Once the zero report was accepted ballot box registration could begin.

Ballot Box Registration

Each ballot box contained a sheet for each election called the Ballot Account. On this sheet the presiding officer at the polling station indicated the number of ballot papers issued for the respective election. For each election the number of each ballot box was entered onto the system as well as the number of ballot papers in each box. The ballot box was then allocated to a scanner.

Scanning

Scanner staff were briefed at the start of the day by the Indra staff responsible for the scanning process, and they were in place by 09:20am, ready to start the count at 10:00am. Individual scanner staff had been well trained beforehand and had advice support when they needed it. There were additional scanning station staff on hand to provide cover for staff breaks, if needed.

Staff at the observer stations and adjudication stations were also in place and well briefed.

At the start of the count day, one ballot box was taken to the first scanning station. The process of opening, retrieving the papers, showing the open, empty box to observers and the full scanning process was stepped through slowly to ensure that the process was understood and clear to all the scanning operators. Subsequently, ballot boxes were taken to the scanning stations by council staff, the seals broken and the process handed over to the scanning staff who had been recruited by Indra and were very effectively supervised.

The papers contained by an elastic band were stacked in the tray to the left of the scanning station. The operator took each batch in turn, and loaded them into the scanner tray. The operator then clicked a button on his desk top to start the scanning process. In many cases the papers had to be squared together to help make sure that they would feed into the scanner cleanly. Papers normally fed through the scanners cleanly, but on some occasions, the input pile needed slight pressure to overcome the cumulative crease profile, which prevented some papers being drawn easily into the scanner.

Scanning continued until each bundle was processed by the scanner.

The scanner captured the images of the ballot paper, back and front.

After scanning each batch of papers, they were wrapped in their red count printout and elastic band, and stacked in the tray to the right of the scanner.

At the end of the scanning process, papers and their red wrappers were returned to the ballot boxes. Trained and competent council staff then stacked the ballot boxes in an ordered fashion in a pre-allocated area of the count room.

Ballot Box Verification

The goal of Ballot Box Verification was to check the number of ballot papers scanned from each box against the number expected according to the Ballot Account.

Once all the bundles for the specific election in that ward were scanned the number of ballot papers scanned for each election was checked against the number on the presiding officer's sheet. If the number was the same the ballot box was verified. If the number was different a re-scan was ordered. The scanner was re-set. In other words the system was cleared of the ballot papers previously scanned.

If the re-scan produced the same number as previously obtained the Returning Officer was prepared to accept the number, provided it was within plus or minus 10 of the number given by the Polling Station staff on the Ballot Account. If the number of ballot papers scanned was greater or lower than this, however, the Returning Officer could have ordered a manual count of papers in that box. This did not occur during this pilot.

Once a ballot box was verified the images of the ballot papers were released to the system. Images of papers deemed valid were sent to the Programme Control module and counted. Ballot papers which were not deemed valid were sent instead to the First Level Adjudication module.

Thresholds

The thresholds for papers sent to adjudication were defined by Bedford Borough Council. The system sent to adjudication any ballot that:

- Had any mark outside the square provided for the voter to mark their vote
- Any mark in the square that did not match with the official mark (X for Borough and Parish elections; 1 and 2 for the Mayoral election.)
- Torn ballots.

First Level Adjudication

At First Level Adjudication the adjudicator was presented with an image of the ballot paper. The image was of high quality and sufficiently clear for the adjudicator to see all the marks on the paper, valid and otherwise. The adjudicator could also flip the image to see the back of the paper including the bar code, if required.

The expectation was that the system would be able to count the majority of the votes. Most votes sent to First Level Adjudication were dealt with either by accepting the votes, in which case the Adjudicator marked the valid votes in boxes provided on screen, or by rejecting the vote as invalid. The Adjudicator was able to accept the ballot paper, reject it or send it to Second Level Adjudication. If that rejection was disputed the ballot paper could be sent to Second Level Adjudication. The First Level Adjudicator could also decide to send votes to Second Level Adjudication.

Second Level Adjudication

Second Level Adjudication dealt with more complex issues including ballot papers where the voter's intention was unclear. It was conducted by the Returning Officer or his Deputy or a similar senior official.

Returning Officer

The Returning Officer alone could see the progress of the count. He was also the first to see the results to be declared. The Returning Officer used this information in his discussions with candidates' agents, including the intimation of the results to be declared.

Declaration of results

The Returning Officer declared the results verbally from a platform positioned at one end of the Count Centre. Declared results were then projected onto the large visual displays within the Count Centre.

Software

- Indra provided a bespoke electronic counting solution based upon established modules within their e-democracy suite of applications. Indra reported that 15% of the application was bespoke to meet Bedford's specific requirements. The adaptations were:
    - Ballot Box Registration
    - Ballot Box Verification
    - First Level Adjudication
    - Second Level Adjudication
    - Result Declaration
    - Ballot Information
    - Manual Adjudication
    - Reports

All the modules were also used in electronic counting pilot in Breckland. The core of system had been used in previous elections for example in Oslo during 2003 and 2005.

The suite of applications contained ten modules:

- Scanner control
- Storage control
- Verification of ballot box
- First and second level Adjudication
- Progress control (the vote count took place in this module)
- Manual entry
- Ballot information
- Count progress
- Result declaration
- Reports

Further description of the modules including an architecture diagram showing the relationships between modules was not supplied to Ovum although it is understood from Indra that they supplied a copy in a meeting they had with the DCA.

A propriety algorithm, ReadSoft Eyes & Hands was used for the Optical Character Recognition (OCR) and Intelligent Character Recognition (ICR) recognition of marks on the ballot paper. The OCR and ICR software worked as expected.

ReadSoft is a Swedish based global software company selling software for data capture for process and transaction management. “Eyes and Hands” is the name given by ReadSoft to their applications.

According to ReadSoft’s web site, “OCR (Optical Character Recognition) is a key element of ReadSoft's automatic data capture technology. It is the OCR technology which enables our products FORMS and INVOICES to read what is written on a document. When a form or an invoice is scanned, it is made into an image which the software can process. It is from this image that ReadSoft can capture, interpret, verify and transfer information. OCR is one of the techniques in ReadSoft's interpretation engine capturing machine print, handwriting, checkboxes, barcodes etc.”

They define ICR, Intelligent Character Recognition as follows:

“ICR (Intelligent Character Recognition) is a further development of the OCR (Optical Character Recognition) technology. ICR allows the software to recognize handwritten characters while OCR deals with machine print. It is the ICR technology which allows our data capture product to read information from, for example, a mail order form where the applicant has filled in the fields by hand.”

Security and fraud

DCA QA Audit

The DCA implemented a QA audit process to check all aspects of system security. The QA process consisted of a telephone interview, which was not observed by the technical evaluator, and all day site visit which was observed. No penetration tests of the system were carried out by the QA auditor.

The site visit established a clear definition of Indra's and Bedford's security responsibilities. These were written into a Project Responsibilities Matrix. Indra's Security Plan produced by the supplier was cross referenced to the Project Responsibilities Matrix which met ISO 27001 requirements.

During the telephone QA interview Indra made available the first draft Security Plan

During the site visit the following additional documents were made available.

- Updated version of the security plan taking into account the issues discussed during the telephone interview;
- The minutes of the meeting containing the Project Responsibilities Matrix (PRM);
- Traceability matrix of the security plan to ISO 27001 requirements and controls;
- The Count Procedures document;
- A draft plan of the physical configuration of the counting site.

A final plan of the physical configuration of the Count Centre was produced by Indra and approved by Bedford. This placed equipment, including the RO terminal, observer and cables as recommended in the QA audit including the installation of physical barriers between the observer area, the scanning/adjudication areas and the central services. The site had 24 hour protection by security guards and the police.

A clear screen policy (i.e. to ensure the screen is blank when unmanned) especially in respect of the Returning Officer's screen was implemented.

The QA auditor satisfied himself over plans for the safe storage of data and software and subsequent post-election erasure of systems of all cast votes before the equipment was shipped outside the UK.

Indra reported that the QA process gave them a better analysis of risks and made them revise their contingency plans.

System security

During the development, acceptance tests and live count the servers, scanners and laptop computers were placed on an isolated Local Area Network with no external or Internet access. All the laptop computers, servers and scanners were clean builds.

The software was frozen by the Indra on 1 May but one amendment was made on count day on instructions from Bedford.

Following the election

- Bedford 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 discs had been erased and re-formatted. Indra reported that all laptops and RAID arrays on the servers were re-formatted to be used by other Indra projects.
- Indra reported that all the servers were cleaned with the following process:
    - Deleted of the OS
    - Use of the Disk Redactor tool
    - Wiping all free unused space on the disks and writing a big file with zeros to overwrite all old (deleted) files on the drives.
    - After using Disk Redactor, all old data will be erased completely without any chances for its recovery.
    - Undone and done in different order all the RAID units with NetApp tool.
- Indra had lodged a sealed copy of the run time software and related logs with their lawyers in Spain.

Count security

Issuing of passwords

Passwords were issued to all Indra and Bedford staff with access to the system. They were issued to Bedford and Indra staff during the training sessions but these expired at midnight on Wednesday 2 May. New passwords were issued on both Thursday 3 May and Friday 4 May. A procedure was established for the issue of passwords to additional or replacement staff trained and used on either 3 May or 4 May.

Indra created a detailed access log showing all interactions with the system. The log details who interacted with the system, the operations carried out and when the interaction occurred.

Confidentiality of votes

The confidentiality of votes was not compromised. 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. This list was kept separate from the cast votes. Numbers were not written on the counterfoils of ballot papers.

The integrity of the vote

The use of unique identifiers on the ballot papers protected the integrity of the vote. Indra reported "Each ballot had a unique identification number and a printed official mark in thermo-reactive ink."

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.

Ballot boxes were handled only by Bedford staff. Bundles of votes were transferred from the box to the scanner by Indra staff but closely observed by counting agents appointed by the candidates.

Once the votes scanned were verified against the number on the Ballot Account, it was not possible to introduce additional votes to the system.

Scanned bundles were wrapped in red papers indicating that they had been scanned.

Individual papers could be retrieved and compared with on screen images.

When the count was complete the ballot papers scanned equalled the number of votes counted.

During the adjudication observers complained that they saw the same ballot papers being adjudicated more than once. This was caused by a bottleneck in the system during periods of heavy usage which caused papers to return to adjudication rather than be counted. If a ballot was re-adjudicated the earlier adjudication was over-written. Whilst the existence of this bottleneck was not entirely satisfactory its consequence was that some ballot papers were thoroughly adjudicated by repeat adjudication.

Indra reported that they did not know the number of ballots which had to be re-adjudicated. They believe it happened because there was an 'overflow' of ballots in adjudication. Because of this the system could not save the ballot so it recycled to adjudication.

The voter experience at the polling station

The voter interacted with the system at the polling station. These procedures were observed by the Commission evaluator. The ballot papers looked like those used in previous elections except that the face of the paper showed the four crosses used

to locate each ballot in the scanner and the reverse of the paper showed a barcode and unique identification number.

The official mark was made on the paper with a rubber stamp using photosensitive ink. Polling station staff were asked to make this mark on the reverse of the paper.

The system was therefore set up to expect to read a mark on the reverse of the ballot paper. Some marks were, however, made on the front of the paper, and were thus detected as 'noise' and sent to first level adjudication.

Fraud

No opportunity for fraud was identified arising from the system for the electronic counting of votes. The safeguards included the use of unique identifiers for ballot papers, ballot box verification, the access log, the ability to examine every ballot on screen and on paper, if required, and to count all or part of the vote by hand.

The isolation of the LAN from any external network prevented additional votes from being introduced.

It was not possible for operators to change the scanned image or gain access to the counting algorithm.

The storage of the run time software and scanned images (in separate places) means that a court could order a specific ballot, or the whole count, to be re-run under controlled conditions to check the declared result. This result could be checked against a result obtained by a manual count.

Adjudicators could enter votes to the system on behalf of electors, based on their interpretation of the elector's intentions as viewed on the scanned image. This process was subject to close observation by agents appointed by the candidates. The scanned image could also be checked against the actual paper.

Impact on the counting process

The technology came into play at the close of poll on Election Day. The technology supported a workflow designed by Bedford.

At the polling stations voters had been issued with two (or three in the wards which also had Parish Council elections) differently coloured ballot papers.

As ballot boxes arrived at the Count Centre they were located in a specified place. Ballot boxes were taken in turn to a table and emptied. The ballot papers for each election were unfolded and sorted face down into piles.

Before the technology engaged with the workflow the system was zeroed witnessed by the Deputy Returning Officer.

Ballot boxes were then registered with the system and allocated to a scanner. Council staff took the ballot boxes to the allocated scanner.

Scanning of ballots

The scanner operator took the bundles of ballot papers out of the box and placed them onto the scanner and commenced the scan. It was quickly discovered that the scanner operator had to apply a little manual pressure to the pile of papers to get them to run through the machine smoothly. This meant that that operator could not prepare the next bundle for scanning until the first was completed.

When scanned the papers were removed from the stack at the rear of the machine and wrapped with a red paper indicating a scanned bundle. The scanned bundle was placed in the ballot box.

If the number of scanned papers corresponded with the number on the Ballot Account the box was verified and the images were released to the system. Valid votes were sent to the Progress Control module and were counted. The doubtful papers were sent to First Level Adjudication.

If not the Returning Officer could either accept the number scanned or order a re-scan. If a re-scan was ordered the system had to be re-set to clear all previous images for that election for that Ballot Box from the system. The system never deletes an image for audit proposes. If a re-scan was ordered the system renamed old images for that particular Ballot box and cleared the scanned votes frm the machine before scanning it again The bundles were then re-scanned. If the number scanned remained the same the Returning Officer verified the number according to the number scanned, amending the Ballot Account.

Re-sets occurred in 6 of 189 boxes because there was a discrepancy between the Ballot Account and the number of papers scanned. In five of the six cases the discrepancy was small but in one ward it was 100 papers. In this case it was

concluded that a gross arithmetic error had happened in respect of that Ballot Account.

Re-sets were not ordered due to no results being contested, uncertainty or routine cross-checking.

All scanning was finished by 6:30 pm on Count Day.

First Level Adjudication

More valid votes than anticipated were sent to First Level Adjudication as following the acceptance test it was decided that Mayoral votes with only one vote on would be allowed through without being sent for adjudication. Of 82,889 papers issued for all three elections 21488 (25.9%) were sent to Adjudication. The breakdown is provided in the following table.

Election	ballot papers counted	Ballots sent to First Level Adjudication	Ballots sent to Second Level Adjudication	Percentage to total counted sent to First Level Adjudication	Percentage of total counted sent to Second Level Adjudication
Mayor	45641	17364	584	38.04%	1.28%
Borough	35913	4643	160	12.93%	0.45%
Parish	1335	306	81	22.92%	6.07%
Totals	82889	21488	825	25.92%	1.00%

Four issues caused valid votes to be sent to First Level Adjudication:

- The ballot papers had been printed in books. Polling clerks had to tear the ballot paper from the book along a perforation. The paper used for printing the ballot papers was tougher than expected. As a result many papers were torn or parts of the perforation remained on the ballot paper. At some stations clerks had removed the staples from the books and had given the voter the whole sheet including the blank counterfoil beyond the perforation. The consequence was that the ballot paper was rejected because it did not conform to the template. Indra responded, on instruction from Bedford, by changing the template to include the perforation.
- The polling clerk had to verify the validity of each paper by stamping it with a photo-sensitive ink. This mark should have been on the reverse of the paper but in some cases it was on the front of the paper. Incorrectly stamped papers did not conform to the template and were sent to First Level Adjudication.
- The voters were asked to use crosses (X) in the Borough and Parish Elections and express two preferences (1 and 2) using numerals in the Mayoral election.

A ballot paper marked with an inadmissible mark was sent to First Level Adjudication.

- The printer failed to supply enough postal votes in four wards. Bedford made good the deficit by using papers printed in house but the positioning marks on the paper were out of true. Each paper showed four crosses (+) on the front which allowed the machine to locate and identify each paper for each election. In this case the crosses were 1 mm out of position of the in-house papers causing all these papers to be sent to first level adjudication. Once this issue was identified Indra again adjusted the template on Bedford's agreement.

The whole system was down during periods when the templates were being adjusted and re-loaded on the system. Scanning and adjudication was at a halt during these periods. The system had to be re-started with the new templates before scanning could re-commence.

Bedford responded by allocating more staff to First Level Adjudication.

Cost and value for money

When Bedford engaged Indra, Indra sent a costed proposal based on Bedford's requirements. Bedford confirmed that proposal (except they increased the number of scanners from 4 to 6) by way of a purchase order.

Bedford stated in its Pilot Application to the DCA that costs were likely to exceed £144,371. A manual count was estimated at nil cost by Bedford on the grounds that as counting was to take place during the normal working day council staff would simply be re-deployed from their normal roles. However, overtime payments would have been incurred if the count had extended beyond the normal working day. Bedford estimated that carrying out a full manual count on Saturday 5 May would have cost £40,000.

The full breakdown of costs for the electronic pilot is yet to be completed. However, Indra's charge, as per their proposal, was £150,792, plus an additional cost of £15,000 for the inclusion of two extra scanners (£7,500 each). This gave a total of £165,792.

The Parish elections took place in four wards but even in those wards the whole electorate was not involved because the parishes were geographically smaller than the wards used for Borough Council purposes.

The total electorate for the Borough elections on 3 May 2007 was 113,905. The total electorate who were also eligible to vote in the four parish elections was 2,303.

The cost per elector was £1.46.

The cost per ballot paper issued was £2.00.

The detail of how these figures were derived is shown in the following table.

Cost of electronic counting	£165,792.00	
Total electorate	113905	
Total electorate also able to vote in Parish elections	2333	(A sub-set of the total electorate)
Ballot papers issued	82889	
Cost per elector	£1.46	Cost of electronic counting divided by total electorate
Cost per ballot paper issued	£2.00	Cost of electronic counting divided by number of ballot papers issued

Conclusions and findings

Conclusions

Ovum's conclusions in relation to the technical aspects of the electoral pilot scheme in Bedford are as follows:

Counting of votes was facilitated by the system. The scheme was not expected to facilitate voting, only the counting of votes. The electronic counting solution produced a sound result, exactly equating the number of votes counted with the number verified, but it took much longer to count than expected.

Procedures were easy to use on the part of voters. The electronic count had no impact on the procedure used by voters at the polling station. The ballot paper used was almost identical to the ballot paper used in a manual count.

The potential risk of personation or other offences or malpractice was low. There was no evidence to suggest that this took place. The integrity of the results declared was not compromised by the use of an electronic system. The system showed the number of votes scanned corresponded with the number of votes counted

Learning and issues arising

The time taken was greater than anticipated, but turnout was also higher. Ballot boxes were sorted on Election Night (3 May). Ballot Box scanning started at 10:00 am on Count Day (Friday 4 May). The electronic count concluded at 1:30 am on Saturday 5 May. This meant that the whole electronic count took a total of 15½ hours, with the scanning element being completed after 8½ hours. Bedford did not therefore achieve its stated objective of concluding the count in 6 hours. However this has to be weighed against the time a manual count would have taken. If, as in 2002, it took 10 hours to carry out a manual count for the Mayoral votes, it would have taken several hours longer to carry out manual counts of the Borough Council elections and Parish Elections. The 2007 Mayoral election involved more than twice the votes than the 2002 election. In the 2002 Mayoral election turnout was 18%. In 2007 turnout was 41%. Nevertheless, Bedford and Indra worked well to resolve the issues faced on Count Day. Indra responded promptly and effectively to the issues as they arose.

The scanning rate was slower than expected and more operators could have helped address this. The assumption had been made based on the specification of the scanners that the ballot papers would be scanned at a rate of 120 ballot papers per minute. In fact the scan rate was only 27 papers per minute. Scanning was slowed by

- the time it took to organise the ballots to be scanned

- the need to re-scan already scanned ballot boxes
- re-organisation of the scanner queues
- the need to use different templates for poll day and postal ballots.

No information is available on the scan rate during the acceptance test, but this was conducted using cut rather than perforated paper. At the scale of the acceptance test the scanning worked well; it was the sheer volume of the task on count day which appeared to slow the process. Using more scanners would have reduced the time taken by scanning. Providing two staff per scanner instead of one would have increased the scan rate because one member of staff could have ensured the ballots went through the machine whilst the other could have organised the next bundle for scanning. However these measures would only have reduced the time of the count if more staff had been deployed at First Level Adjudication.

Problems with the ballot papers used on count day slowed the process also. The use of perforated ballot papers and the way the ballot papers had been folded caused issues which slowed the scanning. Scanning staff found that they had to apply light manual pressure to the ballot paper to encourage them to go through the automatic sheet feeder. Issues relating to the ballot paper also increased the number of images of ballots sent to First Level Adjudication. These were:

- the use of different designs of papers for postal votes compared to Election Day. This caused a delay on Count Day because templates had to be adjusted to accept the postal votes, and this caused some system down time.
- The perforations on the ballots, especially those for the Mayoral election were defective and caused papers to be torn; torn papers were sent to First Level Adjudication.
- The official mark in some instances had been placed in the wrong place leading to an increase in the number of ballots sent for adjudication

Actual ballot papers had not been tested prior to the count. It was already known from the acceptance tests that adjudication was a lengthy process. The issues which caused a higher number of papers than anticipated to go to adjudication are listed above. The testing had shown that torn papers containing valid votes would go to adjudication. Neither acceptance test used the actual ballot papers. Significantly the test ballot papers used were cut rather than perforated. None had been torn from ballot books. Also the use of different ballots for the test compared with the actual election meant that Indra had to redefine the template after the test and prior to the actual count, but some of the postal ballots had used ballots printed in-house bu Beford (as was the case for the test) making the process much more complex than was necessary or anticipated.

The re-adjudication of circulating ballot papers caused confusion and concern amongst observers at the Count. This issue slowed the adjudication but it did not affect the integrity of the vote. No metric could be obtained on the scale of this issue. The number of votes judged invalid after adjudication was in

line with the number found to be invalid in a manually counted election. For example, the number of invalid Mayoral ballot papers was 4.6%

The management of queues within the adjudication should be examined. The queue management system allocated to the next available ballot paper to the next available adjudication station. This meant that adjudicators and observers sometimes saw different papers for different elections. This may have slowed the work rate. If queue management allocated specific elections to specific adjudication screens this could provide the Adjudicators and Observers with more continuity thus increasing the rate of adjudication.

One Election day, three elections, two voting systems. The electronic counting system coped well with the count of three elections using two voting systems.

The client–supplier relationship stood the test of the count day and worked well. Bedford was clear and consistent in its requests to Indra. Indra was well resourced with committed and suitably qualified staff who responded positively and professionally to all of Bedford's requests. Indra delivered a system as specified by Bedford's requirements.

The political stakeholders were given a transparent process emulating a manual count. Bedford achieved its goal of presenting its political stakeholders, that is the candidates and their agents and supporters present at the count, with a transparent process which closely followed the procedures of a manual count. The political stakeholders, naturally, felt frustrated with the electronic system because their perception was that it would speed up the count. Apart from the issue of time, none of the stakeholders questioned the integrity of the system or the results achieved.

The system, however, removed the competitive element. In a manual count piles of counted votes are stored in rows for each candidate. It is thus possible for the political stakeholders to see the progress of the count and to see how their candidate is faring. Agents can see the comparative position of their candidate to the other candidates. This element was not present with this electronic counting solution. As each bundle of votes was passed through the scanner it restacked on the other side just as it had been before scanning. There was no visible check on the number of votes cast for each candidate. It is difficult to see how any electronic counting system could also sort the physical ballot papers votes into piles. It is recommended that it is required of future systems that the large electronic displays show the progress of the count – this might duplicate the piles of ballot papers traditionally witnessed during a manual count. As it was, the electronic displays only showed the scanner queues and the declaration of the results.