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Going mobile: the move to true mobile working

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1 Executive Summary

As a result of efficiency initiatives driven by regulatory price reductions, South East Water (SEW) introduced significant changes in its operational structure. The ability to make the most effective use of field-based staff is essential in reinforcing and continuing these efficiencies. In particular, SEW's Activity Based Costing (ABC) exercise through 1999 and 2000 clearly demonstrated the tangible potential for streamlining the activities of field-based staff. This view was also endorsed by Cambridge Management Consultants (CMC) who worked with SEW during the initial stages of the organisational restructuring.   A large amount of time and cost was previously being incurred by staff visiting offices and depots to collect work instructions and feed back progress and data updates.

On-going operating- efficiency targets of 4% per annum dictated that the company continued to seek efficiencies throughout the business.

It was recognised that an improvement in the efficiency of field staff could be achieved by giving staff access to the information needed to carry out their jobs without the need to visit depots and offices on a daily basis.   Field-based staff also needed the ability to submit information back to the system by the same route.

The other key change, in terms of service delivery, was the extension of the working day. This now covers the period 7am-7pm and works in conjunction with the operating hours of the call centre. Therefore in terms of service delivery the technical solution must provide real time access to data.

2 Introduction

The approach to the project was determined through two initiatives. Firstly, the work carried out in the ABC exercise and by CMC determined the business processes and workflow requirements. Secondly, an extensive consultation exercise was undertaken with operational and managerial staff.

2.1 Objectives

The prime aim of the project was to enable staff to have direct access to information whilst in the field. A decision was taken that regular near-real time updates were necessary in order to enable accurate job status to be monitored by management and provided as information to customers. This would enable operational staff to reduce the time required to carry out customer and work management tasks and minimise travelling time and costs between offices and depots. Productivity could therefore increase with a greater number of jobs being completed satisfactorily within a given period of time. Typical activities included within the scope of the project are mains shutdowns, water regulation inspections and meter installations.

Reduction in paperwork was an additional objective of the project. The current processing of works management and GIS applications is paper-intensive. These high cost and low efficient processes would be curtailed through the new electronic management of processes and data. Improvements in levels of service are also sought from this project.

The restructuring divided operational requirements into four areas; Leakage, Contracts, Production and Networks. The Networks group (44 staff) is directly responsible for the distribution mains network and customer focused activities relating to water supply, this being the most critical area was the focus for this project.

3 Business Case

Prior to restructuring all operational work was depot centric, operational staff (inspectors) would have scheduled work allocated on a daily / weekly basis. Job sheets, GIS plans and other necessary documentation would be collected and then remain with inspectors until the work was completed. Emergency / unplanned work would be passed to an inspector over the phone, again any necessary information was only available at the depot or via the inspectors own, unofficial, records. Any feedback or system updates had to wait until the inspector returned the job sheet to the depot where administration staff would input the data.

This process clearly had a number of disadvantages.

- The printed job sheet became the focus of work; the works management system was only valid when the feedback data had been entered. This could be weeks after completion.

- The divorcing of responsibility for data entry and system updating from the actual work resulted in poor quality / incomplete data updates, particularly in the GIS system. It could prove difficult to translate hand drawn sketches and scribbled notes into reality; attribute data was frequently either missed totally or only partially completed.

- The management of jobs was made difficult by the inability to determine each inspectors real workload; many jobs theoretically in progress were in fact awaiting data entry.

- Customer services centered at Head office and managed via a call centre were rarely in possession of the information to deal effectively with calls. Customer calls tended to migrate down to the depot preventing admin staff from dealing with system updates within a reasonable timescale.

- Excessive travelling time was incurred returning to and from the depot.

- Lack of data at the point of work and incomplete system data encouraged the maintenance of individual records; black books.

- Access to data and systems out of normal working hours was very limited.

The impact of these could be mitigated where inspectors were local to a depot, however when the local depot was no longer available the impact was potentially severe both in terms of cost and operational risk.

A full cost benefit analysis was carried out by South East Water which quantified that savings in excess of 363 man hours per year per inspector could be achieved (equating to 8 full time inspectors). It is anticipated that any saved resource will be reallocated in order to achieve improvements in other areas of the business, such as the following:

- Improvements to business efficiency

- Reductions in operational costs

- Better management and reporting of asset data

- Improvements to job management

- Improvements to customer relations

- Better preparation for competition

- New regulatory requirements

Actual benefits achieved will be measured using the following performance criteria:

- Reduction in average time to complete a job

- Rate of data corrections returned from field

- Reduction in missed appointments and reduction in repeat visits

- Reduced risk of prosecution

Cost savings which can be achieved by reduced travel time for each job has been equated to the requirement for an additional eight full time inspector posts. Additional reduction in depot administration and customer services time would also be realised. The following graph is an example and indicator of the level of completed jobs which it is anticipated could be achieved. The information relates to work carried out in June 2000 as analysed by the South East Water operational managers:
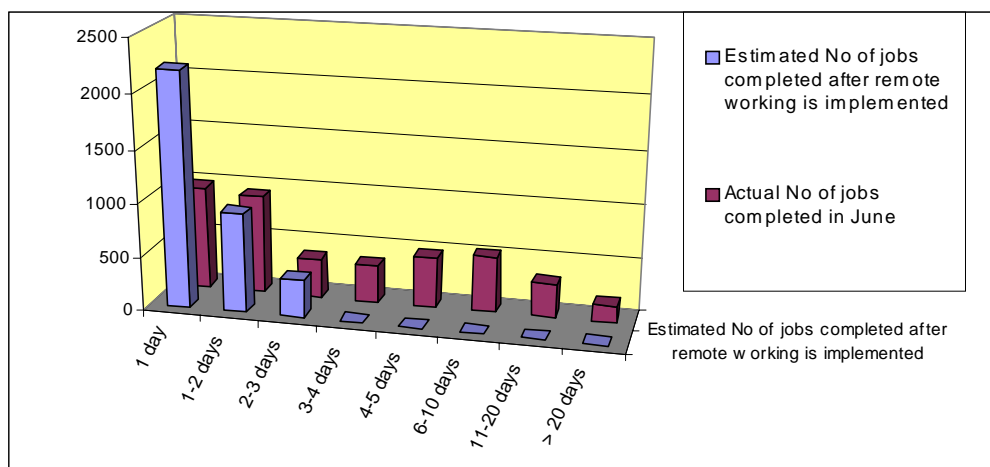
4 Solution

The business imperative was to move quickly to a mobile working environment where staff had full access to core business systems without recourse to a depot.   Consequently the project was divided into three phases.

4.1 Phase 1

To meet the business imperative a short-term and relatively inexpensive measure was designed to reduce travelling to and from a depot and improve the flow of jobs. Each inspector was issued with an internet enabled fax machine and a business only telephone line (PSTN) was installed. Job sheets generated from the works management system were e-faxed to the scheduled inspector each evening or early morning. Feedback was returned by the same method on a daily basis. There were a number advantages to this method:

- Technically simple to implement.

- Could be started quickly with minimal training.

- Staff became used to starting and finishing work at home.

- Reduced the number of visits to the depot.

- The installation of PSTN lines would benefit future phases.

Unfortunate many of the existing flaws were still perpetuated under this solution. The main drawback being the lack of GIS data in the field, which caused a continuing heavy reliance on the depot. However the concept of mobile working and the changing working practice for inspectors was successfully established.

4.2 Phase 2

The lack of easy & reliable access to GIS for both updating and reference was perceived to be a significant operational risk, particularly outside of normal working hours. In parallel with phase one a pilot was established to test the viability of delivering GIS to field based staff. Two options were considered.

- Locally stored system and data with upload / download made periodically.

- Use of a web based system with mobile communications.

The use of locally stored data presented many potential problems.

- Multiple copies of data.

- Control of data updates.

- Accuracy of individual systems.

- Remote system support, both hardware and software.

These drawbacks were considered sufficiently difficult to overcome for us to start our investigation by looking at what web-based options could deliver.

In conjunction with our GIS vendor, GeoTech, we had been working for some time towards the possible implementation of a web based GIS. We were in the fortunate position of having a potential solution, the availability of which could be accelerated to match our needs. More importantly it could be demonstrated to senior business users. The major issue with this approach was the delivery of the data to field based staff, i.e. what network options were available and at what cost. The pilot project was to test proof of concept for the web-based solution and to identify and cost hardware options whilst testing the viability of mobile communications.

For remote networks, as the company already used the Cellnet GSM network for voice traffic, we decided to use this for data in the first instance. It would have proved too costly and increased the implementation time to consider other network options at this time.

4.2.1 Hardware

As part of the pilot a number of hardware options were considered and tested;

- Company standard issue laptop.

- Sub Notebooks.

- Specialised touch screen slate devices.

- Ruggedised Laptops.

Many theories were advanced as to the most suitable unit, for example given a delicate device such as a conventional laptop staff would be more inclined to treat it with respect than a ruggedised device. We reviewed and tested eight different options with the following conclusions.

- Ruggedised equipment was essential.

- The virtual Keyboard on slate devices was considered very user unfriendly.

- Separate elements for slate devices, keyboard modems, network cards etc. made the package cumbersome and vulnerable.

- A touch screen was desirable though not essential

- Screen resolution was more important than size.

Our ideal device was determined to be a single unit with modem, network connectivity and integral keyboard. In short we wanted a reasonably lightweight ruggedised laptop. We selected the Panasonic Toughbook CFM – 34, this was by far the most popular device tested.

One of our major concerns regarding the hardware was how to manage problems. We could not afford for staff to be hanging around waiting for support. We resolved the issue by having a pool of spare PC's that could be swapped for a faulty machine very quickly. In this respect a single unit was felt to be essential.

4.2.2 Communications

The use of the existing GSM network was coupled with the use of PSTN at home. The PSTN access using dialup networking was extremely successful, prior to attending a call out the inspector could connect to the GIS and then download a PDF plot of the required area onto the local drive. This could then be accessed on site using Acrobat Reader. The use of the GSM network was moderately successful, for real time access in normal working hours the response time was far too slow to be viable. However when working out of hours, working practice was developed to derive significant benefit from its use. The use of mobile communications in the trial did act as proof of concept and permitted further investigation into options for mobile communications.

4.3 Phase 3

Phase 3 was started very shortly after phase 2 and was then run in parallel. We commenced by working with consultants, Logica, to produce a feasibility study and then subsequently detailed user requirements and system concepts documents. We determined that that to be viable any system we implemented had to be one that principally delivered existing core systems into a browser environment. Anything else would have required extensive reengineering of the core systems an expensive and time-consuming process. Further to that the technical architecture should be one that laid the foundations for future expansion of mobile solutions and not proprietary to this project. The following design criteria were identified.

- No user specific data was to be held on the remote device. Any person should be able to use any device without recourse to reconfiguration. Very important in respect of issuing replacement PC's from a pool.

- All applications were to run in a browser.

- Where possible, off-the-shelf products should be utilised to provide required functionality.

- Application look and feel should be as close to existing desktop as possible.

- Access to all applications was to be via the company intranet.

- System should be both scaleable and expandable.

- Applications would have to be deliverable over a radio network.

- Access for review and updating was to be in real time

- There should only be one source or entry point for each element of data.

- Communal access to appointments and diary functions was required on-line.

The following schematic shows how applications would be provided through the intranet backbone and onwards to field staff, the South East Water operations centre, contractors and other 3rd parties.

Solution Outline - System Concept
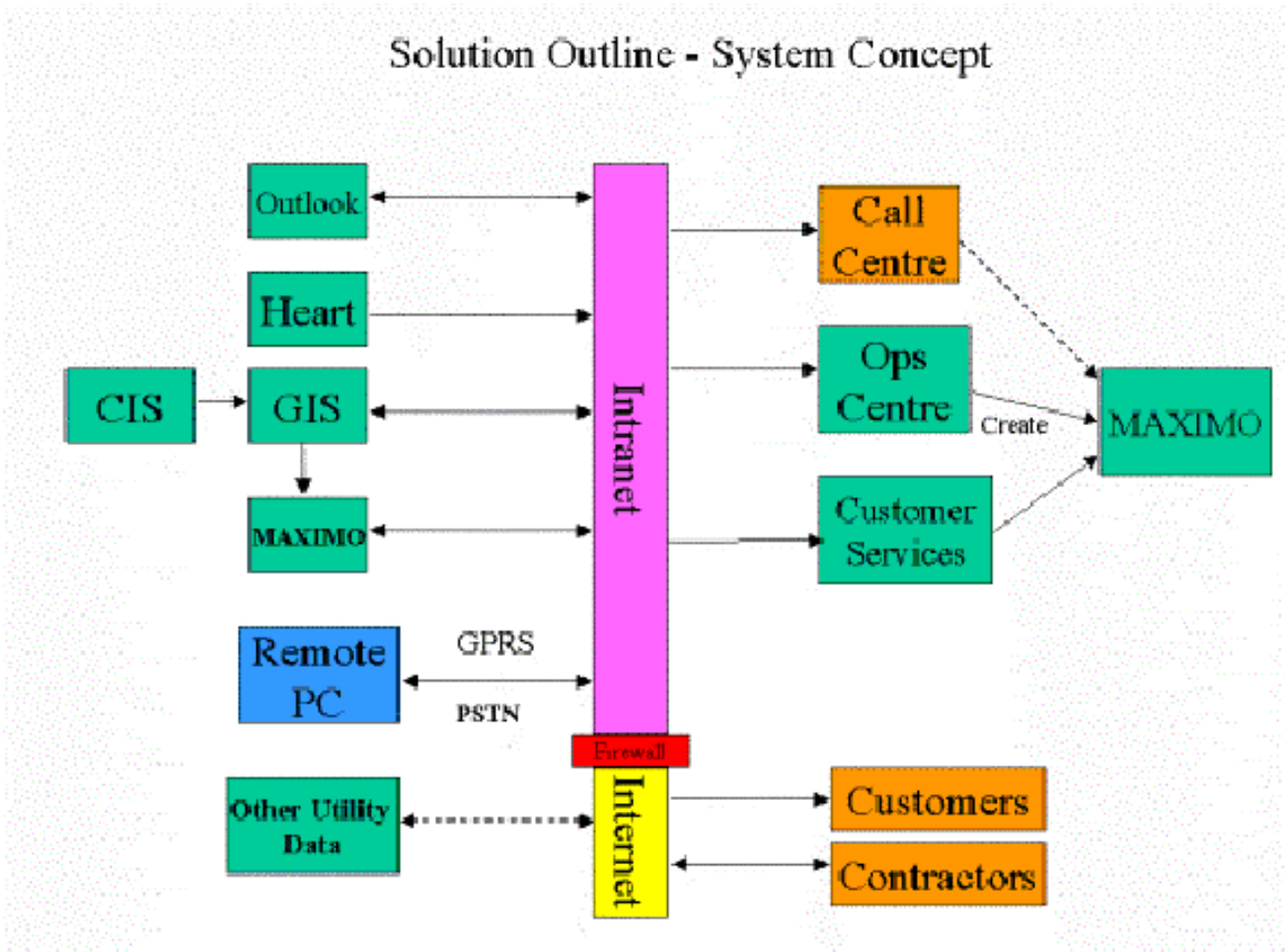
4.3.1 System Overview

The system was designed to act as a web-based information provider for field staff, initially network inspectors. Each user would log onto the system at the start of the working day, and be presented with a list of scheduled tasks. These tasks would be linked with the associated information related to that task (for example the information from a Maximo job sheet and a GIS plan).

The works management application, (Maximo) & Graphical Information System, (GIS) are the two key business systems required by staff. Maximo is the SEW application which manages all operational activities and GIS provides a graphical tool for the maintenance and querying of the mains infrastructure data. In addition to the supply of data, the system provides the functionality to allow for feedback data to be returned to both GIS and Maximo thus closing the loop on each job directly from the field.

Access to Intranet-based information (Heart), e-mail (Outlook) would also be provided on the field system. Heart is the only medium for South East Water staff in the field to receive company notices; it is therefore essential that this system is provided so that staff could be fully briefed on corporate issues. Outlook would provide a two-way link allowing access to email and diary functions.

The choice of communication network was to prove the most difficult.

4.3.2 Communications Environment

Consideration was given to a range of communications options. In an ideal situation, the field worker would always be within contact of the office: even if not physically connected to the network, either side, anywhere in the region could establish a connection immediately.

In practice, what was required was an 'always-on' communications network without the prohibitive cost associated with GSM. In addition the network performance of any radio-based link was likely to be much worse than a physical connection to the local area network, or dial up access via a standard telephone line.

Of all the potential radio communications methods, GSM was selected as the most suitable. The technology was mainstream and proven, and hardware and software readily available. Network coverage is generally good, and improving all the time. Our trial however had highlighted the limitations and potential high cost of this option. Our ideal option would be the proposed 3G networks, these were however unlikely before 2003 even on the most optimistic assessment.

The GSM technology was being enhanced with the introduction of GPRS (General Packet Radio Service), however would this be a reliable option within our project timescale? Working with BT Cellnet we investigated the practicality of this option. BT Cellnet were to be first to market with a commercially available network, May 1999. The major risks we identified are listed below:

- The reliability of the GPRS network. A new and as yet commercially untested network was to be the lynchpin of our solution. Would it live up to the technical hype / telco promises?

- Availability of GPRS Handsets. At the time of making our decision only one manufacturer had an offering (Motorola Timeport 260), though many more were promising commercial delivery within our time window.

- Would our systems perform over the GPRS network at an operationally viable speed?

A careful review of all the potential risks was undertaken. We decided to take a long term view, it was the firmly held belief of the project team that the technology option offered by GPRS was the correct one and would offer a technology platform that would give significant future benefit. We accepted that there could be short term problems but felt that the opportunity offered, to work closely with BT Cellnet in the implementation was one we did not wish to miss.

Clearly in accepting these risks we had to mitigate against them.

4.3.3 System Components
The system comprises two distinct sub-systems.

- Access to the core business systems in real time over the GPRS Network.

- Provision of a fallback solution should the GPRS network prove unreliable.

One of the most important factors in the design of this mobile solution was to improve both the quality and quantity of operational data. When inspectors are increasingly required to work independently the quality of data on our systems has to be comprehensive and accurate, the quality of data and the maintenance of it was therefore considered to be of paramount importance for the ultimate long term success of this project. Experience has taught us that data updates have to be:

- Easy and quick to do.

- Targeted so that the need for them is obvious and of benefit to the person concerned.

- Available to operational personnel quickly and reliably.

4.3.3.1 System Functionality
Maximo
The system functionality was built to deliver an environment where the data access and capture requirements are met. In addition the control of and access to accurate job status information was vital for any improvement in customer service to be made. Consequently Maximo functionality was developed to include the following:

- Web look and feel

- Separate access / security structure for mobile workers. Restricted functionality.

- Change to job status procedure.

The most important element in this area was the ability of inspectors to change the job status in real time. Three new status conditions were introduced.

- On – Route.

- At Site.

- Work Incomplete.

An inspector is allocated a daily workload of jobs, each one set to a status of In Progress by the scheduler. As he / she progresses through the day's work the status of each job is changed to signify the current position. The Work Incomplete status is set where either further action is required to complete the job or no action was taken on that day, in both cases the scheduler will allocate appropriately. As these changes are in real time is now possible for all business areas to deal with customer enquiry's in more efficient manor.

GIS

GIS functionality improvements were far more significant. The web based GIS system used by South East Water is a dynamic map publishing system based on 'Model Server Publisher' software developed by Bentley Systems. All standard review functionality pan, zoom query etc was retained as per a conventional review station, in addition a number of data capture tools were developed for both attribute and graphic data:

- The ability to add, move or delete all point graphic elements

- The capability to manage all the elements of the service network

    - Amend the position of an existing service pipe relative to the correct main and seed point

    - Record new connection information by adding the seed point and linking to the correct address.

- Plotting is by means of generating a PDF image of a selected area. This can be saved or plotted.

- Query functions allow for both direct and relational access.

- Town and Street + post-code gazetteers are provided.

Updates are generated by means of a constantly running batch this produces an almost real time update. Inspectors can visualise their update in approximately 10 – 15 seconds. The data managed by the web system is the master copy of data.

Considerable care was taken in the design of the web interface to minimise the amount of potential traffic. Each user is initially presented with a standard minimal display, this can then be enhanced but is retained for the existing session only. System parameters can be set to adjust all settings.

The only functionality not catered for within the web environment are the tools necessary for the capture and updating of the graphic mains data. The development of these posed the most difficult problem, how to allow editors to maintain graphic files that were simultaneously available for update to web users. We developed functions that managed each file element therefore rather than updating at file level, updating was managed at element level with the editor being responsible for the resolution of conflict (Project Bank).

Email

Email / calendar access was provided by using Web Outlook. This was given to all members of staff irrespective of status. The functionality is very similar to that of the desktop version of outlook. Very little development was necessary to deliver this element of the solution.

Working Environment

Having developed and tested our system solutions we had to develop the van layout to produce a safe and comfortable working environment. We worked, successfully, with a local fabricator to develop a universal van mount that met health and safety requirements and was acceptable to inspectors. The phones proved

more of an issue; it is essential that the user is able to monitor the display to check for problems. It took some time to iron out the various problems:

- Connection to an external arial, GPRS performs better with a stronger signal.

- Charging / powering the phone in the van. When wired through the ignition the constant switching between van battery and phone battery caused signal dropouts.

- Use of an acceptable cradle.

4.3.3.2 Fallback Solution

Each member of staff designated as a potential user of the remote working system has a PSTN connection at home paid for by the company. The portable computer selected for the project comes equipped with inbuilt facilities, which allow communication via conventional telephone lines (PSTN).

For an inspector to undertake a given job two elements are required, the work order details and GIS plan. A report is run from the works management system, MAXIMO, to generate a list of work orders, to which the inspector is assigned. Where appropriate MAXIMO will prompt the GIS web server to create of a PDF map file showing the required water network & map data. These are downloaded on request (desktop icon) to the local hard drive at the start of each working day. Thus each inspector with have all the information necessary to complete his jobs stored locally.

Using dial up networking inspectors will be able to gain access from home to each of the required systems at the start and end of each working day. Consequently at the start of each day the inspector can review on line all his assigned jobs and update the daily download file if necessary. At the end of each day feedback from jobs done can be entered and incomplete jobs returned for rescheduling. For out of hour work the same procedure can be followed, the inspector will be able to gain access to both Maximo and more importantly GIS to obtain job details.

Whilst not having all the benefits of real time access this option did provide for a significant improvement over the fax solution and for the first time enabled inspectors to directly update GIS and Maximo without using depot facilities.

5 Implementation

Our intention was to undertake a full system trial for three months, prior to going live in April. Unfortunately our fears concerning the use of GPRS proved well founded:

- Connection to the network was delayed for some weeks by technical problems.

- Teething problems on the network resulted in excessive signal dropout.

- The hoped for availability of handset options did not materialise.

These problems prevented us from having consistent access with the desired handsets for the full three months. We delayed the rollout start until May; operational restrictions prevented any further extensions.

GPRS aside the most significant issues proved to be staff related.

- Training, a significant percentage of inspectors had few or no PC skills.

- Staff buy-in, many inspectors initially considered the system as control / checking and were unhappy.

- Health and safety / HR issues relating to the use the PC both at home and in the van.

- The significant changes in working practice proved more difficult to sell than we had at first envisaged. System unreliability did not help this issue.

We employed a dedicated trainer who worked, and is continuing to work with HR and the inspectors to resolve the issues.

As we had envisaged the soft issues (HR, Health & Safety, staff buy-in) are proving to be the most difficult to overcome.

6 Conclusion

Success or failure, did we make the right decisions? Particularly regarding GPRS. The answer is yes. Despite a very fraught few months, we have, with considerable assistance from our partners (BT Cellnet in particular), turned the corner. The GPRS network problems have very largely been overcome, we are now getting a relatively consistent and reliable service with good response times. Network dropout is now the exception not the rule. We still have much to do in this area, however the impending introduction of new and faster GPRS handsets and PCMCIA options will enable progress to continue.

The HR issues are taking longer but as the GPRS network reliability improves the system is proving of benefit to the inspectors and therefore more acceptable.