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THE APPLICATION OF INFORMATION SYSTEMS AND TELEMETRY TO OPERATIONAL MANAGEMENT IN ANGLIAN WATER

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ABSTRACT

An account is given of the development of information systems in Anglian Water to meet the requirements of operational management. Part 1 gives an overview of the new computing network for operations applications, including the Operations Information System, a comprehensive operational job management system, and digital mapping. Part 2 describes the implementation and application of telemetry systems which will eventually extend to over 5500 sites, and Part 3 describes the development of process control modules using telemetry outstations. The implementation of these systems has involved close co-operation between Anglian Water and Logica EIS, and Part 4 gives an account of these developments from the supplier's point of view.

Part 1: Information Systems for Operational Management

Anglian Water is the largest by area of the 10 Regional Water Authorities in England and Wales. It covers an area of over 27,000 square kilometres and is responsible to a population of over 5 million people for water supply and distribution, sewerage, sewage treatment and disposal, flood prevention, maintaining water quality and the protection of the water environment. The organisation has a Regional Headquarters at Huntingdon and is divided into a hierarchy of 5 multi-functional Divisions, with a total of 15 Operational Areas and 42 Districts.

In order to carry out its responsibilities in an efficient and effective manner, Anglian Water has taken full advantage of the opportunities offered by computing and the recent advances in Information Technology.

Anglian Water is currently upgrading its Honeywell mainframe. The mainframe, assisted by an ICL mini, is used mainly for financial applications, such as billing, payroll and job costing. It is also the host for a number of other large databases such as the Chemical Data Processing System and the River Flow Processing System. For the Operations Department, the Honeywell is also a host for mathematical models such as network analysis and resource optimisation models. Anglian Water has standardised on IBM PC's for local stand-alone applications and a corporate approach is ensured by a regional procedure involving authorisation of all local developments.

In recognition of the geographically dispersed nature of Anglian Water as an organisation, a distributed computing infrastructure was chosen to support operational applications rather than a centralised solution at regional headquarters. DEC was the chosen supplier and a dual VAX 8350 cluster was installed at all five of the divisional headquarters, with a single 8350 at Regional Headquarters. Within the local area network of the headquarters building Ethernet is used as the communications medium. Extended Ethernet is used over a combination of kilostream and 19.2 kilobit per second lines leased from British Telecom to

provide a completely integrated regional network, linking the divisions together in the form of a star network with the regional headquarters as the hub.

This computing and communications architecture balances the economy of scale achieved by centralising computing resources with the desire to minimise the dependence on communications links. This is achieved by allowing applications to run on host machines not too far removed from the end user. However, in the case of any particular failure the integrated nature of the network will allow applications to run on alternative machines.

DEC's Rdb relational database is the standard database on which both the Operations Information System (OIS), and telemetry are based. DEC's Rally is the fourth generation language that is being used to develop these applications, with Teamdata being applied by the end user to access the data. Standardising on these products will allow integration between OIS and telemetry. It is unlikely that Digital Mapping will be implemented on Rdb but thought is currently being given to an Anglian Water corporate data model that will identify data common to all the applications and ensure a common referencing structure, thereby allowing integration.

Three main operations applications are considered:

- -The Operations Information System, where reference is also made to the development of the new Stores System.
- -Digital Mapping
- -Telemetry, which is split into two papers, the first describing the design and implementation of telemetry within Anglian Water, and the second detailing the extension of telemetry systems to process control applications.

The Operations Information System (OIS), is a system in which clerical procedures, working practices, bonus schemes and aspects of information technology were combined to ensure more efficient management of work and to allow Anglian Water to provide a better service to it's customers. OIS currently deals with water distribution jobs, which account for some 45% of Anglian's work, roughly 3,500 jobs per week. Work in the other functions is to be brought under the umbrella of OIS in the coming months.

A phased implementation and development was adopted. Having identified the objectives OIS was designed and introduced in one of Anglian's five divisions, where it successfully operated for 18 months. Area based Customer Services Bureaux (CSB), were established. These CSB's provide a central point of customer contact and are manned by a work planning team. All work for the districts within that area is scheduled within the CSB. The work planning team was supported by locally networked micro computers which provided a database of job records.

The next phase of the implementation was to further develop the system and introduce OIS across the whole region. This phase of the implementation was operational for a year. The advantage of this phased implementation is that it gives grass roots involvement of the end user operations staff, allowing them to have their input as the system develops.

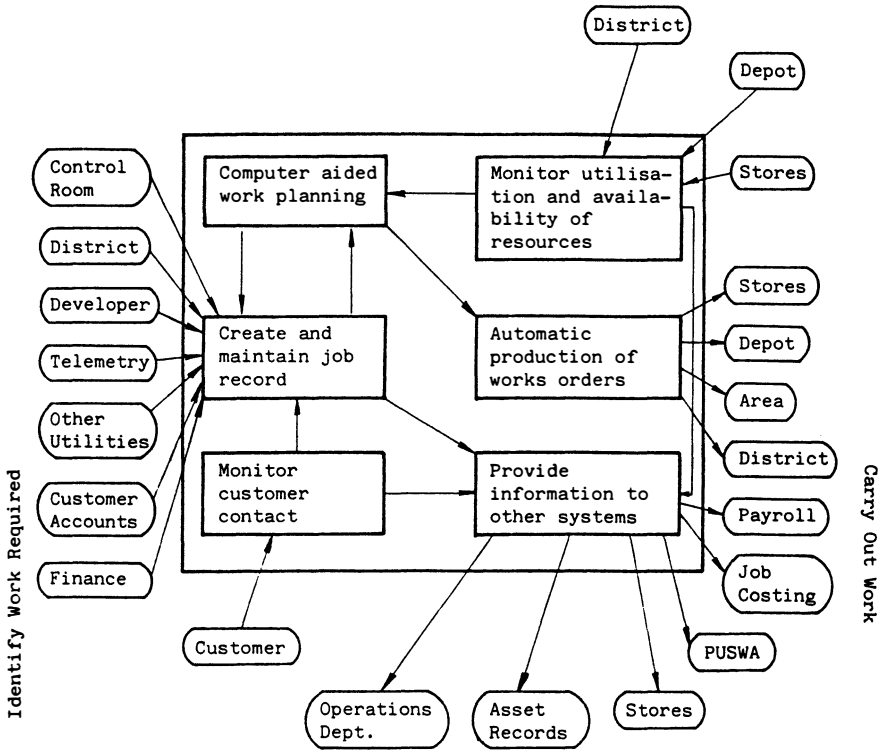
It was always the objective to develop OIS to run on the VAX network. Using the experience that had been gained over the previous phases a User Requirement Specification was produced for OIS 2 to be implemented on the DEC architecture. This was used as a tender document and the contract for the development of OIS 2 was awarded to CAP. A Functional Specification was produced and OIS 2 was prototyped and implemented on the DEC network.

The functionality of OIS 2 is shown in Figure 1. The following components can be identified:

- -All work required is identified and a database of job records created.
- -This database provides both up to the minute and historical details of jobs and therefore both assists in efficient work planning and provides summary statistics of work carried out.
- -Using the communications links Works Orders are electronically transmitted and printed at District or Depot as appropriate. These are instructions to the workforce telling them where to go, what to do and what materials are required.

Figure I Analysis of OIS Phase II

Schedule Work



Monitor Performance

Interface with other systems

-Work is carried out and the utilisation of resources is recorded and monitored.

-OIS 2 acts as a source system providing data to other systems, such as stores, job costing and digital mapping.

In many organisations computer systems have been designed to meet the needs of the Finance Department, or meet the users needs as perceived by the Computer Department. In contrast OIS represents a system designed and implemented by operations staff for the benefit of the Operations Department.

As part of the work planning process, the availability of materials in the stores is checked by the OIS system. This involves an on line transaction between OIS and the Stores System to firstly assess the availability of materials and secondly to commit those materials to a particular job. In order to meet this functionality, and also to incorporate improved stock control procedures, a commercially available stores package was adapted to meet Anglian's requirements and has been implemented on the VAX network.

Anglian Water has recognised the benefits in terms of asset management and improved levels of service that is offered by Digital Mapping. The combination of computer graphics and database techniques allows not only the display of geographically referenced asset information but also provides summary statistics both as reports and directly to other systems.

Early in 1987 Anglian embarked on a pilot study based on an operational district centred on Braintree in Essex, covering about 200 square kilometres. At this stage only applications relating to water distribution were considered. The system was implemented on three stand-alone microcomputers with enhanced graphics and data storage capabilities.

Experience was gained in the fields of data capture, staff training, maintenance and update of data and digital mapping applications. Data capture covered both background and foreground data. The background data is a digital version of the Ordnance Survey map sheets digitised to recognised national standards. The foreground data is Anglian Water's asset information. This foreground data takes two forms, graphic and non-graphic data. The graphic data is that which appears on distribution plans, for example, the location of a water main. It is this foreground graphics data that is overlayed on the background maps using computer graphics to form the map displays. The non-graphics data is information related to the graphics data but which is held in the database and not displayed on the map, for example, the water main manufacturer and any renovation history. Background digital data was obtained from both the Ordnance Survey where it was available and digitising bureaux. Foreground data was digitised by Anglian Water staff.

Following the successful completion of the first phase of the pilot study, the study was extended to cover the whole of the Colchester Division Northern Area, a total of 3225 square kilometres. Because of the importance of integrating Digital Mapping with other operations systems, this phase of the trial was implemented on DEC hardware. Two local area VAX clusters were installed based on MicroVax 2 processors providing concurrent access to four users in the area office and two users at divisional HQ. A kilostream leased line from British Telecom links the two systems and ensures that data, which is maintained on the divisional system, is kept current.

The Digital Mapping System is used to support a wide range of applications which in this phase are not limited to water distribution:

-Support to the OIS System is provided through the provision of plans showing the location of assets to be worked on. A street gazetteer facility provides rapid access to assess information in response to a customer or other enquiry. The sensitive customer facility identifies customers likely to require special attention whilst work or emergencies are underway, for example, dialysis patients. Thought is currently being given to the on-line interaction between Digital Mapping and OIS through the development of a corporate data model and common referencing.

-The Digital Mapping system is also used to support rehabilitation studies. Areas giving rise to problems, such as dirty water complaints, can be clearly identified. With the assistance of network analysis models, for which the Digital Mapping system provides the network data, decisions can be taken to optimise the expenditure of rehabilitation resources.

-New developments can be designed and plotted directly onto the Digital Mapping system and the status of the display updated according to the "as laid" conditions.

-Outgoing PUSWAs are plotted direct from the Digital Mapping system.

Anglian Water intends to proceed with the implementation of Digital Mapping across the region. To this end, the available digital maps from the Ordnance Survey have been purchased and discussions are underway with other utilities considering collaborative ventures with bureaux for the provision of digital background data.

Part 2: Telemetry

The major impetus for the development of telemetry systems in Anglian Water came in 1983, when 19 single-function divisions were replaced by five multi-function divisions. Each division appointed a Systems Engineer, whose major task was the development of a multi-function divisional telemetry system, covering water, sewage and river sites - eventually a total of 5500 sites across the Anglian region.

The principal objectives to be met by installing telemetry systems were:

-To provide operational data, including the alarm state of plant, to allow a prompt response to faults.

-To provide adequate monitoring of the performance of unmanned works to reduce the frequency of visits.

-To reduce the number of continuously manned works and operational centres.

-To collect and store operational statistics for management reports.

-To provide a means of remotely operating or automatically operating plant.

-To improve performance by the development of techniques such as pump scheduling, flood forecasting and leakage control.

Following the completion and approval of project appraisals, each division worked with consulting engineers to develop a specification, to seek and evaluate tenders, and to implement the first phase of its divisional telemetry scheme.

The appraisals showed an acceptable payback period, with the major savings on manpower costs through reductions in the number of routine visits to unmanned sites, and in the number of manned sites and control centres. Smaller savings were projected for other items such as transport and energy.

The initial emphasis was on providing systems which allowed the processing of alarms, logging and archiving of data, remote control of plant, and the use of colour monitors to display trend displays of historic data and current operational data on mimic diagrams. To allow for the later development of automatic control of works, intelligent outstations capable of running sequence programs were used.

One common feature of the systems was that the principal method of communicating with outstations was the use of UHF radio from a number of scanning sites linked to the control computer by private telephone lines. Telephone links to outstations were provided only to sites which had no clear radio path to a scanner, or no power supply or were prone to vandalism. The main reasons for choosing radio were that it was the most cost-effective method of providing a real-time monitoring system for a large number of outstations, and that in the event of faults, maintenance would be under the control of Anglian staff, with no dependence on a third party.

By late 1985, the contract with Logica for the first phase of the Norwich Division system had been successfully completed. This involved the infrastructure of control computers, terminals, scanners, communication links and the first 200 outstations out of a projected total of 1000. The system was one of the first in the UK to cover water, sewage and river outstations and the first to use the newly specified 12½kHz bandwidth UHF radio as the principal means of communication.

One of the principal features of the contract was the good "give and take" relationship between Anglian and Logica staff,which enabled the system to develop as it was implemented, without rigid adherence to the original specification. Many additional software routines were provided by Logica, and Anglian staff were provided with sufficient access to the control system software to enable them to write their own routines - some of which were sold back to Logica. During the contract, it became apparent that at many of the smaller sites, there was scope for a smaller outstation than the multi-board Medina outstation used for this contract; this feedback led Logica to develop the smaller, cheaper, single-board MicroMedina outstation, which has since been widely used throughout Anglian Water. One of the principal lessons learned from the contract was the difficulty in estimating site instrumentation costs prior to carrying out detailed site surveys.

The first major evolution in regional policy on telemetry came in mid-1986. By this time, all divisions had let contracts for the first phase of their systems, and two divisions had started on their second phase. It was recognised that although the telemetry systems being provided would meet the initial day-to-day monitoring requirements, the more advanced objectives would require additional software development and the integration of telemetry data with other information systems. It was felt that this could best be achieved by standardising on common telemetry systems in all divisions, and it was decided to install Logica systems in all five divisions. Following the successful automation of the Alton Water Treatment Works near Ipswich using 22 Medina outstations controlled by an on-site computer, it was further decided to standardise on the use of Medina outstations for the automation of works.

At the same time, a regional Systems Engineers Group was set up to ensure that the five systems were developed in a similar manner. An unusual feature of the Group is that, as well as Anglian Water representatives from regional HQ and the five divisions, it also contains a representative from Logica. Since the Group's inception, regional standards have been developed for outstation and point naming, mimic picture symbols and colours, and data items to be monitored at different types of sites. A regional software maintenance agreement with Logica was implemented to provide both a fault fixing service and regular updates of control system software as new facilities have been developed; this has ensured that common software has been implemented across all divisions. Many of the new facilities have arisen from discussions within the Group.

Regional contracts have been negotiated for the supply of outstation radios (750 in 1987 and 1000 in 1988), and for computer hardware maintenance. The Group specified enhancements to the Medina sequence programming language to allow more efficient and compact sequences for process control. The principal benefit of the Group is that common systems are being developed across the region without a large central team stifling local initiatives; this has allowed divisional staff to continue to identify with their own systems.

Another innovation during this period was the secondment of six Anglian staff (one from each division and one from regional HQ) to work at Logica for a period of six months. The purpose of the secondments was to enable operational staff without particular experience in software or systems engineering to gain insight into modern information technology developments and what they can offer the water industry.

By early 1988, Logica telemetry systems were operational in all five divisions. Each system is controlled by a PDP-11 computer running the MC16 control software, with a second similar computer at a remote site "eavesdropping" on the first computer and acting as a standby. There are currently over 40 UHF radio scanning stations and 1500 outstations operational together with over 40 colour terminals at control centres, area and district offices. Operational control is carried out from area and district office terminals during normal working hours, but is transferred to one or two 24-hour manned centres in each division at night.

Many of the original objectives of introducing telemetry have been at least partially achieved, particularly in the area of reducing the numbers of manned sites and visits to works. As a result of telemetry and other changes in operational organisation and practice, manpower in Anglian Water has reduced by 20% and the number of vehicles by 17% since 1983. The economies which are being achieved through regional agreements and the flexibility available for developing software applications fully vindicate Anglian's decision to develop a region-wide multi-functional telemetry system, and it has been encouraging to see that other Water Authorities are now following a similar path. The close collaboration with Logica has provided a fine example of the benefits which can

be achieved by the public and private sectors working together.

The next major development is the integration of the telemetry systems with the new VAX computer network, by linking the PDP telemetry control computers with the VAX computers at each divisional headquarters. Software is under development to enable telemetry data gathered by the PDP computers to be simultaneously transferred to the VAX and to enable telemetry pictures and alarms to be displayed on IBM PCs, acting as terminals on the VAX network. This will enable the PDP's to be solely concerned with polling and gathering data from the rapidly increasing number of outstations and with serving operator terminals. In addition to providing direct access to telemetry data for a greater number of operational managers, this link will make data available for integration with other systems on the VAX network, such as OIS and digital mapping, and for processor-hungry modelling applications without degrading the performance of the PDP computers.

The next stage is to build upon these foundations by further development of applications involving telemetry data. Some of these will be relatively simple, for example:

-Improved maintenance planning through analysis of pump hours run and trends in fault alarms.

-Identification of problem sites by analysing and comparing the numbers of visits made to different sites.

-Identifying the scope for reducing electricity costs by analysing pump hours run in peak and off-peak tariff periods.

-Automatic generation of monthly operational reports showing sourceworks outputs, sewage treatment works flows, etc.

More complex software development will be required to support applications such as:

-Pump scheduling, to reduce power costs by exploiting storage in service reservoirs and sewer systems.

-Flood forecasting, using telemetered rainfall and river flow data together with weather radar data.

-Leakage detection and control.

-Energy management, using data from the computerised electricity billing system, EMIS, together with telemetered flow and pressure data to monitor electrical efficiency.

-Water quality prediction.

-Process control using outstation sequence programs.

Work is already under way in a number of these areas. An existing stand-alone water quality telemetry system and prediction model for the Bedford Ouse developed by the Institute of Hydrology has been incorporated in the Cambridge Division telemetry system, and the software is being converted form the existing PDP11/23 version to run on the VAX. The model predicts the time of travel to and pollutant concentration at water supply intakes and other key river points, so that remedial action can be taken in good time. A drainage model of the Ely Ouse and South Level river system being developed by Hydraulics Research, which will include a facility for real-time forecasting based on telemetry data, is also to be implemented on the VAX.

Part 3: Process Control and Automation

The use of microprocessor-based control equipment is now commonplace throughout the water industry. The ever increasing intelligence and control capability of telemetry outstations offers an opportunity to capitalise on the investment made in the telemetry network by using these same outstations for process control purposes. Failure to grasp this opportunity will result in a proliferation of process designers' own preferred programmable logic cotrollers (PLCs) which, though satisfying individual scheme requirements cause problems for the end user in respect of non-standard user interface, integration with

telemetry and long term maintenance requirements.

The use of telemetry outstations to their maximum extent for process control purposes facilitates standardisation in both hardware and software, allows systems development to be concentrated more effectively and enables full integration of process automation within an overall framework for information systems.

It is, however, true that contractors who serve the industry are more familiar with PLCs than telemetry outstations for control applications. To overcome this, a select list of electrical contractors has been drawn up for inclusion in tender invitations for automation schemes. These contractors have committed themselves to incorporating outstations into their designs and to develop appropriate process control software using the outstation sequencing language. The recent completion of an automation scheme at Pitsford WTW is a typical example of the success of this approach.

In order to gain the full benefits from standardisation, Anglian Water must ensure a common approach over the specification and production of process control software. To achieve this, a project team has been set up to build on the initiative taken in the Colchester Division to automate a group of 45 sewage treatment works. Working in collaboration with WRC Systems Engineering Group, the approach adopted was to identify process control requirements, develop standard specifications and convert these into outstation software. The project team's remit is to extend this work to cover all process control requirements across the Region.

The software is being developed in a modular format, based on discrete processes as the key requirement is that it is reusable from site to site. A variety of configuration techniques is being employed to achieve this. The benefits resulting from the modular approach are:

- A standardised control methodology - leading to reduced training requirements and increased interchangeability of staff.
- Reduced levels of skill required to implement process control of sites - configuration of modules on a site specific basis is simpler than writing new code.
- The quantity of documentation is reduced.
- Easier and better maintenance of hardware and software due to standardised interfaces and better knowledge of the system.
- Lower overall system costs.

The process control software modules will be able to be installed into telemetry outstations and issued to a contractor as a complete monitoring and control system.

This approach is a marked change from the way process control machinery contracts are normally arranged. Presently, the supplier is responsible for the control system that makes his machinery run to the specification laid down by Anglian Water at tender stage. The issuing of process control software to the machinery supplier means that Anglian Water have to assume responsibility for the control algorithms and their execution. Careful attention to the detail of tender specifications, therefore, is essential to ensure that the tenderer understands precisely how control is to be effected and what plant signalling and instrumentation is required. The tenderer is, however, still required to give a process guarantee. Obviously, the software modules will need to be uprated from time to time to include new process developments. Standardisation must not be allowed to result in stagnation!

A total of 19 sewage treatment software modules have been produced to date, 10 sewage treatment works have so far been automated using this system with further 35 programmed for completion during 1988. The project team has identified a potential for 28 water treatment modules and is presently engaged in the production of software specifications. Tables (1) and (2) show some of the modules being developed.

Current capabilities of telemetry outstation are such that most of the industry's process control requirements can be satisfied. The unique contractor/client relationship between Anglian Water and Logica, its telemetry systems supplier, has enabled joint collaboration

on the direction of future outstation developments. Priorities have been set as improving maths capability, enhancing programming language features, extending memory and improving the packaging for large works applications. These improvements will increase the efficiency and the adaptability of microprocessor control.

TABLE 1 Water Supply and Treatment Software Modules

Module Number	Title
W1	River Intake Pumping
W2	River Intake Chlorination
W3	Pressure & Gravity Straining
W4	Phosphate Removal
W5	Impounding Reservoir Quality Monitoring
W6	Impounding Reservoir Sterilisation
W7	Dissolved Air Flotation
W8	Precipitator/Clarifier Treatment
W9	Precipitator/Clarifier Softening
W10	Pellet Reactor Softening
W11	Base Exchange Softening
W12	Pressure Filtration
W13	Gravity Filtration
W14	Ammoniation
W15	Sulphonation
W16	Booster Pumping
W17	Borehole Pumping - Optimum Cost
W18	Gasless Corehole Chlorination
W19	Borehole Chlorination
W20	Borehole Chlorination (Multiple)
W21	Gravity Aeration
W22	Pressure Aeration
W23	Gasless Sulphonation
W24	Chlorine Dioxide Dosing
W25	Pyrethium Dosing
W26	Plumbo Solvency Treatment
W27	Centrifuging

TABLE 2 Sewage Pumping and Treatment Software Modules

Module Number	Title
S1	(Reserved)
S2	Comminutor/Mono Muncher Operation
S3	D-Screen Operation
S4	Detritor Operation
S5	(Spare)
S6	Balancing Tank Operation
S7	Flow (to Treatment) Control
S8	Stormwater Storage Control
S9	Sludge Storage
S10	(Reserved)
S11	Terminal/Interstage Pumping Control
S12	Sludge Thickening
S13	Primary Sedimentation Tank Operation/Desludging Control
S14	Syphon/Biological Filter Operation
S15	Humus Tank Operation/Desludging
S16	Recirculation (Flow) Control
S17	Oxigest Plant Operation
S18	Dissolved Oxygen Control
S19	Activated Sludge Surplussing Control
S20	Activated Sludge Sed. Tank Operation and R.A.S. Flow Control
S21	(Spare)
S22	(Spare)
S23	Flow Integration
S24	(Spare)
S25	(Spare)
S26	(Reserved)
S27	Housekeeping

Part 4: The Supplier's Point of View

Perhaps the greatest change over the last five years in the relationship between Anglian Water and Logica is the increasing exchange of information between the parties and the existence of joint teams to address particular issues. The mature nature of the relationship that now exists is based on the successful projects that have been carried out in the past and the fact that staff in both organisations know and understand each other better. This has led to a better understanding of what each can contribute towards successful systems implementation.

Over the past five years Logica have been involved in a number of types of project in Anglian Water; from the division-wide telemetry schemes, complex site automation projects, through to management information systems. This has enabled us to gain an insight into the breadth of Anglian's computing systems and perhaps more importantly enabled us to understand how they use computing systems to support their business. It is important for a systems company to remember that any organisation installs computer based solutions for business rather than technical reasons and that success or failure will be judged on these grounds rather than whether or not technology is "state of the art", perhaps a more suitable phrase would be that the technology should be "appropriate".

As has already been stated, the first two major systems that Logica installed in Anglian were the Norwich and Cambridge divisional telemetry systems. Both of these projects were procured against an Authority generated tender document which defined to a fair level of detail the solution required. It is fair to say that both Anglian Water and Logica soon realised that although these formed a good platform from which to build, more detail would be required if the systems were to be successful operationally. Much of these discussions related to the way Anglian Water wanted to operate the systems, particularly the way in which information should be presented to the operators. This was very difficult to tie down for a number of reasons. Firstly the division-wide systems in Anglian were much larger than any systems previously installed in the UK, see below:

	Phase I	Total
Norwich	200 outstations	1000 outstations
Cambridge	250 outstations	1700 outstations

and secondly the requirement that different terminal users would require different views of the system. For example, a District Manager responsible for water sites in North Norfolk would not be concerned with the status of sewage treament works in, for example, West Suffolk. However, the central operator, responsible for all out of hours activities would require a global view. The discussions over this, and similar issues, certainly raised our visibility of Anglian Water's activities and we believe enabled Anglian to gain a better view of how systems could be configured. The joint approach identified to the problem above was for Logica to include additional flexibility in the on-line configuration capability of the system that would enable Anglian to configure the system to their own requirements, knowing that they would be unlikely to stay the same throughout the system's lifecycle.

Another factor that we believe contributed to the successful implementation of these first two schemes was the early identification of the need to set standards and involve the end users, operations staff, in the system. Without standards for picture layouts, point names, etc., we do not believe that any of the Anglian systems would be as easy to use or access. The benefits of standardisation will be increasingly felt as generic applications are implemented that can be installed on any of the five divisional schemes. The early work on standardisation, which has been extended since, has provided Anglian with a firm foundation on which to build. It also highlighted to us both the importance of configuration control, and record keeping. The day-to-day operational costs of these systems is a major element in the overall lifecycle costs of such large schemes and given that they are an important element of an integrated operational management system then the support policy is particularly important.

During late 1986 and early 1987, contracts were awarded to Logica for implementation of divisional telemetry schemes in the other three divisions of Anglian Water. Although the requirements of these three divisions were broadly similar to the first two, it was important that maximum use should be made of their existing investments. We believe that it was also important that we listened to what these divisions wanted so that the systems were implemented to address their individual requirements, but also to ensure that they were consistent with the regional standards and objectives. It has to be said that these were not always easy objectives to meet, but we believe that good working relationships have now been developed with all five divisions. This broadening out of our involvement in 1986 also occurred in parallel with a number of other significant changes with respect to our relationship with Anglian, specifically the establishment of a Regional Maintenance contract, the secondment of staff from Anglian to Logica, and our representation on their Systems Engineers Group. All of these we believe can be referred back to the increased level of commitment of Anglian to Logica systems. They have also increased the visibility of Anglian to Logica's senior management and their recognition of Anglian Water as a major account.

The establishment of a Regional Maintenance Agreement with dedicated resources, both staff and hardware systems, to support Anglian has now been in progress for 18 months and we think from both sides it is viewed as having been successful. Both parties recognise the importance of keeping the operational telemetry systems available, and this has been achieved. Part of the maintenance contract activities that we are responsible for is to ensure that effective configuration control is exercised over the software and documentation, both the systems supplied to Anglian but also to our other clients. Configuration control has been, and continues to be, particularly important as enhancements and modifications identified by Anglian Water as the result of operational use. All of the five divisions have established liaison groups with representatives of the users and these have proved a positive mechanism for identifying modifications and user concerns.

The regionally chaired Systems Engineers Group has provided a mechanism for feeding back user experience to Logica, as well as enabling Logica to present future developments of the systems being used by Anglian Water. However, perhaps the most important role of the group has been to establish the region wide standards for the telemetry systems and to enable experiences to be shared across the divisions. Now that the basic systems foundation has been established the role of the group has developed to be more forward

looking, particularly addressing how telemetry data could be used in other applications systems.

The third activity that occurred during the period early in 1987 that helped develop the relationship between the two organisations was the secondment of six Anglian Water staff to Logica for six months. Although some of the staff were allocated to Anglian Water projects, others worked on projects in the Gas and Oil sectors. This activity was particularly beneficial to both organisations. For the Anglian Water staff, we believe it gave them an insight into the way Logica are organised and operate. Indeed, it has been gratifying to see some of our procedures for planning and reporting being used where appropriate on particular projects in the Authority. It was also beneficial to our staff to work with people with very different backgrounds to form positive teams.

Having installed telemetry across the whole of the Anglian Water region, there is now a greater emphasis towards an integrated set of operational systems. There are we believe a number of reasons for this; the requirements to make telemetry information more widely available; the need for a system to support the new range of operational systems such as the OIS that has been previously discussed. In the middle of 1987, we generated a strategic paper that could address these requirements. The proposed network of VAX computers was installed and commissioned in the spring of this year. A key element of the architecture has been the identification of a common data architecture and this allows Anglian to integrate applications from a number of sources as the need is identified. Considerable effort has also been made to enhance the operator interface. A major part of the VAX network is the use of IBM personal computers to access a wide variety of user applications through a common user interface. It has been recognised that for the 24 hour operators responsible for all of the divisions' systems out of hours, and for managers, a consistent user interface and mechanism for presenting information clearly is of prime importance. The 24 hour operator in Cambridge will be responsible for a telemetry system that monitors in excess of 1700 remote sites, in addition to other systems such as OIS, Mapping, mobile radio, etc.; his need for a common interface system that presents the information he needs, clearly, cannot be understated.

The systems that Logica have installed in Anglian Water have developed considerably over the last five years both in range and size. Perhaps the greatest change over that time has been the increased flow of information that has enabled such a successful set of integrated systems to be implemented. Systems that address the operational needs of Anglian Water.