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Delivering GIS for a new generation at Durham County Council

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Durham County Council first utilised GIS (Geographical Information Systems) way back in 1991, beginning with a successful trial by Highways staff in the Environment Department. After deciding to go with ESRI's Arc/Info software, the GIS expanded and evolved over time as a range of applications were developed and data captured whilst usage began to spread into other areas of the authority.

Managed by a specialist GIS team within the central IT Division, the infrastructure consisted of dedicated Unix servers storing GI (Geographical Information) and running Arc/Info applications which were accessed via specialist Unix emulation software installed locally on desktop PCs.

By the late nineties, a Data Register had been developed to hold metadata about each of the centrally held GI datasets and ArcView was introduced to allow high-end analysis by a small selection of expert users. As its popularity increased, GIS had been adopted to varying degrees by all nine departments within the County Council and a Corporate GIS Strategy was produced. The introduction of new tools from ESRI allowed GIS functionality to be embedded into traditional database applications and the Data Register was redesigned to meet the NGDF (National Geospatial Data Framework) standard. There were approaching four hundred and fifty registered users, with over two hundred access points and over four hundred datasets. GIS had become a key element in the decision making process at both strategic and operational levels.

By 2001, a number of questions and issues were raising their heads:

- How could GIS assist in meeting e-Government targets?

- How could GIS contribute to best value and become more cost-effective?

- How could GIS better meet the working needs of staff?

- How could GIS be promoted to gain greater awareness and widespread use?

- How could GIS assist in partnerships and joined up working?

- How could the upcoming OS MasterMap and other new datasets be handled?

- How could older, dated looking Arc/Info GIS applications be updated?

- How could our supplier's new product ranges help?

- How could a growing backlog of requests for new GI datasets be tackled?

With all of these in mind, the GIS team decided to undertake a complete review of the Authority's existing Corporate GIS Strategy.

The first step was to commission a customer survey to better understand the present and future needs of staff to ascertain how GIS could help them to carry out their jobs more effectively. The survey was devised

with the intention of collecting information on three main issues: auditing the GIS skills of users to determine training needs, identifying further new datasets required or existing datasets in need of updating and also finding out what extra functionality people would like to see in any new applications. In total over four hundred questionnaires were handed out, with an excellent 49% return rate coming back in, giving a good sample of the overall customer base. Along with the three main topics, invaluable feedback was provided on a number of other areas concerned with GIS. From this, a survey report of the findings was produced and fed back into the overall strategy review.

At the same time as the customer survey was taking place, the Authority published its first IEG ("Implementing Electronic Government") statement. This document emphasised that GIS would be an important element in the Council's IEG strategy with a commitment to making geographic information accessible to the public electronically as far as possible. Another consideration, especially given the IEG commitment, was whether GIS could be delivered more cost effectively. The licensing and maintenance costs for hardware and software were considerable in the existing infrastructure, as was the time spent supporting over two hundred individually installed copies of the Unix emulation software and several more of ArcView.

Reviewing the customer survey findings highlighted the need for new types of applications and data as expected, as well as a greater awareness and a comprehensive training programme. Additionally, the potential for the GIS Team to introduce new added-value services was identified, offering data capture, complex data analysis and high quality cartographic map production.

To meet the future GIS needs of the Authority, both internally and to the public, in terms of applications and services was appearing to be beyond what our current systems could offer. Having a solitary vendor (ESRI) for the corporate GIS had been defined within the originally produced strategy. It was known that ESRI had recently released a new suite of products called "ArcGIS" to replace the older versions of the Arc/Info and ArcView software with which the GIS Team had developed all of the in-house applications. Another solution available was "ArcIMS" which could be used to develop internet-browser based mapping applications. It was envisaged that these two products would be the tools utilised to fulfil future requirements.

Despite being basically compatible with Unix, all of the extra functionality integrated within ArcGIS was only available for the Windows-based version. Following further investigation of ArcGIS and a trial of ArcIMS, both were recommended for implementation in the new infrastructure. It was realised that to get the maximum benefit from these products in a multi-user enterprise-wide environment would require the use of a third component, an "ArcSDE" geo-database which stored GI data inside a relational database management system. Until now, within the existing infrastructure, GI datasets were stored as individual files in ESRI's coverage format. However, many advantages could potentially be gained by employing a geo-database; these include simpler administration, storing feature and image data in a single location, improved security, faster retrieval times, reduced network traffic, multi-user editing and creating intelligent data.

A Windows server platform was agreed upon for the implementation of ArcGIS and ArcIMS, whilst that used for the geo-database would be dependent upon the choice of relational database used to host it. After an ArcSDE investigation between two different relational databases, on differing platforms, both seemed equally suitable for the required purpose. The deciding factor was purely down to cost and SQL-Server was chosen. This had an added benefit in that as the new infrastructure was built, it would be consolidated onto a single operating-system platform. Until now, the authority had only used SQL-Server for smaller departmental databases. GIS was to be the first corporate system to utilise it and would act as a test case to determine its potential for other corporate-sized systems in the future.

Having established what products would be used to build the new GIS infrastructure, the needs of future GIS users were categorised into five levels to form the basis of the new development strategy. These were:

Level One: members of the public, councillors and other agencies. This type of application would be delivered over the Internet and consist of a fixed selection of the Council's GI data with basic navigation tools.

Level Two: members of staff who could be occasional users, including all those without access to GIS at present. Delivered over the Council's Intranet, such applications would still have fairly simple navigation tools, but would have access to the Council's full range of GI data.

Level Three: staff using bespoke applications. This referred to GIS component applications that are integrated or embedded into existing database systems.

Level Four: specialist high-end strategic users. Staff using the ArcView package, enhanced by extra functionality written in-house, would be upgraded to ArcGIS.

Level Five: heavy duty users. This covered the more complicated applications, vital to the on-going technical operations of the Authority. Originally developed with Arc/Info, these would be enhanced and re-written with ArcGIS.

Formal proposals for the new added-value services were outlined. A GI Data Capture Service was the first of these. There was already a backlog of requests for new or updated GI datasets and the customer survey had added many more to the list. Having an official dedicated resource in place would allow this problem to be addressed and also mean that protocols could be established so that regular audits of the GIS Data Register were undertaken to ensure the accuracy, currency and validity of data. Further protocols would be implemented to cover data processing and sharing with other local authorities and agencies that would not necessarily hold their GI data in the same format as Durham County Council.

The second new service would be Map Production. Requests for maps were received from many sources, without any procedures in place to deal with them properly. The new service would offer high quality cartographic maps, aimed at those without access to GIS or those who did not have the time, skills or facilities to produce their own. The service would also ensure that maps were only produced for those who were allowed under the terms of our copyright agreements with Ordnance Survey and other data providers.

A third service would offer to undertake GIS Data Analysis projects on others behalf. Work already identified included a Crime and Disorder Audit and Renewable Energy and Neighbourhood Renewal studies.

All three of these services would be able to be delivered to customers much more professionally by taking advantage of the new tools that would be available within the new infrastructure. A fourth service would encompass GIS Training and Support. Whilst training and support already took place, it was not in a formal manner. Offering an official service would mean that a comprehensive training programme could be undertaken, covering all staff that use GIS.

Recommendations from the strategy review for purchasing the required hardware and software were accepted. The building of the new GIS infrastructure, development of applications and provision of services would also require extra staffing resource within the GIS Team. At the time that the strategy review began in 2001, the team consisted of five staff. In conjunction with the review recommendations, a business case was put forward for extra staffing. Over the following months, the Team complement was brought up to eight with the appointment of a GIS Data Capture Officer, the internal transfer of a developer from elsewhere in the IT division and the appointment of a university industrial placement undergraduate. With the extra resources in place, team members were assigned to one of two primary areas, either Data Management or Application Development.

The construction of the new infrastructure then began in earnest. The targets of delivering GIS to the public meant that the new infrastructure would need to capable of hosting applications that were available on a "24x7" basis. High availability and robustness would be an important factor in the new set-up. Technical documentation and white papers from ESRI were consulted, assisting in the planning, design and sizing for the infrastructure. In the first instance, enough hardware was procured to get application development and the core geo-database underway with the extra equipment necessary for implementing high availability to be considered at a later date.

Development priority was given to web-based applications for e-Government. ArcIMS could be implemented "straight out of the box" if so desired, but a great deal of customisation of the interface was possible as was the development of extra functionality. The skills to develop such applications were gained through a mixture of formal training in new programming languages and learning from experience as the

prototype application was written. The prototype, entitled the "Durham Map Viewer" aimed to reproduce an older public access system installed in various libraries around the County. It was not meant to replace the library system, but illustrate how extra functionality and customisation were possible whilst developing standard modules that could be reused in future applications.

At this stage, the web-based prototype developed so far was still accessing file based GI data. Delays were being experienced in obtaining the specification of server hardware required for setting up the geo-database so, in the meantime, a small-scale version was created on a high-spec PC. This looked at procedures for storing samples of different types of information including feature data, raster mapping and aerial photography. Following on from these an extract of the new MasterMap data set was obtained from Ordnance Survey and using specialist conversion processing software, the sample was successfully loaded into the temporary system. A contract order was then arranged with Ordnance Survey and the first delivery of MasterMap for the whole County was received. It was apparent though, that to process an area the size of County Durham and beyond would only be able to be undertaken on the high-powered ArcSDE server itself and not any desktop PC.

Up until the time of the strategy review, the marketing and promotion of GIS within Durham County Council had been very much a low priority as dictated by staffing resources and pressures of other workloads. With progress now being made on the new infrastructure, the time was right to begin publicising the new applications and services that would soon be on offer. The first task was to re-brand the GIS Team with a more recognisable name. The Team's official title was "Information Technology & Reprographic Services - Development Team C – GIS Section", hardly a name for potential new users of services and applications to remember or relate to. Therefore, a trading name was created and from then on the Team would be known as "Corporate GIS Services" with this name being used on all future promotional literature. Approximately four hundred and fifty people had access to some form of GIS, around one third of staff in County Hall. The aim was to increase the numbers using GIS and make other staff at least aware of what GIS had to offer for any potential future uses that may be identified.

Following the renaming of the Team, a range of full-colour promotional information leaflets were produced describing what Corporate GIS Services had to offer including the potential of GIS, the upcoming applications and the added-value services that were being launched. The first large-scale promotional opportunity that arose was to participate in the Council's annual "Learning at Work" day. Situated in the large exhibition area adjacent to the public entrance at County Hall, the Corporate GIS Services stand generated the passing interest of councillors, members of staff ranging up to senior management level and staff from other agencies and authorities that were on business at County Hall that day. To catch people's attention, a free competition was organised for fun. A large map of the entire County was placed on the wall along with an oversized aerial photograph of a single property. Passers by were encouraged to guess the location by placing a sticker onto the wall map, with the closest at the end of the day declared the winner and receiving a framed aerial photograph of an area of their choice as a prize – a geographical version of pinning the tail on the donkey! The competition generated great interest, with over three hundred people taking part, many of whom admitted they did not even know what GIS was. All were then encouraged to take a look at the rolling slide shows explaining GIS, have a go with the prototype web-based browser application, view samples of the Map Production service and to take away copies of the information leaflets.

The first "real" browser application written following the prototype was for the new tourism pages on the Council's official Internet website. Whilst the development itself was reasonably straightforward, a number of other issues were being encountered. The Council website had been developed by following accessibility guidelines issued by Central Government and elsewhere. This meant ensuring that the general public using a wide range of potentially low-specification older home computers could access the site, that it was written in plain English understandable terms and that it did not discriminate against anyone with a disability, for example the visually impaired. Considering the graphical and technical nature of GIS, as opposed to textual information on the rest of the website, it took some time to modify the application to suit the guidelines. Another hurdle was in ensuring Ordnance Survey copyright rules for mapping on the Internet were not breached.

The Ordnance Survey Liaison Officer role for the Authority had traditionally been held within the Environment Department, since that was where GIS was first introduced. One recommendation implemented from the strategy review though was that the Corporate GIS Services Team takes over the role. This allowed for closer working relations with Ordnance Survey on a number of issues and specifically helped discussions regarding Internet usage.

Due to the length of time being taken to resolve issues around the tourism Internet application, attention focused upon internal developments. It had become apparent that the browser functionality available meant that there was wider Intranet potential than originally thought and so the original five development categories were revised. One of the "level three" applications was an embedded GIS linked within the Corporate Property Database. Replacing this and other similar applications with browsers would reduce costs; rationalising packages used and decreasing the overhead time spent installing the software on individual PCs. Work began on the Corporate Property GIS Intranet browser. Linking both ways with the database application, as well as providing traditional navigational tools, it introduced extra features such as the ability to pull up photographs and site surveys of properties from the archives.

Another project, identified with the Education Department, was to provide a web-based mapping browser to schoolchildren over the Council Extranet. The aim would be to support a range of curriculum activities within the classroom and to help in meeting Key Stage targets. Working with education staff, teachers and schools inspectors, the first version of the system was designed, developed and tested over a six-month period before being released to 36 secondary schools in late 2002.

Following the rollout of the initial applications for Internet, Intranet and Extranet, attention turned back to the new GIS infrastructure which consisted of four servers running the browser systems and a much larger machine dedicated to hosting the underlying geo-database. To ensure robustness and high-availability of systems, the infrastructure was doubled in size. Comprehensive testing ensured that the infrastructure could cope with many combinations of server failure and yet still keep services available.

Recently, the number of users has passed the six hundred mark, whilst there are now five hundred and forty GI datasets. Many more Intranet-based GIS applications have gone live to staff covering a varied range of areas. A few examples include Community Support, Public Transport, Consumer Protection, Highways Design and even IT Support. Further progress has been made with GIS on the Internet whilst striving to consider accessibility issues and an Integrated Regeneration GIS site is now available to the public. A joint partnership project for Durham County Council and its neighbouring Northumberland County Council has been completed. Called "Keys To The Past", it contains GIS based historical site and monument information and mapping for the public to view.

Whilst research and development of ArcGIS has continued, so far it has only been implemented internally within the Corporate GIS Services Team due to browser developments taking priority. Web-based GIS, with its ever-increasing functionality, has gone far beyond its original expectations. As the migration from the old Unix infrastructure has commenced some of the "level five" heavy duty applications will now be rewritten as browsers, making this a more cost-effective solution.

A wide range of other projects are planned for the near future, including:

- Initiatives in GIS Data Management, such as existing Council database systems being linked to GIS through integration with the new geo-database. Ordnance Survey's LandLine mapping product will be withdrawn as applications migrate to the new infrastructure and use MasterMap. The new layers within the MasterMap product will be researched and adopted as they become available. A joint project working with Ordnance Survey will look at the impact of the PAI (Positional Accuracy Improvement) Programme on the Council's GI data holdings and possible solutions to the problem.

- The schools Extranet project will see a panel of experts meeting over the summer to develop teaching materials and pupil user guides to accompany use in a range of Key stage lesson activities. By the first quarter of 2004, a simplified version of the system will be rolled out to all 262 primary schools in the County which, when added to the secondary schools total, means that over 70,000 students will have access to on-line geographic information.

- Intranet developments will continue and include a very simple browser to be made available to all County Council staff.

- Further applications will be developed for the Council's Internet website in accordance with e-Government targets. A more direct link to GIS from the main homepage is planned.

- And finally, the development of further partnership projects is also in the pipeline following the success of "Keys To The Past". It is envisaged that the Authority will build on this to work more closely with others and will be in a position to use its new scalable infrastructure to provide managed GIS services outside of the County Council.

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