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Delivering a National Mapping Infrastructure: Case Study from Ordnance Survey

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Abstract

Ordnance Survey has successfully delivered its re-engineered digital mapping base, OS MasterMap[®], providing customers easier access to more up-to-date, intelligent, accurate and consistent geographic information. In parallel, the internal systems to maintain and support the on-going development of OS MasterMap are being modernised. This has included the adoption of Oracle[®] Spatial as the database platform and ESRI[®]/Tadpole technology to provide field editing in the new “seam-free” world. This paper addresses the technical strategy behind these modernisations, the challenges faced and the approach adopted to deliver one of the largest spatially enabled databases in the World.

Introduction

The release of Ordnance Survey's MasterMap product is changing the landscape of the Geographic Information (GI) industry in Great Britain. OS MasterMap represents a major milestone, for both its geographic data content and structure, and for the Internet service delivery mechanisms via which the data is made available. OS MasterMap is the culmination of one of the most significant recent technological achievements for the British GI industry, the re-engineering of the tiled, unstructured topographic data into a seamless, topologically correct and attributed database. Marketed as OS MasterMap Topography Layer, this data provides the single reference framework that underpins the other “layers” that are now being added including, in 2003, the Integrated Transportation Network, Imagery and Address layers.

How did Ordnance Survey do it? In simple terms, by completely re-engineering the back-end technology. New hardware, database and applications software, and importantly, a new approach to delivery. End-users are able to select and pay-for only the data they require, and receive change-only updates, all on-line. OS MasterMap's features and Internet delivery mechanism have provided opportunities and challenges for Ordnance Survey's customers and commercial partners. This paper explores the approach and key success factors, using as a case study the adoption of the Oracle Spatial database that stores the seamless digital mapping base.

Business Objectives

Ordnance Survey has the goal of supplying public bodies and business easier and faster access to more up-to-date, accurate, consistent and useful geographic information. Its IT systems need to be responsive to changing customer requirements.

Historically, IT systems at Ordnance Survey were largely based upon departmental, bespoke, project driven implementations resulting in many incompatible systems and databases. These systems were difficult to integrate, costly to maintain and complex to adapt or extend. What is needed in the new world of OS MasterMap are systems to support **seamless integration, unified data management, robust geoprocessing and flexible application configuration.**

The key business drivers are summarised in the table below.

Business Objectives	
<ul style="list-style-type: none">• Reduce deployment costs• Reduce maintenance costs• Improve data integration• Improve access to data• Improve systems integration	<ul style="list-style-type: none">• Store & maintain once, use many times• Facilitate new product opportunities• Increase business agility• Standards and COTS based

A New Technical Strategy

In 2001, these business requirements led to a new technical strategy.

In line with a government mandate to make all public services available electronically by 2005, Ordnance Survey adopted an eStrategy to deliver its products via the Internet. For OS MasterMap, this means that customers can receive quotations, place orders and download data on-line.

New IT projects at Ordnance Survey would no longer be based on “Best of Breed” bespoke development environments but exploit standards based, commercial off-the-shelf software (COTS). The use of a COTS based system is known to reduce the long-term cost of ownership of new systems and increase the speed and flexibility of new system development. It also signifies a move away from the closely coupled, largely proprietary world of GIS to open standard, or industry standard software.

This approach also supports the deployment of enterprise-wide solutions. An example of this architecture is a single spatial database providing data integration, with a suite of integrated capture, editing and product generation applications that implement business logic and fulfill operational requirements. The advantages include the technical and operational benefits of “store it once, use it many times” and the replacement of the multitude of existing legacy systems with integrated, lower-cost, more maintainable and more flexible solutions.

The new technical strategy was first articulated in a project to support the re-engineering of the back-end infrastructure to support the next generation of field editing tools. A wider Infrastructure Maintenance Programme commenced in 2003 with the objective of migrating from multiple, incompatible legacy systems to a sleeker, tightly integrated data maintenance infrastructure.

A Business Case for Oracle Spatial

Ordnance Survey's new technical strategy is evidenced by the choice of Oracle Spatial as the platform for the "Maia" maintenance database. The Maia database system will store the seamless digital mapping base of Great Britain that underpins the current and future range of OS MasterMap products. Initially it will store the internal format of OS MasterMap large-scale topographic mapping, expanding to include other layers, for example, 1:50,000 Generalised Topography and the Integrated Transportation Network layers. Thus Maia must be designed to be highly scalable to support the future expansion of data complexity, data volume and functionality.

A business case for Oracle Spatial

- An 'open' repository for geospatial data
- Industry standard for spatial data in Relational Database Management Systems
- Robustness, reliability, scalability, availability
- Part of the whole Oracle product family
- Strategic enterprise software within Ordnance Survey has adopted Oracle as its enterprise database platform and has the technical infrastructure and skills to implement this software.

As the defacto industry standard, Oracle Spatial was seen as advantageous for the development of the next generation editing system, the Field Object Editor, as well as new initiatives that will act on the database such as automated generalisation. Oracle Spatial supports OpenGIS[®] and SQL standards, with out-of-the box integration offered by the major GIS vendors. This means that multiple vendor GIS applications can act as clients to the Oracle Spatial database.

An important selection criterion was the ability to store and manage very large volumes of data. There are more than 430 million features in Ordnance Survey's large-scale topographic data set. Oracle9i Spatial stores and spatially indexes these features in a database of about 600 Gigabytes. Managing this volume of data requires the use of advanced spatial features such as partitioned spatial data and indexes, and parallel spatial index creation for improved performance.

Oracle Spatial comes with the high availability, scalability, reliability and performance that are strong features of the Oracle RDBMS. As its digital data business evolves, these features will become increasingly critical to Ordnance Survey.

Another important feature was the ability to support a dynamic data model. With these high data volumes, changes to the database structures will be time consuming to process, but operations such as changing a table definition are fully supported and can be completed on-line, without taking the database out of production. These types of manageability features and the productivity tools provided with Oracle (for example, Oracle Enterprise Manager) increase system availability and contribute to the maintainability of the database system.

Choosing the Field Object Editor

The Field Object Editor, the new generation of field editing and data management systems, provides another example of the new technical strategy. Ordnance Survey's 450 surveyors will use the system to record and seamlessly update the spatial database.

For this project, Ordnance Survey has addressed the need for an end-to-end process going from the field to the map, including field survey, data capture, quality control, data modelling, cartography, etc. This process implies the use of an integrated information system comprising data management, workflow management and the application of business rules and logic, including quality assurance and validation. Oracle Spatial will provide the data management facility (via the Maia database), ESRI ArcSDE will support data versioning and transaction management, and ESRI ArcGIS tools are being used to build the client-side application. The result is a tightly integrated COTS solution that will provide for faster updating, a reduction in operational costs and flexibility in expanding or enhancing the system.

Key Success Factors

OS MasterMap has imposed technical challenges and opportunities both internally to Ordnance Survey as well as externally to customers and partners.

Implementation Approach

In developing the Maia database, Ordnance Survey has implemented a series of evolving prototypes using a dedicated project team. This provides a number of benefits:

- Validation of assumptions with respect to the data model;
- Ability to further refine both functional and non-functional requirements;
- Opportunity for staff to gain experience administering and developing against Oracle Spatial.

Partnerships

Partnerships with the private sector are playing a key role in delivering Ordnance Survey's technical strategy. Early engagement of technology partners such as Oracle, Tadpole and ESRI has been a key factor of the Maia and FOE projects. For example, Oracle provided expertise from the data modelling phase, with an emphasis on implementation considerations for the physical data model. Oracle Consulting assisted with the implementation of the first prototype to provide skills transfer and mentoring. In turn, Ordnance Survey is feeding enhancement requests and new requirements to Oracle for incorporation in future releases of the Spatial product. Similarly, information on SDE is presented to ESRI.

Ordnance Survey is also fostering the relationship with its value-added commercial partners. These partners include software companies, systems integrators, publishers and consultancies. The aim is to encourage innovation for the benefit of end users, and a number of workshops have been held to provide partners with a vision of the future and to assist them in growing the GI market.

Change-Only Updates

Under Ordnance Survey's eStrategy, customers have faster, easier access to up-to-date data. Rather than a complete re-supply of OS MasterMap, customers can receive change-only updates delivered on-line. This raises two issues for the customer:

1. Data management issues to process the change-only updates to ensure that corruptions are not introduced into the customer database (i.e. that it does not lose synchronisation with Ordnance Survey's MasterMap);

2. The opportunity to migrate to a spatial database that will readily support the automatic application of change-only updates. A single spatial database repository solves many of the data integrity, security and file management problems inherent to proprietary file-based GIS and permits the integration of spatial and non-spatial data to support business applications.

Both of these issues have provided openings for commercial partners. Some have developed black-box solutions for applying change-only updates, while database vendors and their partners have been able to leverage the opportunities for a spatial database.

GML as a Transfer Format

In line with Ordnance Survey's support of open standards, OS MasterMap is supplied in Geographic Mark-up Language (GML) format. The sheer volume of GML produced for a large or national coverage has meant that loading the data is a time consuming, resource intensive process. Ordnance Survey's commitment to GML provides the advantage of an open, extensible and flexible format providing widespread interoperability and supporting the future of web services.

When OS MasterMap was first released, the applications to convert GML into spatial database format or proprietary GIS formats were limited and complex. Recent releases of mainstream GIS have incorporated support for loading GML data. Key partners, such as Snowflake Software and Dotted Eyes, quickly brought to market turnkey solutions tailored to OS MasterMap. Other companies now offer complete data loading services.

Helping the Customer

To address the perception that OS MasterMap is complex, and costly to implement, Ordnance Survey has created a pre- and post-sales consulting group called GI Consultants. This team of trained consultants provides free support to customers and advice on the type of software available to load or to store OS MasterMap, data management issues, and practical advice on how to migrate from Land-Line[®] to OS MasterMap.

Additionally, Ordnance Survey has hosted a number of workshops to promote the use of OS MasterMap and to provide customers a forum for sharing information and experiences.

Business Benefits

With OS MasterMap, customers have easier and faster access to more up-to-date, accurate and consistent geographic information. Combined with improved attribution, modelling of real-world features, and fully integrated "layered" digital data products, innovative use of GI in traditional and non-traditional market sectors is encouraged and enabled. The increased availability of high quality GI via the Pan-Government Service Level Agreement (April 2002), which provides 560 government agencies and departments with full access to Ordnance Survey data, will benefit the community in terms of improved decision making, tangible benefits, and by providing a stimulus to the private sector.

The consolidation of existing legacy systems will reduce maintenance costs, provide new opportunities for data integration, improve data consistency and enable applications to be deployed more rapidly. As a result, additional value may be derived from existing data sources, leading to new product creation and sustained revenue growth.

The new Field Object Editor will provide operational efficiencies for the field surveyors and result in a more up-to-date topography being available to the public much more rapidly. Although it is too early to quantify the benefits of the new Field Object Editor, more extensive use of GPS has already achieved an operational saving of about 40 per cent.

Conclusion

Ordnance Survey has embraced a new technical strategy to capture, process and manage its mapping data, and to deliver digital data products over the Internet. Partnerships with private sector companies are helping Ordnance Survey to implement its vision and to transmit the benefits to customers. The timely delivery of more accurate, intelligent data provides increased scope for new application development for both partners and end-users, and in this way, is transforming the GI industry in Great Britain.

Building the new technical infrastructure at Ordnance Survey is a continuing, rolling project. Achievements so far are an exciting beginning and there is more to come.

References

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