Final report

ORDNANCE SURVEY

THE ECONOMIC CONTRIBUTION OF ORDNANCE SURVEY GB

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OXERA

Executive Summary

Ordnance Survey®(OS) has been mapping Great Britain since 1791. In its role as the national mapping agency, OS produces a range of products and services, including a base dataset, which are driven by the needs of the national interest and the demands of customers.

As a primary producer, OS makes a significant contribution to the national economy. This economic contribution is assessed in this report by examining the impact of OS as a purchaser of raw materials from suppliers, as a producer of final goods and services, and as a producer of intermediate goods and services which are used in a variety of sectors. The contribution of OS to distributors and to competitors is also considered.

A value-added approach is used to estimate the economic contribution of OS. While an analysis based on willingness to pay would have been preferable, such an exercise would be difficult and was not feasible within the time limits of this project.

These tangible, measurable, impacts only partially reflect the economic contribution of OS. Consideration must also be given to the social gains resulting from the use of OS products. Such an analysis is, by its very nature, largely of a qualitative nature, but it is important to ensure that the monetary estimate deduced in this analysis does not detract the reader from the wider importance of OS.

Several key conclusions have emerged from this report:

- OS is an integral part of our national life;
- in 1996, OS products and services contributed to 12-20% of gross value added (GVA). This amounted to £79–£136 billion worth of gross value added (GVA);
- this economic contribution of OS comes, in the main, through the use of OS products and services as a primary input into production by several key sectors in the economy (e.g. utilities, local government and transport);
- the quality of OS's information, and especially the currency of the data, is the primary reason given by those interviewed for using OS products and services when alternatives are available;
- the use of OS products and services is developing in the economy, with technology opening up new markets and allowing existing customers to use information in new ways. The ability to combine geographic information (GI) with other digital information has become particularly important to many OS customers.

The static analysis undertaken here does not reflect the ever-changing role of GI in the national economy and the contribution which OS products and services make in enhancing productivity. An analysis of how the economic contribution of OS has changed over time would provide a fuller insight into its contribution to economic competitiveness.

Contents

1. Introduction

At the end of January 1999 OXERA was commissioned by Ordnance Survey® Great Britain (OS) to estimate the value of the economic infrastructure 'built on' OS data. The study has been undertaken over a three-month period and was, therefore, necessarily limited in both size and scope.

The end result of the research is a report that considers the economic value of OS. 'Economic value' is taken to mean the contribution which OS makes to the Great Britain economy as a producer of final and intermediate products and services, as a purchaser of intermediate products and services, and, perhaps most importantly, as the provider of geographic information (GI) in the national interest. There are thus two distinct approaches. The first focuses on the commercial contribution of OS products and services, and the second considers the social and environmental value of OS to society.

Any monetary values provided are, given the nature of the project, broad indicators of the scale of the contribution of OS to Great Britain's economy. Given the lack of empirical evidence for a study of this kind,[1] consideration should be given to the conclusions that are reached on the basis of both qualitative and quantitative assessments. In some instances, financial information that is commercially confidential has been omitted from this public version of the report. The key figures provided demonstrate how conclusions have been reached, and details of the methodology used are provided throughout.

[1] This is not a unique problem to this study. For example, Hoogsteden, C.C. (1999) notes in a working paper for Land Information New Zealand that, 'Quite simply, the necessary empirical data with integrity is not just in short supply at present, it is virtually non-existent.'

2. The Economic Gains from Geographic Information

2.1 Introduction

OS has undertaken the official topographic survey and mapping of Great Britain since 1791. It is responsible for providing and marketing topographic data and mapping at scales of 1:10 000 and larger, depending on the type of area, for the whole of Great Britain. This includes the geodetic and topographical surveys, and the associated work necessary for their completion. OS also produces national series in paper and data products at a range of other scales.

In 1990 OS became an Executive Agency of government. In 1999, it became a Trading Fund, enabling it to focus on the development and exploitation of its commercial activities. It has also recently entered into an agreement with the government, the National Interest Mapping Service Agreement (NIMSA). This is designed to ensure the continuation of the non-commercial (i.e. national interest) elements of OS's business.

An understanding of the economic value of OS must begin with an understanding of the value of GI to the Great Britain economy. As with most national mapping agencies, OS is the central player in the market for GI in Great Britain; as such, it contributes to the growth of, and developments in, the GI market. Similarly, users and other producers influence OS, both by guiding product development and pricing, and by providing complementary products, particularly those involving new technologies. As the technological options have widened, OS has developed a wider range of products and services, many of which were not even conceived of 25 years ago.

This section considers the economic importance of GI, with particular focus on the value provided by geographic information systems (GIS). Later sections focus explicitly on the economic value of OS alone. There have been some studies of the economic importance of GI, and many detailed studies of the specific costs and benefits of particular GIS applications. However, we believe that this is the first time the economic contribution of OS has been presented within the framework of economic analysis. In what follows, it is not always the facts that are new (many are drawn from existing studies and publications), rather the way in which they have been integrated. Much of this discussion will be familiar to those working in the field, but this brief overview provides a useful summary for those new to the sector.

2.2 What is geographic information?

The Chorley Report defines GI as follows:

> 'Geographic information' is information which can be related to specific locations on the Earth. It covers an enormous range, including the distribution of natural resources, the incidence of pollutants, descriptions of infrastructure such as buildings, utility and transport services, patterns of land use and the health, wealth, employment, housing and voting habits of people.[2]

[2] Department of the Environment (1987), 'Handling Geographic Information: Report to the Secretary of State for the Environment of the Committee of Enquiry into the Handling of Geographic Information', Chairman: Lord Chorley, p. 7.

GI is all information that has a spatial context. It encompasses a growing number of datasets, many of which are combined to provide information requirements for the end user. A sample of the types of datasets is shown in Box 2.1.

Box 2.1: Core types of datasets

Administrative boundaries	Location referencing
Buildings	Marketing
Demographic	Postal boundaries
Geology and soils	Railways
Height information	Roads
Hydrography	Sub-surface structure
Land cover	Typography
Land use	Utilities
Local site boundaries	Waterways

Source: GI-BASE (1997), 'Final Report, Study on Demand and Supply for Geographical Information in Europe', OS, Navigation Technologies, and elda Ingegneria spa.

A significant proportion of all information that is publicly available in any economy is GI-related and is used in a wide range of commercial and leisure activities.

GI is an assumed reality of everyday life. Information about where we are, what surrounds us, and where we are going is essential for both commercial and social well-being. This was confirmed in the Chorley Report, where it was noted that:

> Most human activity depends on geographic information: on knowing where things are and understanding how they relate to each other. [3]

The economic value of GI is often underestimated because the knowledge acquired through the use of GI is considered an automatic 'right', which will always be freely available. It is only once the social and economic losses that would result from an absence of GI have been considered that the full value of GI is appreciated.

2.3 Is geographic information a public or a private good?

In order to establish something of the role and value of GI in the national economy, Masser considers alternative economic classifications of GI.[4] He establishes that while GI has many of the characteristics of a resource, a commodity, a capital asset and infrastructure, it does not fit neatly into any of these categories. The difficulty in assigning a particular role to GI reflects, to a large extent, the diffuse, and hence extensive, impact that it has on the economy. For the purposes of this report, it is assumed that GI, as provided by OS, is a basic input into production processes throughout the economy, and a final good consumed by users directly, both for commercial and leisure activities. The role of GI as an asset and infrastructure is also captured in the discussion on the social and environmental value of OS.

One issue is the extent to which GI is a public or a private good. The theoretical differences between these two types of goods have been discussed extensively in

[3] ibid.
[4] Masser, I. (1998), *Government and Geographic Information*, Taylor and Francis. The reader is referred to Section 2 for an extensive discussion of the problems in defining GI.

economic literature and in studies of GI.[5] In essence, public goods are those which, once they have been produced, are available to all, without exclusion; in contrast, private goods can be owned exclusively.

Given the variety of datasets, products, services and uses involved, it is not surprising that GI cannot be defined as either a pure private good or as a pure public good. There are some elements of GI that are distinctly public. GI is non-rival in consumption (i.e. the same information can be consumed by multiple users), but there are attributes of GI provision which make it a private good (e.g. in general, it is not freely available to all consumers, and charges can be used to limit access). GI has grown from being the collection of information required for defence or other public purposes, which could be construed as a public good, to being a wider range of datasets and information uses. It has become what Love defines as a 'quasi-public good'.[6]

Similarly, OS cannot be seen simply as a provider of a public good or a provider of a private good. Elements of business cover both types, although services based on GI are mainly private goods, since they are constructed with particular users in mind. The dual nature of OS outputs and services has been recognised in both the internal organisation of OS and the financial regime established by the government. Thus, the establishment of the Trading Fund recognises the private-good element of OS activities (where it is expected to be commercial), while the NIMSA provides official recognition of the public-good role of OS, and the need to ensure that it continues into the future.

2.4 How far is the collection of geographic information a natural monopoly?

A separate consideration is that the collection and maintenance of GI may in part be a natural monopoly, with the result that the average cost of provision is increased where OS's activities are duplicated by other information providers. Certainly, there would seem to be no benefit from having two identical base datasets of the same location, and there should be substantial efficiency gains from unifying data collection. The implication is that any required level of activity can be supplied most economically by a single firm or a single system.[7] In practice, there is some duplication of geographic data collection within Great Britain, and the extent of duplication may increase in the future, as new digital technologies based on aerial photography become available. Thus, it seems possible for competitors to overcome some of the apparent advantages of a natural monopolist by using new techniques or by selling new products or services.

OS's activities are to some extent split between those which have elements of natural monopoly (the collection, storage and maintenance of GI), and those which are potentially competitive (the conversion of the base GI datasets into products and services, and the sale and marketing of these products and services to customers).

Where there is a natural monopoly, there are difficult choices about pricing since there are many ways of recovering fixed costs, each with different implications for demand. Issues

[5] See, for example, OS (1996), 'Economic Aspects of the Collection, Dissemination and Integration of Government's Geospatial Information: A Report arising from Work carried out for Ordnance Survey by Coopers and Lybrand, May.
[6] Love, J. (1995), 'Pricing Government Information' in 'Agenda for Access: Public Access to Federal Information for Sustainability through the Information Superhighway', report prepared by the Bauman Foundation, Washington DC.
[7] See Sharkey, W. W. (1982), *The Theory of Natural Monopoly*, Cambridge University Press.

of pricing policy have only been touched upon in this report, which deals with the current pattern of demand and use.

2.5 The role of geographic information systems

According to the DTI's White Paper, 'Our Competitive Future: Building the Knowledge Driven Economy':

> Digital technology is the nerve system of the knowledge driven economy. Huge advances have been made in our ability to collect, store, retrieve, analyse and communicate information . . . Information is cheap and plentiful. It is not enough, however, for business simply to collect information. It has to use it effectively to raise productivity, develop new products and processes and serve customers more intelligently.[8]

The same concerns drive the recent book by Bill Gates.[9] The central message of this book is that: 'The successful companies of the next decade will be the ones that use digital tools to reinvent the way they work.' Several of the examples in the book make some use of GI.

The gains from new technology can be categorised into three types:

- **increases in efficiency**, so that the same task can be performed with fewer, often significantly fewer, resources;
- **increases in effectiveness**, so that the same task can be performed with greater accuracy and fewer mistakes;
- **new products and services**, which could not have been produced without this new technology.

The gains can be achieved by various routes:

- reductions in processing costs;
- reductions in search costs;
- more effective scheduling, and therefore reductions in waste;
- reductions in uncertainty, and therefore more effective service delivery;
- better matching of products and services to needs as a result of better information.

Given these potential benefits of technology, it is not surprising that the development of computer-based GIS is assumed to have increased the efficiency and effectiveness with which GI is used throughout the economy. Two definitions of GIS are:

> A GIS is a combination of hardware and software which enables the collection, storage, retrieval and display of geographical and database information in a single system. [10]

> A system of hardware, software, and procedures designed to support the capture, arrangement, manipulation, analysis, modelling and display of spatially-referenced data for solving complex planning and management problems. [11]

[8] DTI (1998), 'Our Competitive Future: Building the Knowledge Driven Economy', paras 2.72–73, Cm 4176.
[9] Gates, B. (1999), *Business @ the Speed of Thought: Using a Digital Nervous System*, Penguin Books.
[10] OS (1997), '*Digital Insight*' booklet.
[11] Cown, D. (1989), The National Centre for Geographic Information and Analysis (NCGIA) lecture.

Together, these definitions identify the range of information covered and its subsequent usage. In Box 2.2, a sample of GIS applications is provided to indicate the significant impact which these systems have in all areas of the economy.

Box 2.2: Geographic information systems applications

Construction and civil engineering	Natural resources and land use
Environmental assessment	Property transfer and land registration
Estate and farm management	Risk assessment
Facilities and asset management	Service provision and retail site location
Incident and crime-pattern analysis	Site location referencing
Map design and production	Telecommunications networks
Marketing, sales and media planning	Traffic management
Medical research and epidemiology	Utility infrastructure
Municipal planning and development	Vehicle routing and scheduling

Source: GI-BASE (1997), 'Final Report, Study on Demand and Supply for Geographical Information in Europe', OS, Navigation Technologies, and elda Ingegneria spa.

It is evident from Box 2.1 that there are many different types of datasets that are categorised as GI and that each has many alternative uses. A key feature of GI is the close relationship between the constituent datasets. There are substantial advantages if users and product and service providers are able to combine the base data-types, thereby creating new sources of information and analysis. In the paper world of the past, the combination of different datasets was either impossible or else difficult and time-consuming. Developments in technology, and the advent of the digital age, have altered the way in which GI can be used, combined and integrated into production processes. The development of GISs has significantly increased the economic value of GI, especially where the different datasets are consistent.

In the EU, DG XIII (Directorate General for Telecommunications) has responded to the agenda set out in the competitiveness White Paper[12] by establishing a work programme to develop a European policy for GI as a contribution to the European information society. The related discussion document sets out a broad strategy, together with indications of the expected economic benefits.[13] The DG XIII document states that the ultimate aim of GI is to 'manage our natural environment more effectively and promote economic growth'.

Box 2.3 gives a broad indication of some of the uses of GI, in a digital context, to emphasise the central importance of GIS to the modern economy. Only when the precise applications are considered can the real potential be understood, particularly in the case of new and innovative uses.

[12] 'Growth, Competitiveness and Employment: The Challenges and Ways Forward into the 21st Century', *Bulletin of the European Communities*, 1993.
[13] DG XIII (1998), 'Geographic Information in Europe: A Discussion Document', August.

Box 2.3: Some new and innovative uses of geographic information

- The use of satellite imagery for early detection of disease and pests in crops.
- Increased agricultural productivity through the use of GI to target pesticides and fertilisers.
- The use of GI to monitor environmental problems, such as deforestation, and climatic change.
- The better targeting of potential consumers by the use of geomarketing techniques.
- GI is now central to many weapons systems.
- Detailed analysis of GI aids crime prevention.
- Large retailers use GI to improve the siting of new supermarkets.
- Car dealers can use GI to rationalise their networks.
- The emergency services use GI to control forest fires more effectively.
- GI can be used to identify preferred property transactions.
- Banks and other lenders use GI to understand more about the likely demand for credit by area and to plan the deployment of their facilities.
- Insurance companies use GI to reduce the cost of poorly written policies.
- Better planning of mobile telecommunications networks, enabling a better matching of capacity to demand.

Source: OXERA based on Gilbert H Castle III (ed) (1993), *Profiting from a Geographic Information System*, GIS World Books; and internal OS information.

It would be misleading to proceed on the assumption that we are dealing only with benefits to business, which can be translated into growth in national income or GVA. For example, many of the uses of GIS involve the heath and social services or other aspects of public provision (e.g. accident protection and avoidance), which generate significant, but non-pecuniary, benefits.

There is concern that some of the business uses of GIS will result in greater manipulation of consumers, rather than greater efficiency and better service standards. This is a philosophical and ethical consideration that is far beyond the scope of this report.[14] What is undeniable, however, is that, as the above box shows, the potential benefits of GI reach far into society. As the DG XIII document states, 'GI and GIS tools, working hand-in-hand, can improve the ability of many societal actors to make informed choices.' As would be expected, a number of the uses relate to the more effective use or protection of land or natural resources. Given the growing pressure on natural resources, and the world's increasingly urgent environmental concerns, these sort of gains are clearly of major importance. However, other uses relate to other kinds of resources (e.g. medical, social and economic).

2.6 The economic value of geographic information in the digital age

Developments in technology have improved the way in which GI is collected and managed. Other changes have increased the range of products and services available, while some previously inaccessible information is now widely available on the Internet. The choice between new and more accurate maps, and old and less accurate maps, is one that has presented itself to users ever since maps began. While this choice remains, it has been superseded to a large extent by the much more fundamental choice between old and new technologies. The essence of digital technologies is that the process of updating maps and other GI can be both instantaneous and much less costly than before; however, the costs of investing in the new systems, including hardware, to handle the new technology should not be underestimated.

[14] These concerns are covered in Pickles, J. (ed) (1995), *Ground Truth: The Social Implications of Geographic Information Systems*, The Guildford Press.

The net economic and social impact of better information is real, but it is inevitably often difficult to measure. Table 2.1 presents examples of the economic advantages which companies and institutions have been able to reap as a result of the use of GIS products. An aggregation of these effects is not really possible. However, there are widespread claims in the USA that 'the dramatic improvements in computing power and communication and information technology appear to have been a major force behind this beneficial [productivity] trend.'[15]

Table 2.1: Some examples of economic gains from geographic information systems

Case study	Benefits	Related OS products
Utilities		
US utilities use GI technology to maintain and manage records and maps, and to support design and administration.[1]	Rates of return range from 15% to 35% Cost:benefit ratios range from 1:1 to 1:5	1:10 000 and 1:50 000 Scale Raster
Southern Water improved its records of sewers and mains[5]	Quicker location of sewers, mains and pipes and quicker resolution of problems	Land-Line®
Southern Electric bought , from Smallworld plc, a digital system to hold the GI needed by the engineers that are maintaining its distribution network[4]	Savings of £14.7m by using the new system, plus a further £1.5m in staff, building and operating costs	1:10 000 and 1:50 000 Scale Raster
North of Scotland Water has transferred to a GIS[6]	The new records are more reliable and easily updated. Engineers can access information from lap-top computers on-site. By combining soil sampling with GIS, the company is building up a better picture of the condition of its infrastructure	
Retailing		
A dairy in the USA reduced wasted vehicle mileage by using a transport logistics tool[3]	Reduced mileage by 9% and hours travelled by 4%	OSCAR Traffic-Manager®
Safeway used GI to analyse marketing data.[5]		Meridian™
Transport		
An intelligent vehicle highway system in California reduced congestion and improved safety[3]	Reduced travel time and fuel consumption, providing both financial and environmental gains	OSCAR®
Carmarthenshire County Council used GI to identify accident black-spots[5]	Faster analysis and resolution of problems	OSCAR Asset-Manager®
Government		
The Ministry of Agriculture, Fisheries and Food (MAFF) has maintained its own stockpiles of food. The use of a GIS to maintain details of commercial food warehouses reduces the need for MAFF stocks		1:10 000 and 1:50 000 Scale Raster

[15] Alan Greenspan, Chairman of the US Federal Reserve Board, quoted in DTI (1998), 'Our Competitive Future: Building the Knowledge Driven Economy'.

Table 2.1: Some examples of economic gains from geographic information systems (cont'd)

Case study	Benefits (quantified where possible)	OS products or equivalent products
Agriculture		
GI helps to improve farm management[5]		Land-Line
Planning		
Heathrow Airport Ltd use GI to analyse the spread of aircraft noise and the extent to which compensation is appropriate[5]	More accurate information means that complaints can now be matched to specific flights	1:10 000 Scale Raster, ADDRESS-POINT™, Strategi®
Cardiff Bay Development Council used GI to identify housing likely to affected by the development[5]	People are now better informed about the plans and preventative action has been more quickly identified	1:10 000 Scale Raster, ADDRESS-POINT, Land-Line
Telecommunications		
NYNEX used GI for market analysis[5]		ADDRESS-POINT, OSCAR Route-Manager®, Meridian
NORWEB communications bought, from Smallworld plc, a geographic and spatial information system[4]	Business and operational savings of 20%	1:10 000 and 1:50 000 Scale Raster
Health services		
A computer-aided ambulance despatching system, in Florida, is based on GI[2]	1 minute was saved on each call, with a total value of $150,000 per year. In addition, the quality of service was improved and lives were saved	OSCAR Traffic-Manager

Sources: [1] Rector, J. M (1993), 'Utilities', chapter 11, in Gilbert H Castle III (ed), *Profiting from a Geographic Information System*, GIS World Books. [2] Norris, J. (1993) 'Health Care', chapter 8 in Gilbert H Castle III (ed), *op cit*. [3] Badillo, A.S. (1993) 'Transport and Navigation', chapter 9 in Gilbert H Castle III (ed), *op cit*. [4] Smallworld plc website. [5] OS (1998) cartesia™, Version 2.1. [6] 'Mapping the IT future', *Water Magazine*, February 26th 1999.

Case studies of this kind inevitably draw attention to the successes. Another study puts these, possibly rather exceptional cases, in perspective. In a survey of the business use of GI,[16] respondents, who were all members of the Association for Geographic Information (AGI), and were therefore more aware of the possible uses of GI than most, were asked to rank the benefits of GIS in a scale ranging from 'very considerable benefits' to 'no benefits at all'. Eleven uses were identified[17] and, in all cases except 'contract negotiation, over one-third of respondents said that the benefits were either 'very considerable' (scored as 1) or close (scored as 2). Nevertheless, in the case of risk assessment, disaster planning, and contract negotiation, about half the respondents said that there were no

[16] Grimshaw, D.J. (1997), 'A Survey of GIS Use in the Business Sector', *Proceedings of the AGI Conference at GIS*.
[17] These were risk assessment; disaster planning; drivetime analysis; financial management; strategic development; customer profiling; site planning; visual presentation; service delivery; contract negotiation; and marketing/targeting.

benefits at all. It is important to bear this range of experience in mind when interpreting the uniformly favourable case studies.

2.7 The value of geographic information and geographic information systems

This report focuses on the value of OS's activities to the Great Britain economy, both in qualitative and quantitative terms. Barr and Masser suggest that:

> Information has no inherent value, it is only of value once used and that value is related to the nature of the use rather than the nature of the information. As a result information has very different values for different users.[18]

The aim of this report is to show something of this variation. Nevertheless, it is tempting to want to place this analysis within the framework of an estimate of the value of GI and GIS as a whole.

A crude guide to the value of GI to the economy is the amount invested in GI. DGXIII estimates that the investment made by government, commercial and industrial organisations for the collection, provision and use of GI in Europe is 10 billion ECU per year (£6.6 billion).[19] It adds that only a small percentage of this investment is thus far linked to commercial exploitation. Estimates have been made by a number of researchers of the total size of the Great Britain GI industry. For example, NOP estimated that the total domestic market was valued at £204m in 1997.[20] The contribution to employment is also significant. OS's own turnover was £75m in 1997/98.

2.8 Conclusion

This section has presented a broad review of the benefits of GI, and in particular of digital information systems. Substantial gains in productivity and improvements in performance standards are possible, although no attempt is made at this point to make an aggregate estimate of value.

It is, however, important not to omit the other wider social and environmental gains from GI. The maximisation of such gains raises difficult questions concerning the best way to price such information and the possibilities for increasing usage by introducing different tariffs.

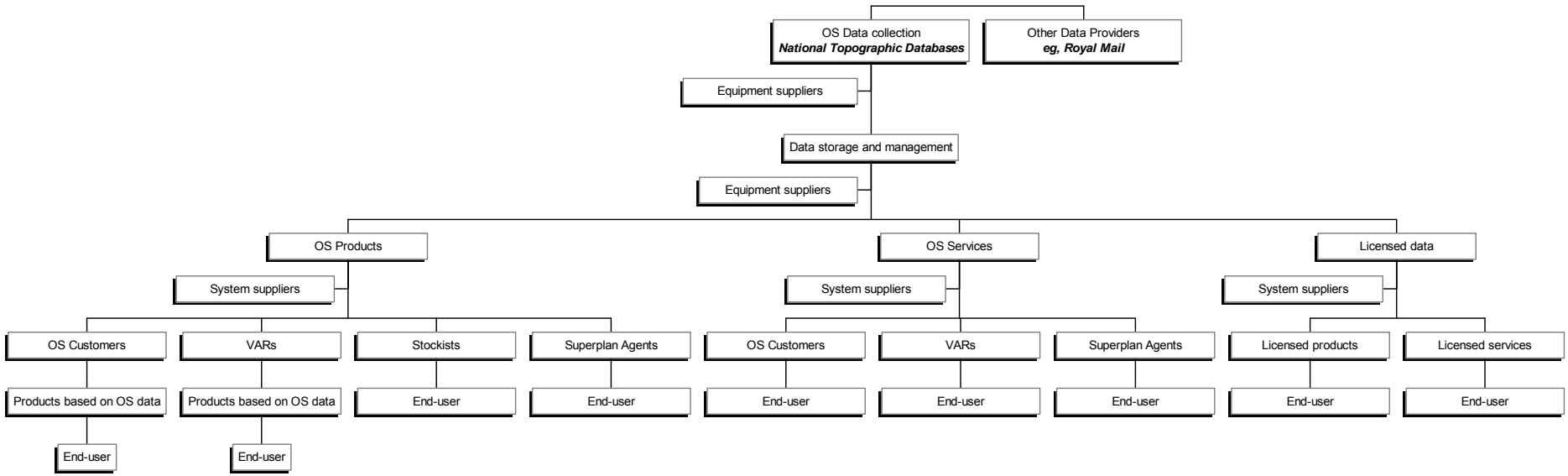
[18] Barr, R and Masser, I (1996), 'The Economic Nature of Geographic Information: A Theoretical Perspective', in *Proceedings of the GIS Research UK 1996 Conference*.
[19] DG XIII (GI2000 initiative) (1996), 'Towards a European Policy Framework for Geographical Information: A Working Document', November.
[20] OS (1998), 'Marketing Strategy', November.

3. The Market for OS Products and Services

3.1 The geographic information market in Great Britain

Despite the dominance of OS, the market for GI in Great Britain is complex. Figure 3.1 identifies the role of OS in the GI market, and provides the basis for the methodology used to estimate economic value, described in Section 4.

Figure 3.1: The Role of OS in the GI market



Source: OXERA.

OS undertakes a variety of activities in the GI market, including data collection, data maintenance, data storage, production and supply of GI products and services. Each element of this production chain provides value to the GB economy. The remainder of this section describes the products and services produced by OS and considers the role of the different players in the GI market.

3.2 Production of products and services

3.2.1 Inputs

The inputs to OS products and services can be split into two categories: base data and other standard production inputs. The base data is generated from the National Topographic Database, which is created and maintained by OS. This covers urban areas at the 1:1 250 scale, rural areas at the 1:2 500 scale, and mountain/moorland at the 1:10 000 scale. It records over 200m features of the landscape and is fully digitised. Other datasets are generated from this base database, and some OS products and services are produced by combining the base data with other GI (e.g. postal codes).

The other inputs to the production process are similar to those used in any manufacturing industry. Table 3.1 shows a range of the services provided to OS by a sample of 100 companies. As OS and its customers have focused more on digital data, and the associated products, so has the proportion of technological inputs changed.

Table 3.1: Services provided by OS's top 100 suppliers

Aerial photography	Mobile communications
Agency workers	Packaging
Car hire/leasing	Parcel service
Cleaning	Partner in joint publications
Communications	Payroll services
Computer consumables	Plotters
Consultancy	Print machinery
Co-publisher for CD-ROM	Printing press
Digital copier	Printing services
Display equipment	PRISM/pen computers
Display/promotional	PRISM/software
Electricity	Promotions
Facilities management	Recruitment
Film/chemistry	Relocation services
Fleet management	Restaurant/catering
Furniture	Rural revision
Gas	Service/supplies
Global Positioning Systems/survey equipment	Software
Insurance broker	Software/maintenance
IT	Special papers
IT consultants	Stationery
IT consumables	Survey equipment
IT equipment	Telephone systems
IT maintenance	Training
IT networks	Travel
Mailing services	Vehicle leasing (private user scheme)
Map paper	Water
Market research	

Source: OS.

3.2.2 Outputs

The information held in the National Topographic Database is combined with other inputs to produce two main sorts of OS products: paper mapping products, and computer data products (which now account for the largest part of the business). OS also provides related services. These are customer-focused, so that OS provides individual users with GI-based solutions to identified problems. Revenue from these products and services is generated through direct sales and from the licensed use of products.

Box 3.1 provides an overview of the main standard products and services currently provided by OS. As with any company working in a sector which is greatly influenced by technological change, the range of products and services is rapidly increasing, and the nature of the products and services is changing all the time.

Box 3.2: OS products and services

Paper maps
A range of leisure, motoring and planning maps are produced at different scales. Examples include the 1:50 000 scale Landranger series and the larger 1:25 000 scale maps, which include the Outdoor Leisure™, Explorer and Pathfinder® series

Scale Raster
Digital data with a familiar map appearance on two scales 1:50 000 and 1:10 000

Land-Line
Large-scale maps available on three different scales—1:1 250 (urban), 1:2 500 (small towns and villages, and developed rural areas), 1:10 000 (mountain and moorland areas).

Superplan Data®
Large-scale (1:1 250) street-level data

Code-Point™
A precise geographic location for each postcode unit

ADDRESS-POINT
Locates and defines residential, business and public postal addresses

Land-Form
Provides a visual representation of the terrain in Great Britain

Strategi
A strategic decision-making tool based on a 1:250 000 vector dataset

BaseData.GB®
A dataset which gives an overview of Great Britain on the 1:625 000 scale

Meridian
A vector dataset which can be used for regional analysis

Boundary-Line™
A vector dataset containing electoral and administrative boundaries

OSCAR
A family of products for customers who use roads or manage assets relating to roads. The products are OSCAR Asset-Manager; OSCAR Traffic-Manager; OSCAR Route-Manager; OSCAR Network-Manager® and OSCAR Drive Restricted Information

3.3 Distribution

There are four main routes by which customers obtain OS-related products and services.

- Direct account sales—confined to business users.
- Value-Added Resellers (VARs)—these are private and public organisations which form partnerships with OS to produce 'off-the-shelf' computer packages incorporating OS data. Complete solutions are offered (e.g. farm-management packages) and prices are negotiated. OS gains a royalty for the data.
- Superplan™ Agents—these supply the full Superplan and Landplan® product ranges by producing maps and data on demand, using installed computer terminals. There are now 35 fully equipped agents in Great Britain.
- Wholesalers and Retailers—these service the consumer sector and are primarily responsible for the distribution of paper maps.

3.4 System Suppliers

An OS digital-data client requires appropriate computer hardware and software to view digital data on screen. For the most part, standard operating systems and personal computers can be used with OS-related data products. The supply of the required software is carried out by System Suppliers. 250 GIS suppliers in Great Britain are currently licensed by OS. The System Suppliers work closely with OS to develop digital products and services, in the knowledge that, for both parties, compatibility of product and software is a necessity for the success of the venture.

3.5 Customers

OS has a heterogeneous customer base which is divided into the business sector (responsible for 80% of total revenues) and the consumer sector. In OS's marketing strategy, these sectors are sub-divided into the following market segments.

Business segments	
Architects, engineers, survey and construction	Manufacturing
Central government	Marketing and business consultancy
Computer and related activities	Mining, drilling and quarrying
Education	Publishing and broadcasting
Emergency services and security	Real estate
Farming and forestry	Recreation, culture and sport
Finance and insurance	Restaurants, public houses and hotels
Health and non-local-authority work	Transport
Legal and environmental consultancy	Utilities
Local government	Wholesalers and Retailers
Consumer segments	
Drivers	Other leisure pursuits
Referencers	Walkers

Some of these segments are much more important to OS than others. In particular, 25% of total revenue is generated from the utilities sector, 20% from central government, and 16% from local government.

The uses of OS data, products and services also differ from sector to sector. For the purposes of this study, it is particularly important to consider how dependent each sector's output production is on OS-related products. In part, this is done by considering what OS-related products and services are used, and the opportunity cost of not using them. A related assessment is made of how crucial OS products and services are as inputs to the production processes of these business users.

The scope and timescale of the project prevents an analysis of the importance of OS in all of the many sub-sectors it serves in the business and consumer markets. OXERA has therefore identified, in conjunction with OS staff, the 10 primary users of OS products, which are as follows. These are considered in more detail in section 6 of this report. The

omission of a detailed assessment of all sectors biases the final economic value estimate downwards.

Utilities	Central government
Local government	Architects, engineers, survey and construction
Real estate	Legal and environmental consultancy
Transport	Computer and related activities
Farming and forestry	Mining, drilling and quarrying

OS's consumer market segment represents the more traditional face of mapping in Great Britain. The major focus in this sector is on the use of paper-mapping products for leisure activities. The economic value of OS to this segment is considered in the overall context of the social and environmental value of the organisation (Section 9).

3.6 Competitors

There are several other companies operating in the GI market in Great Britain, producing both paper products, and digital products and services. While OS remains the leader in the business sector, the intensity of competition has increased significantly in recent years. Many competitors also combine the role of information providers, System Suppliers and VARs to provide a complete package of services to customers. It is clear, however, that the majority of these competitors use OS information as the basis of their products and services. In fact, most of the key players are OS licensees.

OS is also facing competition in the GI market from providers of alternatives to the traditional map, particularly via the Internet. For example, Global Positioning Systems and high-resolution air photography are providing consumers with alternative means of visualising the required data.

4. Methodology

The objective of this study is to provide an estimate of the *current* economic importance of OS. In time, OS may wish to repeat this study and assess the change in importance. If future studies are to be consistent with this one, the methodology used must be transparent. This section provides a description of the alternative methodologies considered and of the final methodology used.

4.1 Willingness to pay

Central to the approach adopted in this report is the assumption that sales figures will almost certainly underestimate the overall value of OS. There are two reasons for this:

- the overall benefits which users gain from their use of OS information will exceed the price they pay for its products;
- other benefits are not included in any economic calculus—e.g. the broader gains to society from environmental improvements brought about by the better use of OS products, or the reductions in mortality produced as a result of improved response times by the emergency services.

The economic value of OS can, in principle, be measured by overall willingness to pay (WTP)—i.e. what each consumer would have paid, had the seller been able to discriminate between customers and to extract the maximum feasible charge. In the case of public goods, such as OS's basic data collection, WTP should be calculated as a total across all users. This should allow consideration of whether the common investment is worth making in the first place, and to what scale.

The best way to assess WTP is to ask people how much they would contribute towards financing OS's basic activities. The NIMSA covers the public interest in the provision of this public good, but there is no reason why overall WTP should equal the cost—indeed, it would be expected that the total value attached to OS's services would exceed the cost of collection. However, a full WTP study, based on surveys, is time-consuming and difficult to accomplish without bias. Such an exercise has not been attempted here.

An alternative approach to estimating WTP is to re-examine the options open to users if OS-based services were not available. Specifically, this would entail looking at the costs which buyers of OS services would have to bear if they could not buy OS products (e.g. the additional surveying costs which engineers would have to bear if they could not use OS maps). This technique can work well at the margin (identifying the additional costs that would be carried if OS had not expanded or improved its services), but it does not work as well infra-marginally. It would be possible to pose the question of what people would do if there were no OS services, but it would be hard to obtain a sensible answer since it would not be plausible to forget about 200 years of maps and map-making. Our analysis of a sample of OS customers demonstrated that interviewees found it impossible to assess how much it would cost them to do without OS products and services.

4.2 The value-added approach

Given the scale of this project, and the limited information concerning the impact of OS on its customers, a high-level value-added approach has been used to estimate the economic contribution of OS. In each sector, value-added is equal to the value of output

produced less the value of goods bought in to produce that output. For the economy as a whole, GVA is the main component of GDP at market prices (consumer taxes being the other).

The methodology is based on the assumption that OS contributes to the economy in seven different ways (as outlined in the table below). Where possible, a monetary estimate of the economic importance of OS activities has been provided under each of these headings. However, the qualitative conclusions about the dependence of particular parts of the economy on OS, and the social value of OS, are probably of more importance.

Table 4.1: OS's contributions to the Great Britain economy and OXERA's measures of each

Economic contribution	Description	Measure
Direct tangible benefit	OS's own value-added derived from its range of products and services	The direct tangible benefit of OS and the indirect tangible benefit of OS to its suppliers are measured together as the total turnover of OS (the value of sales) plus the parliamentary grant[1]
Indirect tangible benefit to OS suppliers	OS's purchases of raw materials and capital goods	
Indirect tangible benefit to customers	OS products and services are inputs in the production of other goods and services	The value-added of each market segment is taken from the national accounts. Then, using information about the sector obtained from OS and interviewees, an assessment is made of the dependence of each
Indirect tangible benefit to distributors	Distributors' margin on OS products and services	The margin which distributors receive over the wholesale price
Indirect tangible benefit to System Suppliers	OS products and services enable software suppliers to develop compatible products sold to final customers	Included in the estimate of the OS-related value-added of the computer-related activities market segment
Indirect tangible benefit to competitors	OS data is widely used by competitors to produce their own products and services	Not quantified
Intangible benefits	OS provides social and environmental benefits to the economy—not all of which are reflected in the value of direct sales	Not quantified

Note: [1] Using the definition of the Office of National Statistics (ONS), the value-added of OS is equal to profit, plus staff costs, plus net taxes and subsidies. The value of OS to its suppliers can be measured as the amount it paid to them (i.e. OS's procurement costs). The direct value-added of OS and the value provided by OS to its suppliers is therefore equal to profit, plus staff costs, plus the parliamentary grant and procurement costs. Profit plus costs are equal to turnover, giving the final measure of turnover plus parliamentary grant.

The base year for the analysis is 1996; this is the most recent year for which ONS data on value-added by sector is available. More recent information on the direct value of OS and on its contribution to distributors and System Suppliers is available, and has been taken into account in our calculations and projections. However, as much of the core financial information is commercially confidential, the breakdown of information is not always provided in this public report.

Given our preferred approach to estimating the economic value of OS (based on WTP), this value-added estimate is an indirect, and certainly theoretically inferior, measure. However, it is consistent with both the basic national accounts data and OXERA's own interviews. It is therefore the best available measure, although, as emphasised above, it should be considered alongside the qualitative analysis of the economic role of OS in the economy.

4.3 Assessing the benefits of OS to other industries and services

The products and services provided by OS, not least of which is raw geographic data, are inputs into the production processes of a wide range of other goods and services in the Great Britain economy. All information, including GI, is a primary factor of production, alongside labour and capital. Given the right skills and computing facilities, information can be converted to knowledge, which is the basis of human capital.

In an attempt to show something of the economic value of OS products and services as an input to the production of other goods and services, the report focuses on the ten key OS business segments. The total figures provided at the end of Section 6 must therefore be viewed as an underestimate, given that OS is also a valuable input used in sectors omitted from the analysis.

Three steps have been taken to assess the contribution of OS-related activities to each of the segments:

- determine the GVA[21] of the sector;
- estimate the proportion of production that is dependent on OS data and services;
- use this proportion to estimate the value-added which can be assumed to be OS-dependent.

The information on GVA for each sector has been determined using data from the ONS,[22] except in the case of central government (see section 6.2).

The analysis is based on information determined from interviews with a sample of customers within these sectors. The views expressed may not necessarily be shared by OS. All those interviewed are existing users of OS products and services and, as such, cannot be assumed to be statistically representative of all potential GI users. However, a wide variety of key user groups have been included in the analysis. The qualitative analysis is used to provide an indication of how dependent a particular sector's production is on OS products and services. For each sector, the degree of dependence on OS as a source of inputs to the production process is determined by placing it in one of the following bands.

[21] GVA at basic prices is equal to gross operating surplus plus compensation of employees, plus taxes less subsidies.
[22] ONS (1998), *UK Input-Output Supply and Use Balances, 1992-96,* Table 3, Demand and Products: the 'combined use' matrix, The Stationery Office.

Rating	Description	Proportion of value-added scored to OS (%)
A	Well above average dependence—the organisation would not be able to produce its outputs without OS-related products and services	80–100
B	Above-average dependence—only a relatively small proportion of the sector's outputs would be produced in the absence of up-to-date OS-related products and services	60–80
C	Average dependence—approximately half of a sector's output is dependent on the use of OS-related products and services	40–60
D	Below-average dependence—some of a sector's outputs are generated using OS-related products and services	20–40
E	Well below average dependence—nearly all of the sector's outputs could be produced in the absence of OS-related products and services	0–20

Given the broad nature of the sectoral analysis, and the limited number of interviews, it is clear that the assumptions about a sector's dependence on OS are very approximate. They do, however, provide a guide to the contribution of OS to production in these sectors, and hence to its contribution to the national economy. In order to place the use of OS-related products and services in context, consideration is also given to the availability of similar products and services from other sources and to the cost of using out-of-date OS information.

The value of any given GI data depends on how current the information is and on its useful life. Useful life varies by type of data and by the use to which it is being put. In the analysis of the economic value of OS, the focus is on the value of currently available information. Older information, and products and services based on out-of-date information, are viewed as substitutes for existing OS products and services.

4.4 Efficiency and effectiveness

In addition to the assessment of the monetary value arising from OS data, the study briefly considers the efficiency and effectiveness of the organisation's production process. Both efficiency and effectiveness directly affect the economic benefit of an activity.

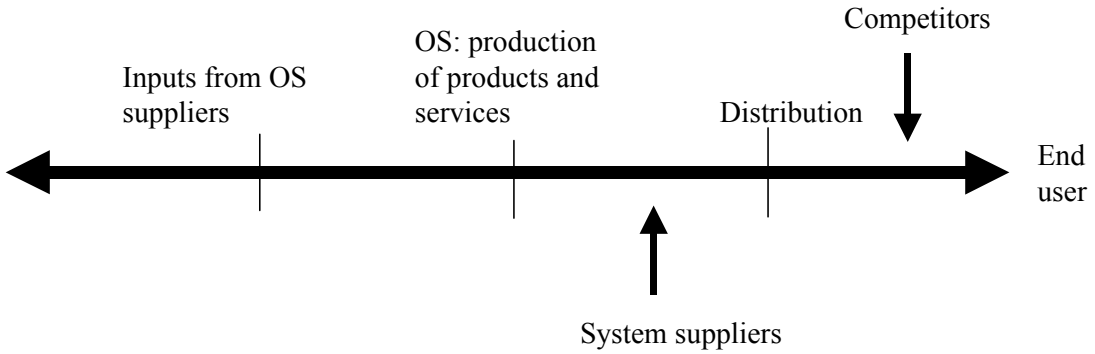
4.5 Conclusion

There seems little doubt that, without quality maps, Great Britain's productive potential would be reduced; it would take more resources to produce the same output. However, it is difficult to determine to what extent. It will not be possible to use our figures to say that GDP would be so many million pounds lower were it not for OS. The analysis will demonstrate, however, the monetary contribution of OS to the national economy and will enable statements such as 'Sectors which contribute *x* proportion of output from Great Britain make significant use of OS products and services.' Similar claims can, of course be made on behalf of other essential inputs (e.g. in one sense, just about the whole of the economy is dependent on the services of the electricity industry). However, this does not mean that a demonstration of the underlying importance of OS is not useful and illuminating.

5. Direct and Associated Tangible Benefit to OS Suppliers

The analysis of the economic value of OS begins, in this report, with OS production at one end of the production chain, to customers at the other, via distribution channels and competitors. The value of OS to its suppliers (upstream value) must also be taken into account. This is done by combining the direct benefit of OS with the indirect benefit to its suppliers.

Figure 5.1: The production chain



The direct value-added of OS is equal to the value of its outputs minus the value of the inputs from other industries and services—i.e. the sum of staff costs, profit and the net contribution from central government. The value of the inputs is an appropriate measure of the value of OS to its suppliers. The combined value-added is therefore equal to the value of OS output, which can be measured as turnover plus the net parliamentary grant. Table 5.1 shows this value over the past five years.

Table 5.1: The value of OS output (£m)

Year	Turnover	Net parliamentary grant	Value-added
1993/94	54.1	16.8	70.9
1994/95	58.6	14.2	72.8
1995/96	66.6	13.2	79.8
1996/97	68.8	12.1	80.9
1997/98	74.8	2.9	77.7
1998/99	81.1	9.9	91.0

Source: OS, 'Annual Report and Accounts', various years.

OS's purchases of inputs from its suppliers also create an indirect economic value. There could be other benefits of OS sales to these companies—e.g. the provision of goods and services to OS may allow them to reap economies of scale and scope that would not otherwise be available, or they may develop technologies that can be used in other circumstances. Neither of these externalities is considered here.

Table 5.2 shows a breakdown of turnover by activity. Over the period shown, the average proportion of turnover from each activity has been 81% from core activities and 19% from the commercial area. Core activities relate to the provision and marketing of topographic data and mapping at scales of 1:10 000 and larger. Mapping at scales of 1: 25 000 and 1: 50 000 is also defined as core. Commercial activities are those which

involve the production and marketing of mapping of scales smaller than 1: 50 000. Consultancy activities are also included in the commercial category.

Table 5.2: Turnover by activity (£m)

Year	Core	Commercial	Total
1993/94	42.9	11.2	54.1
1994/95	46.4	12.1	58.6
1995/96	53.1	13.5	66.6
1996/97	57.3	11.6	68.8
1997/98	61.9	12.9	74.8
1998/99	67.0	14.0	81.1

Source: OS, 'Annual Report and Accounts', various years.

6. Associated Tangible Benefit: Distribution Channels

We have estimated the value provided directly by OS to downstream distribution companies (ie, VARs, Superplan Agents and Retailers). Interviews were conducted covering all three channels and the annual reports of a number of VARs were studied. As much of the financial information gathered was commercially confidential, it is only appropriate to quote the total figures in this public report.

6.1 Value-Added Resellers

Each VAR is different, but, for the purpose of this study, a representative sample has been used. A small number of VARs have been interviewed and a sample of their annual reports has been analysed.

VARs use OS data as a primary input into the production of some of their products and services. In general, they earn no commission from OS for the promotion and sales of its products. The only value-added for VARs is from any margin that is earned on products that use OS data as a base. To estimate the value of OS products and services to these companies, OXERA has examined the annual reports of a select number of VARs. The margin that VARs are likely to make on the sale of OS-related products and services has been estimated, and this has been applied to the cost to the VARs of purchasing these products. Using this approach, OXERA estimates that the value of OS products and services to the VARs in 1996 was £0.48m.

Many VARs are also System Suppliers, and it has proved impossible to determine what proportion of revenues can be attributed to the two activities. There is, therefore, some double-counting, with the OS-related value attributed to some VARs being accounted for in the analysis of value-added by System Suppliers (see section 7.8).

6.2 Superplan Agents

Superplan Agents are retailers that are used by OS to promote and sell the range of Superplan products and services, although they also usually sell a wide range of products and services not related to OS. The analysis is again based on an assumption about the margin that these agents earn on the sale of OS Superplan products and services. This approach results in an estimate of the value of OS to the Superplan Agents of £1.8m in 1996.

It should be noted that there are other potential synergies to be gained from the sale of Superplan products and services that are not quantified here. In particular, there is invariably scope for selling additional, non-OS, products to Superplan customers. These spillover effects have not been quantified.

6.3 Wholesalers and Retailers

Map Wholesalers and Retailers are crucial distribution channels for OS products, particularly in the consumer market. Walkers, referencers, drivers, and others pursuing leisure activities are able to purchase OS products only through Retailers. The market is dominated by the sale of paper products. This is one area where OS's dominance as the national mapping agency is not quite so evident since, in parts of this market, competitors offer similar products. Many of these are, however, based on OS data.

OXERA estimates that OS contributes £4.1m to this distribution channel. This estimate is based on an analysis of the cost of OS products and services to Wholesalers and Retailers, and an assessment of the margins earned by the distributors on these products.

7. Associated Tangible Benefits to OS Customers

7.1 Utilities

The utilities market segment comprises the gas, electricity, water and sewerage, communications, and oil and pipeline sectors. This is the largest market sector for OS and, as such, it has a significant influence on product and service development at OS. For example, the utilities were largely responsible for pushing the move towards digitisation and were a primary influence on the Chorley Report.

The utilities' influence on OS's activities and development reflects the fact that the GI provided by OS is a central element of the day-to-day provision of the national basic services of water, electricity, gas and communications.

Those interviewed in this sector suggested that the main OS products used by the utilities (although these undoubtedly vary by sector) are:

- large-scale digital products;
- small-scale digital products;
- digital gazetteers;
- digital height products;
- Scale Raster;
- large-, medium- and small-scale paper (film) products;
- OSCAR;
- a range of client-specific services.

There is a service level agreement (SLA) between OS and the National Joint Utilities Group (NJUG) that streamlines the supply of data to many companies in the sector and covers copyright use.

The main applications of the products and services purchased are:

- asset and facilities management;
- customer billing;
- marketing;
- radio propagation;
- network analysis;
- risk analysis;
- optimum routing;
- vehicle tracking.

For the most part, OS mapping products are combined with in-house data and are used as the backdrop for this wide range of applications.

Box 7.1: Utility company experience with OS products and services

- Cable & Wireless Communications (CWC) quoted the main products used as Land-Line and ADDRESS-POINT. The 1:10 000 and 1:50 000 Scale Raster are also purchased by the company. OSCAR was used in the past for a particular project, but is no longer used. These products are used for a variety of purposes. In particular, they allow CWC to design the layout of cables so as to obtain maximum revenue by passing as many homes as possible. ADDRESS-POINT is also the primary source of information for the company's subscriber database.

- It is largely the distribution part of an electricity company's business that uses OS products and services. The main products used are Land-Line, 1:10 000 Scale Raster and 1:50 000 Scale Black and White Raster. This data is used to record all underground and overground assets, as required by statute. These asset records are used directly by the company and are supplied to other utilities and contractors working in the company's area. OS products and services are also used for drawing legal and consent plans (for example, when the company is providing connections to a new housing estate), and for drawing up wayleave plans for overhead cables.

- The uses of GI in the water sector were discussed by P. Mahon at the AGI conference in 1998.[23] According to Mahon, 'North West Water now holds some 20,000 OS digital maps at scales ranging from 1:1 250 to 1:625 000.' North West Water's internal information system manages updates from OS and distributes these to various users within the organisation. A Map Maintenance Section has also been established to enable centralisation of the maintenance of records. 'In integrated systems address data is held within a central gazetteer utility or in North West Water's case a location management utility, since the adding of OS co-ordinates to the address is essential for the other corporate systems.'

There is a general recognition that the utility companies need up-to-date, large-scale, GI. For example, they require information on the location of new residential areas before they are built. Without this, the necessary connections would not be provided in an efficient and timely manner. Similarly, information on the location of assets, and an understanding of the surrounding environment, is a prerequisite for good network management, and, for many of the companies, is a requirement established by the sectoral regulator.

The provision of up-to-date digital GI enables the utility companies to improve the efficiency with which their services are provided. Such cost gains provide significant financial returns. One interviewee noted in particular that the electronic transfer of data between utilities was beginning to bring in significant cost savings. The increase in takeovers and mergers, the formation of multi-utility companies, and the growth in dual-fuel providers, and dual-communication service providers, also means that there is a need for consistent data across associated companies. This consistency is provided by the use of OS products and services.

The fact that GI is a necessary input into the running of a utility company, and hence into the provision of their essential services, does not mean that the information need necessarily be purchased from OS. However, those interviewed indicated that alternative sources of similar information were not available.[24]

[23] Mahon, P. (1998), 'Managing Data Information at North West Water', in the *Proceedings of the AGI Conference at GIS*.

[24] Throughout this section competitor products are considered as alternative sources of GI in the absence of OS. This may, however, be misleading, given that many of these products are based on OS data. It is assumed that competitors, or customers themselves, are in a position to update the existing OS datasets.

The quality of OS data was mentioned by interviewees as a primary reason for opting for current OS products and services. If the required GI were not available from OS, the utility companies would survive using local information, 'trial and error', and existing paper products, even though these provide incomplete information. The long-term efficiency of the companies, and their ability to maintain and upgrade the networks, would, however, be called into question. As competition within the utilities grows, and companies move into new and unfamiliar parts of the country, the value of accurate GI is likely to grow.

The main conclusion reached is that the utilities sector is very dependent on up-to-date GI to produce and provide their products and services, and that OS is considered the best available source of the required information. The utilities market segment has therefore been placed into band A on the dependence scale. Table 7.1 provides an estimate of the OS-related value-added for the sector.

Table 7.1: Contribution of OS to the utilities

GVA (£m)	28,724
OS dependency ranking	A
OS-related GVA (£m)	22,979 to 28,724

Note: The value-added for this market segment is determined by aggregating the value-added of the following ONS sectors—electricity production and distribution, gas distribution, and water supply.
Source: ONS (1998), *UK Input-Output Supply and Use Balances, 1992-96,* Table 3, Demand and Products: the 'combined use' matrix, The Stationery Office.

7.2 Central Government

A book on *British Maps and Map-Makers*, published in 1944, concluded:

> The Ordnance Survey has become an integral part of our national life, for there is no public body, from rural district councils and sewerage commissions to the War Office, The Land Registry and the Parliamentary Boundary Commissions, which is not deeply in its debt. It will play a great part in England's future development.[25]

This remains just as true today as it did over 50 years ago. Table 7.2 lists a selection of government departments that are the main users of OS products and services. Users can divided into two groups: policy-makers and operational agencies. One of the interviewees emphasised that, while OS products and services may be necessary for the operational agencies, policy-makers would generally survive in their absence.

[25] Lynam, E. (1944), *British Maps and Map-Makers*, William Collins.

Table 7.2: Government departments using OS products and services

Policy-making	Operations
Department for the Environment, Transport and the Region (DETR)	British Geological Survey
MAFF—policy users	Coal Authority
Ministry of Defence (MOD)	English Heritage
Scottish Office	English Nature
Welsh Office	Environment Agency
	Forestry Commission
	Government Offices for the Regions
	Her Majesty's Land Registry (HMLR)
	Highways Agency
	Historic Scotland
	Home Office
	Intervention Board (MAFF)
	Maritime and Coastguard Agency
	MOD
	MAFF—operational
	ONS
	Planning Inspectorate
	Radiocommunications Executive
	Registers of Scotland
	Royal Mail
	Scottish Environmental Protection Agency
	Scottish Fisheries Protection Agency
	SOAEFD

Source: OS.

Central government covers a broad range of activities and, as such, it is not surprising that it uses a wide variety of OS products and services. A particular value of OS products is that they are built to a standard specification and there is a high degree of certainty about the surveying accuracy.[26] The central government SLA (CGSLA) enables participating departments easy access to a bundle of OS products and covers issues of copyright. Quite separately, the NIMSA has also been agreed, with the DETR acting on behalf of the whole of central government. This provides OS with a contribution from central government to ensure that it continues to produce mapping in the non-commercial areas in the national interest for the benefit of all users.

In order to identify the uses to which OS products are put, OXERA interviewed the DETR and HMLR. There are, of course, many other agencies within the central government sector which use OS products and services to carry out operational tasks (e.g. the Environment Agency requires up-to-date GI for flood-drainage plans). The report does not cover the full range of uses, but the interviews did show some interesting

[26] Some interviewees noted, however, that the degree of confidence in OS accuracy was reduced in some rural areas.

contrasts. One significant user, the MOD, has been omitted and is treated separately in section 7.2.1.

Box 7.2: The DETR's experience with OS products and services

The main products used by the DETR are:

- paper products—notably the 1:10 000 scale, 1:25 000 scale, and 1:50 000 scale county atlases and administrative area diagrams;
- annotation and overlays on paper products—the DETR, or its contractors, place annotations and overlays on OS paper products (e.g. in a designated area, the minerals make-up, or the bus operation areas, may be incorporated onto the map);
- digital products—Boundary-Line is used locally on a day-to-day basis and Land-Line to a lesser extent. In general, digital products are used only when required, rather than being purchased on a regular basis;
- services—OS is one of a number of companies used by the DETR to provide services related to the use of GI.

Seven DETR divisions use the information: the library; the regeneration division; research, analysis and evaluation division; the minerals branch of the planning division; European wildlife division; transport statistics division; and the local government divisions (e.g. for grants or boundaries). There is no doubt a wide range of uses within each. OS products and services are used partly for reference and research purposes and partly for legal reasons (e.g. OS data is used in relation to boundary alignments and the allocation of rural bus grants). Inevitably, data used in these contexts has a limited life span.

The DETR also uses alternative sources of GI, including products provided by commercial map-makers. In addition, satellite imagery, aerial photography and local authority data is used directly by the Department. It can, and indeed, in some divisions, does, operate without OS products and services. The result is that the research underlying policy decisions can be of varying quality and consistency.

Box 7.3: HMLR's experience with OS products and services

The HMLR is under a statutory duty to use OS products and services. It has two SLAs with OS. The first, for surveying services, came into effect in October 1993. At the time, HMLR found that alternative suppliers could do pockets of surveying, but that none could provide a national service. The second SLA is for the acquisition of digital data. This came into effect in December 1996 and covers the acquisition of Land-Line, ADDRESS-POINT and copyright payments.

HMLR is in the process of moving from paper to digital products. It currently uses the following OS products:

- Land-Line and its associated products;
- ADDRESS-POINT;
- ProMap (a VAR product);
- small-scale products;
- surveying services.

HMLR uses OS products and services to produce:

- an index map, based on large-scale OS maps, showing the position and extent of every registered title in England and Wales; and
- filed plans for each registered title.

One issue is the extent to which departments could, if necessary, do without OS products and services. This depends on the ability of users to make do with out-of-date information, to update the information themselves, and to use products from OS's competitors. As in the utilities sector, the costs to individual agencies of updating the information themselves is generally higher than the cost of purchasing new information from OS, although, in some cases, new local information may be directly available within departments as the basis for revision. If departments were to pool their information there

could be economies of scale. However, it is difficult to see how another public organisation, or even group of organisations, could undertake OS's main activities at a lower cost.

The dependency rating will differ between the policy and operational parts of central government. In both cases, the rating can be determined by reference to both current practice and future developments.

- **Policy**—given the general feeling that policy divisions use OS products and services to inform decisions rather than directly in the delivery of services, and, as such, could continue to operate in the absence of current OS products and services, these parts of the central government section are assumed to be in the E band in the dependence ranking. This dependence may, however, increase in the future with the development of the National Land Use Database.

- **Operations**—given the general difficulty of replacing OS products and services or doing without them, it is assumed that the operational arm of central government is in band B in the dependence ranking.

In other sectors, OXERA's estimates of the extent to which national output is dependent on OS products and services are based on ONS figures. In 1996, the GVA of 'central government' was £29.3 billion. However, investigations into this market segment suggest that this value-added figure hides considerable variety across central government. The ONS central government sector is also different to that used by OS with central government trading bodies (e.g. HMLR) now classified as public corporations. A more appropriate base would be the value-added only by those departments listed in Table 7.2, excluding the MOD, which is dealt with separately in section 7.2.1. Proxies for this figure have been obtained from the annual reports for each of the departments and from a few other miscellaneous sources (see Appendix 1). In 1996/97, the total value-added for the 'policy organisations' was £963m, and £7,933m for the 'operations organisations'. This results in a total central government value of £8,896m.

Table 7.3 gives OXERA's proxy estimates for the OS-related GVA for each of the two components of central government. It should be emphasised, again, that this relates to tangible output-related value only, and does not reflect the additional social value which is generated by the use of OS information to design, develop and implement crucial national economic, social and welfare policies. Inevitably, an important part of the value of government use of OS data comes from these wider social values. The social value of OS products and services is considered in more detail in Section 9, but it is important to recognise that, here, we are at the limits of what can sensibly be valued. The exercise is, however, worth undertaking, even on the limited basis assumed here, as a means of ensuring some recognition of the vitally important role which OS's activities play in the business of government.

Table 7.3: Contribution of OS to central government

	Policy	Operations	Total
GVA (£m)	963	7,933	8,896
Dependency rank	E	B	
OS-related GVA (£m)	0 to 192.6	4,759.8 to 6,346.4	4,759.8 to 6,539

Source: See Table A2.1.

7.2.1 The MOD and the armed forces

The origins of OS lie with military needs: quality maps of the coastline were essential to England's defences against Napoleon. However, other needs for maps were soon identified and, while OS continued to be run by a Major General on the active list until 1974,[27] these uses came to dominate. The armed forces' need for GI is still as strong as ever, and new-weapon technologies based on GIS rival any of the advanced digital technologies identified in other areas. The forces' use of domestic GI is, of course, for domestic and defence purposes only, whereas, in engagement, they need GI about other parts of the world.

It would, in principle, be possible to use the technique set out in section 7.2 to provide a proxy for value-added in defence—the equivalent of MOD's value-added is the estimate of 'operating costs, excluding new equipment purchases', set out in Table A.2. However, OXERA has concluded that, whatever the dependency rating we could arrive at, the resulting figure—which would be very large—would not be meaningful, given the difficulty of putting a monetary value on defence.

MOD and the armed forces continue to use OS products and services in various day-to-day activities. The overall value of these uses is best addressed qualitatively as part of the wider societal benefits of OS's activities identified in Section 9.

7.3 Local government

There are currently 484 local authorities in Great Britain. The sector also includes police, fire and ambulance services, and the national parks. This is therefore a large and diffuse market. There is still some policy-making in local government, but, for the most part, local authorities are carrying out decisions made by central government, and so can be compared with the operational arms of central government rather than with the policy-makers.

A local government SLA (LGSLA) has been in place since 1993. It covers digital use of a wide range of OS products and copying royalties, but not publishing royalties. A total amount is paid to OS by all local government departments, and the cost is apportioned between the different sectors on the basis of population and the number of titles taken from OS.

Given the wide variety of different local government activities, it is difficult to identify all the facets of local government's dependence on OS products and services. Some published studies, outlined in the box, illustrate some of the uses.

[27] Owen, T. and Pilbeach, E. (1992), *Ordnance Survey: Map Makers to Britain Since 1791*, OS Southampton.

Box 7.4: Some local authority uses of GI and OS data

The Local Authority Associations' Geographic Information Advisory Group's 1994 '*Go with the flow'* toolkit aims to help local authority staff to 'understand their business in a simple and succinct way'. A key element of the study, and of the resulting 'toolkit', is an analysis of data flows within the business. It is clear from this study that OS products and services provide value to all the core activities undertaken by local authorities, and that this information is disseminated to a wide range of external entities.

Another study assesses the suitability of GIS to the work of one council, Swansea.[28] In making the case for change, the study found that

> Evidence of the usefulness of OS maps to the local authority is provided by the fact that Swansea City Council owns some 24 sets of maps for the area at scales of 1:1 250 and 1:2 500. Many sets date back to the 1960s and most section staff need to go over to the Planning section to consult the most recent map issues.[29]

Gill defined corporate planning as:

> the process of preparing, implementing and monitoring the Corporate Plan, which should consider every SBU (strategic business unit) within the organisation and contain a mission statement, corporate aims, service delivery framework and principal targets.[30]

The author notes that, 'Information is as important a resource in local government as staff, revenue and capital, but has been undervalued for too long.'

The role of information, including GI, is changing as a result of the government's information society initiative for local government, to be implemented by the Improvement and Development Agency.

The main uses of OS products and services in local government are in planning, land management, transport and distribution, marketing and research. They are also used in service-related departments (e.g. in the education divisions, OS products are used to chart journeys to school and school catchment areas).

Those interviewed emphasised that he believed that there were no satisfactory competitors to OS products and services. The wide range of products available from OS under the SLA is also valued, alongside the fact that all the necessary information can be obtained from a single supplier. Further, given the variety of information used within local government, and the range of departments using it, the fact that OS data is consistent between the different products is a valuable feature.

Each authority requires GI relating only to its own area, and alternative sources (including in-house information) could be used in place of OS products and services. Thus, while there is a clear current preference for OS products and services in local government, there is no wholesale dependence on them. Having said this, OS products and services purchased by local government are used throughout the business, and one interviewee emphasised that he could not imagine how a county council could cope without OS maps. For this reason, local government has been placed in band B in the dependency ranking.

Table 7.4 shows the GVA of local government which is assumed to be OS-dependent.

[28] Bromley, R. and Coulson, M. (1989), 'Geographical Information Systems and the Work of a Local Authority: The Case of Swansea City Council', Department of Geography, University College of Swansea.
[29] Bromley, R. and Coulson, M (1989), 'The Value of Corporate GIS to Local Authorities', *Mapping Awareness*, **3**:5, November.
[30] Gill, S. (1998), 'Application of Geographic Information Systems to Corporate Planning in Local Government', *Proceedings of the AGI Conference at GIS.*

Table 7.4: Contribution of OS to the local government

GVA (£m)	46,742
OS dependency ranking	B
OS-related GVA (£m)	28,045 to 37,394

Source: ONS (1998), *The Blue Book*, Table 1.8.1.

7.4 Architects, engineers, survey and construction

This segment includes architects, civil engineers, surveyors, construction and demolition companies. The main products purchased include:

- Superplan Data and plots;
- Land-Line;
- control information;
- Land-Form products;
- site surveys.

The interviewees in this sector noted the following activities as those that involved the use of GI:

- surveying;
- planning applications;
- valuations;
- boundary disputes;
- building regulations;
- defects inspections.

In particular, companies are required by local authorities to use OS 1:1 250 and 1:2 500 scale maps for planning applications and business regulations.

Most of the firms are small and medium-sized enterprises, with limited resources to invest in GI. Some of the construction firms, however, are large. While all these industries require GI, this is not always provided by OS products. This is particularly the case because, in many instances, the information required is limited to a small local area. It would therefore be conceivable that some companies could undertake small-scale surveys themselves, or could contract the job out. According to those interviewed, this is already happening. However, where companies operate in more than one area, as is often the case, gathering and updating GI in several localities could be a significant drain on resources.

In other cases, it would be possible to rely on out-of-date OS products—indeed, some of the smaller companies already operate on this basis. However, as has been seen, the use of OS products and services generally both improves the efficiency with which the work is undertaken, and facilitates new and innovative approaches. Therefore companies which do without OS data risk losing competitiveness.

One interviewee claimed that 90% of turnover was dependent on the use of OS products and services. Another, however, quoted 5% of turnover as an appropriate figure. This demonstrates the wide variety in usage and dependence in the sector. Given the many

alternatives to OS products that could be used to undertake the activities listed above, the sector is placed in D for the dependency ranking. Table 7.5 shows the GVA of the architects, engineers, survey and construction which is assumed to be OS-dependent.

Table 7.5: Contribution of OS to architects, engineers, survey and construction

GVA (£m)	45,342
OS dependency ranking	D
OS-related GVA (£m)	9,068 to 18,137

Note: The value-added for this market segment is determined by aggregating the value-added of the following ONS sectors—architectural etc. activities, and construction.
Source: ONS (1998), *UK Input-Output Supply and Use Balances, 1992-96,* Table 3, Demand and Products: the 'combined use' matrix, The Stationery Office.

7.5 Real estate

This market segment includes companies which develop, buy and sell real estate; those which develop and let property; and housing associations. In 1996 the consultation exercise on the 'National Interest in Mapping', undertaken jointly by OS and the Department of the Environment, found that 67% of those in the land agents sector used large-scale graphics products (Superplan), 50% used large-scale data (Land-Line), 83% used small-scale graphics (Pathfinder), 17% used small-scale data, and 50% used custom products.

A land agent interviewed noted that maps were essential for managing land and estates, as they form the basis of property record systems. The agent adds estate-specific features to OS products, charging clients for the annotation. OS products are, however, responsible for only a small proportion of the business, although they are seen as an essential raw material. The 1996 consultation exercise found that, of the six interviewees in the land agents sector:

- 60% used OS information for map production; and
- 100% used OS information for background mapping for their own information.

Maps form an integral part of the running of an estate agency, but do not, in themselves, generate significant revenues. A dependency rating of E is therefore applied.

Table 7.6 shows the GVA of the real estate sector which is assumed to be OS-dependent.

Table 7.6: Contribution of OS to real estate

GVA (£m)	70,693
OS dependency ranking	E
OS-related GVA (£m)	0 to 14,138.6

Note: The value-added for this market segment is determined by aggregating the value-added of the following ONS sectors—estate agent activities, letting of dwellings, and owning and dealing in real estate.
Source: ONS (1998), *UK Input-Output Supply and Use Balances, 1992-96,* Table 3, Demand and Products: the 'combined use' matrix, The Stationery Office.

7.6 Solicitors and environmental consultancy[31]

OS products and services are used by solicitors and environmental consultants for land and property transactions. The main product used is Superplan. Extracts of OS maps produced by HMLR, and OS maps of particular areas, are used by solicitors to identify both registered and unregistered land. OS maps are used in the conveyancing of both domestic and commercial land and property. Indeed, every sale and purchase transaction in registered land relies on OS information for successful completion.

The exchange of property is, however, only a small proportion of the total business undertaken by the legal profession, and it is not clear that OS maps are used regularly in other legal contexts. For this reason, a dependency ranking of E is used.

Table 7.7 shows the GVA of the solicitors and environmental consultancy which is assumed to be OS-dependent.

Table 7.7 Contribution of OS to the solicitors and environmental consultancy

GVA (£m)	7,901
OS dependency ranking	E
OS-related GVA (£m)	0 to 1,580.2

Source: ONS (1998), *UK Input-Output Supply and Use Balances, 1992-96,* Table 3, Demand and Products: the 'combined use' matrix, The Stationery Office. The figure for the environmental consultancy sector is taken from *The ENDS Report*, December 1997.

7.7 Transport

Transport comprises companies involved in road, rail, air and sea transport, and the majority of products purchased by this sector are small scale. These products and services are used for network construction and route-planning purposes, and for impact-assessment exercises. The majority of companies in this sector are small (e.g. taxi firms, road-freight hauliers) and, hence, have limited resources to spend on GI. The rail and air markets are dominated by large companies.

Companies in this sector require consistent and high-quality GI; there would be significant cost repercussions if planning were disrupted by inaccurate GI. OS data is the main source of such information at the national level. Paper mapping products may be sufficient for most users, although it is clear that many would benefit from using one or more OSCAR products to manage their traffic flows. Examples of the productivity gains from such products are given in Table 2.1 above.

A 1998 conference paper demonstrated how GIS can be used in transport impact assessments.[32] The authors note that 'at BAA's UK airports, the geographic locations of enquirers are compared automatically with the geographic patterns and timings of flights.' The GI used for such an exercise includes 'background mapping, radar data, pollution sources, postal geography and Census', a proportion of which can be supplied by OS. The authors note that 'ADDRESS-POINT is being used to associate properties with different

[31] This is the OS market segment 'legal and environmental consultancy'.
[32] Wood, T. and Pool, G. (1998), 'Managing the Environmental Impact of Airports', *Proceedings of the AGI Conference at GIS.*

levels of noise, in order to manage the new noise insulation and vortex strike protection at Heathrow.' They conclude by stating that:

> coupled with Ordnance Survey digital mapping, ADDRESS-POINT, postcode areas, road networks, pollution data, flight tracks, noise measurements and contours, and public transport service provision GIS provides a very powerful tool and is making a positive contribution to environmental management.

A dependency rating of C has been assumed for this sector on the grounds that, although OS products and services are used in a broad range of activities, it is likely that companies can, for the most part, also use competitor products or their own local information.

Table 7.8 shows the GVA of the transport sector which is assumed to be OS-dependent.

Table 7.8: Contribution of OS to the transport

GVA (£m)	35,377
OS dependency ranking	C
OS-related GVA (£m)	14,151 to 21,226

Note: The value-added for this market segment is determined by aggregating the value-added of the following ONS sectors—railways, other land transport, water transport, air transport, and transport services.
Source: ONS (1998), *UK Input-Output Supply and Use Balances, 1992-96,* Table 3, Demand and Products: the 'combined use' matrix, The Stationery Office.

7.8 Computer and related activities

This market mainly comprises the System Suppliers which provide OS customers with the hardware and software required to run digital products and services. There are currently 270 licensed System Suppliers. While other companies purchase OS data for their own internal business use (e.g. for marketing purposes), OS products and services are rarely purchased by the System Suppliers for their own use.

The total value-added of computing services in 1996 was £9.4 billion. The GIS market is, however, a small part of the overall computing sector. Within the GIS market, OS is only one of a number of data providers that have arrangements with System Suppliers to incorporate geospatial data products within their software. Nevertheless, System Suppliers know that customers often want the quality assurance that is associated with OS data.

Products and services are developed jointly by OS and System Suppliers. In this case, System Suppliers can then use the skills and software gained in OS-related products and services to develop similar packages for other GI providers, or even outside the GI realm. Thus, while the sector can be assumed to be not very dependent on OS products and services, it certainly reaps broader benefits from their existence. In the same way that OS digital products have no value without the associated software and hardware, GIS have no value without data of the required quality.

A dependency ranking of E has been applied, and Table 7.9 shows the GVA of the computer and related activities sector which is assumed to be OS-dependent.

Table 7.9: Contribution of OS to computer and related activities

GVA (£m)	9,361
OS dependency ranking	E
OS-related GVA (£m)	0 to 1,872

Note: The value-added for this market segment is determined by using the value-added of the ONS computing services sector.
Source: ONS (1998), *UK Input-Output Supply and Use Balances, 1992-96,* Table 3, Demand and Products: the 'combined use' matrix, The Stationery Office.

7.9 Farming and forestry

Operators in this sector use OS products and services for a variety of functions, including farm and rural estate management, and the identification of Sites of Special Scientific Interest. There may be an increase in the use of digital data in the sector, led by changes in the way in which MAFF administers Common Agricultural Policy subsidies.

The sector would currently appear to have little dependence on OS products and services, as evidenced by the low rate of take-up of these products. A dependency rank of E has therefore been applied to the sector. However, farming is becoming increasingly sophisticated, with farmers using the Internet to follow market changes and to obtain information about best farming practices. In due course, GI is likely to become fully integrated into these data flows.

Table 7.10 shows the GVA of farming and forestry which is assumed to be OS-dependent.

Table 7.10: Contribution of OS to farming and forestry

GVA (£m)	11,628
OS dependency ranking	E
OS-related GVA (£m)	0 to 2,326

Note: The value-added for this market segment is determined by aggregating the value-added of the ONS agriculture and fishing sectors.
Source: ONS (1998), *UK Input-Output Supply and Use Balances, 1992-96,* Table 3, Demand and Products: the 'combined use' matrix, The Stationery Office.

7.10 Mining, drilling and quarrying

This market comprises mineral extraction, cement, aggregates, china clay extraction, brick making, and oil and gas extraction. OS products and services are used for planning applications, impact analysis, asset management, and landfill. Most of these activities are, by definition, local in nature, and alternative products and services, including old OS products and services, are available. The GI for these activities is also only one of a number of required information inputs—geological information is an obvious addition. The sector is assumed to have a low dependence on OS products and services, and a rank of E is therefore applied to this sector.

Table 7.11 shows the GVA of the mining, drilling and quarrying sector which is assumed to be OS-dependent.

Table 7.11: Contribution of OS to mining, drilling and quarrying

GVA (£m)	19,447
OS dependency ranking	E
OS-related GVA (£m)	0 to 3,889

Note: The value-added for this market segment is determined by aggregating the value-added of the following ONS sectors—coal extraction, extraction (oil and gas), extraction (metal ores), and other mining and quarrying.
Source: ONS (1998), *UK Input-Output Supply and Use Balances, 1992-96,* Table 3, Demand and Products: the 'combined use' matrix, The Stationery Office.

7.11 Total benefit of OS through its customers

Table 7.12 shows the estimated OS-related GVA of the market segments examined to be equal to £79–£136 billion in 1996. Even the top of this range may be an underestimate of the total economic contribution of OS because:

- many other sectors, not considered here, use OS products and services:
- in each sector considered, the estimate is based only on a small sample of information;
- the use of OS products and services in these organisations provides benefits beyond the production process (e.g. the use of a consistent GI dataset may improve corporate planning or organisational behaviour), and no monetary value has been attached to these additional effects.

Table 7.12: Range of OS-related GVA, 1996

Sector	Dependency ranking	GVA (£m)
Utilities	A	22,979–28,724
Central government	E for policy B for operations	4,760–6,539
Local government	B	28,045–37,394
Architects, engineers, construction and surveyors	D	9,068–18,137
Real estate	E	0–14,139
Solicitors and environmental consultancy	E	0–1,580
Transport	C	14,151–21,226
Computer and related activities	E	0–1,872
Farming and Fishing	E	0–2,326
Mining, drilling and quarrying	E	0–3,889
Total		**79,003–135,826**

8. Associated Tangible Benefit to Competitors

The GI market in Great Britain was estimated to have a value of over £200m in 1997.[33] This estimate does not incorporate the value of OS products and services to those activities that are required, by statute, to be based on OS information. OS seems to be responsible for about 40–45% of this market. There is therefore a large amount of value produced by competitors to OS. However, even though sales worth over £100m do not originate directly from OS, a significant proportion can still be judged as OS-dependent because many of the products and services produced by its competitors are based on OS data. In particular, some OS licensees would most likely not exist in the absence of OS.

However, it has not been possible to obtain details of the proportion of competitors' revenues that is based on products and services which use OS data, and no attempt has been made in this report to quantify this impact of OS on the economy. This is likely to be a significant omission from the analysis, and the economic value of OS is assumed to be larger than estimated because of the value of competitor products based on OS data.

[33] 1997 Market Data determined from NOP Market Research.

9. Intangible Benefits

9.1 The social value of geographic information

The economic gains from the use of GI are not limited to gains made in the commercial sphere. There are wider societal benefits arising from the role that OS plays in contributing to:

- national security and defence;
- education;
- the rights of ordinary citizens to access basic locational information; and
- leisure pursuits.

Some of these benefits are reflected in people's purchases of maps and other data. However, there are wider social gains from the universal coverage of OS data. The national interest can be seen to have three components:

- coverage of areas which would be ignored if commercial considerations alone held sway;
- consistency in the content and the presentation of data collected across the nation as whole; and
- maintenance of a mapping infrastructure for use by key public bodies.[34]

Many users, including public-sector bodies, value the access to the OS database, even though in any one year they may only use OS products and services occasionally. These option values, coupled with the broader national interest in having an accurate and up-to-date understanding of patterns of settlement, etc, lie behind the NIMSA (the contract OS has agreed with the government to cover the national interest in OS activities).

These wider benefits also lie behind the various campaigns for cheaper access to the geographic datasets maintained by the UK government—most notably the Friends of the Earth complaint to the European Commission about OS pricing policy.[35] This report does not address this issue. However, the pricing of OS products must clearly affect their use by some people and organisations, and therefore influence the overall social benefit derived from the existing data. This report on the current position takes the existing structure of prices as given.

One current indication of the wider social value of OS is the annual government NIMSA contract with OS, plus the direct expenditures on OS products by social and leisure users. There are also techniques that can be used to establish monetary values for benefits which are social or environmental in nature, rather than commercial, but such work is inevitably difficult and time-consuming. The analysis in this section is, therefore, primarily of a qualitative nature.

[34] Masser, I. (1998), based on the results of the consultation exercise on the 'National Interest in Mapping', OS and DETR joint publication, 1996.
[35] Friends of the Earth (1996), 'Insisting on our Right to Know: Friends of the Earth's Analysis and Experience of the Law on Access to Environmental Information'.

9.2 OS and leisure activities

A qualitative assessment of the value of OS's services should not overlook the substantial value attached by the general public to its traditional map-making and publishing services. OS maps are a familiar and well-respected feature of British cultural life. In the 1930s they were described as 'old friends who guided you to unknown places'[36], and the British public is fortunate to have such a detailed and useful series of maps to guide its leisure. In 1994, there were some 5.2 billion leisure day visits from home made in Great Britain: 13% of these visits were for walking or rambling.[37]

A minimum estimate of the value which people place on maps is to total the annual expenditure on leisure maps, but the overall benefit is larger than this, since some people's WTP exceeds the cover price.

There have been attempts to attach a value to the pleasure that people derive from the outdoors, and significant totals can be obtained. Although the benefits of outdoor recreation are subjective, values can be attached to this experience. The valuation of recreational opportunities by reference to people's willingness to incur travel costs and travelling time, or by the use of questionnaire-based studies, is needed if the benefits gained from these leisure activities are to be assessed against the value of other land and water uses.[38] The Environment Agency uses a rather conservative value of £2.50/visitor/day for the benefit of informal *bankside* recreation (walking, picnicking and bird watching).[39] It is likely that an equivalent informal recreation experience in an area of outstanding natural beauty would reveal higher WTP values. There seem to have been no surveys to assess the contribution of quality maps to the experience.

9.3 The environmental value of geographic information

GI is a necessary component of Environmental Impact Assessment (EIA) studies, although the actual use has been sparingly documented.[40] Joao and Fonseca found that GIS has been applied to a wide range of EIA projects (35 different projects in total), the most common being the impact evaluation of roads, pipelines, housing developments, costs and flood-protection works, and dams and tourism-related projects.[41] The survey also discovered that GIS is currently being used by environmental consultancies for *all* EIA stages, from the preliminary stages of screening and scoping to the final stages of monitoring and auditing.

There is a wider social interest in the better use of natural and man-made physical resources. OS can play a central role in this understanding by providing the necessary GI. OS products and services can generate environmental benefits in several ways:

[36] Sven Berlin quoted in John Paddy Browne, *Map Cover Art*, OS (no date).
[37] 'UK Day Visits Survey 1994', reproduced in *Social Trends*, **27**, The Stationery Office, 1999.
[38] See Knetsch, J. L. and Davis, R. K. (1966), 'Comparisons of Methods for Recreation Evaluation', *Water Research*, Chapter 20, Pergamon; and Smith V. K. and Kaoru, Y. (1990), 'Signals or Noise? Explaining the Variation in Recreation Benefit Estimates', *American Journal of Agricultural Economics*, May, 419–33.
[39] See Benson, J. F. and Willis, K. G. (1990) 'The Aggregate Value of the Non-priced Recreation Benefits of the Forestry Commission Estate, Newcastle, University of Newcastle upon Tyne.
[40] Joao, E. (1998), 'GIS, Environmental Impact Assessment and Scale Issues', *Proceedings of the GIS Research UK 1998 Conference*.
[41] Joao, E. and Fonseca, A. (1996), 'The Role of GIS in Improving Environmental Assessment Effectiveness: Theory vs Practice', *Impact Assessment,* **14**:4, 371–87.

- reduced road congestion and improved transport planning (both of which result from the use of OSCAR products, or similar) reduce noxious emissions;
- given the government's policy of building 60% of new homes on previously developed land,[42] the use of OS products to secure the more effective use of existing 'brownfield' sites, and to avoid the need to take more green fields, provides a considerable environmental benefit.

Although no attempt has been made to assign an absolute value to the social and environmental improvements produced by the use of OS products and services, some indication of their potential scale can be gained by examining related estimates of the benefits of reducing environmental exposure.

- There is a widely accepted estimate that the total cost of traffic congestion to the economy is £21 billion a year (1998 prices); clearly, even a 10% improvement could yield substantial economic gains;[43]
- The Royal Commission on Environmental Pollution lists all the environmental and social costs of road transport that would be reduced with less congestion.[44] These costs range from £2 billion to £19.7 billion for air pollution, £0.1 billion to £3.1 billion for climate change damage, and £0.6 billion to £4.6 billion for noise pollution. Again, therefore, if OS products helped to cut pollution, the savings could be large.
- Hanley and Knight provide an estimate of people's WTP for greenbelt preservation of between £3 and £72 per person per year.[45] The value which the UK population places on the green belt could then be calculated by multiplying these values by the population, and the imputed benefits of preserving the green belt would then range from £145m to £4 billion per annum.
- The targeted application of pesticides provides a further example of the potential social and environmental benefits from the use of GI. Foster and Mourato carried out a contingent valuation study of the effects of pesticide use on health and bird life.[46] They estimated that reduced pesticide use would produce gains of £2.40 per year for each case of ill health avoided, and £16.30 per year for each bird species safeguarded.

9.4 The economic value of quality

OS has adopted the discipline set out in BS EN ISO 9001 to ensure the delivery of top-quality products and services. No provider of GI can sell grossly inaccurate information, but there are degrees of accuracy and reliability. A distinct advantage of OS data over other GI is the use of a standard national grid. This guarantee of accuracy and consistency is an essential element of quality provided, and the majority of those interviewed consider this to be the key advantage to using OS products rather than those of competitors.

[42] DETR (1998), 'Planning for the Communities of the Future', White Paper, The Stationery Office.
[43] Newbery, D. M. (1995) 'Royal Commission Report on Transport and the Environment: Economic Effects of Recommendations. *Economic Journal,* **105**, September.
[44] Royal Commission on Environmental Pollution (1997), 20th Report.
[45] Hanley, N. and Knight, J. (1992), 'Valuing the Environment: Recent UK Experience and An Application to Green Belt Land', *Journal of Environmental Planning and Management*, **35**:2.
[46] Foster, V. and Mourato, S. (1996) 'Behavioural Consistency, Statistical Specification and Validity in the Contingent Ranking Method: Evidence from a Survey on the Impacts of Pesticide Use in the UK', CSERGE.

Consistency also avoids the duplication of costs and makes it easier to deal with copyright infringement. The consultation exercise carried out by OS and the Department of the Environment in 1996 found that the vast majority of all those interviewed believed that national coverage in the National Topographic Database and national consistency in mapping are essential.

The growth in the use of GIS and the associated integration of datasets increases the importance of standardisation and quality in the baseline geographic data. In particular, OS maps are now frequently used as the framework or template for additional information, and, as such, users require maps that are consistent and compatible with other datasets. Masser notes that:

> the economic significance of GI lies in the general referencing framework that it provides for integrating large numbers of different data sets from many application fields in both the public and private sectors.[47]

OS provides both the raw data and a common framework, based on a unique national referencing system, within which this data can be integrated and analysed.

Two other aspects of quality are that the data should be both current and complete. Many of those interviewed noted that only OS provides a complete national coverage at a large scale, with competitors tending to focus on urban areas and small-scale rural maps. Even so, OS products and services may not provide all the information needed; for example, a particular problem of out-of-date information about railway property has been noted. The 1996 consultation exercise confirmed this, with 38% of those interviewed arguing that updating was too infrequent. Since then, however, OS has increased the rate at which the National Topographic Database is updated. By contrast, some users who add their own data to base maps seem to find that there is too much information in some OS products and services.

The timetable for updating OS data is wholly driven by the needs of customers. Major changes (new motorways, extensive development, etc.) are updated within six months of their completion, wherever they may be. All urban areas are updated for significant change every six months. There is a rolling five-year update of all rural areas and a rolling five-year update for mountain and moorland areas. The first five-year rural revision cycle will be completed in September 2000. More frequent updating is available if customers demand it. Some interviewees noted, however, that OS rural information was not always up-to-date. In comparison, OS Ireland updates its urban dataset annually, small-scale tourist maps are updated every five years, rural areas near towns and cities are updated every two to three years, and other areas are updated every five years. Institut Geographique National (IGN) has a rolling five-year plan for the complete coverage of France using aerial photography. The 1:25 000 series is updated every seven years, and the 1:100 000 series is updated every one to two years. OS-equivalent small-scale products have similar revision cycles.

The cost of imperfect information and working with an out-of-date map varies between users and types of user. A report for the US Geological Survey provides a useful means of assessing the basic cost–benefit choice[48]—is the expense of acquiring new information

[47] Masser, I. (1998), *Governments and Geographic Information*, Taylor & Francis Group.
[48] Berknopf , R. L. *et al.* (1993), 'Societal Value of Geological Maps', US Geological Survey Circular 1111.

worthwhile? The examples given relate to geological not geophysical information, but the analytic technique has a wider relevance. The report considers two cases (the siting of a landfill site and the siting of a new bypass road), and assesses the costs avoided by using a new and more up-to-date geological map. This approach could be used more widely. In the cases considered, the net benefits significantly exceed the costs of producing new geological maps, although, clearly, this need not always be the case.[49]

[49] The economics of the choice between making do with inexact maps and investing in revised maps is considered in some detail in Didier, M. (1990), '*Utilité et Valeur de l'Information Géographique*', Economica (Paris).

10. Efficiency and Effectiveness

This report has looked at the role that OS plays both in the economy and in society at large. Inevitably, the focus has been on existing uses. OXERA's preferred method of valuation would be a survey of WTP. Nevertheless, existing costs of provision have in places been taken as indicative of value, on the grounds that, if both commercial users and the government are willing to bear these costs, then they must derive at least equivalent value from their purchases.

This raises issues of efficiency and effectiveness. As the 1997/98 OS Annual Report states, 'being effective means giving customers what they want, when they want it and at a price they can afford. Efficiency is all about doing this with less effort and less cost.'

There are two rather different questions:

- could the cost of providing OS services have been lower, and hence its net contribution to economic welfare higher?
- would usage have been higher if prices had been lower, either as a reflection of greater efficiency or a different pricing policy?

Both are significant questions that require a detailed analysis, which has not been attempted, but they should be highlighted.

Effectiveness may be defined as meeting customer demands with respect to product definition and service quality. The majority of those interviewed by OXERA found that the range of products and services provided by OS was at the very least satisfactory—one public-sector interviewee thought that OS provided a 'very acceptable' standard of service. Many also commented that OS had become much more market-focused in recent years, so that consumer views now had more influence on OS's development plans.

Within the public sector, one measure of efficiency that is often used is the extent of cost recovery. Table 10.1 shows that OS's level of cost recovery has been improving over time, with it successfully outperforming the targets set by government. Its record is significantly better than that of other national mapping agencies.

Table 10.1: OS's cost-recovery performance

Date	Target (%)	Performance (%)
1996/97	83	93
1997/98	86	97
1998/99	90	99

Source: OS (1997/98 and 1996/97), 'Annual Report and Accounts'.

However, this measure of efficiency is not one that would be used in an economic appraisal. This is because it would be perfectly possible to raise the level of cost recovery while reducing the value of the service to society and the economy by excluding some users through charging higher prices.

As discussed in Section 2, there are large efficiencies to be gained in the economy from the increased use of digital technologies. Such efficiencies are generated within OS, and, more significantly, by its contribution to the rest of the economy, through the provision of

digital outputs. All OS's base dataset is now in digital form—a unique achievement for a national mapping agency—and products and services are, for the most part, produced using the most up-to-date technologies (e.g. PRISM, Portable Revision and Integrated Survey Module).

The dissemination of OS's digital product range through the economy has already been discussed: the progress can be summarised here by the fact that two-thirds of total OS sales now come from digital products, and 2,000 companies are known to be using OS-sourced digital data. In contrast, in France, more of IGN's sales come from paper maps than from digital products.

Inevitably, some GI data is best collected by a single source, although there is no reason why the same data cannot then be marketed by several companies. Wherever there is a monopoly, there is a related problem of ensuring that the company maintains a good level of efficiency. As has been seen, some products (e.g. large-scale rural maps) do not seen to be commercially viable. Certainly, no competitor to OS has yet emerged, although the Global Positioning Systems and aerial photography could change this. As discussed in Section 9, alternatives do exist for most other OS products and services, and these markets seem to be becoming increasingly competitive. The conclusion seems to be, therefore, that there are already significant competitive pressures on OS, and that these are probably growing.

11. Conclusion

This report has focused on the contribution OS makes to the Great Britain economy, but it has also looked at the wider, mainly intangible, contribution that it makes to society. Ideally, both would have been measured on a common scale. There are techniques that enable analysts to place monetary values on some of the wider benefits, but a full analysis of the WTP for OS services has not been possible within this timescale. Moreover, however successful an analysis might be in deriving such values, there will always be omissions and uncertainty. Some broader social values will never be measurable on a monetary scale.

The report has, therefore:

- looked at some of the social gains resulting from the use of OS products, and has concluded that OS is an integral part of national life in Great Britain;
- examined the uses made of OS products by the various organisations, both commercial and public, and has made a rough estimate of the contribution to GDP of those sectors most dependent on OS products.

Inevitably, given that a numerical result has been produced, it is this second part of the analysis that is likely to attract most attention. It will be unfortunate if the first contribution is forgotten—it is a mistake only to recognise factors that can be measured in monetary terms. Nevertheless, it is probably inevitable that the main result which people will take from a study of 'the economic contribution of OS' will be a monetary figure.

The central estimate has the following elements:

- OS's own value-added as a provider of products and services;
- the spillover value generated through the use of these products and services by other producers;
- the margin earned by distributors of OS products and services; and
- the value of OS to its suppliers.

Estimates have been made of all these values except for the spillover value generated through the use of OS products and services—here, all we have been able to do is to estimate the total value added by these sectors.

We estimate that OS itself, together with its suppliers and distributors, plus those parts of the economy which make significant use of OS products, contribute 12–20% of GVA. It is the outputs from the other parts of the economy which play the largest role in this total. Indeed, up to 80% of this total (depending on the assumptions about 'dependency') is made up from the output of three sectors: the utilities, local government, and transport.

Table 11.1 shows the breakdown of the estimate that, in 1996, £79–£136 billion worth of GVA was dependent to some extent on OS products and services. We wish to be very clear that this is not the same as saying that, were there to be no OS activity, GDP would be some £79–£136 billion less; in the absence of OS, the economy would find other ways to obtain GI. Equally, we are not saying that OS contributes £79–£136 billion to GDP. Nevertheless, the estimate does demonstrate that GI in general, and OS in particular, play a significant role in the economy.

Inevitably, there are omissions from an analysis conducted at this level of aggregation. A major omission is that, while reference has been made to the economic contribution made by OS's competitors (section 8), it has not been possible to estimate the extent to which the products and services of these companies are themselves based on OS data. An estimate of this kind would add to the total in Table 11.1. There would, in principle, then be another chain to be followed through (i.e. estimates of the value added by those sectors dependent on the products and services of OS's competitors). In practice, however, most of these sectors will already have been covered in the estimates of the value added by OS's customers. Therefore, although this omission is important in principle, in practice the overall impact on the total set out in Table 11.1 is likely to be small.

Table 11.1: The GVA of OS and its suppliers and distributors and of sectors that rely to a significant extent on OS products and services, 1996

Point on production chain	GVA
OS suppliers' sales[1]	£80m
OS's own value-added[1]	
OS distributors' margin[2]	£6m
OS customers[3]	£79–£136 billion
Total GVA	£79–£136 billion

Note: [1] See Table 5.1 for details. [2] See Tables 6.1, 6.2 and 6.3 for details. [3] See Table 7.12 for details.
Source: OXERA.

This is essentially a static view. In fact, the role of OS in the economy is changing. The digitisation of GI, coupled with wider changes in knowledge management, mean that existing users are making new uses of GI. Furthermore, industries and services, which had previously made little or no use of GI, are using it to develop both new products and services, and new processes aimed at raising internal productivity. Ultimately, it is these wider developments which demonstrate the economic importance of GI and the contribution of OS to UK competitiveness.

Appendix 1: Central Government Value-added

Table A1.1: Proxy estimates of value added by government departments using OS products and services

	£m 1996/97	Definition
Coal Authority	40	Total expenditure
DETR central and government offices	262	Gross running costs
English Heritage	130	Total spend
English Nature	40	Gross expenditure
Environment Agency	578	Gross expenditure
Forestry Commission	100	Staff costs and superannuation
HMLR	223	Workload *x* unit costs
Highways Agency	67	Gross running costs
Historic Scotland	13	Running costs
Home Office (excl. Prison Service)	420	Gross running costs
Intervention Board (MAFF)	58	Gross running costs
Maritime and Coastguard Agency	41	Gross running costs
MAFF	454	Gross running costs
ONS	103	Running costs: Sec A activities
Planning Inspectorate	29	Gross running costs
Radiocommunications Executive	29	Gross expenditure
Royal Mail	6,014	Postal services GVA 1996
Scottish Environmental Protection Agency	18	Running costs
Scottish Fisheries Protection Agency	12	Running costs
Scottish Natural Heritage	18	Running costs
Scottish Office	178	Running costs
Welsh Office	69	Running costs
Total	**8896**	
Ministry of Defence (MOD)	17,826	Operating costs (excl. new equipment purchases)

Note: Without a full-scale investigation into each division of each department, it is very difficult to establish the uses of OS products and services. This means that the assumed dependence rating in Section 7.2 is an approximation based on a small sample of information. Some smaller government departments and agencies are excluded, including British Geological Survey.
Source: OXERA based on government expenditure plans and departmental annual reports.