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National and international geospatial data policies

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As the technology of GIS becomes ever more ubiquitous and apparently ever easier to use, other factors condition its development. Perhaps the key factor is the availability of 'content' – the data and information which act as the 'fuel' for geographical information and other computer systems. The existence of such data, their currency, accuracy, and consistency, their availability and price and the terms and conditions of their use, are now all major factors in determining the utility, cost, and effectiveness of GIS. This chapter examines the economic, legal, and other policies of the relevant parties, notably data suppliers – and especially those in government since that is the source of most geospatial data until now. It also examines the consequences of different policies operating within and between different nations. The relevant policies extend far beyond data pricing to include procurement, intellectual property rights, encouragement of markets, monopoly trading, and privacy.

Finally, recent national and international policy initiatives have been set up by governments worldwide to foster wider and safer use of geographical information. An early version of these was the United States National Spatial Data Infrastructure (US NSDI). The key features of this and the similarities and differences between it and two equivalents are outlined. It is concluded that national policies vary enormously both in principle and in their detailed implementation. This has some consequences for the nature of GIS developments in different countries and has particular implications for those organisations operating across national frontiers. However the situation is unlikely to change dramatically in the near future.

1 INTRODUCTION

It is now well established that the use of GIS and geographical information (GI) can play a key role in human activities. This role ranges from the affairs of individual businesses (e.g. Birkin et al, Chapter 51) through the governance and economic development of large areas or countries (e.g. Smith Patterson and Siderelis, Chapter 53; MacDevette et al, Chapter 65) to international development programmes (Htun 1997).

In the early phases of the GIS revolution, the primary concerns of users were hardware and software which functioned reliably and speedily (Coppock and Rhind 1991). In the last half decade or so, however, the primary concern has shifted to the information required to use the GIS. Since acquisition of certain types of geographical information or geospatial data is difficult and/or costly to collect for many individuals, this concern has translated into how to get the data from other parties – where to find them; how to obtain their costs, currency, and reliability; and the terms under which they can be used and the liabilities incurred. For historical reasons, the great bulk of data commonly used in GIS have long been collected by governments at various levels throughout the world. The policies of these governments are therefore primary influences on the current and future use of GIS and provide the main focus of this chapter. Here

the main concern is not what should or could be, but rather what is, the situation in terms of the current availability and utility of geographical information: the chapter therefore takes a very different approach to the Barr and Masser (1997) paper.

The gathering of GI or geospatial information has hitherto been localised. Rarely have attempts been made to collect consistent data over multiple countries though there have been previous attempts to coordinate summaries of it. Of the latter, the earliest and best known is the International Map of the World project initiated in 1891 which petered out in the 1980s (Thrower 1996). Even within individual countries, however, such GI has typically been collected on a basis defined largely by individual government departments either for their own purposes or for use by a limited number of the organs of the state. The only consistency has derived from two sources – historical legacies and inherited frameworks. Thus many government bodies have collected data on a periodic basis in a manner akin to that in which they have previously collected it (e.g. through population censuses) and they have used the 'topographic template' or geographical framework (Smith and Rhind, Chapter 47) as the basis on which to do so. In short, diversity in the manifestations of phenomena to be described, in the classification of features, in spatial resolution and accuracy, in the periodicity of measurement, in the manner in which the data are stored, and in the policies and practices of data dissemination have been the norm at the national and international levels. The results of this are becoming clearer as we gain the technological capacity to assemble and exploit data on a pan-national basis: Mounsey (1991) described the CORINE project of the European Commission in which the greatest rate of change in some commonly used physical parameters were found to occur at national boundaries! A similar situation may be found within large federally organised countries where much data collection occurs at the state or provincial level.

Efforts to foster greater coherence have begun in a significant number of countries. Typically they have been manifested by idiosyncratic national initiatives, often denoted by the title of 'spatial infrastructures'. Most reflect national priorities: thus Mooney and Grant's (1997) description of the Australian National Spatial Data Infrastructure differs considerably from Tosta's (1997) characterisation of the US NSDI.

Concern with data and information policy matters is not new but has expanded greatly in recent years. Any single chapter can only summarise the key issues involved. Highly relevant contributions to this topic have recently been made by Branscomb (1994), Harris (1997), Masser (1998), Onsrud (1995), Onsrud and Rushton (1995), and Rhind (1992, 1996). The reader is, however, strongly advised not only to use these more detailed sources but to seek professional advice in order to understand how his/her organisation is liable to be affected by the matters which are described below.

1.1 The changing context in which policies are set

The creation of geospatial data policies is driven by a number of factors which interact differently in different regional or national domains, some of which are in the process of rapid change. These factors are primarily:

1. the impact of new technologies on data collecting and providing organisations, changing what they do, how they do it, and the consequences for their customers or users. One example of this is a concern to safeguard by legal means the Intellectual Property Rights for information distributed in digital form – and especially for that made available on the World Wide Web (WWW);
2. rapid change in the expectations of users. Few are now content to be told what they can have and, as a result of this and financial changes, the power of the customer or user is now much greater. As a consequence, fewer geospatial data providers are now production led;
3. changes in society values, such as the greater concern for privacy, a diminution of trust in government, and the shift of responsibilities to lower level (e.g. communities) from higher level governments;
4. the effects of reform in government, such as major reductions in staffing, new approaches to financing and management, and public exposure of successes and failures;
5. the advent of significant commercial sector GI providers;
6. the effects of regionalisation and globalisation of business and even government. In Europe, directives made centrally within the European Union force change in national laws on intellectual property, trading practices, and much else. At the

global scale, the work of the World Trade Organisation may well impact on information trading. All of these business-related developments should be contrasted with the need for global data for scientific purposes where little funding is usually available to pay for the information (see also Goodchild and Longley, Chapter 40; Collins and Rhind 1997; Draeger et al 1997).

The most notable areas in which these attentions have focused are on the 'core' or, more specifically, the 'framework' data (Smith and Rhind, Chapter 47). The reasons for this are self-evident: these data are the most widely used and are central to the use of other datasets. Without them, the use of GIS is severely constrained. That said, the principles and practices of many other data collecting and using parties also have a feedback effect on the collectors and providers of these core data. There is therefore much merit in considering them as a whole.

1.2 Who sets data and information policy?

Governments – or amalgamations of them (see section 1.3) – set policies for nations or for the subsets of the nation state for which their jurisdiction extends. Unlike the policies of commercial organisations which are manifested through strategic objectives and targets, major governmental policies are typically made operative through promulgation of statute or law. It should be noted that policy-making takes many different forms worldwide, related notably to the nature of the nation state. A substantial difference used to exist, for instance, between the centrally directed model as represented in the pre-1989 Soviet Union and that in some democratically organised societies. However, similarities as well as differences occur – President Clinton's 1994 Executive Order on the US National Spatial Data Infrastructure is a classic example of 'top down', central direction for agencies of federal government. It has something in common therefore with article 71, item 'p' of the Russian Constitution which defines the state's responsibility for geodesy, cartography, and the naming of geographical features (Zhdanov 1997).

A significant difference in policy-making exists between those nations presently organised as a unified state (e.g. Britain or France) and those organised explicitly as federations (e.g. Australia, Canada, Germany, and the USA). Within federal countries there may well be important differences in policy by geographical area whereas this is much less likely in unitary states. There are numerous reasons for this. One reason is that there are large variations in the powers of the subsidiary bodies in these federal entities: for example, the powers of the US States remain significantly less than those of their Australian equivalents. Responsibility for different functions varies between the federal and state governments even within the same country: thus the population census is a federal responsibility in Australia but topographic mapping of the country is primarily achieved through the states. Parenthetically, one exception to this heterogeneity in data policy and practice occurs when the federal government has a monopoly in data collection of a given type, the best example being the collection of civilian remotely-sensed data in the USA in the past by the National Aeronautics and Space Administration (NASA) and its availability through the US Geological Survey (see section 4.4).

Although geographical homogeneity of policy is much more common in unitary states, differences between policies involving particular data themes may occur under either system of government. Thus, even within any one government, there are usually many different policies which impact upon the organisations responsible for collecting and disseminating geospatial data. Coopers and Lybrand (1996) reviewed the situation in relation to data providers within British government and found considerable differences in policy and practice. Rhind (1996) itemised no fewer than ten sets of laws, treaties, or agreements which influence policies within a single government department in relation to the collection and provision of data. The end result is that national, subnational, and sectoral patterns of data policy are surprisingly varied; the most significant differences to the end-user may also lie in the detail rather than in the fundamentals of the policy.

Considerable variation also exists in the relationships between public and private sectors. The concept of state-owned trading enterprises selling data or services which is common in France and Nordic countries is largely absent from the USA. This is another manifestation of different views of the state and its role: Chamoux and Ronai (1996), Grelot (1997), and Lummaux (1997), have discussed the role of the state in geospatial data provision from a French perspective, while Sandgren (1997) has summarised some important developments in Sweden (see also Dale and McLaren, Chapter 61).

All of the above (and much of what follows) concentrates on governments. Yet other policies and policy-makers are increasingly relevant to the geospatial data world. Dominant suppliers, notably Microsoft, are strongly influential, especially in setting *de facto* standards and in setting price levels. The advent of commercial 'players' in the car guidance information market, in high resolution satellite imagery, and in added value products could change the nature of the policy debate, especially since they often have very different agendas to government (Rhind 1996).

1.3 Regional or global versus national approaches to policy-making

As indicated above, the creation of binding policy is most frequently initiated at national levels in national parliaments or legislatures or through official devices such as Executive Orders. There are, however, at least two other formal ways in which policy may be initiated. These both occur through multinational governmental agreements. In one case, these bind all of the individual states into a regional agreement (e.g. through Directives prepared by the European Commission and approved within the governmental framework of the European Union). In the other, some multinational thematic agreement is forged and accepted (at least in principle) by a self-defined set of national governments. Examples of the latter include Agenda 21 (Htun 1997) and the World Trade Agreement.

In addition to these intergovernmental agreements, however, there are many other less formal attempts to set international policy which, in time, may lead to formal *de jure* or to *de facto* policies. Some national policies also take on an international role, notably those of the US military and of commercial data suppliers. Activities known in mid-1997 which may well lead directly or indirectly to geospatially relevant policy are as follows:

1. 'bottom up' assembly of map-derived databases by groups of national mapping organisations, such as MEGRIN (see Smith and Rhind, Chapter 47);
2. the Japanese-led plans for the development of a global digital map database at 1:1 million scale (Warita and Nonomura 1997);
3. 'bottom up' assembly of map-derived databases by the US military and its partners (Lenczowski 1997);
4. assembly of road and related feature databases for car guidance purposes by multinational private sector consortia (see Waters, Chapter 59);
5. the advent of new satellite systems which provide digital imagery data of resolutions comparable to some maps yet provide global consistency of datum and sensing tools. Most notably these are the forthcoming high resolution commercial satellites (Calvert et al 1997), but also include science missions by NASA, the European Space Agency and others (see Barnsley, Chapter 32; Estes and Loveland, Chapter 48);
6. continuing efforts to harmonise data-related standards on a global basis through official bodies like Comité Europeén de Normalisation (CEN) or International Organisation for Standardisation (ISO) and through the activities of industry-led bodies like the Open GIS Consortium (OGC) (see Salgé, Chapter 50);
7. official policy initiatives like the European Union's extended attempts to define pan-European GI polices (EC 1997) plus 'unofficial', collaborative attempts to formulate and foster governmental acceptance of policy such as that culminating in the Santa Barbara Declaration (Htun 1997) and in the Global Spatial Data Infrastructure meetings (Coleman and McLoughlin 1997; Rhind 1997).

It is again evident that there are huge variations in practice in how and why policy is formed in regard to geospatial data. One fundamental factor, however, strongly influences all these variations and this is now considered.

2 THE BIG ISSUE: THE ROLE OF GOVERNMENT

Many governments worldwide are reviewing their roles, responsibilities, and taxation policies and reforming their public services as a consequence. In many cases this is driven by a changed view of the role of the state (Foster and Plowden 1996). Fundamental reviews and subsequent reforms have taken place in New Zealand (Douglas 1994; Scott 1994), Australia, the Nordic countries, the UK (Rhind 1996), the USA (Gore 1993; Osborne and Gaebler 1992), and elsewhere, leading to some dramatic changes in what government does and how it does it. In some other countries, the process seems to be at a relatively early stage: in Japan, for instance, the creation of government agencies with

public targets was being discussed in mid 1997. Moreover, in some cases the driving factor has been relatively short term: for instance, in Germany stringent financial pressures have arisen from the need to meet the convergence criteria for a single European currency laid out under the Maastricht Treaty: one manifestation of this is that the mapping agency of Lower Saxony has become a type of executive agency and has been instructed to charge customers and thus generate revenues.

In other cases, the imperative has been ideological: a strongly held view of some politicians is that the private sector is necessarily better than the public sector at any production and distribution function (though this view typically takes no account of the equity or accountability issues which form a significant part of government operations). As a result, some functions previously carried out by government have been outsourced though this is not an invariant out-turn of fundamental reviews: the review of the possible commercialisation of some of the US Geological Survey's roles carried out under the Reagan Presidency led to no major policy changes.

Despite these exceptions, the bulk of these reviews has directly impacted on almost all activities where the government is a producer of goods which are widely used by the populace and where taxation has previously funded the activities. Thus they have had significant impacts on the collection and dissemination of geospatial data.

Such reviews have usually been based on at least two general considerations: (1) what does government actually need to ensure occurs in a particular policy area? and (2) how can government's objectives or obligations be met whilst minimising the overall cost and maximising the overall benefit to the taxpayer? With respect to the first consideration, the US Congress has described the inalienable, core role of federal government but its list is couched in rather general terms. Elsewhere the first question has often only been answered through a study of what has happened (i.e. the 'policy' is manifested through the accumulation of its individual actions). One didactic response to the second consideration is provided by ideology – turn over all data collecting and dissemination functions and responsibilities to the private sector. A more sophisticated variant on this is found in New Zealand, where the national mapping organisation has been partitioned into two parts: these are an ongoing regulatory and purchasing body and a production and marketing operation, founded as a state enterprise but which may well move at some stage into the private sector and whose government work is protected only for a limited period (Robinson and Gartner 1997). Other data-collecting bodies in the New Zealand government have been treated in equivalent ways.

There are, however, more fundamental aspects to this question, especially since it must subsume the cultural, legal, and other public policy elements of the first question. In the USA, for instance, it is widely held that the 'near free' cost of federal data provision has led to the creation of an industry which, in paying taxes and in improving decision-making through use of its products, has led to a substantial national benefit (see Elshaw Thrall and Thrall, Chapter 23). Other countries have taken a very different view, based on the contention that charging the market rate for data has various advantages.

This dichotomy of approach to maximising benefit and minimising costs has not been restricted to nation states. Various international bodies or treaties have urged or mandated the merits of one or other of these approaches. Thus the Organisation for Economic Cooperation and Development (OECD), recognising that 'member countries are increasingly financing government services with user charges', has defined the best practice basis for proper charges for public services to reflect their full cost (OECD 1997); on the other hand, the Bangemann Report of the European Union has argued the case for public sector information to be made available cheaply and readily as part of the necessary infrastructure of the 'information society'. This view is replicated in drafts of a Green Paper on Public Sector Information produced by the European Commission (the public servants of the European Union).

To some degree these statements are simply advocacy of principles, but one situation where the tensions between cost recovery and 'free availability' have already arisen is in the operations of the national meteorological organisations. These bodies need to exchange data to maximise the quality of their weather predictions. The data provided by other nations to the US are immediately available over computer networks under various statutes (see section 4 below) to US private sector bodies who can then sell their data-based services in the originating nations. Since these US-based private firms – unlike the original data suppliers – pay little or nothing for the data, they are at a cost advantage

compared to public or private sector service suppliers in the other countries. This situation led to fierce discussions in the World Meteorological Organisation in 1995–96 which were partially resolved by recognising both the need for the free exchange of 'raw' data and the Europeans' wish to charge for (and hence restrict access to) 'value-added' data (e.g. predictions).

3 ELEMENTS OF GEOSPATIAL INFORMATION POLICY

Although they interact, the key elements of geospatial data policy and their 'drivers' are best considered separately in the first instance. Individual policies may, however, be supported by reference to multiple, different benefits. Thus there is some support (and the contrary) on the grounds of economic theory for dissemination of government geospatial data at marginal cost (see below) but Perritt (1994) has argued the same case on US constitutional and technical grounds and urged extension of the same policy to state and local governments in that country.

3.1 The economics of geospatial data

3.1.1 The theory

Coopers and Lybrand (1996) and Didier (1990) have published important contributions in this area. It is usually argued that information is in general a public good in that consumption by one person does not affect its availability to others. It is an optional public good in that – unlike defence – it is possible to opt to take it or not. Love (1995), however, has pointed out that the accessibility and cost of the systems which permit use of information influence whether, in practice, it is a public good (see also Curry, Chapter 55). He argued that information is best defined as a quasi-public good since it may be non-rival but its consumption can also be excluded and controlled. He also points out that the pecuniary value of information may well depend on restricting its availability whilst its social value may be enhanced by precisely the opposite approach. The approach to economics which is adopted partially determines the end result.

Taking geospatial information as a simple subset of information generally (Arrow 1986), it seems to have two possible uses:

1 For consumption: individuals will decide how much value they assign to it based upon their valuation of pleasure, time saving or some other metric, and their awareness of the uses of the potential benefits of the information.
2 As a factor of production where the information is used as part of a good or service: the end-user of that good or service will make his/her decision on the uses to which it can be put, its availability to others, and the ease of substitutability. One obvious example is the use of geospatial information in making planning decisions in government and in commerce. It follows that some decisions will place a high economic value on the information whilst others will give it a high social value. Measuring these values is rather difficult so discussion thus far has typically been at a very high conceptual level.

Economic theory suggests that marginal cost copying is the most efficient allocative procedure. However this is only true for data already collected and if information is regarded in isolation from the rest of the economic system (Coopers and Lybrand 1996). For 'framework data' at least, there is ongoing need for regular updates to be collected and hence for ongoing spending in perpetuity. Moreover, where there is any pressure on budgets (e.g. opposition to continuing high levels of taxation), such considerations will lead to allocative distortions elsewhere in the economy. Indeed, in the longer term, the absence of any contribution from users to the costs of data collection will ensure that there is no information about the appropriate level of resources that should be dedicated to this task. Since governments are in practice increasingly interested in controlling their expenditure, there will be ongoing if uninformed pressure to reduce data collection costs under the marginal cost model, especially since measurement of externalities arising from government actions is difficult and may be impossible.

3.1.2 The actual market for geospatial data

Markets for geospatial data vary greatly between countries, for different types of information and by its spatial and temporal resolution. Most of the market sizing studies done to date provide only limited indications of price elasticity and other important characteristics of these markets. Nevertheless, one general characteristic of the market for geospatial information is its immaturity

compared to that of other types of information (e.g. financial) – and certainly compared to that for other commodities. The reasons for this include:

1. the expectation of many customers is that geospatial information is a free good as well as a public good since it has been provided historically by governments to taxpayers;
2. certain detailed geospatial data have some of the characteristics of a natural monopoly – for instance, once a complete set of information is available for every house in the country and the majority of the costs are sunk ones, it is unlikely that duplicate information sources can be made competitive or are in the national interest;
3. the relative lack of transience of much traditional geospatial data which is analogous to 'reference books';
4. the skills of the user and the available software determine how much can be done with the data and both of these are still developing within national markets;
5. the value varies by many orders of magnitude to different users and knowledge of this on the part of the information producers is limited at present;
6. the extent of linkage with other data (and extraction of added value) which is possible;
7. the poor level of quality specification of most existing products and the relatively untested legal liability issues involved in their use (see Onsrud, Chapter 46).

All of this is largely of theoretical interest to those commercial data suppliers working mainly in the short term. They can (and often must) treat the provision of information as much more akin to that of any other commodity than can government. The information provider in the latter sector who seeks to generate revenue on a significant scale may have some freedoms (e.g. a limited scope for pricing to foster markets in the UK) but is constrained by rules outlawing exclusive deals, differential pricing on a major scale, etc., and s/he is expected to behave to the highest standards of equity, probity, propriety, transparency, and consistency. There are awesome penalties for failing in any one of these – such as public cross-examination on television by the House of Commons Public Accounts Committee in the UK and the associated costs of senior management time. In the USA, some of these considerations do not loom large for the Federal Government where recovery of costs is restricted to the costs of preparing the material for dissemination and for the dissemination itself (see section 4 below).

A final, practical consideration relates to how benefits are measured in government. There is an apparent paradox between the 'atomisation' of government into units whose performance is individually assessed on financial and other criteria (see Foster and Plowden 1996) and, on the other hand, the 'Gestalt' economic benefits which are widely if uncritically anticipated from ubiquitous use of the information superhighway (see, for instance, POST 1995). It has been argued that the latter can only flourish if individual government organisations make available their information in a readily accessed, consistently priced (or free), and frequently updated way. Yet the costs to the 'atomised units' inherent in producing nebulous overall benefits seem almost certain to complicate the meeting of performance targets individual to each separate organisation. The likely out-turn in these circumstances is self-evident! The generalisation of this paradox is that the benefits and costs of making government information widely available usually fall on different organisations – a point of real significance in establishing National Spatial Data Infrastructures (see section 5 below).

3.1.3 Policies on creating added value

The least heralded yet most fundamental advantage of GIS may well turn out to be its capacity to add value. Various ways of adding value to geospatial data have been identified. These include linkage of multiple datasets to facilitate the range of applications which may be envisaged and improving the quality of data through logical intersection of independently compiled databases to identify inconsistencies. Yet the options are much wider than that, as Perritt (1994) has suggested. There is considerable variation in national policies on whether value adding is permitted by the public sector. Indeed, what constitutes 'added value' is difficult to define in regard to geospatial data (see Coopers and Lybrand 1996).

3.1.4 The merits and demerits of cost recovery

All of what has been described above indicates that different legitimations exist for charging a market price for government's geospatial data and, alternatively, for making it available freely or at the cost of copying. The arguments used by proponents of the different views are summarised below, with contrary arguments set out in *italics*. It should be noted that there are legal preconditions for some economically-related policies to be feasible (notably some form of intellectual property rights protection of the information to be exploited; see section 3.2 below).

Arguments for cost recovery

- charging which reflects the cost of collecting, checking, and packaging data actually measures 'real need' and forces organisations to establish their real priorities *(but equal charges to all do not necessarily force setting of priorities since not all organisations have equivalent purchasing power e.g. utility companies can pay more than charities)*;
- users exert more pressure where they are paying for data and, as a consequence, data quality is usually higher and the products are more 'fit for purpose';
- it is equitable since the number of data users is presently small compared to the number of taxpayers. Hence cost recovery minimises the problem of subsidy of some individuals at the expense of the populace as a whole *(some users are acting on behalf of the populace, such as local governments)*;
- empirical evidence shows that governments are more prepared to part-fund data collection where users are prepared to contribute meaningful parts of the cost. Hence full data coverage and update is achieved more rapidly where cost recovery of some significant level is achieved *(but once the principle is conceded, government usually seeks to raise the proportion recovered inexorably)*;
- it minimises frivolous or trivial requests which may well require much resource and detract from the specified functional objectives of the government body concerned *(what is the real role of government? See section 2 above)*;
- it enables governments to reduce taxes in comparison to what would otherwise have been the case.

Arguments for dissemination of data at zero or copying cost

- the data are already paid for hence any new charge is a second charge on the taxpayer for the same goods *(this is unlikely to be true if the data are constantly being updated; moreover, there are many more taxpayers than users)*;
- the cost of collecting revenue may be large in relation to the total gains *(since the latter – including benefits of prioritisation – are unmeasurable, this is unprovable even though it may be true. It does not seem to be true in the private sector)*;
- maximum value to the citizenry comes from widespread use of the data through intangible benefits or through taxes paid by private sector added-value organisations *(the first of these is unmeasurable and the second may fall in the same category, though possibly capable of being modelled; as a result, the contention is unprovable. In any case, this point is irrelevant where costs and benefits are reckoned by government on an organisation-by-organisation basis rather than as integrated national accounts)*;
- the citizen should have unfettered access to any information held by his/her government *(this is a matter of political philosophy rather than economics so is not considered further in this section)*.

Irrespective of the merits of the different arguments, the fact is that different nations adhere to different policies (see section 4). These have had dramatic effects on the data-providing organisations and had some effects on the nature of use of the data. The first of these is illustrated in Figure 1 which compares the sources of financing of two National Mapping Organisations: (Ordnance Survey (OS) and the National Mapping Division of the US Geological Survey (NMD/USGS) by appropriations from Parliament and Congress. This is shown indirectly through the 'cost recovery level'. In the case of Ordnance Survey, this is based on standard commercial accounting practices, including interest on capital: the statistical values shown relate trading revenues from all sources to total cost of operations. In simple terms, the gap is funded by Parliament. In the NMD/USGS case, the philosophy is that the scientific information provided is a public good with benefits that accrue to the nation at large. The type of information provided is multipurpose in nature, and is available to a wide variety of users. As a result, 'cost recovery' is shown as total reimbursements (including programmes joint-funded by other federal, state, and other bodies plus product sales), as a fraction of total expenditures. It should be noted that the NMD/USGS is restricted by statute to recovering from sales only the costs associated with reproducing and distributing natural science information products and the costs of time and materials for scientific services, whilst the OS attempts to recover total costs of operation to include research and development. NMD/USGS is forbidden by statute in establishing copyrights on public domain information products. In the case of joint-funded programmes, the NMD/USGS is restricted to collecting a 50 per cent cost share. Again, it can be considered that the gap is funded by Congress, although the interpretation is less straightforward. In 1996–7, the total cash expenditure of Ordnance Survey was approximately

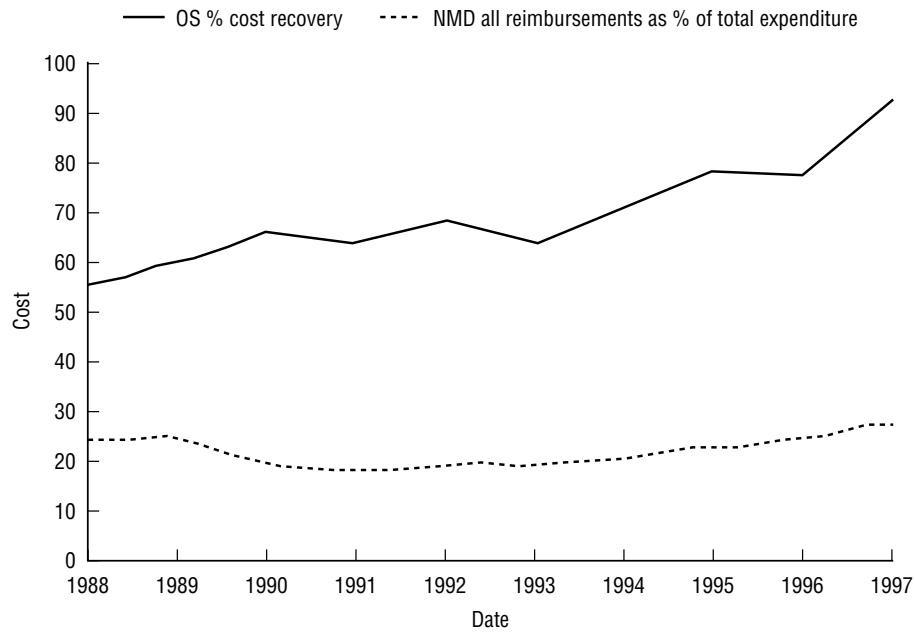

Fig 1. The levels of funding of two National Mapping Organisations (Ordnance Survey and the National Mapping Division of the US Geological Survey) by appropriations from Parliament and Congress, respectively.

US$143m whilst that of NMD/USGS was US$183m. This comparison is made solely to show the different financing models, political philosophies, and laws associated with agency funding in the UK and US governments. Because of the different policy objectives involved, it should be regarded as indicative rather than definitive.

3.2 The legal policy framework for geospatial data

The law impinges on most aspects of the collection, description, conditions of sale, protection, and liability aspects of geospatial data. Defined in the widest sense, at least eight types of law influence the provision of information worldwide (see, for instance, Perritt 1994). Some of these of course do not apply in any one country; some of them apply only to the public sector. They are:

1 statutory or Ministerial authority for public agencies to involve in trading activities;
2 public access laws such as Freedom Of Information Acts;
3 human rights laws;
4 fair trading (or anti-trust) laws;
5 copyright and other Intellectual Property Right (IPR) laws;
6 data protection laws;
7 public procurement laws or regulations;
8 legal liability laws.

An extensive discussion of some of the issues involved, at least in a US context, is in Onsrud (1995). The same author has described one key element of the legal framework – liability for use of such data – elsewhere in this book (Onsrud, Chapter 46) so no further consideration of it will be made here. Since Curry (Chapter 55) has discussed related privacy issues in some detail, these will not be considered in this chapter.

3.2.1 Copyright basics

For the present purposes, only IPR laws embracing patents, copyright, and trade secrets will be considered, with particular emphasis on copyright law. The greatest advocates of strengthening legal protection of their information and high technology industries have been the developed countries, notably the USA and some countries in Europe. Many developing countries have favoured an easier flow of information and technology so as to facilitate their own economic development (Echoud and Hugenholtz 1997). Particular emphasis will be laid in this section on European law since that has been subject to much

discussion, debate, and some change in the mid 1990s and it may well serve as a model for what is adopted elsewhere in future.

In general, there are great international variations in contemporary IPR laws: according to Echoud and Hugenholtz (1997), the greatest differences often occur between civil law countries (e.g. those on mainland Europe) and the common law countries (e.g. the UK, Republic of Ireland). To take one example, the 1992 French IPR legislation makes no distinction between the status (private or public sector) of an organisation holding ownership of these rights. Protection is given against reproduction, representation, adaptation, and transformation by all means and on all media though facts, ideas, and raw data are not covered. The protection covers two areas (Grelot 1997): moral protection and material protection. Under the material protection provision, the author can control who uses the information, the uses to which it can be put, and the duration of the licence.

Finally, it is clear in general terms that online access and distribution do not fit very well with many existing national copyright laws.

3.2.2 Originality

So far as copyright law in general is concerned, a key feature in many nations is the requirement for and definition of originality in the protected work. But defining originality is not simple: Echoud and Hugenholtz (1996) cite a number of court judgements which suggest contrary interpretations being made in different countries. In the UK and in Australia (Masser 1998), databases and maps are protected under copyright provided that 'judgement, skill and labour' have been employed. In the USA, however, the Feist Publications, Inc. v. Rural Telephone Service Company, Inc. case (Karjala 1995) has indicated that US courts under present law regard many databases as comprised of 'facts'. In the absence of strong evidence of intellectual creativity and originality, they will not support copyright protection on the basis of 'sweat of the brow' efforts of the compiler of such databases. As Karjala (1995) has also pointed out, this is likely to introduce disincentives to investment in the creation of databases – a point which the European Union's (EU) Database Directive is designed to combat (European Parliament and Council Directive 96/9/EC).

Whatever the formal legal position, it seems inconceivable that all maps and geospatial databases can be regarded as lacking originality. In practice, the most appropriate interpretation is often not obvious – especially to those inexpert in geospatial data. For example, all small scale maps contain an element of artistry because of the generalisation which is inherent in them and in any digitally encoded version (see Weibel and Dutton, Chapter 10; Kraak, Chapter 11). In the extreme case, the maps may be used as propaganda, involving substantial originality (Monmonier 1996). The same is true for certain classes of large scale maps where these have been compiled by methods which involve interpretation of evidence. On the other hand, maps created through automated interpretation of automatically collected imagery seem very unlikely to be protected under copyright law in the USA or in various parts of Europe (except possibly under the EU's Database Directive).

3.2.3 Restricted acts and limitations

National laws appear to be extremely heterogeneous (Hugenholtz 1994) both as to the scope of the protected (or restricted) acts and to the scope and content of the limitations. In some respects the 1988 UK law is at one extreme: whilst all countries have limitations on reproduction of electronic information stored in 'permanent' form (e.g. on magnetic or optical disks), only the UK law defines transient electronic reproduction as a restricted act e.g. display on a screen.

As in other aspects of IPR law, the 'fair use' conditions of copyrighted material vary widely from country to country. Whilst the UK has strong copyright protection for creators and/or publishers, that country's law also has a 'breathtaking set of library privileges' (Hugenholtz 1994: 36) so far as limitations to statutory restrictions are concerned. Samuelson (1994) states that four factors generally determine whether courts find for 'fair use' in the USA: whether the copying is for personal, non-commercial use; the nature of the copyrighted work (whether entertainment or factual works); the 'substantiality of the taking' (judged qualitatively as well as quantitatively); and the harm or potential harm to the market for the copyrighted work arising from the non-approved copying. These issues are not academic: a specific example where the use of fair trading provisions formed the basis for a long-running court case was the action between the Belgian national mapping agency (IGN) and the commercial organisation TeleAtlas.

3.2.4 Moves to provide and harmonise database protection

Though the EC has issued a Green Paper on copyright, there is presently no standard approach in Europe other than a recent harmonisation of the period of protection. However, many of the aspects of protection of intellectual property have long been under consideration (Echoud and Hugenholtz 1997). Within the European Union, a Directive on the protection of databases which took eight years to agree came into general operation in January 1998. It may well enforce changes in the method of protection available for some databases and this could have major ramifications: under the Database Directive, the period of protection is much shorter than under copyright protection (though databases in existence prior to the date of publication of the Directive in 1986 and previously regarded as covered by copyright protection will continue to be so considered). The period of protection is 15 years though a further period of protection may be obtained if substantial investment has been applied to updating the database. In some countries in the European Union, however, the Directive will provide the first legal protection of certain kinds of databases. This may encourage some non-European data providers to create databases inside the Union and thereby achieve some level of protection; but to do this they have to be operating normally and for an extended period in the EU.

Attempts to harmonise the protection of intellectual property rights on a global basis have met with mixed success (Echoud and Hugenholtz 1997). The most notable recent achievements have been the 1993 global agreement on the trade related aspects of intellectual property rights (TRIPS), which formed part of the seventh (Uruguay) Round of the General Agreement on Tariffs and Trade (GATT), and the 1996 Copyright Treaty of the World Intellectual Property Organisation, an agency of the United Nations (see *http://www.wipo.int*). The latter treaty will come into effect when 30 nations have become signatories to it. Its effects on European IPR protection seem unlikely to be great but this may not be true in many other countries.

The complexity of IPR protection is such that professional advice should always be taken before creating any database which it is intended to exploit commercially. Equally, such advice should be sought before using data from a third party unless the provenance and terms of use of that data are very clear and the data provider has a long track record.

3.2.5 Tools for protecting databases

Some geospatial data are, for most purposes, much more ephemeral than others – thus the bulk of the value of meteorological data is much more transient than that of geology. The moral for information providers – if they are only information providers – is that they should build transience into their data wherever they can persuade customers to accept it and impose a leasing arrangement, rather than one-off sales. Parenthetically, it is clear that both users and data vendors presently understand little of the ephemeral transience of information and the 'half life' of its value, though organisations such as Microsoft are betting heavily on the value of historical material in purchasing libraries like the Bettmann Archive of photographs.

Periodic refurbishment of a stock item, such as the 'localisation' of the information in Microsoft's Encarta CD-ROM, is a good secondary strategy to re-energise the information market. A more comprehensive approach where professional markets are concerned is to build services and supply 'solutions' on top of the supply of information.

Despite the above advice, the problem of protection of investment remains, since much geospatial data is slow to change – though the data specification is a primary influence, typically 1 per cent or less of many 'natural environment databases' change annually. Some solutions have been proposed but many have been found wanting. For instance, encryption of data may be valuable as a form of protection, provided it does more than protect only the 'first time read' of the data rather than any subsequent onward transmission. Perritt (1994), in acknowledging the problem of illegal copying, argued that the solution is for a pricing regime which charges modest amounts via credit card use for small amounts of text retrieved from a database using search keys (e.g. as in the legal database Lexus), with downloading of the whole database being impossibly expensive. It is not clear how this can be translated into the geospatial domain: there is often huge value to be obtained by a pass through the database and finding a null or minimal response (e.g. of competing businesses in a defined area). To permit legal action against data theft, data publishers will have to devise an armoury of techniques to investigate and 'reverse engineer' images and digital maps to assert and prove provenance. 'Finger printing' of geospatial data with distinctive but invisible features thus seems certain to become more widespread.

4 SOME CASE STUDIES

4.1 Australia

Masser (1998) has summarised much information related to GI policies at both Commonwealth (national) and state level in Australia. Essentially, land related matters are dealt with at state and Territory level whilst the Commonwealth is concerned with collection of statistics, the creation of small scale national mapping and the coordination of national policy.

The states' systems for describing land and their survey and mapping systems vary somewhat but have many similarities. The policy aspects do, however, vary somewhat. In the state of Victoria, following a major study by Tomlinson Associates, it was decided that a multi-agency GIS body was a government priority; an Office of Geographic Data Coordination (OGDC) was accordingly set up, housed in the Department of Transport and Finance. It was charged with contributing to increased economic growth for the state, creating a flourishing information industry, supporting greater (Australian) competitiveness in global markets, creating efficiencies across government, and generating a major capital asset for government. The OGDC has identified 61 high priority information products, assessed the cost/benefit of developing these products, and begun work on creating some of them. In addition, OGDC has set up a separate agency in conjunction with Melbourne Water to maintain and upgrade the State Digital Map Database; this operates as a commercial agency to package and market cadastral, topographic, and road centreline datasets. The operational aspects of running this database were contracted to Intergraph Inc. and no copy of the database was retained in government (Mike Smith 1996, personal communication).

The national level coordination of land information is achieved through the Australian and New Zealand Land Information Council (ANZLIC), serviced by the Australian Surveying and Land Information Group (AUSLIG) – a Commonwealth body responsible for the small scale national mapping and known until the 1980s as NATMAP. Members of ANZLIC represent a coordinating body within their own jurisdiction. A great deal of work has already been carried out by ANZLIC in defining and agreeing technical standards relating to the geodetic datum (including acceptance of use of WGS-84 for all mapping in future; see Seeger, Chapter 30), to data models, dictionaries, and transfer standards, and to the national metadata system.

The inherent nature of Australia's government structure is reflected in ANZLIC's statement on the national GI strategy:

'The primary objective of a national data infrastructure is to ensure that users of land and geographic data who require a national coverage, will be able to acquire complete and consistent datasets meeting their requirements, even though data is collected and maintained by different jurisdictions' (Smith and Thomas 1996, quoted in Masser 1998).

The completion of the 'first pass' national digital map produced by the Public Sector Mapping Agencies for use by the Australian Bureau of Statistics in running the 1996 Census (Mooney and Grant 1997) is an example of such a 'middle up' operation in practice.

Perhaps the area of least agreement between the various component bodies has been in regard to data dissemination policies. A draft statement prepared in 1993 for ANZLIC has not (at the time of writing) been formally agreed. It states:

'Government spatial data, already collected and funded in the public interest, could be generally made available at the average cost of transfer, subject to certain conditions [However] any collection, upgrade or further processing of public interest data to meet client needs may be subject to additional charges over and beyond recovering the full cost of distribution' (CSDC 1994).

This policy was intended to apply only to public interest uses of the data, with commercial charging being applied at higher levels. In practice, charging levels to all users vary considerably throughout the country. Licensing data for particular purposes is common.

As elsewhere, pressures to reduce the call on the taxpayer and ensure that users pay for data are evident in the Australian system, including for certain types of data provided by the Australian Bureau of Census. What marks Australia out is the extended, serious, and informed debates on the issues of public good, monopoly trading, public/private sector relationships, and technical issues, all within the context of a highly diverse and

large country – aided, of course, by the fact that there are only eight main players in the states and Territories (see *http://www.anzlic.org.au*).

4.2 The USA

The US Federal Government sees distribution of data it holds at the cost of dissemination (or less) as a matter of principle. Perritt (1994) has pointed out the mutually reinforcing roles of the Freedom of Information Act (FOIA) and the Office of Management and Budget's Circular A-130 (the latter now having been codified as section 3506(d) of The Paperwork Reduction Act 1995) in realising this principle.

Circular 130 (OMB 1993) states that 'the free flow of information between the government and the public is essential in a democratic society'. It also states that charges should be set at 'a level sufficient to recover the cost of dissemination but no higher'. Section 105 of the US 1976 Copyright Act specifies that copyright protection is not available for any work of the US government that is prepared by an employee or officer of the government as part of that person's specific duties.

Thus Federal Government is not generally able to assert copyrights and any other party is free to copy, disseminate, license, or sell data held by the Federal Government at will and without seeking permission or notifying the originators of the uses to which they will be put. There are, however, some potentially important exceptions to this rule. For example, where material has been supplied by foreign governments under specific agreements permitting internal business use (e.g. of data for military purposes), this information may not be passed on and copyright remains with the supplier.

The consequences of this situation are multiple and, in some cases, quite subtle. It has facilitated extensive use of the Internet for data dissemination which in turn has both increased access to the federal geospatial data (Calvert et al 1997; see also Coleman, Chapter 22) and shifted some costs of data acquisition to the end-user. However, the great bulk of financing for data collection in the US Federal Government necessarily arises from appropriations in Congress (see Figure 1) and the level and use of these line budget funds are subject to short term political expediency. In addition, the limited ability to protect information made available by others (especially commercial and some state governments), has made some intersectoral data sharing cooperations impossible or highly tortuous.

The situation in state and local governments varies considerably. Though many states have statutes enabling public free or low cost access to certain types of records, Archer (1995) summarised twenty cases where states had amended or were in the process of amending these statutes to permit cost recovery through higher levels of charging. Masser (1998) provides a summary of various other studies on state and local government approaches. Given the strong US pressure to codify and enforce international copyright laws (see section 3.2.1), it is no surprise that the US commercial sector strongly asserts its copyright on most occasions.

Although the US federal policies on data dissemination are well established, they are not without their critics (e.g. Dando 1996) and occasional re-examinations are carried out. For instance, the National Academy of Public Administration (NAPA) was asked by the American Congress on Survey and Mapping and by four federal agencies in 1997 to study current geographical information functions in the USA and how these could be best structured and performed. NAPA has studied the role of GI in US competitiveness, the most appropriate roles of federal, state, and local governments, and the private sector in the GI 'industry', whether some government functions can be commercialised or transferred to other bodies, and whether there are other means to effect economies in GI in the federal government. The final report reaffirms the merits of existing federal government information policies but argues the need for wider active participation in the National Spatial Data Infrastucture (see section 5).

4.3 The UK

As indicated in various parts of this chapter, the information policy situation in the UK varies not by geography (as in some other countries) but rather by government department (as in the Netherlands: Masser 1998). Coopers and Lybrand (1996) summarised the variability in policy and practice in the UK and Table 1 illustrates the financial part of it. This variability arises from the different remits and targets given to government bodies – especially the Executive Agencies (which have significant freedoms to decide how to achieve these ends) – by Ministers. Information policy is thus generally a second order matter driven by the need to meet

explicit public targets for quality of service, efficiency, and financial performance. All government-generated information is regarded as Crown copyright and its use is licensed though the level of charging may be zero. Some Executive Agencies have delegation of responsibility for administering Crown copyright whilst others follow central direction.

As in any other system, this has advantages and disadvantages to different organisations or individuals. Certainly the level of use of digital geospatial data in the UK has expanded very greatly in the last five years; much of this, however, has been in major organisations and a slower takeup has occurred in smaller organisations (see the general introduction to the Applications Part of this volume). The extent to which this reflects data pricing or the nature of society and availability of computing resources is unclear (and it is in any case changing quite rapidly).

4.4 Remote sensing

Harris (1997) has reviewed national and international policies in regard to collection, access, charging, and storage of remote sensing data as a whole, while Barnsley (Chapter 32) and Estes and Loveland (Chapter 48) provide reviews of the technology and data sources. Draeger et al (1997) and Williamson (1997) have similarly reviewed policies but focused very much on the lessons learned through 25 years of operation of the LANDSAT programme, including the effects of the Reagan era commercialisation of the data supply. All three are particularly helpful studies since civilian satellite remote sensing data have hitherto differed considerably from some other types of geospatial data. They have largely been collected under the 'open skies' policy proposed by the US government in the 1950s and only governments or government-licensed bodies have been able to collect them. The open skies policy was internationally accepted as a United Nations treaty in 1967, with national governments being given implicit responsibility for licensing any national satellite operators. This has ensured that the effects of official policy have been applied much more homogeneously than in other sectors. In the case of the USA, clear policy guidance on the distribution of data from civilian satellite land remote sensing has been available through the 1967 UN Outer Space Treaty, the 1984 US Land Remote Sensing Commercialization Act (Public Law 98-365), the 1986 UN Principles on Remote Sensing, the 1987 US Department of Commerce Private Remote Sensing Licensing Regulations, the 1992 Land Remote Sensing Policy Act (Public Law 102-555), and the Executive Branch's National Space Policy of 1996.

In essence, the LANDSAT programme was run as a US government operation until 1979 when its management was transferred from NASA to the National Oceanographic and Atmospheric Administration (NOAA) and from NOAA to the private sector (EOSAT Corporation) in 1985. The rationale underlying the latter transfer was that

Table 1 Expenditure, revenue, and percentage cost recovery for various UK government information providers in 1994/95.

	Expenditure (£m)	*Revenue (£m)*	*% cost recovery*
Central Statistical Office*	49.5	1.9	4
Office for Population Censuses and Surveys*	70.0	38.0	54
Meteorological Office (includes research revenue)	141.0	57.0	40
British Geological Survey (includes research revenue)	40.0	24.0	60
Hydrographic Office	37.9	22.0	70
Ordnance Survey	74.8	58.6	78
Registers of Scotland (cadastral organisation)	29.6	31.5	106
Her Majesty's Land Registry (cadastral organisation)	197.4	235.6	119

* CSO and OPCS merged in April 1996 to form the Office for National Statistics

revenues from product sales and ground station fees would exceed costs, government subsidies would be eliminated and a profitable commercial enterprise would result. In the event, this did not occur and led to heated debates on pricing strategies and the wisdom of the transfer. Table 2 indicates how the volume of LANDSAT imagery disseminated changed over the period from 1979 to 1989. Despite the market's familiarity with the LANDSAT products and the commercialisation policy, the revenue generated was soon overtaken by that generated from imagery from the French SPOT satellite system (Table 3). Since then, other data providers (e.g. India, the European Space Agency, and the Canadian government) have also all sought to generate revenues from satellite imagery with some greater success.

There are several reasons why the initial commercialisation of LANDSAT failed. One of these is that it may have been premature, given the market's then limited capability to use such geospatial data. Another may well be the strong opposition to charging in the USA engendered by free or low cost access to other federal government data (see section 4.2). Yet another may well be the resolution and timeliness of the data. But another factor could well be the staff culture of those who set up and ran the LANDSAT programme. As scientists and even visionaries, some at least were strongly opposed to the commercialisation. Draeger et al (1997) concluded that:

'It is clear that the management and data distribution policies and practices of the US government and its attempts at commercialisation have prevented the LANDSAT programme from living up to the vision and expectations of its early proponents.'

Despite all these setbacks, a number of commercial firms (see Estes and Loveland, Chapter 48; Barnsley, Chapter 32) have decided to launch high resolution satellites and charge for their imagery on a commercial basis; Williamson (1997) provides a fascinating description of the policy issues faced by the US government in considering the licensing and sale of information and satellite systems to non-nationals. One commercial organisation has bought the firm (EOSAT) involved in the commercialisation of LANDSAT to exploit its

Table 2 LANDSAT data sales and price history. *Source*: Draeger et al 1997

Year	*Film items sold (000s)*	*Average film price (US$)*	*Computer compatible tape items sold (000s)*	*Average CCT price (US$)*
1979	134.4	15	3.0	200
1980	128.3	15	4.1	200
1981	128.8	15	4.4	200
1982	115.0	20	5.0	250
1983	76.6	30	5.6	500
1984	35.0	60	5.0	500
1985	39.1	60	6.7	500
1986	19.1	125	7.8	1000
1987	12.4	150	8.3	1000
1988	9.1	150	8.5	1000
1989	3.6	150	9.1	1000

Table 3 Sales revenues from LANDSAT and SPOT data.
Source: Williamson 1997

	SPOT data sales (US$m)	*EOSAT's LANDSAT data sales (US$m)*
1986	5	15
1987	10	17
1988	16	16
1989	22	18
1990	32	22

distribution channels. Meantime, in the government domain, Williamson (1997) has claimed that LANDSAT 7 data will be available from 1998 under the terms of Circular A-130 and thus be made available at the cost of copying and distribution but Draeger et al (1997) are more cautious, saying that the data price will be 'based on the requirement to offset all costs of spacecraft and mission operations as well as ground processing'.

5 THE ADVENT OF NATIONAL SPATIAL DATA INFRASTRUCTURES

5.1 The US National Spatial Data Infrastructure (NSDI)

The bulk of this section is drawn from a summary of the history of the NSDI by Tosta (1997). During the early 1990s, the Mapping Science Committee (MSC) of the US National Research Council began to investigate the research responsibilities and the future of the National Mapping Division of the US Geological Survey. The MSC coined the phrase 'National Spatial Data Infrastructure' and identified it as the comprehensive and coordinated environment for the production, management, dissemination, and use of geospatial data. The NSDI was conceived to be the totality of the policies, technology, institutions, data, and individuals that were producing and using geospatial data within the USA. The MSC (1993) report proposed a number of actions and responsibilities for various agencies and for the Federal Geographic Data Committee (FGDC) which related to their vision of the NSDI whilst another report a year later urged the use of partnerships in creating the NSDI (MSC 1994).

The FGDC adopted the term NSDI to describe a 'national digital spatial information resource' and discussed the concept of the NSDI with the Clinton Administration teams which were exploring means to 'reinvent' the Federal Government in early 1993. The NSDI was recognised as an idea and a means to foster better intergovernmental relations, to empower State and local governments in the development of geospatial datasets, and to improve the performance of the Federal Government. In September 1993, the NSDI was listed as one of the National Performance Review (NPR) initiatives to reinvent Federal Government. Vice-President Gore stated that '[in] partnership with State and local governments and private companies we will create a National Spatial Data Infrastructure' (Gore 1993).

One of the primary means of implementing the initiatives arising from the NPR was through Presidential Executive Orders. In April 1994, Executive Order #12906: 'Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure' was signed by President Clinton, directing that federal agencies carry out certain tasks to implement the NSDI (see also Lange and Gilbert, Chapter 33). These tasks were similar to those that had been outlined by the FGDC in its Strategic Plan a month earlier and which had since been updated (FGDC 1997). The Executive Order created an environment within which new partnerships were not only encouraged, but required. In the USA, Presidential Executive Orders are only applicable to federal agencies but, in this case, these agencies were directed to find partners (specifically among other levels of government). In practice, state and local governments will often voluntarily cooperate with federal agencies if this makes it likely to result in funding or improve their access to data. In addition, the Executive Order had significant effects in increasing the level of awareness about the value, use, and management of geospatial data among federal agencies specifically. Perhaps more importantly, it raised the political visibility of geospatial data collection, management, and use, both nationally and internationally.

The NSDI is defined in the Presidential Executive Order as 'the technology, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve utilisation of geospatial data' (Clinton 1994). That Order and the FGDC identified three primary areas to promote development of the NSDI. The first activity area is the development of standards, the second improvement of access to and sharing of data by developing the National Geospatial Data Clearinghouse, and the third is the development of the National Digital Geospatial Data Framework. All of these efforts were to be carried out through partnerships among federal, state, and local agencies, the private and academic sectors, and non-profit organisations.

5.1.1 Standards

One component of the Federal Geographic Data Committee is a series of subcommittees based on different themes of geospatial data (e.g. soils, transportation, cadastral), each chaired by a different federal agency (see Tosta 1997). Several working groups have been formed to address issues on which there is a desire among agencies to coordinate and which cross sub-committee interests

(e.g. Clearinghouse, Standards, Natural Resource Inventories). Many of these groups are developing standards for data collection and content, classifications, data presentation, and data management to facilitate data sharing. For example, the Standards Working Group developed the metadata standard, which was formally adopted by the FGDC on 8 June 1994 and mandated in the NSDI Executive Order for use by all federal agencies on new geospatial data collected after January 1995. After a review, work began in 1996 to refine the metadata standard in conjunction with the ISO (see Salgé, Chapter 50). As of mid 1997, 11 different thematic standards were in development by FGDC committees with those on cadastral data and classification of wetlands being endorsed. All of the FGDC-developed standards undergo an extensive public review process that includes nationally advertised comment and testing phases plus solicitation of comments from state and local government agencies, private sector firms, and professional societies. The NSDI Executive Order mandated that federal agencies use all FGDC-adopted standards.

5.1.2 National Geospatial Data Clearinghouse

The second activity area is intended to facilitate access to data, with the goal of minimising duplication and assisting partnerships for data production where common needs exist. This is being done by helping to 'advertise' the availability of data through development of a National Geospatial Data Clearinghouse. The strategy is that agencies producing data describe the existence of the data with metadata and serve those metadata on the Internet in such a way that they can be accessed by commonly used Internet search and query tools (see Guptill, Chapter 49). The FGDC-adopted metadata standard describes the content and characteristics of geospatial datasets. The NSDI Executive Order, besides requiring that federal agencies describe their data using the metadata standard, also stipulated that agencies make these metadata accessible electronically. Nearly all federal agencies, as well as most States and numerous local jurisdictions have become active users of the Internet for disseminating geospatial data. This model does not necessarily assume that data will be distributed for free. Obtaining some of these datasets requires the payment of a fee, others are free. The Clearinghouse can also be used to help find partners for database development by advertising interest in or needs for data.

5.1.3 Digital Geospatial Data Framework

The third activity area is the conceptualisation and development of a digital geospatial framework dataset that will form the foundation for the collection of other data to, hopefully, minimise data redundancy and to facilitate the integration and use of geospatial data (see Smith and Rhind, Chapter 47). The Executive Order directed the FGDC to develop a plan for completing initial implementation of the framework by the year 2000, considering the requirements for developing a database useful for the decennial census by 1998. During 1994, a vision and conceptual plan were developed by the FGDC Framework Working Group (consisting of representatives of state, local, and regional government as well as federal agencies) and was published as a Framework Report (FGDC 1995).

Organisations from different levels of government and occasionally the private sector are increasingly forming consortia in their geographical area to build and maintain digital geospatial datasets that meet a diversity of needs. Examples include various cities in the US where regional efforts have developed among major cities and surrounding jurisdictions (e.g. Dallas, Texas), between city and county governments (e.g. San Diego, California), and between state and federal agencies (e.g. in Utah). The characteristics of these partnerships vary depending on the level of technology development within the partner jurisdictions, on institutional relations, on the funding, and on the type of problems being addressed. Because investments in geospatial data development at the local level are significant and often result in higher resolution data than can easily be collected by states or the federal government, the FGDC aims to foster their development in such a way as to comply with minimal national standards and thus be capable of being integrated, aggregated, or generalised to build datasets over ever larger geographical areas up to and including the nation. Various pilot projects investigating different ways of building the framework were launched in 1996 (FGDC 1997).

In its short lifetime, NSDI has generated huge levels of interest in the USA and beyond (see, for instance, Masser 1998). Some considerable successes have been achieved, notably in the formulation of some standards and the creation of the clearinghouse of metadata. Perhaps its greatest success however has been as a catalyst, acting as a policy focus, publicising the importance of geospatial data, and focusing attention on the

benefits of collaboration – especially important in a country as large and governmentally complex as the USA. The process continues on several fronts; the MSC, for instance, has attempted to anticipate the most significant GIS developments in the period up to 2010 (MSC 1997).

Inevitably, many problems have arisen in NSDI, notably about incentivising different organisations to work together and in ensuring that benefits arise for all organisations incurring costs. The concept of 'bottom up' aggregation of data to form national datasets now being explored is also an intrinsically complex one since the logistics alone of drawing together data from many thousands of other organisations (e.g. US counties) – which vary greatly in resources and inclinations – is daunting. That said, NSDI has been and remains a considerable achievement (*http://www.fgdc.gov/nsdi2.html*) and has triggered equivalents elsewhere, including multinational collaborations (Majid 1997).

5.2 Some NSDI equivalents

5.2.1 The Netherlands

Masser (1998) has described how Ravi – the Dutch Council for Real Estate Information – was restructured in 1993 as a national consultative body for geographical information. The Board of the new Ravi includes most of the main data providers and users in the public sector. The coordination responsibility for geographical information in the Dutch government lies with the Minister for Housing, Spatial Planning, and the Environment. Core funding is provided by his Ministry but other bodies contribute. Private sector bodies are involved through a business forum.

Ravi has, despite modest resources and an inability to enforce any decisions on its component bodies, been rather successful in a variety of projects, including the forging of agreement on creation of a 1:10 000 scale national core database. It has carried out internationally respected work on copyright and other GIS-relevant matters and acted as the host for the European Umbrella Organisation for Geographic Information (EUROGI). Its definition of a National Geographic Information Infrastructure differentiates between 'core' and 'thematic' data, arguing that the primary task is to improve the cohesion between those data falling into the former category. It has also set up a National Clearinghouse for Geographic Information (see *http://www.euronet.nl/users/ravi/english.html*).

5.2.2 The UK National Geospatial Data Framework (NGDF)

In Britain, observation of the US NSDI led in 1995 to what became the NGDF. It was recognised that the situation in the UK differed from that in the US in many ways: notably the structure and role of government is very different, there is already greater availability of high quality geospatial data in the UK, and government policy is very different with regard to dissemination of information.

The problems to be resolved in the UK are seen as:

1. information about geospatial datasets is difficult to obtain;
2. the information available varies greatly in quality between organisations;
3. valuable datasets are held, especially by government bodies, but are not currently available for many reasons;
4. existing datasets have been collected to different specifications so it is not easy to integrate data safely from multiple sources;
5. data are often not easy to access physically;
6. there are presently few services based on data combinations and extraction of added value.

As a result, the NGDF has been designed as a facilitator with a mission 'to develop an over arching UK framework to facilitate and encourage efficient linking, combining, and widespread use of geospatial data which is fit for purpose'. The objectives of NGDF are to: facilitate and encourage collaboration in the collection, provision, and use of geospatial data; facilitate and encourage the use of standards and best practice in the collection, provision, and use of geospatial data; and facilitate access to geospatial data.

If NGDF is successful, data quality will improve as data owners and custodians see new revenue-earning opportunities from sale of data and new added-value derived datasets will be created by combining data from two or more sources. This should lead to growth of the UK geospatial data market through improved access to data, growth of focused data linkage applications and services (including 'one stop shopping'), reduced data collection costs by reducing data duplication, and better decision-making. To bring all this about, the NGDF Board (comprised of data providers in the public and private sectors), with advice and support from the NGDF Advisory Council (comprising users from all sectors, software vendors, academics,

and others), has set up a programme of work for various Task Forces under a NGDF Programme Director. Details of this and progress may be found on the NGDF Web site at *http://www.ngdf.org.uk*.

6 CONCLUSIONS

Some obvious conclusions emerge from all of the above. The first is that there are huge variations in the national policies relating to geospatial data or GI. Many of these are being reconsidered under the impetus of other policy matters (e.g. to force cost reductions in government or to stimulate the private sector information industry). But one trend in recent years has certainly been that many governments are coming to see their geospatial data holdings as assets capable of being financially exploited. Despite the many national initiatives, however, there is little international coherence in the policies underpinning the geospatial data 'business' and this statement is also true in many individual countries. The opinions of key opinion-formers are also far from coherent (Burrough et al 1997). As a consequence, there is no possibility of ensuring complete global harmony in all aspects relating to GI. The range of actors, their range of agendas, and the historical legacies are already much too broad for this to be successful. This presents both opportunities and challenges to those who create geospatial data, who operate multinationally, and who are 'footloose' in their operations: whilst the national variations are troublesome, they also offer advantages in the selection of sites to take maximum advantage of the legal framework as well as low labour costs.

For government and the citizen alike, data policy is a 'no single best solution' field because of the interaction of legal, economic, public policy, and political threads. The interactions between different factors are sometimes highly complex. It is typical – and inevitable – therefore that many of these different policy, elements, or influences produce conflicts which must be resolved by examining the particular tradeoffs involved.

Two particular problems are, however, generic to most national geospatial data policy arenas. The first is how to ensure that the user needs – especially latent ones and those of users with modest resources – are considered in the creation and provision of geospatial data. This is particularly acute when governments are the data providers. The second generic problem is to ensure that those organisations bearing the costs of any new policy also reap tangible benefits; without this, little will happen for economic and political systems are rarely altruistic. The ultimate success of NSDIs and, more generally, of GIS will be very strongly influenced by how well such problems are addressed.

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