INSPIRE

Infrastructure for Spatial Information in Europe

Contribution to the extended impact assessment of INSPIRE

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EXECUTIVE SUMMARY

All public sector organisations will face fundamental change over the next decade as they adapt to the *Information Age.* During this period there will be a move to almost total reliance on electronic media to store records, data and information. The *Information Age* will place obligations on those producing data to adopt management techniques that facilitate secondary use by almost anyone who wishes to use the data. Principles of good governance will no longer allow islands of data and information to be created which are separate from other public authority departments, or indeed from other public authorities, industry or members of the public.

Recent experience of the use of new media has exposed serious inefficiencies in the way data are acquired, handled and turned into information. It is accepted as 'normal' procedure for those who turn data into information to spend days seeking out data from other public sector organisations, to spend many hours checking the quality of the data or adapting the data to the specifications used in their own report. The *Information Age* means that this need not be the case and that current practice leads to a considerable waste of public sector resources. By adopting good data and information management techniques, common standards and common systems, these inefficiencies can be eliminated. The Infrastructure for Spatial Information in Europe (INSPIRE) is intended to provide a common Europe-wide framework to eliminate a number of these chronic inefficiencies.

This will require legislation at European level. The overall objective of the INSPIRE legislation will be to make harmonised and high-quality spatial (geographic) information readily available across public sector bodies in the European Union at local, regional, national and European level in order to support policies with a strong territorial dimension. INSPIRE will begin with information needed for environmental policy, but will be defined in an open way so that it can be extended in the future to agricultural, transport and other sectoral requirements. It also has the objective of facilitating access by citizens and business to spatial information anywhere across the European Union.

The following principles govern INSPIRE and would be included in the legislation:

- that spatial data should be collected once and maintained at the level where this can be done most effectively;
- that it must be possible to combine seamlessly spatial data from different sources across the EU and share it between many users and applications;
- that it must be possible for spatial data collected at one level of government to be shared between all the different levels of government;
- that spatial data needed for good governance should be available on conditions that are not restricting its extensive use; and
- that it should be easy to discover which spatial data is available, to evaluate its fitness for purpose and to know which conditions apply for its use.

When developing the INSPIRE proposal, the following five policy options were considered:

(1) *Do nothing*.

(2) *Voluntary cooperation* among Member States.

(3) *A broad framework* backed by an EU framework Directive based on the subsidiarity principle of devolved management to Member State level where obstacles are addressed in a step-by-step manner.

(4) *A comprehensive framework* backed by an EU framework Directive addressing all obstacles in a comprehensive manner.

(5) *EU Regulation* stipulating how Member States should implement INSPIRE standards and infrastructure.

Option 1 describes the baseline against which the other options were assessed. From the analysis of past progress and current trends, this option concluded that policy-making would still strive to be more integrated and sustainable but, without INSPIRE, the underpinning information base would remain patchy in coverage and variable in quality. Islands of interoperability would be established and it would remain difficult to find the requisite data for lack of an organised structure in which to search for information and because the documentation of data sets (metadata) would be variable. Moreover, even when users found data, they would be unable to access or integrate them easily because the overarching architecture at the technological, organisational and procedural levels would be missing or applied inconsistently.

Option 2 was discarded at an early stage, as policy measures on awareness raising and voluntary coordination have been tried before[1], but have proved to be incapable of overcoming the obstacles to be addressed.

A full impact assessment was carried out for the recommended Option 3 (see below). Option 3 is a coherent set of measures which are consistent with measures taken elsewhere in the world where infrastructures for spatial information have been set up and which address some of the key obstacles to the use of spatial data in Europe. The impact of the remaining options is briefly described below vis-à-vis Option 3.

Option 4, the comprehensive legal framework, goes beyond Option 3 by including additional measures in order to address all the obstacles to accessing and using spatial data for governance across Europe, particularly in relation to data gaps and in relation to harmonisation of historical data. At this stage, it is impossible to assess what the additional costs and benefits would be compared with Option 3 as there is no overview of the availability and quality of existing spatial information. Furthermore, the structures needed to assess the needs and priorities of spatial data collection across the relevant policy sectors are not in place. It was therefore decided not to proceed with this more ambitious option, as it cannot be justified on cost/benefit grounds.

Option 5, the EU Regulation, might produce greater benefits than Option 3 as it would allow for a higher degree of harmonisation of spatial data infrastructures across the Member States. However, this option might have significantly higher costs in certain Member States with established spatial data infrastructures that would need to be adapted to the harmonised approach set out in the Regulation. Therefore, a step-by-step approach is preferred, first bringing together existing initiatives in the Member States in one common framework and only then considering what the additional benefits would be of further harmonisation.

Approach to the extended impact assessment

The extended impact assessment has been based on information that was available to a working group of Member State experts involved in the production and handling of spatial

data and in policies related to the environment, industry experts and a Commission contractor who provided support. A particular challenge was the almost complete absence of previous studies containing quantitative information on the costs and benefits of introducing infrastructures for spatial data. The chosen approach was therefore to determine the impact by referring to the expert knowledge available in the working group and to existing and new case studies of introducing components of spatial information infrastructures. Furthermore, when quantifying the impact the working group tried to make generous assumptions regarding costs and conservative assumptions regarding benefits.

The impact in terms of investment requirements for INSPIRE was therefore covered fairly comprehensively. However, the benefits for the user have mainly been described and quantified only for the environmental sector, as this was the only sector for which information was available to the group. Consequently, the probable wider benefits of INSPIRE to other public sectors and to the private sector could only be briefly described and have not been quantified. The existence of these gaps in the description of benefits was confirmed by feedback received at the public hearing on INSPIRE. In spite of this, the quantified benefits described already justify INSPIRE and the existence of additional benefits in other sectors only strengthens this justification.

Investment requirements for INSPIRE (all figures in €m per annum)

The following table summarises the investment needed to set up and run INSPIRE for 10 years from the date of adoption of the proposal. It assumes that INSPIRE activities are additional to what would be in place at EU, national level and sub-national level, as many activities in this field are already taking place. The added value of INSPIRE is to create the synergy necessary to connect all the separate parts of the infrastructures being created across Europe and to fill the gaps where they exist, thus delivering a fully integrated service. The available evidence indicates that, without INSPIRE, Europe will only have isolated pockets of working infrastructures that will fail to support the knowledge base needed for good governance and the sustainable development and innovation goals set by the Union.

Blocks of INSPIRE policy measures	**EU**	**National Organisations**	**Regional/local**
Harmonisation	2.7	1.8	1
Metadata	0.7	3.5-4	68-70
Data Policy Framework		0.5	
Coordination and implementation including outreach	3	20	100-170
Total investment per annum over 10 years (€m)	**6.4**	**26-27**	**170-240**

To ensure that the exercise fully represents the investment needed to develop the INSPIRE infrastructure, these requirements may be **rounded up to €200–300m per annum for the 25 EU Member States and accession countries over a 10-year period from the start of implementation**. These investment needs will to a large extent be borne by the public sector.

No attempt has been made to make any precise allocation of investment between Member States or between regions, but, taking the higher estimate of €300 m per annum and dividing it equally between 25 member states or 1700 local/regional entities, gives an average annual cost of € 12 m per member state or € 175,000 per region over 10 years.

Qualitative benefits

The policy benefits associated with greater availability of standardised data sets across Europe centre on improvements in pan-European policy formulation, analysis, implementation and evaluation that were previously very costly, time consuming or simply impossible. The wider **environmental gains** include:

- support for many activities related to environment policy implementation, such as:
  - environmental reporting,
  - environmental and other impact assessments,[1]
  - site and area selection,
  - establishment of management plans for specific sites or areas,
  - implementation of registration requirements related to territorial factors,
  - establishment of permits that need to take into account territorial factors,
  - notification requirements and public information,
  - establishment of monitoring networks;
- easier participation by NGOs and members of the public in public debates and decision making – in line with the UNECE Aarhus Convention principles on access to environmental information, access to decision-making and access to environmental justice;
- easier ex-ante evaluation of environmental policy, now an established practice for major Community policy initiatives;
- better monitoring and evaluation of environmental policies and their effectiveness, e.g. through the establishment of indicators that take into account the territorial dimension of the state of the environment or of the factors affecting it;
- support for more integrated policy approaches and policy coordination over different environmental themes and across sectors, as advocated by the 6th EAP;
- better integration of environmental protection objectives into other policies, through the use of information common to various sectors.

The same kinds of benefits as listed above for environmental policy will also occur for other Community policies with a strong territorial dimension. Thus wider **social benefits** will result from overall improvements in the quality of policy and decision-making across Europe at local, regional, national and international level, such as:

- management and provision of information on property ownership and tenure,
- monitoring and management of agriculture, such as crop planning and crop growth monitoring,
- management of public utilities such as water, gas and electricity networks,

[1] Environmental Impact Assessment and Strategic Environmental Assessment, but also other assessment requirements in the context of numerous environmental legislative acts.

- planning and management of transport and logistics,
- operation of emergency services,
- spatial planning.

Furthermore, the impact on commerce (see below) will undoubtedly lead to the creation of new high-quality employment, as has happened in the US.

There is a tendency to focus on the benefits of INSPIRE to the public sector. Yet there are good prospects for **gains by the private sector**. Mention could be made of possible efficiency savings for industries that are for instance active in the utilities, oil and gas, communications, fishing, farming and forestry, mining, drilling, dredging and quarrying, in tourism, property development; surveying, insurance, cable laying, architecture and engineering sectors. Equally important are opportunities combined with the forthcoming Directive on Public Sector Information (PSI) for exploiting public sector data and information, including:

- better and more accurate analysis of different European markets by commercial data users, leading to greater competition, and
- the creation of new products and services by commercial value added information providers, such as in the sectors of travel, logistics, telecommunications and tourism.

Experience elsewhere in the world has shown that a thriving market for added value services can develop on top of public sector spatial data. It is reasonable to assume that the implementation of INSPIRE would contribute to more vibrant economic activity in this area. This assumption is supported by the private sector's positive reaction to the INSPIRE initiative.[2]

Quantified benefits of INSPIRE

Quantification of the benefits of introducing INSPIRE has proved a difficult challenge, as the benefits of more information being available only become apparent after a certain period of time and because they also depend on many factors coming into play. The following table summarises the evidence found in relation to activities in which the availability of spatial information is a decisive factor for achieving the anticipated benefits.

Type of benefit	**Quantitative estimates** (all figures €m per annum)
More efficient EIAs and SEAs[3]	100-200
More efficient environmental monitoring and assessment	100
More cost-effective expenditure on environmental protection	300
More cost-effective implementation of the environmental *acquis*	50
More effective implementation of EC projects	5-15
More effective expenditure on Trans European Networks	140
Reduced duplication of spatial data collection	25-250
Improved delivery of risk prevention policies	120-400
Improved delivery of health and environment policies	350
Total	**1 190–1 800**

[2] Cf. results of the INSPIRE Internet consultation and public hearing http://inspire.jrc.it

[3] Environmental Impact Assessments and Strategic Environmental Assessments as required by Directive 85/337/EEC and Directive 2002/41/EC, respectively.

Adding together the quantified elements gives a **total of €1.2 to €1.8 billion annual net benefits**. These benefits are expected to accrue gradually as the implementation of INSPIRE progresses, reaching their full effect when INSPIRE is fully implemented. **Knowing that these elements only represent a partial view of the whole picture, the conclusion is that the benefits outweigh the investment requirements by a considerable amount**.

The benefits in terms of efficiency gains accrue both to the public sector and to the private sector including the general public, NGOs, private companies, and research institutions. However, the benefits to business are particularly difficult to quantify because either the costs of poor data and poor access are usually hidden within organisations or the benefits will accrue in terms of new services. The distribution of the benefits between public and private sector bodies is therefore difficult to establish. As regards public sector bodies, a distribution of benefits between national and regional/local level of 1:15 can be assumed[4]. This is roughly the same distribution of costs of INSPIRE between national and regional/local level.

Risks

The implementation of INSPIRE has inherent business risks, which need to be managed carefully in order to optimise INSPIRE's benefits. Important challenges will be achieving a shared understanding of the mutual benefits of harmonised policy frameworks, the organisation of direct funding for the INSPIRE initiative, the consistent implementation of INSPIRE across the Member States, the engagement of the thematic stakeholders and the availability of skills at the local level. It is therefore appropriate for the Commission to support and contribute to the coordination of INSPIRE's implementation.

Stakeholder consultation

The extended impact assessment was carried out by closely involving key stakeholders through a working group established by the INSPIRE expert group. These stakeholders brought together a wealth of case studies and expert views on the basis of which the extended impact assessment was drawn up.

In addition to the Internet consultation on the proposed INSPIRE policy measures and in addition to the regular consultation of the INSPIRE expert group, a draft extended impact assessment was made available as input to a public hearing in which 39 persons took part.

Most of the comments made at the public hearing related to the INSPIRE proposal or its implementation and will be taken into account by the Commission. However, the following comments related specifically to the extended impact assessment of INSPIRE, of which the methodology and quality were otherwise supported: the costs of metadata collection are over-estimated, the significant benefits of INSPIRE for the property market have not been analysed, there is too much focus on public sector data and there is no breakdown of the benefits across the different levels of government.

The remarks on the over-estimation of certain costs and the underestimation of a number of benefits are accepted, as this reflects the approach deliberately adopted for the performance of the extended impact assessment. However, the extended impact assessment now emphasises more clearly that the quantitative assessment of benefits does not present the whole picture.

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[4] This assumption is based on the comparison of amounts of data available in maps at national and regional/local level respectively and on the assumption that the benefits of INSPIRE are proportionate to the volume of spatial data available to the user.

The remark on the focus on public sector data has been taken into account in the formulation of the INSPIRE proposal for a Directive. As explained at the hearing, the lack of breakdown of benefits across the different levels of government is linked to the general difficulty of estimating benefits due to the wide range of actors that will benefit from INSPIRE.

Conclusions

There are clear conclusions to be reached from this extended impact assessment of the proposed INSPIRE Directive. **The overall conclusion is that there is a clear business case for implementing Option 3: *A broad framework* backed by an EU framework Directive based on the subsidiarity principle of devolved management to Member State level where obstacles are addressed in a step-by-step manner.**

In addition, it is clear that INSPIRE would, in particular, provide:

- more Europe-wide spatial data of greater consistency;
- consistent Europe-wide documentation of data and data quality;
- direct and free access to services to find and view available public sector spatial data sets;
- access to and delivery of spatial data literally at a few clicks of a mouse button for a range of user needs from citizens and academics to policy-makers and commercial users;
- an incentive for breaking down the barriers to the sharing of spatial data required for good governance;
- a framework for coordination between spatial data users and suppliers;
- a platform for building public-private partnerships for producing and using spatial data.

Of the various options envisaged, that of establishing a broad framework for INSPIRE backed by an EU framework Directive is recommended as it allows a step-by-step approach to tackling the obstacles to the use of best available knowledge, and is in line with the principle of subsidiarity. By putting the proposed measures in place, INSPIRE would yield the following key benefits:

1. The economic benefits far outweigh the cost of setting up and operating INSPIRE: generous estimation of the investment requirements of **€200–300 million per annum for the 25 EU Member States and accession countries against at least €1.2–1.8 billion annual net benefits once INSPIRE is fully implemented**;

2. INSPIRE would help eliminate chronic deficiencies in spatial data from across the public sector in the European Union and contribute to providing the knowledge base to support sustainable development, by bringing spatial data and information management into the *Information Age*;

3. Given the persuasiveness of spatial data for many uses, INSPIRE would produce significant social benefits by contributing to increased transparency in environmental decision-making as required by the UNECE Aarhus Convention and through its potential to support the implementation of social policies in the EU; and

4. INSPIRE would bring major benefits to the commercial sector, especially when allied to the complementary forthcoming PSI Directive, by making spatial data sets held by public sector organisations accessible and usable and by providing a common platform for both public and private sector spatial data.

FOREWORD

This document represents a contribution to the Extended Impact Assessment of the INSPIRE initiative as referred to in **Communication COM (2002)276.** The document constitutes the joint contribution of the INSPIRE Framework Definition Support (FDS) Working Group and the Sheffield University represented by Max Craglia, contractor to the Commission.

1. STATEMENT OF THE PROBLEM

The growing complexity and interconnectedness of issues that affect the quality of life today is increasingly recognized by the policy-makers and influences the way new policies are being prepared today. Many such policies need to be underpinned by information on spaces and places, i.e. geographic information (GI) to assess need, inform policy, and evaluate impacts. However, the current situation of GI in Europe is one of fragmentation, gaps in availability, duplication of information collection and problems of identifying, accessing or using data that is available. In addition, much of the quality spatial information is available at local and regional level, but is difficult to exploit in a broader context for a variety of reasons, which are largely institutional, organisational, and legal in nature rather than technical.

Europe has a long tradition in cartography. Many individual policy actions, including at the Community level, contribute to this tradition by requiring or supporting the gathering of specific geo-referenced information. As a result, detailed geographical information is available in Europe to support a broad range of policies. Indeed, map-based information is used in many reporting, analysis, evaluation and forecasting tools and activities. In addition, the emergence of the Internet allows for widespread and low-cost distribution of this type of information and could contribute to better understanding and awareness of the broad public for various policy issues[5&6]. So can we say that the situation in Europe is satisfactory?

Despite these many initiatives, widespread access and use of geographical information is still a problem in Europe. The existing activities - all very laudable individually - are fragmented and poorly co-ordinated at European level. Although a lot of the geographical information collected could potentially be useful for a wide range of purposes, the wider needs are rarely taken into account.

Traditionally, geographical information has been a specialised activity organised by individual national states and professions in different ways. European standards for data definition and exchange are only now emerging, but are complex to use. Provisions for basic European geographical information- data sets, supporting technology and knowledge infrastructure have not been well co-ordinated across disciplines or national boundaries, making it difficult and expensive to fit data together from many different sources in a seamless way. In spite of the potential for the creation of a market of added-value services on geographical information, a dynamic commercial market for geographical information fails at present to take off in Europe [7], contrary to what happens in the US.

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5 Examples: http://www.europa.eu.int/water/cgi-bin/bw.pl,

6 Example: http://www.europa.eu.int/cornet/environment/nature/natura.htm

7 For example, a market survey dating from March 2001 in North-Rhein Westphalia in Germany suggests that only 15% of the market potential is realised.

The main problems can be summarised as follows:

- Difficulties of access to information (insufficient metadata at all levels);
- Different projections and scales, making existing information difficult to integrate;
- Unclear status of the information as to its currency;
- Prohibitive cost of geographical data;
- Lack of interoperability between data sets, and among web-enabled services;
- Lack of standardisation in the codes used to represent the objects described;
- Varying data quality from one country to another within the same layer of geographical information;
- Lack of long-term solutions (instead: supply of snapshots, absence of information on changes), resulting in information that becomes quickly outdated and hence the need for duplication of data collection efforts.

These obstacles lead to fragmentation, gaps in availability of geographical information[8] duplication of information collection and to problems of identifying, accessing or using data that is available. In this environment, no economies of scale can take place. As a result of these problems, effective Community policy actions suffer because of lack of monitoring and assessment capabilities that take into account the spatial dimension[9].

The problem of having different baseline data sets which make existing information difficult to integrate, is illustrated in the box (right) which shows differences between the European and various nationals measurements for heights.

Another good example, which demonstrates several of the difficulties in the list above, can be seen in the case of the EUROSION project which aims to provide the EC with recommendations on policy and management to address coastal erosion in the EU.[10]

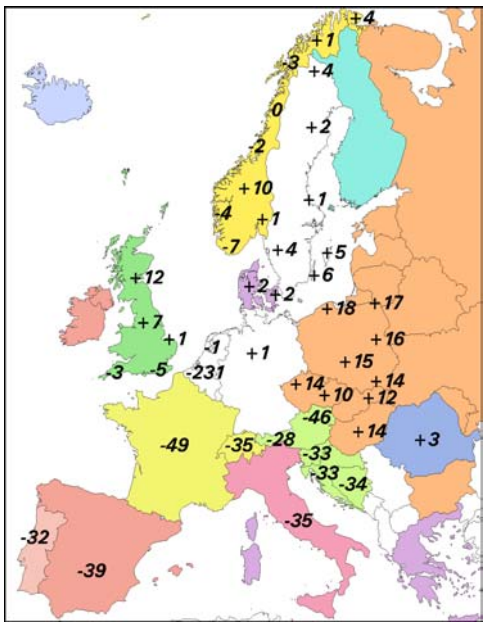

Figure 1: GI standardization: Need of a European Vertical Reference System
Differences between UELN heights and national heights in Europe (in cm)

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8 For example, only a few pan-European geographical information layers exist, often designed for specific purposes that limit the possibilities of their wider use e.g. CORINE Land Cover and the SABE data set (Seamless Administrative Boundaries of Europe) from EuroGeographics.

9 For example: insufficient monitoring capabilities are key obstacles to the further development of a range of priority *themes of* the 6th Environmental action programme, such as soil, bio-diversity, health and environment and marine policy.

10 First interim report of the EUROSION project presented at the Expert group meeting of Member States ICZM contact points of October 2002 Brussels.

The specific problems found by the EUROSION project concerning the geographical information available included the following:

- A large variety of data types exist (satellite images, maps, aerial photographs, diagrams, statistics, reports, databases, etc.) but their integration is time consuming and uncertain.
- Many geographical gaps still remain. These need to be identified and there should be priorities to bridge them.
- Reference systems are not harmonised. There is a need to define a common terrestrial reference system for data production and processing.
- Many data sources are not consistent. There is a need to build pan-European "seamless" data with standard specifications.
- Scales are not compatible. There is a need to adopt a common level of perception and representation of data.
- Many data sets are not interoperable, such that they may define the European coast line with differences of up to 200 meters.
- Costs and access restrictions. For example:
  - Most existing data sets are subject to copyrights that restrict the dissemination of end-products (sometimes, end-products have to be "degraded")
  - Licenses become very expensive when many users need to use the data
  - Quality "labels" are not commonly adopted or are applied inconsistently leading to uncertainty about the products licensed.

This are the findings of just one project but they reflect well the general issues in many similar projects in Europe today. As an additional indication, a survey of 50 organisations across Europe[11] engaged in the preparation of EIAs and SEAs indicated that the five most frequent difficulties related to:

- Problems with getting access to existing data (70%),
- Difficulties with finding out which data is available (56%),
- The data we need is not available (51%),
- Data sets from different suppliers are not compatible (47%),
- Existing data is of insufficient quality (47%).

As a result of these difficulties, over half of the respondents in 2003 indicated that the impact on their work included:

- Lower level of accuracy of description of impacts,
- Higher uncertainty of extent of impacts identified,
- Higher cost of EIA/SEA studies.

[11] Internal research of the European Commission services, publication forthcoming (Environmental Impact Assessment Review)

INSPIRE must therefore address there challenges to achieve the widespread use of spatial information to support governance in Europe through the establishment of a spatial data infrastructure. These challenges can be summarised into the following five main obstacles:

- **gaps in spatial data**: spatial data is often missing or incomplete,
- **lacking documentation:** description of available spatial data is often incomplete,
- **spatial data sets not compatible**: spatial data sets can often not be combined with other spatial data sets,
- **incompatible geographic information initiatives**: the infrastructures to find, access and use spatial data often function in isolation only,
- **barriers to sharing and re-use:** cultural, institutional, financial and legal barriers prevent or delay the use of existing spatial data.

The widespread presence of these barriers have been confirmed by the INSPIRE Internet consultation and public hearing.

2. THE MAIN OBJECTIVES OF THE INSPIRE INITIATIVE

The overall objective of INSPIRE is to make harmonised and high quality spatial (geographic) information readily available for formulating, implementing, monitoring and evaluating European policy, beginning with environmental policy and later extending to agriculture, transport, and other sectors, as well as facilitating access by citizens and business to spatial information, whether at local, regional, national or international levels.

INSPIRE will contribute to sustainable development by supporting the integration of the environment into other policies and the integration of social and economic considerations into environmental policies. For this purpose, spatial data common to several sectors and needed for environmental policies will be organised and co-ordinated by involving the sectors concerned.

The ultimate goals are to contribute to good governance through more and better-informed public participation in decision making by policy makers, and environmental improvement resulting from better-informed decisions by individuals and businesses.

The specific objectives of INSPIRE are:

- to increase the accessibility of quality geographical information,
- to increase the usability of existing geographical information, in particular for supporting good governance in Europe,
- to reduce inefficiencies in the collection, handling, storing and distribution of geographical information, and
- to eliminate institutional and data policy barriers to the use of geographical information.

This report assesses the options for, and the costs and benefits of establishing INSPIRE to achieve these objectives.

3. THE INSPIRE POLICY OPTIONS

When developing the INSPIRE proposal, the following five policy options were considered :

1. *Do nothing*.
2. *Voluntary co-operation amongst Member States supported by EU projects*.
3. *Broad framework* that focuses on public sector spatial data, that requires standardisation only as far as new data or newly updated data is concerned, that does not include new data collection requirements and that establishes a licensing framework that can be adhered to by third parties on a voluntary basis.
4. *Comprehensive framework* that addresses and harmonises all existing spatial data needed for the environment, that establishes a mandatory licensing framework for third party data and that includes new data collection requirements.
5. *Regulation* that lays down detailed provisions on how INSPIRE is to be implemented in the Member States.

The following table sets out the pros and cons of the main options originally considered when developing the INSPIRE concept i.e. to establish an efficient and effective European spatial data infrastructure.

Table 3.1 The Main Policy Options for Managing and sharing Geospatial Data

Option	Pros	Cons
1. ***Do nothing***		Current data and information problems continue
2. ***Voluntary co-operation*** among Member States	Maximum flexibility for Member States	High risk that current problems continue with patchy spatial data infrastructures, poorly supported due to lack of funding and political support
3. A ***broad framework*** backed by a EU Framework Directive based on subsidiarity principle of devolved management to Member State level where obstacles are addressed in a step by step manner	Addresses issues and meets objectives in flexible way	Risk that some important obstacles will not be addressed in time
4. *A* ***comprehensive framework*** backed by an EU Framework Directive that addresses all obstacles in a comprehensive way	Certainty that all obstacles will be addressed	Member States will resist agreeing on a package of measures that is open-ended
5. An ***EU Regulation*** stipulating how MS implement INSPIRE standards and infrastructure	Prescriptive approach with maximum guarantees of harmonisation	Difficulty to take into account the diversity of situations regarding Geographical Information in Member States

The INSPIRE options have evolved out of many discussions within the INSPIRE Expert group and out of the work[12] of the INSPIRE Working Groups on:

- Common Reference Data and Metadata,
- Environmental Data,
- Data Policy and Legal Aspects,
- Architecture and Standards,
- Funding and Implementation Structures,
- Impact Analysis.

Option 1 describes the baseline against which the other options were assessed. Option 2 has been discarded at an early stage. Option 3 is the recommended option and was assessed extensively. The impacts of options 4 and 5 are described by comparing them to those of option 3.

3.1 The Do-nothing Option

Without the adoption of INSPIRE, Europe would no doubt make progress in respect to increased quantity, quality, and general availability of data relevant for policy, good governance and business. The capability to frame and build interoperable geo-processing networks already exists now, and some organisations would over the coming years recast their business around a network-centred approach thus enabling users to address more quickly questions that demand information in a spatial context. None the less, without INSPIRE, these improvements would have only established islands of interoperability and it would remain difficult to find the data needed because there would still be a lack of an organised structure in which to search information, and the documentation of data sets (metadata) would remain patchy. Moreover, even when users found data, they would be unable to access or integrate them easily because the overarching architecture at the technological, organisational, and procedural levels would be missing or would be applied inconsistently. Therefore, whilst there will be incremental improvements at all levels, European, National, and regional/local, some of the underlying difficulties would remain, including:

- the absence of agreed and transparent policies for access and reuse,
- a project-based approach to data that leaves gaps and at the same time wastes resources by duplicating data collections that cannot be fully re-used,
- no framework for regular updates,
- emphasis on voluntary agreements with missing coordination,
- patchy interoperability of geo-spatial data and services,
- poor return on investment because projects are one-off and not well integrated.

The vision of the common market with free movement of people, goods, and services would continue to be hampered by invisible barriers (information, rules, procedures, etc). Policy-making would still strive to be more integrated and sustainable, but the information base

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[12] See position papers of the working groups in http://inspire.jrc.it/

underpinning it would remain patchy in coverage and variable in quality. Therefore, this option will not allow the INSPIRE objectives to be achieved and is not recommended.

This assessment has been confirmed by the results of the State of Play project that assesses the situation in relation to Spatial Data Infrastructure in Europe, based upon in-depth interviews with a wide range of stakeholder in countries that have been actively pursuing the establishment of spatial data infrastructures. Furthermore, the broad support for INSPIRE by the INSPIRE Internet consultation respondents confirms that INSPIRE is needed to deal with the obstacles for the use of spatial data experienced in Europe.

3.2 The Voluntary Co-operation between Member States Option

This option was discarded at an early stage, in view of previous experience in Europe and elsewhere. Indeed, previous experience with policy measures on raising awareness and co-ordination have been tried before (GI2000[13]), but proved to be incapable of overcoming the obstacles to be addressed. The choice of this option would create high risks for the implementation of existing and forthcoming key Community legislative acts, such as the Water Framework Directive[14] and the development of a Community information and monitoring system on soil threats[15].

3.3 The Legislative Framework Options

Options 3, 4 and 5 have progressively been narrowed down to Option 3 during the policy formulation process. This section briefly describes the impacts of options 4 and 5 by comparing them with those of the recommended option 3, described in detail in Section 4 below.

Option 4, the comprehensive legal framework, goes beyond Option 3 by including additional measures in order to address all the obstacles to accessing and using spatial data for governance across Europe, particularly in relation to data gaps and to harmonisation of historical data. At this stage, it is impossible to assess what the additional costs and benefits would be compared with Option 3 as there is currently no overview of the availability and quality of existing spatial information. Furthermore, the structures needed to assess the needs and priorities of spatial data collection across the relevant policy sectors are not in place. It was therefore decided not to proceed with this more ambitious option, as it cannot be justified on cost/benefit grounds.

Option 5, the EU Regulation, might produce greater benefits than Option 3 as it would allow for a higher degree of harmonisation of spatial data infrastructures across the Member States. However, this option might have significantly higher costs in certain Member States with established spatial data infrastructures that would need to be adapted to the harmonised approach set out in the Regulation. Therefore, a step-by-step approach is preferred, first bringing together existing initiatives in the Member States in one common framework and only then considering what the additional benefits would be of further harmonisation.

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13 http://www.ec-gis.org/copygi2000/

14 Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, OJ L 327, 22.12.2000 p. 1-73

15 Communication from the Commission - Towards a Thematic Strategy for Soil Protection, COM/2002/179 final

4. THE RECOMMENDED INSPIRE OPTION

Having discounted the 'Do Nothing' option, the recommended option is Option 3 in Table 3.1 i.e. to introduce an EU Directive based on broad use of the subsidiarity principle to allow flexibility for Member States in implementing INSPIRE. The policy measures related to this option and selected for impact assessment are broad-brush measures that can, if needed, be further fine-tuned to take into account the outcome of the impact assessment and the consultation with the stakeholders.

4.1 Overall scope

Following extensive analysis work, the scope of INSPIRE can be defined by a list of 60 spatial data components grouped together in 17 themes (see Annex 1). These themes cover both information directly related to environment policy (e.g. noise, water quality, protected sites etc) and information of a cross-sectoral nature, often needed by several sectors (e.g. administrative boundaries, elevation, transport networks, land cover, etc). All spatial data sets corresponding to these themes that are held in an electronic form by public sector bodies at national and local level would be covered. They should comprise the spatial data that is relevant to environmental policy.

4.2 General Principles

The following principles govern INSPIRE and would be included in the legislation:

- that spatial data should be collected once and maintained at the level where this can be done most effectively,
- that it must be possible to combine seamlessly spatial data from different sources across the EU and share it between many users and applications,
- that it must be possible for spatial data collected at one level of government to be shared between all the different levels of government
- that spatial data needed for good governance should be available on conditions that are not restricting its extensive use,
- that it should be easy to discover which spatial data is available, to evaluate its fitness for purpose and to know which conditions apply for its use.

4.3 The INSPIRE components

In broad terms, the key components of INSPIRE are typical of any Spatial Data Infrastructure, as indicated for example by Rhind (2000), Masser (1998), and by Craglia et al. (2002), namely:

- Reference and thematic data,
- Metadata that describes who has these resources, what are their characteristics, and the conditions for access and use,
- A Data policy framework setting the rules for access and sharing,
- A co-ordinating mechanisms to make sure that it all works.

The five crucial problems that INSPIRE sets out to address and the policy measures proposed are identified below.

Obstacle 1: Spatial data gaps

Full European coverage for certain data sets in accordance with minimum quality criteria is essential for efficient use of data from a variety of sources. However, there remain important gaps in Europe even for the most essential spatial data sets.

Proposed Policy measures:

1. INSPIRE should set the framework for requiring for spatial data sets full EU coverage in accordance with agreed data collection methods and quality criteria. These requirements would not be part of the INSPIRE framework legislation, but be adopted at later stages through separate legislative processes. The INSPIRE Framework legislation would only refer to the establishment of these future requirements.

Obstacle 2: Data documentation is often lacking

In many cases, data documentation does not exist, making it impossible to find back possibly valuable information; existing data documentation is available in a variety of formats

Proposed Policy measures:

2. Metadata needs to be made available in order to help users identify and locate relevant data sets. Building on this, INSPIRE would require that in the short term, the most important spatial data sets and in the medium term the other spatial data sets corresponding to the themes listed in Annex 1 are documented according to common standards and that the metadata is kept up to date. Metadata should allow discovering relevant data sets and provide information on access and use.

3. Metadata should be made available free of charge for all users

Obstacle 3: Spatial data sets are not compatible/interoperable

Most uses of spatial data require data from various sources (e.g. combine environmental information with basic topographic data, combine information on environment and health), but data from various sources are often not compatible. This requires repeated adaptation of data sources or discourages the use of the spatial data.

Proposed Policy measures:

4. Member States would be required to contribute to the definition of standard ways of organising and presenting spatial data sets. (These standards would take the form of common data set specifications, based on common data models.)

5. Member States would be required to use these specifications for any new data collection, or update of existing data, within the themes detailed in Annex 1. Member States would also be expected to make their existing spatial data sets compatible with these common data set specifications, in the medium term for the most important data sets and in the long term for the other spatial data sets corresponding to the

themes listed in Annex 1. Member States could do this in the first instance by building connectors to their existing databases so that they can be registered with Web-enabled services and become INSPIRE compliant. In the longer run, there will be benefits in upgrading national and local standards to international best practice as reflected in the INSPIRE specifications.

6. The data and information needed to make spatial data sets interoperable[16] should be made available free of charge and be free of use restrictions.

7. The data sets on administrative boundaries that can be used as a reference for seamless integration of other spatial data sets should be made available free of charge and free of use restrictions

Obstacle 4: GIS initiatives in Europe are often incompatible

Technology progress allows us today an integrated discovery, access and use of spatial data from different sources, located at different sites. Several communities have set up their own mechanisms for exchanging spatial data (e.g. regional spatial data infrastructures or thematic spatial data infrastructure like the bio-diversity clearinghouse mechanism), but often these initiatives are not co-ordinated across the boundaries of the communities involved, leading to duplication and forgone potential economies of scale. In Europe, an overarching initiative is needed that will bring together the existing and emerging initiatives into one consistent framework.

Proposed Policy measures:

8. Member States would be required to establish a distributed network of services that publish, discover, view, access and trade the spatial data sets that are covered by INSPIRE, in accordance with common standards.

9. This network should be open to non-public sector providers of spatial data sets and to spatial data that falls outside the themes listed in Annex 1 that are consistent with a minimum set of conditions needed to ensure the overall coherence and ease of access to the Spatial Data Infrastructure. Such conditions could include compliance with metadata standards, conditions for access to metadata and view of data (see below) and implementation of INSPIRE network services.

10. The Commission would need to establish and operate an "EU-Portal" that would provide a multilingual point of access to the spatial data and services accessible through the network.

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16 This information covers for instance the definition of a common European grid system, the definition of a common reference system and the unique identifiers or coding system applied for unique identification of spatial objects and the corresponding information needed to uniquely identify them.

Obstacle 5: Barriers for use

Important barriers exist of a procedural, legal or financial nature for access and use of spatial data, even between public sector bodies. There is often no culture of sharing of information between public sector bodies. Therefore possibilities for reuse of information between different level of government are limited, leading to duplication of data collection and maintenance. In addition, many public bodies apply prohibitive charges or licensing conditions for the reuse of spatial data (including to other public bodies).

Proposed Policy Measures

11. In view of the objectives of INSPIRE to support governance in Europe, Member States would be required to establish a framework for sharing spatial data between public sector bodies that provides:

    - for all public sector bodies, exchange of spatial data that is free of barriers of a transactional, procedural, legal, institutional or financial nature at the point of use.

    - for unrestricted use rights for public sector bodies related to the performance of their public tasks.

12. In complement to a sharing framework between public bodies, a more general licensing framework governing all spatial data of the infrastructure would be established by INSPIRE.

13. In order to make the spatial data infrastructures efficient and appealing from a user point of view, viewing of all data sets corresponding to the themes listed in Annex 1 should be free of charge to all users. Viewing means the display on a screen of the visual aspects of the data, with appropriate legends needed for interpretation. It does not mean download of a copy of the data in its native format or visualisation of all the textual and numerical attributes (e.g. measurements).

Additional measures

Implementing the above measures will require further provisions in the INSPIRE legislation in order to deal with methods, standards and organisational issues, including the creation of a solid framework within which providers and users from various sectors can co-ordinate spatial data requirements and provision.

The INSPIRE legislation would therefore need to establish a flexible procedure for the adoption of the necessary implementation measures. These include the adoption of guidelines for reporting to the Commission of the common data set specifications, data models and standards for documenting, organising and representing spatial data, of technical standards for services for discovery, viewing and downloading of spatial data, and of implementation schedules for standardisation work.

Furthermore, INSPIRE would require the Member States to monitor, on a continuous basis, and according to common rules, the development, implementation, and usage of the spatial data infrastructure as regards the availability of spatial data sets and services.

5. HOW WILL INSPIRE WORK?

5.1 The stepwise approach to implementation

The INSPIRE implementation will follow a step-wise approach, starting with unlocking the potential of existing spatial data and spatial data infrastructures and then gradually harmonising data and information services. This will eventually allow the seamless integration of systems and data sets at different levels into a coherent European spatial data infrastructure. It will require the establishment of appropriate co-ordination mechanisms to ensure that all the key stakeholders are involved. Where relevant, synergies with the GMES initiative will be sought in order to ensure coherence between INSPIRE and GMES.

The **first step** will focus on establishing the coordinating mechanisms at European and national/regional levels, the harmonised documentation of existing data sets (metadata) and the implementation of basic query, view and access mechanisms. Portals will be established at EU, national and regional levels and will provide the opportunity to access and query spatial data sets. This will be a gradual process where first the most frequently used data sets will be documented and accessible and, later on, the other data sets. This will allow the interested user at any level to gradually see a picture of which spatial data exists and for what purposes it can be used. It will also allow the building of interfaces to provide the general public with simple viewing and access to the spatial data.

As data sets become documented and visible, the sharing agreements established between public sector bodies will remove other disincentives from public bodies to re-use spatial data collected by others. This will pave the way for fully exploiting the benefits of the data collected in a wide range of public policies to the benefit of sustainable development.

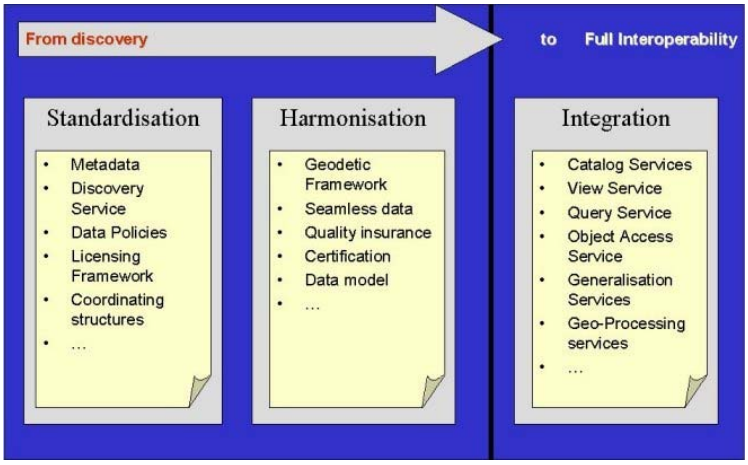
The **second step** will focus on the harmonisation of existing spatial data sets. A better knowledge of the existing data sets achieved through the first step, and the establishment of co-ordination mechanisms, will allow the key stakeholders to contribute to the **definition of common ways to define and characterise spatial objects,** such as transport networks, forests, etc. Once these common specifications are adopted, data providers will start to build interfaces between common specifications and their data sets that will, to a large extent, remain in their original formats. These interfaces will, to a certain extent, “hide” from the user differences between data sets from various sources. It will be the start of a harmonised spatial data infrastructure that will combine information from various sources to support more advanced analysis work.

The **third step** will push the harmonisation one stage further. Even if the above measures significantly increase the ability to combine data from different sources, the use of existing data will, at a certain stage, start to show its limitations. This will be particularly discomforting for the most important spatial data sets to which many others will refer to for linking information to specific places and spaces. Separate legal initiatives will therefore be taken to ensure that, for these data sets, the limitation of existing data in terms of measurement methods, quality, immediacy and geographical coverage will be overcome.

The **fourth and last step** (see Figure 5.1) will build upon the previous steps and concentrate on completing the common models and on providing the services to fully integrate data from various sources and various levels into coherent seamless data sets supporting the same standards and protocols. This will allow real time access to up-to-date data across the whole of Europe. Furthermore, by this stage, INSPIRE will have developed an open framework of interest to other sectors to join, complementing the cross-sectoral and environmental information with details on agriculture, transport, energy etc. This will support cross-sectoral

policy co-ordination and facilitate the integration of environmental, social and economic concern in support of sustainable development.

Figure 5.1: Towards an Infrastructure for Spatial Information



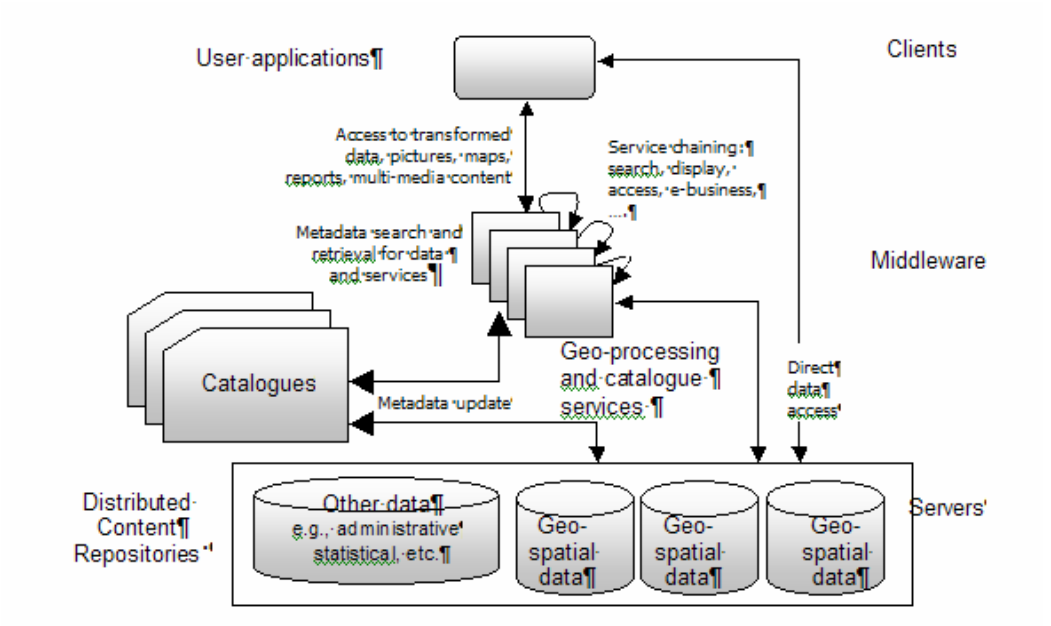
5.2 Technical requirements

Figure 5.2 shows a generic architecture reference model that allows one to describe any spatial data infrastructure. In this model, which is introduced to provide a common understanding of the technical aspects of spatial data infrastructures, a distinction is made between four major groups of components: user applications, geo-processing and catalogue services, catalogues, and content repositories. In this context, the term component refers to a group of technically similar functionalities within the architecture.

User applications include general purpose interfaces for query and viewing, a tool for database administrators, and analytical applications tailored to the information needs of the user. Specifically they must provide the following functionality:

- Publish metadata and data,
- Find geographic information,
- Context-related viewing of geographic information,
- Delivery of geographic information,
- Analyse geographic information,
- Support multi-lingual queries and viewing of results, and
- Support e-business for value-adding products and services.

Figure 5.2: INSPIRE Generic Architecture Reference Model



Geo-processing and catalogue services may process user queries, draw maps from data, regulate access, perform payment operations, and extract and send data to a user application. Typically, this may involve:

- Management/administration/Coordinator specific services,
- Catalog service (find data and/or services),
- Web Map service (WMS),
- Web Coverage service (WCS),
- Web Feature service (WFS),
- Gazetteer service,
- Coordinate transformation service,
- Authentication service,
- Analysis / Geospatial Data fusion service,
- Web Pricing and Ordering Service.

Catalogue Services will operate on Catalogues of spatial (and non-spatial) data, i.e. collections of metadata describing the data and services available, while the stores containing the data are referred to in the Figure as *Repositories*.

INSPIRE's common principles envisage that the feature databases evolve into repositories of multi-purpose data, structured in spatially meaningful packets, with persistent identifiers, well-defined life-cycle rules, and appropriate procedures for managing changes. 'Spatially meaningful packets' implies no artificial divisions and hence a service which at least appears to be seamless.

The architecture described aims at giving users the impression that they are dealing with one database, although in reality they are finding, accessing, reading, and updating a set of different databases.

To develop the INSPIRE a model-driven approach is needed. This must be understood as an evolutionary process based on repeatable building blocks, step-wise and standards based methods, agreed by community of users and engineers and suitable of immediate adoption by the INSPIRE administration and network. The latter point is crucial because all the evidence collected from existing experiences of Spatial Data Infrastructures (SDIs) across the world[17] indicates the importance of involving stakeholders at all levels and build on quick wins. So it is imperative that the process is open and evolutionary, building on a series of iterations that over time move from the general specifications for the more frequently used objects towards more detailed specifications responding to specific requirements (e.g. to satisfy particular applications or legislation demands). For simplicity, these will be referred to as 'data harmonization projects' in the cost benefit analysis. In the course of each data harmonization project, which may last in the region of 12 –18 months, the community of domain experts at European, national, and regional/local level will work closely with engineers and interoperability experts to define:

1. features and feature collections, the basic spatial "units of analysis" and link these together into higher-level units of analysis (e.g. different water bodies form together a river network);

2. the data's geometry and topological relations and the types of associated geometric reference systems the data should be captured in or converted to via an on-the-fly services. At a minimum the data model must specify the requirement that data to be objectified uses the agreed European conventional reference systems that include projections, horizontal, and vertical reference systems (such as ETRS89 and EVRF2000 respectively);

3. agreed terminology and definition of the key attributes of the spatial objects;

4. the necessary codes and unique identifiers and feature coding catalogue (if applicable) and encoding (for transfer data sets) to be used by the application schema;

5. the conceptual schema expressed in Universal Modeling Language (UML) to include the application and spatial schema, the metadata, quality information;

6. the feature types, attribute types, attribute domain, feature relationships, spatial representation, and data organisation, in terms suitable for transformation to electronic metadata;

7. the minimum quality requirements, and updating frequency for future data collections (although these will be subject to application specific legislation) with appropriate nomenclature for display via metadata searching or other requirements using agreed INSPIRE metadata profiles of international standards;

8. a data content standard that is format-independent of a conceptual model that can be implemented with one or more logical and physical models;

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[17] See GINIE project (www.ec-gis.org/ginie) and State of Play Project for example.

9. implementation profiles derived from the conceptual schema as annexes; and

10. the multilingual thesauri for items 1, 3, 7 and 9 to facilitate semantic interoperability.

As mentioned earlier, these requirements must be seen evolving over 10 years of implementation of INSPIRE starting from the more generic to more specific.

As the product specifications are developed in each data harmonisation project they will spawn access/exchange services that use interoperable standard interfaces and encodings. At this stage, it is possible already with exiting technology and methods to build connectors (wrappers) to existing databases so that they can be registered with web-enabled services and become INSPIRE compliant. Over time, as operational and organisational capacity develops, and new data is collected to INSPIRE standards, there may be benefits in upgrading national and local standards to international best practice, thus saving resources and at the same time integrating further the different data sets across Europe.

To achieve the overall objectives four conditions are necessary:

- The systems and working methods developed by INSPIRE must become embedded in the daily processes of users. As argued by the INSPIRE Architecture and Standards Position Paper, *administrative interoperability must precede geospatial interoperability*. This means that the custodians of relevant data sets must be clearly identified (one of the advantages of having metadata), involved early on in the process of defining the specifications, and that they must have adequate human and organisational capacity. This may require dedicated education and training programmes.

- Closely linked to the issue above is that of coordination at European, national, and regional/local levels without which it will not be possible to channel efforts, achieve synergy, and ultimately succeed. Again, evidence from across the world of SDI experiences indicates that coordination is by far the most important component of any SDI. Coordination is required to involve all the stakeholders, ensure that the data harmonisation projects specifications are developed and deployed in a timely fashion, monitor and support implementation of standards, and the creation of metadata, and maintaining political and organisational momentum[18].

- Connect INSPIRE with the wider goals of stimulating the information economy of Europe and the Information Society. This entails coordination with e-government initiatives, leveraging resources to achieve common goals, exploiting increased access to broadband services at the local level which are necessary to INSPIRE implementation, and embedding INSPIRE to the support e-government objectives.

- Integrate the INSPIRE requirements for research and development, particularly in the fields of semantic interoperability, model generalisation, and organisational implementation, and the support actions necessary for capacity building at the local and regional level with the opportunities provided by the 6th Framework for R&D so that they work hand in hand with the staged implementation process envisaged.

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[18] See for example the testimony of Koontz (2003), to the US General Accounting Office on the effort still required in the US to implement a nation-wide SDI.

6. ASSESSMENT OF IMPACTS

6.1 Introduction

The policy measures identified for the recommended option in Section 4 have been regrouped for the purpose of impact assessment into four main blocks that reflect the traditional components of any SDI, namely:

INSPIRE data and data harmonisation: this includes both reference and thematic data, at all levels (European, national, and regional/local). This SDI block includes therefore Policy measures number 1, 4, 5, 6 and 7 of Section 4.3.

Metadata and Catalogues: this block requires the definition of an INSPIRE profile based on ISO 19115, ideally cross referenced to e-government metadata formats based on the Dublin Core, the translation of existing metadata to such profile, the creation and regular maintenance of metadata for the many data sets particularly at regional and local levels that are not documented, building the institutional and professional capacity to do so, i.e. making it somebody's job to create and maintain metadata. As the harmonisation process develops, build the data and services catalogues as well as the content repositories necessary to deliver in operational settings the INSPIRE vision. This block includes therefore Policy measure 2, 3 in Section 4.3.

Data Policy Framework: this block includes the framework of agreements that put into practice the INSPIRE vision whilst respecting subsidiarity principles. In other words, each Member State will have to develop its own way of putting the INSPIRE data policy requirements into practice in accordance to its institutional and financial practices, whilst respecting also other relevant international and European legislation or agreements such as the Århus Convention, the Directives on Public Access to Environmental Information (2003/4/EC) and Public Sector Information (forthcoming), and competition law requiring transparency and non distortion of the market. This block includes Policy Measures 11, 12, and 13 and in Section 4.3.

Coordination and implementation: this block includes a series of measures to support the implementation of INSPIRE. All studies of SDIs across the world indicate the crucial importance of coordination to maintain momentum, avoid duplication of effort and gaps in the infrastructure, link across policy areas, and help build capacity for implementation. Coordination thus includes both strategic and operational management of INSPIRE at EU and national levels. This would cover, inter alia management of the data harmonisation programme, development and maintenance of Internet portals and the technical infrastructure (clearinghouses) needed to search, discover, view, and download the data sets covered by INSPIRE. In this respect it includes Policy Measures 8,9,10 and the additional coordinating measures referred to in Section 4.3 related to coordination at EU, national, and regional level.

6.2 Methodology

The extended impact assessment has been based on information that was available to the INSPIRE Framework Definition Support (FDS) group, a working group composed of Member State experts involved in the production and handling of spatial data and in policies related to the environment, industry experts, and a Commission contractor.

A particular challenge was the almost complete absence of previous studies containing quantitative information on the costs and benefits of introducing infrastructures for spatial data. The chosen approach was therefore to determine the impact by referring to the expert

knowledge available in the working group and to existing and new case studies of introducing components of spatial information infrastructures. Furthermore, when quantifying the impact, the working group tried to make generous assumptions regarding costs and conservative assumptions regarding benefits.

The impact in terms of investment requirements for INSPIRE was therefore covered fairly comprehensively. However, the benefits for the user have mainly been described and quantified only for the environmental sector, as this was the only sector for which information was available to the group. Consequently, the probable wider benefits of INSPIRE to other public sectors and to the private sector could only be briefly described and have not been quantified. The existence of these gaps in the description of benefits was confirmed by feedback received at the public hearing on INSPIRE.

The key to the methodology is that throughout estimates are made of *incremental* costs/investment requirements and benefits of the proposed INSPIRE policy measures, i.e. over and above what would happen without INSPIRE. In each Member State there are existing costs and benefits associated with the production and use of the various data sets that will be covered by INSPIRE. Although some overall estimates of the cost of the current investments in public sector information are used in the analysis, no attempt has been made to derive a new estimate of this base. Rather the impact assessment concentrates on providing figures for the additions to these base expenditures from the INSPIRE initiative. In some cases INSPIRE will simply refocus expenditures that would have taken place in any case, so that there is no incremental cost. But in others new investment is needed as a result of the INSPIRE requirements—though equally there will be new benefits.

Two complementary approaches have been adopted, depending on what data is available:

- the first is to estimate the incremental costs and benefits as a proportion of the costs (or benefits) of related activities. The output of such an analysis takes the general form: incremental of cost of, say, the creation of metadata, is 10% of the data collection costs;

- the second attempts to quantify the costs and benefits in monetary terms, over a defined output. Here the output takes the general form: the costs of the creation of metadata for the complete INSPIRE data sets for all member and accession countries are X person-years, which is equivalent to € Y millions[19].

Within each approach there is a mixture of values with different degrees of precision. It is generally much easier to estimate both cost increases and cost savings (efficiency improvements)—the latter being included here as "benefits". There will be wider generic benefits, sometimes known as "macro-economic benefits"—in terms, for example, of the improvements in public sector policy making or the increases in private sector innovation—which can be associated with the INSPIRE initiative. These benefits can only be described in qualitative terms.

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[19] For the purpose of this impact assessment we assume a daily rate of € 500, and yearly costs of € 100,000 per full-time equivalent person including overheads, office and equipment, and social costs. These costs are assumed the same across EU25 and are not discounted by Purchase Parity Standards. This is clearly resulting in an over-estimation of the costs, erring on the side of caution, and is therefore justified.

6.3 Stakeholders

For the purpose of this impact assessment it is assumed that the following user groups: citizens, NGOs, and research institutions, are unlikely to face significant additional costs from the adoption of INSPIRE, although they will reap benefits. This assumption is predicated on these groups not holding, or producing, any significant data sets to which the INSPIRE requirements would apply.

In respect to the private sector, which in some instances holds or produces important data sets that may be of relevance to INSPIRE, the following is assumed:

- INSPIRE only puts obligatory requirements for public sector data, i.e. data for which the public sector holds Intellectual Property Rights (even if collected by the private sector on commission by the public sector). Therefore, data that involves third party rights will only be affected by INSPIRE when the third party Intellectual Property Right holder agrees to participate on a voluntary basis.

- The data policy framework proposed by INSPIRE will not result in additional costs to the private sector in terms of more restrictive conditions for access, or market distortions as it will be fully in line with existing EU legislation including competition law.

Therefore, the main groups of stakeholders affected by INSPIRE are likely to be:

1. the European Commission - it is predominantly a user of spatial information and thus could be expected to reap mainly benefits. However, the Commission is likely to also share some of the burden of the INSPIRE costs through its involvement in the coordination of INSPIRE at EU level and by making funds available to those who incur costs as a result of INSPIRE. Its net position would therefore include – costs and benefits;

2. national data providers (such as mapping agencies) and related associations (e.g. Eurogeographics) – costs and benefits;

3. national government agencies and organisations such as environment agencies and geological surveys that are both producers and users of GI – costs and benefits;

4. regional and local authorities, that likewise are both producers and users of GI – costs and benefits; and

5. citizens, private sector data users, research institutes – benefits only.

For the purpose of number 4 above, it is assumed that the principal actors are unlikely to be the 90,000 or so local administrations in Europe, as the majority of these are very small. We therefore assume that the key actors are likely to be:

- Cities of over 100,000 inhabitants (approximately 450 units).
- Middle level local authorities (regions, counties, or provinces) in large countries, and central organisations in smaller countries. As a first approximation of the number of organisations involved we have considered that these would be equivalent to NUTS3 administrations in the larger countries, which number 1200 in the 25 Member States of the expanded EU.

The total number of regional/local authorities involved is therefore approximately 1700. This is equivalent to one organisation for every 250,000-300,000 people across Europe.

This is of course only an average and cannot reflect the situation of each individual country. In some countries the nature of the institutional and organisational framework will be such that only organisations at national and regional levels (NUTS 1 and 2) will be involved while in others the responsibilities and hence data holdings are more decentralised. Whilst mindful of these variations, we feel these are at least a first approximation of the numbers involved in the first implementation of INSPIRE.

6.4 Timing of requirements

The extended impact assessment will attempt to provide estimates of the plausible costs and benefits of the INSPIRE measures as grouped in the following four blocks, for each of the main groups of stakeholders:

- Data covered by INSPIRE and data harmonisation,
- Metadata and catalogues,
- Data Policy framework,
- Co-ordination and implementation.

The timing of the requirements will have a significant effect on their costs. As often is the case in SDI-related projects, the costs of implementation are front-loaded while the benefits only start showing at a later stage. This is why every effort should be made to show some early results through an iterative process resulting in evolutionary acquisition and deployment.

For the purpose of this Impact Assessment the following is assumed:

During 2004/2005 some preliminary work will take place while the INSPIRE proposal goes through the legislative process. Such work may include the development of implementation profiles for international standards, guidelines for harmonised discovery metadata, interoperability trials between existing SDIs, discussions about specifications and licensing frameworks, awareness raising activities about INSPIRE, and discussion about coordinating frameworks. These processes are all very important but will be funded through existing budget lines and will not be considered as INSPIRE costs.

INSPIRE costs are assumed to start in 2004-05 after approval of the measure. The sequence of expenditure is assumed to include:

2004-05 Preparatory actions to:

- Establish coordinating and implementation support bodies at European and national level.
- Issue guidelines for implementation and reporting and EU metadata standards.
- Establish harmonised licensing frameworks for data access and sharing.
- Establish Catalogue services including services for discovery, query, view, download and trading.
- Initiate and develop IT services to facilitate the collection of stakeholder requirements and reporting support services.
- Raise the awareness and inform stakeholders on the implications and implementation strategy of INSPIRE.

- Initiate the first two sets of data harmonisation projects through research and development projects for data harmonisation within INSPIRE

2006-2007 Actions to support the transition

- Roll out of the coordination, licensing, and discovery metadata across EU25 and regional/local levels
- Establish and operate the organisational structure to manage the implementation support actions as a service to the Commission, Member States and stakeholders
- Further develop harmonised licensing frameworks.
- Testing and further development of Clearinghouse services.
- Initiate the third set of data harmonisation projects for data harmonisation specification, and delivery of relevant services.
- Continuing awareness raising.

2008-15: Actions related to further implementation

- Operational support
- Three further rounds of data harmonisation projects to extend capabilities and applications to achieve the desired level of interoperability.
- Monitoring and reporting.

This does not mean that full compliance and implementation will be achieved by 2015 but for the purpose of this assessment we assume that most of the costs and benefits will have come on stream by then and that the measure will have achieved its main objectives. It can however be expected that after the 10-year implementation period, the one-off investment costs will significantly reduce.

7. THE INVESTMENT COSTS OF INSPIRE

7.1 Data Harmonisation

As discussed in Section 5, the process of harmonisation needs to be viewed as a series of data harmonisation projects that over time refine and extend the first round of generic specifications to suit specific policy and analytical requirements.

Annex 1 identifies 60 data components organised in 17 data themes. The Environmental Thematic User Needs Position Paper[20] describes in pages 81 and onwards several of the data components and gives examples of some of the data sets that would fall in each component.

The process of harmonisation, as envisaged by the Architecture and Standards Working Group, focuses on the object level, i.e. individual geographic features. It would therefore be appropriate to start focusing on those objects that are most frequently used, and convene expert groups to develop the specifications. In respect to timing, this activity would start with those objects and themes that are already at least partially specified at the European level, and then move outwards to fill the gaps.

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[20] http://inspire.jrc.it/

With these considerations in mind, the following is assumed:

- For the purpose of harmonisation, the 17 themes in Appendix 1 can be grouped in 6 main super themes with a view to working on the common objects that are in most frequent use across domain.

- Each of these super themes will require 6 iterations, or data harmonisations, over a 10 year period to complete the specifications of all the objects relevant to the INSPIRE framework.

- Each data harmonisation project would cost in the region of € 750,000 and last 12-18 months.

These assumptions are based on experience collected in the US to specify the transport domain inclusive of some 20 data sets (US $500,000 over 12 months), and current experience in Europe based on OGC specifications. Given the multilingual and semantic complexity of Europe compared to the US, the costs have been increased by 50% to arrive at the sum above.

The investment required for harmonisation under these assumptions is:

Harmonisation = € 750,000 X 6 super themes X 6 data harmonisation projects = **€ 27 m over a ten year period (i.e. € 2.7 m per annum)**

This investment includes data modelling and applications schemas and the encodings necessary to ensure that data coming from different databases across Europe are displayed with common legends (portrayal). Furthermore, several existing data sets will have been part of the process of testing the specifications as they are developed and will therefore be already "INSPIRE compatible". We assume that these investments will be funded by the EC.

Member States and their organisations at national/regional/ and local level will be required to adopt these specifications for new data collections and updates. It is also expected that they will start encoding their existing databases to enable requests from web-enabled services to link to the INSPIRE specifications. This does not require changes in the existing database structures, but only adding a layer of encoding to increase the level of interoperability, thus capitalizing on past investment. **The additional investment of such operations is estimated at € 2.7 m p.a. of which 70% funded nationally, and 30% regionally/locally**.

7.2 Metadata and catalogues

The standard to which metadata will need to be generated already exists, i.e. ISO 19115. Thus there are no additional INSPIRE costs to create the metadata standard, although an INSPIRE profile will need to be developed and cross-referenced to ISO 15836 (Dublin Core) which is widely use in e-government portals.

The initial INSPIRE requirement will, therefore, require the creation of metadata to the INSPIRE standard for the data sets pertaining to the data components set out in Annex 1. Some of these data sets already have relevant metadata associated with them. For the majority new metadata will need to be created from scratch. There will be a two-stage approach in most instances starting with discovery metadata first and moving then to fuller metadata in catalogues and services enabling interoperability between data set. The creation of this latter type of metadata is embedded in the process of registering data sets to the INSPIRE services to enable interoperable network services.

National agencies and organisations

The majority of the national data sets are held by four types of organisation:

- national mapping agencies:
- geological surveys;
- cadastral agencies; and
- environment agencies.

We assume that each organisation in each country will need 2-3 people full time equivalent for one year to document national data sets, to convert existing metadata, or to create new metadata. This is equivalent to 250-300 people across the EU25. Assuming an annual cost of €100,000 per person, including overheads, (i.e., based on a daily rate of €500), **this comes to a total one-off implementation cost of €25-30m.**[21]

Maintenance costs thereafter may be estimated at **€1m per annum**, to include the translation of the metadata created into more than its native language.

Regional and local organisations

At regional and local level, where we assume that this documentation activity will be undertaken by 1700 or so organisations across Europe, we assume that 2 people full time will be required for a year in each organisation, giving a total of 3400 person years across the EU, and **a one off total cost of € 340 m.**

Given the lack of a culture of data documentation at the local level, INSPIRE ought be considered to give rise to a share of the on-going maintenance costs, at least in the short-to medium run. We estimate these costs to be in the order of 10% of the one-off costs, i.e. some **€34m per annum**, which is on average approximately €1.6m per Member State. As argued earlier, as the process of harmonisation develops, this creation and maintenance of metadata is essential to ensure that machines and services can find, query, and extract the relevant data from their repositories.

European Commission

For the European Commission, the estimated cost to develop the EU portal is estimated to a **€ 500,000 one off cost with another € 200,000 per annum for maintenance and translation**.

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[21] The estimated cost of € 25 million is consistent with the expenditure of the EA in England and Wales that devotes € 1.5m per annum to data management, including 10 people full time on metadata, and another 20 on enforcing data standards, and managing the GIS data layers. This expenditure provides much more than just discovery metadata. As an order of magnitude, this investment represent some 2% of the yearly expenditure by the Environment Agency on IT systems.

Table 7.1: Investment Costs of creating and Maintaining Metadata

	One-off costs (€m)	Recurrent costs (€m)
EC	0.5	0.2
National organisations	25-30	1
Regional/local organisations	340	34
Total (rounded)	**370**	**36**

7.3 Data Policy framework

Given the framework outlined in Section 5 on what is involved under this heading, it is assumed that there will be no significant additional costs coming out of INSPIRE beyond the one-off costs of developing a shared understanding of the mutual value of agreed policy frameworks, and the technical instruments such as licensing that implement such frameworks in line with current EU legislation. This one off cost is assumed to be of the order of 2 full-time equivalent persons for 1 year per Member State i.e. € 200,000 X 25 = **€5 m.**

7.4 Coordination and implementation

Coordination and implementation require that a technical and administrative support is in place to ensure adequate support to the Member States, the stakeholders and the Commission to meet the INSPIRE requirements. In particular, this will need a coordinating and monitoring function to report on implementation, ensure that metadata is created, that data harmonisation projects are well managed and delivered, and that the translation, and clearinghouse services are developed and implemented. Coordination between stakeholders working together to achieve the set objectives, and a dissemination function are needed to ensure that the means are available to implement the data policy framework with respect to awareness, capacity building, and demonstration of results. This function also includes the setting up and maintenance of web services and portals at EU and national levels. As the scope of INSPIRE will cover metadata, specifications, and application of data sets currently held nationally, locally and regionally, the coordination function will need to interact with the 1700 organisations identified above in addition to the national and EU levels.

The following distribution of costs is assumed:

- European Commission: 30 staff needed, which on the basis of a staff cost of €100,000 per annum gives an **annual cost of €3 m**. These costs include the establishment and maintenance of a EU geo-portal, the co-ordination of the data harmonisation process, the monitoring and evaluation of INSPIRE, the preparation of further policy initiatives, including impact assessment and the co-ordination across the different policy sectors, and outreach measures to raise awareness and support capacity building.
- National coordinating structures and clearinghouses, including outreach: 2-5 people for small countries, up to 10 people for large countries, giving a total of 150 people and an annual cost of €15m. Adding the cost of outreach and support to regional/local levels gives a total **annual cost of €20m**.
- Local structures and clearinghouses: assuming 1700 organisations and an expenditure of €50,000-100,000 (between 0.5 and 1 full time equivalent staff each) per annum each, gives an **annual investment of €100-170m**.

7.5 INSPIRE Summary of investment requirements

All investments are **on a per annum basis**. Where one off costs are considered they have been annualised over 10 years at 2003 costs i.e. without discounting.

Table 7.2: The Investment requirements for INSPIRE (in million €)

	EU	National Organisations	Regional/local
Harmonisation			
Development, testing, and implementation of specifications and related services[22]	2.7	1.7[23]	1
Cost of making data needed for harmonisation free of charge[24]		0.1	
Metadata	0.7	3.5-4	68-70
Data Policy Framework		0.5	
Coordination and implementation including outreach	3	20	100-170
Total investment per annum over 10 years (rounded)	**6.4**	**26-27**	**170-240**

It is important to clearly separate the impact of costs on different categories of stakeholders and the sources of funding for bearing these costs. **This impact assessment does not prejudge the possibility that significant parts of the costs of implementing spatial data infrastructures at national or at regional/local level could be co-financed with EU budgets**.

8. THE BENEFITS OF INSPIRE

8.1 Introduction

It is widely recognised in the few cost-benefit analyses undertaken of Spatial Data Infrastructure policies that the quantification of the benefits is particularly challenging. In particular, the following analysis of the benefits, whilst it is complete as was practical, is still only partial because:

1. Whilst some impacts are readily identifiable and can be quantified (such as reduction in duplication of collection costs), often the provision of information is simply a means to different ends and those ends are often the result of many factors. In these cases, a complete identification and valuation of the benefits is impossible.

2. The following sections focuses primarily on the potential benefits to environmental sector. This does not mean that only this sector would benefit from INSPIRE. This initiative is cross-sectoral and will potentially benefit all the sectors with a strong

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22 Management costs included in Co-ordination costs

23 National incurs 70% of the costs, with Regions incurring the remaining 30%

24 It is assumed that the foregone revenues relate only to administrative boundaries that are current sold by the mapping agencies.

spatial dimension, including agriculture, regional policy, transport, and spatial planning. (As an illustration, Annex 2 indicates a range of policies at the European level, which would be affected by INSPIRE, which then translate into national, regional, and local commitments.)

8.2 Qualitative description of the benefits

Two different sorts of benefits are identified: (a) benefits in terms of cost savings i.e. efficiency gains, enabling existing needs to be met more cheaply (these benefits accrue to both data producers and data users); and (b) benefits in terms of the ability of users to access and to use data in new and innovative ways increasing productive potential or improving the efficiency and effectiveness of policy responses.

8.2.1 Efficiency gains

Efficiency is seen both in respect of reductions in the cost of existing activities and the ability to do new things because costs are now lower. Since most existing activity is likely to be done within organisations, the visibility of the current costs of non-compatibility and non-availability is low. Secondary benefits may arise from the standardisation of data sets in so far as less training etc is required to enable users to access and understand a wide range of data. There may also be improvements in quality.

Benefits arise separately from each of the different aspects of INSPIRE: interoperable specifications; access to metadata; data policy framework, and co-ordination. However, it is often difficult to split the benefits accurately between these different components.

Efficiency gains from data standardisation

Interoperable specifications reduce the costs of combining data sets. The benefits of the conversion of the data sets with the resulting benefits accruing mainly to data users, not data providers. In the *absence* of standardisation: some projects will require the expenditure of time and money in order to secure the one off conversion of one or more data sets; in other cases, work will not be done because the cost of data conversion is considered to be excessive.

Efficiency gains from standardised metadata

Metadata produces more widespread knowledge of the existence of available data sets, so that:

a) some users are saved the cost of collecting data which they would otherwise have had to obtain anew (reduced duplication);

b) others find themselves able to pursue activities which would not otherwise have been worthwhile—in some cases wholly new outputs may be involved;

c) the collection of *new* data may now be viable since it can be combined with existing data to create an expanded set of services;

d) The ability to *discover* existing data sets reduces the barriers to entry in markets where “local knowledge” is a necessary condition for entry, which is a contribution to the single market (though this constitutes a wider benefit rather than an efficiency saving).

An example of the benefits of investing in metadata comes from a study by EuroGeoSurveys. The study found that the development of standardised metadata and catalogues that required a total **one-off** investment of some €7 m is benefiting the 22 organisations involved to the tune of some €7 m **per annum** in terms of better internal data management.

A further example of the type of savings that could be generated at the local level comes from Poland[25] is shown below, and is probably similar to thousands of other similar cases across Europe.

Figure 2: Balarzewo: Parcels, buildings and DTM

An example of the benefits that can be expected from having accessible metadata at the local level, comes from the community of Balarzewo, Northeastern Poland, pop. 3400, 123 sq km. As every municipality on Poland, it is required to prepare a planning study (structure plan) setting out its development strategy. To do so it contacted the Institute of Spatial Economy and Housing, in Warsaw, which decided to start off by contacting all the regional and national organisations which might have some geographic data relevant to the locality. To the surprise of the local community, it was possible to find some parcel level data and contour lines held at the regional level in an old database in DOS operating system. By converting this data into a modern GIS database it was possible in a few days to assemble parcels maps and land-owners, land-use, soils, geology and DTM (processed from contour lines). Total cost of data conversion € 1000. Estimated costs or data capture from scratch €50,000. The most astonished at the results were the "owners" of the original data who did not realize what they had and how it could be re-used

Efficiency gains from the data policy framework

The benefits of having simple user licences and access free of barriers at the point of use means that regardless of the financial practices of different Member States, users no longer have to negotiate through the maze of access conditions on an individual basis. This is often identified as one of the biggest barriers to GI development and use, but is also a highly intangible barrier and therefore very difficult to attribute benefits to. There are already examples of the way in which the different practices in Member States are becoming harmonised at the point of use which indicate the benefits of such a data policy framework. INSPIRE would speed up and facilitate this process. The examples include:

- In the Walloon Region, were all public sector organisations have free of charge access to the INFRASIG spatial data infrastructure;
- In Italy, where all signatories to the State-Region Agreement have similar free access;
- In Britain a recently signed pan-government agreement means that all 450 central government organisations have free access to the whole range of Ordnance Survey Great Britain data through a financial settlement negotiated centrally. Local government, the utilities, and academia in Great Britain already had similar centrally negotiated service level agreements.

[25] Pawel Decewicz, Institiue of Spatial Economy and Housing

Also in Britain, the outcome of negotiations between the Ordnance Survey Great Britain (OSGB) and the University sector means that a centrally agreed 5 year licence now covers all government-funded Higher Education institutions. This licence covers access to a selection of OSGB maps and data for teaching and research, including academic publication. The fact that the licence fee does not depend on usage is promoting increased volume of use and the reduction in administration costs has fed into significantly lower charges than would otherwise be the case. The uptake of the service has steadily increased between 1999 (43 subscriptions) and 2003 (74 subscription) out of a total of around 160 institutions eligible to subscribe and has reached 17192 registered users. The service is now being experimentally extended to Further Education institutions.

Efficiency gains from co-ordination

These benefits are the most difficult to quantify, but all the recent studies of SDIs across the Europe and a comparison with other parts of the world indicate that effective SDIs need more than simply strong legislation. They require long and sustained commitment, vision, and support to all the stakeholders involved to keep the project focused and build on the achievements.[26]. With this in mind, we have not put an estimate benefit to the coordination element, but we have plenty of evidence to suggest that without this measure INSPIRE will fail to deliver its objectives.

Who benefits from these efficiency gains?

Efficiency gains accrue both to the public sector and to the private sector including citizens, NGOs, businesses, and research institutions. However, the benefits to business are particularly difficult to quantify because either the costs of poor data and poor access is usually hidden within organisations or the benefits will accrue in terms of new services. Examples include:

a) An internal audit by Shell indicates that 53% of New Frontiers Areas staff time was spent in searching for data, so the scope for efficiency improvements is obvious.

b) There are prospects for greater efficiency in the property and insurance industries, which are big users of GI data.

c) In Canada, in 1990, a number of oil and gas companies determined that their exploration geologists and geophysics spent more than 60 percent of their time searching for information and only about 20 of their time doing something useful with it. They created the Canadian Oil and Gas GIS (Canoggis), in essence a SDI to help them know what information is where, who owns it, and at what price. Canoggis reduced access costs by a factor of about 10 within

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[26] For example the GINIE study of SDIs (www.ec-gis.org/ginie) confirmed the crucial role of coordination in developing and sustaining these infrastructures. Using the US as an example, the Federal Geographic Data Committee (FGDC) which coordinates the National SDI performs all of the functions above with a staff of 15 and a budget of $ 3.6 million per year, of which approximately half is spent as seed money to support the development of metadata and related services and portals at federal, state and local level. Of importance for INSPIRE, is that even with an Executive Order of the US President, without the constant activity of the FGDC much of what has been achieved would have been dissipated by the pull of different organisations and agencies. Of note, as well, that a recent testimony (Koontz 2003) to the General Accounting Office has argued that a much greater effort is still needed to ensure that all the stakeholders are involved and that the objectives of the a more efficient use of GI are achieved.

three years of its creation. After implementation, the searching time fell from 60% to 20% and the using time increased from 20% to 60%.

Based on the comparison of amounts of data available in maps at national and regional/local level respectively, and assuming that the benefits of INSPIRE are proportionate to the volume of spatial data available to the user, we could consider that the distribution of benefits between the national, regional and local level are 1:30:100. However, taking into account that coverage at regional/local is patchier than at national level, we assume a distribution of benefits between national and regional/local level of 1:15. This is roughly the same distribution of costs of INSPIRE between national and regional/local level. But it should be noted that the balance will shift in favour of the regional/local level as the gaps at this level are filled in the future through other policy measures.

8.2.2 Better policy-making, policy-implementation

The wider benefits associated with the greater availability of a standardised data set across Europe centre on improvements associated with the availability of more consistent data and the facilitation of pan-European analysis which was previously impossible. The wider gains include:

- support of a wide range of activities related to environment policy implementation, such as:
  - environmental reporting,
  - environmental and other impact assessments,[27]
  - site and area selection,
  - establishment of management plans for specific sites or areas,
  - implementation of registration requirements related to territorial factors,
  - establishment of permits that need to take into account territorial factors,
  - notification requirements and public information,
  - establishment of monitoring networks;
- easier participation by NGOs and members of the public in public debates and decision making – in line with the UNECE Aarhus Convention principles on access to environmental information, access to decision-making and access to environmental justice;
- easier ex-ante evaluation of environmental policy, now an established practise for major Community policy initiatives;
- better monitoring and evaluation of environmental policies and their effectiveness, e.g. through the establishment of indicators that take into account the territorial dimension of the state of the environment or of the factors affecting it;
- support for more integrated policy approaches and policy coordination over different environmental themes and across sectors, as advocated by the 6th EAP;

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[27] EIA and SEA, but also other assessment requirements in the context of numerous environmental legislative acts, e.g. risk assessments, effectiveness assessments.

- better integration of environmental protection objectives into other policies, through the use of information common to various sectors.

Case studies indicate something of the potential:

- The project which gave rise to the Wilderness Map is a good example of the benefit of increased consistency of national data sets. The Map may be used to analyse land use and cover across Europe with the particular objective of identifying areas that may warrant designation as Sites of Special Scientific Interest or national parks. Once completed the project will allow cheaper and easier access to information sources.
- The GETIS project brings together a large variety of cross-EU data about infrastructure and topography to provide the basis for disaster management, especially flooding, scenario analysis.
- The EUROSION project uses a variety of existing data sets to produce a better understanding of risk associated with erosion. The result will enable some regional authorities to use the database as a tool to prioritise investments on erosion defence. More generally, the project is expected to produce a better understanding of the process of erosion, which should feed through into more efficient land use expenditures that do not try to resist natural dynamics.
- Policies that rely on integrated assessment such as the Water Framework Directive, the Noise Directive, the EIA and SEA Directives, the Structural Funds regulation will significantly benefit from INSPIRE. A survey carried out for EIA and SEA point to benefits of 5.4% of the costs of these assessments.

International examples that support the benefits of an infrastructure like INSPIRE include:

USA

Federal Emergency Management Agency (FEMA)

FEMA staff performed an assessment of the benefits and costs of implementing the Flood Hazard Mapping Program (2001). This visionary plan for the future of the flood mapping program included:

- Completing the conversion of the 100,000 map panel inventory to a digital format;
- Conducting flood data updates for all flood-prone communities with inadequate or no floodplain mapping;
- Integrating communities, States, and regional agencies into the mapping process;
- Converting the maps to metric; and
- Improving customer service to make the maps easier to obtain and use, including electronic and digital printing and distribution.

FEMA considered only those benefits for which reliable data could be obtained. Three primary benefits were quantified: reduced potential loss of new homes; reduced potential loss of new non-residential structures; and reduced cost of map reviews due to the improved digital format, improved distribution and more complete mapping of roads. The total cost of the modernization plan is $847.6 million. The total discounted benefits of the modernization plan are $175 billion - a benefit to cost ratio of over 200 to 1.

Fish and Wildlife Services

The US Fish and Wildlife Services National Wetland Inventory (NWI) now disseminates its digital wetland map files via the Internet. Before NWI started using the Internet to distribute digital wetland map files, they sold approximately 38,000 map files. Now, with access to a GIS and the Internet users have the ability to download and use the digital files of the NSDI. Since map files were made available over the Internet, over 1.35 million map files have been downloaded. At the average cost of $9.20 per map file, Internet users have saved $12.4 million by accessing NWI wetland map files online.

New York State

Members of the Legal and Data Coordination Groups developed a data-sharing framework, which became known as the New York State GIS Data Sharing Cooperative. The cooperative provides an arena to share data at no cost. By signing one standard data sharing agreement, every member has access to every other member's data. Participants, or cooperative members, do not require data to join. Prior to the establishment of the cooperative, best estimates indicated that 800 to 900 GIS data sets were exchanged each year between data holders. In 1998, when cooperative member data was placed online in the New York State Clearinghouse, it resulted in 8,500 data sets being downloaded, valued at $2 million. In 1999, more than 98,000 data sets were downloaded valued at $7.8 million. In 2000, 280,000 data sets were downloaded valued at more than $14 million. In 2001, downloads approached one million.

The Netherlands

An overview of the costs and effects of the implementation of national project 'Space for Geo-Information' (RAVI 2003) was undertaken[28]. All activities needed to implement the 'Space for Geo-Information' programme were systematically determined and their costs estimated based on available information sources and expert knowledge. The following costs were identified: technical implementation, co-ordination, legal adaptation and the purchase of hardware and software. The direct benefits (for example efficiency improvements for government and industry) and the indirect and external effects were distinguished and, where possible, quantified. The total costs of the project to strengthen the Dutch Space for Geo-Information will be 79.6 million Euro (period 2003-2010). In the long-term, the yearly economical benefits are estimated to be higher than 1 billion Euro.

Italy

The growth of the Internet is making information cheaper and easier to obtain and in so doing revolutionising stakeholder involvement in policy debates. As a result NGOs and members of the public are increasingly obtaining the information they need to engage with policy makers, at all levels of government. It is difficult to be specific about the gains which might flow from the implementation of INSPIRE but it is worth noticing that online maps are particularly popular with the public. As an example, Nielsen Netratings reported that in April 2003 in Italy, the web sites with maps have had double figure increases in the number of hits. Specifically, mappe.Virgilio.it is the leader in the field (473,000 visitors, + 40% since January 2003) followed by mappe.libero.it (332 thousand users, + 64%) then www.viamichelin.it (270 thousand, + 41%) and www.maporama.com (250 thousand, + 35%). So the benefits of increased availability of GI on line are clear.

8.2.3 New products and services: competition and innovation

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[28] Berents and Weesie 2001.

There is a tendency to focus on the benefits of INSPIRE to the public sector. Yet there are good possibilities for gains by the private sector. Mention has already been made of possible efficiency savings, but equally important are business opportunities:

- for better and more accurate analysis of different European markets by commercial data users, leading to greater competition; and

- for the creation of new products and services by value added data providers and others.

If cross-EU data is easier to identify and to obtain, private sector companies will find it easier to compete outside the boundaries of their home market. Thus INSPIRE is likely to make some contribution to improving competition within the EU single market.

The main sectors in the economy using the INSPIRE data sets seem likely to be the utilities; the oil and gas industry; cable laying; the communications industry; the fishing industry; farming and forestry; mining, drilling, dredging and quarrying; tourism; surveying; architecture; engineering; property development; insurance. Businesses should be able to increase their international activity if they find it easier to obtain and process data for other locations (e.g., cable laying; surveying; architecture; engineering; insurance.) This is in addition to improved access within national boundaries, which will also increase business opportunities.

There is widespread recognition of the huge changes in applications and in functionality that can be achieved by the application of IT to various geographical and other data sources. Businesses and research institutes will be able to expand the range of their activities.

There are many examples of GI applications, which could hardly have been envisaged in the days before data was available in digital form. Thus, in the UK a commercial value added reseller (Upmystreet) has developed a product which brings together a variety of separate local data sources in order to provide users with a one-stop shop giving them ready access to a range of information about given geographical localities. As a result some people will make considerable savings in time and effort in obtaining the information they need; others will use data that they would not otherwise have taken the trouble to collect.

It is not possible to identify in advance what new products and services will be facilitated by INSPIRE, nor is it possible even to indicate how important such gains might be in quantitative terms (i.e., as additions to GDP). We note the fact that public data has for some time now been much more readily available to all users in the USA, and also that data is generally available at no more than marginal cost (which is generally very low). There is little doubt that the scale of activity in the GIS industry is significantly higher in the USA. Whether the establishment of INSPIRE would trigger the same level of activity in the EU cannot be established here as there might be other factors involved. **It is however reasonable to assume that the implementation of INSPIRE would contribute to more vibrant economic activity in this area.** This assumption is supported by the private sector's positive reaction to the INSPIRE initiative through the INSPIRE Internet consultation and public hearing.

8.3 Quantitative assessment of the benefits

Whilst previous examples have illustrated the benefits from INSPIRE like initiatives, the following sections try to quantify and monetise the additional benefits of INSPIRE compared to the 'do-nothing' baseline. It is recognised that many of the qualitative benefits set out above cannot be described in quantified terms. Whilst all impacts are ultimately tangible, the

improved provision of information often results in those impacts to manifest themselves in unforeseeable ways.

8.3.1 Efficiency gains

Environmental impact assessment

INSPIRE is likely to be of particular use to organisations, both in the public and the private sectors, which carry out Environmental Impact Assessments (EIAs) and Strategic Environmental Assessments (SEAs).

Recordings of the number of EIA and SEA's of Member State expert suggest that 10,000-19,000 EIAs and 3000-5000 SEAs are carried out every year in the EU-15. A questionnaire of the Commission's services of EIA and SEA experts operating in the EU-25 suggests that the average cost of preparing EIA and SEA reports is €73,000. Thus the total cost for carrying out these environmental assessments in the Member States ranges between €950-1,750m. The same survey reveals that problems related to the access and use of spatial data increase the costs of EIA and SEA studies by, on average, 5.4%. If these costs could be removed savings of €50-95 m per annum could be achieved.

The survey suggests that problems related to the availability, quality and use of spatial data increase the time needed to produce EIA and SEA reports on average by 8%. Since the average time for preparing these reports is six months, this would save on average two weeks per EIA or SEA. In order to provide a conservative response, we assume that all these time savings have been included in the overall savings given above. The benefits which are expected to result from the INSPIRE initiative are, therefore, very likely to represent an underestimation and to become more important in the future. For this reason, we work with figures taken from the top end of the above range, given a rounded saving of **€100 m per annum.** These savings represent an underestimation as they do not take into account the increase of SEA's due to the entry into force of the SEA Directive in 2004 and only take very partial account of the EIA's that take place at regional and local level. For a number of countries, it is judged that the estimates of the number of EIA's should at least be doubled. Therefore, the total savings could run **up to € 200 m per annum**.

Environmental monitoring and assessment

The costs of monitoring and assessment of the environment in the pursuit of environmental policy are in the UK some €160m a year. If this expenditure us grossed up over the EU-15 as a whole (pro-rata to GDP), the total is some €1bn. Without INSPIRE much of the monitoring data collected for the primary purpose of monitoring compliance against discharge limits or environmental quality standards would remain costly or impossible to combine for secondary environmental assessment purposes, largely due to inconsistent specifications of data or systems. It would also remain difficult to combine different data for reporting on the state of the environment at a regional, national or international level. Based on similar experience from many organisations, the estimated efficiency improvements arising from harmonisation, consistent metadata, more efficient data handling, and increased quality would lead to efficiency gains of at least 10%, which would be worth **€100 m per annum**.

Environmental protection

Industry across the European Union spends an estimated €33bn per annum on environmental protection measures[29]. A reasonable estimate is that 10% of this total spending relates to data handling, primary and secondary use. The need for investment in mitigation or prevention measures are often based on the results of environmental risk assessments (ERAs) of the discharges arising from industrial installations to air, water and/or land. Data required to carry out ERAs of discharges is often lacking, requiring very expensive data collection campaigns. Assuming a 5% efficiency gain from INSPIRE being in place by making environmental data of known location, quality and standards readily accessible, that would be worth €150 m a year.

Also the public sector makes significant expenditure on environmental protection measures. As an example of this expenditure, it is estimated that the cost of implementing the Directive 2002/49/EC, relating to the assessment and management of environmental noise, is of the order of € 10-15 million per annum for conurbations and € 15 m per annum for the 150 airports in Europe, totalling € 25-30 million[30]. Another example relates to reporting. The cost of the administration and reporting of the implementation of the Water Framework Directive in England and Wales alone in the order of € 15 m per annum with similar costs pro rata for other European countries. A conservative estimate that another € 150 m a year can be saved due to improved reporting and monitoring, leading to **€ 300 m a year total savings**.

EC projects

Estimates from EUROSION suggest that additional costs of €285,000 have been incurred because of the lack of good metadata, dissemination mechanisms, and restrictive access conditions, which have caused delays in the project and required the ultimately that downgraded data had to be used so that it could be released by the project owners. The economic costs of this represents some 13% of the database costs of the project, but there are also potentially negative policy implications by the use of downgraded data. In addition, lack of provision for continued data curation and preservation often means that data produced during a project is lost to future projects in the same work area. This experience is common among EC (and national) projects. It would be reasonable to consider that the EC would save between 5-10% of its project costs through better data management, and by not funding parts of projects that require the collection of data already existing.

A list of other projects that would benefit from INSPIRE includes: GMES (€380m); Forest Focus (€90m); Land Parcel Identification system (€300-500m); ESPON (€12m); and CLC/IMAGE 2000 (€10m) (the figures in brackets represent the expenditure on each). This gives a total expenditure of €800m-1.3bn. Data harmonisation would significantly increase the efficiency of these investments. Even assuming a low 5-10% savings, this would be worth **€40-130m or (rounded) €5-15m per annum over 10 years.**

It is important to note that there are many more projects across the EC that would benefit from INSPIRE. For example the GALILEO programme which represents an investment by the Member States, and industry of several billion Euros will need the terrestrial infrastructure provided by INSPIRE to deliver the benefits expected. While the economic assessment of these benefits has yet to be developed, it is worth nonetheless bearing in mind that the ones

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[29] Environmental protection expenditure by industry in the European Union", Eurostat, Statistics in Focus Series, Theme 8 14/2002

[30] Cost study on noise mapping and action planning", COWI report P-44581-W, 1999

identified above are only a very small part of the total across all thematic sectors. The potential efficiency savings would be **many millions € per annum.**

Adoption of the environmental acquis

EU accession countries are undertaking at the present time major efforts to align their legal framework to the Community a*cquis*, of which environmental legislation is one of the most difficult areas. The estimated cost of adopting the Environmental *Acquis* is €80-110 bn over the next 10 years, or €8-11 bn per annum[31]. A reduction in these costs of 5% would be a reasonable assumption. Taking a conservative approach, 0.5% savings, would be worth **€50m a year**. The anticipated benefits should come from efficiency gains when implementing environmental management, monitoring and reporting in the accession countries. Some accession countries like Poland and Hungary recognise this and are planning or preparing the implementation of components of spatial data infrastructures.

Benefits from Extension of INSPIRE to other Sector Themes

Although the emphasis throughout this assessment is on the environmental sector, it may be useful just to give an example of another sector that could benefit from INSPIRE. Network investments make considerable use of GIS. Thus if an improvement in information reduces the costs of the EU programmes there could be significant efficiency savings, e.g. between 1993 and 2000, the European Investment Bank has financed Trans-European Networks transport projects with a total cost of € 144 bn, approving loans for € 43.6 bn of which € 30.5 bn have already been signed. In the Accession Countries, the EIB has signed transport infrastructure loans for € 5.8 bn (source EIB, 2001). If even only 1% of these investments could be saved for example in the analysis stage of evaluating the environmental and economic impacts of these projects, that alone would be worth **€1.4 bn, or € 140 m per annum.**

Duplication of data collection

Data collected for environmental purposes can be useful both for the environment and for other sectors. For example[32] the first CORINE Land Cover inventory for EU15 and the Accession 10 countries is made available at marginal costs for non-commercial use by the EEA at small scale, but the larger scale data is only made available by each contributing institution at national or regional level with widely different conditions. As a result, an industrial user in Germany who needed land cover data for Germany and for all its neighbouring countries to develop a mobile phone network was obliged to address each neighbouring country individually and start negotiations for access to the data. Because of difficulties caused by the lack of a spatial data infrastructure, the user eventually decided that it would be more cost/time effective to simply duplicate the work already done at national level by the different countries. Costs of CORINE land cover mapping for Germany are estimated around €2 m.

Approximately 5- 10 % of the more than 500 requests per year received by the EEA for the reuse of CORINE data could not be solved and are potential cases for duplication of work similar as described above. The cost for producing CORINE land cover for EU25 is €25 m. **€25 m therefore represents a reasonable estimate of annual duplication cost for land cover data.** The SDI State of Play project conducted by the Commission reveals that similar

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31 COM(2001)304 Final

32 based on information from the EEA Information Centre

duplication also occurs for other spatial data sets[33] and for other sectors in most of the EU 25 countries[34]. Given the huge costs of spatial data collection, potential saving are very important and **assuming that €250 m per annum can be saved in the EU25 due to reduction of data duplication is rather conservative.**

8.3.2 Better policy-making, policy- implementation and innovation

A central hope for INSPIRE, focusing as it does on spatial and environmental information, must be that, as a result, policy making in the EU as a whole will be improved. The main policy areas seem likely to be the environment; water resources; transport; communications; and (possibly) waste; agriculture; energy; public safety. Better information and sharing of information is recognised as central to the delivery of the 6th Environmental Action Programme (6th EAP) and in particular to the thematic strategies that have been launched by the 6th EAP.

There are two ways to approach the quantification of benefits: either we can start with a measure of the total current expenditure within the EU on the policy-area in question; or, where this is possible, we can look at estimates of external damage costs, on the European society, economy or the environment which policy making seeks to address, e.g., the cost of residual damage to the environment or to health from harmful emissions to air; the costs of water resources mismanagement (droughts and floods).

Annual expenditure of consumers of environmental goods and services within the EU25 - i.e., on environmental goods and services whose purpose is to measure, prevent, limit, minimise or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems - totals about € 200 billion.[35] We may assume that the environmental improvement achieved is at least as large as the expenditure. Any improvement in the delivery of environmental policy could therefore be extremely valuable.

Risk prevention

A major area that would benefit from the implementation of INSPIRE relates to the prevention, preparedness and response to natural, man-made and other risks and the improved prevention of natural disasters, many of which have social underpinnings (e.g. development in flood-prone areas, deforestation, and so on). Within the EU-15 the relative importance of a number of most frequent types of natural disasters is illustrated by Figure 8.1.

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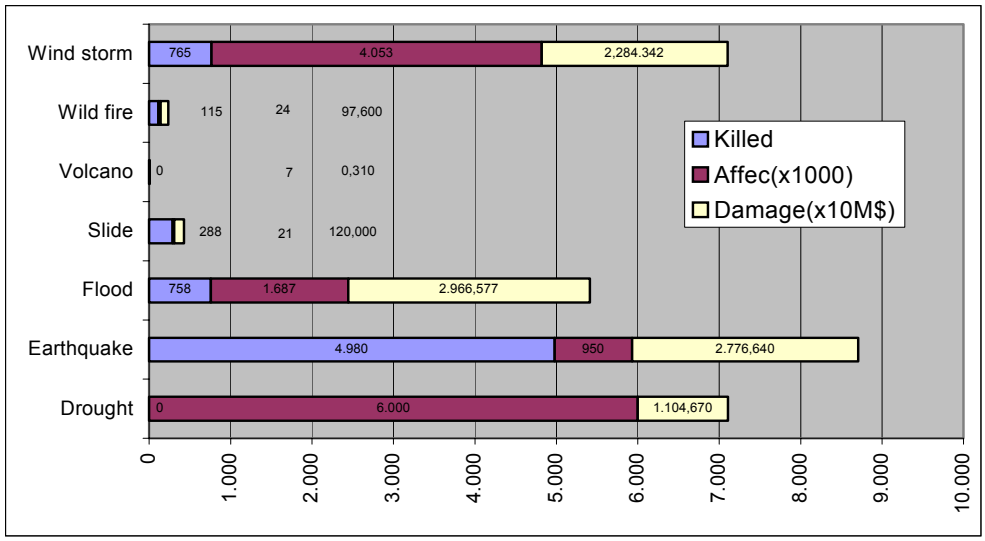
33 Examples are spatial data sets related the data components Addresses, Terrestrial Elevation, Orthophoto-imagery and data, Transport networks, Transmission lines and pipelines, Government service facilities, Trade and service facilities, Settlements, Human health and safety, Surface water bodies/ Hydrography networks, Habitats and biotopes, Species distribution, Water resources and Forest resources

34 In almost all of the 8 countries where a detailed examination of the situation with SDI took place, duplication of data collection has been reported.

35 *Source:* ***Analysis of the EU Eco-industries, their employment and export potential****, a study by Ecotec Consulting Ltd. Available in the Industry/Employment section of http://europa.eu.int/comm/envionment/enveco/studies2.htm. Figure updated to 2003 prices.*

Figure 8.1:Relative Impact of Natural Hazards in EU 15 – 1980-2001 (OFDA/CRED)



Source: The OFDA/CRED International Disaster Database (**EM-DAT: The OFDA/CRED International Disaster Database - www.cred.be/emdat - Université Catholique de Louvain - Brussels - Belgium-)**

The figure indicates damage costs of the order of magnitude of $ 80-100 bn over a 20 year period with over 5000 deaths and some 12 million people affected. Development pressures in Europe, combined with the effects of global warming, are poised to increase the extent of effects in the future. As an example, some very preliminary estimates indicate damage amounting to € 15 bn in Germany, €2 bn in Austria, € 2-3 bn in the Czech Republic and up to € 35 m in Slovakia due to the 2002 flooding (EC internal document).

While much work is needed to integrate risk prevention, mitigation and preparedness throughout the environmental management and planning process, it is important to recognize the potential contribution of early warning and rapid response information systems to this area.

If GMES and INSPIRE had been in place in 2002, it likely that:

- impact scenarios, using modelling based on the various INSPIRE components could have been developed, and mitigation measures taken well in advance, hence, strengthening prevention;
- the preparedness of the civil protection and other competent authorities would have been better, resulting in less loss of life and less deployment costs, i.e. there would have been a more efficient emergency response;
- the costs for recovery/reconstruction could have been reduced or at least the rebuilding would take into account the scenario outputs, hence, avoiding the extensive use of the precautionary principle.

A reasonable estimate of the savings possible would be 2-4%. Combining this with a conservative estimate of € 6-10 bn per annum of potential damage across Europe due to natural hazards, would result in savings of **€120-400 m per annum** and, crucially, lives saved.

Health and environment policy

Better information is at the basis of the approach advocated by the European Health and Environment Strategy[36], allowing the development of new policies that reduce the impact of environmental pollution on health.

Such new policies could, for example, improve the identification of those at risk of asthma and target measures to reduce those risks or 'hot spots'. Across Europe, it is estimated that 10% of children have asthma, with an annual welfare cost, in terms of discomfort, lost schooldays, inconvenience to parents, estimated to cost €5 bn for the UK alone. If this figure is grossed up across the EU-15 (pro-rata to GDP), the total annual cost might be € 35 bn. Even a 1% improvement in policy delivery due to INSPIRE would be worth **€350m a year.**

A study by ECOTEC[37] of the benefits of compliance with the Environmental Acquis in the Accession countries indicated that fully implementing the EU Directives on air quality can lead to 15,000-34,000 fewer cases per year of premature death from exposure to air pollution and between 43,000-180,000 fewer cases of chronic bronchitis. When taken all together the annual benefits of implementing EU environmental legislation range between € 12 and 69 bn. Again if INSPIRE can contribute to the more efficient achievement of a small portion of these benefits, or an increase in them, it will be extremely significant. These are over and above the efficiency savings.

9. BRINGING THE INVESTMENT COSTS AND BENEFITS TOGETHER

The sections above have identified three elements in a cost-benefit calculation: the investment needed by data providers and data users in meeting the requirements of INSPIRE; benefits in the form of increases in the efficiency with which data is either produced or used as a result of INSPIRE; and the benefits related to better policy-making and innovation. These elements are brought together in the following table.

Table 9.1: Summary—investment requirements for INSPIRE (all figures €m)

	EU	National organisations	Regional/local
Harmonisation	2.7	1.8	1
Metadata	0.7	3.5-4	68-70
Data Policy Framework		0.5	
Coordination and implementation including outreach	3	20	100-170
Total investment per annum over 10 years	**6.4**	**26-27**	**170-240**

To ensure that the exercise fully represents the investment needs of INSPIRE, these costs may be **rounded up to €200 - 300m per annum**.

These estimates are at the higher end of the spectrum of possibilities and in practice costs are likely to be lower. One reason for this is that all costs assume full time equivalent staffing costs, plus overheads, of €100,000 per annum. No account is taken of different real; wage rates across the EU-25 or of adjustments on the basis of Purchasing Power Parity.

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[36] COM (2003) 338

[37] ECOTEC 2001: the Benefits of Compliance with the Environmental Acquis, Service Contract for DG ENV B7-8119/2000/159960/MAR/H1

No attempt has been made to make any precise allocation of investment between Member States or between regions, but, taking the higher estimate of €300 m per annum and dividing it equally between 25 member states or 1700 local/regional entities, gives an average annual cost of € 12 m per member state or € 175,000 per region over 10 years.

The cost of INSPIRE may be compared with a base expenditure on INSPIRE-related data which may be roughly estimated at about €5bn a year[38]. The figure of 5bn. may in fact be an underestimate as figures quoted by Rhind (2000) indicates that the expenditure for GI in the US was in the region of $ 4 bn per annum at federal level and $ 6 bn per annum at State and local level, hence a total of $ 10 bn per annum. Given that European data is by and large of higher detail and quality, it is not unreasonable to assume that the European expenditure maybe no less than what is spent in the US. **This would suggests that INSPIRE might add up to 2-3% to total expenditure on geographical information over the period as a whole.**

These costs may then be compared with efficiency improvements; reductions in waste due to unnecessary duplication; and wider benefits. It is suggested that savings equal to the necessary €200-300m a year could quite easily be achieved—the cost savings and duplication savings would need to equal, or exceed 3%, of the current base expenditure on INSPIRE-related data. Equally, the effectiveness of environmental policy would have to improve by only 0.1% to produce a reduction in environmental damage broadly equivalent to the €200m.

The section on benefits includes a number of estimates, though many of the benefits remain to be quantified. Table 9.2 summarises the quantified benefits (i.e. the figures in **bold** in the benefits section).

Table 9.2: Quantified benefits (all figures €m per annum)

Type of benefit	**Quantitative estimates**
More efficient EIAs and SEAs[39]	100-200
More efficient environmental monitoring and assessment	100
More cost-effective expenditure on environmental protection	300
More cost-effective implementation of the environmental *acquis*	50
More effective implementation of EC projects	5-15
More effective expenditure on Trans European Networks	140
Reduced duplication of spatial data collection	25-250
Improved delivery of risk prevention policies	120-400
Improved delivery of health and environment policies	350
Total	**1 190–1 800**

Summing the elements quantified gives a **total of €1.2 to €1.8bn annual net benefits by 2010. Knowing that these elements only represent a partial view of the whole picture, the conclusion is that the benefits outweigh the investment requirements by a considerable amount**.

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38 A study for the EC by PIRA (2000) gives an estimate of total annual investment in all Public Service Information of nearly € 9.5 billion. This includes financial and business information and other non-INSPIRE information, but 40-60% of the total seems to be GI. It is clear, however, that the PIRA coverage of environmental data is incomplete covering, for example, only government expenditure and excluding organisations such as the England and Wales Environment Agency.

39 Environmental Impact Assessments and Strategic Environmental Assessments as required by Directive 85/337/EEC and Directive 2002/41/EC, respectively.

9.1 Phasing of costs and benefits

Like any infrastructure project, the costs will be front-loaded because they are needed to build the infrastructure, and connect those elements that already exist. Once the infrastructure is in place, the cost will diminish significantly because what is needed is maintenance and gradual expansion. In addition, there are specific costs relating to INSPIRE which are one-off with respect data sets (e.g. specifying common data set standards and translating existing data sets to the new standard) which, once incurred, do not reoccur. However, the benefits, in terms of interoperability, continue for many years, if not for ever. As a result, although the investment in INSPIRE need to start straight away and the benefits only start to accrue during the implementation period, by the end of this period (2015) the savings generated by the use of the INSPIRE infrastructure will more than pay for the on-going maintenance costs. Moreover, as INSPIRE is extended to other policy themes, the additional investment required will be marginal as much of the core infrastructure will already be in place, while the benefits will be of an equivalent magnitude to those accruing in the environmental sector.

10. SOCIAL BENEFITS

The European Union has the aim of making Europe the 'most competitive and knowledge-based economy' by 2010. This will depend on uptake of access to the Internet by citizens, but this is already at 40% of households and most countries have programmes to provide public access to the Internet, for example, via libraries, Internet cafes or Internet kiosks in supermarkets. This wider access to the Internet has led to new initiatives aimed at increasing public access to data and information. Notable among these is the UN-ECE 'Aarhus' Convention, which has strengthened the links between access to information, public participation in environmental decision-making and access to environmental justice.

INSPIRE will ensure overall coherence and ease of use of the spatial data underpinning the information made available to citizens under the UN/ECE Aarhus Convention. The resulting better information of the citizen will lead to increased confidence in the accuracy and relevance of public sector information, leading to more engagement in the democratic process of environmental protection and, eventually, in other areas of government action. More specifically, in the environment field, INSPIRE will benefit citizens across Europe by:

- providing access to operational data and information held by public sector organisations to enable people to reach their own judgements about environmental issues in line with the first principle of the Aarhus Convention (Article 5) (and eventually other thematic issues);

- facilitating participation in environmental decision-making in line with the provisions of the second principle of the Aarhus Convention (Articles 6,7 and 8) as adopted in the proposed new EU Environmental Information Regulations;

- assisting in providing access to environmental justice, in line with the third principle of the Aarhus Convention (Article 9) and the European Convention on Human Rights

INSPIRE will also benefit citizens in facilitating access to high quality information about the environment that assists in making key decisions, such as home buying. Examples of the kind of information relevant to purchasing a house, include the likelihood of flooding, whether or not the house was built on contaminated land, the proximity to sources of noise, or if there is a polluting or noxious industrial process nearby. Whilst some of these services already exist in some countries, INSPIRE will facilitate the extension of such services by the public or private sector across the whole of the Union, so that decisions on whether or not to purchase can be

made with full knowledge of the environmental risks. When extended to other sectors, INSPIRE will eventually help provide a range of information relevant to house purchases, such as transport, health care, education facilities, shops, etc that will directly help raise the quality of everyday life for the people of Europe.

INSPIRE will also enable public sector information to be exploited by the private sector, in line with, and complementing, the provisions of the forthcoming Directive on the Re-use and Exploitation of Public Sector Information (PSI). INSPIRE will enable the private sector to 'discover' public sector data, thereby stimulating the creation of added value services useful to the public. INSPIRE will furthermore allow the private sector to publish their data along with the public sector data, provide to public and private organisations a wider choice of data to underpin their activities.

Furthermore, these impacts will undoubtedly lead to the creation of new high-quality employment, as has happened in the US.

10.1 Winners and losers

The investment needs of INSPIRE will to a large extent be borne by the public sector whereas most categories of stakeholders stand to gain as a result of the implementation of INSPIRE:

- *Regional and local authorities:* one of the largest impacts of INSPIRE will occur at the regional and local level, which is the level where many Community policies, in particular in relation to the environment, are implemented or having their effect. As INSPIRE will take into account the available information and needs at local and regional level, regional and local authorities as a group will attract most of the benefits but will also need to make the largest investment in INSPIRE. However, the required investments at the regional and local will be lower than if INSPIRE would not be in place due to increased funding opportunities, greater facility to adopt established standards, specifications, and best practice, and support that will be provided in the context of the implementation of INSPIRE. As users of data sets partly collected internally and partly provided by third parties, the benefits to regional and local authorities arise from avoiding duplication; increased efficiency of locating existing data; and increased efficiency by using data that is available when carrying out public tasks (in the absence of the metadata, such data would be not be used and the public tasks would be carried out without it or require duplication of collection). Moreover, the investment made to build the INSPIRE infrastructure will also support the delivery of e-government services because the largest proportion of the investment is in capacity building and coordination, and therefore will yield wider benefits.

- *National authorities and data providers* will be beneficiaries in terms of gains in efficiency and in terms of the potential for improvements in policy performance. They will however also have to attribute the necessary resources for making INSPIRE happen. Whether authorities or providers are net contributors or beneficiaries will depend on a number of factors, e.g. the extent to which the organisation is both user and producer, the degree of standardisation already achieved etc.

- *Citizens, private sector data users, research institutes:* these stakeholders will be mainly beneficiaries of INSPIRE. The benefits for these organisations arise from having (potential) access to existing data. Private sector data users and research institutes will reduce their search costs and reduce costs of data collection, even if they do not expand their output. Private added value resellers will find it easier to develop new services, to the benefit of the society as a whole.

- *Also EC and international bodies* are likely beneficiaries since INSPIRE will reduce the costs of analysing pan-European information for policy making and policy implementation purposes, but will need to invest in the delivery of INSPIRE and in the support and monitoring of its implementation. Academic institutions (and similar) are also likely to be beneficiaries.

It should be noted that investment needed for INSPIRE will not be distributed evenly over the Member States. Some Member States are further advanced in building their spatial data infrastructure than others and the same is true for the accession countries[40]. Their investment requirements will therefore be comparatively lower although it is at the regional and local level that most investment is still required.

11. POSSIBLE WIDER DISBENEFITS AND RISKS

Consideration needs to be given to whether there might be any possible adverse effects of INSPIRE. Such adverse impacts might include: loss of national focus; confusion as a result of the imposition of external requirements; increased bureaucracy; market distortion, unfair competition, and so on.

No attempt has been made to assess the likelihood of these disbenefits. All that can be said is that policy-making and implementation should be conducted in the light of these possibilities, and so should seek to implement policy in ways which do not give rise to these costs.

Implementation of INSPIRE also has inherent business risks, which need to be managed carefully in order to optimize INSPIRE's benefits. Important challenges will be achieving a shared understanding of the mutual benefits of harmonised policy frameworks, the organisation of direct funding for the INSPIRE initiative, the consistent implementation of INSPIRE across the Member States, the engagement of the thematic stakeholders and the availability of skills at the local level. These and other risks to INSPIRE implementation are summarised in Table 11.1.

[40] See www.ec-gis.org/ginie and the Sate of Play projects for example.

Table 11.1: Risk log for INSPIRE

Number	Risk	Probability	Impact	Counter Measure
1.	Finance not available to implement INSPIRE across all Member States	H	H	Binding legislation needed Make use of existing funding sources, e.g. GMES, Structural Funds Ensure that INSPIRE has sufficient funding
2.	Emerging technology timescales not in line with proposals	L	M	Technology is already proven
3.	Other sectors ignore INSPIRE	H	M	Binding legislation needed, MOU between Directorates and adopt stepwise approach
4.	Unharmonised implementation of INSPIRE	M	H	Binding legislation needed, Closely monitor INSPIRE implementation and adopt corrective measures in case of problems
5	Only partial engagement of thematic stakeholders in INSPIRE	H	H	Binding legislation needed, Build up solid co-ordination and outreach measures
6	Lack of agreement on policy frameworks	H	H	Binding legislation needed
7	Lack of skilled personnel at regional and local level	H	H	Dedicated measures for education and training required.

12. HOW TO MONITOR AND EVALUATE THE RESULTS AND IMPACTS OF THE PROPOSAL AFTER IMPLEMENTATION

This is clearly a critical component that will be addressed by provisions for monitoring and reporting. Given however, the complexity of measuring the impacts of initiatives such as INSPIRE, and the dearth of reliable data on this subject across the world, it would be worth considering a specific INSPIRE accompanying measure, possibly to be funded through the Framework 6 R&D Programme, that brought together some of the key stakeholders with representatives from data producers, users, research, and a sample of national and regional governments, to monitor the incurred costs and benefits as they happen through the implementation of INSPIRE. This would provide a much-valued set of information and data to evaluate impacts, support the extension of INSPIRE to other policy areas, as well as the analysis of impacts in related fields.

13. STAKEHOLDER CONSULTATION

The extended impact assessment was carried out by closely involving key stakeholders through the FDS working group. In addition to the information provided by the previously established working groups, the FDS working group has brought together a wealth of case studies and expert views on the basis of which the extended impact assessment was drawn up.

The INSPIRE FDS Working Group issued questionnaires with targeted questions on the impact of INSPIRE to specific user groups including the other INSPIRE Implementing strategy working group, the research community (AGILE), the private sector and local/regional administrations.

Furthermore, the INSPIRE State of Play project held face-to-face interviews with key stakeholders in 8 countries where impacts of INSPIRE have been discussed.

All this was taken into account in formulating the extended impact assessment.

13.1 INSPIRE Internet consultation

During 2002, the development of INSPIRE has been discussed in several INSPIRE working groups. Input from these groups[41] has been discussed by the INSPIRE Expert group and has been consolidated into an INSPIRE Internet consultation document[42].

The Internet consultation took place from the end of March 2003 until 6 June 2003. The INSPIRE Internet consultation document listed the issues that are addressed in the Extended Impact Assessment.

13.2 Public hearing

In addition to the Internet consultation on the proposed INSPIRE policy measures and in addition to the regular consultation of the INSPIRE expert group, a draft extended impact assessment was made available as input to a public hearing in which 39 persons took part.

Most of the comments made at the public hearing related to the INSPIRE proposal or its implementation and will be taken into account by the Commission. However, the following comments related specifically to the extended impact assessment of INSPIRE, of which the methodology and quality were otherwise supported: the costs of metadata collection are over-estimated, the significant benefits of INSPIRE for the property market have not been analysed, there is too much focus on public sector data and there is no breakdown of the benefits across the different levels of government.

The remarks on the over-estimation of certain costs and the underestimation of a number of benefits are accepted, as this reflects the approach deliberately adopted for the performance of the extended impact assessment. However, the extended impact assessment now emphasises more clearly that the quantitative assessment of benefits does not present the whole picture. The remark on the focus on public sector data has been taken into account in the formulation of the INSPIRE proposal for a Directive. As explained at the hearing, the lack of breakdown of benefits across the different levels of government is linked to the general difficulty of estimating benefits due to the wide range of actors that will benefit from INSPIRE.

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41 See Position papers in http://inspire.jrc.it/

42 See Internet consultation in http://inspire.jrc.it/

Annex 1: INSPIRE Data Components

1.	Geographical location
1.1	Geographical reference systems
1.2	Geographical names
1.3	Geographical grids
2.	Administrative units
2.1	Official administrative units
2.2	Government management zones
2.3	Blocks, census and statistical districts
2.4	Civil security units
2.5	Environment management & reporting units
2.6	Postal codes/regions
3.	Properties, buildings and addresses
3.1	Properties
3.2	Buildings
3.3	Addresses
4.	Elevation
4.1	Terrestrial elevation
4.2	Bathymetry
4.3	Coastline
5.	Geo-physical environment
5.1	Geology
5.2	Geo-morphology
5.3	Soil
6.	Air and climate
6.1	Air and atmospheric conditions
6.2	Meteorological spatial features
6.3	Climate zones
7.	Hydrography
7.1	Surface water bodies
7.2	Water catchments
7.3	Groundwater bodies/aquifers
8.	Ocean and seas
8.1	Oceanographic spatial features
8.2	Sea regions
9.	Biota/biodiversity
9.1	Biomes/ Bio-ecological regions
9.2	Vegetation
9.3	Habitats and biotopes
9.4	Species distribution

10.	Land surface
10.1	Land cover
10.2	Landscape
10.3	Orthophoto-images
10.4	Unclassified satellite data
11.	Natural resource
11.1	Ecosystem resources
11.2	Water resources
11.3	Agricultural land and soil resources
11.4	Forest resources
11.5	Fishery resources
11.6	Geological resources
11.7	Renewable energy resources
12.	Transport
12.1	Transport networks
12.2	Transport services
13.	Utilities and facilities
13.1	Transmission lines and pipelines
13.2	Government service facilities
13.3	Production and industry facilities
13.4	Agricultural and aquaculture facilities
13.5	Trade and service facilities
14.	Area regulation
14.1	Land use plans
14.2	Protected sites
14.3	Area restriction/regulation zones
15.	Natural and technological risks
15.1	Natural risk vulnerability zones
15.2	Technological risk vulnerability zones
15.3	Technological accidents and natural disasters
16.	Areas under anthropogenic stress
16.1	Polluted areas
16.2	Noise and radiation zones
16.3	Areas of intensive exploitation
17.	Society and population
17.1	Urban and rural settlement
17.2	Demography
17.3	Human health and safety
17.4	Governmental services
17.5	Cultural heritage
17.6	Natural amenities

Annex 2: Examples of European policies that would benefit from INSPIRE

Legislation

•Council Directive 79/409/EEC on the conservation of wild birds

•Council Directive 90/313/EEC on the freedom of access to information on the environment

•Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources

•Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora

•Decision No 1692/96/EC on Community guidelines for the development of the trans-European transport network

•Council Regulation (EC) No 1638/98 amending Regulation No 136/66/EEC on the establishment of a common organisation of the market in oils and fats

•Council Regulation (EC) No 1257/1999 on support for rural development from the European Agricultural Guidance and Guarantee Fund (EAGGF) and amending and repealing certain Regulations

•Commission Regulation (EC) No 1750/1999 laying down detailed rules for the application of Council Regulation (EC) No 1257/1999 on support for rural development from the European Agricultural Guidance and Guarantee Fund (EAGGF)

•Regulation (EC) No 1783/1999 on the European Regional Development Fund

•Council Decision No 1999/126/EC on the Community statistical programme 1998 to 2002

•Decision No 1445/2000/EC on the application of aerial-survey and remote-sensing techniques to the agricultural statistics for 1999 to 2003

•Council Regulation (EC) No 1593/2000 amending Regulation (EEC) No 3508/92 establishing an integrated administration and control system for certain Community aid schemes

•Directive 2002/49/EC relating to the assessment and management of environmental noise

•Directive 2000/60/EC establishing a framework for Community action in the field of water policy

•Decision No 1600/2002/EC laying down the Sixth Community Environment Action Programme.

Communications*•COM(1998) 605 Sustainable urban development in the European Union: a framework for action*

•COM(1998) 806 Cohesion and transport

•COM(1999) 22 Directions towards sustainable agriculture

•COM(2000) 20 Indicators for the integration of environmental concerns into the common agricultural policy

•COM(2000) 545 Recommendation concerning the implementation of Integrated Coastal Zone Management in Europe

•COM(2000) 547 on integrated coastal zone management: a strategy for Europe

•COM(2000) 597 Europe and Space Turning to a new chapter

•COM(2000) 855 amending Regulations No 136/66/EEC and (EC) No 1638/98 as regards the extension of the period of validity of the aid scheme and the quality strategy for olive oil

•COM(2000) 1100 laying down guidelines for a Community Initiative concerning economic and social regeneration of cities and of neighbourhoods in crisis in order to promote sustainable urban development (URBAN II)

•COM(2000) 1101 laying down guidelines for a Community Initiative concerning trans-European

•COM(2001) 144 Statistical Information needed for Indicators to monitor the Integration of Environmental concerns into the Common Agricultural Policy

•COM(2001) 264 A Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development

•COM(2001) 609 Global Monitoring for Environment and Security (GMES) - Outline GMES EC Action Plan (Initial Period: 2001 – 2003)

•COM(2001) 718 Towards a European Space Policy

•COM(2002) 179 Towards a Thematic Strategy for Soil Protection

•COM(2002) 404 monitoring of forests and environmental interactions in the Community (Forest Focus)

Annex 3: Case Studies

Case Studies

- ACACIA (UK)
- AIRPHOTO (Finland)
- Cable and Wireless Global Marine (UK)
- CORINE Land Cover
- Disaster Management – Flooding (Hungary)
- Disaster Management – Logwater (Hungary)
- Environment Agency Intranet (UK)
- Environmental Risk Assessment (UK)
- Eurogeosurveys Data Survey
- EUROSION
- Funding a Spatial Data Infrastructure (UK)
- Geospatial One Stop Shop
- GETIS
- GIS at the Environment Agency in Wales (UK)
- GISU (Bos)
- Green Flag (UK)
- Impact of INSPIRE on EIAs and SEAs
- Joined-up Government in Scotland (UK)
- LabGIS
- MAGIC (UK)
- MIDAS
- Monitoring and Combating Noise Pollution (UK)
- National Cartographic Portal (IT)
- National Land Information System - NLIS (UK)
- NGII (Netherlands)
- NYMAP (US)
- OS MasterMap (UK)
- Piemonte (IT)
- Prague Environment Atlas (CZ)
- RSIP (Poland)
- Space for Geo-Information
- State of Maryland (US)
- TERRIS
- Tisza Basin
- Unemployment (CZ)
- UpMyStreet (UK)
- Water Supply Industry (UK)
- What's in Your Backyard ? (UK)
- Wilderness Map

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Glossary

Aarhus Convention
UN ECE Convention on access to information and other rights in environmental matters adopted in 1998. The EU and all Member States have signed it.

Access / View / Download / Reuse
Access is the process of connecting a user with the data set to be used. *Viewing* is the ability to see, either in hard copy or onscreen, a portrayal of data and information which has been accessed in its original form but which may be presented differently (e.g. in map format). *Download* is the electronic transfer of data or information from a source computer to the user's computer so that they may be managed locally. *Re-use* implies the commercial or non-commercial utilisation of data or information for the benefit of third parties.

AGILE
The Association for Geographic Information Laboratories in Europe; the leading European academic body within the GI community. www.agile-online.org

Architecture
The models, standards, technologies, specifications and procedures used to represent, transform and generally accommodate the integration, maintenance and use of information in digital format.

Catalog, Catalogue
Structured information designed to locate geospatial data based on their characteristics expressed in metadata. Catalog services (also called *clearinghouse*) are services designed to help users of application software to find information that exists anywhere in a distributed computing environment.

Co-decision
The process by which the principal elements of EU government (Council, Parliament and Commission) agree on actions.

CORINE
A multi-national European land cover data set at scales from 1:100,000 to 1:1,000,000.

Coverage
The OGC defines coverage as a feature that associates positions within a bounded space to feature attribute values.

Data component, data set
Refers to the specific content subject definition of data; may consist of several data sets, but be a part of a database.

Directive / Regulation
In broad EU Framework, a *Directive* sets out the objectives which it requires Member States to achieve, but leaves the detail of how this should be done to the Member States. A *Regulation* specifies both the objective and the means. (see also *Framework Directive*).

Dublin Core
Widely used Metadata standard promoted by the Dublin Core Metadata Initiative. www.dublincore.org

Elevation
Vertical height above a theoretical earth's surface base. *Altitude* is the synonymous term used in the US Federal Information Processing Standard 70.1.

EAP
Environmental Action Programme

ETRS89
European Terrestrial Reference System (1989). A geodetic reference system.

EU25
The fully enlarged European Union, i.e. the present fifteen Member States plus the ten Accession Countries, which will become full Members in May 2004.

EVRF2000
European Vertical Reference Frame (2000)

Feature
The abstraction of a real-world phenomenon; a set of points, lines or polygons in a spatial database that represent a real-world entity.

Fitness-for-purpose
A measure of quality suitable and sufficient for the general purposes for which data and information are prepared. May be conceptually and legally synonymous with "satisfactory quality" and relate to issues of liability and certification.

Framework Directive
A legal instrument which describes broad objectives used as preparation for more specific and prescriptive follow-up legislation.

Gazetteer
A geographical index or look-up table which retrieves the geometries for one or more features. It may apply to a region, a country or some other specialised group of features.

GINIE
Geographic Information Network in Europe. An EC-funded project involving EUROGI, the umbrella organisation for GI organisations in Europe, the Open GIS Consortium and the EC's Joint Research Centre. www.ec-gis.org/ginie

GMES
Global Monitoring for Environment and Security, an EC initiative associated both with INSPIRE and the European Space Agency.

Infrastructure for spatial information
See Spatial Data Infrastructure

Interoperability
The ability of two or more systems to operate in conjunction with each other; the coherent exchange of information and services between systems.

ISO
The International Organisation for Standards. A world-wide federation of national standards bodies. The ISO Technical Committee 211 (ISO TC211) is responsible for GI matters, standards for which are numbered from 19nnn. http://www.isotc211.org/

Licence, licensing
Agreement on the terms and conditions under which data and information that are the subject of IPR may be supplied and used. May be explicit and formal or implicit and informal.

Metadata
Data about data. Summary information or a description of the characteristics of a set of data; the information and documentation which makes data understandable and sharable for users over time.

NGO
Non-governmental organisation

NUTS
Nomenclature of Territorial Units for Statistics. The classification has five main divisions ranging from national to municipal in scope.

OGC
The Open GIS Consortium, comprising more than 250 organisations, agencies and universities worldwide dedicated to defining and developing standards to allow different GIS software components to work together (see also Interoperability) www.opengis.org

Portal
A portal is a website that gives selected and evaluated links to other websites.

Portrayal
The presentation of information to humans, e.g. a map. A map is a two-dimensional visual portrayal of geospatial data, but it is not the data itself.

Schema
Common data definition which underpins transactions and processes that involve the interchange of data

Spatial Data Infrastructure (SDI)
The relevant base of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data. Equivalent to Infrastructure for Spatial Information

Standards
Documented agreements containing technical specifications or other precise criteria to be used consistently as rules, guidelines or definitions of characteristics to ensure that materials, products, processes and services are fit for their purpose.

Subsidiarity
A principle intended to ensure that decisions are taken as closely as possible to those most affected by them.

Thematic data
Application-specific data such as environmental data