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# The Spatial Data Infrastructure of Spain as an example of success in Europe[*]

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# THE SPATIAL DATA INFRASTRUCTURE OF SPAIN AS AN EXAMPLE OF SUCCESS IN EUROPE.

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## 1. Geographic Information data variety.

Spanish geographic data production is mainly oriented to fulfil the management needs of good governance. However, we can divide it into three levels of geographic data producers in Spain:

**● National Level: Government of Spain.**

The National Government is composed of 17 Ministries. Many of them are geographic information producers (Infrastructures and Transports (IGN-E (National Mapping Agency), CNIG-E (National Centre of Geographic Information), Economy and Finances (Cadastre, National Statistical Institute (INE-E)), Environment-Agriculture-Sea, , Defence, Science and Innovation (Geological Institute of Spain (IGME), Scientific Research Council), Industry-Tourism-Commerce, Housing, etc.

**● Regional Level: 17 Autonomous Regions + 2 Autonomous Cities (Ceuta and Melilla)**

Every Regional Government or Autonomous City Government is composed of Departments. Most of them are also Geographic Information producers on their territories and in many cases there is also a Regional Mapping Agency.

**● Local Level: There are more than 8 100 Municipalities (Local Authorities), 43 Provinces Governments and 10 Island Governments (Balears and Canary Islands).**

The biggest cities and more populated local authorities are also producing and managing GI on their territory.

## 2. The need for harmonisation.

Today, official and private geographic data are used by public, private sectors and citizens in different applications. To manage geographic information coming from

different data producers implies complex and expensive processes to transform and to load it into our own GIS system according a data model different from the original one.

A simpler and less expensive way is to use interoperable web services provided by other organisation. This can be performed using directly these services or adding these services as new links in our GIS system service chain. The correct technological solution to manage these interoperable web services is Spatial Data Infrastructures (SDI).

But in order to get the best from SDI technologies the two key components are:

      ▪ Interoperability

      ▪ Harmonisation

Interoperability is based on standards and common specifications. That means that cooperation, agreement and sharing are needed. To solve data harmonisation governments have two solutions:

▪ On one hand it is to collect all the geographic information in a government wide GIS, ensuring harmonisation to assure data integration and homogeneity in order to supply GI (geographic information) ready to be used by users in their systems. This is quite a complex process, particularly when different governmental levels have varying competence in geographic data.

▪ On the other hand, the solution is to cooperate in order to harmonise GI produced by different authorities or to produce GI jointly, shared and co-owned by several authorities in order to fulfil their requirements ensuring it is unique to their needs.

As an example, experiences from Spain are provided below:


● The National Plan for Aerial Orthophotography (PNOA) is a project proposed by the National Geographic Institute to National Government Ministries orthophoto´s users and to the Regional Government agencies producing orthophotos to fulfil the regional needs. The PNOA project is performing and periodically updating the coverage of Spain by aerial photography, high resolution digital Orthophotography at 50 or 25 cm resolutions, depending on the area, every two years. It also is responsible to obtain a high precision and high resolution Digital Elevation Model, as a whole.


This type of digital orthophotography is precisely the type which organisations and official bodies involved in the Project are obtaining, even though it is done in an uncoordinated way.

The coverage must be obtained through collaboration, regulated by the corresponding Agreements, between the Offices and Departments of the Region Governments responsible for orthophotography production, and the Ministry of Infrastructures and Transports, though the National Geographic Institute, and also among the different organisations and official bodies of the National Government who will be the users of these orthophotos.

These Regional Government Offices shall be the official production or contracting bodies of the works for the photogrammetric flight to be carried out, for the creation of the model and for the orthophotography. They must also assume responsibility for the management of the contracts, which will be carried out according to the agreed specifications among all the project participants, and the quality control of the works carried out in their territorial area. The IGN-E carries out the general project coordination, the final quality control step and the integration of the resulting data.



*Figure 4: Natural color ortho-photo with 50cm spatial resolution*

Financing is shared among National and Regional Governments:

- 66% National Government
- 34% Regional Governments

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● The Information System of Land cover/Land use in Spain (SIOSE). The objective of this project is to produce a land cover/land use database in a cooperative way between the national and the regional administrations with the following

characteristics: Nominal scale: 1:25.000; minimum mapping unit: 1 ha for urban areas and 2 ha for other areas with some exceptions for particular classes of special interest: humid areas, beaches, riverside vegetation; updating period of 5 years (although it is being considered to update urban areas annually); based on satellite (SPOT5) and orthophoto (PNOA) images produced; common data model object oriented (UML description), multiparameter, multilevel, extensible (for particular needs).
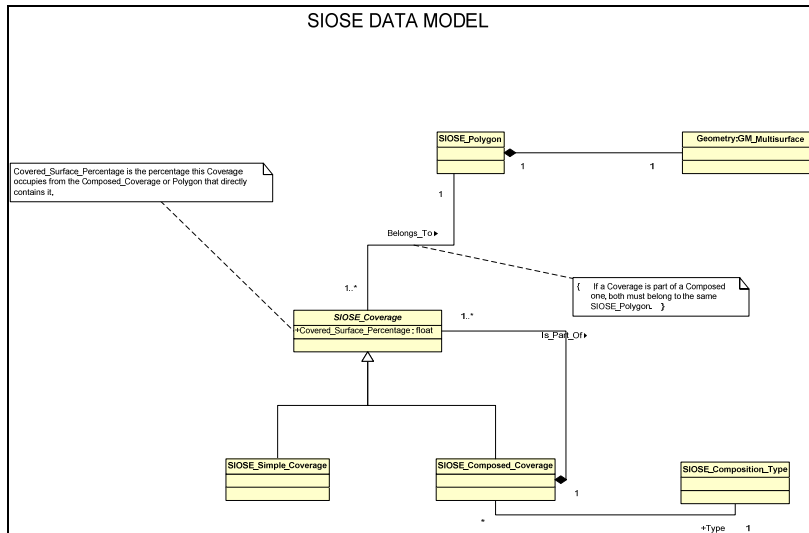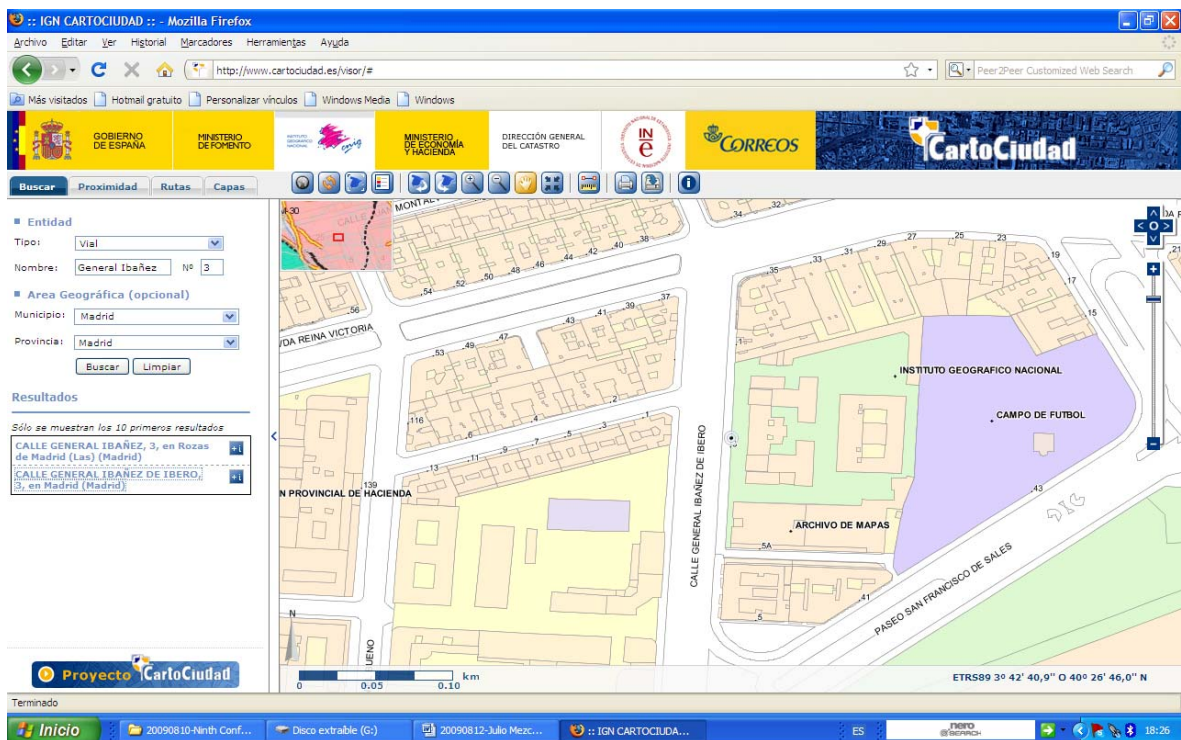


*Figure 5. SIOSE core data model*

Funding of the project is based on:

- 66% National government:
- 34% Regional governments

● Topographic Databases harmonisation between 1:5.000 or 1:10.000 Regional Governments databases and 1:25.000 National Topographic Database produced by IGN-E. This implies searching for a common data model and procedures, data model transformation to use the previously produced databases and generalisation. Today this common harmonised production is under testing and some case, under production with several Spanish regions.

● CartoCiudad database production and updating. CartoCiudad is an official cartographic Data Base of the Spanish cities and villages and their streets and roads networks topologically structured, with spatial continuity all over Spain. This project,

which has vocation of becoming the "official" streets Database of the National Government of Spain, is the result of harmonization and integration of official digital mapping and information produced by several of the main sources of Geographical Information in de National Government of Spain. The CartoCiudad Database allows the carrying out of the following operations: direct positioning (Geocoder Service); inverse positioning (Reverse Geocoder Service); seamless urban and rural aereas displaying; routing and GIS analysis. CartoCiudad data sources are: transport network and population entities from the IGN-E´s Numeric Cartographic Data Base (BCN25); tehe General Directorate of Cadastre´s cartographic information from the Real Estate Cadastre, especially those related to the urban area; the Electoral Census maintained by the Statistical Office (National Institute of Statistic-INE); the Post Office´s Streets Database in relation to postal codes.

# 3. The IDEE Project (National Spanish Spatial Data Infrastructure). Organisational aspects.

Both interoperability and harmonisation are obtained by defining a Spatial Data Infrastructure as a collaborative project based on cooperation and agreement among different actors. When they set up a National Spatial Data Infrastructure (NSDI) it must involve a national stakeholder's national, regional and local governments, academia, companies, and also individual citizens, opening geoportals that publish and shares web OGC services and complementary resources. The NSDI Geoportal needs to be a key resource and an effective leverage providing visibility to all available SDI implementations, contributing to the creation of a healthy competitiveness, stimulating technological innovation showing new developments in every geoportal or node, as a sort of on-line demonstration, taking advantage of the official corporative image from the main actors at every governmental level. In conclusion, the goal is to set up a true GIS on Internet, fully distributed, offering services and functionality based on the interoperability of standardized resources spread over the Internet.

In Spain, the solution adopted to harmonize GI has been the implementation of a NSDI.

The Spanish NSDI **(www.idee.es)** is a SDI composed of many SDIs. Region and Local Governments need to set up their own regional/local SDI and geoportal, giving access to data and service servers at Regional Departments, Local Authorities, Public and Private Companies, and Academic territories. At national level some Ministries public and private companies need also to set up Internet data servers, metadata catalogues, and GI web services.

The National Geographical High Council ("Consejo Superior Geográfico") is the governmental collegiate body appropriate as a Public Authority in Spain to define and set up the NSDI (in Spanish: IDEE for Infraestructura de Datos Espaciales de España) and its national Geoportal. This is an advisory collegiate body relying of the Ministry of Infrastructures and Transports, which technical secretariat is held by National Geographic Institute and whose members are representatives from the three government levels of Spain.  It was established by Art. 9 Law 7/86 for Cartography in Spain and its rules were updated by the Royal Decree 1545/2007.

Its members are:

- President: Undersecretary of the Ministry of Infrastructures and Transports

- First VicePresident: Director General of National Geographic Institute
- Second VicePresident: Director of Hydrographic Institute of the Navy
- Third VicePresident: Director General of the Cadastre
- Representatives from Ministries: Foreign Affaires, Public Administration, Economy & Finances (Cadastre, National Statistical Institute), Environment, Agriculture, Interior (State Civil Defence Office), Defence, Science and Innovation, Industry, Tourism and Commerce, Justice, Education.
- 17 Representatives from every Regional Government
- 6 Representatives from Spanish Federation of Provinces and Municipalities (Local Authorities)

On April 2002 the National Geographical High Council (NGHC) established the commitment to its Specialized Commission on SDI as Executive Board to define and set up the NSDI (IDEE).

The Specialized Commission on SDI works through a Working Group established November 2002, and it is reporting and advising to the NGHC. The Working Group´s members are technical experts representing NGHC members: geographic data producers, academia and companies dealing with catalogue services and data services, etc. It is open to all relevant actors actually involved in the process and having some activity in this field: data producers, software companies, universities, governmental bodies, up to more than 300 individual members. Its main objective is to develop a Spanish project joining initiatives according to a decentralised and transparent framework, based on data harmonisation and interoperability. The Working Group is developing IDEE under the INSPIRE principles and according its rules. WG IDEE organizes three meetings per year and one technical workshop, from 2010 the technical workshop will evolve into a Iberian Congress on SDI (Spain, Portugal and Andorra), and produce recommendations based on electronic revisions and consensus of several items: Minimum services to be implemented in a SDI, Spanish Metadata Core of ISO19115 (NEM), Spanish Model for Gazetteer (MNE) and how to implement WMS. All of them are available at www.idee.es.

## 4. The IDEE Project funding.

The NGHC´s IDEE is funded by the Government of Spain using the National Geographic Institute (IGN-E) budget (State General Budget). IGN-E annual expenses in implementation & maintenence IDEE Geoportal are 1.5 M€/year (2006-2008)..

At the National Government level the main agencies managing GI production, such as IGN-E, Ministry of Environment and Agriculture, Ministry of Science and Innovation, Ministry of Industry and Cadastre, fund their own IDEE nodes or portals. Regional SDIs, and partially IDEE, are funded by Regional Governments. That is the situation in the Regional Governments of Cataluña, Aragón, La Rioja, Navarra, Basque Country, Cantabria, Asturias, Galicia, Castilla y León, Castilla-La Mancha, Valencia, Murcia, Andalucía, Islas Baleares, Canarias and Extremadura. Every day more Local Authorities are developing and funding Local SDIs.

Every agency assumes its own data harmonisation expenses. In multilateral or bilateral projects the expenses are shared by partner agencies. The harmonisation expenses must also be taken into account.

## 5. The IDEE Geoportal.

Figure: The IDEE Geoportal

The IDEE Geoportal was opened on 2003 December as a provisional beta version, the first version appeared in July 2004, and the second version with a new interface dated from 2005. Today it is available in 7 languages (Spanish, English, Basque, Galician, Catalan, Portuguese and French) and it implements 9 different OGC specifications (WMS, CSW, Gaz, WMC, WFS, WCS, WCTS, WPS and SLD), in a chainable and usable way.

The main characteristics of the services and application of the Geoportal are:

- The **Gazetteer** service is based on a database of more than 500,000 geonames, and is implemented as a WFS using the Spanish Gazetteer Model (MNE), a conceptual model for geonames defined by WG IDEE, including some key attributes (language, source and etymology), and allowing several names for the same feature.

- The **Map Viewer** access directly to more than 500 services throughout Spain offering more than 6.500 layers, classified as reference data at the three levels of government (National, Regional and Local), thematic data and other non official data, following the INSPIRE annexes classification.
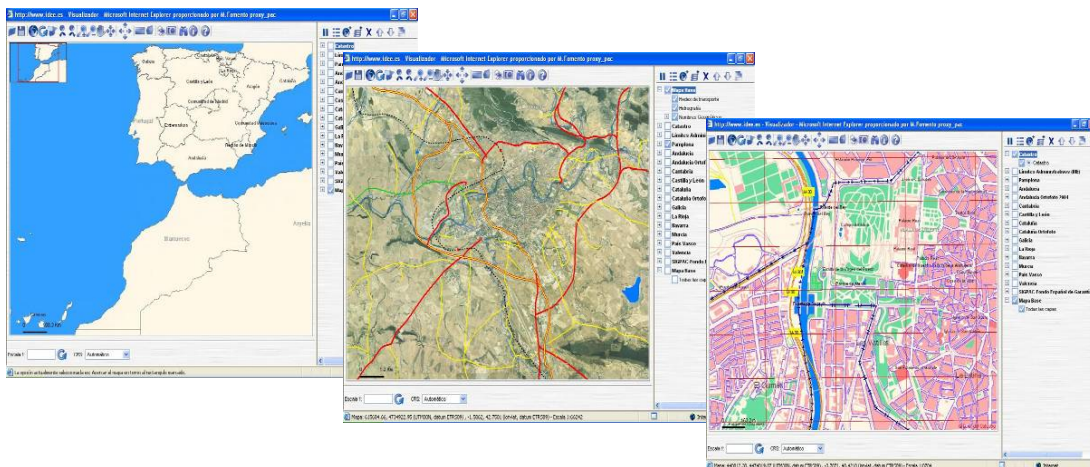


Figure 2: Examples of Map Viewer

- **Catalogue** service allows search and selection in a metadata database, describing more than 40,000 datasets produced by IGN and the Catalonia Cartographic Institute. We are trying now to organize a distributed catalogue harvesting the XML files via FTP collection as a first tentative solution to a distributed catalogue.

- A **Catalogue Service of Services** allows the searching of captured on-line descriptions from Capabilities information about OGC services available in Spain, and provides the address to bind them.

-**Data Download:** It is possible to freely download some general and basic reference data in GML format: Administrative Boundaries of Spain at three scales, Geodetic Networks and a Euroglobal, Map Data Base at 1:1,000,000.

- There are also two simple examples of **remote sensing analysis**: a Corine-Land Cover analysis utility, based on WFS and offering a statistics about land uses in each municipality; and a DTM analysis application, based on WCS, allowing the calculation of maximum, minimum, and average height of an area.

- A set of software tools are available as **freeware**: a simple OGC conformant client application for access WMS and Gazetteer services from PDA; the IGN-CNIG 2D/3D Viewer, a thick OGC client to perform a virtual flight over a cartographic layer(s) served as an WMS and using a DTM obtained via WCS; a simple light WMS viewer to be inlaid in a web page.

- Two **Free Software** applications: CatMDEdit for metadata capture, multiplatform, with multilingual support, thesaurus facilities, ISO 19115 compliant interface and XML export facilities and a Toponomy Editor to graphically edit geonames according to MNE and using WMS services.

Figures of usage and statistics of IDEE Geoportal:

- More than 85,000 visits from January to April 2009.
- More than 28,000,000 individual requests to the services in April 2009.
    - More than 6,300,000 individual request to WMS IDEBase service.
    - More than 20,200,000 individual request to WMS PNOA service.
    - More than 1,500,000 individual request to other WMS service.
- Accesses from 105 countries.

## 6. IDEE Legal Framework.

Since the beginning in 2002 SDI development in Spain was performed according the INSPIRE principles and initiative. IGN-E, Ministry of Environment and National

Geographic High Council IDEE Working Group were working at the Inspire Expert Commission and at the Inspire Implementing Rules Drafting Teams through different SDICs and LMOs. But they were also applying in the Spanish SDI´s implementations every decision approved or foreseen during the Inspire evolution.

The first quick legal step to set up the National Spatial Data Infrastructure Spain used the Royal Decree 1545/2007, Nov 23rd 2007, outlining the National Cartographic System (SCN), to define and set up the NSDI IDEE on its Chapter VI. Royal Decree 1545/2007 defines:

- ▪ The National Reference Geographic Equipment (NRGE)
- ▪ Official Cartographic Production Planning
- ▪ Central Cartographic Register
- ▪ Geographic Information National Infrastructure NSDI according INSPIRE Directive

Some Autonomous Communities (Regions) have set up Regional Laws where Regional SDI is to be set up (Catalonia, Andalusia).

The transposition process began in Spain since the European Directive 2007/2/CE (Inspire) approval on March 14 2007. Ministry of Foreign Affaires and Co-operation assigned to the Ministry of Infrastructures and Transport (IGN-E) has the responsibility on the Directive transposition.  But it also assigned competence in this task to the Ministries of Environment, Agriculture, Economy and Finances, Industry, Tourism and Commerce and Public Health. A Committee for Transposition composed by officers from these Ministries and chaired by an officer from the IGN-E was set up with the specific task to get the first draft ready. At the end of May 2008 the first Transposition Law draft was ready. But the approval process for this Law in Spain is complex because it must be a mandatory law for the three different levels of government.

First of all the Law must agree with all the Spanish stakeholders on SDI and Geographic Information at National, Regional and Local Governments, academia and for public and private companies. The way to reach agreement on the Law is by means of the National Geographic High Council (NGHC). It is mandatory to get the previous approval from the NGHC before to send this Law to the Government.

On July, 11th 2008 a Transposition Law first draft was sent to the NGHC´s Regions representatives. On November, 7th 2008 a new evolved Transposition Law draft was presented and sent to the members of the IDEE Working Group. Once improved with different suggestions and proposals, the Law on Spanish Geographic Information

Infrastructures and Directive 2007/2/CE Transposition Law was then approved by the NGHC´s Permanent Commission, on March, 12<sup>th</sup> 2009. On March, 17<sup>th</sup> 2009 the approved text was sent to the General Technical Secretariat of the Ministry of Infrastructures and Transport in order to get the feedback from all the Ministries, improving the text, as a previous step in order for it to be analysed and approved by the National Government at the Council of Ministers and sent to the Parliament.

## 7. New data policy.

In Spain one of the factors of the SDI implementation success has been that most of the Geographic Information producers Public Authorities are applying a data policy based on open access to geographic information data and services. As an example the IGN-E has established on April, 8<sup>th</sup> 2008, a new data policy setting up that:

▪ National Reference Basic Geographic Information and Metadata are Public Sector Information accessible under conditions of:  Free access, free use, free of charge, with no licensing need.

▪ Digital Geographic Information accessible for **non commercial uses** under conditions of: Free access, free of charge, licensing needed with mention of origin and ownership.

> ▪Services for viewing, analysis and geoprocessing on line by Internet: free of charge.
>
> ▪Downloading by Internet: free of charge; on line licensing needed.
>
> ▪Downloading off line: marginal costs.
>
> ▪ Direct internal use at companies in company management systems is considered non commercial use. Geographic information from IGN/CNIG used as internal can be published on Internet giving added value to the original GI when the uses are non commercial.

▪ Digital Geographic Information will be accessible for **commercial uses** under agreement contract with CNIG. These uses do not require initial fees, only commercial profits sharing. Fees are established by agreement taking into account the Reference Value of the GI and the total business value.