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A STRATEGY FOR THE MANAGEMENT, PRESERVATION, AND REUTILIZATION OF GEOGRAPHICAL INFORMATION BASED ON THE LIFECYCLE OF GEOSPATIAL DATA: AN ASSESSMENT AND A PROPOSAL BASED ON EXPERIENCES FROM SPAIN AND EUROPE

Abstract

In recent years, there has been a growing recognition of the fact that the proper management of information has to include concern for its preservation and future re-use. This ambition is particularly significant for geospatial data.

The primary aim of this article is to define the European and Spanish frameworks for the preservation and reutilization of geographical information, with the ultimate goal of proposing an articulated, lifecycle-based data management model. With this, the intent is to shed some light on a complex, difficult and ever-evolving subject. The article is divided into two main parts. The first part begins with a conceptual justification for geospatial data management and continues by synthesizing the current normative and technological framework for the preservation and reutilization of geographical information. Within this context, the implementation of Spatial Data Infraestructures (SDI) in Spain is evaluated. The second part begins with a case study from Spain that aims to identify different agents and flows that influence the lifecycle of geographical data, as well as the strengths and weaknesses found in each stage of the process under examination. Finally, the foregoing ideas are used in order to propose a SDI-related system for the management of geographical information.

Keywords: geospatial data; data preservation; data re-use; Spatial Data Infrastructures; management of digital geographic information; Spain SDI; European Union

1. INTRODUCTION: TARGETS

Geographical information is a valuable resource, and its efficient use, both now and in the future, depends on appropriate management and maintenance protocols. This is, however, not an easy task due to the frailty of digital information – hence the potential danger of a so-called *digital dark age* – and the growing volume of, and demand for, geospatial data. At the same time, the value of historical geographical data for the analysis and management of processes of territorial change, and the consequential importance of the accessibility and usability of this data is increasingly recognized. For these reasons, the preservation and reutilization of geographical information is a significant challenge. McGarva, Morris, and Janée effectively summarize the problem as follows: "The amount and variety of data is rapidly increasing and, while much of this data is at risk of being lost or becoming unusable, there is a growing recognition of the importance of being able to access historical geospatial data, now and in the future, in order to be able to examine social, environmental and economic processes and changes that occur over time" (2009, 2).

Within this context, the primary aim of this article is to define the European and Spanish frameworks for the preservation and reutilization of geographical information, with the ultimate goal of proposing an articulated, lifecycle-based data management model.

The article is divided into two main parts. The first part, in turn, is divided into three subsections: conceptual justification; legal and technological framework; and the impact of Spatial Data Infraestructures (SDIs) on access and re-use of information in Spain. The work starts with the definition of concepts related to the management, preservation and reutilization of geospatial information. Among other things, an answer will be sought for such questions as: "For what reason and for whom is information preserved?" and, "What is the relationship between the concepts of *management*, *preservation* and *reutilization*?". Following this, the current normative and technological framework for the preservation and reutilization of geographical data will be synthesized in order to assess the degree to which maintenance, access, and use requirements are being met. For this aspect, legal documents will be cited, including both European Union legal dispositions and Spanish laws and decrees. On the other hand, it seems clear that the emergence of SDIs, following the publication of European Directive INSPIRE (2007) and the implementation of the technical advances which have permitted its application, has had a very positive effect on the interoperability, availability, and reutilization of geospatial data**.** A SDI is a virtual networked structure of geographical, and therefore, georeferenced data and geographical information interoperable services. These services (which can be linked and integrated) are accessed via the Internet, and involve minimal protocols and normalized specifications. Finally, the implementation of SDIs in Spain is evaluated by analyzing the statistical indicators and user-available Internet-based resources.

The second part of the article begins with a case study from Spain that identifies different agents and flows that influence the lifecycle of geographical data, as well as the strengths and weaknesses found in each stage of the process under examination. This case study has been chosen, among other reasons, for its emblematic character, its coordinated and decentralized form of implementation, and its wide dissemination in Spain. Finally, the foregoing ideas are used in order to propose a SDIs-related system for the management of geographical information. This proposal is, at this stage, only a first approximation pending further development.

It is necessary to recognize that these are difficult issues, due to the legal, social and technical complexity of the subject, the density of jargon, and the rapid pace of development which follows the exponential increase of available data and the ever accelerating technological capabilities. Taking these factors into consideration, this article is intended to shed a light upon this difficult topic and to share some of the important lessons learned.

2. CONCEPTUAL JUSTIFICATION: CAUSES AND CONSEQUENCES OF THE PRESERVATION AND REUTILIZATION OF GEOGRAPHICAL INFORMATION

Information is a source of knowledge and a factor for the creation of jobs and economic development (Directive 2003/98/CE of 17 November 2003 on the re-use of public sector information). This idea aptly summarizes the relevance of implementing adequate measures for the management and preservation of information. The preservation of information is framed within the broader context of the management of scientific knowledge and is presented as a social challenge with the potential to contribute to the sustainable development of territories.

Other international institutions, such as UNESCO, have made similar claims and have also made specific references to the potential loss of knowledge and cultural manifestations that follows the loss of digital data. According to these international institutions, information must be made available to the public, and preservation strategies play a crucial role in this (*Charter on the Preservation of the Digital Heritage* 2003[1]). Strictly speaking, this charter stresses the significance of information that is considered unique and exceptional, and therefore, of extraordinary value for future generations, i.e., heritage-related information. In any case, the charter introduces one of the most commonly invoked uses of preservation: the conservation of cultural expressions, collective history, and identity of human groups. The notion that information is an instrument for development has inspired several initiatives, such as the program *Information for All*, which was launched by UNESCO in 2000.

On the other hand, there is no doubt that the dissemination of digital technologies and the Internet have made information enormously more accessible than previously, thus contributing to the crystallization of the so-called information society. Confronted with the ever-increasing amount of information available, it may be worth asking ourselves whether this rapid growth is oriented towards an "information-for-knowledge" or an "information-for-leisure" society.

The preservation of information is particularly relevant regarding geographical data due to, among other things, its economic, social, environmental, political and geostrategic projections, as well as its growing volume and use.

Ever since their origins, humans have felt the need to know, understand, describe and represent the world, both immediately around them and further afield, and to transmit this information to others. This has resulted in the creation of media which are used to generate, store, manipulate, analyze and graphically present geographical information. Therefore, the generation of geographical information and cartography responds to an inherently human need. Throughout history, all human groups have used their scientific and technical knowledge for the generation of geographical information.

Although this idea has been subject to some debate, most geographical information can be subject to "georeferencing" and, as such, is susceptible to cartographic representation. This is the reason why maps play a central role in the synthesis, modeling, analysis and representation of territorial information. Traditionally, therefore, geographical information primarily, but not exclusively, revolved around maps. Some authors, however (Bosque et al. 1995), have pointed out that not all geographical information can be expressed in "cartographic" terms, or, at least that it cannot be done easily. This is particularly true of information that has a strong temporal component or is related to social perceptions, which do not always have a clearly defined spatial location or fixed boundaries. The value of geographical information and cartography has been demonstrated on numerous occasions and from multiple theoretical positions: maps can be used to express the evolution of human geographical knowledge; they are a powerful tool for the State and an essential instrument for military operations; they permit a better understanding of spatial phenomena; they are a medium for the dissemination of territorial information in an increasingly globalized world; they may be an excellent tool for territorial analysis and for the synthesis of the results of geographical research; and they play a crucial role in territorial development planning and management and also in the analysis and solution of environmental problems.

For example, the United Nations Conference on Environment and Development, which took place in 1992, illustrates the political awareness of the importance of geographical information, which was labeled as critically important for global, national, and regional decision-making processes concerning the protection of the environment and sustainable development. The conference concluded with the publication of the plan "Agenda 21," which covers pollution, deforestation, toxic waste processing and other crucial issues; these problems cannot be tackled without high-quality and up-to-date geospatial information.

Technical advances, on the other hand, have precipitated an increase in the volume of available geospatial data, especially in digital format, making the management and organization of this data particularly challenging. The role played by Geographic Information Systems since the late 20th century is important due to the capacity of these systems to store, integrate, homogenize, and analyze large volumes of multisource georeferenced data. Another factor that has contributed to a boost in the generation of geographical information is the growing demand from a broadening spectrum of users: public agencies, private firms, researchers, and the general public. In Spain, demand has also been fueled by the proliferation of spatial planning and environmental impact studies following the creation of the current region-based governance system (*Estado de las Autonomias*) in 1978. As a result of this reform, regional agencies assumed jurisdiction over spatial, urban, and environmental planning, and local authorities gained a more prominent role in decision-making processes. Spain's accession to the European Community in 1986 on the other hand, resulted in, among other considerations, the adoption of much more demanding legislation in this regard.

Conversely, as technology progresses and the volume of available information increases, the stability and durability of these documents considerably decreases. The frailty of digital data is, in consequence, one of the main reasons for the implementation of maintenance measures aimed at preventing irreparable losses of knowledge. By its very nature, digital information is frail and ephemeral (Brown et al. 2005), and its preservation poses a significant challenge (Levy 1998). Traditional conservation institutions (libraries, archives and museums) have preserved a rich heritage of map-based historical geographical information. These maps, which come in a wide variety of mediums (clay tablets, papyrus, wood, paper), may have deteriorated over time, but this has generally not prevented access to the information therein. There are also other sources of highly significant geographical and historical information that have been preserved, for example, in Spain, the *Catastro* [cadaster] *del Marqués de la Ensenada* in the 18th century (Catastro de Ensenada 1749-56) and the *Diccionario Geográfico Estadístico e Histórico de España y sus posesiones de Ultramar de Pascual Madoz* in the 19th century (Madoz 1845-50).

Digital information, on the other hand, poses a very different problem. Total or partial loss of information can be sudden, and the deterioration of the physical storage systems can prevent access to the information. Loss of information can have multiple causes (Brown et al. 2005; NCA 2005; Morris and Nagy 2005), for example accidental erasing, viruses, physical deterioration of the device and format obsolescence (which can affect the hardware and/or the software). The problem of obsolescence stresses a further difference between analogical and digital information: whereas the objective of the former is to preserve the information unaltered (indeed, the reason for creating the document is to fix the information), the information preserved in the latter must be transformed relatively often in order to guarantee readability and accessibility. This adds a further element of complexity to preservation measures which in the case of digital information cannot be limited, for example, to maintaining certain environmental conditions (temperature, humidity), but often extend to the creation of a computer infrastructure capable of carrying out the aforementioned transformations. In addition, geographical information has greater limitations than other forms of data for preservation, due, for example, to the large size of the files or the variety and complexity of formats resulting from different types of Geographic Information System (GIS) software. In this regard, we may highlight the storage challenge posed by the growing number and increasing resolution of digital satellite images. The seriousness of the issue is illustrated by the measures undertaken by spatial information-creating agencies, e.g. the National Aeronautics and Space Administration (NASA), or the European Space Agency (ESA) – in order to preserve satellite-generated temporal series.

The preservation of geographical information involves keeping the information up to date and making it easily accessible to the users. Keeping the information up to date is especially important with regard to population-, production- and consumption-related data, all of which often changes rapidly. Obviously, this is costly, which means it is important to decide which information needs to be preserved. Data preservation, therefore, is a thoroughly meditated process that follows the strict implementation of selection criteria, and must also be maintained and updated. In addition, when the information is generated and managed by public agencies a close coordination between organizations is paramount. In conclusion, data accessibility, property, and use must be carefully planned and strictly regulated.

But why must we preserve geographical information, and for whose benefit? As previously noted, the answer may be that information must be preserved so that knowledge is not only retained but also increased (by making sure that information can be reused). Reutilization means that data can be visualized, improved or used as the basis for new information with added value. Therefore, maintenance and updating costs must be fully justified by the plausibility of reutilization. At any rate, we must be aware that predicting the future value of data is not an easy task, but this task could be assisted by monitoring current trends. On the other hand, it is generally believed that the preservation of geographical information is beneficial to the general public (who have incorporated spatial data into their daily lives), public agencies (especially spatial managers and planners) and private firms (as an efficiency-enhancing tool).

Focusing on the issue of reutilization, it must be stressed that accessibility does not sufficiently guarantee the present and future use of the information; data quality and readability are equally important. In this regard, metadata play a crucial role in ensuring that electronic documents meet certain basic values: reliability, authenticity, completeness, accountability (documents must show by whom they were created and modified), usability, and accessibility. The International Standard Organization's ISO 18492/2005 *Long-term preservation of electronic document-bases information* establishes that documents must be readable, intelligible, identifiable, retrievable, understandable, and authentic.

Similarly, the reutilization of information often involves assuming certain conditions, especially concerning the correct use of the documents (e.g., alterations in the document are prohibited and sources must be credited), and it sometimes also includes an economic compensation. There are multiple reasons that can prevent data from being reused, for example: the existence of the data is not known; formats may vary, and the necessary software for the visualization of the data may not be available; data conversion may be problematic; metadata may be lacking, and this may impede the correct interpretation of the information; and data owners may be unwilling to share the information.

Despite this, geographical data is probably the most commonly reutilized information, as well as the most thoroughly normalized and standardized. This has been facilitated – in addition to the aforementioned – by the following factors:

- The wide field of application of geographical information (Brown et al. 2013);
- The traditionally high cost involved in the compilation of geographical data (topography, geology, land use/cover) which, in consequence, results in efforts to avoid redundant work and to enhance existing data with new information;
- The dynamic nature of most natural and human spatial phenomena. Data compiled at a particular point in time are thus not available for recording at a later date, which only increases the importance of their preservation;
- The responsibility assumed by public agencies in the generation of cartography and territorial databases and the changes undergone by these agencies in recent years have helped to make digital information more accessible and abundant;
- The increasing awareness that information generated and managed by public agencies is public property. Access to these data is increasingly understood as a civil right, and the duty of public agencies is to make this access possible;
- The growing effect of the open access trend, which has greatly contributed to making documents freely accessible. This has had a clear effect on the field of geographical information, as illustrated by the SDIs. In his study of the case of Germany, Kuhlen (2007) demonstrated that Open Access brought about a paradigm shift towards the public availability of knowledge;
    - A favorable legal and technical framework.

Similarly, the current economic climate in Europe and Spain, and the subsequent need to optimize resources and reduce costs, encourages the reutilization of existing information even more.

In conclusion, it seems clear that the implementation of geographical information management systems which include measures for the preservation and reutilization of the data is of enormous interest. Ultimately, these systems contribute to gaining a better understanding of the relationship between humans and their environment, to solving management and planning problems and to assisting in spatially-sensitive decision-making processes.

3. LEGAL AND TECHNOLOGICAL FRAMEWORK

3.1. Legal Framework

The wide legal framework for the preservation, reutilization and dissemination of information which has been building up since the 1990s has produced a large number of specific programs and initiatives. The effects of this phenomenon are particularly noticeable with regard to geographical information, wherein these concepts have been developed to a greater extent than in other fields. A detailed analysis of these legal documents is beyond the scope of this work, but we can single out the most significant elements for the following sections (including case study and proposal). Firstly, we outline the legal norms that refer to the reutilization of documents in general, and, secondly, we will focus on those that refer more specifically to geographical information.

Directive 90/313/CEE of 23 June is one of the earliest initiatives on freedom of access to environmental information. It establishes that environmental information in the possession of public agencies must be made freely available to all users, be they natural or legal persons.

In 1998, in order to stir up a political debate on a European scale and to stimulate new ideas among the relevant agents, the European Commission published a *Green Paper* on the role of public sector information, which regarded information as a key resource for Europe. The document begins by stressing the opportunities offered by public sector information for economic growth and employment. It continues by highlighting the growing importance of electronic media and the Information and Communication Technologies (ICTs) in the governance of information society and in the compilation, exploitation, accessibility, and dissemination of public information. Information and Communication Technologies provide access to information through telecommunications. They are part of Information Technology (IT), which focus on the integration and application of computers and telecommunications equipment to the storage, retrieval, transmission and manipulation of data. Specifically, ICTs focus primarily on communication technologies and include, for example, the Internet, wireless networks and cell phones. Finally, the document examines some basic questions concerning data access and commercialization. Certainly the analyses contained in the *Green Paper* aptly synthesize some elements that play a key role in later documents. For example, it points out that in Europe information is fragmented and dispersed as a consequence of the different criteria followed by national legislation; this has detrimental effects on data accessibility. The idea is put forward that the solution is not for the member states to generate more information, but to ensure that the information that is already available is publicly and clearly accessible.

The same idea was stressed in two international statements, the *Budapest Open Access Initiative* (2002)[2], on free access to scientific-academic literature, and the *Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities* (2003)[3]. Both statements demand free access to knowledge.

Also in 2003, the European Parliament and Council issued Directive 2003/4/CE of 28 January (Official Journal of the European Union, L 41/26, 14/2/2003), on public access to environmental information, which supersedes the 1990 Directive (90/313/CEE); because of the disparities present in the national legislation, a unified, clear, and coherent legal text was considered necessary in order to guarantee this right to information.

A key document regarding the reutilization of information at European level is Directive 2003/98/CE of 17 November 2003 on the re-use of public sector information, which was issued by the European Parliament and Council. This document was a significant step because it laid the foundations for a common European framework in this field and defined several key guidelines. Specifically, the first article of the Directive states that the objective is to establish "a minimum set of rules governing the re-use and the practical means of facilitating re-use of existing documents held by public sector bodies of the member states." Following this, the text defines in detail the documents which are, for different reasons, excluded from this action and the need to make re-use of information compatible with the protection of intellectual property rights. Also, key concepts such as "document" and "re-use" are defined (article 2), and it establishes that, whenever possible, documents susceptible to re-use will be made available through electronic means (article 3), in a format that does not depend solely on the use of a specific software. The conditions for re-use are also outlined (article 4), for example paying a fee or acquiring a license (articles 6 and 8). The text also proposes that the member states create public Internet-based portals and catalogs wherein the documents available for re-use can be browsed (article 9). In any case, the Directive clarifies that the authorization of re-use is the responsibility of the individual member states and the specific public agencies involved in each request. In this regard, some authors have criticized this Directive for being too general, which effectively gives the member states too much leeway in its transposition in their national legislation (Valentin and Buenestado 2012, 2).

In Spain, the Directive was transposed with the passing of Act 37/2007 of 16 November on the re-use of public sector information; the norm is to apply to public agencies operating at the national, regional and local levels (article 2). The preamble defines some of the Act's main goals, including the harmonization of public sector information, especially concerning digital formats, in order to ensure a more efficient use of information across borders by both individuals and private firms. This stimulates the generation of products and services with added value. Also, specific mention is made of areas of particular interest in this regard, including geographical information. The Spanish text is a faithful transposition of the European directive. Both texts recognize the value and heterogeneity of the information generated by the public sector and encourage re-use and dissemination under accessible, secure and reliable conditions (articles 4 and 5). Similarly, it is considered important to outline some basic re-use conditions in order to ensure that documents are used appropriately, for example by prohibiting the alteration of documents and by establishing that sources are duly credited (article 8).

Act 37/2007 was further developed through a decree (Real Decreto 1495/2011 of 24 October 2011) on the re-use of public sector information. One of the main differences between the Act and the decree is that the latter limits its scope of application to public agencies which depend on the central government; that is, the decree does not apply to regional and local administrations. Also, the decree places a greater emphasis on the conditions of use and re-use. Special mention must be made of the explicit allusion to metadata, of the insistence that documents must not be altered in any way, that the date when the documents werlast modified must be clearly stated,and that re-use conditions must be met (article,7).The decree also elaborates on the specifications for reusable documents over which exclusive property rights exist or which contain personal information (Chapter IV). Following the passing of this decree, a catalog of the public information available online was created (http://datos.gob.es) in application of article 5. A body for the coordination of public information re-use (Consejo Superior de Administración Electrónica) was also created. The functions of this body are specified in article 6.

Finally, a guide aimed at orienting and informing public bodies of the contents of the norm was issued (MHAP, 2012).

At European level, the promotion of the re-use of public information is now a consolidated strategy as illustrated, for, example, by the creation of the Digital European Agenda (2010). This agenda is set within the broader frame of the Europe 2020 strategy, and it aims to exploit the potential of ICTs through the development of a common digital market for the promotion of innovation, economic development, and progress. The Spanish digital strategy (Estrategia Digital Española, dependent on the Ministry of Industry, Energy and Tourism, Ministerio de Industria, Energía y Turismo; and the Ministry of Finance and Public Administrations, Ministerio de Hacienda y Administraciones Públicas), is the Spanish equivalent of this European initiative, passed on 15 February 2013.

Similarly, 2013 witnessed the approval of Directive 2013/37/UE of 26 June 2013, which modifies Directive 2003/98/CE on the re-use of public information. Unlike its predecessor, the new Directive makes the re-use of information generated by public agencies in member states compulsory rather than optional, with the exception of information which, by virtue of national legislation, is considered restricted; access to this information is subject to the limitations laid down in the Directive (point 8). The new Directive also extends the re-use of public information to libraries, museums and archives. In addition, while the 2003 Directive recommended that as far as possible the readability of documents must not be made dependent on the availability of specific formats, the 2013 Directive was more specific and recommended the use of open and machine-readable formats, together with their metadata, at the best level of precision and granularity, in a format that ensures interoperability. The very introduction of these terms reveals the rapid technological evolution that occurred in the time between the issuance of both directives.

Similarly, Act 19/2013 of 9 December on transparency, access to public information and good governance (BOE, Nº 295, 10/12/2013), establishes the re-use of public information as one of the general principles of public transparency policies; the Act determines that the appropriate mechanisms will be implemented in order to ensure that public information subject to this commitment to transparency is easy to find and can be accessed in conditions of interoperability and usability (article 5).

Parallel to these legal initiatives, diverse plans have been launched in Spain. For example, Plan AVANZA (2005), for technological convergence with the European Union (EU) and the promotion of the society of knowledge, and AVANZA2 (2008), within which there is project APORTA that promotes the re-use and cataloguing of public information, is framed in these contexts.

Interoperability is one of the key requisites for the efficient re-use of information. Among other things, this involves predicting the ability of information systems to exchange information and facilitating the joint use of data from different sources. The importance of this idea is stressed by numerous authors (Sohdheim, Gardels, and Buehler 1999). Increasing awareness of this importance led to the creation of the so-called European Interoperability Framework (EU 2010) and its implementation program Interoperability Solutions for European Public Administrations (ISA), for the period 2010-2015.

In Spain, this aspect was explicitly tackled with the passing of Act 11/2007 of 22 June on electronic access to public services. This Act recognized the citizen's right to interact with public agencies by electronic means, and it proposed the creation of a national interoperability scheme (*Esquema Nacional de Interoperabilidad*) which aimed to guarantee that this policy was carried out efficiently. This Act was further developed by a decree (Real Decreto 4/2010 of 8 January) which regulates the national interoperability scheme. This decree defines interoperability as the ability of information systems to share data and exchange information integrally. The close relationship between interoperability and the preservation and recovery of electronic documents is illustrated by the fact that a sizable part of the decree (articles 21, 22, 24, and 25) focuses on this area.

Focusing on geographical information, its dissemination and access under conditions of interoperability have been fully endorsed at both the European (Directive 2007/2/CE INSPIRE of 14 March) and Spanish (Act 14/2010 of 5 July) levels regarding on geographical information-related services and infrastructures). The Spanish text is a transposition of the European Directive.

In any case, both texts follow a worldwide trend towards the homogenization and sharing of geographical information online in the most efficient way possible. In 1994, the USA, where the aforementioned trend is particularly strong, created the pioneering National Spatial Data Infrastructure (NSDI), which aimed to share geographical information with all public agencies. The infrastructure was defined as the set of technologies, policies, standards and human resources necessary for acquiring, processing, storing, distributing and improving geographical information and for its utilization (Executive Order 12906 1994). At the same time, the initiative Global Spatial Data Infrastructure (GSDI) was also launched with the aim of promoting international cooperation and collaboration in support of national and international SDI developments. In 2001, the *GSDI Cookbook* was published in order to help create SDIs and to share experiences.

The European Union reacted to this trend with the creation of INSPIRE (Infrastructure for Spatial Information in Europe), the legal framework for which was set in Directive 2007/2/CE of 14 March. The compulsory nature of the measures contained in the directive helped to accelerate the creation of national (and also subnational) SDIs. A number of measures were implemented in order to ensure that different SDIs were compatible with one another and could be used at European level. This resulted in the creation of an interconnected hierarchical structure within which information generated on one level could be shared throughout the entire system. Another essential feature of SDIs is their "federated nature". This federated nature describes the aggregation and global search in which their hierarchical nature is deactivated; catalog records are essentially treated as though they were flat, prioritizing whichever ranking best fits the search requirements. The explicit targets of this document illustrative the fact that the initiative came from the Environmental European Agency; these targets strongly emphasize environmental problems and are directed towards tackling a widely recognized concern: the lack of homogeneity in the norms of different countries, which hinders the solution of environmental problems in regions affected by national borders. The European directive INSPIRE is divided into seven chapters: general provisions; metadata; interoperability of spatial data sets and services; network services; data-sharing; coordination and complementary measures; and, final provisions. The directive affects spatial data sets and services in electronic format that fall into a typology of themes defined in annexes I, II and III. The directive determines that member states must ensure that metadata are created for the spatial data sets and services, and that those metadata are kept up-to-date. Similarly, the directive proposes the creation of online shared services and establishes that public agencies must freely facilitate the visualization of the information.

In order to implement the INSPIRE Directive, the European Commission passed Regulation 1089/2010 of 23 November 2010 (Official Journal of the European Union L323/11 of 8/12/2010), which gives detailed technical indications concerning interoperability and harmonization of the spatial data sets defined in the directive (article 1).

In Spain, Act 14/2010 of 5 July on geographical information infrastructures and services (BOE, nº 163 of 6 July 2010) is the legal framework for the creation of SDIs, which are "created in order to facilitate the application of geographical information-based policies and the use of this information by public agencies" (article 1). The Act adopts the principles of INSPIRE, among which the following may be highlighted:

- Access to SDI nodes created by regional public agencies, which must be mutually compatible, must be guaranteed.
- SDIs must guarantee optimal storage, availability, and maintenance of geographical data.
- Data from different sources must be compatible, and data-sharing between users and application must be made possible.
- Dissemination conditions of application to geographical data must in no way restrict the utilization of the information.
- Available data must be easily searchable and examinable (for example, it must be clear *a priori* whether a data set is appropriate for a specific purpose), and conditions of use must be clearly stated, including all legal and technical ramifications.

In recent years, some regional legislation has also been passed to incorporate the national normative, for example in Catalonia (Act 16/2005), Andalusia (Decree 141/2006), Castilla y León (Decree 82/2008) and Aragón (Resolution of 1 June 2010).

In addition, other relevant norms were also passed in Spain in the early years of the 21st century. First, the Act 27/2006 of 18 July on the right of access to information, and public participation and access to forensic information in environmental matters, which transposes European directives 2003/4/CE and 2003/35/CE, aimed at guaranteeing and protecting citizen access to environmental information. Second, the Decree 1545/2007 on the National Cartographic System (Sistema Cartográfico Nacional) (BOE nº 287 of 30 November 2007), which regulates the compilation, storage, edition and dissemination of geographical information by public agencies (article 1). Among other things, this decree defines the National Spatial Data Infrastructure (Infraestructura de Datos Espaciales de España-IDEE) and the Central Administration Spatial Data Infrastructure (Infraestructura de Datos Espaciales de la Administración General del Estado-IDEAGE), and it creates the agency in charge of the creation and maintenance of both SDIs' Internet portals (article 29). The decree establishes that the information contained in the IDEE must be integrally managed and must provide users with online search engines and visualization and downloading and edition services, among others (article 30).

Finally, we must mention Order FOM/956/2008 of 31 March, which endorses a public dissemination policy concerning the geographical information generated by the General Directorate of the National Geographical Institute (Dirección General del Instituto Geográfico Nacional de España) (BOE, nº 85 of 8 April 2008). This order adapts the objectives of the National Geographical Institute (IGN) to the principles established by the INSPIRE Directive.

This legal framework – which is essentially based on the development and regulation of SDIs –emphasizes the dissemination of geographical information and data-sharing, but not so much the preservation and re-use of this information. It is, for example, significant that Decree 1545/2007 does not use the words "preservation" or "re-use," even if it establishes that national public agencies must not only generate geographical information, but also maintain it (for example, the General Directorate of the National Geographical Institute regarding topographic maps, and the Naval Hydrographic Institute–Instituto Hidrográfico de la Marina– with regard to nautical charts) (article 7).

It is, at any rate, clear that the implementation of the current legislation is only possible because of recent technological developments.

3.2. Technological Frameworks and Technical Advances

Since their origin in the 1960s, and even before their use was generalized in the 1990s when they became widely available commercially, GISs have proven to be powerful digital tools capable of capturing, storing, manipulating, analyzing and presenting spatial data. This makes them ideal instruments for the resolution of spatial management and planning issues. Since the 1990s, new advances have considerably enhanced the potential of these functions: the capturing of information has benefited from more frequent and more resolution of remote sensing digital images, Global Positioning System (GPS), Light Detection And Ranging (LiDAR), etc.; storage capacity has also grown; data processing has improved with faster computation devices; analysis has been enhanced by the emergence of new specialized software; and presentation and cartographic expression have gained from the emergence of multimedia and 3D formats. There is little doubt, however, that the most spectacular advances have come hand-in-hand with the expansion of the Internet and other communication networks; this has made possible the transition between GISs and SDIs. In this regard, SDIs have been defined as distributed GISs, where the network in itself is the system and where server-based communication is maintained through shared standards. This is a fine example of the application of interoperability to geospatial information: raster- and vector data models are thus subject to protocols to ensure interoperability.

These advances have improved access to geographical data and its manipulation, analysis, and presentation for a wide range of users (with an accordingly wide range of interests). Similarly, the generalization of geographical information, the emergence of standard formats, the development of user-friendly GIS environments, the promotion of open access and free software, and the development of mobile technologies have also contributed to the growing use of geographical information. This has resulted in the emergence of new working methodologies.

Traditionally, GIS projects collected information from a wide variety of sources, and data homogenization and entry was the most time- and resource-consuming part of the process. Initially, this was, to a large extent, due to the need to scan paper maps, which was a tedious task. Later, a problem arose from the diversity of digital formats in use, the limitations of data-sharing, the lack of available metadata to aid interpretation, the multiplicity of conceptual models with which spatial reality could be processed (essentially vector- or raster-based and, increasingly, object-oriented), and the heterogeneity of documents regarding projections, datums, scales, etc. In addition, users needed special training and costly computer equipment. GIS projects increasingly use Internet-based searching, browsing and downloading of information, but recent years have witnessed the development of an even newer trend, based on remote working. The possibility of storing programs and data in the cloud and of accessing server-based databases without the need to previously download the contents, or even to install the relevant software, has had a significant impact on working procedures. An important step in this regard is the Internet-based distribution of SDI-contained georeferenced spatial data – and their respective metadata – to different GISs. In short, networks and virtual environments have become increasingly important. In addition, these developments have moved the technology closer to the general user, who can find, visualize, use, and combine geographical information via a simple Internet browser. Accordingly, web-based, SDI-integrated geospatial services –e.g., Web Map Services (WMS), Web Feature Services (WFS), Web Coverage Services (WCS), Gazetteer, and Catalog Service for the Web (CSW)– have grown exponentially. These services are standardized by the OGC (Open Geospatial Consortium). As a result, GIS applications have become part of our everyday lives.

Interoperability in the context of SDIs has advanced spectacularly, following the efforts made by a number of agencies towards the creation and adoption of standards at very different levels. These agencies include the Spatial Data Standards Commission, which is dependent on the International Cartographic Association; the Open Geospatial Consortium (OGC); the Committee on Geomatics and Geographical Observation ISO/TC211, which is promoted by the International Organization for Standardization (ISO); and the Technical

Committee CEN/TC 287, which is dependent on the European Committee for Standardization. This has resulted, for example, in the standardization of communication languages (Geography Markup Language or GML, which uses XML grammar), the description of geographical metadata (according to Norm ISO 19115) and web services (according to OGC specifications).

4. IMPACT OF SPATIAL DATA INFRAESTRUCTURES (SDIs) ON ACCESS AND RE-USE OF INFORMATION: THE SPANISH EXAMPLE

The growing importance of ICTs worldwide is clearly illustrated by the socioeconomic dimension of the sector. According to the European Digital Agenda (2010), the ICT sector is directly responsible for 5% of the European Gross Domestic Product (GDP), and it has a market value of €660bn annually. It is also a major source of employment. Its social impact is demonstrated by the fact that 250 million Europeans use the Internet daily, and that their everyday lives have changed as a consequence.

In Spain, Internet access infrastructures have undergone a notable process of expansion and modernization (especially with the implementation of broadband connections) towards full digital connectivity. The social repercussions of this process are illustrated in the following figures: according to the National Telecommunication and Information Society Observatory (Observatorio Nacional de Telecomunicaciones y Sociedad de la Información-ONTSI), in 2012, 47% of the Spanish population had access to Internet connections above 100 Mbps, and 61.8% used the Internet regularly (at European level, these percentages were 34% and 67.5% respectively). In economic terms, the weight of the sector was similar to that found at European level (5.85% of the GDP and a market value of €62.181bn annually in 2010, according to the *Informe del Sector de las Telecomunicaciones, las Tecnologías de la Información y los Contenidos en España 2010*, published by ONTSI).

The growing importance of ICTs in home environments can also be summarized in a few figures. According to the *Survey on Information Technologies in domestic contexts* (*Encuesta de Tecnologías de la Información en los Hogares*), published by the national statistical office in 2003, over 42% of participants had used the Internet in the previous three months; 10 years later, this percentage had risen to 71.6%. As could be expected, the use of the Internet was more frequent among the youngest age groups. Similarly, the proportion of homes with Internet connection increased from 25.2% in 2003 to 69.8% in 2013, although this is still below the European average, especially concerning superfast connections (present in 0.4% of Spanish homes and in 2% of European homes in 2012, according to ONTSI).

Focusing on the expansion of SDIs in Europe and Spain, it must be pointed out that the implementation of SDI-related resources in Spain has been surprisingly fast. This is primarily the result of the support lent by the public administration after the adoption of the principles conveyed by the INSPIRE Directive and its transposition to the Spanish legal framework. This rapid progress has been recognized by the experts: "The Spanish SDI is considered one of the most developed ones in Europe with a very active SDI and INSPIRE-minded community at all governmental levels. This is mainly due to a good coordination, cooperation and agreement at all levels of the government and with all the stakeholders of the NSDI network" (Vandenbroucke and Biliouris 2011, 6). The resulting Internet-based SDI services are easily accessible. These services include the IDEE geoportal and blog, which is dependent on the Spanish Geographical Council (Consejo Superior Geográfico de España) and also publishes a monthly bulletin on SDIs. The geoportal is particularly useful because it allows connection with public SDI nodes at national (created by a number of ministries and other public agencies that are dependent on the central government), regional and local levels (http://www.idee.es). The geoportal includes an interface for cartographic visualization, as well as a wide range of web and search services and a downloading center for geographical data on national, regional and local scales (Figure 1). The geoportal is also a good repository of SDI-related documentation. The IDEE (Infraestructura de Datos Espaciales de España) geoportal is the Spanish equivalent of the European INSPIRE (http://inspire-geoportal.ec.europa.eu) and worldwide DSGI geoportals (http://www.gsdi.org). "[Figure 1 goes here]"

Currently, therefore, a dense network of hierarchically organized geoportals exists, and the availability of web-based services has grown accordingly. Free geographical information has never been so easy to access. As a bare minimum, geoportals offer the services which legislation requires of them, that is, the visualization and browsing of data, for which a searchable metadata catalogue is necessary, as well as visualization, and often also editing and downloading, tools.

Most SDIs in Spain have some common features, for example they all have interfaces for the visualization of cartography, which include tools for searching (by administrative divisions, coordinates, toponyms, or thematic category); zooming and browsing capabilities; 3-D visualizing; measuring (lengths, surface); thematic searching by attributes; and layering (ortophotography, ortho-imaging, basic, and thematic maps). In addition, many of these SDIs include tools for searching and editing coordinates anchored to different datums (as shown in Figure 2), which is essentially a consequence of the fact that Spain is currently changing its reference system from ED50 to ETRS89 (for the Peninsula and the Balearic Islands) and REGCAN95 (for the Canary Islands), as established in Decree 1071/2007 of 27 July, which regulates the official geodesic system of reference in Spain. This transfer must be completed during 2015. "[Figure 2 goes here]"

The availability of metadata catalogs and interoperable maps is of particular interest. These services follow the specifications laid down by the OGC for WMS, WFS, and WCS.

WMS are the most widely used by Spanish public agencies that offer Internet-based geographical services, probably because of their comparative simplicity. This is significant because WMS not only make information more accessible to the user, but also make interoperability and the application of standardized protocols easier for those in charge of generating and disseminating the information.

The quality of these services varies widely between regions and agencies, but a general trend towards improved, and better structured, content is detectable. There is, however, much room for improvement, especially concerning the degree of commitment from local agencies.

The implementation and outcomes of SDIs-initiatives must be constantly monitored in order to assess their impact in terms of labor- and cost-efficiency, especially because most of the resources invested are public. For this reason, Directive 2007/2/CE determines that the "member states shall monitor the implementation and use of their infrastructures for spatial information. They shall make the results of this monitoring accessible to the Commission and to the public on a permanent basis" (article 21, pt. 1). This is, in any case, an onerous task because of the complex nature of SDIs and their on-going evolution (Grus, Crompvoets, and Bregt 2007). SDIs are defined as virtual networked structures that, in addition to geographical information metadata and interoperable systems, include the necessary technologies to make this information searchable and accessible; the norms which regulate its generation, management and dissemination; the agreements, involving both the generators of the information and its users, which regulate conditions of access and utilization; and the monitoring and coordination mechanisms in force. Any assessment of SDIs, therefore, must take all of these factors into consideration.

There are several approaches to this assessment, some of which have been synthesized by C. Morera et al. (2012, 443-452): cost-benefit and cost-efficiency analysis, evaluation of

SDIs-related service, and product use and evaluation of economic, political, and social impact. Numerous academic studies about these approaches have been published (Comprovoets et al. 2008; Grus et al. 2011).

In compliance with the INSPIRE Directive, EU countries issue triennial monitoring reports, which must take the following aspects into consideration (article 21, pt. 2):

- How public sector providers and users of spatial data sets and services and intermediary bodies are coordinated, and of their relationship with third parties and of the organization of quality assurance;
- The contribution made by public authorities or third parties to the functioning and coordination of the infrastructure for spatial information;
- Information on the use of the infrastructure for spatial information;
- Data sharing agreements between public authorities; and
- The costs and benefits of implementing the directive.

To date, Spain has published two reports (for the periods 2007-2009 and 2010-2012). In fact, monitoring is carried out annually and is based on several quantitative indicators, divided into four groups, i.e., spatial data, metadata, access, and services. In order to focus on the subject of this article, i.e., the preservation and re-use potential of geographical information, we decided to concentrate on SDIs and spatial data use-related indicators. It must be pointed out that due to the limitations of the evidence (Capdevila 2013, 45), it is difficult to carry out a detailed quantitative analysis, although general trends may be observed.

Table 1 shows the number of visits (successful connections) to each type of service. In 2013 the leading category is visualization, followed (far behind) by localization and data transformation. Although the data do not reflect a clear trend, the leading position of visualization services is obvious. This is confirmed by the evolution of the data concerning not only the number of visits, but also the number of services available to the user, between

2009 and 2013. In terms of percentage, view services amounted to 88.6% and 99.97% of visits (as recorded in 2011 and 2013, respectively). Regarding the number of services available, the second position is held by downloading services (16.69% in 2009 and 8.63% in 2013).

“[Table 1 goes here]”

In any case, it seems beyond doubt that the implantation of SDIs has made geographical information more easily accessible, but how is this information reutilized and how is value being added to it? Trying to find an answer for this question is indeed too ambitious a task for this article, but we can make an initial approximation with some results based on the infomediary sector in Spain. This sector comprises companies that generate products and services for their commercialization to third parties on the basis of public information. In general, they are small and specialized firms, and the number of them that specialize in the re-use of geographic and cartographic information is notable.

A survey carried out in the framework of project APORTA (ONTSI 2012) among 150 firms in the infomediary sector had interesting results: over 50% of these firms develop products –not exclusively, but primarily– based on cartographic and geographical information, and 90% use information provided by public agencies that are dependent on the central government. Concerning distribution channels, the Internet is clearly in the lead: 90% of the firms obtain these maps from the Internet, while 35% also obtain them in person and 20% through other channels. Concerning other types of images, the situation is similar, with percentages of 81.9%, 54.5%, and 18.2%, respectively.

The perspective of the infomediary sector is also interesting in itself. Participants in the survey claimed that the public agencies need better coordination and that stronger public leadership is also necessary in order to promote re-use. They believe that the legal framework can also be improved. These agents demand solutions for the considerable difference in the quality of the services provided by the different regional governments, and believe that a cultural change is mandatory in order to prevent re-use being perceived as a battlefield for the confrontation between the private and public sectors. The most valued aspects concerning the availability of maps, plans, and images for re-use are, in this order: quality, provenance, and fidelity of the information (all of which scored 3.2 or above out of 5). Re-use is valued most highly among those firms dealing primarily with geographical-cartographic information.

5. ANALYSIS OF THE LIFECYCLE OF GEOSPATIAL INFORMATION ON THE BASIS OF A CASE STUDY: PROJECT SIOSE

The principal aim of this section is to reflect upon the lifecycle of geographical information in order to identify the relevant agents and flows, and at the same time to evaluate management-, preservation-, and re-use-related tasks. This will be shared through the analysis of a case study: Information System on Land Occupation in Spain (Sistema de Información de Ocupación del Suelo en España-SIOSE). This case study was chosen for the following reasons:

- Information concerning land occupation is highly relevant, as illustrated by the abundance of academic works and research groups on the subject (the Commission on Land Use/Cover Change, dependent on the International Geographical Union, is one such example). The political and legal prominence of the subject is also increasing. For example, in the framework of the European Union, information on land use is contained within a database of reference for a large number of policy issues (environmental, agrarian, and territorial, among others). Accordingly, the INSPIRE Directive (annexes II and III) in Europe, and Act 14/2010 of 5 July 2010 on geographical information-related services and infrastructures (article 27) in Spain, have already taken into consideration the growing importance of the subject. In addition, in order to be of use for spatial planners and to be a source for dynamic studies, this type of information needs constant maintenance and updating, which increases its interest as a case study for the implementation of measures for the preservation and re-use of information. Similarly, land-use information is requested by an ever-increasing number of users with a wide range of interests, and this increases the potential applications of re-use.

- The project has an intrinsic interest; SIOSE is one of the most ambitious projects involving harmonized geographical data undertaken to date in Spain, and it is an ideal example of the implementation of INSPIRE and international standardization norms.
- SIOSE is a SDI-distributed GIS application.

In conclusion, in Spain the project stands as a reference for the generation and management of geographical information.

5.1. The Project: Planning

Project SIOSE is part of the National Plan for Territorial Monitoring (Plan Nacional de Observación del Territorio-PNOT), which is coordinated and managed by the National Geographical Institute (Instituto Geográfico Nacional-IGN) and the National Center for Geographical Information (Centro Nacional de Información Geográfica-CNIG). Project SIOSE was clearly inspired by Project Corine Land Cover, promoted by the European Environment Agency and aimed to create a Europe-wide database on land use based on satellite images and at scale of 1:100,000. The project was part of the program Coordination of Information of the Environment (CORINE), which was undertaken with the aim of compiling, coordinating, and homogenizing environmental- and natural resources-related information in the European Union. Project Corine Land Cover was launched in the late 1980s and was divided into several stages; the databases available to date correspond to the years 1990, 2000, and 2006. The information generated by the project has been widely used for territorial planning and analysis purposes. Also, the Spanish (national and regional) public agencies have used it as a model for the coordination, generation, and management of information.

Project SIOSE was launched in 2004 in conformation with the mandate of the INSPIRE Directive. The project aimed to meet an old need (to possess sufficient reliable information on land occupation) and to solve a set of similarly old problems (work duplication; the coexistence of cartographic products with different methodologies, scales, and legends; the adoption of different standards in each region; etc.). The relatively small scale of the undertaking (Spain instead of the European Union) also allowed for greater precision, and a scale of 1:25,000 was chosen instead of CORINE Land Cover's scale of 1:100,000. Obviously, this increased the project's potential with regard to spatial and environmental planning at the regional level. Similarly, it gave a more faithful representation of the territorial diversity of Spain, which was somewhat obscured by data at smaller scales. At the same time, the initial intention of capturing information, not only concerning land cover (that is, the biological coverage, which is easier to identify on the basis of aerial photographies or satellite images), but also land use (more closely related to the socioeconomic use of the land), was definitely a step forward, even if the last variable ultimately could not be implemented.

Project SIOSE, in consequence, aimed to create an information system on land occupation in Spain which could integrate the regional and national databases. The explicit target was to "compile once" in order to "re-use many times," in accordance with the access criteria mandated by the INSPIRE Directive (ETNS 2011, 6). The specific targets of the project are as follows:

- To create a major and multidisciplinary infrastructure of geographical information that can be regularly updated and that meets the needs of national and regional agencies concerning land occupation;

- To avoid duplications and reduce costs in the periodical generation of geographical information concerning land occupation and cover;
- To integrate information generated by the regional agencies in terms of generation, control and management; and
- To comply with European Union requirements concerning land occupation

These ends are clearly inspired by the INSPIRE Directive and by the basic principles of information preservation and re-use. Concepts such as updating, efficiency, integration, coordination, and harmonization are thereby expressed both implicitly and explicitly. However, the targets do not mention clearly the need to preserve the information generated or the measures which need to be implemented in this field.

In order to achieve these targets, an interoperable and normalized object-oriented data conceptual model was designed (ISO 19101, OGC). The spatial work unit chosen was the polygon. Each polygon was defined according to land cover and land use(s). This means that each polygon can only be assigned one cover value (simple or compounded), but more than one use value.

The basic methodology used was computer-aided photointerpretation of satellite images. The primary documents used were SPOT5 satellite images (resolution: 2.5m) taken in 2005, the official administrative limits between regions, high-resolution ortophotographies (below 1m), and the regional land occupation databases. In addition, other complementary sources of information were used, including autumn and summer LANDSAT5 TM images, vector data extracted from the BCN25 national topographic base (IGN), crop maps, forestry inventories, and Sistema de Información Geográfica de Parcelas Agrícolas (SIGPAC). The main tool used was GIS software (primarily ArcGis).

5.2. The Project: Agents and Information Flows

Major agents in this project were the following ones:

- **Promotor and direction at the national level**: Instituto Geográfico Nacional (Ministerio de Fomento de España) as National Reference Center on Land Cover and on Land Use and Spatial Planning
- **Coordinating organisms**: Multilevel hierarchical coordination
    - National team: 7 technicians dependent on the central government and 4 technicians dependent on the regional governments
    - Regional coordination team: 19 technicians
- **Producer**: Co-operative and decentralized production at the regional level
    - Work teams organized by region: 19 teams. Agreements were signed by the Centro Nacional de Información Geográfica and the general administrations of the regions
    - Thematic work teams: 5 groups
- **Information management/Administrators**: Coordinated, decentralized management
    - Key administrator: Instituto Geográfico Nacional (Ministerio de Fomento de España)
    - Secondary administrators: regional governments
- **Distributor**: shared
    - For the national-wide database: Instituto Geográfico Nacional/Centro Nacional de Información Geográfica
    - For each region: regional governments
- **Users**: wide diversity (public agencies, private firms, researchers, universities, associations, foundations, etc.)

The project was divided into several stages:

- Planning
    - Definition of the project structure

  - Generation of technical specifications
  - Constitution of work groups: commissions
- Elaboration
  - Integration of information of reference in a single layer
  - Geometric edition of polygons
  - Photointerpretation and assignation of cover values and attributes
  - Creation of metadata
  - Fieldwork
  - Internal quality control
- External quality control
- Integration of regional databases; creation of a unified national database
- Administration and management of the information
- Dissemination and distribution of the information

Figure 3 presents the information flows resulting from the aforementioned structure:

"[Figure 3 goes here]"

5.3. The Project: Results and By-Products

The project generated a relational database containing geometric and alphanumeric information that gives full coverage of the Spanish territory in 2005. The thematic database describes land cover (simple or compounded) and occupation percentages. In addition, this information is linked to its corresponding metadata and a catalog of photographies which illustrate the different kinds of land cover.

This basic thematic information was essential for the generation of by-products. A good example of this is the project undertaken by the public agencies that are dependent on the regional government in Andalusia, wherein the basic information generated by SIOSE and subsequent by-products –for example, maps representing the distribution of open forest areas, water pools, wetlands, mines, tree types, among many others– have been made publicly available through the Environmental Information Network (Red de Información Ambiental de Andalucía or REDIAM). The statistical analysis of the geographical database has also resulted in the generation of a series of tables.

5.4. Integration of Project SIOSE in the SDIs: Accessibility of Information

As previously noted, project SIOSE was inspired by the INSPIRE Directive and is, therefore, regulated by the dispositions of Act 14/2010 of 5 July 2010 on geographical information-related services and infrastructures, and also of Act 27/2006 of 18 July 2006 on the right of access to information, public participation, and access to forensic information in environmental matters. In consequence, the project is up-to-date with regard to the latest legal framework. For this reason, and despite the fact that this was not one of its original targets, it has been integrated into the national IDEE and regional SDIs. This has had a significant impact on the dissemination and accessibility of information.

The dissemination of project SIOSE has been intense and, as well as with the production and management phases, has been carried out in a coordinated but decentralized manner. Access to the SIOSE database is primarily via the IGN website, but there are also links to it in the different regional portals. Access is, therefore, possible through multiple websites (http://www.ign.es/siose/; http://www.cnig.es; Regional URLs). In addition, in 2009 SIOSE registered its own domain (siose.es) and launched its own website as a platform for data and service dissemination (http://www.siose.es/).

The SIOSE geographical database can be downloaded for free at http://centrodedescargas.cnig.es/CentroDescargas/. Geographical files come in shapefile (.shp) format, and alphanumerical data in access (.mdb) format. In order to download these files, users must be licensed and registered, a requisite that does not apply for metadata XML files. The geographical database is also available, by request, in other formats. Regional administrations also offer the possibility of downloading the part of the database that corresponds to their own territory.

In addition to the data and metadata, SIOSE-generated information can be browsed and visualized in the following interoperable standard web services (OGC): WMS (http://www.ign.es/wms-inspire/siose?request=GetCapabilities&service=WMS) and WMTS (http://www.ign.es/wms-inspire/siose?request=GetCapabilities&service=WMS).

Unlike CORINE, SIOSE has not yet launched a Web Feature Service (WFS) and a Web Coverage Service (WCS). Visualization of the data can use the interface IBERPIX, developed by the Instituto Geográfico Nacional (http://www2.ign.es/iberpix/visoriberpix/visorign.html). Also, an installable application (SIOSE Desktop) has been created, which enables the user to consult the SIOSE database and to generate files, statistics, and graphics using the data.

Dissemination does not focus solely on results, but also includes information about the entire process, which is very positive. The following documents can be downloaded in PDF format (http://www.siose.es/web/guest/documentacion): “Documento técnico SIOSE2005,” “Modelo Conceptual de SIOSE,” “Manual de fotointerpretación,” “Manual de Control de Calidad SIOSE2005,” and “Guía de comprobación en campo.” Although these documents have been updated and amended, the original versions are still available.

5.5. Metadata in Project SIOSE and Preservation and Re-use of Information

SIOSE metadata are normalized to the international standard ISO 19115 (2003 version) and to the specifications established by ISO/TS 19139. The recommendations laid down by the Spanish Metadata Nucleus (Núcleo Español de Metadatos) were also followed. The tool CatMDEdit makes it possible to document the large number of resources involved.

By following the international standard ISO 19115, metadata are grouped in packages, each of which includes several metadata entities (class UML):

- “MD_Identification”: This contains unique elements for the identification of the data. In SIOSE, these elements include the title, presentation format (in this case, a digital map and a digital table), the reference date for the data package (which coincides with the satellite image capture date, i.e., 2005), the team that generated the data, a summary of the data, the credits (in this case, eight public agencies, in addition to the regional governments), the data character set (004 Utf 8), the language (Spanish), the category of the theme, a series of keywords and use restrictions.

- “MD_Constraints”: This informs about data use, access and security restrictions, and conditions of use and access (license).

- **“**DQ_DataQuality**”**: This contains qualitative and quantitative information on the data. These elements describe the sources used and the steps taken to generate the resource.

- “MD_Distribution”: These elements describe who is distributing the resource and how it can be accessed.

- “MD_MaintenanceInformation”: This informs about updates.

Since optimal conditions of use depend on the authenticity, integrity, traceability, and reliability of the information, identification- and quality-related metadata are especially important. Authenticity demands that a strict control over the authorship, date and content (“Identification”) of the files is maintained. Reliability is connected with quality, both of the data and of the methodology followed for its generation, and it stands as a guarantee that the information contained in the database is a faithful reflection of reality. Similarly, conditions of use must be clear and easily accessible, and the same applies to the information, which must be made available in digital format; for this reason, distribution- and use restrictions-related metadata are also of great importance. Finally, it is essential to describe the content of the data, which will enable the user to understand the information. In this regard, the purpose of the project is of interest (Table 2).

"[Table 2 goes here]"

Of the wide spectrum of metadata included in the system, those related to data preservation and format definition are of particular interest since these are key aspects for the current management and the future use of the information. This also applies to the metadata connected to the methodology for the generation of data because preservation must be a part of the general process and, naturally, to those explicitly related to preservation (Table 3)

"[Table 3 goes here]"

An analysis of SIOSE metadata reveals some strengths and weaknesses of the process. The former include the generation of normalized metadata that promote interoperability; the exhaustiveness of the metadata compiled (in accordance to Norm ISO 19115); the generation of metadata on the metadata; and the incorporation of a summary of the purposes of the project (which is not mentioned in Regulations nº 1205/2008, and which is considered to be optional by the Spanish Metadata Nucleus, but is crucial for information preservation and re-use).

The weaknesses include the poor development of temporal metadata; the fact that, although the steps taken by the regional teams in the generation of land occupation databases are explained, this is not also the case concerning the actions after the validation, integration, and generation of the national database; preservation metadata are insufficiently developed (information concerning the relevant agreements, the teams responsible for this task and the changes introduced in the information is lacking); and the specific use to which the resource has already been put is left unexplained.

As shown above, the factor of updating of project SIOSE was not contemplated initially. Updating was made dependent on the needs of the public agencies

This process was launched in 2009, and in 2010 and 2011 an agreement was reached between the CNIG, which is dependent on the Ministry of Public Works (Ministerio de Fomento), and the regional governments for the updating of the database.

6. PROPOSAL FOR THE DEVELOPMENT OF A GEOSPATIAL INFORMATION MANAGEMENT MODEL

There are different models for the preservation of information. One of the most widely used in libraries is the Open Archival Information System (OAIS), designed in accordance with International Norm ISO 14721:2003. This model recognizes three main actors (producer, manager, and consumer) and three types of information package made up of data and metadata: SIP – Submission Information Package, generated by the producers; AIP – Archival Information Package, which includes management and preservation-related information; and DIP –Dissemination Information Package, which is the end result presented to the consumer. Four basic processes apply to the stored information (ingest, archival storage, data management and access/dissemination) and two to the preservation of the information (preservation planning and archive administration). Rodriguez, Valle, and Porcal (2014) presented a different model elsewhere which was further developed at a later date by A. Rodriguez (2014). This system is a result of the combination of the following components: (1) an operational model (agent´s relationships) which shows the processes of generation, storage and use of information, and identifying the intellectual rights; (2) a primary unit for information (the project) which defines the context and the characteristics of information; (3) a conceptual model for archives (OAIS); (4) a procedure to set up an information management system (ISO 15489); (5) the orientation towards continuous improvement (Plan-Do-Check-Act cycle); and (6) the possibility of certificating the system by means of quality criteria (ISO 9000, ISO 30301, ISO 27001, ISO 16363, etc.).

Geospatial database managing systems are widely used (for example, ESRI Geodatabase for ArcGis and PostgreSQL/PostGIS) for geographical information. In other cases, a system is built through the integration of a GIS with a document manager (for example, ECM – Enterprise Content Management; this system is used in the heritage information system of Santiago de Compostela, Spain).

This article has shown that preservation demands the full commitment of all agents involved in the generation and management of information. A political, legal, technical, and social context conducive to the necessary agreements is also mandatory. Also, preservation must be explicitly set as a target from an early stage and must be present throughout the project; that is, it does not end with the delivery and dissemination of the product, but rather extends throughout its lifecycle. In this author's opinion, this lifecycle begins at the planning stage and carries on until the reutilization and valuation of the product (which, let us not forget, is the ultimate aim of preservation), generating a circular flow of constant improvement (see Figure 4). For these reasons, an information management system – broadly understood– includes planning, generation, validation, maintenance, distribution, safekeeping, updating, and reutilization. Accordingly, the commitment of all agents involved in the process is equally important, and each must be made aware of the importance of data preservation and re-use.

The inclusion of preservation among the goals of a management system necessitates defining strategies and specifying measures to that end, which involves adding extra tasks to the process (selection of the information to be preserved and a definition of the implementation criteria, transformation of information, and selection and application of transference mechanisms such as migration or replication, among others). Preservation also involves a constant process of validation of the quality of data and metadata, as well as of the related processes and services, which must conform to normalized standards.

Flexibility is a crucial factor in the creation of a system that is capable of linking the past (needs detected), the present (resources and products generated), and the future (re-use); a flexible system will be capable of adapting to any eventuality (for example, technical, political, legal, economic, institutional and normative changes). This requires an accurate forecast of the economic and human resources that may be needed in the future. Metadata, with their ability to document the changes undergone by information over the course of its lifecycle, play a prominent role in this regard. The analysis of the metadata referring to the ISO 19115 standard that was carried out in connection with our case study reveals that metadata related to the generation of information are much more significant than those concerning any other stage of the lifecycle of the information. A way to achieve a more balanced distribution in this regard is to make metadata related to preservation an obligatory character. It would be convenient to incorporate some of the elements contemplated in PREMIS, especially those referring to so-called "event entities," because they allow for tracking the actions undertaken after the information has been entered in the file. There are three main ways of achieving this: a new ISO standard, the development of profiles, and the extension of ISO 19115 (Ariza et al. 2012). After the analysis of the metadata of project SIOSE, the second option seems more sensible because it makes use of an already consolidated and widely used structure.

Ideally, management systems which include a preservation subsystem to ensure re-use should clearly define the rights associated with the information throughout its entire lifecycle, including permits for carrying out tasks related to digital preservation.

Given the aforementioned requisites, a system oriented towards the preservation and re-use of geographical information involves not only the administration and preservation of data and metadata, but the necessary institutional agreements, political support, technical capacity and normalization standards and criteria. This will allow for the development of better services for an increasingly experienced and demanding user base. This multidisciplinary nature and complexity connects directly with SDIs, which already implement this sort of structure.

Therefore, this author proposes the construction of a SDIs-based networked system for the preservation of geographical information; this system could be understood as a strategic projection into the future. SDIs, in contrast to traditional Corporate GIS, are virtual infrastructures which have enormously facilitated access to, and the use of, information by an increasingly wide range of users. It may be said that metadata are essential for data browsing and use, and that the quality of data is crucial in order to develop effective applications.

Internet dependency, at any rate, creates uncertainty. In turn, it presents benefits of advances in artificial intelligence applied to the Internet, which could make data manipulation much easier and could allow for the automatization of some preservation-related tasks. I agree with Lazorchak and Sewash (2011) that the replication of projects is better than the replication of files since projects are the framework within which the information must be interpreted and understood.

“[Figure 4 goes here]”

7. CONCLUSIONS

The preservation, dissemination, and re-use of geographical information is a way for sustainable development capable of contributing to economic growth, social equity and job creation, as well as to improving environmental management and adding to our accumulated geographical knowledge the production of added value products. The fact that geographical information can be reused by a wide range of users justifies the cost of preservation. Precisely because of this cost, preservation must be planned in advance; rather than “passive safekeeping,” therefore preservation must be understood as “active maintenance,” which involves very different tasks, starting with the selection of the information to be preserved.

This is important due to the large volume of geographical data in existence. Another such task – also essential because most contents have a digital nature – is the updating of data, metadata, and format supports, which is key in order to ensure that this information will be available for future users. Correspondingly, it will be necessary to establish a data transfer process. It is difficult to overrate the importance of updating metadata, which are truly central to the compilation and usability of the information. Finally, the re-use of information also needs users to commit to good-use practices and distributors to guarantee respect for property rights and confidentiality.

This article presented the normative steps taken in Spain and the EU since the 1990s in order to promote the reutilization of public information and to facilitate the dissemination and access to geographical information. In many cases, Spanish norms are close transpositions of previous European directives. Significantly, the most recent European directive on the re-use of public information (Directive 2013/37/UE) introduced a number of ideas that reflect the rapid technological and conceptual advances of recent years. These include the growing social awareness of the value of public information and the increasing perception that this information should be freely available to citizens; the growing presence of ICTs at all levels; the passing of norms (standards) for the promotion of interoperability; and the expansion of the concept of open access. In practical terms, the aforementioned directive made the re-use of public information obligatory, not optional, while recommending that the corresponding data and metadata are made available in open and readable formats, thus guaranteeing interoperability and accuracy. Another positive aspect of the directive is the obligation of member states to issue a triennial report on the extent of information re-use, which allows for the evaluation of the measures undertaken in this regard and for the introduction of corrective actions. In Spain, the plans launched to promote the digital sector and contents (Agenda Digital Española) include a program for the reutilization of public information (initially scheduled to end in 2015, but which can be prolonged until 2020), with a budget of €1.2m. This program should help to promote the creation of added value in geographical data by increasing the activity of the infomediary sector (as seen above, a large proportion of this sector in Spain uses geographical information). The considerable political support behind information re-use is in sharp contrast to the relatively little attention paid to the preservation of geographical information. This has, to a certain extent, been counterbalanced by the role played by SDIs.

Current technological advances have had an enormous impact on our ability to capture, analyze, edit, and represent geographical information, but also to disseminate and re-use it. In Spain, integrated exchange of spatial data has grown exponentially, which has had a profound effect, for example, on the methodology followed in GIS projects. The examination of SDIs initiatives carried out in Spain to date has revealed the following strengths: the creation of a legal framework which incorporates the mandate of INSPIRE and that supports the implementation of SDIs; the constitution of a hierarchical and multilayered coordination structure led by the Consejo Superior Geográfico and a very active work group in the IDEE; the remarkable commitment of public agencies that produce cartography; the creation of a wide network of geoportals, which give access to normalized and standardized data, metadata, and geospatial services; an increase in the number of visits to SDIs, especially concerning the visualization of maps. The weaknesses, on the other hand, include: insufficient awareness of the potential of SDIs on the part of the producers and users of geographical information; there is room for improvement in the fields of data and metadata harmonization, synchronization, and updating; the organization of the increasing volume of information at our disposal could also be improved, because the tendency to transmit all the data, irrespective of quality, persists; interoperable services of map visualization (WMS) are prolific, but this is not the case with systems that include spatial analysis functions; and finally, the analysis of quantitative indicators of assessment reports for the years 2009 and 2013 reveals that the problems posed by incomplete data still apply in many fields, which increases the difficulties involved in inter-territorial comparisons and the detection of trends.

Great efforts have been made for the coordinated and harmonized production of the geographical information of reference, for example with project SIOSE in Spain. This project, which was carefully planned and meticulously documented, has demonstrated the importance of the project as "context" for the interpretation of the information and, in consequence, as a subsystem for preservation and integrated dissemination.

In light of the case study, it seems that the best strategy is to incorporate geographical data preservation and re-use within the framework of a management system that guarantees the authenticity, reliability, and integrity of the information over time. This must be articulated with consideration to the information lifecycle; this lifecycle starts at the planning stage and ends with the re-use of the information and the generation of added value, in what is in fact a circular flow of information along with a continuous improvement process. The positive effects of re-use are therefore not limited to the generation of new information, but also include improving the quality of the available data. It is impossible to overrate the importance of the planning stage, which assumes preservation, use, and generation of added value as key targets from an early stage. Other aspects that must be taken into consideration are the need to predict the economic costs of preservation and to carry out periodical cost-benefit analyses; the incorporation of use- and preservation-related metadata in addition to description- and identification-related metadata; the importance of the generation of metadata at every stage of the process, including planning, generation of information, and preservation and distribution, in agreement with Norm ISO 15836, which recommends the documentation not only of data, but also services and other resources (for example, a project as a whole); the quality of data, metadata, services, and procedures must be assessed according to widely recognized norms and standards; interoperability, not only technological, but also semantic, must be maintained, for both the present and the future; agreements and a high degree of consensus between the agents involved must be reached; and appropriate coordination and monitoring mechanisms and adequate data policies must be implemented.

Therefore, a complex but flexible networked system, one that is capable of adjusting to new norms, standards, formats and technological advances (for example, new mechanisms of automatization) is proposed and highly recommended. Similarly, steps should be taken towards the full realization of SDIs' potential to become a veritable integrated online GIS, where information may be managed and preserved and more advanced spatial analysis functions executed as well as the incorporation of input from program and application developers, and citizens, into this virtual structure. Finally, the trend towards open access to, and use of, geographical information has progressed at a very rapid pace, but this has not been followed by an equivalent advance in our spatial and territorial culture, which, ultimately, are key factors for an efficient re-use of geographical information and a meaningful increase in our knowledge.

INDICATION OF FIGURES AND TABLES

Table 3- Metadata (schema ISO 19115) especially important for the preservation of information in project SIOSE

ACRONYMS

AIP	Archival Information Package
BOE	Boletín Oficial del Estado de España
CNIG	Centro Nacional de Información Geográfica
CORINE	Coordination of Information of the Environment
CSW	Catalog Service for the Web
DIP	Dissemination Information Package
ECM	Enterprise Content Management
ESA	European Space Agency
ESRI	Enviromental Systems Research Institute
ETNS	Equipo Técnico Nacional SIOSE
EU	European Union
GDP	Gross Domestic Product
GIS	Geographic Information System
GML	Geography Markup Language
GPS	Global Positioning System
GSDI	Global Spatial Data Infrastructure
ICTs	Information and Communication Technologies
IDEE	Infraestructura de Datos Espaciales de España
IGN	Instituto Geográfico Nacional
INSPIRE	Infrastructure for Spatial Information in Europe
ISO	International Standard Organization
IT	Information Technology

LANDSAT	Land Satellite
LiDAR	Light Detection And Ranging
NASA	National Aeronautics and Space Administration
NSDI	National Spatial Data Infrastructure
OAIS	Open Archival Information System
OGC	Open Geospatial Consortium
ONTSI	Observatorio Nacional de las Telecomunicaciones y para la Sociedad de la Información
PNOT	Plan Nacional de Observación del Territorio
PREMIS	Preservation Metadata: Implementation Strategies
SDI	Spatial Data Infrastructure
SIGPAC	Sistema de Información Geográfica de Parcelas Agrícolas
SIOSE	Sistema de Información de Ocupación del Suelo en España
SIP	Submission Information Package
SPOT	Satellite Pour l´Observation de la Terre
REDIAM	Red de Información Ambiental de Andalucía
WCS	Web Coverage Services
WMS	Web Mapping Service
WFS	Web Feature Service

ENDNOTES

[1]http://portal.unesco.org/en/ev.php-URL_ID=17721&URL_DO=DO_TOPIC&URL_SECTION=201.html
[2] http://www.budapestopenaccessinitiative.org/read
[3]http://openaccess.mpg.de/Berlin-Declaration

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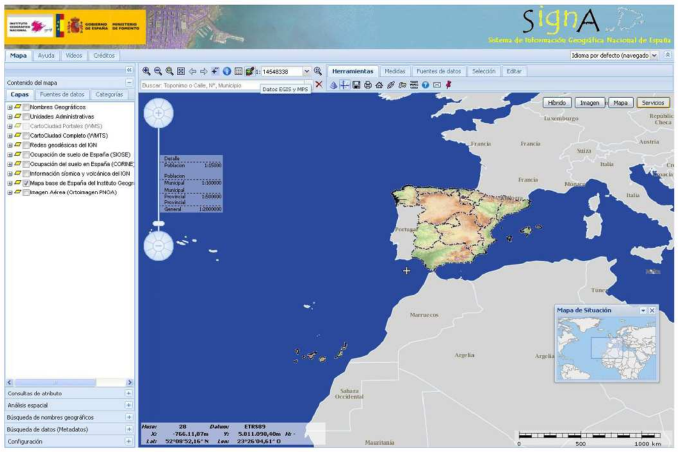
FIGURE 1- The Spanish Spatial Data Infraestructure: IDEE Geoportal

Source: (http://www.idee.es access March 2015)

209x148mm (300 x 300 DPI)

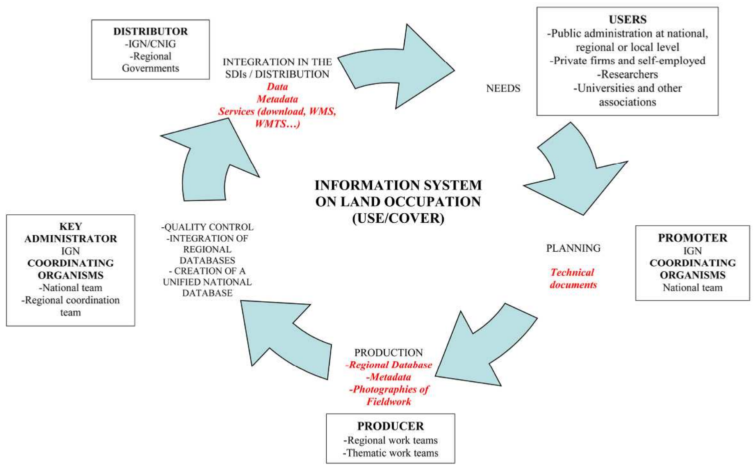
FIGURE 2- An example: viewer and display the spatial data



SIGNA: Search, discover and access geographic information. Visualization of cartography, searching information by localization and attributes, coordinates transformation, etc. http://signa.ign.es/signa/

209x148mm (300 x 300 DPI)

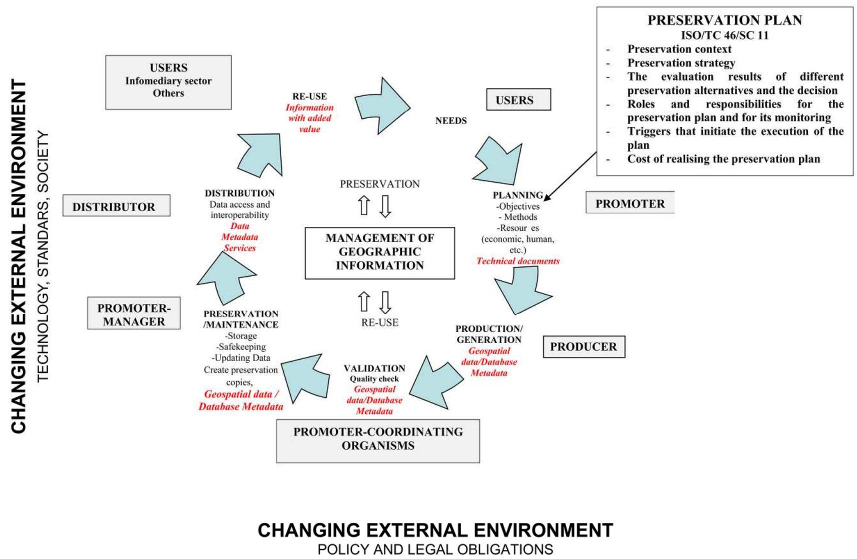
FIGURE 3- Project SIOSE (Information System on Land Occupation in Spain): agents and information flows



Source: the author

209x148mm (300 x 300 DPI)

FIGURE 4- Geographic Information Management Model based on the lifecycle of the geospatial data



Source: the author

209x148mm (300 x 300 DPI)

TABLE 1 : The use of the Infraestructure for Spatial Information in Spain

	2009	2010	2011	2012	2013
SERVICES	**Nº of visits/nº of services**	**Nº of visits/nº of services**	**Nº of visits/nº of services**	**Nº of visits/nº of services**	**Nºof visits/nº of services**
Discovery services (NSi3.1)	9.169	2.214.028	4.058	4.367	15.407
View services (NSi3.2)	4.472.968	664.469	752.811	457.323	702.199
Download services (NSi3.3)	177.428	76.897	544.040	2.937	436
Transformation services (NSi3.4)	3.679	1.936	0	0	12.417
Invoke Services (NSi3.5)	0	74.945	0	0	1.533
All services (NSi3)	**3.167.833**	**603.589**	**713.058**	**405.532**	**634.050**

Resource: *Indicators INSPIRE*, 2009, 2010, 2011, 2012 and 2013

209x148mm (300 x 300 DPI)

Table 2- Metadata (schema ISO 19115) especially important for the re-use of information in project SIOSE

Identifying path	Comment
MD_Metadata.identificationInfo>MD_DataIdentification.citation>CI_Citation.title	Land Occupation Information System for Spain. Scale: 1:25 000. Year 2005. Distributed on sheets.
MD_Metadata.identificationInfo>MD_DataIdentification.purpose	To meet the needs of the central and regional government concerning land occupation. To avoid unnecessary data duplication. To comply with EU requirements. To integrate the database. To create a multidisciplinary geographical information infrastructure and to update it periodically. To create a reference in the field of geographical information and land occupation on both national and European levels.
MD_Metadata.identificationInfo>MD_DataIdentification.citation>CI_Citation.date	**Date:** 2005-01-01 **Data Type:** Creation
MD_Metadata.identificationInfo>MD_DataIdentification.pointOfContact	Contact: Arozarena Villar, Antonio Rol: 006 (Creator) Contact: Valcárcel Sanz, Nuria Rol: 007 (Contact point)
MD_Metadata.identificationInfo>MD_DataIdentification.spatialRepresentationType	001 (vector)
MD_Metadata.identificationInfo>MD_DataIdentification.spatialResolution>MD_Resolution	25,000
MD_Metadata.identificationInfo>MD_DataIdentification.resourceConstraints	Of access: 005 (license) Of use: 005 (license) 008 (Other restrictions): National (except IGN/CNIG) and regional agencies and other public bodies may not use the product commercially; that is, they may not use or distribute it, online or otherwise, for a fee. In addition to this, third parties may not make secondary use of, or disseminate, by-products; that is, they may not generate by-products, with or without added value, and make them freely available online or otherwise. Also, in order to monitor use and the generation of by-products, third parties have to fill out a form with the following information: legal and tax identification of the user; product requested; forecasted use; commitment to report errors or commissions found in the information; commitment to non-commercial use; economic sector for which the application will be of use, i.e.: agriculture, demography, education, energy, forestry, infrastructure, research, environment, planning, security, healthcare, telecommunications, transport, tourism, housing and other; if the activity is environment-related, the specific area must also be mentioned; commitment to cite sources with the dissemination of results; acknowledgment of the property rights over the requested products; commitment to approach the owner of the copyright if

297x420mm (300 x 300 DPI)

	the product is to be used commercially and to acquire the corresponding license.
MD_Metadata.DataQualityInfo>DQ_DataQuality>DQ_Element>DQ_Result	**Report type: Topological consistency** Measure name: Topological control of polygons **Report type: Topological consistency** Measure name: Type of sheet. **Report type: Exactitud posicional externa absoluta** Measure name: Absolute external positional accuracy **Report type: Accuracy of thematic classification** Measure name: Semantic control of photointerpretation
MD_Metadata.distributionInfo >MD_Distribution.distributor	Contact: Centro Nacional de Información Geográfica Role: distributor Contact: regional governments Role: distributor
MD_Metadata.distributionInfo>MD_Distribution.transferOptions>MD_DigitalTransferOption.onLine	http://www.ign.es/siose/ http://www.cnig.es (Regional governments' URLs)

This Table has been made from the information provided by Equipo Técnico Nacional SIOSE, ed. 2012. *Sistema de Información de Ocupación del suelo en España. Manual de Metadatos*, versión 2.1.
http://www.siose.es/SIOSEtheme-theme/documentos/pdf/Manual Metadatos_SIOSE2005.pdf

297x420mm (300 x 300 DPI)

Table 3- Metadata (schema ISO 19115) especially important for the preservation of information in project SIOSE

Identifying path	Comment
MD_Metadata>MD_MaintenanceInformation.maintenanceAndUpdateFrecuency	Non-programmed
MD_Metadata.DataQualityInfo>DQ_DataQuality>LI_Linage	**Tasks**: -Integration of the information of reference -Digitalization of SIOSE polygons -Assignation of covers and attributes
MD_Metadata.DataQualityInfo>DQ_DataQuality>LI_Linage>LI_ProccessStep	**Process 1**: Integration of information of reference -Communications and hydrography; vector data (Instituto Geográfico Nacional-BCN25); -Urban area boundaries and street axes; vector data from cadastres (D.G. del Catastro, Ministerio de Economía y Hacienda); -Cover boundaries; crop maps (Ministerio de Agricultura, Pesca y Alimentación-MCA); -Cover boundaries; forestry maps (Ministerio de Medio Ambiente-MFE). **Process 2**: Digitalization of SIOSE polygons The definition of each polygon is made with reference to the aforementioned geometry and photointerpretation of the images of reference: SPOT5, LANDSAT5 and other images (always in agreement with SPOT5's geometric and temporal criteria). **Process 3**: Assignation of covers and attributes Each polygon is assigned cover and attributes according to the SIOSE data model. Fieldwork trips are undertaken in order to check the accuracy of the photointerpretation.
MD_Metadata.distributionInfo>MD_Distribution.distributionFormat	Name: Geomedia Version: 6.0 Name: ArcGis Version: 9.0 Name: MDB

This Table has been made from the information provided by Equipo Técnico Nacional SIOSE, ed. 2012. *Sistema de Información de Ocupación del suelo en España. Manual de Metadatos*, versión 2.1.

http://www.siose.es/SIOSEtheme-theme/documentos/pdf/Manual_Metadatos_SIOSE2005.pdf

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