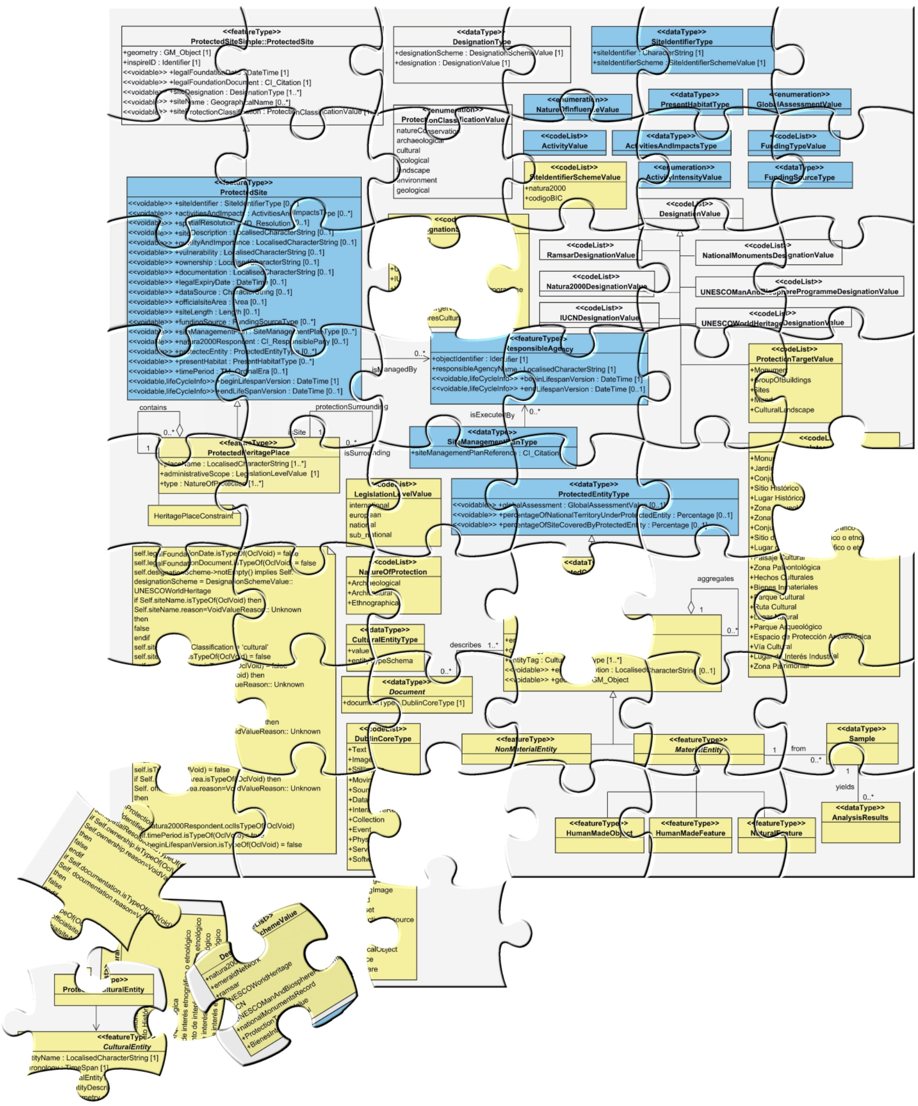
CSIC
Consejo Superior de Investigaciones Científicas

incipit
Instituto de Ciencias del Patrimonio

Carlos Fernández Freire
César Parcero-Oubiña
Antonio Uriarte González (eds.)

A data model for Cultural Heritage within INSPIRE



CAPA 35

CADERNOS de ARQUEOLOXÍA e PATRIMONIO

CAPA 35

Cadernos de Arqueoloxía e Patrimonio

A data model for Cultural Heritage within INSPIRE

Carlos Fernández Freire, César Parcero-Oubiña and Antonio Uriarte González (Eds.)

CSIC incipit
Instituto de Ciencias del Patrimonio

First published: February 2014

CAPA 35

Cadernos de Arqueoloxía e Patrimonio

Edited by

Instituto de Ciencias del Patrimonio (Incipit)
Consejo Superior de Investigaciones Científicas (CSIC)

Contact address

Instituto de Ciencias del Patrimonio
San Roque, 2
15704 Santiago de Compostela
Teléfono +34 981 547053
Fax +34 981 547104

E-mail: capa@incipit.csic.es
Web: www.incipit.csic.es

Depósito Legal: C 243-2014
ISSN: 1579-5349

Table of Contents

ABOUT THIS VOLUME

Text authorship

The work presented here as a technical guideline corresponds to a collective authorship. Many individuals and Spanish organizations have contributed as experts in the different tasks of the development of this INSPIRE Conceptual Data Model for Cultural Heritage:

Juan M. Vicent García, Isabel del Bosque González, Tomás Abad Balboa, Emilio Abad Vidal, Pilar Chías Navarro, Marta Criado Valdés, Pastor Fábrega-Álvarez, Mercedes Farjas Abadía, Carlos Fernández Freire, Alfonso Fraguas Bravo, Francisco García Cepeda, Miguel Lage Reis-Correia, Javier Márquez Piqueras, Victorino Mayoral Herrera, César Parcero-Oubiña, Juan Luis Pecharromán Fuente, Esther Pérez Asensio, Arantza Respaldiza Hidalgo, María Ruiz del Árbol Moro, Antonio Uriarte González, Antonio Vázquez Hoenhe and José Julio Zancajo Jimeno.

A full list of authors and their affiliations may be found at the end of this publication (Annex D. List of Authors, p. 79).

This is not an official document. The views expressed here are the sole responsibility of the authors. It does not represent the official position of any administrative body of either the national, regional or local administration in Spain.

references

This work has been partially supported by the Spanish Government through the projects "Investigación en tecnologías para la valoración y conservación del Patrimonio Cultural" (CONSOLIDER INGENIO 2010 CSD2007-00058) and SPATRIAL-"Definición de un Modelo para la Representación de Aspectos Espaciales del Patrimonio" (HAR2009-1226, Programa Nacional de I+D+I, Ministry of Science).

funding

Editorial funding: Incipit

CAPA 35

A data model for Cultural Heritage within INSPIRE
Carlos Fernández Freire*, César Parcero-Oubiña** and Antonio Uriarte González*** (Eds.)

*Geographic Information Systems (GIS) Laboratory, Centro de Ciencias Humanas y Sociales (CCHS-CSIC)

**Instituto de Ciencias del Patrimonio (Incipit), Spanish National Research Council (CSIC)

***Landscape Archaeology and Remote Sensing Laboratory (LabTel), Institute of History (CCHS - CSIC)

Resumen

Esta monografía presenta los fundamentos, contexto y detalles técnicos de un Esquema de Aplicación para la incorporación de datos espaciales relativos al patrimonio cultural en el marco definido por la directiva europea INSPIRE sobre información geográfica.En la actualidad, INSPIRE representa el marco más relevante para la publicación y distribución de información geoespacial, de un amplio conjunto de temáticas, especialmente las relacionadas con el medio ambiente. Aunque los elementos del patrimonio cultural aparecen parcialmente recogidos en INSPIRE, no hay hasta el momento documentación específica acerca de cómo integrarlos, estructurarlos y publicarlos.Este texto pretende proporcionar una serie de guías técnicas que ayuden a cualquier agente implicado en el manejo de datos patrimoniales a publicarlos siguiendo los principios genéricos definidos en INSPIRE.

Este trabajo supone la publicación detallada de un modelo de datos y un esquema de aplicación que han sido ya parcialmente publicados previamente (Fernández Freire et al. 2013, Parcero-Oubi¶a et al. 2013, Uriarte Gonz§lez et al. 2013).

Abstract

This monograph presents the background, context and technical details of an Application Schema for the inclusion of cultural heritage spatial data into the INSPIRE framework. Nowadays, INSPIRE provides the most relevant framework for the dissemination and exchange of geographical data, covering many different thematic fields, particularly relevant for environmental datasets. Although cultural heritage elements are partially addressed within INSPIRE, there is no specific documentation on how these data should be considered, structured and published. This text aims to provide technical guidelines for decision makers, public administrations and the scientific community for the definition and implementation of harmonized datasets for cultural heritage, according to the interoperability principles of INSPIRE.

This monograph presents in full detail a data model and an application schema, some of whose aspects have been previously published in brief (Fernández Freire et al. 2012, Parcero-Oubi¶a et al. 2013, Uriarte Gonz§lez el at. 2013)

Palabras Clave

IDEs; Patrimonio cultural; Modelo de datos; Esquema de aplicación; Interoperabilidad; INSPIRE

Keywords

SDIs; Cultural Heritage; Conceptual Data Model; Application Schema; Interoperability; INSPIRE

Introduction: Spatial Data Infrastructures and Cultural Heritage

Cultural heritage as spatial information

The concept of *cultural heritage* is highly complex, recently becoming the subject of an increasingly intense theoretical debate regarding not only its definition but also its underlying content. Considered from a distance, and at its most generic, "commonsense" level (see p. 16), most people understand Cultural Heritage as something like the ensemble of tangible and intangible achievements accumulated by a community throughout time, as long as they are recognized in the present as being relevant for them and therefore are worth being preserved for the future. Although preservation nowadays is just a small part of what heritage study and management is all about, it does still remain one of the most visible fields of practice, and is especially relevant when it comes to the interaction between heritage elements and many other fields of economic, social and political practice.

This acknowledgement implies a political burden (for it regards a linkage between cultural heritage and an actual community), and so it has required a legal definition. Besides the history of the concept, we may say that its widespread recognition at an international level is closely related to the *Convention Concerning the Protection of the World Cultural and Natural Heritage* passed in 1972 by the UNESCO and confirmed by 190 countries so far. The content and legal expressions of the idea of cultural heritage within that normative context have been enhanced since the passing of the Convention, thanks to the transposition of its values to the member states and to the creation of new legal international instruments that have broadened the range of items regarded as cultural heritage. Relevant examples of this enhancement are the inclusion of the so-called *intangible cultural heritage* through the adoption, in 2003, of the UNESCO *Convention for* *the Safeguarding of Intangible Cultural Heritage*, or of the inclusion of the figure of *cultural landscapes* within the World Heritage Convention in 1992.

Anyhow, the content underlying cultural heritage is an open matter of debate, always exposed to controversy. International practice, as reflected in the UNESCO World Heritage List, implies an ongoing conceptual broadening, derived from new inscriptions. Difficulties for establishing criteria to clearly delimitate what should be regarded as cultural heritage emanate from the appreciative nature of the concept itself. This difficulties are usually bypassed through the inclusion of extensive definitions in the Convention (see first article), as well as in most state legislations. Besides that, cultural heritage is a highly "granular" concept, which encompasses a wide range of frameworks of reference for what can be considered as significant: some things might be significant at an international level, others nationally, regionally, locally or even just within a reduced group of people.

The term *cultural heritage* will be used here primarily as a normative concept, being within the Spanish case a synonym of *Historical Heritage* (*Patrimonio Histórico* in Spanish), which is the term chosen in the Spanish main national law regulating heritage protection (*Ley 16/1985, de 25 de junio, del Patrimonio Histórico Español* – LPH onwards). The first article of the LPH bears a wide definition (as the UNESCO Convention does) of the range of things that compose heritage.

Most of those things regarded as cultural heritage can be found in a place, or linked to a geographical location. This is especially evident in the case of immovable features (buildings, historical places, archaeological sites, cultural landscapes, etc.), whose integrity is intrinsically tied to the place they occupy. As for movable items, their heritage value may subsist regardless of their location, though it is frequently lessened when moved, since such value depends to a great extent on the successive spatial contexts where it has been through its life cycle (from the places where these movable features were created and used to the museums and collections where they are preserved). Finally, intangible heritage will always be linked to its spatial dimension, as the context for the human activities which generate and recreate it, though its heritage value remains initially detached from any specific object-based appearance. The spatial dimension of cultural heritage is central to understand its nature and to ensure the protection commitments made on behalf of public administrations. This is true either if we approach heritage from the perspective of experts, practitioners or enthusiasts in the field, or if we do it from the point of view of the use and management of land and environment. But this becomes especially relevant when heritage preservation conflicts with landscape change brought about by development, a challenge which has attained an unprecedented scale (Vicent García 2007). This and the problems that arise when guaranteeing accessibility are the main reasons for requiring public intervention to ensure an adequate protection of cultural heritage.

The enduring conflict between heritage conservation and its accessibility on the one hand, and urban and rural landscape transformation processes on the other, poses the main problem for public intervention. This concern has shaped a management practice that has begun, in most cases, by identifying and cataloging heritage features (monument catalogs, archaeological inventories, etc.) before implementing protective measures (by creating legal protection entities).

This activity has engendered a network of spatial data that is quite dense, though fragmentary and heterogeneous and, all too often, barely accessible, even to the public administration itself (the Spanish case is the most familiar to us, and provides a good example of this problem, see Parcero-Oubiña, 2012, though the problem is global, see for instance Snow et al., 2006). Although this may also have been the case in many other fields, heritage management has traditionally been characterized by inefficient data management and unjustified limitations on citizens' rights of heritage use and enjoyment (Corns and Shaw 2010).

As in many other fields related to spatial information, the INSPIRE Directive, issued "to support Community environmental policies, and policies or activities which may have an impact on the environment", represents both a commitment and an opportunity to integrate data and to divulge and make a diverse range of geographic information accessible to the public. Although cultural heritage is included to some extent as one of the layers considered as "reference data" (belonging to Annex I) and is also mentioned in the data specification on Buildings (Annex III), as we will see shortly, the point is not further developed within INSPIRE. However, this is a major opportunity to promote and encourage the development of cultural heritage SDIs within an interoperable framework, taking into account the spatial nature of this specific type of data in order to enhance their role within territorial governance, to help manage their protection and to bring them closer to the general public.

To aid the attainment of those objectives, several steps must be taken on different levels. On the technical level, the development of a data model and an application schema that expands the range of the already existent INSPIRE themes is what we have been considering over the last few months. The results of that work are presented in detail in this volume.

Spatial Data Infrastructures

The emergence of *Spatial Data Infrastructures* (*SDI*) deserves a place along with other remarkable milestones as one of the real steps forward in the scientific evolution of cartography, a science with thousands of years of history and whose origins can be dated back to ancient Alexandria with the work of Eratosthenes (276-196 BC).

It was not until the middle of the 20th century, thanks to the application of the Information and Communication Technologies (ICT) to the management and analysis of large datasets, that a technological and intellectual shift of paradigm in the conception and uses of cartography and geographic information will happen, represented by the emergence of *Geographic Information Systems* (*GIS*)[1] (Buzai and Baxendale 2006: 49). This paradigm should be understood as the ensemble of technical and methodological procedures that enable the management of the spatial dimension of geographical phenomena, allowing the study and analysis of reality from multidimensional and integrated approaches, fostering at the same time the "socialization" of geographic information and placing cartographic science at the service of the users and under their direct control (Mas Mayoral 2008: 18).

Spatial Data Infrastructures (*SDIs*)[2] are interpreted as a natural evolution and extension of Geographic Information Systems (Rodríguez Pascual et al. 2007). A central idea in the emergence of SDIs is the need for an open and general access to geographic information and, therefore, the beginning of its "democratization". The focus on the idea of information sharing and exchange means that a main pillar is the interoperability between data and systems. The adoption of new methodologies, the objective of resource sharing, the possibility to combine information through the Web, the reuse of data and the principle of public usefulness, make some authors refer to SDIs as a new paradigm in the field of geomatics (Guimet 2004; Mas Mayoral 2008; Rodríguez Pascual et al. 2005).

---

[1] The origins of GIS are to be found in the 1960s. The first reference is the *Canada Geographic Information System* (*CGIS*), developed by Tomlinson for Canadian forest resources management.

[2] SDI origins date back to 1994, with the approval in the USA of the Executive Order 12906 – Coordinating Geographic Data Acquisition and Access: The National Spatial Data Infrastructure. More information at The American Presidency Project (Accessed February 04, 2013).

One of the most widespread definitions of SDI is that included in *The SDI Cookbook*, by the GSDI Technical Working Group:

> *"The term 'Spatial Data Infrastructure' (SDI) is often used to denote the relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data. The SDI provides a basis for spatial data discovery, evaluation, and application for users and providers within all levels of government, the commercial sector, the non-profit sector, academia and by citizens in general […]. An SDI must be more than a single data set or database; an SDI hosts geographic data and attributes, sufficient documentation (metadata), a means to discover, visualize, and evaluate the data (catalogues and Web mapping), and some method to provide access to the geographic data. Beyond this are additional services or software to support applications of the data. To make an SDI functional, it must also include the organizational agreements needed to coordinate and administer it on a local, regional, national, and or trans-national scale" (Nebert 2004: 8).*

Therefore an SDI constitutes the policy and technological framework to make available large volumes of geographic information on the Internet, overcoming some common problems with geodata (related to management, integration and location of data with different thematic, spatial and temporal components). Significant norms, rules and standards have been developed to ensure a harmonic development of SDIs, both at the European level (namely INSPIRE) and internationally, most remarkably by the International Organization for Standardisation (ISO) and the Open Geospatial Consortium (OGC).

The legal and organizational framework for SDIs in Spain

The main regulation in Spain regarding geographic information and infrastructures is the LISIGE. This law defines the *Consejo Superior Geográfico* (*CSG*) as the board responsible for the regulation of the institutional framework which facilitates open access to geographic data produced and maintained by public administrations. The *Consejo Directivo de la Infraestructura de Información Geográfica en España* (*CODIIGE*) is the specific body which is committed to implementing policies and to coordinating all the public bodies involved. It is composed of representatives from local, regional and national administrations and operates through working groups, whose function is to analyse the performance of INSPIRE, implementing rules within the public sector and assisting the administrative bodies in meeting their commitments in this field[3].

As suggested above, one of the main problems regarding geographic information in the public domain in Spain is the existence of many official bodies - at different levels (national, regional and local) – each of them responsible for the production, maintenance and publication of different datasets and services. In order to build an integrated framework which gathers together all these agents and the information they produce, while maintaining their autonomy (purely an SDI approach), the IDEE (the Spanish acronym for *Spanish Spatial Data Infrastructure*) was created (Rodríguez Pascual et al. 2005). The IDEE is not only the point of entry to gain access to all the public spatial data in Spain, but it is also an organizational framework which aims to foster the publication and sharing of spatial data and to develop rules and recommendations. The latter function, that of technical guidance and advice, has been carried out since 2002 by the IDEE Working Group (*Grupo de Trabajo IDEE, GT-IDEE*), an open technical group made up of experts and producers of geographic information.

[3] Link (Accessed February 04, 2013).

At the 2010 meeting of the GT-IDEE, a new subgroup on cultural heritage (*GTT-PAH*) was set up (Del Bosque Gonz§lez and Vicent Garc²a 2011). The aims of this subgroup were the harmonization and integration of spatial data on cultural heritage, and the promotion of their publication and visualization within an SDI framework. The group was discontinued in 2011 before its final results were produced. The proposal presented in this volume was further developed by some of the former members of the group (see Annex D. List of Authors, p. 79).

Since the proposal was conceived as an extension of the INSPIRE schema on Protected Sites, we shall start the next section with a review of the framework upon which our proposal was developed. Then, we shall dedicate a section to presenting the conceptual and theoretical foundations of the data model. Following this, the data model itself will be presented in detail.

Additionally, a series of annexes are included with the description of different cases and the complete technical data dictionary.

THE INSPIRE FRAMEWORK

The INSPIRE Directive, published in the *Official Journal of the European Union* on 25 April 2007 and coming into force on 15 May 2007, established an *Infrastructure for Spatial Information in the European Community*. One of the aims of the INSPIRE Directive is to enable the interoperability and harmonization of spatial datasets and services across Europe. *Interoperability* is understood as providing online access to spatial datasets through network services, typically via the Internet, making them available according to commonly agreed data specifications, so that data can be combined in a coherent way, without repetitive manual intervention.

INSPIRE is based on a number of common basic principles:

- Data should be collected only once and kept where it can be maintained most effectively.
- It should be possible to combine seamlessly spatial information from different sources across Europe and share it with many users and applications.
- It should be possible for information collected at one level/scale to be shared with all levels/scales; detailed for thorough investigations, general for strategic purposes.
- Geographic information needed for good governance at all levels should be readily and transparently available.
- It should be easy to find which geographic information is available, how it can be used to meet a particular need, and under which conditions it can be acquired and used.

The key elements of INSPIRE to address these objectives (Craglia and Campagna 2009: 13–14) include:

- Creation of metadata to describe existing information resources so data can be more easily found and accessed.
- Harmonization of key spatial data themes.
- Agreements about network services and technologies.

- Policy agreements on sharing and access.
- Coordination and monitoring mechanisms.

The thematic areas dealt with by the INSPIRE Directive are listed in three annexes. They include 34 spatial data themes, with key components to be specified through technical implementing rules. Each theme should be described according to an INSPIRE *data specification* and a harmonized *conceptual schema* (see Modeling inside the INSPIRE framework, p. 12). The three annexes are organized according to a hierarchy in which datasets included in Annex I are considered the most relevant (reference data). Annex I includes a data theme entitled *Protected Sites*. These are defined as any “area designated or managed within a framework of international, Community and Member States’ legislation to achieve specific conservation objectives” (INSPIRE 2007, Annex I). This explicitly includes protection based on cultural heritage values. Hence, this is where cultural heritage most naturally fits within the INSPIRE schema[4].

Modeling inside the INSPIRE framework

As interoperability is one of the key principles of INSPIRE, it relies greatly on different standards. *Standards* are understood to be commonly agreed specifications regarding a certain aspect, such as data models, services, etc., which must be independent of industry and private companies. The Open Geospatial Consortium (OGC) and the ISO Technical Committee 211 (ISO/TC 211) are the reference organizations for standards in the area of geographic information.

These standards, along with the INSPIRE technical guidelines, provide the necessary framework to harmonize datasets in order to meet the goal of interoperability. As we have seen, interoperability within INSPIRE is focused on access to spatial datasets through network services, typically via the Internet. Two aspects are therefore necessary to achieve interoperability: data harmonization (via modelling processes) and the standardisation of services (via OCG standards).

ISO norms describe and standardise the process of data modelling in various steps, from the portion of the real world to be modelled (*universe of discourse*) to the final representation of the data. *Conceptual modelling* is the process of creating an abstract definition of a universe of discourse and a set of related concepts to describe it. A conceptual model includes not only objects (in our case, most of them are spatial objects) but also their attributes and operations and the relationships that exist among such spatial objects. The conceptual model is described by a *conceptual schema language* that provides a uniform methodology and the format for describing information; the document containing this formalized description is the *conceptual schema*. A conceptual schema that defines how a universe of discourse shall be described in terms of data and operations is called an *application schema*. The conceptual framework is independent of technologies and platforms for physical implementation; it is restricted to those structural and behaviourally relevant aspects of the universe of discourse.

OGC standards support interoperable solutions that "geo-enable" the Web, wireless and location-based services and mainstream information technology. The standards empower technology developers to elaborate complex spatial information and services which are accessible and useful for all kinds of applications.

In the following section we shall present a brief overview of the most common OGC standards and ISO norms concerning the implementation of INSPIRE, in order to facilitate a

[4] Together with the 11th theme of Annex III, Area management/restriction/regulation zones and reporting units (AM Data Specification) (see The INSPIRE Data Specification on Protected Sites, p 14).

better understanding of the proposal we shall put forward.

OGC standards in INSPIRE

The Open Geospatial Consortium (OGC) is an international association of companies, government agencies and universities (there were 473 members in early 2014) participating in a process of consensus in order to develop publicly available interface standards.

Its purpose is to define open and interoperable standards within Geographic Information Systems and the World Wide Web. It promotes agreements between the different companies involved which enable interoperability for geoprocessing systems and facilitate the exchange of geographic information for the benefit of end users.

According to INSPIRE, network services are necessary for the sharing of spatial data between the various levels of public administration in the European Union. These network services should make it possible to discover, transform, view and download spatial data and to invoke spatial data and e-commerce services. OGC has developed the main existing standards for network services, which INSPIRE has adopted.

The OGC standards baseline currently comprises more than 30 standards (GML, KML, etc.), including the following regarding network services:

- *Web Catalogue Service* (*CSW*), which provides access to catalogue information (description of datasets).
- *Web Map Service* (*WMS*), which provides map images (visualization of datasets).
- *Web Feature Service* (*WFS*), for retrieving or altering feature descriptions (acquisition of vector datasets).
- *Web Coverage Service* (*WCS*), for retrieving coverage objects from a specified region (acquisition of raster datasets).

Within INSPIRE, network services should work in accordance with commonly agreed specifications and minimum performance criteria in order to ensure the interoperability of the infrastructures established by the EU Member States. It is important, for the successful implementation of an SDI, that a minimum number of services are available to the public free of charge. INSPIRE forces EU Member States to make available, at the very least, the services for discovering (CSW) and, subject to certain specific conditions, viewing (WMS) spatial datasets.

ISO standards in INSPIRE

The International Organization for Standardisation (ISO) is the most important standards institution in the world. ISO defines standards in many different fields, including digital geographic information and geomatics, which is dealt with by the ISO Technical Committee 211 (ISO/TC 211). This committee has been responsible for the publication of the ISO 19100 series, a set of International Standards (IS) and Technical Specifications (TS) numbered in the range starting at 19101. These standards specify methods, tools and services for geographic data management (including definition and description), acquisition, processing, analysis, access, presentation and sharing in electronic form among different users, systems and locations.

The work of ISO/TC 211 is closely related to the efforts of the Open Geospatial Consortium (OGC). Indeed, both organizations have a working agreement that often results in identical or near identical standards being adopted by both organisations.

ISO 19100 is a set of rules which have the objective of establishing, describing and managing geographic information. For our purposes, three of them are relevant since the application schema for cultural heritage that we will describe here is based on them to some extent:

- ISO 19101:2002 Geographic Information – Reference Model
- ISO/TS 19103:2005 Geographic Information – Conceptual Schema Language
- ISO 19109:2005 Geographic Information – Rules for Application Schema

ISO 19101:2002 Geographic Information – Reference Model

This international standard defines the framework for standardisation in the field of geographic information and sets forth the basic principles by which this standardisation should take place.

This framework identifies the scope of the standardisation activity being undertaken and the context in which it takes place. The framework provides the method by which the subject of the standardisation can be determined and describes how the contents of the standards are related.

Although structured in the context of information technology, this international standard is non-dependent on the application development method or on the implementation technology.

ISO/TS 19103:2005 Geographic Information – Conceptual Schema Language

ISO/TS 19103:2005 provides rules and guidelines for the use of a conceptual schema language within the ISO geographic information standards. The chosen conceptual schema language is the *Unified Modeling Language* (*UML*). It provides a profile of UML for geographic information and guidelines on how UML should be used to create standard geographic information and service models that are a basis for achieving interoperability.

Any UML schema identifies basic classes, specifies relationships, attributes and operations, and defines constraints using text/OCL.

The concept of *class* is central to conceptual modelling. A class is a description of a set of objects that share the same attributes, operations, methods, relationships and semantics. That is, it represents a concept being modelled.

ISO 19109:2005 Geographic Information – Rules for Application Schema

For each geographic dataset there is an application schema that contains the complete and precise definition of its content and structure. ISO 19109:2005 defines rules for creating and documenting application schemas, including principles for the definition of features. Its scope includes the following:

- Conceptual modelling of features and their properties from a universe of discourse.
- Definition of application schemas.
- Use of the conceptual schema language UML for application schemas.
- Transition from the concepts in the conceptual model to the data types in the application schema.
- Integration of standardised schemas from other ISO geographic information standards with the application schema.

The INSPIRE Data Specification on Protected Sites

The *INSPIRE Data Specification on Protected Sites* comprises the 9th theme of Annex I (*Protected Sites*), by the INSPIRE Thematic Working Group Protected Sites. All INSPIRE data specifications follow the structure of the standard ISO 19131:2007 (TC211 2007), and this one is no exception. This data specification includes the technical documentation of the application schema, the spatial object types with their properties, and other specifics of the spatial data themes using natural language as well as a formal conceptual schema language.

The *INSPIRE Data Specification on Protected Sites* applies to all protected sites that are defined by international, European or national legislation of Member States, even if the legislation is managed on a local or provincial level.

Data products based on this data specification are intended to be used for the following purposes:

- to generate European spatial data reports;

- to allow the public to query and view information about protected sites locally and regionally;
- to allow experts to visualise and analyse protected sites locally, regionally, nationally and Europe-wide;
- to allow experts and semi-experts to download data from a single country, a subset of countries or on a European level.

The *INSPIRE Data Specification on Protected Sites* defines *Protected Site* as "an area designated or managed within a framework of international, Community and Member States' legislation to achieve specific conservation objectives" (INSPIRE Thematic Working Group Protected sites 2010: 1).

There are, nonetheless, two main data specifications inside INSPIRE that might concern cultural heritage data: the Data Specification on Protected Sites (PS Data Specification), that develops the 9th theme of the Annex I, and the Data Specification on Area management/restriction/regulation zones and reporting units (AM Data Specification), that develops the 11th theme of Annex III (INSPIRE Thematic Working Group Area management / restriction / regulation zones and reporting units 2013). These data specifications include the technical documentation of the application schema, and a conceptual schema —expressed in UML— that defines the content and structure of the data required by one or more applications, thus guaranteeing its correct understanding.

The PS Data Specification extends the definition of *Protected site* given by the INSPIRE Directive by appealing to that of the International Union for Conservation of Nature (IUCN): "an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means" (INSPIRE Thematic Working Group Protected sites 2010: 1). According to this data specification the objectives for protection may include, among others, the protection of person-made objects including buildings, archaeological sites and other cultural objects.

The AM Data Specification covers a wide range designed to describe "zones established in accordance with specific legislative requirements to deliver specific environmental objectives related to any domain, such as air water, soil, biota (plants and animals), natural resources, land and land use". It may therefore overlap with *Protected sites*, in which case the AM Data Specification is to be used. It establishes a clear distinction for these overlapping cases: Protected sites are intended to manage, regulate and restrict activities to conserve nature, biodiversity and cultural heritage *exclusively*. When they are established to deliver multiple objectives, they should be made available as Area management / restriction / regulation zones objects.

Cultural heritage also overlaps with the Data Specification on Buildings (INSPIRE Thematic Working Group Buildings 2013), for architectural heritage is to be modelled as constructed buildings under that data specification. Nonetheless, many heritage features do not fit within the definition of a building provided by it. The Data Specification on Buildings will collect the real geometry of the building, that constitutes relevant information, leaving the geometry of the protected area apart.

The scope of cultural heritage data falls entirely within the definition of *Protected sites*, although their preservation in the face of development would require management measures modelled under the AM Data Specification, as it may be the case of controlling urban or industrial developments. Nevertheless, both data specifications include information regarding the legal conditions of areas protecting a cultural heritage site, but the actual feature being protected is omitted. This poses two different problems: the absence of a definition which can enable the incorporation of the legal specificities of cultural protected sites, and the characterization of a common framework to convey a minimum amount of data regarding the nature of the cultural heritage protected, which has a spatial dimension as well. The latter has been widely addressed under Annex III themes like *Habitats and Biotopes*, *Species Distribution* or *Buildings*, all of them linked to protected sites, but the specificity and diversity of cultural heritage sites is not to be found within any Annex III theme.

The Cultural Heritage Application Schema proposed in this paper suggests the inclusion of cultural heritage protected areas as a special kind of protected sites and develops a minimal schema to include information about the real-world protected entity. This approach involves some difficulties because, although culturally valued places are explicitly included in those definitions of what an INSPIRE protected site is, the corresponding data specification has been modelled on the particulars of natural protected sites. Overcoming these difficulties shall lead to the integration of legal aspects concerning cultural heritage protected sites but, as it has been pointed out, the PS Data Specification offers a narrow framework for protected sites as statutory designations (McKeague, Corns and Shaw 2012), centred mainly on attributes regarding legal aspects. The protected entity is incorporated as an attribute of the legal entity, using the same structure that the specifications that collect information on equivalent features: *Habitats and Biotopes* and *Species Distribution*.

In order to develop a specific data model to describe cultural heritage protected sites, to incorporate cultural heritage information into the INSPIRE schema, it is basic to clarify the place of the category *protected site* within cultural heritage, and to explore which additional spatial elements fall within the domain of cultural heritage. This is essentially aimed at clarifying to what extent, if any, cultural heritage places differ from other type of protected sites, and this is what the next section is about.

The Spatial Components of Cultural Heritage Information

Before presenting our data model and application schema, some preliminary discussion is needed in order to clarify the theoretical and conceptual foundations on which it will be based. What we need to do first is to set the boundaries of the domain we are dealing with, to define what cultural heritage is composed of. *Cultural heritage* is a wide ranging concept, complex and sometimes controversial. It has undergone some substantial changes in conception, scope and definition through time (see for instance Muriel 2007-8; Vecco 2010).Its study has traditionally fallen within the scope of many different academic or technical disciplines and skills: History, Art History, Anthropology, Archaeology, Museum Studies, etc. More recently, and in parallel to discussions about the nature and meaning of cultural heritage, specific fields of practice, such as Heritage Studies, have emerged (Carman and Sørensen 2009).

The boundaries of the Cultural Heritage domain

As previously said, cultural heritage is just collaterally mentioned in INSPIRE, only in a very specific form: that of protected sites. It is worth examining how INSPIRE defines the category of protected sites and, more specifically, how cultural heritage is mentioned in that definition. The first part of the definition has already been quoted above (see p. 12), and it is further elaborated:

> *"Within the INSPIRE context, Protected Sites may be located in terrestrial, aquatic and/or marine environments, and may be under either public or private ownership. They may include localities with protection targets defined by different sectors and based on different objectives. Objectives for protection may include: the conservation of nature; the protection and maintenance of biological di-*

versity and of natural resources and the protection of person-made objects including buildings, prehistoric and historic archaeological sites, other cultural objects, or sites with specific geological, hydrogeological or geomorphological value. Protected Sites may receive protection due to more than one type of objective, and may have a double or multifarious designation status" (INSPIRE Thematic Working Group Protected sites 2010: 1).

As clearly stated, INSPIRE is primarily concerned with natural protected sites; even the basic definition of what a protected site is has been taken from that context. Besides that, only a very specific part of the wider field of cultural heritage (to many, even minor) may be incorporated into that definition: that of the geographical locations protected, or regulated, for their cultural value by some legal, administrative proceeding. In fact, the concept of heritage is not even mentioned, but that of cultural resources, which actually implies a specific and partial portion of cultural heritage (see for instance Smith 2004). This, as arguable as it may be for many heritage experts, delimits the domain at which an INSPIRE derived data model must attend.

Cultural heritage has been commonly considered, at least in the West, as an object of value deserving of care and preservation by public institutions, be they local, regional, national or international (UNESCO is the most outstanding at the latter level). This idea of cultural heritage as a series of valuable things to be protected and preserved, is a "natural way of thinking about it", although it has been strongly challenged by recent approaches (for instance Byrne, Brayshaw, and Ireland 2003; Kirshenblatt-Gimblett 1995, 2004; Smith and Waterton 2009; Smith 2006), is a "common-sense definition", or the "natural way of thinking about it", as said (and criticized) by Smith and Waterton (2009, 12).

However, even adhering to a more or less traditional concept of heritage such as this, value is not an intrinsic characteristic of heritage elements (Tainter and Lucas 1983; Lipe 1984; Mason 2002). Particularly when considering it as a legal concept (a series of protected things) it must be acknowledged that heritage is not a collection of things, be they material or not, that can be defined objectively, as one can define for instance what a collection of guitars is. The condition of something as part of cultural heritage is the result of a process of value assignation that can be based on different criteria. Heritage does not exist by itself, it is constructed (Pearce 2000; Heinich 2011).

Our proposal is rooted, at its most general and abstract level, on the basic distinction proposed by Parcero-Oubiña and Gonzalez-Perez (forthcoming, see also Gonzalez-Perez and Parcero-Oubiña 2012) between two major classes of things in heritage: what they call *primary* and *derived entities*.

Primary entities are those things, either tangible or not, which when perceived are understood without the need to "be explained", without explicit interpretative processes. A building, a table, a song or a parade are all primary entities. Obviously perception is a culturally-mediated experience, but the point here is that the perception of those entities relies basically on sensorial abilities, rather than on a specific knowledge of subjective reasoning.

The character of primary entities is more easily understood by comparing them with the concept of *derived entities*: those entities whose perception is not direct and obvious, but that are created after an explicit process of interpretation. Consequently, we can only perceive them when they are introduced to us, or we know the logic behind their creation. A cultural landscape, an archaeological site or a UNESCO World Heritage Site are examples of derived entities: rather than seen, they are understood.

The difference between both concepts becomes even clearer if we think in geographical terms. The geometry, the limits of any primary entity, such as a building, may be equally detected by anyone, since it is embedded in the entity itself. However, the geometry, the extent of something like a cultural landscape is completely dependent on the criteria that have been followed to define it, and different subjects may argue for different versions of what that geometry should be.

This does not mean that derived entities are more intangible, abstract or less material than primary ones. The difference lies in the processes that bring them into existence. Gonzalez-Perez and Parcero-Oubiña elaborate on the concept of *archaeological sites*:

> *"The things that comprise it (walls, floors, pottery, etc.) are what we have just called primary entities, entities whose existence can be perceived by anyone; but the site itself is an interpretative concept built upon the aggregation of some of those entities that are considered to form part of a wider entity. That entity (its limits, both spatial and temporal, its function, etc.) is not understood on its own except when the logics behind its demarcation are explained" (forthcoming).*

Taking that perspective as a reference, the concept of a protected site finds its place as one of the possible types of derived entities, a subclass of things that are created by a process of value assignation. They typically embrace, or relate to, a series of primary entities, but they are different things. The data model we have developed tries to incorporate both dimensions of heritage sites: the primary entities that are to be protected and the valorization that converts them into protected sites.

In terms of spatial data, a consequence of this is that the geometry of a protected site (based on formal, legal or administrative decisions, as stated in the *Data Specification on Protected Sites*) is different from the geometry of the real-world phenomena that are protected within it (Figure 1). Even if they may be coincident at times, they are completely different realities. As has been suggested by Parcero-Oubiña and Gonzalez-Perez (forthcoming), they can be paralleled to Smith and Varzi's distinction between *fiat* and *bona fide* objects (Smith and Varzi 2000): while most cultural entities are *bona fide* objects, protected sites are *fiat* objects. In terms of geometry, Smith and Varzi describe the main difference between them:

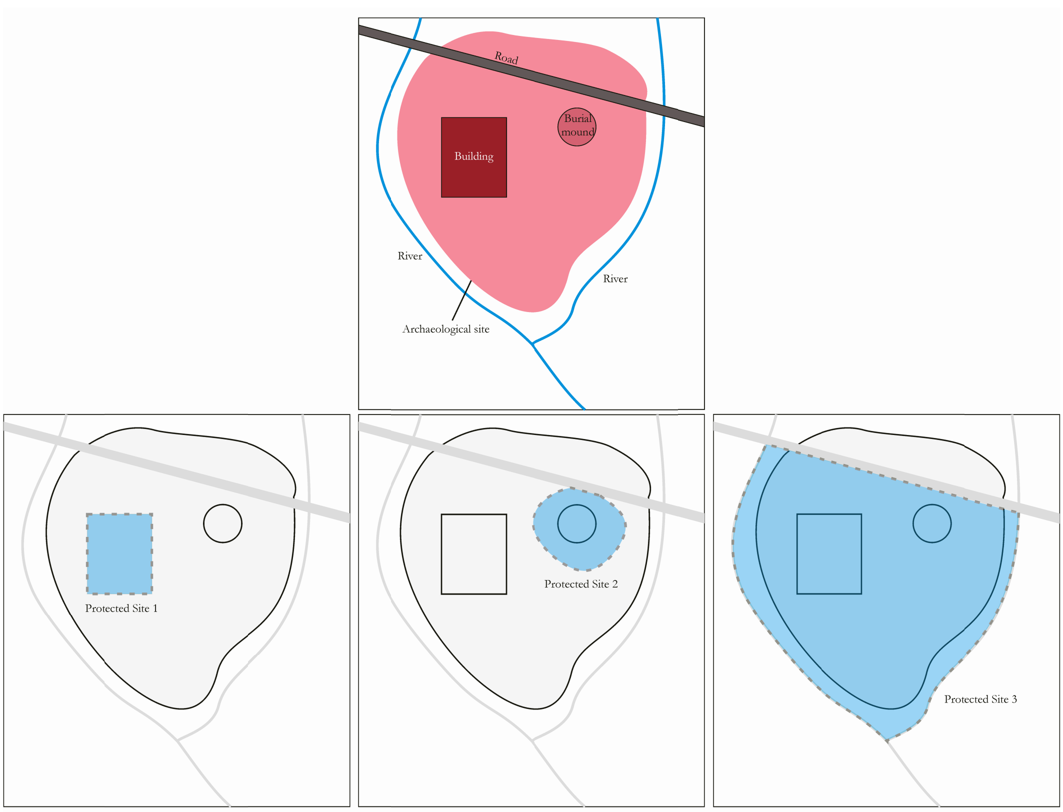


Figure 1. Any cultural entity may "produce" many different protected sites

"Certainly it may be possible, where one has a fiat boundary in a physical object, to generate a bona fide boundary in the corresponding place, e.g. by cutting. But [...] no pre-existent inner surface is brought to light by a process of cutting. Likewise, some national borders will in course of time come to involve boundary markers (barbed wire fences and the like) which will tend in accumulation to replace what is initially a pure fiat boundary with something more substantial. But this is not a process of transformation. The categorical distinction between fiat and bona fide boundaries is absolute" (2000: 409).

In practical terms, the distinction between the real-world phenomenon and the protected site, and their own different geometries, has some further benefits. Let us consider some hypothetical, but feasible, situations:

- Two entities that are objectively equal, or very similar, to each other; for instance, two small Romanesque chapels dating from the 12th century. They can be considered as part of differently valued protected sites. For instance chapel 1 may be protected only by a regional administration, implying that the protected area is restricted to the limits of the building itself, whereas chapel 2 may be considered as a national monument, implying that an area of 50 meters around the building is under protection. However, chapel 1 can be "upgraded" to national monument at any time, thus creating a new protected site on the basis of the same, unchanged real-world phenomenon.
- The condition, form or geometry of a real-world object can change with no corresponding effect on the protected site that encompasses it. For instance, a portion of a building may collapse, totally or partially, but the area subject to protection may remain intact for different reasons.

Therefore, considering cultural entities and protected sites as different, albeit connected, classes has a conceptual foundation, but also practical benefits. Changes in certain attributes of the former (including geometry) do not imply changes in attributes of the latter. Within the proposed model, a cultural entity must be described and mapped just once, although it can be included in many different protected sites (such as local urban planning, a national monument record or a World Heritage Site). This is an additional benefit of the model proposed: it minimizes the effort needed to incorporate information.

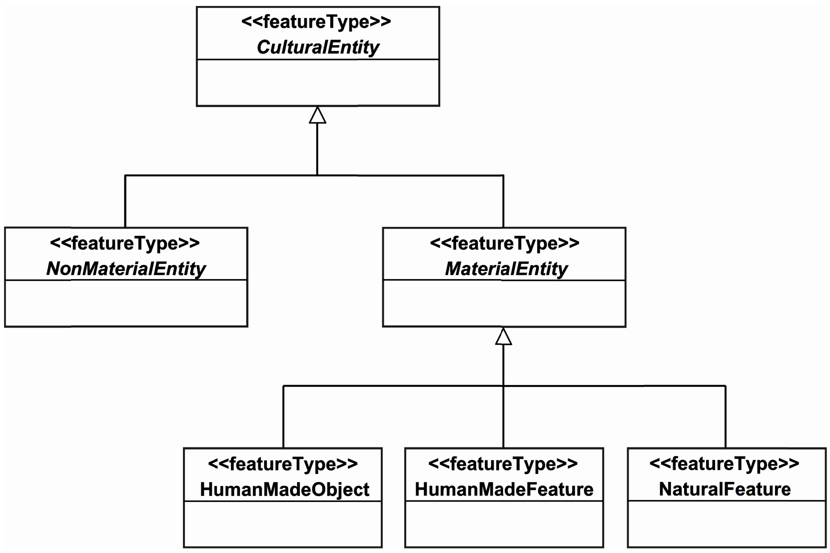


Figure 2. Simplified UML diagram (no attributes) of the subclasses of CulturalEntity

The proposal by Gonzalez-Perez and Parcero-Oubiña (2012, forthcoming) considers the existence of some other types of derived entities beyond protected sites. Even some of the things that we are considering here as cultural entities may be defined as having been produced following an explicit interpretative process. Consider, for instance, the examples of archaeological sites or cultural landscapes mentioned above. They may be converted into protected sites, but quite often they are defined within research processes. Seen from that perspective, the concept of cultural entity might be subdivided following that idea. However, INSPIRE is basically concerned with one type of evaluation, that which induces legal protection, so we have chosen here to observe that difference and to let the end user eventually add further detail and distinctions to this point.

As will be noted, our model is not very prescriptive and is highly abstract, so that it may be applied to any temporal or geographical context. However, there is more detail to it than just a mere distinction between legal objects (protected sites) and real-world objects (cultural entities). From the perspective of typical practices in Heritage Management, a rather common way of organizing heritage elements is to follow a widespread disciplinary classification that differentiates Architectural Heritage, Archaeological Heritage and Ethnographic Heritage (e.g. Querol 2010). However, our model does not follow that path. From a conceptual perspective, it does not correspond to a difference in entities, but to the different perspectives from which things are observed and described. It could be argued that a common agreement would allow most entities to be more easily ascribed to one of those "boxes". For instance, a cathedral could just easily be described as an architectural entity, or a Neolithic settlement as an archaeological site. However, many cases exist where such ascriptions are deeply arguable, denoting the essentially procedural and conventional nature of such "heritage types". Take, for instance, the Roman Coliseum; is it an architectural or an archaeological site? Or the Hungarian village of Hollókő; is it an architectural or an ethnographic site?

Despite all of this, our model acknowledges the fact that many protected heritage sites are described in terms of "disciplinary oriented" concepts. To allow the incorporation of that information, if necessary, the model includes a list of values relating to the nature of protection (see The legal part, p. 27).

A second conventional classification of heritage is that based on the concepts of tangible and intangible heritage and, within the former, of movable and built heritage (e.g. Ahmad 2006). According to the former distinction, places can be protected due to the existence of material entities or for their relationship with the development of "immaterial" cultural practices. Again, the categorical nature of this difference is rather arguable. In fact, although it is widely accepted and used, the very notion of intangible or immaterial heritage has been actively challenged (Smith and Akagawa 2008). Among other reasons, it has been argued that any form of heritage involves both material and immaterial dimensions (Munjeri 2004). Again, this is not a categorical distinction, and thus it is not a solid basis to classify heritage.

However, one cannot deny that reality is composed of things of different natures, both tangible and intangible, that are perceived and, consequently, described in different ways and by using different terms (attributes). The fact that both tangible and intangible entities exist as separate concepts in the model (Figure 2) does not mean that tangible and intangible cultural heritages could or should exist as separate concepts, nor that tangible and intangible protected sites exist: protected sites are by definition (fiat) tangible things, as long as they consist of portions of land (as opposed to intangible heritage elements such as tales, traditions, festivals, etc.). However, some specific cultural entities are distinctly tangible or intangible, such as a building or a song; this is inherent in their nature, and implies different mechanisms for describing and documenting them.

What is more, the model allows a protected site to be linked to both tangible and intangible entities, since the relationship is set at an extremely abstract, high level. For instance, a festival that is celebrated in the same church every year can be documented as two different real-world phenomena (the festival as an event, and the church as a building) that are linked to the same protected site, if the place where the event happens is to be protected due to its heritage value.

Denominating cultural entities and protected sites as separate (albeit connected) classes makes the need for a different consideration of both concepts more explicit, and brings the relevance of the spatial component within the heritage elements to the forefront. When dealing with protected natural sites, the value is typically embedded in the place itself that is protected. Characteristics that make a place naturally valuable are inherently attached to their geographical location, and cannot be set apart from each other. A hill, a lagoon or a marshy area, are all natural features that cannot be protected separately from the place where they are located. Rather than being located somewhere, natural places are best described as locations in themselves. This could also be the case with cultural entities. Indeed, the relevance of location and place in the characterization of cultural features has long been claimed in such disciplines as Cultural Geography (for instance Claval 1995), Anthropology (see Tuan 1974; or Ingold 2000) or Landscape Archaeology (for instance David and Thomas 2008) to name but a few. However, in Heritage Management, locations have been traditionally disregarded as merely contextual, and even circumstantial, attributes of objects and features. When describing cultural features, such as buildings or sites, heritage experts tend to focus on the formal characteristics, with the spatial dimension constituting just another attribute, rather than a property. Currently, in terms of preservation, heritage elements are sometimes preserved by removing them from their places of origin. Dealing with the two proposed categories of spatial objects (legal and cultural), allows us to make the different nature of both aspects explicit and to make clear the need for a different process of reasoning in their creation.

Formalizations of Cultural Heritage spatial data

As far as we know there are no previous proposals for technically integrating cultural heritage information within the INSPIRE framework (but see McKeague 2012; McKeague, Corns, and Shaw 2012). Although work has been done for the creation of heritage-related SDIs (e. g. Omtzigt et al. 2008; Lage et al. 2009; McKeague, Corns, and Shaw 2012; see also Parcero-Oubiña 2012), the conceptual or data models behind those experiences are usually not shown in detail. On the other hand, a number of proposals exist that provide either a general conceptual modelling of cultural heritage elements, well beyond its spatial dimension, or spatially-oriented data models for specific themes. They are not designed, however, to meet the INSPIRE requirements, although they may provide essential theoretical and conceptual foundations for the development of a new proposals.

A number of specific spatial data models for concrete thematic areas of the wider field of cultural heritage have been developed so far. Perhaps archaeology is one of the heritage-related disciplines where a greater consciousness of the need for the management of spatial data exists. As a result, detailed spatial data models exist, for instance, for the documentation of information about archaeological excavations (e. g. Meyer et al. 2007; Pfoser et al. 2007; Katsianis et al. 2008). Although partial in scope and too detailed for our purpose here, they provide a sound definition of concepts and relationships which facilitate their integration as extensions of the general model provided by the Cultural Heritage Application Schema.

With regard to models that engage cultural heritage as a whole, the CIDOC Conceptual Reference Model –CIDOC-CRM– (Doerr 2003; Crofts et al. 2010) is the best known and widespread proposal. CIDOC-CRM constitutes a major effort to build a comprehensive reasoning tool to describe many processes related to the description of heritage features, the documentation of the circumstances involved in their creation and life cycle, and the management of their present day condition. Developed in the context of the ICOM since the 1990s, it is especially aimed at “the curated knowledge of museums” and the management of “all information required for the exchange and integration of heterogeneous scientific documentation of museum collections” (Crofts et al. 2010: i–ii). CIDOC-CRM has attained the status of ISO standard ISO 21127:2006 (TC 46 / SC 4

2006) and has become a major tool for the integration of information in some fields within cultural heritage practice, as diverse as data from archaeological repositories (Tudhope et al. 2011) or ethnomusicology (Strle and Marolt 2012), among many others[5].

However, when considered from the perspective of geospatial information, some drawbacks exist to consider it as a direct source to build an INSPIRE-compliant data model. First, and foremost, CIDOC-CRM is not a data model and it hardly regards the spatial dimension, but rather it is a conceptual reference model, an ontology. It provides a framework of reference to allow the integration and interoperability of different datasets, but it does not define a data model itself (for instance, classes do not have attributes). As we will see later on, some of the capabilities it provides are useful, and some CIDOC-CRM concepts allow data in the Cultural Heritage Application Schema to be easily mapped in its terms, as has been done in other projects where the management of heritage-related spatial information was needed (e. g. Willmes et al. 2012).

However, besides that, two additional questions should be remarked. Firstly, CIDOC-CRM is primarily aimed at objects, rather than at geographical elements. This is not to say that CIDOC-CRM assumes that objects do not have a spatial dimension, or that their spatial location is not considered. Actually, it has developed a thorough and robust model to describe the spatial location of things (Doerr 2003: 87–88; Crofts et al. 2010: xix). However, this model is not primarily aimed at geographical representation or at the management of spatial objects, but at spatial reasoning: things and their spatial location are modelled as two separate classes. The key class there, *Place*, is defined as an abstract location, "in the pure sense of physics: independent from temporal phenomena and matter" (Crofts et al. 2010: 22). Geometry is not conceived as a property of things, but as one of the possible ways to describe a Place, which in its turn is a spatial location where things or objects can be found. This is an extremely rich and powerful model that allows, for instance, to easily describe changes in the location of things through time, which is very coherent with the primary concern that CIDOC-CRM has with objects and with its event-based character (Janowicz 2009). Besides that, it allows simple management of relative locations, which are considered to be "often more relevant in the context of cultural documentation and tend to be more precise" (Crofts et al. 2010: 22) than geospatial locations. Albeit as rich, coherent and powerful as this is, it is a totally different approach with regards to INSPIRE, where location and geometry are inherent properties of things. Examples of the integration of GIS spatial data with the CIDOC-CRM model result, as would be expected, in a data structure where things and spatial entities are two different classes of objects (e.g. Cripps et al. 2004; Hiebel, Hanke, and Hayek 2013).

MIDAS is another proposal worth mentioning here. It is a data standard developed under the coordination of English Heritage, "for information about the historic environment" in England (English Heritage 2012: 8). The MIDAS approach has been adopted and extended beyond England, as in the European project CARARE (Papatheodorou et al. 2011). MIDAS is not an abstract ontology, but a specific data model to document and describe different types of heritage elements. Any of the *Heritage Assets* it defines can be represented as spatial objects, by using what is called a *Map Depiction*. However, since this is not a spatially-oriented system, (1) location is not mandatory and (2) the digital nature of map representations is also optional: "The use of GIS is highly recommended. It provides additional options for recording spatial extents as well as extended querying functionality" (English Heritage 2012: 72). *Map Depiction* is, therefore, a separate class, instead of an embedded component of objects.

[5] A list of cases here.

The interesting point here, however, is the conceptual difference it establishes between the three types of possible Heritage Assets used to describe spatial entities: *Area*, *Monument* and *Artefact and ecofact*. These concepts set apart what can be described as real-world things (monuments and objects) and other heritage-relevant spatial locations, resulting from research or management processes and decisions. *Area* is defined as "a defined area of land, urban or seascape, of significance for an understanding of the historic environment and its management" (p. 25), and examples include areas covered by a research project, designated areas of protection, characterization areas, etc. This is very much in coincidence with the approach of the Cultural Heritage Application Schema, since it avoids the usual confusion when managing heritage elements between the description (and geometry) of designated areas and of the elements (features, objects) that are protected by those designations.

Such a common entanglement is found, for instance, in the CIDOC International Core Data Standard for Archaeological Sites and Monuments (Thornes and Bold 1998). Although not aimed at the use of spatial objects, location is here mandatory information that may be expressed in different ways, being geospatial location one of them. However, protection is conceived as one of the possible properties of monuments and sites, and so location is unique for both (for instance, a monument and its corresponding protected place will share the same location), which could easily cause redundancies or topological problems.

It could be argued that, not being focused on the management of spatial objects, topological questions are not a primary issue for the Core Data Standard. Nonetheless, it is only expected that databases developed in the realm of cultural resources management (CRM) reproduce the confusion between protected places and things protected. A typical CRM approach is that geometry corresponds to a protected demarcation, while descriptive attributes describe the real-world features within. A well-known case for us is that of the otherwise excellent information system of the Instituto Andaluz de Patrimonio Histórico (IAPH 2011). This, as we shall see later on, causes the confusing effect that changes in attributes of the cultural entity (including geometry) mean changes in attributes of the legal entity of protection.

The evaluation of the experiences mentioned as well as others alike led to the definition of the data model that is described in the following sections. Well established concepts and widespread reference models, such as CIDOC-CRM, have been especially considered, so that classes in the Cultural Heritage Application Schema were designed to be easily mapped against them if needed. A key difference, however, exists between the INSPIRE approach and most of the others, since it conceives the spatial dimension of things (location and geometry) as something inherent to them and embedded as one of their properties, rather than as a separate concept such as *Place* in CIDOC-CRM and other models.

An INSPIRE-compliant Data Specification on Cultural Heritage Protected Sites

We will now go on to present and describe in detail the data model and application schema proposed as a cultural heritage extension for the INSPIRE theme *Protected Sites*. In order to keep the model as standard and interoperable as possible, we have made use of several pre-existing schemas and standards wherever possible. This implies two things: interoperability with INSPIRE spatial data and interoperability among heritage data.

Interoperability with other spatial datasets is guaranteed by the integration of our model within already existent INSPIRE schemas; this is an extension and not an independent model. In addition, we have used some other ISO standards to incorporate complex fields of information such as chronology by ISO 19108:2002 (TC 211 2002).

On the other hand, interoperability with cultural heritage data is a little more complex, since one of the basic, long term issues with heritage information is the fragmentation and lack of integration and standard formal procedures for documentation. However, some significant advances have been made in recent years. The CIDOC Conceptual Reference Model (CIDOC-CRM) is one noteworthy example. Having attained the status of ISO standard, and despite its limited application for spatial data, we have used CIDOC-CRM categories and concepts as much as possible.

In addition, it is worth mentioning the Dublin Core Metadata Initiative (DCMI) and its Dublin Core Metadata Element Set, established as an ISO standard – ISO 15836:2009 (TC 46 / SC 4 2009) – and devoted to the description and cataloguing of documentary resources (see The documentary part, p. 34).

Building an Application Schema

Our efforts inside the INSPIRE workflow aim towards building an application schema that may become an interoperability framework for heritage datasets inside the *INSPIRE Data Specification on Protected Sites*. The ISO 19100 series holds clear statements on how to perform such a task, "focusing on abstract, implementation-neutral UML models that can serve as specifications for implementations using various implementation mappings" (ISO 19103 - TC211 2010, Annex F).

An *application schema* is a conceptual schema of the data required by one or more applications, bearing definitions of the features and processes required to produce spatial datasets (AEN/CTN 148 Información Geográfica Digital 2006: 8). It defines the content and structure of data, provides a machine-readable data description to enable the use of automated mechanisms for data management and guarantees a common and correct understanding of data through their documentation, in order to enable unequivocal data retrieval. The language required in INSPIRE to express a conceptual model is UML, as established by ISO 19103:2005.

As well as the main INSPIRE guidelines for building application schemas, the *INSPIRE Data Specification on Protected Sites* highlights the importance of some basic notions (INSPIRE Thematic Working Group Protected sites 2010: 7–9). We would particularly like to emphasize here the importance of stereotypes in order to be able to read, understand and use this document. Our *Cultural Heritage Application Schema* relies on the same stereotypes as the *INSPIRE Data Specification on Protected Sites*. The most relevant are:

- *featureType*: A spatial object type.
- *dataType*: A structure data type without identity.
- *enumeration* and *codeList*: Enumerations are fixed lists of elements that cannot be extended (e.g. the names of the days of the week). On the other hand, code lists are flexible lists of elements for expressing a list of potential values. There are two types of code lists, those managed centrally in the INSPIRE code list register, and those that can be added by data providers. Some of the latter have been crea-

ted for the development of the Cultural Heritage Application Schema.

- *voidable*: If a property receives this stereotype, the value *void* may be used, implying that the dataset holds no corresponding value. That is, a voidable attribute is not mandatory. A reason for that absence must be provided through the use of the code list *VoidValueReason*, with two predefined values: *Unpopulated*, if the characteristic is not part of the dataset (although it might exist in the real world), and *Unknown*, if the correct value is not known by the data provider.
- *lifeCycleInfo*: The possibility of distinguishing multiple versions of a spatial object.

The Cultural Heritage Application Schema

According to the general philosophy and theoretical foundations of the model, as detailed in the section The spatial components of cultural heritage information (p. 16), there are three main parts to our proposal: the *legal part*, the *cultural part* and the *documentary part*. This distribution enables different ways of extending the model depending on the nature of the implementation.

Furthermore, most of the model characteristics are set as voidable, so different applications may be built to meet the needs of a particular data provider. It is generic enough to embrace all kinds of heritage data, as long as they have a spatial reference, something which can be accomplished by the use of different standards, as we have already seen.

In the following sections we will introduce and discuss the schema, starting with an explanation of the main features of the Protected Sites schema that our proposal extends. A detailed documentation of all the classes, attributes and relationships may be found in Annex B. Full UML diagram (p. 45) and Annex C. Data Dictionary (p. 47).

The Protected Sites application schemas

The *INSPIRE Data Specification on Protected Sites* contains two application schemas, *Simple* and *Full* (Figure 3), as well as recommendations and data requirements on subjects such as data quality, metadata, delivery or portrayal. The Protected Sites Simple schema contains a very limited set of attributes, in which geometry and an identifier are the only *non-voidable* items (see Building an Application Schema, p. 24). The Protected Sites Full schema adds many attributes, all of them *voidable* as well, to allow null values when the required information is unknown, or it is not pertinent.

The main class of both schemas is simply called *ProtectedSite*. It holds information on the nature of the areas "of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means" (INSPIRE Thematic Working Group Protected sites 2010: VI). This implies the inclusion of different types of information:

- Legal aspects referring to the document that enable its protection, such as the date, a citation of the document, the expiry date (if there is one), the agency responsible for its protection, the type of protected site according to a predefined schema, the type of protected site according to the nature of the protected entity, an ownership indication and information about the official size of the protected site.
- Other aspects more related to its geographical nature: the site name, which refers to the geographical name and has to be filled in according to the *INSPIRE Data Specification on Geographical Names* (2009), the geometry that defines the location and limits of the protected site and the spatial resolution f this geometry.
- The real-world entities protected by a designated protected site and fully developed under other INSPIRE Annex III themes. As has been already pointed out, Annex III does not include any theme appropriate

for the incorporation of cultural heritage data.

- Another group of attributes is relevant only to natural protected sites and, although they might be appropriate for some types of heritage sites, they are not suitable for cultural heritage information, at least not in the way they are defined inside the *INSPIRE Data Specification on Protected Sites*. This is the case for attributes that refer to habitats, vulnerability, the Natura 2000 network management or even human activities that have an impact on the site's conservation.
- The attribute *timePeriod* is intended to be useful for this kind of cultural heritage data, but we regard its use in its current definition as rather problematic, and propose a *chronology* attribute included in the Cultural Heritage Application Schema to be used instead (see Chronology, p. 36). We consider chronology as an attribute of real-world entities that are included in protected sites, and not of the protected site itself, as a legal object; what is more, a legally defined protected site

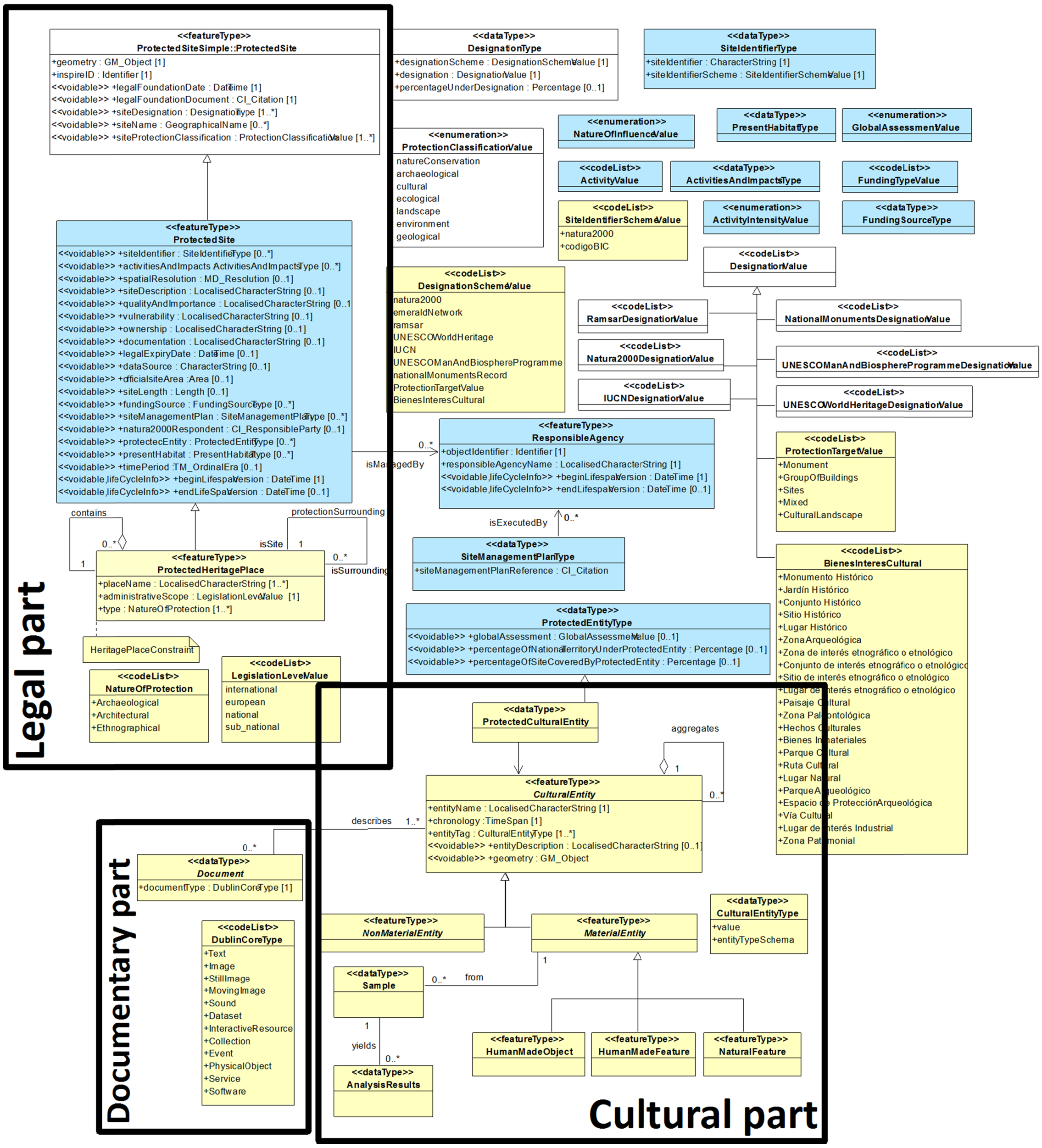


Figure 3. The Cultural Heritage Application Schema with indication of the three parts. More detailed views in the following sections and in Annex B. Full UML diagram (p. 45).

might contain several entities of different chronologies (see a more detailed discussion of this in The spatial components of cultural heritage information, p. 16)

- Finally, there is the chance to keep track of the versioning of the same spatial object through the use of the *lifeCycleInfo* characteristic in the *beginLifeSpanVersion* and *endLifeSpanVersion* attributes.

The Cultural Heritage Application Schema that we are presenting in this text complements the Protected Sites Full schema in two ways. Firstly, by adding a few attributes to some of the classes which already exist in the Protected Sites Full schema. Secondly, by adding a hierarchy of new classes that relate to the existing ones and which allow for the incorporation of the specificities of heritage data. Most of this will be described in detail in the following sections.

The legal part

Directly dependent on the INSPIRE *ProtectedSite* class, this part is focused on the new class *ProtectedHeritagePlace*. A protected heritage place is a protected site specifically devoted to cultural features. It is the main class in the heritage schema, the only required item to fill in. It inherits all the attributes of the *ProtectedSite* class, making some of their attributes compulsory through the use of a constraint, in an effort to offer a minimum of common information, beyond just an identifier and a geometry, which is the minimum required by the *INSPIRE Data Specification on Protected Sites*. It also adds three new attributes: *placeName*, *administrativeScope* and *type*. Implementations of the schema should therefore offer a *ProtectedHeritagePlace* class containing a series of mandatory attributes (and) including information on the following issues:

geometry

Spatial boundaries of the protected heritage place, those defined by the administration responsible for its protection and management. It must be defined following the schema established by ISO 19107:2003 (TC 211 2003). A protected heritage place is a protected site specifically devoted to cultural features.

inspireID

Identifier of the protected heritage place within INSPIRE, as specified in its Generic Conceptual Model (Drafting Team "Data Specifications" 2010: 94–98).

legalFoundationDate

Date of legal creation of the protected heritage place. It should be that of the foundation document (see below).

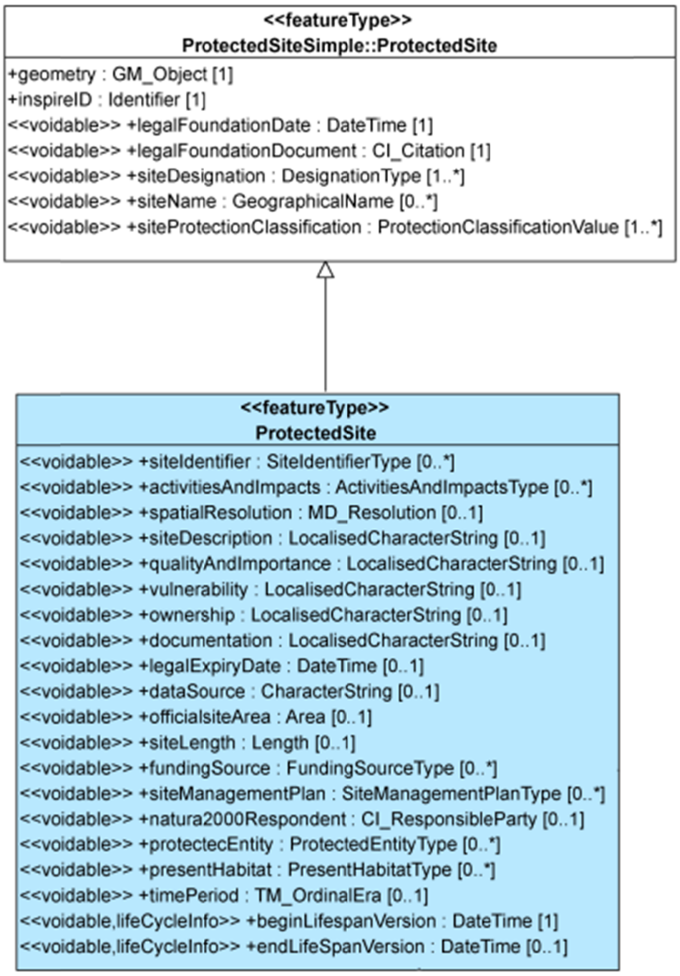


Figure 4. INSPIRE Simple and Full Protected Sites Schema

legalFoundationDocument

Reference of the legal act that created the protected heritage place. This reference consists of a web URL or a text citation.

siteDesignation

Type or category of a protected heritage place, according to a certain designation schema. A designation schema is a set of protection categories established by a certain institution in a specific field and for a specific purpose. Designation schemas are accommodated in the *DesignationSchemeValue* code list; the list of designations of each designation schema is stored in a code list. The Cultural Heritage Application Schema uses three designation schemas with their respective code lists, a pre-existing one taken from the Protected Sites Simple Application Schema (*UNESCOWorldHeritageDesignationValue*) and two added by us in order to enrich the cultural heritage description (*ProtectionTargetValue*, *BienesInteresCultural*). Furthermore, additional designation schemas may be incorporated to the data model by users in order to satisfy their specific needs[6]. The same protected site can have several designations.

- *UNESCOWorldHeritageDesignationValue*: This includes the basic categories of World Heritage inscriptions classification established by UNESCO: *natural*, *cultural* and *mixed*.
- *ProtectionTargetValue*: Type of protected heritage site according to the UNESCO *Operational Guidelines for the Implementation of the World Heritage Convention*[7]: *Monument*, *Group of Buildings*, *Sites*, *Mixed* and *CulturalLandscape*.
- *BienInteresCultural*: This schema has been taken from the Spanish heritage management framework and added to this data model due to its central role in this context. *Bien de Interés Cultural* (*BIC*) is the highest protection status that Spanish heritage institutions can afford a cultural entity. All the currently existing categories of BIC are in the designation schema code list (see a full list of BIC types in Querol 2010: 71–75), although it allows for the addition of new ones as they are defined by Spanish heritage administrations.

siteProtectionClassification

Classification of the protected heritage place based on the purpose for protection. The enumeration *ProtectionClassificationValue*, provided by the *INSPIRE Data Specification on Protected Sites*, includes the following values: *natureConservation*, *archaeological*, *cultural*, *ecological*, *landscape*, *environment*, *geological*. Only *cultural*, *archaeological* and partially *landscape* are related to cultural heritage. As long as archaeological sites and also landscapes are best regarded as a subtype of cultural sites, we propose the filling of the attribute as *cultural* in all cases, leaving further considerations for a new attribute called *type*.

siteIdentifier

An identifier is given to the protected heritage site by a certain manager, according to a national or international identification scheme. As opposed to *inspireID*, which is unique, there can be several site identifiers for the same protected site, as each one can be assigned by a different administration.

For instance, a building listed as a World Heritage Site may have a UNESCO identifier and a different National Monuments Record identifier as well as a different site identifier on a local, municipal level. As long as they refer to exactly the same spatial object, they are linked together by the corresponding unique INSPIRE identifier. However, if these three protected sites refer to a common cultural element but are different, independent spatial objects (the

---

[6] Actually, the Protected Sites Application Schema includes reference to a specific heritage codelist, the NationalMonumentsRecordDesignationValue, which is based on the British National Monuments Record (as defined here). However, following the some of the conceptual foundations of our proposal, the designations it includes relate to the elements that are protected rather than to the protected site itself.

[7] See last version in UNESCO WHC 2012 (Accessed February 08, 2013).

limits of the WHS are, or might be, different to the limits of the protected national monument), they must be considered as different protected sites.

spatialResolution

Spatial resolution of the geometry of the protected heritage place, as specified by ISO 19115:2003 (see Drafting Team Metadata and European Commission Joint Research Centre 2009). Spatial resolution depends on the way the data have been gathered and there are two alternative ways to express it: the cartographical scale the geometry is suitable for (*equivalent scale*), or the size of the smallest feature the geometry can represent, given in linear units (*distance*).

dataSource

Agency or organization responsible for maintaining and providing the data about the protected heritage place. In most Spanish cases it will be the corresponding Spanish regional administration, named *Comunidad Autónoma*, due to the decentralized character of heritage management in this country.

beginLifespanVersion

Date and time at which this version of the spatial object was inserted in the spatial dataset. There is also another attribute, *endLifespanVersion*, for indicating the date and time at which the version of the spatial object was declared obsolete (for example, if the limits of a protected heritage place have been retraced using a more accurate technique). In this case, this attribute is voidable, for there may be spatial objects that will not be removed at any point.

placeName

The place name of the protected heritage place which is used in the legal foundation document. This attribute is different to *siteName* in the *ProtectedSite* class, a voidable attribute intended to be completed with a pre-existing geographical name, as specified in the *INSPIRE Data Specification on Geographical*

Figure 5. ProtectedHeritagePlaces inherit from Simple and Full Schema Protected Sites

Names. The place name attribute, on the contrary, is not taken from a predefined gazetteer, but is entered by the info provider. Many protected heritage places are not mapped and, therefore, their names might not be included in any gazetteer (for instance *Yacimiento Arqueológico Cancho Roano* is the name of an archaeological site that is not included in the official gazetteer).

administrativeScope

Administrative scope of the legal definition of the protected heritage place. The code list *LegislationLevelValue* provides the values for this attribute: *International*, *European*, *National* and *sub-national*.

type

The reason advocated for the site's protection, depending on the scientific or academic discipline that provides the arguments for the creation of the protected site: *Archaeological*, *Architectural* and *Ethnographical* are proposed as possible values, with it being possible to select more than one. These values are in the code list *NatureOfProtection*, which may be extended with new categories if need be. It is important to note that this is not an attribute referring to the inherent nature of the cultural features themselves, but rather to the heritage evaluation one makes upon them. In fact many cultural entities can be "observed" and valorised from the perspective of several disciplines simultaneously. Here, the benefits of setting apart primary and derived entities can be well observed. For instance, a ruined church could be considered as an architectural and an archaeological element, and so could be part of both an architectural and an archaeological inventory. Sticking to a "traditional" disciplinary view on heritage classification would cause redundancies, since a single real-world entity (the ruined church) would be documented twice. Although the description and properties of the protected places created afterwards (including geometry) would be different depend-

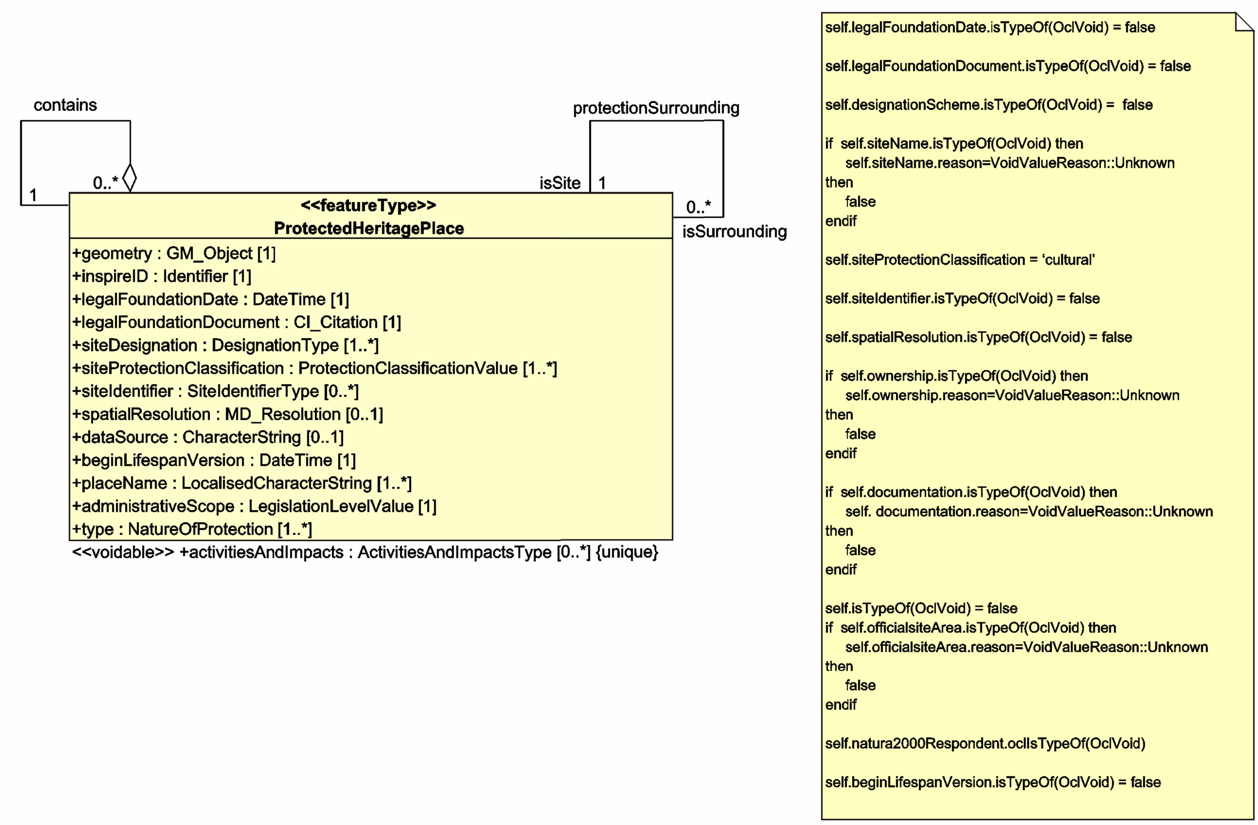


Figure 6. Non-voidable attributes of the ProtectedHeritagePlace and constraint

ing on the disciplinary standpoint, and two different legal objects exist, the properties and description of the church (including geometry) are unique and do not need to be captured twice (and quite possibly in different ways).

A thorough examination of the rest of the attributes will reveal the possibility of a much wider implementation of the legal part: most of the voidable attributes of the *ProtectedSite* class might be used for a cultural heritage application providing a richer approach to a heritage dataset.

An important example is the implementation of different stages in the protection of the same site through the use of the attributes *legalFoundationDate* and *legalExpiryDate*. Protected heritage sites in Spain may typically follow a sequence of legal forms that vary the degree of protection, or that are just different stages to be followed along the process of legal protection. For instance, a site may be included in the *Registro de Bienes Culturales* (national heritage record) first as "launched" (some sort of a preliminary stage) and then finally as "inscribed". By making full use of those two attributes, the site might be recorded as two different legal entities, with the first one (the "launched site") possessing both a *legalFoundationDate* and a *legalExpiryDate*, whose value coincides with the *legalFoundationDate* of the second one (the "inscribed site").

Furthermore, there are two common issues that might arise when working with Spanish legal heritage elements, and quite possibly elsewhere, that we have attempted to solve with this model.

The first one is the inclusion of several protected heritage sites in the legal definition of a wider protected heritage site. It is usual to refer to different protected heritage sites (such as archaeological areas, building complexes, etc.) that fall within the limits of a larger place (for example, a cultural landscape). The self-aggregation relationship named *contains* allows for this kind of behaviour, enabling an aggregation of objects of the same class.

The second one is the usual reference in a legal document to the site's protected surroundings, which may typically have a different legal condition and degree of protection, but whose existence is inseparably linked to the site itself. As long as the protected surroundings have a different geometry, identifier, area, etc., it should be instanced as a new object of the same class, and referred to through the self-association named *protectionSurrounding*.

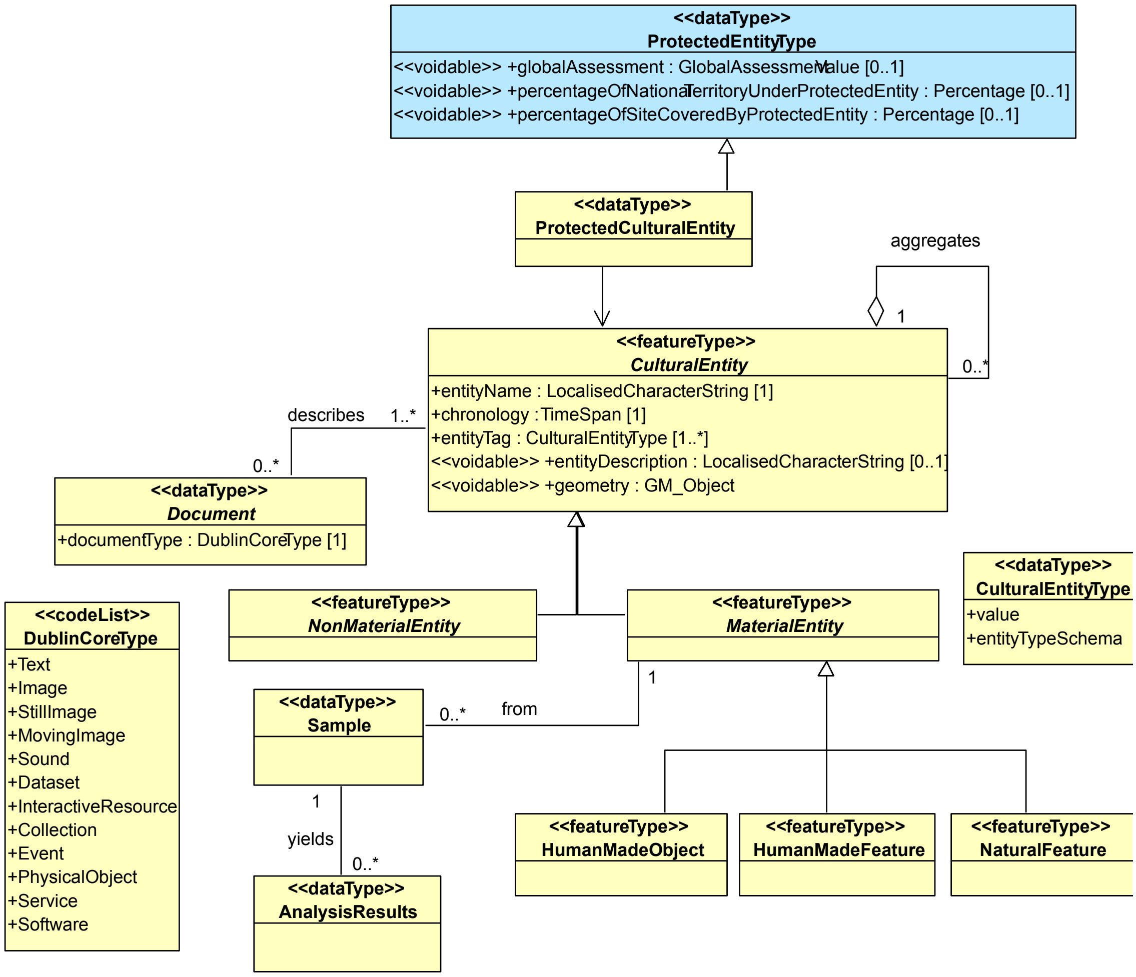


Figure 7. The cultural part of the schema

The cultural part

One of the voidable attributes in the *ProtectedSite* class is *protectedEntity*; that is, the real-world feature protected by the legal entity. In the case of natural protected entities, it is to be filled in with some of the complex objects included in Annex III of the INSPIRE Directive, such as *Habitats and Biotopes* or *Species Distributions*. However, cultural heritage is not contemplated in any INSPIRE document other than the *INSPIRE Data Specification on Protected Sites*. Therefore, we have assumed the task of proposing a schema in order to incorporate the real-world heritage features into the model which would be optional under any circumstances, as the attribute containing all these developments bears the voidable stereotype.

The cultural part focuses on the *CulturalEntity* class, which is designed to include all kinds of real-world entities regarded as cultural heritage. A cultural entity might be a whole building or an archaeological site. But it might also be a smaller feature such as a wall or a brick, with the building constituting an aggregation of those smaller features as well as a cultural entity. Thus, the disaggregation of the elements included in the model depends on the nature of the data gathered by the data provider. The self-aggregation relationship named *aggregates* enables this behaviour.

The *CulturalEntity* class inherits three attributes from the *ProtectedEntityType* class, which belongs to the Protected Sites Full Application Schema, and adds five more in order to develop the description of cultural heritage issues. Three of these attributes are mandatory:

entityName

The name of the entity, that might differ from the name of the protected heritage place it is linked to.

For instance, the World Heritage Site of Santiago de Compostela (Old Town) includes a number of different singular elements (buildings, public spaces, etc.) which can constitute spatial objects on their own.

chronology

All cultural entities have a story to tell which starts at the time they were made and, hopefully, reaches the present day. Our proposal is based on the implementation of the ISO 19108:2002 schema, the features of which will be explained in the following section (see Chronology, p. 36).

entityTag

There are many ways to classify cultural entities according to their nature, function, style, geographical and historical context, etc. Conceiving a universal classification of heritage objects, no matter how generic, would be an overwhelming task. Instead, data providers are encouraged to use a classification or thesaurus of their choice, as long as they specify the thesaurus used and the value adopted for the cultural entity within that thesaurus; the *CulturalEntityType* class includes this information. The thesaurus selected may be a pre-existing one; possible choices are the *UNESCO Thesaurus*, the *English Heritage Thesauri*, the *Art & Architecture Thesaurus* by the Getty Research Institute, and in the Spanish context the *Thesauri-Dictionaries on Spanish Cultural Heritage* or the *Tesauro de Patrimonio Histórico Andaluz*. However, a data provider may also use a classification or thesaurus created *ad hoc* to describe his/her own dataset, such as a basic functional classification of archaeological sites, a list of regional architectural styles or a typology of vessels.

In addition to this basic information, two more elements should be taken into consideration as voidable attributes: a textual description of the cultural entity (*entityDescription*) and, when available, its spatial definition (*geometry*). This implies that the cultural entity might have its own geometric definition, different from that of the protected heritage site that represents the definition of the legal protection. Should this attribute be left blank, only the definition of the legal figure would become available.

Cultural entities are subdivided into different classes in an effort to offer a sound generic framework for any kind of application that might be developed focusing on different aspects of these entities. However, our model will remain at a highly abstract level, so that it will be of application in any context, and every user will be able to incorporate into it the degree of detail and the specific categories of their choice.

The first classification of cultural entities is based on the very basic distinction between *tangible* and *intangible* entities. As we have already discussed (see The spatial components of cultural heritage information , p. 16), we are using here the concepts of tangible and intangible heritage to refer to the physical nature of things that may be related, grouped and regarded as heritage elements. Tangible and intangible elements are definitely different in how they are documented, described and spatially recorded. This is the rationale behind the subdivision of the class *CulturalEntity* into two subclasses *NonMaterialEntity* and *MaterialEntity*. This allows for the separate description and spatial referencing of the different types of things, events or manifestations that are considered relevant for the protection of a site.

On a more detailed level, a new subdivision within the class *MaterialEntity* should be taken into consideration, given the heterogeneity of elements contained within that class. As has already been mentioned, this is based on a standard in the field of cultural heritage, the Conceptual Reference Model (CIDOC CRM), from which we take three classes that embrace all kinds of material entities: *Man Made Object*, *Man Made Feature* and *Site* become respectively *HumanMadeObject*, *HumanMadeFeature* and *NaturalFeature* in our schema.

HumanMadeObject

Comprises physical features that are purposely created by human activity, and have a physical boundary that separates them from other objects, such as a wall or a building.

HumanMadeFeature

Refers to identifiable features human-altered or made, physically integrated inside other objects, with no clear boundaries that separate from them, such as a rock art engraving, a pit or a hypogeous.

NaturalFeature

Deals with pieces of land or sea constituting features singularly identifiable. A forest or a beach are examples of this class. Although cultural heritage refers primarily to human-made things, it is rather frequent that natural features are related to cultural manifestations (such as a tree being related to traditional legends or a forest being the place for a festival). It can also include places or elements of essentially natural quality, such as coppiced woodland.

Finally, we have added two classes (*Sample* and *AnalysisResults*) related to material entities in order to allow for the inclusion of information regarding a very widespread practice within heritage management and research; that of the exploration of physicochemical and biological characteristics of heritage objects. When a cultural entity is material, diverse analytical techniques originating from the natural sciences can be applied to it in order to determine its nature, condition, state of preservation, date, etc. The class *Sample* refers to the material item to be analysed and the class *AnalysisResults*, to the information yielded by each analytical technique carried out on that material. For example, a bone sample can be used for taphonomical analyses, radiocarbon dating, taxonomical assignation and paleodiet studies through trace elements, etc.

The documentary part

This part has been created in order to consider documents referring to cultural entities (Figure 8). A document, in general terms, is any resource that bears information about any aspect of reality (in our data model, cultural entities). The typology of documents is enormously diverse both in format and content, covering an endless spectrum of products; for example, an article describing several archaeological sites, a database of a museum inventory, a photograph of a painting, an architectural plan of a building, a recording of a traditional song, a video showing a ceremonial activity, a virtual reconstruction of an ancient landscape, a web page about traditional livestock trails, etc.

Documents have an autonomous existence and structure beyond the information strictly modelled by our application schema. By virtue of links between cultural entities and documents, data consumers will be able to search for and locate additional information to enrich and widen their knowledge.

The central class in this part is *Document*, meaning any kind of resource that contains information about another entity. In our model, the entities described are specifically cultural entities (*CulturalEntity*).

Just one attribute has been considered for the *Document* class, that referring to the basic type of resource. In any case, additional information about the characteristics (i.e. metadata) of each document can be included, thus extending the data model. According to the Dublin Core Metadata Element Set (specifically its attribute type), twelve specific kinds of documents have been considered[8]:

Text

Its distinctive feature is that it consists primarily of words for reading. According to cultural entities, it can refer to scientific publications, reports, etc.

---

[8] DCMI Type Vocabulary: Link (Accessed February 04, 2013).

Image

Any kind of visual representation.

StillImage

It is a subtype of image, characterized by its static nature, such as a photograph or a drawing. If the image is part of a textual material, Dublin Core recommends assigning the type *Text* to it.

MovingImage

It is another subtype of image, consisting of a series of these offering an impression of motion, such as videos or animations.

Sound

An acoustic representation, intended to be heard, such as story recordings, music, etc.

Dataset

A set of data stored or organized in a structured way, such as a list, a table or a database.

InteractiveResource

A resource requiring interaction from the user to be understood, executed, or experienced, such as web pages, virtual reality objects, etc.

Collection

It is an aggregation of resources. So it may contain documents of any kind.

Software

A computer program.

Service

A system that furnishes a certain function, such as a web server.

PhysicalObject

A real-world object.

Event

An occurrence that happens within a certain lapse of time.

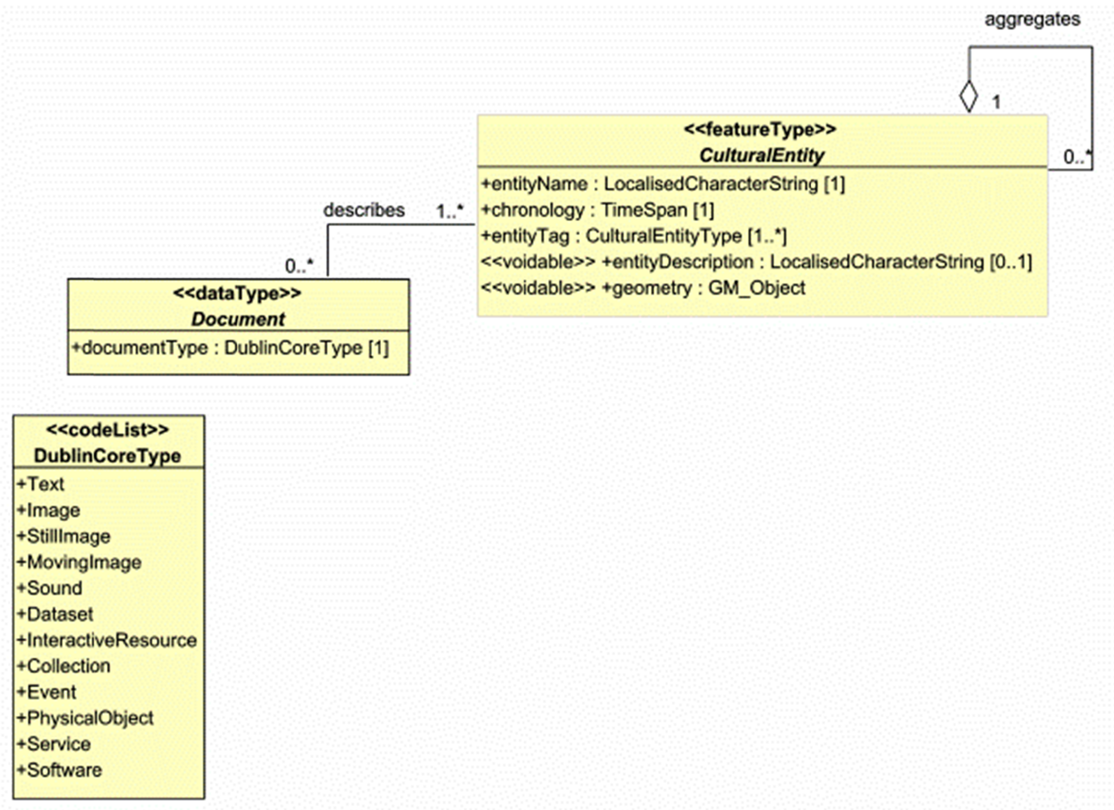


Figure 8. The documentary part

Chronology

For the description of the *chronology* attribute of the *CulturalEntity* class we rely on the implementation of ISO 19108:2002, which provides a sound schema to detail the timeline of a cultural entity, describing chronology as an element with geometry and topology in a single dimension. The timeline of a cultural entity starts at the moment of its creation and, in most cases, extends to the present day, or a moment in the past, marked by a series of events: creation, occupation, abandonment, re-occupation, modification, restoration, etc.

The schema consists of temporal objects that relate to a temporal reference system. Time is treated as a one-dimensional reality so it has both geometry and topology, like any of the spatial dimensions. Time objects might therefore be geometric or topological *primitives*; geometric primitives provide information about temporal position and duration, while topological primitives provide information on temporal contiguity and consecutiveness.

There are two primitive geometric classes, *instant* and *period*, that relate to the topological primitives *nodes* and *edges*, respectively. An instant is a zero-dimensional primitive that represents a position in time that must be associated to a temporal reference system, while a period is defined by a starting and a finishing point. Temporal reference systems must be appropriately documented, using a quote or a description and have a domain of validity that identifies the time and space within which that temporal reference system is valid.

There are different kinds of temporal reference systems. These may consist of ordinal temporal reference systems (e.g. those based on geological or archaeological periods), temporal coordinate systems (e.g. the Julian date), calendar dates (e.g. the Gregorian or the Islamic calendar) or clock times (e.g. 24-hour local times). This means that they can be as accurate or inaccurate as needed, so data providers may implement a rich and complex chronology referencing events with a precise date or there may simply be a rough chrono-

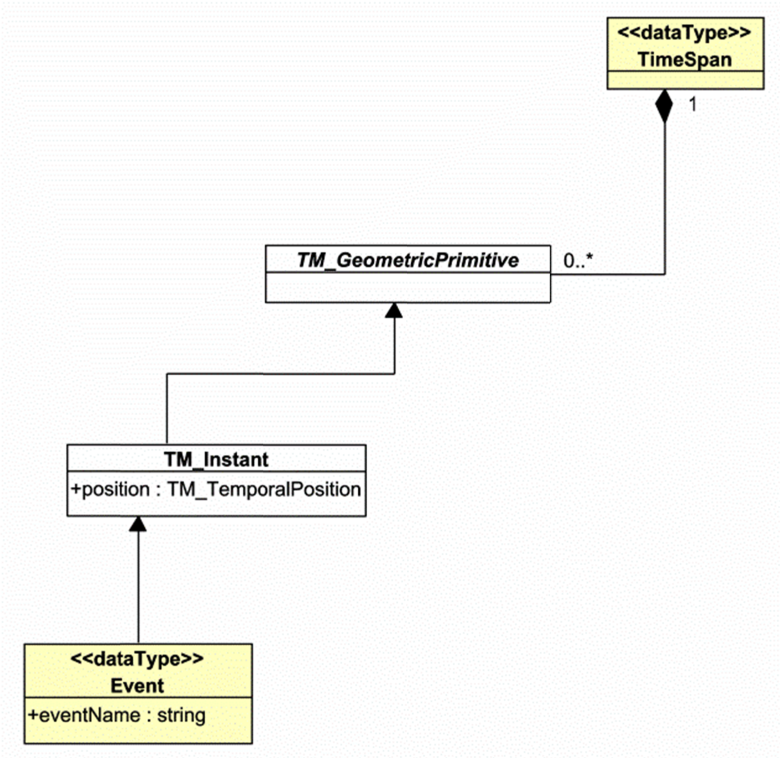


Figure 9. Insertion of the two new chronology classes within the ISO 19108:2002 schema

logical indication to apply to this attribute.

Within this rich schema, we propose the addition of two new classes to complete the description of the timeline of cultural entities (Figure 9):

TimeSpan

A collection of ISO 19108:2002 primitives that gathers the chronological timeline of a cultural entity For example, the moment of creation, the period of use, the time spent for a certain restoration or enlargement, the date of destruction, etc.

Event

Inherits from *TM_Instant*, adding a new attribute to specify the type of instant, may it be the creation of the entity, a modification, a restoration, its destruction, etc.

Concluding Remarks

Cultural heritage is, to a great and important extent, composed of elements with an inherent spatial dimension. In fact, the spatial component of heritage elements is all too often an essential part of their characterization and even of their subjective value as cultural goods. The INSPIRE Directive, issued "to support Community environmental policies, and policies or activities which may have an impact on the environment", represents both a commitment and an opportunity to integrate data and to spread, open up and share geographic data with the public.

Although cultural heritage is not central to the INSPIRE philosophy, it is somehow incorporated into it. INSPIRE presents, perhaps, a unique opportunity to promote and encourage the development of cultural heritage SDI in an interoperable framework, taking into account the spatial nature of this specific kind of data to enhance their role within territorial governance, to help managing their protection and research, to develop our understanding of past societies and to bring them closer to the general public.

We expect that this application schema may fulfill the implementation of heritage spatial data within the INSPIRE Directive, developing interoperability rules that will enable the harmonization and sharing of the protected heritage places datasets, through a Spatial Data Infrastructure for cultural heritage in Spain.

Actually, this Application Schema is currently being experimented in some archaeological SDIs: IDEArq, an SDI planned within the Spanish National Research Council (CSIC) and focused on the dissemination of archaeological project data; and IDEPatri, an SDI for the publication of descriptive and analytical information available regarding the Iron Age sites of the NW of the Iberian Peninsula.

We expect that the data model, whose conceptual foundations and basic structure have been presented in this paper, may contribute to that end: to fulfill the implementation of spatial heritage data within the INSPIRE framework, and to develop interoperability rules that will enable the harmonization and sharing of heritage information. We also hope that the open nature and rather abstract condition of the model (i.e., not proposing specific types of heritage objects but rather high level classes) will help to build bridges between datasets created and maintained in different environments, by different types of agents and with different interests in mind: public administrations, research institutions, museums, but also the general public, a relation that holds great potential in supporting policies and activities that have an impact upon our widely cultural environment.

Acknowledgements

This work has been partially supported by the Spanish Government through the projects "Investigación en tecnologías para la valoración y conservación del Patrimonio Cultural" (CONSOLIDER INGENIO 2010 CSD2007-00058) and SPATRIAL-"Definición de un Modelo para la Representación de Aspectos Espaciales del Patrimonio" (HAR2009-1226, Programa Nacional de I+D+I, Ministry of Science).

The authors wish to thank the anonymous reviewers for their useful comments.

References

AEN/CTN 148 Información Geográfica Digital. 2006. *UNE-EN ISO 19101:2006. Información geográfica. Modelo de referencia (ISO 19101:2002)*. Madrid: AENOR.

Ahmad, Yahaya. 2006. The Scope and Definitions of Heritage: From Tangible to Intangible. *International Journal of Heritage Studies* 12(3):292–300.

Buzai, Gustavo D., and Claudia A. Baxendale. 2006. *Análisis socioespacial con Sistemas de Información Geográfica*. Buenos Aires: GEPAMA.

Byrne, Denis, Helen Brayshaw, and Tracy Ireland. 2003 *Social Significance. A discussion paper*. Hurstville: NSW National Parks and Wildlife Service.

Carman, John, and Marie Louise Stig Sørensen. 2009. Heritage Studies: An outline. In *Heritage Studies. Methods and* Approaches. John Carman and Marie Louise Stig Sørensen, eds. Pp. 1-28. Oxon and New York: Routledge.

Claval, Paul. 1995. *La Géographie culturelle*. Paris: Nathan.

Corns, Anthony J., and Robert Shaw. 2010. Cultural Heritage Spatial Data Infrastructures (SDI) - Unlocking the Potential of our Cultural Landscape Data. In *30th EARSeL Symposium. Remote Sensing for Science, Education, and Natural and Cultural Heritage. UNESCO, Paris (France), 31 May - 3 June 2010*. Rainer Reuter, ed. Pp. 1-8. Paris.

Craglia, Massimo, and Michele Campagna. 2009. *Advanced Regional Spatial Data Infrastructures in Europe*. Luxemburg: Institute for Environment and Sustainability, European Comission Joint Research Centre.

Cripps, Paul, Anne Greenhalgh, Dave Fellows, Keith May, and David Robinson. 2004. Ontological Modelling of the work of the Centre for Archaeology. http://www.cidoc-crm.org/docs/Ontological_Modelling_Project_R eport_%20Sep2004.pdf (Accessed October 15, 2013).

Crofts, Nick, Martin Doerr, Tony Gill, Stephen Stead, and Matthew Stiff. 2010. *Definition of the CIDOC Conceptual Reference Model*. ICOM/CIDOC CRM Special Interest Group.

David, Bruno, and Julian Thomas, eds. 2008. *Handbook of landscape archaeology*. Walnut Creek: Left Coast Press.

Del Bosque González, Isabel, and Juan M. Vicent García. 2011. Las Infraestructuras de Datos Espaciales (IDE) y el Patrimonio Histórico. Constitución y objetivos del GTT-PAH. *Revista PH* 77:142–144.

Doerr, Martin. 2003. The CIDOC Conceptual Reference Module. An Ontological Approach to Semantic Interoperability of Metadata. *AI Magazine* 24:75-92.

Doerr, Martin. 2003. The CIDOC Conceptual Reference Module. An Ontological Approach to Semantic Interoperability of Metadata. *AI Magazine* 24:75-92.

Drafting Team "Data Specifications". 2010. *INSPIRE Generic Conceptual Model*. European Commission Joint Research Centre. http://inspire.jrc.ec.europa.eu/documents/Data_Specifications/D2.5_v3.2.pdf (accessed October 15, 2013).

Drafting Team Metadata and European Commission Joint Research Centre. 2009. *INSPIRE Metadata Implementing Rules: Technical Guidelines based on EN ISO 19115 and EN ISO 19119*. European Commission Joint Research Centre. http://inspire.jrc.ec.europa.eu/reports/ImplementingRules/metadata/MD_IR_and_ISO_20090218.pdf (accessed October 15, 2013).

English Heritage. 2012. *MIDAS Heritage - the UK Historic Environment Data Standard*. http://www.english-heritage.org.uk/publications/midas-heritage/midas-heritage-2012-v1_1.pdf (accessed October 15, 2013).

Fernández Freire, Carlos, Isabel del Bosque González, Juan M. Vicent García, Esther Pérez Asensio, Alfonso Fraguas Bravo, Antonio Uriarte González, Pastor Fábrega-Álvarez, and César Parcero-Oubiña. 2013. A Cultural Heritage Application Schema: Achieving Interoperability of Cultural Heritage Data in INSPIRE. *International Journal of Spatial Data Infrastructures Research* 8:74-97. http://ijsdir.jrc.ec.europa.eu/index.php/ijsdir/article/view/315/355 (accessed February 20, 2014).

Gonzalez-Perez, Cesar, and César Parcero-Oubiña. 2012 A Conceptual Model for Cultural Heritage Definition and Motivation. In *Revive the Past: Proceedings of the 39th Annual Conference of Computer Applications and Quantitative Methods in Archaeology (CAA), Beijing, China, 12-16 April 2011*. Mingquan Zhou, Iza Romanowska, Zhongke Wu, Pengfei Xu and Philip Verhagen, eds. Pp. 234-244. Amsterdam: Amsterdam University Press.

Guimet, Jordi. 2004. Les infraestructures de Dades Espacials (IDE), un nou paradigma en el domini de la informació geoespacial. L'exemple del projecte IDEC. Coneixement i Societat. *Revista d'Universitats, Recerca i Societat de la Informació* 5:122–131.

Heinich, Nathalie. 2011. The Making of Cultural Heritage. *The Nordic Journal of Aesthetics* 22:119-128.

Hiebel, Gerald, Klaus Hanke, and Ingrid Hayek. 2013. Methodology for CIDOC CRM Based Data Integration with Spatial Data. In *CAA 2010 Fusion of Cultures. Proceedings of the 38th Annual Conference on Computer Applications and Quantitative Methods in Archaeology, Granada, Spain, April 2010*. Francisco Contreras, Mercedes Farjas and Francisco José Melero, eds. Pp. 547-554. Oxford: Archaeopress.

IAPH. 2011. *Recomendaciones técnicas sobre la georreferenciación de entidades patrimoniales.* http://www.iaph.es/export/sites/default/galerias/patrimonio-cultural/documentos/gestion-informacion/RTCI_6_georreferenciacion_v1.3.pdf (accessed October 15, 2013).

Ingold, Tim. 2000. *The perception of the environment: essays on livelihood, dwelling and skill*. London: Routledge.

INSPIRE. 2007. *Directive 2007/2/EC of the Council of the European Union and European Parliament setting up an Infrastructure for Spatial Information in the European Community (INSPIRE).* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32007L0002:en:NOT (accessed October 15, 2013).

INSPIRE Thematic Working Group Geographical Names. 2009. *D2.8.I.3 INSPIRE Data Specification on Geographical Names – Guidelines*. European Commission Joint Research Centre. http://inspire.jrc.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_GN_v3.0.pdf (accessed October 15, 2013).

INSPIRE Thematic Working Group Protected sites. 2010. *D2.8.I.9 INSPIRE Data Specification on Protected Sites – Guidelines v3.1.* European Commission Joint Research Centre. http://inspire.jrc.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_PS_v3.1.pdf (accessed October 15, 2013).

INSPIRE Thematic Working Group Area management / restriction / regulation zones and reporting units. 2013. *D2.8.III.11 INSPIRE Data Specification on Area management / restriction / regulation zones and reporting units - Draft Technical Guidelines*. European Commission Joint Research Centre. http://inspire.jrc.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_AM_v3.0rc3.pdf (accessed February 20, 2014).

INSPIRE Thematic Working Group Buildings. 2013. *D2.8.III.2 Data Specification on Buildings – Technical Guidelines*. European Commission Joint Research Centre. http://inspire.jrc.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_BU_v3.0.pdf (accessed February 20, 2014).

Janowicz, Krzysztof. 2009. The Role of Place for the Spatial Referencing of Heritage Data. In *The Cultural Heritage of Historic European Cities and Public Participatory GIS*. York: University of York. http://www.york.ac.uk/res/isthmus/ISTHMUS_Site/JISC_Workshop.html (accessed February 20, 2014).

Kirshenblatt-Gimblett, Barbara. 1995. Theorizing Heritage. *Ethnomusicology* 39:367-380.

Kirshenblatt-Gimblett, Barbara. 2004. Intangible Heritage as Metacultural Production. *Museum International* 56:52-65.

Lage, Miguel, Anthony J. Corns, Juan Luis Pecharromán, and Robert Shaw. 2009. Integration of European Cultural Landscapes Data within Spatial Data Infrastructures (SDI). In *From Present to Past Through Landscape*. Almudena Orejas, David Manttingly and Monique Clavel-Lévêque, eds. Pp. 221-228. Madrid: CSIC.

Lipe, William D. 1984. Value and meaning in cultural resources. In *Approaches to the Archaeological Heritage. A Comparative Study of World Cultural Resource Management Systems*. Henry Cleere, ed. Pp. 1-11. Cambridge: Cambridge University Press.

Mas Mayoral, Sebastián. 2008. El cambio de paradigma de la Cartografía. De la Cartografía al servicio del poder a la interoperabilidad de los servicios de información geográfica. *CT/Catastro* 64:7–36.

Mason, Randall. 2002. Assessing Values in Conservation Planning: Methodological Issues and Choices. In *Assessing the Values of Cultural Heritage*. Marta de la Torre, ed. Pp. 5-30. Los Angeles: The Getty Conservation Institute.

McKeague, Peter. 2012. Historic Environment and INSPIRE – A View from Scotland. In *Progress in Cultural Heritage Preservation*. Marinos Ioannides, Dieter Fritsch, Johanna Leissner, Rob Davies, Fabio Remondino and Rossella Caffo, eds. Pp. 833-840. Springer-Verlag.

McKeague, Peter, Anthony J. Corns, and Robert Shaw. 2012. Developing a Spatial Data Infrastructure for Archaeological and Built Heritage. *International Journal of Spatial Data Infrastructures Research* 7:38–65.

Munjeri, Dawson. 2004. Tangible and Intangible Heritage: from difference to convergence. *Museum International* 56:12-20.

Muriel, Daniel. 2007-2008. El Patrimonio como Tecnología para la Producción y Gestión de Identidades en la Sociedad del Conocimiento. *Revista Chilena de Antropología* 19:63-87.

Nebert, D., ed. 2004. *The SDI Cookbook*. GSDI. http://www.gsdi.org/docs2004/Cookbook/cookbookV2.0.pdf (accessed January 15, 2014).

Omtzigt, Nancy, Nils de Reus, Eric Koomen, and Alessandra Arezza. 2008. The construction of a Spatial Data Infrastructure for cultural heritage. In *Collaboration and the knowledge economy: issues, applications, case studies*. Paul Cunningham and Miriam Cunningham, eds. Pp. 1366-1373. Amsterdam: IOS Press.

Papatheodorou, Christos, Phil Carlisle, Christian Ertmann-Christiansen, and Kate Fernie. 2011. *The CARARE metadata schema, v.2.0*. http://www.carare.eu/bul/content/download/11454/98739/file/The%20CARARE%20metadata%20schema2.pdf (accessed January 15, 2014).

Parcero-Oubiña, César. 2012. Heritage-Oriented Spatial Data Infrastructures in Spain: Waiting on the World to Change. In In *Progress in Cultural Heritage Preservation*. Marinos Ioannides, Dieter Fritsch, Johanna Leissner, Rob Davies, Fabio Remondino and Rossella Caffo, eds. Pp. 692-700. Springer-Verlag.

Parcero-Oubiña, César, Pastor Fábrega-Álvarez, Juan M. Vicent García, Antonio Uriarte González, Alfonso Fraguas Bravo, Isabel del Bosque González, Carlos Fernández Freire, and Esther Pérez Asensio. 2013. Conceptual basis for a cultural heritage data model for INSPIRE. *Revue Internationale de Géomatique / International Journal of Geomatics and Spatial Analysis* 23(3-4): 445-467.

Parcero-Oubiña, C., and César González-Pérez. Forthcoming. What does Cultural Heritage involve? An abstract conceptual model of Cultural Heritage.

Pearce, Susan M. 2000. The Making of Cultural Heritage. In *Values and Heritage Conservation*. Erica Avrami, Randall Mason and Marta de la Torre, eds. Pp. 59-64. Los Angeles: The Getty Conservation Institute.

Querol, María Ángeles. 2010. *Manual de Gestión del Patrimonio Cultural*. Madrid: Akal.

Rodríguez Pascual, Antonio, Paloma Abad Power, José Ángel Alonso Jiménez, Alejandra Sánchez Maganto, Juan Emilio Ayuso González, and Luis Vilches Blázquez. 2007. Las IDE como evolución natural de los SIG. *Boletic* 41:60–67. http://www.astic.es/la-asociacion/boletic/boletic-n%C2%BA-41-marzo-2007 (accessed January 15, 2014).

Rodríguez Pascual, Antonio, Paloma Abad Power, Emilio López Romero, and Alejandra Sánchez Maganto. 2005. La infraestructura de datos Espaciales de España (IDEE): una realidad emergente. *Topografía y Cartografía* 22:26–31.

Smith, Barry, and Achille C. Varzi. 2000. Fiat and Bona Fide Boundaries. *Philosophy and Phenomenological Research* 60:401-420.

Smith, Laurajane. 2004. *Archaeological Theory and the Politics of Cultural Heritage*. New York: Routledge.

Smith, Laurajane. 2006. *Uses of Heritage*. London and New York: Routledge.

Smith, Laurajane, and Natsuko Akagawa, eds. 2008. *Intangible Heritage. Key Issues in Cultural Heritage*. Oxon and New York: Routledge.

Smith, Laurajane, and Emma Waterton, eds. 2009. *Taking Archaeology out of Heritage*. Newcastle-upon-Tyne: Cambridge Scholars Press.

Snow, Dean R., Mark Gahegan, C. Lee Giles, Kenneth G. Hirth, George R. Milner, and Prasenjit Mitra. 2006. Cybertools and Archaeology. *Science* 311:958-959.

Strle, Gregor, and Matija Marolt. 2012. The EthnoMuse digital library: conceptual representation and annotation of ethnomusicological materials. *International Journal on Digital Libraries* 12:105-119.

Tainter, Joseph A., and G. John Lucas. 1983. Epistemology of the significance concept. *American Antiquity* 48:707–719.

TC 46 / SC 4. 2006. *ISO 21127:2006. Information and documentation - A reference ontology for the interchange of cultural heritage information*. International Organization for Standardization.

TC 46 / SC 4. 2009. *ISO 15836:2009 Information and documentation -- The Dublin Core metadata element set*. International Organization for Standardization.

TC 211. 2002. *ISO 19108:2002. Geographic informaction - Temporal schema*. International Organization for Standardization.

TC 211. 2003. *ISO 19107:2003 Geographic Information – Spatial Schema*. International Organization for Standardization.

TC 211. 2003. *ISO 19115:2003. Geographic information - Metadata*. International Organization for Standardization.

TC 211. 2005. *ISO 19109:2005. Geographic information - Rules for application schema*. International Organization for Standardization.

TC 211. 2007. *UNE-EN ISO 19131: 2007. Geographic information - Data product specifications*. International Organization for Standardization.

TC 211. 2010. *Revision of ISO/TS 19103:2005. Geographic information - Conceptual Schema Language*. International Organization for Standardization.

Thornes, Robin, and John Bold, eds. 1998. *Documenting the Cultural Heritage*: Getty Information Institute.

Tudhope, Douglas, Keith May, Ceri Binding, and Andreas Vlachidis. 2011. Connecting archaeological data and grey literature via semantic cross search. *Internet Archaeology* 30.
http://intarch.ac.uk/journal/issue30/ (accessed January 15, 2014).

Tuan, Yi-Fu. 1974. *Topophilia: a study of environmental perception, attitudes, and values*. Englewood Cliffs: Prentice-Hall.

Uriarte González, Antonio, César Parcero-Oubiña, Alfonso Fraguas Bravo, Pastor Fábrega-Álvarez, Juan M. Vicent García, Esther Pérez Asensio, Carlos Fernández Freire, and Isabel del Bosque González. 2013. Cultural Heritage Application Schema: a SDI framework within the Protected Sites INSPIRE Spatial Data Theme. In *Archaeology in the Digital Era. Papers from the 40th Annual Conference of Computer Applications and Quantitative Methods in Archaeology (CAA), Southampton, 26-29 March 2012*. Graeme Earl, Tim Sly, Angeliki Chrysanthi, Patricia Murrieta-Flores, Constantinos Papadopoulos, Iza Romanowska and David Wheatley, eds. Pp. 283-294. Amsterdam: Amsterdam University Press.

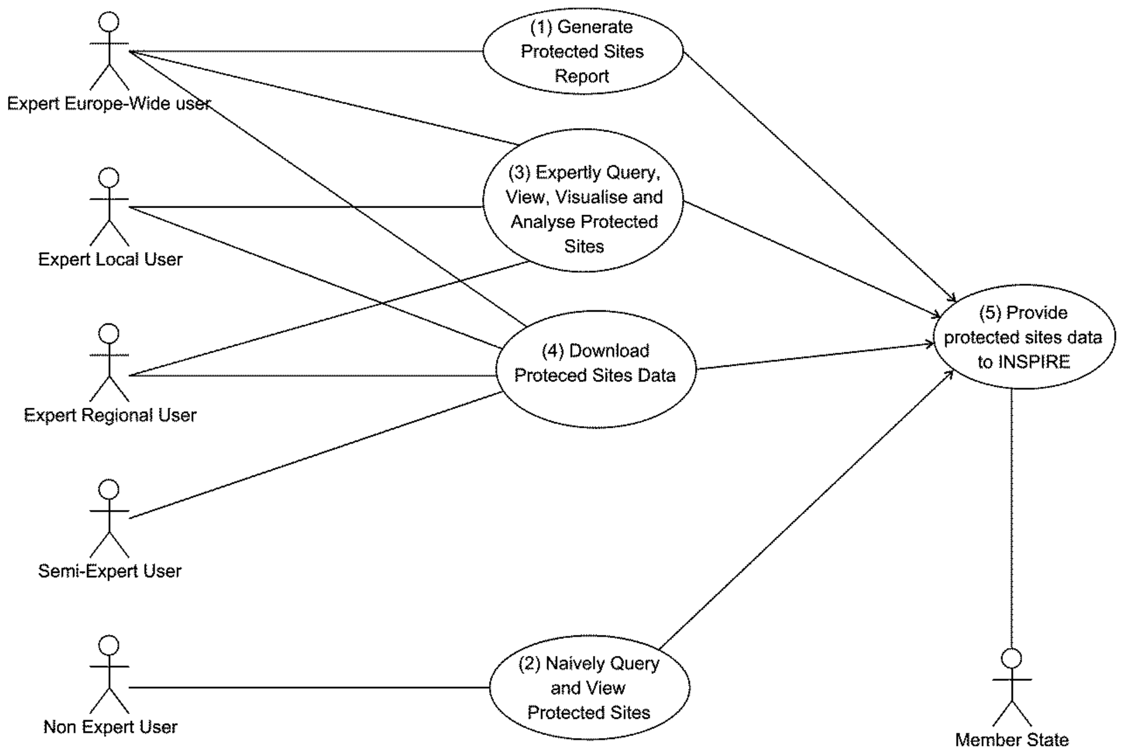
Vecco, Marilena. 2010. A definition of cultural heritage: From the tangible to the intangible. *Journal of Cultural Heritage* 11:321–324.

Vicent García, Juan M. 2007. La Arqueología a comienzos del siglo XXI: Ciencia, tecnología, valores y sociedad. In *XII Jornadas de Estudios sobre Lanzarote y Fuerteventura*. Pp. 325-347. Lanzarote: Cabildo Insular de Lanzarote.

Willmes, C., S. Brocks, D. Hoffmeister, C. Hütt, D. Kürner, K. Volland, and G. Bareth. 2012. Facilitating integrated spatio-temporal visualization and analysis of heterogeneous archaelogical and palaeonvironmental research data. *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences* I (2):223-228.

ANNEX A. USE CASES

Protected Sites (from Protected Sites)



Use Case - (1) Generate Protected Sites Report	
Priority	High
Description	The user analyzes cross-border datasets on Protected Sites (for example, those created in Use Case 5) up to a European extent by means of a GIS application to create overview-maps and/or tabulations on Protected Sites data. The results will be part of special reports of different kinds such as progress in area coverage of Protected Sites per category in the EU (indicators) and composite assessments of the implementation of the EU Directives at the European or bio-geographical level
Pre-condition	Quality controlled Protected Sites data sets are available to the user in line with INSPIRE specifications and the INSPIRE registry provides all necessary information for standardised access to data. The user has access to the INSPIRE GenerateReport Web Processing Service.

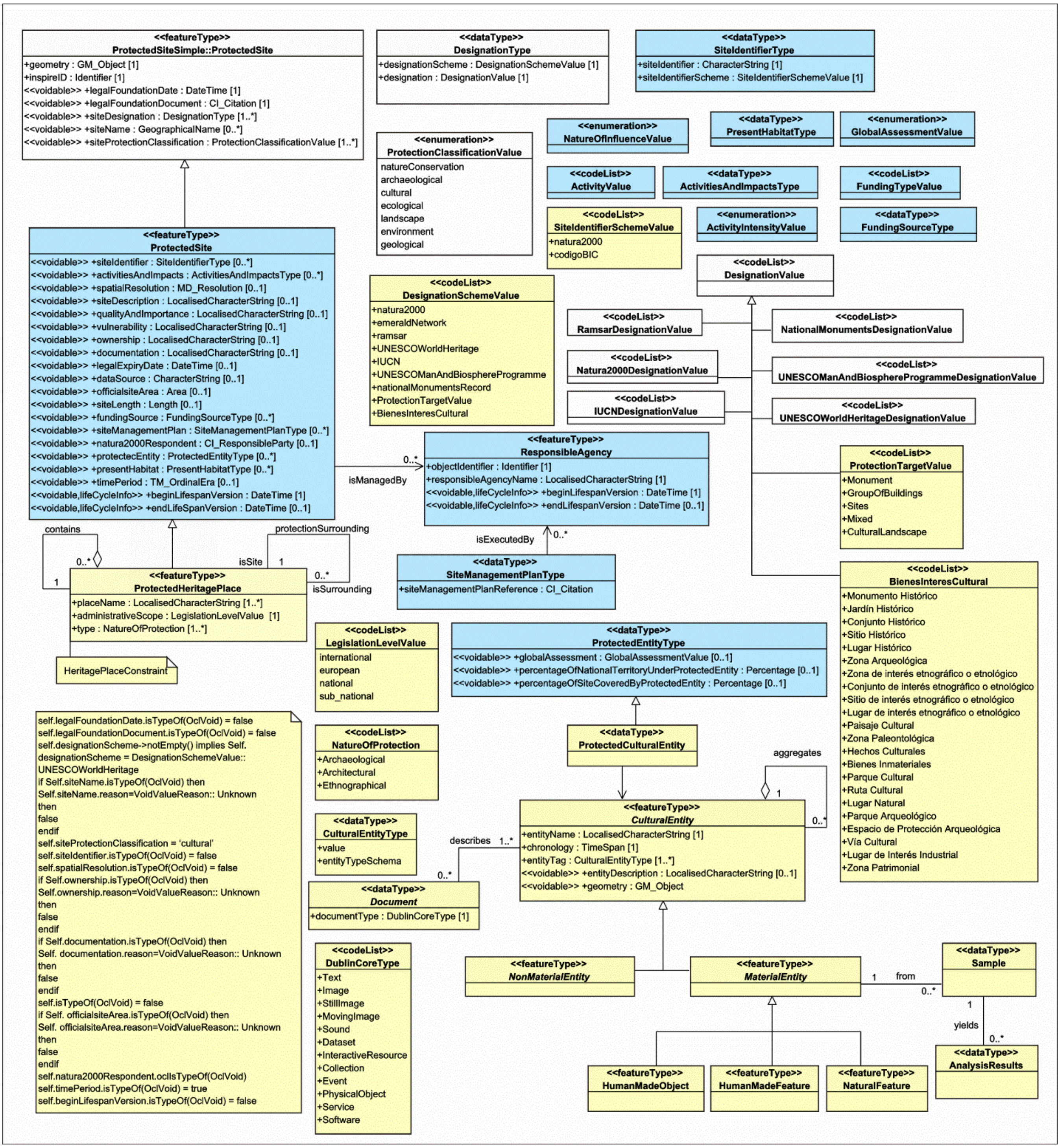
Use Case - (5) Provide protected sites data to INSPIRE	
Priority	High
Description	The user is an EU member state, and prepares and provides its data using the INSPIRE specifications, in the form of a static data set
Pre-condition	Agreement to reporting data specifications and formats at the European level such as nationally designated areas, Natura 2000 sites, and on data collection cycle and reporting deadlines.

Use Case - (3) Expertly Query, View, Visualise and Analyse Protected Sites	
Priority	High
Description	The user creates a view of Protected Sites within the planning proposal area and assesses potential impacts.
Pre-condition	Protected Sites are available in line with INSPIRE specifications to the user and INSPIRE registry provides all necessary information for standardised access to data. The user has access to a client GIS with basic selection tools.

Use Case - (4) Download Proteced Sites Data	
Priority	Medium
Description	The user downloads Protected Sites data and associated metadata in a selected area and with selected feature types included.
Pre-condition	Protected sites are available in line with INSPIRE specifications to the user and INSPIRE registry provides all necessary information for standardised access to data. The user has access to a client GIS with basic selection tools.

Use Case - (2) Naively Query and View Protected Sites	
Priority	High
Description	The user uses a publicly accessible (probably web based) GIS to zoom/pan to or find, by gazetteer search, the location of interest and display the data on screen.
Pre-condition	Protected sites are available in line with INSPIRE specifications to the user by relevant Web Map Services and Web Feature Services. The user has access to a publicly accessible (probably web based) GIS that displays data using the INSPIRE rules.

ANNEX B. FULL UML DIAGRAM



ANNEX C. DATA DICTIONARY

Protected Sites - Simple

Classes and attributes documentation: Simple Schema (from INSPIRE Protected Sites)

Class - ProtectedSiteSimple::ProtectedSite	
Visibility	public
Stereotypes	featureType
Documentation	Definition: An area designated or managed within a framework of international, Community and Member States' legislation to achieve specific conservation objectives. Description: Each protected site has a boundary defined through formal, legal or administrative agreements or decisions. The establishment of a protected site is normally underpinned by legislation and thus given weight in decisions about land use change and spatial planning. Each Site is normally selected as a representative example of a wider resource and selected through a formal criterion based approach. A protected site can be a contiguous extent of land/sea or a collection of discrete areas that together represent a single formal Protected Site. This class has the attributes, constraints and associations that are part of the Simple application schema. Status: proposed
Attributes	
+ geometry : GM_Object	
Documentation	Definition: The geometry defining the boundary of the Protected Site. Description: The geometry may be determined by a wide range of methods, including surveying, digitization or visual reference to natural features or cadastral boundaries and may be defined by the legal document that creates the protected area. The geometry included in a data set that uses this data model is stored as a fixed geometry by coordinates, not by reference to natural, cadastral or administrative boundaries, although it may originally have been defined from these.
Type	GM_Object
Multiplicity	1
Aggregation	None

+ inspireID : Identifier	
Documentation	External object identifier of the protected site. NOTE: An external object identifier is a unique object identifier published by the responsible body, which may be used by external applications to reference the spatial object. The identifier is an identifier of the spatial object, not an identifier of the real-world phenomenon.
Type	Identifier
Multiplicity	1
Aggregation	None

+ legalFoundationDate : DateTime	
Stereotypes	voidable
Type	DateTime
Multiplicity	1
Aggregation	None

+ legalFoundationDocument : CI_Citation	
Stereotypes	voidable
Type	CI_Citation
Multiplicity	1
Aggregation	None

+ siteDesignation : DesignationType	
Stereotypes	voidable
Type	DesignationType
Multiplicity	1..*
Aggregation	None

+ siteName : GeographicalName	
Stereotypes	voidable
Type	GeographicalName
Multiplicity	0..*
Aggregation	None

+ siteProtectionClassification : ProtectionClassificationValue	
Stereotypes	voidable
Type	Class - ProtectionClassificationValue
Multiplicity	1..*
Aggregation	None

Class - DesignationType	
Documentation	A data type designed to contain a designation for the Protected Site, including the designation scheme used and the value within that scheme.
Visibility	public
Stereotypes	dataType
Attributes	
+ designationScheme : DesignationSchemeValue	
Documentation	The scheme from which the designation code comes.
Type	Class - DesignationSchemeValue
Multiplicity	1
Aggregation	None

+ designation : DesignationValue	
Documentation	The actual Site designation.
Type	Class - DesignationValue
Multiplicity	1
Aggregation	None

+ percentageUnderDesignation : Percentage	
Type	Percentage
Multiplicity	0..1
Aggregation	None

Class - DesignationSchemeValue	
Documentation	The scheme used to assign a designation to the Protected Sites. NOTE 1: Schemes may be internationally recognized (for example, Natura 2000 or the Emerald Network schemes), or may be national schemes (for example, the designations used for nature conservation in a particular Member State). NOTE 2: Typically, this code list will be extended with code schemes used within Member States.
Visibility	public
Stereotypes	codeList
Attributes	
+ natura2000	
+ emeraldNetwork	
+ ramsar	
+ UNESCOWorldHeritage	
+ IUCN	
+ UNESCOManAndBiosphereProgramme	
+ nationalMonumentsRecord	
+ ProtectionTargetValue	
+ BienesInteresCultural (added in the Cultural Application Schema)	

Class - DesignationValue	
Documentation	Abstract base type for code lists containing the classification and designation types under different schemes. NOTE 1: Some of these designation and classification lists are closed (for example, Natura 2000), while some change regularly. NOTE 2: Typically, additional code lists will be created as sub-types of this type to represent designation or classification values within Member States, e.g. natuurbeschermingsGebieden, rijksBeschermdeArcheologischeGebieden, nationaleParken, nationaleLandschappen etc. in the Netherlands.
Visibility	public
Stereotypes	codeList

Class - RamsarDesignationValue	
Subtype of	*DesignationValue*
Visibility	public
Stereotypes	codeList
Attributes	
+ ramsar	

Class - Natura2000DesignationValue	
Subtype of	*DesignationValue*
Visibility	public
Stereotypes	codeList
Attributes	
+ specialAreaOfConservation	
+ specialProtectionArea	
+ siteOfCommunityImportance	
+ proposedSpecialProtectionArea	

Class - NationalMonumentsDesignationValue	
Subtype of	*DesignationValue*
Visibility	public
Stereotypes	codeList
Attributes	
+ agricultureAndSubsistence	
+ civil	
+ commemorative	
+ commercial	
+ communications	
+ defence	
+ domestic	
+ education	
+ gardensParksAndUrbanSpaces	
+ healthAndWelfare	
+ industrial	
+ maritime	
+ monument	
+ recreational	
+ religiousRitualAndFunerary	
+ settlement	
+ transport	
+ waterSupplyAndDrainage	

Class - IUCNDesignationValue	
Subtype of	*DesignationValue*
Visibility	public
Stereotypes	codeList
Attributes	
+ strictNatureReserve	
+ wildernessArea	
+ nationalPark	
+ habitatSpeciesManagementArea	
+ naturalMonument	
+ manageResourceProtectedArea	
+ ProtectedLandscapeOrSeascape	

Class - UNESCOManAndBiosphereProgrammeDesignationValue	
Subtype of	*DesignationValue*
Visibility	public
Stereotypes	codeList
Attributes	
+ BiosphereReserve	

Class - UNESCOWorldHeritageDesignationValue	
Subtype of	*DesignationValue*
Visibility	public
Stereotypes	codeList
Attributes	
+ natural	
+ cultural	
+ mixed	

Class – ProtectionTargetValue (added in the Cultural Application Schema)	
Subtype of	*DesignationValue*
Visibility	public
Stereotypes	codeList
Documentation	Type of Protected Heritage Place according to the UNESCO “Operational Guidelines for the Implementation of the World Heritage Convention”. Available at: http://whc.unesco.org/archive/opguide08-en.pdf Pages 13-14
Attributes	
+ Monument	
Documentation	Architectural works, works of monumental sculpture and painting, elements or structures of an archaeological nature, inscriptions, cave dwellings and combinations of features, which are of outstanding universal value from the point of view of history, art or science.

+ GroupOfBuildings	
Documentation	Groups of separate or connected buildings which, because of their architecture, their homogeneity or their place in the landscape, are of outstanding universal value from the point of view of history, art or science

+ Sites	
Documentation	Works of man or the combined works of nature and of man, and areas including archaeological sites which are of outstanding universal value from the historical, aesthetic, ethnological or anthropological points of view.

+ Mixed	
Documentation	Properties shall be considered as "mixed cultural and natural heritage" if they satisfy a part or the whole of the definitions of both cultural and natural heritage laid out in Articles 1 and 2 of the Convention.

+ CulturalLandscape	
Documentation	Cultural landscapes are cultural properties and represent the "combined works of nature and of man" designated in Article 1 of the Convention. They are illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal.

Class – BienesInteresCultural (added in the Cultural Application Schema)	
Subtype of	*DesignationValue*
Visibility	public
Stereotypes	codeList
Documentation	Classification of the *Bien de Interés Cultural*. This is a generic classification gathering in a comprehensive way all the variety o existing BIC within the different administrative scopes. It is based on the book: Querol, M.A., 2010. Manual De Gestión Del Patrimonio Cultural, Madrid: Akal.
Attributes	
+ Monumento Histórico	
+ Jardín Histórico	
+ Conjunto Histórico	
+ Sitio Histórico	
+ Lugar Histórico	
+ Zona Arqueológica	
+ Zona de interés etnográfico o etnológico	
+ Conjunto de interés etnográfico o etnológico	
+ Sitio de interés etnográfico o etnológico	
+ Lugar de interés etnográfico o etnológico	
+ Paisaje Cultural	
+ Zona Paleontológica	
+ Hechos Culturales	
+ Bienes Inmateriales	
+ Parque Cultural	
+ Ruta Cultural	
+ Lugar Natural	
+ Parque Arqueológico	
+ Espacio de Protección Arqueológica	
+ Vía Cultural	
+ Lugar de Interés Industrial	
+ Zona Patrimonial	

Class - ProtectionClassificationValue	
Documentation	The protected site classification based on the purpose of protection.
Visibility	public
Stereotypes	enumeration
Attributes	
natureConservation	
archaeological	
cultural	
ecological	
landscape	
environment	
geological	

Protected Sites - Full

Classes and attributes documentation: Full Schema (from INSPIRE Protected Sites)

Class - ProtectedSite	
Subtype of	*ProtectedSite*
Visibility	public
Stereotypes	featureType
Documentation	Definition: An area designated or managed within a framework of international, Community and Member States' legislation to achieve specific conservation objectives. Description: Each protected site has a boundary defined through formal, legal or administrative agreements or decisions. The establishment of a protected site is normally underpinned by legislation a thus given weight in decisions about representative example of a wider resource and selected through a formal criterion based approach. A protected site can be a contiguous extent of land/sea or a collection of discrete areas that together represent a single formal Protected Site. This class has the attributes, constraints and associations that are part of the Full application schema.
Attributes	
+ siteIdentifier : **SiteIdentifierType**	
Stereotypes	voidable
Documentation	The identifier for the Site using some national or international identification scheme. This is distinct from the inspireID, which is a unique identifier for the record.
Type	Class - SiteIdentifierType
Multiplicity	0..*
Aggregation	None

+ activitiesAndImpacts : **ActivityAndImpactsType**	
Stereotypes	voidable
Documentation	Impacts resulting from human activities or natural processes that positively or negatively affect the conservation status of the protected site. This information is needed to inform evaluation of conservation status of a Protected Site. This includes management activities such as grazing or cutting, land uses such as mineral extraction or transport and natural processes such as disease fluvial erosion.
Type	Class - ActivityAndImpactsType
Multiplicity	0..*
Aggregation	None

+ spatialResolution : **MD_Resolution**	
Stereotypes	voidable

Documentation	The spatial resolution of the protected site geometry. This may relate to a scale of capture value.
Type	MD_Resolution
Multiplicity	0..1
Aggregation	None

+ siteDescription : LocalisedCharacterString	
Stereotypes	voidable
Documentation	A general description of the Site and its characteristics. This attribute corresponds to item 4.1 of the Natura 2000 SDF.
Type	LocalisedCharacterString
Multiplicity	0..1
Aggregation	None

+ qualityAndImportance : LocalisedCharacterString	
Stereotypes	voidable
Documentation	An overall indication of the quality and importance of the Site, in view of the conservation objectives of the various Directives. This attribute corresponds to item 4.2 of the Natura 2000 SDF.
Type	LocalisedCharacterString
Multiplicity	0..1
Aggregation	None

+ vulnerability : LocalisedCharacterString	
Stereotypes	voidable
Documentation	The nature and extent of pressures on the Site from human and other influences and the fragility of habitats and ecosystems found there. This attribute corresponds to item 4.3 of the Natura 2000 SDF.
Type	LocalisedCharacterString
Multiplicity	0..1
Aggregation	None

+ ownership : LocalisedCharacterString	
Stereotypes	voidable
Documentation	A general description of the site ownership. This attribute corresponds to item 4.5 of the Natura 2000 SDF. EXAMPLES Private, State, conservation NGO.
Type	LocalisedCharacterString
Multiplicity	0..1
Aggregation	None

+ **documentation** : **LocalisedCharacterString**	
Stereotypes	voidable
Documentation	References to publications and scientific data concerning the Protected Site. This attribute corresponds to item 4.6 of the Natura 2000 SDF. Information entered should be made according to standard conventions for scientific references. Unpublished items or communications referring to the information given in the recording form should be included where ever useful.
Type	LocalisedCharacterString
Multiplicity	0..1
Aggregation	None

+ **legalExpiryDate** : **DateTime**	
Stereotypes	voidable
Documentation	The date that the protected site was legally destroyed. This is the date that the real world object was destroyed, not the date that its representation in an information system was destroyed or changed.
Type	DateTime
Multiplicity	0..1
Aggregation	None

+ **dataSource** : **CharacterString**	
Stereotypes	voidable
Documentation	The agency or organization that is responsible for maintaining and providing the data about the Protected Site. This may be represented in the form of the URL or name and address of the organization.
Type	CharacterString
Multiplicity	0..1
Aggregation	None

+ **officialsiteArea** : **Area**	
Stereotypes	voidable
Documentation	The official area of the site in hectares. This may not the same as area calculated from the geometry.
Type	Area
Multiplicity	0..1
Aggregation	None

+ **siteLength** : **Length**	
Stereotypes	voidable
Documentation	The length of the site, normally used if the area is not populated.

Type	Length
Multiplicity	0..1
Aggregation	None

+ fundingSource : FundingSourceType	
Stereotypes	voidable
Documentation	The source(s) of financial support that are being used to implement the management plan on a Protected Site. Funding of management on Protected Sites is critical to securing desired conservation status. The resources are supplied from a variety of sources, ranging from private land owners to European funding schemes.
Type	Class - FundingSourceType
Multiplicity	0..*
Aggregation	None

+ siteManagementPlan : SiteManagementPlanType	
Stereotypes	voidable
Documentation	The Site Management Plans that set out practical actions and measures that are needed to ensure that the features for which the site is designated are maintained.
Type	Class - SiteManagementPlanType
Multiplicity	0..*
Aggregation	None

+ natura2000Respondent : CI_ResponsibleParty	
Stereotypes	voidable
Documentation	The person responsible for completing Natura 2000 reporting on the Site. This is likely to be a person from the ResponsibeAgency, but may not be.
Type	CI_ResponsibleParty
Multiplicity	0..1
Aggregation	None

+ protectecEntity : ProtectedEntityType	
Stereotypes	voidable
Documentation	An entity that is protected by a designated protected site (that is, the object or reason for protection). Such entities may include habitats, species and geological, archaeological, cultural and other types of entities.
Type	Class - ProtectedEntityType
Multiplicity	0..*
Aggregation	None

+ **presentHabitat** : **PresentHabitatType**	
Stereotypes	voidable
Documentation	A habitat that exists on the Site. This is distinct from the Habitats for which the Site is protected. These are represented in the protectedEntity attribute.
Type	Class - PresentHabitatType
Multiplicity	0..*
Aggregation	None

+ **timePeriod** : **TM_OrdinalEra**	
Stereotypes	voidable
Documentation	For historical or archaeological Sites, the era in which the Site is thought to originate.
Type	Class - TM_OrdinalEra
Multiplicity	0..1
Aggregation	None

+ **beginLifespanVersion** : **DateTime**	
Stereotypes	voidable, lifeCycleInfo
Documentation	Date and time at which this version of the spatial object was inserted or changed in the spatial data set. This date is recorded to enable the generation of change only update files.
Type	DateTime
Multiplicity	1
Aggregation	None

+ **endLifeSpanVersion** : **DateTime**	
Stereotypes	voidable, lifeCycleInfo
Documentation	Date and time at which this version of the spatial object was superseded or retired in the spatial data set. This date is recorded primarily for those systems which "close" an entry in the spatial data set in the event of an attribute change.
Type	DateTime
Multiplicity	0..1
Aggregation	None

Relations		
isManagedBy : **Association**		
To	End Model Element	Class - ResponsibleAgency
	Multiplicity	0..*

	Navigable	true
Visibility	public	

Class - SiteIdentifierType	
Documentation	An identifier for the Protected Site, using some identification scheme. A Site may have several identifiers using different schemes. EXAMPLE A site may have a Natura 2000 identifier as well as a national identifier. NOTE: Identifiers are unique within the specified scheme.
Visibility	public
Stereotypes	dataType
Attributes	
+ siteIdentifier : CharacterString	
Documentation	The identifier for the Site.
Type	CharacterString
Multiplicity	1
Aggregation	None
+ siteIdentifierScheme : SiteIdentifierSchemeValue	
Documentation	The scheme from which the identifier for the Site comes.
Type	Class - SiteIdentifierSchemeValue
Multiplicity	1
Aggregation	None

Class - SiteIdentifierSchemeValue	
Documentation	The scheme within which the Site identifier was assigned.
Visibility	public
Stereotypes	codeList
Attributes	
+ natura2000	
+ codigoBIC (added in the Cultural Application Schema)	

Class - ActivitiesAndImpactsType	
Documentation	Impacts resulting from human activities or natural process that positively or negatively affect the conservation status of the Protected Site. Information needed to inform evaluation of conservation status of a Protected Site. This includes management activities such as grazing or cutting, land uses such as mineral extraction or transport and natural processes such as disease fluvial erosion.
Visibility	public
Stereotypes	dataType
Attributes	
+ activity	
Documentation	The activities that occur on the site using the Natura 2000 activity types from Appendix E in the Natura 2000 explanatory notes (Standard Data Form Item 6.1).
Type	Class – ActivityValue
Multiplicity	1
Aggregation	None

+ activityIntensity : ActivityIntensityValue	
Documentation	The intensity of the activity's influence on the site.
Stereotypes	voidable
Type	Class - ActivityIntensityValue
Multiplicity	0..1
Aggregation	None

+ natureOfInfluence : NatureOfInfluenceValue	
Documentation	The nature of the influence of the activity on the site (positive, negative or neutral).
Stereotypes	voidable
Type	Class - NatureOfInfluenceValue
Multiplicity	0..1
Aggregation	None

+ percentageUnderActivity : Percentage	
Documentation	The percentage of the protected site over which the activity occurs.
Stereotypes	voidable
Type	Percentage
Multiplicity	0..1
Aggregation	None

Class - ActivityIntensityValue	
Documentation	A code indicating the level of intensity of the influence of the activities in and around the site.
Visibility	public
Stereotypes	enumeration
Attributes	
high	
medium	
low	

Class - NatureOfInfluenceValue	
Documentation	A code indicating the nature of the influence of activities in and around the site.
Visibility	public
Stereotypes	enumeration
Attributes	
+ positive	
+ null	
+ negative	

Class - GlobalAssessmentValue	
Documentation	A code indicating the global value of the site for conservation purposes.
Visibility	public
Stereotypes	enumeration
Attributes	
excellent	
good	
significant	

Class - ActivityValue	
Documentation	The codes of the activities and impacts that occur on and around the site. In the case of the Natura 2000 application schema, the values must come from the Natura 2000 activity types from Appendix E in the Natura 2000 explanatory notes (Standard Data Form Item 6.1). In the case of the Full application schema, values may also come from Water Framework Directive.
Visibility	public
Stereotypes	codeList

Class - FundingSourceType	
Documentation	The source(s) of financial support that are being used to implement the management plan on a Protected Site. NOTE: Funding of management on Protected Sites is critical to securing desired conservation status. The resources are supplied from a variety of sources, ranging from private land owners to European funding schemes.
Visibility	public
Stereotypes	dataType
Attributes	
+ fundingType : FundingTypeValue	
Type	Class - FundingTypeValue
Multiplicity	1
Aggregation	None
+ projectName : LocalisedCharacterString	
Stereotypes	voidable
Type	LocalisedCharacterString
Multiplicity	0..1
Aggregation	None

Class - FundingTypeValue	
Documentation	A list of possible funding types.
Visibility	public
Stereotypes	codeList
Attributes	
+ agriEnvironment	
+ europeanFisheriesFund	
+ interreg	

+ leader

+ leaderPlus

+ LIFEProject

+ obective1

+ objective2

Class - ResponsibleAgency	
Documentation	The agency, organization or body responsible for selecting, describing and designating the protected site. Responsibility for establishing a protected site allows all interested parties to know who to liaise with over queries or requests for more detailed information on each Area. The responsible body will vary according to the basis of establishment with national governments ultimately responsible for Natura 2000 sites, down to voluntary bodies responsible for local designations or quasi-legislative protected sites.
Visibility	public
Stereotypes	featureType
Attributes	

+ objectIdentifier : Identifier	
Documentation	A unique identifier for the Responsible Agency.
Type	Identifier
Multiplicity	1
Aggregation	None

+ responsibleAgencyName : LocalisedCharacterString	
Documentation	The name of the agency responsible for managing the protected site.
Type	LocalisedCharacterString
Multiplicity	1
Aggregation	None

+ beginLifespanVersion : DateTime	
Documentation	Date and time at which this version of the spatial object was inserted or changed in the spatial data set. NOTE: This date is recorded to enable the generation of change only update files.
Stereotypes	voidable,lifeCycleInfo
Type	DateTime
Multiplicity	1

Aggregation	None

+ endLifespanVersion : DateTime

Documentation	Date and time at which this version of the spatial object was superseded or retired in the spatial data set. NOTE: This date is recorded primarily for those systems which "close" an entry in the spatial data set in the event of an attribute change.
Stereotypes	voidable,lifeCycleInfo
Type	DateTime
Multiplicity	0..1
Aggregation	None

Relations

isManagedBy : Association

From	End Model Element	Class - ProtectedSite
	Multiplicity	Unspecified
	Navigable	unspecified
Visibility	public	

isExecutedBy : Association

From	End Model Element	Class - SiteManagementPlanType
	Multiplicity	Unspecified
	Aggregation Kind	None
	Navigable	unspecified
Visibility	public	

Class - SiteManagementPlanType

Documentation	Site Management Plans are descriptions that set out practical actions and measures that are needed to ensure that the features for which the site is designated are maintained.
Visibility	public
Stereotypes	dataType

Attributes

+ siteManagementPlanReference

Documentation	The URL or citation for a document that describes the site management plans.
Multiplicity	Unspecified
Aggregation	None

Relations		
isExecutedBy : Association		
To	End Model Element	Class - ResponsibleAgency
	Multiplicity	0..*
	Navigable	true
Visibility	public	

Class - PresentHabitatType	
Documentation	A habitat that exists on the Protected Site. NOTE: This is distinct from the Habitats for which the Site is protected (see ProtectedEntityType).
Visibility	public
Stereotypes	dataType
Attributes	
+ percentageUnderHabitat : Percentage	
Documentation	The percentage of the total protected site that is covered by the Habitat. NOTE: This may include part or all of the specified Habitat. The percentages for all the habitats present on a protected site should add up to 100%.
Stereotypes	voidable
Type	Percentage
Multiplicity	0..1
Aggregation	None

Class - ProtectedEntityType	
Documentation	An entity that is protected by a designated protected site (that is, the object or reason for protection). Such entities may include habitats, species and geological, archaeological, cultural and other types of entities.
Visibility	public
Stereotypes	dataType
Attributes	
+ globalAssessment : GlobalAssessmentValue	
Documentation	The value of the Site for conservation of the protected entity (species, habitat, etc) concerned.
Stereotypes	voidable
Type	Class - GlobalAssessmentValue
Multiplicity	0..1

Aggregation	None

+ percentageOfNationalTerritoryUnderProtectedEntity : Percentage	
Documentation	The percentage of the total occurrence of the protected entity in the national territory that appears on the Protected Site.
Stereotypes	voidable
Type	Percentage
Multiplicity	0..1
Aggregation	None

+ percentageOfSiteCoveredByProtectedEntity : Percentage	
Documentation	The percentage of the total area of the protected site that is covered by the protected entity (habitat, species, etc). NOTE: Protected entities may not cover the entire protected site, so these percentages may not add up to 100 for a given site.
Stereotypes	voidable
Type	Percentage
Multiplicity	0..1
Aggregation	None

Protected Sites – Cultural Heritage

Classes and attributes documentation: Cultural Heritage Schema (added in the Cultural Application Schema)

Class - ProtectedHeritagePlace	
Subtype of	*ProtectedSite*
Visibility	public
Stereotypes	featureType
Documentation	Main class that comprehends all Protected Heritage Places. They must have a geometry describing their boundaries, established through administrative decisions, as it is underlined in the INSPIRE Data Specification on Protected Sites (D2.8.I.9 INSPIRE Data Specification on Protected Sites - Guidelines). Any Protected Heritage Place might contain other Protected Heritage Places specified in its legal foundation document. They may also have a protected surrounding, that would be another object of the same class.
Attributes	
+ placeName : LocalisedCharacterString	
Documentation	Name of the Protected Heritage Place as in the legal foundation document.
Type	LocalisedCharacterString
Multiplicity	1..*
Aggregation	None

+ administrativeScope : LegislationLevelValue	
Documentation	Scope of its legal protection, to be filled in via enumeration. If there are various protections over the same cultural entity, they all should be instanced as different objects of this class.
Type	Class - LegislationLevelValue
Multiplicity	1
Aggregation	None

+ type : NatureOfProtection	
Documentation	Reason advocated for the site's protection. To be filled in via code list.
Type	Class - NatureOfProtection
Multiplicity	1..*
Aggregation	None
Relations	
contains : Association	

Documentation	Relation between a site and its protected surrounding area.	
To (isSite)	End Model Element	Class - ProtectedHeritagePlace
	Multiplicity	1
	Navigable	true

protectionSurrounding : Association

To (isSurrounding)	End Model Element	Class - ProtectedHeritagePlace
	Multiplicity	0..*
	Navigable	true

Constraints

HeritagePlaceConstraint

Documentation

```
self.legalFoundationDate.isTypeOf(OclVoid) = false

self.legalFoundationDocument.isTypeOf(OclVoid) = false

self.designationScheme->notEmpty() implies Self.designationScheme = Designa-
tionSchemeValue::UNESCOWorldHeritage

if Self.siteName.isTypeOf(OclVoid) then
    Self.siteName.reason=VoidValueReason:: Unknown
then
    false
endif

self.siteProtectionClassification = 'cultural'

self.siteIdentifier.isTypeOf(OclVoid) = false

self.spatialResolution.isTypeOf(OclVoid) = false

if Self.ownership.isTypeOf(OclVoid) then
    Self.ownership.reason=VoidValueReason:: Unknown
then
    false
endif

if Self.documentation.isTypeOf(OclVoid) then
    Self. documentation.reason=VoidValueReason:: Unknown
then
    false
endif

self.isTypeOf(OclVoid) = false
if Self. officialsiteArea.isTypeOf(OclVoid) then
    Self. officialsiteArea.reason=VoidValueReason:: Unknown
 then
    false
 endif

self.natura2000Respondent.oclIsTypeOf(OclVoid)

self.timePeriod.isTypeOf(OclVoid) = true
self.beginLifespanVersion.isTypeOf(OclVoid) = false
```

Class - LegislationLevelValue	
Visibility	public
Stereotypes	codeList
Documentation	Code list that feeds the LegislationLevelValue attribute.
Attributes	
International	
European	
National	
Sub-national	

Class - NatureOfProtection	
Visibility	public
Stereotypes	codeList
Documentation	Code list that feeds the NatureOfProtection attribute.
Attributes	
+ Archaeological	
+ Architectural	
+ Ethnographical	

Class - ProtectedCulturalEntity	
Subtype of	*ProtectedEntityType*
Visibility	public
Stereotypes	dataType
Documentation	Void class that inherits from *ProtectedEntityType*, adding a new relation to *CulturalEntity*.
Relations	
isACulturalEntity : Association	

To	End Model Element	Class – CulturalEntity
	Multiplicity	0..*
	Navigable	true
Visibility	public	

Class - CulturalEntity	
Visibility	public
Stereotypes	featureType
Documentation	Real-world entities regarded as cultural heritage entities. Any cultural entity may aggregate other entities of the same nature. For example, a cultural landscape might include several archaeological, ethnological or architectural sites, or a single site might include several functional areas. Objects of this class might have their own geometry, although it is not compulsory. Otherwise they will just aggregate to a ProtectedHeritagePlace object, which must have a geometry.
Attributes	

+ entityName : LocalisedCharacterString	
Documentation	Name of the cultural entity (note that this name may differ from the Protected Heritage Place placeName attribute).
Type	LocalisedCharacterString
Multiplicity	1
Aggregation	None

+ chronology : TimeSpan	
Documentation	Chronological line of the cultural entity since its earliest remains up to nowadays. To be filled with an object of the TimeSpan class, in the TemporalSchema.
Type	Class - TimeSpan
Multiplicity	1
Aggregation	None

+ entityTag : CulturalEntityType	
Documentation	Classification of the cultural entity according to any existent classification schema. To be filled by a CulturalEntityType object.
Type	Class - CulturalEntityType
Multiplicity	1..*
Aggregation	None

+ entityDescription : LocalisedCharacterString	
Stereotypes	voidable
Documentation	Free text description of the cultural entity.
Type	LocalisedCharacterString
Multiplicity	0..1

Aggregation	None

+ geometry : GM_Object

Stereotypes	voidable
Documentation	Cultural entity geometry.
Type	GM_Object
Multiplicity	1
Aggregation	None

Relations

aggregates : Association

Documentation	Relation between two objects of the same class. A cultural entity might be a whole building or an archaeological site. But it might also be a smaller feature such as a wall or a brick, being the building an aggregation of those smaller features and a cultural entity as well. Thus the disaggregation of the elements included in the model depends on the nature of the data gathered by the data provider.
To	End Model Element: Class - CulturalEntity Multiplicity: 0..* Navigable: true

describes : Association

From	End Model Element: Class - CulturalEntity Multiplicity: 1 Navigable: true

Class - CulturalEntityType

Visibility	public
Stereotypes	dataType
Documentation	Classification of the cultural entity according to any existent classification schema.

Attributes

+ value

Documentation	Classification value as defined in a classification schema.
Multiplicity	1
Aggregation	None

+ entityTypeSchema

Documentation	Classification schema containing the value specified in the value attribute.
Multiplicity	1
Aggregation	None

Class - NonMaterialEntity	
Subtype of	*CulturalEntity*
Visibility	public
Stereotypes	featureType
Documentation	Intangible heritage features with defined boundaries.

Class - MaterialEntity	
Subtype of	*CulturalEntity*
Visibility	public
Stereotypes	featureType
Documentation	Any material feature that might form part of a cultural entity, regardless of its scale. The subdivision in HumanMadeObject, HumanMadeFeature and NaturalFeature is based upon the CIDOC Conceptual Reference Model (ISO 21127:2006).

Relations

from : Association

To	End Model Element	Class - Sample
	Multiplicity	0..*
	Navigable	true

Class - HumanMadeObject	
Subtype of	*MaterialEntity*
Visibility	public
Stereotypes	featureType
Documentation	This class comprises physical features that are purposely created by human activity, and have a physical boundary that separates it from other objects. Examples of this class are wall or a building. This class is analog to the ISO 21127:2006 E22 "Man Made Object" class.

Class - HumanMadeFeature	
Subtype of	*MaterialEntity*
Visibility	public
Stereotypes	featureType
Documentation	Identifiable features physically integrated inside other objects, with no clear boundaries. Examples of this class are rock art, a pit or a hypogeous. This class is analog to the ISO 21127:2006 E255 "Man Made Feature" class.

Class - NaturalFeature	
Subtype of	*MaterialEntity*
Visibility	public
Stereotypes	featureType
Documentation	Piece of land or sea constituting features singularly identifiable. A forest or a beach are examples of this class. This class is analog to the ISO 21127:2006 E27 "Site" class.

Class - Sample		
Visibility	public	
Stereotypes	dataType	
Documentation	Any sample obtained from a material cultural entity.	
Relations		
Association		
To	End Model Element	Class - AnalysisResults
	Multiplicity	0..*
	Navigable	true
from : Association		
From	End Model Element	Class - MaterialEntity
	Multiplicity	1
	Navigable	true

Class - AnalysisResults			
Visibility	public		
Stereotypes	dataType		
Documentation	Any result yielded by an analytical procedure of a sample obtained from a material cultural entity.		
Relations			
Association			
From (yields)	End Model Element	Class - Sample	
	Multiplicity	0..*	
	Navigable	true	

Class - Document		
Visibility	public	
Stereotypes	dataType	
Documentation	Pieces of information associated to the features that make up a cultural entity or to the cultural entity itself.	
Attributes		
public documentType : DublinCoreType		
Documentation	Document types are specified according to the Dublin Core Metadata Initiative (DCMI).	
Multiplicity	1	
Aggregation	None	
Relations		
describes : Association		
To	End Model Element	Clase - CulturalEntity
	Multiplicity	1..*
	Navigable	true

Class - DublinCoreType	
Visibility	public
Stereotypes	codeList
Documentation	The Dublin Core Metadata Element Set is a vocabulary of fifteen properties for use in resource description.
Attributes	

+ Text	
Documentation	Its distinctive feature is that it consists primarily of words for reading. According to cultural entities, it can refer to scientific publications, reports, etc.

+ Image	
Documentation	Any kind of visual representation.

+ StillImage	
Documentation	It is a subtype of image, characterized by its static nature, such as a photograph or a drawing. If the image is part of a textual material, Dublin Core recommends assigning the type Text to it.

+ MovingImage	
Documentation	It isAnother subtype of image, consisting of a series of these offering an impression of motion, such as videos or animations.

+ Sound	
Documentation	An acoustic representation, intended to be heard, such as story recordings, music, etc.

+ Dataset	
Documentation	A set of data stored or organized in a structured way, such as a list, a table or a database.

+ InteractiveResource	
Documentation	A resource requiring interaction from the user to be understood, executed, or experienced, such as web pages, virtual reality objects, etc.

+ Collection	
Documentation	It is an aggregation of resources. So it may contain documents of any kind.

+ Event	
Documentation	An occurrence that happens within a certain lapse of time.

+ PhysicalObject	
Documentation	A real-world object.

+ Service	
Documentation	A system that furnishes a certain function, such as a web server.

+ Software	
Documentation	A computer program.

Annex D. List of Authors

This list includes all the individuals that have contributed to any extent and in different stages to the development of the model.

Del Bosque González, Isabel Coordinator	Centro de Ciencias Humanas y Sociales (CCHS), Consejo Superior de Investigaciones Científicas (CSIC)
Vicent García, Juan M. Coordinator	Centro de Ciencias Humanas y Sociales (CCHS), Consejo Superior de Investigaciones Científicas (CSIC)
Abad Balboa, Tomás	Universidad de Alcalá de Henares
Abad Vidal, Emilio	Centro de Supercomputación de Galicia (CESGA)
Chías Navarro, Pilar	Universidad de Alcalá de Henares
Criado Valdés, Marta	DMS-Group
Fábrega-Álvarez, Pastor	Instituto de Ciencias del Patrimonio (Incipit), Consejo Superior de Investigaciones Científicas (CSIC)
Farjas Abadía, Mercedes	Universidad Politécnica de Madrid
Fernández Freire, Carlos	Centro de Ciencias Humanas y Sociales (CCHS), Consejo Superior de Investigaciones Científicas (CSIC)
Fraguas Bravo, Alfonso	Instituto de Historia (IH). Centro de Ciencias Humanas y Sociales (CCHS), Consejo Superior de Investigaciones Científicas (CSIC)
García Cepeda, Francisco	Dirección General del Catastro
Lage Reis-Correia, Miguel	Fundación Las Médulas – Junta de Castilla y León
Parcero-Oubiña, César	Instituto de Ciencias del Patrimonio (Incipit), Consejo Superior de Investigaciones Científicas (CSIC)
Márquez Piqueras, Javier	IDR–Universidad de Castilla La Mancha (campus de Albacete)
Mayoral Herrera, Victorino	Instituto de Arqueología de Mérida (IAM-CSIC)
Pecharromán Fuente, Juan Luis	Instituto de Historia (IH). Centro de Ciencias Humanas y Sociales (CCHS), Consejo Superior de Investigaciones Científicas (CSIC)
Pérez Asensio, Esther	Centro de Ciencias Humanas y Sociales (CCHS), Consejo Superior de Investigaciones Científicas (CSIC)
Respaldiza Hidalgo, Arantza	Universidad Politécnica de Madrid
Ruiz del Árbol Moro, María	Instituto de Historia (IH). Centro de Ciencias Humanas y Sociales (CCHS), Consejo Superior de Investigaciones Científicas (CSIC)
Uriarte González, Antonio	Instituto de Historia (IH). Centro de Ciencias Humanas y Sociales (CCHS), Consejo Superior de Investigaciones Científicas (CSIC)
Vázquez Hoenhe, Antonio	Universidad Politécnica de Madrid
Zancajo Jimeno, José Julio	Universidad de Salamanca

Instructions to authors

CAPA is a series publishing monographies on various types of cultural heritage related issues. Being an electronic series, it is especially suited for the fast, detailed and full-colored publication of texts of any extent which includes a substantial number of illustrations, maps, etc.

The electronic files that are part of CAPA are stored and archived exclusively by the Instituto de Ciencias del Patrimonio (Incipit). Authors are free to link to the URL that the Incipit designates, but not to independently share the end documents.

Submission of manuscripts

Manuscripts submitted for publication will be preliminary reviewed by the Editorial Board in order to guarantee their accordance with the thematic scope of the series.

All manuscripts will be subject to a blind, external peer-review process.

Original manuscripts will be submitted through the following email address: capa@incipit.csic.es

Submission is permanently opened

Manuscripts will be submitted in digital format. Most common formats will be accepted for the initial submission (pdf, doc,...). After acceptance and corrections, manuscripts will be submitted as MSWord documents with only the following text styles: up to 5 title levels (*Título 1, Título 2, Título 3, Título 4 and Título 5),* Normal, Epígrafe (for figure captions) and Bibliografía (for references). Character formats (bold, italics,..) may be freely used.

Figures might be colored or grayscale. They should be sumbiited as independent files in any standard format (jpg, tif,...). The name of each file will correspond with the figure number within the text (e.g. Figure 01.jpg, Figure 02.tif, etc).

Foot notes should be restricted to a mínimum. When used, they must be formatted as footnotes, with consequitive Arabic numerals (1, 2, 3,...).

References will be included using a text style called Bibliografía. They should follow the Current Anthropology journal style. Full instructions may be found in:

http://www.jstor.org/page/journal/curranth/style.html#examples_of_references

Most reference managers allow direct output with this style. Output style templates for some common reference manager exist:

EndNote: ftp://support.isiresearchsoft.com/pub/pc/styles/endnote4/Current%20Anthropology.ens

ProCite: ftp://support.isiresearchsoft.com/procite/styles/win/Current%20Anthropology.pos

Reference Manager: ftp://support.isiresearchsoft.com/RefMan/Styles/Current%20Anthropology.os

Full authors' names, rather than just abbreviations, must be provided when possible.

Some examples of reference styles:

Doerr, Martin. 2003. The CIDOC Conceptual Reference Module. An Ontological Approach to Semantic Interoperability of Metadata. *AI Magazine* 24(3):75-92.

Johnson, Matthew. 2007. *Ideas of Landscape.* Oxford: Blackwell.

Pearce, Susan M. 2000. The Making of Cultural Heritage. In *Values and Heritage Conservation*, edited by E. Avrami, R. Mason, and M. d. l. Torre. Pp. 59-64. Los Angeles: The Getty Conservation Institute.

Texts which do not adhere to these Instructions for Authors will be returned for appropriate revision.

CSIC
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

incipit
Instituto de
Ciencias del
Patrimonio