

Common Database on Designated Areas (CDDA) in conformity with the INSPIRE data specifications

Step-4: Validation and conformance test

Practical part

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1 Overview

1.1 Normative references

Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007¹

Commission Regulation (EU) No 1089/2010 of 23 November 2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services² and the amendments

INSPIRE DS-D2.5, Generic Conceptual Model, v3.4rc3³

INSPIRE DS-D2.8.I.9, Data Specification on Protected Sites - Guidelines, v3.1⁴

INSPIRE DS-D2.8.I.9, Data Specification on Protected Sites – Technical Guidelines, v3.2⁵

INSPIRE DS-D2.7, Guidelines for the encoding of spatial data, v3.3rc3⁶

1.2 General definitions

Terms and definitions necessary for understanding this document are defined in the INSPIRE Glossary <http://inspire.ec.europa.eu/registry/>. In addition, the following terms and definitions are used:

Protected Site: The INSPIRE Directive defines a Protected Site as an area designated or managed within a framework of international, Community and Member States' legislation to achieve specific conservation objectives.

Protected Sites and Protected Areas are synonymous.

According to the International Union for the Conservation of Nature (IUCN), a Protected Site is 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.

Schema: specification of a set of XML documents.

Target application schema: Application schemas are conceptual models related to specific areas (e.g. INSPIRE themes according to ISO 19109⁷ and INSPIRE Generic Conceptual Model⁸). The application schemas specify requirements on the properties of each spatial object including its multiplicity, domain of valid values, constraints, etc. The application schemas could contain also additional information that is not included in the Implementing Rules in particular multiplicities of attributes and association roles.

¹ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:108:0001:0014:EN:PDF>

² <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2010R1089:20110225:EN:PDF>

³ http://inspire.jrc.ec.europa.eu/documents/Data_Specifications/D2.5_v3.4rc3.pdf

⁴ http://inspire.jrc.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_PS_v3.1.pdf

⁵ http://inspire.jrc.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_PS_v3.2.pdf

⁶ http://inspire.jrc.ec.europa.eu/documents/Data_Specifications/D2.7_v3.3rc3.pdf

⁷ ISO 19109: Geographic information -- Rules for application schema

⁸ http://inspire.ec.europa.eu/documents/Data_Specifications/D2.5_v3.4.pdf

The use of a common conceptual schema language (i.e. UML) allows for an automated processing of application schemas and the encoding, querying and updating of data based on the application schema – across different themes and different levels of detail.

The word “target” stresses the scenario to comply the application schema used as a target for the transformation of the data set.

Target specification: In the INSPIRE specifications development, the term data specification is used as a synonym to data product specification, which is a detailed description of a data set or data set series together with additional information that will enable it to be created, supplied to and used by another party [ISO 19131]⁹. In this scope they are defined for any theme within INSPIRE. The documents called Technical Guidelines available from INSPIRE site show the data specifications.

The word “target” stresses the scenario to comply the specifications used as a target for the transformation of the data set.

Abstract Test Suite (ATS): a set of tests to be applied on a data set in order to evaluate whether it conforms to the requirements of the data specification.

Conformance: fulfillment of specified requirements.

Conformance class: Conformance of a data set with the Technical Guidelines requirement(s) implies conformance with the corresponding Implementing Rules requirement(s). The requirements to be tested are grouped in several conformance classes. Each of these classes covers a specific aspect: one conformance class contains tests reflecting the requirements on the application schema, another on the reference systems, etc.

Schematron: rule-based validation language for making assertions about the presence or absence of patterns in XML trees.

Harmonisation: This means the ability of data to be compatible and implies the adoption of common rules in application schemas, co-ordinate reference systems, classification systems, identifier management, etc. from different points of view. Definition based on NatureSDIplus project publications¹⁰.

Interoperability: It gives possibility for spatial data sets to be combined, and for services to interact, without repetitive manual intervention; in such a way that the result is coherent and the added value of the data sets and services is enhanced [INSPIRE Directive]. Definition based on the INSPIRE Glossary¹¹.

1.3 Symbols and abbreviations

<i>Acronym</i>	<i>Description</i>
ATS	Abstract Test Suite
CDDA	Common Database on Designated Areas
CRS	coordinate reference system(s)
DM	data model
DS	data specifications
EC	European Commission
ETC/BD	European Topic Centre on Biological Diversity

⁹ INSPIRE Generic Conceptual Model;

http://inspire.ec.europa.eu/documents/Data_Specifications/D2.5_v3.4.pdf

¹⁰ <http://www.nature-sdi.eu/>

¹¹ <https://inspire-registry.jrc.ec.europa.eu/registers/GLOSSARY/items>

ETL	Extract - Transform – Load
EEA	European Environment Agency
GCM	Generic Conceptual Model
GIS	Geographic Information System
GML	Geography Markup Language
HALE	HUMBOLDT Alignment Editor
INSPIRE	Infrastructure for Spatial Information in Europe; Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)
INSPIRE MIG	INSPIRE Maintenance and Implementation Group
INSPIRE PS	INSPIRE Protected sites
IR	Implementing Rules (a.k.a Commission Regulation)
ISDSS	Implementing Rules as regards interoperability of spatial datasets and services
IUCN	International Union for the Conservation of Nature
JRC	Joint Research Centre
MT	matching table
MS	Member State
MD	metadata
PS	Protected sites
TG	Technical Guidelines (a.k.a Data/interoperability specification)
UML	Unified Modelling Language
UNEP-WCMC	United Nations Environment Programme – World Conservation Monitoring Centre
XSD	XML Schema Definition
WDPA	World Database on Protected Areas

1.4 Notations

A legend of colours, letters and boxes have been used in order to make easier to identify the huge content of this document.

Red colour: values of the attributes in the final transformed data.

Dark blue colour: examples taken form the GML result.

2 Scope

Before the scope of this document is explained in further details, it is considered necessary to provide a brief overview of the concepts and documents related to the validation/conformance testing process of the implementation of the INSPIRE Implementing Rules (IR) and Technical Guidelines (TG).

The purpose of the “INSPIRE Data Specification on Protected Sites - Technical Guidelines” is to provide practical guidance for implementation that is guided by, and satisfies, the (legally binding) requirements included for the spatial data theme Protected sites in the Commission Regulation No 1089/2010 implementing Directive 2007/2/EC of the European Parliament and of the Council as regards interoperability of spatial data sets and services (further referred to as ISDSS Regulation).

These Technical Guidelines (TG) may propose a specific technical implementation for satisfying IR requirements. In such cases, these Technical Guidelines may contain additional technical requirements that need to be met in order to be conformant with the corresponding IR requirement when using this proposed implementation¹².

Annex A of the Technical Guidelines includes the Abstract Test Suite (ATS) which helps the conformance testing process. It includes a set of tests to be applied on a data set to evaluate whether it fulfils the requirements included in the related data specification and the corresponding parts of ISDSS Regulation. This is to help data providers in declaring the conformity of a data set to the “degree of conformity with Implementing Rules adopted under Article 7(1) of Directive 2007/2/EC”. This is required to be provided in the data set metadata according to Commission Regulation (EC) No 2008/1205 (the Metadata Regulation).

The ATS is applicable to the data sets that have been transformed to be made available through INSPIRE download services (i.e. the data returned as a response to the mandatory “Get Spatial Dataset” operation) rather than the original “source” data sets.

This report continues the reviewing of the Abstract Test Suite (ATS) from INSPIRE PS TG done in the theoretical approach described in the report “Step-4: Validation and conformance test, Theoretical part” (D4.1-Validation_Theoretical)¹³, where the tests have been analysed and grouped according to the available validation methods; and it gives some practical experiences on validation processes used in this project.

¹² <http://inspire.ec.europa.eu/tg/ps/3.2rc1>

¹³ <http://taskman.eionet.europa.eu/issues/21735>

3 Validation practical approach

The current report covers the “Step-4: Run and document the compliance tests” from the general objectives of the project. It describes the practical approach how it is possible to perform a validation process that makes conformant the results obtained.

First of all, it is necessary to point out that the practical processes described in this document are based in the theoretical document “D4.1-Validation_Theoretical”, where the methodology, the processes and the information available from INSPIRE Directive, Implementing Rules and Technical Guidelines are described in detail. The previous theoretical report does a review of the Abstract Test Suite (ATS) from INSPIRE PS Technical Guidelines providing a theoretical approach on how the tests could be used for evaluating the conformance of the data sets. A range of theoretical conformance criteria can be extracted from the Abstract Test Suite but in reality there are no very much experiences what it means in terms of technology and resources to test it.

This document intends to provide practical examples that allow not only to understand the different type of tests and how they can be analysed or used within the validation process, but also introduces some examples about possible errors that can occur presenting the solutions on how they can be solved.

This practical report has been completed with validation approaches made by EEA and Tracasa project team members, obtaining some experiences and real examples. The information described in the current document is provided in order to show and to help the data provider to perform the different tests for the objective of data validation conforming to INSPIRE.

The complete set of reports in this project consists of a theoretical and a practical document, which should allow the end user to perform a validation process, analysing all the quality criteria and solving the problems that may appear during the transformation process.

For the project of “CDDA in conformity with INSPIRE” the set of tests from the ATS is going to be followed. Although they are related with this INSPIRE Protected sites theme, some of them are out of the scope of the project “CDDA in conformity with INSPIRE”. For example, the issues related with metadata and network services that take part in a global INSPIRE sharing environment are not involved in the current project. Such cases are marked with a red colour in the table below.

Network services and metadata are part of the system of sharing data in conformity with INSPIRE Directive and IR. But the objectives of the current project deals with the data transformation only. Therefore, some of the tests form the ATS are out of the scope of this project.

Table 1 List of tests included in the ATS of the INSPIRE PS Technical Guidelines and the ones out of scope of the project marked with red colour

	CONFORMANCE CLASS	TEST	
PART 1 (Normative) Conformity with Commission Regulation No 1089/2010	A.1 Application Schema Conformance Class	A.1.1 Schema element denomination test	
		A.1.2 Value type test	
		A.1.3 Value test	
		A.1.4 Attributes/associations completeness test	
		A.1.5 Abstract spatial object test	
		A.1.6 Constraints test	
		A.1.7 Geometry representation test	
	A.2 Reference Systems Conformance Class	A.2.1 Datum test	
		A.2.2 Coordinate reference system test	
		A.2.3 View service coordinate reference system test	
		A.2.4 Temporal reference system test	
		A.2.5 Units of measurements test	
	A.3 Data Consistency Conformance Class	A.3.1 Unique identifier persistency test	
		A.3.2 Version consistency test	
		A.3.5 Update frequency test	
	A.4 Metadata IR Conformance Class	A.4.1 Metadata for interoperability test	
	A.5 Information Accessibility Conformance Class	A.5.1 Code list publication test	
		A.5.2 CRS publication test	
		A.5.3 CRS identification test	
	A.6 Data Delivery Conformance Class	A.6.1 Encoding compliance test	
	A.7 Portrayal Conformance Class	A.7.1 Layer designation test	
	PART 2 (Informative) Conformity with the Technical guideline (TG) Requirements	A.8 Technical Guideline Conformance Class	A.8.1 Multiplicity test
			A.8.2 CRS http URI test
A.8.3 Metadata encoding schema validation test			
A.8.4 Metadata occurrence test			
A.8.5 Metadata consistency test			
A.8.6 Encoding schema validation test			
A.8.7 Style test			

The main reference information directly available is the application schema from INSPIRE, the one that contains all the specifications from the data model, in this case for INSPIRE Protected sites theme, describing the types, the association roles, etc. Some of the tests are directly related with the information

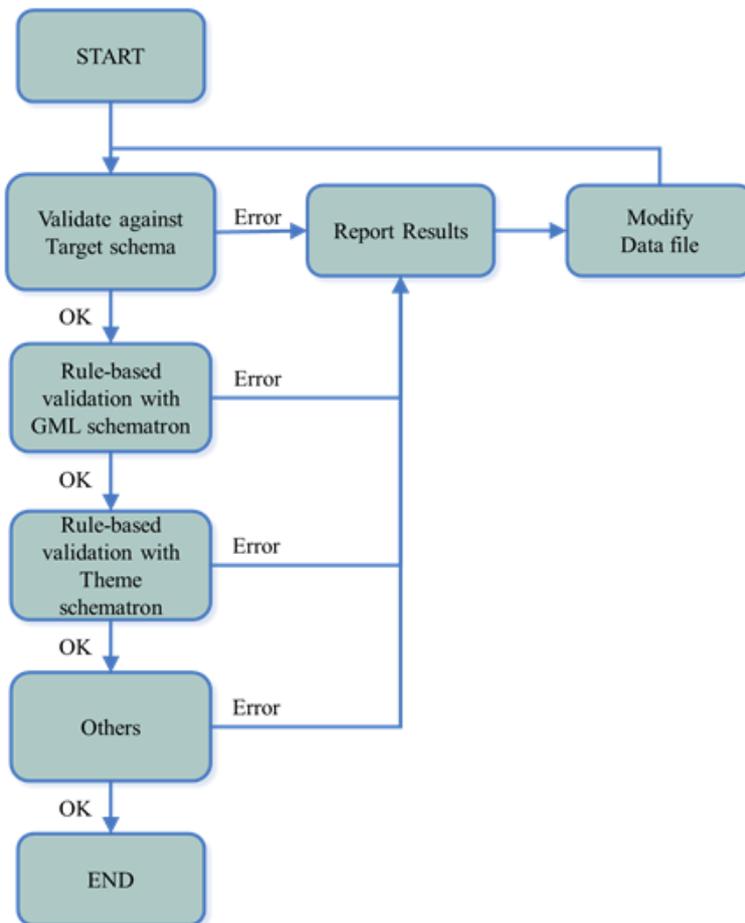
contained in the application schema, where rules, associations, types, etc. are specified as it is described in the ATS.

For those tests grouped in the Application Schema Conformance Class that are related to the rules included in the XSD, a validation against the target application schema using a validation tool can be directly done. In some other tests from the ATS that are not directly related with the information contained in the XSD target application schema, additional rules or methods should be developed in order to cover the whole conformance classes.

Following the INSPIRE PS TG in Section 9.5.1., it is exposed that not all constraints defined in the application schemas can be mapped to XML, therefore they cannot be enforced through schema validation. It may be possible to express some of these constraints using other schema or rule languages (e.g. Schematron) in order to enable automatic validation. A Schematron is a language for making assertions about patterns found in XML documents in the studied validation reports.

From this starting point a methodology of validation can be established which groups the different tests of ATS depending on how they can be accomplished as it is presented in Figure 1. The suggested classes are: testing against target schema - XSD, using a GML Schematron or using theme Schematron. A final other test is also mentioned.

Figure 1 Summary of the validation methods



Examples on how to perform the tests and how to solve common errors found are widely described in this section. For those tests in which the validation have been carried out and checked using specific

validation tools, it is possible to provide some recommendations, however for some other tests, only a theoretical approach can be given by describing an idea on how to do the test.

Any errors encountered during the process at any level, should be documented. This is described and included in the diagram as part of the process (see Figure 1).

From a global point of view of a validation process, documenting errors is important to identify the part of the process where problems appear and to find and describe the solutions not only for the current works but also for next versions and updating processes. Also reporting the errors is important when different actors are working in a validation process and a central point manages the process. In this case the reporting should use a common template in order to make easier to solve the encountered problems.

3.1 Application schema validation

Following the previous Figure 1, the first step should be validating the data against the respective application schema.

The analysis against the application schema is useful to validate some of the abstract tests from the Application Schema Conformance Class and some of the abstract tests from the Technical Guideline Conformance Class of INSPIRE PS TG as it is presented below.

Table 2 List of tests that could be validated using the XSD PS schema application

A.1 Application Schema Conformance Class	A.1.1 Schema element denomination test
	A.1.2 Value type test
	A.1.3 Value test
	A.1.4 Attributes/associations completeness test
	A.1.5 Abstract spatial object test
	A.1.7 Geometry representation test
A.8 Technical Guideline Conformance Class	A.8.1 Multiplicity test
	A.8.6 Encoding schema validation test

These tests are directly related to the rules included in the application schema (XSD) from INSPIRE PS, where the following elements are described: the name of the attributes, the value types and data values and the associations or rules among them are established.

The procedure to compare the information against the application schema is based on the use of an XML validation tool. These tools allow to define a source XML file (XSD schema) and the target XML file to be validated (the transformed GML file) providing as a result a list of non-conformance issues.

Any errors identified during the procedure should be corrected before the process continues. It has to be assured that the XML document refers to the proper schema; just because a data file which is XML valid does not mean that it is valid according to a specific schema.

Date of the test	Summer 2014
Test author	Tracasa
Implementation Under Test (IUT)	CDDA_PS_INSPIRE.gml
IUT description	Data of CDDA remodelled according INSPIRE Protected Sites Simple Application Schema and exported in GML 3.2.1 format.
Reference schema	ProtectedSites.xsd http://inspire.ec.europa.eu/schemas/ps/3.0/ProtectedSites.xsd
Summary	<input type="checkbox"/> The results did not show any Non Conformity <input checked="" type="checkbox"/> The test results showed Non Conformities
Comments	The final result did not show any Non Conformity really, but what it is intended here is to show some examples about different kind or errors that could be found in this process of validation.
Tool used	Oxygen XML Editor SyncRO Soft SRL W3C XML Schema (XSD). http://www.utilities-online.info/xsdvalidation/#.VA1Sbv1_tSn

3.1.1 Errors related to A.1.1. Schema element denomination test

Element	ps:legalFoundationDate
Description	<p><ps:legalFoundationDate>1994-01-01T00:00:00+01:00</ps:legalFoundationDate></p> <p>Severity: error</p> <p>Description: cvc-complex-type.2.4.a: Invalid content was found starting with element '{"urn:x-inspire:specification:gmlas:ProtectedSites:3.0":legalFoundationDate}'. One of '{"urn:x-inspire:specification:gmlas:ProtectedSites:3.0":legalFoundationDate}' is expected.</p>
Rectification	<p>Fix</p> <p><ps:legalFoundationDate>1994-01-01T00:00:00+01:00</ps:legalFoundationDate></p>
Comments	The correct designation of mnemonic names for the attributes has been analysed with this test.

3.1.2 Errors related to A.1.2. Value type test

Element	ps:legalFoundationDate
Description	<p><ps:legalFoundationDate>1994</ps:legalFoundationDate></p> <p>Severity: error</p>

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Rectification	Description: cvc-datatype-valid.1.2.1: '1994' is not a valid value for 'dateTime'.
	Insert date format <ps:legalFoundationDate>1994-01-01T00:00:00+01:00</ps:legalFoundationDate>
Comments	The value type of each provided attribute or association role target specification has been analysed in this test. In this case the application schema is defining a value type: <extension base="dateTime">. It is also related with Art.11 (1) of Commission Regulation 1089/2010 as it is described in A.2.5. Temporal reference system test.

3.1.3 Errors related to A.1.3. Value test

Element	ps: siteProtectionClassification
Description	<ps:siteProtectionClassification>nature2000</ps:siteProtectionClassification>
	Severity: error Description: cvc-enumeration-valid: Value 'nature2000' is not facet-valid with respect to enumeration '[natureConservation, archaeological, cultural, ecological, landscape, environment, geological]'. It must be a value from the enumeration.
Rectification	Insert one of the enumeration list values <ps:siteProtectionClassification>natureConservation</ps:siteProtectionClassification>
Comments	This example analyses the values from an enumeration list provided in the application schema.

Element	ps: siteProtectionClassification
Description	<ps:designation codeSpace="http://inspire.ec.europa.eu/codelist/IUCNDesignationValue/nature2000/">nature2000</ps:designation>
	An error should be expected. The code list IUCNDesignationValue includes the following codes: strictNatureReserve, wildernessArea, nationalPark, habitatSpeciesManagementArea, naturalMonument, managedResourceProtectedArea and ProtectedLandScapeOrSeascape.
Rectification	Insert one of the code list values <ps:siteProtectionClassification>nationalPark</ps:siteProtectionClassification>
Comments	This example analyses the values from a code list with extensibility = none provided in the application schema. The expected result here was to retrieve an error. In order to deal with this issue, it may be necessary to share with INSPIRE MIG these results in order to improve the XSD PS schema and/or the INSPIRE

3.1.5 Errors related to A.1.5. Abstract spatial object test

Element	ps: DesignationValue
Description	<pre><ps:DesignationValue></ps:DesignationValue></pre> <p>An error is found.</p>
Rectification	Skip this attribute from the GML result
Comments	In the INSPIRE PS Simple application schema, the object DesignationValue exists to allow to build the PS data model, but this object will not be present in the final XML instance (GML file) after the conformity with INSPIRE. It is controlled by the correspondent XSD schema. This error has been manually forced to show it as an example.

3.1.6 Errors related to A.1.7. Geometry representation test

Element	ps: geometry
Description	<pre><ps:geometry> <gml:Polygon srsName="EPSG:25830" gml:id="p828"> <gml:exterior> <gml:LinearRing> <gml:coordinates>607403.0883,4757687.5401,0 </gml:coordinates> </gml:LinearRing> </gml:exterior> <gml:exterior> <gml:LinearRing> <gml:coordinates>607817.8393,4757737.3471,0 </gml:coordinates> </gml:LinearRing> </gml:exterior> </gml:Polygon> </ps:geometry></pre> <p>Not valid.</p> <p>Error - Line 12, 25: org.xml.sax.SAXParseException; lineNumber: 12; columnNumber: 25; cvc-complex-type.2.4.a: Invalid content was found starting with element 'gml:exterior'.</p> <p>One of '{"http://www.opengis.net/gml/3.2":interior}' is expected.</p>
Rectification	<p>To use gml:Mutisurface for multipolygons encoding:</p> <pre><ps:geometry> <gml:MultiSurface gml:id="_15c52165-b169-40b9-91d1-cb1b0a7c815e" srsName="urn:ogc:def:crs:EPSG::4258"> <gml:surfaceMember> <gml:Polygon gml:id="_de63f6fa-7310-4b34-a698-e0d5762b03af"> <gml:exterior> <gml:LinearRing> <gml:posList>42.96426248808386 - 1.6830767239679427</gml:posList> </gml:LinearRing></pre>

```

    </gml:exterior>
  </gml:Polygon>
</gml:surfaceMember>
<gml:surfaceMember>
  <gml:Polygon gml:id="_af191e8c-c5c9-4b24-a09b-96010d215723">
    <gml:exterior>
      <gml:LinearRing>
        <gml:posList>42.96465225760745 -
1.6779829722252757</gml:posList>
      </gml:LinearRing>
    </gml:exterior>
  </gml:Polygon>
</gml:surfaceMember>
</gml:MultiSurface>
</ps:geometry>

```

Or to use gml:polygon with one </gml:exterior> and one </gml:interior> for donuts:

```

<ps:geometry>
  <gml:Polygon srsName="EPSG:25830" gml:id="p828">
    <gml:exterior>
      <gml:LinearRing>
        <gml:coordinates>607403.0883,4757687.5401,0 </gml:coordinates>
      </gml:LinearRing>
    </gml:exterior>
    <gml:interior>
      <gml:LinearRing>
        <gml:coordinates>607817.8393,4757737.3471,0 </gml:coordinates>
      </gml:LinearRing>
    </gml:interior>
  </gml:Polygon>
</ps:geometry>

```

To use gml:polygon with one </gml:exterior> for plane polygons:

```

<ps:geometry>
  <gml:Polygon srsDimension="3" srsName="EPSG:25830" gml:id="p1">
    <gml:exterior>
      <gml:LinearRing>
        <gml:coordinates>889441.7255,4684979.8747,0 </gml:coordinates>
      </gml:LinearRing>
    </gml:exterior>
  </gml:Polygon>
</ps:geometry>

```

Comments

If the encoding is wrong the validation using the proper application schema could detect these errors.

3.1.7 Errors related to A.8.1. Multiplicity test

Element	ps: legalFoundationDate
Description	<pre> </ps:inspireID> <ps:legalFoundationDate>1996-01-01T00:00:00+01:00</ps:legalFoundationDate> <ps:legalFoundationDate>1996-01-01T00:00:00+01:00</ps:legalFoundationDate> <ps:legalFoundationDocument> Severity: error Not valid. Error - Line 101, 28: org.xml.sax.SAXParseException; lineNumber: 101; columnNumber: 28; cvc-complex-type.2.4.a: Invalid content was found starting with element 'ps:legalFoundationDate'. One of '{ "urn:x- inspire:specification:gmlas:ProtectedSites:3.0":legalFoundationDocument }' is expected. </pre>
Rectification	<pre> Delete one of the ps:legalFoundationDate </ps:inspireID> <ps:legalFoundationDate>1996-01-01T00:00:00+01:00</ps:legalFoundationDate> <ps:legalFoundationDocument> </pre>
Comments	<p>It is analysed if each instance of an attribute or association role does not includes fewer or more occurrences than specified in the application schema(s). In this case, the attribute legalFoundationDate has a multiplicity 1. Only one occurrence is expected.</p>

Element	ps: DesignationType/ps: designation
Description	<pre> <ps:siteDesignation> <ps:DesignationType> <ps:designationScheme codeSpace="http://dd.eionet.europa.eu/vocabulary/inspire/DesignationScheme Value">nationalDesignationTypeCategory</ps:designationScheme> <ps:designation codeSpace="http://dd.eionet.europa.eu/vocabulary/cdda/designationtypecategory" >A</ps:designation> <ps:percentageUnderDesignation>100</ps:percentageUnderDesignation> </ps:DesignationType> </ps:siteDesignation> <ps:siteDesignation> <ps:DesignationType> <ps:designationScheme codeSpace="http://dd.eionet.europa.eu/vocabulary/inspire/DesignationScheme Value">IUCN</ps:designationScheme> </pre>

	<pre> <ps:designation codeSpace="http://inspire.ec.europa.eu/codelist/IUCNDesignationValue">man agedResourceProtectedArea</ps:designation> <ps:percentageUnderDesignation>-1</ps:percentageUnderDesignation> </ps:DesignationType> </ps:siteDesignation> <ps:siteDesignation> <ps:DesignationType> <ps:designationScheme codeSpace="http://dd.eionet.europa.eu/vocabulary/inspire/DesignationScheme Value">nationalDesignationTypeCode</ps:designationScheme> <ps:designation codeSpace="http://dd.eionet.europa.eu/vocabulary/cdda/designations">ES24</ ps:designation> <ps:percentageUnderDesignation>100</ps:percentageUnderDesignation> </ps:DesignationType> </ps:siteDesignation> </pre> <p>No errors appear. It is a valid encoding.</p>
Rectification	Not necessary
Comments	Other examples with attributes as siteDesignation (multiplicity is 1..*) has been performed. There is one occurrence (as the minimum number of occurrences) and 3 occurrences in the final result are also admitted.

3.1.8 Errors related to A.8.6. Encoding schema validation test

This test includes the **A.6.1. Encoding compliance test** of the ATS - this test analyses if the EN ISO 19118¹⁵ is applied – and also the **Test A.1.1 Schema element denomination Test, A.1.2 Value type test, A.1.3 Value test and A.1.4 Attributes/associations completeness test** due to the accomplished study using the application schema.

Following the specifications in Section 9 of INSPIRE PS TG, the scope of this test is the compliance of the encoding used to deliver the dataset. It is also said that data instance (XML) documents shall validate without error against the provided XML schema and the obligation to use only the allowed code list values specified for attributes and most of the constraints defined in the application schemas cannot be mapped to the XML schema. They can therefore not be enforced through schema validation. It may be possible to express some of these constraints using other schema or rule languages (e.g. Schematron), in order to enable automatic validation.

The final tests applied for all the ATS in this project, using GML Schematron and Thematic Schematron will ensure the conformance of this Encoding schema validation test.

¹⁵ ISO 19118: Geographic information - Encoding

3.2 GML Schematron validation

Once the data file is formally validated against the schema provided – and valid; compliance to further constraints arising from the data specification should also be checked. In this point the process goes a step further: as XML schema validation cannot detect the non-conformance to the constraints, they have to be validated by means of a dedicated encoding of the rules which are behind them.

The objective of obtaining a spatial data set in conformity with the INSPIRE Directive and Implementing Rules deals not only with a fact of being compliant with the application schema but also with general GML encoding rules according to the recommended encoding type – GML 3.2.1 - GML 3.2.2 (GML (ISO 19136, OGC 10-129r1) and ISO/TS 19139 are promoted as the default encoding in INSPIRE¹⁶).

The proposed option check the proper encoding using a Schematron and more specifically this step refers to the use of a generic Schematron focused on GML encoding. It shall contain the encoding rules used to encode spatial data and should be made available to cover the constraints common to all the INSPIRE themes. One of the examples that can be used is the generic Schematron provided by OGC for GML 3.2.1 that can be retrieved from

<http://schemas.opengis.net/gml/3.2.1/SchematronConstraints.xml>

There is only one test that can be covered by this step:

Table 3 List of tests that could be validated using the GML Schematron

A.6 Data Delivery Conformance Class	A.6.1 Encoding compliance test
-------------------------------------	--------------------------------

This test is directly related with EN ISO 19118¹⁷ which specifies the requirements for defining encoding rules for use for the interchange of data that conform to the geographic information in the set of international standards known as the “ISO 19100 series”.

As in the previous process, a tool for performing the validation is required, allowing the comparison between the specific XML (generic GML Schematron) and the transformed GML. Some validation tools are described in the following sections. While in most cases the Schematron rules are configured to only display text messages for errors, some others also provide more informative text.

¹⁶ D2.7: Guidelines for the encoding of spatial data, Version 3.3., http://inspire.ec.europa.eu/documents/Data_Specifications/D2.7_v3.3.pdf .

¹⁷ <https://www.iso.org/obp/ui/#iso:std:iso:19118:ed-2:v1:en>

Date of the test	Summer 2014
Test author	Tracasa
Implementation Under Test (IUT)	CDDA_PS_INSPIRE.gml
IUT description	Data of CDDA remodelled according to INSPIRE Protected Sites Simple Application Schema and exported in GML 3.2.1 format.
Reference schema	SchematronConstraints.sch http://schemas.opengis.net/gml/3.2.1/SchematronConstraints.xml
Summary	<input type="checkbox"/> The results did not show any Non Conformity <input checked="" type="checkbox"/> The test results showed Non Conformities
Comments	The final result did not show any Non conformity
Tool used	<oXygen/> XML Editor v15 by SyncRo Soft SRL

List of GML Schematron Validation Errors

Element	
Description	
Rectification	
Comments	

In this case, it is necessary to use a tool that allows reading Schematron files. The one from <http://schemas.opengis.net/gml/3.2.1/SchematronConstraints.xml> has been used and no errors have been found.

Some examples of these Schematron rules are shown below:

```
<sch:rule context="gml:ValueArray">
  <sch:assert test="not(@codeSpace and @uom)">ValueArray may not carry both a reference
  to a codeSpace and a uom</sch:assert>
</sch:rule>
```

```
<sch:rule context="gml:MultiSurfaceDomain">
  <sch:assert test="count(gml:domainSet/*)=count(gml:domainSet/gml:MultiSurface)">All
  values in the domain set shall be gml:MultiSurface elements or an element in its substitution group.
  Note that the test currently does not identify substitutable elements correctly, this will require the use
  of XPath 2 in the future.</sch:assert>
</sch:rule>
```

3.3 INSPIRE Protected sites Schematron validation

The possibility to implement different rules in Schematron language allows the validation process for the tests of the ATS outside of the application schema. Most of the tests that need to be covered are directly related with the INSPIRE themes and their specific theme-constraints, therefore Schematron rules shall be provided for each data specification.

The third step following the methodological approach presented shows that all data provided in the form of XML/GML files must pass validation according to the corresponding thematic Schematron before considered valid. This step will ensure a better validation result according to INSPIRE Directive. In this process, specific aspects related to the INSPIRE theme are checked, being possible to cover the following tests.

Table 4 List of tests that could be validated using the thematic Protected sites Schematron

Conformance Class	Tests
A.1 Application Schema Conformance Class	A.1.3 Value test
	A.1.6 Constraints test
	A.1.7 Geometry representation test
A.2 Reference Systems Conformance Class	A.2.1 Datum test
	A.2.2 Coordinate reference system test
	A.2.4 Temporal reference system test
A.5 Information Accessibility Conformance Class	A.5.1 Code list publication test
	A.5.2 CRS publication test
A.8 Technical Guideline Conformance Class	A.8.6 Encoding schema validation test

Specific issues such as code list values among other constraints are not included in the application schema and should be implemented as rules in the thematic Schematron. Evaluating the list of tests mentioned above, it can be stated that some of the tests are specific to the pertinent INSPIRE theme, in this case INSPIRE PS, but some others could be considered common to all INSPIRE themes as for instance “A.2 Reference Systems Conformance Class”.

Some discussions and analysis have started to envisage the possibility to develop Schematron rules that could be generic for all data specifications apart from the thematic Schematron that refers only to the specific theme. Within the scope of this project, all the rules that need to be implemented in a Schematron are going to be included in the specific PS Schematron which is the theme inherent to the project.

The validation is also based in the use of specific transformation tools that will compare the specific Schematron against the transformed GML files, providing (as in the previous test) the correspondent result that can display text messages for errors and also informative text. For this group of tests a thematic Schematron has been used from a European project named NatureSDIplus¹⁸, where proofs on validation issues were performed in the same line that this report describes. An example of Schematron implementation is described below.

¹⁸ <http://www.nature-sdi.eu/>

Date of the test	Summer 2014
Test author	Tracasa
Implementation Under Test (IUT)	CDDA_PS_INSPIRE.gml
IUT description	Data of CDDA remodelled according INSPIRE Protected Sites Simple Application Schema and exported in GML 3.2.1 format.
Reference schema	INSPIRE_Data_PS.sch
Summary	<input type="checkbox"/> The results did not show any Non Conformity <input checked="" type="checkbox"/> The test results showed Non Conformities
Comments	The final result did not show any Non conformity really, but what it is intended here is to show some examples about different kind or errors that could be found in this process of validation.
Tool used	<oXygen/> XML Editor v15 by SyncRo Soft SRL

List of Protected Sites Schematron Validation Errors

Element	ps:geometry
Description	<pre><ps:geometry> <gml: MultiSurface srsName="EPSG:4258" gml:id="p1"></pre> <p>SRS Non-EPSG EPSG:4258 (contains(\$srs, 'urn:ogc:def:crs:EPSG')) [assert]</p>
Rectification	<p>Change by srsName="urn:ogc:def:crs:EPSG:4258"</p> <pre><gml:MultiSurface gml:id="_c96c94c5-4f7e-457b-a0f3-da41fe990995" srsName="urn:ogc:def:crs:EPSG::4258"></pre>
Comments	<p>By using rules, it is possible to check more aspects of the INSPIRE application schema.</p> <pre><sch:pattern > <sch:title>Requirement CRS</sch:title> <sch:rule context="//ps:ProtectedSite"> <sch:let name="srs" value="ps:geometry//@srsName"/> <sch:assert test="contains(\$srs, 'urn:ogc:def:crs:EPSG')">SRS Non- EPSG <sch:value-of select="\$srs"/> </sch:assert> </sch:rule> </sch:pattern></pre>

Following this way, more rules could be created to cover all the tests from the list above. As it is mentioned in the previous theoretical report “D4.1-Validation_Theoretical”. Project **eENVplus**¹⁹ currently analyses the way how the different tests could be performed, and prepares some rules in a thematic Schematron. It hasn’t been possible yet to perform a complete validation process of the transformed GML files with this thematic Schematron; but some of the implemented rules have been analysed with objective to perform the validation for as many tests from ATS as possible. As an example: rules related to A.1.6 Constraints test and A.1.7 Geometry representation test have been implemented.

3.4 Other tests

Once the ATS has been analysed, and some experiences about validation process has been acquired, there are some tests from the ATS that should be performed manually because no automated processes are defined yet and in some cases it seems that it will not be possible to do it. This part of the methodology is called “Others” and represents the final step in the validation process (see Figure 1).

All the tests that cannot be analysed by application schema, GML or Thematic Schematron should be analysed. Nevertheless, it is not possible now to automate or describe a specific methodology on how to do it, a theoretical approach is described here to help to understand the approach.

Tests related to the accessibility are probably one of those that should be performed with other methods. Based on the analysis done in the previous theoretical validation report, it has not been possible to establish a defined method for some of the tests. Further works on this issue of validation will find the right way to perform these tests.

A.5 Information Accessibility Conformance Class	A.5.3 CRS identification test
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¹⁹ <http://www.eenvplus.eu/>

4 CDDA validation process

The project “CDDA in conformity with INSPIRE” includes a validation step as a way to ensure the quality of the transformed data, to analyse the feasibility to perform this process and also to evaluate how this process could be applied by Member States on their own data.

The validation process in the current project has been successfully performed obtaining a final valid result. Every agreement reached in the process of establishing the mapping rules has been validated and also every encoded rule has been analysed in this way. All the issues related with the way of mapping the source information to the application schema have been also analysed from a validation point of view. It has been taken into account that the agreements for transformation issues would comply with the final objective of conformity.

To perform this validation analysis, the methodology described in the theoretical and practical reports has been followed. The tools used in the transformation and validation process helped to find the errors and to solve them. The transformation tools used have been mainly HALE and also Tracasa Geobide Converter tool for some analyses. In this process of transformation, it was possible to ensure some quality aspects as the right names of the attributes and to assign the values in a right way. In some cases, the validation process has detected some situations that helped the implementation of the transformation tools. For validation process, the tools used are described in the theoretical report “D4.1-Validation_Theoretical”.

The methodology described here intends to be a guide to help others (data providers) to perform the validation process in their own systems, and it ensures that the final shared information complies with INSPIRE Directive, Implementing Rules or Technical Guidelines. The process has been written in a way that serves as a template which can be used for any data provider that needs to validate their transformed data. The harmonisation of the results found and description how the errors are solved present a helpful method not only to report, but also to share this knowledge with others. Where different data providers work in the same project, it might be useful to establish a central coordinator point where doubts, errors and solutions could be analysed in a more coordinated and harmonised way.