INSPIRE

Infrastructure for Spatial Information in Europe

Questionnaire on the use of the elements of spatial and temporal schema - Report

Title	**Questionnaire on the use of the elements of spatial and temporal schema - Report**
Creator	INSPIRE DT Data Specifications
Date	08.02.2008
Subject	Report summarising the results of the questionnaire
Status	Final
Publisher	INSPIRE DT Data Specifications
Type	Text
Description	Results, statistics and conclusion of the questionnaire on the use of the elements of spatial and temporal schemas.
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Format	Adobe PDF
Source	
Rights	Public
Identifier	INSPIRE-STAQ-report
Language	En
Relation	INSPIRE Data Specifications
Coverage	

These are Dublin Core metadata elements. See for more details and examples http://www.dublincore.org/.

Acronyms / Glossary

Used Term	Definition
EEA	European Environmental Agency
EU	European Union
INSPIRE	Infrastructure of Spatial Information in the European Community
LMO	Legally Mandated Organisation
SDI	Spatial Data Infrastructure
SDIC	Spatial Data Interest Community
STA questionnaire	Questionnaire on the use of the elements of spatial and temporal schema

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Purpose of this document

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), was published in the Official Journal of the European Union on 25 April 2007 and it entered into force on 15 May 2007. INSPIRE lays down the legal framework for the establishment and operation of an Infrastructure for Spatial Information in Europe. The purpose of such an infrastructure is to assist policy-making in relation to policies that may have a direct or indirect impact on the environment.

Implementing Rules are being developed for technical arrangements for the interoperability and harmonisation of spatial data sets and services based on requirements from policies and based on the spatial data infrastructures in the Member States.

To support the development of the Implementing Rules, a questionnaire on the use of the elements of spatial and temporal schemas was published in parallel with an Unique Identifiers questionnaire in May 2007, to solicit additional information on current practice beyond the information that could be extracted from the reference material submitted by stakeholders.

By the legislative point of view Article 7(4) of the INSPIRE Directive requires to cover the definition and *classification of spatial objects relevant to spatial data sets related to the themes listed in Annex I, II or III*. This is addressed, as described in D2.5 Generic Conceptual Model, by using the rules of the ISO 19100 series, in particular spatial properties will be specified for each of the spatial object types in the INSPIRE application schemas following the rules of ISO 19109 (Rules for application schemas), ISO 19107 (Spatial schema) and ISO 19123 (Schema for coverage geometry and functions). A Feature Concept Dictionary will be established for all themes and will include a classification of all spatial objects into spatial object types. For each spatial object type, the dictionary will provide a definition.

Article 8(2)(d) of the INSPIRE Directive requires to address *information on the temporal dimension of the data*. This is addressed in D2.5 by specifying temporal properties for each of the spatial object types in the INSPIRE Application Schemas following the rules of ISO 19109 (Rules for application schemas) and ISO 19108 (Temporal schema).

At the present the draft of the Generic Conceptual Model for INSPIRE data specifications does not contain proposal of restriction for the spatial object types proposed in the ISO standards. The questionnaire was published in particular to support future decisions about the rules on restriction or extension for spatial object types and temporal properties in INSPIRE.

This report was conducted as a survey over seven clusters of questions with related answers, identified as the main streaks within the questionnaire.
The analysis was done in respect of the goals of this report and of the questionnaire itself:

- detecting Influence on Deliverable D2.5;
- achieving more information on the GIS data state of the art within the SDICs and LMOs in the member States.

A brief paragraph on conclusions will summarize the analysis. Two complete summaries on respondents and on responses will be respectively the preface and the final annex for the cluster analysis.

To be noticed that this report is aligned with the Unique Identifiers questionnaire and contains appropriate links to the study on Temporal Metadata for Discovery commissioned by the Spatial Data Infrastructures Unit of the European Commission Joint Research Centre to AMI s.r.l. of Luxembourg. The study was commissioned in 2007 to investigate issues of expression and exchange of temporal information related to resources of importance for the INSPIRE Directive. The objectives were to review existing standards and practices in different thematic communities and make recommendations as input to the preparation of the Implementing Rules for Metadata required by INSPIRE.

1. Basic statistics

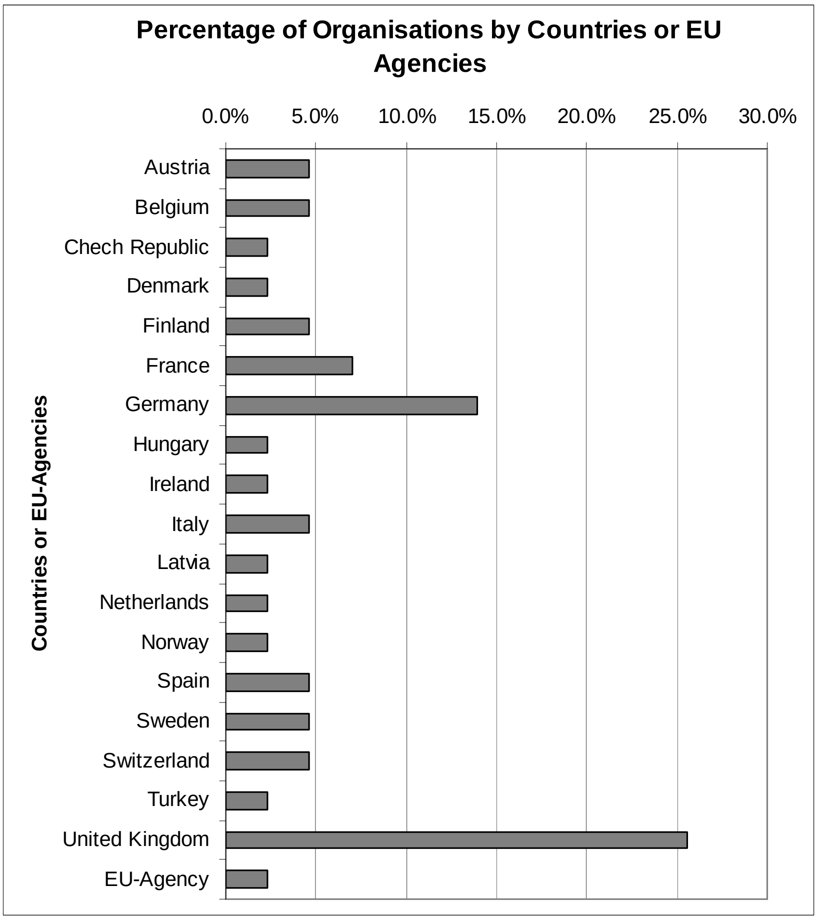
Questionnaire on the use of the elements of spatial and temporal schema was published on the INSPIRE web site (http://www.ec-gis.org/inspire/gtt/) and it was available to registered SDICs and LMOs and other organisations from the geo-information community, responsible for spatial data. The answers were collected in a database.

Basic statistics shows that 43 organisations submitted to the Questionnaire on the use of the elements of spatial and temporal schemas. Based on the derived statistics, it is recognized that the organizations from 15 European Union countries, organisations from Norway, Switzerland and Turkey and one European agency – European Environmental Agency submitted to the questionnaire.
Detailed information is provided in Table 1 and Graph 1.

Country or EU-Institution	Number of organisations	%
Austria	2	4,7%
Belgium	2	4,7%
Chech Republic	1	2,3%
Denmark	1	2,3%
Finland	2	4,7%
France	3	7,0%
Germany	6	14,0%
Hungary	1	2,3%
Ireland	1	2,3%
Italy	2	4,7%
Latvia	1	2,3%
Netherlands	1	2,3%
Norway	1	2,3%
Spain	2	4,7%
Sweden	2	4,7%
Switzerland	2	4,7%
Turkey	1	2,3%
United Kingdom	11	25,6%
EU-Agency (EEA)	1	2,3%
Total	43	100,00%

* EEA – European Environmental Agency

Table 1: Participation of Organizations in the STA Questionnaire, by Countries



Graph 1: Percentage of Organizations, by Countries and by European Agencies, Participating in the STA Questionnaire

2. Cluster analysis on the results of the questionnaire

The present analysis was conducted over seven clusters of answers to evaluate influence on Deliverable D2.5.

A. Account on questions about vector and coverage data

No geometry type in the list was able to be discarded *a priori*, since everyone was pointed out, at least by two or three people for the most complex types. Likewise, no further geometry type was requested to be added to the proposed list. An annotation on **multicurves with contiguity**, **4D objects** (for example vector curves or any other shape embedded in 4D) and **2.55D objects**, proposed apparently as new object types: these can be easily taken back to the categories provided by ISO Spatial schema (and collected in this questionnaire too) and ISO Temporal schema.

B. Account on questions about interpolation methods and temporal aspects for coverages

Respondents declared to manage coverages with a temporal component to the domain. This is in line with D2.5 assumptions.
Respondents declared to need interpolation. The list of requested interpolation techniques was checked to point out the additional techniques mentioned against D2.5 and ISO 19123, with these results:

- **Kriging**
- **Spline**
- **IDW, Inverse Distance Weight**
- **Inverse Square**
- **MISH, Meteorological Interpolation based on Surface Homogenized Data Basis**
- **Extreme-value neighbour**

Doubtful additions (should be clarified thanks to additional information):

- **Linear Precision (Software SCOPE++ of Inpho)**: this seems to overlap with the Linear technique
- **TIN** (it doesn't represent a technique itself, but a coverage type): this may overlap with the Barycentric technique

The requirement to add new techniques is allowed by D2.5 since this is in line with ISO 19123, that states: "Since CV_InterpolationMethod is a CodeList, it may be extended in an application schema that specifies additional interpolation methods."

C. Account on questions about temporal characteristics - management of updates

Respondents declared to perform data update following the ratio of three to one. The answers reflect a large variability on the temporal interval the procedures for data update are applied, from the answer **Continually** to **Anually** or **Irregularly**. Since updates of the data is not specifically addressed by this document and will be addressed by document D2.7 and by the Implementing Rules on Network Services, consistence with D2.5 indications could be investigated and confirmed only on a high level. The specific answers with the related requirements shall be transferred to the competent destinations.
Subject matter are equally the shape and the textual properties of an object, as D2.5 proposed.
Most advanced mechanisms declared as used to identify updated objects are the **Persistent Object Identifier plus Version Identifier** and the **Persistent Object Identifier with Timestamp**, in line with D2.5. This is perfectly in line also with the Temporal Metadata Survey, for the declared employment of the Version ID and the Timestamp.

D. Account on questions about temporal characteristics - versioning of spatial objects

Respondents declared to use versioning for spatial objects or for fully datasets only. The two scenarios will be able to be replicated following the D2.5 assumptions.
The list of many procedures this operation is done according to was checked and picked up as conformant with the D2.5 guide lines.
Respondents declared to know and use all the proposed semantic meaning of time in respect of versioning for spatial objects: **Transaction time**, **Valid time**, **Verification time**. Other semantic meanings of time were indicated in addition: **update time and suppression time**, but they seem to be replication of Transaction time, respectively at the beginning and at the end of the time interval.

E. Account on question about temporal characteristics - semantic meaning of time

Respondents declared to use all the proposed semantic meanings of time: **Time of event in the real world**, **Time or period of data collection / observation**, **Time of insertion in the dataset**, **Time of verification**, **Time of publication**, **Time or period for which a simulation was computed**. This is compatible with D2.5 indications. Two semantic meanings of time were indicated in addition: **update time and suppression time**, like for the previous question (see comment in the previous paragraph). The responses in the two sections D and E are in line with the Temporal Metadata Survey, where Transaction time, Validation time, Publication time, Verification time were mentioned too.

F. Account on question about temporal characteristics – calendars

Respondents declared to use all the proposed temporal reference systems and also some specific calendars. The complete list was analyzed pointing out that the additional calendars are compatible with D2.5 assumptions, since it states to allow all the temporal reference systems relatable using the ISO 19108 model.
These guide lines are consistent with the Temporal Metadata Survey recommendations, where several types of calendars and time measurements were analyzed in detail, from the geological eras to milliseconds. In particular two rules were stated there, put beside ISO 19108 standard: *"points in time are expressed (or converted to) ISO 8601, with the only exception being the expression of geological timescales."* and "*INSPIRE encourage the use of standard vocabulary for geological timescales, such as the Geological Time Scale 2004 developed by the International Commission on Stratigraphy.*"

G. Account on question about temporal characteristics - management of time series data

Respondents declared to adopt some different management ways for time series, but time series management was not mentioned overtly in the D2.5 document. This is the registered list over the declared management techniques, that may be considered to give more detail to the time series description in D2.5:

- **Encoding temporal information in the dataset identifier / filename**
- **Temporal information is part of the dataset / file content**
- **Time series values selected when triggered by an external set of temporal events**
- **Temporal information is part of the metadata entry in a database** equivalent to **Reference to a separate metadata file or record**

3. Conclusion

The analysis of the responses in this questionnaire demonstrated to dispense a moderate influence on Deliverable D2.5, especially due to the wide distribution of complex requirements among the users communities, that does not allow to simplify or restrict the proposed profile of the Generic Conceptual Model.

Furthermore some interesting perspectives, in line with the goal of achieving information on the GIS data state of the art within the SDICs and LMOs, were found out most of all in the additional examples, additional text and comments given by the respondents.
This is a valuable asset, able to give an useful additional input for the future work activities of the DT Data Specifications and the Thematic Work Groups.

Annex I - Overview of Answers

The present annex contains the summary of multiple choice questions and the respective grouped answers given by the respondents for each query in the questionnaire.
The pattern repeated for each query is able to provide the content of the question itself on the left hand and the summarized quantification with the content of multiple answers on the right hand.

Vector data – elementary objects

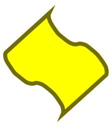
1.

Graphic example	Name	Description	Examples from the real-world	Results - number of answers
	Point	Basic geographic object made of a single isolated point	A traffic light, a borehole, a traffic signal	19 2D 22 2.5D/3D 1 Not used

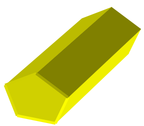
2.

Graphic example	Name	Description	Examples from the real-world	Results - number of answers
 *(or)* 	**Curve**	Basic geographic object made of a single line or curve tract	A pipe, a road tract	22 2D 12 2.5D 7 3D 1 Not used

3.

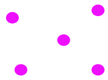
Graphic example	Name	Description	Examples from the real-world	Results - number of answers
	**Surface**	Basic geographic object made of a single free shape surface; the surface may be a plane surface or not	A lake, a football field A water basin	26 2D 11 2.5D 3 3D 2 Not used

4.

Graphic example	Name	Description	Examples from the real-world	Results - number of answers
	**Solid**	Basic geographic object made of a single free shape solid, positioned in any way in 3D space	A building in a 3D view	7 3D 33 Not used 2 Unknown

Vector data – geometric aggregations

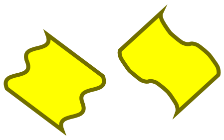
5.

Graphic example	Name	Description	Examples from the real-world	Results - number of answers
	**MultiPoint**	Geographic object made of many (more than one) isolated points. The individual components are allowed to be elementary objects of type Point	An orchard made of individual trees; a water source with many outcrops	11 2D 6 2.5D 4 3D 19 Not used 2 Unknown

6.

Graphic example	Name	Description	Examples from the real-world	Results - number of answers
	**MultiCurve**	Geographic object made of many (more than one) separated lines or curves: no contiguity allowed. The individual components are allowed to be elementary objects of type Curve	A contour line made of more than one not – joined-up tracts; a fault made of many tracts	11 2D 5 2.5D 4 3D 22 Not used

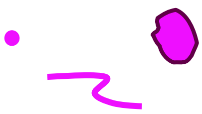
7.

Graphic example	Name	Description	Examples from the real-world	Results - number of answers
	**MultiSurface**	Geographic object made of many (more than one) separated surfaces: no contiguity allowed. The individual components are allowed to be elementary objects of type Surface	In Italy "administrative isles" exist for several municipalities, that is two or few more not-joined-up land areas belong all to one administrative unit A covering made of separated layers (like a pitched roof)	21 2D 4 2.5D 4 3D 12 Not used 1 Unknown

8.

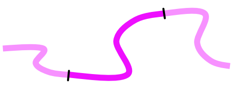
Graphic example	Name	Description	Examples from the real-world	Results - number of answers
	**MultiSolid**	Geographic object made of many (more than one) separated solid objects: no contiguity allowed. The individual components are allowed to be elementary objects of type Solid		3 3D 37 Not used 2 Unknown

9.

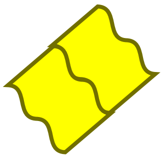
Graphic example	Name	Description	Examples from the real-world	Results - number of answers
	**Mixed Aggregation**	Geographic object made of many (more than one) separated 2D and 3D basic objects: Points, Curves, Polygons, Surfaces, Solids with no contiguity allowed. The individual components are allowed to be elementary objects of type Point or Curve or Polygon or Surface or Solid	A farm composed of the buildings (Polygons), irrigation pipes (Curves), the individual trees (Points)	5 2D 3 2.5D 3 3D 27 Not used 3 Unknown

Vector data – geometric compositions

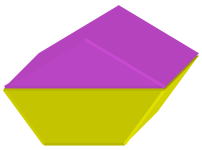
10.

Graphic example	Name	Description	Examples from the real-world	Results - number of answers	
	**Composite Curve**	Geographic object made of many (more than one) individual lines or curves where contiguity is required. The individual components are allowed to be elementary objects of type Curve	A river or any other water course made of individual tracts	18 6 4 10 3	2D 2.5D 3D Not used Unknown

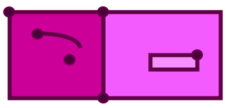
11.

Graphic example	Name	Description	Examples from the real-world	Results - number of answers	
	**Composite Surface**	Geographic object made of many (more than one) individual surfaces where contiguity is required. The individual components are allowed to be elementary objects of type Surface	A cadastral parcel made of sub-parcels A covering made of connected layers (like a pitched roof)	11 6 3 19 2	2D 2.5D 3D Not used Unknown

12.

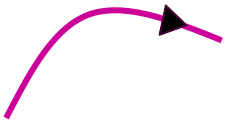
Graphic example	Name	Description	Examples from the real-world	Results - number of answers	
	**Composite Solid**	Geographic object made of many (more than one) individual solid objects where contiguity is required. The individual components are allowed to be elementary objects of type Solid		2 35 5	3D Not used Unknown

13.

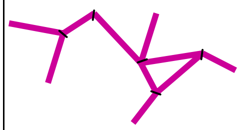
Graphic example	Name	Description	Examples from the real-world	Results - number of answers	
	**Mixed Composition**	Geographic object made of many (more than one) individual 2D and 3D basic objects: Points, Curves, Polygons, Surfaces, Solids where contiguity is required. The individual components are allowed to be elementary objects of type Point or Curve or Polygon or Surface or Solid	Water catchings on a river bank (an example of Points on a Polygon boundary) A building made of separate wall plugs, roof or covering, foundations, technical plants,… potentially coming from different data sources	5 2 3 26 6	2D 2.5D 3D Not used Unknown

Vector data – specific topology aspects

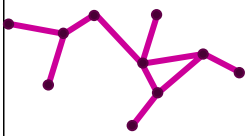
14.

Graphic example	Name	Description	Examples from the real-world	Results - number of answers
	**Orientable Curve**	Geographic object made of a single line or curve tract with a defined orientation direction	An individual tract of a river or any other water course	24 Yes 16 Not used 1 Unknown

15.

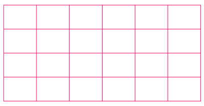
Graphic example	Name	Description	Examples from the real-world	Results - number of answers
	**Graph**	Geographic object made of many (more than one) individual Curves or Composite Curves where contiguity is required and multiple connection is allowed. The individual components are requested to be elementary objects of type Curve or Composite Curve	A water network	19 Yes 19 Not used 2 Unknown

16.

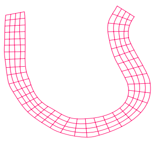
Graphic example	Name	Description	Examples from the real-world	Results - number of answers
	**Edge-Node Graph**	Geographic object made of many (more than one) individual Curves or Composite Curves where contiguity is required, multiple connection is allowed and points function as nodes. The individual components are requested to be elementary objects of type Points, Curve or Composite Curve	A transport network with its crossroads	14 Yes 26 Not used 2 Unknown

Coverages

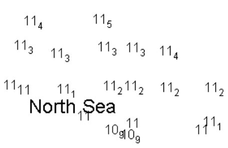
17.

Graphic example	Name	Description	Examples from the real-world	Results - number of answers
(domain shown)  *example* 	**Rectified Grid Coverage**	A rectified grid has grid lines that are regularly spaced. It is defined by an origin in an external coordinate reference system, and a set of offset vectors that specify the direction and distance between the grid lines within that external coordinate reference system.	Satellite imagery, raster maps, digital terrain models	22 2D 13 3D 4 Not used 1 Unknown

18.

Graphic example	Name	Description	Examples from the real-world	Results - number of answers
(domain shown) 	**Referenceable Grid Coverage**	A referenceable grid has grid lines that are irregularly spaced. It is associated with a transformation between grid coordinate values and values of coordinates in an external coordinate reference system. This transformation doesn't need to be in analytic form; it may be a table, relating the grid points to coordinates in the external coordinate reference system.	Numerical models following 'natural' boundaries, or with 'telescoped' resolution	2 2D 5 3D 31 Not used 4 Unknown

19.

Graphic example	Name	Description	Examples from the real-world	Results - number of answers
	**Point Coverage**	A discrete point coverage is characterized by a finite domain consisting of points. Generally, the domain is a set of irregularly distributed points. The principal use of discrete point coverages is to provide a basis for continuous coverage functions, where the evaluation of the continuous coverage function is accomplished by interpolation between the points of the discrete point coverage.	Sensor measurements, boreholes, trigonometric points, hydrographic soundings	11 2D 17 3D 10 Not used 3 Unknown

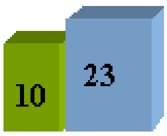
20.

Graphic example	Name	Description	Examples from the real-world	Results - number of answers
	**Curve Coverage**	A discrete curve coverage is characterized by a finite spatial domain consisting of curves. Often the curves represent features such as roads, railroads or streams. They may be elements of a network.	Contour lines with elevation values, construction material on segments of a road system, streamflows associated to segments of a river	11 2D 7 3D 19 Not used 2 Unknown

21.

Graphic example	Name	Description	Examples from the real-world	Results - number of answers
	Surface Coverage	A discrete surface coverage is a coverage whose domain consists of a collection of surfaces. Usually, the surfaces that constitute the domain are mutually exclusive and exhaustively partition the extent of the coverage. Surfaces or their boundaries may be of any shape.	Regional temperature map, maps of soil type and geology	17 2D 8 3D 14 Not used 1 Unknown

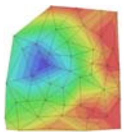
22.

Graphic example	Name	Description	Examples from the real-world	Results - number of answers
	**Solid Coverage**	A discrete solid coverage is a coverage whose domain consists of a collection of solids. Solids or their boundaries may be of any shape. Generally, the solids that constitute the domain of a coverage are mutually exclusive and exhaustively partition the extent of the coverage.	Urban buildings as a set of solids each with attributes such as building name, address, floor space and number of occupants	5 3D 35 Not used 1 Unknown

23.

Graphic example	Name	Description	Results - number of answers
	**Thiessen polygons**	A Thiessen polygon encloses one of a set of points, and consists of the locations in the plane closer to that point than to any other point in the set (also called a Voronoi polygon). The continuous coverage is defined by interpolation between surrounding points. (Note that nearest-neighbour interpolation returns a constant value over each polygon, and acts like a discrete surface coverage.)	10 Yes 27 Not used 3 Unknown

24.

Graphic example	Name	Description	Results - number of answers
	**TIN (Triangulated Irregular Network)**	A Triangulated Irregular Network (or Delaunay triangulation) partitions the plane into non-overlapping triangles with a set of defined points forming the vertices. The continuous coverage is defined by interpolation within each triangle between the points at its vertices.	20 Yes 18 Not used 2 Unknown

25.

Graphic example	Name	Description	Results - number of answers
	**Hexagonal Grid**	A hexagonal grid is a Rectified Grid of dimension two with offset vectors of equal length and directions separated by 60º. The continuous coverage is defined by interpolation between surrounding points. (Note that nearest-neighbour interpolation returns a constant value over each hexagon, and acts like a discrete surface coverage.)	2 Yes 34 Not used 3 Unknown

26.

Graphic example	Name	Description	Results - number of answers
	**Segmented Curve**	A continuous curve coverage is characterized by a finite spatial domain consisting of curves and is based on interpolation along each curve.	9 Yes 26 Not used 4 Unknown

Spatial-temporal coverage domains

Question	Results - number of answers
27. Spatial-temporal coverage domains: Do your coverages have a temporal component to the domain (e.g. time-series, that is data collected over a time interval, regarded as a coverage)?	24 Yes 13 No 1 Unknown 1 Not applicable
28. Please identify interpolation methods that you use to derive a feature attribute values at any direct position within a continuous coverage: Are you using interpolation methods? yes / no / unknown / not applicable	22 Yes 10 No 3 Unknown 4 Not applicable

Temporal characteristics
Management of updates

Question	Results - number of answers	
29. Do you use (as a customer) or provide (as a data provider) change-only updates to existing data sets?	29	Yes
	12	No
	1	Not applicable
30. How often are changes typically transferred within your organisation/community? (multiple answers allowed)	19	Continually
	11	Daily
	7	Weekly
	11	Monthly
	10	Quarterly
	13	Annually
	21	As needed
	12	Irregularly
	1	Unknown
	1	Not applicable
31. What are typical granularities of updates within your organisation/community? (multiple answers allowed):	30	Changed Spatial objects
	21	All data in a tile
	2	Unknown
	6	Other
	3	Not applicable
32. What are typical mechanisms used to identify objects to be updated within your organisation/community? (multiple answers allowed):	15	Persistent object identifier
	17	Persistent object identifier plus version identifier
	17	Filenames
	4	Unknown
	8	Other

Versioning of spatial objects

Question	Results - number of answers	
33. Do you use versioning of your spatial objects in your datasets to maintain information about past states of a spatial object in a spatial dataset? (multiple answers allowed):	19	Yes
	12	No
	13	No, only full datasets are versioned
	1	Unknown
	1	Not Applicable
34. How is versioning managed within your organisation/community? (multiple answers allowed)	15	Versions are tagged with start and end date/time or using a time period
	18	Versions are tagged with version numbers
	10	History of changed attribute values is maintained per attribute
	9	Temporal extent metadata attached to the spatial object
	5	New unique object identifier for every version
	4	Unknown
	3	Other
	5	Not Applicable

Question	Results - number of answers	
35. If time is used to distinguish between two versions of the same spatial object, which semantics is associated with the date/time? (multiple answers allowed)	19	Transaction time = time when the object version was inserted in the database
	17	Valid time = time when the object version became valid/accurred in the real world
	11	Verification time = time when the object version was verified to be correct
	2	Unknown
	2	Other
	8	Not Applicable

Semantic meaning of time

Question	Results - number of answers	
36. If date and time information are used as values of attributes of spatial objects, please describe the different semantics that are associated with the temporal information? (multiple answers allowed)	22	Time of event in the real world
	21	Time or period of data collection / observation
	23	Time of insertion in the dataset
	14	Time of verification
	11	Time of publication
	7	Time or period for which a simulation was computed
	2	Unknown
	3	Other
	6	Not applicable

Calendars

Question	Results - number of answers	
37. Which types of temporal reference systems are used? (multiple answers allowed)	34	Gregorian Calendar
	7	360-day calendar of 30-day months for simulations
	6	Ordinal reference systems
	6	Relative time from an origin
	1	Unknown
	4	Other
	3	Not Applicable

Management of time series data

Question	Results - number of answers	
38. If you manage time series data, please describe how you manage the temporal information? (multiple answers allowed)	15	Encoding temporal information in the dataset identifier / filename
	21	Temporal information is part of the dataset / file content
	3	Unknown
	11	Not applicable
	3	Other