National Spatial Data Infrastructure

"Content Standard for Geo-spatial Data"

Definition of Annex Themes and Scope

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Foreword

An Indian NSDI was created by the Government of India via a resolution in June 2006. The NSDI is for the purpose of acquiring, processing, storing, distributing and improving utilization of spatial data which would be a gateway of spatial data being generated by various agencies of the Government of India; AND WHERE AS the data producing agencies of the Government of India shall be initially the contributing agencies to the NSDI.

The guiding principles of NSDI are that the infrastructures for spatial information in the country should be designed to ensure that spatial data are stored, made available and maintained at the most appropriate level and it is possible to combine spatial data and services from different sources across the Community in a consistent way and share them between several users and applications. It is possible for spatial data collected at one level of govt./public authority to be shared between all the different levels of govt./public authorities; and spatial data and services are made available under conditions that do not restrict their extensive use. It is easy to discover available spatial data, to evaluate their fitness for purpose and to know the conditions applicable to their use. To ensure that the spatial data infrastructures are compatible and usable in a community and trans-boundary context, this requires that common Standards are adopted in a number of specific areas at the National level , and are binding in their entirety.

This document represents a contribution to the Data Specification stage of the NSDI. It defines the scope of the spatial data themes and proposes specifications, which will provide a detailed definition of data content by means of application schema and feature catalogue. Furthermore the Data Specifications will specify requirements for data quality, data consistency, reference systems and metadata. The theme description, scopes and examples in this deliverable may serve as a basis for the final development of the Data Specifications.

Purpose of the document

This document contains the proposal of "Data Specifications" for description and scope of spatial data themes. This deliverable of the “Data Specifications” is considered as a starting point for the development of Data Specifications. The descriptions of individual spatial data themes have been established at different levels of detail. The purposes of the data Content Standard are:

1. To provide common definitions for geo-spatial information found in public records, which will facilitate the effective use, understanding, and automation of business processes.
2. To standardize attributes which will enhance data sharing.
3. To resolve discrepancies related to the use of homonyms and synonyms in the datasets of various organizations/agencies, which will minimize duplication within and among them.
4. To provide guidance and direction for geo-spatial professionals on standardized attributes and definitions, which will improve data creation and their management.
5. To use participatory involvement in the Standard development to reach out to various organizations, which will encourage application of the Standard.

Geospatial Data Theme Principles

Themes:

- are logical groupings of spatial representation of natural and manmade assets serving the needs of citizens, readily discoverable, and accessible to anyone.
- are national in scope and are created and managed in response to well-defined spatial data requirements that are common across multiple agencies and other organizations.
- promote cohesive and collaborative development, maintenance, and evolution of multiple related datasets across Central, State, and local governments and the private or nonprofit sectors.

1. Scope

This deliverable identifies definitions and scope of spatial data themes. For each spatial data themes, the document provides:

- **Definition** – brief explanation

- **Description** – explains the spatial data theme in more detail

- **Scope, Use examples** -Provide prominent use examples, which are in compliance to National policies. "Data Specifications" emphasizes that the examples should not be interpreted as final recommendations or proposals for the upcoming specification. The draft recommendations contained in this document will need to be referred to the concerned nodal agency for consideration and final decisions.

- **Important feature types and attributes** – this is a non-exhaustive list of the most prominent feature types and attributes. The list is not yet an attempt to define content requirements, but shall illustrate the definition/outline of the theme.

- **Overlaps and links with other themes -** known overlap with and/or dependencies from other spatial data themes. This list considers overlaps that are relevant to the definition/outline of the theme. The Working Groups (WGs) for the two themes need to mark out their area of work and cooperate closely, or the themes should be combined in one WG. The list does not consider overlaps and links that refer to organisational constraints (e.g. two themes are managed by the same authority) or general real-world constraints (e.g. objects from both themes often share geometry).

2. Terms and abbreviations

2.1 Terms

(1) application data
data in support of user requirements

NOTE: The term is generally used as a complementary term to “reference data". For example, the road network objects are considered “reference data” and navigation information attached to the road network objects is considered “application data”.

(2) data harmonisation
providing access to **spatial data** through network services in a representation that allows for combining it with other harmonised data in a coherent way by using a common set of **data product specifications**

NOTE This includes agreements about coordinate reference systems, classification systems, application schemas, etc.

(3) data product specification
detailed description of a dataset or dataset series together with additional information that will enable it to be created, supplied to and used by another party [ISO/FDIS 19131 Geographic Information – Data Product Specification]

(4) dataset
identifiable collection of data [ISO 19115:2005, Geographic information — Metadata]

(5) endonym

Name of a **spatial object** in one of the languages occurring in that area where the object is situated

(6) exonym

name used in a specific language for a **spatial object** situated outside the area where that language is spoken, and differing in its form from the name used in an official or well-established language of that area where the **spatial object** is located

(7) feature

abstraction of real world phenomena [ISO 19101:2005, Geographic information — Reference model]

NOTE: The term "(geographic) feature" as used in the ISO 19100 series of International Standards and in this document is synonymous with **spatial object** as used in this document. Unfortunately "spatial object" is also used in the ISO 19100 series of International Standards, however with a different meaning: a spatial object in the ISO 19100 series is a spatial geometry or topology.

(8) feature catalogue

catalogue(s) containing definitions and descriptions of the **spatial object types**, their attributes and associated components occurring in one or more **spatial data sets**, together with any operations that may be applied [ISO 19110:2006, Geographic information — Methodology for feature cataloguing – modified]

(9) feature concept dictionary

dictionary containing definitions and descriptions of feature concepts and feature-related concepts [ISO/CD 19126 Geographic Information – Feature concept dictionary and registers]

(10) gazetteer

directory of instances of a class or classes of features containing some information regarding position [EN ISO 19112:2005, Geographic information — Spatial referencing by geographic identifiers]

NOTE A gazetteer can be considered as a geographical index or dictionary.

(11) geographic identifier

spatial reference in the form of a label or code that identifies a location [EN ISO 19112:2005, Geographic information — Spatial referencing by geographic identifiers]

(12) interoperability

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

(13) metadata

information describing **spatial data sets** and spatial data services and making it possible to discover, inventory and use them

NOTE A more general definition provided by ISO 19115 is "data about data"

(14) object

in this document used synonymous with ***spatial object***

(16) object referencing

method of referencing **application data** to existing **reference data** describing their location to ensure spatial consistency across the **spatial objects** associated in this way

(17) reference data

spatial objects that are used to provide location information in **object referencing**

NOTE Typical reference data are topographic or cadastral data.

(18) spatial data

data with a direct or indirect reference to a specific location or geographic area

NOTE The use of the word “spatial” is unfortunate as in the everyday language its meaning goes beyond the meaning of “geographic” – which is considered as the intended scope – and includes subjects such as medical images, molecules, or other planets to name a few. However, since the term is used as a synonym for geographic, this document uses the term “spatial data” as a synonym for the term “geographic information” used by the ISO 19100 series of International Standards.

(19) spatial data set

identifiable collection of spatial data

(20) spatial object

abstract representation of a real-world phenomenon related to a specific location or geographical area

NOTE It should be noted that the term has a different meaning in the ISO 19100 series. It is also synonymous with "(geographic) feature" as used in the ISO 19100 series.

(21) spatial object type

classification of **spatial object**s

EXAMPLE Cadastral parcel, road segment or river basin are all examples of potential spatial object types.

NOTE In the conceptual schema language UML a spatial object type will be described by a class with stereotype <<FeatureType>>.

(22) spatial reference system

system for identifying position in the real world, , which does not necessarily use coordinates [EN ISO 19112:2005, Geographic information — Spatial referencing by geographic identifiers - modified]

EXAMPLE Geographic coordinates describing positions on the Earth surface (coordinate reference system), linear measurements along a river centreline from the intersection of a bridge (linear reference system), postal codes identifying the extent of postal zones (gazetteer).

(23) theme

grouping of **spatial data** according to thematic attributes

3. Structure of spatial data

This chapter clarifies issues related to terms, concepts and the structure of data specifications. Reference data must fulfill three functional requirements:

- provide an unambiguous location for a user's information
- enable merging of data from various sources
- provide a context to allow others to better understand the information that is being presented

Ideally, the structure of spatial data would reflect the high-level categorisation of real world spatial objects that are logically related. However, the process of organising or modelling the real world objects is a long term process and should be treated as separate projects within different working groups. Therefore, a pragmatic approach has been adopted by categorising data into:

- **Spatial data themes**: High level thematic categories
- **Spatial data components**: sub-categories. A spatial data component comprises a group of spatial data with similar characteristics irrespective of scale
- **Spatial data sets**: lowest level of this conceptual framework, spatial data sets contain real data with defined content and accuracy/scale.

Spatial data themes and their spatial data components (sub-themes). The wide range of themes covered represents the broad needs for fulfilling expected actions for sustainable development and the multi-purpose needs for eGovernment actions.

3.1 Suggested Spatial Data Themes

1. **Geographical Location**
   a. Geodetic Control
      i. Coordinate reference system
      ii. Horizontal information
      iii. Vertical information
      iv. Geographical grids
      v. Data quality information
   b. Geographical names

2. **Boundaries**
   a. Administrative
   b. Others
      i. Forest, Police, colony
      ii. Coast line
3. **Elevation**
   a. Terrestrial elevation
      i. Contour
      ii. Digital Elevation Model (DEM)
   b. Bathymetry

4. **Utilities**
   a. Communication
      i. Telephone line
      ii. Optical Fiber Cable (OFC)
      iii. Mobile Tower
      iv. Communication structures, eg. Telephone exchange
   b. Power
      i. Power line
      ii. Underground cable
      iii. Transformer
      iv. Power related Structure
   c. Gas and Oil Supply
      i. Pipe line
      ii. Filling station
5. **Building**

Survey of India (SOI)
National Hydrographic office

a. Accommodation
b. Commercial/industrial
c. Education
d. Government offices
e. Heritage building
f. Religious

6. Transportation

a. Transport Networks
    i. Road network
    ii. Rail network
    iii. Metro Network
    iv. Water network
    v. Air network
b. Transport Services

Survey of India (SoI)

7. Ortho-imagery — **Indian Space Research Organization (ISRO)**

8. Addresses

a. Address Components
    i. Address Locator
    ii. Buildings, street name
b. Postal Description
c. Identifier, Geographic Position

National Atlas and Thematic Mapping Organization (NATMO)

9. Cadastral information

a. Co-ordinate reference System
b. Geometry
    i. Parcel
    ii. Cadastral Boundary/zone
    iii. Control point
c. Owner
d. Khasra, registration deed/documents
e. Rights and restrictions

Survey of India

10. Soil

a. Site characteristics
   i. Slope
   ii. Hydrologic qualities
   iii. Erodability
b. Physical Parameter
   i. Parent Material
   ii. Soil depth
   iii. characteristics
   iv. Texture
   v. Taxonomy

National Bureau of soil survey and land use Planning (NBSSLUP)

c. Chemical characteristics
   i. PH
   ii. Salinity/electrical conductivity
   iii. Pollutant
d. Suitability

11. Land Use/ land Cover

a. Urban and built-up Land
   i. Residential
   ii. Commercial
   iii. Industrial
   iv. Transportation, Communication utilities
b. Agriculture
   i. Crop land
   ii. Orchard/Horticulture
   iii. Grazing land
c. Forest
   i. Deciduous
   ii. Monsoon
   iii. Coniferous
d. Water bodies/wet land
e. Barren land
f. Icy/snow

Forest Survey of India (FSI) And National Remote Sensing Centre (NRSC)

12. Society and Population

a. Population Data
   i. Population ratio
   ii. Population density
   iii. Birth/death/mortality rate
   iv. fertility

b. Literacy Data
   i. Male/female
   ii. District wise

c. Labor and Economy Data
   i. Agricultural laborer
   ii. Male/Female laborer
   iii. Primary, secondary and tertiary laborer

Census of India

13. Hydrography

a. Physical water bodies
   i. Surface water
   ii. Sea
   iii. Catchment area
   iv. River and drainage basin
   v. Coast line
b. Hydrographic structure
c. Hydrographic network
   i. Water supply
   ii. Sewerage

National Hydrographic Office (NHO)
Central Water Commission (CWC)
Survey of India (SOI)

14. Meteorological Data

a. Rainfall
b. Surface Data
   i. Temperature
   ii. Pressure
   iii. Wind
   iv. Visibility
   v. Cloud
   vi. Moisture
   vii. Precipitation
   viii. Evaporation
   ix. Sunshine
c. Agrometeorological Data
   i. Crop Weather Calendar

Scheme (CWS)
- ii. Dew
- iii. Evapotranspiration
- iv. Evaporation
- v. Soil moisture
- vi. Desert Locust MET (DLM)

d. Marine Data
- i. Wind wave
- ii. Swell Wave
- iii. Sea Surface Temperature (SST)

e. Snow fall Data

f. Other Miscellaneous data
- i. Air Pollution data
- ii. Autographic Data (Hourly)
- iii. Ozone Data
- iv. Radiation data
- v. OLR
- vi. Antarctica Expedition Data

India Metrological Department (IMD)

15. Ground water
- a. Hydro-geological Atlases
- b. Bore well data
- c. Aquifers
- d. Water quality/pollution data

Central Ground Water Board (CGWB)

16. Geology
- a. Surface Mapping
  - i. Systematic Geological Mapping
  - ii. Specialized Thematic Mapping
  - iii. Geochemical Mapping
  - iv. Geophysical Mapping
  - v. Aero geophysical Mapping
- b. Energy Resource data
  - i. Coal and Lignite
  - ii. other than Coal and Lignite
- c. Ores and Minerals (Non-coal minerals/metals)
- d. Geo-environmental data
- e. Geological hazards data

Geological Survey of India

17. Pollution

a. Air quality Data
   i. Sulphur Dioxide (SO2)
   ii. Oxides of Nitrogen as NO2
   iii. Suspended Particulate Matter (SPM)
   iv. Respirable Suspended Particulate Matter (RSPM / PM10)

b. Water Quality Data
   i. Biochemical Oxygen demand (BOD),
   ii. Faecal Coliform

c. Waste Data
   i. Municipal solid waste
   ii. Hazardous waste
   iii. Biomedical waste
   iv. Plastic waste

d. Noise Pollution data

e. Areas of extensive exploitation

Central Pollution Control Board (CPCB)

18. Economic data — **National Council of Applied Economic Research (NCAER)**

19. Natural and technological risk

a. Natural disasters
   i. Earthquake
   ii. Flood
   iii. Cyclone
   iv. Tsunami
   v. Land slide and Avalanche
   vi. Forest fire
   vii. River Erosion

b. Man-made disaster
   i. Nuclear
   ii. Chemical
   iii. Biological
   iv. Environmental
   v. Cyber terrorism

National Disaster Management Authority (NDMA)

3.2 Suggested Current Structure of the Themes

3.2.1 Annex I

1.	Coordinate Reference system	-	SoI
2.	Transportation	-	SoI
3.	Orthoimagery	-	ISRO
4.	Addresses	-	NATMO
5.	Soil	-	NBSSLUP
6.	Forest	-	FSI
7.	Population	-	COI
8.	Hydrography	-	National Hydrographic Office
9.	Land Use	-	NRSC
10.	Metrological Surface data	-	IMD
11.	Physical water bodies	-	CWC, NHO
12.	Ground Water Profile	-	CGWB
13.	Mineral and Energy Resources	-	GSI
14.	Water quality data	-	CPCB, CGWB
15.	Economic Data	-	NCAER
16.	Natural Disaster data	-	NDMA

3.2.2 Annex II

5.10 Geographical Location (Names and Grids)

5.11 Administrative Boundries

5.12 Forest Resources

5.13 Human Health and Safety

5.14 Crime Data

5.15 Climatic Zones
5.16 Geological Hazards
5.17 Contaminated Land
5.18 Natural Disasters

3.2.3 Annex III

6.13 Cadastral Information
6.14 Elevation
6.15 Land Cover
6.16 Urban and rural development
6.17 Cultural Heritage
6.18 Natural Amenities
6.19 Environment
6.20 Renewable Energy Resources
6.21 Noise and Radiation Zones
6.22 Areas of Extensive Exploitation
6.23 Technological Risk Vulnerability Zones
6.24 Technological Accidents

4. Annex I Themes

4.1 Coordinate reference systems

Definition:

Systems for uniquely referencing spatial information in space as a set of coordinates (x,y,z) and/or latitude and longitude and height, based on a geodetic horizontal and vertical datum. For some purposes it is necessary to also have the time the position is recorded due to the dynamic nature of the the Earths crust.

Description:

The theme establishes a structure for spatial referencing of features by coordinates. This topic shall link to appropriate standards for information technology and data where possible, and provide a framework for the development of sector-specific applications using geographic data.

ISO 19111 describes the conceptual schema and defines the description for a minimum data to two cases for which 1-, 2- and 3- dimensional coordinates reference system information shall be given. The first case is given by a coordinate reference system to which a set of coordinates is related. The second case consists of a coordinate operation (coordinate transformation, coordinate conversion, concatenated coordinate operation) to change coordinate values from one coordinate reference system to another.

There are no explicit accuracy numbers given in ISO 19111. We must consider that it has been developed for geographic information in general, but not for precise positioning. Spatial information may be referenced to the earth surface with an improving accuracy on the global scale for the future. Such high accuracy level may be required for some themes. Spatial referencing could no longer be considered as constant in time, if we reach the sub-centimetre level. We need additional parameters compared to ISO 19111 in that case, because that document considers changes in time of the coordinate reference only system through the “date of realisation”. This model is not suitable to describe continuous movements of the spatial reference. Kinematic models or so-called “loading models” are examples to incorporate such dynamics.

The spatial referencing is usually referred to selected points of the earth surface. Such point are, e.g., given by geodetic markers, stations performing permanent satellite observations, levelling benchmarks, or tide gauges. As soon as the marker coordinates are given, they provide a direct access to the realisation of the coordinate reference system.

Scope, use examples:

All users of GI-data need geodetic reference data to be in place. From that point of view the coordinate reference systems are a prerequisite for a successful realisation of all themes of the document. For accurate mapping needs special services that provide various information and corrections from permanent reference stations (accuracy level 1 m to 1 cm). Selected themes, e.g., sea level rise, require the spatial reference and the corresponding changes of control stations for better than 1 mm/year. (What I say is certainly the perceived present day wisdom but with the increasing importance of crowd-sourced data we can have data sets which are of recoded against an unknown datum / reference system but still have value because of the information they provide in terms of relative placement in space and time. The whole topic of how to accommodate such data in (N)SDI is a topic of current research interest)

ISO 19111 could be used as a basis for the implementation of coordinate reference systems for spatial information. The ISO document describes the **definition of a coordinate system** as well as **coordinate operations** to change from one coordinate system to another one. Changes in time are only considered in ISO 19111 through the date of realisation. It has to be studied, whether **kinematic** spatial information could be described by the attributes of coordinate operations as determined in ISO 19111. Alternatively new attributes will have to be defined in addition to the ISO standard to implement this theme. Implementation rules for coordinate reference systems should account for reference systems that are realised in real-time. It has to be confirmed that ISO 19111 features are suitable to describe the reference system information as transmitted by the service provider. The full set of reference information data will not likely be transmitted by the correction service and thus requires further conventions.

Important feature types and attributes:

The following important features are extracted from ISO 19111 for

a) Coordinate reference system

- coordinate reference system identifier
- datum identifier
- datum type
- datum anchor point
- datum realization epoch
- datum valid area
- ellipsoid identifier
- ellipsoid flattening

b) Coordinate operation

- coordinate operation identifier
- coordinate operation valid area
- source coordinate reference system identifier
- target coordinate reference system identifier
- coordinate operation method name
- coordinate operation method formula
- coordinate operation parameter value

Links and overlaps with other themes:

The coordinate reference systems are a prerequisite for a successful realisation of all themes of the Document.

4.2 Transportation

Definition:

Road, rail, air and water transport networks and related infrastructure. Includes links between different networks.

Description:

The transport component should comprise an integrated transport network, and related features, that are seamless within each national border. Transportation data includes topographic features related to transport by road, rail, water, and air. It is important that the features form networks where appropriate, and that links between different networks are established, i.e multi-modal nodes, especially at the local level, in order to satisfy the requirements for intelligent transport systems such as location based services (LBS) and telematics. The transport network should also reflect the transport flow to enable our navigation services.

Route is a kind of "abstract" or invisible objects describing the spatial services offered within a transport system. Bus routes, ferry lines, scenic roads route may be examples of route information. Commonly links or segments of a transport system is brought together to form a route, but may exist as separate feature data. It should be clarified if such data are included within this theme or if not, how one can support such route information.

Scope, use examples:

- Routing systems, traffic management
- Environmental assessments
- Security
- Disaster and emergency management
- Social and economic planning, etc.
- Transport planning
- Land use planning
- Risk planning/management

Important feature types and attributes:

For the road network:

Road link

- form of way (motorway, dual carriage way, single carriage way, slip road, …)
- functional road class (importance for traffic)
- road number
- road name
- condition of facility (disused, under construction, functional)
- Road surface (paved, unpaved)

Bridge, Tunnel

Road node

- form of node (junction, roundabout, ..)
- node number
- node name

For the water network:

Navigable channels (off-shore), navigable watercourses s (in-shore – rivers/canals)

Ferry link

Harbour

Canal locks

For the railway network:

Railway link

- Railway type (e.g. high speed, metro, …)
- Condition of facility (disused, under construction, functional)
- Railway gauge classification
- Energy (electrified or not)

Bridge, tunnel

Railway station

- name

- condition of facility
- function (passengers, freight, both)

For the air transport:

Airport

- Name

International, domestic, Commercial, military, private ….

Heliport

- Name

In view of navigation services, it might be useful to keep the navigation attributes on the road network (Direction of flow, Access restriction, Seasonal restriction, Speed limit, …).

Links and overlaps with other themes:

The main overlaps are:

- Hydrography as water network is both part of Hydrography and Transport
- Addresses: a road link may carry useful information about addresses.
- Land use, as roads is a category in land use data and land use plan data

4.3 Orthoimagery

Definition:

Geo-referenced image data of the Earth's surface, from either satellite or airborne sensors.

Description:

An orthoimage is a raster image that has been geometrically corrected ("orthorectified") to remove distortion caused by camera optics, camera tilt, and differences in elevation. Source is either satellite or air-borne sensors. Data is orthorectified to achieve an accuracy commensurate with a given topographic map equivalent.

Scope, use examples:

Airborne or spaceborne orthoimagery can be considered:

- for the extraction, mapping and updating of specific features on the surface of the Earth(e.g. Transport network, Hydrography, Land cover, Geology)

- for the production of thematic information (e.g. Land use, Production and industrial facilities, Agricultural and aquacultural facilities)
- to provide a synoptic view of a given territory.
- for display as a backdrop to other data

Other applications include:

- the localisation of other thematic data
- the localisation of earth observation image data itself
- the quick georeferencing and delivery of recently acquired images (dedicated to natural or industrial hazards e.g.) to be co-localised with other thematic interest data (geology, soil, old maps...)
- the more frequent updating of rapidly evolving Reference Data layers

Important feature types and attributes:

Usually, orthoimages are represented by discrete rectified grid coverage. The coverage contains a set of values, i.e. the radiometric characteristic.

Overlaps and links with other themes:

- Elevation, because DEM is required for ortho-rectification
- Orthoimages relate with many other themes, as information can be extracted from orthoimages through computer analysis or visual interpretation

4.4 Addresses

Definition*:*

Location of properties based on address identifiers, usually by road name, house number, postal code.

NOTE: besides road name, house number and postal code the other component is a geographical name (city, town, village, suburb/municipality, admin unit)

Description:

An address is an identification and abstract concept expressing the fixed location and path of access of a home, business or other building or land parcel (real property). The full address identification is a hierarchy consisting of components such as geographic names, with increasing level of detail, e.g.: town, street name, address (or building) numbers in addition to the postal code.. Addresses serve several purposes, such as their use in the delivery of mail. The four functions of addresses: location function (e.g. for visits or the delivery of mail), identification function (e.g. in context of a building registration), jurisdiction function (e.g. which authority is responsible for object attached to address), and sorting- and ordering function.

Under real property a number of different objects types can be identified: land parcels, buildings (including apartments), but sometimes also other types such as utilities. For (apartment-) buildings there is in most cases an association with an address. In rural area's there exist buildings without a complete postal address; e.g. only town and street name and no house number. Same in urban area's: e.g. utility service buildings. Note: the registration of the addresses is currently not harmonized within India. Other 'non-building' objects that might have addresses include sport's grounds.

Scope, use examples:

Today, addresses and address information is widely used for number of purposes within business, public administration and in citizens daily life. In a large number of applications, address information is used as a common administrative reference, geographic identification, and linking mechanism. Like similar name-based, reference systems (e.g. place names, cadastre), address data fulfill the requirement of being reference data. Address information might, because it is often considered in a postal context, not be considered true geo-information at the first sight. As an address' most important component is physical location they are geo-information. Addresses are used to link to many other sources of administrative information, which can be related to a location via addresses.

Many countries have their own specific standards for unique addresses (see References for a few examples, such as Norway, Finland, Switzerland, Italy, France, UK and the Netherlands), which are all a little different. There was an international standard ISO 11180:1993 'Postal addressing', but this has been withdrawn on 2004-01-15 by the responsible Technical Committee (TC 154). However, in practice the principles of this standard are still used in many countries. The ISO standard 19112:2003 'Spatial referencing by geographic identifiers' describes methods to specify spatial references via other geographic features (such as a road). This standard describes how to build a hierarchic gazetteer with a possibility to create unique geographic identifiers using parent-child relationships. Addresses are often shown in gazetteers (e.g. all towns in a region, all street names in a town, all house numbers along a street). It is also clear that within one country very often, different organisations are responsible for different aspects of the address (e.g. state/province for the official names of towns, municipality for the official road names and house numbers, postal service for the postal code), which makes consistent updating of the addresses a non-trivial task.

Although all national or local address systems share the same concept and general properties, there exist differences in formal and informal standards, rules, schemas and data models within India. Differences also exists in the extent of the address system e.g. in rural areas. Also the way house numbers are assigned can be completely different (and some harmonization is welcomed). A number of alternatives are:

- house numbers are in sequence of their location within the street (with left/right having odd/even numbers and the low numbers towards city). The drawback is that this is not so very dynamic: inserting of new building or new entrances requires adding letters after a number or other 'tricks' such as non-used numbers.(note that one has to do very careful planning). In some countries letters after the numbers keep significant information, while in other countries they are just a way to create a unique designation.

- house numbers are in sequence of the creation, which is easy to realise and will provide unique numbers. However, for the users of this 'system' it may be difficult to find the proper location

- house numbers are derived from the distance to the start of the road; for example in the urban areas every 10 meters a number, and in rural areas every 100 meters a house number (even if there are no houses). Changing from urban to rural means adding one digit.

- not using house numbers but (2D or 3D) geographic coordinates directly

Cadastres and Land Registries do not in all cases maintain an address register (linked to coordinates). In most cases municipalities are responsible for establishment of road names and building numbers, national post for postal codes. Maintenance is not uniform. Front door or centroid coordinates are mostly available in a nationwide co-ordinate reference system.

Important feature types and attributes:

The main feature types are address with relationships to other features such as cadastral parcel, (apartment-) building and other immovable register objects (such as utilities). Relevant in the context of this theme is first of all the real property identifiers (possibly based on an

administrative unit hierarchy), next the attributes relating this to address and/or reference coordinate of the object and possibly successor/predecessors (e.g. changed road names or house numbers).

Important address attributes are: Postal code, geographic coordinate of address reference point, town, road name, house number (and annexes), and textual descriptions. Note that in some area's waterways may play the role of 'road'. In International context also the country specification is relevant (ISO 3166-1). In between other levels might be mentioned (state, province, municipality, etc.).

The role of list of approved items is often an important part of the standards: approved official names of towns (in multiple language), roads, postal codes, etc.

Addresses should not be regarded just as an identifier for parcel, buildings or other objects. The address itself is an item (feature, object) that has a "location" attribute of type "geometry" (point or area). The feature (object class) "address" can be related to other features e.g. parcel, building, dwelling, bus stop, garbage can or a mailbox. All examples of real word phenomena that we may want to locate by an address.

Links and overlaps with other themes:

There are links with:

- Geographical names
- Buildings
- Cadastral parcels
- Transport (for street name and road number)
- Administrative units

Many countries have building registers. A single building may consist of several units (and sometimes grouped in a specific way, e.g. by entrance). Those registers also often include buildings with building construction permissions. Addresses are linked to (apartment-) buildings, except P.O. boxes. There is no 1:1 relationship between addresses and parcels (or

buildings). There can be addresses linked to zero (P.O. Boxes), one or more parcels (apartment buildings). Addresses do not cover all property units in a country especially in the countryside. For land parcels without a building there may not be a full (complete) postal address, but just an indication of the road name and for real property objects such as utilities it may even be more difficult. Addresses can therefore not be suitable for unique cadastral identification. The operation to obtain a coordinate related to an address is called geo-coding. For apartments this might even be a 3D coordinate (or 2D coordinate, with indication of the level). A building (or parcel) may have more than one address (eg. building is located at a street corner).

4.5 Soil

Definition:

Soils and subsoil characterised according to depth, texture, structure and content of particles and organic material, stoniness, erosion, where appropriate mean slope and anticipated water storage capacity.

Description:

The proposed Soil Framework, which aims at the establishment of a framework for the protection of soil, it is “the top layer of the earth’s crust situated between the bedrock and the surface, excluding groundwater. “soil is generally defined as the top layer of the earth’s crust, formed by mineral particles, organic matter, water, air and living organisms. It is the interface between earth, air and water and hosts most of the biosphere”.

As soil formation is an extremely slow process, soil can be considered essentially as a non-renewable resource. Soil provides us with food, biomass and raw materials. It serves as a platform for human activities and landscape and as an archive of heritage and plays a central role as a habitat and gene pool. It stores, filters and transforms many substances, including water, nutrients and carbon. In fact, it is the biggest carbon store in the world. These functions must be protected because of both their socio-economic and environmental importance.

Soil is an extremely complex and variable medium. Over 320 major soil types have been identified in Europe and within each there are enormous variations in physical, chemical and biological properties. Soil's structure plays a major role in determining its ability to perform its functions. Any damage to its structure also damages other environmental media and ecosystems.

Soil is subject to a series of degradation processes or threats. These include erosion, decline in organic matter, local and diffuse contamination, sealing, compaction, decline in biodiversity, salinisation, floods and landslides. A combination of some of these threats can ultimately lead arid or sub-arid climatic conditions to desertification."

Typically, **soil** is **characterized** on the basis of soil profile descriptions, analysed by taking samples from genetic horizons or depth classes, and classified according to national or international nomenclature. Soil maps contain the borders of typical combinations of soil development factors of the target mapping scale. There is no internationally defined aggregation scheme between the various map scales.

The collection of soil information can be broadly classified into three categories:

a) **Soil mapping**, enabling to identify areas of land for management purposes.

b) **Soil inventories**, providing a one-off assessment of soil conditions and/or properties at a point in time, and **soil monitoring**, providing a series of assessments showing how soil conditions and/or properties change over time.

c) **Soil thematic mapping**

(a) Soil maps

The general aim of soil mapping is to provide a spatial representation and description of the soils of continents, countries, regions, farms, or any area of land of interest. It involves identifying the different types of soils that occur, collecting data on their nature,

properties and potential use, and recording this information on maps and in geographic information systems and derived media.

(b) Soil inventories and soil monitoring

Soil inventories (predominantly based on "soil profiles") provide information on the soil condition. It can be introduced to soil maps as attribute (semantic) data describing soil properties. Soil monitoring is designed to provide information about how soils are changing with time. Geochemical surveys also gather soil information and are specifically targeted to provide information on natural background values and on superimposed anthropic pollution.

(c) Thematic data/risk maps in soil protection and environmental reporting

The general adoption of GIS technology and the creation of databases of georeferenced soil information have allowed a number of new types of assessments producing more policy relevant information than the basic soil maps. For example, modeling approaches using the existing soil inventories allow deriving information like soil erosion risk, organic matter content, diffuse contamination, soil compaction, salinisation, etc.

Scope, use examples:

Soil maps: soil maps have been prepared for regional and national environmental assessment and reporting.

Soil monitoring: Many of the national systems have performed only one observation in time, and therefore cannot be considered as fully operational systems. Van-Camp et al. (2004) conclude that a minimum set of common parameters to be monitored by the existing soil monitoring systems at national level still need to be selected. The same holds true for standardised methods and procedures.

Thematic data: To facilitate the application of the soil data (i.e. to estimate integrative parameters difficult to measure, and to estimate the susceptibility of the soil to pressures).

Important feature types and attributes:

The basic scheme for soil data relies on soil profiles or soil cores. Depending on the respective soil nomenclature, macro-morphological characteristics of soil profiles or soil cores are described. Samples are taken for genetic horizons or depth classes, and analysed for soil chemical, soil biological and soil physical properties. Using this information, soil is classified in order to compare and describe different sites. The type of data in soil data bases varies greatly, between soil maps and resolutions, and between projects.

Examples for feature types and attributes in soil maps:

- dominant soil
- co-dominant soil
- limitation to agricultural use
- soil code
- presence of an impermeable layer
- dominant parent material
- obstacle to roots
- slope class
- textural change
- textural class
- land use
- presence, type of an existing water management system
- soil water regime class
- elevation above sea level, etc.
- major landform

- regional slope
- relief intensity
- wetness index

In addition, each mapping unit can be described based on additional soil properties received from described and/or analyzed soil profiles for the dominating and/or associated soil types.

Overlaps and links with other themes

• Protected sites; area management/restriction/regulation zones and reporting units; habitats and biotopes; species distribution:
soil conditions can be indirect delineation criteria (wet soils in combination with a specific vegetation type; soil conditions affecting historic land use, etc.)

• Elevation: important factor to soil formation
• Land cover, Land use, agricultural and aqua cultural facilities: anthropogenic factors affecting the soil condition
• Geology: parent material is major soil forming factor; with regard to hydrogeology, soil physical characteristics control seepage water and run-off
• Environmental monitoring facilities: soil monitoring systems
• Natural risk zones: relevant in soil protection policies (landslides, floods); can cause important soil loss; soil condition (e.g. clay content) affects the susceptibility and severity of degradative processes
• Atmospheric conditions; meteorological geographical features: important site factor; controls soil processes
• Bio-geographical regions: regional stratification of soil forming conditions; used in soil mapping and soil information application

4.6 Vegetation

Definition:

The geobotanical information about the region.

Description:

The determination of structure and composition of the vegetation is based essentially on stands of ecosystems and their correlation with particular site conditions, commonly based on plant-sociological classification. Vegetation can be mapped either as actual/existing or potential vegetation cover. The classification of potential vegetation depicts the potential distribution of the main natural plant communities. The mapping is based essentially on remaining stands of natural or near-natural ecosystems corresponding to the actual climatic and edaphic conditions.

Once produced, the potential vegetation maps are relatively stable and regarded as reference data/maps. Mapping of existing vegetation at local level needs to be updated to depict changes in vegetation.

Scope, use examples:

The data are used for comparisons and assessments of biodiversity and conservation, at international, national even regional levels. Data in the form of detailed data are being used in land management and local land use planning. Knowledge about the extent of local and regional biogeographical regions, e.g. in the form of vegetation maps, may be used to identify climatic, topographic or geological characteristics, as there is a correcation between certain species and such factors. Looking at geology, it is one of the important factors conditioning biodiversity, either directly (moss, lichen, plants directly developing on bare, weathering rock) or indirectly, via soil and the geology derived major and trace elements it contains. Vegetal biotopes are quite frequently strictly correlated to the existence of subjacent acidic, calcareous or ferro-magnesian (basaltic, ophiolitic for instance) rocks. There are even very element

specific plants that develops on zinc reach soils, making it a very useful indicator for oxydised zinc deposits exploration. The survey of vegetal communities is a precious tool for geological mapping. Geobotany is a scientific speciality.

Vegetation – potential vegetation

- Classification system/ nomenclature
- Name of class
- Code of class
- Date of last verification
- Source

Example data:

• **Potential vegetation** The determination of structure and composition of the potential natural vegetation is based essentially on remaining stands of natural or near-natural ecosystems and their correlation with particular site conditions. The classification of natural (potential) vegetation depicts the potential distribution of the main natural plant communities corresponding to the actual climatic and edaphic conditions.

Links and overlaps with other themes:

Vegetation may link with biodiversity themes such as the Species distribution, and Habitats and biotopes, but may also link to the themes Land cover, Geology, Soil, Mineral resources and Area management/ restriction/ regulation zones and reporting units.

4.7 Demography

Definition:

Geographical distribution of people, including population characteristics and activity levels, aggregated by grid, region, administrative unit or other analytical unit.

Description:

There is a long tradition in collecting demographic and economic/activity statistics. All geographical levels interested, includes municipal and intra-municipal levels. Common to have statistics with geographical breakdown on country level, regional/ county level and municipal level. In some countries also information on census districts. These last decades, the statistical offices have started producing demographic and socio-economic statistics in large urban areas with a reference to blocks of houses and to process these data with a GIS. In some countries, the methodology chosen refers to aggregation of location-based information (address/households) on a grid (e.g. 1x1 km or 0.1x0.1 km).

The theme may thematically be divided into several components.

- population characteristics
- population/ human activity levels

Concerning population information, this will or can include total population, age: population figures for each year class or aggregated year classes (0-5, 6-15, 16-20, 21-30, 31-40, 41-50, 51-67, 68-80, over 81). It could also include gender, mortality, life expectancy, migration. Figures could be offered as yearly versions, one could also like to give information of changes over time, such as growth/reduction in population, e.g. last 2 years, last 5 years, last 10 years. It could also include details on average night and day figures for some of the components. The sub-theme of population could include socio-economic information about the population, such as number of households, rate of employment, education, income, households with children

etc. Themes relevant to local, regional and national statistics also includes topics such as resource exploitation, agricultural production and a variety of environmental themes.

Population distribution could also mean geographical aggregations of buildings into settlements, villages, townships, towns, cities. Data may be materialised as hierarchical settlement databases with details on population figures for geographical objects either **centre point location** or **area/settlement extent**. Population distribution may also be or functional or physical characterisation of built-up areas **within** a settlement area. One example of an overall functional zoning can be the distribution of CBD areas within a city (CBD=Central business district). Detailed area categorisation can be done, e.g. kind of apartment, flat, cooperative society, self-owned, house/villa, semi-detached house, terrace house, apartment block.
Disaggregating of statistics is a methodology for transforming data at a higher aggregation to lower aggregates based on models. Population censuses take place with a periodicity of e.g. 10 years. In between, administrative registers of civil state supply a regular flow of data used generally for presenting annual statistics. New trends in statistics will probably lead to abandon the national censuses of large countries for a rotating system based on regional censuses supplemented by a broader collection of data from administrative registers.

Scope, use examples:

The demand for local statistics has increased over time. For example, the national statistical offices commonly disseminate statistics by municipalities, blocks of houses or grids. The uses of local statistics are many, from the local, regional and national management of public services (education, health, environment, urban planning…) to the consulting companies in domains such as public works or market studies and the research in the socio-economic domain. Data themes of major importance are demography, production, economy, but also such as natural resources and a variety of environmental themes.

Needed within local to national governments, settlement and city development, health and education planning, school enrolment planning, risks assessment. Of major importance to

integrated analysis for sectors or regions. Existing statistics covering long time series make demographic statistics an essential information. The present focus on eGovernment systems within all sectors and the general rapid changes towards including a spatial dimension in management activities and planning will probably boost the use of socio-economic data with a geographical reference. In order to prepare for the increasing user needs, it is expected that national providers disseminate information on relevant aggregation levels, with internationally agreed id's and on formats making it possible to link geometry and attributes. Community policies and all the policies in which the exposure of the population to a risk or harm is a concern as well as those where population increase or migration is a key driver.

Important feature types and attributes:

The definition specifies kinds of features relevant to demography: The definition includes the term "aggregated". DT anticipates that non-aggregated data about population is excluded. Probably therefore information in this theme should not refer to address level or point based location, e.g. of production activities. The mentioned examples of aggregation are by grid, region, administrative unit or other analytical unit.

Underneath is given examples of features, important attributes, however, can be very diverse and is generally referred to as socio-economic attributes. . Different variables can be relevant for different aggregation levels.

Administrative unit

- id
- socio-economic attributes as mentioned above

Grid, e.g. 1x1 km, 100x100m

- id
- socio-economic attributes as mentioned above

Census districts

- id
- socio-economic attributes as mentioned above

Small area statistics "free" regionalisation

- id
- socio-economic attributes as mentioned above

Settlement – small settlement, village, block, township, town, city

- id
- socio-economic attributes as mentioned above

Physical region/area within settlement

- category

Functional region/area within settlement

- category

Can also give population figures at other regional aggregations, e.g. on water catchment level, being done in assessments being part of WFD work.

Links and overlaps with other themes:

The thematic information in the form of attributes collections/tables can be linked to geometry datasets also addressed in other themes, such as geographical grid systems, administrative units and statistical units (census districts). Other themes may be more indirectly linked to the theme demography, as they can be used as an input parameter or geometry needed in the generation of an aggregated population dataset, such as the themes address, land cover and utility and government services

4.8 Hydrography

Definition:

Hydrographic elements, including marine areas and all other water bodies and items related to them, including river basins and sub-basins.

Description:

The theme 'Hydrography' covers the network of rivers, lakes and marine areas, it also includes the river basins. River basin, means the area of land from which all surface run-off flows through a sequence of streams, rivers and, possibly, lakes into the sea at a single river mouth, estuary or delta. Sub-basin means the area of land from which all surface run-off flows through a series of streams, rivers and, possibly, lakes to a particular point in a water course, normally a lake or a river confluence. Groundwater is also an important part of the hydrological cycle of water, but is treated under the Annex theme Water resources.

Scope, use examples:

Hydrography data is being used in:

- Water navigation / transport routes
- Tourism environmental
- Assessment and monitoring in estimation of water resources,
- Assessment of flow patterns of particles and pollutants, pollution monitoring,
- Wastewater cleaning estimation,
- Species migration and biodiversity assessment, the hydrological elements being habitats.
- Inland fisheries management.
- Hazardous waste disposal sites.

- Land use planning/ management,
- Recreation planning and management,
- Transport routes,
- Water supply

Water catchments are used in assessment of water flow and flooding, flow of contaminants, erosion monitoring.

NSDI related policies:

- establishing a framework for Community action in the field of water policy.
- Flood Risk management; Flood Prevention, protection and mitigation.

Important feature types and attributes:

Watercourse

- Name
- Hydrologic code
- Hydrologic persistence (perennial, intermittent)
- Hydrographic Origin Category (natural, man-made)
- Type (stream, canal, aqueduct, ditch, estuary, …, virtual)
- Position/ground
- Navigability

Lake, pond

- Name (if any)
- Hydrologic code
- Hydrologic persistence (perennial, intermittent)
- Hydrographic Origin Category (natural, man-made)

Other entities on water network, such as waterfall, sluice, lock, dam

Isolated water infrastructures, such as fountain, pumping station

River basin

- name
- hydrologic code
- hydrological level (“administrative importance”)

Marine areas :

- category (transitional waters, coastal waters)
- name (if any)
- hydrologic code

Links and overlaps with other themes:

The main relations with other themes :

- Transportation - for water navigation
- Geographical Names - for names of water features
- Elevation - for geometric consistency and coastline
- Land cover - for wetlands, water bodies
- Geology – for aquifers
- Water Resources – for water supply
- Environmental monitoring facilities
- Agricultural and aquaculture facilities - specially for irrigation systems

- Area management/restriction/regulation zones and reporting units as some of these zones are related with hydrography
- Natural risk zones - for instance for flood risks
- Sea regions - concerning the limit between land and sea
- Oceanographic geographical features

Groundwater is by geologists commonly treated as a geological resource. Groundwater in aquifers mainly depends on the geological structure of the subsurface (rock type). Thus it is an integral, inseparable part of Geology. However, as being part of the hydrological cycle, it is strongly related with the theme Hydrography as well. The current definition of Hydrography would accommodate groundwater bodies under "all other water bodies related to hydrographic elements".

4.9 Land use/cover

Definition:

Territory characterised according to its current and future planned functional dimension or socio–economic purpose (e.g. residential, industrial, commercial, agricultural, forestry, recreational).

Description:

Land regulation is the general spatial planning tool at regional and local levels. Land use may be characterised as ordinary mapping of existing functions as an objective picture of the use and functions of a territory, but may also be plans characterising how land may be utilised at present and in the future.

There are two main land use definitions, a **functional** one and **sequential** one. The first of them defines land use as *the description of land in terms or its socio-economic purpose (agricultural, residential, forestry etc.)*. The second one describes land use as *a series of operations on land, carried out by humans, with the intention to obtain products and/or benefits through using land resources.*

Land use plans/ land user regulation

The land use plans regulate actual and future use of areas. The land use plans commonly have significant textual regulations to each area/ land category or specific areas. The land use plans

are of varying detail; Municipal land use plans, detailed regulation plans for blocks or smaller areas within urban areas.

- Land use may be seen as divisions at a high level, e.g. distinguishing between private and state owned land, e.g. at scale 1: 1 million.
- Land use plans is commonly made at regional levels as kinds of master plans, e.g. covering the full extent of municipalities and being at the scale 1: 50.000
- Land regulation plans at detailed low level may cover populated areas or areas of specific economic or social interest. The plans may direct utilization level, the % of building coverage within areas, height regulations or functional regulations, and maps produced may have a detailed scale, e.g. 1: 5000.

It is a very diverse situation concerning land regulation/ land use plans as these spatial data commonly are based on national or regional legislation or other kinds of regulation. The documents/maps are frequently seen as legal documents, and the categories remain for decades as rights directing use land and property. Categories of land use follow such regulations. Furthermore, operational plans may for some areas be old and based on older legislation, and the nomenclature may have changed through time. Operational land use plans may be as old as 100 years or more. Also plans being proposed and being in a process or public/sectoral hearing can be relevant for dissemination in the infrastructure.

A common strategy to activate land use plans in a GIS is through the production of raster versions of land use plans. This is by some seen as a very good strategy, as the rasterisation makes a "copy" of the visual content, thus locking the content and accuracy for changes and misleading interpretation of the legal map documents. Some organisations have a strategy of first supplying raster versions of existing plans, and with a long term plan for establishment of vector versions. (Can be raster or vector – it may be easier to scan a hard copy map in raster form or to classify a remotely sensed imagery in a raster format but software

now exists that can create a vector product from the raster data in a more or less fully automated manner)

Functional land use – according to socio-economic purpose

Functional areas within urban or rural areas may be mapped through fieldwork, register information or through modelling using socio-economic input data in a GIS. The recommended classification of the land use phenomenon is based on the ISIC Rev.3 (International Standard Classification of All Economic Activities) classification drawn up by the United Nations (approved by the Statistical Commission in 1989) and recommended for use throughout the world. This classification is integrated in the sense that it ensures a full harmonization with other main branches of economic classifications: the classifications of products ICPC Central Product Classification) which are fundamental for foreign trade statistics, statistics of production and consumption, energy statistics, etc.

The **ISIC system** is made of four levels of breakdown: 17 sections, 60 divisions, 159 groups and 292 classes. The 17 sections of the first level are characterizing main economic activities. These categories are:

SECTION A Agriculture, Hunting and Forestry

SECTION B Fishing

SECTION C Mining and Quarrying

SECTION D Manufacturing

SECTION E Electricity, Gas and Water Supply

SECTION F Construction

SECTION G Wholesale and Retail Trade, Repair of motor vehicles, motorcycles and Personal and household goods

SECTION H Hotels and Restaurants

SECTION I Transport, Storage and Communication

SECTION J Financial intermediation

SECTION K Real estate, Renting and Business activities

SECTION L Public Administration and Defence, Compulsory social security
SECTION M Education
SECTION N Health and Social work
SECTION O Other Community, Social and Personal Service Activities
SECTION P Private Households with Employed Persons
SECTION Q Extra-territorial Organizations and Bodies

Scope, use examples:

Many of the management and planning activities at local level require detailed data. Proper location, the geographical position, is important. The level of accuracy needed in location varies, the need for (and will to produce) accurate data being higher in urban or built-up areas and lower in rural and natural/semi-natural environments. Similarly, interest in frequent updating decreases with distance from urban central areas. The detailed area planning covers both land and sea/coastal areas. Land Use is important for impact assessment and monitoring of implementation of policies and legal instruments for sustainable management of the environment.

Policies:

Several policies and strategies give highlight the value of regional approaches with integrated land/area management, such as the Integrated Coastal Zone Management, Communication on planning and environment, Water Framework and the Communication on risk prevention.
Environmental Impact Assessments (EIAs) for projects and Strategic Environmental Assessment (SEAs) for policies, plans and programmes ensure that significant environmental impacts are identified, assessed and taken into account in decision-making process to which the public can participate.

Important feature types and attributes:

Kinds of features depend on kind of land use and land use plan. A representation of a land use plan may be structured as a layered dataset.

- boundary of plan/regulation
- land use category area
- land use regulation area
- land use restriction area
- elements within a plan (road boundaries, building boundaries, forest/agricultural land boundaries etc)

Important attributes

- land use category
- land use regulation category
- land use restriction category
- present/existing or proposed/planned/future
- legal reference
- date of entry into force
- link to text regulations for each area

Links and overlaps with other themes:

- Cadastral parcels
- Hydrography
- Transport networks
- Protected sites
- Land cover
- Buildings
- Human health and safety
- Utility and governmental services
- Production and industrial facilities

- Agricultural and aquacultural facilities
- Population distribution – demography
- Area management/restriction/regulation zones and reporting units
- Natural risk zones
- Habitats and biotopes
- Energy resources
- Mineral resources

4.10 Atmospheric conditions

Definition:

Physical conditions in the atmosphere. Includes spatial data based on measurements, on models or on a combination thereof and includes measurement locations.

Description:

Historical versions of the theme definition are:

- Spatial data reflecting the physical conditions of the air and atmosphere, either as isolines, grids or other spatial forms. These can be based on measurements or models. This could also include the measurement locations.
- Physical conditions in the atmosphere, represented as lines, grids or points. Includes spatial data sets based on measurements, on models or on a combination thereof and includes measurement locations.

In order to place into context the range of spatial data types relevant to this theme, we consider the typical 'forecast cycle'. This will:

(a) collect meteorological observations over (say) a six-hour interval,

(b) 'assimilate' these into a numerical model to produce an estimate of the current atmospheric state,

(c) use this analysis as the initial condition for a model forecast run forward in time (typically out to several days). Four broad types of data are involved at different phases of the cycle:

1. **Observations**: around 11000 surface stations globally make up the Global Observing System, reporting such atmospheric parameters as weather, cloud, temperature, humidity, wind, visibility, pressure. A subset of these stations make '*climate observations*' which include daily temperature minimum and maximum, sunshine hours, rainfall amount etc. In addition, around 1000 '*upper-air*' stations make radiosonde (free-rising balloon) observations of pressure, wind, temperature and humidity. Voluntary observing ship and drifting buoys make *marine observations* including sea surface temperature, and wave height and period. Several hundred thousand reports per day of pressure, winds and temperature are made from *aircraft observations*.

2. **Synoptic analysis**: Gridded wind, temperature, humidity, geopotential height, precipitation, etc. Also, 'sensible weather' elements (fronts, cloud, thunderstorm activity etc) will be analysed.

3. **Forecasts**: Numerous forecast products are produced operationally. A conventional weather forecast contains similar elements to the synoptic analysis.

4. **Climatological data**: Long-term time-series' of data (either observations or analyses) may be analysed statistically to create climatologies (e.g. 20th century decadal averages, seasonal/monthly minimum or maximum, etc.).

There is considerable overlap and ambiguity between the themes 'Atmospheric conditions' and 'Meteorological geographical features' – e.g. weather conditions ('Meteorological geographical features') including precipitation, temperature, wind etc. are precisely

components of the atmospheric state ('Atmospheric conditions'). Numerous suggestions have been made by stakeholders to resolve this ambiguity. They include:

- merging the themes
- distinguishing 'field-based data' (*Atmospheric conditions*) from 'point-based data' (*Meteorological geographical features*)
- distinguishing 'time-series & near-real-time data' (*Atmospheric conditions*) from 'gridded climate data' (*Meteorological geographical features*)
- distinguishing 'climate data' (*Atmospheric conditions*) from 'observations and forecasts' (*Meteorological geographical features*)

To resolve the ambiguity between themes, we consider the *multi-level approach* to data needs assessment. Data at *local or regional level* are often needed for management and policy implementation, while lower resolution ('smaller scale') data are often required for reporting and policy development/evaluation. The latter includes *summaries and integrated data products*.

Ambiguity remains in some areas. For instance, it is unclear whether the definition should include air quality information (e.g. airborne particulates, atmospheric chemistry). Similarly, while marine observations are collected in support of meteorological forecasting, they include parameters associated with the oceanographic/sea themes. Certain physical parameters of the atmospheric boundary-layer could be associated either to the atmospheric or oceanographic themes.

Scope, use examples:

Used in environmental and security assessments, in assessment of climatic change etc.

- 'Renewable energy resources' data component, solar power estimation requires national, regional and local inventories on soar energy conditions (climate data); wind energy requires climatological wind measurements.

• The evaluation of 'natural and technological risk zones' is based in part on climate data (e.g. rain, snow, wind)
• Wind/climate information is required to evaluate soil erosion
• Wind information is required for advanced noise zone mapping

Important feature types and attributes:

Four-dimensional (space+time) gridded coverage data, very large datasets; station-based or analysed climatological records.

Links and overlaps with other themes:

Overlap exist with:

- Meteorological geographical features
- Oceanographic geographical features and Sea regions (especially for physical parameters associated with the boundary-layer or atmosphere/ocean interface)
- Environmental monitoring facilities (meteorological and air quality observation stations)

4.11 Water Resources

Definition:

Includes utility facilities such as water supply and its resources available. The schemes for control, conservation and utilization of water resources throughout the country, for purpose of Flood Control, Irrigation, Navigation, Drinking Water Supply and Water Power Development. It also undertakes the investigations, construction and execution of any such schemes as required.

Description:

Water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power. Utility services/networks: Physical construction for transport of water: This may include pipelines for transport of water. Transmission lines to include both land and at river basin water. All kinds of transmission systems have nodes and are linked to facilities for production and treatment. Location of water pipelines – large and local network. Large transmission lines are of interest here. Linked to production facilities for water for consumption/processes. soil conservation, anti-water logging measures, reclamation of alkaline and saline soils, drainage and for drinking water supply; Irrigation lines treated separately under agricultural facilities. Water supply institutions, Utilities/ health.

To collect, coordinate the collection of, publish and analyse the data relating to tidal rivers, river basins, rainfall, runoff and temperature, silting of reservoirs, behaviour of hydraulic structures, environmental aspects etc.

Scope, use examples:

Water monitoring stations. The Water Framework is presenting different kinds of monitoring sites.

- surface water monitoring stations
- drinking water abstraction (investigative station, operational station)
- river basin monitoring stations

Stations may be e.g. hydrometric (water quantity, flow and level only stations), chemical water quality, biological water quality.

Important feature types and attributes:

Objects in networks could both include transmission lines and nodes being pump stations etc. Major production and treatment sites is treated in the theme Production and industrial facilities.

Water supply system network

- segment id
- capacity, max
- average volume
- construction system, including e.g. material used for building the network (cast iron, cement …)
- date of construction
- responsible organization

Overlaps and links with other themes

Water supply might overlap with themes

- Hydrography
- Buildings
- Land use
- Environmental monitoring facilities (like treatment plants/pumping stations)
- Production and industrial facilities
- Energy resources
- Ground water profile

4.12 Ground Water Profile

Definition:

Ground Water Resources, including their exploration, assessment, conservation, augmentation, protection from pollution and distribution, based on principles of economic and ecological efficiency and equity.

Description:

Ground Water Profile is dynamic in nature and hence subjected to periodic changes. It is essential to update the scenario of ground water occurrence, availability and utilization in term of quality and quantity. The effect of ground water withdrawals and out-flows are directly measurable through water table. Since, the main inputs and outputs frequently change with time; the ground water situation is being periodically reappraised. The development of ground water profile leads to changes in its regime and water quality, therefore planning for further development of the resource is to be done on the basis of various findings, which provide valuable information for reorienting ground water development programme keeping in view the emerging scenarios.

- To depict the ground water regime in terms of quality and quantity.
- Ascertaining the factors influencing the ground water scenario.
- Identification of problems and issues pertaining to ground water and provide suitable object oriented strategy for implementation.
- To assess the social and economic aspects of ground water utilization
- To update the existing database on ground water regime.
- To demarcate the ground water worthy and unworthy areas.
- To recommend suitable follow up action/ remedial measures/ administrative and technical measures for the specific problems.

Scope, use examples:

The scope of the conjunctive use are as follows:-

- To evolve a suitable plan for controlling the problem of rising water levels by adopting the technique of conjunctive use of surface and ground water, and proper drainage.
- To prepare sector/ blockwise plans for development of ground water resource in conjunction with surface water based on mathematical model results.

- To test the sustainability of the present irrigation pattern with respect to conjunctive use of water resources and suggest improvement for future.
- To evaluate the economic aspect of groundwater development plan with respect to Cost benefits ratio, internal rate of return and pay back period etc.
- Development of groundwater in areas with low stage of ground water development
- Development of deeper aquifers
- Development of ground water in flood plain areas
- Development of ground water in water logged areas
- Salinity in ground water:
- contamination in ground water

Important feature types and attributes:

Yet to be decided

Overlaps and links with other themes

- Hydrography
- Buildings
- Land use
- Environmental monitoring facilities (like treatment plants/pumping stations)
- Production and industrial facilities
- Energy resources
- Water resources

4.13 Mineral and Energy resources

Definition:

Mineral resources including metal ores, industrial minerals, etc. Energy resources including hydrocarbons, hydropower, bio-energy, solar, wind, etc., where relevant including depth/height information on the extent of the resource

Description:

The mineral resources data theme refers to the description of natural concentrations of very diverse minerals of potential or proven economic interest. The concept of energy resources provides focus to the resource aspect. Important attributes are the nature, genesis, location, extent/distribution of these resources. The economic and technical data related to the location of areas licensed for exploration or mining, to the exploitation of deposits, transport, treatment and waste disposal are not covered by this theme. However, storing of material near mines and quarries is necessary. Knowledge how the constituents affect the surroundings is of importance, e.g. leakage from sulphides etc. They are to a large extent covered in other themes, such as production and industrial facilities. Energy minerals such as coal, uranium, oil and gas are excluded in this theme.

The term resource can be problematic to define, the quantification and thus location of a resource is depending on the technical and economic situation. Resource aspects should not only be restricted to the resources under utilisation, but should also include un-utilised resources.

Mineral resources data refers to:

- **Anomalies:** locations where background concentrations of potentially valuable elements in soils, stream sediments or rocks onshore or offshore exceed the normal background values expected given the local geological context. Such maps are widely

used in mineral exploration. Attributes are location, chemical elements, nature of the sampled element (s), analytical value(s);

• **Occurrences:** points or areas where concentrations of a given mineral (s) are observed but without a proven economic potential. Attributes are location, nature of the mineral(s), analytical data, nature of the host rock, geometry/ morphology of the observed occurrence(s)

• **Deposits:** areas bearing mineral concentrations with economic potential.

Fossil fuel resources include

- Oil accumulation: hydrocarbon fields, petroleum volumes
- Natural gas accumulations, including solid methane clathrates

- Coal, lignite or peat deposits
- Uranium ore deposits

For these resources the nature, location and 3D geometry of the deposit (= geological resource) of the deposit, the nature of the economic energy carrier and the size of the reserves at a point in time are key attributes.

A mineral resource encompasses all quantities of mineral resources, discovered and undiscovered, that are contained in, or have been produced from, naturally occurring accumulations on or within the earth's crust.

Resource information is generally available for deposits held by companies listed on the Western stock markets, as they face reporting obligations. National legislation also influences the detail of data publicly available. Detailed data or data related to some rare metals deposits with high-technology applications, may be difficult to obtain considered to be of economic/ private interest and therefore, problematic to distribute.

The mineral resources sector is divided in a number of segments, differentiated by the technologies involved in exploration and mining, the markets and the nature of the exploited material(s):

- Metal mining (non-energy metallic ores, uranium pertaining to the energy sector);
- Industrial minerals;
- Construction minerals and rocks; e.g. natural stone (dimension stone), sand and gravel and crushed bedrock aggregates
- Ornamental stones;
- Precious and semi-precious stones.

The different kinds of renewable energy resources may include:

- **Hydropower:** Water resources especially mapped according to energy potential. Commonly undertaken in the MS, carried out by governmental bodies or private firms.

- **Bio-energy resources:** Forest resources, “scrap” forest, cereals or agricultural residues can be used for energy purposes, e.g. in the form of firewood or biodiesel. The resources or supply is sometimes being estimated and mapped.

- **Wind energy:** Country inventories of wind energy is being done in areas where wind is being utilised or planned utilised. Estimated by wind measurement together with topographical information.

- **Geothermal energy:** The Earth's natural heat flow is of high interest as a renewable and clean energy source. Mapping of the resource can be available or relevant at local, regional or national levels. Geothermal energy systems use the natural heat of the subsoil by utilising warm groundwater from surficial deposits for direct heating or electricity generation (open system). Alternatively, shallow geothermal flows are exploited by ground source heat pumps (closed system). Common heat sources in bedrock or subsoil

may be utilized - a circulation of an antifreeze solution in collector hoses which are lowered into relatively shallow boreholes bedrock or circulation of ground water from deep boreholes in bedrock. Heat pumps are suitable, too, for example for extraction of heat from air, rivers, seas and artificial components**.**

• **Solar power and resources:** In order to reduce the need for extra heating solar conditions at local sites are important to bring into account in local planning. National, regional and local inventories on solar energy conditions is needed, relating to heating needs. Systems for storing solar heat is found at some locations. Solar resources may also be used in electricity production, through the use of solar cell technology (silicium cells). Air-based heat pumps can use solar energy stored in the air.

• **Other energy resources such as waves, currents etc.:** The different kinds of renewable energy resources is long. The list above is only giving some examples.

The quantification of the resources may be aggregated or detailed. The detailed information is to a large extent private business information. This includes for instance data about the internal structure of geological structures within oil fields. However, for public planning purposes at the local level detailed information about some of the renewable energy resources may be relevant.

The geographical representation of the resources (objects) may be different in different scales. In the mapping and exploitation of the resources 2-d (ordinary maps) and 3-d geographical data are being used. Resources may be mapped by natural boundaries. Aggregated or overview information can be referring to grid cells in a geographical grid system, administrative units/areas, statistical units/areas or points.

Scope, use examples:

The use and potential of geographical data about mineral and energy resources will depend very much on scale and detail of available information.

Digital geographical information about mineral resources is used:

- for the management of resources and exploitation activities
- for the promotion of private sector investment
- in land use planning
- in environmental impact assessments
- as a basis for local, regional, and national policy making

- as input-data in assessments of state of the environment, e.g. modelling pressure and sustainability

Digital energy resource data can be used in different settings

- in management of resources and exploitation activities
- in policy development and regional policies
- in strategic work and resources planning
- in land use and urban planning
- in environmental impact assessments
- as input-data in assessments of state of the environment, e.g. modelling of future emissions, pressure and sustainability

Important feature types and attributes:

Depending on the segment only some of these attributes are of relevance for mineral resorce

- Localisation of each ore/mineral deposit,
- Name of each deposit

- Nature of the principal constituent of the deposit, defined by its economic value/ potential
- Nature of the secondary constituent(s) of the deposit, defined by its/ their economic value/ potential
- Geological properties, mechanical behaviour, quality aspects
- Tonnage and grade of the resource in the ground + reserves in the ground + the part of the reserves already extracted (reserves are that part of the resource that are technically exploitable under current economic conditions)
- Tonnage of the principal constituent (s) of the deposit included in the resource and reserves
- Average grade of the principal constituent (s) of the deposit
- Ore type and origin of the mineralization (hydrothermal, magmatic, sedimentary [alluvial, marine, glacial …], skarn …)
- Granulometry (in case of sand and gravel)
- Harmful constituents, radiation
- Usage of occurrence
- Age of the mineralization: oldest and youngest documented ages
- Age of the host rock: oldest and youngest documented ages
- Geometry of the deposit, including depth and extension of the mineralisation at given cut-off grades
- Nature of the related alteration of the host rock (if existent)
- Status of the deposit

Generalised or aggregated information about mineral resources may be found as geographical data with grid cells or administrative regions resolution.

Some energy resources, such as oil or hydropower can be localised quite distinctly, while other resources, such as solar resources or wind resources based on point measurements are modelled/interpolated into "continuous" area and 3D-objects,

Energy resource object (2D or 3D-volumes)

- resource type (oil, gas, wind,..)
- name (place/location name)
- id
- quantifitation
    - o volume
    - o date of quantification

Water catchment area

- id
- average runoff

Administrative/ statistical unit

- resource type (oil, gas, wind…)
- quantification
    - o amount
    - o date of quantification

Grid cell

- resource type (oil, gas..)
- name
- id
- quantifitation
    - o volume
    - o date of quantification

Links and overlaps with other themes:

- Geology
- Land use
- Soil
- Production and industrial facilities
- Area management/restriction/regulation zones and reporting units
- Oceanographical geographical features,
- Hydrography

4.14 Polluted Areas
4.15 Economic Data } To be described later

4.16 Natural risk zones

Definition:

Vulnerable areas characterised according to natural hazards (all atmospheric, hydrologic, seismic, volcanic and wildfire phenomena that, because of their location, severity, and frequency, have the potential to seriously affect society), e.g. floods, landslides and subsidence, avalanches, forest fires, earthquakes, volcanic eruptions.

Description:

"Natural risk zones" are zones where natural hazards areas intersect with highly populated areas and/or areas of particular environmental/ cultural/ economic value. Risk in this context is defined as: risk = hazard x probability of its occurrence x vulnerability of the exposed populations and of the environmental, cultural and economic assets in the zone considered.

Natural hazards are natural processes or phenomena occurring in the biosphere that may constitute a damaging event. Natural hazards can be classified by origin namely: geological, hydrometeorological or biological. Hazardous events can vary in magnitude or intensity,

frequency, duration, area of extent, speed of onset, spatial dispersion and temporal spacing. An international definition on hazard is relevant in defining the theme. The internationally agreed terminology on disasters should be adopted in this document: Hazards is defined as a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Hazards can include latent conditions that may represent future threats and can have different origins: natural (geological, hydrometeorological and biological) or induced by human processes (environmental degradation and technological hazards). Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterised by its location, intensity, frequency and probability.

Geological hazards are natural earth processes or phenomena that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Geological hazard includes internal earth processes or tectonic origin, such as earthquakes, geological fault activity, tsunamis, volcanic activity and emissions as well as external processes such as mass movements: landslides, rockslides, rock falls or avalanches, surfaces collapses, expansive soils and debris or mud flows. Geological hazards can be single, sequential or combined in their origin and effects.

Hydrometeorological hazards are natural processes or phenomena of atmospheric, hydrological or oceanographic nature, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Hydrometeorological hazards include: floods, debris and mud floods; tropical cyclones, storm surges, thunder/hailstorms, rain and wind storms, blizzards and other severe storms; drought, desertification, wildland fires, temperature extremes, sand or dust storms; permafrost and snow or ice avalanches. Hydrometeorological hazards can be single, sequential or combined in their origin and effects.

Many of the hazards are sudden in their nature. However, several categories of natural hazards with major impacts on civil security and on environmental/ cultural and economic assets are

not sudden in nature. They may be permanent phenomena going unnoticed (e.g. radon gas emanations, deficit or excess of elements in soils and water), or slow phenomena (slow ground motion). Technological hazards are commonly sudden failure of a construction or a process causing significant damage. Natural hazards have the potential to precipitate technological hazards. Usually continuous processes like pollution/emission are not classified as hazards. However, repeated emissions might be called hazards, e.g. large scale chemical, radiation or oil spills. Continuous pollution and other environmental problems may have an adverse effect also on the size and frequency of some kinds of natural hazards.

Knowledge about "Natural hazards areas" is important in the identification and delineation of risk zones. The natural hazards areas may reflect all atmospheric, meteorological, hydrologic, geological and wildfire phenomena that, because of their location, severity, and frequency, have the potential to seriously affect society, e.g. floods, landslides and subsidence, avalanches, forest fires, earthquakes, volcanic eruptions, shrinking and swelling soils, radon gas emanations, deficit or excess of trace elements in soils or water. Data and services are probably needed for both risk assessment and emergency situations Special warning services may be relevant. Underneath is given examples of some important natural hazards, with information on occurrence: location and frequency and with some information on the datasets, coverage etc.

Areas prone to flooding by inland waters and lakes:

Areas flooded due to exceptional raise of water table in groundwater, rivers and lakes, affecting adjacent land or areas further away being at the same altitude or lower than the flooding water. Affecting housing and industrial sites, agricultural land, transport network, sewage systems, dams etc: Occurrence: Flat river plains, delta areas, valley bottoms and shorelines.

• Physical mapping of areas susceptible to flooding, line for highest recorded level, also division into zones with different susceptibility classes. Data needs: detailed elevation model and measurements in the field

• Areas with certain regulations/ restrictions for different land use/ resource use linked to flooding risk.

• Constructions for flood control

• Data set on restriction zones on land use/ building/ activities downstream reservoirs in case of reservoir brake-down

• Drainage capacity of ground and soil sealing areas with low drainage capacity

Areas prone to flooding by spring tide/ exceptional sea level rise

Areas prone to flooding due to exceptional raise of water table the sea and backwaters, affecting adjacent land or areas further away being at the same altitude or lower than the flooding water. Affecting housing and industrial sites, agricultural land, transport network, sewage systems, dams etc Occurrence: Flat coastal areas, areas lower than original sea level. Commonly harbours, trade areas etc. Frequency: Floods, as storms, are among the most common natural disasters in Europe – with the effect of being of the most costly in terms of economy and insurance.

• Physical mapping of areas susceptible to flooding, line for highest recorded level, also division into zones with different susceptibility classes. Data needs: detailed elevation model and/or measurements in the field.

- measures by radar satellites or air born equipment to measure water level
- field measurement

• Constructions for flood control

• Areas with certain regulations/ restrictions for different land use/ resource use linked to flooding risk.

Earthquakes

Earthquakes are widespread phenomenon and are more frequent than any other disaster. Data needed for getting overview and handling the hazard:

- date and time of occurrence; - epicenter location, depth, with a liability index - Magnitude and type of magnitude used - Observations (local intensity with a liability index) - Triggered effects - Fault
- Data needed for emergency/ rescue operations

Volcano eruptions:

A few active volcanoes exist. The activity is low and generally the threats are minimal compared to other natural hazards. Some destructive events have occurred in the Mediterranean countries, such as Italy over the past decades. Actions are usually coped with at the local level.

- It is difficult to outline important spatial data sets linked to volcano activities. There might exist maps on expected lava flow channels and restriction areas for certain activities.

Mud slides, land slides and quick (saline leached) clay soils slides:

- clay rich shrinking and swelling soils
- areas of unstable terrain, slide area divided into zones of different susceptibility classes
- borehole locations with further information on the salt content etc
- affected area if area is subject to slumping and landslip
- Areas with activity restrictions – which kinds of operations are allowed in order to prevent slides and which areas are not to be built on. Different countries have different threshold levels e.g. concerning slope degree on land used for buildings, the values depending on the ground condition (soil, clay, bedrock)

Areas prone to mountain blocks slides and stone slides:

Occurrence: Mountain block slides mostly in alpine environment with "young landscapes" where frost and water erosion is active, stone slides areas with steep slopes and loose material. Problems occur where land use includes settlements, infrastructure etc.

- Physical mapping of areas susceptible to land block slides divided into zones with different susceptibility classes. Based on mapping of bedrock structures.
- Physical mapping of areas susceptible to stone slides divided into zones with different susceptibility classes. Further info on kind of material. A rough assessment can be based on analysis of slope angle, slope length and rock stability.
- Anticipated affected areas followed by a land block slide; the stone masses themselves and following flooded areas.
- Areas with certain regulations/ restrictions for different land use/ resource use linked to land block slide risk and stone slide risk.
- Constructions for directing stone slides

Areas prone to snow slides - avalanches:

Occurrence: In areas with significant snow cover combined with steep slopes. Wind will affect the creation of snowdrifts.

- Physical mapping of areas susceptible to snow slides divided into zones with different susceptibility classes
- Areas with certain regulations/ restrictions for different land use/ resource use linked to snow slide risk.
- Constructions for directing slides

Areas susceptible to forest, bush and grassland fires

Areas susceptible to forest, bush and grassland fires can be analysed by using

- Satellite images

- Vegetation cover, composition and strata
- Elevation data
- Meteorological data, Precipitation, temperature, winds,

Areas of installations prone to storms/ wind damage

Occurrence: Unclear picture; seas, coastal areas and narrow valleys, but also other areas within the continent. In addition storms, as floods, are among the most common natural disasters in Europe – thus also being the most costly in terms of economy and insurance.

- Data sets. Areas with recorded extreme wind

Coastal erosion

Coastal erosion is an important and costly category of natural hazard of growing significance in a climate change context

Radon areas

Natural radiation from bedrocks and unconsolidated rocks are considered as natural risk zones due to a possible high radon concentration in indoor air.

Scope, use examples:

Recent local and trans-national disasters have demonstrated that data and services about natural hazards and risk zones are of paramount importance of efficient risk management. This was one of the reasons why "Safety of the Citizen" has been selected as one of the main topics for future. The enhanced 'risk and hazard' monitoring and coordination responsibilities planned or already in place are directly linked to Natural Hazards problems

It is an aim to minimise risks by making the society more resistant to hazards, either by minimising threats or by regulation of land use and production activities susceptible to the hazards. Some areas are more prone to natural hazards than others. It is important to identify

these areas and build up regulations for long term land and production management. Maps, spatial databases and online spatial services are being used actively to carry out such management. Risk analysis is the basis for all work on planning and living with natural and technological hazards. All areas may in some way or other be affected by natural hazards, and areas with certain kinds of human activity may be hit by technological hazards.

The different kinds of users for handling hazards may be grouped into four:

- reporting, trends and overall policy development , commonly at national and international level
- assessment of natural and technological risks – mapping of areas prone to be hit by hazards
- planning phase for securing public safety- long term regulation and management of land and activities
- disaster response and emergency operations

In order to perform these activities certain kinds of data and services are needed. It is essential with a well organised supply system. The different kinds of data and services to be used and handled in these kinds of actions can be

- satellite images and air photographs as orthophotos
- vector data sets with polygons and lines
- simple point information tables
- address information system handled in GIS data bases
- online and web services of different kinds offered to specific user communities or the public, from organisations such as meteorological or hydrological offices.

The issues will be further elaborated below.

Four different forms of usage are identified below, including an outline of their spatial data needs. Based on the data, different kinds of services may be developed and used.

• **Reporting, indicators, trends, overall policy development:** The needs for spatial data by this use is limited. Usually one will need reporting units such as countries, regions, or catchment areas. There will be some use of generalised versions of data sets to be used under the other use categories. Overall trends in frequency of natural hazards is for some of the phenomena linked to the environmental situation – climate change in particular and land cover changes in particular. Data needed for analysing links and dependencies are needed.

• **Susceptibility analysis, mapping and prediction:** Data sets describing and analysing the natural phenomena causing hazards, commonly detailed data with high accuracy is needed, such as measuring stations, detailed thematic mapping through fieldwork (e.g. specific aspects of soil and land cover) , air photo interpretation or remote sensing, analysis of detailed elevation models, water flow data linked to the river and lake network, meteorological and climate data, seismic activity mapping etc. Work is seen to be carried out by both local authorities, national mapping agencies, national thematic agencies or international organisations.

• **Physical and sector disaster-prevention planning:** Making disaster-resistant communities by long term physical and sector planning, usually carried out at local and regional level. The mapping carries of by thematic agencies as described over will is used and transformed into simplified data sets and planning documents showing areas of high risk and restriction zones at or around high risk areas. The delimitation of the restriction zones would need population data, land use plans etc.

• **Emergency operations/disaster response:** The emergency operations for both natural and technological hazards needs more or less the same kinds of data. In order to make emergency management a faster and more accurate means to reduce effects, data are needed in several parts of the operation;

- Monitoring; continuous or real time situation reports, giving information on trends, direction etc.
- Overview and identification of qualities at land and sea; persons, property, production activities, infrastructure and environmental qualities that can be affected by the hazard/ disaster. It is essential to access the extensiveness of the anticipated damage caused by natural and technological hazards. There is a need to know about population information at the lowest possible level, property information making it possible to identify owners of individual properties, address register for information purposes and identification, mapping of areas/ infrastructure affected, such as roads, rail, telecommunication lines, water, gas pipe lines, oil installation at sea, storage areas for hazardous substances, resources such as important groundwater bodies, other extraction points for water or other resources, land use, location of high value environmental areas (biodiversity, recreation, cultural heritage sites etc)
- Location of resources needed to perform the operation; Infrastructure, road and rail capacity, water supply points, depot for emergency equipment (oil spill extraction boats, vehicles etc) location and capacity of hospitals, information to see vehicle information on location, allocating resources, deploying personnel. Included here is also the administrative boundaries for responsibility areas of different bodies involved in the operation.

Links and overlaps with other themes:

The broad field of natural risks may link and overlap may other themes, mostly concerning physical environment; Land use (land use plans may reflect risk zones), Elevation, Hydrography, Land cover, Geology, Environmental protection facilities, Meteorological geographical features, Oceanographic geographical features.

Chapter 5 & 6 To be elaborated later once the Annex I Themes are in progress

Conclusion

To specify a time schedule for all three Annex is very important. Maybe for Annex I themes a time limit of two years will suffice and thereafter for Annex II and III themes one to two years each will be sufficient. Aim should be to have all the themes ready in five years of time. We could use new data capturing technologies and process against Theme to balance the desirability of having the data social and economic importance with the cost and feasibility of acquisition within a given time period. It is again an important aspect to involve user organizations/agencies during the preparation and evaluation stage. It is also recommended that private/voluntary organizations may be used for carrying out the survey for any specific theme to hasten up the process of data specifications.