



# UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO



## SPATIAL DATA INFRASTRUCTURE PART\_II

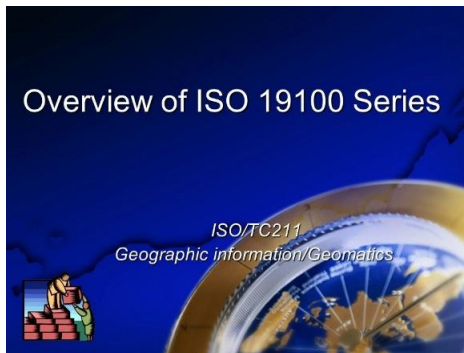
Dr. Jorge Prado Molina  
Geography Institute, UNAM.



# CONTENTS

## Primary components to establish an SDI:

- Institutional arrangements
- Framework data
- Policies.
- Standards
- Technologies



# CONTENTS

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## SDI Organization:

- Institutional arrangements
- SDI development model (mandatory or voluntary)
- Partnership
- Authoritary data sources
- Governance
- Board of directors
- COMMITTEES



# CONTENTS

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## Components of an SDI.

- Resources: data bases, maps, servers, and other available data.
- Metadata.
- Services offered by an SDI.
- Software:

The importance of using free software



# SDI Definition and Key Capabilities

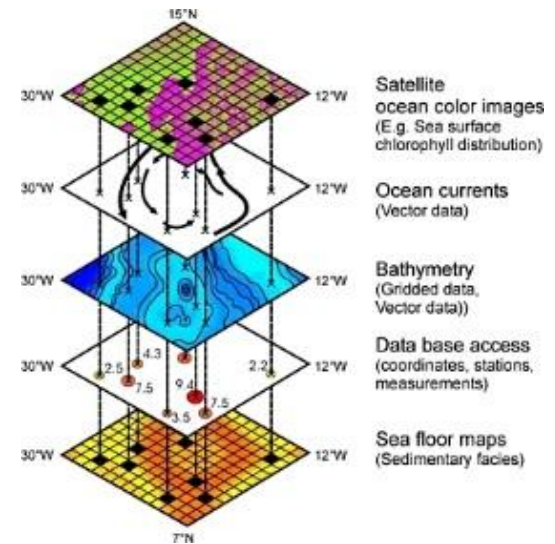
“The relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data”

(GeoConnections, 2005)

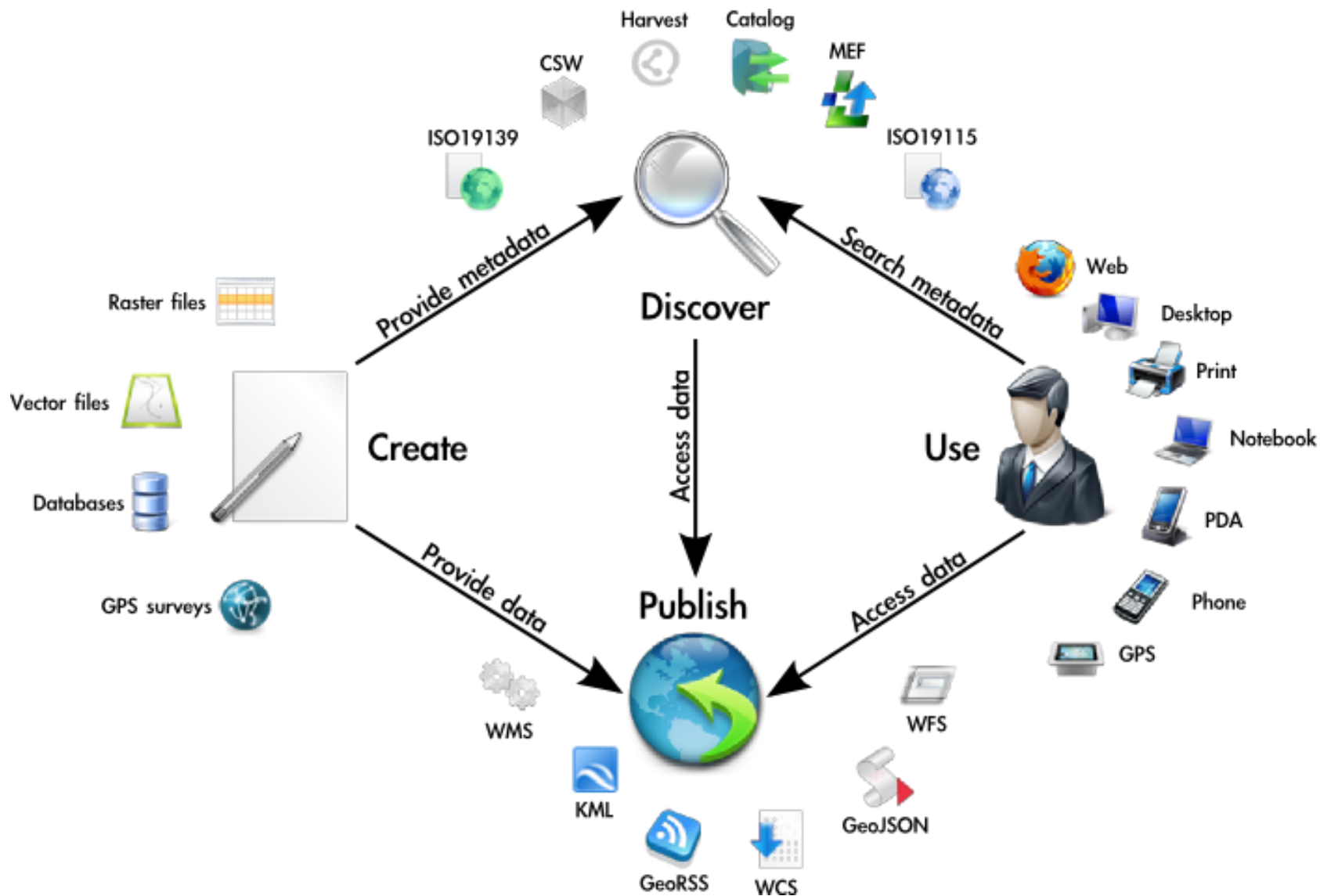


# SDI Definition and Key Capabilities

An SDI consists of more than a single spatial data set or database; it hosts spatial data and attributes and provides sufficient documentation (metadata) and a means to discover, visualize, evaluate and access the data.



(GeoConnections, 2005)



# SDI Key Capabilities

**Enable online access to a wide range of spatial information and services.**

**Enable integration of geographically distributed spatial information.**





# SDI Key Capabilities

**Enable collaboration by multilateral information exchange and synchronization.**

**Allow autonomous organizations to develop interdependent relationships in a distributed environment.**

**Facilitate the definition and sharing of spatial semantics**



# INTEROPERABILITY

The common ingredient in fulfilling these fundamental SDI capabilities is interoperability.

Interoperability facilitates information sharing and allows users to find information, services and applications when needed, independent of physical location.



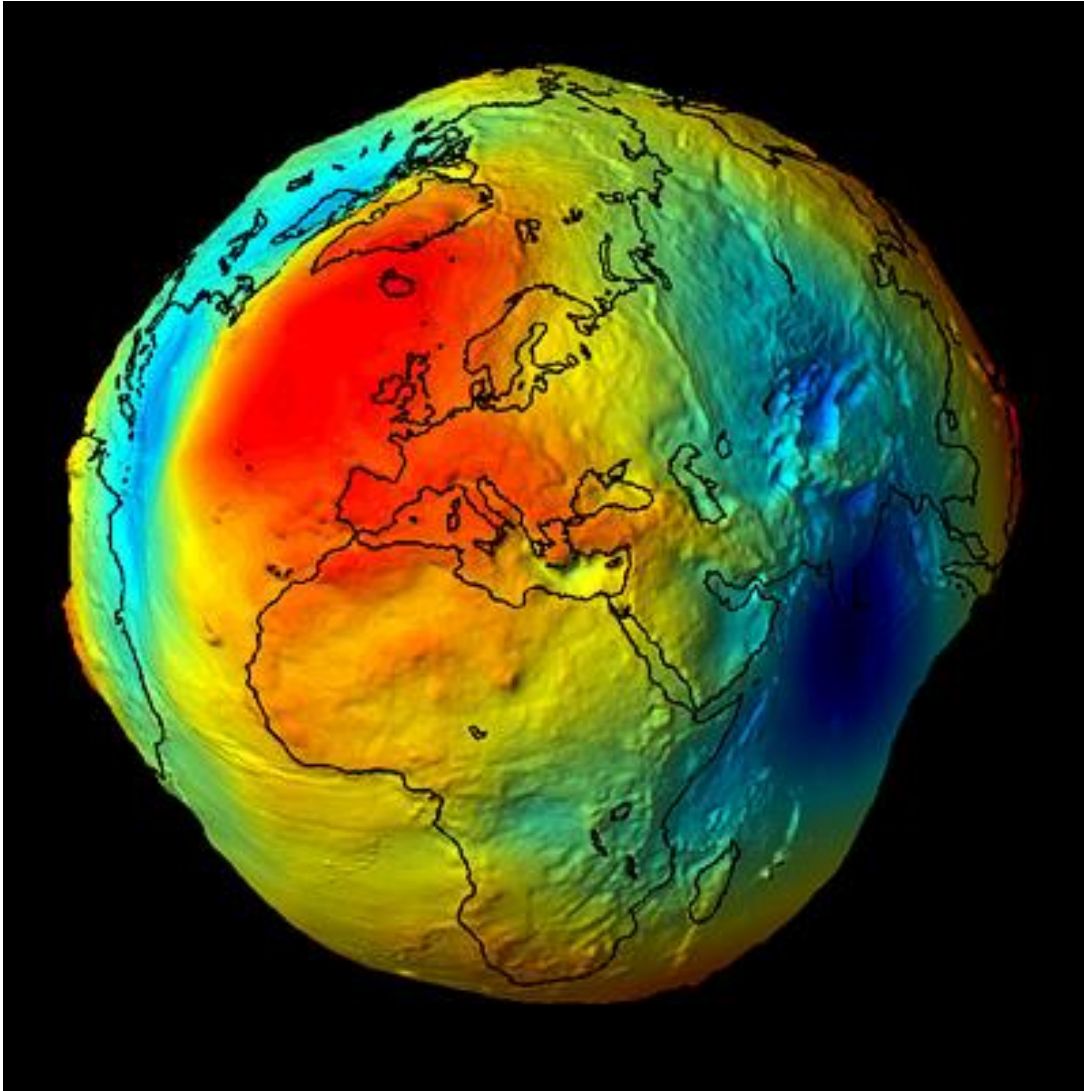
# Interoperability

It allows users to understand and employ the discovered information and tools, regardless of platform (local or remote).

Through interoperability, users can also evolve a processing environment without being constrained to a single vendor's offerings.

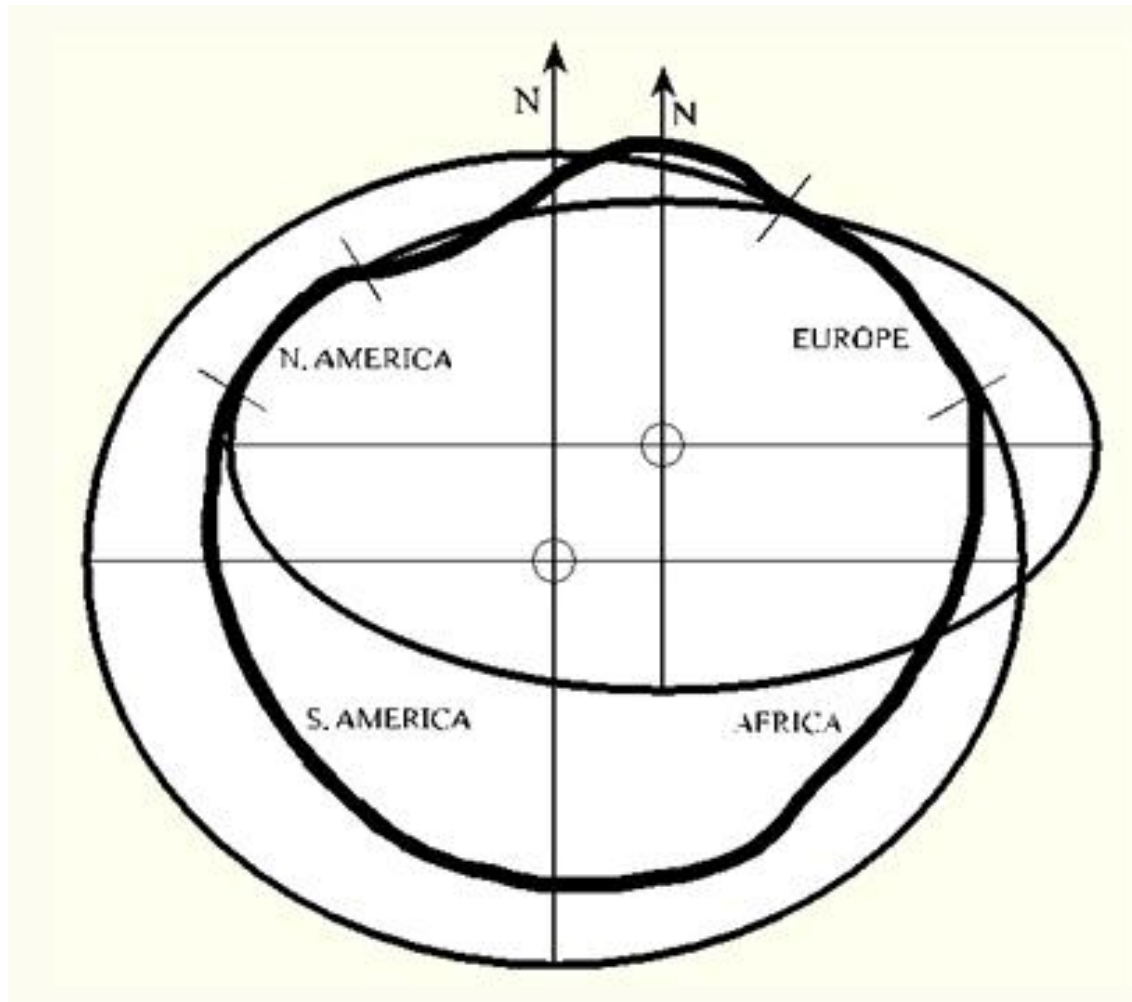


# EXAMPLE OF INTEROPERABILITY.



REFERENCE  
ELIPSOIDS TO  
REPRESENT  
EARTH

An ellipsoid useful for North America, doesn't work for Europe and vice versa.

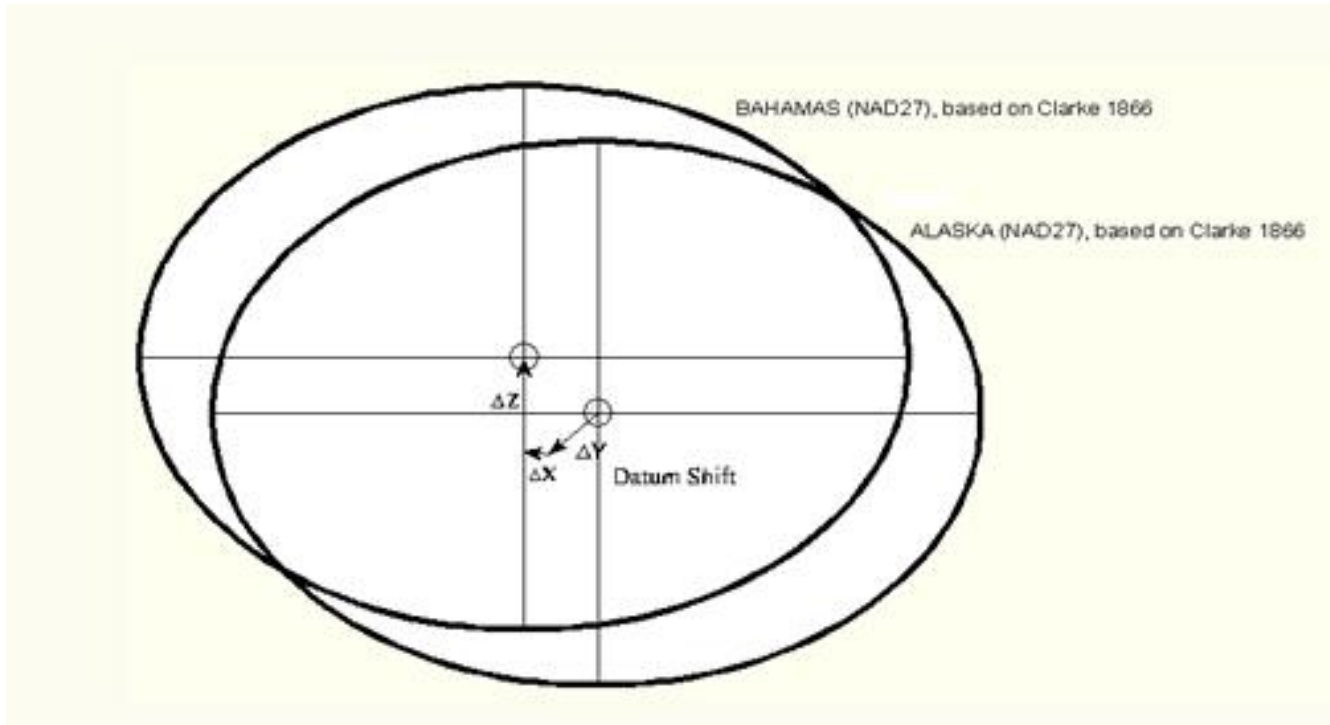


## Shifting between different datum, compared against WGS84

Datum	Ellipsoid	Datum shift (m)* ( Dx, Dy, Dz )
Alaska (NAD-27)	Clarke 1866	-5, 135, 172
Bahamas (NAD-27)	Clarke 1866	-4, 154, 178
Bermuda 1957	Clarke 1866	-73, 213, 296
Central America (NAD-27)	Clarke 1866	0, 125, 194
Bellevue (IGN)	Hayford	-127, -769, 472
Campo Inchauspe	Hayford	-148, 136, 90
Hong Kong 1963	Hayford	-156, -271, -189
Iran	Hayford	-117, -132, -164

\* Positions compared to the WGS84

# There are differences, even between NAD 27 datum



To achieve interoperability between systems and system components, an SDI must include the following:

- ***Network Protocol Interoperability*** – Allows basic communications between components
- ***Standard Interface Specifications*** – Allow client applications to execute procedures on remote systems

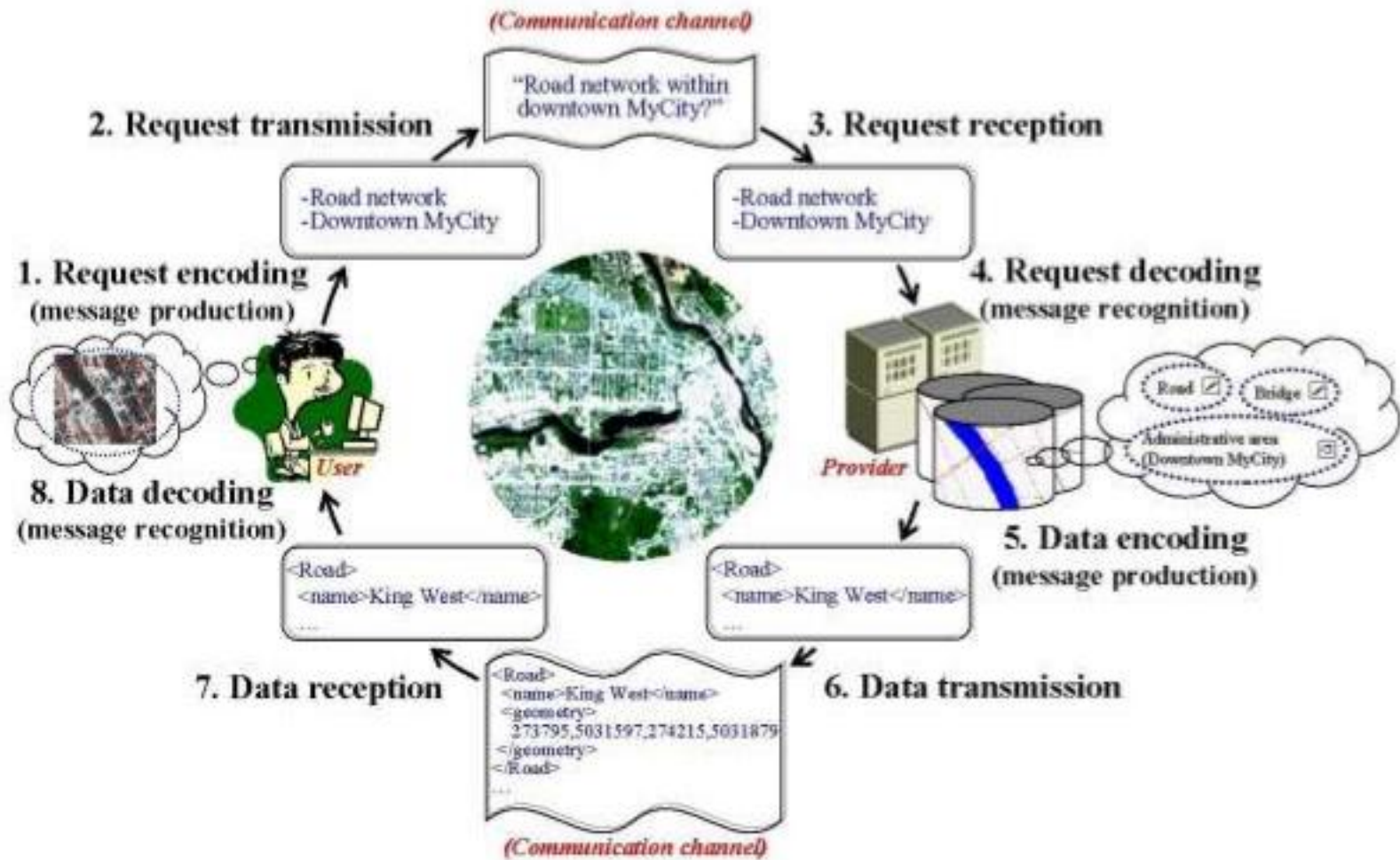




- **Data Transport Interoperability** – Allows for sharing of data and services through transparent access, regardless of any proprietary data storage formats.
- **Semantic Interoperability** – Means that applications can interpret data consistently in the same manner in order to provide the intended representation of the data.



- **Agents (e.g., human beings, systems, etc.) interact together at the system, syntactic, schematic, and semantic levels to share information.**
- **Each agent has its own conceptual representation of reality and uses it to encode (steps 1 and 5) and decode (steps 4 and 8) messages (e.g., queries and responses about GI), which are transmitted (steps 2 and 6) to or received (steps 3 and 7) from another agent through the communication channel.**



Source: Brodeur & Badard, 2008

# Interoperability

- It happens only when both agents engaged in the same understanding.



# SDI COMPONENTS

The primary components of an SDI can be briefly described as follows:

**Institutional arrangements**

**Framework data**

**Policies**

**Standards**

**Technologies**



# INSTITUTIONAL ARRANGEMENTS

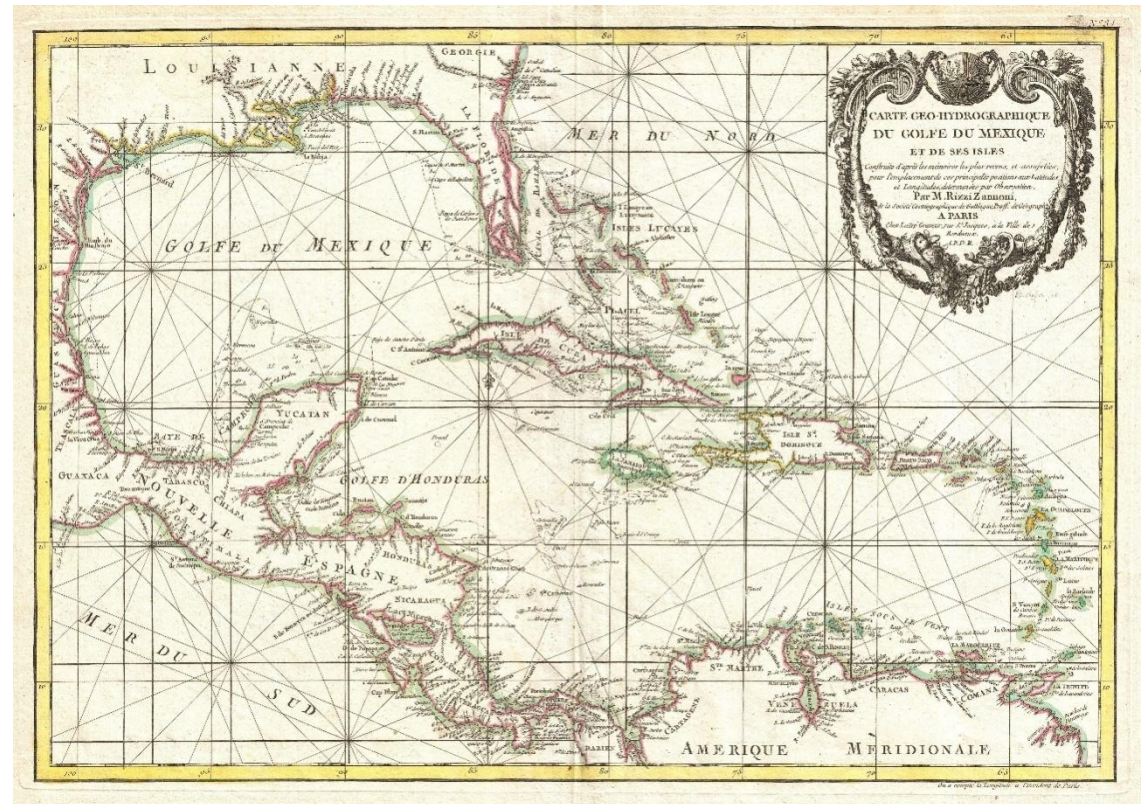
**Institutional framework** – The mechanisms created to enable key stakeholders to collaborate and engage actively in the planning and implementation of the SDI.

These can take the form of legislation, regulations, policies or written agreements.



# FRAMEWORK DATA

The set of continuous and fully integrated spatial data that provides context and reference information for a jurisdiction.







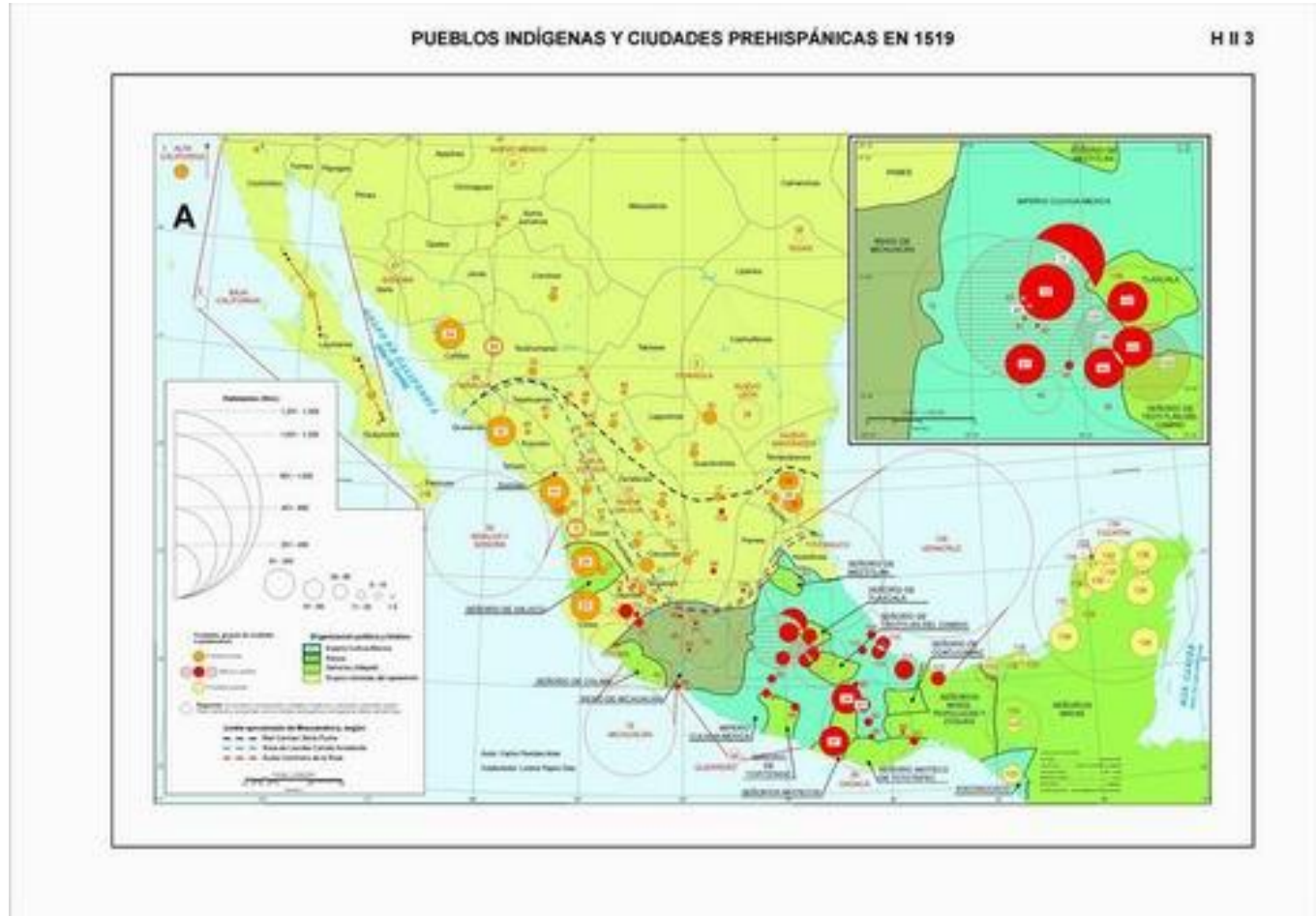
# FRAMEWORK DATA

**Sometimes called base mapping data, are expected to be widely used and generally applicable, either underpinning or enabling spatial applications by helping to integrate other types of spatial data (sometimes called thematic data).**



# FRAMEWORK DATA

## thematic data



# POLICIES

The strategic- or operational-level instruments that help facilitate the development or use of an SDI.

Strategic policies address high-level issues and set directions for organizations (e.g., enforcing compliance with certain standards and procedures).

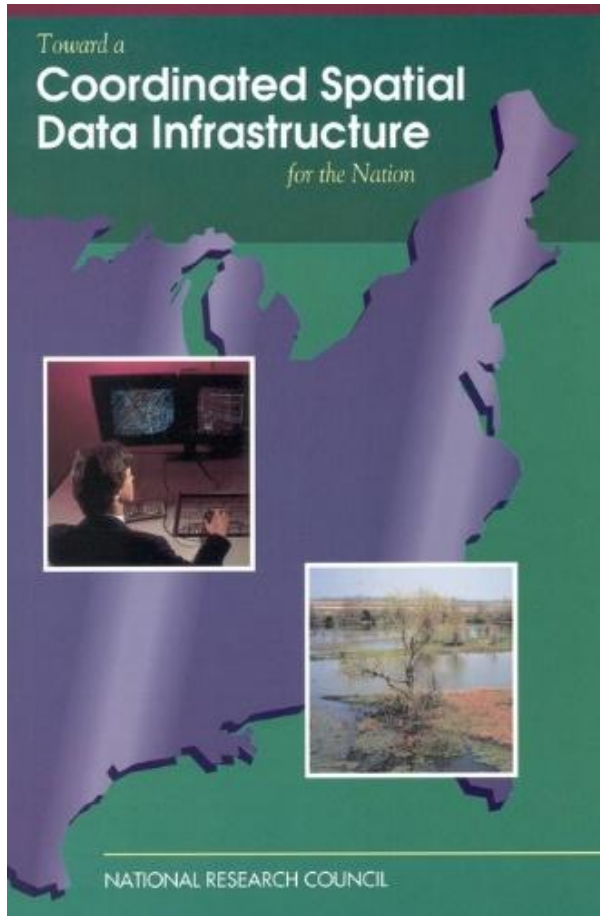


# POLICIES

Address topics related to the lifecycle of spatial data and help facilitate access to and use of spatial information (e.g., guidelines and manuals dealing with data collection, management, dissemination and use).



# Policies which foment alliances and partnership.



- **Building Partnerships**

Since no single organization can build an SDI, collaborative efforts are essential for the success of any SDI initiative, and particularly so with the SDI voluntary model.



- **Building Partnerships**

Cooperation and partnerships across different levels of the public sector and with the private sector are an important means at every stage of SDI development to collect, build, share, and maintain spatial data.



# Standards

- Spatial standards are technical documents that detail interfaces or encodings, which have been developed to address specific interoperability challenges.
- The more standardized the structure and content of information, the more effectively it can be accessed, exchanged and used by both humans and electronic devices.





# Standards

In Geography, norms are elaborated mainly by the International Standard Organization (ISO), and the Open Geospatial Consortium (OGC); these kind of norms require both: usage, and acceptance at world level.

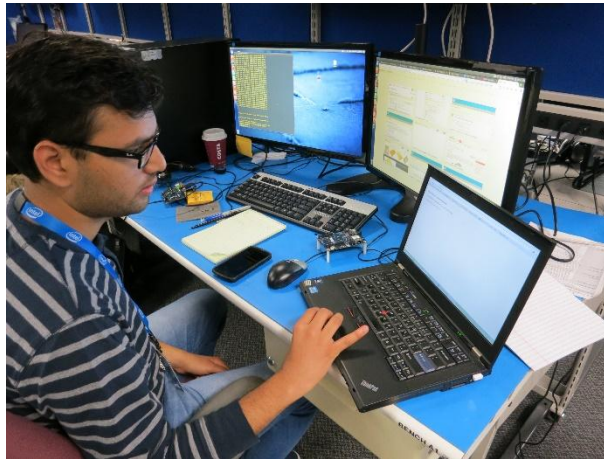


International  
Organization for  
Standardization



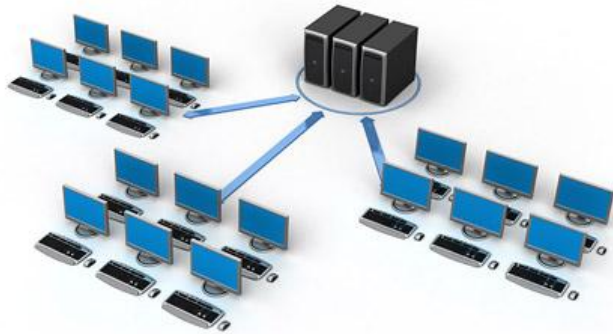
# Standards

And due to its nature, are more recognized by informatics experts than cartography and Earth sciences experts, because they are designed to work in a technical interoperability environment with the purpose to share data and geographic information through the web.



# Technologies

The technological architecture of an SDI is composed of a network of physical servers that provide Web services, and data via these services, in such a way that an application can be developed that makes use of these services.



# Technologies

The Internet is the “highway” through which data and services are accessed, and applications use data from Web services so that users can produce and analyze spatial information to make informed decisions.



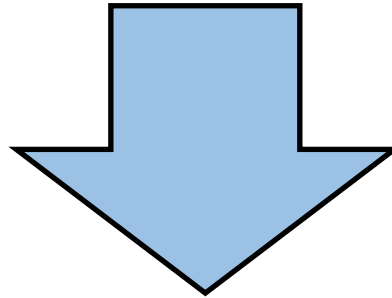
# Technologies

There are technological considerations associated with the development and implementation of an SDI.



# SDI components.

- ONCE MAIN COMPONENTS WERE DEPICTED.



**Lets see its organization**



# SDI ORGANIZATION

## COMPONENTS OF AN SDI

- Institutional arrangements
- SDI development model (mandatory or voluntary)
- Partnership
- Authoritative data sources
- Governance
- Board of directors
- COMMITTEES

Alignment with government priorities



# SDI ORGANIZATION

- **Institutional arrangements**

Once the decision to proceed with an SDI initiative has been made, the institutional arrangements must be put in place to enable the infrastructure to develop and mature.

**What type of model will be used?**

**Who will lead the SDI development?**

**What are the sources of authoritative spatial data?**





# SDI ORGANIZATION

- SDI development model (mandatory or voluntary)

Mandatory model of SDI development is normally backed up by legislation, regulation or some other type of government decree.

In America: Brazil, Chile, Mexico, United States, Uruguay, and Venezuela



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INFORMATION MANAGEMENT  
FOR THE AMERICAS



INSTITUTO DE  
GEOGRAFÍA  
N.A.M.



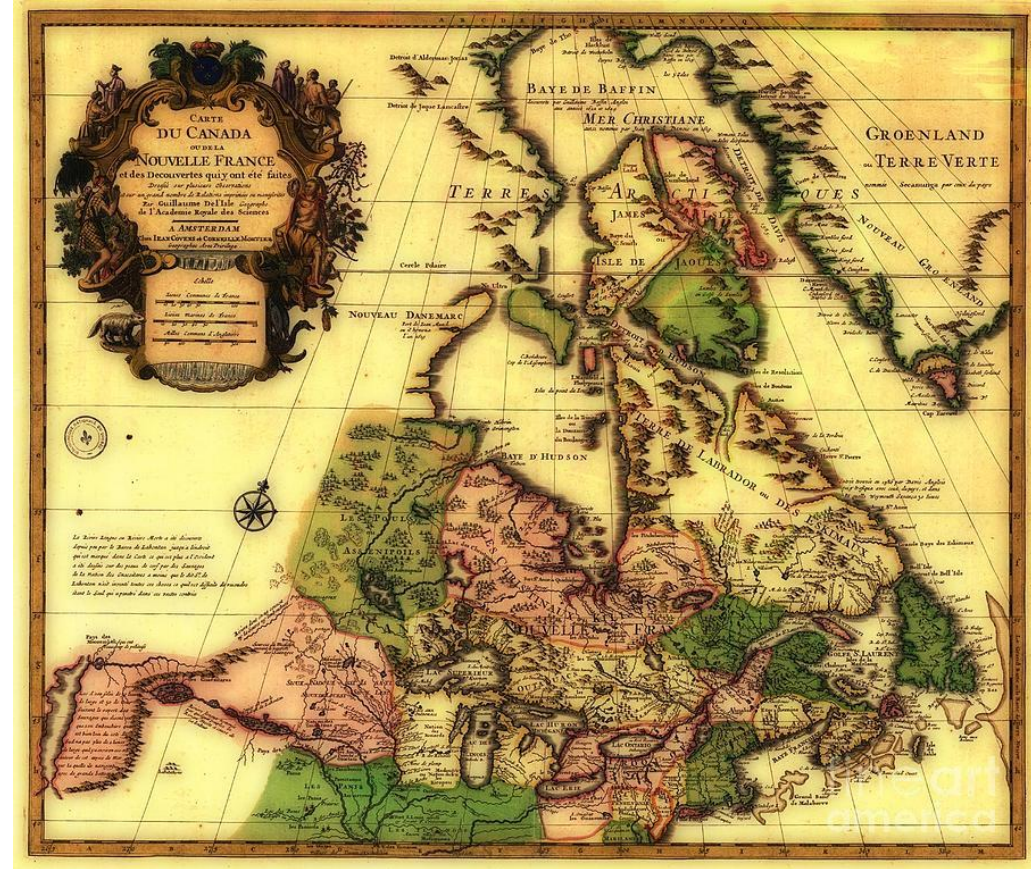
AGENCIA MEXICANA  
DE COOPERACIÓN INTERNACIONAL  
PARA EL DESARROLLO

# SDI ORGANIZATION

- SDI development model (mandatory or voluntary)

SDI voluntary model is less prevalent, but has been successfully used in some countries in the Americas.

Perhaps most noteworthy is Canada.



# SDI ORGANIZATION

- **Partnership** 
- **Authoritative data sources**

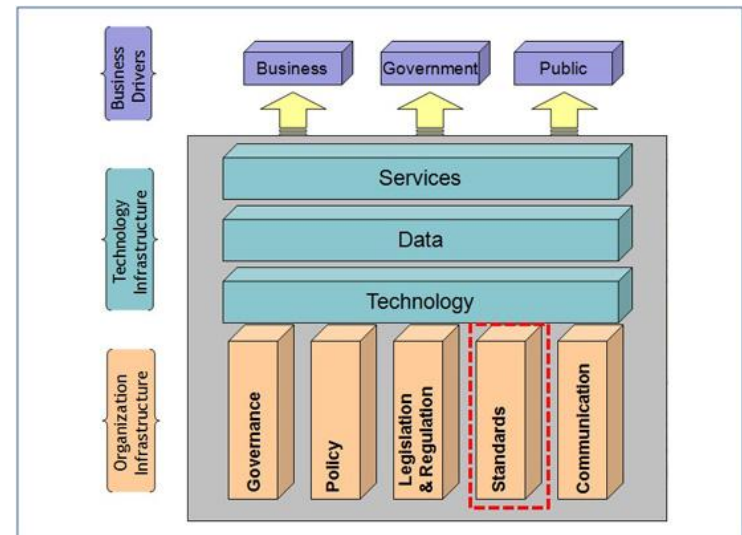
**Successful SDI initiatives rely upon a solid foundation of authoritative framework data that is provided by qualified data providers, typically national mapping organizations.**



# SDI ORGANIZATION

- **Governance**

Closely associated with the institutional arrangements necessary for SDI initiatives is the establishment of a governance structure.



# SDI ORGANIZATION

- **Board of directors**

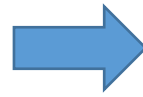
**Consideration of recommendations in independent evaluations of SDI performance**

**Promotion of the implementation and active use of the SDI deliverables within key communities of practice**

**Identification of strategic priorities for the SDI initiative**



# SDI ORGANIZATION



# COMMITTEES

## Policy Committee

Identification of key strategic policy and operational policy needs

Promotion of the adoption and implementation of SDI policies by the stakeholder community

## Technology Committee

Commissioning of research and studies to support SDI architecture definition

Definition of overall SDI architecture and the technologies required for its implementation



## Framework Data Committee

Identification and approval of framework data themes/layers.

Development of a strategy for the creation of a standardized framework data set.

## Standards Committee

Evaluation of international spatial data standards for endorsement as standards for the SDI initiative



# SDI ORGANIZATION

- **Alignment with government priorities**

**Government priorities change over time, depending on the aims of the political parties in power, and SDIs must exhibit the flexibility to adapt to those changes if they are to be sustainable.**

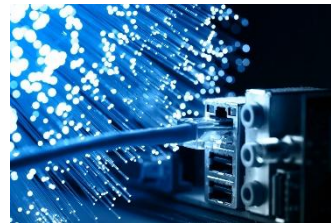
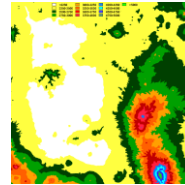
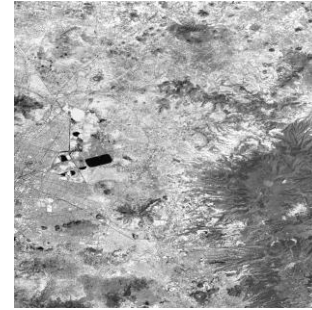




# Resources: data bases, maps, servers, and other available data.

The catalog of all existing information.

- Base Maps
- Orthoimages
- DEM's
- Satellite imagery
- Internet access and speed
- Servers
- Laboratories



# METADATA



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INFORMATION MANAGEMENT  
FOR THE AMERICAS

The application of a common set of standards for SDIs may reduce life cycle costs, enhance interoperability, decrease implementation risk, and improve services.

A specific theme of technical normativity: metadata



# METADATA

Metadata of an object are the data that describes it univocally

Allows structured search and comparison of held spatial data by others.



# METADATA

## Benefits using metadata:

- Data query is more simple.
- Data could be better used, information gives certainty and a visage of how best to use these data.
- Data can be used independently of the personnel involved in its generation, gathering, etc.
- Facilitate comprehension to other persons or even SDI's.

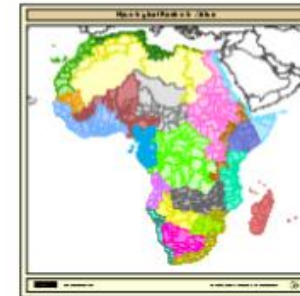


# METADATA

## Example of metadata

### MY GEONETWORK CATALOGUE (MY ORGANIZATION)

Hydrological Basins in Africa (Sample record, please remove!)



[Metadata](#) | [Metadata \(XML\)](#)  
| [Download](#) | [Visualization service URL \(WMS\) \(Hydrological basins in Africa\)](#) |

Title	Hydrological Basins in Africa (Sample record, please remove!)
Date	2000-07-19T14:45:00
Date type	Creation
Abstract	<p>Major hydrological basins and their sub-basins. This dataset divides the African continent according to its hydrological characteristics.</p> <p>The dataset consists of the following information:- numerical code and name of the major basin (MAJ_BAS and MAJ_NAME); - area of the major basin in square km (MAJ_AREA); - numerical code and name of the sub-basin (SUB_BAS and SUB_NAME); - area of the sub-basin in square km (SUB_AREA); - numerical code of the sub-basin towards which the sub-basin flows (TO_SUBBAS) (the codes -888 and -999 have been assigned respectively to internal sub-basins and to sub-basins draining into the sea)</p>

# METADATA

Metadata language	eng
Character set	UTF8

## OnLine resource

Linkage	<a href="http://www.fao.org/ag/AGL/aglw/aquastat/watresafrica/index.stm">http://www.fao.org/ag/AGL/aglw/aquastat/watresafrica/index.stm</a>
Protocol	WWW:LINK-1.0-http--link
Linkage	<a href="http://localhost:8080/geonetwork/srv/en/resources.get?uuid=da165110-88fd-11da-a88f-000d939bc5d8&amp;fname=basins.zip&amp;access=private">http://localhost:8080/geonetwork/srv/en/resources.get?uuid=da165110-88fd-11da-a88f-000d939bc5d8&amp;fname=basins.zip&amp;access=private</a>
Protocol	WWW:DOWNLOAD-1.0-http--download
Linkage	<a href="http://geonetwork3.fao.org/ows/296">http://geonetwork3.fao.org/ows/296</a>
Protocol	OGC:WMS-1.1.1-http-get-map

Topic category	Inland waters
----------------	---------------

## Keyword

Keyword	watersheds
Keyword	river basins
Keyword	water resources
Keyword	hydrology
Keyword	AQUASTAT
Keyword	AWRD
Type	Theme

My GeoNetwork catalogue - My organization | 2016-07-27 | 1 / 2

# METADATA

Keyword	Africa
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Type	Place
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## Extent

### Geographic bounding box

West bound	-17.3
------------	-------

East bound	51.1
------------	------

South bound	-34.6
-------------	-------

North bound	38.2
-------------	------

## Spatial resolution

Denominator	5000000
-------------	---------

## Lineage

Statement	The linework of the map is obtained by delineating drainage basin boundaries from an hydrologically corrected digital elevation model with a resolution of 1 * 1 km.
-----------	--

## Resource constraints

Use limitation	
----------------	--

File identifier	da165110-88fd-11da-a88f-000d939bc5d8
-----------------	--------------------------------------

Metadata language	eng
-------------------	-----

Character set	UTF8
---------------	------

## Metadata author

Individual name	Jippe Hoogeveen
-----------------	-----------------

Organisation name	FAO - NRCW
-------------------	------------

Role	Point of contact
------	------------------

Date stamp	2007-11-06T12:13:00
------------	---------------------

# Services offered by an SDI

**SDI offers different services and functions via internet through a simple browser, without the need of another specific software.**





The most important services provided by an SDI are:

## Web Map Service (WMS).

It allows visualization of cartography generated from a single or multiple sources: data bases, digital maps, ortophotos, satellite imagery, etc.

Available related information could be retrieved of currently consulted cartography



# Web Feature Service (WFS).

Allow access to vectorial data through an specific language: Geographic Markup Language (GML).

Accessing the archive which defines the geometry, described from a set of coordinates, of a cartographic object like a river, city, lake, etc.



# Web Coverage Processing Service (WCPS)

WCPS defines a language for filtering and processing of multi-dimensional raster coverages, such as sensor, image, and statistics data.

This raster query language allows clients to obtain original coverage data, or derived information, in a platform-neutral manner over the Web.



# Web Catalog Service (WCS)

- As with WMS and WFS services, a WCS allows clients to choose portions of a server's information holdings based on spatial constraints and other query criteria.
- Uses metadata to carry-on queries



## Data Sources

## Services



# Services offered by an SDI Gazetteer

Locates a geographical phenomena, searching in nomenclators or lists of geographic names.  
Geographic coordinates are linked to names.



**Gives back location, through geographic coordinates, of the queried name.**

**Query could establish other searching criteria in the list (river, mountain, town, ...)**

**LOCATION :**

- ❖ **original name:** Dhanera
- ❖ **geographical location:** Banas Kantha, Gujarat, India, Asia
- ❖ **geographical coordinates:** 24° 31' 0" North, 72° 1' 0" East

# IDE Software

- Multiple software tools employed in SDI development and implementation, must comply with Open Geospatial Consortium (OGC) standards, in order to be integrated to the system and accessible through a web Geoportal.





## DATA BASES



PostgreSQL

## GIS



QUANTUM GIS

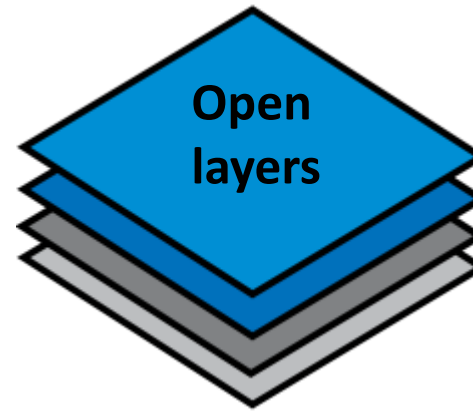
## MAP SERVER



GeoServer



**Web Visualizer**



**Metadata server**



# IDE Software

**It is very important than these software tools belong to the category of Open Software.**

**Maybe there will be limitations in some capacities, but benefits are bigger.**



# THANKS

