Project for the Strengthening of Spatial Data Infrastructures in Member States and Territories of the Association of Caribbean States

Capacity Building Program

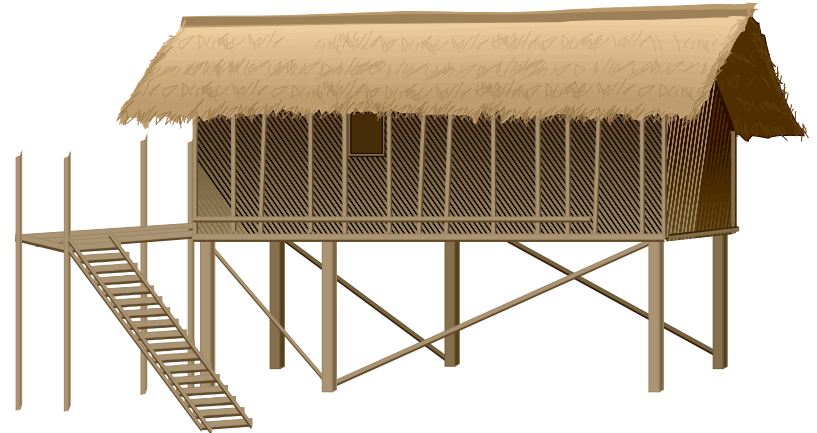# Geographic Information Systems

Dr Earl Edwards
Ms. Valrie Grant, MSc.

Topic 2:
Planning and Implementing a GIS

UN-GGIM:Américas
COMITÉ REGIONAL DE LAS
NACIONES UNIDAS SOBRE
LA GESTIÓN GLOBAL
DE INFORMACIÓN GEOESPACIAL
PARA LAS AMÉRICAS

ACS AEC

Association of Caribbean States
Asociación de Estados del Caribe
Association des Etats de la Caraïbe

AMEXCID
AGENCIA MEXICANA
DE COOPERACIÓN INTERNACIONAL
PARA EL DESARROLLO

INEGI
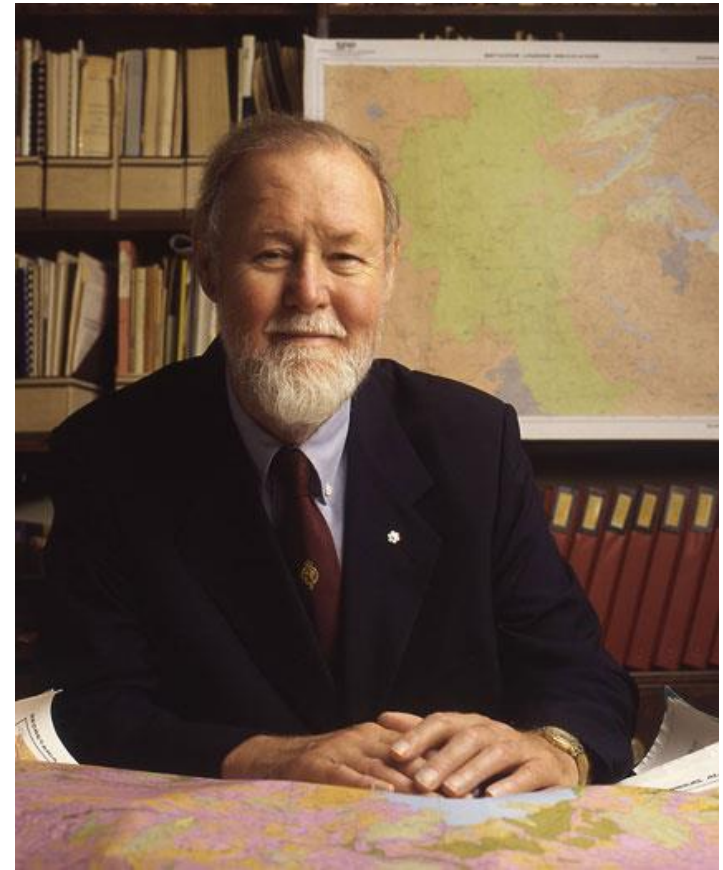INSTITUTO NACIONAL
DE ESTADÍSTICA Y GEOGRAFÍA

Topic Outline

- Types of GIS Implementation
- Traditional GIS Approach
- Enterprise GIS
- The GIS Development Cycle
- Needs Assessment
- GIS System Integration

…if you were building your dream house, would you use blueprints?
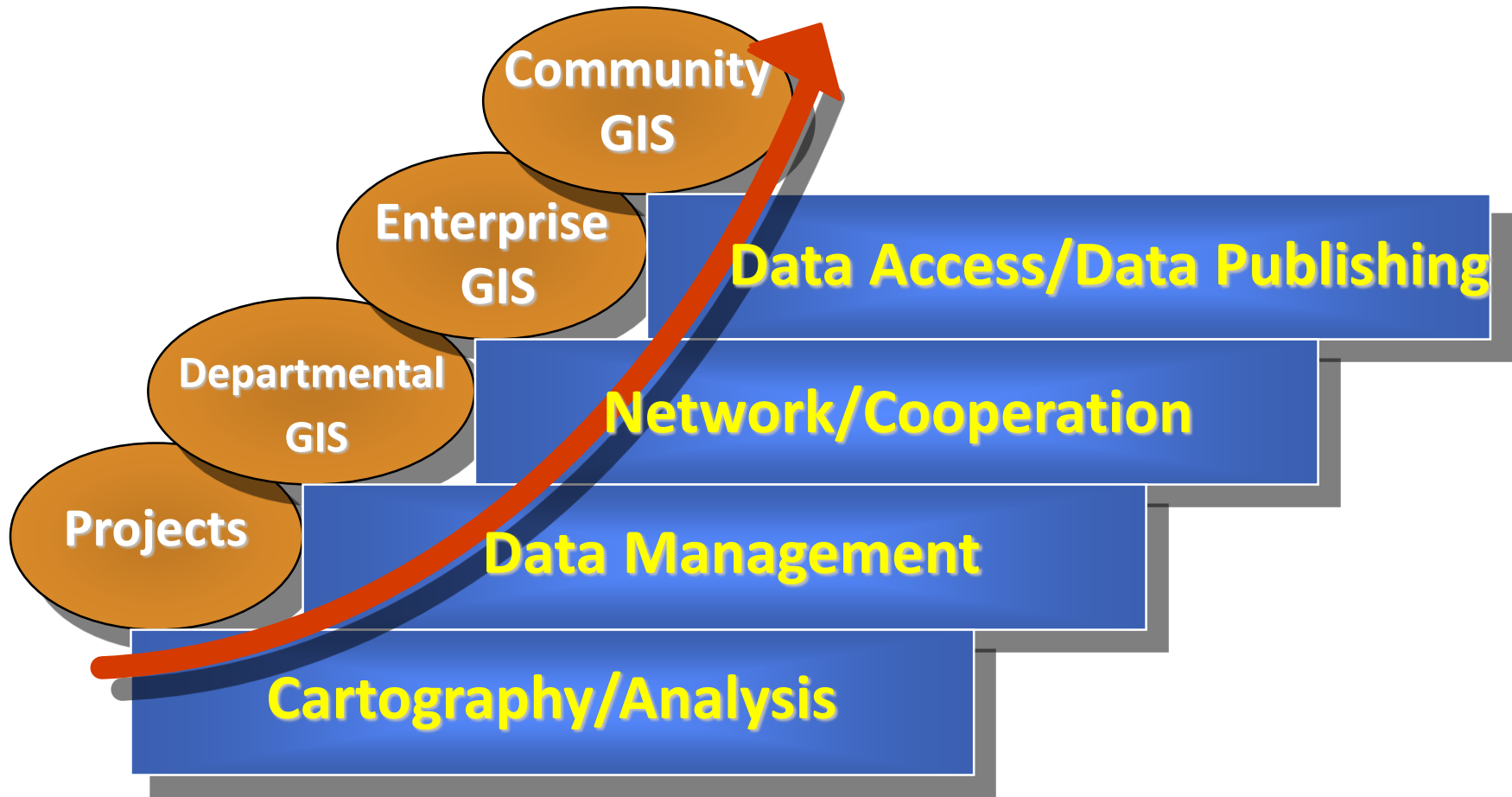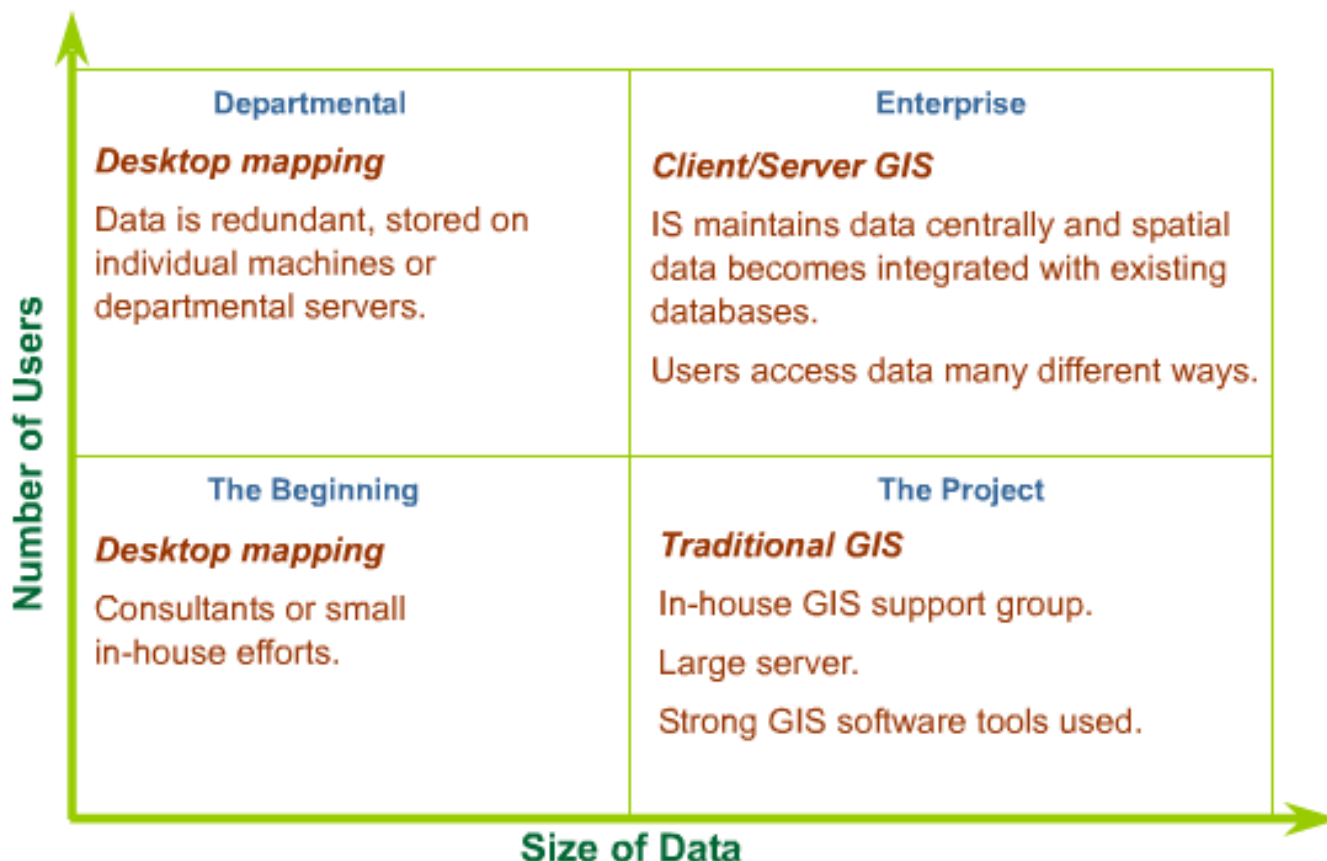
The First GIS

- In 1962 Roger Tomlinson was credited with developing the first operational GIS

- It was called the Canada Geographic Information System (CGIS)

- This GIS was developed for Canada's Federal Dept. of Forestry and Rural Development.

GIS Evolution

GIS Types

Number of Users (vertical axis) / **Size of Data** (horizontal axis)

| Departmental	Enterprise
Desktop mapping Data is redundant, stored on individual machines or departmental servers.	**_Client/Server GIS_** IS maintains data centrally and spatial data becomes integrated with existing databases. Users access data many different ways.
The Beginning **_Desktop mapping_** Consultants or small in-house efforts.	**The Project** **_Traditional GIS_** In-house GIS support group. Large server. Strong GIS software tools used.

Types of GIS Implementation

- **Project**

- **Single department application (Departmental GIS)**

- **Multi departmental application**

- **Enterprise system (Enterprise GIS)**

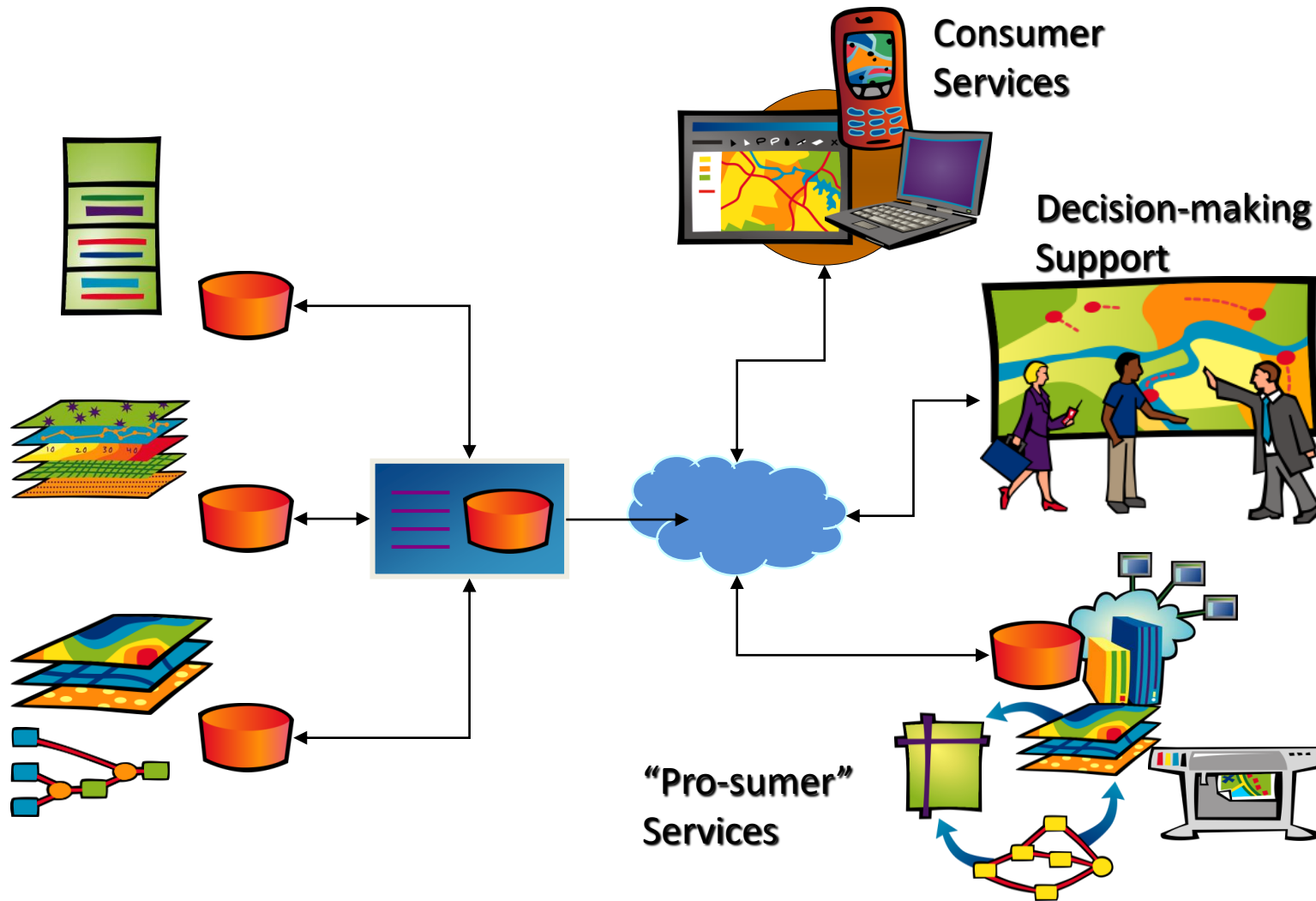- **Multi Institutional endeavor (Community GIS)**

Traditional GIS Approach
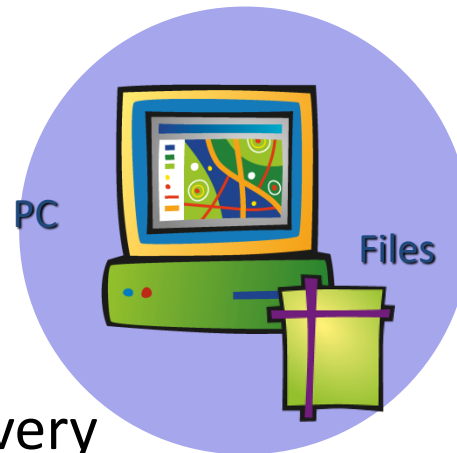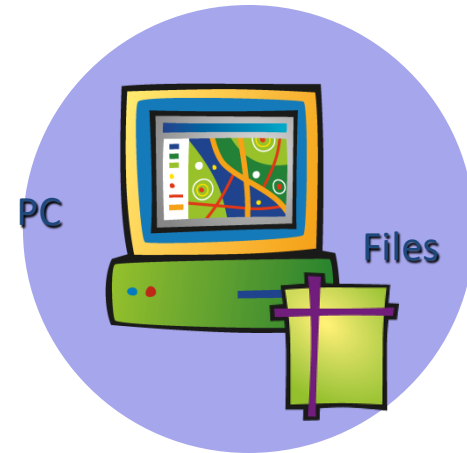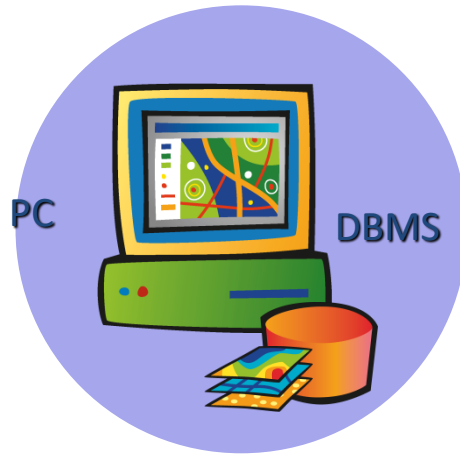
Courtesy: ESRI

- Silos of Geospatial Data
- Non Existent Metadata
- No Mechanism for Data Discovery
- Must have access to GIS Software

Enterprise GIS Approach

Consumer Services

Decision-making Support

"Pro-sumer" Services

Enterprise GIS Approach

- ## What is Enterprise GIS?

    A geographic information system that is integrated through an entire organization so that a large number of users can manage, share, and use spatial data and related information to address a variety of needs, including data creation, modification, visualization, analysis, and dissemination

    Wade, T. and Sommer, S. eds. *A to Z GIS*
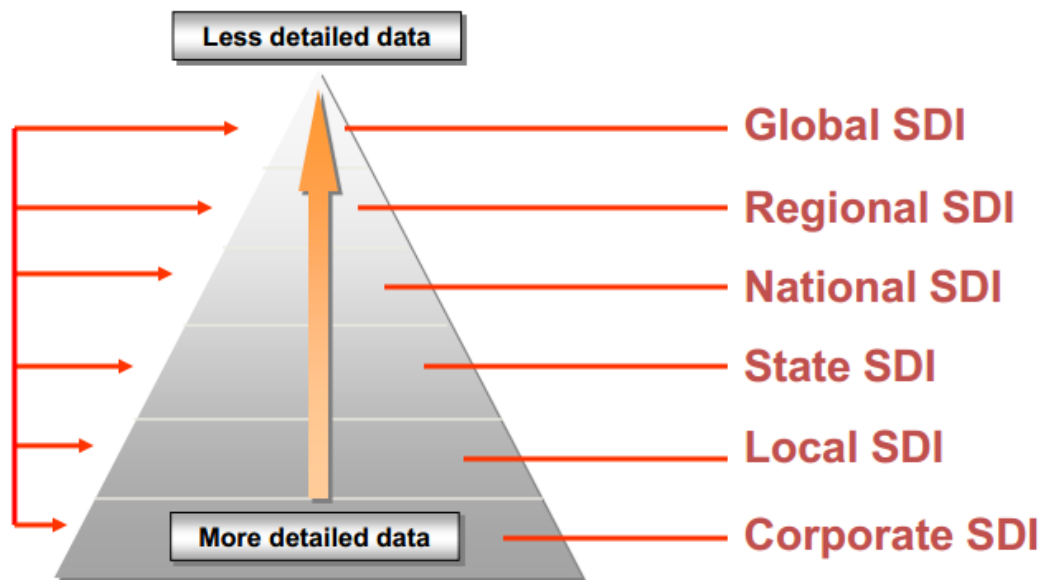
Spatial Data Infrastructure (SDI)
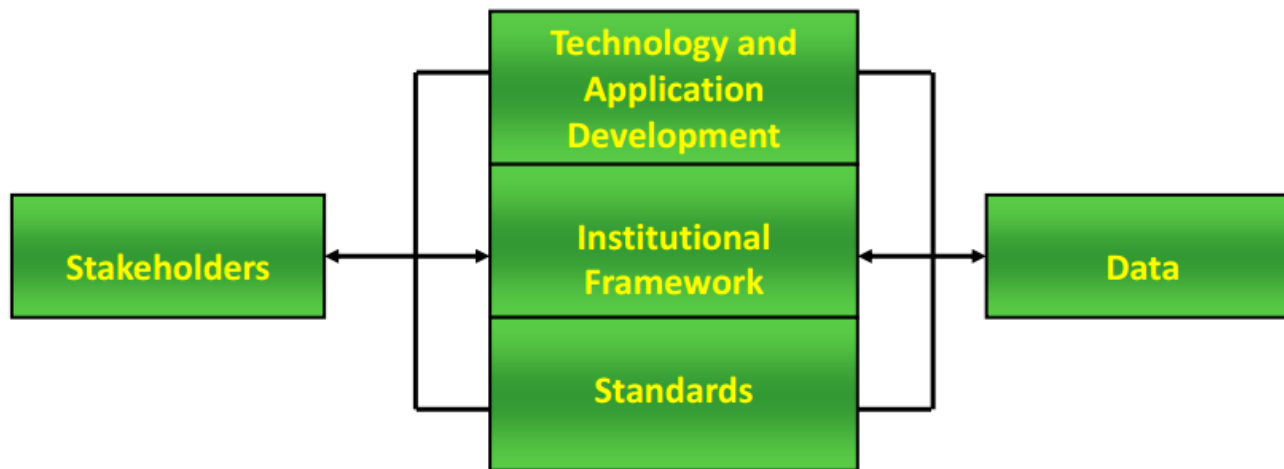
What is an SDI ?

Comprises of the relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data.

A spatial data infrastructure provides a basis for spatial data discovery, evaluation, download and application for users and providers within all levels of government, the commercial sector, the non-profit sector, academia and the general public.
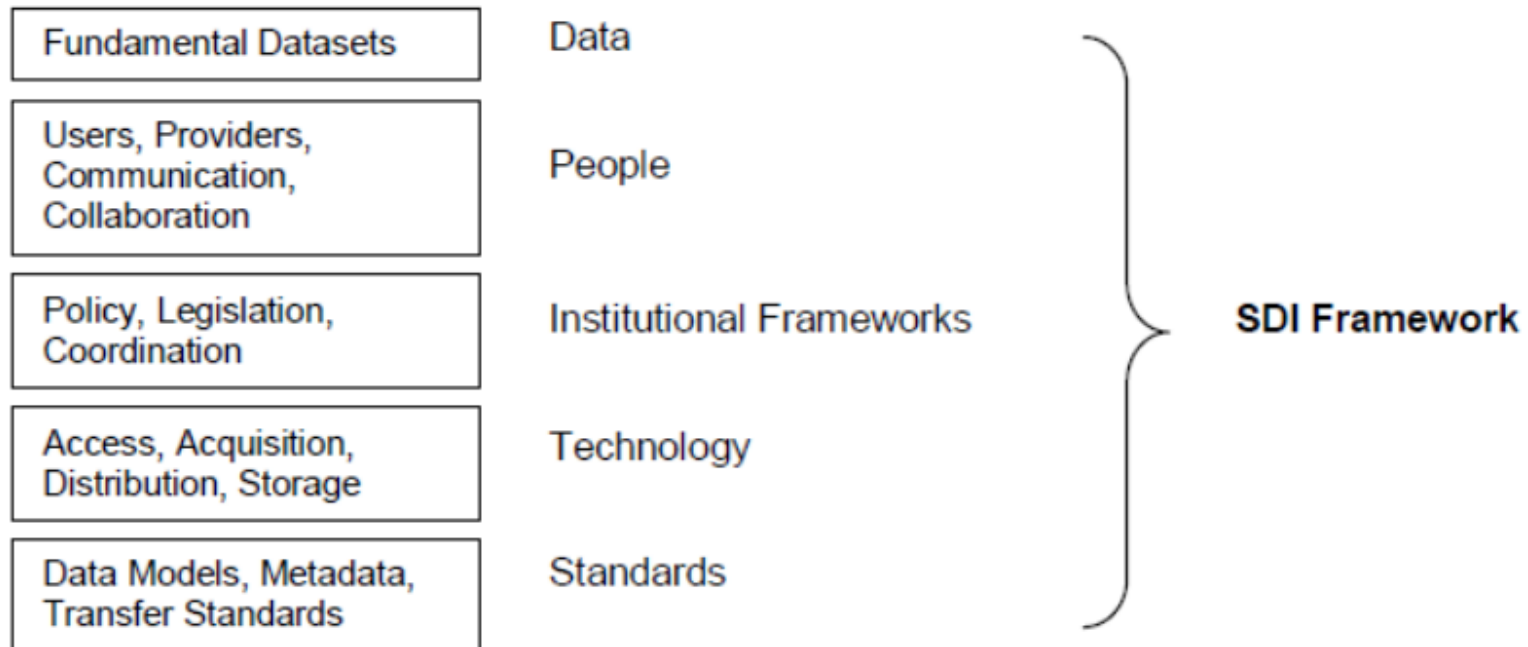
ANZLIC

UN-GGIM:Américas COMITÉ REGIONAL DE LAS NACIONES UNIDAS SOBRE LA GESTIÓN GLOBAL DE INFORMACIÓN GEOESPACIAL PARA LAS AMÉRICAS

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INEGI INSTITUTO NACIONAL DE ESTADÍSTICA Y GEOGRAFÍA

SDI Hierarchy

The principle objective for any stakeholder is to support their decision-making.

Less detailed data

More detailed data

- Global SDI
- Regional SDI
- National SDI
- State SDI
- Local SDI
- Corporate SDI

Components of an SDI

Fundamental Datasets	Data	
Users, Providers, Communication, Collaboration	People	
Policy, Legislation, Coordination	Institutional Frameworks	**SDI Framework**
Access, Acquisition, Distribution, Storage	Technology	
Data Models, Metadata, Transfer Standards	Standards	

Building a GIS is Like Building a Pyramid

Outputs ← →
Applications ← →

Everybody wants this now – Patience!
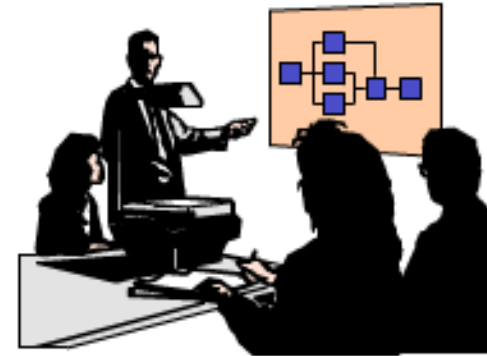
Data Layers
Data Layers
Base maps

Must build this first
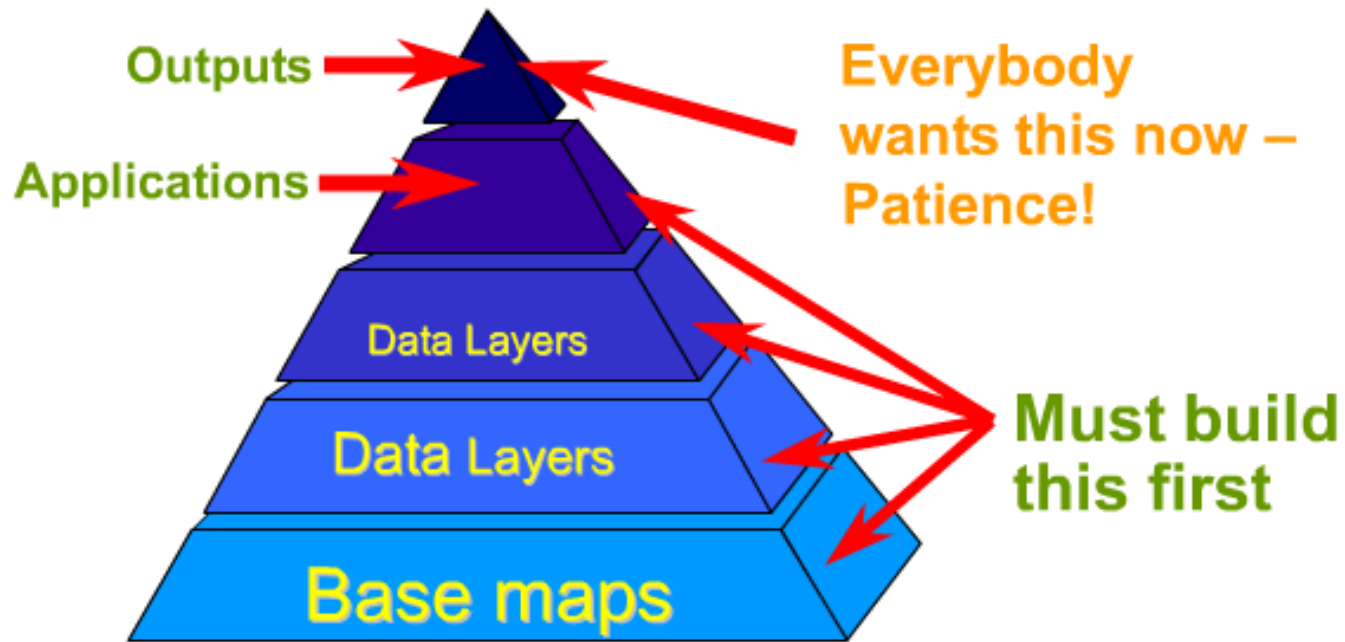
Step 1 — User Needs Assessment

Step 2 — Data Inventory and Evaluation

Step 3 — System Design and Implementation Plan

Step 4 — Pilot Project

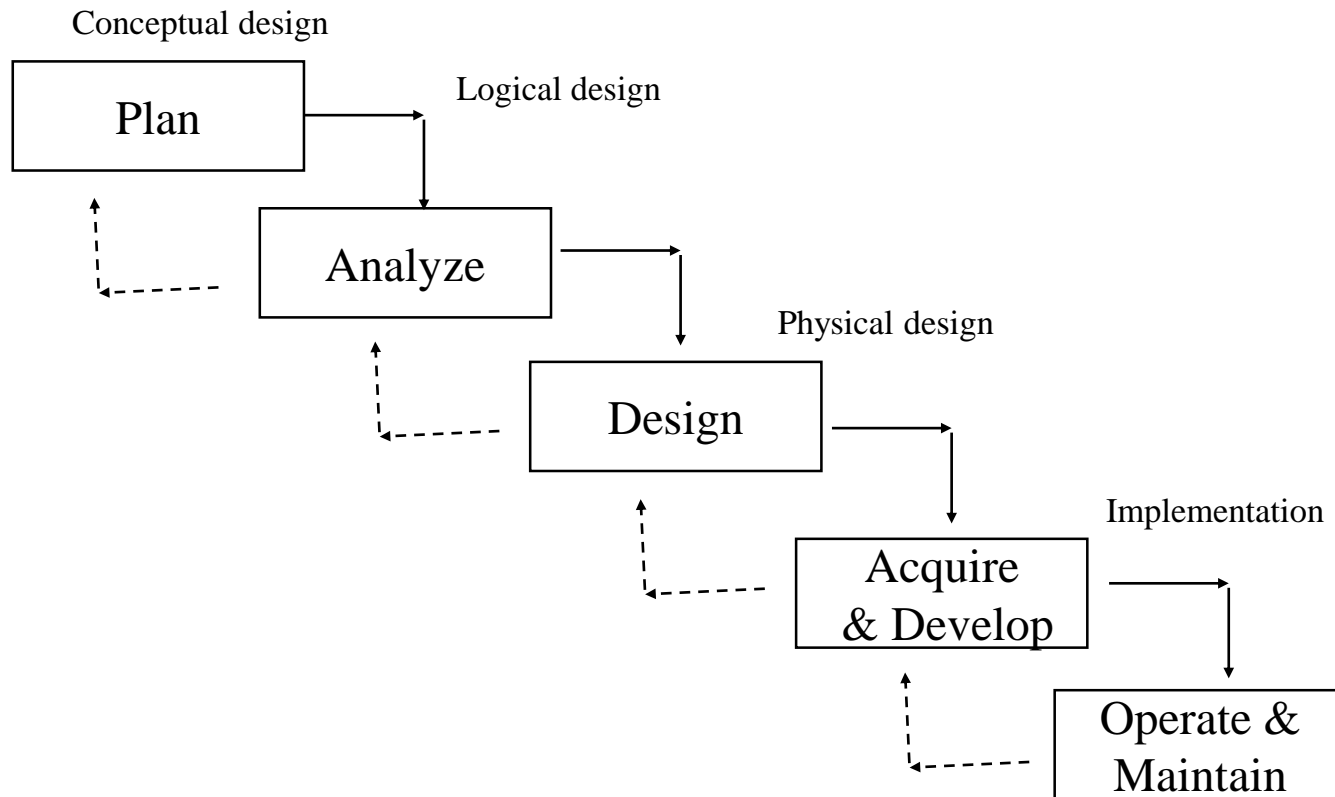Step 5 — Operational Implementation

Courtesy: Esri

Five-step Process from Somers/URISA

Conceptual design

```
┌──────────────┐
│     Plan     │ ──────► Logical design
└──────────────┘
        ┌──────────────┐
        │   Analyze    │ ──────►
        └──────────────┘
                                Physical design
                ┌──────────────┐
                │    Design    │ ──────►
                └──────────────┘
                                        Implementation
                        ┌──────────────┐
                        │   Acquire    │ ──────►
                        │  & Develop   │
                        └──────────────┘
                                ┌──────────────┐
                                │  Operate &   │
                                │   Maintain   │
                                └──────────────┘
```

Source: Rebecca Somers, *Quick Guide to GIS Implementation and Management* Park Ridge, IL: Urban and Regional Information Systems Association, 2001, p.7

A 10-Stage GIS Planning Methodology
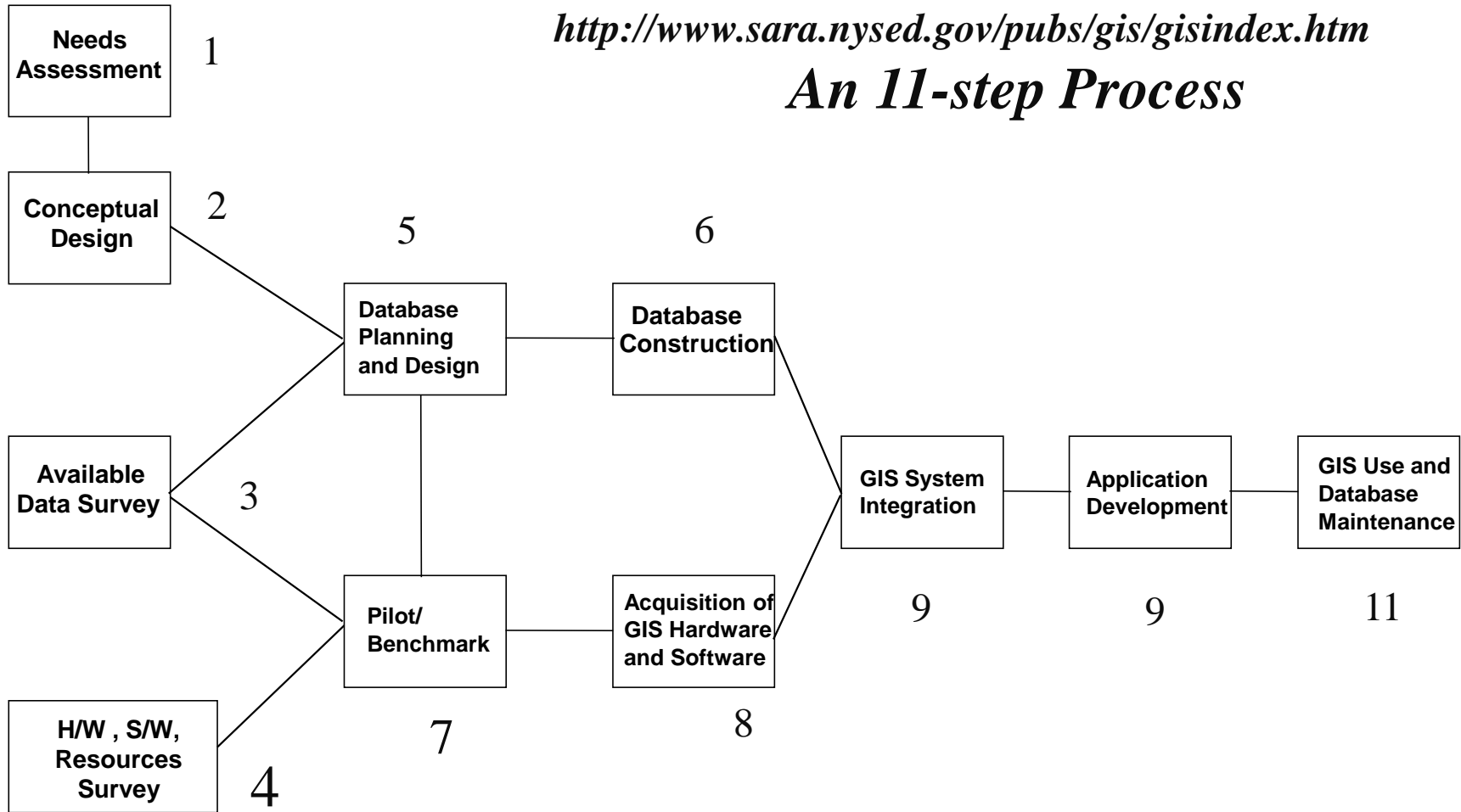## Tomlinson, *Thinking About GIS*

- Consider the strategic purpose
- Plan for the planning
- Conduct a technology seminar

Conceptual Design

- Describe the information products
- Define the system scope
- Create a data design

Logical Design

- Choose a logical model
- Determine system requirements

Physical Design

- Benefit-cost, migration and risk analysis
- Make an implementation plan

Implementation

GIS Development Guides
State of New York, Local Government Technology Services (1997)

http://www.sara.nysed.gov/pubs/gis/gisindex.htm
An 11-step Process

Needs Assessment 1			
Conceptual Design 2	5	6	
	Database Planning and Design	**Database Construction**	
Available Data Survey 3			**GIS System Integration** 9 — **Application Development** 9 — **GIS Use and Database Maintenance** 11
H/W , S/W, Resources Survey 4	**Pilot/ Benchmark** 7	**Acquisition of GIS Hardware and Software** 8	

Analysis of Requirements

1. Definition of Objectives

2. User Requirements

3. Preliminary Design

4. Cost-Benefit Analysis

5. Pilot Study

Specification of Requirements

6. Final Design

7. Request for Proposal (RFP)

Evaluation of Alternatives

8. Shortlisting

9. Benchmark Testing

10. Cost-Effectiveness Evaluation

Implementation of System

11. Implementation Plan

12. Contract

13. Acceptance Testing

14. Implementation

A *Fourteen* Step Implementation Process!

(assumes external acquisition)

Source: Longley, et. al. p. 391

GIS Development Cycle

- Needs Assessment
- Creation of an implementation plan
- Develop a theoretical framework
- Survey of Available Data
- Survey of GIS Hardware and Software
- Detailed Database Planning and Design
- Database Construction
- Pilot Study/Benchmark Test
- Review/modify the original plan
- Acquisition of GIS Hardware and Software
- GIS System Integration
- GIS Application Development
- GIS Use and Maintenance

Needs Assessment

- A needs assessment is the first step in implementing a successful GIS within any enterprise

- A needs assessment is a systematic look at how departments function and the spatial data needed to do their work

- In addition to the final needs assessment report that is generated, intangible benefits are realized by an organization

Basis for Needs Assessment

- Describing their needs to the GIS analysts
- Learning what the GIS will be capable of accomplishing for them
- Understanding the nature of the GIS development cycle - the time involved and the costs.
- This is the single most important element in GIS development
- Must consider 3 factors:
  - Who are the users?
  - What is the end product?
  - Who is going to manage the GIS ?

Conducting a Needs Assessment

- The most significant aspect of a needs assessment is to document the findings in a standard and structured manner.

- Very important to adopt or develop a standard method to be used for the description of all the GIS tasks, processes and data that will be included in the needs assessment.

- Need to develop forms for use

Needs Assessment Activities

- The main activities will be:
    - Conduct "start-up" (technology) seminar or workshop
    - Interview each potential user
    - Prepare documentation (forms) for each application, etc
    - Review each application description with the user
    - Obtain user approval of and sign-off for each application description

Purpose of the Technology Seminar

- Introduce GIS to the participants (if necessary)
- Introduce GIS terminology and methods that will be used
- Introduce the planning process
- Explain to participants the reason why the work is being done
- Make clear the nature of the contribution required of participants
- Afford participant the opportunity to assess their work needs and identify the information that would help
- Compose a list of information products needed by the organization
- Opportunities for improving business workflows using GIS

Results of the Needs Assessment

- At the conclusion of a needs assessment, an organization will have all of the information needed to plan the development of a GIS system:
  - *The Applications to be developed*
  - *The GIS Functions required*
  - *The Data needed in the GIS database*
  - *The Data maintenance procedures.*

The implementation plan

- Define the scope of the project
  - Spatial boundaries
  - End products
  - Participants/users
- Create project goals and timelines
- Assign responsibilities

Develop a theoretical framework

- Sketch out how things will work
  - Work flow
  - Data flow
  - Quality assurance
  - Documentation
    - Procedures!!!!
  - Training and consensus building

Survey available data

- **DO NOT RE-INVENT THE WHEEL!!!**
- Become familiar with the origin of data
- Look to see who is producing data

Survey of hardware and software

- Do not just limit software search to GIS packages
- Include all of the software being used by prospective users – see if it can integrate
- Likewise for hardware – most organizations use many different platforms
- TALK TO VENDORS AND GET ON SITE DEMONSTRATIONS

Detailed database planning and design

- For our purposes we'll always base things upon a DBMS

- Many ways to diagram, but we'll use Entity-Relationship (ER) diagrams

- For GIS, it's best to construct ER diagrams based upon connectivity (cardinality)

Entity-Relationship (ER) Diagram
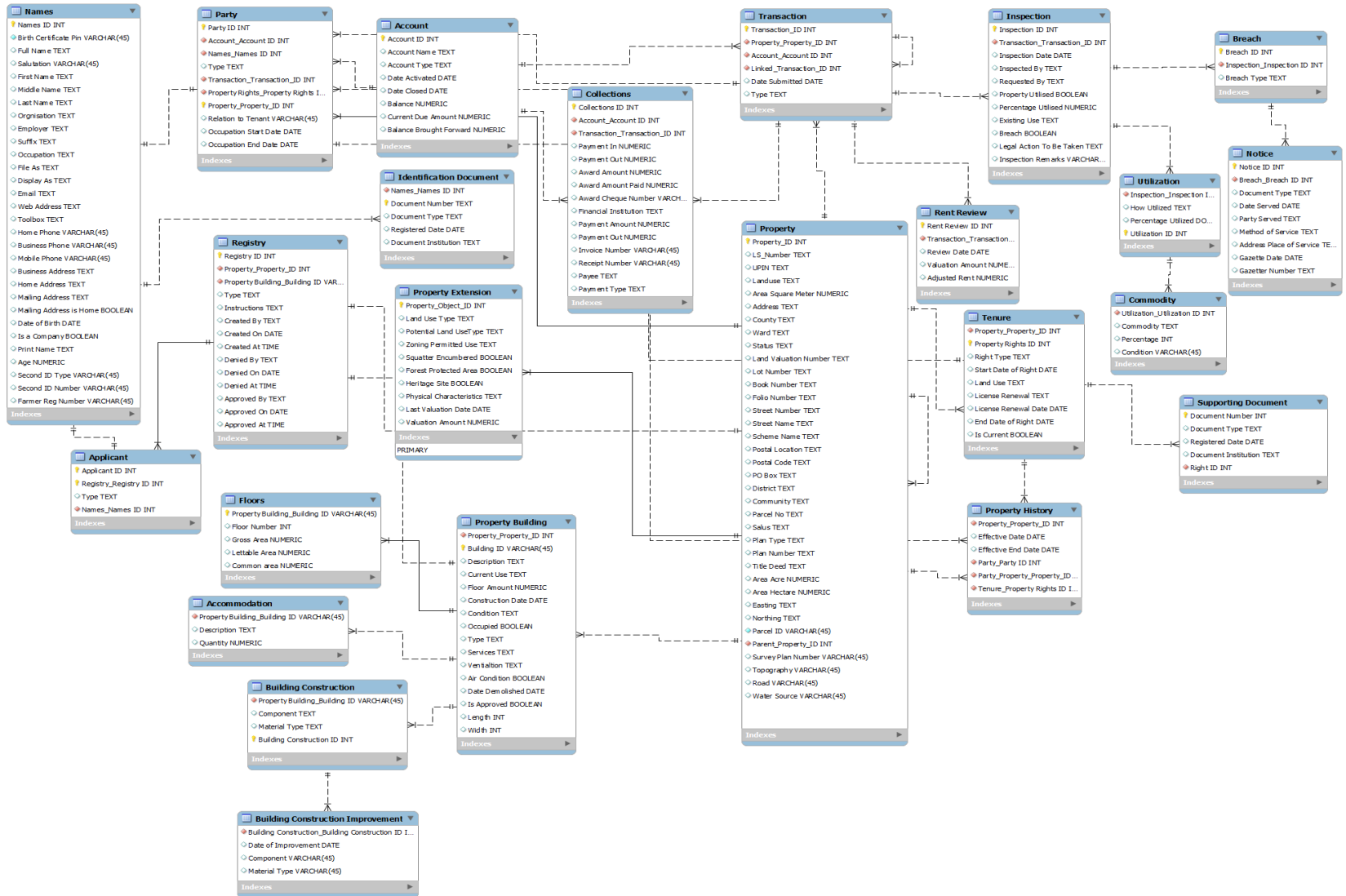
Database Construction: Additional Considerations

- What will be the source for each data item?
- How will sharing be arranged? . . purchase? . . license? . . other agreement?
- Who will own the data?
- How will new GIS data be integrated with existing data files (legacy systems)?
- Who will be responsible for updates to the data?
- How will the cost of the data (creation and maintenance) be allocated?
- Who will provide public access to the data?
- Who will be responsible for data archiving and retention? . . of the original? ..of copies?

Pilot Study/Benchmark Test

- Pick a subset that is representative of all assets/areas to be incorporated in the GIS
- Involve all parties and users
- GET FEEDBACK!

Review and modify

- Review and modify plan
- Achieve buy-in
- Do not move forward until pilot study complete and all users are satisfied

Purchase hardware and software

- Talk to your purchasing guys up front
- Learn the purchasing "rules"
- Competitive bids

Roll it out

- System integration
- Subsequent application development
- Use and maintenance

GIS System Integration

- Bringing the final database and the hardware and software together and testing their combined operation.

- GIS hardware and software have been acquired and data conversion is complete or at an advanced stage

- Different components of the hardware and software may have been purchased separately

- It is now necessary to put all the pieces together, test them to make sure they work as expected,

GIS System Integration

- ## GIS System Components
    - GIS Software
    - GIS Hardware
    - Network
    - Database

National Spatial Data Infrastructure Technology Architecture
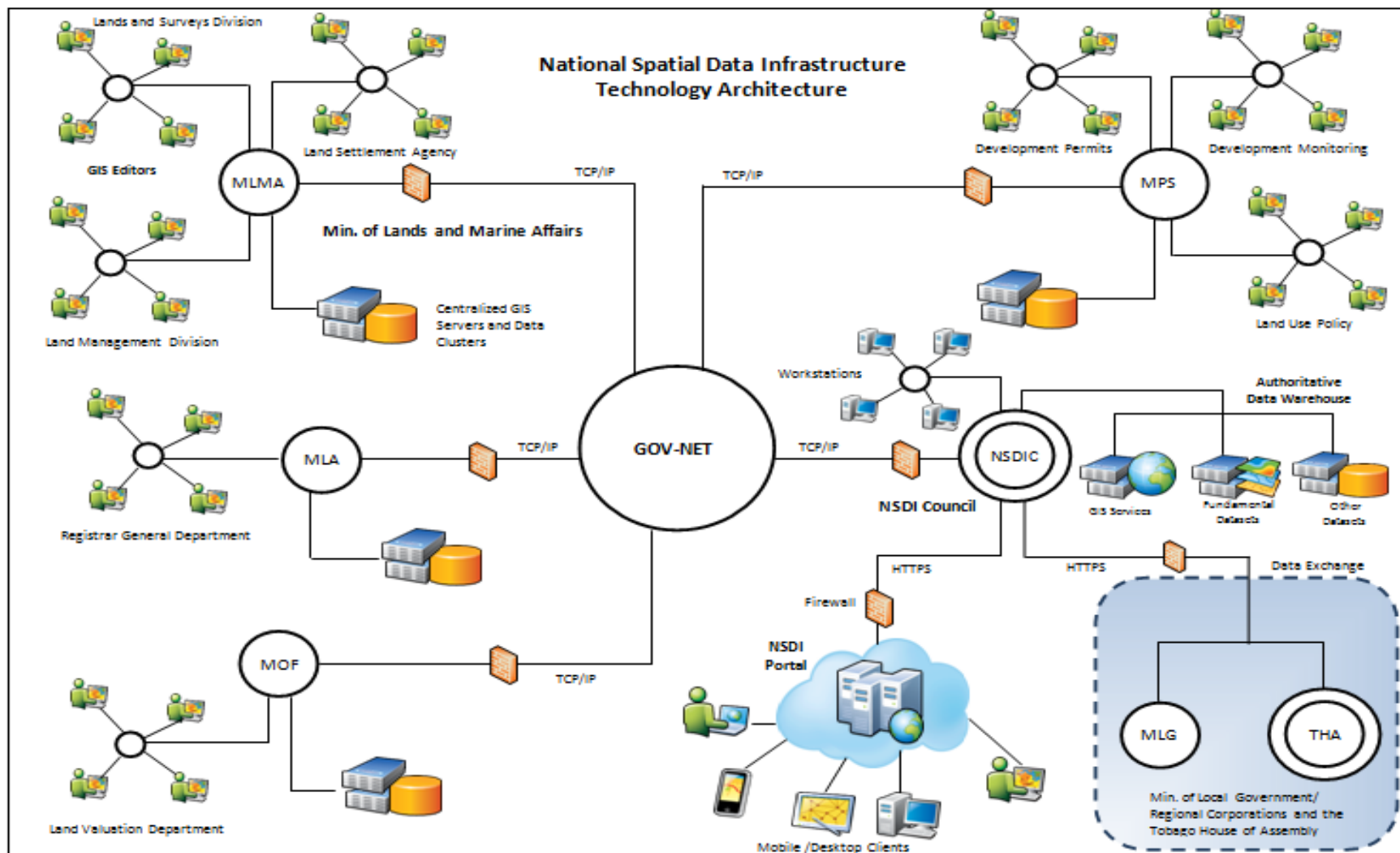
What Comes Next?

- Application Development
- System Testing
- User Training
- Maintenance

Transaction Studio - Desktop

Parcel Viewer

UP NEXT …..

Activity: Planning for a GIS in your
Organization

Planning A GIS Activity Guide?

- Why do you need a GIS?
- What information products do your organization require?
- What is the current business process for the most use information product/application?
- For this information product what data do you require? Define your master data list
- How will you source the data?
- What functions and Applications do you need for this information product?
- What would be your software needs?
- What hardware will you require?
- What are your Human resource requirements?

Acknowledgement

Except where stated, images used in this presentation were acquired from multiple sources on the world wide web.