CDM

Effective GIS Implementation Requires a Solid Data Model Design Process

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A properly researched well thought out Data Model design:

- Provides smoother transition for staff
- Enables an effective interface for data maintenance
- Creates a structured repository for your data
- Could determine the failure or success of the system it supports

Ensuring your GIS implementation fits readily into your organization requires a “suitable” Data Model

What Is a Suitable Data Model

- Incorporates existing business processes
- Has buy in from stakeholders
- Fits harmoniously into operations
- Thoroughly researched
- Well thought out

Two aspects which should be considered for effective GIS implementation

- How current data sources support your business
- How the new system will support your business work flow once it is implemented

How current data sources support your business

- Why do these sources exist?
- Who uses them and how?
- How are they maintained?
- Identify known limitations

GIS data availability impacts its use and provides new opportunities

- The data will be more readily available
- Multiple users can access the data simultaneously
- Data from many different sources can be accessed simultaneously

There will be change

- Intended or not, you will end up changing the way your organization works.
- Anticipating and managing this change during the Data Model design process is the key to a successful GIS implementation.

GIS is not merely a system for providing facts and figures; it

- is a valuable resource for enabling users to perform their roles more efficiently.
  - Provides users to experience a better understanding of decisions
  - Better grasp of the processes which enable your organization's operation to function
- allows you to set up a structure to provide the information to best support those decisions and processes without re-engineering your entire operation.

Data Model

A data model has three main components:

The *structural* part: collection of structures used to create the modeled entities or objects
The *integrity* part: collection of rules governing the constraints on the data structures to ensure structural integrity
The *manipulation* part: collection of operators to update and query the data contained in the database

Data Model Elements

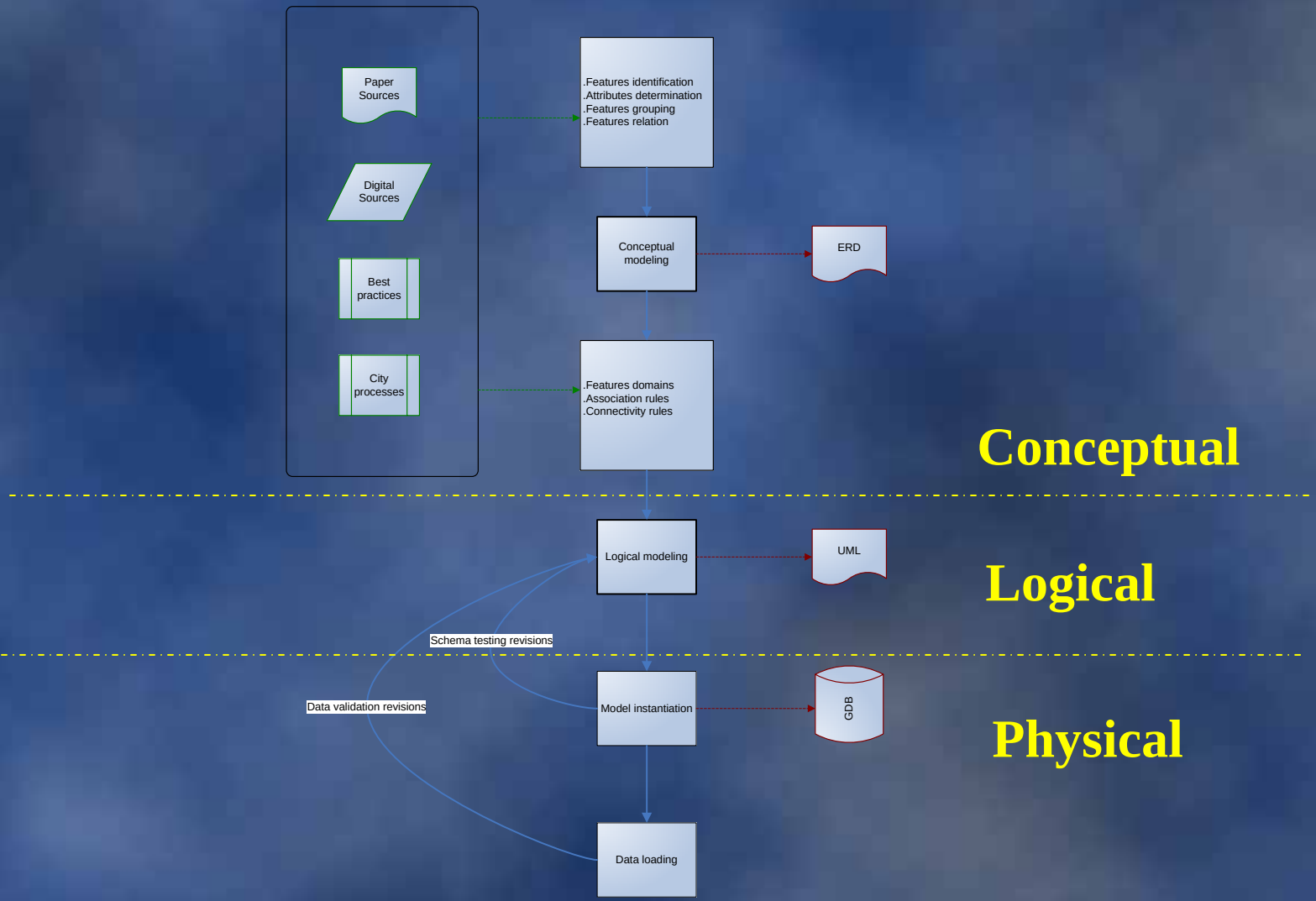
Structural Elements	Parameterized Behavior Elements	Custom Behavior Elements
Feature datasets Geometric networks Feature classes Relationship classes Fields Subtypes	Elements Domains Connectivity rules Relationship rules	Custom features Feature class extensions Custom interfaces

The *structural* part: All structural elements and custom features

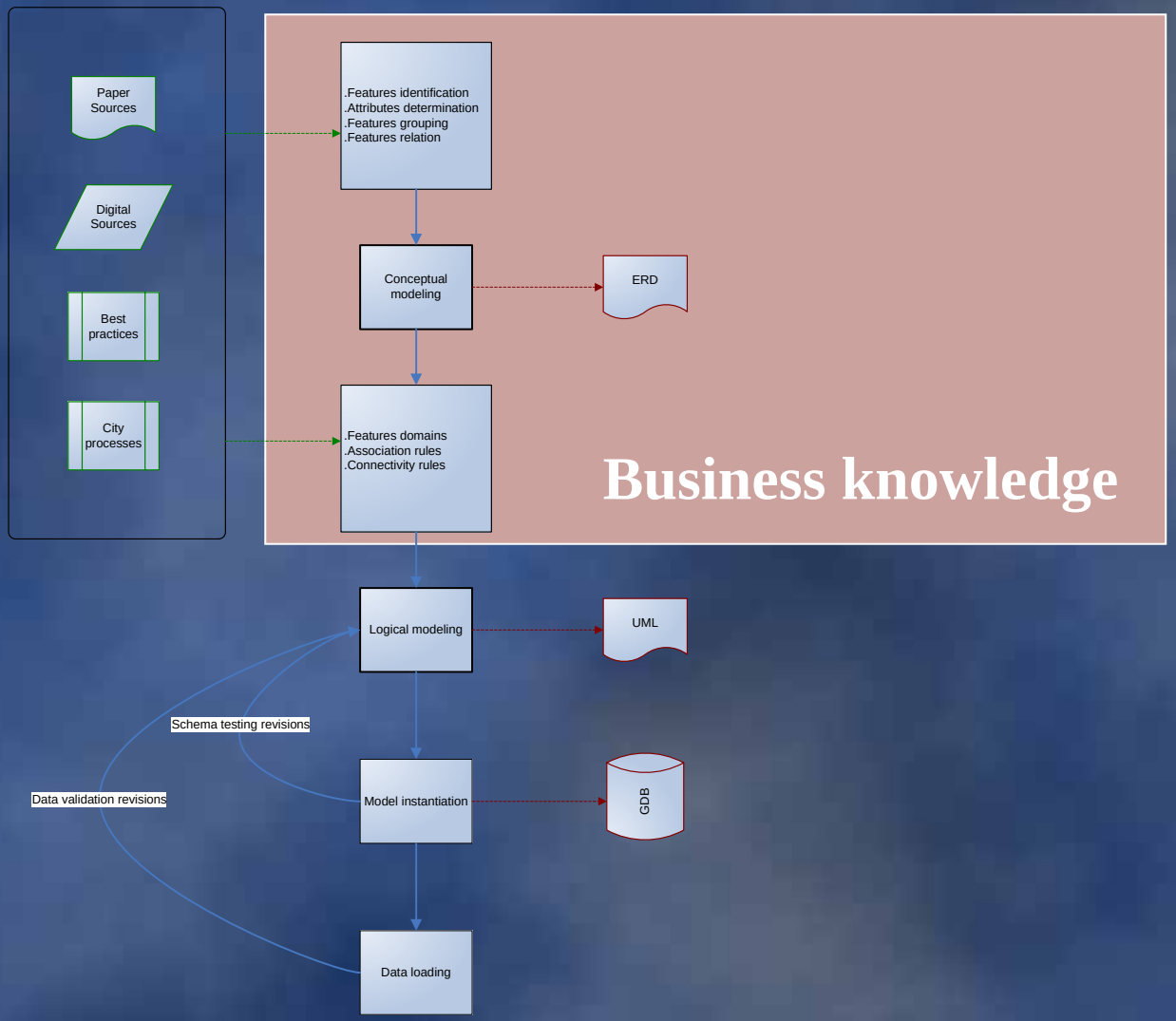
The *integrity* part: Parameterized behavior elements and feature class extensions

The *manipulation* part: ArcObjects and feature class extensions

Data Modeling



Business Knowledge



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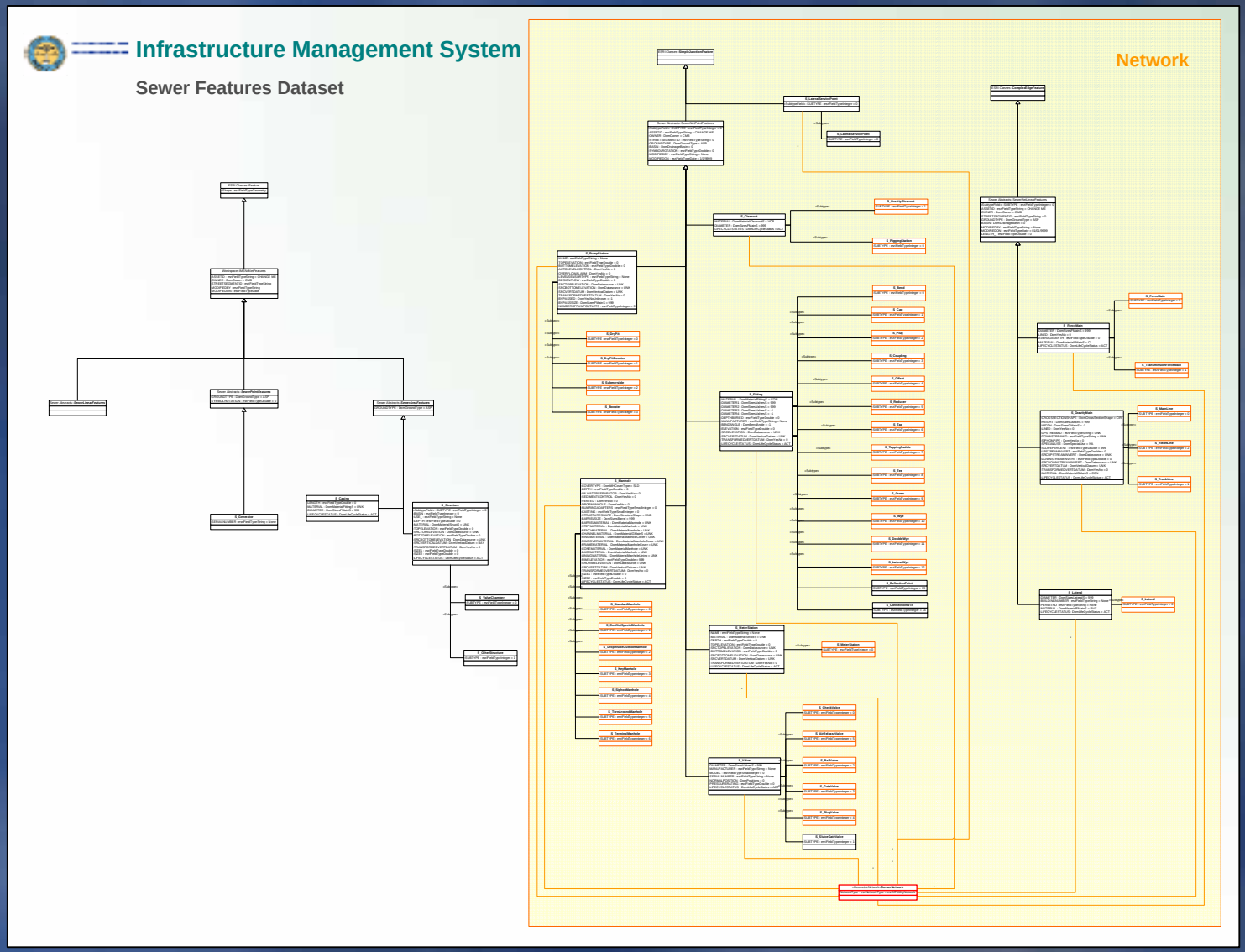

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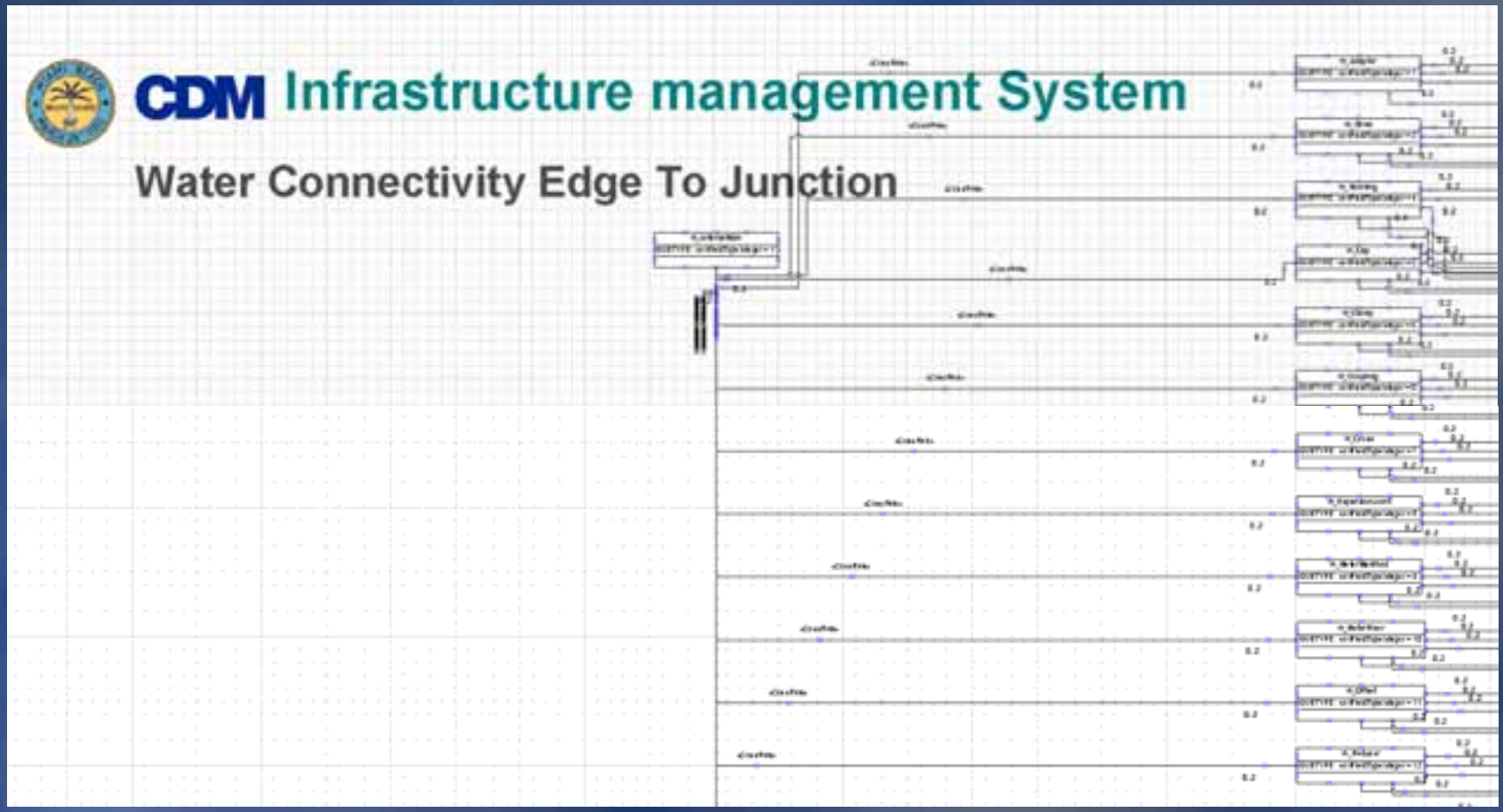
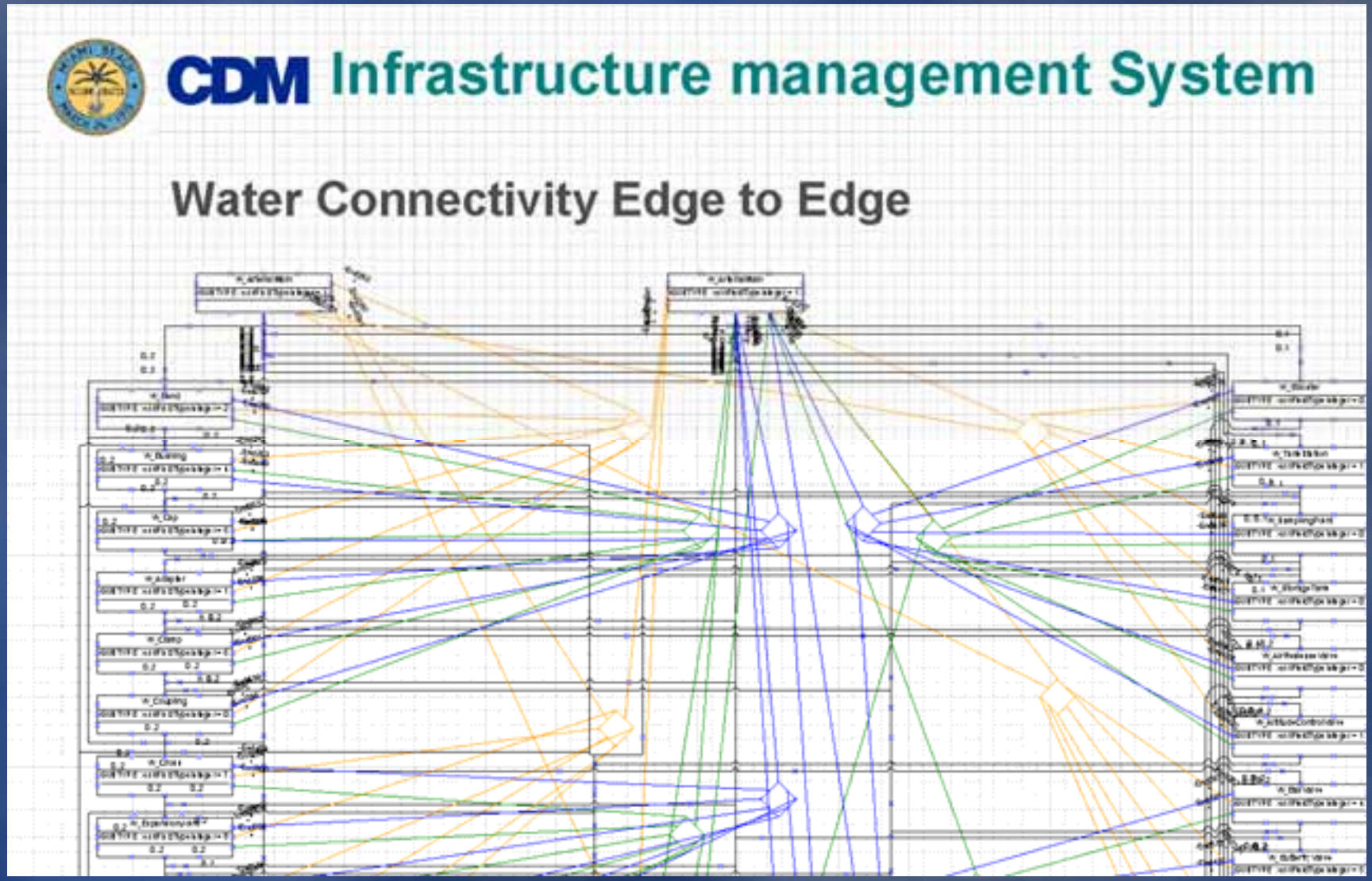


Business Knowledge

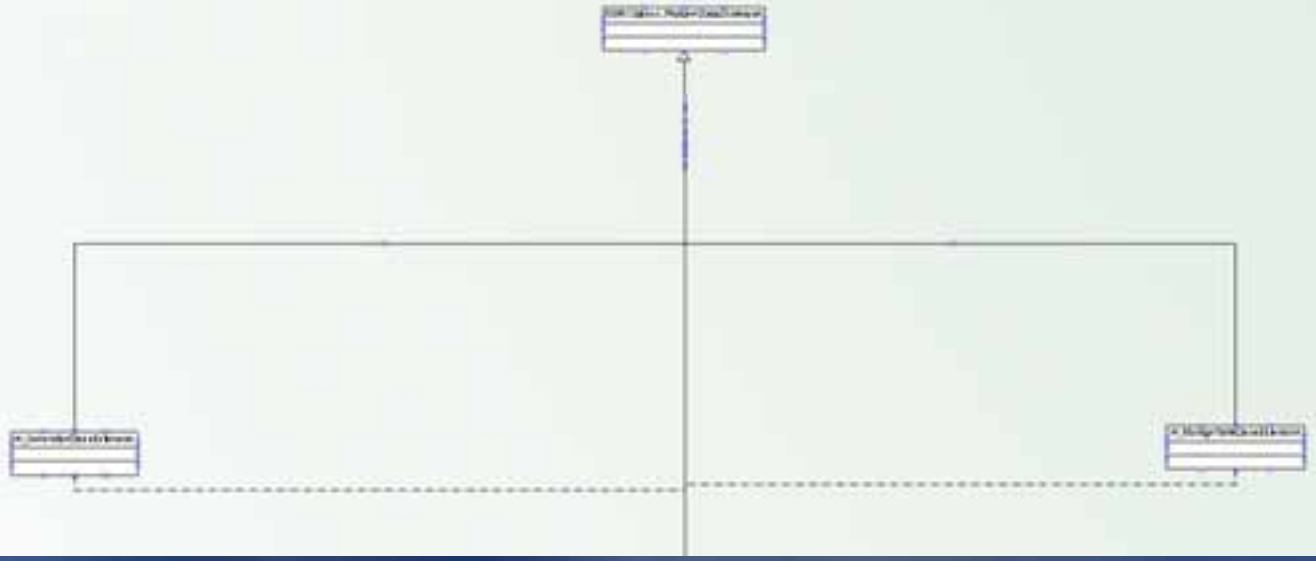


Business Knowledge

CDM

Infrastructure Management System

Water Features Extensions



Step 1 - Capturing Business Knowledge from Source Documents

- Each operation has its own unique combination of source documents.
- Business rules evolve during the maturation of the operation.
- There are many similarities among operations of the same nature; however, no two are exactly alike.

Source Prioritization

- As the business processes required to enable an operation to function evolved, the historic records or source documents required to meet those needs were transformed into their current configuration.
- These sources must be analyzed and prioritized.
- Archive redundant and obsolete information.

Source Utilization

- While generating the database design it is extremely important to identify source documents which are most critical to the needs of the operation.
- The information contained in these documents is more likely to be accurate due to the constant attention these documents receive.
- Careful attention must be paid to the way the information is used from these sources and the way it is manipulated.

Stakeholder Input

- The document users should be interviewed to enable the database design team to have a sound understanding of the current operational practices.
- This process also allows the staff most impacted by the new GIS to buy into the program by seeing that it will enable them to perform their responsibilities more effectively and efficiently.

Historic Source Tracking

- It is important to identify the role of older less used documents and to incorporate the information provided in those documents.
- This process provides an opportunity to identify conflicts between current documents and historic documents.
- All documents maintained by the operation representing the evolution of the current system configuration should be scanned.
- Often resolution of conflicts can only occur through understanding the evolution of the system.

Source Data Filtering

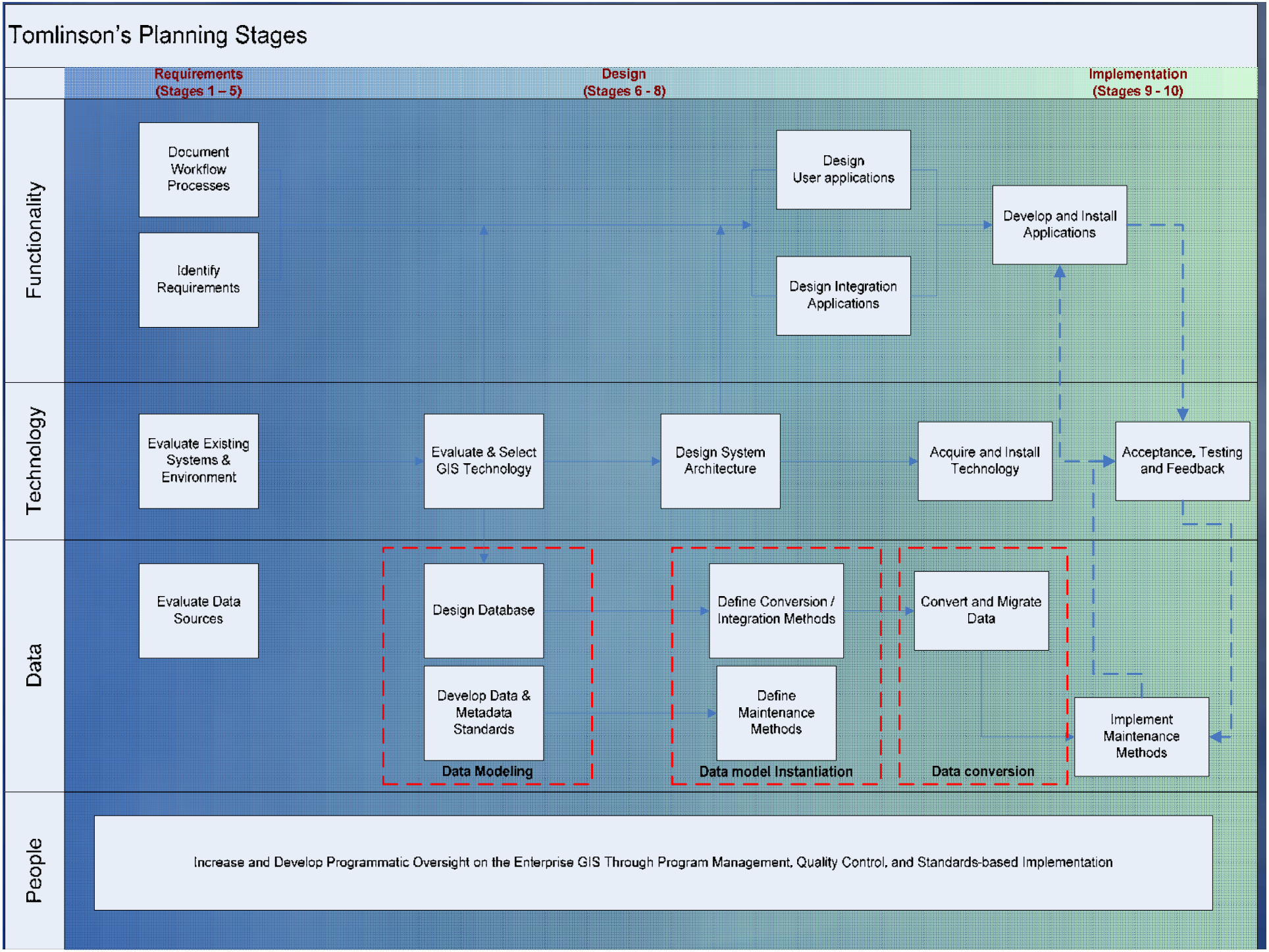
- Information not currently provided by the available source documents and not needed for an organization to function should be accounted for during the database design.
- It should not be captured during the data conversion effort. The most efficient time to add this information is during data maintenance when the system is in service.

Step 2 - User Needs Assessment

- The value of performing a user needs assessment was highlighted in Zerger and Smith, “Impediments to Using GIS for Real-Time Disaster Decision Support” (2003).
- This paper highlights the importance of discovering rather than anticipating user needs for the successful design and implementation of a functional GIS.
- Unless you have a sound understanding of the needs of the ultimate users of the GIS, it is highly unlikely that the resulting data model will be able to provide the best value possible to the organization.

User Needs Assessment (Cont.)

- Many organizations have learned to adapt to the GIS systems which have been implemented for them using the one size fits all approach.
- Such an approach usually meets considerable resistance from staff who must now learn to “deal” with the new system being thrust upon them.


Tomlinson's Planning Stages
Requirements (Stages 1 – 5)
Design (Stages 6 - 8)
Implementation (Stages 9 - 10)
Functionality
Technology
Data
People
Document Workflow Processes
Identify Requirements
Design User applications
Design Integration Applications
Develop and Install Applications
Evaluate Existing Systems & Environment
Evaluate & Select GIS Technology
Design System Architecture
Acquire and Install Technology
Acceptance, Testing and Feedback
Evaluate Data Sources
Design Database
Develop Data & Metadata Standards
Define Conversion / Integration Methods
Define Maintenance Methods
Convert and Migrate Data
Implement Maintenance Methods
Data Modeling
Data model Instantiation
Data conversion
Increase and Develop Programmatic Oversight on the Enterprise GIS Through Program Management, Quality Control, and Standards-based Implementation

Assessing the Organization

- There are systematic methodologies to assess an organization's informational "products" needs (from Dr. Roger Tomlinson's methodology in *Thinking About GIS*)
- A poorly implemented assessment can actually create problems when the GIS is ultimately instantiated.

Staff Interviews

- It is important to carefully record staff input and provide feedback in a timely fashion to engage them as stakeholders in the process.
- Informational products and suggestions must be clearly identified and separated.
- If long term needs are not adequately anticipated during the evaluation and design of the GIS, the resulting GIS may be incapable of handling future growth and expansion which otherwise should have been identified and designed into the system.

Importance of Design

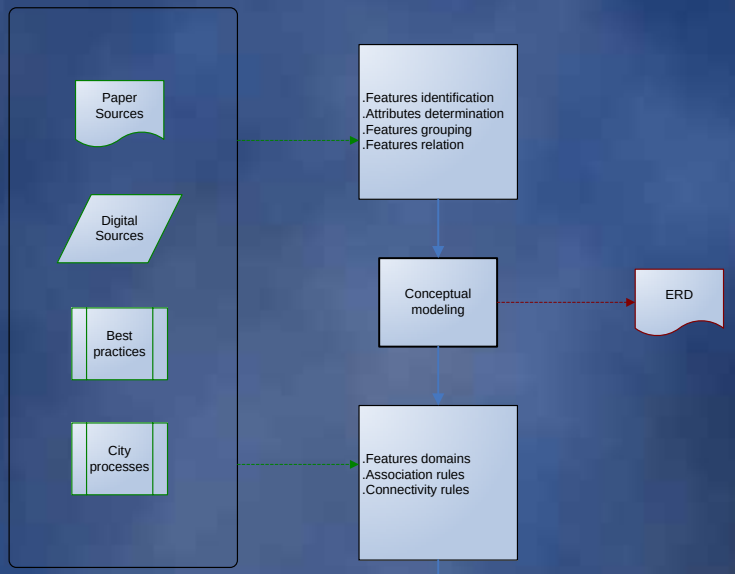
- An inadequate design can lead to a premature need to re-architect the system due to a lack of foresight. (Carr, *Managing Geographic Information Systems in the Public Sector*, 1999)
- Over design can result in the procurement of equipment far more expensive and robust than required causing unnecessary project expenditures for no appreciative return on the investment.

Step 2 - Summary

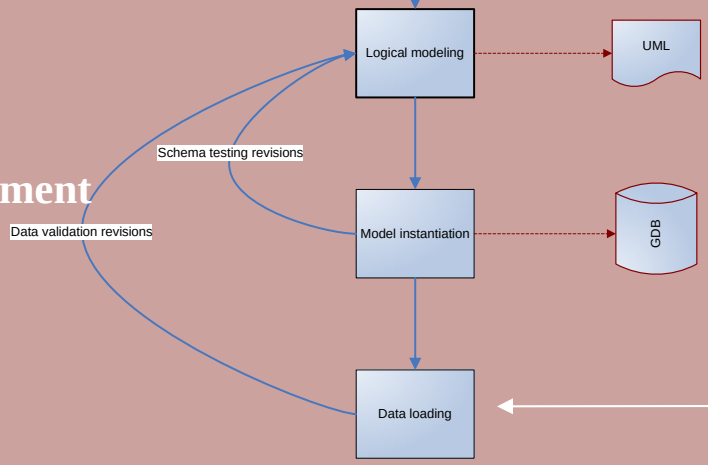
- Time spent
  - selecting a methodology
  - interviewing staff
  - and understanding their daily work flows and business rules

  leads to a design and implementation of a Data Model reflecting existing business operations which staff will more readily accept.

Step 3 - Iterative Modeling



- •. Datasets refinement
- •. Normalization (3NF)
- •. Business goals adjustment



Data Conversion

Business after GIS Implementation

- The result of introducing GIS into an organization should be an increase in efficiency and productivity.
- Many organizations find themselves in the position of doing more without adding staff.
- Change is inevitable; however, it can be managed so as to minimize its impact on the operational staff.
- Post GIS implementation work flow should reflect the accumulated organizational knowledge to the greatest extent possible.

Conclusion

- Time spent understanding operational work flows is time well spent.
- A well thought out GIS implementation will have the least impact on long established procedures.
- Altering work processes alienates staff.
- Data traditionally accessed by going to a drawer or cabinet and searching through piles of documents are readily available.

Conclusion (cont)

- If properly managed the introduction of GIS into an operations workflow should be relatively painless.
- Staff will find that their daily roles have changed only in ways which enable them to perform their assignments more efficiently.
- A solid database design will help ensure the successful integration of GIS into your organization.