

Project Development
Requirements Analysis

SIE 510 GIS Applications

Spring 2009

Information Systems Design Process

- Requirements analysis – specifies what the the system is required to do based on user/stakeholder input
- Design – specifies how the system will address the requirements
- Implementation – translates design specifications into a working system

Requirements analysis is critical to the success of a project.

Requirements Analysis

Requirements analysis can be applied at several different levels

- Overall system design
- GIS application design
- Database design

Determines data, information, system components, data processing and analysis functions required by an organization, enterprise, individual user.

Requirements analysis for GIS applications

May need to cover requirements for:

- database design
- user interface design
- functional requirements
- hardware and software requirements

Requirements Analysis

Includes three primary activities:

- **Eliciting requirements:** communicating with stakeholders to determine their requirements.
- **Analyzing requirements:** determining whether the stated requirements are clear, complete, unambiguous, and consistent and resolving any problems.
- **Recording requirements:** documenting requirements in various forms, such as natural-language documents, use cases, user stories, or process specifications.

Requirements Analysis

Techniques for eliciting and checking requirements from users

- Holding interviews or focus groups (or requirements workshops) and creating requirements lists.
- More recent techniques include prototyping, and use cases

Requirements analysis components

- Organizations' goals and objectives
- Current practices, problems encountered, and redundancies
- Organizational issues - management structure, resources, staff training
- Applications
- Data requirements
- Conceptual data base design
- Hardware and software
- System integration
- Cost of implementation- applications development, data conversion, hardware, software, resources, training, update and maintenance
- The Strategic Implementation Plan over a period of 3-5 years

Requirements Analysis for GIS application design

Identification of users:

Who will use the system? - system users, end product users. What are their needs? what is their level of expertise?

What are required products/outputs:

Current products? proposed products? longer term products?

what formats? maps? tables? charts? frequency of production? media? specialized presentation requirements? target audiences?

Evaluation of work flow:

what do the users need to do? what are they required to do? routine tasks? one off tasks? as yet undefined tasks?

types of data used, formats of data, data accuracy requirements, data display requirements

Steps in Database Design

1. Requirements analysis
 2. Conceptual design
 3. Implementation design
 4. Physical design
- Data is the core of GIS and the quality of the system/application depends on quality of the data
 - Database design is a fundamental component of GIS application design

Conceptual design

- Synthesis of information from requirements analysis according to semantic rules
- Outcome is a **conceptual model**
- The conceptual model describes entities, attributes and relations among entities independent of implementation details

Implementation Design

- Transforms the conceptual data model into an internal model - schema that can be processed by a particular Database management System (DBMS)

Physical Design

- Involves design of internal storage structures, record formats, access methods, record blocking

Steps in requirements analysis for database design

1. Identify scope of the design effort
2. Establish metadata collection standards - who to interview, what to collect - how to structure interview
3. Identify user views
user view- subset of data used by a person in a specific context
- can be identified by reviewing tasks, documents
4. Build a data dictionary
define and describe each item in detail: name, description, type, length, range and relationships

Steps in requirements analysis for database design

5. Identify data volumes and usage patterns how much data is used, how frequently, how frequently does data change
6. Identify operational requirements

Establish Data Collection Standards

- Formalize the interview process
- Ideally use a structured interview process with standardized data collection forms

Survey form example

Organization Unit Profile

Organization:

Director:

Location:

Interviewer:

Date:

Describe the overall mission of your department

Provide an organizational chart including job descriptions

Task List

List tasks performed by a department and give estimates of how often this task is performed (routine/non-routine, daily, monthly, yearly)

Task	Frequency
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____

Task #_____

Data Requirements

Data Sources:

What data is used by the organization in the performance of this task?

What is the source of this data (in house, other department, outside)?

If in-house collection, describe collection method, including estimate of frequency of collection. Provide any data forms, if applicable.

Task #_____

Data Requirements

Data Descriptions/contents

Describe the spatial reference of the data – (does it have one, need one)?

Describe the scale, resolution, accuracy and/or reliability of the data

What is the areal coverage of the data available/required?
temporal coverage available/required?

Task #_____

Data Requirements

Data Storage

What is physical format of the data?

What volume of data needs to be maintained?

How long is data maintained?

What archiving procedure is used if any?

Task #_____

Data Operations

Describe the operations/processing required for a task including frequency

List personnel involved in this task including amount of time each person spends on the task and their level of training

List the tools used in this task (hardware and software) and give their locations

List any maps used or produced in this task

Rate the current efficiency of this task:

[very efficient, efficient, poor]

Task # _____ **Information Products**

Describe any products associated with this task

What is the intended purpose of this product?

Who are the intended users [internal use, public access]?

What is the overall importance of this information?

Describe the spatial reference of this information.

Describe the accuracy, resolution and or reliability.

Are there required formats for the product?

Use Cases

A *use case* is a technique for documenting the potential requirements of a new system or software change.

A use case provides one or more *scenarios* that convey how the system should interact with the end user or another system to achieve a specific business goal.

Break down requirements into user functions.

Use Cases

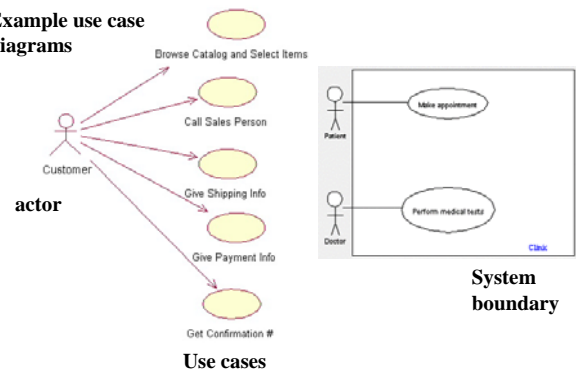
A use case describes a sequence of interactions between a user and an application without specifying the user interface.

Each use case captures:

- The actor (who is using the application?)
- The interaction (what does the user want to do?)
- The goal (what is the user's goal?)

Use Cases

Example use case diagrams



Functional requirements

Show how the use cases are to be satisfied.

Functional requirements define the internal workings of the software: the calculations, technical details, data manipulation and processing, and other specific functionality

They are supported by non-functional requirements, which impose constraints on the design or implementation (such as performance requirements, security, quality standards, or design constraints).

Identify User Views

Subset of the data required by a particular user to make a decision or carry out some action.

Extracted by reviewing user tasks, use cases, and types of decisions. Forms, reports, graphs, maps can be useful information for defining views

Build a Data Dictionary

Each data item identified in a view should be defined in detail

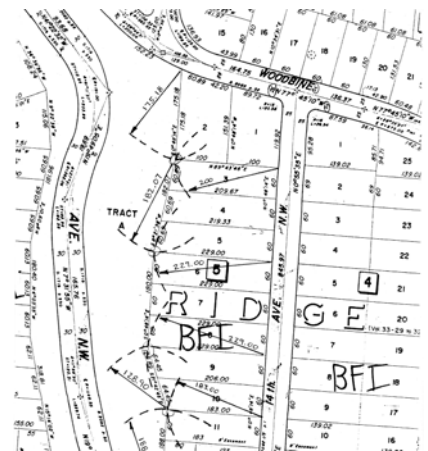
Identify and document each item's attributes: name, description, type, length, allowable range

View Integration

Consolidate terms and eliminate redundancies

User View

City of Seattle Maps



Data Dictionary – Feature Table

Attribute	Table	Point	Arc	Polygon	Attribute	Annotation
CONTROL (continued)						
PRIMARY HORIZONTAL CONTROL — CONT'D						
Moment Type	•	•			•	
Source	•				•	
Creation Method	•				•	
Date Recorded	•				•	
SECONDARY HORIZONTAL CONTROL						
ID Number					•	
WSP Northing					•	
WSP Easting					•	
PLSS Corner Type					•	
Elevation					•	
Denom					•	
Control Point Type	•				•	
Moment Type	•				•	
Source	•				•	
Creation Method	•				•	
Date Recorded	•				•	
Status Code	•				•	
Status Date	•				•	
CONTROL LINE						
Arc/Curve Data			•		•	
Control Line Type	•				•	

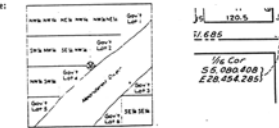
Data Dictionary – Feature Table

FEATURE NAME Attribute	Code Table	Point	Arc	Polygon	Attribute	Annotation
PUBLIC LAND SURVEY SYSTEM						
SIXTEENTH SECTION						
Sixteenth Section Number				•		•
Quarter Section Number						•
Section Number						•
Township Number						•
Range Number						•
Government Lot ID Number						•
Kroll Map Number						•
SIXTEENTH SECTION LINE						
Line Type Identifier				•		•
DONATION LAND CLAIM (DLC)						
DLC ID Number					•	•
Name					•	•
Closest Error					•	•
Closest Adjustment Type	•				•	•
DONATION LAND CLAIM LINE						
Arc/Curve Data					•	•
CONTROL						
PRIMARY HORIZONTAL CONTROL						
ID Number						•
Station Name						•
WSP Northing						•
WSP Easting						•
Elevation						•
Denom						•

Data Dictionary Feature Definition

ELEMENT SET FEATURE NAME Attribute	Valid Values/Range
PUBLIC LAND SURVEY SYSTEM	
SIXTEENTH SECTION	
Sixteenth Section Number	NW, NE, SW, SE
Quarter Section Number	NW, NE, SW, SE
Section Number	1 through 36
Township Number	23 through 35
Range Number	R3 through R9
Government Lot ID Number	NA, 1 through 999
Kroll Map Number	1 thru 999, N, S, E, W
SIXTEENTH SECTION LINE	
Line Type Identifier	Range Line Township Line Section Line Quarter Section Line Sixteenth Section Line
DONATION LAND CLAIMS	
DLC ID Number	37 to 99
Name	40 characters
Closest Error	Numeric 6*
Closest Adjustment Type	Compass (Bowditch) Rule Least Square Crandall Method Transit Rule Arbitrary
DONATION LAND CLAIM LINE	
Arc/Curve Data	—
CONTROL	
PRIMARY HORIZONTAL CONTROL	
ID Number	11 characters
Station Name	40 characters
WSP Northing	150,000,000 to 300,000,000 (Numeric 11.3)
WSP Easting	1,600,000,000 to 1,800,000,000 (Numeric 11.3)
Elevation	-10 to 2,000 (Numeric 7.2)

Data Dictionary Feature Definition

FEATURE DEFINITION ELEMENT SET: PUBLIC LAND SURVEY SYSTEM
Feature Name: Sixteenth (1/16) Section
Alias: Quarter-Quarter Section
Feature Definition: A unit of description of public lands; one-fourth of a quarter section formed by dividing a section into four parts by lines connecting the opposite quarter section line mid points and containing 40 acres. Government lots are special cases of the sixteenth section. These are fractional lots established by federal government surveys to handle irregular areas—often a surrogate sixteenth section.
Description/Comments: Also contains any government lot based on 1/16 corners: Fractional lot due to 1) excess/deficiencies in townships (N & W sides) 2) irregular tracts adjacent to meander lakes or rivers, 3) new survey approaching former government survey, 4) section bounded by reservations, national parks, mining claims, donation land claims, 5) irregular tracts by special instructions 7) islands.
Graphic Element Type: Point Arc X Polygon Annotation
Graphic Element Definition: Represented by a 4-sided polygon formed by connecting arcs to 4 PLSS Corner Points.
Example: 
Attributes: Sixteenth Section Number Section Number Range Number Kroll Map Number
Quarter Section Number Township Number Government Lot Number

Data Dictionary – Attribute Description

ELEMENT SET: PUBLIC LAND SURVEY SYSTEM

Feature:	Sixteenth Section
Attribute:	Sixteenth Section Number
Alias:	
Attribute Definition:	A unique identifier of a sixteenth section; a location designation of a 1/16 section within the 1/4 section
Comments:	This field will be coded "NA" in the event the polygon represents a government lot.
Data Type/Size:	2 characters
Valid Values/Range:	NW, NE, SW, SE, NA

Summary

Requirements analysis provides an initial understanding of the level of effort and realistic schedule required to implement a system or application envisioned by users.

A requirements analysis report forms a framework for a common understanding between the client and a developer in terms of breadth and scope of the envisioned system or application.

Summary

Issues arising from requirements analysis:

- Technical personnel and end users typically have different vocabularies. They can believe they are in perfect agreement until the finished product is supplied.
- Engineers and developers may try to make the requirements fit an existing system or model, rather than develop a system specific to the needs of the client.
- Analysis may be carried out by engineers or programmers, rather than personnel with the people skills and the domain knowledge to understand a client's needs properly.
- Requirements can be a moving target

Listen carefully, think creatively, be patient