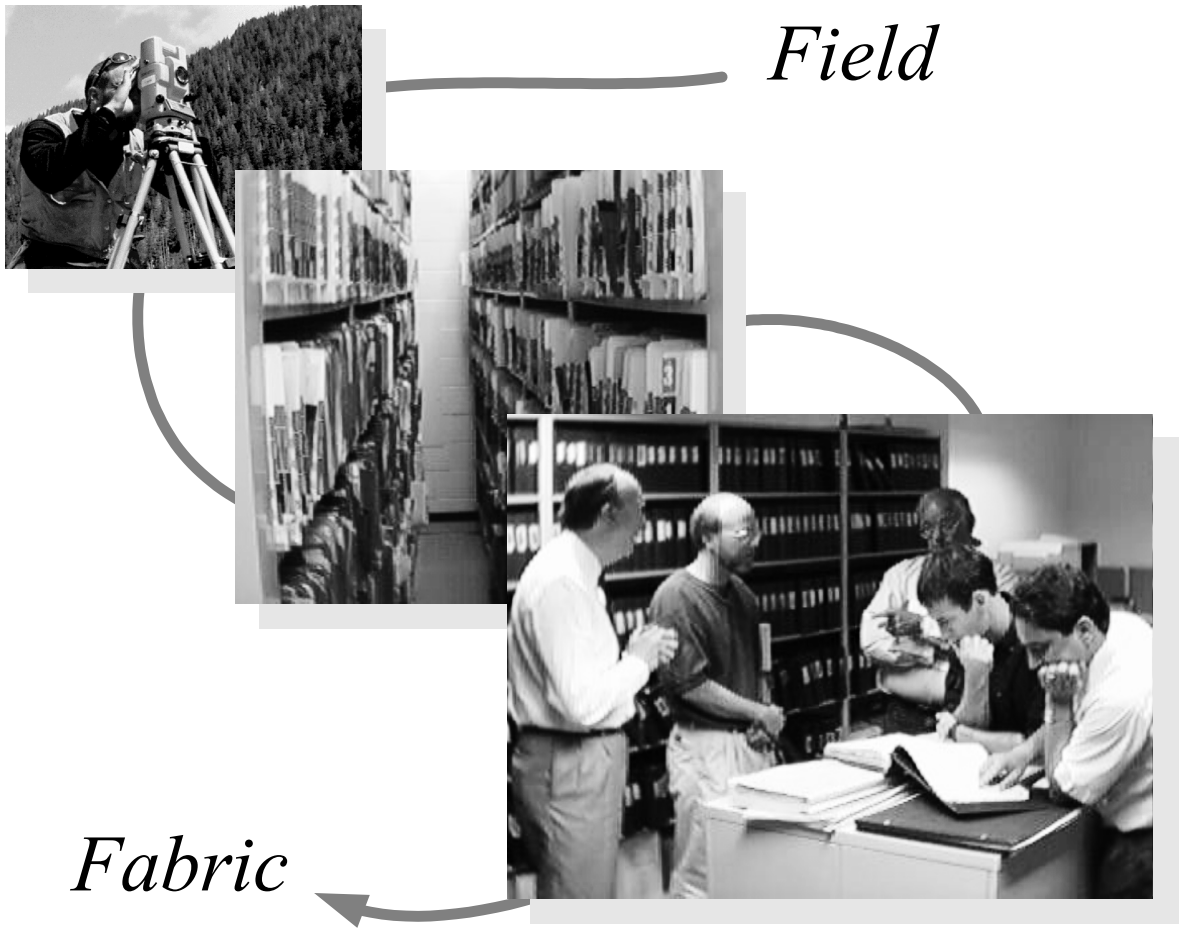
Concept of Operations and User Requirements



March 2000

NILS
NATIONAL INTEGRATED LAND SYSTEM

National Integrated Land System
Concept of Operations
and User Requirements

March 2000

Bureau of Land Management

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Preface

Summary of Public Outreach - January, 2000

The National Integrated Land System (NILS) Project Team's public outreach efforts have included gathering requirements and informing the public through meetings and workshops, through presentations at user group meetings, and through the Internet. To get as much user involvement from the widest audience as possible, public outreach has involved users throughout the United States from the private sector and from the Federal, State, local and regional governments. The NILS Project public outreach activities are summarized below.

Requirements Gathering Workshops
Requirements workshops were held in Boulder, CO; Redlands, CA; Denver, CO and Phoenix, AZ. The goal of the requirements workshops was to develop business process requirements for Survey Management, Measurement Management, Parcel Management, and GeoCommunicator as the core components of NILS. Participants represented user perspectives from the private sector and from government agencies such as the Bureau of Land Management (BLM - AK, AZ, CA, CO, OR, MT); the U.S. Forest Service (AZ, CO, GA, OR, WO); Boulder County, Colorado; Salt Lake County, Utah; Polk County, Oregon; Oakland County, Michigan; Pinal County, Arizona; Maricopa County, Arizona; the State of Arizona; and the State of Washington.

Site Visits
Site visits were conducted to verify the requirements and use cases with the actual business processes of private sector organizations and Federal, state, county and local government agencies. Site reviews were conducted in the Pacific Northwest and in the Eastern United States as a validation of the business process requirements being gathered for NILS.

The following sites were visited: BLM Oregon State Office, Portland, OR; U.S. Forest Service Region 6, Portland, OR; Polk County, OR; Washington State Department of Natural Resources, Olympia, WA; Thurston County, WA; U.S. Forest Service Region 2, Atlanta, GA; the Tennessee Valley Authority (TVA), Chattanooga, TN; Fulton County, GA; and the State of Florida Department of Environmental Protection, Tallahassee, FL.

User Group Meetings
Overview presentations on the NILS Project were conducted at the following meetings: National Association of Counties, St. Louis, MO (July 1999); Utah GIS Council Conference, Snowbird, UT (Sept. 1999); GIS in the Rockies Conference, Denver, CO (Oct. 1999); and National States GIS Council, New Orleans, LA (Aug. 1999).

NILS requirements review presentations were conducted at the following meetings: Geographic Coordinate Database (GCDB) Technical Advisory Group (GTAG) at the University of Maine in Orono, ME (Sept. 1999); Southwest Users Group, Breckenridge, CO (Oct. 1999); GCDB Management & FGDC Cadastral Subcommittee, Billings, MT (Nov. 1999); BLM and U.S. Forest Service Lands Group, Billings, MT (Nov. 1999).

NILS Public Meetings
Public meetings were conducted in five cities across the country to present the draft *Concept of Operations and Business Process Requirements* document. Announcement of the meetings was sent

to all public agencies in the area via mail, email, and through the Internet via the NILS web site. The goal of the public meetings was to inform the public of the NILS project, to present the requirements document, and to solicit comments. The public meetings were held in Portland, OR; Phoenix, AZ; Denver, CO; Atlanta, GA; and Washington, D.C. One hundred eighty nine people attended the public meetings. Sixty-five organizations were represented. The number of participants by organization type is as follows:

American Indian/Native Nation/Tribe	**1**
City	**4**
County	**16**
Federal Agency	**116**
BLM	48
MMS	2
National Geodetic Society	3
NPS	8
NSZ	3
USACE	1
USBOR	9
US Census Bureau	1
USOSM	1
Farm Service Agency	1
USFS	13
USFWS	19
USGS	7
Non-Profit Association/Organization	**3**
Private Firm	**32**
Regional Government	**2**
State Agency	**13**
University/College	**2**

Comments have been received on the draft *Concept of Operations and Business Process Requirements Document* as follows:

Comments received on-line	**12**
Comments received through E-mail/US mail	**21**

Internet
A NILS internet site at **http://www.blm.gov/nils** has been developed to inform the general public and the NILS partners on all activities related to the NILS project. The web site also contains all NILS documents, a calendar of activities, meeting/workshop notes, and an on-line comment form for submitting comments on the requirements document. There were 877 hits to the NILS requirements document page on the NILS web site during the 30 day comment period.

1.0 Executive Summary

"Parcel mapping is a continuous process that should evolve toward increasing reliability and accuracy. These maps are never finished, and require constant updating to keep pace with cadastral transactions. Parcels are complex features. To determine the overall geometric relationships, ties to physical geography, and historical and legal objects must be considered. Even the definition of what constitutes a parcel often varies widely. It is important, however, to stress the importance and use of the parcel in the GIS environment. Though reliability, consistency, accuracy, and precision are all important attributes of a parcel map, they should still be considered only a model of the physical and legal world, and not an exact replica."

James G. Donahue, PLS. Cadastral Mapping for GIS/LIS. ASPRS/ACSM, 1994. Copyright ASPRS/ACSM

1.1 Purpose of the Document

The purpose of this document is to provide for the extensive review of the National Integrated Land System (NILS) Concept of Operations and User Requirements by the NILS partners and others involved with cadastral land records. Meetings were held in Portland, OR; Phoenix, AZ; Denver, CO; Atlanta, GA and Washington, D.C. to facilitate the review. The document was also available on the Bureau of Land Management (BLM) web page at **www.blm.gov/nils**, and the comment period was from November 29, 1999 until January 15, 2000.

NILS is an initiative to provide a business process method to collect, maintain, and store parcel-based information that meets the needs of the widest possible spectrum of land title and resource information providers and customers. NILS is being managed in a partnership environment. The primary partners are BLM, the U.S. Forest Service (USFS), states, counties and private industry.

A list of participants is included in Appendix B. In addition, NILS has an advisory group, called the Parcel Consortium, which includes BLM, Forest Service, Environmental Systems Research Institute (ESRI), Oakland County, MI and Fairview Industries.

1.2 NILS

1.2.1 Vision and Scope

BLM is in the process of developing a bureau-wide architecture to provide the framework for all information technology investments. This framework includes conducting business process analysis for BLM's core business functions. The NILS Project is conducting the business process analysis for the core business functions for providing land and resource title information.

The NILS project is an initiative to develop a common solution for BLM and the Forest Service and their partners for the business processes involved with the management of cadastral land records. Because these business processes have much in common with those of the larger survey and land management community and the BLM and Forest Service are committed to working in partnerships, the NILS project is a cooperative venture. NILS will implement the Federal Geographic Committee's Cadastral (FGDC) Data Content Standard, while contributing to the National Spatial Data Infrastructure (NSDI). The BLM is managing the NILS Project using the Managed Evolutionary Development (MED) methodology, which is a phased development process. An overview of this process is included in Section 6.

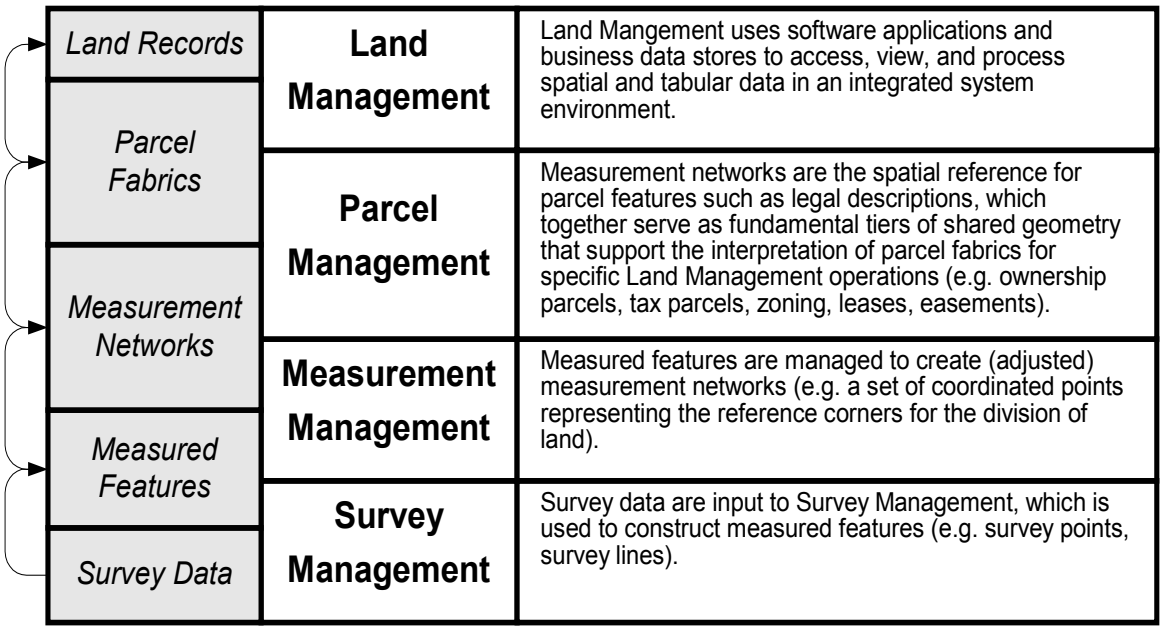
1.2.2 Field-to-Fabric Concept

A central goal of NILS is that users would have the tools to manage land records and cadastral data in a Field-to-Fabric manner. (See Figure 1.1) This concept implies the fundamental goal of developing a common data model that unifies the worlds of Surveying and Geographic Information Systems (GIS). This unification concept is fundamental for land records managers and maintainers of cadastral mapping databases as they strive to improve the accuracy and quality of their data.

One prevailing pattern in the management of land records and cadastral data is that the accuracy of maps can be enhanced using new data acquired by more accurate techniques. As new surveys translate into legal descriptions and subdivision plats, map maintainers can use these new measurements as a source of control for their maps. The professional community of land surveyors and land records managers require better tools to find and extract data from a GIS, to use that data to prepare for and to complete a field survey, and to incorporate the new survey data as improved control to enhance the GIS.

The geographic representation of cadastral data is often managed as a series of maps (e.g. assessor map books, master title plats). Using GIS tools, these maps may be automated (digitally converted) and managed in a digital drawing environment. When map layers are used to manage the geometry/geography of cadastral features like parcels, the individual features in the map layer should share geometry at common corner points and along common boundaries. A **fabric** refers to a collection of map features that share geometry at nodes (corners) and edges (boundaries) in a topological structure. When features in a fabric are edited, a change to a geometric element (i.e. a point, line or area feature) affects the shape of all features that are topologically tied to the edited feature.

Figure 1.1 Field-to-Fabric Concept



1.2.3 Methodology

An object-oriented analysis and design (OOAD) method was used to capture the essential business process requirements that would be supported by the NILS software application.

The object-oriented approach, as it relates to the design and development of software applications, focuses on modeling the real-world entities that are involved in an integrated set of business processes. Essential business processes are identified, named and described as a system's use cases. Use cases serve as conceptual containers for the series of steps that are performed to complete a given workflow process. As the description of the use case becomes more detailed, a set of real-world actors, inputs, documents, forms, processes, interactions and outputs are identified. These process-related entities are 'candidates' for the types of software 'objects' that must be designed and developed. (See Section 5.2 for more detail on the OOAD method).

1.3 Business Process Overview

The NILS Project includes the business processes which involve the ability to provide land and resource title information.

The following is a brief description of the components of the NILS Project:

- Common Cadastral (land) Data Model data model built upon the FGDC Cadastral Content Standard, enhanced to meet the core functional requirements of the NILS partnerships. The model would contain feature object classes representing the properties, rules, and behaviors of cadastral entities, and designed as an open and extensible format to facilitate both generalization and customization.
- Survey Management Process: An integrated set of automation objects that are embedded into compatible survey data collection software packages to support the capture of measurement features and metadata into a database format. The goal of the Field Survey Process is to minimize the need for data conversion and re-construction as measured features are incorporated into the land records management system.
- Measurement Management Process: Produce a new feature coordinate solution by performing a weighted planimetric-geodetic adjustment according to the qualitative characteristics of individual feature elements in the working set. Measurement Management Process enables users to create a higher-quality, control network database for the Public Land Survey System (PLSS) and the non-Rectangular Survey System (metes and bounds), relying upon much of the feature and functionality inherent in the GCDB Measurement Management system (GMM).
- Parcel Management Process: A process for managing land records and cadastral feature data stored in the database model, providing custom feature classes, tools, and procedures for editing land records in a transactional, history tracking environment. Users would be able to customize the Parcel Maintenance process to accommodate their established workflow and business processes.
- GeoCommunicator: An proactive Internet subscription process for sharing access to data stores and to planned and existing program project activities in cadastral and realty to facilitate collaborative capabilities and data sharing.

1.4 Overview of NILS Use Cases

The following section provides an overview of the use cases for each business process area.

1.4.1 Overview of Survey Management Use Cases

Concepts

The use cases for survey management (SM) are intended to describe the various business processes necessary to conduct field surveys in an automated GIS environment. An important aspect of any survey project is to research all available records for pertinent data. The first use case, ***SM-01 Survey Research***, is designed to assist in locating and evaluating survey and survey related records. The ***SM-02 Pre-Field Survey Setup*** use case guides a

user through the necessary steps to prepare a data collection device (i.e. laptop or palmtop) for use in the field. This may include the transfer of reference data to the data collection device immediately or at a future time. The ***SM-02 Pre-Field Setup*** may occur on a data collection device or on a desktop personal computer for later transferal to the data collection device. The ***SM-03 In-Field Survey Setup*** use case assists a user in configuring or modifying a *field survey setup file* for a data collection device. The field survey setup file is an output from ***SM-02 Pre-Field Survey Setup.*** The ***SM-04 Collect Field Data Observations*** use case provides for the polling (reading) of observations from *measuring devices* such as a total stations, the storage of the observations, and reduction of the observations (i.e., mean of the observation sets, slope distance to horizontal, difference in elevations, etc.). ***SM-05 Perform COGO and Layout*** provides coordinate geometry functions.

Summary of Important Survey Management Use Case Terms

Research scope. Data to be investigated for a given project defined by spatial extent and source criteria. May include digital records and hardcopy records during a defined epoch. The sum total of the selected search parameters or the query including spatial extent.

Survey project. This is an organizational/system concept to represent a set of field activities. It's where and how all the relevant data and files are stored for future use. A Survey Project may be comprised of one or more *Field Surveys*.

Field survey setup file. A list of parameters and configurations for the setup of a *data collection device*. A file which contains the type of data to collect; geodetic vs. planar geometry; the hardware/communications parameters; the area of interest; setup instructions for custom in-field menus and data collection forms; paths to reference data (i.e. coverages), images, and documents; and the link from the Field Survey to its Survey Project.)

Data collection device. An instrument for digital storage of readings and information about those readings. Information may be manual or digital input. Typically a personal computer capable of being connected to a measurement device.

Field survey data set. The set of reference data transferred to a data collection device for use in the field (i.e. coverages, images and documents.) that pertains to a Survey Project.

Readings. A value taken from an arbitrary scale (chronometer, theodolite circle, compass, chain, etc.) returned by a measuring device. A measurement device's direct output of observations (i.e. circle readings, distance, etc.). This can vary depending on the type of measuring device.

Observation sets. A set of one or more readings from a measuring device (may be multiple observations for the same feature).

Measurements. The reduced and/or mean values of an observation set. The angular difference between readings, the distance, or the azimuth/bearing. See the appendices for a complete definition of a measurement.

1.4.2 Overview of Measurement Management Use Cases

Concepts

The use cases for Measurement Management (MM) are intended to manage survey measurement and other geometric data in an automated environment. The inputs into the Measurement Management system are the following:

- **Measured bearings and distances** of lines from the Survey Management system, other digital sources, paper records and data attributes,
- **Measured geographic coordinates** of corners, as well as attributes,
- **Terrain-based boundaries** extracted from traditional map coverages, and
- **Rules of construction** for further division of land, as interpreted from legal records. Examples are offsets and PLSS section subdivision.

The purpose of Measurement Management is twofold. One purpose is to combine the individual components of measurement data from a variety of sources and reliabilities (pre-adjusted measurement network) into a seamless and coherent network (adjusted measurement network). The second purpose is to further divide the network to its needed detail based on legal descriptions to form all the spatial features needed to display the known legal descriptions (legal description fabric).

The general steps (and use cases) included in Measurement Management are:

- Assemble all measured feature components for the adjustment area, including error estimates and data source descriptions. (System Utilities such as **Input** and **Import Data**; Use cases: ***MM-01 Construct Measured Feature, MM-03 Edit Measurement Data)***
- Perform least square adjustment/analysis, which includes automatic transforms of data to common units and projections. (Use case: ***MM-02 Adjust and Analyze Measurement Network***.)
- Inspect analysis results for anomalies that may indicate data entry blunders. Fix blunders. (Use cases: ***MM-03 Edit Measurement Data***.)
- Option: Inspect results of analysis on blunder-free data for clues to refine error estimates. (Use cases: ***MM-03 Edit Measurement Data***)
- Apply stored rules and further divide the network into pieces as interpreted from legal records. (Use case: ***SM-05 Perform COGO and Layout***.)
- Copy the results into the legal description fabric, overwriting what existed in the adjustment area.

Creating measurement networks with Measurement Management provides the foundation for the legal description and parcel fabric tiers. Integrated maintenance of cadastral data is made much more efficient when geometry can be shared. The measurement management functionality should assist in the interpretation of (1) the reliability of each point position and (2) where data editing is needed. Based on such an interpretation, new data can be added to the pool of measurement data and elements that no longer aid the optimal solution can be removed. Any area can be selected and adjusted, usually based on what point

positions will be enhanced by the new data being added. New data, once attributed and verified as *blunder*-free, can be integrated into a seamless network.

Summary Of Important Measurement Management Use Case Terms

COGO Procedures. A unique set of Coordinate Geometry computations. In Measurement Management, the results of these computations are not subject to adjustment. The stored COGO procedures are reapplied to the Adjusted Measurement Network after each adjustment. These procedures are derived from interpretations of the rules of construction as laid out in legal records such as survey plats and deeds.

Error Estimate. A numeric value expressing the reliability of each piece of data in the pre-adjusted survey network. This value expresses the amount of adjustment that would be expected to occur during the least square adjustment and is used as a weighting to control the adjustment of better data. This value is usually applied consistently to distances, bearings and control coordinate values within each survey. The pre-adjustment estimates are based on date, equipment and surveyor. The refinements to these estimates are based on the reports from the least square adjustment/analysis.

Least Square Adjustment/Analysis. A mathematical process that simultaneously combines all measurements in a dataset and adjusts their residuals to derive the optimum positional values as well as statistics that include the reliability of each derived value. A *Parametric Least Square Analysis/Adjustment* is a "weighted" least square adjustment, in that it considers the quality of data that varies throughout the data set.

Weight. Numeric values that are used to restrict the amount of adjustment of a measured value, based on the confidence in the measurement's reliability. A highly reliable measurement will have a small "error estimate" and is referred to as being "more weighted" than unreliable data.

1.4.3 Overview of Parcel Management Use Cases

Concepts

The use cases for Parcel Management (PM) are intended to describe the various business processes necessary to maintain land records in an automated environment. The first use case, ***PM-01 Verify Parcel***, outlines the various steps necessary in the original filing of a document (i.e., deed being recorded or application filed). ***PM-02 Construct Legal Description*** allows for creation and maintenance of current and historical legal descriptions. ***PM-03 Edit Legal Description Fabric*** allows for generation and maintenance of survey and non-survey descriptions and geometries in an integrated 'coverage' that are the building blocks for parcel legal descriptions. ***PM-05 Edit Parcel Fabric*** allows for building and attributing parcels necessary to maintain a 'coverage' based on a particular business practice (e.g., ownership, rights, and restrictions) in a user-defined geographic area.

There are certain key survey and mapping terms that must be understood in order to 'navigate' the Parcel Management use cases. Please reference the complete listing of definitions available within the appendix. A diagram is also included in this overview to help explain the relationship between the various measurement network and fabric layers.

Summary Of Important Parcel Management Use Case Terms

Legal description. The narrative and geometric description for a discrete area of land. Descriptions may be related to parcels (many-to-many) and to geometry features.

Area Legal Description. AKA Areal Reference. Delimited in reference survey system having area taxonomy, nesting and division rules (e.g. geopolitical, PLS, Block-Lot, mineral survey, irrigation lots, and nominal areas).

Perimeter Legal Description. Record boundary, metes and bounds, sequenced set of bearings and distances, strip description, adjoiner description, riparian or aquatic area description, reference calls to natural features (e.g. contour, ridgeline, watercourse).

Portion/Remainder Legal Description. Area as a quantity (e.g. 'north sixty acres of...', 'the north four-hundred feet of…'), exclusions; other reference calls; ambiguous areas that cannot be mapped relative to any reference.

Measurement Network. A set of topologically related measurements (coordinate points and lines) and constructions (area-based features, non-surveyed features). May be in various states of connectivity and adjustment.

Pre-Adjusted Measurement Network. Multiple coordinate values exist for some points, so lines which should be connected may not be connected (due to measurement errors).

Adjusted Measurement Network. All over-determined points have unique coordinates.

Legal Description Fabric. An adjusted measurement network to which constructions (terrain feature boundaries, non-survey data) have been added.

Parcel Fabric. A Legal Description Fabric that has been modified to represent parcel configuration for a specific business purpose (e.g. ownership parcels, tax parcels, historic parcels).

Parcel. A single cadastral unit, which is the spatial extent of the past, present, and future rights and interest in real property.

Parcel Legal Description. A composite description that contains all the *legal descriptions* that define a parcel and can be used to derive the full spatial extent of the parcel.

1.4.4 Overview of GeoCommunicator Use Cases

Concepts

The use cases for GeoCommunicator (GC, or GeoCom) are intended to describe the business processes necessary to communicate land-related activities and data over the Internet. Consumers of spatial information may use GeoCommunicator to discover:

- *WHAT* data and activities are related to their personal area of interest (e.g. a state or county) and how to access the information, and/or
- *WHERE* (geographic extent) specific data and activities (e.g. Public Land Survey coordinate data sets, planned field survey projects) are linked to the land and how to access that information.

The GeoCommunicator includes an activity notification option based on a subscriber's defined geographic extent. Providers of spatial information describe their data and activities in a searchable index, locate their geographic extents on a map interface, and enable information flow through email contact and links or paths to existing data stores.

The ***GC-01 Conduct Search*** and ***GC-02 Browse Search Results*** use cases provide tools for the Browser actor seeking spatial information. The Browser specifies the 'where' (spatial extent), the 'what' (data or event category), and the 'when' (time-frame) in a spatial query and views/downloads the results. This actor may become a Subscriber through the ***GC-07 Manage Subscriber Account*** use case where flags, defined by a spatial query, are set that trigger automatic notification (e-mail).

Actors intending to provide information apply through the ***GC-05 Manage Provider Account*** use case and utilize tools and procedures described in the ***GC-06 Submit Data*** and ***GC-03 Submit Event*** use cases. Event Providers submit descriptions of planned activities, the location (spatial extent), and duration (calendar). Data Providers submit abbreviated metadata including data format and currency (current-to date), location (spatial extent), and the paths or links to existing data. They become Event Providers when data activities such as collection and maintenance are submitted.

The ***GC-10 Post Comment*** use case provides for communication among GeoCommunicator actors. Any actor may join a topical forum or e-mail group. They may communicate with Providers concerning their data and events (identify errors, ask questions, etc.). An actor may post an Information Notice describing available information, in response to a data call or as a proposal for inclusion within the GeoCommunicator. An Information Request may be posted as a data call (when no information can be found with the ***GC-01 Conduct Search*** process), or to share in developing a new data set, form a partnership, participate in a joint decision. The remaining use cases are designed for an Administrator actor to manage accounts, to manage the on-site data and links to the off-site data, to monitor the events calendar, to trouble-shoot communication problems, and to maintain the GeoCommunicator web site..

Summary of Important GeoCommunicator Use Case Terms

Data Discrepancy. Data sets of the same category in the same spatial extent whose boundaries, positions (coordinates) or attributes do not match.

Data. Collections of information, organized by category in sets, described by metadata, and related to a land index; searchable by GeoCom actors. *Data* in this context is “published” data, in a variety of formats or media, and not necessarily digital.

Event. A significant change in state or status occurring at a point in time or for a duration of time as a function of a process or activity that might trigger a flag for notification. *Event* expands on the concept of activity, which usually connotes a conscious human effort, to include change due to transactional and system operations. *Event* is intended to capture the dynamic aspect of communication. *Events* may not necessarily result in published data. See further discussion of *Event* under *GC-03 Submit Event.*

Master Catalog. This is the consolidated view of all Provider Catalogs for administrative management, *CG-09 Manage Accounts*. The GeoCommunicator catalog is a subset of the Master Catalog, searchable and viewable by browsers and subscribers.

Reference Documents. Related technical or educational information that may explain, expand, or document data or events. May have no direct relationship with a spatial data set (e.g. manuals, RFIs, reports, regulations, etc.) or be related to a land index.

Research Results. Map and tabular view of items that match the search parameters of the Research Scope and access permission level in the Conduct Search process.

Research Scope. The total of all choices and defaults for *Conduct Search* before the query is launched. Includes combinations of the following parameters – data categories (types of data ex. cadastral, wildlife, hydrology), event categories (ex. data submission, data call, industry activities or events, general or specific communication), spatial extent (ex. latitude/longitude coordinate box, drawn polygon, administrative boundary, address), data quality (i.e. data integrity, data consistency, measurement type), temporal constraints (time periods or ranges). Search is conducted based on search criteria and Actor's access level.

Spatial Extent. Location on the ground (footprint). Includes any method for describing a point or area. Examples include Latitude/Longitude, PLSS, minimum bounding rectangle, boundaries (admin, other).

Spatial Reference. Projection(s), coordinate system(s), datum used. Listed in Data Catalog.

Subscriber Account. Those interested in receiving updates of information on a managed basis. When new data is posted for a category, a notification will be sent to those who have subscribed to that category of information. This notification process may be on a scheduled basis where a subscriber has requested notification updates at preset times, or an *ad hoc* basis where notification is immediately triggered as an event occurs. Subscribers manage subscription options in their account profile.

1.5 Next Steps

The requirements and use cases documented in this report are only the first step in the overall NILS development process. The next steps in the NILS project will involve an iterative series of analysis, design, build and test tasks. Future NILS phases will be managed using MED and in compliance with the BLM architecture.

2.0 Introduction

2.1 Purpose of the Document

The purpose of this document was to provide for the extensive review of the National Integrated Land System (NILS) Concept of Operations and User Requirements by the NILS partners and others involved with cadastral land records. Meetings were held in Portland, OR; Phoenix, AZ; Denver, CO; Atlanta, GA and Washington, D.C. to facilitate the review. The document was also available on the Bureau of Land Management (BLM) web page at **www.blm.gov/nils**, and the comment period was from November 29, 1999 until January 15, 2000.

NILS is an initiative to provide a business process method to collect, maintain, and store parcel-based information that meets the needs of the widest possible spectrum of land title and resource information providers and customers. NILS is being managed in a partnership environment. The primary partners are BLM, the U.S. Forest Service, states and counties and private industry. A list of participants is included in Appendix B. In addition, NILS has an advisory group, called the Parcel Consortium, which includes BLM, U.S. Forest Service, ESRI, Inc., Oakland County, MI and Fairview Industries.

2.2 Background

2.2.1 Department of the Interior, Bureau of Land Management

The mission of the Bureau of Land Management (BLM) is "to sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations." BLM, which is part of the Department of the Interior, manages about 264 million acres of public lands. BLM also manages another 300 million acres of subsurface mineral resources that underlie lands administered by other government agencies or are owned by private interests. These lands are located in 28 states, primarily in the West and Alaska.

The BLM maintains land and mineral records for the Nation’s public and Indian lands, including over one billion documents such as land surveys, surveyor notes, tract books, Master Title Plats (MTP), Historical Indices land patents, mining claims, oil and gas leases, and land and mineral case files. Many of these paper documents are deteriorating and some are becoming illegible. Most of the original records and plats are manually maintained and stored in a number of locations throughout the western United States and several locations in the East. Some of the information contained in these documents has been entered into various databases beginning in the 1970s.

When the energy boom began in the early 1980s, BLM found it could not handle the paper workload demand and recognized the need to become more efficient and cost effective by automating many of its public land tenure records. BLM began an effort to automate its land and mineral records. This proposed system was called the Automated Land and Mineral Record System (ALMRS) but this system was never completed.

2.2.2 Department of Agriculture, U.S. Forest Service

The U.S. Forest Service, Department of Agriculture, manages approximately 191 million surface acres of land scattered throughout the United States. In 1958, the Forest Service began a modernization effort to update its land status records that resulted in the establishment of the standard Land Status Atlas, containing status maps and a summary of tabular records of title, partial interests, rights and use restrictions pertaining to Forest Service lands. In the 1990s the Forest Service began it's current effort to modernize the Forest Service land records with a project called the Automated Land Project (ALP), which is being implemented throughout the agency.

2.2.3 States, Local Governments, and Private Land Owners

Land records management is also a critical business process for states, counties, townships and cities in the U.S. These are the agencies that interact with private land owners to do the following:

- Manage natural resources (state departments of natural resource management, large private land owners)
- Process land use and development permits (state departments of environmental protection, local governments)
- Record deeds and subdivisions (county recorders, registers)
- Maintain cadastral maps (county assessors)
- Manage infrastructure and rights-of-way (state and local government departments of public works, surveying, engineering, etc.)

All these agencies require powerful tools to access and manage land records and cadastral data as an integral part of daily business operations.

2.2.4 Common Tools and Data Models for Shared Management of the Landscape

Over the last two decades, land managing agencies at all levels of government have found it increasingly difficult to share information, maintain current records and to provide accurate and timely land tenure information to public customers or to support the decision-making process. Population growth, public scrutiny, complex title and use transactions, legal challenges, deteriorating, difficult to access records in a climate of decreased financial support have forced all agencies to consider alternative, more effective technologies.

2.3 The NILS Vision

The NILS vision is to provide a business process method to collect, maintain, and store parcel-based land information that meets the common, shared business needs of the widest possible spectrum of land title and resource information providers and customers. The goals of NILS include the following:

- Provide a comprehensive, integrated, common data model and framework for the management of cadastral land tenure records

- Improve access to land title record information, including ownership, uses and boundaries
- Provide graphic display for land management information
- Facilitate land information data sharing and cooperative collection efforts
- Improve response time to land information queries
- Support the ability to provide a common digital portrayal of land and resource parcels across all jurisdictions
- Provide for the ability to efficiently update information with new or better sources of information
- Provide framework for decision support for collaborative ecosystem management
- Facilitate data sharing, cooperative collection, joint and multi-use land management and distribution of data
- Provide the ability to link parcel-based information with other resource information using geographic information system (GIS) technology to facilitate analysis (Figure 2.1)
- Improve the quality of the information needed to manage and display land, including subsurface information, land descriptions, parcels, control, and coordinates
- Integrate positional and descriptive land information for both surveyed and unsurveyed boundaries
- Provide the ability to link alphanumeric (attribute) data with a graphic representations of where the activity occurs (Figure 2.2)

Figure 2.1. Linking Parcel-Based Ownership, Restriction, Rights, Uses, Administration, Case, and Customer Information Using GIS to Facilitate Analysis

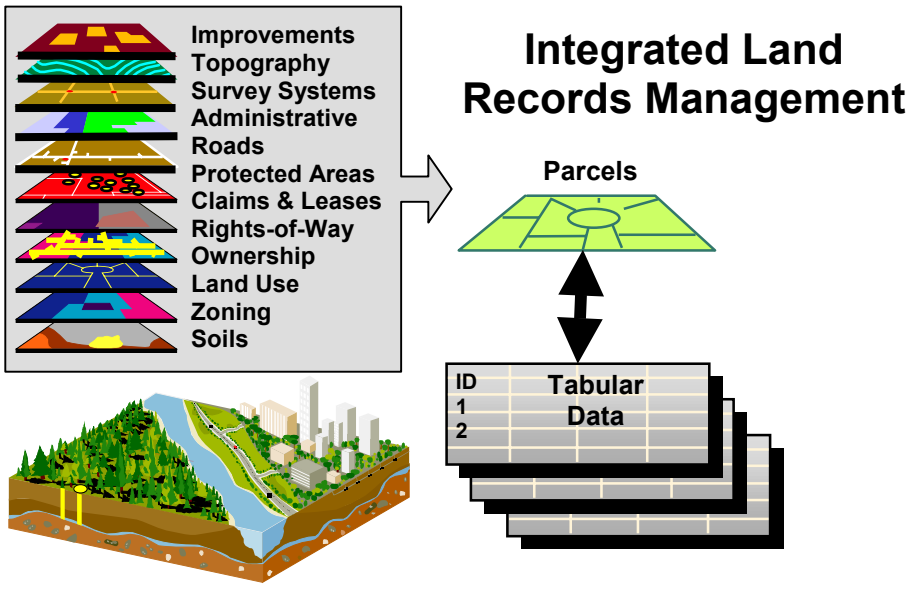
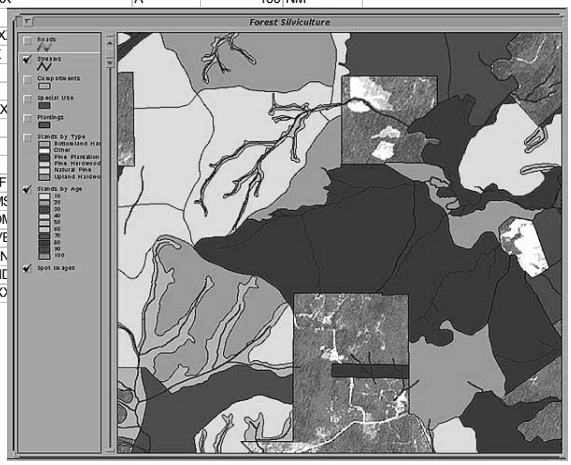


Figure 2.2. Linking Attribute Data and Geographic Data

Land Management agencies and organizations need the ability to link alphanumeric (attribute) data and (geo)graphic representations. This is an example of BLM's attribute data from the LR 2000/Case Recordation System

Land Id	System Id	Blm Admin State	Meridian	Township	Range	Section	Aliq Part	Sur Type	St Acreage	Geo State
8603	CR	NM	23	0230N	0130W	21	NE;	A		NM
8605	CR	NM	23	0290N	0100E	1	S2NE,SE;	A		NM
8614	CR	NM	23	0290N	0100E	10	N2N2,S2SE;	A		NM
8617	CR	NM	23	0290N	0100E	13	N2,NESW,N2SE,SESE;	A		NM
8619	CR	NM	23	0290N	0100E	17	NE,SENW,SW,N2SE,SESE;	A		NM
8630	CR	NM	6	0340S	0420W	14	E2,SW,S2NW;	A		KS
8635	CR	NM	23	0300N	0120W	19	SENE;	E		NM
8641	CR	NM	23	0200S	0250E	2	L4,SWNW,NWSW;	E		NM
8656	CR	NM	23	0150N	0060E	711	PT OF LOTS 1-5,S2NW,SE;	1		NM
8771	CR	NM	TX	141			BLK 79 T 1;SEC 5-8,17-20	1		TX
8772	CR	NM	TX	141			29,30 BLK 80 T 1,SEC 1,12	1		TX
25646600	ST	NM	23	0040N	0340E	15	XXXX	A	160	NM
25646603	ST	NM	23	0040N	0360E	27	XXXX	A	160	NM
25646604	ST	NM	23	0030N	0340E	20	XXXX			
25646611	ST	NM	23	0040N	0360E	17	XXXXX			
25646612	ST	NM	23	0040S	0310E	19	X X			
25646613	ST	NM	23	0040S	0310E	19	X			
25646614	ST	NM	23	0040S	0310E	19	X			
25646615	ST	NM	23	0030N	0350E	14	XX			
25646619	ST	NM	23	0050S	0310E	7	X X			
25646620	ST	NM	23	0050S	0310E	7	X			
25646621	ST	NM	23	0050S	0310E	7	X			
25821482	ST	NM	23	0030N	0260E	20	OF LND F			
26403128	ST	NM	23	0020S	0030W	31	MS378,MS			
26403532	ST	NM	23	0080S	0050E	28	OKLAHOM			
26572778	ST	NM	23	0100S	0190W	28	UNSURVE			
26572948	ST	NM	23	0190S	0150W	11	AND SWN			
26642397	ST	NM	23	0190S	0150W	23	1357, AND			
50463309	ST	CO	6	0050N	0670W	2	XX			

For example, there are currently 4.8 million rows of data in the Land Description Table and 25.8 million rows in the Case Land Table



2.4 Project Initiation

On January 7, 1998, Michael Dombeck, Chief, Forest Service and Pat Shea, Director, Bureau of Land Management signed a Memorandum entitled "Bureau of Land Management-Forest Service Partnership for Land Management and Customer Services." This became known as the "Service First" initiative. Subsequently, a Partnership Agreement for an ALP/ALMRS Joint Development Project was signed on June 11, 1998 by four sponsors: Jack Arthur (Director, IRM) and Jack Craven (Director, Lands) for the Forest Service, and Gayle Gordon (Assistant Director, IRM) and Pete Culp (Assistant Director, Minerals, Realty & Resource Protection) for the Bureau of Land Management. Additionally, a Project Charter was signed in March, 1999 by the four project sponsors. With approval of this charter, the project was renamed the National Integrated Land System.

2.5 NILS Scope

The NILS project is an initiative to develop a common solution for BLM and the Forest Service and their partners for the business processes involved with the management of cadastral land records (see the business process summary in Figure 2.3). Because these business processes have much in common with those of the larger survey and land management community and the BLM and Forest Service are committed to working in partnerships, the NILS project is a cooperative venture. NILS will implement the Federal Geographic Committee's Cadastral (FGDC) Data Content Standard, while contributing to the National Spatial Data Infrastructure (NSDI). The BLM is managing the NILS Project using the Managed Evolutionary Development (MED) methodology, which is a phased development process. An overview of this process is included in Section 6.0.

The BLM is in the process of developing a bureau-wide architecture to provide the framework for all information technology investments. This framework includes conducting business process analysis for BLM's core business functions. The NILS Project is conducting the business process analysis for the core business functions for providing land and resource title information. These functions fit into the larger scheme of BLM's other business processes (as depicted in Figure 2.4). Other land management agencies and organizations have similar business processes, and the NILS business processes fit into these in a similar fashion.

Figure 2.3. Summary of NILS Business Process Use Cases

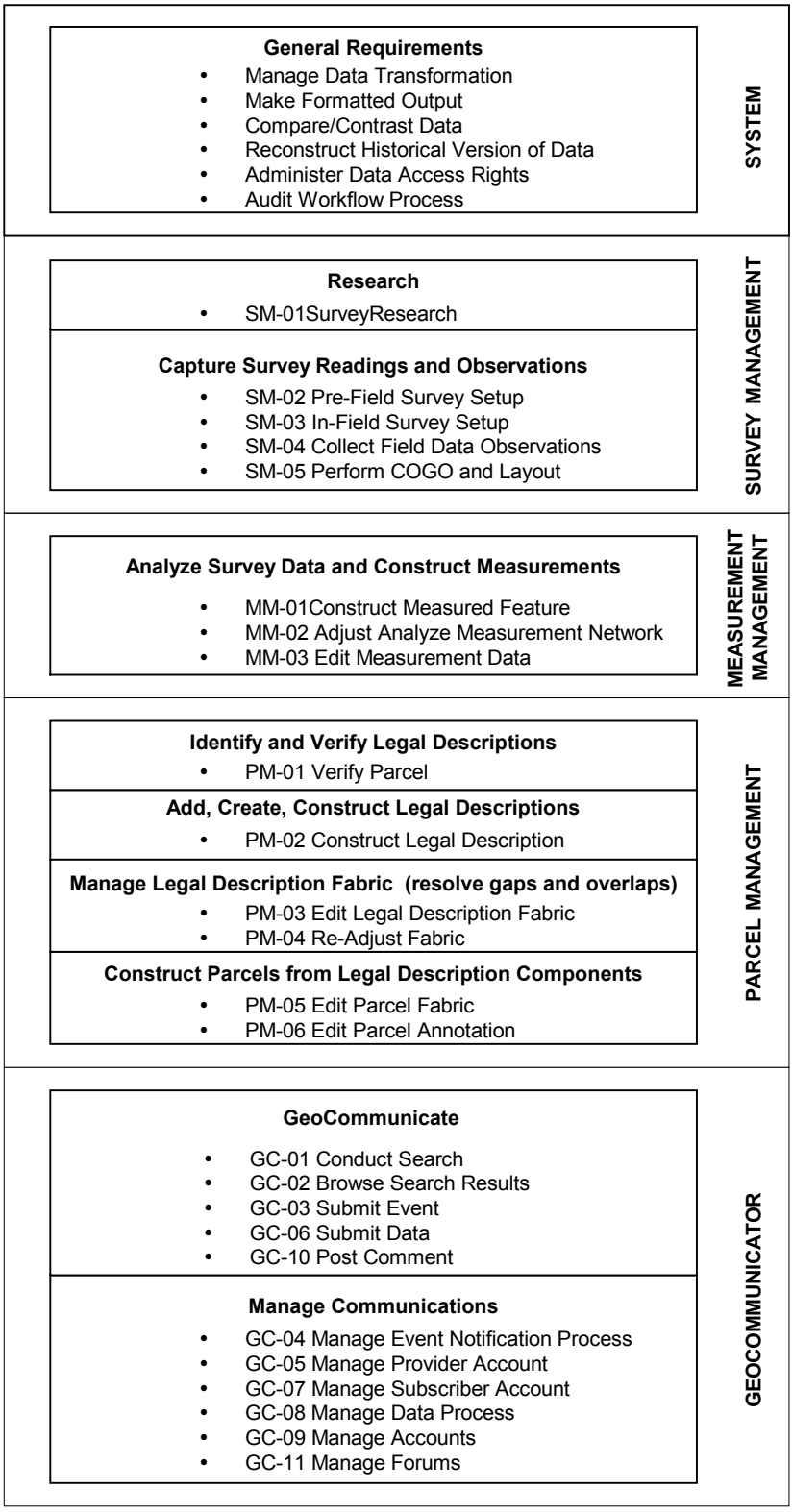
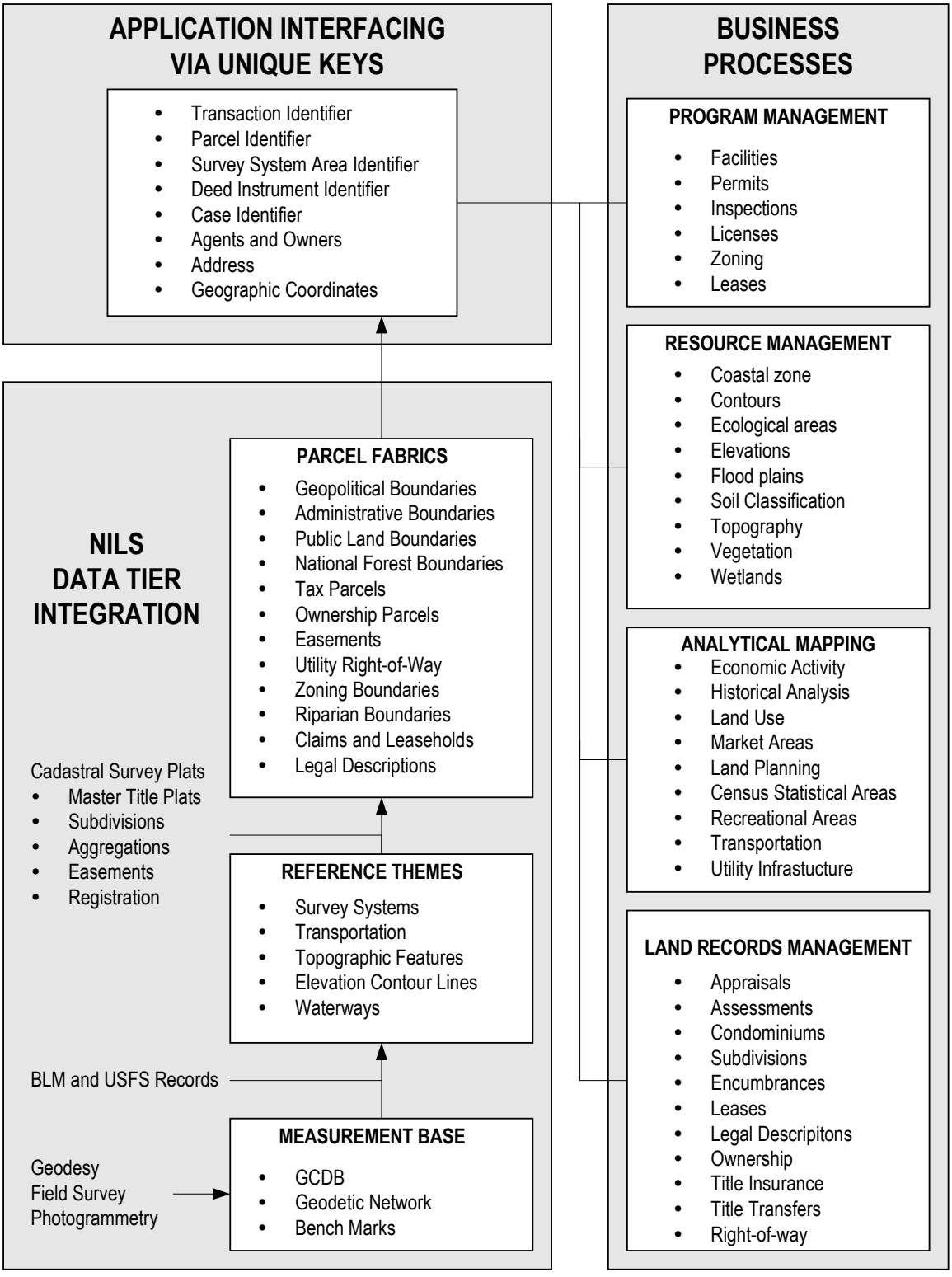


Figure 2.4. The Context of the NILS Business Processes

The NILS business processes fit into a larger context of land and resource management business processes



2.6 The Field-to-Fabric Concept

A central goal of NILS is that users would have the tools to manage land records and cadastral data in a Field-to-Fabric manner. This concept implies the fundamental goal of developing a common data model that unifies the worlds of Surveying and GIS. This unification concept is fundamental for land records managers and maintainers of cadastral mapping databases as they strive to improve the accuracy and quality of their data.

One prevailing pattern in the management of land records and cadastral data is that the accuracy of maps can be enhanced using new data acquired by more accurate techniques. As new surveys translate into legal descriptions and subdivision plats, map maintainers can use these new measurements as a source of control for their maps. The professional community of land surveyors and land records managers require better tools to find and extract data from a GIS, to use that data to prepare for and to complete a field survey, and to incorporate the new survey data as improved control to enhance the GIS.

The geographic representation of cadastral data is often managed as a series of maps (e.g., assessor map books, master title plats). Using GIS tools, these maps may be automated (digitally converted) and managed in a digital drawing environment. (See Figure 2.5) One of the desired characteristics of such maps is that all the map sheets may be combined into a single geographic representation, often called a map layer. A **fabric** refers to a map layer of features that share geometry at common nodes (corners) and along common edges (boundaries) in a topological structure. (See Figure 2.6) When features in a fabric are edited, a change to a geometric element (i.e., a point, line or area feature) affects the shape of all features that are topologically tied to the edited feature. Fabrics may be constrained to manage a seamless coverage of the land area (i.e. no gaps or overlaps).

There are many possible types of fabrics. A fundamental data model for NILS would include a common **fabric object** (super-class) that can be extended to handle various tiers of infrastructure depicting the cadastral (land) data. These tiers would include specific fabrics that contain control features, measurement features, surveyed coordinates, land boundaries, terrain features, land descriptions and constructed land units (parcels) as necessary to manage and display land use, land rights and land ownership. Common tools, properties, rules, and behaviors are needed to manage land from the fieldwork to the building and managing of the parcel fabrics.

Figure 2.5. Managing Cadastral Land Data

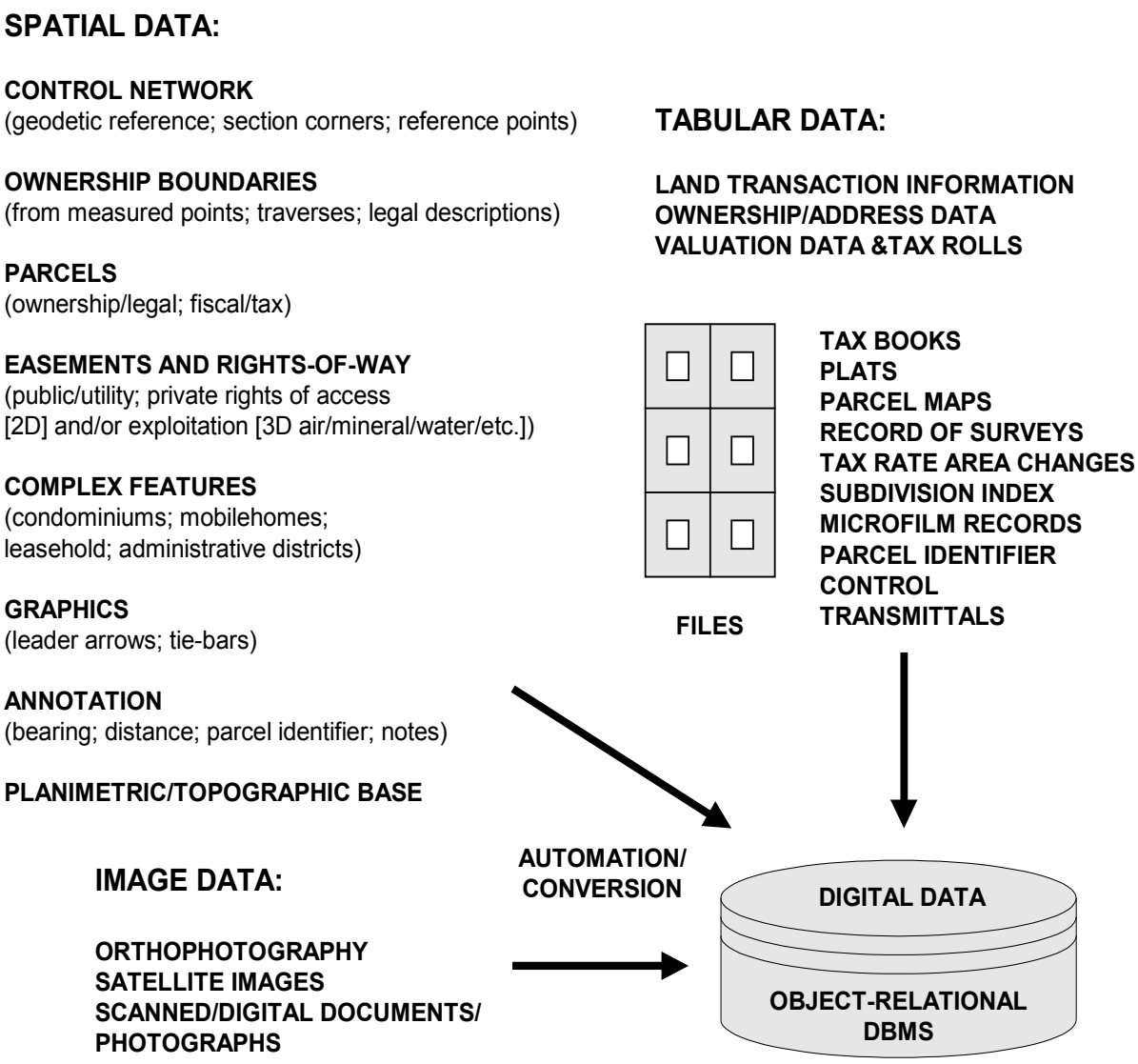
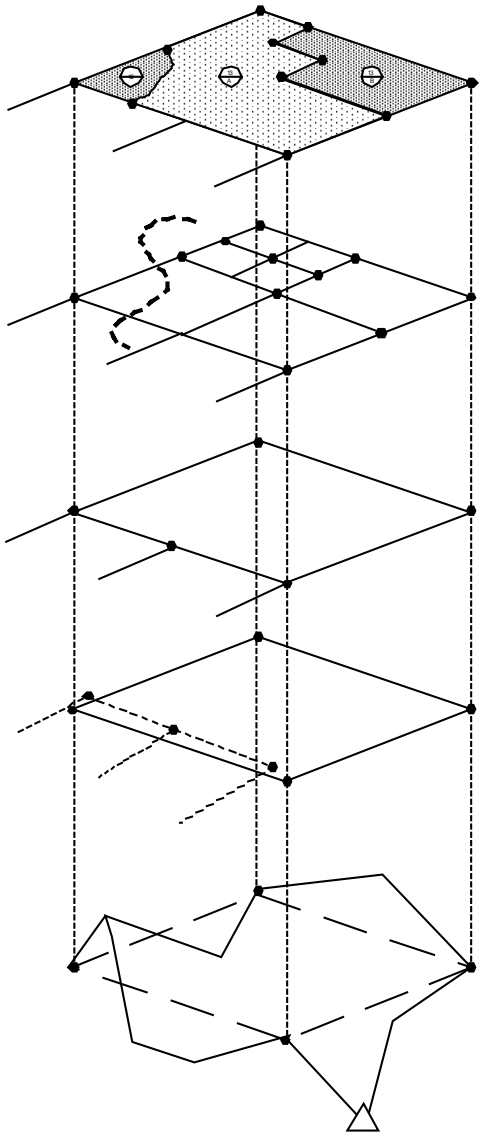


Figure 2.6 Multi-Tiered Fabric



100200 36-45- 16.60270 118-52- 38.51301
200100 36-44- 23.99490 118-51- 27.14100
200200 36-45- 15.90876 118-51- 28.09974
200340 36-46- 35.15316 118-51- 27.29489
300100 36-44- 23.48340 118-50- 22.57801
300340 36-46- 35.39932 118-50- 22.06715
340300 36-46- 9.56402 118-49- 49.98441
400200 36-45- 15.28190 118-49- 19.57962
500200 36-45- 14.68768 118-48- 14.52309
700200 36-45- 14.13204 118-46- 6.29519

PARCEL FABRIC

An interpreation of underlying geometry for a business purpose. This fabric represents aggregations of the legal description to form parcels as described in deeds and other land records.

LEGAL DESCRIPTION FABRIC

This fabric is the Adjusted Measurement Network that has been densified with COGO procedures to further divide the land as prescribed by legal documents. These elements are divided to the degree necessary to support the construction of parcels. The geometry of physical features as derived from a GIS coverage may be used as a reference to create a description that is bounded by an unsurveyed boundary such as a river, ridgeline or highway. Each area is labeled with the identifier of the associated legal description.

ADJUSTED MEASUREMENT NETWORK

A set of topologically related measurements (coordinate points and lines) and constructions (area-based features, non-surveyed features) that have been adjusted with the surrounding measured features to derive a network solution for the most likely coordinate values.

PRE-ADJUSTMENT MEASUREMENT NETWORK

A set of topologically related measurements (coordinate points and lines) and constructions (area-based features, non-surveyed features) that have been internally adjusted, but that do not edgematch with adjoining measurement features in the overall land net.

SURVEY TRAVERSES

This consists of control points and the bearings and distances necessary to physically survey to the points (indicated by dots in the figure) that are going to define the measured features. At this point the measured data within the survey has been adjusted so there is a distinct set of coordinates.

FIELD SURVEY DATA

This consists of listings of measured angles, measured distances, GPS and other control coordinates, descriptions of features that are being measured and information about the measuring tools. The preadjusted measured values all have some error in them by nature and this prevents these values from forming a distinct set of coordinates. Directions (bearings and azimuths) are derived from this set of angles.

2.7 Summary of NILS Business Process Components

The National Integrated Land System (NILS) is a joint project between the BLM and the USDA Forest Service in partnership with the states, counties, and private industry to provide business solutions for the management of cadastral records and land parcel information in a Geographic Information System (GIS) environment. The goal of NILS is to provide a process to collect, maintain, and store parcel-based land and survey information that meets the common, shared business needs of land title and land resource management. The Forest Service and BLM's vision is to make parcel-based land information available for managers, specialists and the public in an organized automated system. A fast, easy, user-friendly automated national integrated land system will provide both agencies, our partners and the public with better tools for efficient multiple-use management of the national forest and public lands.

The NILS concept would provide the user with tools to manage land records and cadastral data in a Field-to-Fabric manner. The user would be able to use field survey measurement data directly from the survey measuring equipment, manipulate this data into lines and points, and create legal land and parcel descriptions to be used in mapping and land record maintenance. Data and information would be accessible via the Internet for research and analysis.

This concept implies the development of a common data model that unifies the worlds of surveying and GIS. This unification concept is fundamental for land records managers and maintainers of cadastral mapping databases to improve the accuracy and quality of the data to create standard land descriptions and cadastral data that can be used by anyone.

NILS is intended to provide a common data model and tools to manage land records as described in the following system component overviews:

- **Common Cadastral (land) Data Model—**Data model built upon the FGDC Cadastral Content Standard, enhanced to meet the core functional requirements of the NILS partnerships. The model would contain feature object classes representing the properties, rules, and behaviors of cadastral entities, and designed as an open and extensible format to facilitate both generalization and customization.
- **Survey Management Process—**An integrated set of automation objects that are embedded into compatible survey data collection software packages to support the capture of measurement features and metadata into a database format. The goal of the Survey Management Process is to minimize the need for data conversion and re-construction as measured features are incorporated into the land records management system.
- **Measurement Management Process—**Produce a new feature coordinate solution by performing a weighted planimetric-geodetic adjustment according to the qualitative characteristics of individual feature elements in the working set. The Measurement Management Process enables users to create a higher-quality, control network database for the Public Land Survey System (PLSS) and the non-Rectangular Survey System (metes and bounds), relying upon much of the feature and functionality inherent in the GCDB Measurement Management system (GMM).

- **Parcel Management Process—**A process for managing land records and cadastral feature data stored in the database model, providing custom feature classes, tools, and procedures for editing land records in a transactional, history tracking environment. Users would be able to customize the Parcel Management process to accommodate their established workflow and business processes.
- **GeoCommunicator—**A proactive Internet subscription process for sharing access to data stores and to planned and existing program project activities in cadastral and realty to facilitate collaborative capabilities and data sharing.

3.0 Land Records Environment

"There is something admirable about American land tenure, a free system which has permitted landless laborers and penniless immigrants to climb the agricultural ladder…"

G.S. Wehrwein, 1939, cited in Spiegel, Henry W. Land Tenure Policies at Home and Abroad. Chapel Hill, University of North Carolina, 1954, p.4

3.1 Introduction

Land and survey systems describe the way we own and transfer land. A deed describes from whom land is obtained, the extent of the land that is conveyed, the rights received in the transfer, and information about dates and people. Land and survey systems provide the formats and information that need to exist to own and transfer land.

Geographic information system (GIS) technology encompasses the concepts of both automated mapping and database management, and uses computer graphics to show spatial relationships. GIS plays a big role in improved and expanded performance of job tasks and responsibilities of users in government, environmental, industrial, and utility settings. While the potential of a GIS is limitless, the need to capture parcel information is fundamental to achieving that potential.

3.2 Cadastral and Land Records Concepts

The NILS is focused on building the tools and systems for parcel mapping and attribute relationships for digital parcel mapping. Control surveys are the spatial foundation of base maps and parcel mapping. The NILS project incorporates the capture and adjustment of control and framework data to support parcel mapping. The parcel mapping itself involves interpreting legal descriptions and expressing them as parcels. The last step is to link the mapping to transaction processing (attribute) systems. This final step provides a GIS with the richness it needs to play its supporting role of decision support.

3.2.1 Control Surveys

Control surveys are important for establishing a spatial reference framework for all parcel mapping. Regardless of the method of compilation, whether it is aerial photography, coordinate geometry or global positioning systems, the control surveys are a necessary first step. The density and accuracy of the control survey network may be varied and the way in which it is used in a parcel mapping project may vary, but it is essential and present in all GIS and parcel mapping projects.

A geodetic control network is the reference framework on which continuous and consistent mapping and surveys are based. To understand the function of geodetic control it is important to realize that a map or a plane survey is a flat representation of the real, curved world. If the maps are to become an authentic representation of the real world we have to be able to 'paste' small pieces of (flat) map contents onto a curved world. Geodetic control is

the mechanism that enables us to perform this 'pasting' accurately and consistently. Obviously, the need for geodetic control depends on the accuracy specifications of the map (GIS), the extent of area being mapped (the larger the area, the larger the deviation between a curved surface and a plane), and the desire for compatibility with other mapping or GIS projects.

3.2.2 Geodetic Datum

NILS - as both a data model and a software solution - will support user-defined implementations that have the datum, coordinate systems, projections, ellipsoids, and spatial references as chosen by the user. NILS will not dictate any of these as standard, but will enable all of them.

A datum is defined as any numerical or geometrical quantity or set of quantities which serve as a reference or base for other quantities. Traditionally, two types of datums are used: horizontal and vertical.

A horizontal datum is a surface of constant values which forms the basis for the computations of horizontal control surveys. In a horizontal datum a reference ellipsoid is used as a mathematical approximation of the shape of the earth. Five parameters are required to define a horizontal datum: two to specify the dimensions of the ellipsoid, two to specify the location of an initial point (origin), and one to specify the orientation (i.e., north) of the coordinate system. The two main horizontal datums used in the U.S. are the North American Datum of 1927 (NAD27) and the North American Datum of 1983 (NAD83).

In 1986, NAD83 replaced NAD27 because the latter was found not to be accurate enough to support modern positioning activities that occur in highly accurate electronic measurement systems and satellite-based positioning systems (Figure 3.1). NAD83 is an earth-centered datum and relies on an ellipsoid (and other constants) of the Geodetic Reference System of 1980 (GRS 80). It is important to note that Global Positioning System (GPS) position calculations are based on the World Geodetic System of 1984 (WGS 84) datum, which for all practical purposes is identical to GRS 80.

A vertical datum is a surface that represents heights above the geoid. The geoid is an approximation of sea level. Heights referred to the geoid are called orthometric heights, which stand in contrast to ellipsoidal heights, which refer to the ellipsoid. In the U.S. there are two vertical datums: the National Geodetic Vertical Datum of 1929 (NGVD29) and the North American Vertical Datum of 1988 (NAVD88). Superceding NGVD29, NAVD88 is a newly-defined and computed vertical datum, and provides a consistent, very accurate set of height values for cartographers, surveyors, and geodesists. One should note that the elevation of a given point can vary significantly depending on whether it is expressed in NGVD29 or NAVD88 values.

Figure 3.1. Expected Horizontal Change from NAD27 to NAD83 (WGS84) in Meters

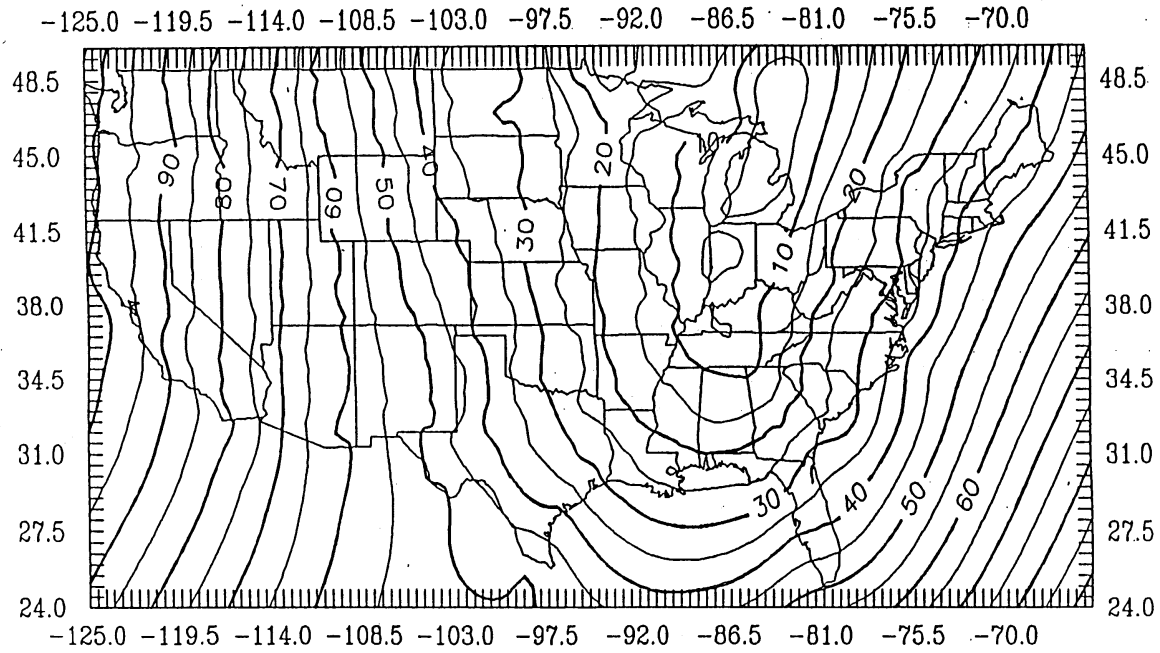
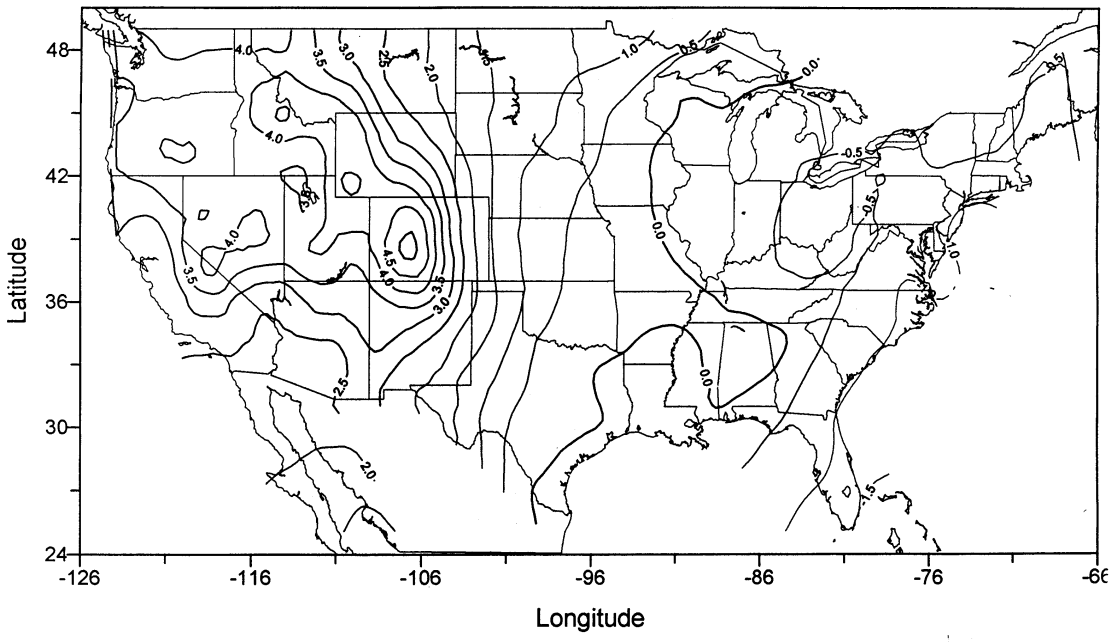
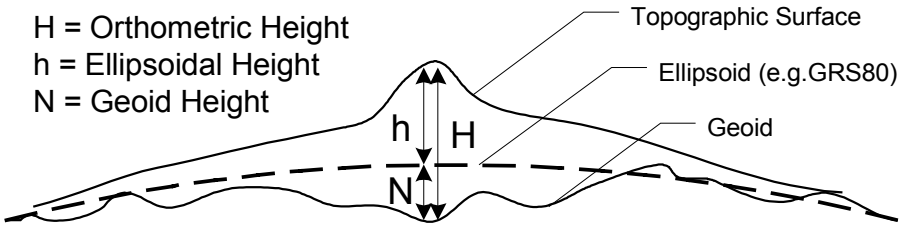


Figure 3.2 Expected Vertical Change from NAVD88 to NGVD29 in Feet



While elevations are not required for most parcel mapping applications, elevations and depths are required to support many business processes. Since GPS offers a three-dimensional solution, elevations are available for every point. This elevation data should be stored in the GIS. As mentioned earlier, the GPS-derived elevation refers to the ellipsoid (ellipsoidal height), not the orthometric height. (See Figure 3.3). Therefore, before one uses any elevation data it is imperative to identify the height system on which the elevation is based.

Figure 3.3. Ellipsoidal Height



3.2.3 High Accuracy Reference Networks (HARN)

The original NAD83 geodetic network was computed mostly by using traditional surveying observations and methods. Very few GPS observations were included in the adjustment computation. The design and implementation of this network preceded the developments of the GPS technology and therefore the practical usage of these control points for GPS applications can be problematic.

To remedy this situation many states developed a High Accuracy Reference Network (HARN). The HARN was designed to establish 'GPS-able' geodetic control points accessible 24 hours a day by car or light truck within, at most, 30 to 45 minutes travel. Once a HARN is established, a new adjustment is computed and the points in the network are assigned new coordinates (different from those of the original NAD83 adjustment).

3.2.4 The State Plane Coordinate System (SPCS)

It is impossible to map a curved Earth on a flat map using rectangular coordinates (x,y or northing, easting) without distorting angles, distances, or areas. It is possible to design a map projection such that some of the three are undisturbed or minimally distorted. The State Plane Coordinate System (SPCS) is a map projection system that minimizes angular distortions if only a small portion of the earth is flattened out. Thus, the SPCS is a rectangular (x,y or northing, easting) coordinate system describing geodetic positions of a limited area (a state or a portion of it) on a plane. The coordinates are computed by projecting latitudes and longitudes from a mathematical approximation of the earth (i.e., NAD27 or NAD83) onto a rectangular grid. SPCS consists of a set of mathematical relationships that are used to convert northings and eastings into latitudes and longitudes and vice versa. It also includes a set of formulas to compute the size and the direction of location displacement (positional error) resulting from the projection process.

The NILS project would include the tools to conduct these conversions.

3.2.5 Parcel Mapping

Data sources for parcel mapping fall into one of two general categories: primary or secondary data. Primary data sources include data compiled directly from field measurements using traditional surveying methods or GPS. The most common methods of producing parcel maps depend on secondary sources. Secondary data sources include data compiled from deeds, legal descriptions, survey maps or previously compiled hard copy parcel maps, such as tax maps. The quality of spatial data secondary sources depends not only on the accuracy of the descriptions and extractions but also on the ability of the cadastral mapper to interpret the information in the documents.

COGO, or *coordinate geometry*, is a computational method that converts secondary data sources, such as bearings or azimuths and distances into point coordinates. Using mathematical calculations, the COGO software transforms field measurements into geographic positions and spatial relationships.

Another type of computation called *least squares adjustment* is a statistically based computational method that also transforms measurements and data from secondary sources into geographic positions. The advantage of least squares over coordinate geometry is that the statistical quality of every geographic position is determined from the quality of the measurements or secondary sources that are used in the computation. Least squares also provides a simultaneous computation of any defined area. The disadvantage of least squares adjustment is that it may appear more complicated at first and it is not as familiar to most cadastral mappers as coordinate geometry.

The NILS project includes developing both of these types of tools into one environment called measurement management. Measurement management is the data and process to evaluate and apply a variety of observations and data for parcel data to achieve the best possible parcel map at any point in time.

3.2.6 Sources for Parcel Data

Parcel data are available from various sources. The most common data sets are the maps and deeds that can be found at in county courthouses across the country. In the federal government the BLM is designated as the official keeper of the land records for federally owned land. Other land agencies such as the Forest Service, Fish and Wildlife and the National parks also have land information that can be used to build parcel maps.

In some cases parcel maps have been generated by local governments to support tax mapping. In these cases a cadastral mapper has interpreted deeds and surveys and compiled those interpretations on to a hard copy map. Sometimes these paper maps are based on control surveys and sometimes they are representations that are not registered to the ground through control. Even though a tax map may not show bearings and distances, these parcel representations may be a good start for a local government in building a GIS. The NILS project would have tools to automate and transform these hard copy representations into a measurement management system where the data can be maintained into the future.

3.2.7 Quality Assurance and Quality Control

Quality control methods are applied throughout the creation of and maintenance of any parcel map. Quality assurances are the measures that are put in place to verify that the

quality control methods are being used and properly applied. The following are some quality assurance procedures that might be instituted in a parcel mapping program.

- *Visual Check*—compare the positions of parcel lines to orthophotography. Look for buildings crossing lot lines, lot lines that extend beyond the ROW lines, and lots that are not completely enclosed.
- *Distance Check*—Systematically check actual lot line lengths (those listed in the deeds) to the lengths computed in the GIS.
- *Statistical Error Check*—Using the principles of least squares analysis view the statistical error for computed points and compare these to the known points and to measurements of known quality.

The NILS project tools would provide for these and other quality assurance tools and methods.

3.2.8 Relating Attribute Data to Digital Parcels

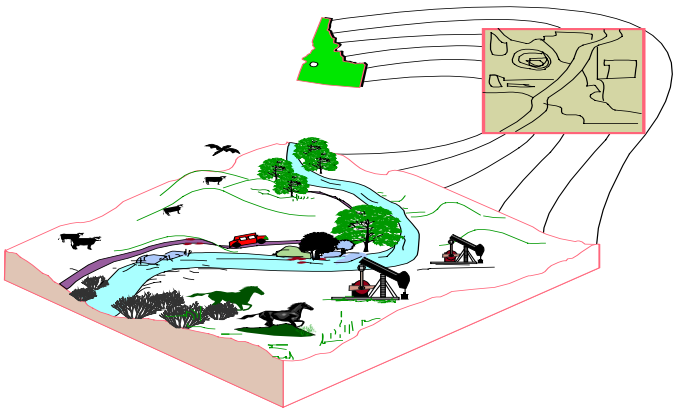
Attribute data provides richness to the GIS. It is parcel attribute data that forms the basis for most decision making. One of the most effective ways to enhance the benefits of a GIS parcel base is to incorporate data layers, such as tax assessment data, which are readily available at the municipal or county levels.

Each parcel in a GIS has a corresponding set of data 'behind the scenes.' Fields that are grouped into a record for each feature distinguish this underlying attribute data. It is this organizational structure that facilitates common GIS applications, such as graphically selecting a feature to retrieve the data linked to it in a feature attribute table. (See Figure 3.4.)

The NILS project supports adding any number of attributes and related text information to the digital parcel map. The tools for adding attributes and linking to existing systems is part of the functionality, but the specifics of which attribute information any location or jurisdiction may need are left to the end users.

Figure 3.4. The Vehicle for Linking All of the BLM's Activities and Land

NILS envisions the ability to make parcel-based land information available for all managers, specialists and the public in an organized automated environment.



3.3 Key Documents Related to Land and Survey Systems

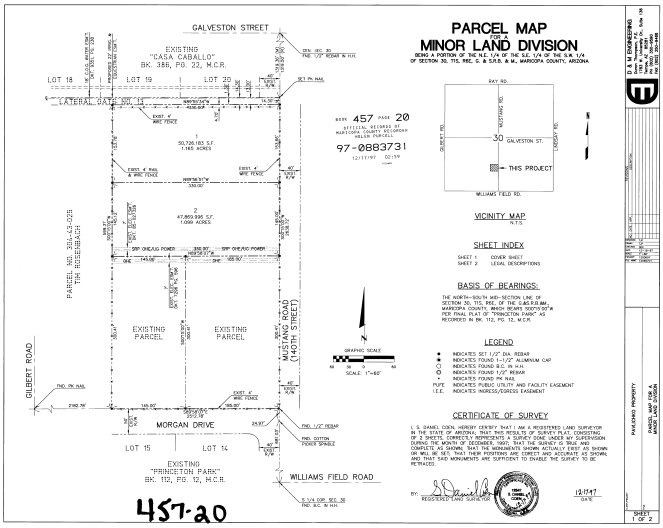
There are several familiar documents that are used to describe and transfer land ownership. These documents provide records of transactions. They are important to the NILS project because records of transactions are the basis of the data collected and used by land management agencies and many levels of government.

Perhaps the most familiar land-related document is the deed. There are two primary types of deeds: warranty deeds and quit claim deeds. Warranty deeds are used when the current owner and seller (grantor) warrants to the buyer (the grantee) that the rights and interests in the land are good. In a quit claim deed the owner or seller quits the interests they have in the land and passes any interests they may have to the buyer (grantee). It is actually possible to quit claim title to something you do not own to another person since you are not warranting that you have anything to convey.

Another type of document that is important to local and county governments is a survey plat. Traditional survey plats contain significant information in addition to the spatial configuration of land parcels. Capturing, editing and displaying this important information is performed by licensed professionals and done in accordance with applicable statutes and regulations. A survey plat describes the observations and measurements made by a licensed land surveyor. It establishes the rights and interests and the extent of land as observed and determined by the surveyor. Survey plats are important to NILS because they provide an important source for observations and measurements in the measurement system. Unlike the descriptions of land in deed, survey plat descriptions are known to be collected by a licensed land surveyor.

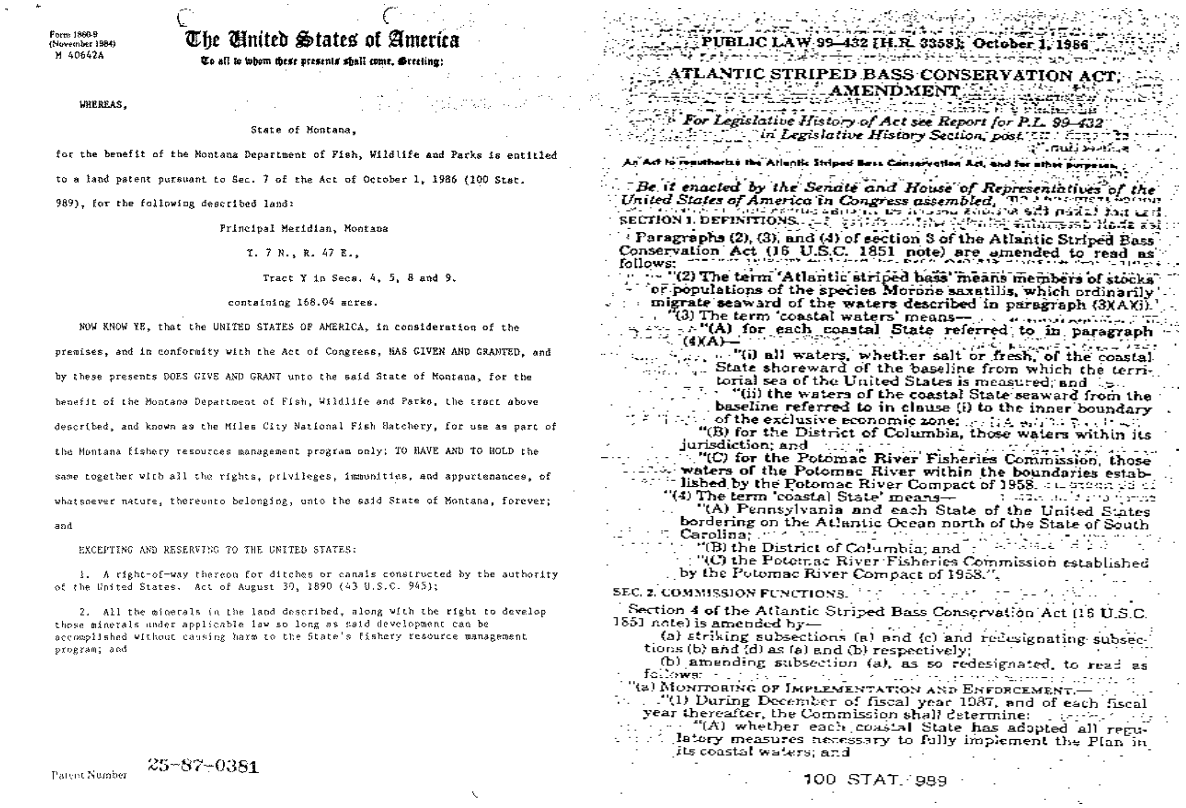
The requirements for survey plats vary from state to state. In some states they are called plats of survey or certified survey maps. Regardless of the name or the observation and reporting standards, all survey plats are collected by surveyors and contain important measurements for determining parcel boundaries and mapped features (Figure 3.5).

Figure 3.5. A Survey Plat



Government patents are special type of deed that conveys interest in land from the federal government to an individual or corporation. Government patents are special types of quit claim deeds. Once land passes from the federal government to another landowner, an original patent can never be issued again. Original patents are important to NILS because they often establish a beginning point for the status determination (Figure 3.6).

Figure 3.6. Patent (left) and Act of Congress Authority For Patent (right)



Form 1860-9
(November 1984)
M 40642A

The United States of America

To all to whom these presents shall come, Greeting:

WHEREAS,

State of Montana,

for the benefit of the Montana Department of Fish, Wildlife and Parks is entitled to a land patent pursuant to Sec. 7 of the Act of October 1, 1986 (100 Stat. 989), for the following described land:

Principal Meridian, Montana

T. 7 N., R. 47 E.,

Tract Y in Secs. 4, 5, 8 and 9.

containing 168.04 acres.

NOW KNOW YE, that the UNITED STATES OF AMERICA, in consideration of the premises, and in conformity with the Act of Congress, HAS GIVEN AND GRANTED, and by these presents DOES GIVE AND GRANT unto the said State of Montana, for the benefit of the Montana Department of Fish, Wildlife and Parks, the tract above described, and known as the Miles City National Fish Hatchery, for use as part of the Montana fishery resources management program only; TO HAVE AND TO HOLD the same together with all the rights, privileges, immunities, and appurtenances, of whatsoever nature, thereunto belonging, unto the said State of Montana, forever; and

EXCEPTING AND RESERVING TO THE UNITED STATES:

1. A right-of-way thereon for ditches or canals constructed by the authority of the United States. Act of August 30, 1890 (43 U.S.C. 945);

2. All the minerals in the land described, along with the right to develop those minerals under applicable law so long as said development can be accomplished without causing harm to the State's fishery resource management program; and

Patent Number 25-87-0381

PUBLIC LAW 99-432 [H.R. 3358]; October 1, 1986

ATLANTIC STRIPED BASS CONSERVATION ACT; AMENDMENT

For Legislative History of Act see Report for P.L. 99-432 in Legislative History Section, post

An Act to reauthorize the Atlantic Striped Bass Conservation Act, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. DEFINITIONS.

Paragraphs (2), (3), and (4) of section 3 of the Atlantic Striped Bass Conservation Act (16 U.S.C. 1851 note) are amended to read as follows:

"(2) The term 'Atlantic striped bass' means members of stocks or populations of the species Morone saxatilis, which ordinarily migrate seaward of the waters described in paragraph (3)(A)(i).

"(3) The term 'coastal waters' means—

"(A) for each coastal State referred to in paragraph (4)(A)—

"(i) all waters, whether salt or fresh, of the coastal State shoreward of the baseline from which the territorial sea of the United States is measured; and

"(ii) the waters of the coastal State seaward from the baseline referred to in clause (i) to the inner boundary of the exclusive economic zone;

"(B) for the District of Columbia, those waters within its jurisdiction; and

"(C) for the Potomac River Fisheries Commission, those waters of the Potomac River within the boundaries established by the Potomac River Compact of 1958.

"(4) The term 'coastal State' means—

"(A) Pennsylvania and each State of the United States bordering on the Atlantic Ocean north of the State of South Carolina;

"(B) the District of Columbia; and

"(C) the Potomac River Fisheries Commission established by the Potomac River Compact of 1958."

SEC. 2. COMMISSION FUNCTIONS.

Section 4 of the Atlantic Striped Bass Conservation Act (16 U.S.C. 1851 note) is amended by—

(a) striking subsections (a) and (c) and redesignating subsections (b) and (d) as (a) and (b) respectively;

(b) amending subsection (a), as so redesignated, to read as follows:

"(a) MONITORING OF IMPLEMENTATION AND ENFORCEMENT.—

"(1) During December of fiscal year 1987, and of each fiscal year thereafter, the Commission shall determine:

"(A) whether each coastal State has adopted all regulatory measures necessary to fully implement the Plan in its coastal waters; and

100 STAT. 989

3.4 Describing What We Own

When we think of land ownership we often think of what is called fee ownership or complete ownership. But in fact what we own is more likely characterized as a bundle of rights, sometimes referred to analogously as a bundle of sticks with each stick being a right in land. For example, the hunting rights, ingress and egress (the right to pass over) are examples of rights that may be separated from the fee or simple ownership to someone else. The collection of rights that can be given to others are sometimes called separable rights since they can be separated from the right of occupancy and enjoyment. In most states the mineral rights, sometimes called the mineral estate, can be separated from the surface rights. In recent times things like transferable development rights have also become separable rights.

The separable rights are important to NILS because to support federal land management and to determine the federal land ownership status all of the separable rights must be tracked through time.

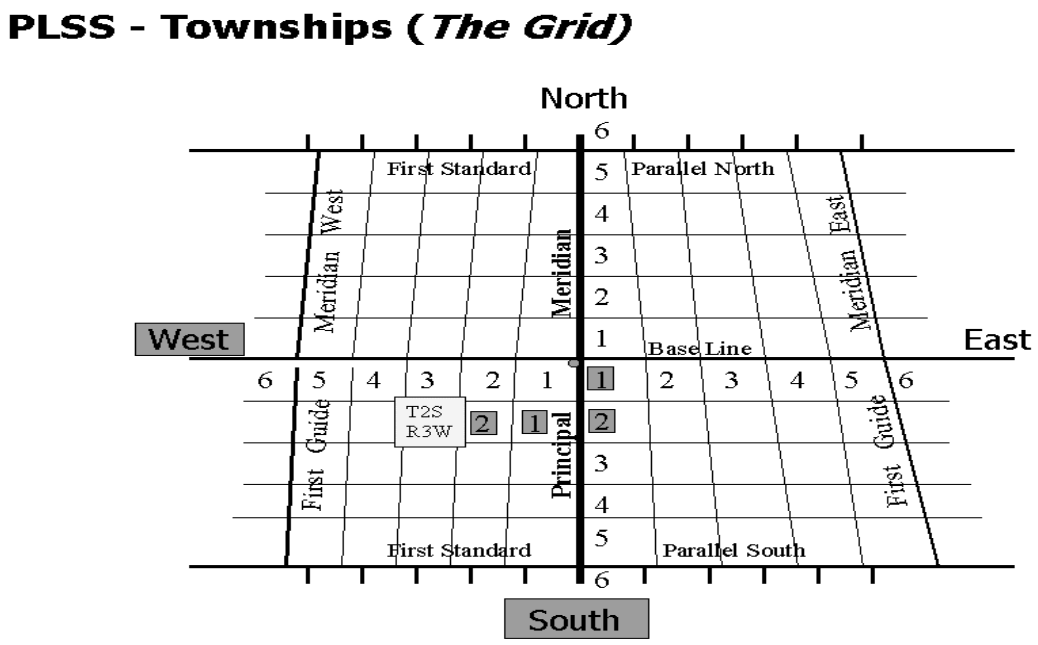
3.5 Describing the Extent of What We Own

3.5.1 History

In the first days of the nation settlements were made by chartered trading companies and merchant adventurers. The Plymouth and Virginia companies are two examples. The authority of these companies came from European thrones and sponsors. These groups had no methods or procedures for distributing land and held land as community ownership. As the colonies grew, land distribution was made in grants to individuals and groups and were described along natural and observable features.

After the Revolutionary War the first public domain was established as land held by the government. These public domain lands were the first lands held by the new nation. The first project to dispose of part of the public domain was the Northwest Ordinance passed by Congress in 1785. As part of this ordinance Thomas Jefferson devised a rectangular system of surveys called the Public Land Survey System (PLSS). The purpose of the PLSS was to inventory the land and to measure and divide it into predefined units for the orderly disposal of the land. The PLSS is based on nominally one mile by one mile areas, called sections. Thirty-six sections combined in a six mile by six mile block formed a PLSS Township (Figure 3.7). Today, the public land survey system dominates the land descriptions in the West. The regular grid areas became the basis for roads and land ownership and today the grid is visible from space. The public land survey system is not only a method of survey and measurement: it is the nation's first land inventory.

Figure 3.7 The Public Land Survey System



There are several notable exceptions to the use of the PLSS. Unlike other states, Texas was an independent republic at the time of its admission into the Union. The Texas methods for dividing and parsing out land are based on systems defined in the Republic. To this day

there are large single landowner tracts in Texas. The King's ranch in Texas is one of the largest privately held single tracts of land in the world. In the Southwest large Spanish land grants were brought into the Union as single blocks. These too came in under prior republic ownership. The third deviation from the rectangular system in the West is other grants of land that existed prior to the establishment of the rectangular system. Some of these are town sites, some are grants, or homesteads, but they all stand as islands of non-rectangular descriptions nested within the public domain.

3.5.2 Legal Descriptions

A discrete area of land may be described by narrative and geometry. The narrative version is what the land records community commonly refers to a **legal description**. It is this text version that is included in instruments of conveyance (deeds, patents), withdrawals (Executive Orders, Public Land Orders), and in leases, permits, and so on.

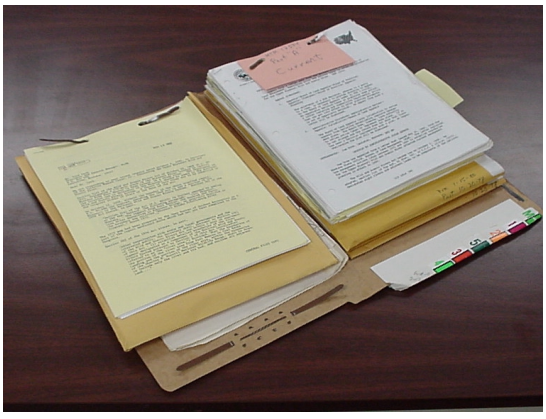
Legal descriptions typically have a geometry that can be located relative to some survey system. Categories of legal descriptions include the following:

- Area legal description (also known as an areal reference)—Examples of area legal descriptions are: geopolitical, PLS, Block-Lot, Mineral Survey, and irrigation lots. An area legal description is nominal; it is delimited in a reference survey system having area taxonomy, nesting and division rules.
- Perimeter legal description—Examples of perimeter legal descriptions are: record boundary, metes and bounds, sequenced set of bearings and distances, strip description, adjoiner description, riparian or aquatic area description, reference calls to natural features (e.g., contour, ridgeline, watercourse).
- Portion/remainder legal description—Examples are: area as a quantity {e.g., 'north sixty acres of…', 'the north four-hundred feet of…'), exclusions; other reference calls; ambiguous areas that cannot be mapped relative to any reference.

3.6 BLM Examples of Land Records

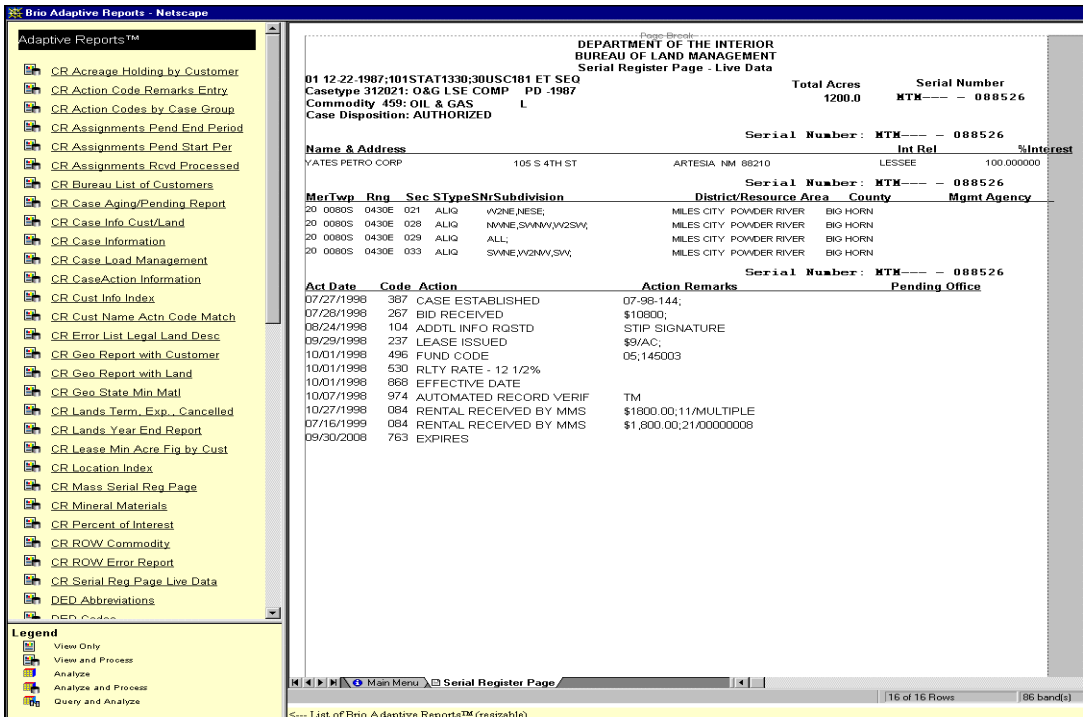
Case File—A record that documents a specific action, event, person, place, or project, such as serialized land and mineral files, and grazing files (Figure 3.8).

Figure 3.8. A Case File



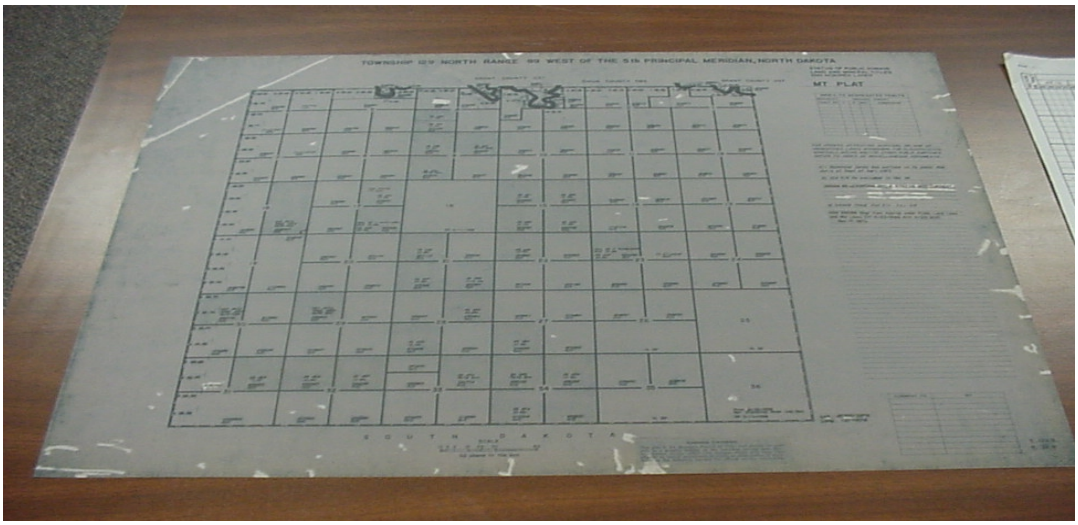
Serial Register (SRP)—A case record which consists of serial pages bound in volumes in a public room, on microfiche, or in a computer data file (Figure 3.9).

Figure 3.9. A Serial Register in a Report Viewer



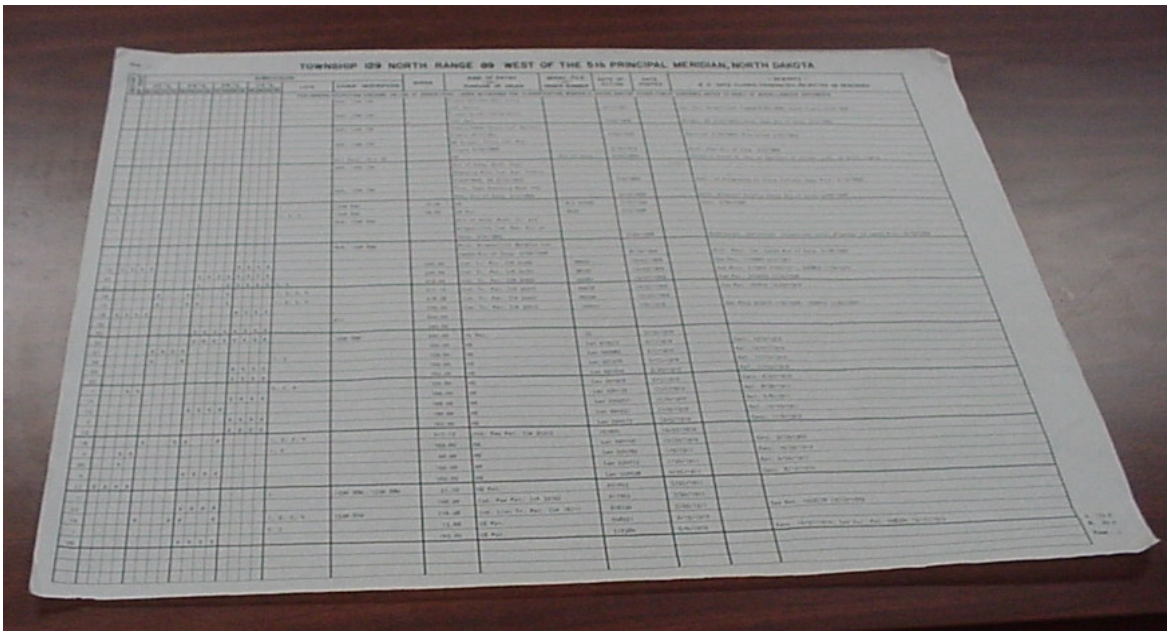
Master Title Plat (MTP)—A composite of the survey plats of each township on which is shown the ownership and land status (Figure 3.10).

Figure 3.10. An Original Master Title Plat Printed on Mylar



Historical Index (HI)—Works hand in hand with MTP above. An HI is a chronological narrative of all past and present actions, which affect the use of or title to public lands and resources (Figure 3.11).

Figure 3.11. An Original Historical Index Printed on Vellum



Control Document Index (CDI)—An index consisting of microfilmed copies of patents and deeds that convey title to and from the United States. It also includes microfilmed copies of documents that affect or have affected control, or limit or restrict the availability of right, title or use of Federal lands. The CDI microfilm cards are arranged chronologically within townships by state, meridian, range and township (Figure 3.12).

Figure 3.12. A Control Document Index Cabinet

3.7 Examples of State and Local Government Land Records

Register of Deeds

When dealing with land ownership, a County Recorder or Register of Deeds is likely to perform any or all of the following duties:

- Record documents (such as deeds) pertaining to real estate property, and collect fees set by statute
- Make acceptable legal documents a matter of permanent public record
- Make a microfilmed or optically scanned digital copy of the recorded documents
- Index documents so they may be located in the future
- Maintain cross-referencing indexes to recorded records
- Maintain a set of plat maps which show the current ownership of every tract of land in the county
- Make records available for public inspection
- Provide copies of documents (usually for a fee)
- Record information updates, such as name changes
- Index recorded documents by the names of the principal parties, by the location of the land (abstract), and by the kind of instrument
- Provide certified replacement copies for lost originals

In general, when dealing with transactions, a County Recorder's role is *passive*. This means that recorders are observers of transactions, but not participants in the transactions. Recorders are most interested in the **record** of the transaction.

An agency like the BLM, on the other hand, is an *active* participant and is interested in the rights associated with the transaction, such as monitoring leased allotments, or converting land uses. The BLM makes decisions on how the land will be used while transactions are taking place. County recorders generally document transactions, without being involved in the decisions about uses of the land. Explanation of passive and active roles for land records management is contained in Appendix D.

The list below describes a typical series of steps that a County Recorder's office might go through when recording a document pertaining to rights and interest in property, such as a deed.

1. The original document is recorded with a date and time.
2. The document may be stamped or otherwise noted with information about fees and/or taxes.
3. Any accompanying affidavits and powers of attorney are recorded and indexed.
4. A copy of the document is indexed and filed.
5. The original document is returned to the customer, who is charged a fee for the recording of their document.

6. Documents are preserved, and may be in books, on microfilm/microfiche, and/or scanned and stored digitally.
7. Duplicate copies are stored off site, in secure locations, vaults, archives, etc.
8. Information on real property transactions (deeds which convey rights and interests in land between grantors and grantees), is passed along to the Assessor's and Treasurer's Offices.
9. Information for Department of Revenue tax reference may pass through the Recorder's office, but may not be recorded.
10. The tract index and plat map are updated with information about the property from the recorded document.
11. If the transaction is the creation of a subdivision, documents for the new block and lot descriptions are indexed, and the survey plat is updated.

County recorder activities frequently entail additional steps than those summarized above, such as noting information for property in dispute or litigation, agreements between corporations, and tax liens (e.g., property tax management and land use regulation).

3.8 NILS and Standards

Because NILS is sponsored by federal agencies, it is essential that NILS provides a data model that supports compliance with the relevant federal data standards. The NILS data model will be an implementation framework that individual agencies may customize as required. State and local NILS users may implement modified versions of the data model and NILS will provide functionality to support the inter-agency data sharing and exchange that is fundamental to a National Integrated Land System.

At the federal level, the primary data content standards come from the Federal Geographic Data Committee (FGDC), which was formed by OMB Circular A-16 to support the development and maintenance of a National Spatial Data Infrastructure (NSDI). More information on the NSDI and FGDC can be found at **http://www.fgdc.gov**.

There are several important FGDC standards that are being leveraged by the NILS project. The first is the Cadastral Data Content Standard. This standard was first approved in December 1996 and it forms a basis for describing the syntax or common definition of objects or items used to describe land ownership. The following describes how the Cadastral Data Content Standard might apply to a County Recorder or Register of Deeds as an example of what is meant by content standard.

The left column of Table 3.1 contains a list of real property and cadastral data typically recorded and stored by County Recorders and Registers of Deeds. The right column contains the corresponding Cadastral Data Content Standard entity and attribute.

Overall, the table lists a potential of twenty-seven connections between commonly used County Recorder data and the FGDC Cadastral Data Content Standard. This represents twenty-nine links, key terms, or relate items—in other words, a wealth of capability to work not only with standardized definitions but to use these definitions as understandable links between multiple agencies and varying databases.

Table 3.1 illustrates the following:

1. The Cadastral Data Content Standard offers a significant range of definitions and terminology for data commonly used by county recorders.
2. There are likely to be some attributes in the Cadastral Data Content Standard that county recorders may not use. For example, the list of typical county recorder data above does not include information on restrictions, found in the Standard.
3. Likewise, there are likely to be elements in local data that are not included in the Cadastral Data Content Standard, such as information about tax districts and street names.

County Recorder offices (and other county departments) can make use of many of the Cadastral Data Content Standard's attributes to link their data with other departments, as well as with other County, State, and Federal agencies, and business dealing with real property and cadastral information.

A second important FGDC standard is the Geospatial Metadata Content Standard. This standard describes how data about data or information about the lineage, quality, source contact, and possible intended use of data. These data are extremely important if information is posted to the Internet shared or used by anyone other than the data producer. cadastral data falls into this category on all counts. As an implementation framework, the NILS data model will provide support for embedding FGDC-compliant metadata.

The ALTA (American Land Titles Association) standards provide definitions for what should be included in a survey done for a lending institution or for a private landowner. It includes recommendations about information such as historical use of the land, floodplain and wetlands locations, underlying geological conditions, mineral rights, and any element that may cloud or affect title to the land. While the NILS data model as a framework will not directly implement ALTA standards, the NILS data model would support a custom database implementation if a user agency needed to achieve compliance with the ALTA standard.

Cadastral and land ownership data have unique database implementations by individual user agencies. This creates a true patch work quilt of quality, completeness, and consistency across the nation. One of the goals of the NILS project is to provide the tools to develop a common backing to this quilt fabric that can be used by all governmental units.

The Manual of Instructions for the Survey of the Public Lands of the United States, 1973 is an example of standards that describe techniques of survey from 'field to fabric' for BLM surveyors (Figure 3.13).

Table 3.1. County Recorder Data and Corresponding CDCS Entities

County Recorder Data	Cadastral Data Content Standard Entity or Attribute
County	Public Agency/County
State	Public Agency/State
Town	Public Agency/City-Village-Town
County Recorder Office	Public Agency/Public Agency Name
Recorder's indexing number	Transaction/Transaction ID
County Recorder	Transaction/T-Source Agent
Book, Page	Transaction/T-Source Index
Date Recorded	Transaction/Recorded Date
Time Recorded	Transaction/Recorded Time
Parcel Number	Parcel/Parcel Local Label
Survey Meridian and Baseline	PLSS Description/Origin of Public Land Survey System
Township	PLSS Township/Township Number
Range	PLSS Township/Range Number
Direction	PLSS Township/Township Direction (or Range Direction
Section	PLSS Township First Division/Type
Section Number	PLSS Township First Division/Designator
Quarter Section	PLSS Township Second Division/Second Division Type
Quarter Quarter Section (16th)	PLSS Township Second Division/Second Division Type
Block	PLSS Township Second Division/Second Division Type
Lot	PLSS Township Third Division/Third Division Type
Parcel	PLSS Township Third Division/Third Division Type
Boundary Azimuth or Bearing	Straight Line/Direction Value
Boundary Distance	Straight Line/Distance Value
Acres	Parcel Area/Parcel Area Unit
Quantity of Acres	Parcel Area/Parcel Area Quantity
Monument Description	Corner Point/Monument Type
Land Surveyor's Name	Agent/Agent Name
Date of Survey	Legal Area Descriptions/LAD Source Date
Owner Name	Agent/Agent Name

Figure 3.13. Example Description of 'Field-to-Fabric' Survey Techniques

quently this permits their complete showing on the base drawing.

Occasionally it is feasible to letter the number and name of each claim on the base drawing. More often this is impracticable, and serial numbers for the purpose of indexing only should be assigned to all segregated locations throughout the township and carried to a marginal table followed by the survey number and name of each location. When this is done only the serial numbers are shown on the face of the drawing. Where a number of mineral surveys are segregated, large scale drawings on additional sheets may be required for each of the sections invaded. An outline of the mineral surveys is shown on the base plat for the sections involved, and a marginal reference is made on the base drawing calling attention to the sheets upon which the segregations in the various sections may be found. In many instances an enlarged diagram on the base plat will obviate the necessity for an additional sheet. Figure 84 (discussed in section 9–74) is an example of a drawing which should be shown as an enlarged diagram on the base plat.

9–10. Transparent color overprints are employed for those plats where topographic features tend to obscure the essential data on the base drawing. Overprints are not required where these features may readily be shown in black on the base drawing.

DRAFTING THE BASE DRAWING

9–11. Township plats are generally drawn on the scale of 1 inch equals 40 chains, on sheets 19 x 24 inches when trimmed. The scale is often enlarged to 1 inch equals 20 chains for showing portions of townships in detail; the scale of 1 inch equals 10 chains or larger is employed where necessary. A bar or graphic scale stating only the unit of measurement is shown on all plats. The size of the sheets is always made 19 x 24 inches, regardless of the scale or area to be show; this is important on account of the need for uniformity in the dimensions of filing devices. A borderline rectangle 16½ x 20 inches is right for the normal township plat; the size of the rectangle may be varied slightly when necessary. Generally the drawing is placed to the left of the center of the sheet, thus allowing space for the memorandum and other data in the margin to the right and resulting in a better balanced plat.

9–12. The plat subject should be compiled or laid out with a good grade, medium hard drawing pencil, one which will make a clean mark, but not so hard that it will engrave the lines.

9–13. The township is drafted as a plane, without allowance for reduction from the spheroid, as is required in the making of small-scale topographic maps showing large areas. All *regular* townships are laid out as a rectangular grid, with allowance for fractional measurements along the north tier and west range of sections.

9–14. In the case of *irregular* townships, or those containing meanderable bodies of water, or irregular tracts, the drawing should be laid out from the field closing sheets, duly balanced. The point of origin is selected on the drawing, from which point the exteriors are carefully laid out, each salient being accurately located by scaling, from the point of origin, the balanced values of the total latitude and departure of that salient. The section boundaries are then laid out similarly from suitable points of origin on the exteriors. Finally the subdivisions of each section, including the necessary lines of segregation and meander lines, are accurately scaled by the method of total latitudes and departures from an origin on the section boundary. On this plan the work may be laid out without introducing accumulative errors of scaling.

9–15. Elements of triangulation figures and offset lines are not shown on the plat when the field procedure results in ascertaining the course and length of the line established. Such diagrams are shown in the field notes if needed for a clear understanding of the procedure but are not required on the plat.

9–16. Plats of entire townships show the complete condition of all exteriors, including closing and standard township and section corners, with connecting courses and distances (figure 81). The connecting courses and distances are omitted where the scope of the work is not sufficient to determine the relationship accurately. A line common to two townships is

4.0 The User Environment

4.1 Information in the User Environment

The user environment includes a mix of manual and automated business processes that involve information in many formats and systems (some decentralized). Users need to be able to link this information together into a common solution to manage their particular business process. Spatial data and record information (alpha/numeric, text, etc.) need to be able to be linked. Accurate, timely, consistent information is necessary to manage land in an efficient, cost effective manner.

The volume of data and records involved in land management is enormous. For example:

- Private-sector organizations manage volumes of land information as they interact with government agencies and within the private sector for the purchase, lease, sale, use and management of lands. For example, mining and timber companies must manage millions of acres of land, and title companies often develop their own land information systems to support the verification of title for insurance as part of land transactions.
- State, county and local governments manage thousands of cadastral and subdivision plats. Most states have agencies that manage the state's land holdings. These holdings can be parks, lands for facilities, roads, resource areas, set asides, or development rights. In most states, local governments (typically counties) are responsible for recording land ownership information, records of surveys, and, in some cases, conducting surveys. State and local governments approve or review developments, land plans, and surveys.
- The Bureau of Indian Affairs (BIA) has a responsibility to protect tribal lands, assets, resources, and treaty rights, as well as a duty to carry out the mandates of federal law with respect to American Indian and Alaska Native tribes. The BIA administers 43,450,266.97 acres of tribally-owned land, 10,183,530.13 acres of individually-owned land, and 417,224.98 acres of federally- owned land which is held in trust status.
- The National Park Service (NPS) is responsible to promote and regulate the use of Federal areas known as national parks, monuments and reservations, to conserve the scenery, natural and historic objects and the wildlife therein, and to provide for their enjoyment by such means as will leave them unimpaired for the enjoyment of future generations. The National Park System encompasses approximately 80.7 million acres, of which more than 2.8 million acres remain in private ownership.
- The U.S. Fish and Wildlife Service (USFWS) is the principal Federal agency responsible for conserving, protecting and enhancing fish, wildlife and plants and their habitats for the continuing benefit of the American people. The USFWS manages the 93-million acre National Wildlife Refuge System of more than 520 national wildlife refuges and thousands of small wetlands and other special management areas.
- The U.S. Forest Service (USFS) is responsible for managing 192 million acres of forest and grasslands. In addition, a majority of America's forests are privately owned (393 million acres). The USFS updates road and steam inventories, participates in land exchanges, fulfills cartographic requests, and monitors rangeland.

- The Bureau of Land Management (BLM) is responsible for keeping and maintaining the documents related to land ownership for the United States, surveying and maintaining the public lands surveys system, and maintaining the Master Title Plats for close to 50,000 townships. It maintains over 140,000 plats, including survey plats, supplemental plats, and oil and gas plats. The BLM manages approximately 46 million parcels of land. Overall, the BLM manages 264 million acres of surface and 300 million acres if subsurface.

4.2 Users and Cadastral and Land Records Transactions

Each day across the United States, persons involved in land records manage and make decisions affecting millions of acres of land. These decisions are often based on both manual and automated transactions entered into a variety of systems that frequently produce other required events to take place within the business process. The various transactions are often interrelated and can trigger an update cycle that effects various cadastral databases.

Figure 4.1 depicts some of the users involved in land record management activities and some of the typical events in the land management and land records update cycles.

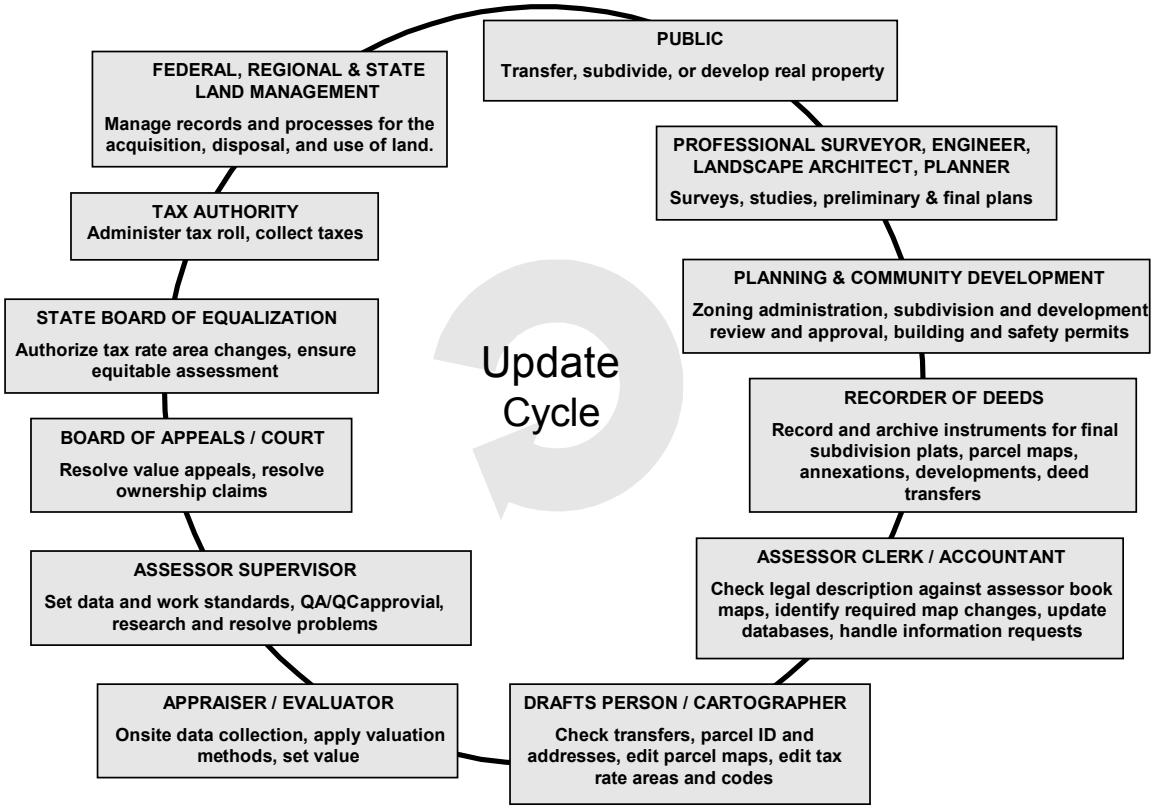


Figure 4.1. Users Involved in Land Rcord Management Activities

4.3 User Roles

Federal, state, county, and local government staff and private land and resource managers, professional surveyors and others with requirements for cadastral land records participated in the initial business process analysis. As a result of this participation the organizations were able to envision a return on their investment that included such goals as increased staff productivity and elimination of process and data redundancy.

Teams were formed representing the entire spectrum of this user community to describe the business processes, define the supporting scenarios for each process and provide steps that might occur within a scenario. The combination of these business processes, scenarios and steps is what makes up the requirements and use cases described in Sections 7.0 through 11.0.

Other user groups, such as BLM's GCDB Technical Advisory Group, the National Association of Counties' GIS Committee, the National States Geographic Information Council, the Intertribal GIS Council, and other state and local organizations from across the United States have been provided briefings on the NILS Project. Great interest in the project has resulted from these briefings.

The NILS is promoting partnerships for the development of a common data model and tools that may be extended and/or customized to meet the needs of all who wish to cooperatively collect, maintain and store parcel-based data.

4.4 Benefits

As a principal sponsor of NILS, the BLM will prepare a Return on Investment (ROI) Analysis and Report prior to the design and development phases of the project. This ROI will be compliant with the Clinger/Cohen Act. The other NILS partners may have similar requirements for preparing investment analysis.

The following are some of the qualitative benefits which would result from the implementation of NILS.

- Integration of positional and descriptive parcel-based land information for all boundary information (surveyed and non-surveyed)
- Users would be able to relate information to a specific parcel on the landscape
- Provide the ability to link the display of parcel-based land status and ownership with other resource information
- Facilitates analysis of potential land uses, opportunities, and conflicts for planning and environmental analysis and other decision making processes
- Consistent methods of creating and editing parcels
- Resolves problems with associating or aggregating legal description(s) from the legal description fabric.

5.0 The Technology Environment

In compliance with the Information Technology Reform Management Act of 1996, the BLM is developing a Bureau Architecture. This will provide a mission-driven framework for BLM's Information Technology investment decisions. All of the technology decisions and investments for the NILS Project will be based on the Bureau Architecture. This includes designing and building an integrated structure of processes, information flows, software, and hardware to meet the business process requirements. The Forest Service and other NILS partners will make their investment decisions on their own internal architecture needs. The following subsections provide a high-level overview of the computing environment requirements.

5.1 Computing Environment

5.1.1 Desktop Environment

The client computing environment for NILS would be industry standard desktop platforms that provide a windowing graphical user interface.

5.1.2 Server Environment

The server computing environment for NILS would be industry standard platforms that can host object or relational database management systems and support a transactional, multi-user client base.

5.1.3 Intranet Environment

Applications outside of GeoCommunicator may be capable of performing database updates. They may connect to the central database(s) using secure Intranets and wide-area networks.

5.1.4 Internet Environment

GeoCommunicator may be hosted inside of web browsers. Most applications may run inside the browser itself, for data catalog browsing, mail, forums, and so on. GeoCommunicator facilities for data upload and download would be based on standard Internet protocols such as the File Transfer Protocol (FTP).

5.1.5 In-Field Computing Environment

The use cases in the Survey Management business process area would require interfacing with field instruments to transfer data between the instruments and the system. They also would require computational support for survey activities. Survey Management outputs then feed into the Measurement Management subsystem for the construction of the *legal description fabric.*

There is a spectrum of computing capabilities that could be provided to the field surveyor. The high end of the spectrum would provide full Measurement Management capabilities, allowing measurement network construction and editing to be performed in the field. Errors or inconsistencies in the results could be resurveyed before the crew leaves the project site.

The low-end solution would provide field computation support and survey device interfacing only, perhaps running on small portable computers.

5.2 Software

NILS would be built using commercial off-the-shelf (COTS) software products as much as possible. Customization for specific hardware and system interfaces would be needed, as well as extensions to COTS software for BLM-specific survey practices or other work processes. Developing web sites, and handling reports and map formats may require customization for the specific business needs of other NILS partners.

5.2.1 Object-Oriented Analysis, Design and Development Methodology

Overview of OOAD

An object-oriented analysis and design (OOAD) method was used to capture the essential business process requirements that would be supported by the NILS software application.

The object-oriented approach, as it relates to the design and development of software applications, focuses on modeling the real-world entities that are involved in an integrated set of business processes. Essential business processes are identified, named and described as a system's use cases. Use cases serve as conceptual containers for the series of steps that are performed to complete a given workflow process. As the description of the use case becomes more detailed, a set of real-world actors, inputs, documents, forms, processes, interactions and outputs are identified. These process-related entities are 'candidates' for the types of software 'objects' that must be designed and developed.

The OOAD approach was selected as the NILS analytical and design method for two important reasons:

- Modeling focuses on the actual business process requirements of the system users.
- The analysis and design methods are part of an industry standard, comprehensive method of software development that is cost-effective, flexible and maintainable.

Object Orientation (OO)

The object-oriented method contrasts with previous generations of software development that utilized procedural languages and thus produced 'monolithic' applications. Such software was characterized as being extremely customized and expensive both to develop and to maintain (it was not easy to modify as new functionality or environmental factors were introduced). In many cases users were forced into a workflow environment to accommodate the programming language rather than their desired business operations.

The object-oriented approach emerged as an improved development environment that broke the design-once, build-once 'monolithic' model by replacing procedures with a specification for component-to-component interfacing. That meant that specific parts of the system (component) could be built individually as separate software 'classes', as long as each class followed the protocol for requesting and providing processing services with other classes. Classes could be built to provide the system functionality required to process information based on the real-world entities (objects) that were involved. And as the nature or behavior of an object required modifications, the software could accommodate the programming

update without a major re-writing of code. Object-oriented programming languages were created, and standard protocols for object-to-object interfacing were adopted.

Clients, Classes, Objects

These new software classes are templates for 'objects' that are created in a computer's processing memory area. Objects are system binary files that act as 'clients' (sending requests for services) and 'servers' (using the parameters in the request to complete a process and return information). An object-oriented software application uses an integrated set of objects that interact to retrieve, process and store information.

Objects have properties, behaviors and states. The state of an object can be thought of as the set of its current properties (variable and attribute data values). Behavior refers to the methods or operations that can be performed on or by an object (as defined by the specific class from which the object was 'instantiated'). It is because objects are 'encapsulated' (they have their own states and available behaviors) that object-oriented applications are so efficient and flexible to maintain.

For example, a parcel object would have inherent properties to manage its state and attributes (active/inactive, planned, historical, versioned, edited, etc.) A parcel object would have inherent behaviors that govern how it may be created, deleted (inactivated and stored in an historical repository), edited (split, merged, reshaped), adjusted (in a parcel fabric), linked to external data, and symbolized for display and plotting.

Component Object Model (COM)

Object classes can be independently developed as software components because standard protocols for object-to-object interfacing have been adopted. Microsoft created the Object-Linking and Embedding (*OLE*) and COM specifications and finally evolved ActiveX using COM. COM has become the desktop software industry standard for object-oriented development.

Unified Modeling Language

UML can be used to specify component interfaces and relationships. The use case method utilized in documenting the NILS business process requirements is a UML-supported approach.

Several Computer Aided Software Engineering (CASE) tools have been developed which can create UML diagrams (graphical representations of data models) and can engineer both database schemas and software code. The schema can be implemented in commercial relational database management systems. CASE tools can create code in the form of proto-objects (stub-code) already set up in a user-specified programming language and ready for additional programming to implement object behavior, rules and properties.

Why Geo Objects, COM and OO are Better

- Classes, as the building blocks for software applications, are based on ***user-specified*** object properties and behaviors needed to perform ***user-specified*** business operations.
- Object-components are based on standards-there are clearly-defined and well-understood standards that define component interfaces precisely.

- Extensibility. Object components are based on standards. Users (core developers, third party developers and end users) may create and/or extend object components to build or customize a software system.
- Powerful design and analysis tools. There is a rich collection of CASE tools and specialized component suites for object component design and development.
- Language neutrality and independence. Many software languages support COM, and COM-based applications can utilize COM-compliant classes developed in any language.
- Standards for components promotes efficiency and cost-effectiveness of maintenance and change incorporation.
- The Inter-process capability of COM supports distributed computing (e.g., on distributed systems and over the Internet).

NILS would be built using a use case driven object modeling process. The analysis and design would be documented using the notation of UML. Whenever possible, modeling objects would be mapped to or derived from software classes, reusing the functionality of COTS software.

5.2.2 COTS Products

The key features of a desktop software product that may be relevant to the NILS project are:

- an extensible geographic object model with customizable object behaviors and interactions,
- support for long transactions,
- support for survey measurement networks and networks of constructions (import, computation, cogo constructions, least squares),
- support for land parcel transactions and lineage,
- DBMS-based data storage,
- custom-extensible through standard object-oriented technology.

In addition, the software may provide support for the mapping and reporting capabilities needed by the GeoCommunicator. It would be driven in part by the same back-end database technology as the rest of the system.

5.2.3 Customization Requirements

Field Instruments

Specific hardware and system interfaces for survey instruments and field computers may be needed for each adopting organization.

BLM-Specific Survey Practices

BLM-specific survey practices would probably require the incorporation of some GCDB Measurement Management (GMM) functionality.

Web Site Development

NILS would acquire COTS products for managing e-mail, forums, notices, events, and accounts. The design of the GeoCommunicator web site's pages and visuals, data upload and download procedures, and other interfaces would require development and customization.

Report and Map Format and Content

An extensive set of products may be produced. These would be based on both the core data models and customized parcel fabrics or data layers.

Base Parcel Fabric Customization

Each type of homogenous parcel fabric (public lands, assessment parcels, zoning, registry/ownership, etc.) may require custom extension of the NILS data model to more effectively model the business and data needs of each adopting organization.

Unique Deployment for Business Application and Database Integration

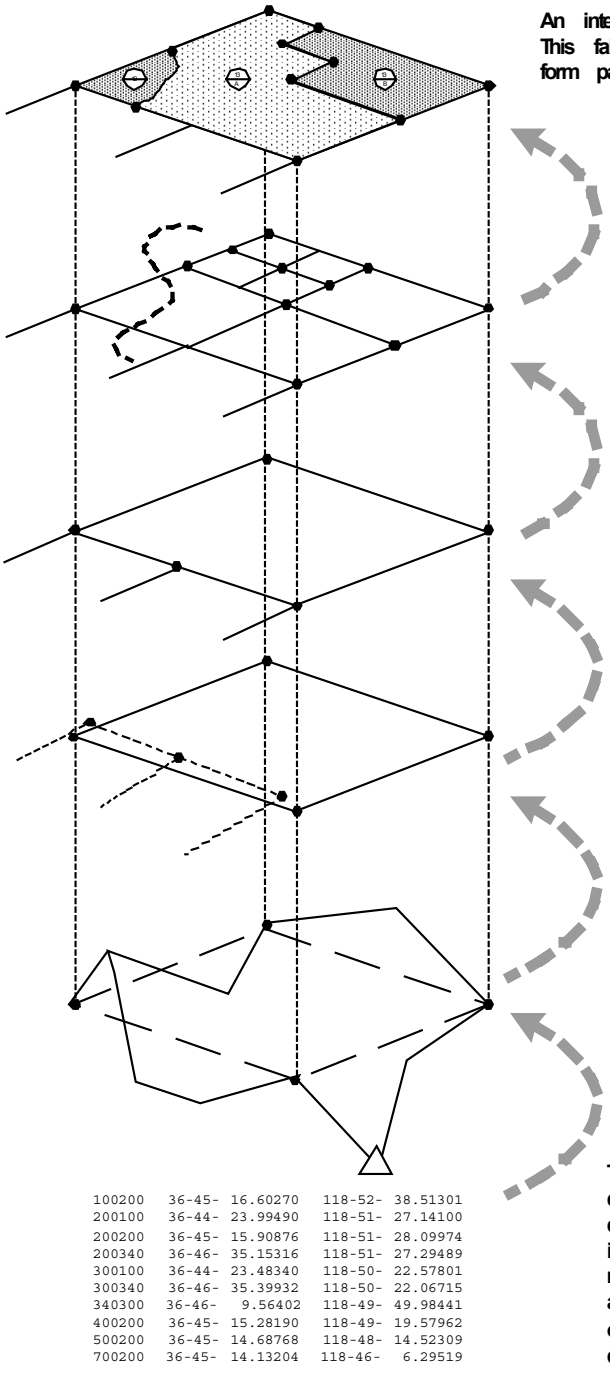
Each agency will have a custom deployment of NILS that may include customizing the data model and the interaction with external applications and databases. Private, Local, County, State, and Federal users will require a deployment configuration to manage the integration with Program applications and to access their legacy land management systems. For example, based upon business needs, an agency may choose to manage geo-political boundaries either as reference mapping layers, or as a custom deployment of the common NILS data model.

5.3 Data

NILS supports two broad categories of land records data: the map data delineating parcels, and the non-spatial record information about those parcels. Since there are major non-mapping-based data management systems in place in many jurisdictions where NILS would be applicable, NILS needs to be concerned primarily with the problems of maintaining the parcel map data. The map data would, of course, have unique identifier keys to enable joining with non-spatial record information so that record data can be maintained in conjunction with parcel data.

The NILS data architecture would be multi-tiered (Figure 5.1). Survey observations (e.g., traverses, measurements) define coordinate locations that serve as the basis for constructing measurement networks. Point elements in the measurement network may be used to construct measured features. The geometric elements (lines and areas) of the legal description fabric are constructed from the underlying measurement network elements. Parcel features in the parcel fabric are built from one or more areas or boundaries contained in the legal description fabric. Parcels are associated to external databases (e.g., assessment, ownership, case management).

Figure 5.1. Multi-tier Data Architecture



100200 36-45- 16.60270 118-52- 38.51301
200100 36-44- 23.99490 118-51- 27.14100
200200 36-45- 15.90876 118-51- 28.09974
200340 36-46- 35.15316 118-51- 27.29489
300100 36-44- 23.48340 118-50- 22.57801
300340 36-46- 35.39932 118-50- 22.06715
340300 36-46- 9.56402 118-49- 49.98441
400200 36-45- 15.28190 118-49- 19.57962
500200 36-45- 14.68768 118-48- 14.52309
700200 36-45- 14.13204 118-46- 6.29519

PARCEL FABRIC

An interpreation of underlying geometry for a business purpose. This fabric represents aggregations of the legal description to form parcels as described in deeds and other land records.

LEGAL DESCRIPTION FABRIC

This fabric is the Adjusted Measurement Network that has been densified with COGO procedures to further divide the land as prescribed by legal documents. These elements are divided to the degree necessary to support the construction of parcels. The geometry of physical features as derived from a GIS coverage may be used as a reference to create a description that is bounded by an unsurveyed boundary such as a river, ridgeline or highway. Each area is labeled with the identifier of the associated legal description.

ADJUSTED MEASUREMENT NETWORK

A set of topologically related measurements (coordinate points and lines) and constructions (area-based features, non-surveyed features) that have been adjusted with the surrounding measured features to derive a network solution for the most likely coordinate values.

PRE-ADJUSTMENT MEASUREMENT NETWORK

A set of topologically related measurements (coordinate points and lines) and constructions (area-based features, non-surveyed features) that have been internally adjusted, but that do not edgematch with adjoining measurement features in the overall land net.

SURVEY TRAVERSES

This consists of control points and the bearings and distances necessary to physically survey to the points (indicated by dots in the figure) that are going to define the measured features. At this point the measured data within the survey has been adjusted so there is a distinct set of coordinates.

FIELD SURVEY DATA

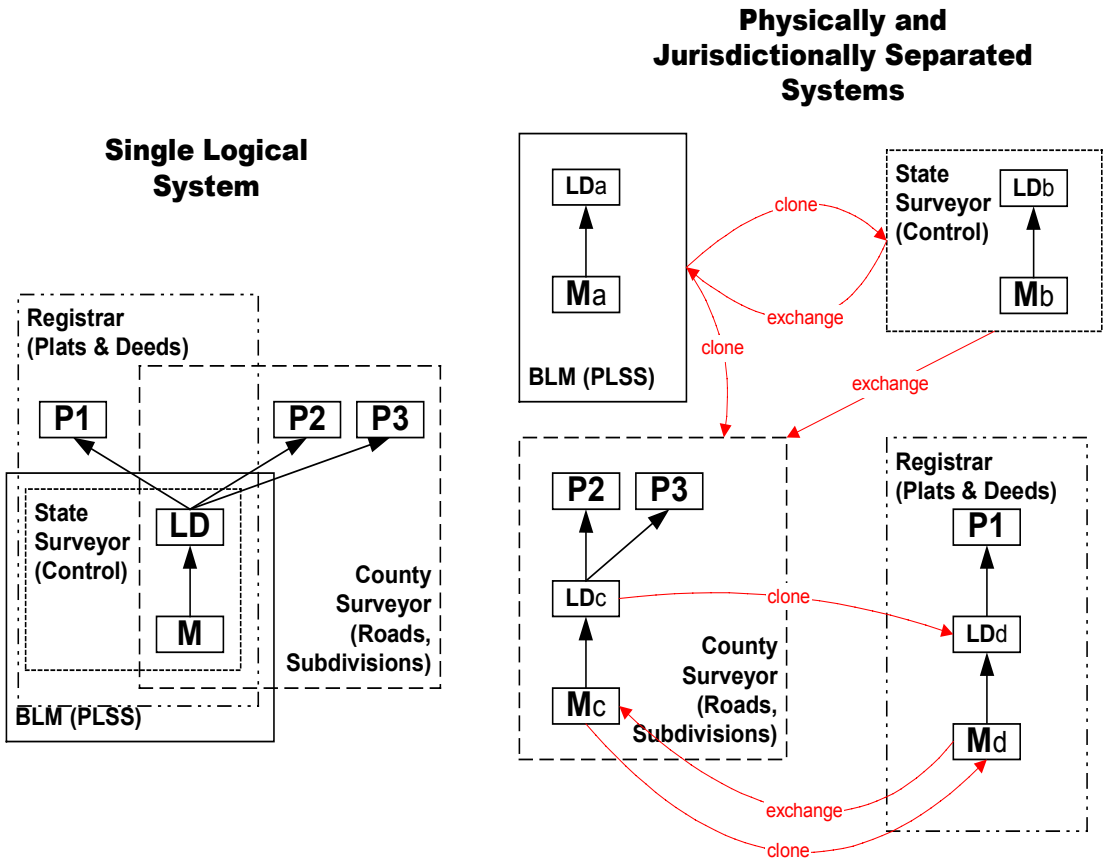
This consists of listings of measured angles, measured distances, GPS and other control coordinates, descriptions of features that are being measured and information about the measuring tools. The preadjusted measured values all have some error in them by nature and this prevents these values from forming a distinct set of coordinates. Directions (bearings and azimuths) are derived from this set of angles.

There are several new challenges for the data model defined by NILS. NILS assumes the ability to maintain multiple, complex relationships among all data elements described in this document. Specifically, NILS conceives of a set of interrelated, distributed data that can be shared and/or copied between different organizations, and selectively synchronized as shown in Figure 5.2.

Security and auditing is of prime importance. First and foremost, it keeps data secure. It is also the mechanism used to review mapping decisions made by one individual or an entire organization before incorporating data into a departmental system or another organization's system. It forms the basis of the selective exchange of information shown Figure 5.2.

Figure 5.2. Data Relationships Among Organizations

KEY: M = Measurement Network; LD = Legal Description Fabric; P1…P3 = Parcel Fabrics. In a single system, database integrity is straightforward because parcel fabrics all point to a common legal description fabric. In multi-system configurations, versions (clones) must be managed when data is shared (exchanged). Version management includes tracking changes, conflict resolution and synchronization.

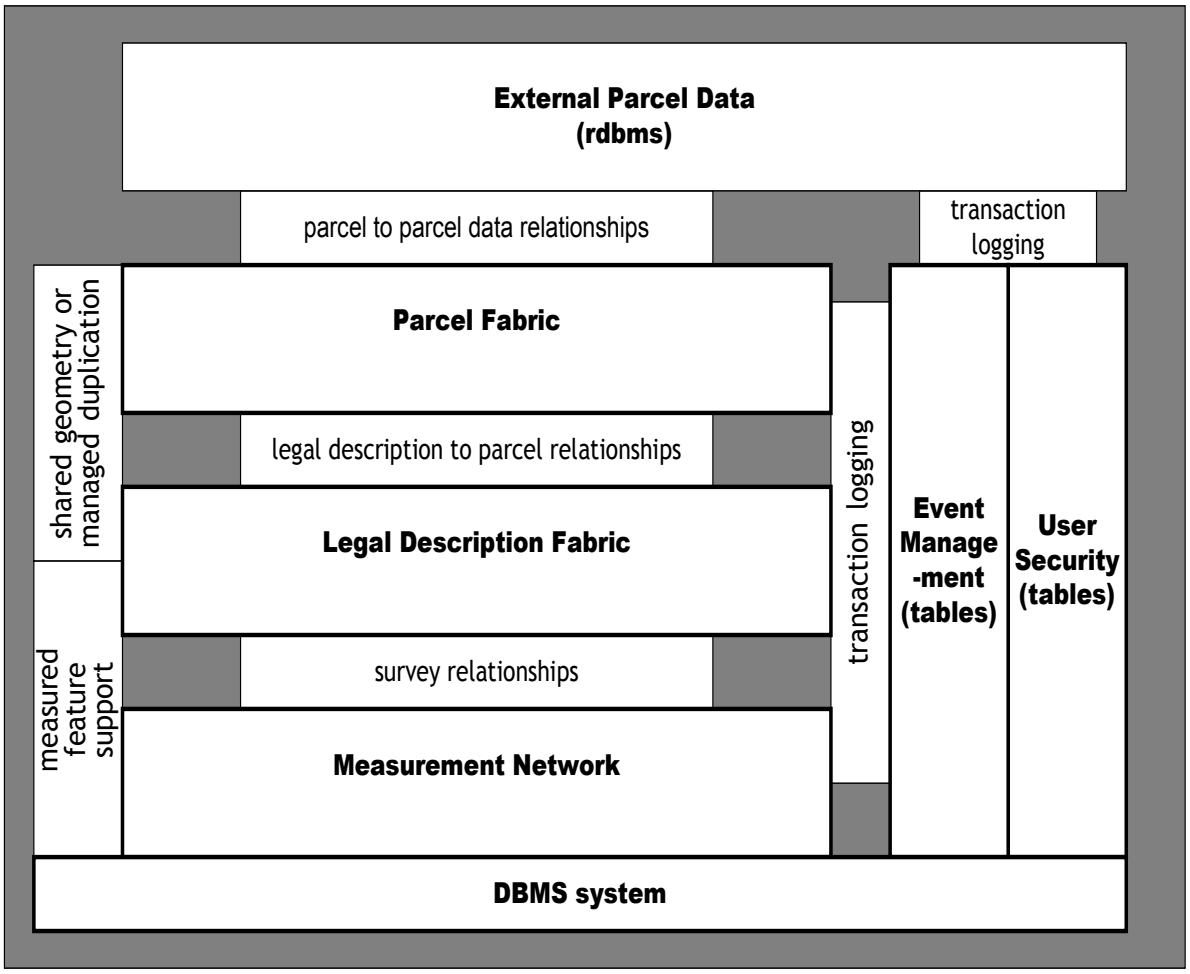


5.4 Concept for NILS Data Model

The relationships between NILS survey measurements, legal descriptions, parcels, external parcel attributes, and transactional information are shown in Figure 5.3. In an object-oriented implementation, relationships may be modeled as rules for topology and event notification. Topology relationships might include rules to manage the sharing of coincident geometry. Attribute or geometry changes in a feature fabric may trigger event notification which would initiate additional processing of related features based upon user-configured rules.

See Section 7.0 for more detail on general requirements.

Figure 5.3. Relationships among NILS Information



6.0 Use Case Development

6.1 Introduction

This section provides an overview of the use case development process, a summary of the design and development process that would follow, and the conventions used for documentation of the use cases.

6.2 Use Case Development Process

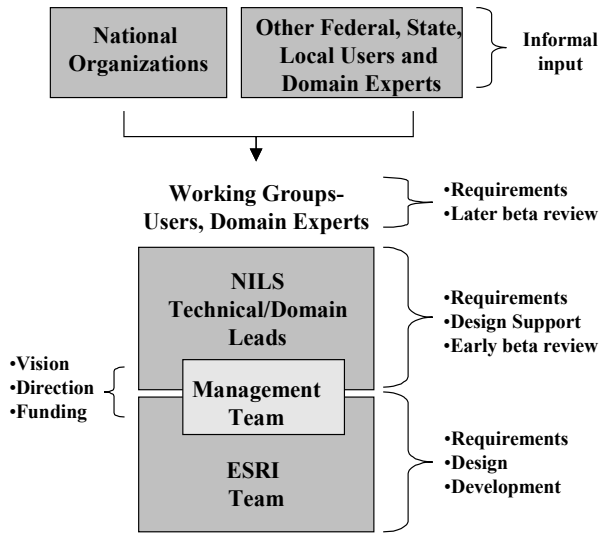
6.2.1 Team Organization and Management

The vision of NILS is to support the core functionality in a 'Field-to-Fabric' cadastral-land records management system. The overall range of functionality was captured in the following four business process areas:

- **Survey Management (SM)—**Field data collection and reduction
- **Measurement Management (MM)—**Land survey calculations and parcel geometry creation
- **Parcel Management (PM)—**Joining data and attributes to respective parcels
- **GeoCommunicator (GC)—**Communicating results to interested parties

A team of domain experts, system analysts, and experienced users was formed to support the use case development process for each of these business process areas. The technical team was supported by a small management group. The NILS team interacted with a broader group of domain experts and users to solicit informal input and comments (Figure 6.1).

Figure 6.1. NILS Team Organization



The BLM is managing all phases of the NILS project using the proven guidelines of **Managed Evolutionary Development** (MED). MED is a process to manage a project throughout its entire lifecycle by adhering to the initial vision, developing the design around how end-users perform the work, preparing an investment analysis, describing what the system must do, defining its components and strictly following a master plan and schedule. The most important points to be noted here are adhering to the vision and following a prescribed schedule.

The NILS project schedule was developed using project management tools such as Work Breakdown Structure (WBS) and Gantt Charts. The WBS is a deliverable oriented grouping of project elements that organizes and defines the total scope of the project.(PMBOK 1996[1]) It drives planning efforts and identifies low-level work tasks to be performed. Gantt Charts show project tasks, the task schedule, and allows identification of resources for those tasks.

6.2.2 Use Case Development

Use cases are meant to capture idealized business processes, and they are purposefully generic rather than platform- or software-specific, because the NILS applications are intended as a core framework that may be configured to support operations as needed at any given user agency (i.e. users would build on the common elements provided by the NILS applications to support their specific business operations). The NILS applications are intended to focus on tools for the integration of spatial and tabular data within a common data model - in this sense, NILS may serve as a foundation that indirectly supports the larger context of land records management and land management per se.

The teams focused on an optimal workflow process, and tried to avoid re-capturing processes as found in existing software packages. The teams did review and perform preliminary **gap analyses** on existing software (ALP, Cadastral Electronic Field Book [CEFB], Cadastral Measurement Management [CMM], Geographic Coordinate Data Base [GCDB] Measurement Management [GMM], etc.) to generate ideas and identify the areas where current functionality was lacking. Use cases emerged as simplified, core concepts to describe the 'what' of the NILS business processes. The use cases are not meant to capture the 'how' of implementation—*how* the system works is a design issue.

Domain experts, system analysts and experienced users from the BLM, the U.S. Forest Service, and the Parcel Consortium gathered for a series of use case development workshops. The workshop participants represented a broad range of Federal, state, local, and private specialists from the surveying and cadastral community. Appendix B includes a list of workshop participants. Three- to five-day workshops were held for each of the following business process areas:

- Survey Management
- Measurement Management
- Parcel Management
- GeoCommunicator

[1] PMBOK 1996 – PMI Standards Committee, 1996, A guide to the Project Management Body of Knowledge (PMBOK), Upper Darby, Pa: Project Management Institute.

At the conclusion of each workshop the use cases for a business process area were documented, reviewed and edited. When use cases for all business process areas were completed the leads for each area met and reviewed all use cases for missing and/or overlapping processes and functionality, and consistency in concepts and terminology.



Preliminary use cases were organized and informally presented to groups of end users around the country. The use case review tour made stops at the following locations:

- BLM Washington/Oregon State Office in Portland, OR
- U.S. Forest Service Office in Portland, OR
- Polk County in Dallas, OR
- State of Washington Department of Natural Resources in Olympia, WA
- Thurston County in Olympia, WA
- Fulton County in Atlanta, GA
- Tennessee Valley Authority in Chattanooga, TN
- U.S. Forest Service Regional Office in Atlanta, GA
- State of Florida Department of Environmental Protection in Tallahassee, FL



Several NILS advisory committees participated in the informal use case review, including the following:

- The Geographic Coordinate Data Base (GCDB) Technical Advisory Committee (GTAG)
- The BLM and US Forest Service Lands Program Staff
- The FGDC Cadastral Data Subcommittee

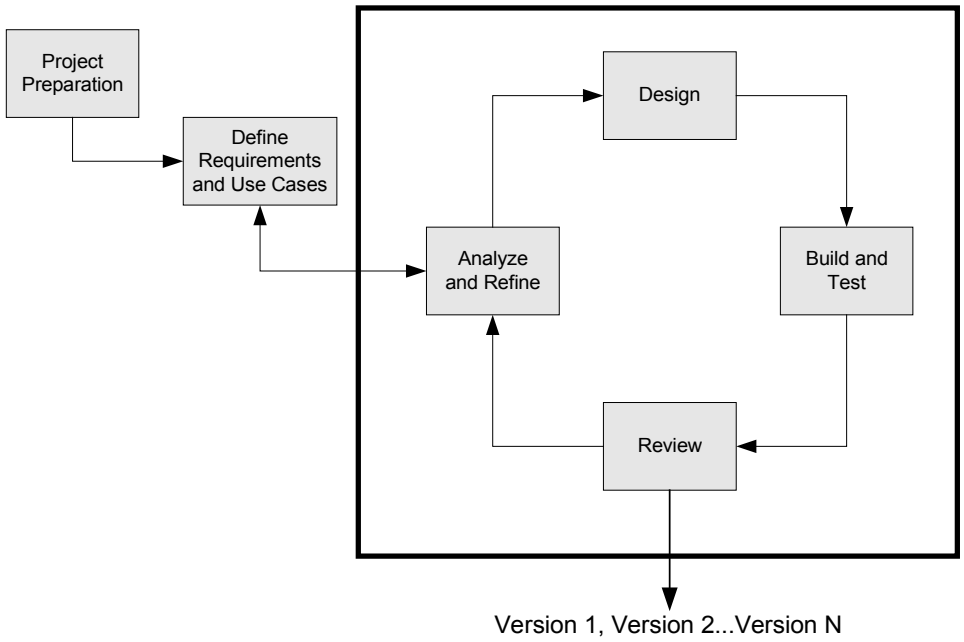


After receiving good validation and feedback from the review groups and tour site hosts, the NILS teams met to document the draft the requirements and use cases presented in this document.

6.2.3 Next Steps in the Development Process

The requirements and use cases documented in this report are only the first step in the overall NILS development process. The next steps in the NILS project will involve an iterative series of analysis, design, build, and test tasks (Figure 6.2).

Figure 6.2. Iterative Development



First, an analysis-level object model would be derived from the use cases. An object model is a graphic that shows the relationships, properties and behaviors of (potential) software objects. Through data flow modeling and robustness analysis, both the use cases and the object model would be refined until they are internally consistent and sufficient to meet the requirements. Next, the system's dynamic behavior would be modeled using sequence diagrams and the object model would be expanded and refined into a design-level class model (Figure 6.3).

At this point, the various systems would be partitioned and mapped to existing COTS, extensions to COTS, and new software components. The traditional task of database modeling is subsumed into the object modeling exercise, where the COTS object model would be extended to new classes of objects to support NILS requirements (Figure 6.4).

Figure 6.3. Example Object Model

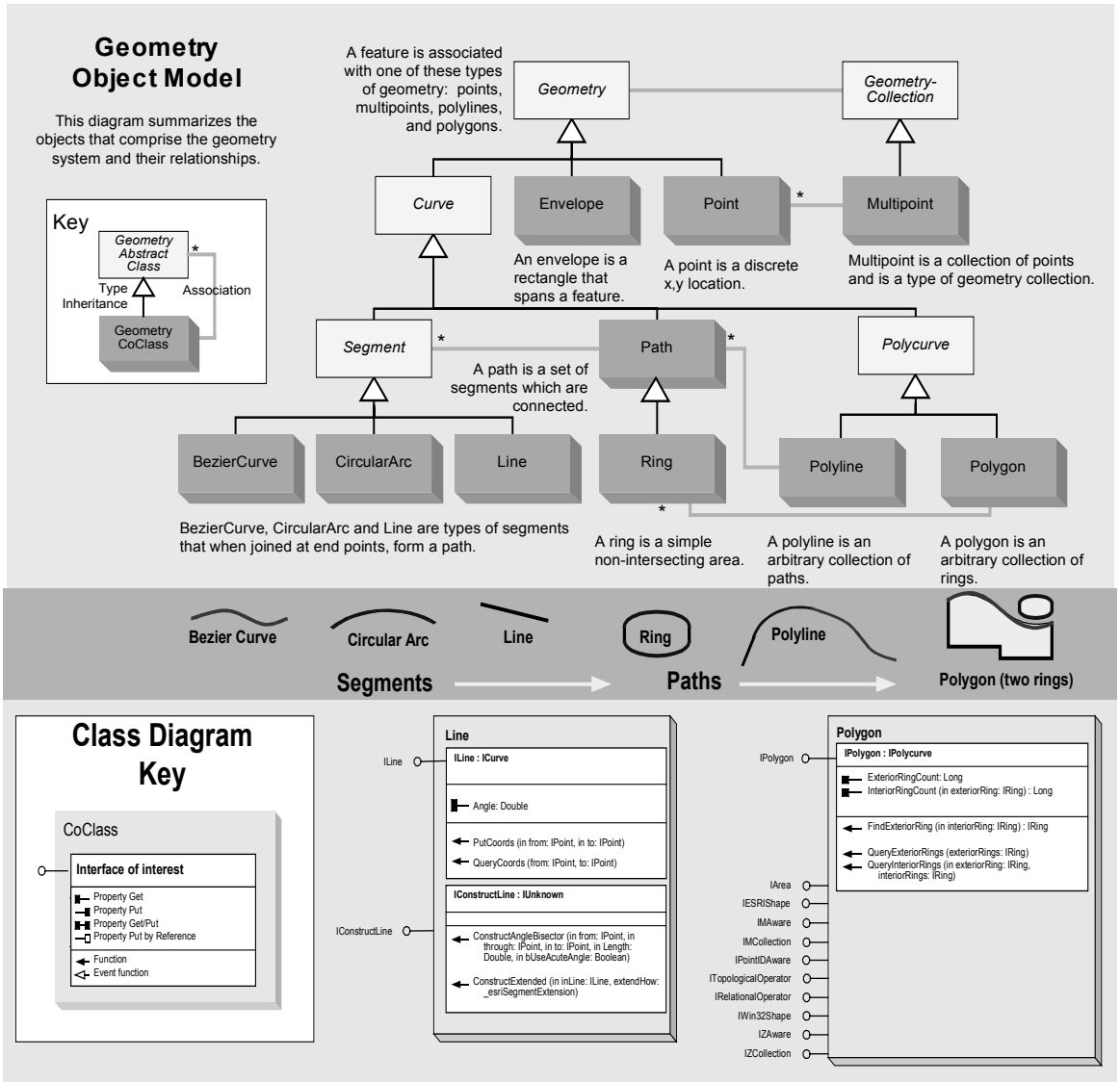
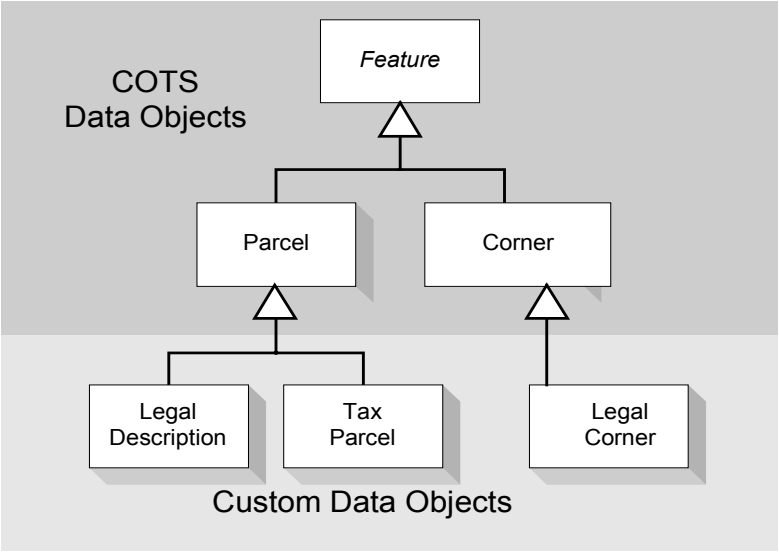


Figure 6.4. Extending COTS Data Objects



6.3 Use Case Documentation Conventions

Each use case is documented in the following four subsections:

- Analysis
- Overview
- Primary Scenario
- Secondary Scenarios

6.3.1 Analysis

The Analysis subsection typically has five parts: (1) Context, (2) New Concepts, (3) Key Features and Functionality, (4) Application Integration, and (5) Development Issues.

The **Context** section provides a discussion of how the use case supports the subject business process. Context includes reference to issues of data flow and workflow within the overall system. **New Concepts** are the domain-specific business process terms, ideas and things that are managed or processed in the use case. Concepts often become candidates for new software classes. **Key Features and Functionality** discusses the types of tools and interfaces that the user might experience. Features and functionality will often translate into user-interface controls and properties or behaviors for software objects. **Application Integration** is a system-oriented discussion of how the business process relates to other business processes. **Development Issues** includes some potential challenges that may occur or be solved as software and applications are coded and integrated into a system.

6.3.2 Overview

The Overview subsection contains the use case name, description, actors (use case initiators), system pre-conditions, system post-conditions and any system cross-references. The Overview is documented in the table format explained in Table 6.1.

Table 6.1. Information in the Use Case Overviews

Use Case	Use Case Name
Description	A short English-version narrative describing the business process
Actors	The users or system events that may initiate the use case.
Pre-Condition	The state of the system prior to initiating the use case.
Post-Condition	The state of the system when the use case is complete
Cross-Reference	Other use cases or system components

6.3.3 Primary Scenario

The Primary Scenario (typical course of processing) is an ordered series of steps performed by the actor and the system to complete the business processing that the use case is defined to handle. The Primary Scenario is documented in table format. (See Table 6.2.)

Table 6.2. Information in the Primary Scenario

Actor Action	System Response
1. This use case begins when a user initiates a process	2. What the system does next.
3. What the actor does next.	4. Etc. [no data found] Inform user and display data browser.

Conditional processes are noted in brackets and interpreted as if preceded by the word 'if'. In the example above, **[no data found]** is read **'if no data found'**, and is then followed by the proper action to take.

6.3.4 Secondary Scenarios

Secondary Scenarios (alternate courses) capture situations where processing may diverge to handle atypical events. The Secondary Scenario is documented in table format. (See Table 6.3.)

Table 6.3. Information in Secondary Scenarios

Name	Point of Occurrence/Overview
Atypical process	Step #2: Go do something else.

6.3.5 Other Conventions

- Use Case names are shown in ***Title Case Bold Italics.***
- Key concepts are *italicized* and defined in the glossary.
- The term 'actor' (within the use case scenarios) refers to any of the actors identified for the use case.

6.4 Use Case Actors

Use cases are business processes, but they are implemented as applications in an integrated software system. These applications don't start themselves; they must be initiated by an actor. The teams authored a variety of actor names and roles. Where possible, names associated with staffing positions in an agency were generalized into role-based actors. So where the analysis teams thought of many types of surveyors (land surveyor, resource surveyor, etc.), the use cases simply refer to that class of actors as 'surveyor'.

Table 6.4. List of Actors and Roles Found in Use Cases

Actor	Role
Administrator	System Administrator
Administrator (GeoCommunicator)	Person or persons responsible for GeoCommunicator site maintenance, links to provider sites, account maintenance, data administration.
Browser	The anonymous visitor to the GeoCommunicator site.
Customer	External User (public)
Data Entry Technician	Enter preliminary *data,* produce maps and reports.
Data Provider	An individual or agency that has submitted data reference information for inclusion in the GeoCommunicator catalog.
Event Provider	An individual or agency that has submitted event reference information for inclusion in the GeoCommunicator catalog.
External Trigger	Something outside the system, such as a separate database application, that can initiate a use case.
Parcel Editor	Person who manages the *legal description* and *parcel fabrics*.
Subscriber	An individual or agency that has a GeoCommunicator account to control preferences, notification parameters, etc.
Supervisor	Manages Surveyors, Data Entry Technicians, Parcel Editors, etc.
Surveyor	Professional Land Surveyor
User	Any User

7.0 General Requirements

As the teams captured business processes, it became necessary to make some preliminary assumptions about the fundamental system functionality that would be provided. Several use cases were identified repeatedly in different workshops. After the use cases were jointly reviewed by the core team it was decided to handle many of these generic functions as system requirements and utilities.

The concept for the NILS software system would include general features and functionality as described in the section below.

7.1 Cadastral / Land Records Data Architecture

One of the essential requirements of NILS is to provide a common data model that operationally integrates surveying (measurements) and cadastral land record data. There are several aspects to this requirement as described in the following sections.

7.1.1 Object-oriented Data Model

The NILS Project is pursuing an Object-Oriented data modeling approach because the implementation of NILS requires an extensible data architecture to model the real-world objects that NILS must manage as software objects (that are processed by an application). The data architecture must provide a common conceptual standard that supports data class extension for modeling the many variations of object properties, behavior and interfacing required for custom deployment.

7.1.2 FGDC Compliance

The NILS data architecture must comply with the Federal Geographic Data Committee's (FGDC) *Cadastral Data Content Standard*. It is expected that the NILS data architecture would extend the FGDC *Cadastral Data Content Standard*. (See Figure 7.1.)

7.1.3 Tiered Network

NILS must support the management of map geometries (features) as topologically-integrated, seamless map layers (feature fabrics). The NILS data architecture and production tools should manage measurements and parcel-based features as a multi-tiered network of associated object features. NILS should support topology association to share geometry dimensionally within and across fabric tiers - this implies two-dimensional topology (area features), zero-dimensional (point features) and one-dimensional (line features). See Figure 5.1 for a visual example. [NOTE: the discussion above is not intended to preclude a data model that captures measurements in three dimensions (i.e. X, Y and Z) or one that manages and represents rights or interests that occur beyond the surface estate.]

7.1.4 Feature-level Metadata

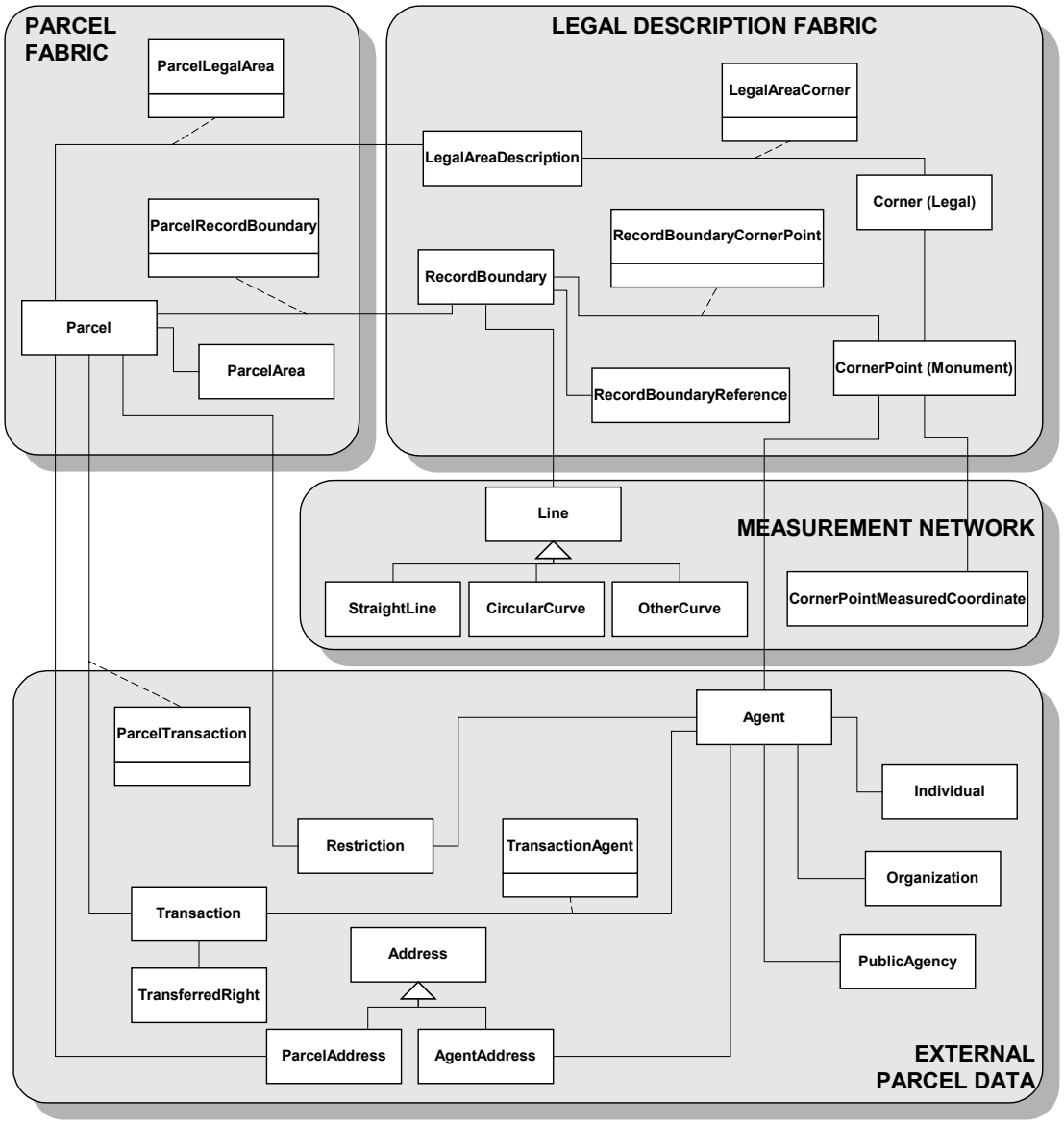
It is very clear that the NILS software system and data model must automatically capture metadata at the feature level. Individual features are created by construction and computation methods according to specific rules and regulatory environments. To enable

data sharing, a user must be able to extract a set of features from a data set. The subset of features must be operationally complete, that is, the subset includes the features and all associated data objects as necessary to manage the data subset using the NILS software system. This means that metadata for each feature's associations and construction rules must persist when data is exchanged.

7.1.5 History/Lineage Management

For cadastral data, the maintenance of feature lineage is essential. For any given parcel, the system must automatically record relationships to its parents. The system must handle time and date information regarding the activation and deactivation (creating and retiring) of parcels. Inactive parcels must be indexed and stored accessibly to support historical searching and reconstruction of historical geometric/attribute configurations.

Figure 7.1
FGDC Cadastral Content Standard Entity-Relationship Diagram with NILS Data Tiers



7.2 Basic GIS

The NILS software system should include basic geographic information system functionality for map display, query, analysis, reporting and plotting. There are several aspects to this requirement, as described in the following sections.

7.2.1 Map and Data Display

It is fundamental to NILS that land records and cadastral data be managed as spatial data. Even when editing alpha-numeric attribute values in non-spatial data, the user should have the ability to see feature geography in a map view. The map view has all the tools necessary to add/remove reference layers, to modify symbology, to pan and zoom, to select features, etc.. Map display includes powerful tools for feature rendering and annotation. Display includes the rendering of raster files (grids, satellite images, digital orthophotos, etc.; may be geo-referenced), terrain models and document images.

The concept of managing a particular geographic area is an essential feature in cadastral/land records processing. The system must support the process of finding a spatial extent that is associated to the subject case, survey, parcel or project. This provides the user the ability to verify the status, location and context for the subject feature. These 'spatial extents' might be saved and re-used in other processes (further along in the workflow required to complete the processing of a case, deed, subdivision, etc.).

In addition to map viewing, the system must provide database displays (tabular reporting) that are interactive with the map view. As features are selected/unselected in one view, the appropriate features or records are likewise selected or unselected in the associated view.

7.2.2 Query

The system must provide the functionality to create and submit spatial or logical queries as a means to refine selected feature sets and to return information about the selected features.

7.2.3 Analysis

The system must provide tools to perform various types of spatial, temporal, mathematical, boolean and logical analysis. Examples of temporal analysis might include the reconstruction of a historical version of data or establishing a view to compare and contrast data sets. Historical analysis would include routines (1) to make graphic and textual comparison of new or proposed data sets with existing data sets, (2) to provide a report of the contrasts, and (3) to perform quality control.

7.2.4 Reporting and Plotting

NILS must provide a framework that enables users to create their required business reports. Examples include Subdivision Reports, Tax Map Sheets, Records of Survey, Survey Plats, Field Survey Notes, Master Title Plats, Derived Status, etc. The user may select a pre-defined template and apply this formatting to generate a report. The user may define and save a custom report format as a template. Reports may include (or be included as) elements in a plot file.

The system must provide high-end cartography tools to generate formatted map layouts (digital and hardcopy plots). As with reports, the user may select a pre-defined layout template and apply this formatting to generate a plot file. The user may define a custom layout and save it as a template. Layouts may include (or be included in) a report.

7.3 Database Management

The management of data is treated as set of system features and functionality. Operations include data set management procedures (by end-users) and database administration (by a database administrator).

7.3.1 Manage Data and Subsets

The system must provide tools to find and manage files, spatial data sets, feature classes (map layers), tabular data, images (scanned documents, geo-referenced images such as digital orthophotography), etc. Data management tools include the capabilities (1) to select data, (2) to manage data subsets by creating subsets, editing data sets, merging data set types and/or appending subsets into larger data sets.

7.3.2 Manage Data Properties and Relationships

Once data has been selected, the user must have the ability to edit the properties of the data. This functionality does not refer to editing data attribute values, but rather to the set of parameters over which the user has control. These data properties include metadata information about a data elements, and includes the management of object rules (validation, construction) and relationships (geometry-sharing, compositional associations).

7.3.3 Perform Datum Transformation

This is a general category of functionality that must be provided to transform data from its current projection and/or datum into a different projection and/or datum. Data conversion as necessary to support dataset import and export to a range of industry standard formats is required. This set of functionality specifically includes support for **X, Y, *and* Z** coordinate-value transformations as would be applied to measurements to convert to/from *orthometric height* and *ellipsoidal height* (GPS gives ellipsoidal heights, conventional vertical benchmarks give orthometric height).

7.3.4 Administer Access Rights

The system must support a multi-user environment in which data and databases are distributed. Some data would be stored and accessed via a central repository, and some data will be stored and accessed locally. Users would require various levels of access (read-only, read-write, etc.), perhaps even within an individual data set (i.e., the user may have write access only to a specified attribute in a table). The system must provide support for administering user permissions for a range of data types according to both individual- and group-level access restrictions.

7.3.5 Transactions and Versioning

The system must provide tools to manage database integrity in a multi-user editing environment. The system must:

- support long transactions (i.e., database transactions that persist beyond the user-session [*not to be confused with customer or case management transactions*])
- handle extraction (to create a working version of a data set or subset)
- manage feature locking (if required in the parent data set)
- track changes (in the new version)
- support rollback and commit points
- resolve version conflicts (merge working version into parent or other version).

7.3.6 Data Automation Support

This is a significant issue for all NILS users. The system must provide support for migrating from existing database schemas into the NILS data schema. The system must provide tools to assist the user in developing a translation routing (e.g., a wizard that produces a batch conversion routine, based on a source-target schema element mapping). Support must be provided for a range of automation processes, specifically including:

- Manual digitizing from a hardcopy map or plat (e.g., master title plat, subdivision plat)
- Scanning and vectorization from a hardcopy map or plat
- Manual data entry (building coordinate files, etc.)
- Conversion/Migration (import from another system or format, analyze and depict the source schema, and assist in the translation to the new schema). For example, BLM has already produced several routines to translate a Geographic Coordinate Database (GCDB) data set into an ArcInfo coverage format.

7.3.7 Import/Export

The ability to share data and to exchange data is a key feature for NILS. The system must provide tools to convert data to/from dissimilar systems and formats. This process is related to the Data Transformation process. NILS should support translation from and to industry-standard formats, including one or more open (published, non-proprietory) formats.

7.4 System Integration

7.4.1 Audit Support

The system must provide support for quality-control processes. Database commits and other operator actions should be logged into an event system to provide a means for process supervisors to review operations.

An example of this process would be for a registered surveyor to review a measurement network construction solution. Data validated by a registered surveyor might receive a higher source quality rating. Data representing survey measurements might have a higher quality rating than data vectorized from scanned survey plats.

The implementation of a quality-rating scheme would be user-defined. For example, the NILS audit process could be used to support a standardized quality rating scheme for data set certification.

7.4.2 Workflow, Document and Event Management

The effective processing of land records and databases must be performed within an integrated workflow management environment. This means that NILS must be seamlessly integrated with tools to guide and track business transactions from their inception through the necessary processing to their final completion. NILS should provide an intuitive set of tools to assist agents in processing transactions. The system should manage processing automatically and intelligently. Users should always be able to access the transaction and determine its status. The system should automate linkages to all source and reference documents. For example, the system should enable the linkage of case processing documents and legal descriptions to the appropriate spatial features and land transactions. Automating the transactions involved in accessing records, processing documents and linking them into the appropriate BLM Case File is an example of how strong workflow management tools could reduce redundancy and increase efficiency.

7.4.3 Architecture for Data Sharing

NILS must support operational deployments that have a variety of database management configurations. From smaller, single-database organizations to large, multi-site distributed enterprises, the NILS applications must provide tools to access, integrate and manage spatial datasets and tabular databases. One of the critical goals of NILS is that users may adopt a common data model and tools for sharing data to promote integration of land information systems. The vision of NILS is that data will be exchanged among users at various levels (local, state, federal, private) to better manage our land records and so to better manage our lands. See Section 11 for further detail concerning the data- and information-exchange functionality of the NILS GeoCommunicator.

7.5 Summary

The development of effective software to support NILS would require a wide range of system functionality. The infrastructure and tools provided at the system level must support the Cadastral/Land Records Data Architecture, Basic GIS functionality, Data Management, and System Administration and Integration.

8.0 Survey Management Use Cases

8.1 Overview of Survey Management Use Cases

The use cases for survey management (SM) are intended to describe the various business processes necessary to conduct field surveys in an automated GIS environment. An important aspect of any survey project is to research all available records for pertinent data. The first use case, ***SM-01 Survey Research***, is designed to assist in locating and evaluating survey and survey related records. The ***SM-02 Pre-Field Survey Setup*** use case guides a user through the necessary steps to prepare a data collection device (i.e. laptop or palmtop) for use in the field. This may include the transfer of reference data to the data collection device immediately or at a future time. The ***SM-02 Pre-Field Setup*** may occur on a data collection device or on a desktop personal computer for later transferal to the data collection device. The ***SM-03 In-Field Survey Setup*** use case assists a user in configuring or modifying a *field survey setup file* for a data collection device. The field survey setup file is an output from ***SM-02 Pre-Field Survey Setup.*** The ***SM-04 Collect Field Data Observations*** use case provides for the polling (reading) of observations from *measuring devices* such as a total stations, the storage of the observations, and reduction of the observations (i.e., mean of the observation sets, slope distance to horizontal, difference in elevations, etc.). ***SM-05 Perform COGO and Layout*** provides coordinate geometry functions.

> ***Note:*** *There are certain key survey and mapping terms that must be understood in order to interpret the survey management use cases. These terms have special meaning in the context of the use cases. They are defined in complete list can be found in Appendix A- Glossary of Use Case Terms.*

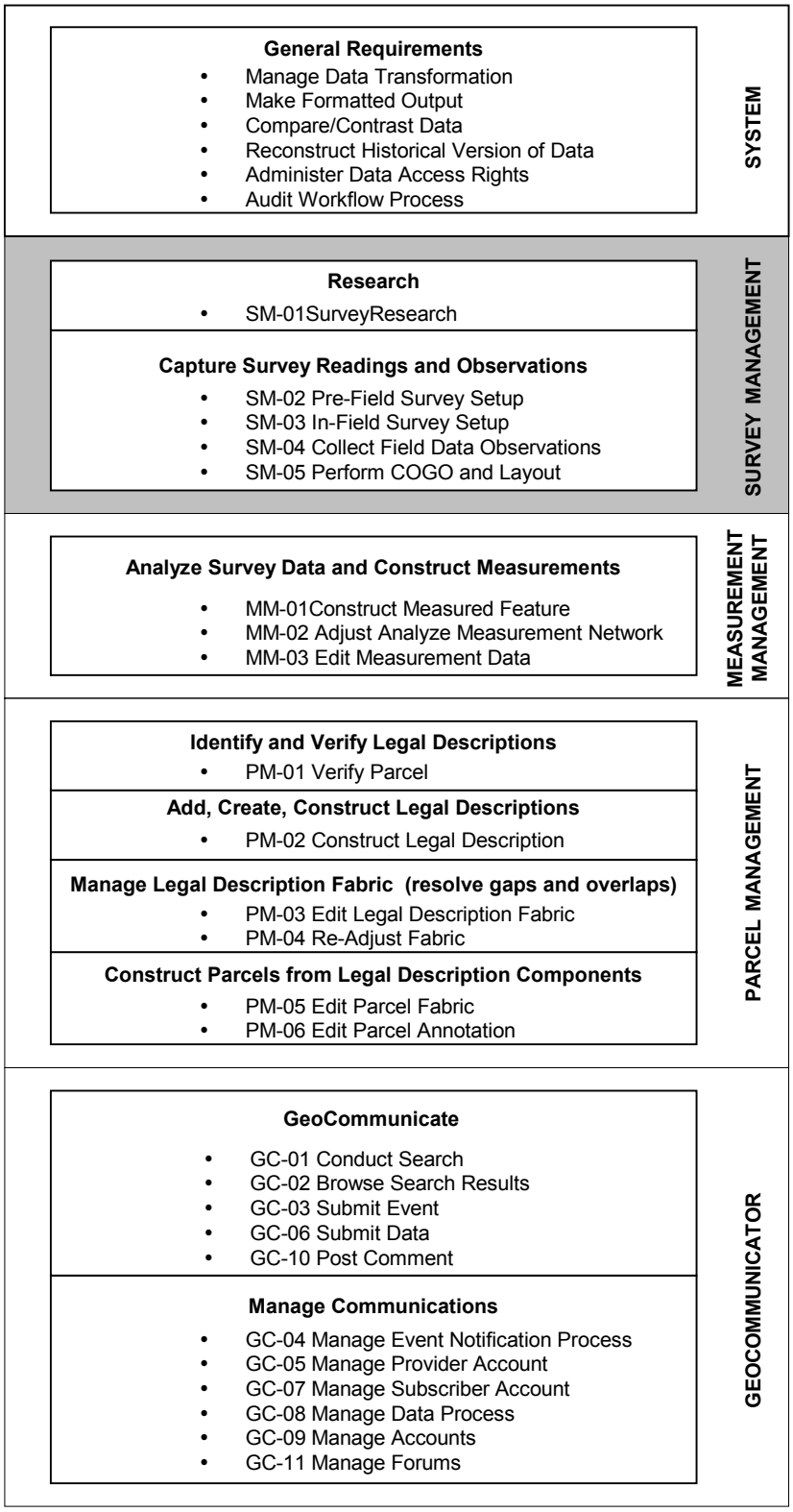
8.2 Survey Management Use Case Analysis

The remainder of this section presents the individual survey management use cases. Survey management use cases are used to build the measurement foundation of the NILS 'Field-to-Fabric' concept. Table 8.1 summarizes the survey management use cases. Figure 8.1 shows the relationship of these use cases to the other NILS use cases.

Table 8.1. Survey Management Use Cases

Use Case	Section	Description
SM-01 ***Survey Research***	8.3	Locate, view and evaluate all relevant digital database and non-digital records for the *research scope*. Sources may include hardcopy records, plats, monument rubbings, aerial photos, survey notes, etc.
SM-02 ***Pre-Field Survey Setup***	8.4	Process to create a *field survey setup file* to manage the collection of *readings*, *observations*, and *measurements*.
SM-03 ***In-Field Survey Setup***	8.5	This is the in-field process to configure a *data collection device* and/or a *computation device* by selecting and applying a *field survey setup file*. (An example *data collection device* is a palmtop configured with NILS field survey software. An example *computation device* is a laptop configured with NILS field survey software. Data collection devices and/or computation devices are distinguished from a measuring device such as a total station.)
SM-04 ***Collect Field Data Observations***	8.6	Actor performs field data collection by recording *readings* using a *data collection device*. Readings are *computed* with a *computation device* to derive *observations* and *measurements.*
SM-05 ***Perform COGO and Layout***	8.7	Process to use coordinate geometry (COGO) tools to calculate coordinate positions. Includes planar and geodetic calculations. May be used to perform layout or to search for *point* locations. May be used in conjunction with building a *measurement network*, a *legal description fabric*, or a *parcel fabric*.

Figure 8.1. Business Process Analysis-Survey Management Use Cases



8.3 SM-01 Survey Research

8.3.1 SM-01 Survey Research Analysis

Context

Surveyors have indicated that they spend significant amounts of time performing research in preparation for any survey. The surveyor must search through various records repositories to find the legal descriptions, ordinances, and other jurisdictional documents that affect the land status of the survey area. To the extent that records and data are available in digital form, the surveyor can capture relevant reference materials and save them for use in the field.

New Concepts

Survey. Typically, a boundary survey performed in the field by a professional land surveyor, but not meant to exclude a variety of field survey types (e.g., *boundary survey, site survey, resource mapping, right-of-way survey, transect survey, administrative survey, densification of control corners, topological survey, engineering/construction survey, real-time mapping (GPS), ALTA, custom, vertical control survey*).

Survey Project. This is an organizational/system concept to represent a set of field activities. It's where and how all the relevant data and files are stored for future use. A *survey project* may be comprised of one or more *field surveys*.

Research Scope. Data to be investigated for a given project defined by spatial extent and source criteria. May include digital records and hardcopy records during a defined epoch. The total of the selected search parameters or the query including spatial extent.

Key Features and Functionality

The actor has the ability to define and redefine search parameters. Reference sources include all available paths (local data, WAN/LAN data, internet data). The actor can browse available data and information (may have to download data files first) and save those that are within the *research scope*. The idea of specifying, saving and re-using research templates is a potentially useful feature.

Application Integration

SM-01 Survey Research is very closely related to the GeoCommunicator ***GC-01 Conduct Search*** and ***GC-02 Browse Research Results*** use cases. GeoCommunicator provides access to many categories of data and events. A surveyor may want to publish notice of the survey research or planned survey event to attract cooperators or information that would improve the field effort. A surveyor may wish to look for 'data discrepancies'-areas where the survey world just doesn't come together well.

These types of research are not possible unless indexes and catalogs of related information and data are accessible-the survey reference library must be maintained.

Development Implications This is the first use case in the 'Field-to-Fabric' cadastral maintenance process.

8.3.2 SM-01 Survey Research Overview

Use Case	SM-01 Survey Research
Description	Locate, view and evaluate all relevant digital database and non-digital records for the *research scope*. Sources may include hardcopy records, plats, monument rubbings, aerial photos, survey notes, etc.
Actors	Surveyor, Survey Supervisor
Pre-Condition	Actor needs to research available, relevant records to support a *survey project*.
Post-Condition	Available digital and non-digital records have been identified and listed for use in ***SM-02 Pre-Field Survey Setup.***
Cross-Reference	***SM-02 Pre-Field Survey Setup***; System Audit Process; ***GC-01 Conduct Search***

8.3.3 SM-01 Survey Research Primary Scenario

Actor Action	System Response
1. This use case begins when an actor launches the ***SM-01 Survey Research*** process.	2. Display research definition tools (e.g. define spatial extent, source types, date ranges)
3. Actor defines an initial *research scope* and record types (i.e. query parameters).	4. Search and locate records (GeoCommunicator, internet locations, databases, etc.)
	5. Display research scope and list references to available records. Indicate record location and type.
6. Actor browses list; may view available records of interest.	7. Display record in appropriate format. [view another record] Return to #6.
8. Actor selects records and requests hard copy or soft copy.	9. Process selection. [soft copy] Save selected records to actor-specified destination. [hardcopy] Print selected records.

Actor Action	System Response
10. Actor may refine list. Actor may choose to save and/or print project *research scope* and/or record list. Actor may choose to relate record list to a *Survey Project*.	11. *Research scope* and record list is saved/printed for use in ***SM-02 Pre-Field Survey Setup***. Link record list, records and *research scope* to *Survey Project*. [new *Survey Project*] create project

8.3.4 SM-01 Survey Research Secondary Scenarios

Name	Point of Occurrence/Overview
Automatically archive initial record list as part of System Audit Process setup.	Step 5: Create link to *survey project* and save record list index.
Actor wants to save initial record list.	Step 5: Go to #10.
Actor wants to expand or limit *research scope*.	Step 5: Return to Step 3.

8.4 SM-02 Pre-Field Survey Setup

8.4.1 SM-02 Pre-Field Survey Setup Analysis

Context

Once survey research is completed, the surveyor must prepare instruments and equipment. It is often the case that a particular *survey project* is divided into multiple *field surveys*, each of which has a specific set of associated *data*, files and set up parameters. The goal of this use case is that a survey party or parties could select from a set of *field surveys* and apply the setup file information to configure the instruments. This may include establishing data sets, device drivers, communication protocols, and so on.

Concepts

Computation device. The computing hardware system and processing software for deriving *observations* and *measurements* from *readings*. May be used with a *data collection device* on the same computing hardware system.

Data collection device. An instrument for digital storage of *readings* and information about those readings. Information may be input manually or digitally.

Field survey. A category of *surveys*. *Measurement* of *features* for locating the position, or layout, of physical objects or theoretical position. For example, a property corner is theoretical, but a property corner monument is a physical object.

Field survey data set. The organizational/storage container for data, files and information pertaining to a particular *field survey*.

Field survey setup file. A list of parameters and configurations for the setup of a *data collection device*.

Field survey setup file template. A form to assist an actor in creating or editing a list of parameters and configurations for the setup of a *data collection device*. (Field survey setup file templates are used to guide the generation of a *field survey setup file*, which defines the type of data to collect; geodetic *vs.* planar geometry; the hardware, communications parameters; the spatial extent; setup instructions for custom in-field menus and data collection forms; paths to reference coverages, images, and documents; and the link from the *field survey* to its s*urvey project*.)

Measurement. A value that is constructed as a result of computations performed using *observations*.

Observation. Single set of *measurement* values for a *feature*. The values may include vertical or zenith angle, horizontal angle, slope

distance, backsight and foresight heights, and so on. The act of obtaining a distinct piece of information that helps describe the dimensions or spatial relationships between points on physical features.

Readings. A value taken from an arbitrary scale (chronometer, theodolite circle, compass, chain, etc.) returned by a *measuring device*. (See *observation.*)

Survey project. This is an organizational/system concept to represent a set of field activities. It's where and how all the relevant data and files are stored for future use. A survey project may be comprised of one or more *field surveys*.

Key Features and Functionality

This process is where the actor prepares the necessary files to properly configure the instruments and data to be used in a particular field survey. The actor has the option to import information saved during the research process. Templates are associated with standard field survey types. An example of template information would be a pre-defined data collection form that is associated to a stored database (identifies the attribute fields to be populated, to be viewed as read-only, etc.) The actor may select a template, may then input to or modify the template, or may generate a custom setup and save it as a template. The actor can select from a set of measuring devices, data collection devices and computation devices to be used together during the field survey. Based on the options chosen by the actor, the appropriate hardware and software configuration information is saved for use in the field.

Application Integration

This set of operations is typically preceded by ***SM-01 Survey Research*** and followed by ***SM-03 In-Field Survey Setup.***

Development Implications

This set of tools has significant dependency and limitations related to the possible set of hardware and software that may be used in combination for field survey. GIS-type functionality requires display and processing capability as available from the generic class of system referred to a *computation device*. A *data collection device* may have a scaled-down operating system and display (e.g., a palmtop unit) or may be a totally closed, custom hardware system integrated with the surveying hardware. To enable the full power of GIS (and measurement management) in the field may require a computation device.

8.4.2 SM-02 Pre-Field Survey Setup Overview

Use Case	SM-02 Pre-Field Survey Setup
Description	Process to create a *field survey setup file* to manage the collection of *readings*, *observations*, and *measurements*.
Actors	Surveyor, Supervisor
Pre-Condition	Actor needs to compile information, generate a *field survey setup file* and configure a *data collection device* and/or a *computation device* in preparation for a *field survey*. The host computer must be connected to the main database.
Post-Condition	A *field survey setup file* is created and uploaded to the *data collection device* and/or a *computation device*. Available supporting data is copied to a local *field survey data set*, and GeoCommunicator notice is sent if that option was chosen.
Cross-Reference	***SM-01 Survey Research***; ***SM-03 In-Field Survey Setup***; ***GC-10 Post Comment***

8.4.3 SM-02 Pre-Field Survey Setup Primary Scenario

Actor Action	System Response
1. This use case begins when the actor launches the ***SM-02 Pre-Field Survey Setup*** process	2. Display choice of *field survey* types. Example *field survey* types include: Boundary survey Site Survey Resource Mapping Right-of-way survey Transect survey Administrative survey Densification of control corners Topological survey Engineering/Construction survey Real-time mapping (GPS) ALTA Custom Vertical Control survey
3. Select survey type.	4. Retrieve and display *field survey setup file template*, based on selection. [survey type is "custom"] Assist in constructing and optional saving of a custom template.

Actor Action	System Response
5. Input to *field survey setup file template* as appropriate. May set GeoCommunicator toggles. May create *survey project* and establish links to it from *field survey*. May import information saved during the ***SM-01 Survey Research*** process.	6. System imports data and creates *field survey setup file* based on responses to prompts (in #2 and #4). Provide option to configure *data collection device* and/or a *computation device*. [import information] Import Survey Project parameters as saved in ***SM-01 Survey Research***. [required template fields not filled in] Advise actor and return to #5. [GeoCommunicator notification is toggled ON] Transmit information about planned/proposed *field survey* to GeoCommunicator. [establish link to *Survey Project*] Create a link between the *survey project* and the *field survey*. [new *Survey Project*] Create project.
7. May configure a separate in-field hardware system.	8. Upload *field survey setup file* to *data collection device* and/or a *computation device*. Upload reference data specified in the *field survey setup file*.

8.4.4 SM-02 Pre-Field Survey Setup Secondary Scenarios

Name	Point of Occurrence/Overview
Missing data; actor lacks permission	Step #4. System notifies actor.
Hardware configuration error; System out of storage space.	Step #8. System notifies actor.

8.5 SM-03 In-Field Survey Setup

8.5.1 SM-03 In-Field Survey Setup Analysis

Context

This is the in-field version of setting up to perform a field survey.

Concepts

Same as ***SM-02 Pre-Field Survey Setup***

Key Features and Functionality

The main difference between this set of operations and the pre-field operations is that the actor must be able to modify setup files while in the field. A survey crew may be performing several *field surveys*, and requires the ability to select a new setup, to modify it if needed, and to launch the new field data observation collection processes with the appropriate data, menus and forms.

Application Integration

This is the first step by the surveyor while in the field. Hardware, software, data and associated information are configured. The system is ready for station orientation and collection of readings, observations and measurements.

Once in the field, the data collection device is typically not connected to the LAN/WAN: if any information is missing, either the field survey must be performed in a modified format, or it must be postponed until all necessary data and configuration information is obtained.

8.5.2 SM-03 In-Field Survey Setup Overview

Use Case	SM-03 In-Field Survey Setup
Description	This is the in-field process to configure a *data collection device* and/or a *computation device* by selecting and applying a *field survey setup file*. (An example *data collection device* is a palmtop configured with NILS field survey software. An example *computation device* is a laptop configured with NILS field survey software. Data collection devices and/or computation devices are distinguished from measuring devices such as a total station.)
Actors	Surveyor, Supervisor
Pre-Condition	Actor is in the field and needs to initiate a *field survey*. The *data collection device* and/or *computation device* must be configured by applying a *field survey setup file*. Actor may need to modify field survey setup file parameters.

Use Case	SM-03 In-Field Survey Setup
Post-Condition	*Data collection device* and/or *computation device* is ready to begin collecting *readings*, *observations, and measurements* for the *field survey*.
Cross-Reference	***SM-02 Pre-Field Survey Setup***; ***SM-04 Collect Field Data Observations***

8.5.3 SM-03 In-Field Survey Setup Primary Scenario

Actor Action	System Response
1. This Use Case begins when the actor launches the ***SM-03 In-Field Survey Setup*** procedure.	2. Display the list of available *field survey setup files* to be used. [survey type is "custom,"] System should prompt actor to construct/save a custom *field survey setup file* (use ***SM-02 Pre-Field Survey Setup*** use case).
3. Select a *field survey setup file*.	4. Display *field survey setup file* in an edit form. Note: depending on the *data collection device* and/or *computation device* configuration, the *field survey setup file* edit form may disable some choices (some choices grayed out).
5. Modify the *field survey setup file* as appropriate (and if needed) and save. Apply field survey setup file to *data collection device* and/or a *computation device* .	6. Configure *data collection device* and/or a *computation device* based on final *field survey setup file*. Launch field data observation collection processes with appropriate data, menus and forms. [Required *field survey setup file* fields not filled in] Advise actor and return to #5.

8.5.4 SM-03 In-Field Survey Setup Secondary Scenarios

Name	Point of Occurrence/Overview
Actor lack of permission	Step #4. System notifies actor.
Hardware configuration error; configuration errors, i.e. Data requested by *field survey setup file* is unavailable.	Step #6. System notifies actor.

8.6 SM-04 Collect Field Data Observations

8.6.1 SM-04 Collect Field Data Observations Analysis

Context

This set of operations is the actual work of performing the *field survey*. Initial orientation is completed and instruments are set up and calibrated. The surveyor is ready to sight to a feature, capture readings, and process readings to derive measurements. The surveyor may sight to and traverse from point to point as needed to derive the geometry and/or attributes of the subject features. In a *boundary survey*, the subject features are typically corners, boundary lines, and areas.

Once the component readings are collected, they may be processed by a variety of computation methods to derive observations and measurements.

New Concepts

Computation. A set of processing methods or algorithms applied to achieve a desired solution. COGO procedures use computations.

Observation collection form. A list of configuration options to assist the actor in the setup for the collection of a particular type of observation.

Observation Set. Multiple observations for the same feature.

Measuring device. An instrument for determining the dimensions of a feature (as readings). Examples are total station, theodolite, transit, compass, and steel tape.

Key Features and Functionality

Once the *field survey setup file* is applied, the surveyor has available a prepared set of collection methods, forms, observation types and computations. The surveyor performs initial orientation to stage the instruments and obtain the basis of bearing. Tools are available to determine the next *feature* to be captured, and to assist in (1) the collection of the necessary component readings into *observation sets* based on the type of observation, and (2) the computation of those readings into *observations* and *measurements*. Observation sets can be input to and processed, evaluated, modified, and repeated until a satisfactory observation is derived.

Application Integration

This set of operations is highly integrated with ***SM-05 Perform COGO Layout*** tools as computations always available to the surveyor. When working with measurement networks, tools such as ***MM-01 Construct Measured Features*** are also available. The *survey data set* and the *survey project* include the necessary information to conduct and complete the *field surveys* that are required.

Development Implications

In-field collection systems that lack a *computation device* will have limited computational capabilities.

8.6.2 SM-04 Collect Field Data Observations Overview

Use Case	SM-04 Collect Field Data Observations
Description	Actor performs field data collection by recording *readings* using a *data collection device*. Readings are *computed* with a *computation device* to derive *observations* and *measurements.*
Actors	Surveyor
Pre-Condition	*Data collection device* and *computation device* have been configured. Operator wants to capture and/or compute the relevant *readings, observations,* and/or *measurements*.
Post-Condition	*Readings, observations,* and/or *measurements* have been collected, computed, verified and stored.
Cross-Reference	***SM-03 In-Field Survey Setup***; ***SM-05 Perform COGO and Layout***

8.6.3 SM-04 Collect Field Data Observations Primary Scenario

Actor Action	System Response
1. This use case begins when the actor launches the process to collect and compute *readings, observations,* and/or *measurements*.	2. Open and display appropriate *observation collection forms* as defined in the *field survey setup file*.
3. Select and input to an *observation collection form*.	4. Populate *observation collection form* and subforms (e.g. metadata) as appropriate for the next *observation set*. (May be to reference station identifiers-new, occupied, backsight or foresight; may be RTK (Real-Time Kinematic) survey station information.) [new station] Setup station.
5. Operate the *measuring device*, obtain a *reading* and interact with *data collection device* (i.e., sight, measure and poll).	6. Capture *reading, observation* or *measurement*, add to current *observation set*. Provide tools for *computation*. Note: automated *readings* cannot be modified (Read-Only).

Actor Action	System Response
7. Select a *computation* to apply.	8. Perform *computation*. Processes *observation set* as needed to derive *observations* and/or *measurements*. Display *observation set* and computed *measurements* as a map and as a report (of foresights, backsights and mean bearing, etc.). Provide choices to accept, reject or repeat current *observation set.* [*observation set* outside of defined tolerance] Notify/return to #3. [*observation set* in tolerance] Go to #9 [*observation set* not complete] Return to #5 [need to modify manually input observation data for *observation set*] Return to #3
9. Choose to accept, reject or repeat current *observation set*, choose a new observation type, or choose to close session.	10. Process action. [accept] Store *observation set* and *measurement.* [reject] Go to #3. [repeat] Go to #3. [new observation type] Go to #2. [close session] Exit with save options.

8.6.4 SM-04 Collect Field Data Observations Secondary Scenarios

Name	Point of Occurrence/Overview
Actor needs to delete *observation set.*	Step #9. Delete *observation set*.
Actor needs to modify *observation collection form(s)*	Steps #3+. Return to #3.

8.7 SM-05 Perform COGO and Layout

8.7.1 SM-05 Perform COGO and Layout Analysis

Context

This is the toolbox that provides coordinate geometry (COGO) calculation methods and procedures. NILS actors may access COGO tools during a variety of operations. Surveyors perform computations in the field as they attempt to locate and calculate coordinates for physical features such as monuments, buildings, and watercourses. COGO computations are used during the construction of measured features within a measurement network. Parcel editors use these calculations and procedures to build legal description geometry and to edit the parcel fabric.

New Concepts

COGO procedure. A unique set of coordinate geometry (COGO) *computations* used to calculate coordinate positions. Example position calculation methods are *in-field coordinate geometry (*e.g., *bearing/bearing intersection)* and *layout by angle and distance*.

COGO procedure parameter form. A list of configuration options to assist the actor in the setup of *COGO procedures*.

Point-ID duplication protection. Prevents entry of an existing point identifier for any point already in the present data set into the COGO parameter form.

Procedure duplication protection. Prevents entry of an existing point procedure for any point already in the present data set into the COGO parameter form.

Key Features and Functionality

The actor may choose from a variety of defined procedures and computation methods. Custom procedures can be defined by grouping and saving a set of standard computations. COGO procedures may be modified before and after processing to revise the input values and features, or to revise the calculation methods and steps used in the procedure. As geometric features are created, reference is maintained to the construction procedures that were employed to support data integrity (unique ID and method for each feature) and so that measurement-based features can be properly adjusted and re-constructed as needed.

Application Integration	COGO procedures as defined computations and calculations for the construction of measurement-based features must be available throughout the NILS application. If developed, ***SM-05 Perform COGO and Layout*** would be an application interface based on fundamental (lower-level) system functionality for building measurement-based features.
Development Implications	COGO procedures, calculations, computations and construction methods are essential tool components in the Field-to-Fabric common data model.

8.7.2 SM-05 Perform COGO and Layout Overview

Use Case	SM-05 Perform COGO and Layout
Description	Process to use coordinate geometry tools to calculate coordinate positions. Includes planar and geodetic calculations. May be used to perform layout or to search for point locations. May be used in conjunction with building a measurement network, a legal description fabric, or a parcel fabric.
Actors	Surveyor, Supervisor, Parcel Editor
Pre-Condition	Actor wants to calculate or layout the coordinates for point locations.
Post-Condition	New coordinates and their *computations* (calculation and COGO procedures) are saved.
Cross-Reference	***SM-04 Collect Field Data Observations; MM-01 Construct Measured Features; PM-03 Edit Legal Description Fabric; PM-05 Edit Parcel Fabric; MM-03 Edit Measurement Data;*** System Reconstruct Historical Version

8.7.3 SM-05 Perform COGO and Layout Primary Scenario

Actor Action	System Response
1. The use case begins when actor selects ***SM-05 Perform COGO and Layout***.	2. Display available position calculation methods (*COGO procedures* and other *computations*).
3. Choose *COGO procedure* type.	4. Present the appropriate *COGO procedure parameter form*. Assist actor to select features.
5. Select features (*points*, lines)	6. Update *COGO procedure parameter form* based on feature selection. Update display. Provide option for further input or run procedure. [no features selected] Go to #4. [features not correct / not complete] Go to #5.

Actor Action	System Response
7. Input to or modify *COGO procedure parameter form*. Run procedure.	8. Use selected features and *computation* parameters to generate point coordinates. Update *COGO procedure parameter form* with calculated coordinates or layout information. Update graphic display, including notification and symbolization of pre-existing points or IDs within distance tolerance. Prompt to save resulting coordinates and/or *computations.*
9. Respond to prompt.	10. Process according to input from actor. [save coordinates] save coordinates with appropriate point ID (may be new or replacement of existing) [save computations] save *computations* (to support audit; retrievable for layout, reconstruction). Prompt actor for (a) next *computation* of same type, (b) new *computation* type, or (c) quit?
11. Respond to prompt.	12. Process according to input from actor. [new] Go to #2. [next] Go to #4. [quit] End.

8.7.4 SM-05 Perform COGO and Layout Secondary Scenarios

Name	Point of Occurrence/Overview
Surveyor needs to establish a *field survey* before performing calculations.	Step #2/3. Use ***SM-02 Pre-Field Survey Setup*** or ***SM-03 In-Field Survey Setup*** to retrieve/apply *field survey setup file* and retrieve/setup *measurement data set* and reference data set.
Surveyor needs to establish an *observation set* to select input features or save output features.	Step #5/6. Use ***SM-04 Collect Field Data Observations*** and retrieve/setup *observation set*.
Actor needs to reconstruct a feature or duplicate a procedure from existing *COGO procedures.*	Step #3/4. Assist actor to find and retrieve feature and/or *COGO procedure*.
Actor needs to modify *computation.*	Step #7/8. Display *computation* in *COGO procedure parameter form*. Actor modifies values and system recalculates coordinate position.
New point violates *Point-ID duplication protection.*	Step #8. [point ID already exists] retrieve *computation* for existing *point*, display in *COGO procedure parameter form*. Actor modifies as needed. (Examples: (a) overwrite existing, (b) rename current or (c) cancel current, (d) mean, (e) append to point definition)
New point violates *procedure duplication protection.*	Step #10. [a *point* has previously been calculated with an equivalent *computation*] prompt actor to choose correct ID, delete duplicate ID.

9.0 Measurement Management Use Cases

9.1 Overview of Measurement Management Use Cases

The use cases for Measurement Management (MM) are intended to manage survey measurement and other geometric data in an automated environment. The inputs into the Measurement Management system are the following:

- **Measured bearings and distances** of lines from the Survey Management system, other digital sources, paper records and data attributes,
- **Measured geographic coordinates** of corners, as well as attributes,
- **Terrain-based boundaries** extracted from traditional map coverages, and
- **Rules of construction** for further division of land, as interpreted from legal records. Examples are offsets and PLSS section subdivision.

The purpose of Measurement Management is twofold. One purpose is to combine the individual components of measurement data from a variety of sources and reliabilities (pre-adjusted measurement network) into a seamless and coherent network (adjusted measurement network). The second purpose is to further divide the network to its needed detail based on legal descriptions to form all the spatial features needed to display the known legal descriptions (legal description fabric).

The general steps (and use cases) included in Measurement Management are:

- Assemble all measured feature components for the adjustment area, including error estimates and data source descriptions. (System Utilities such as **Input** and **Import Data**; Use cases: ***MM-01 Construct Measured Feature, MM-03 Edit Measurement Data)***
- Perform least square adjustment/analysis, which includes automatic transforms of data to common units and projections. (Use case: ***MM-02 Adjust and Analyze Measurement Network***.)
- Inspect analysis results for anomalies that may indicate data entry blunders. Fix blunders. (Use cases: ***MM-03 Edit Measurement Data***.)
- Option: Inspect results of analysis on blunder-free data for clues to refine error estimates. (Use cases: ***MM-03 Edit Measurement Data***)
- Apply stored rules and further divide the network into pieces as interpreted from legal records. (Use case: ***SM-05 Perform COGO and Layout***.)
- Copy the results into the legal description fabric, overwriting what existed in the adjustment area.

Creating measurement networks with Measurement Management provides the foundation for the legal description and parcel fabric tiers. Integrated maintenance of cadastral data is made much more efficient when geometry can be shared. The measurement management functionality should assist in the interpretation of (1) the reliability of each point position and (2) where data editing is needed. Based on such an interpretation, new data can be

added to the pool of measurement data and elements that no longer aid the optimal solution can be removed. Any area can be selected and adjusted, usually based on what point positions will be enhanced by the new data being added. New data, once attributed and verified as *blunder*-free, can be integrated into a seamless network.

9.2 Measurement Management Use Case Analysis

The remainder of this section presents the individual Measurement Management use cases. In the NILS 'Field-to-Fabric' concept, Measurement Management use cases are used to build measurement networks as the geometric sources for fabrics.

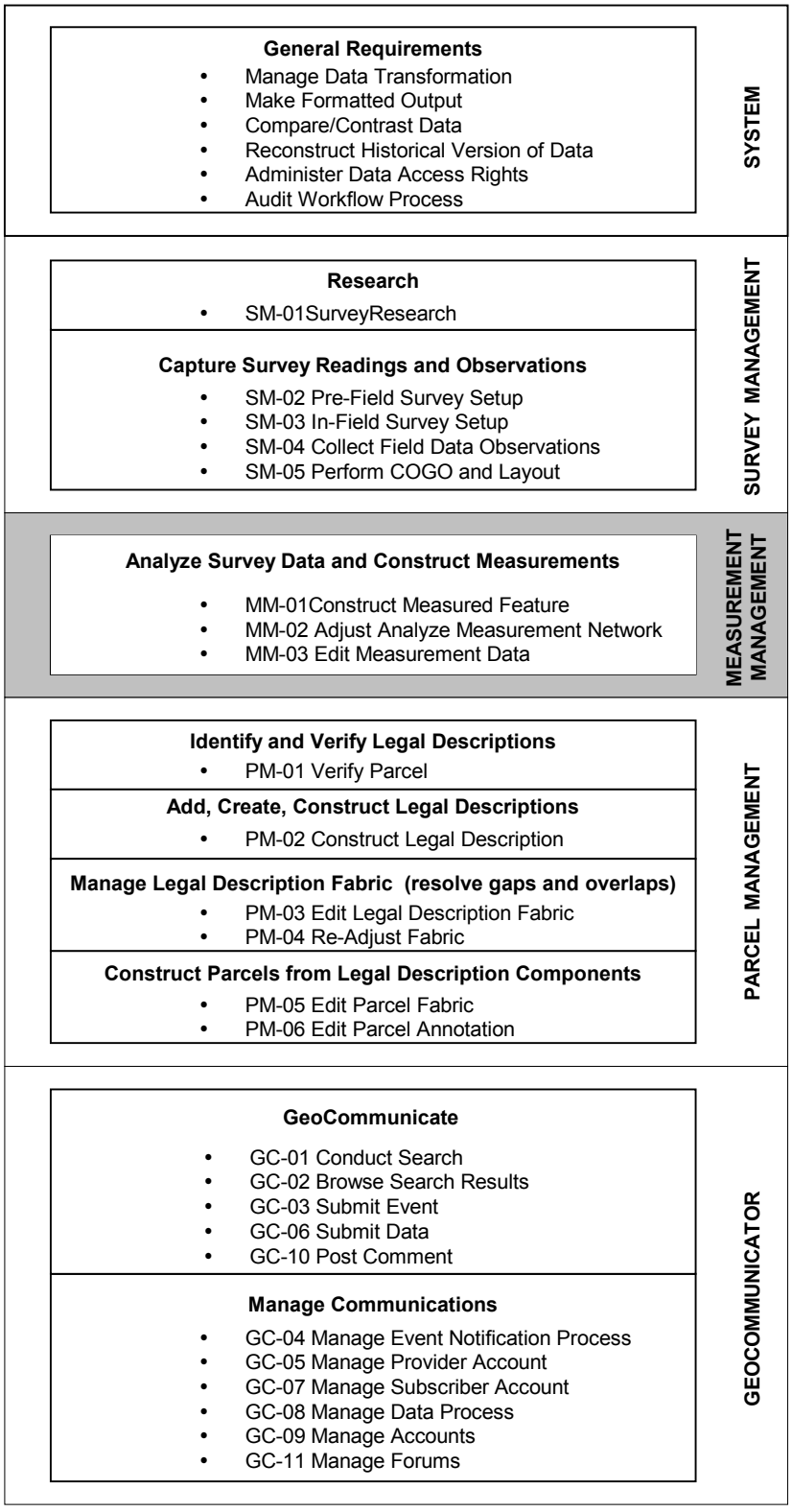
Please note that Measurement Management as a process would have access to the system functionality provided to support other use cases. Therefore use cases such as ***SM-05 Perform COGO and Layout***, and Make Formatted Output (a system requirement) are utilized in the measurement management process, but are not included in this section.

Table 9.1 lists the Measurement Management use cases. Figure 9.1 shows the relationship of these use cases to the other NILS use cases.

Table 9.1. Measurement Management Use Cases

Use Case	Section	Description
MM-01 Construct Measured Feature	9.3	*Measured Features* are constructed from component elements in a *measurement network* by applying construction and *computation* methods. *Measured features* have topological associations to their component elements (i.e. component features and/or *survey points*.) This use case may be used in conjunction with building a *measurement network*, a *legal description fabric*, or a *parcel fabric*.
MM-02 Adjust and Analyze Measurement Network	9.4	Perform an iterative *parametric least squares adjustment* on a *measurement network* to analyze and adjust coordinate values for *points*. Generate statistics on *measurement* and coordinate reliability. May be used in resolving the cartographic and/or coordinate representation (relationship) of non-survey *features* (map control, *legal descriptions*, digitized, scanned/vectorized) relative to surveyed *features*. May be used to resolve the representation of non-surveyed *features* without reference to surveyed *features*. NOTE: A *measurement network* may be composed of *legal descriptions* as well as *measurements*.
MM-03 Edit Measurement Data	9.5	Manual entry/edit of *measurement data* values. Includes types of *anomaly detection* and *anomaly correction* as part of edit validation.

Figure 9.1. Business Process Analysis—Measurement Management Use Cases



9.3 MM-01 Construct Measured Feature

9.3.1 MM-01 Construct Measured Feature Analysis

Context

The fundamental concept behind measured features is the establishment of topological associations that can transform measurement-based features into super-features that are constructed from, and may adjust with, their underlying measurements. A feature class in a measurement data set can be a mixed collection of (ordinary) features and measured features—this provides the migration path for current GIS actors to evolve their cadastral feature fabrics into a measurement-based fabric over time.

Concepts

Measured Feature. A feature constructed from component elements in a measurement network by applying construction and computation methods. Measured features have topological association to component features and/or measurements.

Measurement Network. A set of topologically related measurements (coordinate points and lines) and constructions (area-based features, non-surveyed features). May be in various states of connectivity and adjustment. Types:

> ***Pre-Adjusted Measurement Network.*** Multiple coordinate values exist for some points, so lines which should be connected may not be (due to measurement errors).
>
> ***Adjusted Measurement Network.*** All *over-determined points* have unique coordinates.
>
> ***Legal Description Fabric.*** An *adjusted measurement network* to which constructions (terrain feature boundaries, non-survey data) have been added. All polygons representing legally-described areas have been formed from the measurement network and other boundaries to support the parcel fabric.
>
> ***Parcel Fabric.*** A feature class related that has been modified to represent parcel configuration for a specific business purpose (e.g., ownership parcels, tax parcels, historic parcels). Parcel features may be associated with component features in the Legal Description Fabric.

Survey Point. A point feature that has XYZ coordinate values. Any point in a *measurement network*. Each s*urvey point* has a list of coordinate values or a c*oordinate set*.

Key Features and Functionality

This set of operations is basically a set tools that apply the necessary computations to construct various types of measured features.

Example Measured Feature Types. *Legal Description* (section, government lot, city lot, aliquot part, etc.), *True Line, Boundary, Representative Corner* (multiple; porcupine; theoretical), *Corner, Parcel, Administrative Area*, etc. May include physical objects such as buildings and other structures.

Example Computations. Section subdivision, *offset line, defining measurement, proportion, intersection* (distance-distance). Note: methods may be geodetic/non-geodetic.

Application Integration

In the course of constructing measured features, the system may use COGO and Layout functions (see ***SM-05 Perform COGO and Layout***). The construction of measured features may often occur within the context of editing measurement data or fabrics. An example is the construction of a legal description and the operations necessary to edit the legal description fabric.

Development Implications

In the NILS system model, field surveys produce observations that are built into measurements. Measurements are associated, survey-based features within a measurement network. The elements of a measurement network are mass-adjusted using a *parametric least-squares analysis* to yield most probable coordinate values for all points.

Before a measured feature can be constructed, some underlying survey-based features must exist within a measurement network. The minimal unit required is a survey point. A survey point can become a measured corner. A set of two survey points defined as measured corners can be used to construct a measured line. A survey point combined with the necessary parameters can be used to construct a measured curve. Measured lines and curves can be joined at measured corners to define a measured area. Measured areas can be associated through rules of aggregation and division to define a feature fabric (legal description, parcel).

9.3.2 MM-01 Construct Measured Feature Overview

Use Case	MM-01 Construct Measured Feature
Description	*Measured Features* are constructed from component elements in a *measurement network* by applying construction and *computation* methods. *Measured features* have topological associations to their component elements (i.e. component *features* and/or *survey points*.) This use case may be used in conjunction with building a *measurement network*, a *legal description fabric*, or a *parcel fabric*.
Actors	Surveyor, Supervisor, Parcel Editor
Pre-Condition	Component *survey points* and *measured features* are available. Actor wants to construct a new *Measured Feature* from supporting data.
Post-Condition	A *measured feature* is constructed and attributed appropriately.
Cross-Reference	***SM-05 Perform COGO and Layout; MM-03 Edit Measurement Data; PM-02 Construct Legal Description***

9.3.3 MM-01 Construct Measured Feature Primary Scenario

Actor Action	System Response
1. This use case begins when a actor launches the ***MM-01 Construct Measured Feature*** process.	2. Display current *measurement data set* (may include *measured features*, *survey points* and reference features). Provide tools for selection and construction. Note: measurement-based elements in a *measurement data set* have *computation* methods that are automatically applied to properly construct and display the *measurement data set*. [no data set] Establish current measurement data set
3. Select spatial extent in which to perform *Measured Features* construction.	4. Update display (includes symbology to indicate both type and status of measurement data set elements). Display choices for *computation* methods to support construction of *Measured Features*.
5. Select type of *Measured Features* to construct.	6. Process through construction steps, prompt for actor input as needed.
7. Select *survey points* and/or existing *Measured Features* that define the new *Measured Feature*. Input appropriate attribute values for the new *Measured Feature*.	8. Apply computation methods associated with construction rule and construct new *Measured Feature* with inherent attribute values (e.g., curve construction parameters, boundary type, object links, ID, metadata, etc.). Display new *Measured Feature*. Choice of Save, Revise, Next Feature, Quit.

Actor Action	System Response
9. Select from choices	10. Perform chosen operation. [save] Save to measurement data set. [revise] Return to #7. [next] Return to #5. [quit] Exit.
NOTE: No secondary scenarios	

9.4 MM-02 Adjust and Analyze Measurement Network

9.4.1 MM-02 Adjust and Analyze Measurement Network Analysis

Context

Adjustment and Analysis together are the core of Measurement Management, the second phase in the Field-to-Fabric process (i.e., surveying to measurement management to parcel management).

It is the nature of surveying and legal description writing that techniques, technology, skill and interpretation over time have resulted in multiple solutions for a given set of features. Cadastral fabrics have a derived status that must account for all the component divisions of land that led to the configuration at present. Based upon a standardized assessment of the reliability (quality, accuracy) of each element in a measurement network, an adjustment process is applied to find the best coordinate values for the points within the area of adjustment.

Adjustment is an art as well as a mathematical process. The measurement analyst has a variety of optional methods available to discover gross errors (blunders and anomalies), to narrow the adjustment area, and to report on the results of adjustment. Analysis and adjustment happen together in a series of iterations, during which edits occur, reliability is reported and revised, changes are evaluated, and new solutions are attempted.

The measurements and measured features that comprise a measurement network become the basis for higher-tiered fabrics (legal description and parcel). As adjustment alters coordinate values, the geometry of a feature changes. The NILS data model concept provides for the maintenance of topological associations between tiered fabric features and their underlying measurements. This model supports the qualitative evolution of a fabric over time in response to transactions that supply better data. As the measurement network is adjusted (perhaps to incorporate new survey data), the topologically-associated feature geometries in related fabrics would automatically update.

New Concepts

Adjustment Limits. Values that indicate when sufficient numbers of least square analysis iterations have been reached. This prevents endless looping of iterations. There are two types of limits: *residual tolerance* and *iteration limit*.

Iteration Limit. The maximum number of iterations an adjustment can have before it is assumed that the solution is diverging.

Parametric Least Squares Adjustment. A Least Square Analysis/Adjustment that considers the quality of data that varies throughout the data set. A weighted least square adjustment.

Reliability Parameter Form. A data entry tool accessible prior to successive *least square adjustment* sessions that allows the actor to set or adjust the *reliability values,* such as (1) to toggle on/off function to calculate *reliability values*, and (2) to set a buffer distance around the selected set of *measurement features* to limit the actual set of *measurement features* to be used when generating *reliability values.*

Residual Tolerance. A small distance amount (such as 0.01 feet) under which further refinement through network adjustment would not result in any meaningful positional refinement.

Reliability Values. Data describing the ellipse surrounding an adjusted point's coordinates that represent a statistical chance that the true coordinate values will be within the ellipse. Ninety five percent chance is a usable measure.

Robusting. A technique in *Least Square Analysis/Adjustment* where data discrepancies are localized to where they occur rather than the normal smoothing out over a large area. This is a technique to locate *blunders*.

Key Features and Functionality

This set of operations enables the actor to iterate through a successive series of adjustments. A range of adjustment and analysis options (e.g., anomaly detection, reliability reporting and robusting) are provided—the actor may specify the parameters and methods to apply during each iteration. The analysis is supported by tabular reports and a map view. The actor can manage the map view to symbolize various aspects of the adjustment—error ellipses, adjustment factors, reliability values, etc. Multiple solutions may be saved so that they can be reconstructed and used in future analyses or adjustments.

Application Integration

Measurement networks may be as small as a traverse (several survey points) or as large as a state. The actor controls the extent and type of adjustment.

As *anomalies* and *errors* are found, the actor would utilize the ***MM-03 Edit Measurement Data*** tools to make corrections. Input to the adjustment process may be manual (via the ***MM-03 Edit Measurement Data*** tools) or by import (e.g., from a *Field Survey*). Conversion to or from commercial survey software systems would be a useful integration function.

It is important to give the actor control in managing the means by which (geometric/topological) associations are made and handled during the update process. Actors will want to have feature-by-feature control on the update process—a continuum of actor-defined control, from locking the geometry of some related features to the automatic adjustment of others.

Development Implications

Support for the tiered, topologically-integrated data model requires an application to manage dynamic object-object relationships that is backed by a correspondingly complex database implementation.

9.4.2 MM-02 Adjust and Analyze Measurement Network Overview

Use Case	MM-02 Adjust and Analyze Measurement Network
Description	Perform an iterative *parametric least squares adjustment* on a *measurement network* to analyze and adjust coordinate values for points. Generate statistics on measurement and coordinate reliability. May be used in resolving the cartographic and/or coordinate representation (relationship) of non-survey *features* (map control, *legal descriptions*, digitized, scanned/vectorized) relative to surveyed *features*. May be used to resolve the representation of non-surveyed *features* without reference to surveyed *features*. NOTE: A *measurement network* may be composed of *legal descriptions* as well as *measurements*.
Actors	Surveyor, Supervisor, Parcel Editor
Pre-Condition	Necessary *measurement network* features have been input.
Post-Condition	The input *measurement network* has been adjusted and analyzed as a whole to derive a revised *measurement network* in which each *point* has been given its most appropriate coordinate value and error statistics according to the adjustment parameters chosen. *Reliability values* may have been generated for adjusted *points*.
Cross-Reference	***MM-03 Edit Measurement Data; PM-04 Readjustment of Legal Description Fabric***.

9.4.3 MM-02 Adjust and Analyze Measurement Network Primary Scenario

Actor Action	System Response
1. This use case begins when the actor launches the adjust/analyze process.	Transform *measurements* into common datum and unit type. Display available *measurement network* features symbolized to indicate status, reliability, etc.). Provide tools to select data.
3. Option to select a sub-set of *measurement network* features for adjustment.	4. Update display to show spatial extent and selected *features* (symbolized to indicate status, reliability, etc.). [selected sub-set not correct] Return to #3. Display *Analyze/Adjust Parameter Form*.
5. Input to *Analyze/Adjust Parameter Form* to define parameters and options for analysis and adjustment operations. Note: Option to activate anomaly detection options. Example methods include Closure Report, Unconstrained Adjustment, Graphic of Unadjusted data, Robusting Report, Color-code snoop values, etc. Option to set reporting and statistical parameters (e.g., level of residual to report); may set *adjustment limits* (*residual tolerance* and *iteration limit*); may just generate *reliability values* on adjusted points.	6. Perform an iterative *parametric least squares adjustment* to analyze and adjust coordinate values for *points* to determine their most appropriate location according to the adjustment parameters chosen. Generate statistics on *measurement* and coordinate reliability. Generate anomaly reports and display as appropriate. Update Display (symbolized to indicate status, reliability, adjustment factor, etc.). Display choice of Revise Adjustment Parameters, Re-Iterate, Save, Generate Reliability, Quit [*adjustment limits* not reached] Automatically repeat #5 and #6 up to a preset limit of iterations. [Revise adjustment parameters] Return to #5. [Re-Iterate] Assist actor to specify an additional number of iterations from a specified solution version (return to #5). [Edit Measurements] Change incorrect measurement values detected by *robusting* or by inspection of report. [Save] Update working version of *measurement data set.* [Generate Reliability] display *Reliability Parameter Form*, go to #7 [Quit] Exit
7. Input to *Reliability Parameter Form*. Set buffer distance, etc.	8. Generate *Reliability values* for adjusted points according to parameters chosen. Display choice to Return, Revise, Quit [Return] Go to previous task. [Revise] Go to #7. [Quit] Exit.

9.4.4 MM-02 Adjust and Analyze Measurement Network Secondary Scenarios

Name	Point of Occurrence/Overview
Adjust with *Robusting*	Step #6 – After adjustment, prompt actor to modify weighting default factors. Create alternate working version and repeat Steps 5-6 until actor ends *robusting* process.
No solution with adjustment limit	Step #6 – Report to Actor (Actor may proceed to ***MM-03 Edit Measurement Data***)

9.5 MM-03 Edit Measurement Data

9.5.1 MM-03 Edit Measurement Data Analysis

Context	To build a measurement network, some initial source data is required. *Measurement data* types include raw coordinate files, survey source IDs, error estimates, etc. This is the set of tools to manually input or edit *measurement data*, often utilized in process of automating records (e.g., a township plat or survey plat). Sometimes surveyors and editors will work directly from field notes, a survey plat or other reference to directly enter coordinate information prior to performing analysis and adjustment of a measurement network. In addition to a data input application, this is also an editor. When *blunders* and/or *errors* are discovered during the analysis/adjustment process, the actor may open an edit session and make corrections to the *measurement data*.
New Concepts	***Anomaly Correction.*** Process to edit and correct anything irregular or abnormal (*blunder, error*) in *measurement data*. ***Anomaly Detection.*** Process to identify anything irregular or abnormal (*blunder, error*) in *measurement data*. ***Blunder.*** A mistake, such as recording the wrong value or measuring to the wrong feature. See *error*. ***Error.*** The imprecision of a measurement. All measurements have error. See *blunder*. ***Measurement data.*** The raw measurement files (e.g., GMM's INRAW), control points, coordinate files, survey source IDs, error estimates, and/or survey business rules that are associated with a *measurement data set*.
Key Features and Functionality	The actor may select from a set of *measurement data* types and perform manual data entry. The actor may open an edit session for an existing *measurement data set*.
Application Integration	*Measurement data* may be edited while the actor is in between iterations of analyzing and adjusting a *measurement network*. The measurement-based data model will support data validation rules, and the edit process will provide pre-defined *error/blunder* detection and correction procedures to assist the actor in cleaning *measurement data.*
Development Implications	Requires definition in the data model of the types of *measurement data* needed to build *measurement networks*.

9.5.2 MM-03 Edit Measurement Data Overview

Use Case	MM-03 Edit Measurement Data
Description	Manual entry/edit of *measurement data* values. Includes types of *anomaly detection* and *anomaly correction* as part of edit validation.
Actors	Data Entry Person, Surveyor, Supervisor
Pre-Condition	Actor needs to enter/edit *measurement data* values in preparation for constructing, analyzing, adjusting, or updating a *measurement network*.
Post-Condition	Data has passed verification/validation check and has been added to or updated the destination data set.
Cross-Reference	***MM-02 Adjust and Analyze Measurement Network***

9.5.3 MM-03 Edit Measurement Data Primary Scenario

Actor Action	System Response
1. This use case begins when the actor launches the ***MM-03 Edit Measurement Data*** process.	2. Prompt for edit session parameter form (to specify *measurement data set* and *measurement data*).
3. Actor inputs values to set edit session parameters.	4. Provide additional forms to set data and verification/validation options. NOTE: Some *anomaly detection* is intelligent based on selected *measurement data set* and *measurement data* type. Actor may modify detection/reporting options.
5. Actor inputs values to set validation parameters.	6. Process selection. Display appropriate data entry form and prompt actor to input/edit data fields.
7. Input/edit data.	8. Process edits. Some automatic data validation occurs during this processing. Provide option to run specific data validation, return to edit, save to a target *measurement data set*, close session.
9. Select Action.	10. Process selected data validation, generate reports and update graphical display as appropriate. Repeat options as provided in #8.
11. Select action. View reports, return to edit, save, exit.	12. Process action. [save] Writes or appends data to target *measurement data set*. [not done or errors detected] Repeat #2-#9 and make corrections.
NOTE: No secondary scenarios	

10.0 Parcel Management

10.1 Overview of Parcel Management Use Cases

10.1.1 Concepts

The use cases for Parcel Management (PM) are intended to describe the various business processes necessary to maintain land records in an automated environment. The first use case, ***PM-01 Verify Parcel***, outlines the various steps necessary in the original filing of a document (i.e., deed being recorded or application filed). ***PM-02 Construct Legal Description*** allows for creation and maintenance of current and historical legal descriptions. ***PM-03 Edit Legal Description Fabric*** allows for generation and maintenance of survey and non-survey descriptions and geometries in an integrated 'coverage' that are the building blocks for parcel legal descriptions. (See Figure 10.1 for a high-level view of the NILS data architecture) ***PM-05 Edit Parcel Fabric*** allows for building and attributing parcels necessary to maintain a 'coverage' based on a particular business practice (e.g., ownership, rights, and restrictions) in a user-defined geographic area.

There are certain key survey and mapping terms that must be understood in order to 'navigate' the Parcel Management use cases. Please reference the complete listing of definitions available within the appendix. A diagram is also included in this overview to help explain the relationship between the various measurement network and fabric 'layers.'

10.1.2 NILS Data Architecture

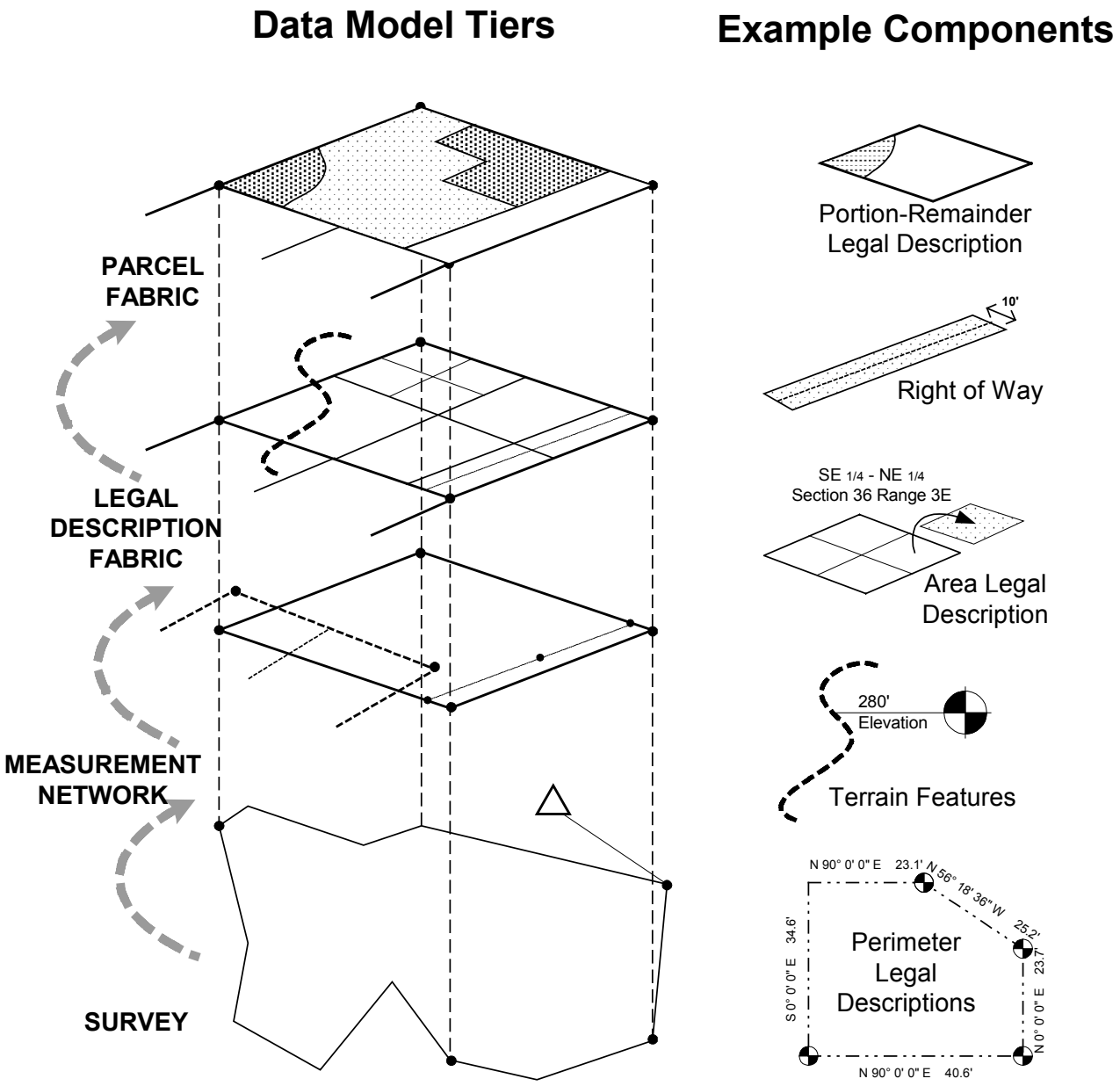
Figure 10.1 illustrates that Legal Description (LD) fabric is separate from parcel fabrics. Area, perimeter, and portion/remainder legal descriptions are generated in the LD fabric by processes (use cases) within Measurement Management (MM) and Survey Management (SM) and/or by legal description editors using automated tools (e.g., *COGO*) within the LD fabric. The parcel fabrics are maintained in PM use cases (i.e., parcel editors choose when and exactly what changes need to be made for a parcel).

The layers need to be separate for several reasons: (1) not all parcels have been described in terms of legal description(s), and (2) not all legal descriptions to date have been created in a separate LD fabric through use of coordinate geometry, section subdivision, or digitizing/ adjustment from a map (data conversion issues). One of the goals of the parcel editor should be to strive for better control. As stand-alone parcels get created/ updated, additional legal descriptions will be created, and the parcel will be defined (or re-defined) in terms of the legal description(s). This new description based on one/several legal descriptions attached to a parcel is defined as the parcel legal area description.

The 'toolkit' for maintenance of LD and parcel fabric will be very **comparable** and is often described within survey use cases or as 'system level' functionality. The data requirements (which support the functional requirements) for LD and parcel editors are **very different**. As a rule, parcel editors will concentrate on work relating to ownership, land use rights, management, beneficiary, tax assessment, administration, land management, and many other types of parcel right and restriction issues. LD editors will concentrate activity within the

broad categories of survey/survey maintenance based on control established within the *measurement network*.

Figure 10.1. High level View of NILS Data Architecture (Measurement Network, Legal Description Fabric, and Parcel Fabrics)



10.2 Parcel Management Use Case Analysis

The reminder of this section presents the individual parcel management use cases. In the NILS 'Field to Fabric' concept, measurement management use cases are used to build measurement networks as the geometric sources for fabrics.

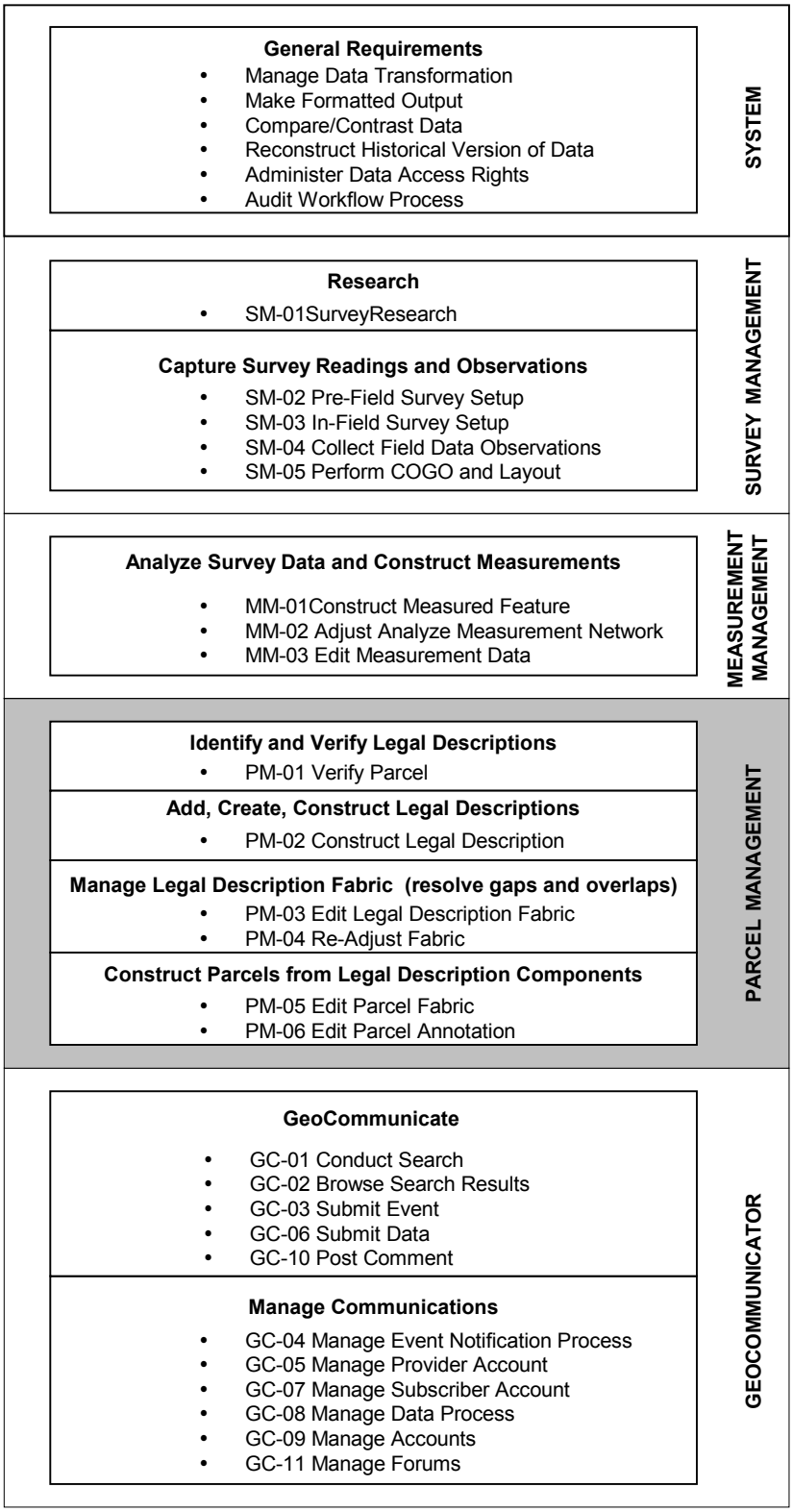
Please note that Parcel Management as a process would have access to the system functionality provided to support other use cases. Therefore use cases such as ***SM-05 Perform COGO and Layout***, Make Formatted Output (a system requirement), ***MM-02 Adjust and Analyze Measurement Network***, and ***MM-01 Construct Measured Feature*** are utilized in the parcel management process, but are not included in this section.

Table 10.1 lists the Parcel Management use cases. Figure 10.2 shows the relationship of these use cases to the other NILS use cases.

Table 10.1. Parcel Management Use Cases

Use Case	Section	Description
PM-01 Verify Parcel	10.3	To identify and verify parcels affected by an initiating event and to determine the appropriate maintenance actions needed to process the parcel(s) or event.
PM-02 Construct Legal Description	10.4	Process to create the basic *legal description* components—geometry and attributes (text, ID, source ID, etc.). Legal descriptions may have topological association to *features* (e.g., *parcels*), to component features and/or to *measurements*. Legal descriptions may be saved into a collection of unadjusted legal descriptions (includes historic legal descriptions).
PM-03 Edit Legal Description Fabric	10.5	Process to edit the *legal description fabric*. Insert new *legal description* components and/or edit existing components. Fit, assemble, and resolve *legal description* components within the legal description fabric.
PM-04 Re-adjust Fabric	10.6	Process for adjusting the coordinates of an existing *feature fabric* (e.g., *legal description fabric, parcel fabric*) to enhance (cartographic) alignment with a reference source that has desired *control features (*also known as map control).
PM-05 Edit Parcel Fabric	10.7	Process to define *parcels* within the *parcel fabric* by associating or aggregating *legal description(s)* from the *legal description fabric*. Process to create new parcel records and/or to edit parcel attribute values.
PM-06 Edit Parcel Annotation	10.8	Create or modify annotation within or associated to *parcel fabric*, *legal description fabric*, or *measurement network* to support display and formatted output.

Figure 10.2. Business Process Analysis—Parcel Management Use Cases



10.3 PM-01 Verify Parcel

10.3.1 PM-01 Verify Parcel Analysis

Context

The process to verify a parcel given its description is one of the most common land records management operations. Once verified, the records pertaining to the subject parcel can be queried or modified, or if the parcel does not exist, an update process can be initiated.

Customers (i.e., the public, making miscellaneous inquiries) often know a parcel owner, a parcel location, a parcel address, a parcel identification number, and so on, and want to access all available information about the property.

Land records managers must interpret parcel-related documents either prior to, or after they are recorded. Interpretation is needed to (1) verify the status of the parcel, and (2) to determine the appropriate action required to correctly process the document.

Surveyors, attorneys and title companies access records to verify and/or write parcel legal descriptions and associated documents that control the spatial extent and use of property. Often these professionals are performing research and analysis to compare and contrast parcel-related information, sometimes by reconstructing historical configurations of ownership or other rights in land.

Mistakes made in verifying or processing parcel legal descriptions can cause significant problems at many levels. Errors are perpetuated into the record, and researchers who do not make comprehensive inquiry may utilize the wrong version of a parcel legal description. The potential for adverse economic impact in terms of rights and interests is large—in some cases the difference of a foot can be worth hundreds of thousands of dollars.

Verification of parcels is part of the larger process for managing land records. In every agency, there is a workflow associated with the proper disposition of any document. Sometimes these documents act as triggers and initiate a variety of reviews and processes. It is essential that the workflow process is managed effectively to ensure compliance with the regulations that govern an agency's document-processing duties. Often this document management involves multiple steps during which information, notes, decisions and actions must be compiled and shared with the next agent in workflow process.

New Concepts

Bureau motion. A land action initiated by the Bureau of Land Management or another federal entity.

Classification. The process of determining whether the lands are more valuable or suitable for transfer or use under particular or various public land laws than for retention in Federal ownership for management purposes.

External triggers. Transactions in an associated system or database that cause the need for processing in NILS.

Parcel legal description. A composite description that contains all the *legal descriptions* that define a parcel and can be used to derive the full spatial extent of the parcel.

Right. An interest recognized and protected by the law, respect for which is a duty, and disregard of which is a wrong (Salmond). A capacity residing in one man of controlling, with the assent and assistance of the State, the actions of others (Holland). Burke, J. (1976). Osborne's Concise Law Dictionary, 6th Edition. London: Sweet and Maxwell.

Restrictive covenant. An agreement creating an obligation contained in a deed, forbidding the commission of some act.

Sketch. A draft or interim version of a parcel, that is used as the basis for creating a new parcel and/or to verify the geometry, attributes and validity of a given *parcel legal description*.

Subdivision rule. *(Portion/Remainder, Perimeter Or Other Area Reference)*. See *Legal Description*. The available methods to divide or aggregate parcels according to a specific survey system.

Transaction agent. Any participant or party identified in land transaction.

Withdrawal. Withholding an area of Federal land from settlement, sale, location, or entry under some or all of the general land laws, for the purpose of limiting activities under those laws in order to maintain other public values in the area, or reserving the area for a particular public purpose or program, or transferring jurisdiction over an area of Federal land, other than property from one management agency to another.

Key Features-Functionality

This use case covers three basic functions, (1) identifying a property, (2) verifying the attributes of the property, and (3) determining a processing method and submitting the document into the workflow management system.

Identification may occur by a variety of methods based on the document or parcel information known to the actor. Searching

would include geographic and logical queries. Spatial searches would typically be a 'drill-down' from a wide area (city, county, township, forest, region, etc.) into a specific area. Attribute queries might include searching by a unique *legal description*, parcel identification number (PIN), other attribute (address, owner, case number), or event category (new claims, vacated rights-of-way, annexations, etc.).

Of course it is possible that the parcel cannot be found because it is new or its reference attributes are incorrect. Possible additional functionality might include rejection of the document, editing of the database to correct an error, or editing to create the new parcel record.

As part of creating a new parcel record, having the ability to sketch a parcel would include tools to translate a parcel legal description into its representative boundary geometry. Sketching may involve the use of COGO methods to traverse the boundary of a metes and bounds legal description. Sketching may also include tools for creating a new parcel record is by applying a pre-defined subdivision rule to an existing parent parcel. Subdivision rules would be associated with a survey system (e.g., 'quarter a PLS section').

Once the parcel is found or sketched, the actor may review (sometimes edit) various attributes to verify that the subject parcel is indeed valid and may be further processed. The actor would employ one of several pre-defined verification processes to review the status of the parcel. An example verification method would be to display of attributes, *rights, transaction agents, restrictive covenant*, and parcel acreage in comparison to subject geometry.

Once the parcel is verified, the actor must determine the proper processing action. The system would provide maintenance processing choices such as attribute change (owner name change, etc.), geometry change (division or aggregation), replacement or revision to document. The exact choice of processing operations would be based on the workflow environment of the agency.

Application Integration

PM-01 Verify Parcel is integrated (1) with the ***PM-05 Edit Parcel Fabric*** use case tools and data handling, (2) with the Compare and Contrast Data and Reconstruct Historical version as verification methods, and (3) with the concept of *external triggers* as system actors that could initiate the ***PM-01 Verify Parcel*** use case or be triggered by the use case, as when an external system must be activated to handle the data management for newly-created parcels.

The integration of parcel verification with a workflow management system is a key integration issue. Each agency will have a 'customized' workflow system to some extent. There are many issues with managing workflow inter-dependencies, protocols and rules.

A single 'case' or transaction will often require parcel verification on multiple occurrences. In the Bureau of Land Management the 'life' of the case involves many configuration changes to the parcel's geometry and attributes. Over time, case transactions would trigger parcel verification multiple times as the necessary transactions are processed, perhaps on an associated external database.

Development Implications The extent and depth of work required to integrate with, or develop, a 'workflow management system' for NILS is uncertain.

10.3.2 PM-01 Verify Parcel Overview

Use Case	PM-01 Verify Parcel
Description	To identify and verify *parcels* affected by an initiating event and to determine the appropriate maintenance actions needed to process the parcel(s) or event.
Actors	Customer, Data Entry Person, Data Analyst, Parcel Editor
Pre-Condition	An initiating event has occurred (e.g., application received, deed recorded, public counter request, letter request, agency-determined need—*bureau motion, withdrawal, classification*, etc.). Actor needs to verify *parcel(s)* and determine appropriate action.
Post-Condition	Affected *parcels* have been identified. The geometry of subject parcel may be selected (if pre-existing), sketched and/or saved (if new). Actor determines appropriate maintenance action.
Cross-Reference	***PM-05 Edit Parcel Fabric***; Compare and Contrast Data; Reconstruct Historical version; external triggers.

10.3.3 PM-01 Verify Parcel Primary Scenario

Actor Action	System Response
1. This use case begins when the actor launches the ***PM-01 Verify Parcel*** process.	2. Prompt actor to identify subject parcel by geography, *legal description*, parcel ID, other attribute or event category. Provide option to import digital image or drawing, etc.
3. Input to identify subject *parcel*.	4. Process input. Attempt to find parcel. Display *parcel*, associated *parcel legal description*, and all component legal description geometries. Provide verification methods (visual, new *sketch*, attribute comparison, other).
5. Select verification method to compare subject parcel with features from reference data set.	6. Process verification method. Example Verification Method: Find and displays attributes, *rights, transaction agents, restrictive covenants*, and parcel acreage in comparison to subject geometry. Provide maintenance processing choices. Examples of maintenance: attribute change (owner name change, etc.), geometry change (division or aggregation), replacement or revision to document.
7. Actor determines appropriate maintenance action and selects action.	8. Process action. Provide options to report, save, and submit subject *parcel* information into workflow process. [submit into workflow] Provide workflow options
9. Input and submit to workflow.	10. Process subject parcel information and transmit to next step in workflow.

10.3.4 PM-01 Verify Parcel Secondary Scenarios

Name	Point of Occurrence/Overview
Import digital image or drawing, etc.	Step #2. Actor will import the subject *parcel* from a digital source. Imported parcel(s) will provide input to Step #4.
Subject *parcel legal description* not found.	Step #4. Notify actor. Provide options to: reject document (advise customer and interrupt processing of document) sketch parcel, or forward to ***PM-03 Edit Legal Description Fabric*** or ***PM-05 Edit Parcel Fabric*** use cases (may be a new parcel—pass to editor as a new transaction)
Sketch parcel.	Step #4. Enable survey tools (COGO and measurement management, etc.). Process input iteratively as needed to complete *sketch*. Provide options to close *sketch*. Process closure as appropriate. Attempt to close. Report error and display adjustments with subject *parcel(s)* located and highlighted. Option to return/revise. [Parcel will not close within tolerance] Notify actor. Possible optional step is to enter a 'Research Edits' analysis mode.
Create Legal description by *subdivision rule, legal description portion/remainder, legal description perimeter* or other *legal description area reference*.	Select parent area. Step through definition of the subject part. Derive legal description of subject and remainders. Assign IDs.
External triggers	NOTE: In the case of iterative transactions, this use case can be initiated multiple times from outside this use case via another database. It is important to note that a single 'case' or transaction will often access this use case on multiple occurrences throughout the 'life' of the case.

10.4 PM-02 Construct Legal Description

10.4.1 PM-02 Construct Legal Description Analysis

Context

Typically, land records management requires the capability to generate *legal descriptions* that have both a geometry and a text description. The description is relative to some survey system (including the PLS System, among others).

The *legal description* may be thought of as the 'atomic parcel', or as the described area or linear unit(s) that constitute a *parcel*. Passive agencies, such as Recorders and Registers of Deeds may desire to save *legal description* footprints in an unadjusted data set. The geometry (footprints) of *legal descriptions* may be constructed (like *measured features*), and stored in a collection (feature class) without performing interpretation and adjustment to resolve gaps and overlaps. This collection of legal description *geometries* might include historical as well as current *legal descriptions*, and so be used to support research.

Because people write, interpret, and change *legal descriptions*, the descriptions are often incorrect. For the purpose of maintaining a topologically-clean *legal description (or parcel) fabric*, we have to adjust the geometries to resolve gaps and overlaps. There are many cases where *legal descriptions* must be interpreted and adjusted rather than positioned and used verbatim as indicated in the deed document. (For example, a boundary line of a parcel is intended to follow a section line, is described as running due south, and the actual section line does not have a due south bearing.) The legal description/parcel editor would interpret the *legal descriptions* and make adjustments to resolve these types of inconsistencies.

Recall from the analysis of the ***MM-01 Construct Measured Feature*** use case that in the NILS data model, parcels are built up from *legal description* geometries which are managed in the adjusted *legal description fabric*. A *parcel legal description* may reference one or more underlying *legal descriptions*. *Legal description* geometries may be constructed just as *measured features* (see ***MM-01 Construct Measured Feature)*** associated to underlying *measurements*. This three-tier, topological data model is the basis for integrating GIS and survey within the NILS framework.

New Concepts

Legal Description. The narrative and geometric description for a discrete area of land. Descriptions may be related to parcels (many-to-many) and to geometries.

> ***Area Legal Description.*** (AKA Areal Reference)e.g., geopolitical, PLS, Block-Lot, Mineral Survey, irrigation lots. Nominal; delimited in reference survey system having area taxonomy, nesting and division rules; discussion of 'tracting' and frameworks for spatial indexing.
>
> ***Perimeter Legal Description.*** Record boundary, metes and bounds, sequenced set of bearings and distances, strip description, adjoiner description, riparian or aquatic area description, reference calls to natural features (contour, ridgeline, watercourse).
>
> ***Portion/Remainder Legal Description.*** Area as a quantity (e.g., 'north sixty acres of..', 'the north four-hundred feet of…'), exclusions; other reference calls; ambiguous areas that cannot be mapped relative to any reference.

Legal Description Fabric. (See *Measurement Network*). An *adjusted measurement network* to which constructions (terrain feature boundaries, non-survey data) have been added. An *adjusted measurement network* to which constructions (terrain feature boundaries, non-survey data) have been added. All polygons representing legally-described areas have been formed from the measurement network and other boundaries to support the *parcel fabric*.

Parcel Fabric. (See *Measurement Network*). A feature class that represents a parcel configuration for a specific business purpose (e.g., ownership parcels, tax parcels, historic parcels). Parcel features may be associated with component features in the *Legal Description Fabric*.

Key Features-Functionality

This set of operations includes functionality for constructing both text and geometric representations of a *legal description*. Construction methods (corresponding to *legal description* types) include area subdivision (section or parcel split/combine), perimeter (metes and bounds), and portion/remainder. *Legal descriptions* may be saved for future use in building the *legal description* and *parcel fabrics*.

Application Integration

Constructing *legal descriptions* is part of the land records management process that must be integrated with the workflow management system. Once constructed, *legal descriptions* are adjusted into a *legal description fabric*, and are used to build parcels in the *parcel fabric*.

In the ***PM-01 Verify Parcel*** use case, legal descriptions may be sketched or created—this would involve the tools provided in this ***PM-02 Construct Legal Description*** use case. Much of the functionality for this use case is based upon the ***MM-01 Construct Measured Feature*** use case.

The actor may import a parcel legal description as sketched in the ***PM-01 Verify Parcel*** use case. This is part of the integration of workflow management.

Development Implications

See the development implications in the ***MM-01 Construct Measured Feature*** use case. The same issues of managing a tiered, topologically-related data structure apply in this use case.

Legal descriptions may be constructed against a reference layer (i.e., by using the geometry of a feature in the legal description fabric). The system must handle reference data that is stored in a spatial reference system that is different from the subject spatial reference system .

10.4.2 PM-02 Construct Legal Description Overview

Use Case	PM-02 Construct Legal Description
Description	Process to create the basic *legal description* components—geometry and attributes (text, ID, source ID, etc.). *Legal descriptions* may have topological association to features (e.g., parcels), to component features and/or to measurements. *Legal descriptions* may be saved into a collection of unadjusted *legal descriptions* (includes historic *legal descriptions*).
Actors	Surveyor, Supervisor, Parcel Editor, External Trigger
Pre-Condition	Reference and component features are available. *Legal description* does not exist.
Post-Condition	*Legal description* is created, attributed and stored appropriately.
Cross-Reference	***MM-03 Edit Measurement Data, PM-01 Verify Parcel, PM-05 Edit Parcel Fabric, PM-03 Edit Legal Description Fabric, MM-01 Construct Measured Feature***

10.4.3 PM-02 Construct Legal Description Primary Scenario

Actor Action	System Response
1. This use case begins when a actor chooses ***PM-02 Construct Legal Description***.	2. Prompt to establish edit session. Display index to available reference data—*legal description fabric*, *parcel fabric*, other *measurement network* features. [workflow established in '***PM-01 Verify Parcel***'] apply previous parameters [no data set] establish current *measurement data set*
3. Input to set up construction session. Set working *spatial extent* and reference data elements.	4. Update display, symbolized to indicate type and (historical) status of reference data elements. Display choices for *legal description* construction. [digital plat, plan or sketch exists] provide import option
5. Make choice to either (1) Import plat, plan or sketch, or (2) Input to define a new *legal description*.	6. Process construction method. Prompt for input from actor as needed.
7. Input as appropriate to construct geometry, text and attribute values for the new *legal description*.	8. Apply inputs and complete construction. Display new *legal description* against reference data. Provide choices: Save, Revise, Next Feature, Undo, Quit.
9. Inspect *legal description*. Select from choices.	10. Perform chosen operation. [save] save to *legal description* collection (options to trigger operational workflow/transaction tracking system, e.g., to measurement adjuster and *legal description fabric* adjuster) [revise] return to #7 [next] return to #5 [quit] exit

10.5 PM-03 Edit Legal Description Fabric

10.5.1 PM-03 Edit Legal Description Fabric Analysis

Context

Recall from the analysis of the ***PM-02 Construct Legal Description*** use case (1) that an individual *legal description* has a geometry—the 'footprint' as an atomic unit, and (2) that parcels are built up from *legal description geometry*.

The *legal description fabric* is the structural tier that provides the foundation for parcels. It is within the *legal description fabric* that *legal description geometries* may be resolved into a seamless framework—a spatial representation of areas that have been legally described within a nested survey-system hierarchy. Some business requirements may require the management of overlaps or a hiatus in legal description geometry. For example, a Register of Deeds may manage these geometries as ownership parcels without any attempt to adjust or resolve overlaps. Tracking and portraying boundary disputes is another example of a geometry collection that would not be seamless.

As new sources of parcel geometry (changes) occur (subdivision, deed splits, combinations, etc.) the respective *legal descriptions* are constructed and their geometries are incorporated into the *legal description fabric*. In the NILS data model, geometry editing occurs on these 'atomic areas' within the *legal description fabric. Legal description geometries* become the source for the *parcel fabric*.

The *parcel fabric* tier is an application-oriented representation—a feature/data framework for managing business entities like ownership parcels, tax parcels and their associated rights, interests, uses, and restrictive covenants.

New Concepts

Legal description geometry. The 'footprint' of a *legal description*. A spatial representation of an area that has been legally described within a nested survey-system hierarchy. The 'atomic unit' for building parcels.

Key Features-Functionality

Editing happens in a transactional environment, where features in a production version are locked and extracted to a working version. Edits are made to the working version, quality-controlled, accepted, and committed back into the production version.

Basic editing tools are provided. If an error of geometry, attribute value, construction rule, or feature association is identified, the editor would have the tools to select the subject feature and reshape, modify attributes, etc.

This set of operations also provides the means to insert new legal description geometries into a fabric. The insertion process will employ a set of procedures to perform line editing within a topological, two-dimensional planar geometric network. This means that each area is unique and that these areas share common boundaries (perimeter lines) and corners (nodes and vertices). An area may be split or subdivided, causing the 'parent' area to become 'historical' and the 'child' areas to become 'active'. Two or more areas may be combined—the parents become historical areas and the new 'child' is activated.

A set of procedures are required to process the insertion properly. Tools for performing COGO procedures are provided to modify the constructed geometries and fit them into the fabric. There are business rules for splits and combinations, there are rules for resolving conflicts, differences, gaps and overlaps. There are rules for establishing and recording precedence. The rules as applied during division and aggregation are preserved in association to the subject features.

Support for the multi-tier data model is provided. This means that legal description geometries may have ties to underlying measured features (in a measurement network) as well as ties to parcels in a 'higher' tier. There is actor control over the type and extent of automatic geometric updating that occurs among features which have geometric/topological associations.

Application Integration

Legal description components (text description, attributes and geometry) are built as noted in the ***PM-02 Construct Legal Description*** use case. Editing must use constructed legal description components.

Editing will require connection to associated databases in some cases.

Once edited, the legal description fabric may be 're-adjusted' by establishing associations to various controls (survey control, map control).

Once the legal description geometries are edited, the actor may need to update respective map annotation features (see ***PM-06 Edit Parcel Annotation***).

The tightest integration is with the parcel fabric, which may be thought of as a kind of 'view', 'shared geometry' or 'region' layer that is built upon the 'atomic' legal description layer.

As with all use cases, legal description fabric editing must be integrated with a workflow management system.

Development Implications

The integration for relating *features* in the multi-tier model implies a more complex data model and therefore a more complicated maintenance procedure. The system must support automation from an existing data structure into the tiered model. However, the model must also support system implementations that opt to bypass the multi-tier approach.

10.5.2 PM-03 Edit Legal Description Fabric Overview

Use Case	PM-03 Edit Legal Description Fabric
Description	Process to edit the *legal description fabric*. Insert new *legal description* components and/or edit existing components. Fit, assemble, and resolve *legal description* components within the *legal description fabric*.
Actors	Parcel Editor, Supervisor
Pre-Condition	A *legal description fabric* and possibly some newly-constructed *legal description* components exist. Actor needs to modify the *legal description fabric*.
Post-Condition	The *legal description fabric* has been modified. *Legal description* history has been posted. *Legal description fabric* resolution rules (and priority of their application) are saved and available to drive the annotation process and subsequent fabric modifications.
Cross-Reference	Link to attributes; ***PM-02 Construct Legal Description***; ***PM-01 Verify Parcel***, Readjust Legal Description Fabric, Create-Modify Parcel Annotation

10.5.3 PM-03 Edit Legal Description Fabric Primary Scenario

Actor Action	System Response
1. This use case begins when a actor launches the ***PM-03 Edit Legal Description Fabric*** process.	2. Prompt actor to establish an edit session (select *legal description fabric*, select a spatial extent, set session parameters).
3. Set session parameters, select *legal description fabric* and *spatial extent*.	4. Lock selected features in the *legal description fabric.* Extract selected features from *legal description fabric* to a working version. Display the working version of the *legal description fabric.* Provide editing tools (insert new legal description component, edit existing component, etc.).

Actor Action	System Response
5. Select edit process and interact with system to perform edit.	6. Process edit. [insert new *legal description* component] provide choices for newly constructed legal description component, provide insertion tools (split/merge/re-shape geometry, change attributes, change feature relationships, etc.) [edit existing *legal description* component] provide selection and edit tools (change attributes, geometry and relationships) Resolve any conflicts caused by insertion and/or edits (e.g., remove gaps and overlaps). Store procedures used to resolve *legal description* conflicts and differences for each decision. Provide choices to return, exit, or commit working version prior to session closure.
7. Select Commit, Return, Exit.	8. Process action. [not done] Iterate until all conflicts and differences resolved. [commit] commit changes in working version to the *legal description fabric*. Update history. [feature relationship updates] per actor settings, update affected features (features in other layers that have an association to the legal description fabric). [exit] close session

10.6 PM-04 Re-adjust Fabric

10.6.1 PM-04 Re-adjust Fabric Analysis

Context

There are situations for which the data steward of a particular series of digital map layers (feature fabrics) may need to make cartographic adjustments to improve the alignment of features in one fabric with corresponding features in a reference source. Frequently older-generations of digital maps were based on reference sources that were controlled at a low quality (little or no survey control). Reference sources might be new digital orthophotography, a new terrain model, new GPS coordinates, a new street centerline layer, etc.

While cartographic alignment is important to promote visually aesthetic maps, the primary reason for re-adjustment is to support analytical operations that use the map overlay process. Analysis of maps each based on different reference sources (control) will yield erroneous results.

It is generally anticipated that the re-adjustment is made to improve the quality of the subject features (increased accuracy in representing the real-world). However, it is possible to 'degrade' survey-controlled feature coordinates so that they more closely align with a particular map series (e.g., a map series that is a commonly-used agency standard). This would be the case if an agency found it more economical to align a small number of feature fabrics to match a more numerous set of mapping even though the 'reference series' was controlled at a lower-quality, rather than to attempt to re-align all the layers in the reference series to the higher-quality feature fabric.

In either scenario, the user may choose to develop the adjustment coefficients and apply them to a **set** of associated feature fabrics.

This process is similar to (and may actually use) the ***MM-02 Analyze and Adjust Measurement Network*** use case. The difference is that this operation may require the creation and use of controls that actually have a low reliability (less accurate than surrounding surveyed coordinates) but which in effect must act as very accurate controls to override the coordinate locations that are derived from the least squares adjustment process.

New Concepts

Control. A *feature* or set of features with positional coordinates that is used to adjust the geometry of an associated map layer.

Key Features-Functionality

The user makes selection of the reference source (from which the control will be selected) and one or more target feature layers.

Tools are provided to select (and define) controls in the reference source. Features in the target fabric(s) are then selected and linked to the control. The process is interactive—the entire set of controls could be established, to be followed by the association process; or the controls and features could be respectively defined and linked in an iterative (paired) process.

Once a set of controls are identified and a corresponding set of associated features have been linked, the user can perform re-adjustment. The re-adjusted feature fabrics are then shown relative to the reference source. The user can continue establishing controls, associating features, and running the re-adjustment until satisfied. The final re-adjustment is saved.

Application Integration

If the target feature fabric is one upon which other (tiered) fabrics are based, changes to the geometry of the target fabric must be automated into the associated fabric(s). An example of this would be when re-adjustment was performed on the *legal description fabric* and the effects were automated into the associated *parcel fabrics*.

Development Implications

There is a need to provide for non-standard types of control and ensure that the adjustment process supports their use.

10.6.2 PM-04 Re-adjust Fabric Overview

Use Case:	PM-04 Re-adjust Fabric
Description	Process for adjusting the coordinates of an existing feature fabric (e.g., legal description fabric, parcel fabric) to enhance (cartographic) alignment with a reference source that has desired *control* features *(*also known as map *control*).
Actors	Parcel Editor
Pre-Condition	New *control* features of any type are available or can be generated from available reference sources.
Post-Condition	Coordinates of feature fabric(s) are adjusted.
Cross-Reference	Measurement Management use cases; Edit Legal Description/Parcel Fabric

10.6.3 PM-04 Re-adjust Fabric Primary Scenario

Actor Action	System Response
1. This use case begins when a user launches the re-adjustment process.	2. Prompt user to select target feature fabric(s) and reference source.
3. Select target feature fabric(s) and reference source.	4. Display target feature fabric(s) and reference source. Provide *control* section tools and prompt for identification of *control*.
5. Select *control* to be used. May need to define new *control* (may be coordinate point file, a location on a digital orthophotograph, etc.)	6. Establish *control* and update display to indicate that *control* is available. [new *control*] provide tools to define *control* (type, coordinates, parameters, etc.) [more *controls* to establish] return to #5 Provide choices for associating fabric features to control.
7. Select from procedures. Select feature(s) from fabric(s) and associate to *control*.	8. Process associations iteratively until complete. [not complete] return to #7 Provide choices for re-adjustment.
9. Select adjustment procedure. Respond to prompts and submit.	10. Perform adjustment and display results. Prompt to save/exit. [solution not correct] return to #9 [edit/more *control*] return to #5 [edit/more associations] return to #7
11. Review re-adjustment solution. Select save or exit.	12. Process choice. [save] Save adjusted *control*, adjustment coefficients and fabric. [exit] end session

10.7 PM-05 Edit Parcel Fabric

10.7.1 PM-05 Edit Parcel Fabric Analysis

Context	In the NILS data model, parcel geometry editing occurs on the 'atomic areas' managed within the *legal description fabric. Legal description geometries* become the source for the *parcel fabric*. The *parcel fabric* tier is an application-oriented representation—a feature/data framework for managing business entities like ownership parcels, tax parcels and their associated rights, interests, uses, and restrictive covenants.
New Concepts	Estate. The degree, quantity, nature and extent of interest which anyone has in lands or in any other property. Transaction Agent. Any participant or party identified in land transaction.
Key Features-Functionality	Editing occurs in a transactional environment. The p*arcel fabric* and the associated *legal description fabric* are selected, and the edit session is performed upon a working version. To create a new parcel, the editor establishes relationships to active *legal description geometries* that are the source for the parcel's geometry. For contiguous *legal description geometries*, internal lines would be dissolved to create the outer boundary of the parcel (according to the *parcel legal description*). A single parcel may be comprised of multiple, possible non-contiguous *legal description geometries*. Parcel Identification Numbers (PINS) are managed as the primary key, and the editor may also make general attribute value changes as well. Tools and procedures are provided to establish connections to remote data sources (for data viewing, linking and editing). Upon committing the working version to the parcel fabric, parent-child relationships and parcel history are managed.
Application Integration	The system must support integration with document management (e.g., link a parcel to its associated documents), with workflow management (e.g., receive and send notifications), and with external triggers and databases (sources of change, or sources that are automatically updated based on the commit of updates to the parcel fabric). Annotation of the *parcel fabric* may performed from within the edit session.

Development Implications The system must support data automation from pre-NILS databases. The system must support implementations that do not use the multi-tier fabric approach.

10.7.2 PM-05 Edit Parcel Fabric Overview

Use Case	PM-05 Edit Parcel Fabric
Description	Process to define parcels within the *parcel fabric* by associating or aggregating *legal description(s)* from the *legal description fabric*. Process to create new parcel records and/or to edit parcel attribute values.
Actors	Parcel Editor
Pre-Condition	The *legal description geometries* necessary to define the parcel exist in the *legal description fabric*.
Post-Condition	*Parcel fabric* has been updated.
Cross-Reference	***PM-03 Edit Legal Description Fabric***; ***PM-02 Construct Legal Description***; ***PM-01 Verify Parcel***; External Applications/Triggers/Databases

10.7.3 PM-05 Edit Parcel Fabric Primary Scenario

Actor Action	System Response
1. This use case begins when the actor launches the ***PM-05 Edit Parcel Fabric*** process.	2. Prompt to set up session. Provide available *parcel fabric*s, *legal description fabric* and tools to select subject.
3. Input to select fabrics and subject parcel(s).	4. Display fabric and selected parcels. Prompt to initiate a data lock or version transaction on selected parcel(s).
5. Interact with tools to establish transaction.	6. Process transaction. Establish the working set. Display working set. Provide tools to form parcels and edit attribute values.
7. Interact with tools to form new parcels and/or edit attribute values.	8. Process action. May include processing related to *estates*, related parcels, and source documents (see secondary scenarios. May include processing related to attributes such as *rights, transaction agents, restrictive covenants*, and parcel acreage Provide choices to repeat, revise parcel changes, exit session, commit changes.

9. Select action.	10. Process action. [revise] go to #7 [repeat] go to #2 [commit] update *parcel fabric*, close transaction, update history. [exit]

10.7.4 PM-05 Edit Parcel Fabric Secondary Scenarios

Name	Point of Occurrence/Overview
Link to source documents	Step 8. Invoke Document Management System for selection list of potential documents to link.
Associate related parcels between different *parcel fabric*s	Step 8. Display *Parcel fabric*s and associate parcels and their associated attributes and prompt actor to define relationship(s).
Manage/define *estates*	Step 8. Open or link to source of *estate* data for selection list to accept or modify.

10.8 PM-06 Edit Parcel Annotation

10.8.1 PM-06 Edit Parcel Annotation Analysis

Context	There are several aspects to handling annotation. Annotation may be derived automatically by an application that applies actor-defined parameters (for font, placement, etc.) and uses feature attribute values as the annotation text. This approach is generic and flexible, but sometimes fails to adequately handle text placement. To support high-quality formatted output, the cartographer may desire to attend to all aspects of annotation—text font, size, color, angle, etc. In this approach, annotation may be saved within the subject feature class (i.e., with the geometries), or it may be saved as a separate annotation feature class. This provides cartographers and actors flexibility in managing and displaying annotation for a variety of display situations (views and scales, etc.) and formatted output product types.
New Concepts	none
Key Features-Functionality	The actor selects the target fabric or measurement network and edits annotation. A set of annotation editing tools are provided to customize the annotation features. Actors may define new annotation symbols. Annotation edit are updated to the target feature fabric or measurement network.
Application Integration	This set of operations may be called from within the feature construction and/or fabric editing process. Editing may require transactional processing to manage data integrity.
Development Implications	May require development of a new set of survey-, measurement-, and parcel-based annotation symbols and procedures.

10.8.2 PM-06 Edit Parcel Annotation Overview

Use Case	PM-06 Edit Parcel Annotation
Description	Create or modify annotation within or associated to *parcel fabric*, *legal description fabric*, or *measurement network* to support display and formatted output.
Actors	Cartographer, Parcel Editor
Pre-Condition	An existing *parcel fabric*, *legal description fabric*, or *measurement network* needs new or updated annotation.
Post-Condition	*Parcel fabric*, *legal description fabric*, or *measurement network* is annotated.
Cross-Reference	***PM-05 Edit Parcel Fabric***, ***PM-03 Edit Legal Description Fabric***, Construct Measured Features, ***PM-02 Construct Legal Description***

10.8.3 PM-06 Edit Parcel Annotation Primary Scenario

Actor Action	System Response
1. This use case begins when the actor launches the edit annotation process.	2. Prompt for session setup—selection of annotation options (fonts, symbols, etc.), setup of style (size, position, etc.), custom annotation/symbol set, (tie-bars, ovals, actor-defined graphic features). [nothing is selected] prompt actor to select *parcel fabric*, *legal description fabric*, or *measurement network*.
3. Set annotation session options.	4. Display *parcel fabric*, *legal description fabric*, or *measurement network*. Provide annotation tools.
5. Interact with tools to select features and update annotation.	6. Process updates. Update display. Provide choices of Next/Exit/Save.
7. Select an action	8. Process action. [need to adjust session] return to #2 [next] return to #5 [save] save *parcel fabric*, *legal description fabric*, or *measurement network* [exit] close session

11.0 GeoCommunicator Use Cases

11.1 Overview of GeoCommunicator Use Cases

The use cases for GeoCommunicator (GC, or GeoCom) are intended to describe the business processes necessary to communicate land-related activities and data over the Internet. Consumers of spatial information may use GeoCommunicator to discover:

- *WHAT* data and activities are related to their personal area of interest (e.g. a state or county) and how to access the information, and/or
- *WHERE* (geographic extent) specific data and activities (e.g. Public Land Survey coordinate data sets, planned field survey projects) are linked to the land and how to access that information.

The GeoCommunicator includes an activity notification option based on a subscriber's defined geographic extent. Providers of spatial information describe their data and activities in a searchable index, locate their geographic extents on a map interface, and enable information flow through email contact and links or paths to existing data stores.

Accessing Spatial Information

The GeoCommunicator is a web-enabled environment in which graphical map tools and tabular text tools allow the user to narrow their geographic and content search for spatial information before results are reported. Spatial information (in the GeoCommunicator context) includes metadata and catalog references to data and related activities that have a geographic component. The GeoCommunicator combines some of the concepts of a data clearinghouse, and an information subscription service with the NILS 'Field-to-Fabric' concept in which events from raw data collection to final data set integration and publication may be identified and communicated. Planned surveys, readjusted parcel data, watershed analysis, resource inventories, public planning processes, ongoing data conversion projects, currently available data and contacts are examples of spatial information that will be part of the GeoCommunicator. Spatial information in the GeoCommunicator context also includes activities on the land that do not necessarily result in data, such as stream enhancement projects, habitat restoration, recreational facilities development, and land related communication activities such as public land-use planning, conferences and forums.

Scope of GeoCommunicator

The GeoCommunicator is not a data warehouse, nor is it intended to replicate the efforts of the FGDC clearinghouse. The GeoCommunicator is used to coordinate ongoing information and establish a system where agencies and people that download information from the Internet can have a sense of updates and notifications related to that data. The GeoCommunicator is also not a data repository. A national GeoCommunicator site will provide links to existing contacts and data sources, but it is not a mechanism to resolve discrepancies in data sets, to store data sets, or to centralize data distribution.

It is intended that GeoCommunicator will meet field level business requirements by providing an indexing capability down to the appropriate units (section, parcel, quad), by

expanding data and activity categories to support a wide variety of land management business areas (field survey, title plant, natural resources), and by providing communication tools that improve customer service, promote partnerships, avoid redundancy and duplication, and facilitate data standardization across the landscape. It is envisioned that a national GeoCommunicator site could link regional GeoCommunicator sites hosted by a variety of agencies or organizations.

The first implementation of the GeoCommunicator will be used by the NILS project to assist in managing its project coordination and activities. The GeoCommunicator use cases are linked to Survey and Parcel Management use cases (see Figure 11.1), but GeoCommunicator actors are generic (not agency specific), and the GeoCommunicator functionality is not limited to NILS generated data or activities.

Summary of Use Cases

For each of the GeoCommunicator use cases, the following sections (sections 11.3 through 11.13) contain subsections for analysis, overview, primary scenario, and secondary scenarios. Within the analysis subsections are discussions of context, concepts, key features, application integration and development implications that will help direct subsequent design and development phases. The initial context of the use cases is in the survey management and cadastral business area, but other domains will be modeled and tested to insure that GeoCommunicator functionality is flexible and extensible. The discussion of concepts related to each use case is especially important because key terms are given definitions specific to their use in the primary and secondary scenarios. All significant terms for all use cases are also defined in Appendix A, Glossary. The use case scenarios capture actor (a user category) input and system response in a logical work flow format.

The ***GC-01 Conduct Search*** and ***GC-02 Browse Search Results*** use cases provide tools for the Browser actor seeking spatial information. The Browser specifies the 'where' (spatial extent), the 'what' (data or event category), and the 'when' (time-frame) in a spatial query and views/downloads the results. This actor may become a Subscriber through the ***GC-07 Manage Subscriber Account*** use case where flags, defined by a spatial query, are set that trigger automatic notification (e-mail).

Actors intending to provide information apply through the ***GC-05 Manage Provider Account*** use case and utilize tools and procedures described in the ***GC-06 Submit Data*** and ***GC-03 Submit Event*** use cases. Event Providers submit descriptions of planned activities, the location (spatial extent), and duration (calendar). Data Providers submit abbreviated metadata including data format and currency (current-to date), location (spatial extent), and the paths or links to existing data. They become Event Providers when data activities such as collection and maintenance are submitted.

The ***GC-10 Post Comment*** use case provides for communication among GeoCommunicator actors. Any actor may join a topical forum or e-mail group. They may communicate with Providers concerning their data and events (identify errors, ask questions, etc.). An actor may post an Information Notice describing available information, in response to a data call or as a proposal for inclusion within the GeoCommunicator. An Information Request may be posted as a data call (when no information can be found with the ***GC-01 Conduct Search*** process), or to share in developing a new data set, form a partnership, participate in a joint

decision. The remaining use cases are designed for an Administrator actor to manage accounts, to manage the on-site data and links to the off-site data, to monitor the events calendar, to trouble-shoot communication problems, and to maintain the GeoCommunicator web site.

11.2 GeoCommunicator Use Case Analysis

This section presents the individual GeoCommunicator use cases. GeoCommunicator functionality is available system-wide - i.e. NILS users performing Survey, Measurement or Parcel Management would have access to GeoCommunicator.

Table 11.1 lists the GeoCommunicator use cases. Figure 11.1 shows the relationship of these use cases to the other NILS use cases.

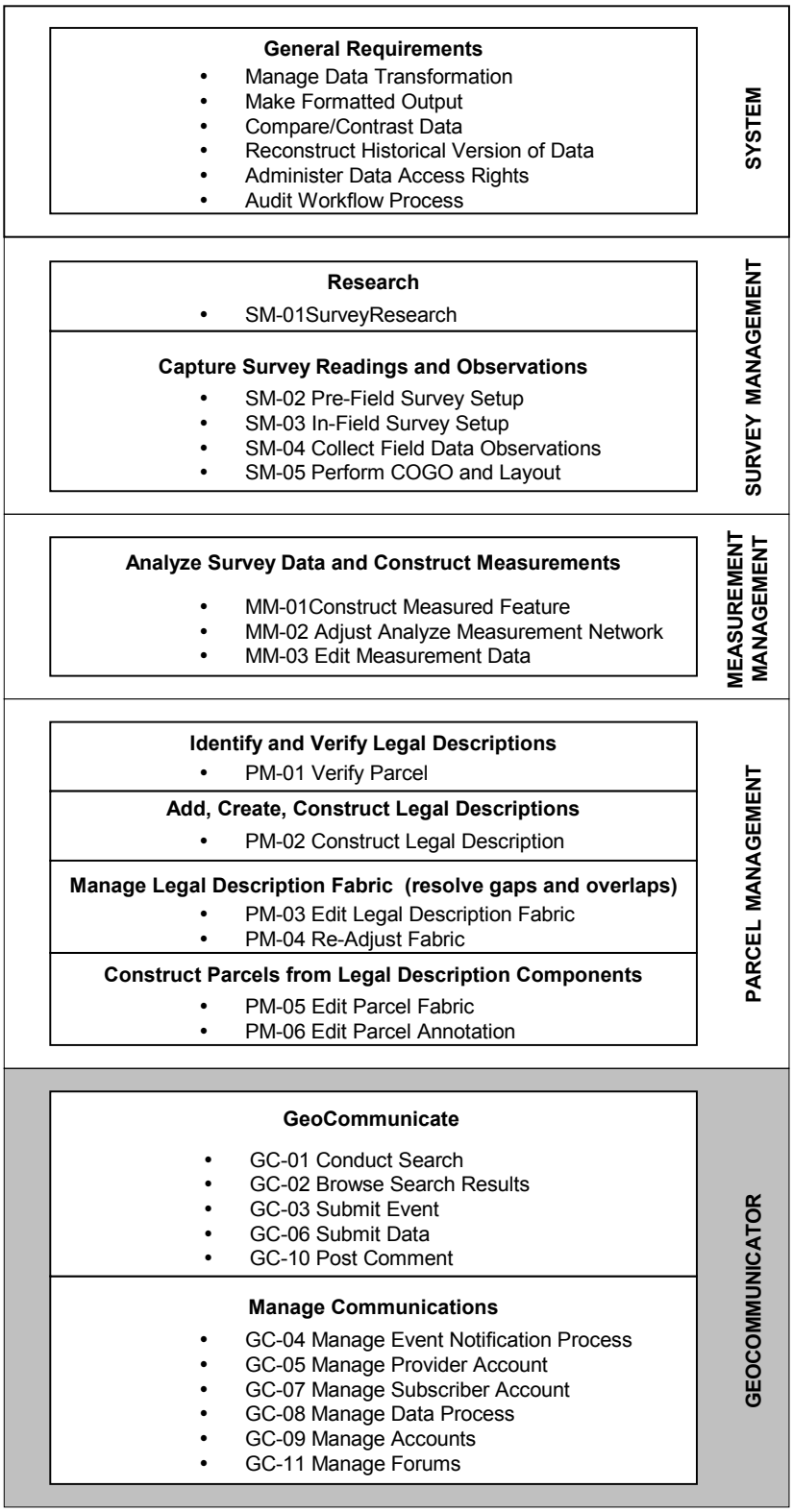
Table 11.1. GeoCommunicator Use Cases

Use Case	Section	Description
GC-01 Conduct Search	11.3	Process to find *data references*, *reference documents* and *events*. Establish or modify search parameters that define a *research scope* and submit query. Example parameters include: ▪ *data category*; ▪ *event category*; ▪ *spatial extent*; ▪ *logical operators*; ▪ *temporal constraints*; ▪ *reference document category* Subscriber may opt to save search parameters for re-use at a later time.
GC-02 Browse Search Results	11.4	View, evaluate, and/or remove items (data references, reference document and events) returned from the *conduct search* process. The Actor may navigate to on-line data references (URLs).
GC-03 Submit Event	11.5	Process to submit an event and/or add a new *event category.* NOTE: Specific events may be automatically triggered by other system events. Event Providers submitting events would have their stored account information pre-populated into the event submission form. Any Actor can become an Event Provider by establishing a provider account.

Use Case	Section	Description
GC-04 Manage Event Notification Process	11.6	System administration of errors related to events and triggered notifications including the resolution of errors involving subscription and event notification. Also resolve failed e-mail notification and remove outdated events. Approve requests for new event categories. NOTE: System automatically: ▪ creates a list of subscribers to be notified (by event category and spatial extent) by matching key criteria from the event and subscriber databases; ▪ sends e-mail notification to the appropriate subscribers; and ▪ logs communications and produces an event/notification error list.
GC-05 Manage Provider Account	11.7	Process to establish or modify a *data provider account* or an *event provider account* (provider information).
GC-06 Submit Data	11.8	Process to submit index and catalog information for *geo-referenced data*, *geo-related data* and/or *reference documents* to GeoCommunicator. This includes: ▪ data reference (URL or physical location); ▪ relevant *data catalog* information (e.g. metadata); ▪ date; ▪ access restrictions; ▪ spatial reference; and ▪ spatial extent. NOTE: Provider may post product availability, restrictions, and subscriptions in the data catalog. NOTE: Providers will supply references to data housed in remote storage locations. This use case ***may*** include some security administration for restricted-access data sources.
GC-07 Manage Subscriber Account	11.9	Process to establish or modify subscriber account including: ▪ Actor information; ▪ Actor preferences; and ▪ Subscription/notification parameters (spatial extent, event categories, scheduling). NOTE: Browser may elect to become a new subscriber and pass current *research scope* information into the account setup.

Use Case	Section	Description
GC-08 Manage Data Process	11.10	System administration to: ▪ quality control (QC) data reference information; ▪ insert new/replacement data reference information; ▪ modify data catalog; or ▪ delete data references from the system. NOTE: Some providers will supply physical storage site/contact references to data rather than web site URLs. NOTE: Data submissions will be automated where possible.
GC-09 Manage Accounts	11.11	System administration of subscriber and provider accounts including: ▪ certifying new accounts; ▪ resolving errors; and ▪ managing account-related issues.
GC-10 Post Comment	11.12	Process to handle *communication events* to: ▪ a topical forum (via e-mail); ▪ e-mail group (e.g. to review proposed data); ▪ data provider (e.g. to report errata); ▪ publish an information notice (e.g. an RFP, a Public Notice, or data discrepancy); or ▪ publish an information call (e.g. data request, reference request or event request). NOTE: Browsers may have limited communication access. Subscribers may have enhanced access to forums
GC-11 Manage Forums	11.13	The System Administrator: (1) sets up and closes communication forums, e-mail groups; (2) monitors content; and (3) manages errors.

Figure 11.1 Business Process Analysis—GeoCommunicator Use Cases



11.3 GC-01 Conduct Search

11.3.1 GC-01 Conduct Search Analysis

Context

For NILS business operations, the GeoCommunicator will facilitate access to surveying and land records-related information to support research, notification, and integration of land management activities. ***GC-01 Conduct Search*** is the first step to facilitate research that may save time and identify opportunities for shared collection, maintenance and decision making.

Example: GeoCommunicator for Surveyors

For the surveying community, ***GC-01 Conduct Search*** can become a standard tool to submit a request for survey information using geographic, temporal or categorical parameters.

Surveyors will potentially use the information provided by the GeoCommunicator to facilitate:

- short and long-term survey project program planning;
- pre-field research for specific survey projects;
- accessing specific information while conducting a survey project.

GC-01 Conduct Search will provide references to available data and activities that correspond to a user-defined query for land records.

New Concepts

Data. Collections of information, organized by category in sets, described by metadata, and related to a land index; searchable by GeoCom actors. *Data* in this context is "published" data, in a variety of formats or media, and not necessarily digital. Examples:

- Geo-Referenced Data-Raster or vector data that contain world coordinates.
- Geo-Related Data-Data that is associated or linked to a point or area entity (spatial objects). Examples: Survey Plat of a township; Patents and deeds linked to a parcel by legal descriptions.

Reference Documents. Related technical or educational information that may explain, expand, or document data or events. May have no direct relationship with a spatial data set (e.g. manuals, RFIs, reports, regulations, etc.) or be related to a land index.

Event. A significant change in state or status occurring at a point in time or for a duration of time as a function of a process or activity that might trigger a flag for notification. *Event* expands on the concept of activity, which usually connotes a conscious human effort, to include change due to transactional and system operations. *Event* is intended to capture the dynamic aspect of communication. *Events* may not necessarily result in published data. See further discussion of *Event* under *GC-03 Submit Event.*

Examples:

Land Management. Cadastral Survey Events: Field survey project is planned, described, located, and time-framed; partners are added; description changes; location is extended; project begins; project ends; coordinate data available; official plats and notes published.

Data. GCDB Data Maintenance Events: Data available from one or more field survey projects; planned data maintenance, described, located, and time-framed; data call for more survey and control issued; project extents change; revised data set published.

Communication. Land-use Planning Events: Land-use issues and planning process described, located, and time-framed; alternatives are published; public input period begins; ends; final plan published

System Business. GeoCom Administrative Events: New activity category added; data contact email address changes; new subscriber added to data provider's list.

Research scope. The total of all choices and defaults for *Conduct Search* before the query is launched. Includes combinations of the following parameters – data categories (types of data ex. cadastral, wildlife, hydrology), event categories (ex. data submission, data call, industry activities or events, general or specific communication), spatial extent (ex. latitude/longitude coordinate box, drawn polygon, administrative boundary, address), data quality (i.e. data integrity, data consistency, measurement type), temporal constraints (time periods or ranges). Search is conducted based on search criteria and Actor's access level.

Category. Facilitates *Conduct Search* by organizing data, activities, forums, etc by subject matter (content). Nested sub-categories refine search by status, e.g., published, existing, current, planned, etc.

Spatial extent. Location on the ground (footprint). Includes any method for describing a point or area. Examples include Latitude/Longitude, PLSS, minimum bounding rectangle, boundaries (admin, other).

Logical operators. Conditions, parameters of a query.

Temporal constraints. Date and time range parameters.

Research Results. Map and tabular view of items that match the search parameters of the Research Scope and access permission level in the Conduct Search process.

Search Parameter Form. GeoCommunicator form for Actors to enter search parameters.

Default Spatial Extent. The maximum allowable spatial extent, set by the Administrator, for *Conduct Search*. Also, an actor's profile will provide the option to define an initial spatial extent for example specific state or county.

Map view. Displays reference themes as aids in *Conduct Search.* Displays geo-referenced spatial extents (footprints) of *Research Results*. Tabular view potentially displays item category(s), description, timeframes and status (availability, restrictions, cost, location, etc.).

Key Features-Functionality

The Actors ***GC-01 Conduct Search*** are Browser and Subscriber.

Through a graphical (map and icon) and/or textual (pull-down menus, selection boxes or input forms) interface, define a query to fulfil the business mandate. The research scope will most likely be a combination of geographic, category and temporal parameters.

The query will run against the Master Catalog and Index, and return a list of items that fulfill the research scope. The list will provide web-links (URLs) to on-line data sources and site/contact information for additional information. The Actor may want to communicate with a data/event/reference document provider.

If the research results returned in ***GC-02 Browse Search Results*** do not meet the business needs the Actor can change the research scope (search criteria) and resubmit the search. If the results meet the business needs the user may contact or navigate to the data provider site.

Subscribers may save their search parameter forms as a templates for future searches.

Application Integration

GC-01 Conduct Search functionality is closely linked with the following GeoCommunicator use cases:

- ***GC-02 Browse Search Results*** providing Actors with the tools to review and evaluate the information returned by the ***GC-01 Conduct Search*** process,
- ***GC-07 Manage Subscriber Account*** allowing *Browser* Actors to request a *Subscriber* Account,
- ***GC-10 Post Comment*** providing Actors the ability to communicate directly with the provider(s) of a data set(s).

Development Implications

GC-01 Conduct Search functionality is closely linked with ***GC-02 Browse Search Results*** and therefore will be developed in parallel as the highest priority GeoCommunicator functionality.

11.3.2 GC-01 Conduct Search Overview

Use Case:	GC-01 Conduct Search
Description	Process to find *data references*, *reference documents* and *events*. Establish or modify search parameters that define a *research scope* and submit query. Example parameters include: ▪ data category; ▪ event category; ▪ spatial extent; ▪ logical operators; ▪ temporal constraints; ▪ reference document category Subscriber may opt to save search parameters for re-use at a later time.
Actors	Browser, Subscriber
Pre-Condition	The Actor wishes to conduct a search for available data, reference document, and events. If Actor is a subscriber the login process is completed.

Use Case:	GC-01 Conduct Search
Post-Condition	Research results are returned to the Actor as a symbolized map and tabular view indicating available reference document(s), data(s) and event(s) that match the research scope search parameters. The map view displays the spatial extent of available data and events relative to the spatial extent of the defined research scope. The tabular view displays the status (availability, restrictions, cost, location, etc.) and/or category of data, reference document and events. Subscriber may have saved search parameter form as a template for future searches. NOTE: Research Results are returned according to subscriber (group) permissions.
Cross-Reference	***GC-02 Browse Search Results***; ***GC-07 Manage Subscriber Account***; ***GC-10 Post Comment***

11.3.3 GC-01 Conduct Search Primary Scenario

Actor Action	System Response
1. This use case begins when the Actor launches the conduct search process.	2. Display *search parameter form* and map with *default spatial extent*. [Actor is a subscriber] provide choice of pre-saved *search parameter forms* (query templates).
3. Refine *research scope* by input to *search parameter form* and/or by interacting with map view. [Subscriber] select pre-saved *search parameter form*.	4. Update values in the *search parameter form* and update the *map view*. NOTE: The *spatial extent* of the *research scope* is updated in the *search parameter form*, as it is changed by the Actor in the map view, and vice-versa.

Actor Action	System Response
5. Submit search.	6. Based on permissions level, process search parameters against the *catalog* of available data, reference document and events return *research results* to the Actor as a map view and tabular view. Views use symbols to indicate location, status and category of *data*, *reference document* and *events*. System may indicate: ▪ available formats and sizes of data; or ▪ specific items are not immediately viewable and must be obtained from the data provider (password/group protection). Actor is prompted to Save Results, Revise Search, Cancel, Save Search, etc.
7. Choose next action.	8. Process as needed. [Save Results] save resulting information for use in browse [Revise] go to #3 [Cancel] quit [Save Search] prompt Actor to name/save search parameter form as a template.

11.3.4 GC-01 Conduct Search Secondary Scenarios

Name	Point of Occurrence/Overview
Actor wants to communicate with data/event/reference document provider.	Step #6. Call ***GC-10 Post Comment***

11.4 GC-02 Browse Search Results

11.4.1 GC-02 Browse Search Results Analysis

Context

The purpose of ***GC-02 Browse Search Results*** is to provide the ability to review the *research results* of an information request to the GeoCommunicator in order to evaluate geographic, categorical and/or temporal relevance.

Key Features-Functionality

The Actors of ***GC-02 Browse Search Results*** are Browser and Subscriber. A Browser has the limited functionality of viewing the research results. In addition to viewing the search results, a Subscriber can save search parameters or subscribe to future releases of the data. A Browser can opt to become a Subscriber by requesting a Subscriber Account.

Based on the research scope defined in ***GC-01 Conduct Search*** the Actor can manage the research results display by adding, or removing items via the map view or via the tabular view. Once the research results list is refined as desired it can be saved or printed. The Actor may use the data references to navigate to selected data provider sites and review and/or download available data.

If the relevance of the information returned fails to meet the business objectives, the Actor has the option of refining the search criteria, initiating a new query, or leaving the search functions of GeoCommunicator.

The Actor can review the result items that fulfill the research scope criteria. Item types may include:

- Data - land records mapping (vector or raster), image, attribute and/or metadata;
- Reference Documents - e.g. survey support information, field notes, technical or legal documents. This support information can be geo-referenced (have known coordinates) or geo-related (related to a known location on the Earth);
- Events: display event information including data, activity and communication.

Footprints will graphically depict the spatial extent (size and shape) of item(s) that fulfill the research scope criteria.

Subscribers have the option of saving the research scope query for future re-use.

Application Integration

GC-02 Browse Search Results functionality is closely linked with GeoCommunicator's:

- ***GC-07 Manage Subscriber Account*** allowing Browser Actors to request a Subscriber Account,
- ***GC-10 Post Comment*** providing Actors the ability to communicate directly with the provider(s) of a data set(s),
- ***GC-01 Conduct Search*** providing Actors the ability to modify their *research scope* or search criteria.

Development Implications

GC-02 Browse Search Results functionality is closely linked with ***GC-01 Conduct Search*** and therefore will be developed in parallel as the highest priority use cases.

11.4.2 GC-02 Browse Search Results Overview

Use Case	GC-02 Browse Search Results
Description	View, evaluate, and/or remove items (data references, reference documents and events) returned in the research results. The Actor may navigate to on-line data provider sites.
Actors	Browser, Subscriber
Pre-Condition	The Actor has conducted a search and received the research results.
Post-Condition	Actor has refined the items in the research results. Actor has viewed and/or navigated to the information required.

Use Case	GC-02 Browse Search Results
Cross-Reference	***GC-07 Manage Subscriber Account***; ***GC-10 Post Comment***; ***GC-01 Conduct Search***

11.4.3 GC-02 Browse Search Results Primary Scenario

Actor Action	System Response
This use case begins when the Actor interacts with items in the *research results*. The Actor may: ▪ manage display of the data footprints; ▪ view available metadata and event information; or ▪ select items and navigate to the provider site.	2. Process Actor action and display item source information as appropriate. Map view may show data's spatial extent. [manage display] add/remove from map view or tabular view [view metadata] display additional information [view event] display event information
3. Views items	4. Provide options to: ▪ navigate to provider site ▪ contact the *Data Provider*; ▪ print; ▪ save *research results*; ▪ refine the search; ▪ cancel the search/browse process.
5. Choose action.	6. Process action. [Navigate] jump to URL source [Contact Data Provider] route to Data Provider [Print] set up and print [Save Research Results] save current *research results* to an output file. [Cancel] quit;

11.4.4 GC-02 Browse Search Results Secondary Scenarios

Name	Point of Occurrence/Overview
Need to refine search	Steps #1,3,5 – return to ***GC-01 Conduct Search***

11.5 GC-03 Submit Event

11.5.1 GC-03 Submit Event Analysis

Context

The purpose of ***GC-03 Submit Event*** is to provide a process to share an event (data category, activity, and communication) by registering the details of the event on the GeoCommunicator.

An event may also be registered automatically as a result of an event trigger from another NILS sub-process (i.e. a specific, pre-defined survey management event). Data events have a *spatial extent*. Activity and communication events may or may not have spatial extents. Event submission may cause subscribers to be notified of activities. The event submission form would provide information on the format of the data, how frequently it is updated, and what the data contains. An update to the data might trigger a notification.

As an example, an agency could be a data provider. In this case the provider would complete an event submission form. The event in this case would be 'supply data'. 'Data updates' events would trigger notification to registered subscribers.

Another example of an event could be a 'proposed data collection'. The triggers could be 'updates', 'new partner identified', 'specifications finalized', 'funding received', 'project is finalized' and is now a 'planned activity', or 'project has been scheduled'. The subscribers would receive automatic updates based on these triggers.

Browsers can submit a request to become an Event Provider by applying for an account with the event provider designation. Subscribers and Data Providers can become an Event Provider by requesting the event provider designation be added to their current account.

A data provider is a special case of an event provider. The events for a data provider are centered around data. A data provider may have proposed, planned, or in progress as well as data set in hand and is being maintained on some schedule.

This process pertains to the Event Provider actor.

New Concepts

Activity Event. Any activity on the land submitted through the SubmitEvent (manual) process by the Event Provider.

Category. A classification of similar data sets, events, event providers, reference information, or communication events to facilitate the Submit and Search processes.

Communication Event. Any creation of a discussion forum, e-mail group, information notice, sending an e-mail, or information call submitted through the post comment process.

Data Event. Any data submitted through the submit data process that automatically sets a flag to trigger a notification.

Event Submission Form. A GeoCommunicator form for submitting an event.

Event Catalog. A listing of data by category type (Data, Activity Event, Communication Event, etc.) that may contain any or all of the following: metadata (description), current-to date, location/path to local storage, access restrictions, spatial reference, spatial extent, duration dates, data events (notification flags), activity events or communication medium events. Also called Catalog Information.

Event Category. Any activity, data submission, or communication that may trigger a notification.

Event Provider Forms. Will automatically be pre-populated from account information when events are being submitted.

Key Features-Functionality

Event Notification is triggered by the submission of a category event. Subscribers to that category of event (and spatial extent if applicable), will be notified of an update to the Master Catalog pertaining to that Area Of Interest.

Events have a provider agency or person, a name or title, a description of the activities that cause a trigger or notification, expected frequency of notifications, expected information to be included in the delivery, duration of the event, and other information that may be important to subscribers. Events will have a defined geography or area of applicability.

Event catalog interaction will allow:

- list current events;
- add new events;
- update existing events;
- delete existing events; and
- add new event categories.

The Event Provider is prompted for event submission metadata and details about the event itself through an event submission interface (form). This form may include mandatory submission fields including the name and e-mail address of the event provider, spatial extent, event submission category(s), event period timeframe, and associated documents.

New event forms provide a means for Event Providers to request that new event categories be added to the GeoCommunicator system. The new event form establishes a new event entry. Event submission form details are loaded into Master Catalog when verified by automated submission integrity controls.

Upon submission completion, or in a nightly batch process, events are added to the event database.

Application Integration

Submit Event functionality is closely linked with GeoCommunicator's:

- ***Submit Data*** process to submit geo-referenced data, geo-related data and/or reference documents and relevant data catalog information such as metadata to GeoCommunicator,
- ***Manage Event-Notification Process*** providing system administration of errors related to subscriber event notifications, which are also called event triggers.
- ***Manage Provider Account*** allowing Browsers or Subscribers to establish or modify data provider, event provider account information.

Development Implications

Submit Event is a high-priority function to improve project-related and general communications within the spatial and decision making industry.

11.5.2 GC-03 Submit Event Overview

Use Case	GC-03 Submit Event
Description	Process to submit an *event* and/or add a new *event category.* NOTE: Specific *events* may be automatically triggered by other system events. *Event providers* submitting events would have their stored account information pre-populated into the *event submission form*. (Any Actor can become an *event provider* by establishing a provider account).
Actors	Event Provider
Pre-Condition	Existing event provider wants to submit an event.
Post-Condition	Event has been submitted. System automatically processes events once they are submitted.
Cross-Reference	***GC-06 Submit Data***; ***GC-04 Manage Event Notification Process***; ***GC-05 Manage Provider Account***

11.5.3 GC-03 Submit Event Primary Scenario

Actor Action	System Response
1. This use case begins when an *event provider* launches the event management process.	2. Display interactive *event catalog* (e.g. list, add, update, or delete activity events, or add activity event categories) with account information pre-populated.
3. Input to *event catalog*. Select add, update/modify, or delete event activity. May add activity event category (test support for this in proof-of-concept).	4. Display appropriate add, update, or delete sub-forms. Event provider must specify event category, date, and its *spatial extent*, etc.
5. Submit.	6. Process event and insert into database. Trigger notifications as required. The current event calendar is updated and re-published. The GeoCommunicator automatically generates a subscriber notification list by matching key criteria (*event category* and *spatial extent*) from the event and subscriber databases. The system then sends e-mail notification to the list of subscribers.

11.5.4 GC-03 Submit Event Secondary Scenarios

Name	Point of Occurrence/Overview
New Event Category	Step#3. Provide new event request form and route to administrator for approval along with event information.
Browser wants to submit event	Step #2. Establish an account and collect required Actor information.

11.6 GC-04 Manage Event Notification Process

11.6.1 GC-04 Manage Event Notification Process Analysis

Context

The purpose of the GeoCommunicator ***GC-04 Manage Event Notification Process*** is to provide the Administrator with an interface (tools) to resolve errors related to event and notification processes. An event management and notification process logs event notification errors for the Administrator to resolve.

Key Features-Functionality

A need for an Administrator interface (tools) to facilitate:

- event notification (e-mail) problem resolution;
- removal of outdated events from the GeoCommunicator; and
- approval requests for new *event categories*.

The GeoCommunicator automatically generates a subscriber notification list by matching key criteria (*event category* and *spatial extent*) from the event and subscriber databases. The system then sends e-mail notification to the list of subscribers.

A list of 'to be resolved' event and notification transactions including unresolved errors, unresolved notifications (e-mail addresses), new *event category* requests, and expired events is displayed to GeoCommunicator Actors logging on with Administrator group level privilege.

Administrator tools (wizards) will assist processing the error, updating the error transaction list(s), and updating databases as needed. Processing may require that an account be temporarily disabled.

As problems are resolved the Administrator can delete each from this list which will trigger the notification process to re-send the notification(s).

Application Integration

'Manage Event-Notification Process' functionality is closely linked with GeoCommunicator's:

GC-07 Manage Subscriber Account allowing Browsers to request a Subscriber Account,

GC-03 Submit Event process to submit a *data category event*, *activity event*, or *communication event* to GeoCommunicator since an event may result in a new or updated data set submission.

11.6.2 GC-04 Manage Event Notification Process Overview

Use Case	GC-04 Manage Event Notification Process
Description	System administration of errors related to events and triggered notifications including the resolution of errors involving subscription and event notification. Also resolve failed e-mail notification and remove outdated events. Approve requests for new *event categories*. NOTE: System automatically: ▪ creates a list of subscribers to be notified (by *event category* and *spatial extent*) by matching key criteria from the event and subscriber databases; ▪ sends e-mail notification to the appropriate subscribers; and ▪ logs communications and produces an event/notification error list.
Actors	Administrator
Pre-Condition	An event notification issue must be managed.
Post-Condition	Event notification issue is resolved.
Cross-Reference	***GC-07 Manage Subscriber Account***; ***GC-03 Submit Event***

11.6.3 GC-04 Manage Event Notification Process Primary Scenario

Actor Action	System Response
1. This use case begins when the Administrator launches the 'manage notification process'	2. Display unresolved errors, unresolved notifications, requests for new *event categories*, and expired events.
3. Select an item to resolve.	4. Provide tools to handle errors, check e-mails, check event database, and approve/create new *event category*.
5. Use tools to resolve item.	6. Process item, update error lists (clear item), and update databases as needed. Send notifications upon resolving item (confirming fix and attempting to re-send {potentially} undelivered notifications)

11.6.4 GC-04 Manage Event Notification Process Secondary Scenarios

Name	Point of Occurrence/Overview
E-mail error	Notify Subscriber, temporarily disable subscriber account (route interim communication to holding area) and resolve communication error.

11.7 GC-05 Manage Provider Account

11.7.1 GC-05 Manage Provider Account Analysis

Context

The purpose of ***GC-05 Manage Provider Account*** is to provide Data Providers a process to request and manage their account (including profile).

New Concepts

Data Provider Form. Captures input from a Data Provider resulting in the creation or modification of Data Provider account information in the Manage Provider Account use case.

Event Provider Form. Captures input resulting in an event category from an Event Provider in the Submit Event process.

Provider Catalog. This is essentially the provider form, populated with current profile, account, and data/event information of an established provider. It includes the list of subscribers to the provider's data and events. It is the view of information to be managed by a provider in this use case.

Master Catalog. This is the consolidated view of all Provider Catalogs for administrative management, *CG-09 Manage Accounts*. The GeoCommunicator catalog is a subset of the Master Catalog, searchable and viewable by browsers and subscribers.

Key Features-Functionality

Provider Accounts are assigned to those Actors interested in submitting new, or updates of, information on a managed basis. As new data (***GC-06 Submit Data***) or new events (***GC-03 Submit Event***) are provided to the GeoCommunicator, a data or event entry is submitted to the Master Catalog.

When information about new data (or events) is posted to a category of the GeoCommunicator Catalog, a process is initiated to generate notification to GeoCommunicator subscribers.

Browsers (not yet a Data Providers) can submit a request for a Provider account at any time during a GeoCommunicator session. New provider account requests are routed to the account administrator for verification, creation with a userID/password pair and assigned group (role) privileges.

Mandatory information will be required to become a Data Provider. At a minimum this will include contact information and metadata.

Each provider will have an account profile with an interface (form) providing the ability to change information and preferences.

Upon submission, the Provider's account information is automatically verified and then routed to the GeoCommunicator Administrator.

Provider user-IDs/passwords will be assigned to enable saving of profile and access privilege information.

Application Integration

Manage Provider Account functionality is closely linked with GeoCommunicator's:

- ***GC-09 Manage Accounts*** providing the GeoCommunicator Administrator with tools to manage Subscriber and Provider accounts.

11.7.2 GC-05 Manage Provider Account Overview

Use Case:	GC-05 Manage Provider Account
Description	Process to establish or modify provider account information.
Actors	Data Provider, Event Provider
Pre-Condition	Provider needs to establish or modify provider account.
Post-Condition	Provider account is updated.
Cross-Reference	***GC-09 Manage Accounts***

11.7.3 GC-05 Manage Provider Account Primary Scenario

Actor Action	System Response
1. This use case begins when the Actor launches the data provider account management process.	2. Prompt for account/password NOTE: see new data provider account option below.
3. Enter account/password	4. Display *data provider form,* populated with existing values
5. Input/modify *data provider form*. Enter/update provider details; may cancel provider account. Submit.	6. Process changes to *data provider* account [delete account] prompt for confirmation
7. Confirm selections	8. Route to account administrator.

11.7.4 GC-05 Manage Provider Account Secondary Scenarios

Name	Point of Occurrence/Overview
New *data provider account*	Step #2. Presents blank *data provider form* and assist Actor to establish account.

11.8 GC-06 Submit Data

11.8.1 GC-06 Submit Data Analysis

Context

The purpose of ***GC-06 Submit Data*** is to provide a process to share *geo-referenced data*, *geo-related data* and/or *reference documents* with others by registering the data/data sets on the GeoCommunicator.

Data may be packaged as a set of associated data elements from various categories. Data categories that have a spatial extent (footprint) can be displayed and searched for spatially. Categories of data include spatial layers, tabular, images, *reference documents*, *data discrepancies* and proposed layers, etc. Some *reference documents* may have no direct relationship with a specific spatial data set (e.g. manuals, RFIs, reports, etc.).

New Concepts

Data Catalog. A listing of data by category type (Data, Activity Event, Communication Event, etc.) that may contain any or all of the following: metadata (description), current-to date, location/path to local storage, access restrictions, spatial reference, spatial extent, duration dates, data events (notification flags), activity events or communication medium events. Also called Catalog Information.

Spatial Reference. Projection(s), coordinate system(s), datum used. Listed in Data Catalog.

Key Features-Functionality

Data providers may supply references (URLs or physical locations) to data. Submissions may include spatial (vector and raster having a spatial extent or footprint), imagery, and scanned documents such as Plats or field notes.

Browsers can become Data Providers by applying for an account. Subscribers and Event Providers can become Data Providers by requesting the Data Provider designation be added to their current account. Data Provider forms will automatically be pre-populated from stored account information when new data sets are being submitted.

Data catalog forms will include data provider details, access control settings, data quality indicators, references to data source, and required fields to set up data event notification parameters.

Data catalog interaction will prompt for one of the following:

- list current items (entries);
- add new items - display blank *data catalog* form, capture *data catalog* information and indicate new data set source;
- modify (update/replace) existing items (by data set owner only) - display appropriate *data catalog* page and capture changes to the catalog information;
- delete existing items (by data set owner only) - display appropriate data catalog page and flag for delete. A database management batch process will be run on a regular basis to find and remove (possibly archive) these items.

After the submission is complete, the information will be routed to the GeoCommunicator administrator for action. If the Administrator cannot complete the request, an e-mail describing the problem will be sent to the Data Provider.

During a data set submission the Data Provider will be prompted to supply descriptive data (metadata) about the data set through a data set submission interface (form). This form may include mandatory submission fields including contact information, spatial extent, data category(s), data collection timeframe(s) and potentially the quality of the measurement process and the access category of the data set.

The result will be an updated *data catalog* that can be queried to list the data items by source-ID, data provider name, date, category, etc.

The submission of a new data category or data set may trigger notification to the appropriate subscribers.

Application Integration

GC-06 Submit Data functionality is closely linked with GeoCommunicator's ***GC-03 Submit Event*** process to submit a *data category event*, *activity event*, or *communication event* to GeoCommunicator since an event may result in a new or updated data set submission.

Development Implications

Initial data provision will be for prototypes.

11.8.2 GC-06 Submit Data Overview

Use Case:	GC-06 Submit Data
Description	Process to submit index and catalog information for *geo-referenced data*, *geo-related data* and/or *reference documents* to GeoCommunicator. This includes: ▪ data reference (URL or physical location); ▪ relevant *data catalog* information (e.g. metadata); ▪ date; ▪ access restrictions; ▪ spatial reference; and ▪ spatial extent. NOTE: Provider may post product availability, restrictions, and subscriptions in the data catalog. NOTE: Providers will supply references to data housed in remote storage locations. This use case ***may*** include some security administration for restricted-access data sources.
Actors	Data Provider
Pre-Condition	An authorized data provider needs to submit or modify data catalog information.
Post-Condition	Data provider's *data catalog* information has been submitted for addition, replacement or deletion.
Cross-Reference	***GC-03 Submit Event***

11.8.3 GC-06 Submit Data Primary Scenario

Actor Action	System Response
1. This use case begins when a data provider launches the submit data process	2. Prompt for data provider account number/password
3. Enter the account number/password	4. Verify account. If valid, display an interactive *data catalog* that lists the data sources the data provider has registered. The *data catalog* displays all relevant information (source-id, metadata, etc.). Prompt for disposition options (e.g. Add New, Modify data catalog, Update, Delete)

Actor Action	System Response
5. Interact with the *data catalog*. May select an item from the *data catalog* and select an action.	6. Process action. *Data catalog* forms include: ▪ access settings; ▪ security settings; ▪ reference to data source; ▪ subscriptions, etc. *Data catalog* form may include specification of "new data" event notification parameters/flag(s) for the system. [Add New] Display blank *data catalog* form and capture *data catalog* information and indicate new data source [Modify *data catalog information*] Display appropriate data catalog page and capture changes to *data catalog* information [Replace] Display appropriate data catalog page and capture changes to *data catalog* information and indicate new data source [Delete] Display appropriate data catalog page and flag for delete
7. Input to *data catalog* forms, verify and submit	8. Process submittal. Route to data administrator for action, notify administrator, and track in workflow management.

11.9 GC-07 Manage Subscriber Account

11.9.1 GC-07 Manage Subscriber Account Analysis

Context

The purpose of 'Manage Subscriber Accounts' is to provide a process for Subscribers to manage their account information (and profile) governing notifications (as triggered by new or updated data, events and/or communications. Subscribers may delete their accounts.

New Concepts

Subscriber Account. Those interested in receiving updates of information on a managed basis. When new data is posted for a category, a notification will be sent to those who have subscribed to that category of information. This notification process may be on a scheduled basis where a subscriber has requested notification updates at preset times, or an *ad hoc* basis where notification is immediately triggered as an event occurs. Subscribers manage subscription options in their account profile.

Subscriber Account Form. This form is displayed with current values for the subscriber. A blank form is displayed for new subscribers.

Key Features-Functionality

There will be mandatory information to become a subscriber to GeoCommunicator. At a minimum this will include contact information.

Each subscriber will have an account profile with an interface (form) providing the ability to change preferences and subscription parameters such as *spatial extent*, event categories and scheduling.

Subscribers get a userID/password pair to secure their profile, notification and access privilege purposes.

Upon submit the Subscriber account form is automatically verified and then routed to the GeoCommunicator Administrator.

Browsers (not yet Subscribers) can submit a request for a Subscriber account at any time during a GeoCommunicator session. New Subscriber account requests are routed to the account administrator for verification, creation with an userID/password pair and assignment of group (role) privileges.

As new data (***GC-06 Submit Data***) or new events (***GC-03 Submit Event***) are provided to the GeoCommunicator a data or event entry will be added to the Master Catalog. Although all GeoCom Actors will have the option of viewing a calendar of most recent events

from the GeoCommunicator, Subscribers will also be sent notifications on specified spatial extents. On a regular basis the system will determine which subscribers, and in what timeframe each of these subscribers, need to be notified of each new event.

Application Integration

GC-07 Manage Subscriber Account functionality is closely linked with GeoCommunicator's:

- ***GC-01 Conduct Search*** providing Actors the ability to modify their *research scope* or search criteria,
- ***GC-02 Browse Search Results*** providing Actors with the tools to review and evaluate the information returned by the Conduct Search process,
- ***GC-09 Manage Accounts*** providing the GeoCommunicator Administrator with tools to manage Subscriber and Provider accounts,
- ***GC-04 Manage Event-Notification Process*** providing the GeoCommunicator Administrator with an interface to manage and resolve problems related to events and notifications.

Development Implications

GC-07 Manage Subscriber Account capabilities are not necessary to perform the highest priority functions ***GC-01 Conduct Search*** and ***GC-02 Browse Search Results***.

11.9.2 GC-07 Manage Subscriber Account Overview

Use Case	GC-07 Manage Subscriber Account
Description	Process to establish or modify *subscriber account* including: ▪ Subscriber information; ▪ Subscriber preferences; and ▪ subscription/notification parameters (*spatial extent*, event categories, scheduling). NOTE: Browser may elect to become a new subscriber and pass current *research scope* information into the account setup.
Actors	Subscriber
Pre-Condition	Subscriber needs to establish or modify *subscriber account* or subscription/notification parameters.
Post-Condition	*Subscriber account* or subscription/notification parameters are updated.
Cross-Reference	***GC-01 Conduct Search***; ***GC-02 Browse Search Results***; ***GC-09 Manage Accounts***; ***GC-04 Manage Event Notification Process***

11.9.3 GC-07 Manage Subscriber Account Primary Scenario

Actor Action	System Response
1. This use case begins when the Actor launches the manage subscription process	2. Prompt for account/password (see new subscriber option)
3. Enter account/password	4. Display *subscriber account form* populated with current values.
5. Input/modify *subscriber account form*. ▪ Enter/update subscriber information ▪ Select/update event notification category, its spatial extent, and its notification frequency ▪ Select cancel subscription option, if desired ▪ Verify and submit.	6. Process changes to *subscriber account form*. Route to account administrator for certification when secure access is required. [delete account] prompt for confirmation
7. [Delete] Confirm selection	8. Delete subscriber account.

11.9.4 GC-07 Manage Subscriber Account Secondary Scenarios

Name	Point of Occurrence/Overview
New subscriber account	Step#2. Assist Actor to establish new account. Route to account administrator for certification when secure access is required.

11.10 GC-08 Manage Data Process

11.10.1 GC-08 Manage Data Process Analysis

Context

The purpose of ***GC-08 Manage Data Process*** is to provide the GeoCommunicator Administrator with an interface (tools) to manage the *data catalog*.

New Concepts

A Data Provider submits a data reference for inclusion into the data catalog, or the Administrator has received a message indicating an error with a data cataloging process.

The data set information will be loaded into a temporary table allowing validation to be performed off-line. When the data information is flagged for production readiness it will be added to the Production data cataloging.

The Administrator has the responsibilities of performing:

- quality control on data references submitted for inclusion in the data catalog;
- inserting new/replacement data reference information into the data catalog
- deleting replaced or outdated data reference information from the data catalog;
- troubleshoot a problem with either the data cataloging process

Tools (wizards) will be provided to view, verify and process data catalog submittals.

Key Features-Functionality

The system produced lists of 'to be resolved' transactions. As troubleshooting is performed, the Administrator can remove the transaction from the 'to be resolved' list. The Administrator will:

- Quality control data references submitted for inclusion in the data catalog. A data catalog update process will check for mandatory fields (e.g. date, format, spatial extent).
- Insert replacement data references for existing items in the master index.
- Delete invalid source information from the *Master Catalog*.

Completing the processes above may trigger the notification process. Subscribers to the category and/or spatial extent of the subject data reference will be sent notification based on their specified subscription parameters.

Application Integration

GC-08 Manage Data Process functionality is closely linked with GeoCommunicator's:

- ***GC-06 Submit Data*** process to submit *geo-referenced data*, *geo-related data* and/or *reference documents* and relevant *data catalog information* such as metadata to GeoCommunicator,
- ***GC-09 Manage Accounts*** providing the GeoCommunicator Administrator with tools to manage Subscriber and Provider accounts,
- **System Utility- 'Compare/Contrast Data'** providing a graphic or textual comparison of new/proposed data references with existing data references and provide a report of the contrasts;
- ***GC-10 Post Comment*** providing Actors the ability to communicate directly with the provider(s) of a data reference(s).

11.10.2 GC-08 Manage Data Process Overview

Use Case	GC-08 Manage Data Process
Description	System administration to: ▪ quality control (QC) catalog information; ▪ insert new/replacement data reference information; ▪ modify *data catalog*; or ▪ delete data reference from the system.
Actors	Administrator
Pre-Condition	Data Provider has: ▪ submitted new/replacement data reference information; ▪ requested deletion of data references; or ▪ the Administrator has received a communication indicating an error in the data catalog information.
Post-Condition	Data catalog has been checked for relevant and required information including: ▪ format; ▪ reference locations/URLs; ▪ *spatial reference*; ▪ *spatial extent*; ▪ metadata; and ▪ access restrictions. Qualified data reference information has been loaded, indexed, and made available for searching. Event notification has been triggered.
Cross-Reference	***GC-06 Submit Data***; ***GC-09 Manage Accounts***; ***GC-10 Post Comment***

11.10.3 GC-08 Manage Data Process Primary Scenario

Actor Action	System Response
1. This use case begins when the data administrator receives notification of a submittal and launches the data management process.	2. Display a list of new submittals.
3. Select a submittal	4. Display *data catalog* information for selected submittal. Provide QC tools to verify and process submittal. Assist Administrator in testing catalog and viewing reference information (wizard?).
5. Perform QC process on *data catalog* information. Verify.	6. Provide controls for transaction on main database including: ▪ delete; ▪ modify/replace; ▪ add
7. Choose transaction.	8. Process transaction. Update transaction log. Trigger the event notification process on the transaction. [Delete] Remove reference information from index and delete catalog information from main database. [Add] Create source reference, add to index and insert catalog information. [Modify/Replace] Delete and Add. Replace previous version of reference information in master index and replace catalog information.

11.10.4 GC-08 Manage Data Process Secondary Scenarios

Name	Point of Occurrence/Overview
Error on QC	Step #5. Notify Data Provider.

11.11 GC-09 Manage Accounts

11.11.1 GC-09 Manage Accounts Analysis

Context

Subscriber and Provider accounts need to be managed for new account certification, account error/issue resolution.

The purpose of ***GC-09 Manage Accounts*** is to provide the GeoCommunicator Administrator with the necessary tools (system management utilities) to resolve any issues and requests relating to Actor accounts.

New Concepts

The Actor of ***GC-09 Manage Accounts*** is the GeoCommunicator Administrator. The Administrator account is assigned to the person or persons responsible for managing the GeoCommunicator system.

Key Features-Functionality

A list of 'to be resolved' account transactions is made available to the Administrator. As changes are made the Administrator can remove the transaction from the 'to be resolved' list.

Examples of transactions the Administrator must perform include:

- assigning account name and password to a new account request. The password must meet minimum good practice password formatting;
- verifying account status with a Subscriber or Provider by testing e-mail address submitted. Determine and assign the Subscriber or Provider to an access group;
- deleting an account (includes a process to remove the Subscriber or Provider from e-mail groups and transfer or delete forums managed by that Subscriber or Provider).

An account management interface (form) will be available for the Administrator to fulfill these functions.

Application Integration

GC-09 Manage Accounts functionality is closely linked with the following GeoCommunicator use cases:

- ***GC-07 Manage Subscriber Account*** allowing Browsers to request a Subscriber Account,
- ***GC-05 Manage Provider Account*** allowing Browsers or Subscribers to establish or modify data provider, event provider account information.

Development Implications ***GC-09 Manage Accounts*** will move higher in priority as more Browsers request GeoCommunicator Provider and Subscriber accounts.

11.11.2 GC-09 Manage Accounts Overview

Use Case	**GC-09 Manage Accounts**
Description	System administration of Subscriber and Provider accounts including: ▪ certifying new accounts; ▪ resolving errors; and ▪ managing account-related issues.
Actors	Administrator
Pre-Condition	An account-related issue must be managed.
Post-Condition	Account-related issue is resolved.
Cross-Reference	***GC-07 Manage Subscriber Account***; ***GC-05 Manage Provider Account***

11.11.3 GC-09 Manage Accounts Primary Scenario

Actor Action	**System Response**
1. This use case begins when the administrator launches the manage accounts process	2. Display unresolved account transactions.
3. Select transaction to manage.	4. Display account management form. Provide tools to: ▪ assign account and password; ▪ verify Actor status with data provider; ▪ assign Actor to a group; ▪ delete account; ▪ etc.
5. Select tools and apply.	6. Process changes to account.

11.11.4 GC-09 Manage Accounts Secondary Scenarios

Name	**Point of Occurrence/Overview**
Cancel Subscription	Step #5/6. Search for associated forums, e-mail groups, etc. and delete Actor.

11.12 GC-10 Post Comment

11.12.1 GC-10 Post Comment Analysis

Context

GeoCommunicator facilitates access to cadastral and land records-related information, and enables communication between information stakeholders.

The purpose of the ***GC-10 Post Comment*** function is to provide GeoCommunicator users with an effective and efficient means of communicating information to their industry peers. Comments can be posted by all actors including: Browser; Subscriber; Data Provider; Event Provider; and Administrator.

New Concepts

Communication Event. Any creation of a discussion forum, e-mail group, information notice, sending an e-mail, or information call submitted through the ***Post Comment*** process.

Data Discrepancy. Data sets of the same category in the same spatial extent whose boundaries, positions (coordinates) or attributes do not match.

Key Features-Functionality

Comments may be posted as part of industry-related discussions or requests, specific forum decisions, or general communication.

The ***GC-10 Post Comment*** interface will provide the following major functions:

- assist actor to input information, including spatial extent as appropriate, when posting a comment;
- a wizard to assist actors to register for participation in selected e-mail groups or discussion forums;
- a wizard driven interface to assist actors to prepare topical e-mail for various GeoCom users or user types. This process (with intelligent event parameters automatically populated) interfaces to an industry standard e-mail system;
- a wizard to assist actors to publish information notice(s) or data call(s). A request form is provided to indicate notice or request type, spatial extent, dates, etc.;
- provide a request form to handle submission, setup and notification of new e-mail groups or discussion forums.

Browsers will have the opportunity to establish Subscriber or Provider accounts, which is a prerequisite to being able to 'Post Comments'.

Application Integration

GC-10 Post Comment functionality is closely linked with GeoCommunicator's:

- ***GC-11 Manage Forums*** process for the system administrator to manage communication forums and e-mail groups.
- ***GC-03 Submit Event*** process to submit a *data category event*, *activity event*, or *communication event* to GeoCommunicator since an event may result in a new or updated data set submission,
- ***GC-04 Manage Event Notification Process***' providing system administration of errors related to subscriber event notifications,
- ***GC-09 Manage Accounts*** providing the GeoCommunicator Administrator with tools to manage Subscriber and Provider accounts.

11.12.2 GC-10 Post Comment Overview

Use Case	GC-10 Post Comment
Description	Process to handle *communication events* to: ▪ a topical forum (via e-mail); ▪ e-mail group (e.g. to review proposed data); ▪ data provider (e.g. to report errata); ▪ publish an information notice (e.g. an RFP, a Public Notice, or data discrepancy); or ▪ publish an information call (e.g. data request, reference request or event request). NOTE: Browsers may have limited communication access. Subscribers may have enhanced access to forums
Actors	Browser, Subscriber, Data Provider, Event Provider, Administrator
Pre-Condition	Actor wishes to communicate information.
Post-Condition	Actor has sent or published information.
Cross-Reference	***GC-11 Manage Forums***; ***GC-03 Submit Event***; ***GC-04 Manage Event Notification Process***; ***GC-09 Manage Accounts***

11.12.3 GC-10 Post Comment Primary Scenario

Actor Action	System Response
1. This use case begins when the Actor launches the post comment process.	2. Display *communication events* options. Options may include: ▪ request new e-mail group or discussion forum; ▪ participate in e-mail group or discussion forum (join if first time); ▪ send e-mail; ▪ publish information notice; or ▪ publish information call.
3. Select option.	4. Prompt Actor to input necessary information and request confirmation. Assist Actor to establish *spatial extent* of *communication event* where/when appropriate. [Request new e-mail group or discussion forum] Display request form, handle submission, setup and notice. [Participate in e-mail group or discussion forum] Display group selection form, establish communications. If Browser, establish account. [Send e-mail] Display e-mail event form (intelligent event parameters populated, group and administrator address information provided as appropriate). [Publish information notice] Display information notice form (to input type of notice, spatial extent, dates, etc.) [Publish information call] Display information request form (to input type of request, spatial extent, dates, etc.)
5. Input information, confirm and submit.	6. Process request – verify information provided and setup as needed.

11.12.4 GC-10 Post Comment Secondary Scenarios

Name	Point of Occurrence/Overview
Error with information input, Actor permissions, etc	Step #6. Notify Actor and return to #5.

11.13 GC-11 Manage Forums

11.13.1 GC-11 Manage Forums Analysis

Context

The GeoCommunicator will provide a means for users to discuss an industry-related topic or issue. (An example of a topic forum may be a data discrepancy with a spatial extent, perhaps a disputed corner post location).

The purpose of 'Manage Forums' is to provide the GeoCommunicator Administrator with an interface (tools) to manage the GeoCommunicator discussion forums.

Key Features-Functionality

GeoCommunicator users have 'read access' and 'post-access' (via e-mail) to a forum. All posts must include the date of posting, e-mail address of poster and a subject line indicating the forum topic. Individual forums may require additional posting requirements.

A description of how to create and manage a forum will be available on the GeoCommunicator.

A forum submission form will require a forum category, description and forum manager contact information. When this form is complete the request is routed to the Administrator who will create the forum to the specifications and send an e-mail to the forum initiator.

A list of 'to be resolved' forum transactions is displayed to the Administrator. The Administrator resolves items and deletes the transaction from the 'to be resolved' list. Notifications are sent as appropriate.

If an account is to be deleted from a GeoCommunicator system, a process will first ensure that the account owner is not a forum manager. The forum may need to be reassigned prior to the account deletion.

A process will be necessary to check the last modified date of the contents of each forum. If a forum is dormant for a predefined period of time, (e.g. 6 months), an e-mail will be sent to the forum manager requesting authorization to archive the forum. A copy of that e-mail is also sent to the Administrator.

Each forum must have one or more forum managers (initiator and content manager may or may not be the same person).

The forum manager will have the on-going responsibility of notifying the Administrator when changes are needed for the forum. They should also notify the Administrator when the Forum has reached a resolution and can be archived.

All GeoCommunicator users have access to forums unless the forum initiator requests access-level constraints.

Application Integration

GC-11 Manage Forums' functionality is closely linked with the following GeoCommunicator use cases:

- ***GC-04 Manage Event Notification Process***' providing system administration of errors related to subscriber event notifications,
- ***GC-10 Post Comment*** providing Actors the ability to communicate directly with the provider(s) of a data reference(s).

Development Implications

The intent is to use industry standard products to provide the forum functionality. ***The GC-11 Manage Forums*** functionality and utilities will be somewhat defined by the selected product.

11.13.2 GC-11 Manage Forums Overview

Use Case	GC-11 Manage Forums
Description	The System Administrator: (1) sets up and closes communication forums, e-mail groups; (2) monitors content; and (3) manages errors.
Actors	Administrator
Pre-Condition	Administrator has received request for new forum/e-mail group. Administrator receives system error on communications.
Post-Condition	Communications are setup, closed, monitored and managed as needed.
Cross-Reference	***GC-10 Post Comment***; ***GC-04 Manage Event Notification Process***

11.13.3 GC-11 Manage Forums Primary Scenario

Actor Action	System Response
1. This use case begins when the administrator launches the manage forums process.	2. Display: ▪ forum/e-mail group errors; ▪ requests for new forums and e-mail groups; ▪ requests for adding participants to a forum or e-mail group; and ▪ lists of active forums and e-mail groups.
3. Select an item to resolve.	4. Provide appropriate management tools based on selection.

5. Use tools to research and resolve error or forum/e-mail group request. May access previous communications to monitor content.	6. Process actions include: ▪ update system and database(s); ▪ clear item from unresolved list; and ▪ send notification(s) on resolution.

11.13.4 GC-11 Manage Forums Secondary Scenarios

Name	Point of Occurrence/Overview
New forum or e-mail group	Step #5/6. Treat as a type of event and trigger notifications as appropriate

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Appendix A. Glossary of Use Case Terms

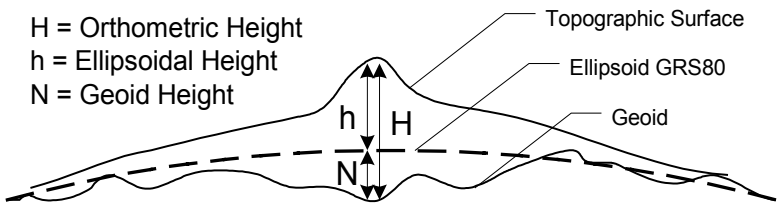
This glossary is a snapshot of the definitions for the use cases in this version of the requirement document. Since this document will evolve during the design processes, a single, unified glossary will be maintained.

The NILS Unified Glossary will be available from the NILS web page, **http://www-a.blm.gov/nils/**.

Term	Definition
Accuracy See ***Precision***	1. The degree of conformity or closeness of a measurement to the true value. [Mikhail and Gracie] 2. Nearness to truth. [Brown] 3. Degree of conformity with a standard. Accuracy relates to the quality of a result, and is distinguished from precision, which relates to the quality of the operation by which the result is obtained. [ACSM]
Adjusted point	A point whose coordinates are the result of an *adjusted measurement network*.
Adjustment limits	Values that indicate when sufficient numbers of *least square analysis* iterations have been reached. This prevents endless looping of iterations. There are two types of limits: *residual tolerance* and *iteration limit*.
Administrative area	1. An area of land managed for a specific purpose. Examples: USFS National Forest, BLM District, Land Planning Zone, county, etc. 2. An organizational unit. The unit has distinct jurisdictional responsibility for all activities in a geographic area.
Administrative survey	This is a series of *measurements* and *observations* that are done for the purpose of describing the limits or conditions of a public decision. Administrative surveys are gathered for informational purposes and are not intended to provide information on the extent of legal *rights* and interests.
ALTA	American Land Title Association
Analyze/adjust parameter form	A data entry form accessible prior to the adjustment where the user can control meaningful aspects of the adjustment, such as use of point elevations, use of *weighting*, *adjustment limits*, *robusting option.*
Anomaly	Anything irregular or abnormal.
Anomaly correction	Process to edit and correct anything irregular or abnormal (*blunder*, *error*) in *measurement data*.
Anomaly detection	Process to identify anything irregular or abnormal (*blunder*, *error*) in *measurement data*.
Area of Applicability	The geographic extent of an *event*. This is the extent for which the *event* is applicable. An *event* is available for subscription if a *subscriber's area of interest* overlaps any part of the area of applicability. The area of applicability is defined by pre-defined frameworks or registration cells such as states, counties, or PLSS Townships. In future releases, this restriction may be omitted.

Term	Definition
Area of interest	Represents the geographic extent of data to be processed. An area of interest can be specified by the *browser* or *subscriber* from "free form" or user defined footprints or by registering to pre-defined cells, frameworks, or reference grids.
Blunder See ***Error***	1. A mistake. A blunder is not an error, although infrequently a blunder is called a gross error. 2. A mistake. A blunder is not an error, though a small blunder may remain undetected in a series of observations and have the effect of an error in determining the result. Examples of blunders are (1) reading a horizontal circle incorrectly by an even degree; (2) neglecting to record a tape length in a measured traverse; and (3) reversing the numerals in recording an observation. [ACSM] 3. MISTAKE-A mistake is not an error, but is a blunder on the part of the observer. [Moffitt and Bouchard] 4. GROSS ERRORS are the results of blunders or mistakes that are due to carelessness of the observer [Mikhail and Gracie] 5. A mistake. Not an error. [Brown]
Boundary	1. A boundary (also land boundary) is a line of demarcation between adjoining land *parcels* as determined by legal descriptions. Boundaries can be marked by monuments, fences, hedges, and so on, or not at all. 2. LAND BOUNDARY-A line of demarcation between adjoining parcels of land. The parcels of land may be of the same or of different ownership, but distinguished at some time in the history of their descent by separate legal descriptions. A land boundary may be marked on the ground by material monuments placed primarily for the purpose-by fences, hedges, ditches, roads, and other service structures along the line-or defined by astronomically described points and lines; by coordinates on a survey system whose position on the ground is witnessed by material monuments which are established without reference to the boundary line; and by various other methods. [ACSM] 3. LAND BOUNDARY-Usually the line of demarcation between adjoining land parcels as determined by legal descriptions. Land boundaries can be marked by monuments, fences, hedges, etc. or not at all. [Brown]
Boundary survey	A survey made to establish or to re-establish a boundary line on the ground or to obtain data for constructing a map or plat showing a boundary line. The term boundary survey is usually restricted to surveys of boundary lines between political territories. [ACSM]
Browser	A Browser has the limited functionality of viewing research results and navigating to Provider URLs. A Browser can opt to become a *Subscriber* by requesting a Subscriber Account. A Browser may retrieve data that is downloadable from provider storage locations to local disk.
Bureau motion	A land action initiated by the Bureau of Land Management or another federal entity.

Term	Definition
Catalog **Data catalog** **Event catalog**	A listing of *data* by *category type* (data, activity *event*, communication *event*, etc.) that may contain any or all of the following: metadata (description), current-to date, location/path to local storage, access restrictions, spatial reference, spatial extent, duration dates, data events (notification flags), activity events or communication medium events. Also called Catalog Information. Information from the provider catalogs will be used by the administrator to construct the master index.
Category	Indicates the lumping together of similar individual data sets, activity *events*, reference information, or communication *events* to facilitate the ***GC-01 Conduct Search*** process. Broad categories such as *data*, activity *events*, and so on, will be subdivided into smaller categories such as transportation data and field survey activities. The ***GC-02 Browse Search Results*** use case would display all items under the selected categories.
Category types	Indicates an item to query, an item to subscribe to, or an item to submit for e-mail notification. Examples include data category, activity event category, reference information category, forum category, email group category, chat group category, information notice category, information request category.
COGO procedure parameter form	A list of configuration options to assist the user in the setup of *COGO procedures*.
COGO procedures	A unique set of Coordinate Geometry (COGO) *computations* used to calculate coordinate positions. Example position calculation methods: *in-field coordinate geometry* (e.g.*, bearing/bearing intersection)* and *layout by angle and distance*.
Computation	A set of processing methods or algorithms applied to achieve a desired solution. *COGO Procedures* use computations.
Computation device	The computing hardware system and processing software for deriving *observations* and *measurements* from *readings*. May be used with a *data collection device* on the same computing hardware system.
Control	In general, coordinated and correlated position data forming a framework to which detail surveys are adjusted. Basic control may be either horizontal or vertical; it is usually executed with greater precision and accuracy than is required for dependent surveys. Also the point or points permanent in character within a network of basic control, for which the coordinates and/or elevation to a specific accuracy are known and which are used as origin and closure for making a control survey or for making an engineering, cadastral, or other survey. [ACSM]
Conveyance	A transfer of legal title to land or *rights*. An instrument, such as a deed, patent, tentative approval or interim conveyance, by which interest in mineral and/or real property is transferred from grantor to grantee.

Term	Definition
Data (GeoCommunicator)	Any and all non-event information, regardless, of format or medium, that is searchable by GeoCommunicator users. Geo-Referenced-Raster or vector data that contain world coordinates. Geo-Related-Data that is associated or linked to a point or area entity (spatial objects). Examples: Survey Plat of a township; Patents and deeds linked to a *parcel* by *legal descriptions*. Reference Document-Helpful technical information related to *events* or data. May have no direct relationship with a spatial data set (e.g. manuals, Request For Information (RFI), reports, etc.). Data may be packaged as a set of associated data elements from various categories. Data categories that have a *spatial extent* (footprint) can be displayed and searched for spatially. *Categories* of data include spatial layers, tabular, images, *reference documents*, *data discrepancies* and proposed layers, etc. Some *reference documents* may have no direct relationship with a specific spatial data set (e.g., manuals, Request For Information (RFI), reports, etc.).
Data collection device	An instrument for digital storage of *readings* and information about those *readings*. Information may be manual or digital input. Typically a personal computer capable connected to a *measurement device*.
Data discrepancy	Data sets of the same *category* in the same spatial extent whose positions (coordinates) and/or attributes do not match.
Data provider form	Captures input from a data provider resulting in the creation or modification of data provider account information.
Data set	A collection of data, such as an array or table of data items, a file, a program, or any other organized unit of data. Field survey data set-The set of reference data transferred to a data collection device for use in the field (i.e. coverages, images and documents.) that pertains to a *Survey Project*.
Deed description	A measurement as defined in a deed *legal description*.
Default spatial extent	Default spatial search area defined by the site administrator.
Defining measurement	A *measurement* in a conveyance instrument that defines an area of land.
Ellipsoidal height	The distance from the ellipsoid to a point measured along a line normal to the ellipsoid. [BLM Training] 

Term	Definition
Engineering/ Construction survey	Construction-The survey measurements made, while construction is in progress to control elevation, horizontal position and dimensions and configuration; to determine adequacy of completion; and to obtain essential dimensions for computing construction pay quantities. [ASCM] Engineering-A survey executed for the purpose of obtaining information that is essential for planning an engineering project or development and estimating its cost. The information obtained may, in part be recorded in the form of an engineering map or plat. [ACSM]
Error See ***Blunder***	1. An error is the difference between the true value of a quantity and the measured value of the same quantity. 2. The difference between an observed or computed value of a quantity and the ideal or true value of that quantity. Because the ideal or true value of a quantity, with few exceptions, cannot be known with exactness, the term error is applied to a difference between an observed or computed value of a quantity and some standard or accepted value used in lieu of the ideal or true value. [ACSM] 3. An error is the difference between the true value of a quantity and the measured value of the same quantity. Errors result from instrumental imperfections, personal limitations, and natural conditions affecting the measurement. [Moffitt and Bouchard] 4. Errors have been traditionally classified into three types: (1) *gross* errors, (2) *systematic* errors, and (3) *random* errors. [Mikhail and Gracie] 5. The difference between a measured value and the true value. A smaller magnitude; not a mistake or blunder. [Brown] 6. Since the true value of a measured quantity can never be determined, errors are likewise indeterminate, and hence they are strictly theoretical quantities. [Wolf]
Error ellipse	An ellipse surrounding an adjusted coordinate describing the likelihood of the true value to be close to the adjusted value. In SM and MM extensions, the 95% level is chosen as most helpful. An error ellipse based on 95% is saying that the true value, if known, is expected to occur within the error ellipse 95% of the time.
Error estimate	A numeric value expressing the reliability of each piece of data in the pre-adjusted survey *network.* This value expresses the amount of adjustment that would be expected to occur during the least square adjustment and is used as a weighting to control the adjustment of better data. This value is usually applied consistently to distances, bearings and control coordinate values within each survey. The pre-adjustment estimates are based on date, equipment and surveyor. The refinements to these estimates are based the reports from the *least square adjustment/analysis*.

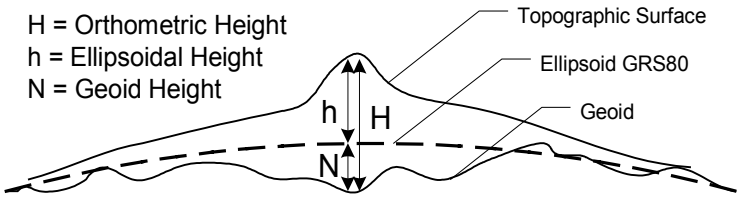
Term	Definition
Estate	The degree, quantity, nature and extent of interest which anyone has in lands or in any other property. Surface – All *rights* in the surface of the land except the oil, gas and other mineral or subsurface rights which a party owns including the right to transfer and dispose of the surface of that land. The surface estate is severed from the mineral estate in a conveyance when the grantor excepts or reserves all or part of the minerals from the land being conveyed. Sub-Surface – As opposed to surface estate. Includes more *rights* than mineral estate. Term originated by Congress in ANCSA and is continually being defined by the courts, who stated sand and gravel are included in the subsurface rights.
Event	Any activity, data submission, or communication that might trigger a *notification* and searchable through GC-01 Conduct Search. Activity Event. Any activity on the land submitted through the GC-03 Submit Event (manual) process by the Event Provider. Example: Survey fieldwork planned by BLM cadastral surveyors. Data Event. Any data submitted through the GC-06 Submit Data process that automatically sets a flag to trigger a *notification*. Example: Data has been updated. Communication Event. Any creation of a discussion forum, email group, information notice, sending an email, or information call submitted through the GC-10 Post Comment process. An activity event (e.g. data collection) may result in a data submission event.
Event Notification	The GeoCommunicator system process to match activity parameters against subscription parameters and to initiate notifications to the appropriate subscribers.
External trigger	A transaction in an associated system or database that causes the need for processing in NILS.
Fabric See ***Measurement Network*.**	A collection of topologically related *features*.
Feature	A cadastral land records object that has a field of type geometry. Features are stored in feature classes.
Field survey	*Measurement* of *features* for locating the position, or layout, of physical objects or theoretical position. For example, a property corner is theoretical, but a property corner monument is a physical object.
Field survey data set	See *data set*
Field survey setup file	A list of parameters and configurations for the setup of a *data collection device*. A file which contains the type of data to collect; geodetic *vs.* planar geometry; the hardware/communications parameters; the area of interest; setup instructions for custom in-field menus and data collection forms; paths to reference data (i.e., coverages), images, and documents; and the link from the *field survey* to its *survey project*.

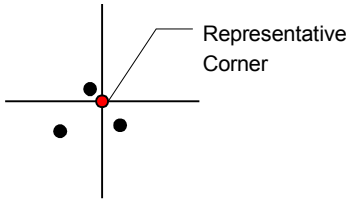
Term	Definition
Field survey setup file template	A form to assist a user in creating or editing a list of parameters and configurations for the setup of a *field survey setup file* for a *data collection device*.
Form	General term indicating interactive window with prompts to collect information. Account management form. Captures input from an administrator in the ***GC-09 Manage Accounts*** use case. Catalog form. Captures input from a data provider resulting in the creation or modification of the data provider's *catalog* entries in the ***GC-06 Submit Data*** use case. Provider account form. Captures input from a user applying for a data provider or event provider account through the ***GC-05 Manage Provider Account*** use case. Email event form. Captures input resulting in an email, which is sent to the administrator in the ***GC-10 Post Comment*** use case. Event submission form. Captures input resulting in an *event category* from an event provider in the ***GC-03 Submit Event*** process. Information notice form. Captures input resulting in a published request which is sent tot the administrator in the ***GC-10 Post Comment*** use case. Information request form. Captures input resulting in a data call request, which is sent to the administrator in the ***GC-10 Post Comment*** use case. Search parameter form. Captures input resulting in the research scope in the ***GC-01 Conduct Search*** process. Subscriber account form. Captures input form a subscriber resulting in the creation or modification of subscriber account information in the ***GC-07 Manage Subscriber Account*** use case.
Geoidal undulation correction	Correction term computed at a benchmark station and applied to the model computed orthometric height at the vicinity of the benchmark.
Intersection	The point where two lines cross.
Iteration limit	The maximum number of iterations an adjustment can have before it is assumed that the solution is diverging.
Least square analysis/ adjustment	A mathematical process that simultaneously combines all *measurements* in a *data set* and adjusts their residuals to derive the optimal value as well as statistics that include the reliability of each derived value.

Term	Definition
Legal description	The narrative and geometric description for a discrete area of land. Descriptions may be related to *parcels* (many-to-many) and to geometries. Area legal description (AKA Areal Reference) - e.g. geopolitical, PLS, Block-Lot, Mineral Survey, irrigation lots. Nominal; delimited in reference survey system having area taxonomy, nesting and division rules Perimeter legal description - record boundary, metes and bounds, sequenced set of bearings and distances, strip description, adjoiner description, riparian or aquatic area description, reference calls to natural features {contour, ridgeline, watercourse} Portion/remainder legal description - area as a quantity {e.g. 'north sixty acres of… 'the north four-hundred feet of…'}, exclusions; other reference calls; ambiguous areas that cannot be mapped relative to any reference.
Legal description geometry	The 'footprint' of a legal description. A spatial representation of an area that has been legally described within a nested survey-system hierarchy. The 'atomic unit' for building *parcels*.
Logical operators	Conditions, parameters of a query.
Map view	General term for the map interface that persists during a GeoCommunicator session.
Master catalog	The catalog of all *data*, *events*, and *reference documents* from all providers.
Master index	The index of all *data*, *events*, *reference document*, and communication opportunities submitted to the administrator from all providers. The master index is generated from the provider catalog(s).
Measured feature	A *feature* constructed from component elements in a *measurement network* by applying construction and computation methods. Measured features have topological association to component *features* and/or *measurements*. Example measured feature types: *legal description* (section, government lot, city lot, aliquot part, etc.), *true line, boundary, representative corner* (multiple; porcupine; theoretical), *Corner*, *Parcel*, *Administrative area*, etc. May include physical objects such as buildings and other structures. Example computations: section subdivision, *offset line*, *defining measurement*, *proportion*, *intersection* (distance-distance). Note: methods may be geodetic/non-geodetic.

Term	Definition
Measurement	1. The reduced and/or mean values of an observation set. The angular difference between readings, the distance, or the azimuth/bearing. 2. An object that is constructed as a result of computations performed using *observations*. 3. Measurements are of two kinds, direct and indirect. A direct measurement is made when the observed quantity is compared with the scale directly. An indirect measurement is made when the observed quantity is determined by several related and dependent observations. [Davis, Foote and Kelly] 4. Measurement must involve observation. No measurement is made until something is observed. Accordingly, the terms *measurement* and *observation* are often used synonymously. [Mikhail and Gracie]
Measurement data	The raw measurement files (e.g., GMM's INRAW), control points, coordinate files, survey source IDs, error estimates, and/or survey business rules that are associated with a *measurement data set*.
Measurement data set	A set of *measured features* constructed from survey points and other *measurement features*.
Measurement network	A set of topologically related *measurements* (coordinate points and lines) and constructions (area-based *features*, non-surveyed *features*). May be in various states of connectivity and adjustment. Pre-adjusted measurement network: Multiple coordinate values exist for some points, so lines which should be connected may not be (due to measurement *errors*). Adjusted measurement network: All *over-determined points* have unique coordinates. Legal description fabric: An adjusted measurement network to which constructions (terrain feature boundaries, non-survey data) have been added. All polygons representing legally described areas have been formed from the measurement network and other boundaries to support the parcel fabric. Parcel fabric: A feature class that represents a parcel configuration for a specific business purpose (e.g. ownership parcels, tax parcels, historic parcels). Parcel features may be associated with component features in the *legal description fabric*.
Measuring device	An instrument for determining the dimensions of a *feature* (as *readings*). Like total station, theodolite, transit, compass, steel tape, etc.

Term	Definition
Metadata	1. Information about objects - their source, derivation, construction, changes, and characteristics. 2. Metadata are data about data that describe the lineage, source, quality or other fitness-for-use information. (FGDC) Feature Class Lineage (transformations, etc.) Coordinate Systems and Datums Feature-level Spatial (geospatial) Lineage (parent-child) Source Quality-Accuracy Audit (transactions, versioning)
Observation	1. Single set of *measurement* values for a *feature*. The values may include vertical or zenith angle, horizontal angle, slope distance, backsight and foresight heights, etc. 2. The act of obtaining a distinct piece of information that helps describe the dimensions or spatial relationships between *points* on physical *features*. 3. Act of recognizing and noting some fact or occurrence, especially in nature, often involving the *measurement* of some magnitude with suitable instruments. Direct observation. A measure of the quantity whose value is desired. Example: a single measure of a horizontal angle. Observed value. A value of the quantity that is obtained by instrumental measurement of the quantity. The term observed value is often applied to the value of a quantity derived from instrumental measurement after corrections have been applied for systematic errors, but before accidental errors have been taken out by some method of adjustment. [ACSM]
Observation collection form	A list of configuration options to assist the user in the setup for the collection of a particular type of *observation*.
Observation set	A set of one or more *readings* from a *measuring device* (may be multiple observations for the same *feature*).
Offset line	A supplementary line close to and roughly parallel with a main line, to which it is referred by measured offsets. Where the line for which data are desired is in such position that it is difficult to measure over it, the required data are obtained by running an offset line in a convenient location and measuring offsets from it to salient points on the other line. [ACSM]

Term	Definition
Orthometric height	The distance from the geoid to a point measured along a line normal to the geoid. [BLM Training] 
Over-determined point	A point whose coordinate values may be derived in more than one way.
Parametric least square analysis/adjustment	A least square analysis/adjustment that considers the quality of *data* that varies throughout the data set. A weighted least square adjustment.
Parcel	A single cadastral unit, which is the spatial extent of the past, present, and future *rights* and interest in real property. [FGDC]
Parcel legal description	A composite description that contains all the legal descriptions that define a *parcel* and can be used to derive the full spatial extent of the *parcel*.
Point See ***Survey Point***	The position or location in a reference system determined by survey. [BLM]
Point-ID duplication protection	Prevents entry of an existing point identifier for any point already in the present data set into the *COGO procedure parameter form*.
Precision See ***Accuracy***	1. The degree of closeness or conformity of repeated measurements of the same quantity to each other. [Mikhail and Gracie] 2. The degree of refinement in the performance of an operation, or the degree of perfection in the instruments and methods used when making the measurements. A measure of the uniformity or reproducibility of the result. Precision relates to the quality of the operation by which the result is obtained, and is distinguished from accuracy which relates to the quality of the result. [ACSM] 3. The nearness of readings to one another which may not be accurate, i.e., measuring with a long tape. [Brown] 4. A quality associated with the refinement of instruments and measuring, indicated by the degree of uniformity and repeatability of measurements.
Procedure duplication protection	Prevents entry of an existing point procedure for any point already in the present *data set* into the *COGO procedure parameter form*.
Proportion	To equitably distribute systematic *errors*, between known *points*.

Term	Definition
Provider	All providers are event providers. There may be some providers that only have supply data or update data. These provdiers may be thought of as data providers. *Browsers* can submit a request to become an Event Provider by applying for an account with the event provider designation. Subscribers and Data Providers can become an Event Provider by requesting the event provider designation be added to their current account.
Reading See ***Observation*.**	1. A value taken from an arbitrary scale (chronometer, theodolite circle, compass, chain, etc.) returned by a *measuring device*. 2. A *measurement device's* direct output of *observations* (i.e. circle *readings*, distance, etc.). This can vary depending on the type of *measuring device*. 3. Readings can be averaged and have factors applied to them to achieve a more usable value that we are calling *Observations*. Example: four angle readings are averaged to obtain the observed angle. Example: a slope distance reading and vertical angle reading are automatically combined within the total station to derive an observed horizontal distance.
Reference document	Helpful technical information related to *events* or *data*. May have no direct relationship with a spatial data set (e.g. manuals, Request For Information (RFI), reports, etc.). Searchable in ***GC-01 Conduct Search.***
Reference features	Features used entirely, or in part to define other features.
Reliability values	Data describing the ellipse surrounding an adjusted point's coordinates that represent a statistical chance that the true coordinate values will be within the ellipse. Ninety-five percent chance is a usable measure.
Reliability parameter form	A *data* entry tool accessible prior to successive least square adjustment sessions that allows the user to set or adjust the *reliability values,* such as (1) to toggle on/off function to calculate *reliability values*, and (2) to set a buffer distance around the selected set of *measurement features* to limit the actual set of *measurement features* to be used when generating *reliability values.*
Representative corner	A *measured feature*, which has been chosen to be the corner position over other *measured features* in the immediate vicinity.(e.g. multiple, theoretical, porcupine) 
Research results	Map and tabular view of items that match the search parameters of the Research Scope and access permission level in the ***GC-01 Conduct Search*** process.

Term	Definition
Research scope	*Data* to be investigated for a given project defined by *area of interest* and *source* criteria. May include digital records and hardcopy records during a defined epoch. The sum total of the selected search parameters or the query including *spatial extent*.
Residual, error	1. The difference between any value of a quantity in a series of observations, corrected for known systematic errors, and the value of the quantity obtained from the mean or other adjustment of that series. [ACSM] 2. They [residuals] are similar to errors, but errors are obtained by subtracting the true value, rather than the best possible value, from the measurements. [Moffitt and Bouchard]. 3. The difference between any measured quantity and the most probable value for that quantity. It is the value which is dealt with in adjustment computations, since errors are indeterminate. The term 'error' is frequently used when 'residual' is in fact meant, and although they are very similar, there is a theoretical distinction. [Wolf]
Residual tolerance	1. A small distance (such as 0.01 feet) under which further refinement through network adjustment would not result in any meaningful positional refinement. 2. Tolerance - A mathematical term indicating the allowable variation from a standard or from specified conditions. [ACSM]
Restrictions (segregations)	Removal, for a specified period, subject to valid existing *rights*, of public lands from the operation of one or more of the public land laws, including the mining laws. Restrictions are administrative, judicial, or other limitations or permissions for the use and enjoyment of land by the land right holder. These are not transferred rights, although succeeding owners may agree to the same restriction on a Parcel. Not all restrictions are the result of a segregation. For example local governments often manage restrictions through zoning ordinances.
Restrictive covenant	An agreement creating an obligation contained in a deed, forbidding the commission of some act.
Right	1. A Right is a benefit or enjoyment in real property that can be conveyed, passed, or otherwise allocated to another for economic remuneration. [Black; FGDC] 2. An interest recognized and protected by the law, respect for which is a duty, and disregard of which is a wrong. [Burke; Salmond] 3. A capacity residing in one man of controlling, with the assent and assistance of the State, the actions of others. [Burke; Holland]
Right-of-way survey	The plat and field note record of the observations, measurements and monuments descriptive of a right-of-way. Right-of-way is the legal right to cross the lands of another. Also, used to indicate the strip of land for a road, railroad, power line, or easement.

Term	Definition
Robusting	A technique in *least square analysis/adjustment* where data discrepancies are localized to where they occur rather than the normal smoothing out over a large area. This is a technique to locate blunders. Robustness. This is a method of using least squares as a filtering mechanism for detection of blunders. Robustness averages the absolute value of a measurement's residual with its error estimate, and that average becomes the new error estimate in a readjustment. The measurements with large residuals get reassigned larger error estimates, and vice-versa. This enables the adjustment to be filtered to the suspect measurement. The success of robustness in blunder detection is a function of size of the blunder, number of blunders, and the geometry and redundancy of the traverse network. [GMM]
Search parameter form	GeoCommunicator form for actors to enter search parameters.
Site survey	This is a series of observations and measurements conducted at a construction site to determine the requirements for buildings, roads, and cut and fill.
Sketch	A draft or interim version of a *parcel*, that is used as the basis for creating a new *parcel* and/or to verify the geometry, attributes and validity of a given *parcel legal description*.
Spatial extent	Location on the ground (footprint). Includes any method for describing a point or area. Examples include Latitude/Longitude, PLSS, minimum bounding rectangle, boundaries (admin, other).
Spatial reference	Projection(s), coordinate system(s), datum used. Listed in Data *Catalog*.
Station	1. A definite point on the earth whose location has been determined by surveying methods. It may or may not be marked on the ground. A station usually is defined by the addition of a term which describes its origin or purpose [condensed from ACSM] 2. A definite point on the earth whose location has been determined by surveying methods. It may or may not be marked on the ground. A station usually is defined by the addition of a term which describes its origin or purpose. Usually marked on the ground by a monument of special construction, or by a natural or artificial structure. INSTRUMENT STATION - A station at which a surveying instrument is set up for making measurements. [ACSM]
Subdivision rule	See *legal description*. The available methods to divide or aggregate *parcels* according to a specific survey system.
Subscriber	Subscribers create an account on GeoCommunicator and set parameters for the types of activity and data *events* about which they would like to receive an automatic notification.
Subscriber account form	Form is displayed, populated with currently held values for that subscriber along with current dates. If not yet a subscriber (or provider), a blank form is displayed.

Term	Definition
Survey project	This is an organizational/system concept to represent a set of field activities. It's where and how all the relevant data and files are stored for future use. A Survey Project may be comprised of one or more *Field Surveys*.
Survey point	A *point feature* that has XYZ coordinate values. Any point in a *measurement network*. Each survey point has a list of coordinate values or a coordinate set.
Temporal constraints	Date and time range parameters.
Topological survey	A survey which has for its major purposes the determination of the configuration (relief) of the surface of the earth (ground) and the location of natural and artificial objects thereon. Also, the designation of an organization making such a survey. [ACSM]
Transaction agent	Any participant or party identified in land transaction.
Transect survey	This is a series of observations and measurements gathered to determine a profile or cross section of the land. These are most common in road, power line or other utility construction projects. Transect surveys may be used in agricultural practices.
Traverse	1. A series of connected lines of known length related to one another by known angles. [Moffitt and Bouchard] 2. A method of surveying in which lengths and directions of lines between points on the earth are obtained by or from field measurements, and used in determining positions of the points. A survey traverse may determine the relative positions of the points which it connects in series, and if tied to control stations on an adopted datum, the positions may be referred to that datum. CLOSED TRAVERSE-A survey traverse which starts and ends at the same station, or upon stations whose relative positions have been determined by other surveys of equal or higher order of accuracy. [ACSM] 3. A succession of straight lines connecting a succession of established points along a route of a survey [Davis, Foote and Kelly] 4. A sequence of field measurements (length and directions) if lines between points on the earth and used to determine positions of points. [Brown]
True line	1. The term true line is used to indicate the direct forward bearing from one monument to the next, as distinguished from a random line. [ACSM] 2. A line of constant bearing (rhumb line) between two corners of a survey. [BLM]
Vertical control survey	The measurements taken by surveying methods for the determination of elevation only with respect to an imaginary level surface, usually mean sea level. [ACSM]

Term	Definition
Weight, weighting See ***Error Estimate.***	Numeric values that are used to restrict the amount of adjustment of a measured value, based on the confidence in the measurement's reliability. A highly reliable *measurement* will have a small 'error estimate' and is referred to as being 'more weighted' than unreliable data. Surveying Weight. The relative reliability (or worth) of a quantity as compared with other values of the same quantity. If one value of a quantity has a weight of 2, and another value of the same quantity has a value of 1, the first value is worth twice the second value, and a mean value would be obtained by taking the weighted mean - twice the first value plus once the second value, the sum being divided by 3. [ACSM]
Withdrawal	Withholding an area of Federal land from settlement, sale, location, or entry under some or all of the general land laws, for the purpose of limiting activities under those laws in order to maintain other public values in the area, or reserving the area for a particular public purpose or program, or transferring jurisdiction over an area of Federal land, other than property from one management agency to another.

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[BLM], BLM Glossaries of BLM Surveying and Mapping Terms, Second Edition, 1980.

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[Brown], Brown, Curtis M. Boundary Control and Legal Principles, 3rd Edition, 1986.

[Burke], Burke, J. Osborne's Concise Law Dictionary, 6th Edition. 1976. London: Sweet and Maxwell. Salmond and Holland

[Davis, Foote and Kelly], Davis, Foote and Kelly. Surveying, Theory and Practice, 5th Edition, 1966

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[Moffit and Bouchard], Moffitt, Francis H. and Bouchard, the late Harry. Surveying 6th Edition, 1975.

[Wolf], Wolf, Paul R., Elements of Photogrammetry, 1974.

Appendix B. NILS Workshop Participants

Measurement Management Workshop

May 10–14, 1999

Dan Ontiveros, AKSO
Dennis McKay, AZSO
Rod Skinner, BIA
David Grainger, CASO
Jordan Henk, ESRI
Don Chambers, ESRI
Fathi Dwaik, ESRI
Dan Mahar, ESRI
John Steffenson, ESRI
Charles Macleod, ESRI
Paul Loesftadt, Hands on Technical Training Inc. (HOTT)-*facilitator*
Ed Bell, Salt Lake County, UT
Mark Miller, Salt Lake County, UT
Kurt Wurm, University of Maine
David O'Hara, USFS - Region 6
Susan Higashi, USFS - Region 6
Al Kayser, USFS - Region 9
Bob Ader, WO350
Jerry Sullivan, WO510

Survey Management Workshop

June 7–11, 1999

Robby Robinson, AKSO
Dennis McKay, AZSO
Stephen Malloy, AZSO
David Grainger, CASO
Jordan Henk, ESRI
Fathi Dwaik, ESRI
Don Chambers, ESRI
Charles Macleod, ESRI
Dan Mahar, ESRI
Paul Loesftadt, Hands on Technical Training Inc. (HOTT)
Edward Bell, Salt Lake County, UT
Johnny Shippy, USFS - Region 2
Virginia Pyles, WO510

GeoCommunicator Workshop

June 15–16, 1999

Santiago Garcia, Arizona State Cartographer's Office
Dean Wiese, AZSO
Mike Boyd, ESRI
David Neufeld, ESRI
Brent Blair, ORSO
Robert Varner, USFS Regional Ecosystem Office
Bob Ader, WO350
Nancy Licht, WO510

Parcel Management Workshop

June 21–25, 1999

Robbie Robinson, AKSO
Gene Trobia, Arizona State Cartographer
Paul Tessar, Boulder County
Ken Ziebarth, Boulder County, CO
Dan Mahar, ESRI
John Steffenson, ESRI
Charles Macleod, ESRI
Don Chambers, ESRI
Fathi Dwaik, ESRI
Nancy von Meyer, Fairview Industries
Rick Dickman, MTSO
Bonnie O'Neil, NIRMC (Apex)
Penny Peters, Oakland County, MI
Scott Oppmann, Oakland County, MI
Dean Anderson, Polk County, OR
Susan Higashi, USFS - Region 6
David O'Hara, USFS - Region 6
Tracy Adkins, USFS - Region 8
Greg Tudor, WA - DNR
Barb Kett, WO510

GeoCommunicator Workshop-Cadastral Focus

August 24–26, 1999

Santiago Garcia, Arizona State Cartographer's Office
Dennis McKay, AZSO
Dean Wiese, AZSO
Mike Boyd, ESRI
Jordan Henk, ESRI
Charles Macleod, ESRI
Brian Dalager, Maricopa County DOT
Brent Blair, ORSO
Jack L. Avis, Pima County, APLS
Ignacio Godinez , Pinal County Assessor Office
Rod Hampton, Pinal County Assessor Office
Susan Gorman, Tonto National Forest
Nancy Licht, WO510

Requirements Refinement Workshop #1

July 10–12, 1999

Dennis McKay, AZSO
David Grainger, CASO
Jordan Henk, ESRI
Fathi Dwaik, ESRI
Rick Dickman, MTSO
David O'Hara, USFS -Region 6
Greg Tudor, WA - DNR
Barb Kett, WO510

NW Site Visits

August 30–September 3, 1999

ORSO - BLM
Washington State - Department of Natural Resources
Thurston County, WA
Dennis McKay, AZSO
David Grainger, CASO
Jordan Henk, ESRI
Fathi Dwaik, ESRI
Tim , ESRI
Mike Boyd, ESRI
Rick Dickman, MTSO

Polk County, OR
Brent Blair, ORSO
Dean Anderson, Polk County, OR
Region 6 office, USFS
David O'Hara, USFS - Region 6
Greg Tudor, WA - DNR
Roy King, WO510
Barb Kett, WO510
Leslie Cone, WO510

Eastern Site Visits

September 27–October 1, 1999

Dennis McKay, AZSO
Don Chambers, ESRI
Jordan Henk, ESRI
Timothy Patterson, FL State, Dept. of Environmental Protection
Alvin Gloer, FL State, Dept. of Environmental Protection
Doug Smith, Fulton County, GA
Carl Anderson, Fulton County, GA
Charlie Smart, TVA
Alan Voss, TVA
Don Morrow, TVA
Richard Koelsch, TVA
Dallas Sluss, TVA
Ralph Honeycutt, TVA
David O'Hara, USFS - Region 6
Tracy Adkins, USFS - Region 8
Mike Lane, USFS - Region 8
Lee Davidson, USFS - Region 8
Greg Tudor, WA-DNR
Leslie Cone, WO510
Ginny Pyles, WO510

GTAG Requirements Review

September 27–October 1, 1999

Steve Robinson, AKSO
Tom Wohlwend, AKSO
Dennis McKay, AZSO
David Grainger, CASO
Don Ashbaugh, COSO
Dan Eshelman, ESO
Don Chambers, ESRI
Jordan Henk, ESRI
Kevin DeRossett, IDSO
Mark Dixon, MTSO
Tom Noble, NARSC

Joe Schmitt, NMSO
David Morlan, NVSO
Larry Holmes, ORSO
Ray Hintz, Univ. of Maine
Kurt Wurm, Univ. of Maine
Al Kayser, USFS - Region 9
Steve Hope, UTSO
Don Buhler, WO350
Jerry Sullivan, WO510

GeoComunicator Workshop 3

October 5–7, 1999

Santiago Garcia, Arizona State Land Cartographers Office
Dean Wiese, AZSO
Dennis McKay, AZSO
Mike Boyd, ESRI
Jordan Henk, ESRI
David Neufeld, ESRI
Brent Blair, ORSO
Nancy Licht, WO510

Requirements Refinement Workshop #2

October 18–22, 1999

Dennis McKay, AZSO
Gina Lefort, BLM - GCDB Denver
Jerry Sullivan, BLM - NILS Denver
Roy King, BLM - NRMC
Barb Kett, BLM - WO510
David Grainger, CASO
Eric Weitzman, ESRI
Don Chambers, ESRI
Jordan Henk, ESRI
Mike Boyd, ESRI
Nancy vonMeyer, Fairview Industries
Rick Dickman, MTSO
Bob Casias, NMSO
Brent Blair, ORSO
Stanley French, USFS - Region 9
David O'Hara, USFS - Region6
Al Kayser, USFS Region 9
Greg Tudor, WA - DNR
Bob Ader, WO350
Ginny Pyles, WO510

BLM and FS Lands Group Requirement Review

November 3–4, 1999

Terry Hassett, AKSO
Angel Mayes, AZSO
Bill Ming, CASO
Herb Olson, COSO
Paula Langley, ES-MFO
Don Chambers, ESRI
Rick Dickman, MTSO
Dee Baxter, MTSO
Bobbe Young, NM-CFO
Bob DeViney, ORSO
Scott Bixler, USFS - Region 1
Carol Maier, USFS - Region1
Leslie Cone, WO510

Appendix C. Web Sites

The following web sites contain information and documents that are related to information this document.

www.blm.gov/nils-The Bureau of Land Management site has information about the National Integrated Land System, including review meeting information, project plans, the Concept of Operations and User Requirements, and links to other sites.

www.fs.fed.us-The U.S. Forest Service general information site.

www.spatial.maine.edu/~kwurm-The Geographic Coordinate Database (GCDB) general information site, including GCDB data for download.

www.fgdc.gov-The Federal Geographic Data Committee (FGDC) site includes all the FGDC standards. The Cadastral Data Content Standard is just one of several standards available at this site.

framework.dnr.state.wa.us/fw/cadastre/partner-The Washington State Cadastral Framework Project general information site. The project has extended and implemented the FGDC Cadastral Data Content Standard in a system. The site includes information and definitions about the project.

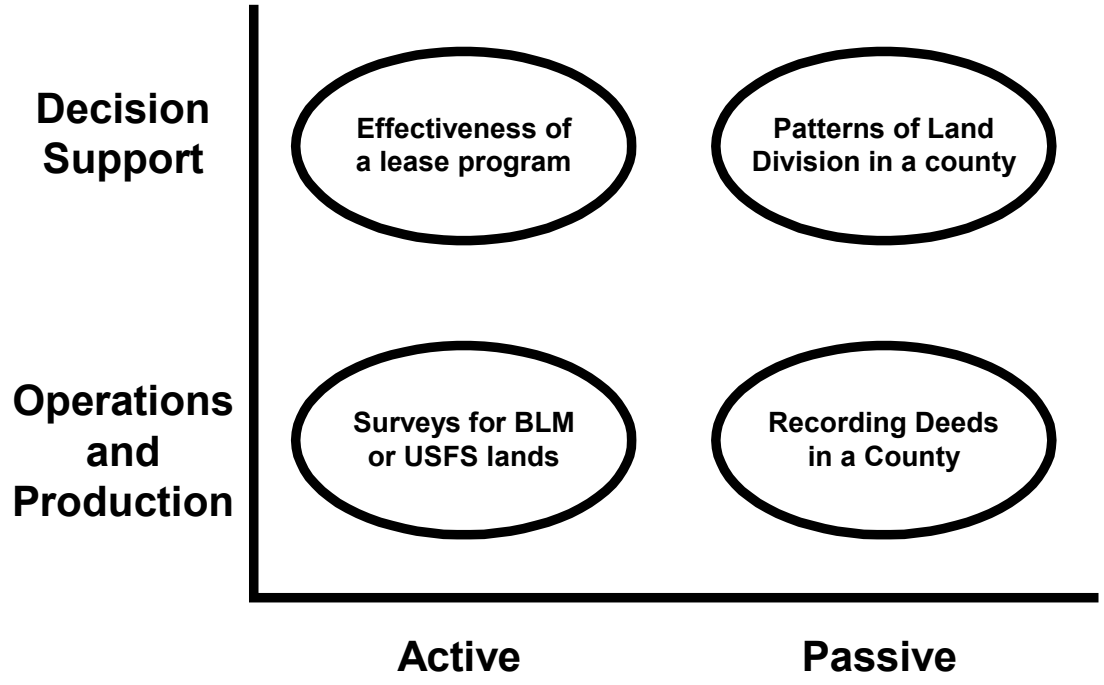
www.co.oakland.mi.us-Oakland County, Michigan general information site. The GIS portion of the site includes information about the GIS activities in the county.

www.fairview-industries.com-The Fairview Industries site includes the FGDC Cadastral Data Content Standard, information about the history of the standard, and educational material on how to implement the standard.

Appendix D. Parcel Maintenance Perspectives

Parcel Maintenance Perspectives
June 22, 1999
by Nancy von Meyer

The following describes potential views or perspectives of parcel management that may be reflected in each of our views of parcel maintenance. Because the definition of a parcel varies widely, one approach to focusing on a parcel definition is to consider these various perspectives of the use and design of parcel maintenance. These perspectives are a continuum and the discussion summarizes the extents of the continuum. Any one system or person or program could be a combination of these perspectives.



Operations ---------- Decision Support

Operations are the production systems. This perspective focuses on the day-to-day upkeep of parcel information. Typically these systems have relatively frequent update. Concerns in these systems often include things like:

- Sufficient lineage about individual data elements to track its source and reliability,
- Historical tracking of elements (corners, boundaries, and parcels) to aid with construction and upkeep,
- Legal evidence information for corners and boundaries, and

- Capturing information as presented in legal descriptions, such as showing non-closed parcels.

Decision Support systems are completed parcel information that is used to support other applications in the organization. Typically the parcel data in these systems is read only to the system and the parcels are defined and combined to support the business of the organization, such as tax parcels, zoning parcels, or ownership parcels. One organizations can have multiple decision support representations of parcels. Concerns in these systems often include:

- Definition of the parcel unit as prescribed by a program, such as a property tax administration program.
- Completeness of representation
- Currency of the data and frequency of updates and postings
- Vertical integration with other decision support themes

Active ---------- Passive

Active refers to an active role in the parcel transaction. For example, if the organization is a named participant on a transaction or other document then they are actively participating in the transaction. An active role is typically concerned with monitoring their rights and interests in the parcel. This may include things like knowing and tracking their chain of title.

Passive refers to a passive role in the parcel transaction. This refers to an observer and recorder of the transaction. Typically records of deeds are passive observers to transactions. They are not named in the document but have a responsibility for recording and maintaining the document itself. Typically passive role implies that the observer has little if any control over the content of the document. Concerns generally focus on the document format, the completeness of information and presentation of the materials.

Appendix E. Hawaiian Land Title Names

Hawaiian Land Title Names
Summary Report

This report is a summary of information obtained from the Hawaiian Studies Institute and a report written by Robert King, Principal Cadastral Engineer for the Territory of Hawaii.

1. Background

Ancient Hawaiian Lands belonged to the gods. The king in turn held lands for the gods. District or High Chiefs held land for the king on the condition of tribute and military service. This type of tenure or land holding is called land in fief or fee land where an estate is held in from a lord on condition of homage or service. Each district chief divided his estate among chiefs of lesser rank who owed him service. The land was divided in this way again and again.

When a chief died, his holdings reverted to the king, who would then re-divide the land. Newly appointed kings were not necessarily related to the king who died. At the accession of the king it was ancient custom to re-distribute the land among those loyal to the new soveriegn.

Common people who worked the soil did not own the land. They were tenants-at-will, at the will of the chiefs who granted them land. Common people were not immune from property taxes. There was a royal tax on goods produced from the land and the sea. There was also a labor tax, which was paid in public work labor.

2. Land Tenure Revision

The arrival of the missionaries and the world-wide recognition of Hawaii as a civilized country lead the king to restructure the government. One of the important parts of the restructuring was the revision of the system of land holding. In 1839 the Declaration of Rights was written and in 1840 the Constitution was written. A statement in the Declaration of Rights and the Constitution about the land is as follows:

> Protection is hereby assured to the persons of the people, together with their lands, their building lots, and all their property while they conform to the laws of the kingdom, and nothing whatsoever shall be taken from any individual except by express provision of the laws.

Convinced that the ancient feudal system was incompatible with the movement toward a civilized nation, the king and his chiefs resolved to separate and define the land interests of all people in the kingdom. Three classes of persons were named as having vested interested in land, the king, the chiefs, and the tenants.

On December 10, 1845 the legislature created the Board of Commissioners in Quiet Land Titles, more commonly known as the Land Commission. In 1846 the Commission established that the king should allow himself one third of the land, the chiefs or landlords would be allowed another third and the common people or tenants would be allowed one third. This principle had the full force of law through the legislature. There was some action with tenants by the Land Commission, but the divisions with the king and his chiefs proceeded unsuccessfully. On December 18, 1847 the land

division of the king and his chiefs was turned over to the Privy Council. On March 7, 1848 the Privy Council completed the division with the king and his chiefs and laid the results down in a book called Mahele Book. The division is known as the Mahele of 1848.

After the Mahele of 1848, the king further divided his land. He set aside two thirds of the land for the public domain. These lands could be sold to raise funds for the treasury. These were called Government Lands. The remaining one third was kept as Crown Land. The Chiefs had to bring their divisions before the Land Commission to have them finalized.

The Land Commission was dissolved on March 31, 1855 and all its records and unadjudicated claims were deposited with the Minister of Interior. The title history of all Hawaiian Lands now stem from one of three sources: Land Commission awards, sales of government lands, and sales of crown lands.

Government Lands were administered by the Minister of Interior. The Land Commission could only consider claims to farms and building lots arising prior to December 10, 1845. The government lands were disposed of through Royal Patents or Grants that are also known as Land Patents or Grant. These are tracked by Grant number and are shown on title maps. The Commissioner of Public Lands retains these records. Other sales occurred as common deeds were recorded in the Bureau of Conveyances.

Crown Lands were considered the private property of the king. Sales of crown lands were recorded in common deeds and recorded in the Bureau of Conveyances. These deeds are commonly called Kamehameha Deeds. After the reign of Kamehameha the Fifth the crown lands were made unalienable. Any lands that were not sold at that time would descend to the heirs of the crown forever. No leases over thirty years could be given on any crown lands. A Board of Commissioners of Crown Land was created to manage the land.

In 1893 the monarchy was overthrown. A provisionary government carried out the affairs of state. On July 4, 1894 a constitutional convention declared the existence of the republic of Hawaii. One of the articles of the Constitution was:

> That portion of the public domain heretofore known as crown land is hereby declared to have been heretofore, and now to be the property of the Hawaiian Government, and to now be free and clear from any trust of or concerning the same, and from all claim of any nature whatsoever, upon the rents, issues, and profits thereof. It shall be subject to alienation and other uses as may be provided by law.

The affect of this was to merge the former crown lands with the public lands and make one designation of public lands.

3. Land Division

The boundaries of the divisions of land have been passed down through generations. Most of the features were natural features and all of the boundaries were given names. In some cases cairns, stone walls and other boundary features were constructed.

The geographic division of the islands into districts and sections was established over 500 years ago. Each island was divided into several districts called Moku. Each Moku represented the domain of a high chief. Mokus varied in extent and size. Their boundaries did conform to the geography.

The next division was the Ahupuaa. A typical Ahupuaa is a strip of land extending from the sea to the mountain so that its chief would have his share of all the various products of the mountain region, the cultivated lands, and the sea.

An Ili is a division of an Ahupuaa. An Ili often consists of two or more sections or areas of land in different parts of the Ahupuaa. Ilis with this characteristic are called Leles, which comes from the Hawaiian word for jump.

Within the Ahupuaa and Ili were lands cultivated by common people. Taro lands or wet lands were called Aina Kalo. Each patch within the Aina Kalo is called a Loi. The dry cultivated lands were called Aina Kula and each patch within the dry areas were called Moo and Kihapai. The patches that were cultivated exclusively for the chief were called Koele or Hakuone. The boundaries of the taro areas were delineated with narrow banks. The dry cultivation areas were marked by hard packed earth. Stone walls, cut saplings, and wooden fences were also used to mark boundaries.

Attached and considered to be part of the Ahupuaa was the ocean abutting the sea front. The chief that controlled the Ahupuaa also held exclusive right to fishing in the ocean in front of the Ahupuaa. The fishing rights extended from the low water mark to the reef. If there was no reef then the rights extended one geographical mile. Fishing rights that were part of the public lands or lands that were crown lands and became public were made free to all people. In private areas the chief had the privilege to tabu and take for himself one species of fish a year. The tenants had the rights to other species. By agreement the chief could take one third of the total catch and leave two thirds of the total catch to the tenants. This law of fishing rights is still largely in effect today. Private fisheries are known as knonchiki fisheries.

4. Base Maps and Control

Going back as far as the 1845 Land Commission, all of the various boundaries have been surveyed using a variety of techniques. No attempt was ever made to build a base map or to correlate the various surveys to one another. Using differing basis of bearing for direction measurements and differing units of measure of length, it was nearly impossible to combine the individual surveys into one base map. In 1870 the Hawaiian Government Survey was initiated to established geodetic control points on the islands. The US Coast and Geodetic Survey, now the National Geodetic Survey, provided assistance, methods, and standards.

A recent Federal Geographic Data Committee is working on describing the problems and potential solutions for resolving a description of the Ahupuaas on the Island of Moloka'I, County of Maui. The investigation will lead to options for completing cadastral framework data to represent Ahupuaa boundaries in a way that they can be used by the people in Hawaii and be incorporated in the NSDI Framework. These boundaries may also be represented in the USGS Digital Line Graph (DLG) boundary category.

5. Relationship to the Cadastral Data Content Standard

The Hawaiian land title descriptions fit easily into the current Cadastral Data Content Standard. The bearing and distance descriptions of land boundaries fit with existing elements in Record Boundary. The geographic control on the corners also fits with current information in the Corner Point and related entities.

The one addition to accommodate the Hawaiian system is to add the land division names to the domains of values in the Survey System Description entities. These additions are as follows:

Survey System Name	Hawaiian Land Division
First Division	Moku
Second Division	Ahupuaa
Third Division	Ili, Moo, Kihapai, Loi

The description of the fishing rights will be handled as other segregated rights in either terms and conditions or in the rights and interests tables.

Appendix F. Steps for Developing a Unified Land Records Management System for the BLM

Rick Dickman, Data Administrator

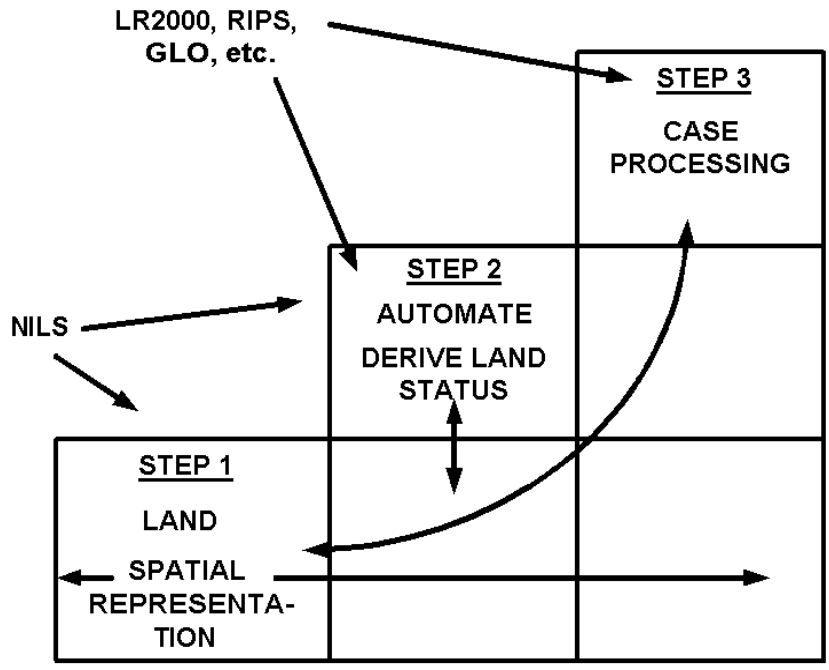
BLM Montana State Office

March 2000

Introduction

NILS will develop capabilities and functions in an orderly progression. Each step is an achievable, usable segment of capabilities and functions. NILS is currently in the analysis and design phase of the initial (LAND) step. Each level is a building block or a list of prerequisites for the development of the successive level. BLM data is both the strength and the weakness in this proposed effort. LR2000 is identified in the explanations below as an example of a land recordation database, but parallels can and should be made for other Federal, State, and County recordation systems. At the end of this paper is a list of concerns that highlight BLM data cleanup requirements and modeling enhancements necessary to complete these steps.

Figure F.1. Steps for Developing a Unified Land Records Management System for the BLM



Step 1

The LR2000 land module is based on an alphanumeric model that was created in the late 1970's. The LAND design is based upon a *nominal* classification model, which means that each legal description is identified as part of a survey hierarchy that identifies specific meridian, township, section, and named (thus nominal) locations within a section (i.e. to the 16^{th} level or 40 acres). Creating a spatial representation of land based on the nominal model requires the use of parcel generator software. As long as descriptions are collected within the limitations of the software (i.e. rectangular in nature and above the 40 acre limitation) the software can accurately represent the boundary on a map display. Unfortunately a substantial percentage of legal descriptions do not fit within these limitations. Mineral surveys, homestead entry surveys, and metes and bounds descriptions are non-rectangular in nature. Rights-of-way descriptions are commonly linear based descriptions. Many case descriptions are texturally based (e.g. "north 60 acres of tract 37"). None of the these latter examples of land descriptions can be accurately described using parcel generator software unless the user further edits the boundary to accurately reflect the geographic extent.

These limitations within LR2000 will be resolved in NILS by providing a spatial representation of land based on geo-coordinate locations (not dependent upon nominal location). The case land descriptions currently located within the LR2000 database will need to be converted into the NILS spatial land model. As example, the user will be able to select atomic level land descriptions from the legal description fabric to create a parcel legal description. Two possible scenarios to help describe this functionality are:

- User selects land in a spatial display and the software writes the aggregated textual description with the associated parcel ID(s) back to transaction database.
- User enters a textural legal description and NILS provides the spatial representation of the alphanumeric description and writes the aggregated textural description and parcel ID(s) to the transaction database.

Step 2

One of the initial steps within the processing of any case is to verify whether the lands in the application are available for the use being requested (i.e. derive land status). As an example, the government can not lease lands for oil and gas if the minerals were conveyed in a patent with the surface estate for the lands in question. Today this step is completed manually by interpreting the notations on a master title plat (MTP). Sometimes the MTP does not have enough detail (e.g. it identifies a withdrawal line but does not provide the segregative extent of the withdrawal), so additional research of original documents is required to determine the availability of land. Requirements for this program have been written that provide a cumulative value on a parcel of land for the following categories of information:

- retained US rights, including surface and mineral estate,
- Ownership/Surface Management Agency, and
- surface/subsurface restrictions, often described as segregation on the land).

Implementing these requirements on top of the alphanumeric land within LR 2000 will inherit all of the limitations of this model described in Step 1. Incorporating the elements necessary to derive land status in the NILS land model and including automated status derivation tools within a Geographic Information System (GIS) will resolve these problems. Since NILS will use object-oriented technology, business rules may be modeled as relationship classes to manage land status derivation. Using objects and GIS functions opens many possibilities, including real time derivation.

Step 3:

The third step would be to transition to a true automated case processing system. LR2000 is a case recordation system. Case activities include approving or rejecting proposed authorizations on the land, monitoring existing authorizations for compliance with regulations, and closing out a file based on termination or expiration of activities within expressed terms and conditions associated to the case. At various steps in case processing, the user is required to update LR2000 so that the automated record will stay 'in sync' with the manual record.

Closing the gap between the manual and automated record notation could be as simplistic as adding word processing 'macros' which allow for single entry of the core data elements such as land and customer information that is unique to the individual case. Automatic filling of forms, letters, mailing labels, etc. could be included in case processing. Automation of the land status derivation (as described in Step 2) is a critical aspect of case processing.

At a minimum, the data model in NILS could also be enhanced to support ties to existing third party document imaging, management, and workflow management programs. Vital steps in the workflow of a case which earmark data (i.e. documents/maps/plats which move from the out box of one individual/office to the in box of another) can be identified and supported in an automated environment. The integration of numerous activities, some of which are identified above, completes the vision and transition a passive land recordation system into an active case processing system.

Concerns Within This Approach

1. Our current legacy data sets need to be integrated. LR2000 has comparable (duplicate) data within Case Recordation, Status, and Mining Claims Recordation Systems. There are unique characteristics within the various databases, including the structure of land (for example, some data sets use an 'X' pattern to delineate aliquot parts or nominal locations, some use textual based descriptions [e.g. NENE]). The databases do not always use the same data elements. There are duplicate cases within the various databases that need to be merged into one case without loss of data content. For example, the Withdrawal data collection in Status was expanded to include the full case history. Each document within the Withdrawal Case was abstracted as a separate case part which, in layman's terms, means the current boundary of the withdrawal (boundary on the MTP) is the net effect of the various case parts rather than a single case description. To transition data successfully into NILS and allow enhanced reporting capabilities (including deriving land status), we need to have one fully integrated database for all case types.

2. Derivation of land status and development of an active case processing system requires enhancement to the existing transaction model within the cadastral data content standard.

Note: The concerns referenced above are part of the "gap analysis" between ESRI custom off-the-shelf software (COTS) and required functionality within NILS.