NILS
NATIONAL INTEGRATED
LAND SYSTEM

NILS Detailed Requirements

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Bureau of land Management

NILS Detailed Requirements *Revision I*

Change History

Date	Primary Author	Description
9/29/2000	Mark Williams	Compilation of NILS Requirements.
12/4/00	Dennis, Mark	Modification based on detailed MM meetings.
7/2/01	Dave, Mark	*Revision I*, based on SM and MM meetings, added Use Case cross-references for SM/MM.
8/8/01	Mani, Jerry	Check/correct grammar, punctuation, etc.

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National Integrated Land System Requirements *Draft*

Introduction

This document identifies the requirements for the National Integrated Land System (NILS). This document contains four sections:

- General Requirements
- Survey Management
- Measurement Management
- Parcel management

General Requirements – This section defines the basic requirements of the National Integrated Land System. These requirements build the foundation for the specific requirements defined in Survey Management, Measurement Management and Parcel Management.

Survey Management – This section defines the requirements to incorporate survey measurement features and metadata directly into a GIS database format. Survey Management is primarily focused on the capture of survey data in the field.

Measurement Management – This section defines the requirements to adjust and analyze measurement networks within a GIS database. Measurement Management is primarily focused on the adjustment of the measurement data captured in Survey Management.

Parcel Management – This section defines the NILS requirements for managing land records and cadastral feature data stored in a GIS database model.

Each requirement is identified with an ID number, and is grouped according to the use case number from the "Concept of Operations and User Requirements" document.

This document, along with the "Concept of Operations and User Requirements" document provides the foundation for the next phase of NILS.

General Requirements

This section defines the basic requirements of the National Integrated Land System. These requirements build the foundation for the specific requirements defined in Survey Management, Measurement Management and Parcel Management.

General Requirements

ID	Use Case #	Requirement	Description	Detail	Expected Functionality
G1.0		**Data Architecture**			
G1.1		**Object Data Model**	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.	The object model will be configurable so that it will work in many different situations. NILS will supply a Core UML model (or several) that can be morphed into an implementation model, either by manual editing or automated procedures. The resulting model will contain only those elements that are useful to the owners of the database.	System must: ~ Have published object architecture with specifications for interfaces and custom extension. ~ Support minimal versions of the model (e.g. perhaps parcels without measurements)
G1.2		**Object Modeling Tools**	The system must provide tools for users to define a custom data model and build/implement a physical schema.	The NILS Core model will contain essential attributes only. The database analyst, or the migration tools, will extend schema to include additional attributes or relationships to tables in external databases. For example, the model will support keyed associations between parcels and owners, but the attributes to be kept about owners will be subject to refinement by the analyst in the NILS database, or kept in some other mainframe database. The model may be substantially simplified if the organization implementing it is a land owner (forestry company, oil company, state lands department) managing their own real estate interests, or is a cadastral organization responsible for maintaining public land records.	System must provide: ~ One or more base UML object models. ~ Example implementation data sets and models. ~ An implementation guide. ~ Tools to customize a base model and derive a schema and database. See Data Conversion Productivity Tools.

G1.3		**FGDC Compliance**	The NILS data architecture must comply with the Federal Geographic Data Committee's (FGDC) Cadastral Data Content Standard.	The NILS Core object model will contain abstract and concrete feature classes, subtypes, relationships, and domain definitions. These elements will be chosen to represent the types of data that are needed in a parcel-based GIS to support land records, such as: ~ Agent, Individual, Organization, Public Agency ~ Address. ~ Corner, Corner Point, Corner Point Measured Coordinate. ~ Legal Area Description. Survey System Description, Outer Continental Shelf Description, Public Land Survey System Description. ~ Record Boundary, Circular Curve, Other Curve, Straight Line, Record Boundary Reference. ~ Restriction; Transferred Right. ~ Parcel, Parcel Area. ~ Transaction. The model must also support inter-object relationships (intersection entities) such as: Legal Area - Corner; Legal Area - Record Boundary; Parcel - Legal Area; Parcel - Record Boundary; Parcel - Transaction; Record Boundary - Corner Point; Transaction - Agent	The NILS Core data model will be fundamentally compliant with the FGDC Cadastral Data Content Standard. Beyond basic survey-parcel geometry, the model should handle: ~ Rights and interests in the parcels. ~ The transactions which create parcels and interests. ~ Agents or parties to those transactions. ~ The relationships between parcels, their parent parcels, and the transactions that created them. See http://www.fairview ~ industries.com/mod6.htm. NOTE: It was discussed to have a workshop to see how active estate/case management work with the model. See Workflow, feature lineage, transaction/version, etc.
G1.4	SM and MM use cases	**Measurement-integrated GIS Data Architecture**	NILS must provide a common data model that operationally integrates surveying (measurements) and cadastral land record data.	The model should work for small counties that may not have the requirement or resources for maintaining a rigorous survey-based geometry. The Parcel Management use cases clearly require integration with measurements and the requirement to perform adjustment of parcel fabric features.	System must: ~ Support the construction of feature geometry with COGO tools. ~ Support the adjustment of feature geometry via a parametric least squares computation. ~ Support use of COGO tools for feature edit without requiring persisting measurements. See Survey, Measurement and Parcel Use Cases.

G1.5		**Hierarchical Survey Systems (i.e., PLSS)**	The system must support arbitrary hierarchical land tenure reference systems, intelligently dividing only to the required levels of the system, and be able to subdivide to lower levels when needed.	In regular, hierarchical land description systems, valid legal descriptions can be composed from subdivisions at several levels in the hierarchy. It's possible to provide polygons for descriptions at all levels of the hierarchy, but often, higher-level descriptions are sufficient until activity actually occurs at a lower level. For example, the PLSS used in the United States can describe regular parcels down to the 40-acre level, but in the less developed parts of the country, the 640-acre level (one section) is the smallest unit that activity customarily occurs on.	System must: ~ Support construction and division within multiple nested/hierarchical features of a survey system. ~ Support rules and validation for specific survey systems. ~ Manage legal description fabric division to the required levels of the system ~ Support further legal description fabric subdivision to lower levels as needed ~ Support rules for 'survey division' as well as 'protracted division'
G1.6		**Multi-Part Features**	The system must support composite features that are comprised of multiple individual geometric features.	There are many examples of parcels that when split by subsequent divisions, retain their original description. For example, a railway right-of-way may bisect a PLS section, yet the ownership of both remaining parts of the section remains with one owner, with the land for the section (minus the r/w) treated as a single parcel. As another example, when small parcels are carved out of larger parcels, the remainder of the large parcel (whether a single polygon or several) will retain the original designation, sometimes qualified by the word "remainder".	System must: ~ support the use of multi-part polygons to represent single parcels.
G1.7	MM 1.06 MM 1.07 MM 1.08 MM 1.09 MM 1.10	**Parametric and Non-Parametric Curves**	The system must support curves.	Parcel boundaries are often defined as curves. The model must support this. Examples include: ~ circular curves, spiral curves, parabolic curves (parametric) ~ offsets to spiral curves (non-parametric) **See Glossary update**	System must: ~ Support construction of parametric and non-parametric curves ~ Convert data imported from coverages containing splined curves created by COGO to true curves.

G1.8	PM 4.01 PM 4.02 PM 4.03	**Annotation Features**	The system must manage feature annotation that is linked to or derived from a feature's attributes, and placed as a label or dimension.	Generally, the dimensions shown on parcel maps have legal description elements as their source. The actual dimension will be derived from legal description elements that correspond to a single topological primitive, or from the sum of the legal description values that correspond to groups of elements that that span multiple topological primitives.	System must: ~ Support feature-linked annotation that retrieves information from complex sources. (Examples: bearings, dimensions, from measurements and records [e.g. plat]). ~ Support creation of non-linked annotation ~ Support automatic and user-defined annotation placement (e.g. at intervals along a feature, adjusts placement based on view scale) See Annotation Controls.
G1.9		**Tiered Network**	The NILS data architecture and production tools should manage measurements and parcel-based features as a multi-tiered network of associated object features.	Component tiers include: ~ non-surveyed boundaries (riparian boundaries, contours and ridges, other natural features) ~ surveyed areas (plats, hierarchical survey reference systems [GCDB/PLSS], legal descriptions) ~ derived polygonal features (e.g. interpretive features [ownership parcel, tax parcel], administrative areas that are not persisted as feature classes; assessor blocks) ~ administrative areas and other parcel types which are based on legal description (e.g. boundary defined by offset from a natural feature [wilderness boundary])	System must ~ Support the management of geometries features as topologically integrated, seamless feature fabrics. ~ Support 'parcel' areas that do not have a 'defined' legal description ~ Support 'parcel' areas that are based on legal descriptions
G1.10		**Topology**	NILS should support topology association to share geometry dimensionally within and across fabric tiers	The model must permit maintenance both topological and non-topological data. There are two reasons for this. Some types of parcel features overlap (such as easements) and have limited or no topological relationships to each other. The second reason is that topological relationships between feature classes (shared geometry) require that all participating feature classes be stored in a single feature dataset. NOTE: NILS implementations may use distributed/localized data storage architectures that are constrained by political/administrative or technical considerations (see Data Sharing)	System must: ~ Provide topology tools to manage associations within and between two-dimensional (area) features, zero-dimensional (point) features and one-dimensional (line) features. ~ Provide 'business-rule'-based topological management (user-defined business rules and constraints). User controls where and how coincidence and adjustments do or do not occur when features participate in a topology. ~ Support parametric curves in a topology

G1.11	MM 2.04 MM 2.05	**Manage Feature-level and Source-Level Metadata**	The NILS software system and data model must automatically capture metadata at the feature level. The implementation of a quality-rating scheme may be user-defined. Constructed features have an associated reliability that can be managed by the operator.	Individual features are created by construction and computation methods according to specific rules and regulatory environments. This means that metadata for each feature's associations and construction rules must persist when data is exchanged. For example, capture the 'sketch' of the legal description as well as the 'adjusted' geometry when it is fit back into the fabric. Incorporate all the transactions that altered the geometry of the parcel (e.g. executive order changes a boundary). A set of features (e.g. a feature class) may have metatdata at the 'source' level. The object model must store data from many sources simultaneously. Digitized data of unknown precision and high-precision survey data can exist within a single parcel layer. For example, the NILS audit process could be used to support a standardized quality-rating scheme for data set certification. Data validated by a registered surveyor might receive a higher source quality rating. Data representing survey measurements might have a higher reliability than data vectorized from scanned survey plats.	System must: ~ Capture metadata for each feature's associations and construction rules ~ Persist feature-specific metadata ~ Use feature metadata to properly construct feature classes ~ Support management of Source-Level metadata (see below). Support FGDC Metadata compliance ~ Capture and persist the actual source and precision for the high-precision survey data and for data with lesser or unknown precision. ~ Integrate management of source-level metadata to feature-level metadata (e.g. some source level not applied to features, some feature-level not applied to source) ~ Provide a framework for implementing a custom source and feature quality rating scheme
G1.12		**Maintain Primary and Foreign Key Relationships**	The system must support primary - foreign key joins to external applications/databases.	When the features or objects stored in the NILS database contain keys to data in external tables, external data or procedures will be needed to validate the foreign key values that are stored within the NILS database. Otherwise, foreign keys to non ~ existent referenced rows will persist in the NILS database and lead to invalid conclusions when using the parcel data. When new keys are needed for new features or objects, external data or procedures must again be used to provide the keys and possibly cause new rows to be inserted into the foreign tables. Deletes must be similarly cascaded when the NILS database contains the primary keys and joined records exist in foreign tables.	System must: ~ Maintain the relationships between features and objects ~ Persist the relationships into the NILS database and maintain referential integrity. ~ Support local identifiers as aliases for provider/contributor identifiers (agency-agency cross identifier)

G1.13		**Strata Features**	The model must be capable of representing the rights in sub parcels whose footprints overlap.	This includes single-story condominiums that include rights to shared common areas as well as multi-story buildings with parcels of arbitrary vertical extents. The heart of the issue is being able to deal with overlap in the horizontal mapping plane, NOT accurately depicting the elevations and volume of the units in true 3D.	System must: ~ Support construction and use of overlapping land management units for objects such as airspace condominiums, right-of-ways, above-surface and sub-surface parcels.
G1.14		**Addresses**	See FGDC Cadastral Content Standard.	Addresses are associated with the entrance/delivery point for a service (such as police, fire, mail) A parcel might contain multiple buildings, each of which has numerous entrances/delivery points for services. Contrariwise, a vacant should probably not have a situs address, unless it was previously improved, or planned for improvement. While NILS users may not have to manage this complexity, support is required for this approach because the ongoing/hands-on addressing authority is typically a permitting/licensing business rather than a parcel maintenance or planning function.	System must: ~ Support simple address management ~ Support external address management systems ~ Support complex address management among spatial features such as streets, parcels, buildings and service entrances. ~ Comply with FGDC (e.g. agent address, parcel address)
G1.15		**Lineage & Status**	For any given parcel, the system must automatically record relationships to its parents. The system must support applications that manage and/or analyze overlapping land units (each with specific rights, interests and/or restrictions) to derive the status of a subject parcel.	Specifically, the rights (or other activities) that are encompassed in the current ownership (or status) are dependent in part by the rights held by the previous owner. Some of the prior rights can be determined by reviewing previous land transaction records, and some of them must be navigated to via the parent parcel(s) of the subject parcel. Every modification committed to the database must preserve a copy of the data being modified, and the modified record must be connected to the previous one. This applies equally to spatial data (features), non-spatial data (objects), and the relationships between them.	System must: ~ Capture land transaction information during parcel editing ~ Maintain the lineage of every parcel ~ Provide tools to navigate the land transaction/lineage chain ~ Support external applications that query/update NILS databases to derive and manage status ~ Integrate with Metadata management

G1.16		**Feature State**	The system must manage the state of a feature as it moves through the workflow processing cycle.	In order to support the land development approval process, proposed parcels (of whatever form – ownership, legal, tax) need to be modeled in the system. Parcel data is not only continuously changing, but also parcel users need to view a parcel's status at arbitrary times in the past.	System must: ~ Provide a data model that enables the management of the state of a feature ~ Provide tools to manage feature state as part of the workflow process ~ Provide tools to query and report the state of a feature. ~ Support external applications that manage land projects (e.g. case management) See Workflow
G1.17		**Activation & De-activation**	The system must handle time and date information regarding the activation and deactivation (creating and retiring) of parcels.	Cadastral data derives from land transactions that have associated dates.	System must: ~ Provide a database transactional model for editing ~ Capture and persist various date-related aspects of the feature ~ Provide tools to manage feature date aspects
G1.18		**Historical Management**	Inactive parcels must be indexed and stored accessibly.	Parcel management may require the concept of active and inactive or retired parcels.	System must: ~ Provide a data model for managing inactive/historical parcels ~ Provide tools to 'construct' the history of a parcel from its records ~ Provide tools to support historical searches ~ Provide tools to reconstruct historical geometric/attribute configurations
G1.19		**Flexible data storage**	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 Solution must provide tools to access, integrate and manage spatial datasets and tabular databases.	System must: ~ Support integrated access to centralized, localized, and remotely distributed data storage architectures ~ Provide tools to deploy and manage complex data storage architectures

G1.20		**Data Sharing**	To enable data sharing, a user must be able to extract a set of features from a data set.	Issues revolving around data sharing within or between organizations may drive the implementation of certain relationships. Certain fundamental layers (legal description geometry or survey databases) may need to be replicated or selectively copied if institutional boundaries prevent a single-database solution.	System must: ~ Support creation and sharing of data subsets of features that are operationally complete (the subset includes the features and all associated data objects as necessary to manage the data subset using the NILS software system.) ~ Provide a structure to manage replication so that users of a replicated version are notified when the original is updated. (See GeoCommunicator subscription/notification; see USFS 'Regional' edits of 'Forest' data sets).
G1.21		**Alphanumeric - spatial integration**	It is fundamental to NILS that land records and cadastral data is managed as spatial data.	Even when editing alphanumeric attribute values in non-spatial data, the user should have the ability to see feature geography in a map view.	System must: ~ Provide an interface to existing land management applications ~ Provide the spatial 'land' management functional component for these existing applications ~ Provide and manage a repository for cadastral data that may be shared across an agency or between agencies ~ Enforce database integrity for the 'land' repository
G2.0		**Application User Interfaces**			
G2.1		**Map Controls**	The map view has all the tools necessary to add/remove reference layers, to modify symbology, to pan and zoom, to select features, etc.		System must: ~ Provide a graphic display of all land-related spatial information ~ Provide tools to manage the user's view of the spatial data (pan, zoom) ~ Provide tools to select features and manage the selected set ~ Provide tools to report and edit the attributes of selected features

G2.2	PM 4.01 PM 4.02 PM 4.03	**Annotation Controls**	Map display includes powerful tools for feature rendering and annotation.	Like most map series, assessment and other parcel maps will follow specific symbology and style guidelines. (See BA -TRM)	System must: ~ Provide tools to manage annotation (text characteristics, link to features, etc.) ~ Provide tools to manage various scales of annotation ~ Provide tools to manage automatic positioning of annotation to avoid conflicts ~ Provide tools to add, edit and modify the position of feature annotation and dimensions ~ Provide tools to dimension portions of a feature based on a linked attribute of the feature ~ Provide tools to place all parcel numbers in a tier of parcels that lie on a common street segment such that a line through the labels runs parallel to the street. See Annotation Features.
G2.3		**Multi-format integration within Spatial Display**	The user interface for viewing spatial features includes the rendering of raster files (grids, satellite images, digital orthophotos, etc.; may be geo-referenced), terrain models and document images.	See georeference requirement under Coordinate Transformation.	System must: ~ Provide a data model that supports the integration of multiple spatial and image formats ~ Provide a spatial feature display interface that supports the integrated viewing and use of multiple spatial and image formats ~ Support production of map output with integrated data types
G2.4		**Set and Save Area of Interest**	The concept of managing a particular, user-defined geographic area is an essential feature in cadastral/land records processing. 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.).	The system must support the process of finding a spatial extent that is associated to the subject case, survey, parcel or project. Example Area of Interest: ~ a named place (Grand Canyon; Hot Spring campground, etc) ~ an administrative area (Oakland County) ~ the footprint of an area that was defined by a query (all land to be withdrawn on October 1, 2005) ~ a working extent for an active project (Case #2345)	System must: ~ Support definition of an Area of Interest by: 1. Dragging a box on the map 2. Defining a polygon on the map 3. Geocoding to an address/intersection 4. Navigating to a nominal location 5. Navigating to a nominal feature 6. Navigating to a legal description area 7. Defining an area by buffering a feature 8. Defining an area by spatial analysis of features (overlay, union, intersection) ~ Provide a tool to save an area of interest ~ Provide tools to manage/edit an area of interest ~ Support use of saved area of interest
G3.0		**Analytical, Reporting and Plotting Tools**			

G3.1		**Map-Table Reporting**	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.	System must: ~ Provide automatic integration between map features and a tabular report of their attributes
G3.2		**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.	Support ad hoc and 'canned' complex SQL queries, extended SQL queries, spatial queries (contains, overlaps, touches, etc.).	System must: ~ Provide a query generation tool ~ Support ad hoc query ~ Support saving of queries for reuse ~ Integrate query result to update selected features in spatial display and tabular display
G3.3		**Analytical Templates**	The system must provide tools to perform various types of spatial, temporal, mathematical, Boolean and logical analysis. Support saving and re-use of user-defined analyses.	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.	System must: ~ Provide a framework for building custom analytical templates ~ Provide tools to modify a saved analysis template ~ Provide tools to manage the application of analyses as specific instances of a template ~ Provide tools to share analyses among users ~ Provide analytical templates for comparing datasets to determine differences ~ Provide analytical templates to verify/validate features and attribute domains for various common feature datasets
G3.4		**Report Generation**	NILS must provide a framework that enables users to create their required business reports. The user may define and save a custom report format as a template.	Examples include Subdivision Reports, Tax Map Sheets, Records of Survey, Survey Plats, Field Survey Notes, Master Title Plats, Derived Status, etc. Reports may include (or be included as) elements in a plot file. May include productivity tools to help in generating the report.	System must: ~ Provide a framework for building report templates as a type of analytical template ~ Provide tools to manage the application of a report as specific instances of a report template ~ Provide tools to generate reports from the attributes of features and their relationship attributes ~ Provide tools to save a report ~ Provide tools to modify a saved report (also save as certain industry formats e.g. html/XML; .pdf) ~ Provide tools to share reports among users ~ Provide tools to embed a report into a map layout

G3.5		**Plotting**	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.	System must: ~ Provide a framework for building map templates as a type of analytical template ~ Provide tools to manage the application of a map as specific instances of a map template ~ Provide tools to generate maps from the attributes of features and their relationship attributes ~ Provide tools to save a map (save as html, postscript, .pdf, bitmap, etc.) ~ Provide tools to modify a saved map ~ Provide tools to share maps among users ~ Provide tools to embed a map into a report ~ Provide tools to generate map series (atlas, map books, etc.)
G4.0		**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).	
G4.1		**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.	System must: ~ Provide tools to find and manage datasets and files ~ Provide tools to select data ~ Provide tools to define and manage subsets of datasets ~ Provide tools to modify the elements participating in a dataset/subset
G4.2		**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.	System must: ~ Provide tools to modify the properties of a dataset, or one of its logical elements (feature class)
G4.3		**Manage Feature-level Metadata**	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).		System must: ~ Provide tools to modify the properties of a feature class, including is construction metadata

G4.4		**Perform Coordinate 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. Includes calculation of geoidal undulation.	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. Includes tools to georeference raster data objects (digital orthos, etc.)	System must: ~ Provide tools to transform datasets into industry-standard projections, coordinate systems, datums, formats, etc. ~ Provide tools to convert to/from orthometric height and ellipsoidal height (GPS gives ellipsoidal heights, conventional vertical benchmarks give orthometric height). ~ Provide tools to georeference raster images
G4.5		**Administer Access Rights**	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).	Includes management of application and database access rights. Database access may be highly secure (to the table or even feature level) based on the system implementation and administration roles within the jurisdiction/authority matrix.	System must: ~ Support a multi-user environment in which data and databases are distributed ~ Provide support for administering user permissions for a range of data types according to both individual- and group-level access restrictions. ~ Provide tools to manage access discrete levels of applications (functions) and the database (tables and features)
G4.6		**Database Transactions and Versioning**	The system must provide tools to manage database integrity in a multi-user editing environment.	The parcel object model must meet real-time performance criteria during editing operations. Editing response should be immediate.	The system must: ~ Support multiple simultaneous user-editors ~ Support long database transactions (i.e. that persist beyond the user session [not to be confused with customer or case management transactions]) ~ create a version (Replication; Copy; Extraction?) ~ manage optimistic feature tracking (assess pessimistic locking) ~ track changes (in the new version) ~ support rollback and commit points ~ resolve version conflicts (merge working version into parent or other version) ~ meet performance criteria
G4.7		**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.	System must: ~ Provide a framework for capturing the modifications to a database ~ Provide tools to analyze and manage the modification events

G4.8		**Quality Control Process**	See Compare/Contrast (old use case).	See old match-merge functionality. Compare versions and discover errors.	System must: ~ Provide tools to compare (versions of) datasets in a quality control procedure. ~ Assist user in discovering 'differences' between datasets ~ Assist user in tracking and correcting dataset errors
G5.0		**Data Automation Support:**	The system must provide support for migrating from existing database schemas into the NILS data schema:	The data migration tools will take as input an existing database or the parcel object model schema (UML), and then generate conversion procedures and new schema which, when run, will migrate the pre-existing database into the database. The user may interact with the database analysis component. This may prompt the user for a number of design decisions that will affect the structure and implementation of the resultant database. The decision matrix may well form the basis for a reusable productivity tool that will allow the user to configure completely new databases, not just migrate the existing ones.	
G5.1		**Conversion Productivity Tools**	The system must provide tools to assist the user in developing a translation routing (e.g., a productivity tool that produces a batch conversion routine, based on a source-target schema element mapping). Conversion/Migration (import from another system or format, analyze and depict the source schema, and assist in the translation to the new schema). NOTE: Before actually running the procedures, the user may want to make some changes to the new database schema.	Database migration will take a long time to process for large databases. The conversion procedure should be restartable where it left off if it fails. It should run unattended as much as possible. In General, it should be as robust as possible In the face of unpredictable data or system errors, such as RDBMS configuration problems or exhausted disk space. The output database must be fully indexed for performance. Other optimization techniques should be used where possible, such as using subtypes instead of feature classes when possible. The spatial characteristics of the input database should be used to set up grid sizes and so on.	System must: ~ Provide templates for different types of data ~ Handle common spatial data file formats. ~ Assist the user in inputting to setup the conversion ~ Validate input data - check that polygon topology exists or can be built, that the data is complete, and that the data conforms to constraints, relationship rules, domain values, etc. ~ Support staged conversion ~ Provide a suite of tools to assist the user in importing/converting from an existing database to a NILS database
G5.2		**Library Tiles**	Support conversion of library and ArcStorm databases.	Any edge issues with library tiles need to be resolved automatically. For example, features that cross tile boundaries should be reconstituted into single features.	System must: ~ Support conversion of library and ArcStorm databases.

G5.3		**Annotation**	Support conversion of annotation.	Both feature-linked and plain annotation must be migrated into the NILS database.	System must: ~ Support conversion of Arc 7.x annotation to NILS database.
G5.4		**Regions**	Support conversion of Region topologies.	The pre-existing parcel database may contain multiple discrete layers that could benefit from shared geometry, or may be based on a region model where underlying polygon features are shared. The migration tools should (optionally) create shared geometry in the first instance and preserve it in the second instance.	System must: ~ Support conversion of Region topologies.
G5.5		**Staged Processing**	The procedures should be designed such that a database can be migrated in stages. The parts of the database to be migrated in each stage could be defined by input file, tile, input "layer", output feature class, area, or type (spatial/feature class or tabular/object).	For purposes of staging the database migration, subsets of the data may be converted in many different processes at different times. The additional data must be reconciled against any changes that have been made to the previously imported data, since there may be conflicts along the edges between the data sets. There may also be conflicts where underlying shared geometry was created in the first passes, edited, and then new layers that rely on the shared geometry are loaded.	System must: ~ Support staged conversion
G5.6		**Digitization**	Manual digitizing from a hardcopy map or plat (e.g., master title plat, subdivision plat)		System must: ~ Support manual digitizing from a hardcopy map or plat (e.g., master title plat, subdivision plat)
G5.7		**Scan-vectorization**	Scanning and vectorization from a hardcopy map or plat		System must: ~ Support scanning and vectorization from a hardcopy map or plat
G5.8		**Coordinate Entry**	Manual data entry (building coordinate files, etc.)		System must: ~ Support manual data entry (building coordinate files, etc.) ~ Generate point features in database from the entered points

G5.9	MM 3.01 MM 3.02 MM 3.07 SM 3.01 SM 3.02 SM 3.03	**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-proprietary) formats. NOTE: A lot of survey data may exist in the form of COGO traverse files. These should be converted into survey information. Imported datasets may contain COGO attributes. These should be imported and converted to the format used by the survey tools, or stored simply for use later as dimension text.	System must: ~ Provide tools to translate data to/from industry standard formats ~ Provide tools to migrate purely tabular data from non-spatial DBMS into the database as Object classes. ~ Generate intersection tables and supporting relationships ~ Load data (validate key values, validate intersection tables) ~ Convert existing survey information to be stored and used in the database
G6.0		**Workflow Management**	The effective processing of land records and databases must be performed within an integrated workflow management environment. NILS should provide an intuitive set of tools to assist agents in processing transactions.	The orderly operation of an enterprise depends on workflow management for the completion of routine business processes. Most activities that cause land records to be updated are part of complex business processes, primarily because of the value of the land to all participants in the land transactions. These business processes will be referred to simply as processes. A process contains the definition of a series of activities or tasks that must be performed during the execution of the process. The process is a single object that contains the definition of the tasks and their interrelationships. In a sense, it is a template for doing work. When the process needs to be brought into action, a specific job is created. A job may correspond to a work order in some business environments, or other sequences of actions that are initiated by management action, customer calls, service requests, or other triggers.	System must: ~ Provide a framework to seamlessly integrate workflow processes with all NILS operations and functions ~ Provide tools to guide and track business transactions from their inception through the necessary processing to their final completion.

G6.1		**Automatic Workflow Operations**	Tools for Process Definition and Editing. This broad task definition allows a process to encompass the entire business process, whether digital or not, and whether performed in the system hosting the workflow management or not.	Tools will be needed to define processes and to change them as business practices or system implementations change. A central repository will hold the process definitions. New jobs will be created from these processes. Within a process, each task generally relies on the completion of one or more predecessor tasks before it can begin. The relationships between tasks are based on the logic of the business process, and the content of each task (or the activity performed in the task) corresponds to a function that is performed by someone (whether using a computer or not) or a function performed by the computer system.	System must: ~ Provide tools to define process templates ~ Manage job processing through interdependent tasks ~ Support integration and tracking of manual and system tasks
G6.2		**Manage object inter-relationships in the workflow**	The system should automate job instantiation and linkages to all source and reference documents. The system should enable the linkage of case processing documents and legal descriptions to the appropriate spatial features and land transactions. Automate transaction source object linking	The job contains the status of each task in the process as work proceeds on the job. It will also contain (or point to) the intermediate data products that are generated during the course of job. The logic of the job, that is, the tasks and their interrelationships, is taken from the process definition, then brought into action through the specific job. For example, a process called "Update Tax Role On Land Transfer" may have hundreds of jobs that could be named, say, "Update for Registered Deed 103245". This particular job would contain (or reference) the data corresponding to the deed as it winds it's way through parcel mapping of the land in question, PIN assignment, ownership records update, reappraisal, and so on. 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.	System must: ~ Provide tools to define a job as an instance of a process, and attach the necessary features, data, files, etc. ~ Support the linking of multiple objects, documents, data, etc. into a collection for management as a case or land transaction. ~ Support links to both online information and offline archival data.

G6.3		**Job Management**	Tools to generate reports, analyze jobs and manage jobs. Users should always be able to access the transaction and determine its status. Managers should be able to view all jobs in the system that are within their areas of responsibility. They have to be able to assign and reassign jobs and view their current status.	New jobs will be created most often in response to paper transactions. It is also likely that a programmable interface will be needed to support job initiation from other systems such as customer information systems or other workorder processing systems. Jobs will occasionally be cancelled. Each process must be able to roll back all work that has been done when a job is cancelled. When a task is complete, the job may pass to a specific person in another department. Alternatively, after the task completes, the job may be passed to another department where a manager will do the actual staff assignment. Another consideration is that a job may be reassigned based on day-to-day workloads. This will be an administrative action that occurs before (or during) the execution of a task is completed.	System must: ~ Provide tools to analyze and report on the status of processes, jobs, tasks and agents. ~ Provide a job management framework to initiate, cancel and transfer jobs. ~ Provide tools to assign and re-assign jobs to specific agents
G6.4		**Security, Users, and Roles**		Every user of the workflow system must be authorized to use it. Each user should be assigned one or more roles within the system (perhaps attached to a job function or department), and have their capabilities limited to those contained within their role(s).	System must: ~ Manage and enforce user roles securely.
G6.5		**Workflow Task Management**	System must integrate tasks with COTS applications and manual offline operations.	See below.	
G6.5.1			Workflow Task - automated processing by commands in COTS software	The functions that are provided by the COTS software will be needed to process data.	System must: ~ Integrate workflow management with COTS software.
G6.5.2			Workflow Task - manual processing in COTS software	A task may involve manual editing of a database in the COTS software. The primary way that land-related transactions will update the parcel database is through editing sessions using the editor component of the COTS software.	System must: ~ Integrate workflow management with COTS software.
G6.5.3			Workflow Task - automated processing by arbitrary commands	It should be possible to hook any other automated processing into a process.	System must: ~ Provide application interfacing to Integrate workflow management with external application tasks.

G6.5.4			Workflow Task - offline processing; automated in other systems, non-digital	There will be many tasks that involve external systems. We may not be able to integrate them at a system level because of security issues, software and hardware interface issues, or because these tasks are performed manually. These types of tasks could be handled by having a few generic tasks that provide instructions to the user to complete the offline work, and then having them click a button when the task has been completed.	System must: ~ Integrate workflow management with external manual tasks.
G6.5.5			Workflow Task - data transfer, or data ownership transfer, or version transfer	The tasks in a process will often be performed by different people in different parts of an organization. When a job is sent from one person to another, the data, ownership, or version that houses the data must also be transferred so that the receiving party can then work with the data. This may involve sending files from one person's disk area to another's, or granting rights on temporary database tables, or enforcing single-user ownership of database versions and then transferring this ownership.	System must: ~ Support transfer of a job and granting access to job-related data
G6.5.6			Workflow Task - notification	When a job passes from one person to another, it may be necessary to send an email notification in case the recipient, in the normal course of business, doesn't normally check the workflow system for new work. Notifications can also be added to a task for informational purposes only. That is, as the result of a particular task, interested parties can be notified even if they don't have to participate in the job itself.	System must: ~ Support automatic notification based on the process specification

Survey Management

This section defines the requirements to incorporate survey measurement features and metadata directly into a GIS database format. Survey Management is primarily focused on the capture of survey data in the field.

This section has been revised to include cross-references to the Survey Management Use Cases

Survey Management

ID	Use Case #	Requirement	Description	Detail	Expected Functionality
S1.0		**Data Model Elements**			
S1.1	MM 1.01 MM 1.02 MM 1.03 MM 1.04 MM 1.05 MM 1.06 MM 1.07 MM 1.08 MM 1.09 MM 1.10 MM 1.11 MM 1.12 MM 1.13	**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.	
S1.2	MM 1.01 MM 1.02 MM 1.03 MM 1.04 MM 1.05 MM 1.06 MM 1.07 MM 1.08 MM 1.09 MM 1.10 MM 1.11 MM 1.12 MM 1.13	**COGO procedure parameter form**		A list of configuration options to assist the user in the setup of COGO procedures.	
S1.3	MM 1.01 – MM 2.08.7	**Computation**		A set of processing methods or algorithms applied to achieve a desired solution. COGO procedures use computations.	
S1.4	MM 1.01 – MM 2.08.7	**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.	
S1.4	SM 2.01	**Data collection device**		An instrument for digital storage of readings and information about those readings. Information may be input manually or digitally.	

S1.6	SM 1.02 SM 2.01 SM 4.01	**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.	
S1.7	SM 1.02	**Field survey data set**		The organizational/storage container for data, files and information pertaining to a particular field survey.	
S1.8	SM 2.01	**Field survey setup file**		A list of parameters and configurations for the setup of a data collection device.	
S1.9	SM 2.01	**Field survey setup file template**		A form to assist an user 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 survey project.)	
S1.10	SM 1.01	**Index and Catalog**		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.	
S1.11	MM 2.02 – MM 2.08.7	**Measurement**		A value that is constructed as a result of computations performed using observations.	
S1.12	MM 2.02 – MM 2.08.7	**Measurement 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.	
S1.13	SM 2.01	**Measuring device**		An instrument for determining the dimensions of a feature (as readings). Examples are total station, theodolite, transit, compass, and steel tape.	

S1.14	SM 4.01	**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.	
S1.15	SM 4.01	**Data collection form**		A list of configuration options to assist the user in the setup for the collection of a particular type of observation. Display of the results of the computations.	
S1.16	SM 4.01	**Set of Readingst**		Multiple observations for the same physical feature.	
S1.17	SM 4.01	**Readings**		A value taken from an arbitrary scale (chronometer, theodolite circle, compass, chain, etc.) returned by a measuring device. (See observation.)	
S1.18	SM 1.01 SM 1.02	**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.	
S1.19	SM 4.01	**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).	
S1.20	SM 1.02	**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.	

S1.21	SM 4.01	**Traverse Data**		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.	
S2.0	SM 1.02	**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.	The configuration of survey 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.
S2.1	SM 2.01	**Hardware data collection devices**	Specific set of surveying data collection devices.	Standard procedure needs to be followed to set up each individual device and load and configure the in-field data collection software tools.	System must: ~ Support communication interfacing and file exchange formats for a set of industry-standard devices and formats ~ Support High Priority manufacturer technologies: Trimble (both USFS and BLM); AshTech; ASCII; Topcon; Leica; Zeiss, Nikon.
S2.2	SM 3.02 SM 3.03	**File Transfer Mechanism**	Necessary software for data transfer to/from data collection device to PC	Any coordinates computed on Computation Device can be transferred to a Data Collection Device for use in corner search or true line staking. Data may not be immediately usable inside the Data Collection Device and will require conversion and reformatting. Collected data needs to be transferred and may require conversion and reformatting to be usable for measurement analysis.	System must: ~ Support import/export with translation to/from the Computation Device and the Data Collection Device. ~ Support same high priority technologies as listed above.
S2.3	SM 1.01 SM 2.01	**Support Files**	For a Data Collection Device to be fully functional, support files are needed in the field.	For example, Solar and Polaris ephemeris file and the astronomic processing program. Also, state plane coordinate system zone constants for NAD27 and NAD83.	System must: ~ Package all required support files for use by the Data Collection Device.

S2.4	MM 1.01 – MM 1.13	**Miscellaneous Coordinate Geometry functions**	Light COGO functions help in data collection in the field.	System must provide a toolset of light versions of COGO computations that can be used on an in-field device (Data Collection Device) (as opposed to the fully-functional Computing Device version of the tools).	System must provide tools to perform: ~ layout calculation on-the-fly, in the field ~ determine record, midpoint positions ~ closure calculation ~ compass rule adjustment ~ search for intervening corners ~ inversing ~ intersection ~ resection ~ computation of astronomic observations, determine basis of bearing
S2.5	SM 1.01	**File Management**	Tools to manage survey files.	System should provide tools for creating and managing survey files. Do not limit file naming to 8.3 compliance.	System must: ~ Provide flexible tools to manage survey files. ~ Import/Export tools should assist user in handling file names that won't get truncated when used on the target system.
S3.0	SM 1.02	SM-01 Create or Open Survey Project	System must provide a means to input the parameters of the survey. System uses the correct type template to assist the user in defining the survey set up parameters.	This process is where the user prepares the necessary files to properly configure the instruments and data to be used in a particular field survey. The user 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 user may select a template, may then input to or modify the template, or may generate a custom setup and save it as a template. Input to Survey setup file template as appropriate. May set GeoCommunicator communication toggle(s). May create survey project and establish links to it from field survey. May import information saved during the Research process.	System must: ~ Display choice of field survey types. ~ Store the rules for configuring various types of surveys (with the exception of type 'custom') as a template. ~ Assist the user to input into the template and define a specific survey project. ~ Imports data and creates Survey setup file. 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

S3.1	SM 1.01	**Survey Research**	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.	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.	The user has the ability to define and redefine search parameters. Reference sources include all available paths (local data, WAN/LAN data, internet data). The user 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.
S32	SM 1.01	**Connect to Search Index and Catalog**	System must support the connection to remote search indices and catalogs.	Research is not possible unless indexes and catalogs of related information and data are accessible The survey reference library must be maintained. One of the main catalog sources for research will be GeoCommunicator. GeoCommunicator should provide access to many categories of data and events. See GeoCommunicator specification. Examples. 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.	System must: ~ Support connection to various on-line catalogs and indexes of survey-related data **NOTE: Catalogs and Indexes should capture the spatial extent (footprint) of the data source to support effective searching.**
S3.3	SM 1.01	**Define Search**	System must provide a means to input the parameters of the search.	Typical search parameters include: ~ location (defined spatially) ~ nominal location (defined as township, range, section, aliquot) ~ legal description identifier, parcel identifier (LAD-ID, PIN, PID) ~ transaction identifier (patent, case number, transaction-ID) ~ parties involved (grantor, grantee, agent) ~ survey identifier (survey number) ~ survey source (survey type) ~ date (date range) ~ format and storage location (digital, file, etc.)	System must: ~ Display research definition tools (e.g. define spatial extent, source types, date ranges) ~ Assist user to define the search ~ Validate search parameters as input

S3.4	SM 1.01	**Process Search**	System must use search as defined to read specified indices and catalogs and capture matches.	There is an implied compatibility requirement between the format of the indices and catalogs, and the engine for searching.	System must: ~ Search and locate records (GeoCommunicator, internet locations, databases, etc.) ~ Display Results in a browsable, hyperlinked report.
S3.5	SM 1.01	**Edit Search/Results**	System must allow refinement of search parameters, and re-processing of search.	Provide an interactive environment where the search parameter form and the search results are available so the user can modify the search parameters, select and remove unnecessary results, etc. to refine the results. User may look at source metadata or actually view the source (if accessible) and evaluate its usefulness.	System must: ~ Provide a unified search tool that allows edits, and is integrated with results.
S3.6	SM 1.02	**Open New Survey**	System must provide tool to open a new survey	This is necessary to support the upcoming SAVE.	System must: ~ Provide tools open a new survey and input the required properties, save to the specified data set.
S3.7	SM 1.01	**Download Source Data**	System must enable researcher to select a digital data item from the search results, view it for evaluation if accessible, and download it to a specified local storage area.	Researcher will want to evaluate data and save it if it appears to be useful for the survey.	System must: ~ Provide tools to select a data item, view it, and download it to a specified local storage area. ~ Update the pointer to the data in the search results.
S3.8	SM 1.01	**Save Search Scope to Survey**	System allows researcher to perform a SAVE AS on the (refined) search results.	Support multiple formats for re-use: ASCII, XML, HTML, table, and spreadsheet.	System must: ~ Maintain the correct pointers from search result item to the physical storage location. ~ Support export to noted formats.
S4.0	SM 2.01	**SM-02 Field Survey Setup**	Process to create a field survey setup file to manage the collection of readings, observations, and measurements.	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.	**QUESTION:** **Could a survey be treated as a workflow job, with tasks, each of which has specific instructions for the crew to follow in setup, layout and collection?**

S4.1	SM 2.01	**Configure Field Systems**	The system guides the user in configuring the hardware and software for use with the survey parameters selected.	System must support a set of hardware/software configurations. May configure multiple, separate in-field hardware systems. A supervisor may run setups for several crews as needed to complete the survey plan. These setups are applied to a set of devices in the field - essential a complete survey package of setup instructions for hardware, software, and running the survey itself (corners to locate, monument; measurements to collect; etc.). The package includes any necessary data (orthophotography, map layers, reports, previous surveys, etc. that may be needed in the field.	System must: ~ Provide option to configure data collection device and/or a computation device. ~ Assist user to select from a set of measuring devices, data collection devices and computation devices to be used together during the field survey. ~ Save the appropriate hardware and software configuration information for use in the field. ~ Assist user to upload the field survey setup file to a data collection device and/or a computation device. ~ Assist user to upload reference data specified in the field survey setup file.
S4.2	SM 1.02 SM 2.01	**Viewing-Managing Data with different spatial references**	Ability to take vector, raster data from different source datum/projection and use them together in a single spatial user interface. Ability to manage data subsets and spatial reference for improved performance in the field.	User may evaluate the common view as projected/georeferenced on the fly. User may want or need to subset or transform vector or raster data. Example: Get it all in geographic coordinates (lat/long) so that the user can capture actual coordinates of a feature, or use lat/long to locate a potential feature. Example: User may want to 'clip' a portion of a larger raster image and save as a compressed image (e.g. jpeg).	System must: ~ Provide tools to view and evaluate data's spatial reference, verify that the common view will work in the field ~ Support viewing and use of reference data in a common spatial interface for the user. ~ Provide tools to georeference images, transform data, or clip data and export to a new image.
S4.3	SM 2.01	**Validate Survey Parameters**	The system should manage security, ensure data is not corrupted on transfer, and verify that the complete set of parameters was properly loaded to the file and/or configured properly on the devices.	Example errors that the system should trap: ~ Missing data ~ user lacks permission ~ Hardware configuration error ~ System out of storage space	System must: ~ Apply the setup file and configure data using a transactional framework that confirms all parameters have loaded properly.

S4.4	SM 2.01	**Apply a Setup File**	The user selects a setup file to use (option to edit before applying).	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.	System must: ~ Display the list of available field survey setup files to be used ~ Assist the user to select the required field survey setup file ~ Display survey setup file in an edit form ~ Assist the user to make edits to the setup ~ Run a configuration routine to establish communications among the devices ~ Validate setup and user permissions (notify if error) ~ Load any forms or data required for the survey ~ Assist the user to perform the initial orientation and be ready to begin collecting data
S6.0	SM 4.01	**SM-04 Collect Field Data in Real Time**	The user performs field data collection by recording readings using a data collection device. Readings are computed with a computation device to derive observations and measurements. The system provides an interface to collect readings into a set of readings, refine/compute the observation, and record an observation value.	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. In-field collection systems that lack a computation device will have limited computational capabilities.	System must: ~ Provide a collection framework based on the survey setup file (survey plan, reference data, etc) ~ Assist user to complete the collection according to the setup file ~ Provide menu choices and forms for collecting readings ~ Assist in the collection of the necessary component readings into a set of readings based on the type of reading ~ Perform the computation of readings into observations and measurements. ~ Assist the user to process, evaluate, and modify a set of readings until a satisfactory observation is derived.

S6.1	SM 4.01	**Select/Apply Data Collection Form**	The system provides a set of valid observation, reading, or measurement collection forms (wizards) based on the survey setup in progress.	System is already configured, so user will operate the measuring device, obtain a reading and interact with data collection device (i.e., sight, measure and poll). The system will capture the reading, observation or measurement, and add to current set of readings.	System must: ~ Assist the user in following the proper steps to correctly collect the chosen observation. ~ Assist user to input to the form by taking a reading and sending the value to the form. ~ Provide Wizard (help option) without constraining the advanced user from taking readings in an alternate order ~ Validate the reading. Note: automated readings cannot be modified (Read-Only).
S6.2	SM 4.01	**Select/Apply Data Reduction**	The system must provide tools for reduction of an set of readings to a measurement.	The user selects a reduction computation and the subject sestet of readings. The system provides assistance to setup the computation and validate the input. User may inspect the results before accepting and storing the results of the computation.	System must: ~ Processes the set of readings as needed to derive observations and/or measurements. ~ Validate components, check tolerances, completeness and process input data. ~ Display sestet of readings 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.
S7.0	MM 1.01 – 1.13	**SM-05 Perform COGO and Layout**	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.	This is the toolbox that provides coordinate geometry (COGO) calculation methods and procedures. NILS users may access COGO tools during a variety of operations. COGO procedures, calculations, computations and construction methods are essential tool components in the Field-to-Fabric common data model. 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.	COGO procedures as defined computations and calculations for the construction of measurement-based features must be available throughout the NILS application. Perform COGO and Layout would be an application interface based on fundamental (lower-level) system functionality for building measurement-based features. 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.

S7.1	MM 1.01 – 2.08.7	**Select/Apply COGO Computation**	The system must provide an interface for computation.	The user 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. System must provide the following COGO computation operations: ~ layout calculation on-the-fly, in the field ~ determine record, midpoint positions ~ closure calculation ~ compass rule adjustment (grant boundary adjustment) ~ irregular boundary adjustment ~ search for intervening corners ~ inversing ~ intersection ~ resection ~ compute astronomic observations, determine basis of bearing ~ single and double proportion ~ one-point control ~ two-point control ~ three-point control See Measurement Management.	System must: ~ Support BOTH planar AND geodetic versions of the computations. ~ Display available position calculation methods (COGO procedures and other computations) ~ Assist the user in choosing a COGO procedure type ~ Assist the user to define a custom computation ~ Present the appropriate COGO procedure parameter form ~ Assists the user to select measurements and/or features (points, lines, areas?) ~ Use the selected features and computation parameters to generate point coordinates ~ Update the COGO procedure parameter form with the calculated coordinates or layout information ~ Update the graphic display, including notification and symbolization of pre-existing points or IDs within distance tolerance ~ Capture the relationship among the features and the respective computations
S7.2	MM 1.01 – 2.08.7	**Computation Validations**	The system must validate the input and output of the computation.	The system has rules for protecting against ID duplication or procedure duplication.	System must: ~ Provide Point-ID duplication protection to prevent entry of an existing point identifier for any point already in the present data set into the COGO parameter form. ~ Provide Procedure duplication protection to prevent entry of an existing point procedure for any point already in the present data set into the COGO parameter form.

S7.3	MM 1.01 – 2.08.7	**Accept/Edit/Save**	The system allows the user to review the results of the computation, to evaluate them, to revise the input data elements or computation parameters, and if acceptable, save the coordinate values of the result.	The user may accept the results and save coordinates with an appropriate point ID (may be new or replacement of existing). The user may also elect to save the computations (to support audit; retrievable for layout, reconstruction).	System must: ~ Persist the coordinate values and the parameters/metadata of the computation for the subject features.

Measurement Management

This section defines the requirements to adjust and analyze measurement networks within a GIS database. Measurement Management is primarily focused on the adjustment of the measurement data captured in Survey Management.

This section has been revised to include cross-references to the Measurement Management Use Cases.

Measurement Management

ID	Use Case #	Requirement	Description	Detail	Expected Functionality
M1.0	MM 1.01 – 3.07	**Data Objects**		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.	
M1.1	MM 2.01 – MM 2.08.7	**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.	
M1.2	MM 2.01 – MM 2.08.7	**Anomaly Correction**		Process to edit and correct anything irregular or abnormal (blunder, error) in measurement data.	
M1.3	MM 2.01 – MM 2.08.7	**Anomaly Detection**		Process to identify anything irregular or abnormal (blunder, error) in measurement data.	
M1.4	MM 2.01 – MM 2.08.7	**Blunder**		A mistake, such as recording the wrong value or measuring to the wrong feature. See error.	

M1.5	MM 2.01 – MM 2.08.7	**Error and Error Estimate (weight)**	In Measurement Management, 'error' refers to the imprecision of a measurement. All measurements have error. See blunder.	In a parametric least squares adjustment of measurement data, the parameter for weighting data is an estimate of the quality of the data. Data with a low error estimate is given a higher weight and with a high error estimate is given a lower weight. Error estimates can be based on the accuracy of a given measurement (For example: The National Map Accuracy Standard for a position on a topo map). An error estimate can be applied to any measurement. As a constant and/or ppm for distance, as angular error for angles or azimuths and as positional accuracy for points. The *reliability* of source data may be used as an estimate of its error, but can be only pertinent to that data set. For example, there maybe an azimuth rotation in relation to surrounding survey data and the source data is still accurate within itself. To fit the source data in with the surrounding surveys, without altering the source data (often it is an official record), an error estimate the same as the azimuth rotation would be used.	
M1.6	MM 2.01 – MM 2.08.7	**Iteration Limit**		The maximum number of iterations an adjustment can have before it is assumed that the solution is diverging.	
M1.7	MM 2.01 – MM 2.08.7	**Measured Feature**		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).	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.
M1.8	MM 1.01 - MM 3.07	**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.	Elements in a Measurement Dataset.

M1.9	MM 1.01 - MM 3.07	**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.	The measurements that comprise a measurement network become the basis for higher-tiered fabrics (legal description and parcel) which may include survey (measured) features and non-survey features. 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 (i.e. Survey 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 (i.e. Survey Features) would automatically update. NOTE: A measurement network may be composed of legal descriptions constructed as measurements. 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.
M1.10	MM 2.01 – MM 2.08.7	**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.	
M1.11	MM 2.01 – MM 2.08.7	**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.	

M1.12	MM 2.01 – MM 2.08.7	**Reliability Value**		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. Computed during a LSA they are the same as an error ellipse, which is defined by a radius (semi-major axis) of maximum error (SU), radius (semi-minor axis) of minimum error (SV), and the angle from north (positive clockwise) of the direction of maximum error(T). The position is generally stronger in the traverse direction, and weakest away from the traverse directions. They only apply to the position of a point. The coordinate values of a point will fall within the area of an error ellipse with a certain level of confidence. The reliability of a line's length and direction can only be as reliable as the endpoints.	
M1.13	MM 2.01 – MM 2.08.7	**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.	
M1.14	MM 2.08.4	**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.	
M1.15	MM 1.01 – MM 1.05	**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.	

M2.0	MM 1.01 – MM 2.08.7	**MM-01 Construct Measurement**	Tools to construct measurements from survey points (simple measurements) and/or other measurements (complex measurements).	This use case may be used in conjunction with building a measurement network. This set of operations is basically a set of tools that apply the necessary computations to construct various types of measurements.	Constructing Measurements is fundamental to constructing Survey Features - some underlying survey points must exist within a measurement network. The minimal unit required is a survey point. A set of survey points can be used to construct more complex types of measurements. System must support the construction of various types of measurements. NOTE: measurements in a measurement data set have computation methods that are automatically applied to properly construct and display the measurement network. Example types of Measurements: ~ Record Boundary ~ True Line ~ Line Measurement ~ Line Sequence ~ Curves ~ Angles ~ Defining Measurement ~ Control Point Coordinate ~ Record Area
M2.1	MM 1.01 – MM 2.08.7	**Construction**	The system provides a set of valid measurement construction methods, and assists the user in completing or editing the construction.	Example computations to support construction of a measurement (See COGO and Layout): Section subdivision, offset line, defining measurement, proportion, intersection (by directions and/or distances), line coincidence. Example construction concepts: Set 'invisibility' attribute for a 'pseudo' computation line that was used only to construct certain types of measurements, and does not really serve as a record boundary to define a legal area. We need to see how we can deal with these in the prototype. **Note: computation methods may be geodetic and/or non-geodetic.** See McKay's ' ***Procedures for Automatic Subdivision of a Section***', '***Coincidence of Lines: Justification and overview***', and '***Draft DEFINITIONS of Core Data Elements For Maintaining Spatial Representation Of Parcels***'	The system must: ~ Display the current measurement data set (may include measurements, survey points and reference features). ~ Allow user to see symbols that suggest how the measurements were constructed ~ Provide tools for selection and construction ~ Respond to the user's spatial selection and inputs ~ Provide user with tools to edit existing construction methods ~ Construct and display the measurement

M2.2	MM 1.01 – MM 1.13	**COGO Computations**	Provide COGO functions	Provide COGO computations for construction, such as Traverse, intersection, inverse, area, etc. (see Survey COGO and Layout).	System must ~ Provide the full toolset of COGO functions for construction of measurements.
M3.0	MM 2.01 – MM 2.08.7	**MM-02 Adjust and Analyze Measurement Network**	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.	Adjustment and Analysis together are the core for resolving imperfections in the geometry of recorded data, whether the data recorded is from field measurements (Survey Management), is from recorded survey plats and horizontal reference data (Measurement Management), or is from recorded deeds and existing coverages (Parcel Management). 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. 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 and/or to other non-surveyed features (e.g. a map control)
M3.1	MM 2.01 – MM 2.08.7	**Setup**	Select the dataset and specify parameters and computations for the adjustment.	The user must: ~ Input to Analyze/Adjust Parameter Form to define parameters and options for analysis and adjustment operations ~ Give the adjustment a unique name ~ Specify option and activate anomaly detection options ~ Specify option and set reporting and statistical parameters (e.g., level of residual to report) ~ Specify option and set adjustment limits (residual tolerance and iteration limit) ~ Specify option and just generate reliability values on adjusted points	The system must: ~ Transform measurements into common datum and unit type ~ Display available adjustments symbolized to indicate status, reliability, etc.) for comparison and selection. ~ Provide tools to select adjustment and a set of measurements ~ Provide tools to manage weighting on the selected set of measurements ~ Update display to show spatial extent and selected measurements (symbolized to indicate status, reliability, etc.). ~ Assist user to make a version or subset of the measurement data set (bring data into a personal database?) ~ Assist user in specifying the adjustment parameters (e.g. choose a technical or a cartographic-alignment adjustment): ~~ Present user with ability to set adjustment limits (residual tolerance and iteration count) ~~ Present user with reliability parameter form: buffer distance and autorun ~~ Present user with anomaly detection options: ~~~~ Unconstrained Adjustment (use of only one control point) ~~~~ Robusting options on/off ~~~~ Turn on/off pop-up graph of Standard Error of Unit Weight (SEUW) reported after each iteration ~~~~ Set reporting and statistical parameters

M3.2	MM 2.01 – MM 2.08.7	**Pre-Adjustment and Utility Tools**	Manage necessary functions to prepare input data for least squares adjustment, including utility tools for conversion and transformations. (See CMM)	Define project parameters (state plane zone, for example). Generate approximate coordinates for all traverse points (with necessary reductions if state plane zone is selected) and quick check on misclosure and blunders, with the ability to view the traverse graphically. The ability to provide error estimates for individual measurements. Transformation tools between state plane coordinates and geodetic coordinates. Conversion tools from specified data collection devices to generate input files for further processing. Provide a set of programs to convert collected data from a set of specified data collection devices to pre-adjustment and analysis format.	System must: ~ Provide pre-adjustment tools such as: ~~ Apply known corrections ~~ Reduction ~~ Quick Coordinate Generation ~~ Closure Check ~~ Detect Blunders ~~ View Traverse ~~ Edit Error Estimate (AKA '**weight**'; may be based on source reliability) ~~ Transform Projection/Datum ~~ Manage Import from Data Collection Device ~~ Run a preliminary adjustment to determine the appropriate adjustment area (based on degree of significance, impact ripple of the new data)
M3.3	MM 2.02	**Graphic of unadjusted measurement data**	A tool for pre-adjustment analysis.	Build a graphic display of the unadjusted measurement data. Plot lines end on end in as much the same order as they were entered, although this isn't entirely possible. Plot control points in their unadjusted position. A similar approach is described in manual data entry, where data will appear on the screen unadjusted, but tied to adjusted data. The anomaly tool being described here is necessary to view a completely unadjusted aspect of a user-specified area.	System must: ~ Display all data in a user-specified area, with lines assembled end-on-end in their unadjusted geometry and control points plotted in their unadjusted position ~ Display control point identifiers (labeled or colored) such that they can be discerned from the line endpoints, which must also be labeled with their Point ID. ~ Provide tools to highlight a line on the graphic display and edit that line in the editor interface.
M3.4	MM 2.01 – MM 2.08.7	**Adjust**	This set of operations enables the user 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 user may specify the parameters and methods to apply during each iteration. User has the option to use a Robusting method on the adjustment. It is important to give the user control in managing the means by which (geometric/topological) associations are made and handled during the update process. Users will want to have feature-by-feature control on the update process - a continuum of user-defined control, from locking the geometry of some related features to the automatic adjustment of others.	System must: ~ 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. ~ Adjust with Robusting if specified. ~ For Robusting, prompt user to modify weighting and create alternate working version ~ Raise an error when there is no solution with adjustment limit

M3.5	MM 2.01 – MM 2.08.7	**Analyze**	Review the results of the adjustment and determine the necessary modifications required to improve the adjustment solution.	The analysis is supported by tabular reports and a map view. The user 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. Analysis includes comparing the adjusted lines and angles to their original measurements as a mean to detect blunders. Create and process a subset of the data also used to locate blunders. Viewing the results of the adjustment process from different weighting options helps analyzing the importance of weights and optimizing the solution.	System must: ~ Generate statistics on measurement and coordinate reliability. ~ List of each adjusted element, with measured, residual and snoop values ~ Generate anomaly reports and display as appropriate. ~ Support Anomaly Detection and Correction Algorithms such as: ~~ various methods of blunder detection ~~ robusting (solution optimization with alternate weighting) ~ Generate Reliability report and display. ~ Update Display (symbolized to indicate status, reliability, adjustment factor, etc.). ~ Graphic of area with lines symbolized according to data source and snoop values, distinguish between distance snoops and direction snoops, and polygons symbolized based on unadjusted closures. ~ Integrate with the Adjustment Setup to enable modification and iteration of adjustment Example Anomaly Detection methods include: ~ Closure Report ~ Unconstrained Adjustment ~ Graphic of Unadjusted data ~ Robusting Report ~ Symbolize snoop values
M3.6	MM 2.03 – MM 2.05	**Anomaly Detection - Area Misclosures**	Provide user with report on geometric misclosures of every area. Where multiple measurements are made of any line, then misclosures between those measurements would be reported and some way must be presented to sort through the different solutions.	A misclosure report is preferably a graphic display where the misclosures are written inside the area, with an option to fill areas with colors that are color-ramped based on misclosing distances or on ratio of misclosing distance to perimeter. A user would perform the area misclosure report on a selected area. Options would exist to view the misclosures as distances printed within the area, as the cardinal equivalents printed within the area, as ratios of the distance to the perimeter printed within the area, and/or by shading the area with a color-ramping scheme that highlights the problem areas.	System must: ~ Provide tool option of simplifying the display by suppressing misclosure data from areas that fall within a user-specified tolerance. ~ Provide tool to highlight a line on the graphic display and edit that line in the editor interface. ~ Provide tool to highlight a series of lines of similar direction and compute/display the sum of the distances of that line. ~ Provide tool to query for the line measurement that is most likely in error (the one that produces the highest misclosure) in cases of multiple measurements along a single line. ~ Integrate analysis with editing
M4.0	MM 2.01 – MM 2.08.7	**MM-03 Edit Measurement Data**	Manual entry/edit of measurement data values. Includes types of anomaly detection and anomaly correction as part of edit validation.	To build a measurement network, some initial source data is required. Measurement data types include raw coordinate files, survey source IDs, error estimates, etc.	

M4.1	MM 2.01	**Input**	Manual entry of measurement data values.	The user may select from a set of measurement data types and perform manual data entry. Example use: may be data entry from a set of field notes, or from a hardcopy survey plat. User may enter/edit data in a spreadsheet-type layout where any cell the cursor is in can accept edits. The spreadsheet should use values from the previous line; once the cursor has moved into null cell, the value defaults to the value of the previous line. System should process and validate on the fly (e.g. enter algebraic equations and have the solution entered as the measured value).	System must: ~ Provide tools to select the type of data to be input ~ Display the appropriate data entry form ~ Capture input data and display lines graphically as they are entered (with reference data for visual validation) ~ Provide slider bars, drop down lists, and other graphical devices, where appropriate, to minimize blunders and data entry time (defaults and algebraic shortcuts for data values based on previous cell values) ~ Process input on-the-fly and validate data (trap logical errors real time, such as values exceeding specified range; integrate anomaly detection tools) ~ Provide the ability to view and re-order the data in the spreadsheet to assist the discovery of blunders, anomaly patterns, etc. ~ Manage the Point ID numbering scheme (simplest example, automatically increment the point ID numeric value ~ Support viewing the data in any single unit or in the native units of the entered data (Note: if native units, then color code or have some text tag next to value to indicate its unit) ~ Assist with saving data
M4.2	MM 2.01 – MM 2.08.7	**Edit**	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 user may open an edit session and make corrections to the measurement data.	The user may open an edit session for an existing measurement data set. Measurement data may be edited while the user 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.	System must: ~ Prompt for edit session parameter form (to specify measurement data set and measurement data) ~ Provide tools to select a subset of measurements (include spatial selection of measurements) ~ Provide additional forms to set data and verification/validation options ~ Provide tools to edit error estimates (weighting) for a selected set of measurements ~ Process selection ~ Display appropriate data entry form and prompt actor to input/edit data fields ~ Provide ability to select a subset of cells in an edit spreadsheet and batch update their values to a user-specified value ~ 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. ~ Process selected data validation, generate reports and update graphical display as appropriate ~ Close out by saving dataset and updating dataset metadata

Parcel Management

This section defines the NILS requirements for managing land records and cadastral feature data stored in a GIS database model.

Parcel Management

ID		Requirement	Description	Detail	Expected Functionality
P1.0		**Data Objects**			
P1.1		**Agent**		Any participant or party identified in land transaction.	
P1.2		**Control**		A feature or set of features with positional coordinates that is used to adjust (or fix) the geometry of an associated map layer.	
P1.3		**Encumbrance**	Servitudes, Restrictions, Covenants and Restrictions	These are all specific instances of encumbrances. The term rights and interests are used to mean positive rights and interests as well as negative encumbrances and simplify the entire discussion. Covenant. An agreement creating an obligation contained in a deed, usually restricting some acts or activities. A type of negative encumbrance.	
P1.4		**Estate**		The collection of rights in real property, as modified by the degree of interest held by the agent(s). Example: A collection of rights that becomes ownership is called an estate.	

P1.5		**Event**		An action that requires a land record to be processed within an agency's business workflow. Example events: **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 trigger**. Transactions in an associated system or database that cause the need for processing in NILS. **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.	
P1.6		**Interest**		The degree of interest in property may be classified by the time of enjoyment and they are (1) estate in fee, sometimes call fee simple (2) estate for life (3) estate for years and (4) estate at will. The degree of interest may also be divided among agents. See Estate, Right, Encumbrance, etc.	
P1.7		**Instrument**		A legal document to define the estate, agents and legal description of property Example: Conveyance Instrument, Lease, Special Use Permit	

P1.8		**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. Legal Descriptions are a necessary part of a land conveyance and includes four components (1) caption (2) body (3) qualifying clauses and (4) augmenting clauses. The caption is sometimes called the general description is often used in Recorders tract indices. The body describes the precise area. Qualifying clauses take something away and Augmenting clauses give something in addition to what is in the body, such as ingress and egress.	
P1.8.1			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. **Descriptions by Area Reference** - Reference to a recorded map or plat. These are common "area descriptions". The map or plat contains the linear measurements necessary to describe the areas. NOTE: "nominal" here means a named area, identified and described elsewhere (a map or legal description document)	

P1.8.2			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). **Bounds Descriptions** - perimeter descriptions without a direction of travel. **Metes Descriptions** - perimeter descriptions with a direction of travel described by a series of measurements. **Metes and Bounds Descriptions** - Not included in the types described in this document. Perimeter descriptions with a direction of travel described by a series of measurements and calls to endpoints.	
P1.8.3			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.	
P1.8.4			Strip Descriptions	**Strip Descriptions** - description of a centerline with an offset on either side can also be a radial description with a center point and a distance or radius around the point. Sometimes stationing is provided along the line with the offset along the stationing.	
P1.8.5			Description by Calls	Description by reference to physical objects. These are sometimes called deed calls or running out the calls.	
P1.8.6			Description by Division Line -	This is a division of an existing or previously defined area, such as a lot or a PLSS Section, dividing by a described line. This type of description always creates a remainder or other area that must be described as well. The line may be a measurement, such as metes or a natural feature, such as call to a river or a road. This is a combination description because an area must be identified and then divided.	

P1.8.7			Description by Distance	This is a division of an existing or previously defined area, such as a lot or a PLSS Section, dividing by a described line. This type of description always creates a remainder or other area that must be described as well. The division line may be a measurement, such as metes or a natural feature, such as call to a river or a road. This is a combination description because an area must be identified and then divided.	
P1.8.8			Descriptions by Proportional Conveyances	Descriptions by Proportional Conveyances. This is a division of an existing or previously defined area, such as a lot or a PLSS Section, be specifying a proportion of area, such as half or quarter. This type of description always creates a remainder or other area that must be described as well. In the PLSS many of these proportional area division rules have been defined, for example the SE 1/4 of a section is defined by connecting opposite quarter corners and then selecting the southeastern quarter of the resulting division. These rules may not and generally do exist for non-PLSS areas.	
P1.8.9			Description by Exception	This is a division of an existing or previously defined area, and then excepting out an area. The exception can be any exempt area. This type of description always creates a remainder or other area that must be described.	
P1.8.10			Description by Acreage	This is a division of an existing or previously defined area, such as a lot or a PLSS Section, be specifying an area amount. This is similar to the proportional area, except the amount of acreage being described in stated such as 10 acres.	
P1.8.11			Indeterminate Descriptions	These are descriptions of areas or extents of land that can not be solved without significant research into the intent of the parties participating in the description and subsequent conveyance.	
P1.9		**Legal Description Fabric**		A collection of legal description geometry areas, represented either as standard features or as Survey Features. All polygons representing legally-described areas have been formed from the measurement network and other boundaries to support the parcel fabric.	

P1.10		**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.	
P1.11		**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.	
P1.12		**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.	
P1.14		**Right**		As applied to real property, a right is the relationship between an agent and the use of an asset in the land. An agent's use of a right is modified by the degree (time, percent, etc.) of interest. Rights and interests are controlled and regulated by the state in which the land is contained except for the federal government and tribal nations, which control rights and interests independent of states. A right is positive type of encumbrance.	
P1.16		**Sketch**		A draft or interim geometry of a legal description, 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.	
P1.17		**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.	

P2.0		**PM-01 Verify Parcel**	*AKA PARCEL TRIAGE: WORKFLOW STEP #1.* 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.	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. 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.	
P2.1		**Identification**	Attempt to find a match for the subject legal description. May match geometry in the Legal Description Fabric or the Parcel Fabric. May match parcel or legal description text or IDs in the database.	Identification may occur by a variety of methods based on the document or parcel information that is included in a database or as a spatial characteristic of the parcel. Searching would include geographic and logical queries. (NOTE: we can't support manual ('*organic*') searches the information to be queried has to be somewhere). 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.	System must: ~ Assist user to identify subject parcel by geography, legal description, parcel ID, other attribute or event category. ~ Support spatial search methods ~ Support logical/tabular search methods ~ Provide option to import digital image or drawing, etc. ~ Process input. ~ Attempt to find parcel or legal description. ~ Display parcel or legal description, associated (parcel) legal description text and attributes, and all component legal description geometries. ~ Provide verification methods (visual, new sketch, attribute comparison, other).

P2.2		**Construct Sketch**	May be used when a parcel/legal description can not be identified. May also be used to create a sketch for independent verification of geometry against an identified fabric feature. As part of creating a new parcel record, having the ability to sketch a parcel's legal description(s) would include tools to translate a parcel legal description into its representative boundary geometry (see methods listed below).	Identification may occur by a variety of methods based on the document or parcel information known to the user. Searching would include geographic and logical queries. See Identification. 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 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').	System must: ~ Provide tools to create the geometry of the legal description (See Construct Legal Description) ~ 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 closed sketch with subject legal description geometry located and highlighted. ~ Option to return/revise.
P2.2.1			Construct Sketch with Legal Description Interpreter Tool to create a geometry from a legal description text. (See Legal Description Generator under Construct Legal Description).	Identification may occur by a variety of methods based on the document or parcel information known to the user. Searching would include geographic and logical queries. See Identification	System must: ~ Assist the user to locate and/or define a geometry by 'automatically' interpreting a textual legal description. ~ May take an image, convert intelligently to text, and format text for interpreting the components of the description
P2.2.2			Construct 'Sketch' by Subdivision Rule	Use a special construction to divide an existing geometry and create a 'sketch'.	System must: ~ Assist user to select parent legal description/parcel area. ~ Step through definition of the subject part of the parent area. ~ Derive legal description of subject and remainders. ~ Assign IDs.
P2.3		**Verify and Edit 'Sketch'**	Once the legal description or parcel geometry is found or sketched, the user may review various legal description and/or parcel attributes to verify that the subject legal description or parcel is indeed valid and may be further processed.	The user would employ one of several pre-defined verification processes to review the status of the legal description or parcel. Example: compare/contrast geometry and attributes. User may open an edit session to edit geometry on the 'sketch' version.	System must: ~ Process verification method. Example Verification Method: Find and display attributes, rights, transaction agents, restrictive covenants, and parcel acreage in comparison to subject geometry. ~ Edit the geometry of the 'sketch' ~ Support integration with workflow processing.

P2.4		**Insert into Workflow Process**	Once the legal description or parcel sketch is verified, the user must determine the proper processing action.	If there are no geometry changes the user can move on in the workflow - a 'version' of the sketch may be created. If geometry changes are required, the user returns to sketch editing for correction. 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.	System must: ~ Assist user to determine appropriate maintenance processing. ~ Provide options to report, save, and submit subject parcel information into workflow process. ~ Provide workflow options ~ Process subject parcel information and transmit to next step in workflow.
P3.0		**PM-02 Construct Legal Description**	Process to create the basic legal description components - geometry and attributes (text, ID, source ID, etc.).	This set of operations includes functionality for constructing both text and geometric representations of a legal description. 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.	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. 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. 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).
P3.1		**Setup Construction Session**			System must: ~~ Assist to establish edit session. ~ Display index to available reference data (legal description fabric, parcel fabric, other measurement network features.) ~ If no data set is current, establish current measurement data set ~~ Assist user to input setup parameters (data set, spatial extent, construction method) ~ If a digital plat, plan or sketch exists, provide import option ~ Update display, symbolized to indicate type and (historical) status of reference data elements.

P3.2		**Construction**	Construct Legal Description geometry and text. A legal description geometry may be a type of Survey Feature if based on measurements.	There are many types of legal description, each with appropriate construction rules. See P1.8 for the list of Legal Description types. May import a 'sketch' to assist in constructing the legal description. Legal Description Generator Utility. Includes a productivity tool to create a legal description text from a geometry - the user selects a type of legal description to generate and inputs to the 'productivity tool'.	System must : ~ Provide tool to import a sketch. ~ Process construction method. ~ Assist with input from user as needed. ~ Apply inputs and complete construction (add attributes, etc.). ~ Assist the user to draft a textual legal description for a selected geometry. ~ Display new legal description against reference data. ~ Provide choices: Save, Revise, Next Feature, Undo, Quit.
P3.3		**Inspect, Save and Input to Workflow**		User may compare/contrast the edit 'version' against the sketch and the fabric to validate geometry and attributes. The 'version' is then available for the next task in the edit job.	System must: ~ Assist in validating the legal geometry ~ Save geometry and attributes (text, anno dimensions) to legal description collection ~ Manage options to trigger operational workflow/transaction tracking system
P4.0		**PM-03 Edit Legal Description Fabric**	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.	Editing of parcel fabrics has typically been handled in a database transaction environment, where features in a production version were locked and extracted to a working version. Edits were made to the working version, quality-controlled, accepted, and committed back into the production version. The edit 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.	NILS requires an editing environment that manages database transactions uniquely (to support auditing, history, etc.) and enforces data integrity. 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.

P4.1		**Setup Edit Session**		Editing will require connection to associated databases in some cases.	System must: ~ Assist user to establish an edit session (connect to/select legal description fabric, select a spatial extent, set session parameters) and process input. ~ Place a system-generated flag on selected features in the legal description fabric to indicate that they are involved in an edit transaction . ~ Create a working version of the selected features from legal description fabric. ~ Display the working version of the legal description fabric. ~ Provide editing tools (insert new legal description component, edit existing component, etc.).
P4.2		**Edit - insert process**	Insert new legal description component.	This set of operations also provides the means to insert new legal description geometries into a fabric. User may work with the sketch and the fabric features. Legal description geometries may become Survey Features as part of the insert process. 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.	System must: ~ Provide choices for newly constructed legal description component ~ Provide insertion tools (split/merge/re-shape geometry, change attributes, change feature relationships, etc. ~ Assist user to insert (i.e. a productivity tool, based on user input, apply business rules) ~ Provide selection and edit tools (change attributes, geometry and relationships) ~ Validate (resolve any conflicts caused by insertion and/or edits (e.g., remove gaps and overlaps). ~ Validate insertion according to business rules ~ Validate insertion according to topology rules ~ 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.
P4.3		**Edit - manage (persistent) topological associations**	Integrate Topological Relations in Multi-Tier Topology NOTE: This includes establishing the survey feature relationship to measurements. It could also include additional custom behavior between legal descriptions and parcels, for example.	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. Beyond shared geometry and survey feature to support topological operators (contains, disjoint, etc.)	System must: ~ Provide support for the multi-tier data model. ~ Assist user to control the type and extent of automatic geometric updating that occurs among features which have geometric/topological associations. ~ Manage ties between legal description geometries and underlying measured features (in a measurement network) ~ Manage ties between legal description geometries and parcels in a 'higher' tier.

P5.0		**PM-04 Re-Adjust Fabric**	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 (which may include map control).	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.	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.
P5.1		**Setup Adjustment Session**		The user makes selection of the reference source (from which the control will be selected) and one or more target feature layers.	System must: ~ Assist user to select target feature fabric(s) and reference source. ~ Display target feature fabric(s) and reference source. ~ Provide control selection tools and~ Assist for identification of control.
P5.2		**Add Control**		Tools are provided to select (and define) controls in the reference source. There is a need to provide for non-standard types of control and ensure that the adjustment process supports their use.	System must: ~ Assist user to define new control (may be coordinate point file, a location on a digital orthophotograph, etc.)
P5.3		**Integrate Control**		Features in the target fabric(s) are then selected and linked to the control.	System must: ~ Provide choices for associating fabric features to control. ~ Persist associations to manage feature geometry updates

P5.4		**Adjust**		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. Provide all functionality as required in MM Adjust/Analyze.	System must: ~ Process associations iteratively until complete ~ If the target fabric is not based on measurements, a new measurement database will be constructed ~ The adjustment (both process and results) will be persisted into the (new or existing) measurement database. ~ 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.) ~ Assist in the analysis/evaluation of the adjustment ~ Provide ability to toggle between the 'technical' and the 'cartographic alignment' adjustment ~ Provide choices for re-adjustment ~ Save adjusted control, adjustment coefficients and fabric
P6.0		**PM-05 Edit Parcel Fabric**	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.		The system must support data automation from pre-NILS databases. The system must support implementations that do not use measurements.
P6.1		**Setup Edit Session**		Editing occurs in a transactional environment. The parcel fabric and the associated legal description fabric are selected, and the edit session is performed upon a working version.	System must: ~ Provide available parcel fabrics, legal description fabric and tools to select subject. ~ Process input selections ~ Display fabric and selected parcels.

P6.2		**Manage Transaction**		To create a new parcel, the editor establishes relationships to active legal description geometries that are the source for the parcel's geometry.	System must: ~ Assist user to initiate a version of the fabric within a database transaction environment (with unique database transaction ID) on the selected parcel(s) ~ Process database transaction and set a system flag to indicate that the selected parcel features are involved in a transaction. ~ Establish the working set. ~ Display working set. ~ Track edits and record to audit system ~ Manage closing the database transaction and incorporating the edit into the original version.
P6.3		**Edit**		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, possibly 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.	System must: ~ Provide tools to form parcels and edit attribute values (include COGO and Layout tools and computations) ~ Process geometric edit actions ~ Provide tools to create multiple, dynamically integrated edit windows (spatial, at various scales, and tabular for attributes) ~ Provide snapping options, to permit snapping to background layers (e.g. legal description geometry) when needed. ~ Enable features to be copied by selecting/copying them from one of the background layers and pasting them into the target layer. ~ Support mass attribute update of all selected features. ~ Assist in assigning unique parcel identifiers
P6.4		**Productivity Tools**	These productivity tools streamline the most common parcel editing operations.		
P6.4.1			Parcel Insert/Merge/Split productivity tools and COGO Tools	Tools for basic division and aggregation methods.	System must: ~ Provide productivity tools to assist with common edit operations for division and aggregation ~ Provide productivity tools to assist with common edit operations such as a COGO spreadsheet, Fillet, Intersection, Layout, Offset, and Proportion
P6.4.2			Manage Estate and Encumbrance Attributes Update attributes about rights, interests, or agents. Manage restriction, covenant attributes.	Tools and procedures are provided to establish connections to remote data sources. The remote data sources contain information related to rights and interests (See note below)	System must: ~ Open or link to source of estate data for selection list to accept or modify ~ Process actions related to attributes such as rights, transaction agents, restrictive covenants, and parcel acreage.

P6.4.3			Reconcile Versions Process to compare versions of a parcel and determine what final configuration will become the 'official' version to be stored in the parcel fabric.	At the completion of editing processes and before the Manage Feature Associations, it may be necessary to reconcile various representations of parcel geometry, spatial attributes, or other attributes. Reconciliation produces the final version of an edited parcel. This final version goes into the parcel lineage, whereas non-reconciled versions may not be a part of the parcel lineage.	System must: ~ Provide tools to compare versions of a parcel and to discover differences ~ Provide tools to pull attributes or geometry from any of the available versions and create the final version ~ Provide tools to 'insert' or save the final configuration of the parcel into the parcel fabric
P6.4.4			Manage Feature Associations See similar functions in Edit Legal Description Fabric.	Includes spatial/topological constraints, keys to remote databases, and history. Upon committing the working version to the parcel fabric, parent-child relationships and parcel history are managed.	System must: ~ Display Parcel fabrics ~ Assist user to define relationship(s) ~ Associate parcels and their attributes ~ Manage lineage and history
P6.5		**Manage Workflow**	In the workflow concept of "job", the user will need different, mostly-automated tools for managing jobs. Each job will be associated with one or more dataset versions.	Once a user opens a job in the editor, the system should automatically open the correct datasets, etc, as well as the correct version of the database. The user will also need to switch jobs from within the editor, so there will have to be new tools and commands to support this. 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).	System must: ~ Integrate with workflow process to manage versions (see Manage Transaction) ~ Invoke Document Management System for selection list of potential documents to link ~ Establish key-key links with document indexing systems

P7.0		**PM-06 Edit Parcel Annotation**	Create or modify annotation within or associated to parcel fabric, legal description fabric, or measurement network to support display and formatted output.	Annotation may be derived automatically by an application that applies user-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 users flexibility in managing and displaying annotation for a variety of display situations (views and scales, etc.) and formatted output product types.	The user selects the target fabric or measurement network and edits annotation. A set of annotation editing tools are provided to customize the annotation features. users may define new annotation symbols. Annotation edit are updated to the target feature fabric or measurement network.
P7.1		**Setup Annotation Session**		See Annotation Controls in the General DFFS.	System must: ~ Assist user with session setup ~ Assist user to select parcel fabric, legal description fabric, or measurement network. ~ Assist user in selection of annotation options (fonts, symbols, etc.), setup of style (size, position, etc.), custom annotation/symbol set, (tie-bars, ovals, user-defined graphic features).
P7.2		**Edit Annotation**			System must: ~ Provide annotation tools ~ Assist user to apply annotation tools ~ Process updates ~ Update display ~ Save edited annotation features