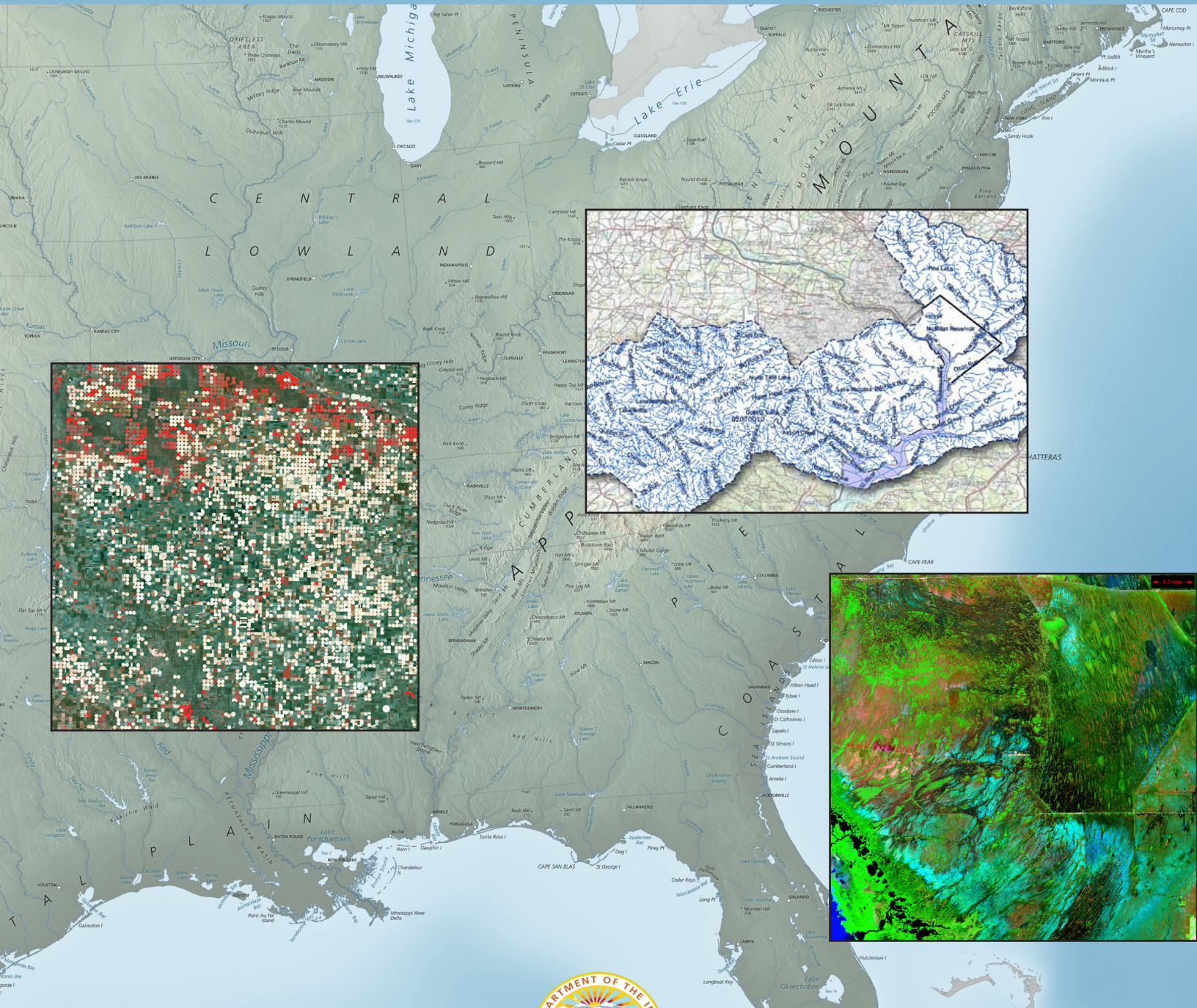# Geospatial Services Model

Serving the Geographic Business Needs of the
U.S. Department of the Interior

July 2007

U.S. Department of the Interior

Geospatial Services Model
Serving the Geographic Business Needs of the U.S. Department of the Interior

Front cover: From left to right: Garden City, Kansas, 2000 (USGS); National Hydrologic Dataset (NHD) subbasin covering Washington, DC (USGS); Everglades, Florida, 2000 (USGS); Background: U.S. shaded relief map (USGS).
Back cover: Top left: Malaspina Glacier, Alaska, 2000 (USGS); Center left: Digital Raster Graphics (DRG) of San Francisco Bay, CA (USGS); Bottom left: Hawaiian Islands (NPS); Center: Desolation Canyon, Utah, 2000 (USGS); Background: U.S. shaded relief map (USGS).

Geospatial Services Model
Serving the Geographic Business Needs of the
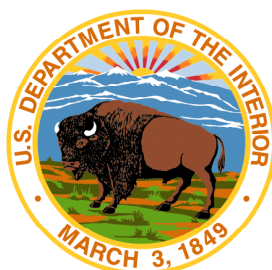## U.S. Department of the Interior
July 2007

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Chapter 1

Introduction

1.1. Purpose

The "Geospatial Services Model: Serving the Geographic Business Needs of the U.S. Department of the Interior" describes the critical findings and recommendations resulting from a geospatial analysis of those bureaus, agencies, and other entities under the U.S. Department of the Interior (DOI), referred here to as bureaus. The purpose of this document is to define how geospatial data and technology will be used to enhance the business activities of DOI to achieve its mission and goals. Geospatial data and technology are strategic, national assets involving major investments. While geospatial capabilities have been implemented across all DOI bureaus, these capabilities have not been documented and implemented in systematic ways, leading to impediments to potential interoperability and lost potential for cost savings.

DOI's geospatial investments are not currently managed as a cohesive set of assets and services. Historically, the costs of DOI's Geospatial services and products have been hidden from true understanding at the enterprise level, with a few exceptions. Costs and efficiency improvements or benefits to the business have not been quantitatively established. Geospatial information is produced and maintained by many different bureaus and program areas resulting in a confusing collection of data and services that are difficult for business areas to utilize. The Geospatial Services Model effort describes a recommended path to a target future state and milestones for measuring performance.

This services model provides key background information, discussion of issues, and proposed recommendations for the geospatial modernization blueprint (GMBT). This modernization blueprint is part of the DOI Enterprise Architecture process that is developing take-action modernization blueprints [1] using the Methodology for Business Transformation (MBT) process [2]. The MBT process identified the need for a Geospatial MBT (GMBT). This methodology conforms to the Federal Enterprise Architecture (FEA) [3] efforts with the goal to make the best use of available funds to achieve strategic goals and objectives for the DOI through Information Technology (IT) Capital Planning and Investment Control (CPIC) [4]. DOI's Geospatial Blueprint effort has been coordinated with the Office of Management and Budget's (OMB) Geospatial Line of Business (GeoLoB) [5] to prevent duplication of effort and ensure a clear division of labor with other federal agencies. The Enterprise Geospatial Information Management (EGIM) team [6], composed of bureau subject matter experts on the Geospatial Enterprise effort within DOI, was tasked to support the development of the GMBT in coordination with the Core Modernization Blueprint Team (CMBT) [7] or Core Team, composed of bureau executives and sponsors, which provides governance for the GMBT.

Mount Saint Helens pre-eruption
(Credit: USGS)

Mount Saint Helens post-eruption
(Credit: USGS)

"DOI's geospatial investments are not currently managed as a cohesive set of assets and services."

This services model is not intended to provide a complete and detailed discussion of the analysis. Detailed analysis discussion and supporting information will be found in the Geospatial Modernization Blueprint scheduled for release later this year.

1.2. Background

Most of the services provided by DOI program and mission areas are associated with a specific location or geographic area. Tracking, providing, and improving the delivery of these services require that information about such locations be collected and managed. Multiple DOI programs often perform services on overlapping geographic areas. In fulfilling their mission, bureaus often depend on, or provide, geospatial information along with related geospatial technologies and services.

DOI's business activity depends on geospatial information—knowing where things are and understanding how they relate to one another. Geospatial information is part of our daily lives, whether it is being used to make decisions on social or environmental issues, for emergency responses, or to find our way to a campground. The purpose of this Geospatial Services Model is to define how geospatial data and technology will be used to enhance the business activities of DOI to achieve the mission and goals.

The advent of inexpensive, intelligent information and communications technology has greatly enhanced our ability to produce large quantities of geospatial information. Users could retrieve, overlay, and analyze geospatial information on any subject, for any area, and at any desired level of resolution, if the data became available in standard digital format. Today, geospatial technology provides a simpler and more powerful means to combine many different kinds of data, leading to a variety of new geographical information applications that are constantly growing and evolving. The rapid growth in geospatial information resources and applications has led to DOI concerns about how to manage them efficiently and effectively. Inefficiencies can result in higher costs and reduced business performance. Common issues include duplication of geospatial information and databases, poor quality or inadequate geospatial information, difficulty in accessing and locating geospatial information and services across bureaus, and a limited capacity to share geospatial information among program and mission areas. Ineffectiveness can result from a general lack of coordination of acquisition and subsequent lifecycle management of geospatial data.

1.3. Business Focus Area

In 2006 DOI budget data identified that more than $270 million was spent on geospatial data, labor, services, and technologies [8]. However, this amount may not accurately reflect the full scope of DOI investment in geospatial resources, because the collection, storage, and use of geospatial data are deeply intertwined with many core mission systems, functions, and IT infrastructures in DOI. Unlike other traditional DOI lines of business, there is no comprehensive organizational or functional model that owns or manages geospatial issues. The area of geospatial business represents a collection of data, content, standards, technology, staff (government and contractor), technology tools, services, and systems that directly relate to 87 percent of DOI functional responsibilities. [9]

DOI is a major civilian player in the challenge to meet the national goals and objectives of OMB Circular A-16, Revised, "Coordination of Geographic Information and Related Spatial Data Activities" [10]. DOI used its A-16 roles and responsibilities as a framework to organize and classify its spatial data architecture.

"DOI's business activity depends on geospatial information…"

A key finding of this services model is that across DOI, geospatial business stakeholders are consistently confronted by a common set of issues, concerns, and needs related to geospatial technology and data that, if resolved, would benefit their overall work performance. These include:

"I know the information exists, but I can't find it or access it conveniently."

"If I can find it, can I trust it"?

"I don't know who else I could be working with or who has the same needs."

"I have no way to share costs across DOI."

"I am not fully aware of all the existing DOI geospatial capabilities."

The focus of the Geospatial Blueprint is on internal DOI geospatial data requirements and associated responsibilities as designated in Circular A-16 [10]. DOI initiated the blueprint study of its geospatial business and technical environments during the fall of 2005 to gain a better understanding of geospatial costs and value, and to discover opportunities to improve their usefulness. The objective of the blueprint study is to answer two basic questions: Are there more efficient ways to use geospatial capabilities in DOI? Are there opportunities for gaining increased benefit from current investments and expenditures?

The recommendations identified in this Geospatial Services Model and the Geospatial Modernization Blueprint are centered on creating a strategic shift in the delivery of future geospatial data and services. These recommendations are intended to provide the foundation for a sustainable migration to a service delivery model for DOI business improvement. This migration involves an approach that includes the optimization and standardization of geospatial programs, systems, and data assets to achieve an integrated "enterprise services" model supported by an improved governance approach and coordinated enterprise planning and investment strategy, as shown in Figure 1-1. The OMB GeoLoB [5] has established these categories to classify federal geospatial improvement efforts.
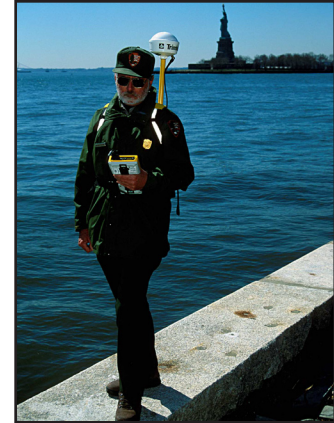
Ellis island mapping with GPS
(Credit: NPS)
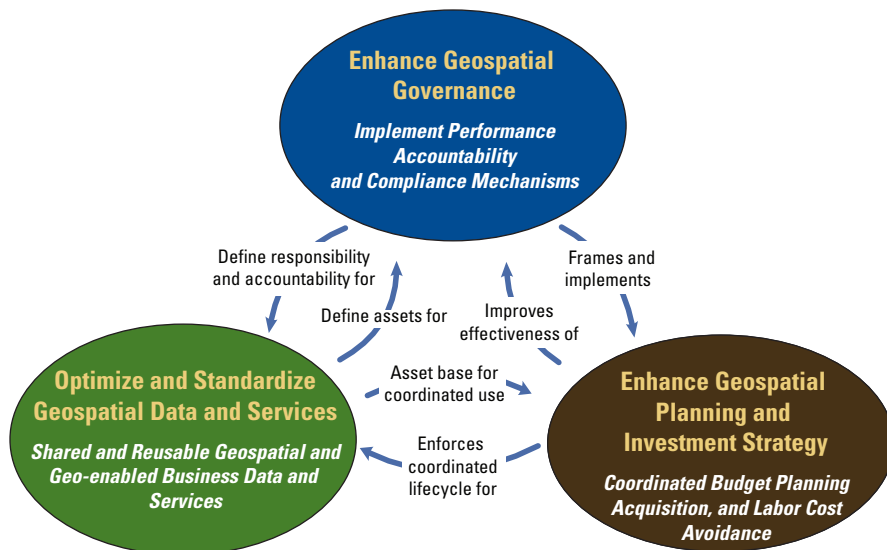
Figure 1-1. Geospatial Blueprint Recommendations

DOI has significant investments in standards and assets such as The National Map (TNM) and the National Integrated Lands System (NILS), but overall, has been adopting standards and enterprise capabilities slowly and in a disjointed fashion. DOI should accelerate and manage its creation or adoption of DOI enterprise and industry standards to reduce the barriers to geospatial information use. A successful model of enterprise service delivery will create an even greater business demand for these assets while reducing their incremental service delivery costs.

This enterprise services delivery model will require coordinated investment planning and requirements management to identify cost avoidance and savings opportunities. The services delivery model will require that the geospatial services and data assets be managed as a single enterprise portfolio of capability rather than as distinct, often unrelated program and mission areas, to achieve measurable and optimal performance.

"A successful model of enterprise service delivery will create an even greater business demand for these assets while reducing their incremental service delivery costs."

3

Ranger on patrol on the Tanner Trail
(Credit: NPS)

The potential value for DOI to adopt the enterprise management of key geospatial data assets and services has been demonstrated in several public institution business case studies. The Washington Department of Transportation [11] has demonstrated, through a rigorous investment analysis, the financial benefits of sharing a data asset across multiple programs. Its business case for a statewide transportation dataset improved the initial return on investment (ROI) by a factor of 11 through cost avoidance and savings. This demonstrates the value of acquiring and building out geospatial data in a shared and coordinated business model. The State of Oregon has developed a business case [12], the GIS Utility, that takes the managed data approach a step further. Oregon has demonstrated that it can improve the efficiencies of business processes at all levels of government and functional areas by providing geospatial data assets through enterprise services and improved access. It is projected that a $173 million investment will yield a $1.1 billion return over 10 years [12] (Figure 1-2) of revenue enhancement, cost avoidance and savings, operations and efficiency.
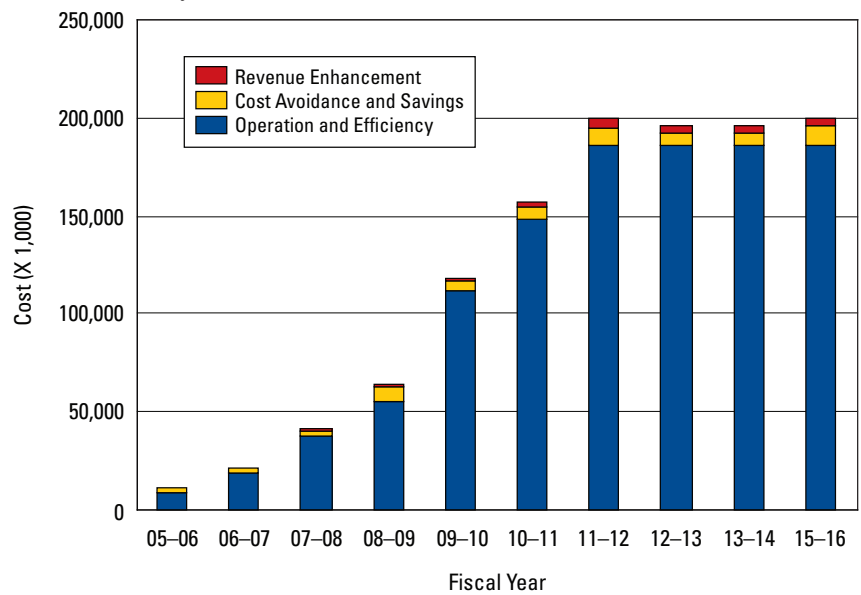
(Notes: Abbreviations: GIS, geographic information systems)

Figure 1-2. Annual Financial Benefits of GIS Use. [12]

4

1.4. Vision

DOI mission areas and goals of resource protection, resource use, recreation, and serving communities are enabled effectively and efficiently with geospatial data, information, and services [5]. The vision for the geospatial business focus area is to:

- Improve the ease, usability, and reuse of location-based information and services

- Create long-term savings and business efficiencies

- Improve the effectiveness of DOI investments

Strategies and objectives for achieving the geospatial vision for DOI include:

- Identification and development of critical reusable enterprise geospatial services and supporting business processes to improve business effectiveness

- Identification of areas to improve existing business processes, data, or IT to support program decision making

- Improvement in the usefulness of existing geospatial investments and assets by:

  - Identifying opportunities to collaborate

  - Improving geospatial interoperability through appropriate standards adoption

  - Reducing duplicative databases and business processes

  - Aligning best-of-breed existing capabilities with existing and future requirements

  - Investing in missing needed capabilities to achieve program objectives

  - Improving the quality and reliability of DOI-trusted data assets

The cost avoidance and savings potential for standards that are based on enterprise services, coordinated investment planning, and department-wide acquisition planning have already been demonstrated at DOI and in other federal efforts, as shown in the following list:

1. The existing ESRI GIS Enterprise Licensing Agreement has had cost avoidance and savings of $46 million over 5 years. [13]

2. System development costs using open geospatial standards based on development can yield a 26% total lifecycle cost savings. [14]

3. Past DOI consolidated data acquisitions resulted in $72 million of data at the cost of $11 million in 1999. [15]

(Notes: Abbreviations: DOI, U.S. Department of the Interior; ESRI, Environmental Systems Research Institute; GIS, geographic information systems)
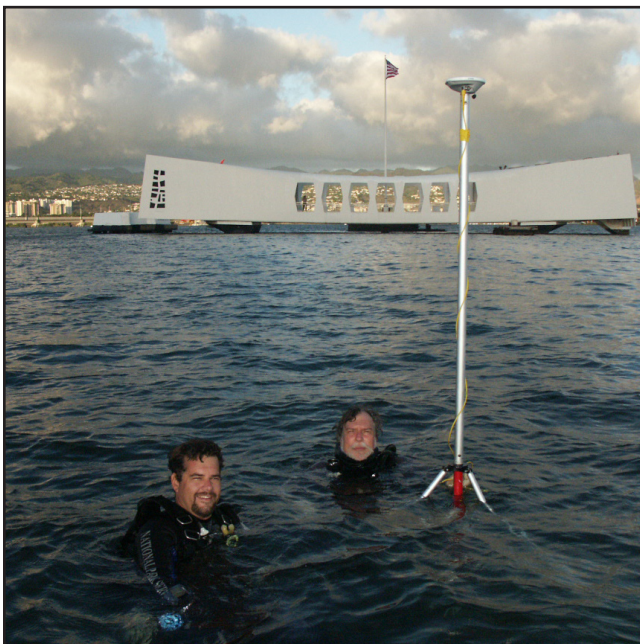
USS Arizona mapping project (Credit: NPS)
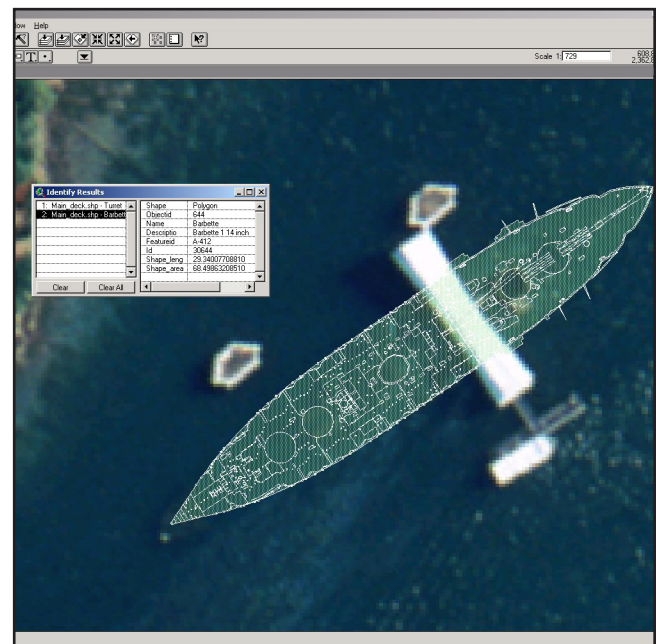
USS Arizona mapping project (Credit: NPS)

Cranes along the Platte River, Nebraska (Credit: FWS)

Recommendations for DOI Business Transformation

Gulf of Mexico off shore drill rig
(Credit: MMS)

This section provides additional detail on the specific recommendations that the area of DOI geospatial business should undertake to realize the desired target state. Each recommendation is integrated into an overall transition plan as described in Chapter 3. These recommendations are structured and presented according to the categories described in Figure 1-1.

2.1. Optimize and Standardize Geospatial Data and Services

The optimization and standardization recommendations involve the identification and establishment of two key elements. First, designate a set of reliable managed repositories of similar geospatial information. These will be referred to as an "Authoritative Data Source" (ADS) [16]. Second, create a set of shareable services, a service-oriented architecture (SOA), that uses an ADS to provide maps, data, and data exchange capabilities for multiple types of consumers. The ADS will be supported by DOI ensuring the data and service will be available to the consumer. These recommendations rely on DOI's adoption of data and technology standards along with supporting data lifecycle management policy and processes.

2.1.1. Recommendation—Establish ADSs and Supporting Geospatial Services

Currently, DOI geospatial information is produced and maintained by many different bureaus and program areas primarily to serve mission or program needs, respectively. As a result, DOI geospatial information management is not well coordinated across bureaus and programs. The ability to share geospatial information both within and external to DOI is increasingly more vital to fulfill internal mission needs and external demands. Consumers of geospatial information often find it difficult to locate reliable sources of geospatial information. Once they discover such information, they find it difficult to determine its accuracy and timeliness as well.

This recommendation has two parts. The first part is to establish a series of ADSs for similar geospatial information that is highly valuable and reusable across DOI. The second part is for information access and delivery services to be provided by the ADSs. These services will provide maps for visualization, data for manipulation, and data for exchange. This two-part strategy affords DOI the opportunity to focus on select and critical geospatial data assets and incrementally manage the evolution of the assets and architecture.

"…establish a series of ADSs for similar geospatial information that is highly valuable and reusable…"

Fire retardant drop
(Credit: BLM)

The DOI ADS approval process consists of three phases:

- Assess and designate the candidate ADS — An assessment during a blueprint analysis to identify opportunities to improve the quality and reusability of critical data assets for the enterprise

- Acceptance — Review by the business and IT owners to determine the extent to which the ADS can be supported.

- Transition and Maintenance — Migration of the supporting data and infrastructure to the ADS managed state to improve service to the greater DOI community.

This project is piloting the DOI ADS process using the Federal Land Ownership and Cadastral data themes.

Data Aggregation in the ADS Model

An ADS is a repository of geospatial data and information that is identified, cataloged, and published to provide trusted, timely, and secure information to support the consumer. Creating ADSs is not a new concept in the federal geospatial arena. As a standard, the ADS information management model has been adopted by both the Department of Defense (DOD) [17] and the Department of Homeland Security (DHS) [18] to enhance mission capabilities that leverage geospatial assets. Again, it should be noted that the ADS concept will be first used to manage DOI information that has the greatest potential value or reuse to the DOI user community.

As an example, the ADS concept can be applied to DOI facilities or trails information. Multiple organizations have these data, multiple bureaus need the data, it is difficult for the bureaus to obtain data from one another, and it is difficult to keep data synchronized as they change.

Aggregating enterprise information has value to the organization through standardization of production processes and standards implementation, and by providing a foundation of improved accessibility and delivery for end users. In the ADS model, producers will submit data and information to a target ADS and data steward(s), where the data and information would be integrated and shared as an enterprise asset for reuse.

The services model analysis reviewed numerous geospatial ADS candidates that are required by the DOI mission with the intention of identifying the best available asset for each type of geospatial data to support the business need. The candidates were assessed against six data quality criteria for their reuse potential and against DOI's sphere of influence. The top priority candidates are identified in Table 2-1.

Table 2-1. Recommended Geospatial Authoritative Data Source (ADS) Candidates (continued on next page)

Candidate Authoritative Data Source Recommendation	Organization
Establish ADS for A-16 federally owned lands —Candidate ADS: NILS as ADS for A-16 federal ownership boundaries (land).	BLM
Establish ADS for national daily large fire incident and associated burn areas (not historical) from the existing business practices. Publish as interoperable map service for all to read and use. Candidates for ADS include: ICS-209, GeoMAC or MODIS. The final designation of the ADS is deferred to the wildland fire community's NWFEA Blueprint efforts.	DOI
Establish ADS for GAP data - Candidate ADS for NBII and its maps servers as authoritative data sources for GAP data.	USGS
Establish ADS for DOI asset and facilities services (dams, trails, recreational facilities, etc.); Assets not reported via A-16 facility locator requirement—Candidate ADS is a Facilities Management Systems (FMS) standard for DOI, enterprise facilities.	DOI
Establish an ADS for water quality and quantity tracking—Candidate ADS: NWIS services, stream gauges (water quality and quantity over time). Recommend map and data services be made available through OGC compliant interface	USGS
Establish ADS A-16 Digital Ortho Imagery Large Scale and High Resolution Imagery Services—Candidate ADS: TNM (for multiple large-scale products).	USGS
Establish ADS for national hydrography dataset—Candidate ADS is NHD delivered through TNM.	USGS
Establish ADS for A-16 Cadastral offshore—Candidate ADS: MMS offshore will assess and determine if NILS can be integrated into OCS-Connect system. If not, current plans for OGC standards-based integrated map servers should be deployed at the MMS level and provide the authoritative representation to DOI.	MMS / BLM
Establish ADS for A-16 elevation—Candidate ADS is TNM.	USGS
Establish ADS for A-16 Cadastre—Candidate ADS: NILS for management and delivery of land net derived from survey or digitized PLSS.	BLM
Establish ADS for A-16 shoreline information—Candidate ADS is MMS-delivered authoritative spatial representation of this information to DOI consumers. Coordi-nate with A-16 partners to ensure DOI has latest data or data of known provenance. Long-term work with NOAA to develop a map service for DOI consumers.	MMS
Establish ADS for DRG topographic maps (seamless color balanced DRG data)-Candidate ADS is TNM.	USGS
Establish ADS for A-16 VEG—Candidate ADS: recommend DOI use the target contributing producer process to manage its contribution to the authoritative A-16 source provider in the interim. DOI should work toward the establishment of online map and data services from the A-16 provider (USFS) via the GMO. Simultaneously, it is recommended to develop a DOI-wide ADS solution for its need for finer scale vegetation mapping (approximately 1:12k) based on the National Vegetation Classification System.	DOI
Establish ADS for cultural inventory—develop secure enterprise inventory for internal use.	NPS
Establish ADS A-16 law enforcement incident information—Candidate ADS is a secure map server with incident data to support analysis for law and other program areas, such as safety, facilities, and recreation.	DOI
Establish ADS for offshore minerals—Candidate ADS: OCS-Connect or MMS map services.	MMS

(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; DOI, U.S. Department of the Interior; DRG, Digital Raster Graphics; FMS, Facility Management Systems; GAP, Gap Analysis Program; GeoMAC, Geospatial multiagency coordination for wildfire support; GIS, geographic information systems; GMO, Geospatial Management Office; ICS, Incident Command System; MMS, Minerals Management Service; MODIS, Moderate Resolution Imaging Spectroradiometer; NBII, National Biological Information Infrastructure; NHD, National Hydrologic Dataset; NILS, National Integrated Lands System; NOAA, National Oceanic and Atmospheric Administration; NPS, National Park Service; NWFEA, National Wildland Fire Enterprise Architecture; NWIS, National Water Information System; OCS, Outer Continental Shelf; OGC, Open GIS Consortium; PLSS, Public Land Survey System; TNM, The National Map; USFS, U.S. Forest Service; USGS, U.S. Geological Survey; VEG, Vegetation Mapping Program)

Lava sky light at Hawaii Volcano Observatory (Credit: USGS)

Geospatial training class
(Credit: NPS)

ADS Information Access and Delivery Services

The second part of the recommendation addresses stakeholder needs for efficient access to geospatial information maintained in any given ADS. We recommend that enterprise data, map, and exchange services be provided by the ADSs. These services are defined in Table 2-2. Service providers will manage these services using Service Level Agreements (SLAs) that will ensure the consumer's confidence and participation, and we will build these services on industry standards to make them as extensible as possible to many types of reuse.

Table 2-2. Definition of ADS Services

ADS Service	Description
Data Service	The set of capabilities that provides support for data management (storage, access, organization, analysis, and manipulation).
Map Service	The capability to present geographical information access via data layers without hosting them locally. Consumers of the map service will always have access to the latest updates without data duplication.
Exchange Service	The capability for the automated delivery of electronic data to a consumer using a predefined set of standard data formats and communication protocols.

The ADS services strategy will lead to incremental costs and overhead associated with maintaining enterprise geospatial information by the ADS owner. Based on the current service levels for a typical ADS candidate, costs associated with supporting enterprise services will likely extend beyond current local program funding. However, when the improved productivity access and delivery of ADS-managed geospatial assets are taken into account, it is anticipated that the benefits of funding incremental investments in ADSs to provide enterprise services will outweigh these costs. The Core Team and EGIM are in the process of establishing the financial benefits of this service model. To mitigate funding risks and concerns associated with sustaining an enterprise service delivery model, we recommend that a funding model be established that provides additional budget, where needed, to account for incremental costs associated with achieving and maintaining certification and service delivery levels for candidate ADS service providers. Possible funding strategies are listed in Table 2-3.

"…we will build these services on industry standards to make them as extensible as possible to many types of reuse."

Leveling crew 1905 Keeler, CA (Credit: USGS)

Table 2-3. Funding Strategy Alternatives for Establishing a Geospatial ADS

1	Shared Working Capital Fund (WCF) for geospatial services and data assets
2	Assessment of bureaus and systems based on use
3	Assessment of programs that use ADS services
4	New investment (Shared Exhibit 300 with FY10 funding request)
5	Fee for Service (for example, subscription)
6	Fee for use (incremental to any existing cost recovery fee)
7	Incremental investment (managed under existing investments to provide for ADS services)
8	Assessment of redundant and inefficient data source and services for reallocation

(Notes: Sources: Shared Exhibit 300 [4]. Abbreviations: ADS, Authoritative Data Source; FY, Fiscal Year)

Shasta Dam, Shasta, California
(Credit: BOR)

The proposed implementation-sequencing plan for this recommendation is presented in Figure 2-1.

Task Item No.	Task Name	2007			2008				2009				2010			
		Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	Establish the process for certification of ADS stewards (DAC)	▬	▬	▬												
2	Perform pilot ADS certification for at least one steward (designated ADS steward, DAC, and EGIM)		▬	▬												
3	Develop priorities and approved plan for expanding to provide additional ADS capabilities (Core Team, EGIM, GMO, affected ADS stewards, and owners)				▬	▬										
4	Establish a funding model for incremental costs associated with upgrading to ADS service levels (Core Team)	▬	▬	▬	▬	▬										
5	Perform ongoing ADS certification (designated ADS stewards, GMO, IRB, and EGIM)					▬	▬	▬	▬	▬	▬					
6	Establish ADS-driven services (designated ADS stewards, GMO, and EGIM)					▬	▬	▬	▬	▬	▬	▬				

(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; DAC, Data Advisory Committee; DOI, U.S. Department of the Interior; EGIM, Enterprise Geospatial Information Management; IRB, Investment Review Board [manages the portfolio by selecting, controlling, and evaluating the information technology investment for DOI] [4]; PMO, Project Management Officer)

Figure 2-1. Sequencing Plan for Establishing ADSs and Services for Recommendation 2.1.1

Mapping mining site
(Credit: OSM)

2.1.2. Recommendation—Establish Data Lifecycle Management, Policy, and Services Practices

Data stewards will be responsible for ensuring that the products and data provided by the ADS conform to pre-defined service levels (for example, data quality, accuracy, timeliness, etc.) as established in an SLA. Given that the data supported by each ADS will likely be provided by local producers, there will be a need for a standardized data exchange and quality management to support the controlled exchange of data. Without such supporting practices, ADSs will be confronted with increased risks and complexity associated with maintaining multiple, nonstandard formats and processes for transferring locally produced data to the ADS. This lack of standardization will lead to significantly higher ADS management costs and will result in lower levels of reuse, timely information, and productivity.

This recommendation establishes a standard DOI data lifecycle management (LCM) process aligning local geospatial data producers and the target ADS. The process is designed to include quality control, metadata management, data transfer, and workflow accountability. The ADS concept and the supporting lifecycle processes will be underpinned by DOI policy. The key policy recommendations associated with establishing standards and best practices are described in Table 2-4. Monitoring of such policies will rely on the data stewards, EGIM, and a newly established Geospatial Management Office (GMO) to coordinate oversight (See Recommendation 2.3.1).

Table 2-4. Policies that Support the Geospatial Data Lifecycle Management

1	Existing systems or investments that own and manage OMB Circular A-16 data or other geographic data deemed to be of "national or DOI-wide" interest shall publish their data as standards-based map services.
2	ADS shall support the extension of the enterprise data model through controlled management processes to help reduce local datastores.
3	All DOI geospatial ADS shall define and establish the necessary universal key practices, metadata, attribution standards, positional accuracy, and temporal standards.
4	Each ADS shall establish standards for the exchange of locally produced data. DOI programs collecting digital geospatial data as a contributing producer to any given ADS shall conform to such standards.

(Notes: Sources: OMB Circular A-16 [10]. Abbreviations: ADS, Authoritative Data Source; DOI, U.S. Department of the Interior; OMB, Office of Management and Budget)

Data lifecycle management and policies will promote standard best practices that will greatly facilitate the ADS service delivery model. End users and consumers of DOI geospatial information will benefit as lifecycle practices and enterprise ADS standards further improve the efficiency and productivity associated with gathering, manipulating, and evaluating geospatial data. These lifecycle processes will include a bureau-led, quality-control step to ensure ADS quality. In addition to increased data reuse potential, the lifecycle processes will greatly enhance the capability to track data assets of DOI-wide interest that are produced in its federated model. The federated model recognizes the need for organizationally and geographically distributed information producers and their expertise to be key contributors to the enterprise model. Without a coordinated bureau quality-control process, there is the risk that local producers could easily become disenfranchised. The proposed implementation-sequencing plan for this recommendation is presented in Figure 2-2.

"The federated model recognizes the need for organizationally and geographically distributed information producers…"

12

Task Item No.	Task Name	2007			2008				2009				2010			
		Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	Establish a policy that OMB Circular A-16 or other DOI-wide data be published as a map service (SAOGI, Core Team, EGIM, and GMO)	▬	▬	▬	▬											
2	Establish a policy that only incremental value-added information and attributes be maintained (ADS, EGIM, and GMO)			▬	▬	▬	▬									
3	Establish universal key practices, metadata, attribution, positional accuracy, and temporal standards (ADS, EGIM, and GMO)			▬	▬	▬	▬	▬	▬	▬	▬	▬	▬			
4	Establish a funding model for incremental costs associated with upgrading to ADS service levels (Core Team)	▬	▬	▬	▬											
5	Establish performance measurements, monitoring, and reporting to ensure compliance with the policies (EGIM and GMO)			▬	▬	▬	▬									

Fire fighter
(Credit: BLM)

(Notes: Sources: OMB Circular A-16 [10]. Abbreviations and acronyms: ADS, Authoritative Data Source; DOI, U.S. Department of the Interior; EGIM, Enterprise Geospatial Information Management; GMO, Geospatial Management Office; OMB, Office of Management and Budget; SAOGI, Senior Agency Official for Geospatial Information)

Figure 2-2. Sequencing Plan for Establishing Data Lifecycle Management for Recommendation 2.1.2

2.1.3. Recommendation—Establish DOI Product Generation Services for Geospatial Products and Information

Many users of DOI geospatial products and data, including DOI mission workers, geospatial subject matter experts (SMEs), external partners, citizens, or industry users, experience difficulty in navigating multiple complex interfaces scattered over numerous Web locations and repositories. It is expensive and difficult for a user to convert efficiently the many themes of required data into a useable format to support their efforts. The current model requires an individual to have geospatial skills, knowledge of DOI products, and time to sort through redundant holdings or understand the DOI organizational structures. Today, there are multiple mechanisms to find, order, configure, and track requests. While the target ADS model and supporting services will help alleviate this problem by organizing the back-end resources, there are still issues associated with improving user navigation and requesting data, formatting, and delivering products to achieve labor efficiencies for external consumers and DOI consumers, as described in Table 2-5. The proposed solution will integrate with existing assets, including the Geospatial One-Stop (GOS) portal [19] and search services and the recommended ADSs.

Equipment inspection for a deep sea dive
(Credit: MMS)

Table 2-5. Key Business Operations Supported by Product Generation Services

1	Provide a business oriented DOI-wide geospatial product catalog to facilitate navigation and access to available DOI data assets.
2	Provide data formatting, transformation, and delivery services to generate geospatial databases, products, data exchanges, and dynamic user views.
3	Provide user navigation, product configuration, and status tracking services.

(Notes: Abbreviations: DOI, U.S. Department of the Interior)

This recommendation was developed to provide access in a consistent, user-friendly means to present, manage, and process orders for geospatial data, products, and services provided by DOI. A business-driven, enterprise service delivery model for geospatial information products and data will include capabilities for requesting, configuring, transforming, and delivering products, geospatial databases, exchange data formats, and logical views of information. These services will provide an improved business-driven approach to locating, configuring, and obtaining existing DOI geospatial products and information that leverages multiple DOI ADSs.

This recommendation realizes one of the key benefits in the development of ADS and data lifecycle management, established with Recommendation 2.1.2. With the data in a managed state, it is now possible to develop functionality once and use it for the many systems supporting the enterprise data assets.

This recommendation has two implementation stages. The first stage provides an interim solution to support the transition to the target state. This stage requires the creation of a DOI geospatial product and service catalog and the reorganization of existing product request and delivery mechanisms into a more cohesive and user-friendly model. The second stage extends the DOI geospatial product and service catalog and product framework to implement geospatial data requests, configuration, and delivery services into the business cycle.

The Core Team, EGIM, and GMO will coordinate development and maintenance of DOI's geospatial catalog of products and services. They will facilitate the interim phase reorganization along with product and services representatives. In the longer term, the GMO will work with EGIM to implement the target product generation services model. As with the need for a funding model to implement ADSs, it will be necessary for the Core Team to establish a funding model for the development of product generation services. A FY2010 investment is planned. The proposed implementation-sequencing plan for this recommendation is presented in Figure 2-3.

"With the data in a managed state, it is now possible to develop functionality once and use it for the many systems supporting the enterprise data assets."

Grazing cattle on federal lands (Credit: BLM)

Task Item No.	Task Name	2007			2008				2009				2010			
		Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	Establish and maintain a catalog of DOI geospatial products and services (GMO)		▬	▬												
2	Manage data and product requests and delivery of services (GMO, EGIM, and Core Team)					▬	▬									
3	Phase 1—Restructure the access to the current access and delivery services for geospatial products and services (EGIM and GMO)				▬	▬	▬									
4	Establish a funding mechanism delivery services for cross-agency products and services (GMO and Core Team)			▬	▬	▬										
5	FY10 investment to support Phase II integration of service delivery with the business cycle (GMO and EGIM)							▬	▬	▬	▬					
6	Integrate and implement Phase II service delivery management for FY10 and beyond (GMO and EGIM)									▬	▬	▬	▬	▬		

(Notes: Abbreviations and acronyms: DOI, U.S. Department of the Interior; EGIM, Enterprise Geospatial Information Management; FY, Fiscal Year; GMO, Geospatial Management Office)

Figure 2-3. Sequencing Plan for Geospatial Product Generation Service Delivery for Recommendation 2.1.3

Vegetation survey Klamath Marsh, Oregon with FWS (Credit: BOR)

2.1.4. Recommendation—Implement Geo-Enabled Key Asset and Stewardships Business Systems Interfaces

The inability to readily access and use location-based finance and facilities information across DOI results in challenges when planning for and implementing land and resource stewardship and capital planning activities. The application of geospatial visualization, mapping, and processing capabilities can greatly improve cross-program operational knowledge and awareness that will improve financial performance and accountability. By creating the spatial or location-based relationships among financial investments, assets, and the managed land, DOI's existing stewardship assets can provide better services that will improve the accountability of investments to land stewardship goals.

This recommendation provides the ability to spatially associate and display the financial, facilities (FMS), and project assets and activities that are being tracked in the Financial Business Management System (FBMS) to a given piece of land. This requires establishing the necessary spatial data relationships and interfaces from FBMS to the recommended target geospatial ADSs, as described in Table 2-6. These geospatial interfaces take advantage of existing key enterprise data assets and offer a new means to perform quality assurance, analysis, visualization, and reporting on improved real property and land assets. Improved geospatial business intelligence will provide a dynamic means to understand the changes in land ownership (title) and land status (land use, leasing, easements, rights-of-way, and permitting) and improve the financial system data integrity and asset management.

Park Ranger at entrance station
(Credit: NPS)

Table 2-6. Summary of Interfaces for the Financial Business Management System

1	FBMS "Real Property Process" realty module interface to authoritative spatial data and supporting land transaction information managed in NILS/Trust NILS TAAMS and LR2000 [20]
2	FMS for real property business process with supporting interfaces from FBMS modules (Financials, Asset Management, and Materials Management) through the planned FMS gateway to the enterprise facilities (FMS)
3	NILS/NILS Trust (LR2000 and TAAMS) to FMS using the inherent spatial qualities of the feature data

(Notes: Abbreviations and acronyms: FBMS, Financial Business Management System; FMS, Facility Management Systems; LR2000, Legacy Rehost 2000—BLM and Minerals Records 2000 system [20]; NILS, National Integrated Lands System; TAAMS, Trust Assets Accounting Management System)

This recommendation is consistent with the existing scope of the Financial Management Modernization Blueprint as defined in the FBMS Operational Concept [21]. This recommendation also suggests a complementary, interfacing strategy that will yield greater benefits to more users. The FBMS, NILS, and facilities business and system owners will need to review and accept these recommendations for the integration of geospatial capabilities.

The approach for implementation will require that a cross-functional project team be established with representation from each of the three major investments described in Table 2-6, as well as the financial management business area, the EGIM, the GMO, and the land and resources management community. The DOI Policy, Management, and Budget Office (PMB) will have the primary coordination role for all project tasks. This team will have the following objectives:

- Identify the affected business processes and rules, document the requirements, generate cost estimates and benefits, and incorporate the necessary activities into the existing development plans

- Develop a shared funding strategy to support system interface and enterprise services development

- Post the approved plan on the DOI enterprise project-planning database to facilitate the coordination of the projects and to be included as milestones in the respective investment business cases (i.e., Exhibit 300s)

- Coordinate the development of the facilities data collection strategy in support of the target FMS implementation and the long-term reuse by the extended DOI community

The shared funding model should be similar to the funding model approach developed to support Recommendation 2.1.3. The proposed implementation-sequencing plan for this recommendation is presented in Figure 2-4

Task Item No.	Task Name	2007 Q2	Q3	Q4	2008 Q1	Q2	Q3	Q4	2009 Q1	Q2	Q3	Q4	2010 Q1	Q2	Q3	Q4
1	Perform requirements analysis, identify project cost and benefits, and develop integrated development plan (PMB—ADS for Land Ownership, EGIM, and GMO)					▬	▬									
2	Develop shared funding strategy to support interface and enterprise services development (PMB—ADS for Land Ownership, EGIM, and GMO)					▬										
3	Establish ability to track milestones at the enterprise level for coordinated development and investment planning (PMB—ADS for Land Ownership, EGIM, and GMO)								▬	▬						
4	Establish standardized, coordinated facility data collection to support single instance to support FMS (PMB—EGIM, GMO, data stewards, and System Project Manager)								▬	▬						
5	Execute system projects to implement interfaces as needed for improved business intelligence (PMB—ADS for Land Ownership, EGIM, and GMO)													▬	▬	

(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; DOI, U.S. Department of the Interior; EGIM, Enterprise Geospatial Information Management; FMS, Facility Management System, GMO, Geospatial Management Office; PMB, Policy, Management and Budget Office [DOI])

Figure 2-4. Sequencing Plan for Improving Business Intelligence and Understanding for Recommendation 2.1.4

Flooding at Carita Creek, New Mexico
(Credit: USGS)

2.1.5. Recommendation—Adopt and Implement Geospatial Interoperability Standards and Licensing for Enterprise Geospatial Technology and Data

As with the legacy practices for local management of data (as addressed by Recommendation 2.1.2) and infrastructure (addressed by Recommendation 2.1.4), DOI has evolved a fragmented approach to the adoption of interoperability standards and the licensing of enterprise geospatial technology. This has resulted in increased costs associated with maintaining multiple licenses and the need to support multiple technology solutions that may not be based on industry standards.

This recommendation establishes a DOI enterprise license agreement (ELA) strategy for key technologies and adopts geospatial interoperability standards for reengineering of existing applications and for new technology investments. This recom-

Wading stream flow measurements in Idaho (Credit: USGS)

mendation minimizes the need for redundant technology investments at the program level and provides standardized solutions that support interoperability across the enterprise. Beneficiaries of this recommendation include program managers, system owners, and developers, most of whom will have access to standardized technologies and data solutions that meet industry best practices and geospatial program requirements to attain lower overall enterprise-wide technology costs. However, this approach may require that some programs and system owners who currently depend on nonstandard geospatial products or interoperability standards adopt and integrate these new standards as reengineering opportunities occur. Key recommended actions for implementing this recommendation are described in Table 2-7.

Table 2-7. Recommendations for Implementing Technology Standards

1	Review Federal Geospatial Enterprise Architecture standards and adopt appropriate and applicable standards for geospatial technologies as recommended by the Federal Chief Information Officer (CIO) Council in the DOI Technical Reference Model
2	Establish a training class for application and system developers to ensure adoption of Open GIS Consortium (OGC) service and data interoperability standards
3	Establish ELAs for key supporting technologies such as ERDAS for image processing, AutoCAD for computer-aided design, and global positioning system (GPS) tools such as Trimble, Garmin, and Magellan

(Notes: Sources: Federal Geospatial Enterprise Architecture; DOI Technical Reference Model. Abbreviations and acronyms: AutoCAD, software supporting computer-aided design and drafting; DOI, U.S. Department of the Interior; ELA, enterprise license agreement; ERDAS, software package for processing imagery, including satellite, radar, etc.; GIS, geographic information systems)

The proposed implementation-sequencing plan for this recommendation is presented in Figure 2-5.

Task Item No.	Task Name	2007			2008				2009				2010			
		Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	Review and adopt the Federal Geospatial EA standards for geospatial technologies in the DOI TRM (CTOC, EGIM, and GMO)		▬	▬	▬											
2	Establish a training class for developers on OGC data interoperability standards application development (EGIM and GMO)					▬	▬	▬								
3	Establish ELAs for key technologies for image processing, computer aided design, and GPS (EGIM and GMO)		▬	▬	▬	▬	▬	▬								

(Notes: Abbreviations and acronyms: DOI, U.S. Department of the Interior; CTOC, Chief Technology Officers' Council; EA, enterprise architecture; EGIM, Enterprise Geospatial Information Management; ELA, enterprise license agreement; GIS, geographic information systems; GMO, Geospatial Management Office; GPS, Global Positioning System; OGC, Open GIS Consortium; TRM, Technical Reference Model for the Department of Interior Enterprise Architecture effort utilizing the Methodology for Business Transformation [MBT] by developing and implementing take-action modernization blueprints [4]. Also see http://www.doi.gov/ocio/architecture/index.html)

Figure 2-5. Sequencing Plan for Enterprise Technology Standards and Licensing Agreements for Recommendation 2.1.5

2.2. Enhance Geospatial Planning and Investment Strategy

DOI does not coordinate the capture of geospatial business requirements during the work activity planning cycle for the enterprise. Currently, multiple bureaus and programs are often unaware of the potential to identify opportunities for shared geospatial data acquisition, other forms of resource use, or cost sharing. For example, the geospatial enablement of the Budget and Science Information System Plus (BASIS+) system within the U.S. Geological Survey (USGS) and the Wetlands Treatment projects within U.S. Fish and Wildlife Service (FWS) are examples of efforts to try to mine the potential value of a geospatially based planning process.

Currently, geospatially supported DOI programs do not have a mechanism for coordinating work planning processes that can help identify and coordinate common resource needs of individual projects and programs. This lack of a mechanism results in inefficiencies and redundancies, causing overall higher program costs to procure and produce geospatial products and services required to support the mission. The target solution will include a budget coding enhancement, improved work and investment planning processes (CPIC) [4] and leverage GOS [19] and TNM.

2.2.1. Recommendation—Establish a Geospatial Business Requirements and Investment Planning Process

This recommendation establishes a DOI-wide geospatially smart requirements planning process that will identify common needs for acquisition of geospatial data, contract services, and resources during the work activity planning cycle. The key benefit of a requirement planning process will be the ability to identify and manage cost avoidance opportunities associated with resource requirements, geospatial data, and services acquisition.

Working through the Core Team and EGIM, the GMO should define and establish the standard business process to support the submission, review, and approval of program requirements for geospatial data, IT services, products, and contract services. It is recommended that EGIM and GMO work together to initiate a FY2007 cross-bureau pilot of the affected work activity and investment planning business processes to identify long-term cost benefits and performance measures associated with managing a sustained DOI-wide geospatial requirements planning process, such as the DOI High-Priority Mapping Program [15]. The GMO should also establish an interim enterprise-wide repository for geospatial work activity requirements to support the pilot while assessing the viability of a FY2010 investment. A policy should be established requiring program managers to submit their requirements to the repository.

To implement this recommendation successfully, it is necessary to include a shared funding model that supports acquisition of shared geospatial products and services. This model is necessary to alleviate any risks associated with the possible perception that consolidated requirements are not otherwise funded equitably across all programs that benefit. The recommended short-term approach is for lead programs to fund the additional requirements as identified by the GMO to drive both the increased utility of newly acquired geospatial assets and the adoption of technology, interoperability, and data standards.

The Core Team, EGIM and GMO should collaborate to develop alternatives for an appropriate funding mechanism for acquisition of shared geospatial products and services resulting from consolidated requirements across programs. This will include utilizing GOS [19] and other DOI integrative mapping efforts. The Core Team should approve and sponsor this funding model. The proposed implementation-sequencing plan for this recommendation is presented in Figure 2-6.

The value of geospatially enabling these key business process steps is that it will be possible to visualize and spatially analyze DOI's planned activities by location and type of work. With this insight into location and understanding of the type of product to be created and the work to be performed, DOI will be able to ask the following types of questions:

1. Is there an opportunity to use geospatial resources more effectively?

2. Is the nature of the work such that there are common information and data requirements?

3. Is anyone planning on collecting data in my area? Who does one contact?

4. How does one compare business requirements to established production and collection plans from the mapping programs, for example, Geology, Imagery, Elevation, and Wetlands?

5. Who are the end users of my product or services? Will there be interoperability issues? Will there be legal issues or policy conflicts?

Coal seam mining Gillette, Wyoming
(Credit: OSM)

Task Item No.	Task Name	2007			2008				2009				2010			
		Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	Establish an interim capability and repository solution for managing geospatial requirements (GMO)			▔	▔	▔	▔	▔	▔	▔	▔	▔	▔			
2	Establish a long-term, enterprise-wide repository for geospatial requirements (GMO)													▔	▔	
3	Establish policy and performance measures for the requirements planning for geospatial products and services (EGIM and GMO)				▔	▔										
4	Institute the planning process for DOI-wide program requirements for geospatial products and services (GMO and EGIM)						▔	▔								
5	Establish long-term funding needs for a DOI-wide consolidated requirments across programs (GMO, EGIM, and Core Team)						▔	▔	▔	▔						
6	Establish a shared funding and investment mechanism for consolidated reqirements across programs (GMO, EGIM, and Core Team)								▔	▔	▔					
7	Deploy the long-term planning process for DOI-wide requirements for geospatial products and services (GMO and EGIM)											▔	▔	▔	▔	▔
8	Enhance existing CPIC process to capture geospatial data and services requirements (Core Team, EGIM, GMO)				▔	▔	▔									

(Notes: Abbreviations and acronyms: CPIC, Capital Planning and Investment Control; DOI, U.S. Department of the Interior; EGIM, Enterprise Geospatial Information Management; GMO, Geospatial Management Office)

Figure 2-6. Sequencing Plan for Establishing a Requirements Planning and Investment Process for Recommendation 2.2.1

2.3. Enhance Geospatial Governance

Today, geospatial assets are highly distributed throughout the DOI organizational and business network with no coherent management mechanism designed to exploit the overall value and evolution of these assets. Management of the performance and accountability of a $270 million, multiple-owner portfolio of distributed technologies, data assets, and services poses a new challenge for DOI [8]. At the time of publication of this report, elements of the geospatial assets have been organized around business or organizational lines. Federated services and data pose different challenges and require a new approach to management and governance.

2.3.1. Recommendation—Establish Geospatial Governance, GMO, and Portfolio Management

The key to improved geospatial performance and accountability is to manage the operational and developmental requirements of the bureaus against the existing baseline of technology, services, and data assets. Management of the business and operational requirements will provide the coordination necessary to guide the evolution of geospatial data and services from the current baseline to the target state. As new investment requirements are levied on the baseline, the geospatial governance group would validate and prioritize such requirements with the DOI consumers and providers to develop a coordinated investment strategy. Providing a vehicle to identify and review and prioritize requirements will enable geospatial assets to mature systematically in a planned manner, extending the IT and operational costs further. The existing DOI investment governance will receive investment requests that have business buy-in and crosscutting value. The recommended target state governance model is presented in Figure 2-7. Key elements of the recommended governance model are described in Table 2-8.

Fire coordination meeting—2007 Georgia / Florida (Credit: FWS)

Table 2-8. Components of the Geospatial Governance Model

Geospatial Governance Component	Description
Senior Agency Official for Geospatial Information (SAOGI)	The designated leader for an agency's geospatial assets. This role is currently assigned to the Deputy Assistant Secretary for Water and Science.
Executive or Geospatial Core Team	Senior Bureau management with strong interest in improving the overall efficiency of DOI geospatial program resources and capabilities to achieve improvements in DOI-wide mission effectiveness
Enterprise Geospatial Information Management (EGIM)	Senior bureau geospatial leaders and SMEs with knowledge of and responsibilities for addressing bureau geospatial program and information requirements, including information exchange, data, technology, business process, and systems and applications
Geospatial GMO	Technical and administrative support staff that develop and manage the implementation of DOI geospatial program requirements Senior Agency

(Notes: Abbreviations: DOI, U.S. Department of the Interior; GMO, Geospatial Management Office; OMB, Office of Management and Budget; SME, Subject Matter Expert)

Figure 2-7 diagram text:

Office of Management and Budget

GeoLoB Status Performance Reporting

DOI Investments Performance Reporting Architecture Reporting eGov Reporting

Federal Geospatial Governance

Federal Geospatial Line of Business

Align and Manage Federal Geospatial Services and Data Planning Activities

DOI Geospatial Governance

SAOGI

Sponsors

Executive Team (Core Team)

DOI IT Investment Management

DOI IT Governance

Directs, Advises, and Priortizes

DOI Partners and Providers

External— Data Exchange, SLA, MOU, Service Acquisitions Management

External Data and Service Providers

Enterprise Geospatial Information Management (EGIM)

Enterprise Geospatial Services Investments
OMB Compliance Reporting
eGov Milestone Reporting
Architectures and Standards Compliance
Portfolio Performance

Supports and Coordinates with

Business Requirements and Communications

DOI Programs, Mission Owners, and Partners

Geospatial Management Office (GMO)

DOI Stakeholders

Geospatial Governance

(Notes: Abbreviations and acronyms: DOI, U.S. Department of the Interior; EGIM, Enterprise Geospatial Information Management; eGOV, electronic government; GeoLoB, Geospatial Line of Business; IT, information technology; MOU, Memorandum of Understanding; MS, milestone; OMB, Office of Management and Budget; SAOGI, Senior Agency Official for Geospatial Information; SLA, Service Level Agreement)

Figure 2-7. Geospatial Governance Model for Recommendation 2.3.1

Rialto beach, Pacific Ocean (Credit: NPS)

DOI's geospatial investments are not currently managed as a cohesive set of assets and services that provide optimal value to DOI's mission. This results in higher overall costs for DOI because of investments in redundant system or IT capabilities, geospatial data, exchange agreements, or contract services.

This recommendation includes a governance mechanism that is intended to provide geospatial portfolio and program management services for the mission areas. It evaluates and manages geospatial enterprise business requirements and licensing agreements; operational data needs; and services acquisition to identify cost savings and avoidance opportunities. Additionally, this mechanism evaluates the geospatial portfolio to ensure the optimal investment strategy to maintain and evolve the geospatial services.

Effective governance will facilitate optimization of business planning requirements, reduce the risks of unnecessary expenditures, and improve the management of SLAs, ELAs, data exchange agreements, and optimization of IT investment requirements for the portfolio. This reduction in risk will benefit DOI programs that currently rely on geospatial information and capabilities to complete their mission and the supporting operations and maintenance efforts provided by GIS and IT support staff. In addition, the governed shared services will minimize barriers associated with the cost and complexity of adopting geospatial capabilities for business areas not taking full advantage of such means today.

In addition, adoption of this recommendation will ensure that target-state geospatial services will be trusted and sustained year-to-year and not be subjected to local influences. Furthermore, it will provide more transparent access to service performance results and a voice for the DOI geospatial consumer in establishing common investment requirement priorities.

This recommendation presents a significant transformational change required to adopt shared enterprise business practices. It provides the management vehicle for local program and enterprise providers of geospatial products and data to work through the issues associated with migrating to enterprise services to ensure consumer satisfaction.

Communication and change management activities are essential to overcoming legacy cultural and organizational resistance to change. The governance community will be responsible for ensuring that policy, funding, service relationships, existing federated investment processes, and future funding strategies are coordinated and equitable in support of evolving federated geospatial assets.

An important step in implementing this recommendation is establishing the DOI GMO to support the management of exchange agreements, ELAs, SLAs, service performance management, geospatial data, and services acquisition consolidation using enterprise requirements management. The GMO function is central to the implementation of many of the other recommendations in this Geospatial Services Model. Once established, the GMO will develop an inventory of enterprise data and services assets for the geospatial portfolio, including existing ELAs, enterprise services, approved ADSs, and enterprise data agreements. This inventory will facilitate a sustained portfolio management process necessary to support governance and decision-making toward the evolution of a portfolio of enterprise geospatial assets. The SAOGI and Core Team will establish the strategic direction for the GMO services. Once a strategy has been established, the EGIM will coordinate the resources to achieve these objectives.

The project team, Core Team, and EGIM, have revised the EGIM FY2009 Exhibit 300 to request an additional $500,000 starting in FY2009 for GMO staffing. The proposed implementation-sequencing plan for this recommendation is presented in Figure 2-8.

Loma Prieta earthquake
(Credit: USGS)

"Effective governance will facilitate optimization of business planning requirements, reduce the risks of unnecessary expenditures..."

Artificial reef platform
(Credit: MMS)

Task Item No.	Task Name	2007			2008				2009				2010			
		Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	Establish the Geospatial Management Office (GMO, EGIM, and Core Team)		▬	▬												
2	Develop and execute Change Management and Communication Plan (EGIM, GMO, and Core Team)			▬	▬	▬										
3	Develop an inventory of enterprise data and services assets for the Geospatial Portfolio (GMO)				▬	▬										
4	Establish sustaining portfolio management processes and performance criteria for the portfolio (Core Team)				▬	▬	▬									
5	Establish SLA models for ADS and Services (GMO)					▬	▬	▬	▬	▬	▬					
6	Pursue ELAs for key enterprise technology solutions (GMO)					▬	▬	▬	▬							
7	Establish enhanced budget coding to support geospatial financial tracking (Core Team, EGIM, GMO)					▬	▬	▬	▬	▬	▬	▬				

(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; EGIM, Enterprise Geospatial Information Management; ELA, Enterprise License Agreement; GMO, Geospatial Management Office; SLA, Service Level Agreement)

Figure 2-8. Sequencing Plan for Establishing a Geospatial Governance Model for Recommendation 2.3.1

Grand Canyon from Pima Point (Credit: NPS)

Business Transformation Sequence Plan

Watershed delineation collaboration efforts (Credit: BOR)

This "Geospatial Services Model: Serving the Geographic Business Needs of the Interior" document describes the critical findings and recommendations of the geospatial architecture analysis of those bureaus, agencies, and other entities under the DOI, referred here to as bureaus. The purpose of this Geospatial Blueprint is to define how geospatial data and technology will be used to enhance the business activities of DOI to achieve its legislated mission and goals. Our vision is the DOI mission areas and goals of resource protection, resource use, recreation, and serving communities [5] will be geoenabled effectively and efficiently enabled with geospatial data, information and services.

It is recommended to immediately implement the governance model to create the portfolio and initiate the organizational change management (Recommendation 2.3.1). DOI's geospatial investments are not currently managed as a cohesive set of assets and services. Effective governance will facilitate optimization of business planning requirements, reduce unnecessary expenditures, manage SLAs, ELAs, data exchange agreements, and optimization of IT investment requirements for the portfolio. Governed shared services will minimize barriers associated with the cost and complexity of adopting geospatial and geospatially enable additional business areas. This recommendation will develop an inventory of enterprise data and services creating a geospatial portfolio for DOI. Geospatial technology, services, and information assets will establish a baseline value and efficiency contribution to DOI's business. Enterprise services will be measured and monitored with a standard set of performance criteria. Performance and measures will represent the service consumer, service provider, business planner and data acquisition efforts. This recommendation is a key solution necessary to adopt shared enterprise business practices to deliver consistent high quality data and manage operational costs.

Historically, the acquisition costs of DOI's geospatial data, services, and products have been hidden from true understanding at the enterprise level, with a few exceptions. Costs and efficiency improvements or benefits to the business have not been quantitatively established. It is recommended to immediately initiate the geospatial business requirements planning process (Recommendation 2.2.1) to enhance DOI's work activity and CPIC planning when acquiring geospatial data, technology and services. This recommendation will manage and optimize the requirements to identify cost savings and avoidance opportunities for contract services, skills, data, IT services and technology purchases.

DOI geospatial information is produced and maintained by many different bureaus and program areas. Geospatial information management is not well coordinated

"Our vision is the DOI mission areas and goals… will be geoenabled…"

**Alaska Maritime National Wildlife Refuge
Crew off-loading for summer field camp**
(Credit: (FWS))

across DOI. It is recommended to immediately establish ADSs and supporting geo-spatial services (Recommendation 2.1.1) to clearly establish data management control to support standards development and effective data management and to reduce redundant proliferation of service development. The ADS governance approval will involve the Data Advisory Committee, Geospatial Core Team, affected bureau or program sponsors, principal data stewards, and the DOI Investment Review Board (IRB). Governance and consistent reliable funding mechanisms will be determined to support sustainable ADS implementations and build cross organizational trust.

Principal data stewards will be responsible for ensuring that the products and data provided by the ADS conform to pre-defined services defined in an SLA. Data supported by each ADS will include all local producers, and there will be a need to standardize data lifecycle business process to support the roll-up efforts. Recommendation 2.1.2 will establish data lifecycle management, standards, policy, services and practices. This effort will align local geospatial data producers and the target ADS to establish standards, best practices, and provide a sustainable ADS model. The preferred solution would be to extend the existing capabilities of GOS [19] to accommodate this process.
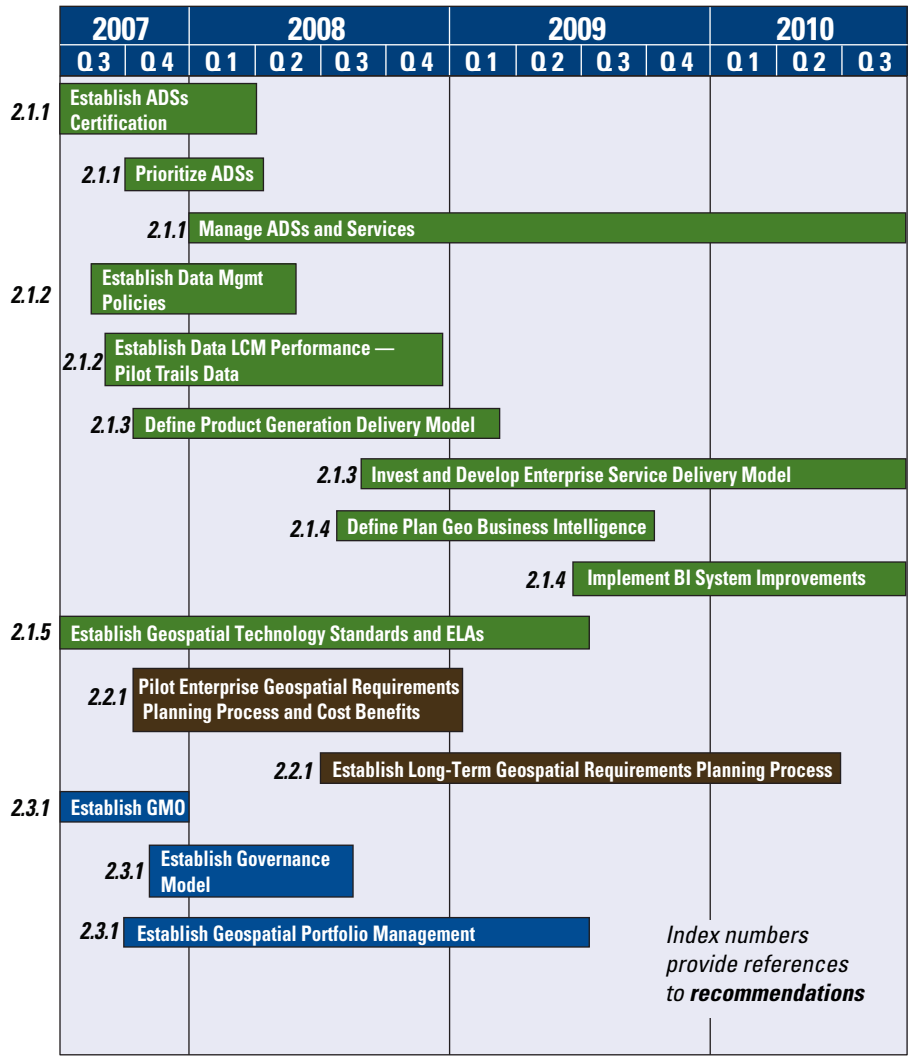
Recommendation 2.1.3, to establish DOI product generation services for geospatial products and information, will provide access to a consistent, business oriented and user-friendly system to present, manage, process, and deliver available geospatial data, products, and services. Currently, consumers are forced to work through an inconsistent and convoluted service access model to identify geospatial data and products. This is a major barrier to geospatial adoption and extending the investment in DOI data assets. The target model is designed to address simplified access across multiple repositories of data, provide standardized product configuring, eliminate the development of similar functionality at each ADS, and provide efficiencies by automating complex data manipulations. This will make possible the development of functionality once, reuse it for many systems in the enterprise, and identify future functionality.

By creating spatial or location-based relationships among DOI financial investments, assets, and managed land, existing stewardship assets can provide better services to improve accountability. Recommendation 2.1.4 to implement geo-enabled key asset and stewardships business system interfaces will provide the ability to spatially associate and display such information. The geospatial interfaces take advantage of existing key enterprise data assets and offer a new means to perform quality assurance, analysis, visualization, and reporting on improved real property and land assets. Improved geospatial business intelligence will provide a dynamic means to understand the changes in land ownership (title) and land status (land use, leasing, permitting) and improve the financial system data integrity. This recommendation provides for this future vision.

Recommendation 2.1.5 to adopt and implement geospatial interoperability standards and licensing for enterprise geospatial technology identifies the need to establish key technologies and standards for existing applications and new technology investments. This establishes a cost benefit recommendation for the respective products and reviews by the DOI governance community. Technology and interoperability standards will be evaluated for adoption into the DOI TRM. Interoperability specifications such as the OGC will be foundational to the development and maturity of the DOI geospatial services.

The transformation sequence plan for the recommendations is presented in Figure 3-1. This plan summarizes the tasks and timelines identified for each of the recommendations and requires that multiple activities start in parallel. Detailed analysis

discussion and supporting information will be found in the Geospatial Modernization Blueprint scheduled for publication later this year. Final approval of the blueprint is anticipated by the IRB in 2007.

Erosion control with fiber netting
(Credit: (OSM))

	2007		2008				2009				2010		
	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3
2.1.1	Establish ADSs Certification												
2.1.1		Prioritize ADSs											
2.1.1			Manage ADSs and Services										
2.1.2	Establish Data Mgmt Policies												
2.1.2	Establish Data LCM Performance — Pilot Trails Data												
2.1.3		Define Product Generation Delivery Model											
2.1.3				Invest and Develop Enterprise Service Delivery Model									
2.1.4				Define Plan Geo Business Intelligence									
2.1.4					Implement BI System Improvements								
2.1.5	Establish Geospatial Technology Standards and ELAs												
2.2.1	Pilot Enterprise Geospatial Requirements Planning Process and Cost Benefits												
2.2.1			Establish Long-Term Geospatial Requirements Planning Process										
2.3.1	Establish GMO												
2.3.1		Establish Governance Model											
2.3.1		Establish Geospatial Portfolio Management											

*Index numbers provide references to **recommendations***

(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; BI, business intelligence; ELA, Enterprise License Agreement; Geo, geospatial; GMO, Geospatial Management Office; LCM, lifecycle management; Mgmt, management)

Figure 3-1.   Recommendation Implementation Overview

CHAPTER 4

Future View of the Geospatial Enterprise

The recommended Geospatial Services Model provides a series of solutions that satisfy the objectives and vision of the Core Team and EGIM while addressing the issues identified by business community stakeholders. The stakeholders initially defined the problems of efficiently identifying and accessing quality, reliable geospatial information to support their demanding business objectives and complex analytical tasks. They also identified the need to improve the means to identify cost sharing opportunities and improve the mechanisms to access geospatial data. The recommended services architecture provides a governed approach to managing, procuring, maintaining, and delivering enterprise geospatial information assets to the stakeholders to improve their business processes and the value of existing business and IT assets.
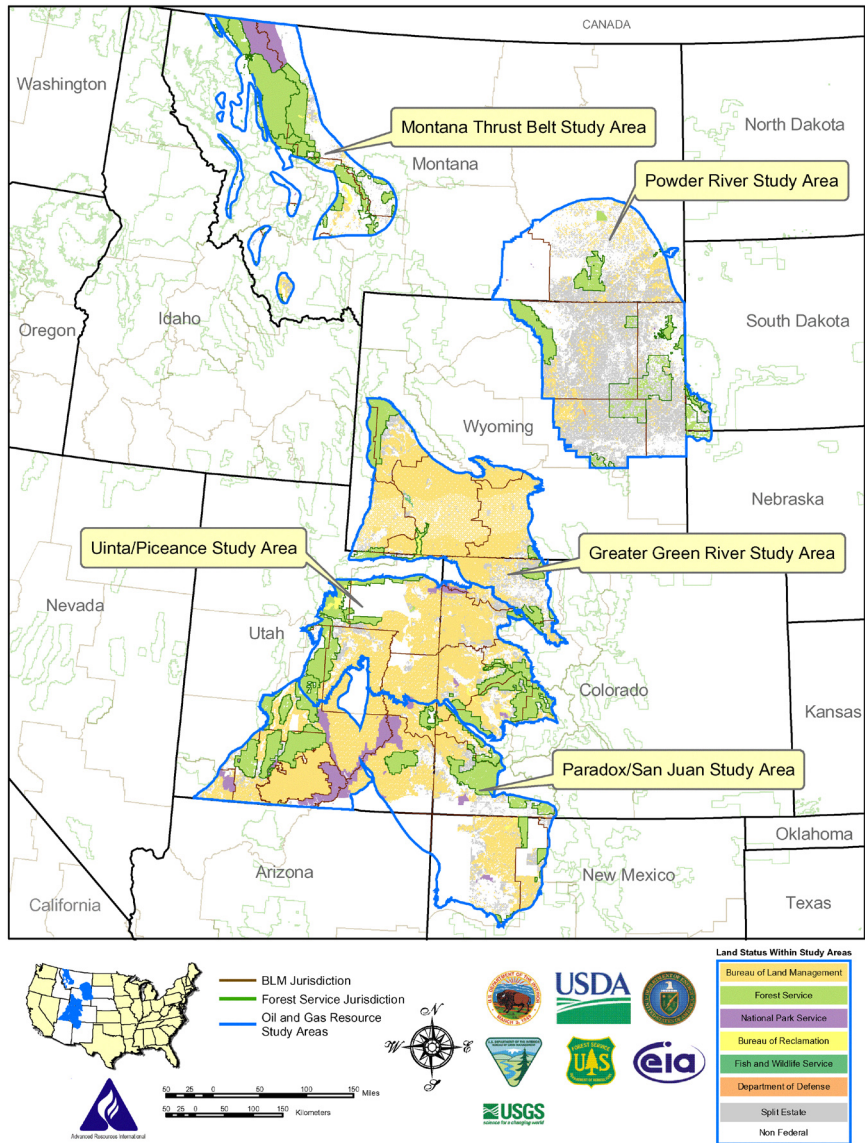
A Geospatial Services Model of this scale can be difficult to envision. To illustrate the business value of the recommendations, it is useful to describe it in the context of real world examples. A BLM stakeholder provided a compelling example when he described the effort required to support the Energy Policy and Conservation Act (EPCA) [23] Inventory and the Energy Policy Act of 2005 (EPAct) [24]:

"The biggest challenge was definitely the data collection. Neither the BLM nor the Forest Service has done much in the way of data standards or any central repository for land use planning geospatial data. We had to contact each office (about 80 through Phase II) to get the plans and attendant GIS data. Many older plans did not have that data and we paid the contractor to digitize them" [25] Figure 4-1.

Center pivot irrigation system
(Credit: USGS)

Figure 4-1. Legend:
- BLM Jurisdiction
- Forest Service Jurisdiction
- Oil and Gas Resource Study Areas

Land Status Within Study Areas:
- Bureau of Land Management
- Forest Service
- National Park Service
- Bureau of Reclamation
- Fish and Wildlife Service
- Department of Defense
- Split Estate
- Non Federal

(Notes: Abbreviations: EPCA, Energy Policy and Conservation Act)

Figure 4-1. EPCA Phase I Federal Land Status

This anecdote clearly illustrates several common barriers to organizational and process efficiency. The stakeholder knew their data requirements and knew how to analyze and derive the necessary strategic decision support information. However, they were dependent upon a core set of data that was not available because of lack of standardized means to create, manage, and deliver it through a reliable reproducible process. The effort was further complicated by a common need to coordinate and access information across multiple DOI bureaus, federal agencies, and external partnerships with no information about the relevant planned activities. Compounding the issue, the land use planners suffered from these same challenges while trying to establish their initial analysis and policy. These same barriers persist each time any analysis requires data used in the EPCA process or produced as a result of the EPCA process. The services model is intended to address the fundamental enterprise data management, access and exchange needs by providing this data for use with the EPCA, National Environmental Policy Act (NEPA), and the multitude of other DOI business processes.

How do the geospatial recommendations address these barriers? In the target state, the Energy Policy analysts, the land use planners, and others will become consumers of an approved and managed geospatial services provided by an approved ADS. The ADS will be supported by the contributions of the local expert data producers and stewards using information standards and reproducible business processes to support the approved ADS service provider. The ADS service provider will deliver the reliable updated geospatial information to the consumers through a series of standardized services accessible to applications, commercial off-the-shelf (COTS) geospatial tools, browsers, or systems. The target state will provide an enhanced work and investment planning capability that will alert planners and other activities to cost sharing and cost avoidance opportunities and will improve information sharing.

In order to ensure the transformation to an enterprise geospatial services model, it requires the policy underpinnings of a proactive operational and strategic governance model to guarantee the optimal priorities are established and executed. The business and IT assets will be managed within a performance based portfolio of data, technology, and services—a federated model.

"The target state will provide an enhanced work and investment planning capability that will alert planners and other activities to cost sharing and cost avoidance opportunities and will improve information sharing."

Grand Canyon from Mather Point (Credit: NPS)

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Burning at Eastern Virigina Rivers National Wildlife Refuge (Credit: FWS)

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Abbreviations and Acronyms

A-16	Circular no. A-16
ADS	Authoritative Data Source
AS-IA	Assistant Secretary — Indian Affairs (DOI)
AutoCAD	Software supporting computer-aided design and drafting
BASIS+	USGS Budget and Science Information System + USGS financial and management tracking system.
BI	business intelligence
BIA	Bureau of Indian Affairs (DOI)
BLM	Bureau of Land Management (DOI)
BOR	Bureau of Reclamation (DOI)
BRM	Business Reference Model (for the U.S. Department of the Interior Enterprise Architecture effort utilizing the Methodology for Business Transformation (MBT) by developing and implementing take-action modernization blueprints [4]. Also, see: http://www.doi.gov/ocio/architecture/index.html
CIO	Chief Information Officer
CMBT	Core Modernization Blueprint Team
Core Team	Core Modernization Blueprint Team (CMBT)
COTS	commercial off-the-shelf
CPIC	Capital Planning and Investment Control (Also, see http://www.doi.gov/ocio/cp/cpic_guide.pdf)
CTOC	Chief Technology Officers' Council
DAC	Data Advisory Committee
DHS	Department of Homeland Security
DOD	Department of Defense
DOI	U.S. Department of the Interior
DRG	digital raster graphics
EA	enterprise architecture
EGIM	Enterprise Geospatial Information Management
eGov	electronic government
ELA	enterprise license agreement
EPAct	Energy Policy Act of 2005. Also, see: http://www.doe.gov/about/EPAct.htm
EPCA	Energy Policy and Conservation Act. Also, see: http://www.blm.gov/epca/
ERDAS	software package for processing imagery, including satellite, radar, etc.
ESRI	Environmental Systems Research Institute (creators of GIS software)
FBMS	Financial Business Management System
FEA	Federal Enterprise Architecture
FGDC	Federal Geographic Data Committee
FMS	Facility Management Systems
FWS	Fish and Wildlife Service, also referred to as "USFWS" (DOI)
FY	Fiscal Year (for federal government: Oct. 1–Sept. 30)
GAP	Gap Analysis Program
FY	Fiscal Year (for federal government: Oct. 1–Sept. 30)
GAP	Gap Analysis Program
GeoLoB	Geospatial Line of Business
GeoMAC	Geospatial multiagency coordination for wildfire support
GIS	geographic information systems
GITA	Geospatial Information & Technology Association
GMBT	Geospatial Methodology for Business Transformation
GMO	Geospatial Management Office
GOS	Geospatial One-Stop—portal available at http://gos2.geodata.gov/wps/portal/gos
GPS	Global Positioning System
ICS	Incident Command System
IRB	Investment Review Board (manages the portfolio by selecting, controlling, and evaluating the information technology investment for DOI) [4].
IT	information technology
LCM	lifecycle management

LR2000	Legacy Rehost 2000—Bureau of Land Management and Minerals Records 2000 system
MBT	Methodology for Business Transformation (for more information, see http://www.doi.gov/ocio/architecture/mbt/mbt_services.htm)
MMS	Minerals Management Service (DOI)
MODIS	Moderate Resolution Imaging Spectroradiometer
MOU	Memorandum of Understanding
MS	milestone
NASA	National Aeronautics and Space Administration
NBII	National Biological Information Infrastructure
NEPA	National Environmental Policy Act
NHD	National Hydrologic Dataset
NILS	National Integrated Lands System
NOAA	National Oceanic & Atmospheric Administration
NPS	National Park Service (DOI)
NWFEA	National Wildland Fire Enterprise Architecture
NWIS	National Water Information System
OCIO	Office of the CIO
OCS	Outer Continental Shelf
OCS-Connect	multi-year electronic government (e-Government) transformation of the Offshore Minerals Management program at the Minerals Management Service (MMS)
OGC	Open GIS Consortium
OMB	Office of Management and Budget
OSM	Office of Surface Mining (DOI)
PLSS	Public Land Survey System
PMB	Policy, Management, and Budget Office (DOI)
PMO	Project Management Officer
ROI	return on investment
SAOGI	Senior Agency Official for Geospatial Information
SLA	Service Level Agreement
SME	Subject Matter Expert
SOA	Service Oriented Architecture
TAAMS	Trust Assets Accounting Management System
TNM	The National Map. Also see http://nationalmap.gov/
TRM	Technical Reference Model for the U.S. Department of the Interior Enterprise Architecture effort utilizing the Methodology for Business Transformation (MBT) by developing and implementing take-action modernization blueprints [4]. Also see http://www.doi.gov/ocio/architecture/index.html
UID	Unique Identification
USFS	U.S. Forest Service
USGS	U.S. Geological Survey (DOI)
VEG	Vegetation Mapping Program
WCF	Working Capital Fund

Both photographs: Fish survey and cross-section, Stanislaus River, California
(Credit: BOR)

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