U.S. Department of the Interior
Enterprise Architecture

DOI Enterprise Architecture

Geospatial Modernization Blueprint
Recommendations and Architectures

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1. Geospatial Blueprint Introduction

Most of the services provided by the U.S. Department of the Interior (DOI) program and mission areas are location or geographic area specific. Providing, tracking and improving delivery of these services require that information be collected and managed. Multiple DOI programs often perform services on overlapping geographic areas {1}. In fulfilling the its mission, the bureaus often depend on geospatial technologies, providing geospatial information and/or services.

DOI's business activities depend on geospatial information—knowing where things are and understanding how they relate to one other. Geospatial information is part of the fabric of our daily lives, whether it is being used to make decisions on social or environmental issues, for emergency responses, or just to find the way to a campground. The purpose of this Geospatial Modernization Blueprint [2] is to define how geospatial data and technology will be used to enhance the business activities of DOI and its bureaus and to achieve their mission and goals [3].

The advent of inexpensive, powerful information and communications technology has greatly enhanced our ability to produce large quantities of geospatial information. Users can retrieve, overlay, and analyze geospatial information on any subject, for any area, at any desired level of resolution, provided that the data are available in digital format to an appropriate standard. Geospatial technologies provide a simpler and more powerful means to integrate and combine many different kinds of data, leading to a variety of new geographical information applications that are constantly expanding [4].

The rapid growth in geospatial information resources and applications has led to DOI concerns about how to manage it more efficiently. Inefficiencies can result in higher costs and reduced business performance. Problems include duplication of geospatial information and databases, lack of standards, limited network performance, poor quality or inadequate geospatial information, difficulty in accessing and locating geospatial information across agencies, limited capabilities to share geospatial information among program and mission areas, and a general lack of coordination of acquisition and subsequent lifecycle management of geospatial data [4].

2. Executive Summary

The success of DOI's mission is dependent on its science, land and resource knowledge of not only the federal properties it is charged to steward, but an acute awareness of national and global conditions that affect the results of its efforts. A key unifying principle that will enable the DOI to balance its stewardship skills and responsibilities with the forces of larger human and natural influences is geospatially based information. Today, the DOI budget data suggest that more than $270 million is being spent annually on geospatial data, labor, services, and technologies [5]. However, this figure may not accurately reflect the full scope of DOI investment in geospatial resources, as the collection, storage, and use of geospatial data are deeply intertwined with many core mission systems, functions, and information technology (IT) infrastructures in DOI. Unlike other traditional DOI lines of business, there is no organizational or functional model that owns or manages geospatial issues. The area of geospatial business focus represents a collection of data, content, standards, technology, staff (government and contractor), technology tools, services, and systems that directly relate to 87% of DOI functional responsibilities [6].

DOI is a major player in the challenge to meet the national goals and objectives of Office of Management and Budget (OMB) Circular A-16, Revised, "Coordination of Geographic Information and Related Spatial Data Activities" (hereinafter, referred to as "A-16") [7]. DOI used its A-16 roles and responsibilities as a framework to organize and classify its spatial data architecture. The focus of this Blueprint is on internal DOI geospatial data requirements and associated responsibilities as designated in the A-16 categories with recognition external data dependencies.

To gain a better understanding of geospatial costs and value, and to discover opportunities to improve its usefulness, DOI initiated this Blueprint study of its geospatial business and technical environments during the fall of 2005 [8]. The objective of the Blueprint study is to answer some basic questions: Are there better, more efficient ways to use geospatial capabilities in the Department? Are there opportunities for gaining increased benefit from current investments and expenditures?

A key finding of this Blueprint is that across DOI, geospatial business stakeholders are consistently confronted by a common set of issues 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, who has the same needs?"
- "I have no way to share costs across the department!"
- "I am not fully aware of all the existing DOI geospatial capabilities!"

The concepts in this Blueprint are intended to create a strategic shift in the delivery of geospatial services to resolve these common issues. These Blueprint recommendations provide the foundation for a sustainable migration to an enterprise geospatial service delivery model. This approach must address the optimization and standardization of geospatial programs, systems, and data assets to achieve "enterprise services".. Sustaining the model will require an improved governance approach and coordinated enterprise planning and investment strategy. The Blueprint has adopted the OMB Geospatial Line of Business's (GeoLoB) [1] framework to organize its concepts and recommendations as shown in Figure 2-1.

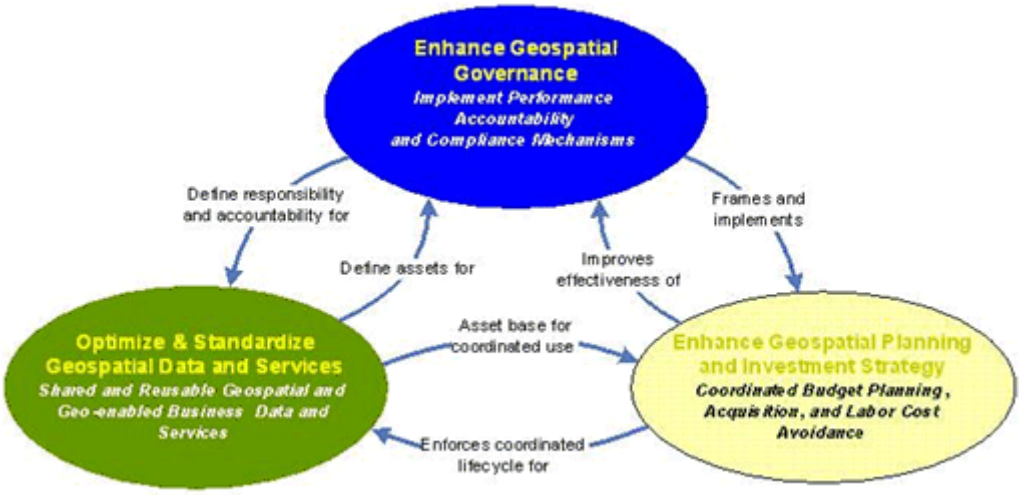


Figure 2-1 Geospatial Blueprint Recommendations Framework

DOI has made significant investments in standards based assets such as The National Map (TNM), with its Open GIS Consortium based map services and the National Integrated Lands System (NILS) with its FGDC based data model. The DOI would benefit from accelerating the adoption of DOI enterprise or industry standards to continue to reduce the barriers to using geospatial information and its capabilities. A successful model for 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 also 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 a measurable and optimal performance.

The potential value of adopting enterprise management of key geospatial data assets and services has been demonstrated in several public institution business case studies. The Washington Department of Transportation [9] 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 method demonstrates the value of acquiring and building outward geospatial data in a shared and coordinated business model. The State of Oregon has developed a business case [10]—a geographic information system (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 with improved access. It is projected that a $173 million investment will yield a $1.1 billion return over 10 years [10] (Figure 2-2) of revenue enhancement, cost avoidance and savings, and operations and efficiency.

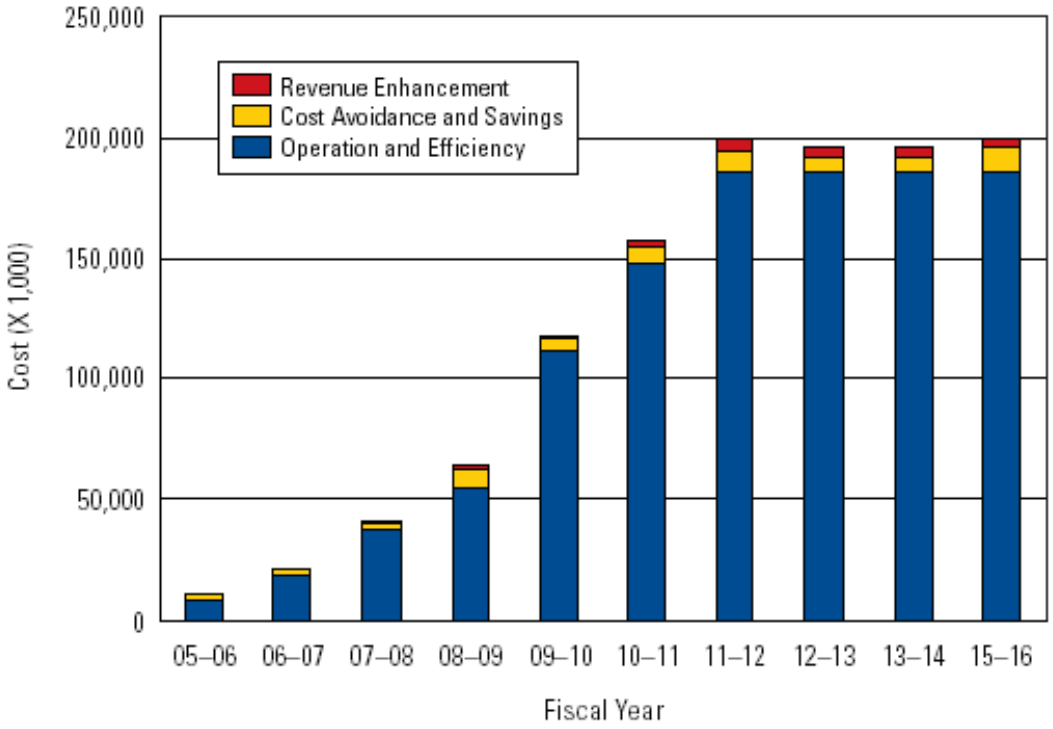


Figure 2-2 Annual Financial Benefits of GIS Use. [10]

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:

- The existing Environmental Systems Research Institute, Inc (ESRI) enterprise license agreement (ELA) has provided $46 million of cost avoidance benefits over a 5 year period [11]
- System development costs using open geospatial-standards-based development can yield a 26% total lifecycle cost savings. [12]
- Past DOI consolidated data acquisitions resulted in $72 million of data to be purchased for $11 million in 1999. [13]

Geospatial Vision and Goals:

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 [1]. 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
- Supporting business processes to improve business effectiveness through standardization
- 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 required needed capabilities to achieve program objectives
    - Improving the quality and reliability of DOI-trusted data assets

3. DOI Geospatial Concept of Operations

The Concept of Operations (CONOPS) [14] establishes the desired approach on how the DOI' s stakeholders and supporting processes work together to deliver geospatial products and data. The CONOPS describes the high-level architectural elements and how geospatial assets are acquired, produced, and served in the overall context of the target state, Figure 3-1.

The DOI geospatial target state defines the geospatial consumers as citizens, managers, planners, geospatial users, applications, systems, or services. Data producers are the programs or locations creating and maintaining geospatial information that have been deemed to be of DOI-wide interest. The key technical strategies include the Authoritative Data Source (ADS) [15], a cohesive set of data assets that provide trusted, timely, and secure information to business processes, data lifecycle management practices, enterprise geospatial requirements management, and geospatial service delivery. Underpinning the strategies are interoperable technology and data standards that promote sharing and reuse of geospatial information and effectively increase the utility of DOI geospatial assets.

Each ADS will provide a trusted location where geospatial producers can store their information securely and consumers can access the data and services with confidence that the data are quality certified. The ADS will use existing DOI data stewardship and data lifecycle management processes (DOI Data Standardization Procedures, April 2006.) to sustain their quality certification and coordinate the multitude of contributing producers. Subsequently, the certified data will support the delivery of standards-based geospatial services to DOI consumers. The DOI consumers will enter into service level agreements with the service providers to ensure accountability and track performance.

This type of service delivery model will allow DOI to reach more of its consumers with its geospatial assets and reduce current costs of operations. The same standards-based service will be accessible from Web browsers, desktop GIS tools, and system or service interfaces. Enterprise requirements management will further improve service delivery by providing a mechanism for identifying and coordinating geospatial capabilities and activities across DOI to efficiently satisfy consumer needs and avoid redundant acquisitions. It is key to recognize the breadth of this challenge and to focus on those assets of enterprise value and not to address a multitude of local unique requirements.

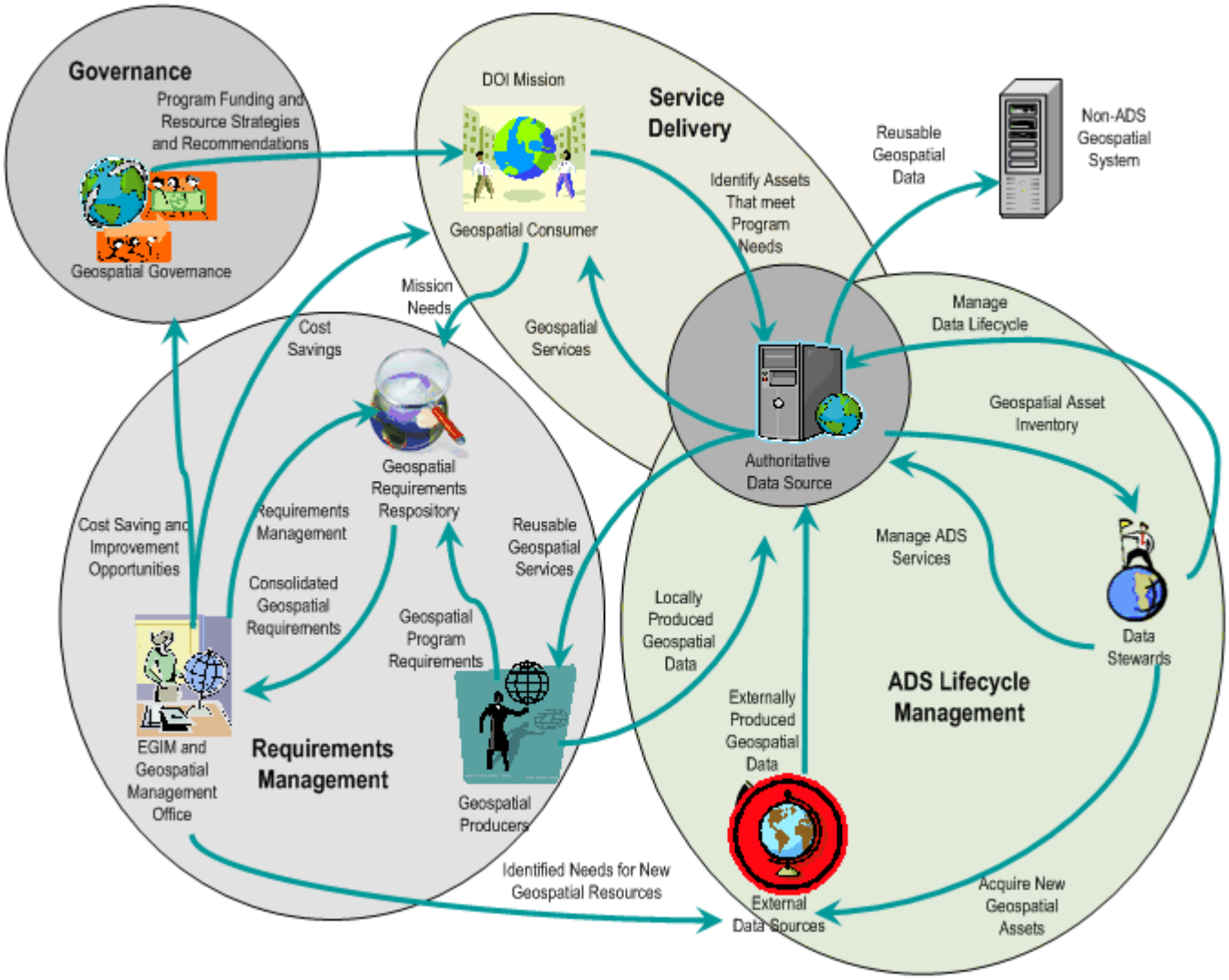
At the heart of the Blueprint is the governance component. Governance is necessary to provide a geospatially informed business-driven management environment for the target enterprise geospatial assets. Governance will coordinate the integration of these services into the business areas by providing requirements management, investment planning, and external data exchange coordination. The overview of the Blueprint findings and recommendations are shown in Table 3-1.

Table 3-1 Summary of Findings and Recommendations

GeoLoB Blueprint Category	DOI Geospatial Blueprint Findings	DOI Geospatial Blueprint Recommendations
Optimize and standardize geospatial data and services	Existing data and services have potential for serving the DOI enterprise. Currently 1,200 DOI locations locally produce and store geospatial data with potential for DOI reuse.	4.1.1 Recommendation 1: Establish ADS and supporting Geospatial Data Services
		4.1.2 Recommendation 2: Establish Data Lifecycle Management, Standards, Policy, Services, and Practices
		4.1.3 Recommendation 3: Establish DOI Product

GeoLoB Blueprint Category	DOI Geospatial Blueprint Findings	DOI Geospatial Blueprint Recommendations
		Generation Services for Geospatial Products and Information
		4.1.4 Recommendation 4: Implement Geo-Enabled DOI Business System Interfaces and Services to improve Business Intelligence
		4.1.5 Recommendation 5: Adopt and Implement Geospatial Interoperability Standards and Licensing for Enterprise Geospatial Technology
Enhance geospatial planning and investments strategy	There is no spatially supported enterprise planning processes to identify and optimize common DOI business requirements.	4.2.1 Establish Requirements Planning Process
Enhance geospatial governance	DOI's Geospatial Investments are not currently managed as a cohesive set of data assets and services that provide optimal value to the mission.	4.3.1 Recommendation 1: Establish Geospatial Governance
		4.3.2 Recommendation 2: Establish the Geospatial Management Office to Provide Program and Portfolio Management Support Services

(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; DOI, U.S. Department of the Interior)



(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; DOI, U.S. Department of the Interior; EGIM, Enterprise Geospatial Information Management)

Figure 3-1 Target Geospatial Concept of Operations

Success of DOI's geospatial target CONOPS is dependent on establishing an enterprise "services" business model. An effective services-business model requires the underpinnings of a strong enterprise planning element and supportive governance component. The governance services ensure accountability and performance of the enterprise assets or portfolio (services, systems, data, and technology) to the business objectives. The planning capability services ensure the establishment and management of enterprise business requirements to drive an effective use of resources in budget preparation and acquisition. In a business environment as complex as that of DOI, these services become even more significant and critical in managing organizational risks. This type of model is often described as a Service-Oriented Architecture (SOA) [16]. SOA has been recommended as a best practice in the DOI Conceptual Architecture and the DOI Target Solution and Application Architecture. Simply stated, the geospatial business benefit of SOA is to develop standardized data, the supporting services and the means to manage them for the benefit of multiple organizations. The industry definition of SOA is defined as follows:

> "*Service-Oriented Architecture (SOA) is a paradigm for organizing (governing and managing) and utilizing distributed capabilities that may be under the control of different ownership domains. It provides a uniform means to offer, discover, interact with, and use capabilities to produce desired effects consistent with measurable preconditions and expectations of meanings. SOA standards are derived from Organization for the Advancement of Structured Information Standards (OASIS).*" [16]. (More information is available at http://www.oasis-open.org/home/index.php)

When the target Blueprint model is implemented, traditional DOI users, subject matter experts (SME), and GIS experts will apply their skills and resources to solve more complex problems for more users. Users will be able to access reliable geospatial information using existing enterprise systems or simple access methods. Additionally, DOI systems and applications will no longer have to manage the data within their system environments, but rather plug into an SOA as consumers of geospatial services. Service providers will achieve an economy of scale that is based on increased data usage, more efficient access, and reduction in per unit delivery costs. This results in cost reduction benefits to DOI through reduction in labor costs to access and manipulate geospatial data while extending the reach of the data investment to a greater pool of users. The transformation of DOI data producers to service providers will yield enhanced business services and efficient reuse of data. A powerful example of this would be the need to access an authoritative version of Federal Land Ownership or the Cadastre framework datasets. Today most users are downloading and maintaining local copies or not using it at all because of its complex nature. In the future, online access from an authoritative source will enable interactive use or download support.

4. Key Geospatial Blueprint Findings and Recommendations

4.1 Optimize and Standardize Geospatial Data and Services

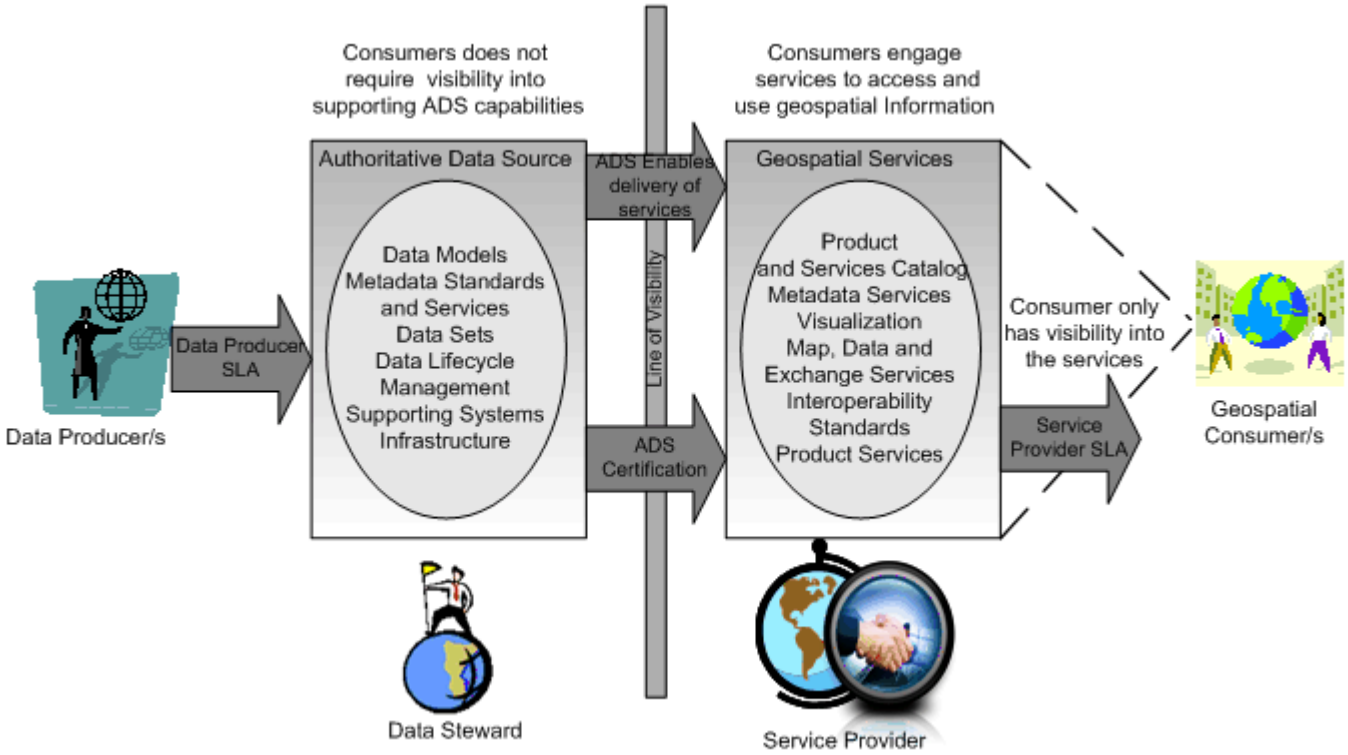
FINDING 1 — Existing data and services have the potential for serving the DOI enterprise: currently 1,200 DOI locations locally produce and store geospatial data with potential for DOI reuse.

The optimization and standardization recommendations involve the identification and establishment of standards based ADS assets, the coordination and development of enterprise data, map and exchange services, and improvements in systems interface. These recommendations are dependent on DOI's adoption of data and technology standards, data lifecycle management policy and procedures, and governance processes to manage and monitor the recommendations implementation and results..

DOI produces, acquires, shares, and consumes an enormous amount of geospatial information and technology to support its mission while playing a major role within the federal geospatial community. It is responsible for over 50% of the data themes identified in A-16 (See Appendix A), "Coordination of Geographic Information and Related Spatial Data Activities" [7]). It is the managing partner for the GeoLoB [17] and coordinates the Federal Geographic Data Committee (FGDC) [18]. Its significant demand for geospatial data has been the single most important consideration in the Blueprint strategy because of stakeholder comments. Historically, each bureau or program has had to invest in data acquisition, infrastructure, data lifecycle management improvements, standardization efforts, and technology or application development as a microcosm within DOI. This has led to suboptimal data and technology implementations. The strategy to coordinate and extend selective existing geospatial assets required across the DOI, will lead to optimization and standardization of benefits in data, services, infrastructure, system development, application interfacing, and human resources.

Improving DOI's geospatial data quality and accessibility while extending its usefulness, is the foundation to the Target Geospatial Architecture [18]

The primary building block of the Target Geospatial Architecture [18] revolves around establishing the mechanisms to manage, sustain, and deliver improvements in geospatial data quality, accessibility, and usefulness for DOI's business consumers. These are the core elements of the target geospatial service delivery model in Figure 4-1. Currently, potentially reusable data assets are being collected, processed, and stored in many locations with limited knowledge of their comparative quality or availability. This information is difficult to discover, obtain, and make available to a broader set of stakeholders in a repeatable or simple cost-effective fashion. The current operational model creates access barriers to the greater pool of DOI users while simultaneously introducing data quality risks. Furthermore, the current fragmentation of uncertified data creates a very complex and expensive path to develop shareable enterprise geospatial services. It is imperative to have qualified data and information as a precursor to any type of service development.



(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; SLA, Service Level Agreement)

Figure 4-1 DOI Geospatial Service Delivery Model

The optimization and standardization recommendations provide a coordinated means to align existing DOI geospatial efforts while providing solutions to existing gaps in data management and shared enterprise services. The recommendations are to implement the following:

- Use standard data and metadata lifecycle management processes, services, and policies to maintain the quality and reliability of the targeted ADS for DOI consumers
- Establish enterprise ADSs that act as a cohesive set of data assets to provide trusted, timely, and secure information to business processes and consumers where the information is visible, accessible, understandable, and credible
- Secure standards-based interoperable geospatial services for map visualization, data access, and electronic data exchanges in conjunction with ADSs to simplify the technology baseline, reduce data risks, and increase access for DOI consumers and systems
- The recommended target geospatial operational model supports these three optimization and standardization concepts (see Figure 4-1). The recommended data lifecycle management process will align the local producers of enterprise data with the appropriate target ADSs and standards. The targeted ADSs will become the enterprise management and control node to ensure the status, availability, and quality of an enterprise data asset. The enterprise geospatial services will use the ADS to provide efficient and reliable access to the qualified information using standards that are based on interoperability methods. These three concepts will minimize costly and cumbersome file transfers, research, redundant acquisition, and data exchanges, and reduce data-quality risks and system development costs [12]. These three concepts will allow existing and future geospatial users to adopt the enterprise information confidently to improve their business performance, processes, and improve decision-making.

4.1.1 Establish ADS and Supporting Geospatial Data 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. At the same time, the ability to share geospatial information both internal and external to DOI becomes increasingly more vital in fulfilling internal mission needs and external demands. Consumers of geospatial information often find it difficult to locate reliable sources of geospatial information and, once they discover such information, they find it difficult to ascertain its accuracy and timeliness.

This recommendation has two key parts. The first part is to establish a series of ADSs for the integration of highly reusable DOI geospatial assets. The second part of the recommendation addresses the mechanisms for information access and delivery services that ADSs provides. 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.

It is important to implement enterprise ADS recommendations to improve reuse of DOI data assets. The top ADSs candidates from the Geospatial Core Team [19] and the Enterprise Geographic Information Management (EGIM) Team [20] ranking are identified in Table 4-1.. Clearly, established data management control is necessary to support standards development, effective data management and reduce proliferation of service development. The existing data inventory was evaluated to determine which data was needed across the enterprise and how it was currently being managed. The evaluation looked at functional reuse, stewardship, standards implementation, and data characteristics, such as accuracy, completeness, consistency, precision, timeliness, uniqueness, and validity (see Appendix B). This evaluation led to identification of the best available candidate ADS to manage an asset of DOI-wide interest. These ADS "candidates" were ranked (see scoring details in Table 6-2) using the following criteria:

- What is the reuse potential to the DOI business?
- Is there the authority to effect change on the asset?
- How well did it score against the qualitative ADS criteria?

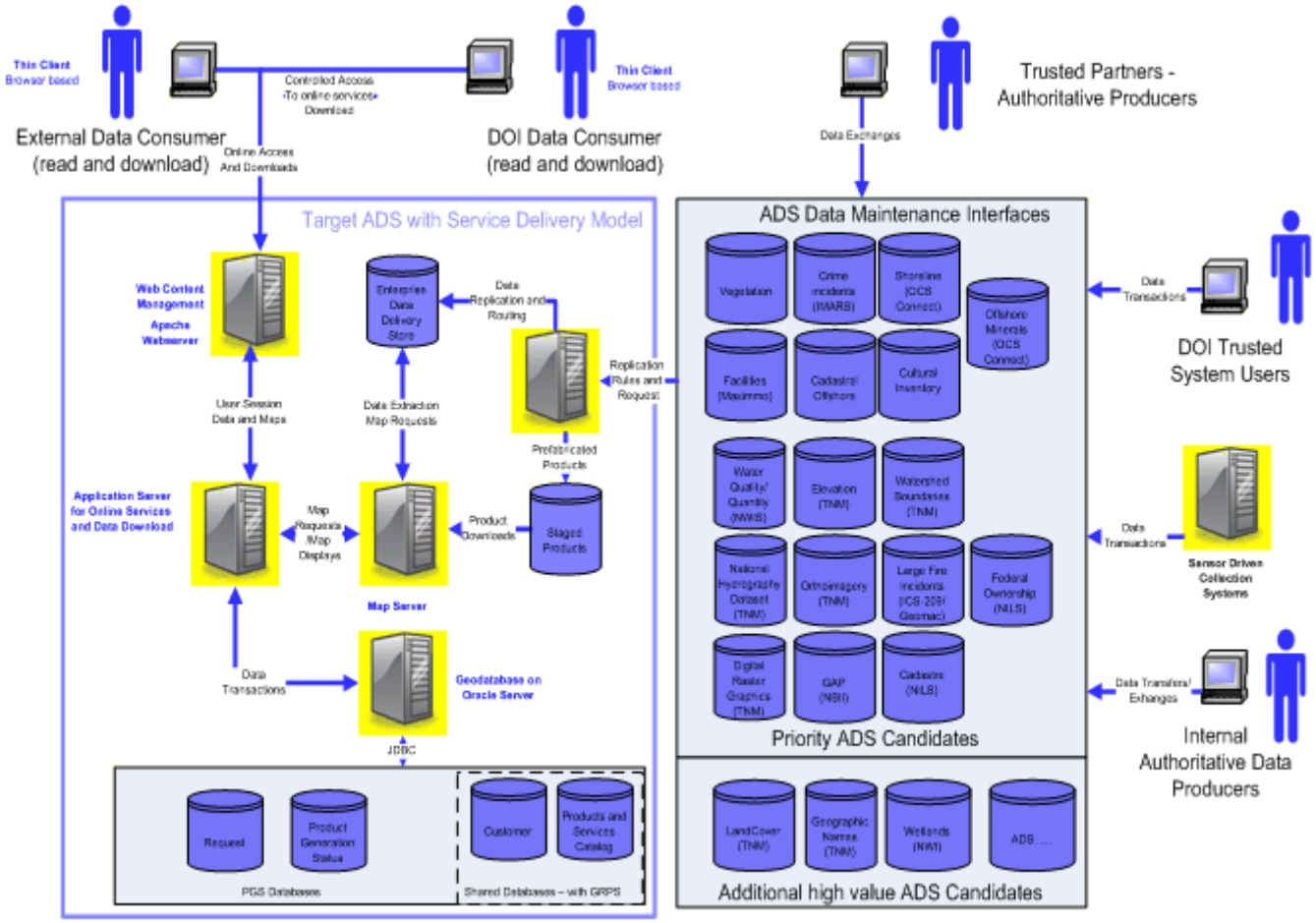
Table 4-1 Recommended Geospatial ADS Candidates

Candidate ADS 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 an 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

Candidate ADS Recommendation	Organization
Establish ADS for DOI asset and facilities services (dams, 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. Coordinate 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—Candidate ADS is to develop secure enterprise inventory for internal use.	NPS
Establish ADS A-16 information on law enforcement incident—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; BLM, Bureau of Land Management; 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 system; GMO, Geospatial Management Office; ICS, Incident Command System; MMS, Minerals Management Service; MODIS, Moderate Resolution Imaging Spectroradiometer; NBII, National Biological Information Infrastructure; NHD, National Hydrography 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, OpenGIS Consortium; PLSS, Public Land Survey System; TNM, The National Map; USFS, U.S. Forest Service; USGS, U.S. Geological Survey; VEG, Vegetation Mapping Program)

The target concept is described in Figure 4-2, which lays out the key ADS recommendations from overall DOI service model perspective.



(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; DOI, U.S. Department of the Interior; GAP, Gap Analysis Program; GeoMAC, Geospatial multiagency coordination for wildfire support; GRPS, Geospatial Requirements Planning System; IMARS, Incident Management Analysis and Reporting System; JDBC, Java Database Connectivity; Maximo, software package for asset management and services; NBII, National Biological Information Infrastructure; NILS, National Integrated Lands System; NWI, National Wetland Inventory, NWIS, National Water Information System; OCS, Outer Continental Shelf; PGS, Product Generation System; PLSS, Public Land Survey System; TNM, The National Map)

Figure 4-2 Target ADS Environment

The success of the geospatial ADS model is predicated on geospatial governance. The candidate ADS governance scenarios are fully modeled and described in Appendices N and O. The key participants are the Data Advisory Committee (DAC) [21], EGIM [20], Geospatial Management Office (GMO) Geospatial Core Team [19], affected bureau or program sponsors, principal data stewards, and the DOI Investment Review Board (IRB) [22]. Once approved, the responsibilities of operating the ADS and its associated delivery services will have an impact on the responsible organization. When an organization is designated as the ADS, it is being assigned the responsibility to be a key data asset manager and geospatial service provider for DOI and its external consumers. To be successful as an enterprise ADS, each provider needs to commit to perform the following responsibilities:

- Lead within DOI business and data stewardship efforts
- Adopt the target DOI data standards and map service technology specifications (see Appendix C)
- Participate in the development of ADS funding strategies to ensure a sustainable service model for its consumers using IT investment or programmatic funding means

- Establish Service Level Agreements (SLAs) with local data producers and internal and external consumers
- Register geospatial services in Geospatial One-Stop (GOS) [23], Component Organization and Registration Environment (http://CORE.GOV) [24], and future DOI service registries
- Collaborate with the GMO to record results on service-level performance and customer satisfaction
- Adopt and implement DOI-approved standards for data exchange—positional, temporal, attribute and metadata [18]
- Provide lifecycle and system resources to support the processing demands of the users
- Ensure the security and configuration control of the published data and services
- Participate actively in the development and management of the DOI Geospatial Portfolio
- Participate actively in the requirements management processes for DOI enterprise planning and geospatial portfolio management addressing DOI and consumer needs
- Participate actively in the DOI Governance processes to improve overall geospatial asset performance
- Provide effective outreach and communications to the users
- Participate in DOI's role in the federal GeoLoB [1] if data and services are deemed of national interest

There are several outstanding change management issues to be resolved regarding the designation of an enterprise ADS. Non-owning organizations will now be dependent on sources of information to meet their mission objectives that are no longer under their direct organizational control. There will be a need for governance and a consistent reliable funding mechanism to sustain the upkeep of an ADS that will ensure consumer and provider participation. The Blueprint project (see Appendix D), led by the Geospatial Core Team, is investigating incentive and funding models to support sustainable ADS implementation and to build cross-organizational trust. The SLA and the governance models (Draft Geospatial Governance Model) are critical elements for success. As these issues are resolved, any affected Blueprint recommendation will be updated. The ADS implementation will require consuming systems and applications to be reengineered to take advantage of the target ADS services. The ADS affected systems list can be found in Appendix E.

4.1.2 Establish Data Lifecycle Management, Standards, Policy, Services, and Practices

Principal data stewards will support the EGIM and GMO who will be responsible for ensuring that the products and data provided by an ADS conform to standards (e.g., data quality, accuracy, timeliness, etc.) as established in an SLA. Given that local producers will likely provide the data supported by each ADS, there will be a need for a standardized data lifecycle business process for the controlled submission of data to ensure that data standards are met. Without such a process, an ADS would be confronted with the challenges of maintaining nonstandard data, multiple formats, and processes for multiple local producers. As the process matures, there will be a need for improved query techniques to identify the reliable information. Without these practices, nonstandard data will lead to significantly higher data management costs and will result in lower levels of reuse, value and productivity.

This recommendation establishes a standard DOI data lifecycle management process (Sec 8, 378 DM 1, Data Resource Management, and OCIO Directive 2006-011) 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 4-2. Monitoring the effectiveness of such policies will rely on the data stewards, EGIM, and a recommended GMO to coordinate oversight.

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

• Existing systems or investments that own and manage 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. • An ADS shall support the extension of the enterprise data model through controlled data management processes to help reduce local redundant data stores. • ADOI geospatial ADS shall define and establish the necessary universal key practices, metadata, attribution, positional accuracy, and temporal standards. • Each ADS shall establish standards for the submission of locally produced data. DOI programs collecting digital geospatial data and contributing to ADS shall conform to the standards.

(Notes: Abbreviations and acronyms: A-16, OMB Circular A-16 [7]; ADS, Authoritative Data Source; DOI, U.S. Department of the Interior; OMB, Office of Management and Budget)

The lifecycle management business processes are critical to support the incremental build up and maturation of enterprise ADS assets and provide a sustainable ADS model. The preferred solution would be to extend the existing capabilities of GOS to accommodate the process. This mechanism will provide the capability to track data assets of DOI-wide interest that are produced in a DOI federated model. This process is described in Appendix F.

It is recommended that GOS services be upgraded to improve DOI lifecycle management by providing the following extensible services:

- Provide a metadata process enhancement that will provide for simple identification of DOI's ADSs
- Provide a metadata query that will allow the ADSs to be identified, promoted, and accessed through the user and services interfaces
- Provide the means to manage the contributing producer process on the basis of data themes and contributing geographic areas of responsibility
- Provide the "best available source" data search service to present the user with prioritized information that is based accuracy, completeness, consistency, precision, timeliness, uniqueness, validity, and availability.

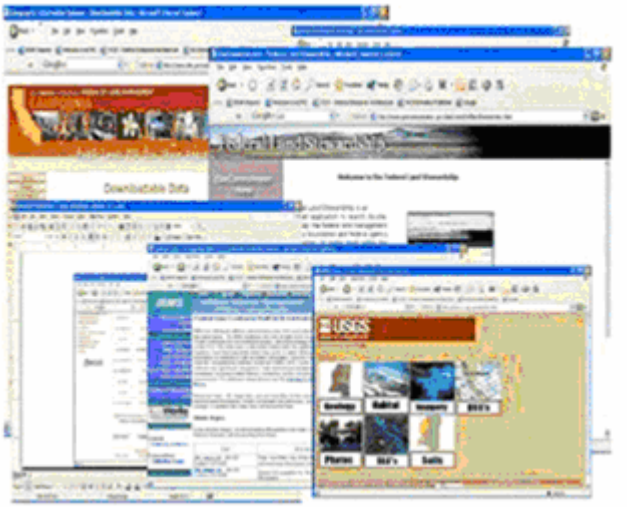
Currently GOS users have a difficult time sorting though the comparative value of the metadata found from a query. These new services will improve usability and visibility of DOI's ADS assets. These upgraded GOS services are listed and described in Appendix G. The supporting business process is described in Appendix F.

To further support the data lifecycle implementation, it is recommended that the EGIM review and recommend the data and exchange standards from Appendix C to the DAC [21], for adoption in the DOI Data Reference Model (DRM) [25]. The federal Geospatial Enterprise Architecture (GEA) profile [26], sponsored by the federal Chief Information Officer (CIO) council [27], has endorsed a list of standards and specifications necessary to achieve the data and services interoperability objectives of the

GeoLoB [1]. This list includes data standards, such as the existing FGDC data standards [28] and the International Standards Organization (ISO) data [29]. The recommendations will be formally submitted to the DAC by EGIM/GMO

4.1.3 Establish DOI Product Generation Services for Geospatial Products and Information

Many users of DOI geospatial products and data, including DOI business users, geospatial SMEs, external partners, citizens, and industry users, experience difficulty in navigating multiple complex geospatial system interfaces scattered over numerous Web locations and repositories (see Figure 4-3). It is time-consuming for a user to efficiently locate and convert numerous data themes into useable formats. The current model requires an individual to have geospatial skills, knowledge of DOI data holdings, and a lot of time to evaluate redundant holdings or understand the DOI organizational structures.



Today there are multiple mechanisms to find, identify, configure, and track requests for available geospatial products and data. Although, the target ADS model and supporting map, data, and exchange services will help alleviate this problem by organizing the back-end resources, there are still challenges associated with improving user navigation, configuring, formatting, and delivering products to achieve efficiencies and improve user experience for external DOI partners and consumers. This basic process is modeled in Appendix H.

Figure 4-3 Non-Integrated Geospatial Product Navigation Access and Delivery

This recommendation will provide the capability to access a consistent, business-oriented and user-friendly system to present, manage, process and deliver available geospatial data, products, and services. The key to this development is to provide a simple mechanism to allow internal and external consumers to build an area of interest (AOI) and associate standard DOI business needs using a geospatial catalog. The catalog will describe DOI products and services and allow the user to create a relationship between a standard business request and the catalog.. This business-driven enterprise service delivery approach will enhance and facilitate reuse of data assets and simplify the effort to configure, transform and deliver the products to the user. The system to deliver these services will be called the Product Generation System (PGS).

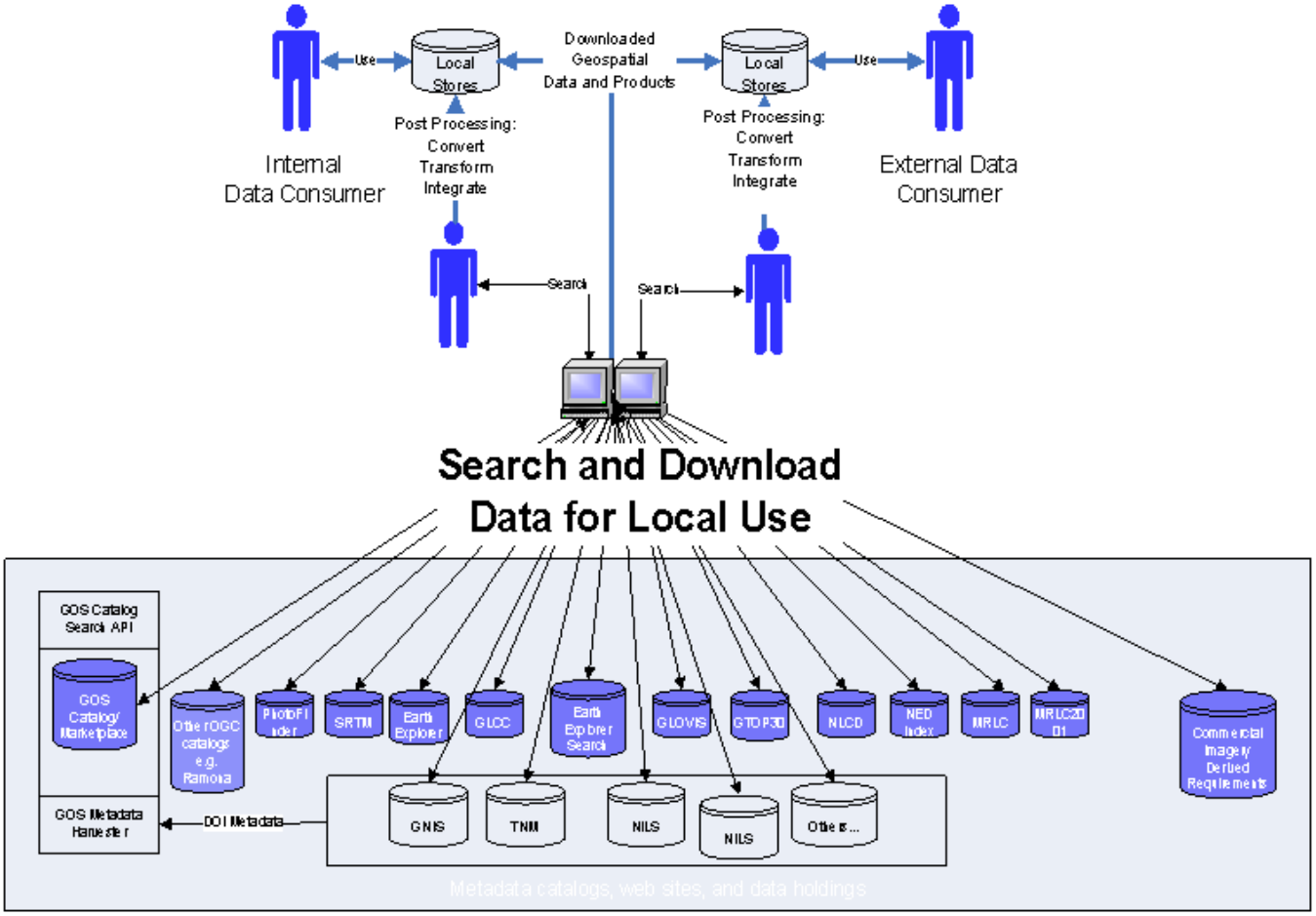
The supporting services and capabilities of the PGS are described in Table 4-3. This solution will integrate with key existing assets, including the GOS portal [23], existing search services, and the recommended ADSs.

Table 4-3 Key Business Operations Supported by Product Generation System

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

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

In the current state, as shown in Figure 4-4, the GOS portal [23] and other Web sites provide catalog search capability for locating geospatial data sources. Numerous Web sites provide the capability to locate and download products for the consumers. At present, consumers are forced to work through an inconsistent and redundant service access model to identify geospatial data and products. This is a legacy condition that is the result of service development practiced at the local program or product level. Although DOI catalogs and indices provide access to a large collection of DOI datasets and source material, they are time consuming and expensive to navigate. Currently, most product and data downloads come in a predetermined format. Once downloaded, the geospatial user typically must integrate the data to conform to their local needs. There are no enterprise services to facilitate this process for the users. It requires advanced geospatial skills. This is a major barrier to geospatial adoption and to extending the investment in DOI data assets.



(Notes: Abbreviations and acronyms: API, application programming interface; DOI, U.S. Department of the Interior; GLCC, Global Land Cover Consortium; GLOVIS, Global Visualization Viewer; GNIS, Geographic Names Information System; GOS, Geospatial One-Stop; GTOP30, Digital Elevation Model 30 arc-second; MRLC, Multi-Resolution Land Characterization; MRLC2001, Multi-Resolution Land Characterization 2001; NED, National Elevation Data; NILS, National Integrated Lands System; NLCD, National Land Cover Dataset; OGC, OpenGIS Consortium; Ramona, metadata mining project integrated with Geospatial One-Stop SME, Subject Matter Expert; SRTM, Shuttle Radar Topography Mission; TNM, The National Map)

Figure 4-4 Current Product Generation Environments

The target model is designed to address simplified access across multiple repositories of data, provide standardized product configurations, eliminate the development of similar functionality at each ADS, and provide efficiencies by automating complex data manipulations that are commonly performed by experienced subject matter experts.

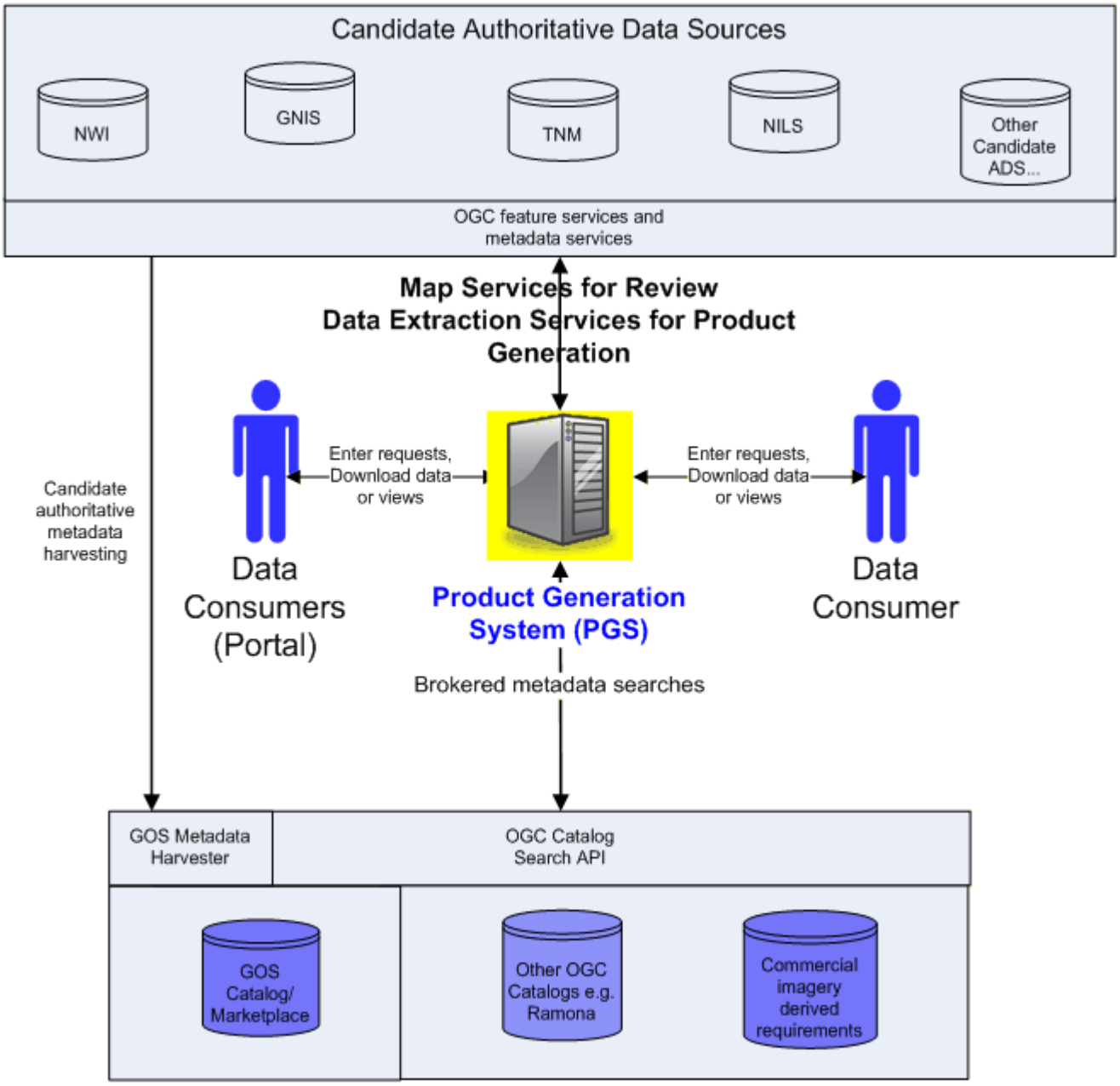
In the target state, the PGS will realize the benefits of the ADS and its data lifecycle management practices, established with Recommendation 4.1.1. With the data in a managed state, it will now be possible to develop functionality once and reuse it for the many systems supporting the enterprise data assets. The DOI data sources included in the as-is state include many of the candidate ADSs. As these candidate ADSs are certified, they will be migrated into the PGS target state model.

The target state for the PGS environment is depicted in Figure 4-5. This model introduces the concept of product and data configuration services that rely on enhanced data search, configuration, formatting, and delivery capabilities. The target PGS becomes the focal point for internal and external consumers to request available DOI geospatial products and data. The target state will extend the DOI geospatial

product and services catalog implementation to a model for enterprise service delivery for available products and data. The PGS will support the collection of consumer data, business driven product selection, and configuration parameters and notifications options. This stage will integrate the following:

1. The existing capabilities of GOS catalog services combined with ADS identification and promotion
2. Share services developed for the Geospatial Requirements Planning System (GRPS) – Figure 4-14
    a. Requirements Broker—enables searching across multiple catalogs
    b. Best Source Search—identifies the best source materials from the respective FGDC-based [28] catalogs, while comparing them to the original requirements
    c. Requirements Optimizer—identifies and evaluates the results of Best Source Search to identify consolidation opportunities and gaps in data or identify similar contract services needs over the same geographies
3. Shared consumer functionality and DOI geospatial products and services catalog
4. Extended product generation, cartographic formatting, and downloading services currently being planned for TNM
5. Online map and data services planned for each DOI ADS

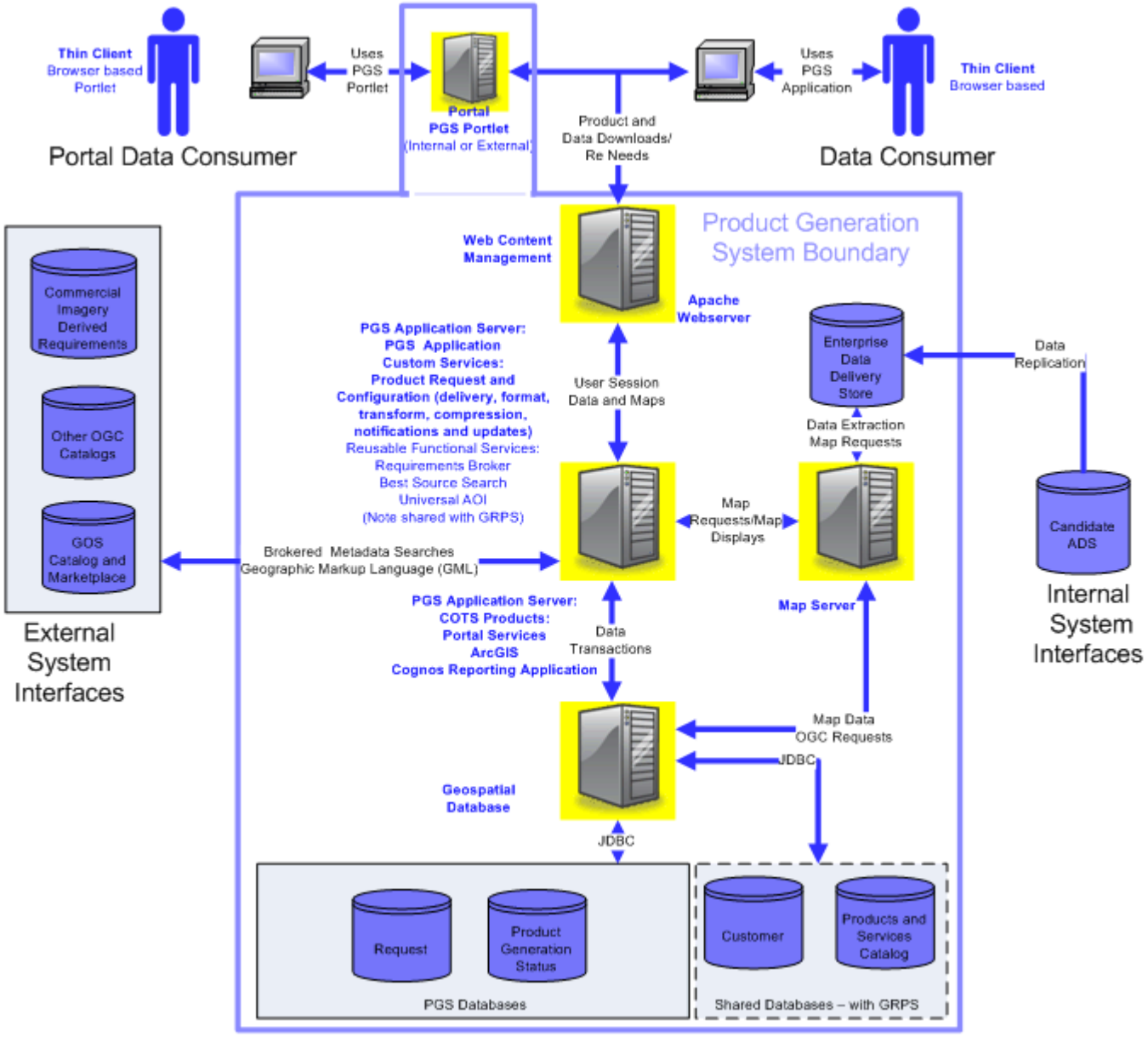
The target state requires adherence to OpenGIS Consortium (OGC) [30] interoperability standards to ensure engineering flexibility and cost effectiveness. The services components will be provided as Web services and registered and described in GOS [23] and CORE.GOV [24]. These services will be designed to support a service implementation that will be useable from GOS, Communities of Interest (COI) portals, and organizational portals. This service implementation will provide maximum flexibility for internal and external consumer communities to create and download data configured to their needs. DOI metadata catalogs that are currently not available in GOS will be migrated to its catalog service or be exposed via its own OGC [30] and Z39.50 [31] standards through the application programming interface (API). This interface will enable cross catalog searches and provide access to detailed metadata holdings.



(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; API, application programming interface; GIS, geographic information system; GNIS, Geographic Names Information System; GOS, Geospatial One-Stop; NILS, National Integrated Lands System; NWI, National Wetlands Inventory; OGC, OpenGIS Consortium; PGS, Product Generation System; "Ramona," metadata mining project integrated with Geospatial One-Stop; TNM, The National Map)

Figure 4-5 Target Product Generation System Environments

The PGS target architecture, Figure 4-6, will be a Web service that will be made available to portal-based COIs or organizations. The implementation will integrate with the existing GOS catalog services through the OGC compliant [30] catalog API. Product configuration parameters will include specifying the desired data inputs, transformation, compression, formatting, and delivery options selected from the geospatial products and services catalog. Based on selected products and specified parameters, the system will perform an automated search, ranking, and delivery using the best source search service and the GOS catalog [23]. The user will be presented with the information for selection and approval. Once the parameters are finalized, the system will extract, transform, and deliver the information.



(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; AOI, area of interest; ArcGIS, GIS software from ESRI; COTS, commercial off the shelf; GIS, geographic information system; GML, Geographic Markup Language; GOS, Geospatial One-Stop; GRPS, Geospatial Requirements Planning System; JDBC, Java Database Connectivity; OGC, OpenGIS Consortium; PGS, Product Generation System)

Figure 4-6 Target Product Generation System (PGS) Architecture

Additionally, DOI PGS associated with the target state include features such as replication services, data storage and management, notifications, and automated data updates. As planned and available data status changes over the specified working areas, users will have the option to be notified or have new data delivered according to the original specifications. These features will support the use cases for DOI workers who participate in prolonged studies and projects. For example, consider the situation where a collection of existing geospatial datasets serves as the basis for a vegetative study. Once these datasets are assembled, a product generation service can provide services to update an existing component dataset automatically once an updated version of that data is available. By automatically updating the

underlying data, such a service has the effect of regenerating a new version of the geospatial information (i.e., product) whenever there is a change to a component dataset. Such capabilities provide the capability to "push" information in much the same way as mobile computing devices are automatically synchronized and updated with new emails whenever new emails are received at the central mail server. The full suite of IT and business services are identified in Figure 4-7.

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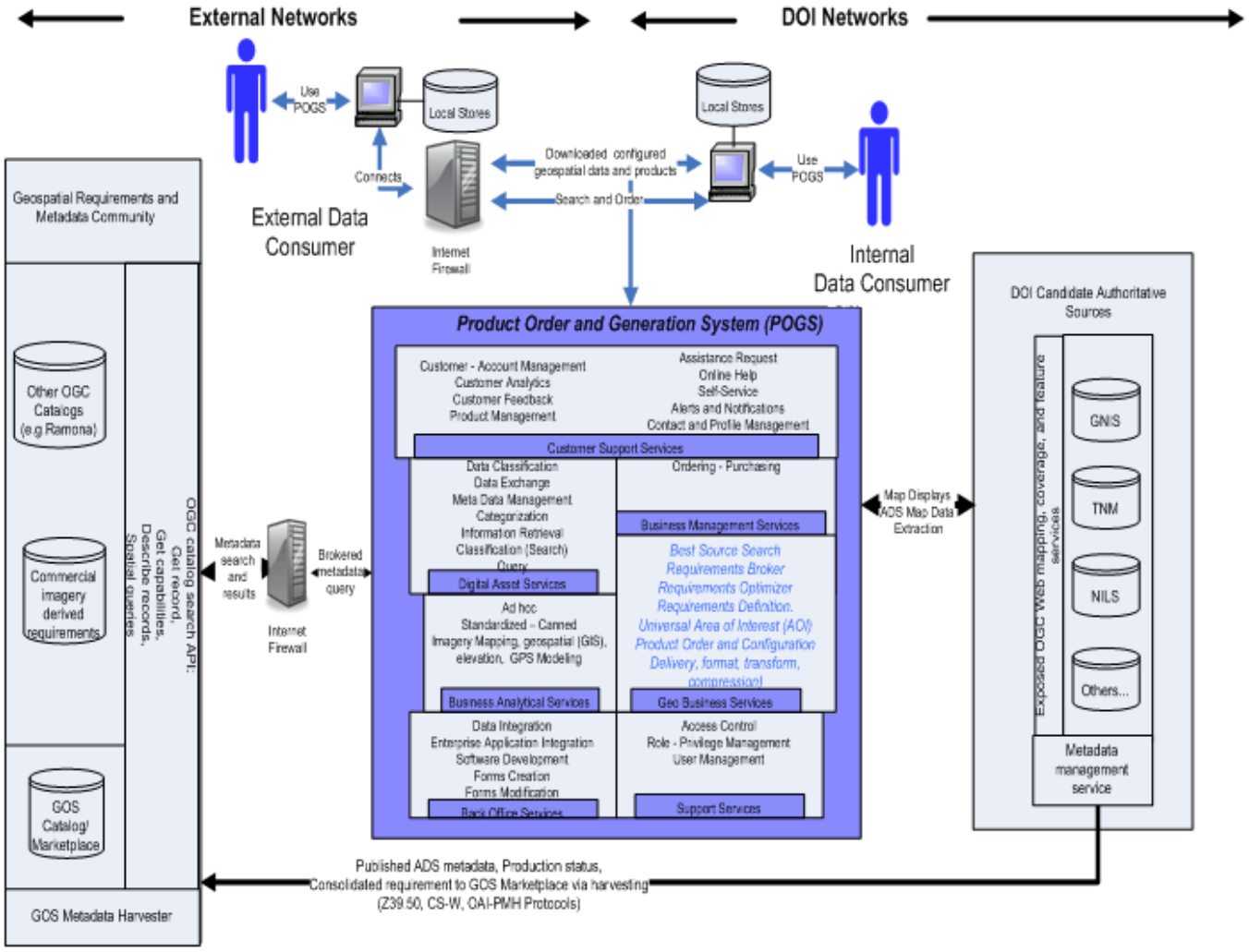
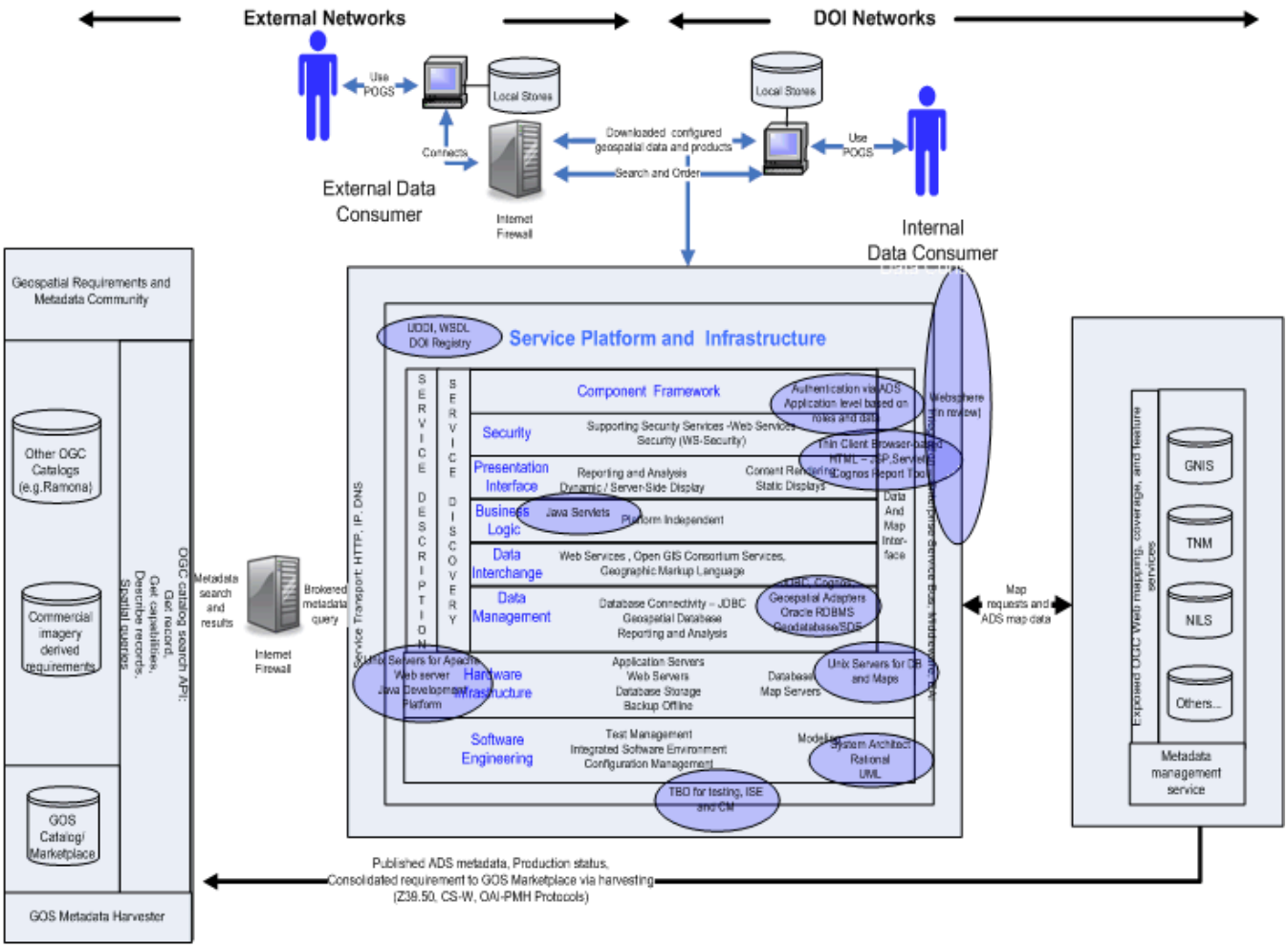


(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; AOI, area of interest; API, application programming interface; DOI, U.S. Department of the Interior; GIS, geographic information system; GNIS, Geographic Names Information System; GOS, Geospatial One-Stop; NILS, National Integrated Lands System; OGC, OpenGIS Consortium; PGS, Product Generation System; Ramona, metadata mining project integrated with Geospatial One-Stop; TNM, The National Map)

Figure 4-7 Target Product Generation System (PGS) Services

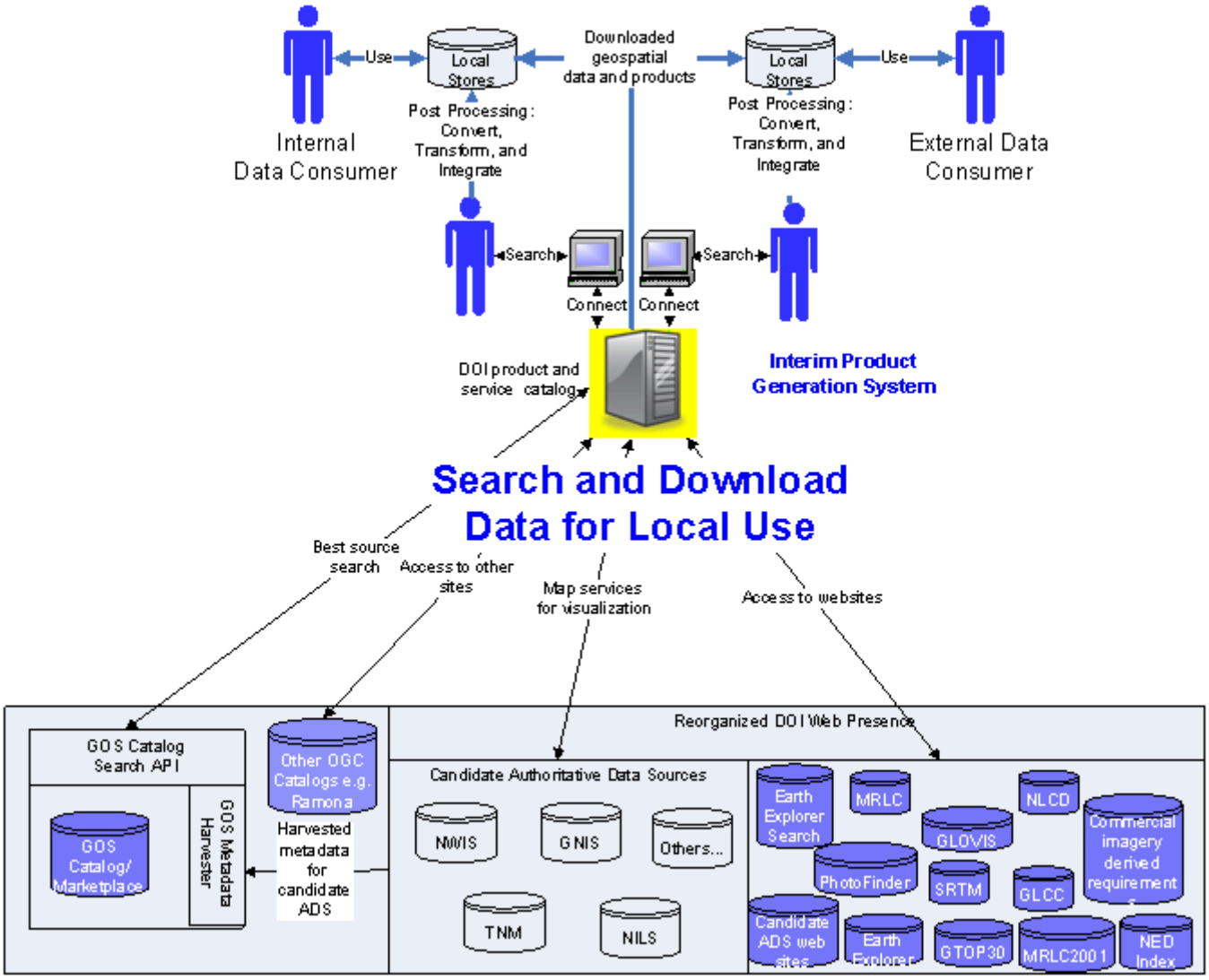
The PGS technology platform is designed to align and interoperate within the larger DOI environment, but will share much of the same technology solution as the GRPS, GOS, and the ADSs. Interoperability is the foundation to the geospatial architecture. The PGS will be built on standards from OGC [30] and FGDC [28] to ensure enterprise interoperability and maximum reuse. The key technology products shown in Figure 4-8 will be used to support system development and cost estimation..



(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; API, application programming interface; CM, Configuration Management; CS-W, OpenGIS Catalog Service for the Web; DB, database; DOI, U.S. Department of the Interior; EAI, Enterprise Application Integration; GIS, geographic information system; GNIS, Geographic Names Information System; GOS, Geospatial One-Stop; HTML, Hypertext Markup Language; IDBC, Internal Device Buffer Code; ISE, Integrated Software Environment; JDBC, Java Database Connectivity; JSP, Java Server Pages; NILS, National Integrated Lands System; OAI-PMH, Open Archives Initiative Protocol for Metadata Harvesting; OGC, OpenGIS Consortium; PGS, Product Generation System; "Ramona," metadata mining project integrated with Geospatial One-Stop; RDBMS, Relational Database Management System; SDE, spatial data engine; TBD, To Be Determined; TNM, The National Map; UDDI, Universal Description Discovery and Integration; UML, Unified Modeling Language; WS, Web Services; WSDL, Web Services Definition Language; Z39.50, Client Server Protocol)

Figure 4-8 Target Product Generation System Technologies

This recommendation requires an interim transition stage to support the target implementation. The interim system state, as seen in Figure 4-9, provides an organizing strategy that is a necessary incremental step toward the target state. This interim stage requires the creation of a DOI-wide business-aligned geospatial product and services catalog, the reorganization of the DOI Web presence to facilitate access to all existing supporting DOI geospatial sites, and the provision of basic services that will allow the capability to perform searches that are based on business inputs. The catalog will reflect geospatial data and products that are owned and managed by DOI and provide direct links from the business need to the DOI ADSs and other data source metadata records within GOS [23].



(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; API, application programming interface; DOI, U.S. Department of the Interior; GLCC, Global Land Cover Consortium; GLOVIS, Global Visualization Viewer; GOS, Geospatial One-Stop; GNIS, Geographic Names Information System; GTOP30, Digital Elevation Model 30 arc-second; MRLC, Multi-Resolution Land Characterization; MRLC2001, Multi-Resolution Land Characterization 2001; NED, National Elevation Data; NILS, National Integrated Lands System; NLCD, National Land Cover Dataset; NWI, National Wetlands Inventory; OGC, OpenGIS Consortium; Ramona, metadata mining project integrated with Geospatial One-Stop; SRTM, Shuttle Radar Topography Mission; TNM, The National Map)

Figure 4-9 Interim Product Generation System Environments

The creation of the geospatial product and services catalog will be completed as part of the interim state. This work will be coordinated with the ongoing USGS Web redesign effort and the development of an TNM products and services catalog. The key objective is to provide a defined set of products and services that will help consumers bypass the current organizational fragmentation of DOI's assets. The catalog will facilitate efficient access to a wide variety of backend sites. The DOI Geospatial catalog will work in concert with the GOS metadata catalog [23]. The access will be provided through dynamically generated web pages and content. No product or data configuration capability will be available in this stage. This system architecture is represented in Figure 4-10.

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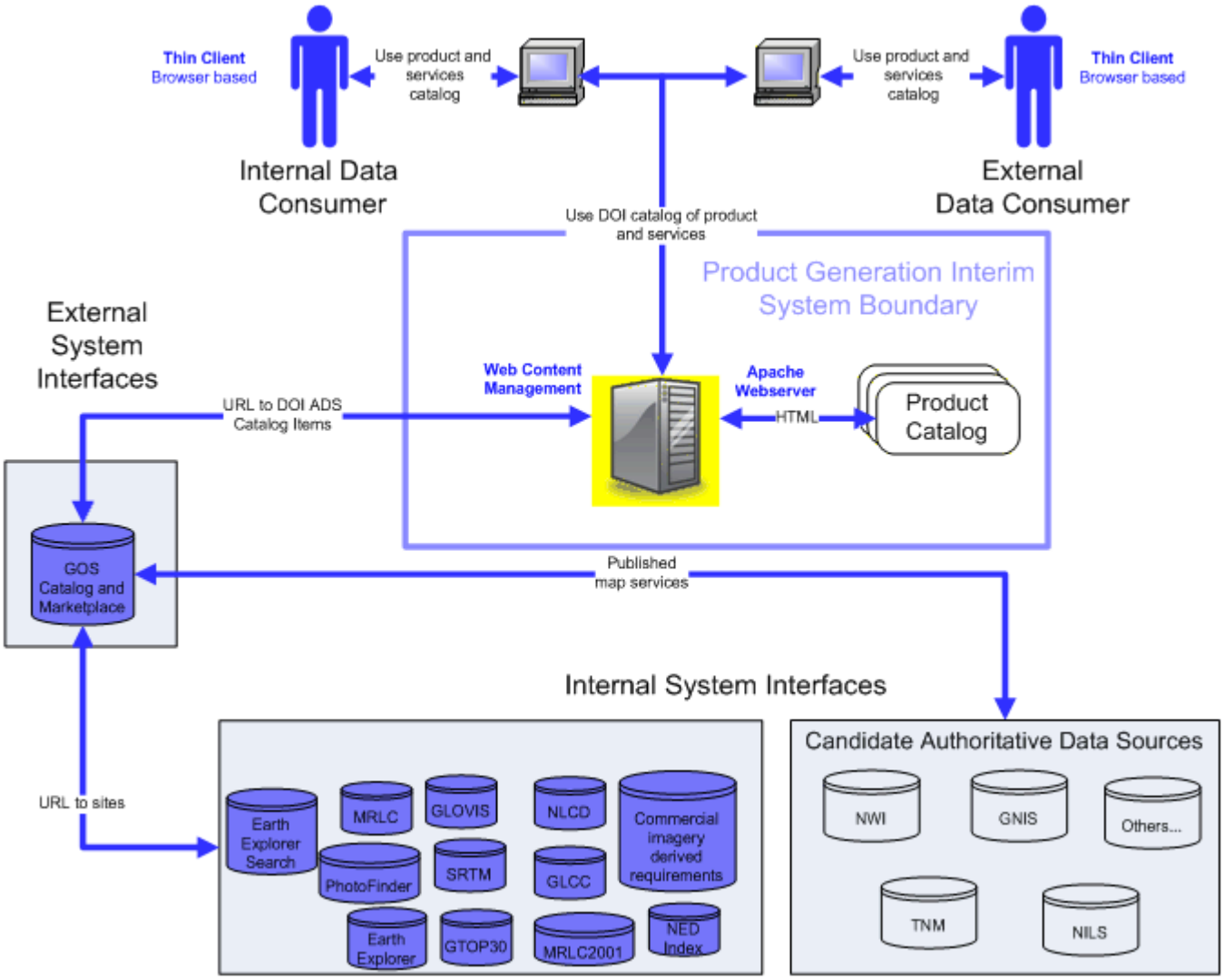


(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; DOI, U.S. Department of the Interior; GIS, geographic information system; GLCC, Global Land Cover Consortium; GLOVIS, Global Visualization Viewer; GNIS, Geographic Names Information System; GOS, Geospatial One-Stop; GTOP30, Digital Elevation Model 30 arc-second; HTML, Hypertext Markup Language; MRLC, Multi-Resolution Land Characterization; MRLC2001, Multi-Resolution Land Characterization 2001; NED, National Elevation Data; NILS, National Integrated Lands System; NLCD, National Land Cover Dataset; NWI, National Wetlands Inventory; OGC, OpenGIS Consortium; Ramona, metadata mining project integrated with Geospatial One-Stop; SRTM, Shuttle Radar Topography Mission; TNM, The National Map; URL, Uniform Resource Locator)

Figure 4-10 Interim Product Generation System Architecture

The GMO and EGIM [20] will coordinate the development of the DOI geospatial products and services catalog. They will work with business SMEs and products and services representatives. They will coordinate with the TNM, GOS, and other ADS owners to create the first phase of the catalog and the TNM PGS. In the long term, the GMO will work with EGIM to implement the target PGS capabilities. As with the need for a funding model to implement ADSs, it will be necessary for the Geospatial Core Team [19] to establish a funding model to support the development of enterprise PGS. A Fiscal Year (FY)2010 investment is planned to support implementation of the PGS.

Note that the PGS will affect the existing IT capabilities baseline. The affected capabilities are described in Appendix I. As the PGS functions are implemented, these systems will be need to be reengineered and accommodated in the transition plan.

4.1.4 Implement Geo-Enabled DOI Business System Interfaces and Services to improve Business Intelligence

The inability to readily access and use location-based finance and facilities information results in challenges to operate and plan for 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 and performance 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 investments to land and resource stewardship goals.

This recommendation provides the ability to spatially associate and display the financial, facilities (Enterprise Facilities ADS), and project activities that are being tracked in the Financial Business Management System (FBMS) [32] 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 4-4. 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 (BI) will provide a dynamic means to understand the changes in Federal Land Ownership (title) and land status (land use, leasing, easements, right-of-way, permitting) and improve the financial system data integrity.

Table 4-4 Summary of Interfaces for Business Systems and Intelligence

• FBMS "Real Property Process" realty module will interface to authoritative federal land ownership and cadastral spatial data in NILS. The Land transaction information managed in TAAMs/TAAMS Spatial [33] and NILS/LR2000 [34] (Note the final disposition on TAAMS and TAAMS Spatial will be determined in the Trust Blueprint) will provide the land status information respectively.
• "Enterprise Facilities ADS for Real Property" business process with supporting interfaces from FBMS [32] modules (Financials, Asset Management, and Materials Management) through the planned Gateway to the Enterprise Facilities
• NILS/LR2000 [34] to Enterprise Facilities ADS using the inherent spatial qualities of the feature data

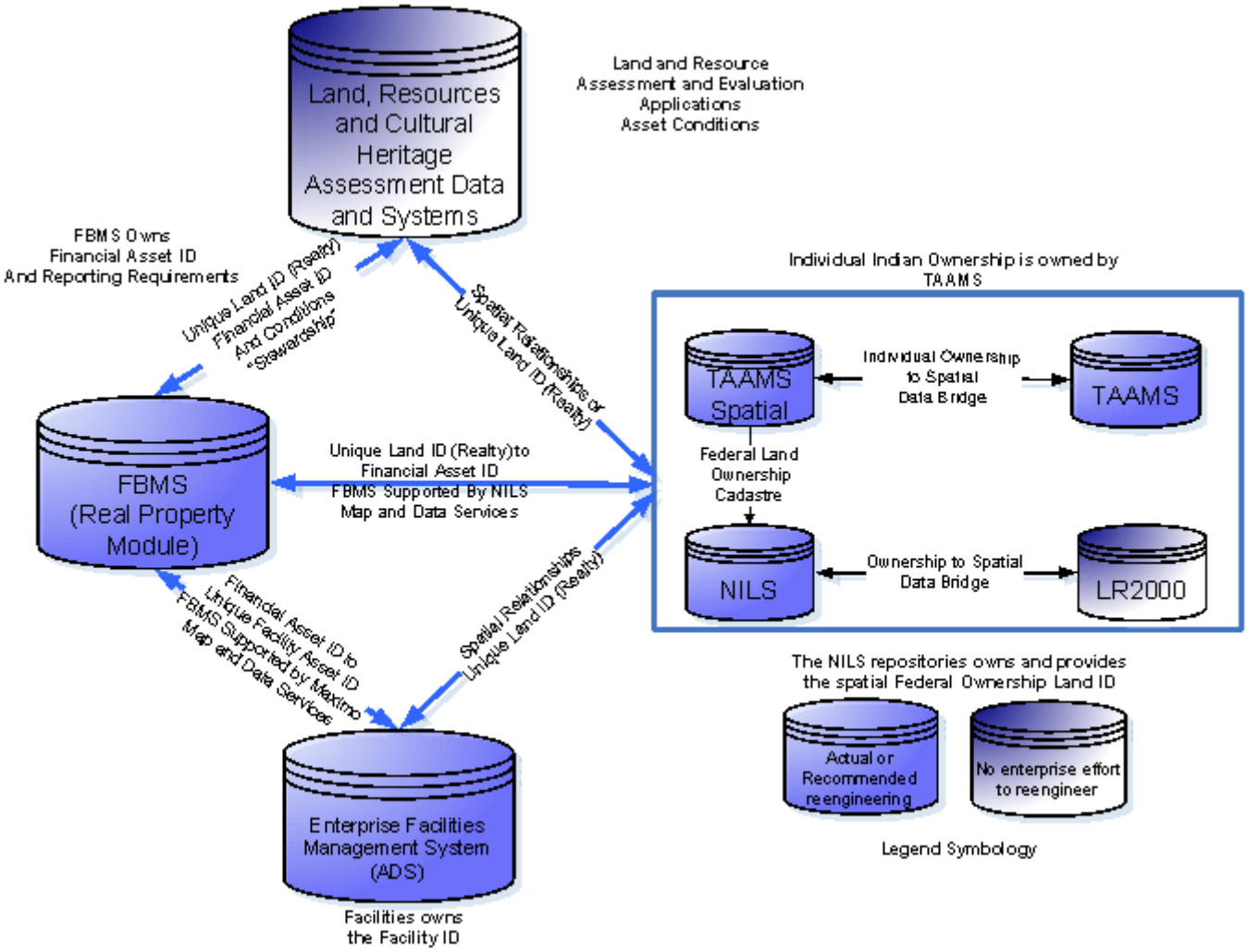
(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; FBMS, Financial Business Management System; LR2000, Legacy Rehost 2000—Bureau of Land Management and Minerals Records 2000 system; NILS, National Integrated Lands System; TAAMS, Trust Asset Accounting Management System)

Stewardship objectives can be enhanced greatly through enterprise geospatial information and services. This recommendation will enable land and resource managers to address inquiries more quickly and accurately. The types of inquiries that will be facilitated are:

- What resources have been invested in a parcel of managed land over time?
- What does one need to be aware of while planning? What are the baseline conditions, current management criteria external factors, future trends, or expected outcomes?
- What restorative projects or treatments have been conducted? What stewardship responsibilities does one have on nonfederal lands?
- How do these activities affect the land management measures and objectives?
- What is or has been the associated cost of performing land protection or maintaining multiple uses?

- What else is planned or budgeted for the future?

Effective land and resource stewardship entails extensive planning that is based on the results of land or resource assessments and evaluations. It requires insight into the past actions from projects, current activities, and projected uses of the land. It also requires an insight into the available land and resource information, available scientific knowledge, facilities assets status, financial data, and policies. The current operational model requires that this demanding and complex set of information assets be brought together through data calls, multiple system data entry, and complex reporting. The inability to integrate this geospatial and other information for the broader community of DOI users compromises many downstream business practices, including planning, engineering, facilities and financial management, disaster management, assessments, and evaluations. Without this integration, the extended user community must become the information integrator.



(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; FBMS, Financial Business Management System; ID, identifier; LR2000, Legacy Rehost 2000—Bureau of Land Management and Minerals Records 2000 system; Maximo, software package for asset management and services; NILS, National Integrated Lands System; TAAMS, Trust Asset Accounting Management System)

Figure 4-11 To-Be Business System Interface Model

The data from the systems shown in Figure 4-11 will have a high reuse potential and greater usability when spatially enabled. The data integrity, which is based on the unique identifiers of these key systems, needs to be implemented and managed using configuration management practices at the enterprise level

to support the numerous business practices, the target SOA model, and enterprise data reuse. Without a systematic means to build and manage these relationships accurately, there will be continued business process inefficiencies. The federal ownership, cadastre, and Enterprise Facilities ADS have already been recommended as ADS candidates in part on the rationale to improve stewardship accountability and reporting accuracy. An additional step would be to spatially enable the relationships from these systems to FBMS [32] relating the real property identifiers to the corresponding spatial representations found in NILS. This would spatially enable the real property information within FBMS. Having access to this information would improve the accountability, planning, and operational activities. With these new interfaces, and approved ADS data and map services, the target state would be positioned to provide a critical set of services to enhance the efficiencies of the many current and future land management business processes, systems, and applications for the land and resource communities.

To achieve the spatial enablement of NILS, FBMS, and Enterprise Facilities ADS, these enterprise-level investments, which are in varying stages of development, should be influenced to achieve the following:

- Establish and enforce the primary key relationship of the actual or planned expense of the facilities investment in FBMS to the spatially located physical assets within the Enterprise Facilities ADS. With the location of the facilities established, they can be spatially related to the official Federal Land Ownership holdings within spatial databases of NILS/LR2000 (Legacy Rehost 2000—Bureau of Land Management and Minerals Records 2000 system). This three way connection builds the investment to asset to land relationship that supports financial stewardship reporting requirements. The spatial relationship offers new means to perform quality assurance, analysis, visualization, and reporting on investments in portions of managed lands. The NILS relationship provides a dynamic means to understand the changes in Federal Land Ownership or status and improves the financial system data integrity. Finance data will be owned and managed in FBMS; facilities projects and feature data will be owned and managed in Enterprise Facilities ADS; and Federal Land Ownership will be managed in the NILS/LR2000. TAAMS/SPATIAL [33] will ensure cadastral and federal ownership is synchronized with NILS..
- Establishing this type of relationship to the Land and Cultural Heritage efforts would provide the similar benefits for financial and land stewardship. Future development efforts should be constrained through governance to take advantage of these interfaces and ensure consistency with the long-term target architecture.

These investments, when interfaced through spatially enabled data and map services, will incorporate the foundation for a location-based land and resource stewardship capability to satisfy DOI's financial preparation guidance requirements more efficiently. Additionally, with a financial reporting requirement for all facilities to be visited every 5 years [35], the Blueprint recommends creating a complete spatially enabled facilities inventory. This will occur by creating a facilities data collection plan using the 5-year inspection requirement as the driver. Spatially enabled facilities information has a high reuse value. The Bureau of Indian Affairs (BIA) Facilities Management System (FMS), the Bureau of Reclamation (BOR) FMS, National Park Service (NPS) Facility Maintenance Software System (FMSS), and Bureau of Land Management (BLM) Facility Asset Management System (FAMS) are already pursuing the creation of spatial facilities assets. This type of activity will need to be coordinated at the enterprise level to ensure that the necessary standards for geospatial data are established for the Enterprise Facilities ADS. Note that, if the Enterprise Facilities ADS does not go forward, this model can still be done with the previously agreed data standards for enterprise assets on multiple facilities instances, but will encounter more risks (e.g., reduced data quality) and require greater operational resources. FBMS Concept of Operations [32] has identified this as a risk as well.

The EGIM and Geospatial Core Team recognize the risks and challenges associated with this recommendation. It is critical to align with the implementation plans for facilities and FBMS. The current operational concept has defined the "Manage Real Property Buildings, Structures & Land Assets" process as the key integration point for facilities and land transactions. FBMS defines the business process responsibility as follows:

> "*This process details the management and operations to maintain accountability and control of real property buildings and structures that may be a single physical structure or building, or grouping of structures, buildings, land features, or other tangible real property that has a specific service or function, such as a farm, cemetery, campground, marina, or sewage treatment plant. The processes relate to the normal performance of recording the financial impacts of property transactions in accordance with laws, regulations, and standards and ensure accountability and control for all property throughout its lifecycle, from the time the government takes title to or possession of property until when formally relieved of accountability by authorized means. Also included are management and operations to maintain accountability and control of real property land assets. The processes include recording physical and financial transaction data of the possible types of acquisitions withdrawals, easements, rights-of-way, land-leases, mineral leases, use permits, licenses, and other restrictions that could be associated with the land*." [32]

It is important, prior to the development of these interfaces, to ensure the business and data ownership rules are defined to maximize existing data and services reuse.

To mitigate these risks, a cross-project team representing these three major investments, business and data representation, geospatial expertise, and the land and resources communities should be established to create reengineered cross-organizational spatially enabled business processes and rules. It should address facilities asset planning as well as financial and land stewardship. The Policy Management and Budget (PMB) organizations should take the leadership role. The team should document the requirements, generate costs estimates and benefits, and integrate the necessary activities into the existing development plans. It is also recommended that the team develop a shared funding strategy to support the interface and enterprise services development. Once approved, the plans would be posted on the planned DOI enterprise project planning environment to facilitate the coordination of the projects and to be included as milestones in the respective investment business cases (i.e., Exhibit 300s) [27]. The team should coordinate the development of a data collection and funding strategy of DOI facilities data.

4.1.5 Adopt and Implement Geospatial Interoperability Standards and Licensing for Enterprise Geospatial Technology

As with the legacy practices for local management of data (addressed in 4.1.2), DOI has developed a fragmented approach to the adoption of interoperability standards and the licensing of enterprise geospatial technology. This approach has resulted in increased administrative costs associated with maintaining multiple licenses, and higher software and system maintenance costs [11].

This recommendation is presented to establish a DOI ELA for key technologies and adopt geospatial interoperability standards for reengineering of existing applications and for new technology investments. This will eliminate the need for redundant technology investments at the program level and provide standardized solutions that support interoperability across the enterprise.

The Blueprint's authors reviewed the DOI's technology standards and the technology product baseline. The key technology, the ESRI suite of products, is the "preferred" and the dominant product standard within the DOI. The list of ESRI products in the DOI Technical Reference Model (TRM) are classified as "preferred." The product suite is currently managed under an ELA. As mentioned in the Geospatial Services Model summary, this ELA has resulted in $46 million savings over 5 years [11]. The analysis of the geospatially related technologies within the TRM has revealed potential candidates for additional ELAs. These products are the following:

- Global Positioning System (GPS)
- Image Processing Software
- Computer-Aided Design (CAD)
- Image Serving and Delivery
- Geospatial Knowledge Base
- Compression Technology
- Geo-enabled Portable Data Format (PDF) Technology

It is recommended that the GMO coordinate an evaluation of the potential for an ELA for each of the products in collaboration with the bureaus and EGIM. They shall establish a cost benefit recommendation for the respective products and present the information to the DOI governance community including Geospatial Core Team, Chief Technology Officers' Council (CTOC), and if warranted, the IRB.

It is recommended that the GEA profile technology and interoperability standards be evaluated for adoption into the DOI TRM [25]. Existing DOI services, such as The National Map and Geospatial One-Stop use interoperability specifications from the OGC [30]. It is foundational in the development and maturity of the DOI geospatial services model to move to these standards to as great a degree as possible. It will provide greater application and service flexibility and tool interoperability. Adoption of these specifications will mitigate vendor lock-in.

It is recommended that DOI create a training class for developers to ensure the consistent adoption of OGC interoperability standards for Geo-based application development. System development that is based on the OGC standards and specifications have demonstrated 26% savings on software development over a five year lifecycle [12].. This responsibility would be assigned to the EGIM team to integrate with their existing training task and be coordinated with the CTOC.

Currently, TNM is conducting a technology assessment of several image serving products to address anticipated larger future demands requirements for online service delivery and performance. Theses results will be published in early 2008 and coordinated with the EGIM/GMO and CTOC.

4.2 Enhance Geospatial Planning and Investment Strategy

FINDING 2 — There is no spatially supported enterprise planning process to identify and optimize common DOI business requirements

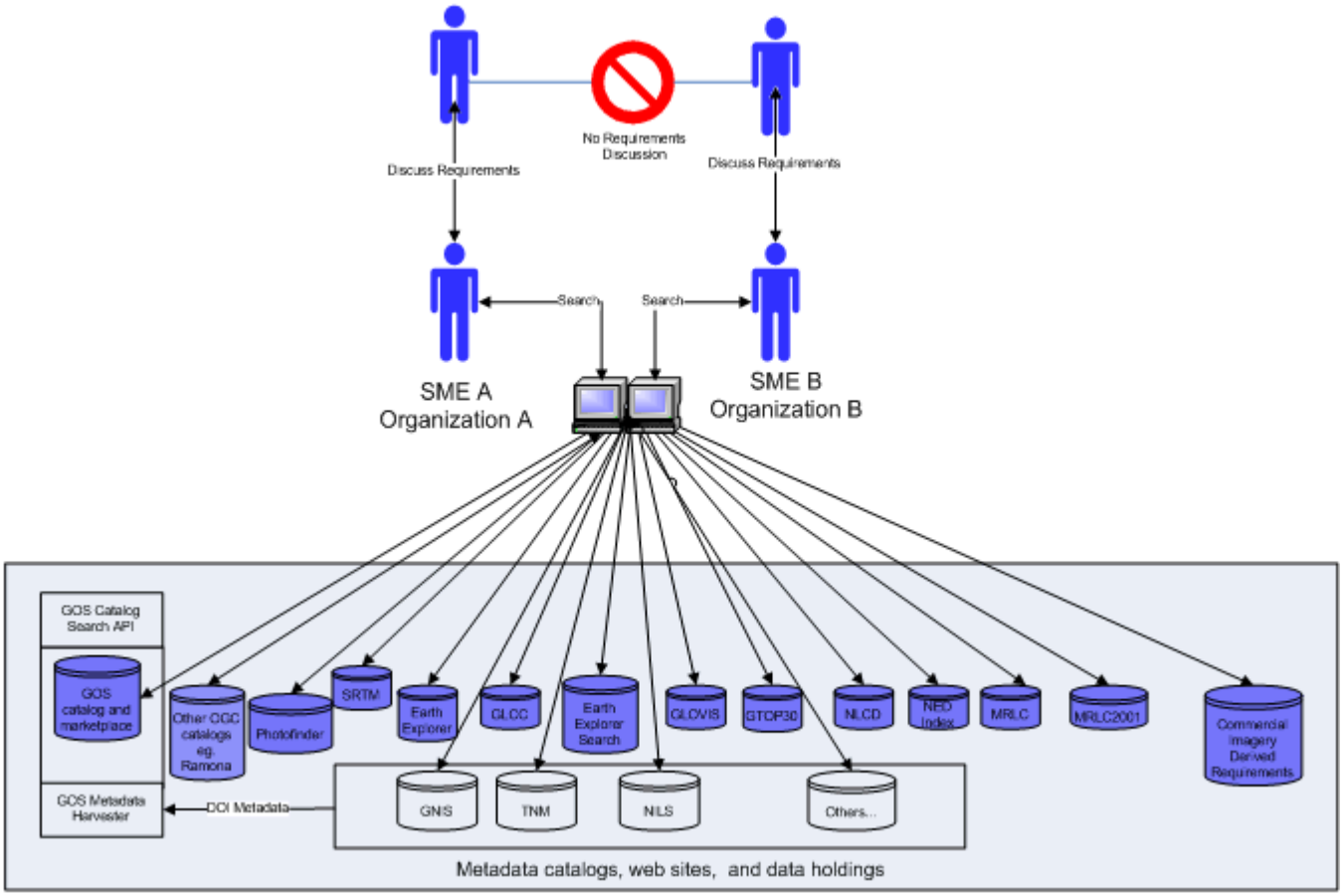
4.2.1 Establish a Requirements Planning Process

Currently, DOI programs do not have an enterprise mechanism to identify geospatial needs for planned work. Without this mechanism, identifying the needs for shareable geospatial data and contract services is extremely challenging. This often results in inefficiencies and redundancies of data purchases and contract service procurements (e.g., field mapping, data collection, etc.) causing overall higher program costs. An enterprise planning mechanism will provide the opportunity to answer the following questions:

- Is there an opportunity to use geospatial resources more effectively?
- Is the nature of the work such that there are common information and data requirements?
- Is anyone planning on collecting data in my area? Who does one contact?
- How does one compare business requirements to established production and collection plans from the mapping programs, e.g., Geology, Imagery, Elevation, and Wetlands?
- Who are the end users of my product or services? Will there be interoperability issues? Will there be legal issues or policy conflicts?

Figure 4-12 depicts the current state, wherein requirements are identified and managed at the individual program or project levels. For each activity, the planners must assess the quality and availability of existing geospatial data and contract services against the program's incoming business requirements and determine gaps. Program planners across the DOI do not have an effective means to see where other planned geospatial-related work will be performed. As a result, the requirements cannot be analyzed to identify cost avoidance and improved contract resource utilization opportunities. This process will be coordinated with the EGIM and GMO will provide the requirements consolidation support.

Additionally, program planners may use the numerous catalogs, such as the GOS [23] portal to search the existing metadata in an attempt to satisfy data needs. Whereas GOS and other catalogs offer search and query capabilities to support data requirements investigations, planners often require the assistance of geospatial and program SME to identify the quality and validity of geospatial datasets or services to meet the business requirements. The Geospatial Blueprint Stakeholder analysis and geospatial SMEs (see Appendix S) have confirmed that this process is time consuming, complex, and often inconclusive and have identified it as a key issue. Inconclusive results drive planners to avoid taking the risk and uncertainty associated with using the existing geospatial data. Often, their decision involves the purchase of new geospatial data and services to satisfy their requirements even when viable solutions exist. These are significant barriers to satisfying cost effective acquisition of data and services.



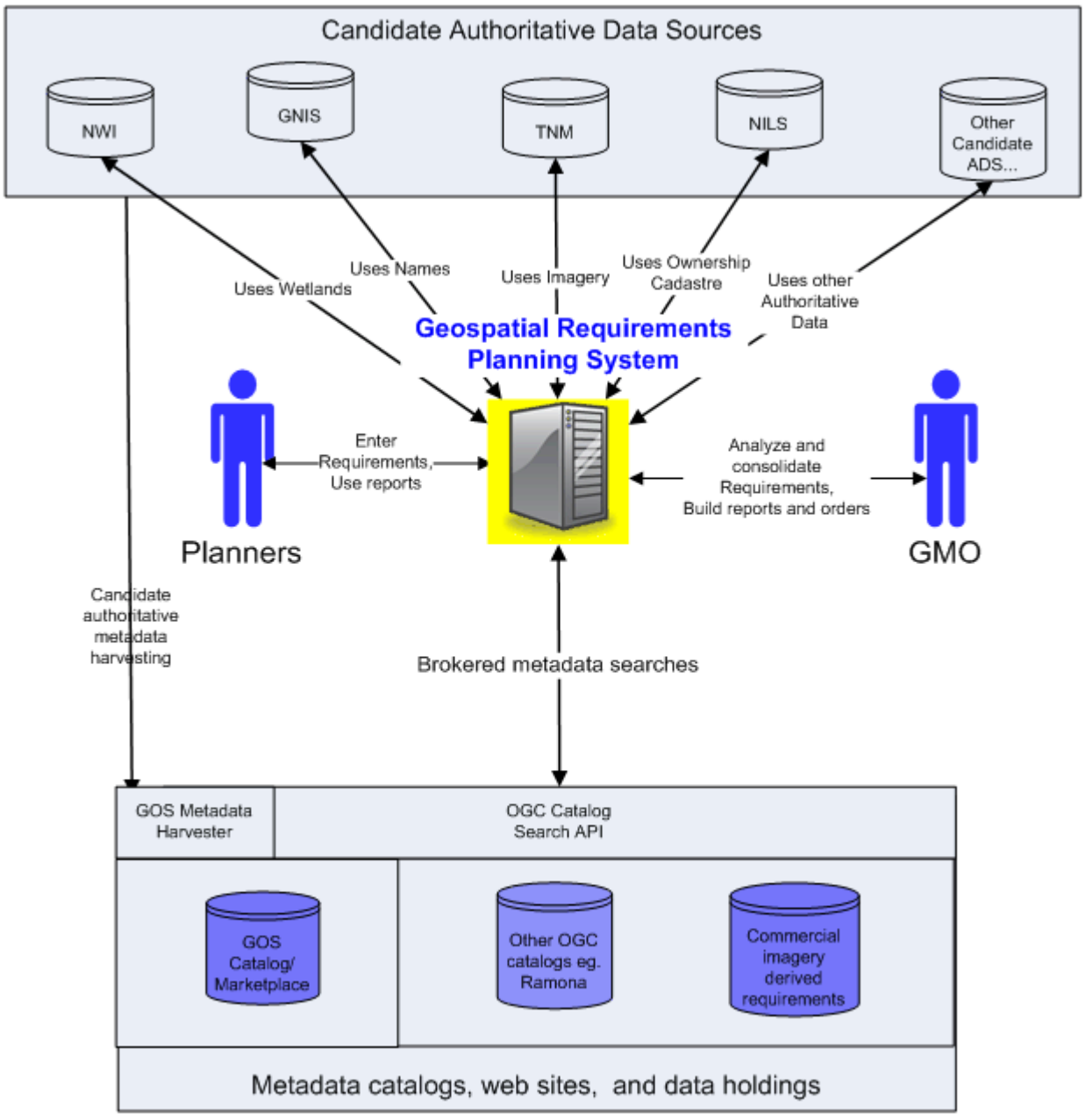
(Notes: Abbreviations and acronyms: API, application programming interface; DOI, U.S. Department of the Interior; GIS, geographic information system; GLCC, Global Land Cover Consortium; GLOVIS, Global Visualization Viewer; GNIS, Geographic Names Information System; GOS, Geospatial One-Stop; GTOP30, Digital Elevation Model 30 arc-second; MRLC, Multi-Resolution Land Characterization; MRLC2001, Multi-Resolution Land Characterization 2001; NED, National Elevation Data; NILS, National Integrated Lands System; NLCD, National Land Cover Dataset; OGC, OpenGIS Consortium; "Ramona," metadata mining project integrated with Geospatial One-Stop; SME, Subject Matter Expert; SRTM, Shuttle Radar Topography Mission; TNM, The National Map)

Figure 4-12 Current Requirements Planning System Environment

The requirements planning recommendation is to establish a DOI-wide GRPS that will identify common needs for acquisition of geospatial data and contract services established during work activity planning. The key benefits of the system will be cost efficiencies from greater reuse of the existing geospatial assets, improved metadata management, labor efficient searches, and the ability to manage geospatial data and contract services to better exploit cost avoidance opportunities.". Programs will benefit only from the direct participation in the requirements planning process. This system can support research efforts that are time and situation sensitive or unique bureau requirements, such as emergency management and very large scale engineering mapping, but should not delay or deny the acquisitions to meet these specific mission objectives.

The value of doing consolidated geospatial data purchases has already been proven within DOI. In 1999, DOI saved over $60 million by consolidating requirements before purchasing data in the DOI High Priority Lands program. During 6 years of program operation, $256 million in geospatial data were obtained for $54 million by coordinating the common data procurement requirements prior to purchase. However the manual process of preparing for the consolidated purchase proved cumbersome. The GRPS will automate this process and provide a coordinated means to collect, analyze user needs, and identify shared acquisition opportunities.

Figure 4-13 shows how the target GRPS system environment will interact with other major components and systems of the target geospatial architecture. In the desired state, GRPS enables program planners to easily create and manage geo-coded program work requirements by spatially defining the areas of interest and describing what information and contract services they need to support their effort. The users will be aided by a series of standardized product and service templates that will conform to FGDC [28] metadata standards and facilitate the requirements capture and definition.



(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; API, application programming interface; GIS, geographic information system; GMO, Geospatial Management Office; GNIS, Geographic Names Information System; GOS, Geospatial One-Stop; NILS, National Integrated Lands System; NWI, National Wetland Inventory; OGC, OpenGIS Consortium; "Ramona," metadata mining project integrated with Geospatial One-Stop; TNM, The National Map)

Figure 4-13 Target Geospatial Requirements Planning System Environment

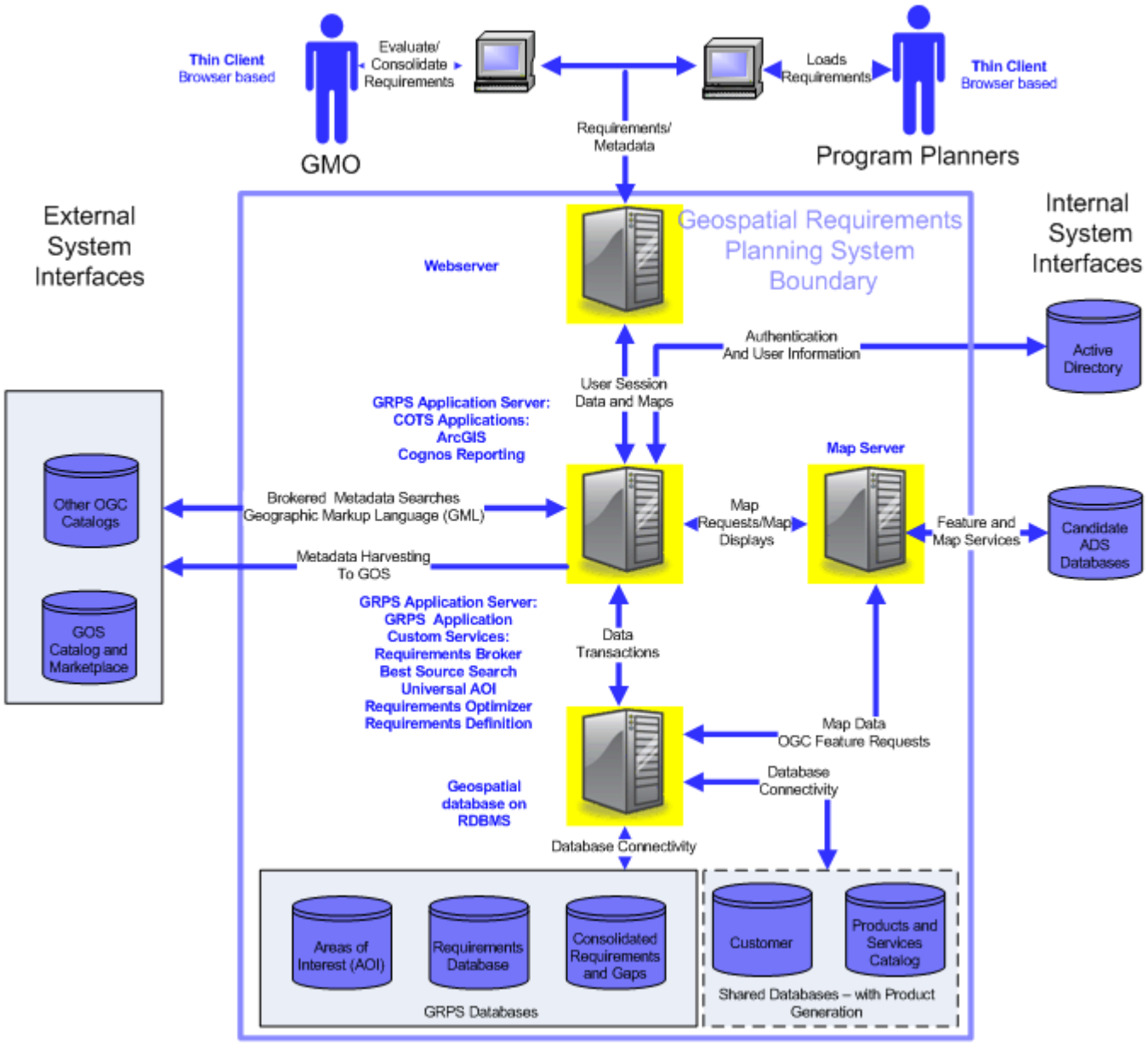
Figure 4-14 shows the GRPS target systems architecture with detailed support infrastructure and technology components. The critical user interface component will be developed by integrating Web-based programming with the functional services of GIS to build and manage consumer information, reusable universal AOI, and Requirements Definition services. The data captured through these services will be stored in a geospatially enabled relational database. User access and control will integrate with Active Directory (AD) Services and support single sign-on. ArcGIS will provide geospatial functionality with supporting Web mapping services from ArcGIS Server to manage and render the content. Using ArcGIS and ArcGIS Server will leverage the DOI ESRI SmartBUY.

The GRPS will provide the users with geospatial vector and imagery data for reference and visualization purposes. Ultimately, GRPS will take advantage of DOI target candidate ADS map services as they go online. Until the appropriate ADSs are available, the critical vector data required for the creation of the AOIs will be stored locally. As they are certified, the OGC GRPS will be redirected to the authoritative source. GRPS is intended to be a consumer of the future ADS map service development.

The target GRPS will need to develop several key custom business logic components as Web services. These key components are the following:

- Requirements Broker—enables searching across multiple catalogs
- Best Source Search—identifies the best source materials from the respective FGDC-based [28] catalogs while making comparisons with the original requirements
- Requirements Optimizer—identifies and evaluates the results of Best Source Search to identify consolidation opportunities and gaps in data or identify similar contract services needs over the same geographies

The Requirements Broker will be engineered to interface with the existing OGC Catalog API available through GOS and other clearinghouse metadata catalogs. It will provide for cross catalog search methods. This method will support the Best Source Search query, which is designed to identify the source metadata that best aligns with the requirements. The optimizer evaluates the brokered search results to identify data gaps and consolidation opportunities. It is recommended that the GOS [23] investment take the lead on the Best Source Search capability and provide this as a service through its catalog API. These brokered queries do not require sophisticated transaction management services from enterprise application tools, but could take advantage of the services if they were available. As a part of the target state transition, the multiple DOI metadata sources and data holdings should be migrated to GOS to support the one-stop shop principle.

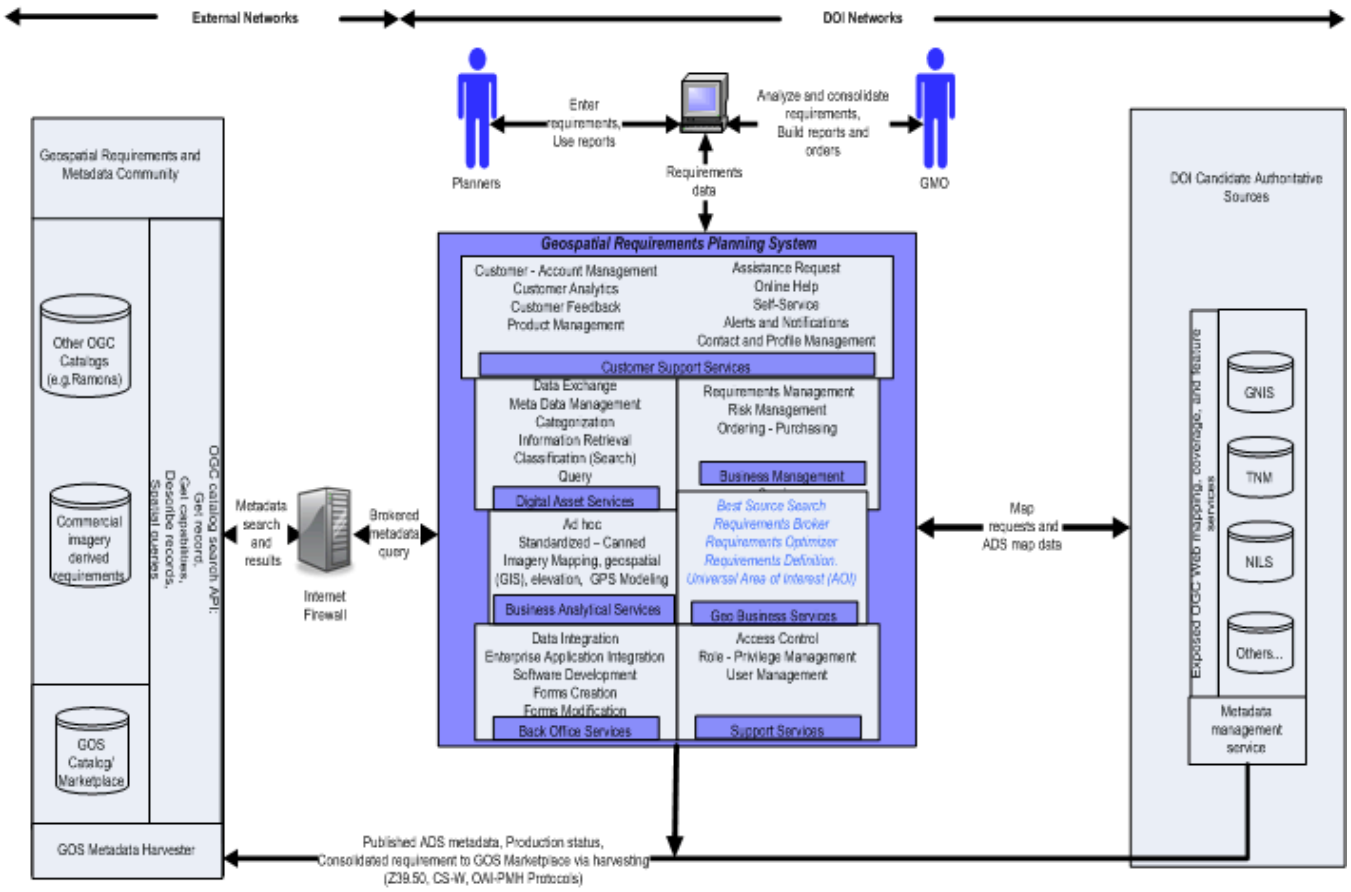


(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; AOI, area of interest; ArcGIS, GIS software from ESRI; Cognos, business intelligence reporting software; COTS, commercial off the shelf; GIS, geographic information system; GML, Geographic Markup Language; GMO, Geospatial Management Office; GOS, Geospatial One-Stop; GRPS, Geospatial Requirements Planning System; JDBC, Java Database Connectivity; OGC, OpenGIS Consortium; RDBMS, Relational Database Management System)

Figure 4-14 Target Geospatial Requirements Planning System Architecture

The GMO will create requirements text and map reports to publish to the GRPS database. The users will review the information in conjunction with the GMO to finalize consolidation opportunities and gaps prior to acquisition. The GRPS will require a configurable general reporting and analysis tool that will support canned and ad hoc reporting requirements. Once the requirements have been consolidated and reviewed, the gaps will be published using an FGDC metadata standard and harvested by the existing GOS capabilities. The data transport will be Geographic Markup Language (GML) and will be published to the marketplace records. GOS marketplace notification will be used to notify GMO of any external interests in cost sharing.

Figures 4-15 and 4-16 show the GRPS target environments as described by the Services Reference Model (SRM) [25] and the TRM [25] respectively. These services and supporting technologies will be needed to implement the GRPS target system architecture. The key business functional services are called out in Business Management section of the diagram in Figure 4-15. These custom services provide the efficiency to the requirements process. The system will be deployed on the DOI Intranet and will take advantage of existing network and security services. Target performance will be dependent on adequate network connection and capacity. The implementation plan for the FY2010 investment will investigate the use of a shared set of internet and database servers with existing capacity to mitigate costs. The GRPS will exploit standard best practices for software engineering and conform to the DOI Solution Architecture Target Logical Solution and Service-Oriented Application Reference Architecture Version 1.0.

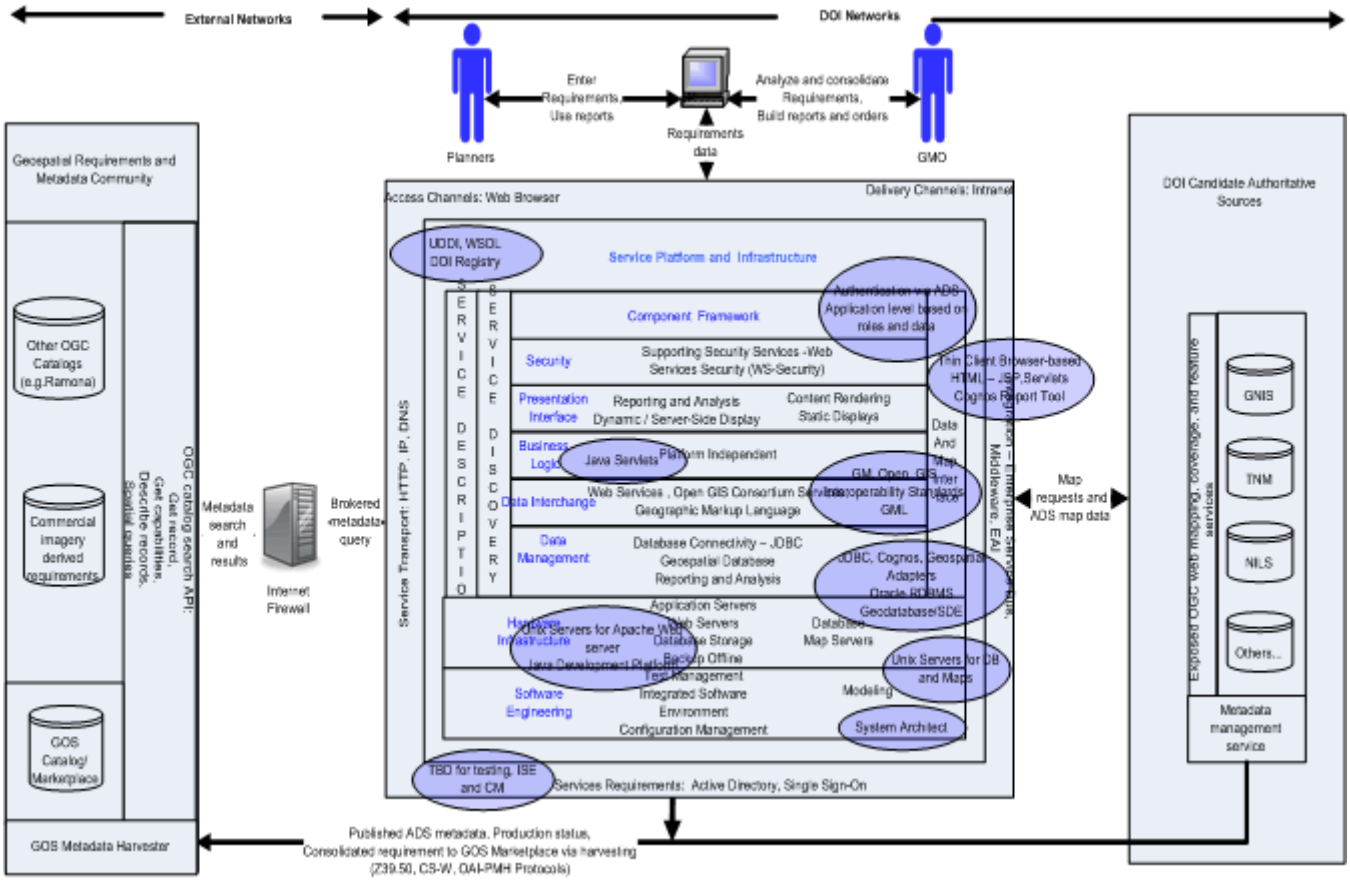


(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; AOI, area of interest; API, application programming interface; CS-W, OpenGIS Catalog Service for the Web; DOI, U.S. Department of the Interior; GIS, geographic information system; GMO, Geographic Management Office; GNIS, Geographic Names Information System; GOS, Geospatial One-Stop; GPS, Global Positioning System; NILS, National Integrated Lands System; OAI-PMH, Open Archives Initiative Protocol for Metadata Harvesting; OGC, OpenGIS Consortium; PGS, Product Generation System; "Ramona," metadata mining project integrated with Geospatial One-Stop; TNM, The National Map; Z39.50, Client server protocol)

Figure 4-15 Target Geospatial Requirements Planning System Services

The GRPS technology platform is designed to operate with the existing infrastructure and applications and to leverage existing capabilities where feasible. The key to this interoperability is the focus on the OGC standards. This focus will improve application extensibility and efficiency of development. These standards will support the GRPS need for map and data displays for visualization of image and feature

data, metadata harvesting, and metadata management and support the need to search across multiple catalogs. GRPS will be a consumer of the existing GOS catalog, catalog search, metadata harvesting, and marketplace services. Recommended upgrades for GOS are discussed in Recommendation 4.1.2. GRPS will be a consumer of map services from available ADSs. The key technology products are overlain on Figure 4-16 to support system development and investment planning.



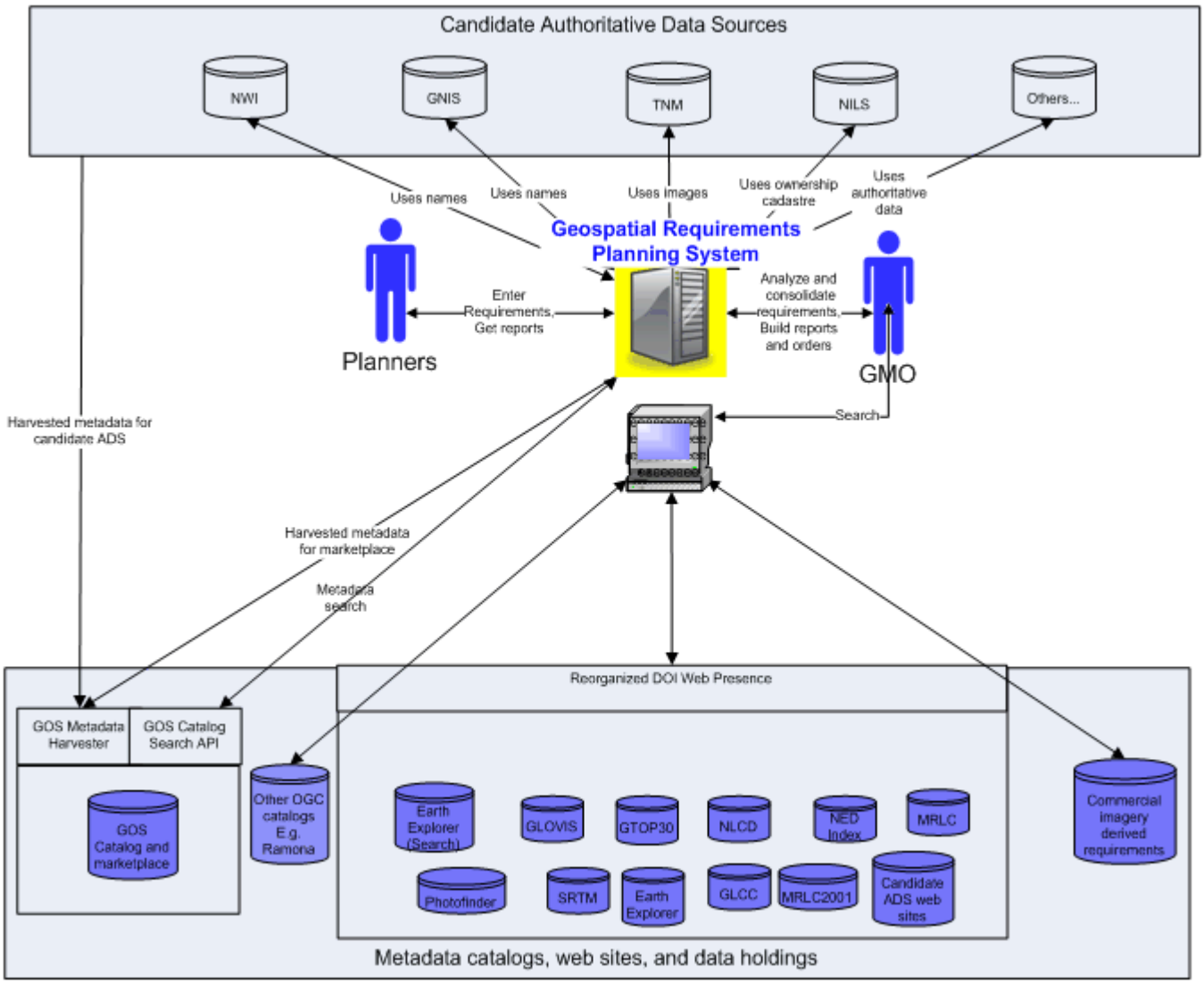
(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; API, application programming interface; CM, Configuration Management; CS-W, OpenGIS Catalog Service for the Web; DB, database; DNS, domain name system; DOI, U.S. Department of the Interior; EAI, enterprise application interface; GIS, geographic information system; GMO, Geospatial Management Office; GNIS, Geographic Names Information System; GOS, Geospatial One-Stop; HTTP, hypertext transport protocol; IDBC, Internal Device Buffer Code; IP, internet protocol; ISE, Integrated Software Environment; JDBC, Java Database Connectivity; JSP, Java Server Pages; NILS, National Integrated Lands System; OAI-PMH, Open Archives Initiative Protocol for Metadata Harvesting; OGC, OpenGIS Consortium; PGS, Product Generation System; "Ramona," metadata mining project integrated with Geospatial One-Stop; RDBMS, Relational Database Management System; TBD, To Be Determined; TNM, The National Map; UDDI, Universal Description Discovery and Integration; UML, Unified Modeling Language; WS, Web Services; WSDL, Web Services Definition Language; Z39.50, Client Server Protocol)

Figure 4-16 Target Geospatial Requirements Planning System Technology

Working with EGIM, the GMO should implement and establish the target business process and supporting capability that enables the submission, review, and approval of program requirements for geospatial data, products, and services. It is recommended that EGIM and GMO work together to initiate a cross-agency, multi-program activity to build out the interim system and supporting database in FY2008. The initial consumers will be managers of programs or projects with large geospatial requirements needs. This activity will establish the initial holdings of the database and help formulate long-term cost efficiency benefits from the improved business process. The interim system will provide for the capture, definition, prioritization and requirements consolidation mission business requirements.

The data store contents from the interim state will be transitioned to the target state to ensure baseline metrics and support future cost benefit understanding. The EGIM and GMO will support the development of the interim enterprise-wide database for geospatial requirements and take the lead on development of the 2010 investment. While the simplified access to required geospatial data should encourage most planners to take advantage of the new capability, a policy should also be established to require programs to submit their requirements to the database.

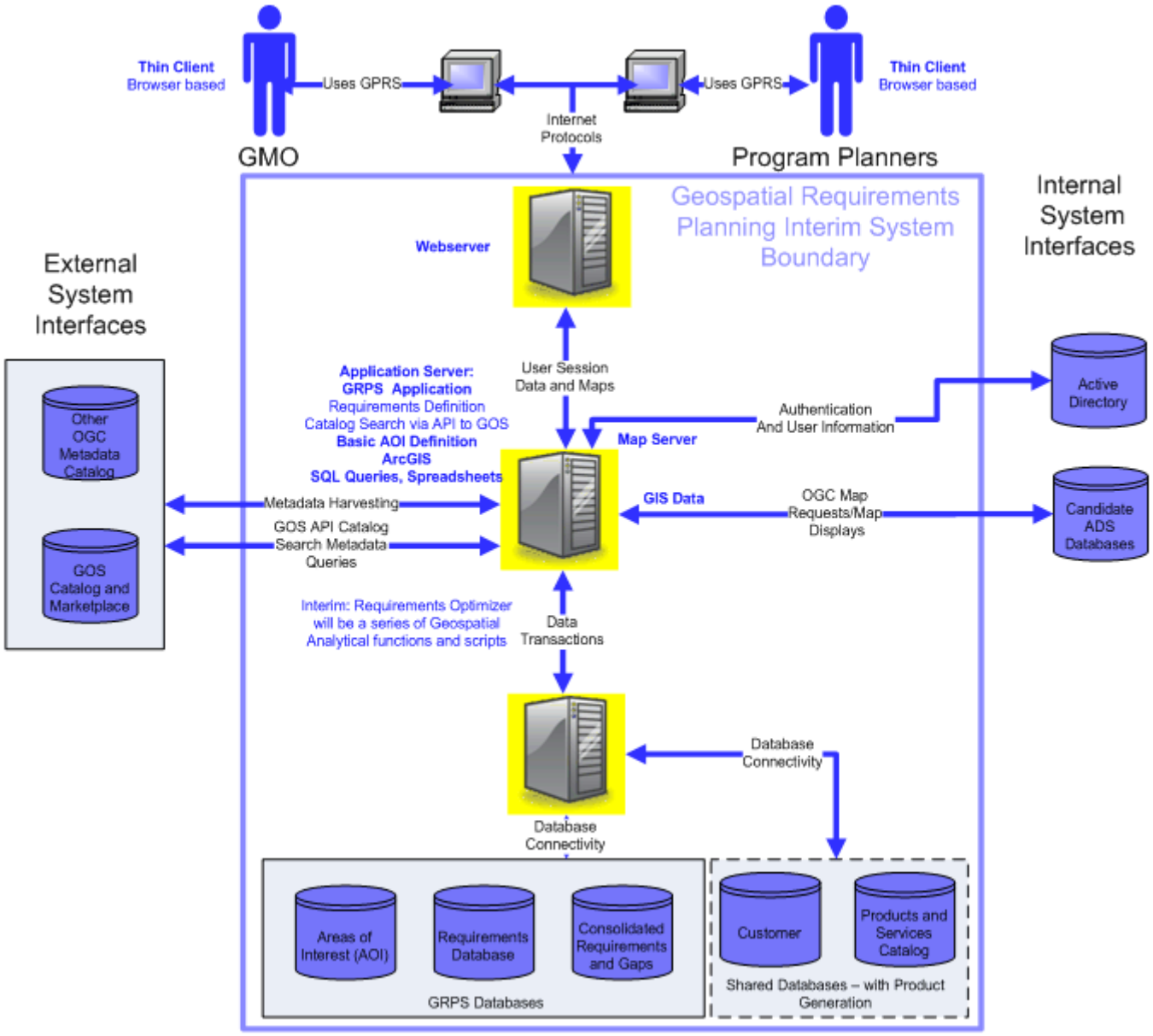
The interim solution in Figure 4-17 will leverage existing infrastructure assets as much as possible to reduce costs. The interim solution will provide the functionality for planners to define and geo-code business requirements, perform analysis, and report on consolidation opportunities while storing the requirements in the database. The GMO is positioned to perform requirements analysis and provide recommendations for consolidated acquisition of geospatial data, resources, or services. The scope of the interim phase will include working with the available ADS candidates and other data source needs. It is recommended to transition these sources of metadata and geospatial products into an improved interim Web presence to simplify access for DOI consumers. The EGIM and GMO will establish baseline cost metrics to support acquisition of the business's geospatial information needs.



(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; API, application programming interface; DOI, U.S. Department of the Interior; GIS, geographic information system; GLCC, Global Land Cover Consortium; GLOVIS, Global Visualization Viewer; GMO, Geospatial Management Office; GNIS, Geographic Names Information System; GOS, Geospatial One-Stop; GTOP30, Digital Elevation Model 30 arc-second; MRLC, Multi-Resolution Land Characterization; MRLC2001, Multi-Resolution Land Characterization 2001; NED, National Elevation Data; NILS, National Integrated Lands System; NLCD, National Land Cover Dataset; NWI, National Wetlands Inventory; OGC, OpenGIS Consortium; "Ramona," metadata mining project integrated with Geospatial One-Stop SME, Subject Matter Expert; SRTM, Shuttle Radar Topography Mission; TNM, The National Map)

Figure 4-17 Interim Geospatial Requirements Planning System Environment

The interim GRPS system architecture shown in Figure 4-18, will interface with the GOS API and its available metadata publishing and harvesting techniques to extract the metadata to support requirements optimization. The GMO will use GIS analytical functions and scripts to compare the user supplied requirements to the best available metadata. The GMO will report on the consolidation process back to the users using simple spreadsheets and shape files. This interim phase will provide geospatial requirements solutions for the initial set of consumers, insights into risk issues and mitigation, process validation, cost efficiencies from aligning existing assets to the business requirements, and the cost avoidance for acquisitions. These solutions and lessons will be used for its future investment planning.



(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; AOI, area of interest; API, application programming interface; ArcGIS, GIS software from ESRI; COTS, commercial off the shelf; GIS, geographic information system; GML, Geographic Markup Language; GMO, Geospatial Management Office; GOS, Geospatial One-Stop; GRPS, Geospatial Requirements Planning System; OGC, OpenGIS Consortium; PGS, Product Generation System; SQL, Structured Query Language)

Figure 4-18 Interim Geospatial Requirements Planning System Architecture

To implement the geospatial requirements planning recommendation successfully, it will be necessary to develop a shared funding model to ensure mission participation in the acquisition of shared enterprise geospatial products and services. A shared funding model was the premise of the success of the "DOI High Priority Lands Programs". The funding process will be transparent and ensure that the requirements with the greatest value and reuse potential receive funding. The recommended short-term approach is to pilot the business process with select key stakeholders to support the development of the business case planning financial data and functional requirements. Geospatial data and service providers should begin to transition to the data and technology interoperability standards that are necessary for this and other enterprise geospatial needs. The EGIM with the GMO should develop alternatives solutions

for the best fit funding mechanism. The Geospatial Core Team must approve this funding model. The overall roles and responsibilities for this business process are defined in the Appendix N "EGIM/GMO Consolidates Contract Service, Data, and Skills Business Operational Requirements".

It is important to note that the geospatially enabled requirements definition process is an augmentation service to current work activity planning models that are generically represented in the business process models in Appendices J, K, L, and M. These appendices describe the current and future models.

4.3 Enhanced Governance

FINDING 3—DOI's geospatial investments are not currently managed as a cohesive set of assets and services that provide optimal value to the DOI mission

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 the geospatial assets. Management of the performance and accountability of a $270 million, multiple-owner portfolio of distributed technologies, data assets, and services pose a new challenge to DOI. FY2006 geospatial costs for data, technology, some human resources, and services make it comparable to the actual Activity-Based Costing (ABC) labor costs for the Law Enforcement and IT business areas (see Table 4-5). As of September 2007, 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. The objective of the geospatial governance model is to provide a accountable decision-making body to establish and manage the performance value of the geospatial assets and coordinate DOI-wide priorities prior to the initiation of the investment process.

Geospatial services differ from other cross-cutting organizational functions, such as Finance, IT, and human resources (HR) in that they are not owned within the organization. They improve mission performance by exploiting new means of analyzing data, improving business processes, and enhancing decision support or scientific understanding. Geospatial services value are derived from the initial use of assets within one program and magnified by its reuse in the others. This reuse network is highly dynamic and will require the governance of these assets to be the same. 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 requirements are levied on the baseline, the geospatial governance group would validate said requirements with the DOI consumers and providers to develop a coordinated improvement strategy. Providing a vehicle to identify and review requirements will enable geospatial assets to mature systematically in a planned manner, extending the IT and operational resources further. DOI IT governance will receive investment requests that have business buy-in and cross-cutting value.

Table 4-5 Geospatial Costs Compared with DOI Activity-Based Costing (ABC) for FY2006 Labor

Business Area	Labor Costs Total – FY2006 (rounded to nearest $100)
Community and Social Services	$1,330,317,101
Water	$1,194,590,388

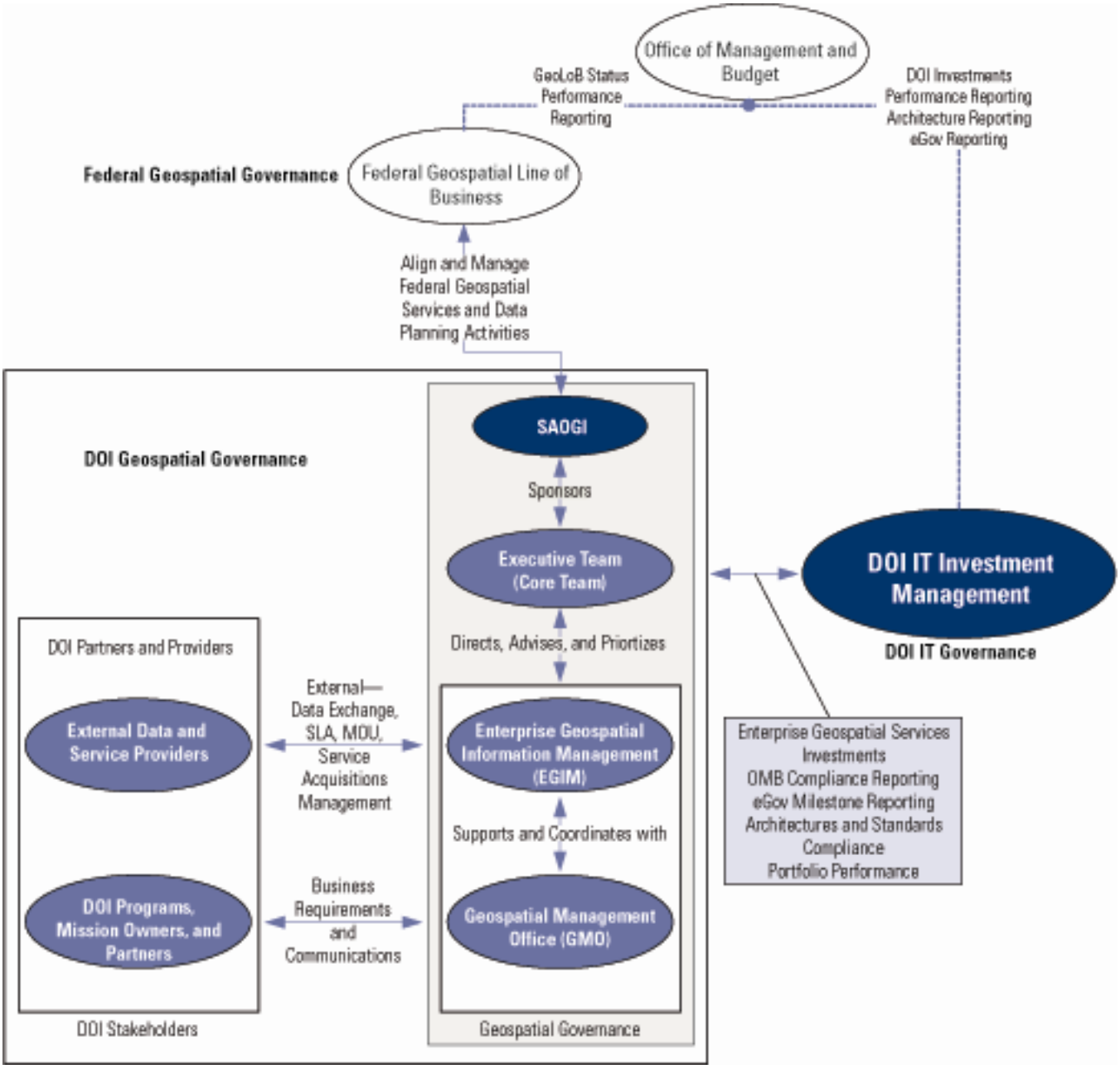
Business Area	Labor Costs Total – FY2006 (rounded to nearest $100)
Science Knowledge Advancement	$1,119,816,336
Biological Communities	$1,074,407,165
Facilities and Real Property	$1,038,049,174
Recreation	$764,949,887
Non-Energy Minerals	$711,559,435
Indian Trust	$655,423,436
Wildland Fire	$535,802,897
Technical Assistance	$487,582,955
Administrative Support	$423,001,703
Energy	$378,396,939
Landscapes and Watersheds	$357,920,833
Information Technology	$274,516,268
Geospatial	**$~270,000,000**
Law Enforcement	$253,939,104
Cultural and Heritage	$181,853,376
Leading	$164,735,454
Human Resources	$156,322,512
Ownership Management	$130,013,538
Insular Economics	$105,312,680
Procurement	$104,953,593
Finance …etc…	$78,717,589

(Notes: Abbreviations and acronyms: DOI, U.S. Department of the Interior, FY, Fiscal Year)

4.3.1 Establish Geospatial Governance

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 style of management results in higher overall costs for the Department because of investments in redundant system or IT capabilities, geospatial data, supporting data and map services, exchange agreements, or contract services.

This recommendation establishes a geospatial governance mechanism that will provide portfolio and program management services for the mission areas. It will evaluate and manage geospatial enterprise business requirements, exchange and licensing agreements, operational data needs, and services acquisition to identify cost savings and avoidance opportunities. Furthermore, this mechanism will evaluate the geospatial portfolio to ensure the optimal investment strategy to maintain and evolve the geospatial technology, data, and service assets. The "draft" target state governance model is presented in Figure 4-19.



(Notes: Abbreviations and acronyms: DOI, U.S. Department of the Interior; EGIM, Enterprise Geospatial Information Management; eGOV, electronic government; GeoLoB, Geospatial Line of Business; GMO, Geospatial Management Office; 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 4-19 Geospatial Governance Model

To determine the roles, responsibilities, and relationships required to manage DOI's geospatial domain, the EGIM team developed 20 governance use cases (see Appendix O) to determine how the governance model would initially operate. The use cases identified the need for several new roles within the organization. These roles are listed and defined in Table 4-6. The use cases established the necessary target roles and responsibilities between the IRB, DOI architecture governance, service providers, service sponsors, and consumers.

The use cases were classified and grouped into topical categories required to align with the Blueprint recommendations including ADS, service development, service delivery, service management, investment planning, policy, and requirements management. From these, the basic process models were derived and aligned with the necessary roles of the operational service model and governance participants. This scenario will guide the GMO and EGIM, Geospatial Core Team, and the Senior Agency Official for Geospatial Information (SAOGI) with clearly defined points of accountability and responsibility to manage improvements to the enterprise geospatial assets.

Table 4-6 Key DOI roles within Geospatial Governance

Geospatial Governance Roles	Description
Senior Agency Official for Geospatial Information (SAOGI)	Designated leader for an agency's geospatial assets. This role is currently assigned to the Deputy Assistant Secretary for Water And Science – Designated by OMB Memorandum??
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. Recommended role is a result of the Geospatial Blueprint Analysis.
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
GMO	Technical and administrative support staff that develop and manage the implementation of DOI geospatial program requirements in coordination with Geospatial Core Team and EGIM. Recommended role is a result of the Geospatial Blueprint Analysis.
Geospatial Sponsor	The organization that is responsible for management and support to ensure the success of the service provider. Recommended role is a result of the Geospatial Blueprint Analysis.
Geospatial Producer	An organization that is responsible to produce geospatial data and information for a geographic location to the standards of a DOI-wide data asset. Recommended role is a result of the Geospatial Blueprint Analysis.
Geospatial Service Provider	An organization responsible to deliver geospatial data and capabilities to the DOI geospatial consumer community and its partners. Recommended role is a result of the Geospatial Blueprint Analysis.
Business Steward	Coordinates implementation of data standards in systems supporting a business area with DBA, etc. Ensures data quality within implementation. Recommended role is from DOI Data Standardization Procedures, April 2006.
Principal Data Steward	The person or group that manages the development, approval, creation, and use of data associated with a specific data standard managed within a specified business area, functional area, or subject area, ensuring that standardized data can be used to satisfy data requirements throughout DOI. Recommended role is from DOI Data Standardization Procedures, April 2006.

Geospatial Governance Roles	Description
IRB—Investment Review Board EGOV—e-Government Team ITMC—Information Technology Management Council IBAT—DOI Business Architecture Team DAC—Data Advisory Committee CTOC—Chief Technology Officers' Council IAWG—DOI Architecture Working Group	See: http://www.doi.gov/ocio/architecture/programs.htm. Recommended roles are DOI Investment Review Board Governance Structure.

(Notes: Abbreviations and acronyms: DBA, Database Administrator; DOI, U.S. Department of the Interior; EGIM, Enterprise Geospatial Information Management; GMO, Geospatial Management Office; SME, Subject Matter Expert)

Effective geospatial governance will facilitate optimization of business planning requirements and reduce the risks of unnecessary expenditures; manage SLAs, ELAs, and data exchange agreements; and optimize IT investment requirements for the portfolio. This governance 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 that are 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 subject to short-term budget or local influences. It will provide transparent access to service performance results and a voice for the DOI geospatial consumer in establishing common investment requirement priorities.

This recommendation presents a key transformational solution necessary to adopt shared enterprise geospatial assets and services. 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 and ensuring DOI 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, transparent, and equitable in support of evolving federated geospatial assets.

4.3.2 Establish the Geospatial Management Office to Provide Program and Portfolio Management Support Services

Historically, the costs of DOI's geospatial services and products have been hidden from true understanding at the enterprise level. With the exception of a few clearly identified assets, such as the Geographic Coordinate Database (GCDB) and The National Map, efficiency improvements or benefits to the business have not been quantitatively established. Intuitively, geospatial tools, technology, information, and skills are necessary and beneficial to science, resource and land management bureaus. Without a quantified benefits approach, the true contribution of DOI's geospatial investments and the aggregate of geospatial skills and assets are not measurable. Without a quantifiable value proposition, achieving greater resource allocations, investments dollars, and increased level of stakeholder buy-in

will continue to be a challenge. The EGIM with the support of the GMO are charged with fulfilling this objective.

The SAOGI, or their designee, will be the DOI representative to federal geospatial activities, such as the FGDC [28] or the GeoLoB [1]. The SAOGI is the executive sponsor for the DOI geospatial governance and is ultimately accountable for its success.

The Geospatial Core Team [19] provides for strategic guidance and prioritization of the limited financial and human resources available via the GMO and the EGIM [20]. All bureaus are represented on the Geospatial Core Team. They will take direction from the SAOGI.

The DOI mission including the business planners, service consumers, and providers will be able to promote their needs to the geospatial governance body. Requirements will be assessed for their potential enterprise value and risk. The requirements will be prioritized by the Geospatial Core Team.

The EGIM and GMO, using the priorities established by the Geospatial Core Team, will provide two fundamental services: program and portfolio management. These services are needed to establish and improve DOI's investment in geospatial data, technology, and services. The GMO will provide program support for the development and management of exchange agreements, ELAs, SLAs, policy, marketing, communications, geospatial data, and services acquisitions that are based on the enterprise requirements established by the mission areas. The EGIM will work with the GMO and provide technical expertise, requirements clarification, bureau communication, review agreements, support implementations, and ensure GMO planning activities are consistent with the objectives of the blueprint. The GMO manage and optimize the bureau provide business requirements to identify cost savings and avoidance opportunities for DOI contract services, skills, data, and technology purchases. The EGIM [20] will be responsible for interaction with the respective bureaus and programs to develop and validate requirements. They will ensure the DOI priorities and needs are effectively addressed.

The following list contains examples of existing DOI contracts or purchases that are recommended to be managed at the enterprise level. The GMO with the assistance of EGIM will provide support for these initiatives:

- Nature Conservancy species data—used by many organizations
- Commercial streets data and geo-coding and geospatial routing services (streets data bases - e.g.: NAVTEQ, Tele Atlas)—currently used by multiple bureaus. DOI will require a baseline set of streets data to integrate federally owned transportation assets
- Externally produced A-16 [7] data required by DOI to perform its functions, such as floodplains, medium scale vegetation, and political boundaries, to name a few.
- A-16 [7] data produced by DOI and supplied to external agencies through exchange agreements or service models such as the National Cadastre.

Additionally, the Geospatial Core Team, with the support of the GMO and the technical and business understanding of the EGIM will develop and manage the portfolio of DOI's enterprise geospatial assets. The objective is to assess all the operational activities and assets and evaluate them for performance and financial benefit to the mission.

The GMO will develop an inventory of enterprise data and services assets and create the geospatial portfolio. The EGIM will validate the portfolio.. The portfolio will include existing ELAs for

technology and data, enterprise services, approved ADSs, and enterprise data agreements. This inventory will be used to support the portfolio management evaluation processes that are required by OMB oversight, DOI geospatial governance, and other DOI IT governance organizations. The EGIM and GMO will develop the investment plans for the enterprise services that are currently gaps in the architecture including PGS and GRPS.

Under governance model, the GMO will support the EGIM who will evaluate the geospatial technology, services, and information (assets) to establish a baseline value and assess its efficiency contribution to DOI's business outcomes. The success of the geospatial data and services architecture will be measured by increases in the reuse of information, cost avoidance or reduction in technology, or improving the efficiency of the existing business processes and respective outcomes. The enterprise services, as they are brought online, will be measured and baselined. The baseline will be monitored for subsequent improved contributions to business performance. An assets contribution to business performance will be used to establish the comparative financial and productivity value of the geospatial assets to each other. These comparisons will be used to determine investment planning priorities. It is recommended that the GMO develop a standardized set of criteria to measure performance accountability and have it reviewed by the EGIM and Core Team.. This would provide the framework for the operational SLAs and ensure a continuum of information to assess the portfolio. Target performance categories and measures will need to represent the service consumer, service provider, business planner, and data acquisition. The following Table 4-7 lists a recommended set of categories and measures for the portfolio:

Table 4-7 Recommended Geospatial Performance Measures

Role	Performance Area	Performance Category	Performance Measures	Blueprint Recommendations
Geospatial service provider	Service quality	Availability and quality of service	Percentage of uptime or percentage of customer satisfaction	Enterprise services and ADS
Geospatial service provider	Technology	Financial	Cost of service delivery to the user	Enterprise services and ADS
Geospatial service provider	Data accuracy and quality	Data accuracy and quality	Percentage of collection meeting standards	Enterprise services and ADS
Geospatial service provider	Usage / collection area	Usage / collection area	Percentage of change in usage and collection area	Enterprise services and ADS
Geospatial service consumer	Process and activities	Labor cost / unit of output	Cost of output	Enterprise services and ADS
Geospatial service consumer	Process and activities	Usage	Number and frequency of use	Enterprise services and ADS
Geospatial service consumer	Process and activities	Usage	Percentage of functional business areas using enterprise data and service assets	Enterprise services and ADS

Role	Performance Area	Performance Category	Performance Measures	Blueprint Recommendations
Geospatial service consumer	Service coverage	Percentage of DOI planned requirements satisfied	Percentage of fulfilled services	Uses enterprise requirements management and planning
Geospatial service consumer	Process and activities	Productivity and efficiency	Percentage of time saved based on service	Enterprise services and ADS
Geospatial business planner	Technology	Information and data	Cost of saved theme of information	Uses enterprise requirements management and planning and data lifecycle management
Geospatial business planner	Technology	Information and data	Reuse, area, or theme; transaction, downloads, and extractions from ADS	Uses enterprise requirements management and planning and data lifecycle management
Geospatial business planner	Process and activities	Productivity and efficiency	Labor and contract services; cost avoidance; cost through collaboration opportunities	Uses enterprise requirements management and planning
EGIM/GMO	Technology	Financial	Costs savings and avoidance from ELA	Enterprise licensing

(Notes: Abbreviations and acronyms: ADS, Authoritative Data Source; DOI, U.S. Department of the Interior; EGIM, Enterprise Geospatial Information Management; ELA, enterprise license agreement; GMO, Geospatial Management Office)

5. Geospatial Transition Planning and Schedule

This section describes, at a conceptual level, the sequence of implementation activities for the Blueprint. Now that a target solution and its value have been described, how will the key activities roll out in a transition strategy? This is shown in Figure 5-1.

It is recommended that the target governance model be implemented immediately along with the supporting EGIM and GMO roles to create to create the geospatial portfolio and initiate the organizational change management. The EGIM and GMO will develop procedures to support the DOI business community's geospatial needs for DOI enterprise agreements, acquisition services, and SLAs, as well as establishing the portfolio. They will help simplify the number of management points within DOI. ** Some technical and investment information has been removed and is available in the DOI internal version of the Geospatial Blueprint **

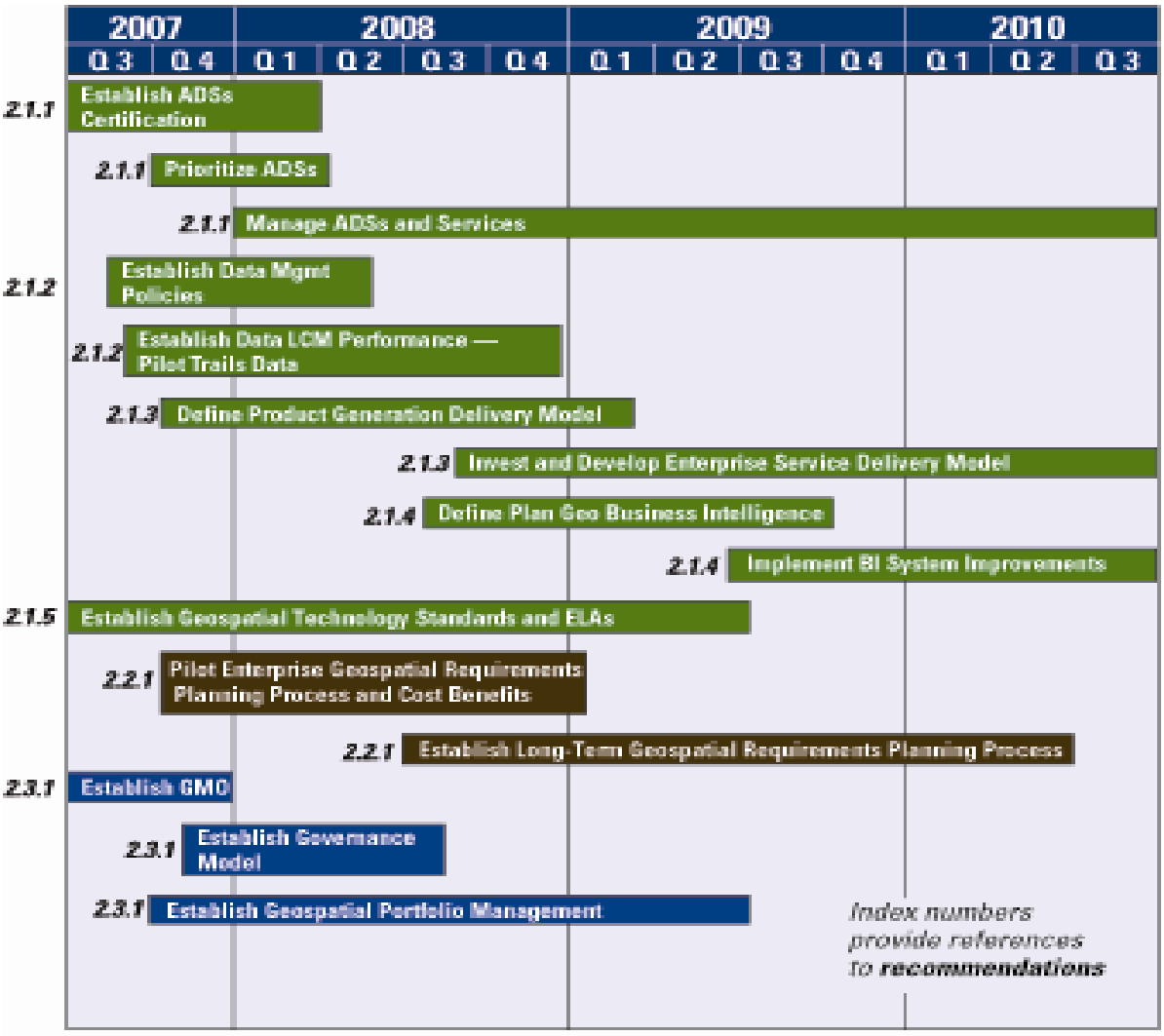
As a part of the transition, the Blueprint recommends a pilot activity to establish an enterprise business process to capture geospatial needs that are based on planned work activity requirements. The pilot will use actual projects and business community representation from multiple bureaus to exercise the Blueprint's recommended improvements. The pilot will establish prototype requirements, an enterprise business process, and a cost analysis to determine the viability of investing in an enterprise solution for FY2010.

The third major element of the transition plan is the establishment of DOI's ADS lifecycle management and associated map, data, exchange, and functional services. This Blueprint has established and prioritized a number of enterprise assets that are based on their maturity, reuse potential, and sphere of influence. The first ADS transition activities will be for federal land ownership and cadastre data themes in conjunction with NILS. The DAC team has conducted the pilot assessment that is given in Appendix P. These pilot transition activities are designed to prove the ADS process, understand the change management issues, and create lessons learned that will be shared with the remaining ADS candidates. Subsequently, an enterprise trails dataset will provide the test case for processing of an orphaned dataset (required by many organizations, but not having a definitive owner). The EGIM will take the lead on this activity to demonstrate the data collection, integration, and servicing of an enterprise data asset that is currently highly fragmented within DOI, but is useable by multiple bureaus and programs. The National Map will take the leadership on the transition of Geospatial Names, National Hydrography Dataset (NHD), high resolution orthographic imagery, elevation models, and national boundaries data. The remaining ADS will be prioritized for evaluation and certification by the Geospatial Core Team and coordinated with program and system owners prior to the FY2010 investment cycle.

The recommendation for PGS will focus on improving the current deployed capabilities within the TNM, whereas the business case for FY2010 is developed to create the shared enterprise services. The interface plan between the FBMS [32], facilities, and NILS is dependent on numerous projects, but is recommended to occur prior to execution of its current operational concept to ensure optimal efficiency

and usefulness for the greater stakeholder community. The projected start date for this effort is FY2009. This is subject to resource availability from these projects.

The transition plan requires multiple activities to start in parallel. Final approval of the Blueprint is anticipated by the IRB in the fall of 2007. This has been established as the official transition project start date. It is currently planned to have a number of pilot or initial operating capabilities that support several recommendations including the requirements planning, Geospatial Management Office, and the final ADS assessment. Many of the recommendations have dependencies on existing IT assets baseline, ongoing development efforts, or existing management structures that will require coordination. These coordination points are identified in the detailed transition plan. This plan, the Recommendation Implementation Overview (Figure 5-1) and Appendix Q, will establish the final time estimates, interdependencies, and resource levels once the prioritized activities have been determined and the Blueprint is approved.



(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 5-1 Recommendation Implementation Overview

6. Value Measurement Methodology Analysis

The purpose of the Value Measurement Methodology (VMM) [36] is to evaluate the recommendations within the Blueprint in the context of estimated cost, value, and risk to the organization. The objective is to improve the investment planning, risk management and business prioritization and inform the project decision-making process. The VMM was applied to the Blueprint recommendations by the DOI EGIM [20] who provided subject matter and mission expertise. In the case of Recommendation 1 in section 4.1.1, each recommended candidate ADS was assessed as if it were an individual recommendation. Each bureau was requested to evaluate these recommendations independently. Six of the eight bureaus completed the exercise. The BIA and the Minerals Management Service (MMS) did not complete the assignment because of competing priorities. The bureaus compiled the following information on the recommendations:

- Balanced Scorecard Weighting Criteria for: Business Results, Customer Results, Process and Activities, People, Technology, Fixed Assets
- Risk Register including: Risk Definition and Mitigations, Probability, Impact ranged 1–10 with 10 being the most risky
- Value Estimates: Value choices ranged 1–10 with 10 being the most valuable
- Cost Categories and Cost Ranges: Costs estimates were based on the value ranges in Table 6-1

Table 6-1 VMM Cost Categories and Ranges

VMM Cost Category	VMM Cost Category Ranges (in dollars)
10	20,000,000 and up
9	10,000,000–19,999,999
8	5,000,000–9,999,999
7	2,000,000–4,999,999
6	1,000,000–1,999,999
5	500,000–999,999
4	250,000–499,999
3	100,000–249,999
2	25,000–99,999
1	0–24,999

(Notes: Costs are in dollars. Abbreviations and acronyms: VMM, Value Measurement Methodology)

After the bureaus created the information, it was compiled into an aggregated DOI value, cost, and risk adjustment worksheet, which is given in Table 6-2. The table lists the references to the Blueprint recommendations number, the recommendation itself, and the key VMM data: the estimated cost and value and the corresponding risk adjusted cost and value. The remainder of the columns added to correlate existing ADS ranking information to support the VMM analysis. Only the ADS type recommendations from 4.1.1 will have a corresponding score. The objective was to assign a risk adjusted estimated value and cost for each recommendation. The risk adjusted values were used to correlate the initial priorities represented in the total score for ADS. The total score was derived from its Reuse Potential, Qualitative ADS Score, and DOI control scores.

Table 6-2 VMM Cost, Risk, and Value Sorted by Blueprint Recommendation and ADS Ranking

Blueprint Rec. Ref.	Blueprint Recommendation	VMM Base Cost Est.	VMM Base Value Est.	VMM Risk Adj. Cost	VMM Risk Adj. Value	Bureau Agency	Reuse Potential	ADS Score	DOI Control	Total Score	Ranking
4.1.1	Establish ADS for A-16 federally owned lands — Candidate ADS: NILS as ADS for A-16 federal ownership boundaries (land).	5.67	6.58	7.03	4.09	BLM	294	5	5	7350	23.33
4.1.1	Establish ADS for GAP data - Candidate ADS for NBII and its maps servers as ADSs for GAP data.	4.17	4.83	5.41	3.57	USGS	103	4	5	2060	19
4.1.1	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	3.17	5.43	3.94	3.99	DOI	129	3	3	1161	19
4.1.1	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	4.25	5.09	5.51	3.23	USGS	14	5	5	350	15
4.1.1	Establish ADS A-16 Digital Ortho Imagery Large Scale and High Resolution Imagery Services—Candidate ADS: TNM (for multiple large-scale products	5.33	6.32	7.43	4.20	USGS	240	5	5	6000	15

Blueprint Rec. Ref.	Blueprint Recommendation	VMM Base Cost Est.	VMM Base Value Est.	VMM Risk Adj. Cost	VMM Risk Adj. Value	Bureau Agency	Reuse Potential	ADS Score	DOI Control	Total Score	Ranking
4.1.1	Establish ADS for DOI Asset/Facilities Services (Dam, Rec. Facilities etc.) - Assets not reported via A-16 Facility Locator requirement) - Candidate ADS is Enterprise Facilities Management Systems - The FY2007 Trails pilot will be used to discover and expose the change management, ownership and funding issues associated with orphaned datasets and the proposed ADS recommendation	6.17	5.58	7.85	3.14	DOI	255	1	5	1275	15
4.1.1	Establish ADS for national Hydrography dataset—Candidate ADS is NHD delivered through TNM	4.50	6.69	5.91	4.68	USGS	216	5	5	5400	15
4.1.1	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	3.33	3.97	4.29	2.59	MMS and BLM	69	3	5	1035	14
4.1.1	Establish ADS for A-16 elevation—Candidate ADS is TNM.	4.17	5.84	5.24	4.33	USGS	185	5	5	4625	13
4.1.1	Establish ADS for A-16 Cadastre—Candidate ADS: NILS for management and delivery of land net derived from survey or digitized PLSS	4.67	6.37	6.29	4.33	BLM	274	5	5	6850	11.33

Blueprint Rec. Ref.	Blueprint Recommendation	VMM Base Cost Est.	VMM Base Value Est.	VMM Risk Adj. Cost	VMM Risk Adj. Value	Bureau Agency	Reuse Potential	ADS Score	DOI Control	Total Score	Ranking
4.1.1	Establish ADS for A-16 shoreline information—Candidate ADS is MMS-delivered authoritative spatial representation of this information to DOI consumers. Coordinate 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	3.50	4.27	4.17	3.25	MMS	44	3	1	132	11
4.1.1	Establish ADS for DRG topographic maps (seamless color balanced DRG data)-Candidate ADS is TNM	4.67	6.35	5.99	4.14	USGS	178	5	3	2670	10
4.1.1	Establish ADS for cultural inventory—develop secure enterprise inventory for internal use	4.50	5.01	5.68	3.70	NPS	128	1	2	256	9
4.1.1	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	3.83	4.66	4.59	3.33	DOI	29	2	5	290	9

Blueprint Rec. Ref.	Blueprint Recommendation	VMM Base Cost Est.	VMM Base Value Est.	VMM Risk Adj. Cost	VMM Risk Adj. Value	Bureau Agency	Reuse Potential	ADS Score	DOI Control	Total Score	Ranking
4.1.1	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.	5.50	6.44	7.59	4.10	DOI	138	1	1	138	9
4.1.1	Establish ADS for offshore minerals—Candidate ADS: OCS-Connect or MMS map services	1.67	2.77	1.91	1.93	MMS	27	4	5	540	9
4.1.1	Establish NHD as Authoritative Source for A-16 Watershed Boundaries deliver through the TNM – Note: included in NHD	3.83	5.15	5.47	2.68	USGS	N/A	N/A	N/A	N/A	N/A
4.1.2	Original Recommendation Removed (Infrastructure Consolidation)	5.17	5.12	7.26	3.02	N/A	N/A	N/A	N/A	N/A	N/A
4.1.3	Product Generation Services	4.33	5.40	6.51	2.72	GMO and EGIM	N/A	N/A	N/A	N/A	N/A
4.1.4	Geo-Enabled Key Asset and Stewardships Business Systems Interface	4.17	4.34	4.53	3.07	DOI PMB and BLM	N/A	N/A	N/A	N/A	N/A

Blueprint Rec. Ref.	Blueprint Recommendation	VMM Base Cost Est.	VMM Base Value Est.	VMM Risk Adj. Cost	VMM Risk Adj. Value	Bureau Agency	Reuse Potential	ADS Score	DOI Control	Total Score	Ranking
4.1.5	Enterprise Licensing	3.83	6.16	5.03	4.05	GMO and EGIM	N/A	N/A	N/A	N/A	N/A
4.2.1	Enterprise Requirements Planning	4.83	5.43	6.27	3.08	GMO and EGIM	N/A	N/A	N/A	N/A	N/A

(Notes: Abbreviations and acronyms: A-16, OMB Circular A-16; Adj., adjustment; Adj., adjusted; ADS, Authoritative Data Source; BLM, Bureau of Land Management; DOI, U.S. Department of the Interior; DRG, digital raster graphics; EGIM, Enterprise Geospatial Information Management; Est., estimate; FY, Federal Year; GAP, Gap Analysis Program; Geo, geospatial; GeoMAC, Geospatial Multiagency Coordination for Wildfire Support; GIS, geographic information system; GMO, Geospatial Management Office; ICS, Incident Command System; k, one thousand; MMS, Mineral Management Service; MODIS, Moderate Resolution Imaging Spectroradiometer; N/A, not applicable; NBII, National Biological Information Infrastructure; NHD, National Hydrography Dataset; NILS, National Integrated Lands System; NOAA, National Oceanic and Atmospheric Administration; NPS, National Park Service; NWFEA, National Wildlife Fire Enterprise Architecture; NWIS, National Water Information System; OCS, Outer Continental Shelf; OCS-Connect, multi-year electronic government (e-Government) transformation of the Offshore Minerals Management program at the MMS; OGC, OpenGIS Consortium; OMB, Office of Management and Budget; PLSS, Public Land Survey System; PMB, Policy Management and Budget; Rec., recommendation; Ref., reference; TNM, The National Map; USFS, U.S. Forest Service; USGS; U.S. Geological Survey; VEG, Vegetation Mapping Program; VMM, Value Measurement Methodology)

The EGIM, using the VMM process, analyzed the recommendations from a risk management perspective. They reviewed each recommendation and identified the most significant risk in each of the following categories: cultural, environmental, political, economical, and technological. Each risk was scored numerically on a scale of 1 to 10 with 10 being the greatest risk. Additionally each risk was assigned a probability of occurrence.. Subsequently, the cross bureaus inputs were categorized into risk groups with the associated scores aggregated. This provided the means to determine the areas and relative magnitude of risks from the bureaus perspective. Table 6-3 represents the aggregated cross bureau categorized top 15 risks. Risk mitigations were developed and will be used to support the change management activities for the governance practices and the transition planning.

Table 6-3 VMM—Ranking of Highest Risk Areas of Geospatial Recommendations

Rank	Risk Grouping	Aggregate Risk
1	Data quality risk	44
2	Organization and culture risks	28
3	Funding responsibility risk	19
4	Requirements management risk	19
5	External dependency (non-DOI) risk	13
6	Security risk	12
7	Budget impacts and control risk	11
8	Infrastructure risk	10
9	Network risk	10
10	Business process impacts risk	9
11	ADS in principle risk	9
12	Project interdependency risk	8
13	Communication risk	8
14	Data availability risk	7
15	Governance risk	7

The complete risk understanding can be found in Appendix R. This table lists the top risk for all risk categories for all recommendations with scores and mitigations. The top risks were cross-walked to the detailed blueprint findings and influenced the development of its solutions. The VMM cost, value, and risks information were used to support prioritization and transition planning.

7. Architecture Analysis and Discussion

Note: This section discusses the creation of the Target Geospatial Conceptual Architecture that is based on stakeholder information, DOI architecture standards and principles, project guidance, and the As-Is architecture artifacts. The conceptual architecture provided the management, business, and technical framework to organize the identified issues and findings. The conceptual architecture is intended to create models to ensure that key principles and ideas that are essential to the recommendations and are clearly communicated to the reader. From this organizing principle, detailed solutions are discussed in the findings and recommendations sections with supporting information in the appendices

7.1 Purpose

This section describes the process of creating and analyzing the initial geospatial architectural information and how this information is used to create issues, findings, and recommendations. It is intended for architects. The specifics of the findings and recommendations are more fully described in Section 4. This Architecture Analysis and Discussion section is not intended to describe these in detail. The Geospatial Blueprint project used DOI's Methodology for Business Transformation (MBT) V1.0 [3].

7.2 Geospatial Blueprint Strategy

The strategy for the project is established in its initial step and is comprised of a shared vision and set of objectives. These strategies will provide the framework to develop and validate findings and recommendations of the effort. The cross-cutting nature of geospatial architecture required the team to address how DOI assets can be used to address multiple mission areas and ownership of enterprise assets within multiple organizations.

7.2.1 Geospatial Vision Statement

The 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. This arrangement will provide the following:

- Improve the ease, usability, and reuse of location-based information and services
- Create long-term savings and increase business efficiencies
- Improve the effectiveness of DOI investments

The project participants then collaboratively established the following objectives, which provided guidance to the Blueprint analysis:

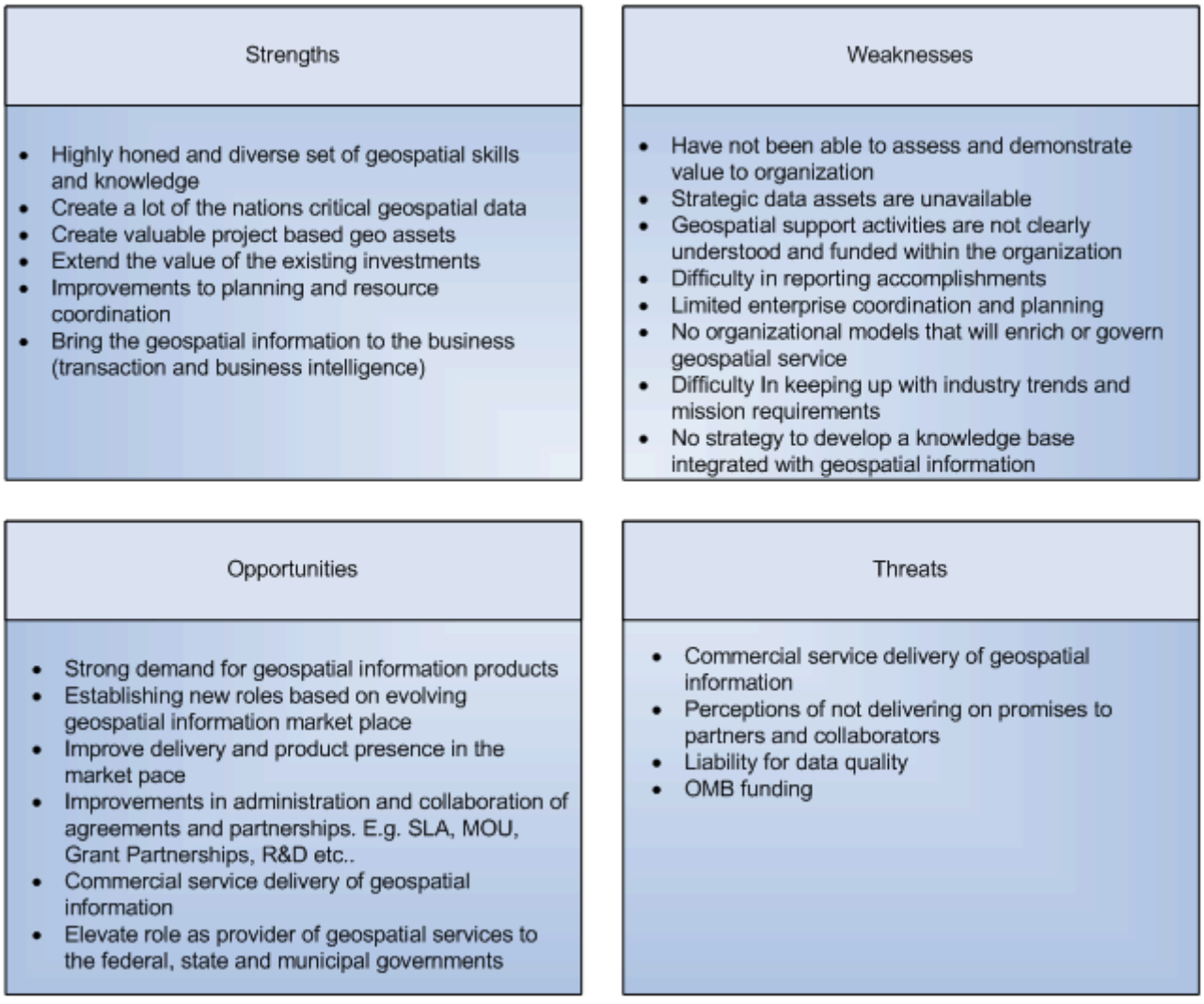
7.2.2 Geospatial Objectives

- Identification and development of critical reusable enterprise geospatial services and supporting business processes to improve business effectiveness
-
- Identification of areas to improve existing business process, data, or information technology to support program decision-making
-

- Improve the usefulness of existing geospatial investments and assets by:
  - Identifying opportunities to collaborate
  - Improve geospatial interoperability through appropriate standards adoption
  - Reduce duplicative data stores and business processes
  - Align best of breed existing capabilities with existing and future requirements
  - Invest in missing needed capabilities to achieve program objectives
  - Improve quality and reliability of DOI data assets

7.3 Geospatial Stakeholder Analysis

To get an accurate understanding of the existing issues and validate the geospatial objectives, the Blueprint team conducted 68 stakeholder interviews with 99 individuals representing all bureaus (see Appendix S). The interviews were documented and evaluated to formulate a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis [37]. The results are shown in Figure 7-1.



(Notes: Abbreviations and acronyms: geo, geospatial; MOU, Memorandum of Understanding; OMB, Office of Management and Budget; R&D, research and development; SLA, Service Level Agreement)

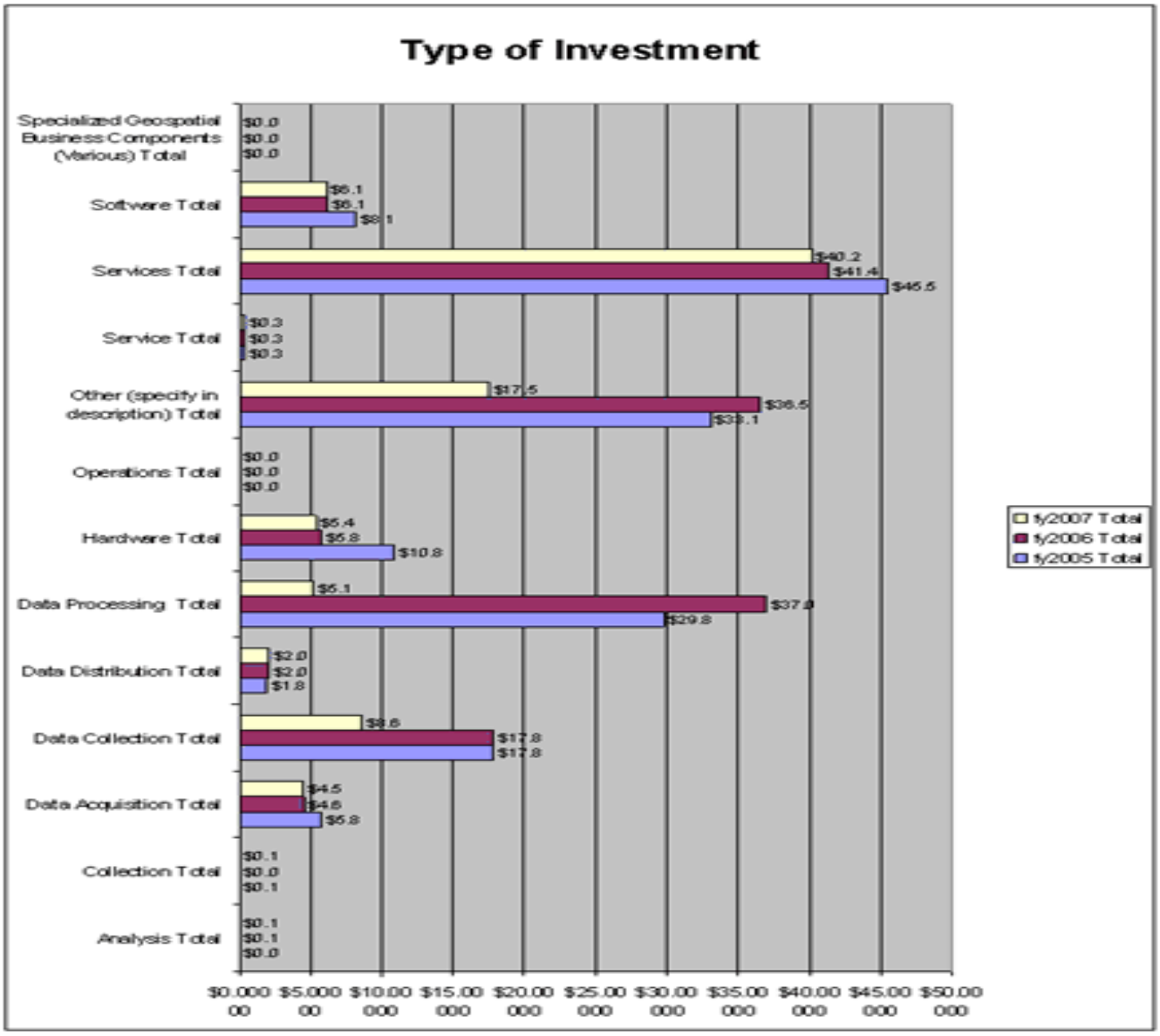
Figure 7-1 Geospatial Blueprint SWOT Diagram

From the stakeholder discussions, it was apparent that geospatial data needs to play an even more significant role within DOI. Producing and managing geospatial data is a DOI obligation under A-16 [7] and other legal mandates (see Appendix T). DOI currently produces and applies geospatial data, its skilled labor, and technical capabilities to solve many of its current business challenges at local, regional, ecosystem, and national scales. These supporting geospatial practices are a necessity for efficiency of business operations, service delivery, and accomplishing business results. The SWOT analysis identified the need to address geospatial data and services lifecycle management, asset availability and awareness, and coordinated enterprise planning as the strategies to get more from its current capabilities and assets

The SWOT also identified numerous change management issues and barriers to the implementation of the stakeholder needs. These included IT security, funding constraints, current funding models, inter-program and organizational dependence, lack of awareness of existing capabilities, communication, and cultural reluctance. Ultimately, SWOT analysis ensures the Blueprint recommendations are grounded in business and stakeholder needs, and the resulting findings and recommendations address the issues.

7.4 Geospatial Performance and Business Analysis

With the stakeholder needs established, the analysis turned to DOI's Performance Reference Model (PRM) [25] and Business Reference Model (BRM) [25]. The PRM is a standardized framework to measure and characterize performance in a common manner. DOI's PRM contains elements of its strategic plan and a relationship to the BRM function activities and DOI's associated labor costs. The PRM was analyzed to see if there was an effective means to measure the performance contribution of DOI's geospatial investment in data, skills, services, and technology to mission outcomes. DOI spent an estimated $270 million in FY2006 on geospatial data, skills, services, and hardware (see Figure 7-2) [5]. As of September 2007, these expenses have not been tracked in support of DOI's mission goals and objectives. The expenditures are distributed among numerous categories, but not tracked within the current budget process.



(Notes: Source: 2006 OMB Geospatial Data Call; data provided by EGIM)

Figure 7-2 DOI's Geospatial Investments by Service Area over FY2005–07

The BRM was analyzed to identify the functions that require some form of geospatial data or supporting geospatial processing method. From the BRM analysis [6], it was estimated that over 300 of the functions performed by DOI currently use or could use geospatial assets for efficiency and effectiveness in support of its mission. The extreme dependency on geospatial functionality and data by the respective bureaus is clearly demonstrated in the Service to Citizens business area of the BRM (Table 7-1).

Table 7-1 Geospatial-Dependent Business Functions

DOI Geospatial-Dependent Business Functions	
Service to Citizens	
Number of functions	**Number of Bureaus that support functions**
46	7
14	6
38	5
28	4
45	3
21	2
45	1

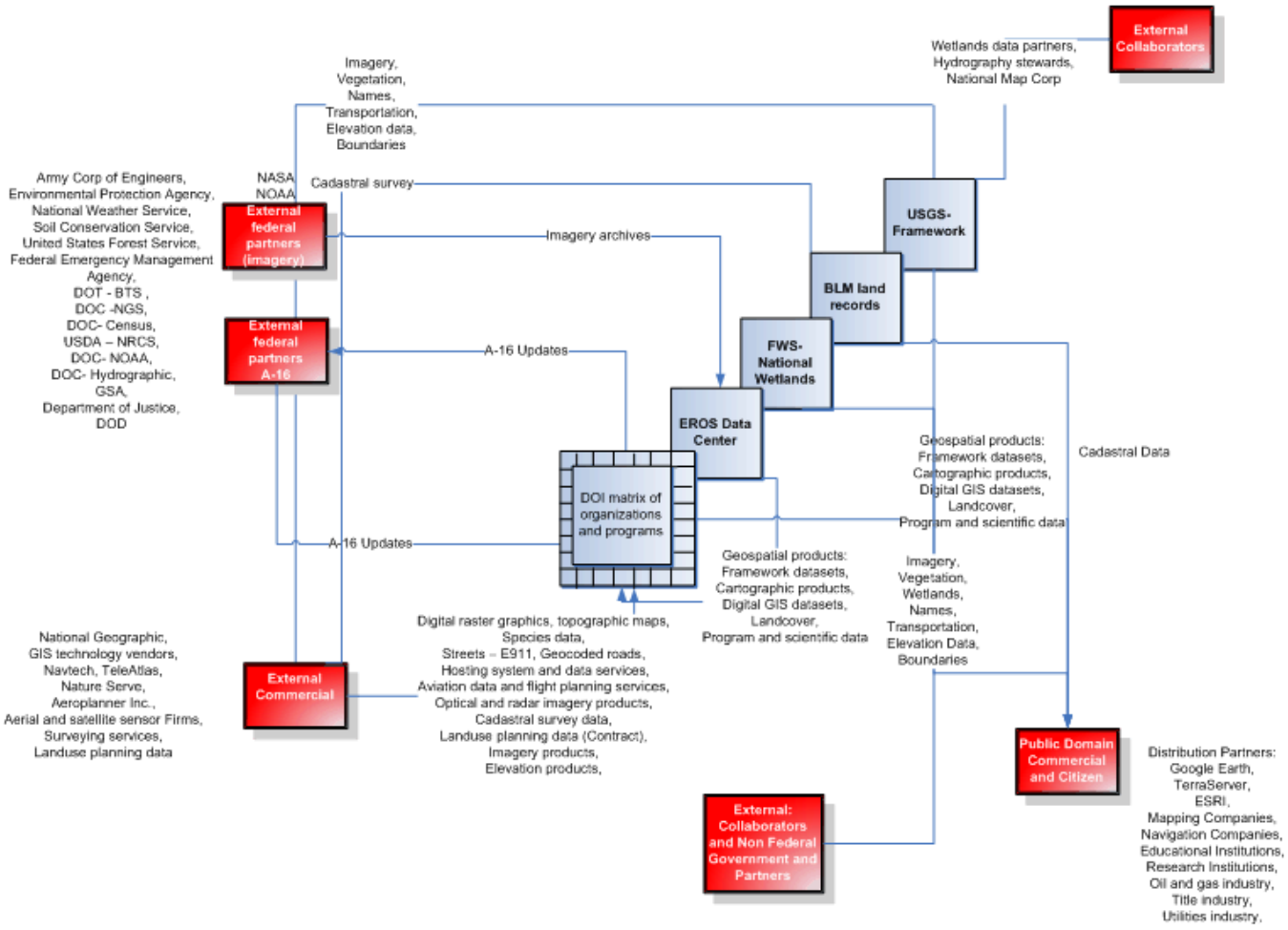
(Notes: Abbreviations and acronyms: DOI, U.S. Department of the Interior)

Many of the goals associated with these function require tracking geospatial measures (acres, linear miles, etc.) to assess their accomplishments. Fifty percent of DOI's end outcomes and 68% of its intermediate outcomes use a spatial measure or require a spatial process to help accomplish its goals [6]. Many of these measures are reported by multiple bureaus. This implies the business or work processes are geospatial in nature and could provide the means to trace resource expenditures. Additionally, this strongly suggest the potential for reuse of common geospatial services and data reuse at the enterprise level. If these enterprise common assets were identified and managed, they could provide the basis for performance tracking and improved planning. However, in the current geospatial environment, there is no clear or integrated view of how DOI's geospatial work efforts or investments are contributing to its business performance. The target state requires a means to relate the value of the geospatial contribution to the mission objectives. Without measures and the means to assess value to the business, it will be difficult to establish the value of geospatial investment dollars and answer questions such as the following:

> "Is DOI investing in the most useful data asset?"
>
> "How much does a spatial implementation benefit a business process?"
>
> "Is it investing in its most highly reusable service?"
>
> "What should its next investment be?"

Next, the analysis focused on determining what significant products and services the DOI geospatial community is required to deliver or receive from its stakeholders to be successful. Not only does the DOI product and service exchange need to reach across the Department, but it is required to coordinate with a diverse and external community of users and providers.

The number of DOI's external stakeholders is exceedingly large and diverse. Similarly, the products and services it must deliver and obtain are just as numerous and complex. Information, data, and products exchanges take place at all different levels of the organization for internal and external consumption. Figure 7-3 lists the general categories of external stakeholders and depicts a model for exchange of information products and services



(Notes: Abbreviations and acronyms: A-16, OMB Circular A-16; BLM, Bureau of Land Management; BTS, Bureau of Transportation Statistics; DOC, Department of Commerce; DOI, U.S. Department of the Interior; DOD, Department of Defense; DOT, Department of Transportation; DRG, digital raster graphics; EROS, Earth Resource Observation System; ESRI, Environmental Systems Research Institute, Inc.; FEMA, Federal Emergency Management Agency; FWS, Fish and Wildlife Service; GDT, Geographic Data Technology; GIS, geographic information system; GSA, General Services Administration; NASA, National Aeronautics and Space Administration; NGS, National Geodetic Survey; NOAA, National Oceanic and Atmospheric Administration; NRCS, Natural Resources Conservation Service; NWS, National Weather Service; USDA, U.S. Department of Agriculture; USFS, U.S. Forest Service; USGS, U.S. Geological Survey)

Figure 7-3 Geospatial Stakeholder Exchange Model

While the exchange model does not detail every institution, it is quite clear that DOI has a significant role in providing geospatial services to many commercial and government institutions in addition to the public. Conversely, DOI requires large collaborative exchanges of information and knowledge from state and local governments, commercial interests, and other federal agencies to complete its mission. The number and complexity of these relationships or obligations imposes technical and administrative overhead costs and data quality risks when they are managed at multiple points within the organization. The following is an abbreviated list of types of organizations that the DOI geospatial community needs to interact with:

- A-16 [7] and federal agencies (see Appendix A)
- State and local Governments
- Educational and academic Institutions
- Commercial geospatial industry including value-added resellers, analytical firms, and engineering
- Citizenry
- Private industry with interests on federal lands
- Environmental organizations
- Nonprofit organizations

7.5 Geospatial Business Analysis

The previous steps focused on stakeholder needs and performance and established a strategic understanding to guide the operational business analysis. The business analysis investigated the existing business requirements, processes, functions, and organizational environments to identify enhancements that will address stakeholder needs. As stated earlier, unlike other blueprint efforts, there is no organizational or functional model that owns or manages geospatial information. It is a collection of data, content, standards, technology, staff (government and contractor), technology tools, services, and systems that support approximately 87% of DOI functional responsibilities [6]. A detailed analysis of a subset of the BRM, Service to Citizens, demonstrates an even greater geospatial dependency and highlights the need for common services and information. Table 7-2 shows the magnitude of how many functions are performed by mission operations of multiple bureaus that could benefit from shared capabilities.

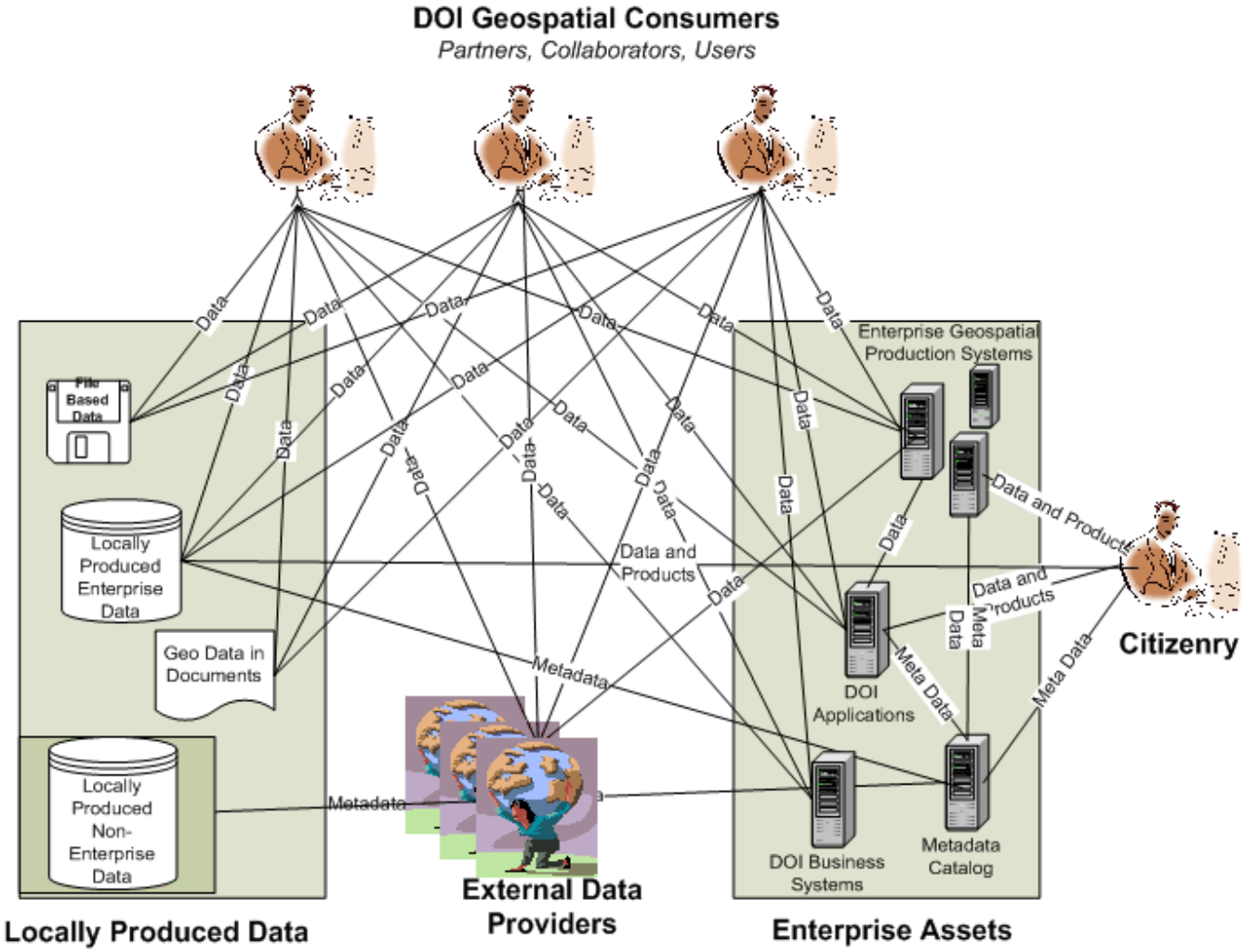
Table 7-2 Service to Citizens—Business Functions Requiring Geospatial Information

Service To Citizens				
Bureau	**Percentage of functionality requiring geospatial information**	**Functions dependent on geospatial information**	**Functions not dependent on geospatial information**	**Total number of functions**
BLM	95	203	11	214
BOR	92	104	9	113
BIA	92	110	9	119
FWS	95	143	8	151
MMS	98	60	1	61
NPS	92	141	12	153
OSM	99	75	1	76
USGS	96	108	4	112

(Notes: Abbreviations and acronyms: BLM, Bureau of Land Management; BOR, Bureau of Reclamation; BIA, Bureau of Indian Affairs; FWS, Fish and Wildlife Service; MMS, Minerals Management Service; NPS, National Park Service; OSM, Office of Surface Mining; USGS, U.S. Geological Survey)

DOI has a geospatial operational model that is very complex in nature. It has over 1,200 locations producing geospatial data, with responsibilities to produce and manage 18 national datasets (DOI

manages 18 of the 34 A-16 data themes) and a large number of programs with heavy data interdependence on one another. A great deal of the geospatial modeling, analysis, and planning work falls outside of a system or application environment. Its distributed nature and business interdependence introduces many challenges and barriers to optimizing and standardizing geospatial data, business functionality, or the supporting assets. Examples of underutilized enterprise assets, TNM, NILS, and GOS, are still not fully effective within the DOI arena. Metadata is not fully populated in GOS, and some businesses do not know how to use or tap the power of TNM nor are they aware of the availability of the Cadastre and Federal Land Ownership information in NILS. Having a capability and exploiting it are two different types of challenges. It is very difficult to know who needs or produces data on what scale and quality at so many locations. The current operational model is characterized in Figure 7-4 and shows the complexity of accessing vital geospatial assets.



(Notes: Abbreviations and acronyms: DOI, U.S. Department of the Interior; Geo, geospatial)

Figure 7-4 As-Is Geospatial Conceptual Model

DOI's current geospatial information and services can be described in two business models:

1. Model 1: Digital data collection, processing, and publishing to support national mapping and information objectives. Data is used by numerous business areas for basic geographic

understanding, visualization, mapping, and feature identification. The information is cross-cutting in nature with high degrees of reuse to support multiple business functionality.

2. Model 2: Digital data collection and processing for DOI planning, land and resource management, science, field mapping, visualization, project support, and analytical business need to support core program or mission areas and their partners. The information supports complex decision support or system transactions, such as effects of land treatments, assessment of irrigation effectiveness, scientific studies, facilities planning, and recreation utilization. This model is highly distributed and is typically found as GIS projects, geospatial modeling activities, or isolated systems.

Model 1 maintains a large number of cross-cutting, geospatial-oriented programs, such as, Wetlands, Geologic Mapping, Landsat, GCDB, Geographic Names Information System (GNIS), and National Digital Elevation Program (NDEP). They have critical "national mapping" or geographic information responsibilities for ensuring geographic completeness, currency, and accuracy of the geospatial content. The program's mapping outputs are critical information that is consumed by the public, industry, federal agencies, and DOI mission areas. Their standardized data provides the basis for exchange or delivery of geospatial features and attributes information. These existing programs can be characterized as geospatial information production systems or programs and are represented in the first five horizontal blocks of the As-Is value chain in Figure 7-5.

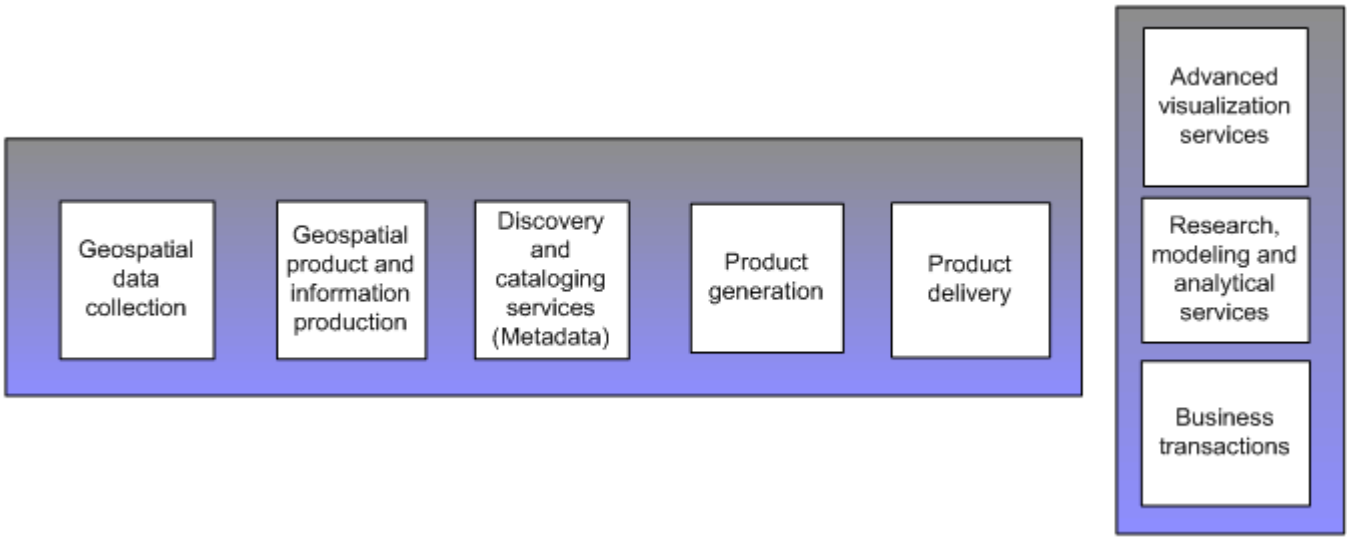


Figure 7-5 Geospatial As-Is Value Chain

Currently, these mapping programs collect the data and integrate, catalog, create products, and deliver images and GIS products, while providing a limited set of data serving through a variety of formats and exchange mechanisms. These programs have established effective histories, a strong programmatic alignment, and clear ownership of the enterprise geospatial data assets.

For example, the NDEP program has clearly defined a role within the nation and the DOI. All bureaus, with the exception of MMS, which does offshore work, have indicated they use and contribute financially to these data assets and services provided via the USGS. Over 99% of DOI's known and reported elevation model costs, identified in the 2006 OMB Data Call [5], have been originated in or

coordinated through this program. It is clearly an enterprise data asset and service provider. Similarly, the National Wetlands Inventory (NWI) has demonstrated a clear sense of authority, ownership, and organizational alignment to a critical national mapping asset. The efficiencies and benefits that coordinated data collection, production, and management provide to the DOI community are very valuable. Typically, geospatial acquisition, processing, cataloging, and integration consume 60–80% [38] of the costs to create usable geospatial information. This strongly suggests production economies of scale can be achieved when aligning geospatial thematic data to sustainable organizational ownership and supporting production capabilities. Cost distribution for Terrestrial Elevation and Wetlands Mapping data, although paid for by multiple bureaus, was nearly 100% coordinated to the responsible mapping program.

Conversely, when there is no clear sense of organizational ownership and established supporting business and data practices, the ability to coordinate production and optimize requirements, establish accurate inventories, provide service delivery, or optimize production costs are severely compromised. DOI's geospatial and business communities proactively seek to fulfill their geospatial business requirements. They create valuable data in many different formats with differing levels of positional accuracy and multiple data standards. This makes the data more difficult and costly to reuse.

This problem is illustrated by the difficulty in establishing a complete and accurate DOI trails dataset. This information is valuable to many bureaus and programs. It is often exchanged, but just as frequently it is stored locally. The information has the potential to provide baseline data to projects, financial asset management, land-use planning projects, scientific studies, and IT systems, as well as citizens-focused services such as recreation.

In the current state, to make the trails data useful, it would have to be duplicated, format-converted, transformed, have attributes manipulated, and be corrected for positional accuracy, assuming it was cataloged and could be discovered. This puts an undue burden on the mission and geospatial SMEs to perform these tasks and maintain a complete working knowledge of the type and quality of DOI's data assets. This type of effort is a large hidden cost in current operations and one of the costs savings rationales for developing capabilities such as TNM. The trails example suggests an opportunity to improve basic data lifecycle management practices for an enterprise-wide asset, as identified in the stakeholder interviews, to improve the cataloging, discovery, and availability of this information for greater reuse within DOI and externally.

Model 2 focuses on the use of the cross-cutting information from its production systems and program created geospatial data from the mission areas. These DOI program areas are major consumers of Model 1's data assets, which are necessary, but not sufficient to completely support the DOI's business objectives. These business areas create additional value-added business information via land-use planning modeling, and analysis methods; resource assessments; resource inventory; and monitoring techniques; or with facilities and engineering activities to name just a few. These business functions are generically represented in the As-Is value chain by the block on the right in (Figure 7-5). It is only when this information is combined with the cross-cutting geospatial data and service assets from Model 1, that the DOI land, resource management, science and financial stewardship objectives and needs are typically met.

The As-Is analysis suggests aligning Model 1's data production systems and Model 2's program produced business data to create higher quality reusable enterprise-level information. This will improve DOI decision support, planning, and business efficiencies. This enterprise information needs to be made accessible to DOI's wide number of business functions in a standardized and managed manner. The

breadth of the potential value can be seen in Table 7-2 describing the number and percentage of DOI Service to Citizens business functions that can be made more efficient.

7.6 Geospatial Data and Information Analysis

Understanding DOI's requirements for data and information is the foundation in understanding geospatial architecture. Geospatial data is expensive to acquire and produce. As mentioned earlier, 60–80% of the costs of geospatial data are spent on the collection and integration of the information. It is the objective of the Blueprint to manage and optimize these steps as much as possible for the data needed by the enterprise.

The data assets inventory had been initiated by the EGIM during its project efforts and reflects the operational needs of the bureaus. The inventory consists of over 400 themes of information. It has been categorized to ISO and A-16 standards and classified by its use (create or read). The data analysis estimates that 75% of the geospatial theme content requirements and assets [6] are categorized as A-16. [7]. Twenty-five percent of the A-16 assets are under the stewardship of non-DOI agencies. As a result DOI has an external dependency for enterprise data from these providers, from private sources and a multitude of state and local government partners. Approximately 25% of DOI's inventoried themes does not fall within the A-16 definition and is used for internal business needs..

The data analysis clearly indicated that there is a high degree of cross-DOI need for the same information. Not all of these needs or data assets are under the control of a "formal" system, database, repository, or "known" data management plan. Geospatial stakeholders expressed the need to access the most reliable and trustworthy sources of geospatial information to avoid redundant costs, regenerating the same information, or using outdated or unreliable information. As of September 2007, within DOI, there are varying degrees of "trustworthiness" or "reliability" in the multitude of Web sites, catalogs, systems, or desktop computers that store the geospatial data.

In Figure 7-3, one can see this large bi-directional flow of information. This complex dependency introduces a management opportunity to identify the means to ensure cost effective access and use of authoritative and reliable information.

The Blueprint is using DOI's ADS method to assess and identify a candidate's datasets and supporting IT capabilities to manage a target enterprise data asset. An ADS is a cohesive set of data assets that provide trusted, timely, and secure information to support one or more business processes. Its information needs to be visible, accessible, understandable, and credible to information users. The Blueprint objective was to create the baseline knowledge to recommend best available and most valuable candidate ADS while also identifying gaps. The ADS analysis results can be reviewed in Appendix B.

The first step of the ADS process was to establish the relationships of the data inventory to the existing data stewardship program, data standards, and supporting IT capabilities. The ISO and FGDC data standards identified in the federal GEA [26] were used in support of the ADS assessment and categorizations.

Each ADS candidate has been qualitatively scored against the following criteria:

- Accuracy-Qualitative: Assessment to determine which data accurately reflects real-world object or matches original source of data

- Completeness: Degree to which values are present in the attributes that require it
- Consistency: Degree to which redundant facts are equivalent across two or more databases
- Precision: Degree to which data is known to the right level of granularity
- Timeliness: Degree to which data is up to date and available to support a given knowledge worker or process
- Uniqueness: Degree to which there are no redundant occurrences or records of the same object or event
- Validity: Degree to which data conforms to its definition, domain values, and business rules

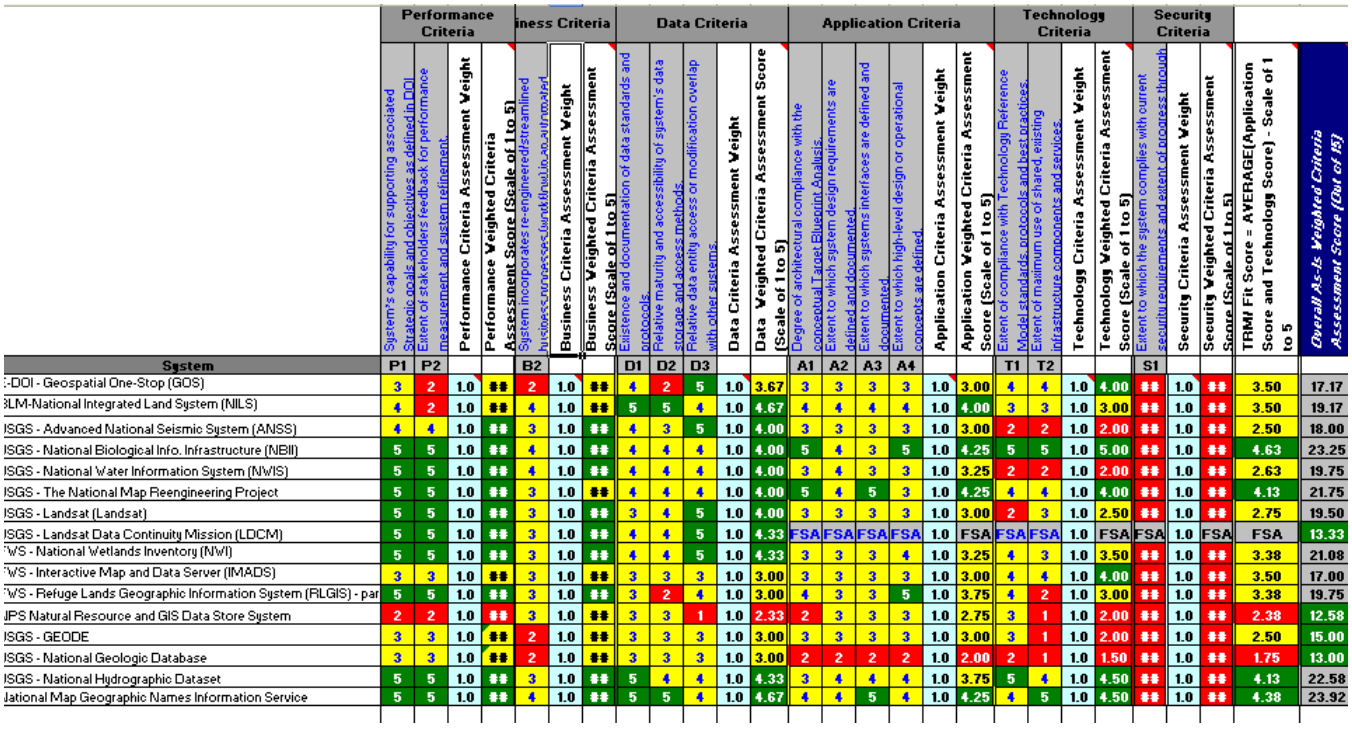
The Geospatial Core Team [19] and the EGIM [20] subject matter experts ranked the candidates to identify those with the greatest potential value to the DOI. The ADS assessment resulted in generating an ordinal score for each candidate ADS. The scoring resulted in an overall value indicating the enterprise maturity for the ADS.

Next, the ADS candidates were evaluated against DOI business information to determine which data had the highest reuse potential. The functional analysis was conducted on the Business Reference Model, stakeholder notes, existing blueprints, product descriptions, use case scenarios, and existing requirements documents to determine its reuse potential. Once the reuse potential was determined, it was important to establish the practicality of influencing these assets. Each candidate was scored for this influence factor. The DOI owned assets where there is a regulatory or policy responsibility (e.g., cadastral theme) were assigned a "5" indicating a high degree of influence. If DOI required the information, but had no control, it received a "1" as the lowest level of inf1uence. These two factors when multiplied with the ADS quality score produced an overall ranking. These rankings were reviewed by the Geospatial Core Team in conjunction with the EGIM subject matter experts identifying the top 16 enterprise ADS candidates. Those with low scores on the ADS indicated complexity and risks that would need to be addressed through major changes in data lifecycle management practices before the enterprise would be able to take full advantage of them. Those with high scores on the ADS quality and reuse potential, and are under DOI's influence could provide a set of near term candidates to approve and support with improvements to data lifecycle management processes.

The results of the data analysis strongly confirmed the stakeholder concerns about confidence in finding and accessing reliable enterprise data in a managed state. The analysis also confirmed the reuse potential of the enterprise geospatial data assets and the future value of coordinated enterprise data service delivery model. This cross cutting data service delivery model will be important to the spatial enablement of the target business process efficiencies.

7.7 Geospatial Systems, Services, and Technology Analysis

After the performance, business and data architectures were investigated, and the geospatially related system inventory and technology baselines were analyzed. The classification of geospatial systems is not straightforward. There are few pure geospatial systems in place today. There are supporting programs, investments, functions, and datasets, but relatively few solely geospatial systems. Most often, geospatial information is thought about as a characteristic of a business process, data, or system. Given this ambiguity, the existing system inventory analysis was focused on enterprise geospatial data producing, managing, or serving systems (Figure 7-6). The systems were reviewed to identify potential reusable services or manage enterprise data assets.



System	P1	P2			B2			D1	D2	D3			A1	A2	A3	A4			T1	T2			S1				
:-DOI - Geospatial One-Stop (GOS)	3	2	1.0	##	2	1.0	##	4	2	5	1.0	3.67	3	3	3	3	1.0	3.00	4	4	1.0	4.00	##	1.0	##	3.50	17.17
BLM-National Integrated Land System (NILS)	4	2	1.0	##	4	1.0	##	5	5	4	1.0	4.67	4	4	4	4	1.0	4.00	3	3	1.0	3.00	##	1.0	##	3.50	19.17
ISGS - Advanced National Seismic System (ANSS)	4	4	1.0	##	3	1.0	##	4	3	5	1.0	4.00	3	3	3	3	1.0	3.00	2	2	1.0	2.00	##	1.0	##	2.50	18.00
ISGS - National Biological Info. Infrastructure (NBII)	5	5	1.0	##	4	1.0	##	4	4	4	1.0	4.00	5	4	3	5	1.0	4.25	5	5	1.0	5.00	##	1.0	##	4.63	23.25
ISGS - National Water Information System (NWIS)	5	5	1.0	##	4	1.0	##	4	4	4	1.0	4.00	3	4	3	3	1.0	3.25	2	2	1.0	2.00	##	1.0	##	2.63	19.75
ISGS - The National Map Reengineering Project	5	5	1.0	##	3	1.0	##	4	4	4	1.0	4.00	5	4	5	3	1.0	4.25	4	4	1.0	4.00	##	1.0	##	4.13	21.75
ISGS - Landsat (Landsat)	5	5	1.0	##	3	1.0	##	3	4	5	1.0	4.00	3	3	3	3	1.0	3.00	2	3	1.0	2.50	##	1.0	##	2.75	19.50
ISGS - Landsat Data Continuity Mission (LDCM)	5	5	1.0	##	3	1.0	##	4	4	5	1.0	4.33	FSA	FSA	FSA	FSA	1.0	FSA	FSA	FSA	1.0	FSA	FSA	1.0	FSA	FSA	13.33
WS - National Wetlands Inventory (NWI)	5	5	1.0	##	3	1.0	##	4	4	5	1.0	4.33	3	3	3	4	1.0	3.25	4	3	1.0	3.50	##	1.0	##	3.38	21.08
WS - Interactive Map and Data Server (IMADS)	3	3	1.0	##	3	1.0	##	3	3	3	1.0	3.00	3	3	3	3	1.0	3.00	4	4	1.0	4.00	##	1.0	##	3.50	17.00
WS - Refuge Lands Geographic Information System (RLGIS) - par	5	5	1.0	##	3	1.0	##	3	2	4	1.0	3.00	4	3	3	5	1.0	3.75	4	2	1.0	3.00	##	1.0	##	3.38	19.75
JPS Natural Resource and GIS Data Store System	2	2	1.0	##	3	1.0	##	3	3	1	1.0	2.33	2	3	3	3	1.0	2.75	3	1	1.0	2.00	##	1.0	##	2.38	12.58
ISGS - GEODE	3	3	1.0	##	2	1.0	##	3	3	3	1.0	3.00	3	3	3	3	1.0	3.00	3	1	1.0	2.00	##	1.0	##	2.50	15.00
ISGS - National Geologic Database	3	3	1.0	##	2	1.0	##	3	3	3	1.0	3.00	2	2	2	2	1.0	2.00	2	1	1.0	1.50	##	1.0	##	1.75	13.00
ISGS - National Hydrographic Dataset	5	5	1.0	##	3	1.0	##	5	4	4	1.0	4.33	3	4	4	4	1.0	3.75	5	4	1.0	4.50	##	1.0	##	4.13	22.58
lational Map Geographic Names Information Service	5	5	1.0	##	4	1.0	##	5	5	4	1.0	4.67	4	4	5	4	1.0	4.25	4	5	1.0	4.50	##	1.0	##	4.38	23.92

(Notes: Abbreviations and acronyms: BLM, Bureau of Land Management; DOI, U.S. Department of the Interior; FWS, Fish and Wildlife Service; GEODE, USGS Geologic Discipline data delivery system; GIS, geographic information system; NPS, National Park Service; USGS, U.S. Geological Survey)

Figure 7-6 System Scoring Table

The geospatial target SOA [16] strategy will require systems to be technologically extensible to support the service delivery model through application integration, service extensions, or replication strategies. The system scoring provides indicators for service adoption, data alignment, and technology extensibility for the target service delivery model. Unlike many blueprints that are focused on a single functional business area, the Geospatial Blueprint is designed to promote enterprise reuse across multiple business areas and organizations. Additionally, it is important to note that much of DOI's work processes are not currently supported by the existing systems or applications inventory. This suggests that the consumer community for geospatial data assets extends well beyond the current set of DOI's IT system users and reinforces the criticality of the ADS concept. This is an opportunity for DOI to use its existing system architecture to underpin the ADS objectives by evolving its system towards managing enterprise data assets and supporting information access through services. With the technology advances in geo-enabled Web services and standards, it is now possible to extend the system architecture to desktop and browser technologies through shared services when supported by reliable information.

Whereas there are few pure geospatial systems within DOI, there are conservatively still 135 systems that consume or require geospatial functions and enterprise data to achieve their mission objectives [6].

With the cross-cutting reuse concept in mind, DOI's complete portfolio of systems from the DOI Enterprise Architecture Repository (DEAR) [26] was reviewed to identify current consumers of geospatial information or systems that could, in the future, take advantage of the SOA geospatial data and services. The analysis used DEAR information, capital planning documentation, SME input, completed and in-work blueprints, and existing system scoring data to support the analysis. The objective of the systems analysis was to establish current scope of consumer applications and identify the potential value of shared services and reusable data assets. For example, there are multiple systems managing geospatial information, such as ownership or Cadastre in local system stores when there is potential enterprise solution available (see Appendix E).

The current state of geospatial map and data services development from the existing repositories of geospatial data is limited. There are several subject areas where services have been provided, but none of which provide the information through a verified and supported service delivery model at the DOI enterprise level. Programs such as GNIS and NWI have demonstrated that services can be constructed, but they operate with only a limited outreach to consumers. Other programs such as NILS, are focused on select business functions and also have a much wider set of potential consumers to reach. The existing services will continue to be sub-optimal to the broader consumer base until an enterprise service delivery model is established and supported by enterprise governance.

The systems analysis also revealed several enterprise gaps and redundancies in the geospatial architecture including Real Property Management [35], geospatial data requests, product creation and delivery, and geo-enabled work activity planning.

The analysis of DOI's business requirements for Real Property Management [35], finance and land stewardship performance and accountability, revealed an information requirement to have stewardship efforts recorded in the context of an official land records description. In the current state, this information is recorded in text-based form not spatially. Additionally, the stewardship requires that DOI must report on improvements from fixed assets and other forms of investments including expenditures to restore land to an acceptable condition. The FBMS [32] development plans were reviewed to determine how this requirement was going to be addressed. The plan calls for integration with the enterprise facilities effort through a non-geospatial interface. It does not address the potential interface to the NILS where the official land records description is stored. Development of this interface without the supporting ADS will lead to greater maintenance costs and integrity issues.

A review of planning-oriented systems within the inventory identified a number of local systems, such as the National Fire Plan Operations and Reporting System (NFPORS) or organization-wide systems, such as the USGS's BASIS-PLUS (or "BASIS +") system adopting the practice of spatially enabling where work is going to occur. These are good practices, but are being used for project tracking and performance monitoring. The gap for true work activity planning persists where planners can establish the geospatial location of the work and supporting resource types (data, services, and human resources) and review opportunities for cost avoidance and savings during their budget planning process.

With the legacy focus of geospatial data production at the program level, it is not surprising that the system inventory has redundant means to discover, request, create, and deliver geospatial information and products. The extraction, compression, and download capabilities are embedded in numerous backend systems including Seamless, Land Survey Information System (LSIS), and NWI to name a few. There are multiple discover channels into the detailed inventories of imagery products forcing internal and external users to navigate a complex set of interfaces to request or discover their information.

Lastly, the technology baseline, or TRM [25] was reviewed. DOI is heavily invested in the ESRI product line that is now managed under an ELA. DOI's current skill base and investment in training in this technology product line is substantial. This is the defacto standard. The ELA provides for desktop, advanced geospatial analytical, Web map servicing, map production, and data management product technologies. These tools are in widespread use throughout DOI. The analysis of the TRM [6] identified other geospatial product technologies, such as GPS, CAD, and image processing, that are in high use with no ELAs.

Further investigation of the DOI TRM [25] identified the opportunity to adopt standards identified by the recently released Federal Enterprise Architecture Geospatial Profile version 1.1, January 27, 2006. [28]. The development of the future interoperable geospatial enterprise services will demand the developer community subscribe to DOI Solution Architecture Volume I: Target Logical Solution and Service-Oriented Application Reference Architecture [39]. This document articulates development guidance, standards, and best practices for the development of services. The Service-Oriented Application Reference Architecture and the GEA [26] guidance provide the foundation for target state geospatial interoperability standards for system and services.

The critical technology element, currently a gap in the DOI TRM [25], is the OGC [30] specifications. These are critical to exposing reusable services cost effectively. System development that is based on the OGC standards and specifications have demonstrated a 26% total lifecycle cost savings [12]. It is important that DOI formally adopt these standards in the TRM and begin to deploy them in a managed engineering approach. Several federal organizations, including the National Geospatial-Intelligence Agency (NGA) [40], the National Aeronautics and Space Administration (NASA) [12], the Department of Defense (DOD) [41], and the Department of Homeland Security (DHS) [42] have adopted or are moving to adopt the specifications. DOI has several existing implementations that are taking advantage of these specifications now, such as TNM, NWI, and others. They are demonstrating basic technical success and promises of open interoperability. DOI's existing GIS software platform allows interconnectivity with data stores enabled through most of these specifications. Given the large amount of work done within the GIS tool environment and the need to share data and geospatial modeling techniques, the benefits of standards go well beyond the value of system development. The investigation of the current state has not indicated use of Web Mapping Context capabilities (saving persistent stylized views of geospatial data for simple reuse) in the architecture. This is a potentially valuable capability to broaden the use of geospatial data assets to managers and inexperienced geospatial users.

The TNM program is currently investigating several technologies to support the interoperability and performance to support the data access and service delivery model. Currently, the service connector or adaptor technologies for the OGC specifications reflect the ESRI baseline. The TNM program is investigating additional vendor technologies to determine the best value future performance and capacity demands. In addition to improved performance, the standards based-connectors support the target conceptual architecture best practice of open standards. The TNM program is also investigating OGC compliant data management and delivery technologies for improving the performance of raster and vector data management and delivery. The results of these activities will produce valuable technical information for the broader DOI geospatial community as well as potential changes to the TRM baseline.

With the stakeholder analysis completed and As-Is information collected, the EGIM and Geospatial Core Teams analyzed the information to develop the findings and key issues. These items were reviewed and further analyzed as needed to create a set of proposed findings with supporting recommendations

and target state solutions that were consistent with the vision and objectives established by the Geospatial Core Team. This was an iterative process where each pass defined the issues, recommendations, and solutions more clearly. The team eventually grouped the key findings categories encapsulating the stakeholder needs and tempered by the architectural and operational environment information. The key findings are described below:

1) **Optimize and Standardize Geospatial Data and Services:** Existing data and services efforts have the potential for serving a broader set of consumers and improving business efficiency for the DOI enterprise.

2) **Enhance Geospatial Planning and Investment Strategy:** There was no spatially intelligent means to support work activity or project planning processes that would identify shared business requirements and produce cost avoidance savings.

3) **Enhance Geospatial Governance:** DOI's geospatial investments are not currently managed in an enterprise fashion where the organization could ascribe value or evolve the assets to meet a greater number of shared needs.

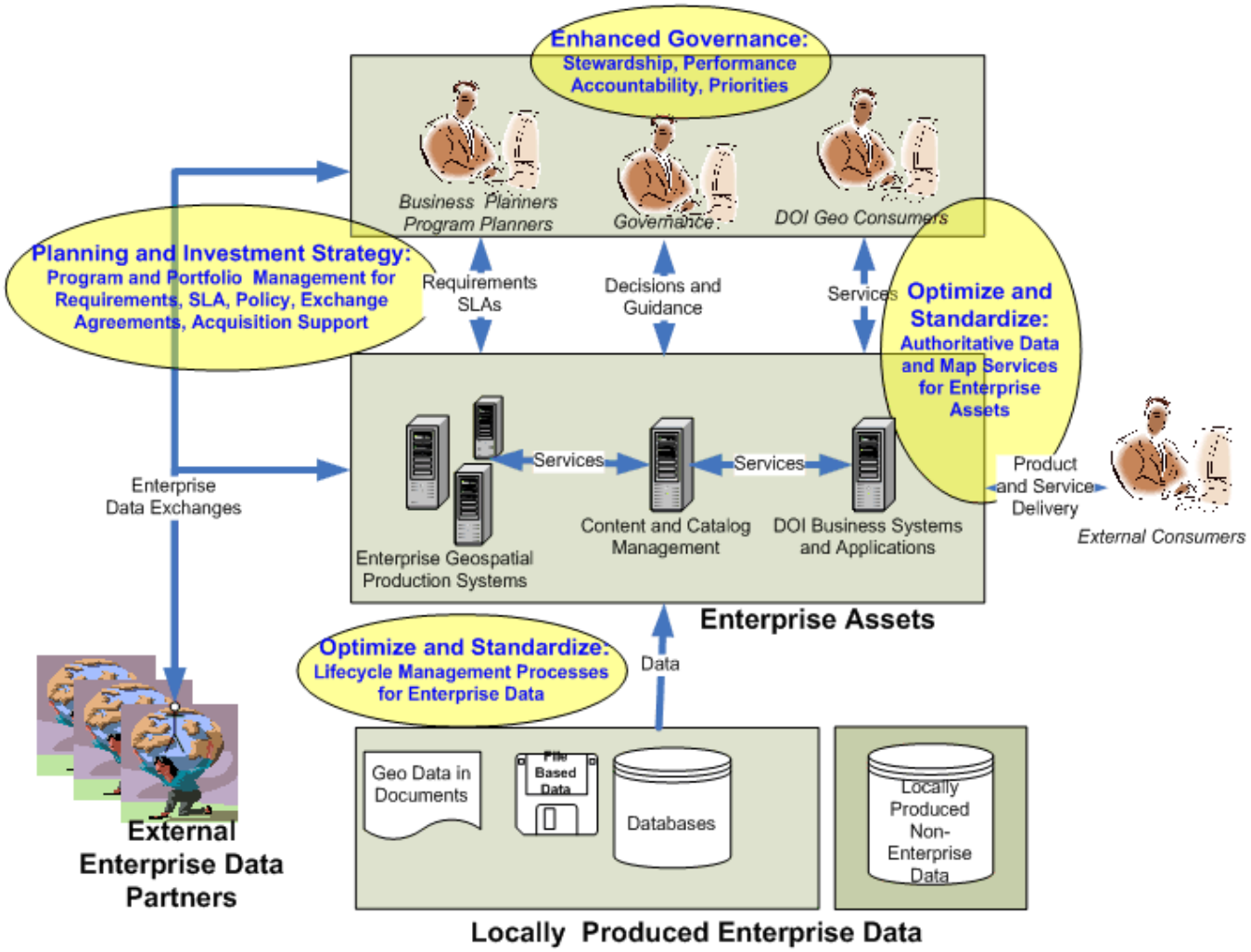
The business, data, and systems analyses indicate there is substantial value to be gained by optimizing and standardizing DOI's existing enterprise data and system assets into a coordinated service delivery model. The service delivery model will allow DOI to maximize its resources across organizational boundaries in support of science, land, resource, fire, recreation management, and other program objectives. This is a driving force behind the key recommendations in the target state. There are a number of assets that had been moving towards a service delivery model, such as the TNM and NILS, but were providing solutions to a limited consumer base. Other valuable, but less mature enterprise assets, can be transitioned to a similar model, but over a longer time frame with greater coordination or investment. All of these assets are of great value to the enterprise, but historically have been compromised by data fragmentation or single program focused management. As the data lifecycle management and supporting IT infrastructure alignment improves, these too would then provide the basis for implementation of shared enterprise authoritative data and supporting geospatial services. All authoritative assets will be governed and managed as a federated portfolio of data, services, and technology assets. The assets will have clear lines of roles and responsibilities required to support the delivery model. As the service delivery model matures, it will provide the means for multiple types of geospatial consumers and business areas to effectively access quality-reliable enterprise data. Business area adoption will be established as a key objective of the target state.

The business and systems analyses indicated redundancies and gaps in the capabilities to develop or create geospatial products and data to support a stand-alone work effort or offline projects. Use cases for mobile computing, long standing projects, or data transfer needs will require an extensible enterprise mechanism that will support the extraction of data from multiple ADS sources and rectify the current usability and interface complexities. An effective user interface design will provide greater access to less sophisticated users and encourage users to reuse enterprise asset sources.

The business analysis indicated a key business planning process gap or best practice at the enterprise level. The organization does not have an enterprise repeatable means to identify the geography of planned work activities. This spatial planning process would provide planners, and project and program leads with the capability to identify and subsequently optimize DOI's acquisition of geospatial data and services for its projected work activities. This planning process is necessary to avoid redundant data acquisition and optimize contracted services. It would support existing work activity planning processes.

An enterprise service delivery model, with its supporting portfolio assets, will require development of the necessary governance, performance, and accountability mechanisms to ensure the services model is organizationally supported, trusted, and effectively managed. These mechanisms will be predicated on SLA and geospatial domain governance.

The target conceptual model, see Figure 7-7, is dramatically altered by the geospatial findings and recommendations. The introduction of enterprise geospatial services, ADS, requirements planning, and the supporting governance model lays the framework and establishes the relationships between the multiple local data producers, enterprise data, and quality services. It provides the opportunity to establish simplified service relationships from many consumers to a set of reliable managed information and preclude numerous and potentially redundant services from being developed. The transition to the target services delivery model requires these clearly defined relationships. These relationships form the basis of the service delivery model. With the supporting geospatial planning and governance, these service relationships can be managed more cost effectively and their benefits assessed more readily. These relationships are at the heart of the recommended SOA. The ADS, data lifecycle management processes, and services can be implemented incrementally and still provide great benefit to the organization.



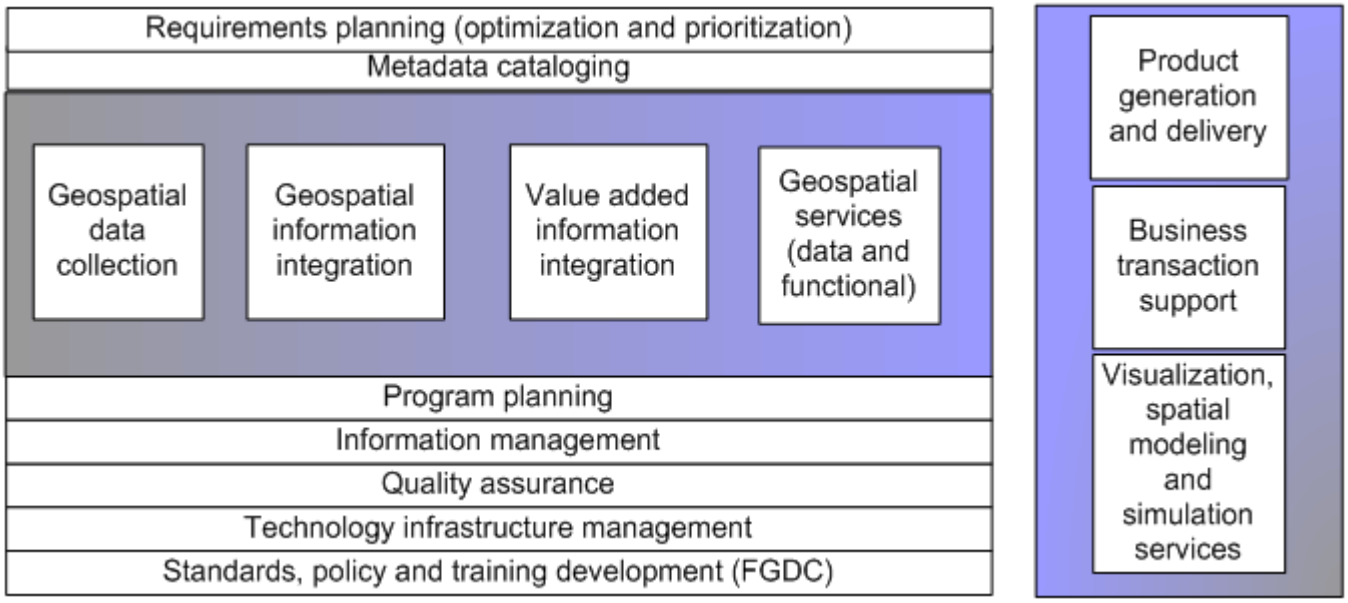
(Notes: Abbreviations and acronyms: DOI, U.S. Department of the Interior; Geo, geospatial; SLA, Service Level Agreement)

Figure 7-7 Geospatial Target Conceptual Model

The interoperable SOA model [39] allows for simplified access by new classes of users through simple browser technology, desktop GIS tools, or through systems or applications. This approach will free up existing SMEs and GIS experts to apply their skills and savvy towards solving greater value-added or more complex business problems. Inexperienced users are now able to access geospatial information without using systems or sophisticated GIS tools. Service providers can achieve an economy of scale that is based on increased data usage, more efficient access, and reduction in per unit delivery costs. This results in cost reduction benefits to the organization through improved data access and increased use while extending the reach of the data investment. The transformation of DOI data producers to service providers will yield enhanced business services and efficient reuse of data. A powerful example of this would be the need to access an authoritative version of Federal Land Ownership or the Cadastre framework datasets. Today, most users are downloading and maintaining local copies or not using it at all because of its complex nature.

It is estimated that 290 DOI business functions, innumerable industries, the public, and many federal, state, and county governments could all benefit from the federal Cadastre and federal land ownership Data [6].

The target conceptual model has impacts on the high level business geospatial architecture. The business model initially expressed in Figure 7-5 is restructured to account for the new concepts. In Figure 7-8, there are three fundamental changes to the target state value chain. The target value chain now addresses the misalignment of enterprise data and IT assets to support optimization and standardization of geospatial data, services and technology, and key business interfaces to create the geospatial service delivery model. The architecture analysis identified the opportunities to connect enterprise data producers with the geospatial consumers to achieve economies of scale on data management, service development, and most importantly, business access to reliable information. The target value chain accounts for the current gap in the enterprise geospatial planning for resource optimization by providing the means to identify and consolidate common resource requirements using geospatial methods. Lastly, it accounts for the need to manage the data, technology, and financial assets of a geospatial portfolio through a cross-organizational governance model with program management support. These fundamental changes will be successful only with an effective program management and governance structure because of the high degree of cross-organizational dependency.



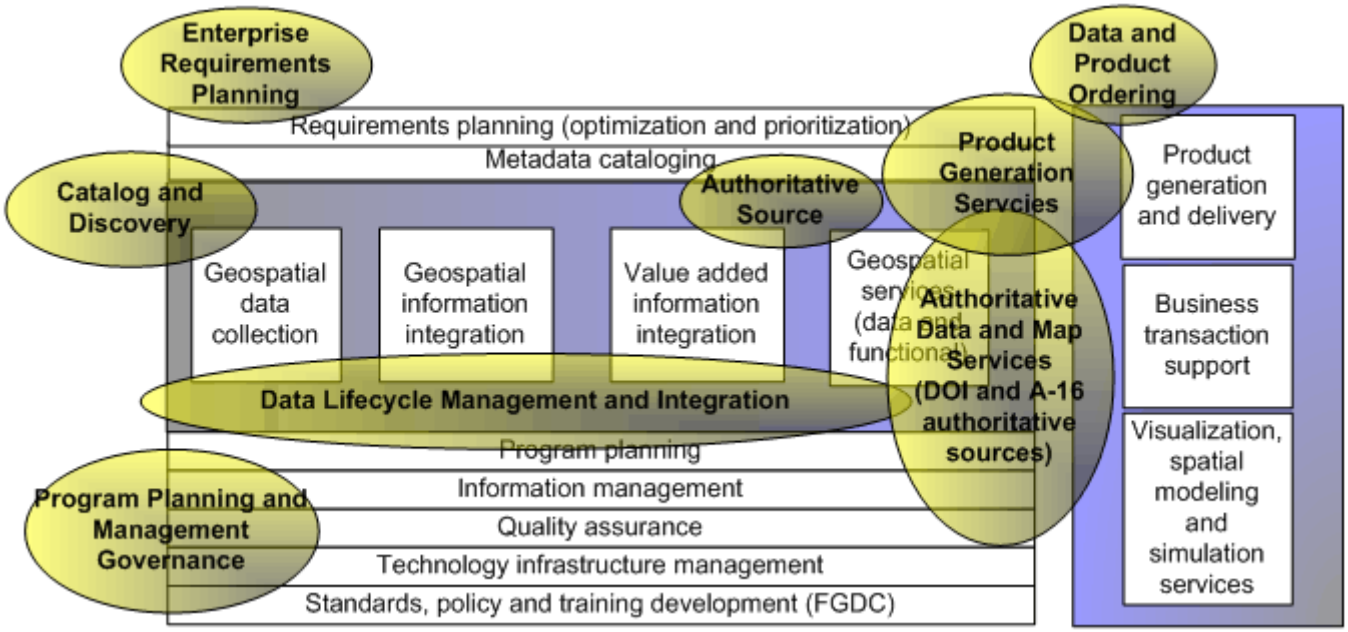
(Notes: Abbreviations and acronyms: FGDC, Federal Geographic Data Committee)

Figure 7-8 Geospatial Target Value Chain

All the alterations to the target state value chain and conceptual models imply actual changes to the existing management, governance, performance, business, and technical architectures. As with all changes, this target model will create the opportunity for financial benefit and resource efficiencies if executed. It does not come without some need for strong governance and change management efforts to manage the associated risks. The cross-organization governance participants will be responsible for providing the change management and communications plans to address these risks. The recommendations have been segmented and designed to mitigate risk by using pilot concepts and incremental ADS implementations, and supported by cross-bureau governance participation. The

geospatial recommendations identified in Figure 7-9 represent these changes. They are supported by a more detailed target solutions description in the Findings and Recommendations section 4.0. The recommendations have corresponding transition plans, risk analysis, and preliminary value and cost estimates to support management planning. For a long term and wide reaching solution, such as those found in the Blueprint, there are corresponding governance scenarios to ensure a sustainable implementation.

These are fully described in the Findings and Recommendation sections (4.0) and referenced in Figure 7-9. The conceptual architecture is fundamental to the understanding of the implications of the geospatial solutions.



(Notes: Abbreviations and acronyms: A-16, OMB Circular A-16; DOI, U.S. Department of the Interior; FGDC, Federal Geographic Data Committee)

Figure 7-9 Geospatial Target Value Chain with Target Solutions Overlay

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9. ABBREVIATIONS AND ACRONYMS

Abbreviation or Acronym	Definition
A-16	OMB Circular A-16
ABC	Activity-Based Costing
ADS	Authoritative Data Source
ADT	Abstract Data Types
ANSI	American National Standards Institute
AOI	area of interest
API	application programming interface
ArcGIS	GIS software from ESRI
ASCADS	Automated Storage Conversion and Distribution System
BASIS +	USGS Budget and Science Information System + USGS financial and management tracking system
BCS	Business Component System
BI	business intelligence
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BNF	Backus-Naur form
BOR	Bureau of Reclamation
BRM	Business Reference Model
BRM-TIER	Business Reference Model-Technical Independent Evaluation Report
BTS	Bureau of Transportation Statistics
CAD	computer-aided design
CADD	computer-aided design and drafting
CAP	Common alerting protocol
CIO	Chief Information Officer
CM	Configuration Management
Cognos	business intelligence reporting software
COI	Communities of Interest
COM	Component Object Model (see OLE)
CONOPS	Concept of Operations
CORE	Component Organization and Registration Environment
CORBA	Common Object Request Broker Architecture
COTS	commercial off the shelf
CQL	Collection Query Language
CSDGM	Content Standard for Digital Geospatial Metadata
CS-W	OpenGIS Catalogue Service for the Web
CRSSP	Commercial Remote Sensing Space Policy

Abbreviation or Acronym	Definition
CRUD	Create read update delete
CT	Coordinate Transformation
CTOC	Chief Technology Officers Council
CU	Cultural
DAC	Data Advisory Committee
DB	Database
DBA	database administrator
DBMS	Database Management System
DEAR	DOI Enterprise Architecture Repository
DHS	Department of Homeland Security
DLRM	Digital Land and Resource Management
DOC	Department of Commerce
DOD	Department of Defense
DOI	U.S. Department of the Interior
DoD	Department of Defense
DOQ	Digital Orthophoto Quadrangle
DOT	Department of Transportation
DRG	digital raster graphics
DRM	Data Reference Model
DSA	Data subject area
DTED	Digital Terrain Elevation Data
EAI	Enterprise Application Integration
EC	
EGIM	Enterprise Geospatial Information Management
EGOV	Electronic government
EHRI DW	Enhanced human resource integration
ELA	Enterprise license agreement
EN	Engineering
EO	End outcome
EROS	Earth Resource Observation System
ESRI	Environmental Systems Research Institute, Inc.
ETL	Extract, transform, load
FAMS	Facility Asset Management System
FBMS	Financial Business Management System
FEA	Federal enterprise architecture
FEMA	Federal Emergency Management Agency
FGDC	Federal Geographic Data Committee
FIRM	Facility Information Resource Management
FM 92-X Ext. GRIB WMO	Application specific data interchange standard

Abbreviation or Acronym	Definition
FMS	Facilities Management System
FMSS	Facility Maintenance Software System
FWS	Fish and Wildlife Service (also known as USFWS)
FPU	Fire Planning Units
FY	Fiscal Year
GAO	General Accounting Office
GAP	Gap Analysis Program
GCDB	Geographic Coordinate DataBase
GDT	Geographic Data Technology
GEA	Geospatial Enterprise Architecture
Geo	Geospatial
GEODE	USGS Geologic Discipline data delivery system
GeoLoB	Geospatial Line of Business
GeoMAC	Geospatial multiagency coordination for wildfire support
GIO	Geographic Information Officer
GIS	geographic information system
GLCC	Global Land Cover Consortium
GLO	Government Land Office
GLOB	GeoLoB – Geospatial Line of Business
GLOVIS	Global Visualization Viewer (USGS)
GMBT	Geospatial Modernization Blueprint Team
GML	Geographic Markup Language
GMO	Geospatial Management Office
GMS	GeoMobility Server
GNIS	Geographic Names Information System
GOS	Geospatial One-Stop
GPS	Global Positioning System
GRPA	Government Performance Results Act
GRPS	Geospatial Requirements Planning System
GSA	General Services Administration
GTOP30	Digital Elevation Model 30 arc-second
GTOPO60	Digital Elevation Model 60 arc-second
HR	human resources
HTML	Hypertext Markup Language
HTTP	hypertext transport protocol
HUD	U.S. Department of Housing and Urban Development
IAWG	U.S. Department of the Interior Architecture Working Group
IBAT	U.S. Department of the Interior Business Architecture Team
ICS	Incident Command System
ID	Identifier

Abbreviation or Acronym	Definition
IDBC	Internal Device Buffer Code
IEA	U.S. Department of the Interior Enterprise Architecture
IMARS	Incident Management Analysis and Reporting System
INCITS	InterNational Committee for Information Technology Standards
IRB	Investment Review Board (DOI)
IS	Information System
ISE	Integrated Software Environment
ISO	International Standards Organization
ISO/IEC	International Organizational Standardization/International Electrotechnical Commission
ISO/TC 211	ISO Technical Committee 211 (Geographic Information/Geomatics)
ISS	International Space Station
IT	information technology
ITMC	Information Technology Management Council
ITS	Intelligent Transport System
JDBC	Java Database Connectivity
JSP	Java Server Pages
KB	Knowledge base
KM	Knowledge management
LBS	Location-Based Service
LCM	lifecycle management
LIDAR	Light Detection and Ranging
LR2000	Legacy Rehost 2000 (Bureau of Land Management and Minerals Records 2000 system)
LRS	Land Remote Sensing
LSIS	Land Survey Information System
Maximo	software package for asset management and services
MBT	Methodology for Business Transformation
MGRS	Military Grid Reference System
MMS	Minerals Management Service (DOI)
MODIS	Moderate Resolution Imaging Spectroradiometer
MRLC	Multi-Resolution Land Characterization
MRLC2001	Multi-Resolution Land Characterization 2001
MRM	Minerals Resource Management
NASA	National Aeronautics and Space Administration
NBII	National Biological Information Infrastructure
NDEP	National Digital Elevation Program
NED	National Elevation Data
NEPA	National Environmental Policy Act
NFPORS	National Fire Plan Operations and Reporting System
NGA	National Geospatial-Intelligence Agency
NGS	National Geodetic Survey

Abbreviation or Acronym	Definition
NHD	National Hydrography Dataset
NIFC	National Interagency Fire Center
NILS	National Integrated Lands System
NLCD	National Land Cover Dataset
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NVCS	National Vegetation Classification System
NWFEA	National Wildlife Fire Enterprise Architecture
NWIS	National Water Information System
NWS	National Weather Service
OAI-PMH	Open Archives Initiative Protocol for Metadata Harvesting
OASIS	Organization for the Advancement of Structured Information Standards
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 Geospatial Consortium
OLE	Object Linking and Embedding (see COM)
OMB	Office of Management and Budget
OpenLS	OpenGIS Location Service
ORM	OpenGIS Reference Model
OSM	Office of Surface Mining (DOI)
OWS	OpenGIS Web Services
PDF	Portable Data Format
PGS	Product Generation System
PLSS	Public Land Survey System
PMB	Policy Management and Budget
PO	Political
POC	Point of Contact
PGS	Product Generation System
PRM	Performance Reference Model
QA	quality assurance
QC	quality control
Ramona	metadata mining project integrated with Geospatial One-Stop
RASCI	Responsible, Accountable, Support, Consult, Inform
RAWS	Remote Automated Weather Station
RMIS	Regional Mark Information System
ROI	Return on Investment
SAOGI	Senior Agency Official for Geospatial Information
SAR	Synthetic Aperture Radar

Abbreviation or Acronym	Definition
SAS	Statistical Analysis System
SCS	Sensor Collection Service
SDE	Spatial Data Engine
SDSFIE	Spatial Data Standard for Facilities, Infrastructure, and Environment
SDTS	Spatial Data Transfer Standard
SensorML	Sensor Model Language
SF	Simple Feature
SHPO	State Historic Preservation Office
SLA	Service Level Agreement
SLD	Styled Layer Description
SME	Subject Matter Expert
SNOTEL	Snowpack Telemetry
SOA	Service-Oriented Architecture
SQL	Structured Query Language
SRM	Services Reference Model
SRTM	Shuttle Radar Topography Mission
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TAAMS	Trust Asset Accounting Management System
TBD	to be determined
TE	Technology
TIFF	Tagged Image File Format
TIMS	Technical Information Management System
TNM	The National Map
TRM	Technical Reference Model
UDDI	Universal Description Discovery and Integration
UML	Unified Modeling Language
UoM	unit of measure
URL	Uniform Resource Locator
USACE	U.S. Army Corps of Engineers
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USNG	U.S. National Grid
UTM	Universal Transverse Mercator
VEG	Vegetation Mapping Program
VMM	Value Measurement Methodology
VPF	Vector Product Format
WBD	Watershed Boundary Delineation

Abbreviation or Acronym	Definition
WCS	Web Coverage Service
WFS	Web Feature Service
WMC	Web Map Context
WMS	Web Map Service
WRCC	Western Regional Climate Center
WS	Web services
WSDL	Web Services Definition Language
XIMA	Image and Map Annotation
XML	Extensible Markup Language
Z39.50	client server protocol

10. GLOSSARY OF TERMS

Name	Description
ABC-work-activity	Activity Based Costing (ABC) is a management process that examines how program activities consume resources and produce outputs. In ABC, work processes are broken down into activities so that the cost and performance effectiveness of the activities and processes can be measured. The ABC-Work-Activity object describes an activity that can have work tied to it to measure effort against.
Authoritative Data Source	A cohesive set of data assets that provide trusted, timely, and secure information to business processes.
bathymetry	Bathymetry—the measurement of the depth of bodies of water.
block groups	Block group—the name for a subdivision of a census tract. A census tract is a small, relatively permanent statistical subdivision of a county or statistically equivalent entity, delineated for data presentation purposes by a local group of census data users or the geographic staff of a regional census center in accordance with U.S. Census Bureau guidelines. The block group is the lowest-level geographic entity for which the U.S. Census Bureau tabulates sample data from a decennial census.
business area	An FEA BRM Business Area as defined by OMB.
cadastral	Cadastral data—the data representing the cadastre.
cadastre	Cadastre—a public record, survey, or map of the value, extent, and ownership of land as a basis of taxation.
catalog	Catalog—A collection of entries, each of which describes and points to a feature collection or a service. Often used as synonym for Register.
component	Component—a reusable program building block that can be combined with other components across a distributed network to form an application. See also Service Component. (FEA Enterprise Architecture Glossary Of Terms).
coverage-feature	Coverage-feature that acts as a function to return values from its range for any direct position within its spatial, temporal, or spatiotemporal domain. Examples include a raster image or a digital elevation model or a satellite image. See also Feature (ISO 19123:2005(E)).
dataset	Dataset—identifiable collection of data (ISO 19113:2002(E).
dataset series	Dataset Series—collection of datasets sharing the same product specification (ISO 19113:2002(E)
data-subject-area	A broad classification of information or a grouping of related entities (those in which data are closely related and describe a general business idea or object) is called a Data Subject Area (DSA). A DSA is a grouping of entities based on a commonality of the data, and NOT how it is used by any given business process or application.
data steward	The person or group that manages the development, approval, creation, and use of data associated with a specific data standard managed within a specified business area, functional area, or subject area, ensuring that standardized data can be used to satisfy data requirements throughout DOI.
earth cover	Earth cover or land cover is the physical material at the surface of the earth. Land covers include grass, asphalt, trees, bare ground, water, etc. There are two primary methods for capturing information on land cover: field survey and through analysis of remotely sensed imagery. The nature of land cover is discussed in Comber et al. (2005).

Name	Description
end outcome	End Outcomes (EO) are long-term performance goals that describe and support the DOI's strategic goals. End Outcomes express a desired result and are measured by one or more performance measures / indicators. Performance measures indicate the success in achieving the long-term goal.
end-outcome measure	A measurable indicator of the End Outcome that can be systematically tracked to assess progress made in achieving predetermined End Outcome goals and using such indicators to assess progress in achieving these goals. A measurement must be an Operational Measurement Indicator in the Mission and Business Results Measurement Area. The Operational Measurement Indicators that agencies create should be determined by referencing the End Outcome indicators identified in the DOI Strategic Plan. A Measure must fit within the three Measurement Categories of the Mission and Business Results Measurement Area of the PRM. These categories are Services for Citizens, Support Delivery of Services, and Management of Government Resources. This Measurement Area aligns with Measurement Areas described in the Business Reference Model Version 2.0.
feature-abstraction	Feature-abstraction of real world phenomena (ISO 19101:2002(E)).
function-activity	BRM-TIER represents an entity in the FEA BRM. A BRM-TIER can be a Business area, Line of Business, or Business Sub Function or a further Agency specific decomposition. It is the super entity for BUSINESS-AREA, LINE-OF-BUSINESS, SUB-FUNCTION, LEVEK-SUB-FUNCTION, WORK-ACTIVITY, and PROCESS-STEP.
geocoding	Geocoding—the process of identifying the geographic location of a postal address—a subset of georeferencing.
geodetic	Geodetic control—Geodetic control surveys are usually performed to establish a basic control network (framework of known point locations) from which supplemental surveying and mapping work is performed. Geodetic network surveys are distinguished by use of redundant, interconnected, permanently monumented control points that comprise the framework for the National Spatial Reference System (NSRS) or are often incorporated into the NSRS.
geographic information system	Geographic Information System (GIS)—a system for the storage, retrieval, analysis, display, and maintenance of geographic information.
georeferencing	Georeferencing—the process of identifying the geographic location of a piece of information (the most common example is finding the latitude and longitude of a postal address, which is usually called geocoding—a subset of georeferencing).
geospatial data	Geospatial data—data with implicit or explicit reference to a location relative to the Earth (Adapted from ISO 19118:2005(E)).
geospatial information	Geospatial information—information concerning phenomena implicitly or explicitly associated with a location relative to the Earth (Adapted from ISO 19101:2002(E)).
geospatial information system	Geospatial Information System—information system dealing with information concerning phenomena associated with location relative to the Earth (Adapted from ISO 19101:2002(E)).
geospatial service	Geospatial Service—service that transforms, manages, or presents [geospatial] information to users (Adapted from ISO 19101:2002(E)).
geospatial service component	Geospatial Service Component—A Service Component (component or service) that has geospatial data or information as a primary input and/or output. (See Component and Geospatial Service).
hydrography	Hydrography—the scientific description and analysis of the physical conditions, boundaries, flow, and related characteristics of the earth's surface waters. Hydrographic data typically refers to the boundaries of water bodies.

Name	Description
intermediate outcome	Intermediate Outcomes describe and support major milestones of an annual End Outcome goal. There are two or more Intermediate Outcome Goals to every End Outcome Goal. The actual results, effects, or impacts of a business initiative, program, or support function. Actual outcomes typically are compared to expected outcomes.
intermediate-outcome measure	A measurable indicator of the Intermediate Outcome that can be systematically tracked to assess progress made in achieving predetermined End Outcome goals and using such indicators to assess progress in achieving these goals. A measurement must be an Operational Measurement Indicator in the Mission and Business Results Measurement Area. The Operational Measurement Indicators that agencies create should be determined by referencing the End Outcome indicators identified in the DOI Strategic Plan. A Measure must fit within the three Measurement Categories of the Mission and Business Results Measurement Area of the PRM. These categories are Services for Citizens, Support Delivery of Services, and Management of Government Resources. This Measurement Area aligns with Measurement Areas described in the Business Reference Model Version 2.0.
Investment project	The INVESTMENT-PROJECT model object captures both information- technology-related investment and project information. An IT Investment represents a special type of capital project (or investment). An Investment for an IT project has a corresponding Exhibit 300 and is represented by a summary line on an Exhibit 53. A Program may sponsor many Investments, but an Investment may only have one sponsoring Program. Many Programs, however, may support an Investment by contributing funds, and a Program may support many Investments.
line of sight	Line of Sight—the indirect or direct cause-and-effect relationship from a specific IT investment to the processes it supports, and by extension, the customers it serves and the mission-related outcomes it contributes to.
line-of-business	An FEA BRM Line of business. The LINE-OF-BUSINESS inherits attributes from BRM-TIER. The complete As-Is DOI Business Architecture for the following business areas: Fire Management, Law Enforcement, Finance, Recreation etc….
metadata	Metadata—data about data (ISO 19115:2003(E)).
mission area	This is the goal level used in bureau and office plans, sometimes referred to as the mission goal level in bureau plans. This level is not directly measurable. Interior crosswalks budget activities to the GPRA program activity level.
orthoimage	Orthoimage—a georeferenced image prepared from a perspective photograph or other remotely-sensed data in which displacement of objects due to sensor orientation and terrain relief have been removed. It has the geometric characteristics of a map and the image qualities of a photograph.
orthorectification	Orthorectification—the process of transforming raw imagery to an accurate orthogonal projection. Without orthorectification, scale is not constant in the image and accurate measurements of distance and direction cannot be made.
patterns	Patterns—unique combinations of architectural or design elements (e.g. processes, components, etc.) that have proven to be useful in solving recurring architectural or design problems. The naming and reuse of patterns forms the basis of a vocabulary for communicating past experience between architects and designers. (FEA Enterprise Architecture Glossary Of Terms).
product specification	Product Specification—description of a universe of discourse and a specification for mapping the universe of discourse to a dataset (ISO 19113:2002(E)).
register	Register—set of files containing identifiers assigned to items with descriptions of the associated items (ISO 19135:2005(E), adapted from ISO/IEC 11179).

Name	Description
registry	Registry—information system on which a register is maintained (ISO 19135:2005(E), adapted from ISO/IEC 11179).
service	Service—1) a specific type of component that is explicitly intended to be shared and reused by multiple applications, either internal or external to the organization (FEA Enterprise Architecture Glossary Of Terms), or 2) distinct part of the functionality that is provided by an entity through interfaces (ISO19119:2005 (E)).
service component	Service Component—Modularized service-based applications that package and process together service interfaces with associated business logic into a single cohesive conceptual module. Aim of a Service Component is to raise the level of abstraction in software services by modularizing synthesized service functionality and by facilitating service reuse, service extension, specialization, and service inheritance. See also Component and Service.
service-component	The final layer of the SRM is the Component level. These 168 Components represent the lower-level, logical "building blocks" of a business or application.
service-domain	The Customer Services Domain defines the set of capabilities that are directly related to an internal or external customer, the business¦ interaction with the customer, and the customer-driven activities or functions [REF: FEA_SRM_Release1.0].
service-oriented architecture (SOA)	Service-Oriented Architecture (SOA)— a way of designing a system to provide services to either end-user applications or other services through published and discoverable interfaces. In many cases, services offer a better way to expose discrete business functions, and therefore, an excellent way to develop applications that support business processes. (FEA Enterprise Architecture Glossary Of Terms).
shared service	Shared service—a form of "internal outsourcing," enables corporations to achieve economies of scale by creating a separate internal entity within the company to perform specific services, such as payroll, accounts payable, travel and expense processing. A typical shared services initiative takes advantage of enterprise applications and other technological developments, enabling the company to achieve further improvements to quality in processes, such as finance, accounting, procurement, IT, and human resources. At the core of shared services is the idea that new technologies offer businesses the opportunity to 1) make better use of scarce skills, 2) provide information and services more efficiently, and 3) reduce the cost of administration. See also Service. (FEA Enterprise Architecture Glossary Of Terms).
sub-function	An FEA BRM Business SubFunction. SUB-FUNCTION inherits attributes from BRM-TIER.
subsystem	Subsystems are used to refer to groups of applications or components that form part of the system. A subsystem is a logical organization for a solution and is not directly deployed on the technology infrastructure.
sys-comp/deployment-instance	This associative entity will be implemented as a matrix (or other means to be determined) in system architect to resolve the many-to-many relationship between PROCESSING NODE and SYSTEM-COMPONENT. It describes how a SYSTEM-COMPONENT is deployed on X,Y,ZPROCESSING-NODES— When, How, and the Architecture Tier (Web, Network, Application, Database).
system	Any organized assembly of resources and procedures united and regulated by interaction or interdependence to accomplish a set of specific functions. [JP1] An IT system is a combination of hardware, software, and documentation that implements and describes a solution. A system is the top-level organization for a solution and is not directly deployed on the technology infrastructure.

Name	Description
System component	System components are used to describe the constituent bits of functionality from which the system has been assembled. A system component has the following three characteristics: 1) It is a modular unit of functionality; 2) It is logically isolated from other system components by making its functionality available through defined programming interface boundaries and may use other component interfaces; and 3) It is associated with a processing node and is actually deployed on the technical infrastructure (as opposed to systems and subsystems, which are containers or collections that are not directly associated with a processing node).