

August 18, 2009

To: National Geospatial Advisory Committee

From: NGAC Governance Subcommittee

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Subject: Draft Proposal to Measure Progress Toward Realizing the NSDI Vision

Date: August 19, 2009

### **EXECUTIVE SUMMARY**

*What cannot be measured cannot be managed. As such, the US National Spatial Data Infrastructure (NSDI) is not being managed. Drawing upon the guidance provided by the Executive Office of the President for the establishment of the NSDI decades ago, this document offers a discussion of the categories of metrics that should be maintained by the Federal Government, as well as detailed example metrics for each category.*

*This document was authored by the Governance Subcommittee of the National Geospatial Advisory Committee in the hope of institutionalizing such metrics within the US Federal bureaucracy, and bringing Congressional oversight to the achievement (or lack thereof) of specific, well defined, metrics-driven goals. As national focus is shone on these metrics-driven goals, we as a Nation will be forced to adapt our institutions as necessary, in order to achieve the desired operation and governance of the NSDI, which is an essential component underpinning the achievement of our nation's highest priority goals.*

*In reading this document, one will observe that the proposed measures are National in scope, and not merely Federal. In this day and age, national capabilities (where NSDI is cross cutting) are not just the result of Federal decision-making or investment. They are the result of a complex interaction between various levels of government, many complementary aspects of industry, a vast array of academic and research institutions, the non-profit sector, and consortiums/associations that span all these categories. The metrics discussion in this document strains to encompass this complexity, and to harness it in the service of a better managed - indeed, better governed NSDI.*

## **1) PREFACE:**

The purpose of this paper is to propose an initial scope and discussion format for the NGAC Governance Subcommittee to facilitate development of a set of formal metrics to be applied to the development of the National Spatial Data Infrastructure. The Subcommittee believes that implementation of a system of metrics, such as offered below, is necessary to calibrate the effectiveness of national efforts to:

- a) Organize and quantify geospatial resources needed to underwrite prescribed Federal programs and activities.
- b) Assess the efficiency of structural and procedural approaches designed to deliver vital national services to the public as defined initially by the various stakeholder and citizen requirements cited in the original 1990 version of OMB Circular A-16 and related executive orders.

Since 1990, and continuing with increasing significance during the years since the 2002 revision of OMB Circular A-16, many technology and societal developments have occurred which have contributed to effecting substantial changes in the government, social and technological environment of the NSDI, as well as the realities which the FGDC must face in exercising its mandate to act as the interagency coordinating body for NSDI-related activities. The NGAC Governance Subcommittee is acutely aware of and motivated by the nature of the ambient changes which have occurred in society during the last two decades, and judges it to be its responsibility to premise its commentary on a reasonable and sympathetic assessment of the impact of such changes on both the NSDI and the FGDC organization.

Also, the Subcommittee understands that it is tasked with evaluating the effectiveness of the Federal government's approach to addressing the collection of issues traditionally adduced to the definition of the "NSDI" in accordance with the revised OMB Circular A-16 and incorporated Executive Order 12906. The Subcommittee, therefore, proposes to define a series of key metrics through which to measure organizational and technical characteristics of the current system that if not addressed will compromise the nation's ability to fully realize the vision of the NSDI. In this context, the Subcommittee believes its primary responsibility is to focus on a measurement approach designed to identify and address issues of immediate concern with respect to FGDC operation, but that in so doing it will

evoke issues of broad strategic significance to the Federal government, issues that may justifiably require involvement of higher level Federal authority to successfully address. In this latter case, we interpret the Subcommittee's role to be informational only, and not intended to suggest organizational or process modifications beyond the Committee's overall mandate.

Nevertheless, the need to differentiate issues that fall within the scope of the NGAC from issues of government-wide organizational concern is complicated by the unavoidable fact that any metrics pertinent to measuring the success of "today's" NSDI development must by definition be driven by complex multidisciplinary challenges which were not well-defined in the initial period of NSDI/FGDC conception, and, therefore, not prominent in the minds of policy planners concerned for the most part with the emerging significance of geospatial data. Such issues are now of overriding concern across the majority of departments of the Federal government, as well as throughout the various FGDC stakeholder organizations at the state, tribal and local levels of government and in the private sector. As discussed in both NGAC and its Governance Subcommittee contexts, these issues will in the future certainly demand the coordination of broad public and private sector response requiring both statutory support in Congress as well as coordination at the highest levels of the Executive Branch. Subcommittee discussion of these issues, colored by knowledge of the over-riding authority required to manage them, will of course be prominent in our thinking and proportionate metrics suggested as possible.

The final output of the Governance Subcommittee for this first, two-year term of NGAC operations will include:

- 1) A finished paper defining the NSDI metric system, a first approximation represented herein, including analytical objectives implied by these metrics.
- 2) An implementation plan for the formal application of metrics to the NSDI development process.
- 3) A set of presentation slides representing the Subcommittee's full report to be presented at the December NGAC meeting, assuming the full Committee authorizes continued development of the Subcommittee's proposal.

## **2) VISION AND MISSION FOR THE GOVERNANCE SUBCOMMITTEE WITHIN THE FRAMEWORK OF THE NGAC:**

### A) Vision:

The Governance Subcommittee envisions the enduring benefits of effective coordination of interest groups and stakeholders in the development of an effective NSDI – an NSDI that provides all citizens

ready access to society's rich, multi-source geospatial data and technology assets, and promotes and leverages interdisciplinary techniques needed to address the increasingly complex natural and societal challenges facing the nation.

B) Mission:

To provide guidelines for defining the measurable scope of NSDI governance by analyzing high-level policy directives to formulate actionable performance objectives susceptible of evaluation with respect to achieving the NSDI Vision. This activity will define the components of the NSDI to be measured, and help set in motion a repeatable procedure for measuring and reporting progress.

There are strategic challenges profoundly dependant on access to and use of a wide variety of geospatial data from many non-integratable sources for which a modern, technologically capable, network-based and interoperable NSDI is critically important, but which are not specifically defined and resourced to be addressable within the present scope of organized NSDI support processes. Current NSDI positioning with respect to such challenges must be evaluated with respect to modern-day capabilities by employing metrics that calibrate the effectiveness of FGDC policies, research and management practices in order to suggest possible modification of the FGDC process.

Strategic problems against which an NSDI must be measured include (at least) the following issues for which the US NSDI program is not currently organized. (See Palatiello article RE: [http://www.jmpa.us/documents/Geospatial\\_Demand\\_EIJ.pdf](http://www.jmpa.us/documents/Geospatial_Demand_EIJ.pdf))

- (1) Climate Change
- (2) Smart-Grid, Carbon Market Development & Energy
- (3) Health Care
- (4) Highways and Transportation
- (5) Mortgage Crisis / National Cadastre
- (6) Emergency Response/Emergency Management
- (7) Sustainable Development/High Performing Communities
- (8) Homeland & National Security & DHS Reauthorization

Technology challenges against which an NSDI must also be measured include the following issues which are not adequately resourced or addressed with sufficient regulatory authority to exercise supervisory control over the many Departments

and agencies of government which should be contributing to the coordinated build-out of NSDI capabilities.

- (1) Enforcement of Agency Responsibilities for Creating and Maintaining NSDI Framework Data Compliant with National Geospatial Standards
- (2) Geospatial Standards and Service Architecture Requirements (“the last mile”)
- (3) Impending Commercial & Public Interest Review of Geospatial Market Practices and Legal Framework
- (4) Cyber-infrastructure & Security

### **3) MAJOR THEMES OF NGAC GOVERNANCE SUBCOMMITTEE NSDI PERFORMANCE METRICS:**

It is the understanding of the Subcommittee that efforts are underway within the Geospatial Line of Business to define a set of measures and metrics that specifically pertain to progress on developing the A-16 framework datasets. We have not yet had the benefit of reviewing this work and therefore have not considered it in this draft. Additionally, we strongly feel that metrics must be developed that go above and beyond indicators of progress on dataset development, and have therefore established a set of measurement themes that address a more broad range of issues pertaining to the NSDI.

In this first approximation of NSDI metrics we have limited our exercise to five general measurement themes chosen to represent the range of issues and influences projected by the FGDC’s organization, development and outreach activities. Since this is a first draft and no precedent was available for guidance,, the committee chose to proceed on the basis of common sense and practical experience, offering up a heterogeneous collection of raw material to invite creative dialogue and consideration of organizational factors possibly more appropriate for accurate evaluation, at the same time mindful that establishing useful metrics for such institutional development must ultimately result from a comprehensive community-wide consensus process, These themes are as follows:

- i. Societal Metrics
- ii. NSDI Environment Statistics
- iii. Data Metrics
- iv. Technology Metrics
- v. Organizational/Governance Metrics

With this introduction in mind, the members of the NGAC Governance Subcommittee contributed to the following sections, each edited somewhat for consistency of format and depth, and ordered to conclude with a section on “governance” measures, but none meant to be absolute in its approach, and all inviting comment in anticipation of an editing process resulting in a formal proposal for the December meeting. As follows:

**A) Societal Metrics:**

Societal metrics are meant to determine the extent to which geospatial data and processing (the NSDI) have become part of the general information infrastructure and decision support process, as well as a resource for government business practices.

- 1) Do citizens understand and appreciate the value of geospatial information for use in their daily lives (e.g., in car navigation systems, web search)? For the benefit of government decision making (broadband mapping, mortgage crisis)?
- 2) Is geospatial data accessible to citizens, in a current, complete and accurate manner to make consumer decisions?
- 3) Is geospatial data accessible to businesses, in a current, complete and accurate manner to make investment, economic development, jobs creation decisions and to be leveraged for economic growth in the new economy?
- 4) Is geospatial data accessible to government decision-makers (Executive Branch), in a current, complete and accurate manner to make policy decisions?
- 5) Is geospatial data accessible to Congress (Legislative Branch), in a current, complete and accurate manner to make policy decisions?
- 6) Is geospatial data and information sufficiently integrated into the IT infrastructure to be a dependable, ubiquitous resource that citizens, businesses, or government can easily access to make consumer, investment or policy decisions?
- 7) Has the visualization of data, by means of geospatial techniques, become pervasive and so much a part of decision-making and

analytic processes, that its inclusion is a given, not requiring a thought or consideration?

- 8) Have the resources of the NSDI proved successful in the creation of academic curricula in elementary, secondary and higher education contexts.
- 9) Etc.,etc.

## **B) NSDI Environment Statistics:**

In order to evaluate progress in development of the NSDI, it is necessary to explore another sparsely researched area. Little has been published and systematically reviewed relating to the quantification of the “NSDI” that is perceived generally in the market or academia to adequately describe the full extent of NSDI activities or economic implications. One good reason for this debilitating situation is that there is little agreement across public and private sector organizations and the long list of “NSDI stakeholders” in the US as to exactly what constitutes an “NSDI”, a problem that is compounded by the fact that the term “NSDI” is used world-wide by dozens of states, political organizations and trade associations opportunistically to reflect local or idiosyncratic concepts, in general failing of consistency across national boundaries, regions and cultural groupings.

Revised OMB Circular A-16 delineates clear and useful guidelines for conceptualizing an NSDI concept, one that is loosely defined as a federally centered set of policies designed to coordinate the nation’s various federal, local, tribal and private sector activities relating to the creation and use of spatial information. As a model for abstract policy development A-16 is spare and elegant, and has had a profound influence on global efforts to establish a consistent approach to dealing with geospatial issues. However, many of the essential concepts addressed by A-16 are not only abstract, but dynamic, and reflect the ad hoc nature of development of geospatial resources and practices in public sector organizations as well as throughout the private sector. As a result, the NSDI in reality reflects only a tenuous relationship between policy and accepted practice, and remains, despite the disciplined and professional leadership efforts of the FGDC, unquantifiable and, except in the area of federally mandated and funded data development programs, regulated only by an informal network of trade associations and voluntary consensus standards organizations. Moreover, neither A-16 nor Executive Order 12906 provide a definition of roles and responsibilities for

differing sectors and stakeholders (government or private sector) in the geospatial community, thus exacerbating confusion, conflict and inefficient duplication. This also contributes to the inability of the geospatial community to mobilize as a cohesive advocate for sound public policy,

The Governance Subcommittee has not formally surveyed the body of literature that may be assumed to have been developed by the various stakeholder groups relative to both definition and quantification of aspects of NSDI activity and resulting public and private sector development. Undoubtedly such a survey will be required in order to formalize the Subcommittee's assessment of the success of NSDI development efforts. However, the members of the Subcommittee, drawing collectively from significant personal experience with geospatial programs, agreed upon the apparent lack of quantification of NSDI-related developments, and the need to define a context for further discussion by including within its recommendation of NSDI metrics an initial list of quantification requirements.

Consistent with the Subcommittee's premise that "we can't manage what we can't measure", it is necessary to compile information relating to the frequency of data collection necessary to support the assessment of metrics, identification of organizations responsible for data collection and related project areas, and information or conditions resulting, for example, from the following actions:

- 1) Definition of the geospatial market by means of a formal market study focused on parameters reflecting NGAC consensus.
- 2) Quantification of the Federal geospatial market in conjunction with Geospatial Line of Business research activity, with specific emphasis on determining the magnitude and scope of Federal government spending.
- 4) Establishment of a NAICS Code for geospatial
- 6) Establishment or a Small Business Administration "size standard" or definition of small business in the geospatial field
- 7) Quantification of federal grant money for geospatial-related activity directed toward state, local government, NGOs, and universities.

- 8) Quantification of the federal geospatial workforce, qualified by a structured definition of geospatial jobs and projects, and differentiated from contractor participation or management of federal geospatial projects.
- 9) Quantification of the overall US geospatial workforce, qualified, as much as possible, by the same definitions used in relation to the Federal workforce.
- 10) Quantification of Federal government spending on geospatial workforce development, including information concerning geographical distribution of spending and the nature of projects.
- 11) Quantification of Federal government spending on geospatial research and how that research contributes to a strategic research agenda to meet market needs.
- 13) Quantification of the aforementioned data points at the state, regional, local and tribal levels, as applicable, in order to capture a full and complete picture of the geospatial market and other factors related thereto.

### **C) Data Metrics:**

We do not have data oriented metrics to benchmark success in building the NSDI. Such metrics may relate to the currency, completeness (which may include interoperability & metadata), scale/resolution, or accessibility of the data. As such, it is difficult to marshal any evidence of progress toward the initial completion, or the ongoing maintenance, of the seven framework datasets (e.g., Geodetic Control, Elevation, Orthoimagery, Transportation, Hydrography, Governmental Units, Cadastre). The same holds true for the other layers called out specifically in Appendix E of OMB Circular A-16. (\*= Framework Layer)

- 1) Baseline (Maritime): Co-leaders: DOC, NOAA and DOI, Minerals Management Service (MMS)
- 2) Biological Resources: DOI, U.S. Geological Survey (USGS)
- 3) \*Cadastral: DOI, Bureau of Land Management (BLM)
- 4) \*Cadastral (Offshore): DOI, MMS

- 5) Climate: Co-leaders, Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) and DOC, NOAA
- 6) Cultural and Demographic Statistics: DOC, U.S. Census Bureau (USCB)
- 7) Cultural Resources: DOI, National Park Service
- 8) \*Digital Ortho Imagery: DOI, USGS
- 9) Earth Cover: DOI, USGS
- 10) \*Elevation Bathymetric: Co-leaders: DOC, NOAA (U.S. waters outside channels) and US Army Corps of Engineers (USACE) (inland waterways)
- 11) \*Elevation Terrestrial: DOI, USGS
- 12) Buildings and Facilities: General Services Administration
- 13) Federal Land Ownership Status: DOI, BLM
- 14) Flood Hazards: Federal Emergency Management Agency
- 15) \*Geodetic Control: DOC, NOAA
- 16) Geographic Names: DOI, USGS
- 17) Geologic: DOI, USGS
- 18) \*Governmental Units: DOC, USCB
- 19) Housing: Department of Housing and Urban Development (HUD)
- 20) \*Hydrography: DOI, USGS
- 21) International Boundaries: Department of State
- 22) Law Enforcement Statistics: Department of Justice
- 23) Marine Boundaries: Co-leaders: DOC, NOAA and DOI, MMS
- 24) Offshore Minerals: DOI, MMS
- 25) Outer Continental Shelf Submerged Lands: DOI, MMS
- 26) Public Health: Department of Health and Human Services
- 27) Public Land Conveyance (patent) Records: DOI, BLM
- 28) Shoreline: DOC, NOAA
- 29) Soils: USDA, NRCS
- 30) \*Transportation: Department of Transportation, Bureau of Transportation Statistics
- 31) Transportation (Marine): USACE
- 32) Vegetation: USDA, U.S. Forest Service
- 33) Watershed Boundaries: Co-leaders: DOI, USGS and USDA, NRCS
- 34) Wetlands: DOI, Fish and Wildlife Service

As metrics do not exist for the currency, completeness, scale/resolution, or accessibility of these data layers, there is currently absolutely no hope

of achieving or defending sustainable funding or to ensure continued relevance of these data collection programs to changing stakeholder business needs.

For each of these datasets, a dashboard view should be created that provides information on progress towards completion of datasets that are not yet finished, as well as information on project plans and schedules for making these critical datasets available as a part of the NSDI. The new OMB IT Dashboard provides a unique opportunity to build these key metrics and present them in a way that is consistent with other IT investment tracking going on in the Federal government.

It is important to note that locally collected and maintained datasets as well as commercially available datasets are a core component of framework datasets (as well as the other A-16 data layers), and no one in the federal government is keeping an inventory of these data sources such that metrics could be gathered.

#### **D) Technology Metrics:**

While many technical aspects of the NSDI could be measured, it is perhaps most critical to measure that aspect which most directly contributes to the open exchange of geospatial data – the web services through which data is published for use by any federal, state, local, tribal, non-governmental, or commercial application. And, in accordance with the work that has been done in support of the Federal Enterprise Architecture Geospatial Profile, the metrics (below) focus on the use of international, industry-driven, government-sponsored, consensus-based, interoperability standards that have been developed by Standards Development Organizations (SDO) such as the International Organization for Standards (ISO) and the Open Geospatial Consortium (OGC) in coordination with bodies such as the Organization for the Advancement of Structured Information Standards (OASIS), the World Wide Web Consortium (W3C), the Internet Engineering Task Force (IETF), and the like.

In this context, it seems that a measure of NSDI technology success is the degree of compliance with respect to the following:

- 1) Names of datasets, Service URLs of, and percentage of public datasets available for public consumption via OGC WMS (e.g. picture)
- 2) Names of datasets, Service URLs of, and percentage of public datasets available for public consumption via OGC WFS or WCS (e.g., data). Specify output formats available by service offering.
- 3) Names of sensor networks, Service URLs of, and percentage of public sensor networks available for public consumption via OGC SOS (e.g., data)
- 4) Names of sensor networks, Service URLs of, and percentage of public sensor networks available for tasking via OGC SPS (e.g., tasking interface)
- 5) Names of datasets, Service URLs of, and percentage of commercial proprietary datasets available for public consumption via OGC WMS (e.g., picture)
- 6) Names of datasets, Service URLs of, and percentage of commercial proprietary datasets available for public consumption via OGC WFS or WCS (e.g., picture). Specify output formats available by service offering.
- 7) Names of sensor networks, Service URLs of, and percentage of commercial proprietary sensor networks available for public consumption via OGC SOS (e.g., data)
- 8) Names of catalogs, Service URLs of, and percentage of public Catalogs available for public consumption via OGC CS-W (e.g., discovery)
- 9) Names of catalogs, Service URLs of, and percentage of commercial proprietary Catalogs available for public consumptions via OGC CS-W (e.g., discovery)
- 10) Of these services, which, how many, and what percentage of them offer industrial grade availability (for instance 99.99%, 24x7 uptime). Specify degree of uptime.

- 11) Using these metrics, what percentage of NSDI framework datasets have relevant OGC services available (WxS)

### **E) Organizational/Governance metrics:**

The following statements are offered as proposed objectives to be achieved when the NSDI vision is fully realized. Once agreement is reached on the desired objectives for the fully operational NSDI, metrics will be defined to measure progress toward their achievement, possibly more than one metric for some objectives:

- 1) Policy makers understand the value of GIS & technology as an essential business tool and information and communication infrastructure, and recognize the importance of the NSDI to formulating a comprehensive assessment of the nation's strategic information requirements.
- 2) The roles and responsibilities of various sectors and stakeholders (government or private sector) in the geospatial community are well defined, understood and respected/honored, in order to eliminate or minimize confusion, conflict and inefficient duplication, as well as to enable the community to mobilize as a cohesive advocate for sound public policy
- 3) National information infrastructure policy demonstrates recognition of the essential requirement to invest in the implementation of diverse "public-private partnerships" with geospatial stakeholder organizations, commercial enterprises, and research institutions to meet the program objectives of NSDI development.
- 4) Wide spread partnerships exist between government and non-government interests to improve cost effectiveness of solutions to shared geospatial needs
- 5) Within the coordinated framework of the nation's IT strategy and the NSDI, elected officials and senior administrators demonstrably promote the economies enabled by inter-agency collaboration in addressing major societal problems requiring shared geospatial resources.

- 6) Multi-jurisdiction collaborative relationships fundamental to implementation of the NSDI vision, at local, regional and national levels, are organized and supported by implementation of a demonstrably effective national conflict resolution policy.
- 7) Cross sector "service level agreements" are effectively managed (e.g. web service dependencies) and co-developed with CIOs and the IT and business communities. (Adherence to standards and best practices could also accomplish this with actual SLAs. The thousands of SLAs that might be needed would get impractical to manage.)
- 8) Is there a process in place for decisions and priorities to be based on both local and national needs and issues.
- 9) Are multiple organizations (or an encompassing national council) participating in the support of on-going "foster collaboration" costs (e.g., cross sector needs assessment, defining solutions, monitoring effectiveness)
- 10) The public value that could be realized if a geospatial commons exists, is understood and is the norm for framework data – consists of data resources of adjoining jurisdictions in place at the regional level and are components of national solutions to the same information needs.
- 11) Interdisciplinary, cross-sector know-how is fully leveraged to address a broad range of problems challenging society.
- 12) Multi-county (regional) geospatial collaborations are fully integrated into their respective state SDI and the NDSI, and function as an operational component of each, as if a virtual enterprise
- 13) As per OMB Circular A16, is the federal enterprise completely and effectively collaborating with other major stakeholders to collectively provide coordinated national leadership toward a commonly supported vision

- 14) Is a federal entity effectively coordinating federal agency activities as defined in OMB Circular A-16
- 15) As per OMB Circular A16, are strategy, standards, data models, “complete” guidance, and best practices in place for implementation by willing organizations with sufficient resources guided by NSDI leadership.
- 16) ***ADD Roles and Responsibilities Statement -- see Appendix, Item g(i)***

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DRAFT

## APPENDIX

### CHARACTERISTICS OF A “NATIONAL” STRUCTURE: REALIZING THE NSDI VISION

- 1) NSDI policy effectively promotes synergistic relationships among membership organizations representing traditional interest groups that provide essential organization, communication and leadership services positioned to structure the geospatial market domain, e.g. FGDC, NSGIC, NACo, MAPPS, OGC, GITA, URISA, USGIF, etc.
- 2) The roles and responsibilities of various sectors and stakeholders (government or private sector) in the geospatial community in the NSDI are well defined, understood and respected/honored, in order to eliminate or minimize confusion, conflict and inefficient duplication, as well as to enable the community to mobilize as a cohesive advocate for sound public policy.
- 3) National policy enacted that reflects and encourages the pursuit of the public value that can be created if the vision (vision proposed by the NGAC’s vision and corroborated by the community) of the NSDI is realized.
- 4) A new organizational structure must be created, as no existing organization has a business need that encompasses the breath of scope and stakeholders needed to achieve the vision of the NSDI.
- 5) The proposed national governance mechanism must be trusted and have the authority to achieve and maintain agreement (and adjudicate differences through consensus-based processes) across sectors on policies and procedures, funding, shared information needs, action to address these needs, and daily management of the NSDI as if a national, virtual enterprise.
  - a) The scope, membership, and funding for the organization is established through legislation.
  - b) The national governance process is understood, documented, and accessible to the entire professional geospatial community and users.

- c) All affected and relevant stakeholder interests (local, regional, state, tribal and federal government interests together with non-government interests) to decide policy collectively, with no interest dominating.
- d) Incentives for participation must be articulated.
- e) The model must include communications mechanisms and feedback loops.
- f) States and tribal governments to serve as the primary organizational focuses, recognizing that state laws govern those interests with jurisdiction within each state.
- g) Day-to-day operations of the component elements of the NSDI are “networked” to ensure effective communication between those charged with making policy and those who have accepted responsibility to manage the operations of the many components that comprise the NSDI. In other words, the structure ensures active stakeholder participation in the management of nationally significant geospatial assets. This characteristic assumes:
  - i. Roles and responsibilities for all components (data, services, applications, etc.) are well articulated.
  - ii. Willing organizations, with sufficient resources, have assumed defined roles and responsibilities for each NSDI component (custodians)

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