To: National Geospatial Advisory Committee

From: NGAC Governance Subcommittee
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Subject: Proposal to Measure Progress Toward Realizing the NSDI Vision

Date: November 18, 2009

EXECUTIVE SUMMARY

What cannot be defined cannot be measured, and what cannot be measured cannot be managed. Drawing upon motivational concepts expressed by the Executive Office of the President relating to establishment of the NSDI decades ago, this document effectively encourages a more precise definition of the NSDI and related governance structures by proposing and populating five categories of potential metrics selected to imply both concrete operational objectives and the requirement for effective and quantifiable management practices on the part of the Federal Government in concert with its partners in the geospatial community.

This document was authored by the Governance Subcommittee of the National Geospatial Advisory Committee for the purpose of institutionalizing such metrics within the Federal government, as well as the broader NSDI enterprise. When fully populated and implemented, these metrics will enable oversight and measurement of progress toward achievement of well defined and prioritized objectives.

The initial categories of metrics selected by the committee address many aspects of the NSDI beyond its original data-centric definition: 1) societal metrics intended to determine the extent to which geospatial data, processing and applications have become part of the general information infrastructure and decision support process; 2) environmental measures which describe the full extent of geospatial activities and their economic implications; 3) data metrics providing evidence of progress toward the initial completion or the ongoing maintenance of framework data layers at a minimum; 4) technology metrics for the fitness and quality of the underlying technology infrastructure in use across relevant organizations; and 5) governance metrics to measure progress toward the realization of a national governance structure for the NSDI.

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 simply 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 private practice, a vast array of academic and research institutions, the non-profit sector, and both consortia and associations that span all these categories. The metrics discussion in this document endeavors to encompass this complexity, and to harness it in support of defining and implementing a better governed, fully realized and more effective NSDI.*

1) PREFACE:

The Subcommittee 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 "National Spatial Data Infrastructure" in accordance with the revised OMB Circular A-16 and incorporated Executive Order 12906. The Subcommittee, therefore, proposes to define an illustrative series of key metrics by 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 current NSDI development efforts. In so doing, the Subcommittee understands that its approach may evoke issues of broad strategic significance to the Federal government, issues that may justifiably require involvement of higher level Federal authority to successfully address. However, the need to identify such issues is amply justified by the unavoidable fact that any metrics pertinent to measuring the success of "today's" NSDI development must by definition be driven by complex technology, commercial and policy challenges which were not well-defined in the initial period of NSDI/FGDC conception, and, therefore, not prominent in the minds of NSDI planners concerned primarily with the potential significance of geospatial data. Many of these issues we now find to be 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, regional, and local levels of government and in the private sector.

The NGAC Governance Subcommittee believes that implementation of a system of metrics, as offered below, is necessary to determine the effectiveness of national efforts to:

a) 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.

b) Organize and quantify geospatial resources needed to underwrite prescribed national geospatial programs and activities at all levels of government.

c) Realize the vision of a truly ***National*** Spatial Data Infrastructure where the roles and responsibilities of all partners inside and outside the government are well understood and parties are held accountable for results.

That such an exercise is essential at this point is clear, and thought to be necessary to assure the improvement and continuing relevance of federal NSDI development operations with respect to rapidly changing public and private sector realities.

In addressing the issue of NSDI metrics, the NGAC Governance Subcommittee has been acutely aware of and motivated by the changing nature of the technology environment that has characterized the social process during the last two decades, and to a great extent premises its commentary on a realistic assessment of the impact and potential consequences of such change on both the NSDI and the FGDC organization. Since 1990, and continuing with increasing significance during the years since the 2002 revision of OMB Circular A-16, many technological and societal developments have occurred which have contributed to effecting substantial changes in government process and information requirements, and, by implication, the realities that the FGDC must face in exercising its mandate to act as the interagency coordinating body for NSDI-related activities. To illustrate the relative urgency of the situation it is useful to begin by examining some of these realities and their constraining effect on NSDI development.

An issue of great significance in this regard, and one that most clearly illustrates the unresolved barriers to NSDI development efforts is the currently escalating private sector capacity to amass and commercialize many forms of geospatial data formerly assumed to be accessible only from public sector sources and funded through public sector budgets. Increasingly the use of such "open market" commercial data is available at very low, or no cost, and much of it in real time, as instrumentation evolves to support the deployment of fine-grained and multi-dimensional sensor nets, and as increasing adoption of geospatial interoperability techniques speeds data fusion and complex model development. These changes are co-occurring with an explosion of open source, mash-up and crowd-sourcing activity. As a consequence, the concept of the NSDI becomes even more difficult to define, and with the growth in private sector geospatial activity, far more

difficult to coordinate, much less regulate with public sector policy at any level of government.

The stress created in the market in general, and in public sector planning and procurement operations in particular, cannot be overlooked. Of greatest interest to the NSDI developers should be the potential for commercial data sourcing to compete, even at the framework level, with authoritative federal data sets, in commercial as well as public sector applications. Until definitive national policy governing the sourcing and use of geospatial data materializes, the force of geospatial market development may tend to increase, creating a de facto "spatial infrastructure" which, like present financial industry and health care practices, could continue to advance with little consideration of Federal (i.e. FGDC) guidance.

The NSDI paradigm that most people have taken for granted could then possibly evolve into a very different, possibly non Federal-centric concept. The NSDI could indeed become for the nation a virtual resource, wired together by the web, and at its "statutory" core merely a collection of requirements statements and regulatory functions. And its focus could indeed be, as suggested by recent administration policy statements, the promotion and support of specifically targeted thematic or regional programs for which full national resources and extensive coordination is not needed, but which hold the potential, with successful implementation and Executive level support, to propagate as needed on a national scale.

It is interesting to note in this context that in August, 2009, the Executive Office of the President (the Directors of the Office of Management and Budget (OMB), the Domestic Policy Council, the Office of Urban Affairs, and the National Economic Council) in fact issued a guidance memorandum on developing effective place-based policies and instructed the heads of federal agencies to begin developing proposals in response to this guidance as part of the fiscal year 2011 budget process. Combined with the Obama Administration's establishment of a Chief Performance Office (CPO) in OMB, the need for metrics designed to clarify the objectives and measure the performance of the NSDI would seem to be imperative. Indeed, an item in the Washington Post (http://www.washingtonpost.com/wp-dyn/content/article/2009/01/07/AR2009010701842.html) noted, "When it comes to government performance, one of the best ways to improve it will be to improve the way we measure it."

With such possibilities in mind, it is more important than ever to ensure that a competent NSDI measurement structure is put in place, and that the resulting management potentials and authority implicit in FGDC's present positioning be realized. The environment of change described above is becoming increasingly

well defined and characterized by strong general interest in law and policy issues relating to novel forms of data generation, unprecedented distribution channels, ownership of data, accuracy, liabilities, intellectual property rights and liabilities. In this sense the market is not just evolving with technology drivers, but is also being shaped by incipient law and policy precedents sure to structure corporate business models and indirectly influence government procurement policy. These issues also become part of the measurement picture, and should be considered to bear the greatest relevance to NSDI governance.

At a policy level, the implications of these and other challenges hampering current NSDI efforts that the Subcommittee is motivated to address were in fact evident recently in several highly visible contexts: (1) When Congress and the Administration were developing an inventory of "shovel-ready" projects to fund for economic stimulus for what became the American Recovery and Reinvestment Act of 2009 (ARRA), the FGDC in particular and the geospatial community in general could produce neither a list of shovel ready geospatial projects nor a status on completion of any of the NSDI framework data layers, (2) Congress is considering climate change and potential "cap and trade' legislation, notwithstanding the fact that the nation lacks a set of geospatial data layers to measure, monitor, verify and validate the effects of climate change or to administer a cap and trade system. Moreover, such a system is absent in the legislation pending before Congress, and (3) the health care reform legislation currently before Congress creates a massive demand for geographic information (the House passed bill has more than 750 references to terms such as "geography", "place", "location", etc.), but establishment or use of a geographic information systems approach is absent in the legislation, as is the establishment of a coordinated geospatial management office (GMO) in the department of Health and Human Services (HHS). Clearly, there are significant national and societal needs for geospatial data, but the nation lacks the data or systems needed to successfully implement such major public policy initiatives.

It is the opinion of the Subcommittee that the application of appropriately defined metrics will identify the deficiencies in NSDI implementation to which such problems are attributable, and that resulting policy development will address the requirement for implementation of a national governance structure designed and funded to effectively preside over the coordination of all sectors (including, in particular, non-Federal stakeholders) in a shared, cooperative effort to realize the vision of the NSDI. (It should be noted in this regard that to facilitate development of performance metrics, the Subcommittee found it necessary to postulate the characteristics of such a national governance structure – these characteristics are listed in Appendix A.) When in final form, the example metrics that are offered

herein are intended to provide policy makers and managers with the information needed to close the gap between the current state of the NSDI and the desired end-state.

As discussed in both NGAC and its Governance Subcommittee contexts, achieving the desired end-state will demand the coordination of broad public and private sector response and may require 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, is prominent in our thinking.

Finally, the Governance Subcommittee intends that this white paper serve principally as a catalyst to achieve concurrence on key high-level attributes of a national structure for governance of the NDSI, and a system of metrics by which to measure and manage progress toward the desired end-state. Without end-state targets, measurement of progress is not possible.

Key attributes of a system of metrics for which the Subcommittee is seeking concurrence include:

- National in scope – all sectors actively engaged in the governance mechanism and measure of progress;
- High-level "end-state" characteristics of a national governance mechanism;
- Categorization of performance metrics according to five measurement themes; and,
- Appropriateness of topics covered by the example metrics cited.

Next steps would include defining a plan for vetting the high-level concepts among critical (national) stakeholder organizations, refining the example metrics and defining candidates for support responsibility (again national not federal), recommending an implementation strategy, etc.

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; that promotes and leverages interdisciplinary techniques needed to address the increasingly complex natural and societal challenges facing the nation; and, that evolves to incorporate measurable process maturity objectives as geospatial

capabilities continue to influence the design and utility of enterprise information systems.

B) **Mission**:
To define the components of the NSDI to be measured; to provide guidance 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; and, to help set in motion a repeatable measurement and reporting procedure.

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 by employing metrics that calibrate the effectiveness of FGDC policies, research and management practices to address related requirements.

Strategic challenges include (at least) the following:

(1) Climate Change
(2) Energy (to include Smart-Grid and Carbon Market Development)
(3) Health Care
(4) Intermodal Transportation
(5) Housing and Cadastre (to include the Mortgage Crisis)
(6) Emergency Response/Emergency Management
(7) Environment and Sustainable Development/High Performing Communities
(8) Homeland & National Security

(See http://www.jmpa.us/documents/Geospatial_Demand_EIJ.pdf, article by John Palatiello, member of the Subcommittee and Executive Director of MAPPS.)

Technology challenges against which an NSDI must also be measured, which are not adequately resourced or addressed with sufficient regulatory authority to exercise supervisory control over the many departments and agencies of government that should be contributing to the coordinated build-out of NSDI capabilities, include the following:

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 and public interest review of geospatial market practices and legal framework.

3) MAJOR THEMES OF PROPOSED 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 performance 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 there is no precedent available for guidance, the Subcommittee chose to proceed on the basis of common sense and practical experience. The following proposal offers a heterogeneous collection of raw material to invite creative dialogue and consideration of organizational factors important to useful evaluation. In doing so, the Subcommittee is also mindful that establishing useful performance metrics for such institutional development must ultimately result from a comprehensive community-wide consensus process. The five suggested metric themes are as follows:

A) Societal Metrics
B) NSDI Environment Statistics
C) Data Metrics
D) Technology Metrics
E) Organizational/Governance Metrics

With this introduction in mind, suggested metrics follow for each of the five themes, none meant to be absolute in its approach.

A) Societal Metrics:

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

decomposed into survey questions, with responses on a Leichhardt-type scale **(**e.g., 1-5 or 1-10).

1) How aware are citizens of the value of geospatial information for use in their daily lives (e.g., in car navigation systems, web search)? How aware are citizens of the value of geospatial information for good government decision making (broadband mapping, mortgage crisis)?

2) How easily can citizens discover, browse and access current, complete and accurate geospatial datasets and geo-enabled business data, (whether local, regional, state, tribal, Federal, academic, commercial)?

3) To what extent are do private sector investors and public sector economic development officials have access to the local, regional, state, tribal, and Federal geospatial datasets, or geo-enabled business data, that they need to make:
   a) Investment, economic development, jobs creation decisions?
   b) Environmentally sustainable decisions?

4) To what extent can government decision makers (Executive Branch at all levels of government) quickly access and analyze the geospatial data and geo-enabled business data necessary to engage in place-based policy formulation, policy evaluation, programming and budgeting?

5) To what extent can legislators (at all levels of government) quickly access and analyze the geospatial data and geo-enabled business data necessary to engage in place-based policy formulation, policy evaluation, programming and budgeting?

6) To what extent can citizens, as they interface with all levels of government, quickly access and analyze the geospatial data and geo-enabled business data necessary to engage in place-based decision making that empowers their daily lives, and their ability to participate in the workings of government?

7) To what extent have NSDI online applications and geospatial data resources become embedded in academic curricula (e.g., elementary, secondary and higher education contexts.)?

8) To what extent does the NSDI contribute to the public benefit value chain?

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 geospatial activities or their 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, state, local, tribal, academic and private sector activities relating to the creation and use of spatial information. As a model for abstract policy development, A-16 is sparse 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 also 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, Executive Order 12906 provides inadequate 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. And, while A-16 and the recently developed A-16 Supplemental Guidance do define roles and responsibilities, it presumes an operational NSDI from a Federal rather than National perspective. This disconnect contributes to the inability of the geospatial community to mobilize as a cohesive advocate for sound public policy. The lack of a national operational perspective also inhibits the ability to effectively assist organizations in building their enterprise spatial data

infrastructures (SDI), which can become part of the larger fabric of the NSDI. This integration of SDI's across industries, local and regional governments, states and federal entities is fundamental to the maturation of the NSDI as a true National level resource.

The Governance Subcommittee has not formally surveyed the body of literature that is 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 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 on the NSDI environment 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 recommended by the NGAC and adopted by the FGDC.

2) Quantification of the Federal geospatial market, with specific emphasis on determining the magnitude and scope of Federal government spending, by Departments, Agencies and Bureaus.

3) Measurement of economic activity directly related to geospatial data and technology, or enabled by geospatial. At a minimum, this would involve the establishment of a comprehensive NAICS Code for geospatial, beyond references in NAICS 541370.

4) Measurement of small business activity directly related to geospatial data and technology, or enabled by geospatial. At a minimum, this would involve the establishment of a Small Business Administration "size standard" or definition of small business in the geospatial field

5) Quantification of Federal grant money for geospatial-related activity directed toward state, local government, NGOs, and universities.

6) 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.

7) Quantification of the overall US geospatial workforce, qualified, as much as possible, by the same definitions used in relation to the Federal workforce.

8) Quantification of Federal government spending on geospatial workforce development, including information concerning geographical distribution of spending and the nature of projects.

9) Quantification of Federal government spending on geospatial research and how that research contributes to a strategic research agenda to meet market needs.

10) 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.

11) Promotion of the use of a robust, mature set of general process integration methods, goals, best practices and specifications as part of measures of how well the different elements of an organization support the development of a mature policy and operational environment to meet mission and business requirements.

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, accessibility and archival requirements for different versions of 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, and 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 no hope of achieving or defending sustainable funding or to ensure continued relevance of these data collection and development programs to changing stakeholder business needs.

For each of these data themes, 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. NSDI dashboard elements should build on the work that has recently been completed in support of the National Map program, which contains metrics on progress and data lifecycle components for several NSDI framework datasets.

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 that at present there is no trusted mechanism for maintenance of an inventory and gathering of metrics for this vast set resources positioned to supplement federal programs. The FGDC and COGO should lead the geospatial community in development of processes necessary to maintain data metrics for these themes across all sectors.

D) Technology Metrics:

Data workflows, business processes, and relationships between all levels of government need to be documented, understood and utilized to develop and sustain the NSDI. Fundamental to all such process support of NSDI development is the fitness and quality of the underlying technology infrastructure in use across relevant organizations. While many technical aspects of the NSDI could be measured, it is perhaps most critical to measure aspects of that infrastructure which most directly contribute to the open exchange of geospatial data that it must facilitate – the web services through which data is published for use by any federal, state, local, tribal, non-governmental, or commercial application.

In accordance with the work that has been done in support of the Federal Enterprise Architecture Geospatial Profile, the metrics proposed 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) Names and Web Service URLs of datasets that are ONLY available through proprietary web service interfaces, or only available through web Graphical User Interfaces (GUI), and not otherwise available.

11) Of these services, which, how many, and what percentage of them offer industrial grade stability and availability (for instance 99.99%, 24x7 uptime)? Specify degree of uptime.

12) Of these services how many have versions permanently archived or preserved to ensure repeatability if necessary to meet the requirements of any future legal proceeding?

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

E) Organizational/Governance Metrics:

This exercise in the development of metrics is proposed to measure progress toward the realization of a national governance structure for the NSDI capable of effectively addressing the strategic problems outlined above. Some are binary (Y/N), and others meant to be scored on a Leichhardt-type scale **(**e.g., 1-5 or 1-10) by a broad crosscut of the NSDI community.

1) To what extent do policy makers agree that geospatial data and technology are essential business tools for formulating a comprehensive assessment of the nation strategic posture with regard to major policy issues of the day? Are decision makers at all levels of government informed and engaged in supporting, defining, and using the NSDI?

2) Is there a strategy in place to promote and communicate the benefits of the NSDI? Have quantitative and qualitative successes been documented?

3) Does a national governance organization/entity exist which has authority to define and implement cross-sector agreements on policies, procedures, action, evaluation and management of a well-defined NSDI program? To what extent is it effective?

4) To what extent are roles, responsibilities and relationships clearly articulated with respect to each component of the NSDI (data, services, applications, etc.) for the purpose of mobilizing effective support for relevant public policy?

5) To what extent are the component NSDI roles and responsibilities supported (i.e. understood, respected and honored) by organizations with sufficient capacity? To what extent are these roles supported across relevant sectors and stakeholder organizations? To what extent are these custodial organizations maintaining harmonious cooperative relationships?

6) Is there an adequate national conflict resolution policy and structure in place to aid in the implementation of the NSDI vision using multi-jurisdictional, collaborative relationships across local, regional, state, and national interests? To what extent is it effective?

7) To what extent have diverse "public-private partnerships" with geospatial stakeholder organizations, commercial enterprises, and research institutions been harnessed to meet the program objectives of NSDI development in a cost effective manner?

8) To what extent have service level agreements been established between authoritative data stewards and the user communities that rely on their data to drive mission applications?

9) To what extent does the operation and governance of the NSDI take into account and prioritize both local and national needs?

10) To what extent has the NSDI enabled or empowered greater participation in public governance processes?

11) Have priorities been identified by means of the quantitative business planning of data steward agencies, state spatial data infrastructure strategic plans, and other activities on the part of NSDI stakeholders?

12) To what extent do the SDIs of local jurisdictions, states and regions function as interoperable enterprises, integrated as pieces of the NSDI? Do the strategic planning efforts of all fifty states focus in a similar way on public-private partnerships and governance structures within their geographical domains?

13) With reference to OMB Circular A16, how effectively is the Federal enterprise collaborating with other major stakeholders toward achieving a commonly supported vision?

14) How effectively is each Federal entity performing and coordinating its geospatial activities as defined in OMB Circular A-16 and the Supplemental Guidance document?

15) How effectively is the annual business case made to the Executive and Legislative branches of the Federal government demonstrating NSDI resource requirements for support of strategic national goals?

16) Is there a collaborative funding strategy in place that enables organizations using spatial information resources at all levels of government to coordinate opportunities and investments? Is Federal funding to a geography or activity contingent on compliance to such a strategy?

4) CONCLUSION

The collaboration of multiple, disparate organizations formed to address shared geospatial information needs is capable of creating significant value for both participants and society in general. Such collaboration, involving the disparate interests and combined efforts of local, regional, state, national and tribal organizations, defines the National Spatial Data Infrastructure, creating the framework for development of its many essential components, and providing the capacity for quantification and management of the nation's most vital natural, institutional and human resources.

The importance of a strong national governance model is therefore quite clear, one that is capable of effectively coordinating the activities of a highly federated system, characterized by disparate, cross-sector interests and functioning as a virtual enterprise. It is equally clear that such an enterprise cannot be managed effectively in the absence of a trusted methodology for monitoring and evaluating indicators of progress and efficiency, which also provides a sustained evaluation of both the strengths and weaknesses of the collaborative process itself.

It is in this context that the NGAC Governance Subcommittee proposes a series of performance metrics through which to measure progress toward realizing the vision of the NSDI. Further, it is the Subcommittee's hope that its measurement approach will catalyze a meaningful critique of present policy guidance and governance structures to the end that both funding levels and organizational

authority supporting the continued development of the NSDI are commensurate with its fundamental and defining importance to our society.

5) HIGH LEVEL IMPLEMENTATION STRATEGY

Once full NGAC agreement is reached on desired NDSI performance measures and related high-level concepts, a detailed implementation plan would be pursued. In general, the suggested metrics implementation strategy would involve several national organizations working in concert with a lead Federal agency to broadly administer surveys across numerous constituencies in a standardized manner. The frequency of administration would be driven by the content of the measures. Surveying on an annual basis is anticipated to be required for a subset of the measures, with a repeating cycle of 3-5 years for all measures. The lead Federal agency would compile the results and report them to the overseer of national geospatial policy. That entity would be responsible for fostering policy and operational changes as required to accomplish and sustain performance targets.

6) RECOMMENDED NEXT STEPS

The NGAC Governance Subcommittee hereby respectfully requests:

A) Endorsement by the full NGAC at its December 2009 meeting of the high-level characteristics presented in this Phase I paper regarding a national governance mechanism for the NSDI and a system of metrics to measure progress toward the desired "end-state".

B) Authorization to immediately begin building upon this Phase I deliverable to:
   a. Define a plan for vetting the high-level concepts (organizational and performance measurement) described herein among critical (national) stakeholder organizations.
   b. Define an operational national governance structure and recommend an implementation strategy.
   c. Refine the example metrics, define candidates for support responsibility (national not federal) and recommend an implementation strategy.

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APPENDIX A

CHARACTERISTICS OF A "NATIONAL" STRUCTURE: REALIZING THE NSDI VISION

To motivate understanding of the sort of generic attributes of an "end-state" that might be envisioned as a result of applying and acting on the set of metrics devised by the sub-committee, we provide, as an example, the following partial policy and governance profile of an evolved NSDI program. In so doing, our intention is not to preempt an evaluation process, but to be informative, and to illustrate the kind of synthesis and reporting implied by the use of such metrics.

What follows is a list of attributes of the NSDI that represent the sub-committee's application of its metrics to a selection of parameters of NSDI development, and projection of the results of an ensuing evaluation:

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) of the NSDI are well defined, understood and respected, with the result that confusion, conflict and inefficient duplication of effort are eliminated or minimized, and the community of NSDI stakeholders is mobilized as a cohesive advocate for sound public policy.

3) National policy is adopted and resources allocated to enable active pursuit of the values inherent in the NSDI vision.

4) A high-level organizational structure is created, or evolves, to meet the business needs implied by the scope and stakeholders vision of the NSDI.

5) The resulting national governance mechanism must be trusted and have the authority to achieve and maintain agreement (i.e. adjudicate differences through consensus-based processes) among stakeholders and across sectors on policies and procedures, funding, shared information needs, action to address these needs, and daily management of the NSDI as a mandated virtual enterprise.

a) The scope, membership, and funding for the organization should be established through an informed legislative process.

b) The national governance process should be understood, documented, and accessible to the entire community of geospatial professionals and users.

c) All affected and relevant stakeholder interests (local, regional, state, tribal and Federal government interests together with non-government interests) should be represented in an organization positioned to become the trusted authority for determining policy and resource requirements on behalf of NSDI development, and have the standing to represent NSDI interests to both congress and the administration.

d) Incentives for participation must be articulated.

e) The model must include communications mechanisms and feedback loops.

f) States and tribal governments must become a primary organizational focus for development of collaborative methods and their legal implications, recognizing that state laws govern those geospatial information interests, and define the jurisdictional environment within each state.

g) Day-to-day operations of the component elements of the NSDI must be "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).