



GEOSPATIAL STANDARDS: A NATIONAL ASSET

A Report of the National Geospatial Advisory Committee
March 2017

Introduction

What is a standard?¹ A standard is established by consensus and provides rules, guidelines, or characteristics for activities or their results. Standards and conformity assessment impact almost every aspect of life in the U.S. and are essential to a sound national economy. Behind the scenes, standards make everyday life work. Standards may establish size or shape or capacity of a product, process or system. They define terms so that there is no misunderstanding among those implementing or using the standard. As examples, standards help ensure that a light bulb fits a socket, that you can withdraw money from any ATM in the world, and that plugs for electrical appliances fit outlets.

In the geospatial community, numerous companies, organizations, trade associations, consumer groups, and government agencies are actively developing standards. By being an active part of the process, these groups are providing ideas and enhanced services to their constituents and/or are gaining a tangible competitive advantage over their competitors. Geospatial Standards Development Organizations (SDOs)—and the experts who populate their committees—work to enhance quality of life and improve the competitiveness of U.S. businesses operating in the global marketplace.

Today, almost every agency of government has a need for geospatial standards. This is true whether as an element of the regulatory process, such as an environmental impact statement, or as part of emergency response, such as providing targeted logistical support.

Standards and related compliance programs help save money and improve performance, quality, safety, and reliability—whether we’re talking about the competitiveness of American industry or an agency’s procurement processes.

This NGAC position paper identifies awareness of the existence, relevance, and value of standards as a key issue impacting the adoption and use of geospatial standards. The paper also identifies other possible reasons for the lack of the effective use of geospatial standards. The paper includes an example of a successful model for the uptake of geospatial standards by the global community. Finally, the paper identifies recommendations for action by the Federal Geographic Data Committee (FGDC).

Who Develops Geospatial and Related Standards?

Most standards promoted and used in the geospatial community have originated from consensus agreements in voluntary consensus standards organizations, such as the Open Geospatial Consortium (OGC), the World Wide Web Consortium (W3C), Organization for the Advancement of Structured Information Standards (OASIS), and the Internet Engineering Task Force (IETF). Additional abstract standards have been defined and agreed upon in the ISO Technical Committee 211 (geomatics). There are common characteristics in how standards are developed, approved, and maintained through these organizations. These characteristics are well documented in Office of Management and Budget (OMB) Circular A-119 (“Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities”) and subsequent revisions.

OMB Circular A-119, originally released in 1998 and most recently updated in 2016, “establishes policies on Federal use and development of voluntary consensus standards and on conformity assessment activities.” From the Circular:

“Voluntary consensus standards bodies” are domestic or international organizations, which plan, develop, establish, or coordinate voluntary consensus standards using agreed-upon procedures. For purposes of this Circular, “voluntary, private sector, consensus standards bodies,” as cited in Act, is an equivalent term. The Act and the Circular encourage the participation of federal representatives in these bodies to increase the likelihood that the standards they develop will meet both public and private sector needs. A voluntary consensus standards body is defined by the following attributes:

- (i) Openness.
- (ii) Balance of interest.
- (iii) Due process.
- (vi) An appeals process.
- (v) Consensus, which is defined as general agreement, but not necessarily unanimity, and includes a process for attempting to resolve objections by interested parties, as long as all comments have been fairly considered, each objector is advised of the disposition of his or her objection(s) and the reasons why, and the consensus body members are given an opportunity to change their votes after reviewing the comments.”

Historically, a number of U.S. government organizations have also developed and promoted standards for use in the geospatial community. These organizations include the U.S. Department of Defense and the FGDC. Each of these organizations have their own internal policies and procedures for developing geospatial standards. However, over time these government organizations have been moving away from developing specific agency or organizational standards and more toward evaluating and approving standards for community use developed by voluntary consensus standards organizations, such as the OGC.

Barriers to Utilization of Standards

Many U.S. organizations—especially at the local level—have little or no awareness of the existence or relevance of geospatial standards or the value they can bring to their organization. This lack of awareness is evident across local to tribal to state to national government organizations and among the consultants and private organizations that support them. Most of these organizations have heard of Geographic Information Systems (GIS), or Global Positioning Systems (GPS), and most probably use mapping applications on their smart phones.

There may be other barriers to standards utilization. For example, is there a perception of competitive disadvantage or a higher initial cost to code to standards? Are there technical barriers such as lack of standards-compliant tools? Is there a lack of incentive for doing work to standards? Is there a lack of knowledge or awareness in academic geospatial/GIS graduate programs?

FGDC has been evaluating, vetting, and endorsing standards for many years. Within the FGDC community and the related Geospatial Intelligence Standards Working Group (GWG) in the Department

of Defense, there is a higher level of awareness of standards and the value their use can bring to FGDC and GWG members and the geospatial community. However, evidence for standards adoption by those members is mixed.

The NGAC has identified factors related to the issue of knowledge diffusion and eventual uptake (use) of geospatial standards. These include:

- Sustainability: A community to provide continued support for a given standard.
- Engagement: Availability of outreach and educational materials so that developers and users understand the role and use of geospatial standards.
- Procurement: Working with agencies and others to incorporate correct technical language in procurements.
- Testing and compliance: Buyers often demand/require that tests be available to determine whether a given standard is properly implemented as per the requirements specified in the standard document.
- Discovery: Can implementation communities, developers, and users actually find the standard(s) that best solve their respective interoperability issues?

These factors, as discussed by the NGAC, helped to frame the recommendations provided later in this document.

Example: WaterML Case Study

Since the establishment of the Open Geospatial Consortium and ISO Technical Committee 211 over twenty years ago, dozens of standards for the geospatial/GIS community have been developed, approved, and made publicly available. Some of these standards have been extremely successful, while others have been less successful. What makes for a successful standard as measured by uptake and endorsement? The following example describes the successful development, approval, and diffusion of an international geospatial standard.

WaterML

A good example of a success story is WaterML and its extensions. WaterML was initially developed by the Consortium of Universities for the Advancement of Hydrologic Science (CUAHSI). CUAHSI is a National Science Foundation (NSF) funded consortium of over 100 universities and international water science related organizations. After internal discussion, the CUAHSI membership under the guidance of Dr. David Maidment (University of Texas, Austin) brought WaterML into a voluntary consensus standards organization (OGC) where a very active group of international collaborators worked on WaterML2. As part this effort, a joint World Meteorological Organization (WMO) / OGC Hydrology Domain Working Group (DWG) collaboration began to address standards development and interoperability of hydrological information systems at an international level. This joint group met face to face numerous times at both OGC meetings and Hydrology DWG meetings. The USGS has been an active participant in the WaterML standards and interoperability experiment process. There are numerous other U.S. and international organizations involved. WaterML is both a data model and an encoding. There is now broad uptake of the standards, partly due to the WMO involvement and more importantly due to some U.S. policy requirements being satisfied by work at the USGS.

The latest successful use of WaterML is for the NOAA national water forecast model (2016). This application is the culmination of years of research and cooperation between NOAA and the academic community, led by Dr. David Maidment and Edward Clark (National Weather Service). A key enabler is the use of OGC standards NetCDF-CF and WaterML concepts and data exchange between the atmospheric and hydrologic models.

Lessons Learned:

The above use case provides evidence of how a very successful standard is developed, agreed to, promoted, and implemented. Lessons learned include the following:

- There must be a Champion.
- Collaboration is required across a broad set of constituents.
- Engage a Standards Developing Organization (SDO) to provide a “neutral” sandbox in which constituents with different priorities and technical or political requirements can participate.
- Domain expertise is critical.
- Driven by policy needs (e.g., water as a critical resource).
- Collaboration across SDOs to ensure political will, socialization, and sustainability.
- Considerable outreach is required.

Recommendations

Recommendation 1: Discovery – Create a National Inventory of Key Geospatial Standards

The NGAC recommends that the FGDC coordinate the development and maintenance of a publicly accessible inventory (registry) of relevant geospatial standards. The initial contribution to this inventory could be those international or national standards already vetted and endorsed by the FGDC and the Geospatial Intelligence Standards Working Group (GWG). Key aspects of this activity would be:

- Define and use consistent metadata. These metadata would include domain of interest and a short use case or cases to describe the interoperability issue addressed by the standard.
- Provide strong governance (FGDC/GWG joint activity).
- Define and broadcast a process/mechanism for submitting a standard for consideration.
- Look to successful use cases for using inventories. Identify existing, successful implementations of similar inventories.

Recommendation 2: Role of the FGDC

For over a decade, the FGDC has been both developing new standards as well as evaluating, vetting, and endorsing standards for consensus standards organizations. However, today the FGDC simply does not have the resources to follow both standards paths. Therefore, the NGAC recommends that the FGDC no longer develop new standards. Instead, the FGDC should continue to collaborate with voluntary consensus standards organizations to provide requirements and to facilitate the development of standards in these SDOs that meet national requirements. The FGDC is already heavily engaged in the work of geospatial SDOs. This work should continue and perhaps increase in scope.

Recommendation 3: Outreach & Education

One issue that has challenged both the FGDC and the geospatial standards community in general is “getting the message” out to users of geospatial data and services. There is a strong need to promote a

standards culture not just in the Federal government, but also across the U.S. geospatial user and technology communities. Related to some of the above discussion, the FGDC, in collaboration with its partners, can provide leadership to:

- Communicate the benefits of standards.
- Provide use cases and exemplars to allow users to determine the business value of using open geospatial standards.
- Determine which standards to use.
- Co-sponsor seminars and workshops for partner organizations.
- Consider which standards should (or can) be specified in legislation.

Summary

The effective and consistent implementation of standards reduces life cycle maintenance costs, lowers the barrier of entry into markets, decreases overall risk, future-proofs existing legacy systems, enhances innovation, and increases competition. These benefits have been documented in numerous studies.² Using geospatial data underpins an incredible array of both government and citizen-facing enterprise systems, applications, and portals. The sharing and re-use (re-purposing) of geospatial data is critical in terms of cost savings and value. Geospatial standards are an effective measure to meet those requirements. The FGDC has a critical role in knowledge transfer and educational activities related to standards uptake and successful use in the US national economy.

NOTE: This paper was prepared by a subcommittee of the NGAC that included the following members: Carl Reed (chair), Gen. William Reddel (vice-chair), Talbot Brooks, Frank Harjo, Xavier Irias, and Harvey Thorleifson.

¹ Much of the introductory content is paraphrased from the ANSI Value of Standards Website.

² https://portal.opengeospatial.org/files/?artifact_id=49518