

## Strategic Pathway 6

# Standards

*This **strategic pathway** establishes and ensures the adoption of standards and compliance mechanisms for enabling data and technology interoperability to deliver integrated geospatial information and to create location-based knowledge.*

*The **objective** is to enable an efficient and consistent approach for different information systems to be able to discover, manage, communicate, exchange and apply geospatial information for a multitude of uses, improved understanding and decision making.*

### **Summary**

The pace of societal and technological change requires new thinking about national geospatial information management roles and investments. This includes a commitment to geospatial data integration and interoperability based on open, consensus-based standards. Standards provide the critical architecture by which data can be discovered, collected, published, shared, stored, combined, and applied. The application of standards facilitates the management and sharing of geospatial information, not only from government authoritative sources, but also from the private sector, academia and citizens, and among each other. Most importantly, standards facilitate the integration and location enablement of all kinds of information to enable more effective policies and decision-making.

Effective geospatial information management is characterized by using a mixture of international and national standards and compliance mechanisms that create a unifying nationwide good practice. A national, inclusive governance process and policy environment are essential to assure consistent usage of standards and to promote local, regional, and international compatibility.

Standards are essentially an agreement between providers, regulators and users. They provide rules, guidelines and characteristics that enable connection between systems, data, people, hardware, software and procedures. When applied, standards reduce effort, time and cost of implementing technologies, improve return on investment, and help future-proof systems by enabling new capabilities to be added with minimal effort.

Common to the effective use of standards are four key elements that are required for an interoperable and cooperative data sharing environment, to improve service and product delivery, and for evidence-based policy and decision-making.

The four elements are:

- **Standards Governance and Policy** - ensures that the benefits of standards can be maximized through coordinated governance and coherent policies.
- **Technology and Data Interoperability** - standards enable different technologies, systems, and geospatial data to work together seamlessly, and provide the flexibility to innovate and rapidly mobilize newer technologies and data sources.
- **Compliance Testing and Certification** - leverages testing, measurement, and certification processes to assure proper implementation of standards.
- **Community of Practice** - accelerates the benefits of standards and interoperability by sharing and leveraging proven, standards-based good practices.



These elements are underpinned by principles that promote the successful use of standards to improve sharing and use of geospatial information and optimize geospatial information management in a country. The principles are put into practice through several strategic actions that deliver and strengthen the implementation of the Integrated Geospatial Information Framework (IGIF). Examples, matrices and checklists are provided in the appendices to assist countries to work through concepts and processes to successfully complete each action. The overall structure for standards is illustrated in, and anchored by Figure 6.1.

When implemented the actions (and their interrelated actions<sup>1</sup>) will enable the achievement of the four elements, which in turn will deliver significant and sustainable national outcomes and benefits for a country. These outcomes include attaining:

- Minimized barriers to data and information sharing and integration in support of government-wide policy, decision-making and service delivery;
- Enhanced abilities to share geospatial information across jurisdictional boundaries (local, national, and global) and with the private sector, to cooperatively address issues of common importance;
- Rapid mobilization of new sources of data and new technologies, as well as avoidance of lock-in to specific technology providers;
- Improved uptake of geospatial information across government and with the private sector and citizens; and
- Efficiencies in geospatial data production and lifecycle management, saving effort, time and cost in reusing and repurposing data.

---

<sup>1</sup> Examples of the interrelated actions across Strategic Pathways are described in the introductory chapter; Solving the Puzzle: Understanding the Implementation Guide.

Elements of Standards	Standards Governance and Policy	Technology and Data Interoperability	Compliance Testing and Certification	Community of Practice
<b>Guiding Principles</b>	Leadership Compliance Governance Engagement	Collaborative Modernized Practises Interoperability Scalable		Usability Responsive Extensible Open and Accessible
<b>Key Actions for Strengthening Geospatial Information Management</b>	<b>Direction Setting</b> Standards Governance Standards Awareness Strategic Goals	<b>Planning for Change</b> Action Plan Institutional Arrangements	<b>Ongoing Management</b> Standards Review Program Community of Practice Capacity Development	
	<b>Understanding National Needs</b> Baseline Survey Standards Inventory Needs Assessment and Gap Analysis	<b>Taking Action</b> Implementation Communication and Engagement Risk Assessment	<b>Achieving Outcomes</b> Compliance Success Indicators	
<b>Tools to Assist in Completing the Actions</b>	National Governance Model Standards Baseline Survey Standards Needs Assessment and Gap Analysis	Roles and Responsibilities for National Standards Governance Standards Training, Tools and Related Resources	User Community Case Studies and Statements of Benefits Community Good Practices	
<b>Interrelated Actions</b>	Governing Body (SP1) Geospatial Information Coordination Unit (SP1) Specialist Working Groups (SP1)	Data Framework (SP4) Data Inventory (SP4) Stakeholder Identification (SP9) Metadata Management (SP4)	Communication Plan (SP9) Community of Practice (SP8) Benefits Realization (SP3)	
<b>Outcomes</b>	Minimized Barriers to Data Sharing and Integration Improved Uptake of Geospatial Information	Enhanced abilities to share and address common issues Efficiencies in Geospatial Data Production and Lifecycle Management	Rapid Mobilization of New Sources of Data and Technologies	

**Figure 6.1:** The overall structure for the Standards Strategic Pathway - showing the four key elements, guiding principles, actions and interrelated actions, and the tools provided in the Appendices to support and achieve the outcomes.

## 6.1 Introduction

---

*Standards provide the rules, guidelines and characteristics that enable connection between systems, data, hardware, software, procedures, and people. Standards are essential to strengthening integrated geospatial information management.*

In information technology environments, standards enable systems to communicate with one another, facilitate the integration of diverse geospatial data, and allow geospatially-enabled mobile phone Apps to communicate and work anywhere across a multitude of devices.

In an ever-changing world, open standards help assure that organizations can more quickly take advantage of new geospatial information sources and new technology tools. Open standards are a central element in the growing trend to open government. A goal of open standards is to ensure that 'interoperability' (the ability to integrate datasets and related services of different types and from different sources) will minimize such costs and problems.

Effective national geospatial information management are typically characterized by a mixture of international and national standards and related compliance mechanisms. Open international standards<sup>2</sup> are the recommended norm. Such standards represent the consensus of private and public sector organizations worldwide and are guided by the proven processes of consensus standards bodies. Open international standards are an empowering first choice toward improving local, national and international data sharing - enabling different data sources, technologies and vendor products to work together or 'interoperate' seamlessly.

There are three key international organizations with the objective of developing open standards for geospatial information and technologies; sometimes referred to as the Standards Development Organizations (SDO) for geospatial information. Members of the SDOs represent government, industry, research and academia, and develop standards through consensus. They are:

- The **International Hydrographic Organization (IHO)** is an intergovernmental consultative and technical organization established in 1921 to support safety of navigation and the protection of the marine environment. Among its main objectives, IHO is to bring about the greatest possible uniformity in nautical charts and documents (i.e., standardization). The provision of hydrographic and nautical chart services is one of the obligations of coastal State signatories to the International Convention for the Safety of Life at Sea (SOLAS) treaty under the responsibility of the International Maritime Organization (IMO).
- **International Organization for Standardization Technical Committee (ISO/TC 211) Geographic information/Geomatics** was founded in 1994 for standardization in the field of digital geographic information. This work aims to establish a structured set of standards for information concerning objects or phenomena that are directly or indirectly associated with

---

<sup>2</sup> **Open international standards** are voluntary consensus-driven standards published by the SDOs. Open standards are developed, approved, and maintained via a collaborative and consensus-driven process and made available to the general public. Open standards facilitate interoperability and data exchange among different products or services intended for widespread adoption (source: [http://standards.unggim.ogc.org/unggim\\_guide.html#\\_standards\\_awareness](http://standards.unggim.ogc.org/unggim_guide.html#_standards_awareness) and [www.itu.int/en/ITU-T/jpr/Pages/open.aspx](http://www.itu.int/en/ITU-T/jpr/Pages/open.aspx)). Open does not necessarily imply free of cost. Depending on a SDO's business model, costs of developing standards are recovered from membership fees or sales.

a location relative to the Earth. These standards may specify, for geographic information, methods, tools, and services for data management (including definition and description), acquiring, processing, analyzing, accessing, presenting, and transferring such data in digital/electronic form between different users, systems and locations. The work shall link to appropriate standards for information technology and data where possible, and provide a framework for the development of sector-specific applications using geographic data.

- The **Open Geospatial Consortium (OGC)** is an international not-for-profit standards organization founded in 1994, representing over 500 businesses, government agencies, research organizations, non-profit organizations, and universities united with a desire to make location information FAIR – Findable, Accessible, Interoperable, and Reusable. OGC facilitates an international forum of thought leadership and expertise in geospatial and location information and technologies. OGC identifies barriers to interoperability, and defines, documents, tests, validates, and makes freely available open standards and associated community good practices for use with geospatial content and services.

Together the standards developed by these organizations form an integrated ecosystem. For example, OGC and IHO standards leverage the abstract standards defined by ISO/TC 211. This ecosystem facilitates the publication, discovery, access, maintenance and use of geospatial information across a range of applications, systems and business enterprises. In addition, general IT and internet standards from organizations such as the World Wide Web Consortium (W3C), ISO, the International Telecommunications Union (ITU) and the Internet Engineering Task Force (IETF), are also essential for internet and mobile communications; smart, safe, and resilient cities and other core IT infrastructures that have an influencing role in how geospatial information is managed.

Standards provide a critical component in an architecture by which data can be discovered, collected, published, shared, stored, combined and applied. When applied, standards reduce effort, time and costs associated with the implementation of technologies, improve return on geospatial data and system investments, and help future-proof systems by enabling new capabilities to be added with minimal effort.

A broad range of geospatial information and associated technologies are available worldwide. As governments and society become increasingly digital in both service delivery and policy making, standards help to quickly mobilize these technologies. Underpinning this strategic pathway is the principle that using these geospatial standards optimizes geospatial information management. This applies to collection, application, and sharing the geographic information. This will then address important challenges for decision makers, improve government service delivery, help address the sustainable development goals (SDGs), and save assets and lives.

The effective implementation of a common standards framework helps to remove technical barriers to data sharing, integration and application to address a range of topics and challenges that transcend local, national, and international borders. This helps make the decision to share and cooperate among organizations and governments a matter of institutional policy and “human interoperability” or the willingness to share.

## 6.2 Context and Rationale

---

*Geospatial information management practices have evolved over time. Today, standards are used as good practice to enable data sharing and integration.*

Geospatial information management practices grew from the use of proprietary, open source, and government developed software and systems. This led to organizations developing and using different formats, data models, and technologies. These technology and data silos, whether protected or open source, made interoperability difficult. Approaches to solving the interoperability difficulties include the adoption of standards and other technology solutions such as the rise of ETL (exchange, transform & load) software; direct-read and write exchange; and the growth of openly published formats and models. Standards play a vital role in the continual evolving landscape of geospatial innovation. Today, we see in the marketplace the concurrent evolution of technology and standards, and these go hand in hand to create interoperability.

Given that geospatial information is managed and provided by a number of organizations – from national geospatial and mapping agencies to commercial data providers to volunteered geographic information – there is an overwhelming requirement to easily discover and share this information. For this to occur, countries are strongly encouraged to adopt a standards-based approach to geospatial data management.

Today, standards available for geospatial information management stem from a mature global effort to address the challenges associated with data sharing and interoperability. Organizations around the world are now adopting open geospatial standards to promote geospatial information discovery, access, integration, and use to address a range of local to international issues. Technology and data providers have implemented these standards in their products and services to assure that data will interoperate seamlessly with other technologies and across user communities.

Collectively, SDOs support the intentions of the IGIF and have been progressively addressing the need for open consensus-based standards and frameworks for geospatial information management. Standards organizations work across the public and private sectors to understand the implications of new technology and societal trends, and to make it easier to integrate data from various sources so that data can be readily used for decision making.

**Open international standards** have been adopted and implemented in products and services worldwide to enable geospatial information sharing, integration, and application to address a range of social, economic, and environmental issues. International standards have been developed based upon the hard lessons learned over time by other implementers, and often represent the most efficient overall approach to technology development.

While the focus of this strategic pathway is on open international standards, other means of information sharing described in this pathway are further defined in '[A Guide to the Role of Standards in Geospatial Information Management](#)'<sup>3</sup> (Standards Guide), summarized below:

---

<sup>3</sup> A Guide to the Role of Standards in Geospatial Information Management is available as an online web resource and a downloadable print publication at <http://standards.unggim.org/>

- **Specifications** generally offer an interoperability solution similar to that of standards, but are not necessarily developed in the same voluntary, consensus-based process.
- **Profiles** based on international standards may be established and endorsed by governance bodies to meet the specific needs of their country or organization.
- **Good practices** describe how one or more open standards are applied against scenarios or defines a profile that tailors open standards to the requirements of a specific community.
- Over time and with broad adoption, a specification may be so widely used that the community considers it a **de facto standard** for a given application, even if it was not assigned an official status by a governance body.

Closed standards or specifications carry risks that may pose hidden challenges such as delays and costs of expanding or adapting data and software tools to work with other resources, software, or organizations. Organizations should be aware of the potential risk to interoperability of closed standards or specifications and consider these risks on balance with the benefits. Open standards and specifications, on the other hand, help organizations best balance their needs while minimizing business and technology risks.

In an ever-changing world, open standards help assure that organizations can more quickly take advantage of new geospatial information sources and new technology tools. The use of open international standards helps avoid risk and ensure the gap between marketplace innovation and adopted standards does not grow.

The use of standards facilitates management and sharing of geospatial information not only from government authoritative sources, but also from the private sector, academia, NGOs, community groups and citizens. National standards should be developed and applied only when international standards do not meet national needs. Where national standards are deemed to be required, they should strive to either profile existing international standards or use defined international standards as a framework. This approach can strike a balance between meeting national requirements, as well as ensuring regional or international interoperability.

The pace of societal and technological change requires continuous review of national geospatial information management roles and investments. Nationally integrated geospatial information management is built for both connected to disconnected operations. Standards support web services and catalogues, as well as file transfers and offline processing where connectivity is less reliable. A commitment to interoperability based on open, consensus-based standards is essential to keeping pace with changing technology.

## 6.3 Approach

---

*The approach to effective data management is to establish good practice standards and compliance mechanisms.*

In this strategic pathway, the approach is to establish standards and compliance mechanisms to strengthen integrated geospatial information management and, in particular, to enable different information systems to communicate and exchange data, enable knowledge discovery and inferencing between systems using unambiguous meaning.

At the national level, policy commitment and consistent data governance processes assists in aligning government and other stakeholders to implement a common standards framework for efficient geospatial information management. This strategic pathway, like standards themselves, is a truly integrative pathway, building on the recommendations of SP1: Governance and Institutions and SP2: Policy and Legal regarding overall governance and policy for standards. In addition, the actions in section 6.6 below support, and are complementary to, the recommendations in SP4: Data.

**Governance and Institutions** (SP1) identifies the necessity of forming a national Governance Model and Governing Body that includes emphasis on promoting/adopting standards and interoperable systems. SP1 also identifies the need for a whole-of-government Geospatial Coordination Unit, along with Specialist Working Groups, to provide guidance for cross-government standards for access and use of geospatial information. Where applicable, the Standards Working Groups will work with the country's National Standards body or authority, to provide cooperative national leadership for the approval and adoption of existing standards or the development of new national standards as required.

In **Policy and Legal** (SP2), standards represent a key beneficial non-binding policy component that can help advance an enabling policy and legal environment for geospatial information management. The adoption of these standards by key government agencies responsible for geospatial information management will have broad impacts across a country's geospatial ecosystem. Government agencies can also make standards binding by requiring them in requests for proposals (RFPs) and included in contracts.

**Data** (SP4) highlights the importance of metadata, data standards, data quality, and other standards to enhance the integration and interoperability of individual and disparate data sets. SP4 also underscores standards for: i) compliance as part of a comprehensive data theme roadmap and data management plans; ii) the use of international web service standards to make geospatial data accessible, and; iii) compliance to support interoperability.

**Partnerships** (SP7) emphasizes national and global partnerships in developing standards and norms for strengthening geospatial information management capabilities.

**Capacity and Education** (SP8) underscores that developing the appropriate capacity will require collaboration across all levels of government (local, national, regional, international); particularly when it comes to information exchange. A consistent approach to capacity development is required to enable compliance with data sharing policy and data release guidelines, and the application of data and Information Communication Technology (ICT) standards to enable interoperability, as well as cooperation in data custodianship roles and responsibilities. In particular, cooperation of experts from across developed and developing countries will be important to leverage the value of lessons learned.

**Communication and Engagement** (SP9) emphasizes an engagement strategy for active interaction with stakeholders and users to raise awareness, advocate and strengthen geospatial information management, including the exchange of information regarding the use of standards to maximize access.



The implementation of standards within the national context is often a combination of bottom-up organizationally driven activities, and top-down national initiatives in policy and governance. This strategic pathway recognizes that countries have different legal, policy, governance and operational approaches to geospatial information management. Therefore, it offers a set of recommended actions that may be implemented in various ways, and in a choice of sequences, to establish initial capability or to improve existing capabilities.



**Figure 6.2:** The approach for standards.

This pathway also acknowledges that individual organizations and stakeholders within a country may have independently adopted a common set of geospatial information and technology standards, not endorsed by the country, to increase internal efficiencies and flexibility for growth as new enabling technologies became available. However, by following a nationally endorsed standards strategy and framework proposed in this pathway, organizations and stakeholders can further assure interoperability locally, nationally, and internationally.

In this strategic pathway, the approach includes four key elements that are a guide for countries to ensure that standards are an integral part of geospatial information management. These elements include coordinated and consistent **standards governance and policy**, seamless **technology and data interoperability**, the ability to leverage **compliance testing and certification** processes to assure proper implementation of standards, and a **community of practice** for sharing and leveraging skills and knowledge relating to good practice standards and their implementation. These elements are explained in more detail in section 6.4 below.

The approach includes strategic pathway actions that are recommended as a means to achieve the four key elements. The actions, which are underpinned by guiding principles, provide the step-by-step guidance to implement and achieve the desired outcomes. While most of these actions may be unique to this strategic pathway, there are several interrelated actions detailed in other strategic pathways that may also need to be completed. Tools to assist in completing the actions are available in the appendices to the strategic pathway. The approach for Strategic Pathway 6: Standards is illustrated in Figure 6.2 and explained in the following sections.

The actual implementation approach of each strategic pathway action will depend on country-specific needs, which may be influenced by country priorities, existing capabilities, resourcing potential, culture and other practicalities. Whatever the implementation approach, each action should reference the guiding principles below (See Section 6.5) as these describe what is important for effective and efficient geospatial information management.

## 6.4 Elements

---

### 6.4.1 Standards Governance and Policy

*National success in standards requires an efficient governance model, inclusive of relevant stakeholders, and a commitment to assess, establish, maintain and implement a common standards framework.*

Standards are a key component of integrated geospatial information management at the national level. Nationwide success requires a clear leadership commitment and structure, a governance model inclusive of relevant stakeholders, a commitment to assess, establish, and maintain a common standards framework as well as a policy and legal environment that supports for the advancement of the framework.

Major components of Standards Governance and Policy include: (a) the establishment of a National Standards Strategy; (b) a government steering committee, coordination units and working groups coordinated across all levels of government; (c) a broad, all-inclusive stakeholder representation and engagement in the standards coordination process; (d) a clearly defined and empowered organization

to lead cross-government and community coordination on geospatial information management and standards; (e) a process to review, develop as necessary, and endorse a common framework of national data and technology standards; and (f) the representation of national requirements in international SDO activities.

In practice, even though governance structures vary from country to country, the aforementioned components typically exist within such structures in one form or another. SP1: Governance and Institutions provides guidance and recommendations on practical national governance models.

#### **6.4.2 Technology and Data Interoperability**

*Technology and data interoperability enable different systems and diverse data types to work together seamlessly.*

This in turn, provides the flexibility to rapidly mobilize newer technologies and data sources in the future. Technology standards, such as for Application Programming Interfaces (API), are used to specify how software components interact with each other through standard interfaces to enable different systems and services to work together. When technology standards are implemented independently in products or online services, the intent is that they work together seamlessly, saving time, effort and cost. This is because, programming to standard interfaces reduces the dependency on implementation specifics and makes code more reusable.

Geospatial data standards provide a digital encoding to locate and describe the features and conditions that are on, above or below the Earth's land and ocean surface. This includes geographically-related features that are naturally occurring (rivers, rock formations, coastlines, etc.), artificial (dams, buildings, radio towers, roads, etc.) or intrinsic, implied, and transient information (political boundaries, electoral districts, weather systems, distribution of population, ethnicity, etc.). Data standards support the management of geographic features as coverages (elevation models, data cubes, multispectral imagery, etc.), and attributes (water quality or soil classifications, etc.). Geospatial data standards are integral to the reuse and repurposing of information.

Geodetic standards are another essential category of international standards. These standards enable essentially geographic positioning required to enable accurate and precise positioning, measurement, and interrelation of geospatial information for all Earth observation techniques.

Technology and data interoperability (including semantic interoperability) enable diverse data and systems to work together. In terms of semantic interoperability, it is essential to agree on semantics; that is, to agree on the meaning of words, terms and concepts used in geographic data models that are shared between organizations, and even within the same organization. Agree terms are managed in a data vocabulary, sometimes referred to as a data dictionary. When the terminology used in data models is different, it can cause confusion and make data matching difficult, and thus create data integration problems. Technology and data interoperability standards 'mediate' these differences, enabling data models to be more easily integrated.

There are many examples of the critical importance of semantic mediation. The European INSPIRE<sup>4</sup> programme works to unite the nations of Europe to develop common data content standards and

---

<sup>4</sup> Infrastructure for Spatial Information in the European Community Directive.

associated methods to mediate the many different languages used in the region. The OneGeology<sup>5</sup> alliance produced a common global geologic science standard model, the OGC Geoscience Markup Language (GeoSciML), to enable national geological surveys to map their national geological models to a global standard. The IHO has established a global digital registry of marine and maritime entities used in international charts, publications, and associated data visualization and data transfer standards. Through the semantic mediation process, national data can be combined with common meanings to address regional topics that transcend national boundaries. Thus, semantics is an important part of standardization at national, international, and local levels.

### 6.4.3 Compliance Testing and Certification

*A system of compliance is used to promote data sharing and use.*

Compliance testing and certification ensures that organizations are implementing nationally or internationally endorsed standards that support data sharing and reuse, and to verify that technology products and services acquired by government are reliable and properly implemented against the required standards. There are several compliance strategies that should be considered by countries including regular assessments, education and training, government mandates, performance metrics, testing and certification functions.

### 6.4.4 Community of Practice

*A community of practice is a group of people who share skills, knowledge and experiences about the implementation of standards.*

It often leverages formal and informal partnerships and agreements to share and adopt community standards good practices. A community of practice also accelerates the realization of benefits of standards and interoperability by sharing and leveraging proven, standards-based good practices between otherwise unconnected entities. It also provides commonality across diverse uses and levels of operation, and helps to promote consistent, sharable training and educational programs.

## 6.5 Guiding Principles

---

*By applying these guiding principles, countries will achieve technology and data interoperability leading to effective reuse and repurposing of geospatial information.*

The following guiding principles serve to characterize the commitments necessary to advance a common standards framework for geospatial information management, sharing, usage and decision-making, and to raise awareness and understanding of standards at the local, national, and international levels. These principles illustrate the value achieved by adopting and implementing open standards as part of a common framework for geospatial information management, and the need to embed standards into legislation, policies and directives. The guiding principles for standards are:

- **Leadership:** A lead organization or agency to promote nationwide common standards and cross-government coordination to ease data sharing, management and use.

---

<sup>5</sup> [www.onegeology.org](http://www.onegeology.org)

- **Compliance:** Clear policy on the adherence to and use of open, consensus-based standards.
- **Governance:** Clearly defined and inclusive governance structure for standards development, adoption and endorsement for national implementation including broad public, private sector and citizen participation.
- **Engagement:** Clearly articulated laws, policy and standards framework that is endorsed at the national level and communicated broadly.
- **Collaborative:** A community of practice that engenders shared experiences, success stories and lessons learned, as well as a national forum for stakeholders to coordinate standards and good practices.
- **Modernized Practices:** International, vendor-neutral, open consensus-based standards that encourage the use of geospatial data and software that fit today's needs.
- **Interoperability:** Standards are applied to achieve the greatest level of interoperability across all levels of government, the private sector, users, and non-government partners/stakeholders.
- **Scalable:** A standards framework that promotes seamless data sharing from the local to national level and to regional and international levels.
- **Usability:** A common, consistent standards framework that facilitates efficient reuse and repurposing of geospatial information and interoperability of systems.
- **Responsive:** Standards are adopted in a way that influences and responds to national requirements, addresses gaps in capability and promotes specific technological developments.
- **Extensible:** The ability to add new geospatial capabilities as future needs demand through ongoing revision of standards and practices.
- **Open and Accessible:** Standards are available for use nationally, without restrictions, and unencumbered by patents or other limitations that restrict their use.

## 6.6 Actions

---

*The strategic pathway actions are recommended as a means to achieve the four key elements of the Standards Strategic Pathway.*

They are a guide to good practice and efficient integrated geospatial information management. Country-specific actions may be influenced by factors such as country priorities, existing capabilities, resources, culture and other practicalities. These will influence approaches for implementing each strategic pathway and their related actions.

For ease of use, particularly to assist countries in the initial and early stages of developing and strengthening their national geospatial information management arrangements, the actions are presented in a sequential step-by-step structure. A road map illustrating this order and where the actions typically occur and are completed, is presented in Figure 6.3. However, it is acknowledged that

countries, depending on existing national arrangements, may also wish to start their actions at different steps along the pathway, and in a different sequence. Therefore, a less structured road map is additionally presented in Figure 6.4.

Some actions may have interrelated actions that need to be achieved prior to, or in conjunction with, the strategic pathway actions. These interrelated actions are also illustrated in Figures 6.3 and 6.4, are referenced in the text, and detailed under other strategic pathways.

Whatever the implementation approach, each action should take into account the guiding principles in section 6.5, as these describe drivers for attaining effective and efficient geospatial information management. The actions for the standards are divided into six categories, which are:

1. Direction Setting
2. Understanding National Needs
3. Planning for Change
4. Taking Action
5. Ongoing Management
6. Achieving Outcomes

The following actions are typically used to address gaps in capability. They serve as a guide to building the necessary capacity to strengthen integrated geospatial information management processes and systems.

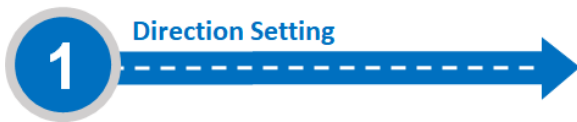


**Figure 6.3:** Standards includes several actions and tools designed to assist countries to establish good practice standards and compliance mechanisms for enabling data and technology interoperability to deliver integrated geospatial information. The actions are divided into six categories and reflect the order with which these actions are typically completed.



**Figure 6.4:** Standards includes several actions and tools designed to assist countries to establish good practice standards and compliance mechanisms for enabling data and technology interoperability to deliver integrated geospatial information. The interrelated actions provide key linkages to other strategic pathway actions.





### 6.6.1 Standards Governance

*National-level laws, policy and governance that encourages the adoption of a common standards framework benefits the successful implementation of integrated geospatial information management.*

Many countries have established policies mandating or encouraging government and stakeholders to align with a common set of nationally endorsed, open, consensus-based national and international standards to better ensure the ability to share and use geospatial information broadly.

Standards should be a component of the national geospatial Governing Body established to advance a country's integrated geospatial information framework (See SP1: Action 1.6.1). The Body would have responsibility for overall governance and strategic direction regarding standards for use across government, coordinate awareness activities, and recommend policies that promote adoption and alignment to the endorsed common standards framework.


The following sections are suggested to be conducted within the context of the governance structure discussed above.


A Geospatial Information Coordination Unit (See SP1: Action 1.6.2) should operate under the Governing Body's guidance and . It should have a whole-of-government national scope, and authority to engage across the whole of government. It would:

- Represent cross-government needs for standards;
- Establish and maintain a standards 'lifecycle management' process to review, assess, develop, evaluate, and endorse national standards for geospatial information management;
- Promote broad public/private sector stakeholder dialogue and forums to raise awareness and to promote the alignment of a common standards framework across the nation;
- Establish, maintain and measure requirements for interoperability with trans-boundary and other international frameworks;
- Represent national interests within national, regional and global SDOs;
- Develop and implement procedures, policies and laws, as appropriate, to monitor and assess compliance with endorsed national and international standards;
- Support standards knowledge and capacity development through training programs and community good practice sharing; and
- Develop procedures and policies promoting the procurement, implementation and use of standards-based data and technologies (See SP4: Action 4.6.7) for cross-government data access, sharing and usage for improved decision making.

The Geospatial Information Coordination Unit would also establish liaisons with relevant SDOs and professional associations to monitor emerging national, regional and global standards, represent national standards requirements, and to network with peers and industry experts regarding innovative new standards practices.

Standards Working Group (See SP1: Action 1.6.3), sub-committee of the Coordination Unit, should comprise technical expertise from across government agencies and departments, and may liaise with the national body for standardization, where one exists. Standards Working Groups will typically be required to assess government’s standards’ needs, recommend standards for inclusion in the nationally endorsed geospatial information management standards inventory, and develop data content and encoding standards for foundational data managed by departments across government.

 Examples of National Governance Models associated with standards for geospatial information management are provided in Appendix 6.1.

 See Interrelated Actions on a Governing Body (SP1); Geospatial Information Coordination Unit (SP1); and Specialist Working Groups (SP1).

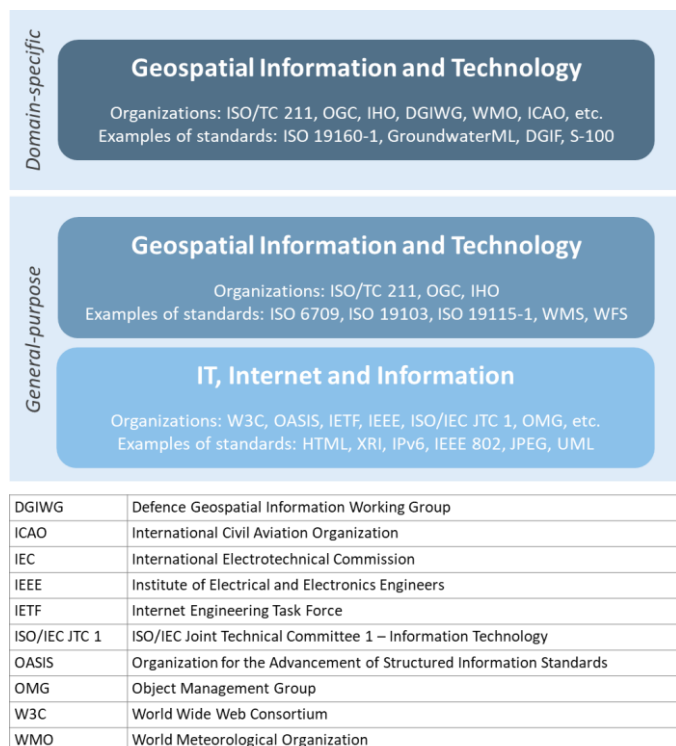
### 6.6.2 Standards Awareness

*Part of the leadership role is to understand the practice of standards and to raise awareness of the benefits of moving towards a standards-based approach for geospatial data management*

A heightened understanding and awareness of the relevance of standards, at all levels of government and with the private sector, academia and community groups etc., as an information sharing enabler, is crucial to strengthening capability. It should be included in the Standards Communication and Engagement Strategy and Plan (See section 6.6.10).

The above definitions and descriptions are provided to help raise awareness of standards and their influence on technology and data management.

There are several types of standards relevant for integrated geospatial information management, in the broader context of interoperability of systems, and in relation to other Strategic Pathways, the SDGs, and e-Government initiatives. Standards address *domain-specific* geospatial applications, as well as general *geospatial information and technology* applications. These standards operate along with a family of *general-purpose ICT standards* that enable interoperability across various devices, networks, sensors and systems (Figure 6.5).



**Figure 6.5: Types of standards (Ostensen et al., 2015).**

**General-purpose Information Technology, Internet and Information Standards** are for defining the baseline of interdependencies between fundamental hardware and software elements relied upon by all:

- Internet, web, mobile, and other high-level IT standards.
- SDOs for these standards include the World Wide Web Consortium (W3C), International Telecommunications Union (ITU), and Institute of Electrical and Electronic Engineers (IEEE), among others.

**General-purpose Geospatial Information and Technology standards** represent the majority of geospatial standards and are developed by the three SDOs for geospatial information, the Open Geospatial Consortium (OGC), International Organization for Standardization (ISO) Technical Committee 211 Geographic Information/ Geomatics, and the International Hydrographic Organization (IHO). The following types of standards are included:

- *Geospatial data content (content models)* are standards relevant to all data themes and are expressed in a common standards-based data model. These include standards regarding geospatial data definitions, representation, data quality, general architecture, and other aspects of geospatial information. They collectively provide guidance on geospatial data collection, production, and maintenance (SP4).
- Some standards aim at *describing* the data. These ‘metadata’ standards are important when specifying the data, or reporting the quality of the data, so that users can evaluate the fitness-for-purpose of the data for a certain application.
- *Geospatial technology standards* are standards specially designed to minimize the complexity of geospatial data discovery, access, integration, processing, and application across different technologies, systems, devices, and networks.

**Domain-specific Geospatial Information and Technology Standards** are for the provision of specific data and applications by the user. These standards are directly targeted at a certain data theme, domain, application, or user community, e.g. the global fundamental geospatial data themes of UN-GGIM (See SP4: Action 4.6.1 – Data Framework). Examples include: Land Cover; Addressing; and Marine planning and applications.

More information on Standards is available in ‘*A Guide to the Role of Standards in Geospatial Information Management*’<sup>6</sup> (Standards Guide) This document provides detailed recommendations on key standards to consider for national adoption and implementation.

The Committee of Experts adopted, by decision 5/108, the Standards Guide and Companion Document at the Fifth Session of UN-GGIM in 2015 as the international geospatial standards good practice for Spatial Data Infrastructure (SDI), and encouraged all Member States to adopt and implement the recommended standards appropriate to their country’s level of SDI maturity. A revision of the Standards Guide was adopted at the Eighth Session of UN-GGIM Committee of Experts in 2018. At its Eleventh Session, the Committee of Experts endorsed a revised on-line version of the Standards

---

<sup>6</sup> A Guide to the Role of Standards in Geospatial Information Management is available as an on-line web resource and a downloadable print publication at <http://standards.unggim.org/>

Guide which included improved alignment with the IGIF. The Standards Guide addresses the role of standards in geospatial information management, and:

- Defines and explains what a standard is;
- Makes a case for open standards;
- Discusses why such standards are valuable;
- Describes geospatial standards and related good practices;
- Identifies the intended audience / roles for those who will benefit from using the Guide;
- Introduces a goal-based approach to standards adoption, and a multi-tiered standardization approach to attaining desired levels of geospatial capability;
- Characterizes emerging standards and trends;
- Provides concrete examples of standards in use; and
- Concludes with helpful resources and suggestions for next steps.



See Interrelated Actions on Data Framework (SP4)

### 6.6.3 Strategic Goals

*The implementation of a Common Standards Framework includes defining goals for what a country is endeavoring to achieve by implementing a standards-based approach to geospatial information management.*

As an example, the US Office of Management and Budget Circular A-119 defines ‘voluntary consensus standards’<sup>7</sup> as standards developed or adopted by voluntary consensus standards bodies, both domestic and international. These standards include provisions requiring that owners of relevant intellectual property have agreed to make that intellectual property available on a non-discriminatory, royalty-free or reasonable royalty basis to all interested parties. Circular A-119 further states that a voluntary consensus standards body is defined by the following attributes: (i) Openness; (ii) Balance of interest; (iii) Due process; and (vi) An appeals process.

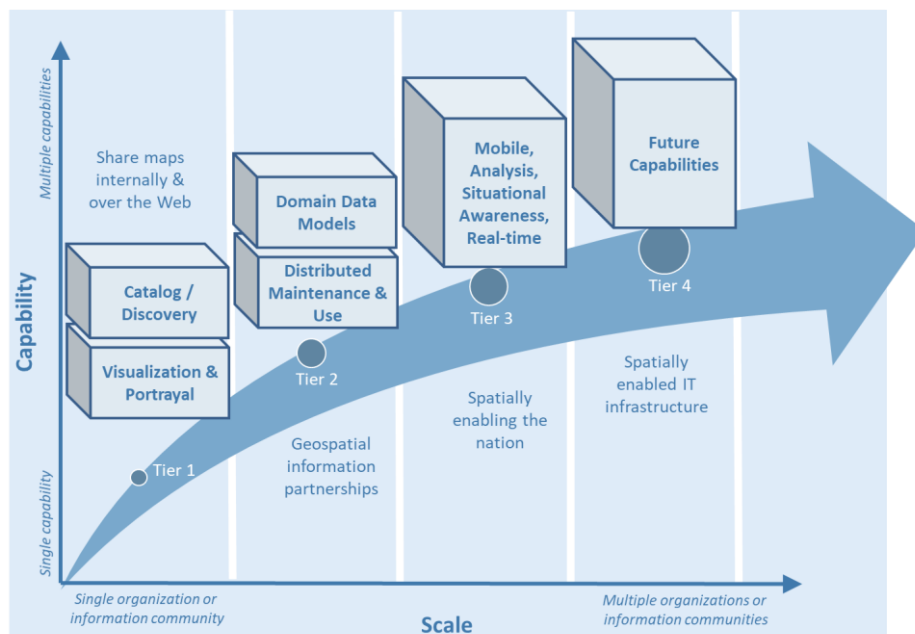
Organizations, institutions and information communities are likely to be starting their standards journey at different points in the capability/maturity continuum, requiring a phased implementation approach that considers the different levels of experience and expertise of the people involved.

Some organizations and institutions will be advanced, while others are just beginning, and some are only just considering the use of standards. The standardization maturity model (Figure 6.6) considers the different levels of knowledge and experience, and describes a standardization trajectory. This maturity model can be used for goal setting. These levels are identified as *tiers*. The goals for each tier are defined as follows:

---

<sup>7</sup> OMB Circular A-119, Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities is available at <https://www.whitehouse.gov/wp-content/uploads/2017/11/Circular-119-1.pdf>.

- **Tier 1:** Enable stakeholders (including users) to view and query interactive maps on the web. This goal is closely associated with the ability of an organization to discover, share / publish and use geospatial information.
- **Tier 2:** Provide access to geospatial information over the web, provide geospatial information download services, and optimally, to provide and cooperatively maintain specific data themes, such as roads, from multiple sources in a way that creates a consistent and integrated ‘view’ of the geospatial information for users by conforming to an agreed, common data model.. Tier 2 builds on the infrastructure, policies, technologies, and standards deployed and matured in Tier 1.



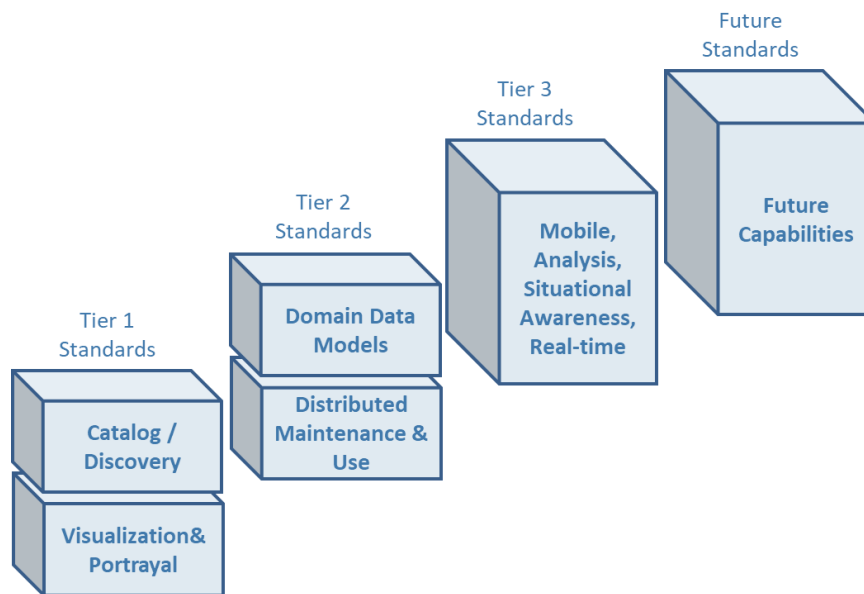
**Figure 6.6:** Geospatial levels of standards use (Standards Guide).

- **Tier 3:** Share foundation/framework geospatial information and services across government and with the broader community to improve knowledge and understanding, thereby contributing to evidence-based decision making, situational awareness, and improved societal outcomes. This goal is to spatially enable a country to develop a comprehensive geospatial information management framework that provides access to multiple themes of information, applications for using the shared information, and access via a variety of environments (mobile, desktop, etc.). This is also one of the principles of the Global Statistical Geospatial Framework, which urges the use of internationally adopted standards and good practices from both the geospatial and statistical communities to enable greater interoperability of statistical and geospatial data<sup>8</sup>;
- **The future:** Current emerging practice, which may still be aspirational in some ways, is to integrate the geographic information framework with wider government or national information frameworks, and with the general architecture of the world-wide web, cloud and edge processing, sensors and the Internet of Things. SDOs are working to advance standards

<sup>8</sup> The Global Statistical Geospatial Framework is available at [http://ggim.un.org/meetings/GGIM-committee/9th-Session/documents/The\\_GSGF.pdf](http://ggim.un.org/meetings/GGIM-committee/9th-Session/documents/The_GSGF.pdf)

to address emerging needs and facilitate the integration of new technologies and opportunities such as crowd-sourcing of geospatial information and big data analytics, the application of artificial intelligence (AI) and Machine Learning (ML) Advancing standards for these and other emerging capabilities is the focus of innovation in various places, including the OGC’s Innovation Program.

The Standards Guide defines the specific standards and good practices associated with requirements for each tier, and thus each goal, of an organization’s desired capability and collaboration. It also provides recommendations on the application of specific standards for each tier (Figure 6.7) so that countries can progressively move towards improved technology and data standards for geospatial information management, sharing and use.



**Figure 6.7:** Standards applicable to different tiers (Standards Guide).

In addition, the Standards Guide focuses on broad data sharing and coordination via the web. The standards referenced in the Standards Guide support interoperability of data and technologies on a device, within a system, or via physical media (USB drives, DVDs etc.) within and among organizations involved in the production, management, or application of geospatial information.

The Standards Guide also introduces the concept of ‘Foundational Standards’ which, in this context, means standards that support *all* tiers. Those types of standards form the technological basis for geospatial information exchange.

## 2 Understanding National Needs

### 6.6.4 Baseline Survey

*The first step towards understanding the needs standards at the national level is to conduct a baseline of the current situation on data management, interoperability and standards, and the level of compliance.*

This involves understanding the national levels of cooperation and stakeholders involved in geospatial information management including:

- How data are maintained and exchanged;
- How data is attributed and described (e.g., in metadata, policy, catalogues etc.);
- How frequently it is exchanged and with what technologies;
- Whether data are openly accessible or restricted, and the data and system security measures that are in place; and
- How data is used today, who are the users, and what are the benefits?

The baseline is typically completed by assessing each organization that produces, value adds and uses geospatial information via a Baseline Survey. The objective of the Baseline Survey is to gather information about the current geospatial standards ecosystem in a country. This information is an important part of the Standards Needs Assessment and Gap Analysis as it helps to understand gaps in current capabilities.

Because the baseline only captures a particular point in time, it can be used to measure progress by conducting the survey again at a later date.



An example of a Standards Baseline Survey is provided in Appendix 6.2.

### 6.6.5 Standards Inventory

*A standards inventory is used to understand what standards are used by participating government organizations, users, and data and technology providers.*

A Standards Inventory is used to understand which standards are implemented within each participating government organization, by users, and/or by data and technology providers, and how, e.g. de jure or de facto.



See Interrelated Actions on Data Inventory (SP4) and Stakeholder Identification (SP9)

The Standards Inventory is also used to understand any national profiles of international standards in use. For example, a national metadata profile of the ISO 19115-1 and 19115-2 metadata standards for geospatial data and their access and processing, and importantly, who the users of the standards are

(See SP9: Action 9.6.4 – Stakeholder Identification). For efficiency, the Standards Inventory should be conducted at the same time as the Data Inventory (See SP4: Action 4.6.2).

### 6.6.6 Needs Assessment and Gap Analysis

*A Standards Needs Assessment and Gap Analysis is typically conducted once agreement on the strategic goals and current situation have been reached among the national stakeholders.*

The analysis of *needs* may result in several alternative scenarios concerning and relating to national goals for standards. These scenarios should be closely considered, looking at analysis, impact assessment and feasibility, as well as considering challenges and opportunities. The model of tiers introduced in Section 6.6.3 (Figures 6.6 and 6.7), in which different levels or tiers of increasing capability and collaboration are defined, is useful at this stage.

The tiers documented in the Standards Guide can be used as a guide for conducting a Needs Assessment and Gap Analysis, particularly when they have been used to align the strategic goals for a country's Common Standards Framework.



An example of a Standards Needs Assessment and Gap Analysis Template based on the four tiers is provided in Appendix 6.3.



### 6.6.7 Action Plan

The results of the Needs Assessment and Gap Analysis should inform the Country-level Action Plan with activities needed to strengthen the application of standards. Key questions to be considered in the process include:

- **What:** What are the functions required? Share maps/geospatial data across networks within an organization, on the web, or institute a better cataloging system to track physical maps? Support multi-jurisdictional geospatial data collection and maintenance? Support cooperative geospatial activities with neighboring and/or like countries?
- **When:** When do we intend to reach our goals or different steps? Is there a stepwise approach with milestones that must be scheduled? What are the key priorities by which an overall schedule will be developed?
- **Who:** Who are the key experts and decision-makers needed to support the activities identified?
  - Governance and policy bodies as defined in section 6.6.1;
  - Experts needed for developing information models, specifications, and IT environments;
  - Organizations providing experts;
  - Organizations responsible as authoritative data owners; and
  - Reference groups and stakeholders.



- **Costs and funding:** What are the costs, what types of costs, how is the national plan funded etc.?
- **Relation to other initiatives or activities:** A major national project will have an impact on other ongoing projects, and there can be both synergies and challenges to deal with. Certainly, relationships to the implementation of other Strategic Pathways at a national level will be highly relevant.
- **Capacity Development:** What is the approach for capacity development and the related resources and tools available?

### 6.6.8 Institutional Arrangements

The institutional arrangements must be cognizant of the Governance Model (See SP1) adopted for nationally integrated geospatial information management. An important consideration is the organizational governance roles, structures, and processes to:

- Ensure that all roles, responsibilities and organizational structures are in place and fostering a successful implementation;
- Identify the level of organizational capability required to meet the mission;
- Define the level of organizational engagement and resources necessary for participation in the standards governance process, as described in section 6.6.1, for successful cooperation between national agencies and stakeholders, and for sharing and exchanging geospatial data;
- Ensure that acquisition/procurement actions include requirements for common nationally endorsed standards;
- Consider the role of national bodies of standardization since standardization relies not only on “open standards” and “voluntary consensus” and international standards will often need to pass through a national process before being made official; and
- Consider participation in international standards organizations as part of capacity development and a means of influencing standards. IHO, OGC and ISO TC/211 have membership opportunities and support public comment processes for input on standards in development and related documents.



A summary of key Roles and Responsibilities for National Standards Governance is provided in Appendix 6.4.

## 4 Taking Action

### 6.6.9 Implementation

*When applying data and technology standards, it is recommended that countries adopt the Standards Guide.*

Once an agreement on the goals and path forward has been reached through the Standards Working Group (and the National body for standardization where applicable), these goals serve as a basis for implementing standards-related actions within the Country-level Action Plan, and should reflect the short-term national ambition, e.g. three to five years, as well as a longer-term perspective.

When applying data and technology standards, it is recommended that countries adopt the Standards Guide and take actions necessary to implement endorsed international and national standards at a chosen level or tier of capability. Basic steps for all countries include:

- **Maintain an inventory of data and associated technical standards:** It is of crucial importance that the inventory of data at the national level is regularly maintained and on an ongoing basis (See SP4: Action 4.6.2). This includes discussions on related data standards and standards associated with the capture, cataloging, discovery, management and distribution of geospatial data.
- **Document Metadata:** “Without metadata it is difficult to discover and access geospatial data. Incomplete metadata will make it difficult to impossible to determine the usefulness of data for mapping and analysis” (See SP4: Action 4.6.11). For this reason, it is important to ensure that geospatial data managed by an organization has associated metadata according to standards such as ISO 19115-1 and ISO 19115-2. Several profiles of ISO 19115 have been adopted around the world, and there are a number of useful tools and training resources available on-line (See Appendix 6.5). Additionally, a checklist for establishing metadata is provided in SP4: Appendix 4.9.
- **Establish desired geospatial information management functionality:** As described in sections 6.6.2 and 6.6.3, a Standards Guide was developed by OGC, ISO/TC 211 and IHO to provide details on the tiers of geospatial information management capability, and the associated standards to be implemented with each tier. This document should be directly consulted to identify common standards for implementation with the desired level of capability. The Standards Guide supports several tiers of capability. If existing geospatial information management capabilities do not support recommended standards as noted in the Standards Guide, recommended standards should be identified as actions as part of future acquisition or IT development.
- **Determining Compliance with Standards:** Ensure that geospatial products, services and data models to be implemented have been tested and are certified as compliant with the standard where such tests and certification services are available for a standard. The ISO/TC 211 package of standards (numbers typically between ISO 19100 and 19199) offer annexes with

self-evaluations in the standards, along with ready-made test cases. OGC offers on-line test and certification procedures for technology offerors to certify that they have properly implemented the standard. The OGC website includes a list of products that have been certified as compliant with specific OGC standards.

- **Adopt common geospatial terminology:** Common geospatial vocabularies should be used throughout the country.
- **Standards for semantic mediation:** Harmonization at the national level (See section 6.4.2), geospatial data maintained across cooperating organizations may need to be mediated to address differences in the data standards chosen for a particular geospatial data theme. The action required is to identify needs for the creation of standards-based encodings to support semantic mediation of similar data themes managed by cooperating organizations.
- **Set up IT and test environment:** To address compliance of systems to adhere to nationally endorsed standards.



A list of Standards Training, Tools and Related Resources are provided in Appendix 6.5 as well as in Appendix 8 of the Standards Guide (<http://standards.unggim.ogc.org>)

See Interrelated Actions on Metadata Management (SP4).

#### 6.6.10 Communication and Engagement

*Communicating the Action Plan is an ongoing task during all phases of implementation and operations.*

As part of the Standards Governance (See section 6.6.1), raising awareness across government and with relevant national stakeholders will be key. Communication is an ongoing task during all phases of implementation and operations. The aim is to communicate the benefits of applying national standards, the approach for how to proceed, what the impact will be, and how this affects different groups and stakeholders. After the implementation phase, the responsibility goes back to the Governing Body to ensure that long term benefits are made at the national level.

Besides making the public aware of the national standards and its implementation progress, communication is also of vital importance at an operational level as an ongoing process, facilitating stakeholder and community involvement. Communication plans should emphasize the importance and value of implementing international open standards to:

- Avoid being locked into a particular technology or vendor;
- Reduce costs over the lifecycle of a system or systems;
- Ensure the ability to share data when necessary;
- Enable interoperable sharing and operations;
- Enable innovation by facilitating rapid mobilization of new technologies and data sources, and
- Support disconnected or local operations.

Strategic Pathway 9: Communication and Engagement emphasizes a strategy for actively engaging and involving stakeholders and users, to raise awareness, advocate and strengthen geospatial information management, and including the application of standards to maximize access.



See Interrelated Action Communication Plan (SP9).

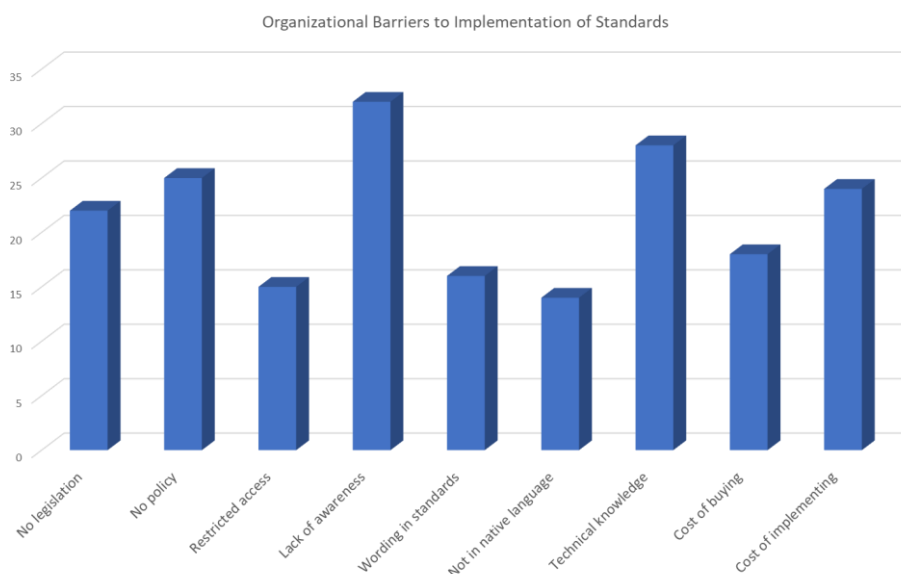
### 6.6.11 Risk Assessment

*Major barriers to implementing standards can be reduced by policy and/or legislation supportive of standards.*

A recent survey conducted by ISO/TC 211, IHO and OGC identified major barriers to implementing standards today (Figure 6.8). Barriers can be reduced by implementing policy and/or legislation supportive of standards, and by raising awareness, education across the community, and assuring adequate resources to address standards implementation throughout the geospatial information management and information technology lifecycle. Appendix 6.4 discusses the various roles and responsibilities in standardization, for management as well as for developers and users. Allocating roles and responsibilities is one way to reduce risk and overcome barriers to the implementation of standards.

International open standards are emphasized in the Standards Guide as a first choice, and will best position countries to support interoperability and compatibility of geospatial information and systems from the local to global level. Many countries adopt international standards as part of their National Standards policy.

National data standards and related encoding standards should leverage the global fundamental geospatial data themes established at the international level (See SP4: Action 4.6.1) whenever possible to promote data sharing across national borders when multi-national issues arise.



**Figure 6.8:** Organizations' barriers to implement standards (Survey by Standards Development Organizations for UN-GGIM, 2018). Lack of awareness and technical knowledge are prominent barriers.

Caution should be taken when considering the use of proprietary or de facto standards. These standards should balance the requirements for interoperability, access and use, and be used in parallel with international or national standards when possible.



#### 6.6.12 Standards Review Program

*While geospatial standards are quite mature, they do not remain static and require periodic updates.*

It is important to understand that geospatial standards, like the technology they support, are quite mature and are broadly implemented in technologies globally. However, Standards have a lifecycle, and will not remain static. To ensure consistent flow of geospatial data, Standards require periodic updates by the SDO community as they accommodate new technologies and user requirements. As such, it is important that any organization that employs the use of standards should maintain an ongoing process for review in order to update their systems, as necessary. To quote the Standards Guide: “Policymakers should also keep in mind that advances in technology inexorably changes organizational structures, workflows and business models.”

Data standards and technical specifications are subject to change for several reasons, and may trigger a review for the following reasons:

- Stakeholder needs have changed since the standards were developed, and will do so again;
- Standards are impacted by new policy and/or legislation. For example, Government Information Classification Code and new privacy laws; and other government mandates;
- Standards may need to be brought in line with related national standards, such as those pertaining to a change in the horizontal or vertical datum;
- Standards may need to be updated to reflect a change in the technology used to manage geospatial information. For example, hardware/software upgrades, new equipment, a change to formats of external data sources, and/or a paradigm shift in technology used;
- Business key performance indicators (KPI) require standards to be periodically reviewed based on the date of the last revision; or
- Standards may be reviewed as a result of lessons learned, such as from feedback from the public or regulator, non-compliance reports and subsequent resolutions, and incidents resulting from poor data management. These may include inadequate emergency response times, and changing business needs.

A Standards Review Program is typically used to prompt a review of data standards and technical specifications to keep abreast of new policy initiatives and changing stakeholders needs. It may be used to:

- To prompt the review of standards and specifications at regular intervals to assure standards and specification are compliant with the latest technology, as well as being internally compliant i.e. that internal references among the standards and specification are still valid.
- Reinforce the ongoing commitment to the development, implementation, and maintenance of a comprehensive data standards program;
- Facilitate an efficient and effective regulatory review process;
- Promote innovation in the development and use of standards;
- Implement common data standards to improve the quality and integrity of data; and
- Ensure effective continuous communication and collaboration with stakeholders on data standards.

A Standards Review Program will typically be coordinated by the Geospatial Coordination Unit or at an organization level. A Standards Review Program will typically include:

- Goals and objectives of the Standards Review Program;
- Governance process for ongoing review including roles and responsibilities;
- A schedule identifying when standards are to be reviewed;
- Communication strategies for conducting the review;
- Approval processes for new or revised standards;
- Scope of the review e.g. what data standards and technical specifications are to be brought under the review process; and
- Communication strategies for releasing new and revised data standards and technical specifications.

The Standards Review Program should be collaborative, flexible and adaptable to stakeholder needs and the changing environment. Stakeholders should be notified that a data or technology standard, or technical specification is under review, and a time set aside to consult with these stakeholders. A list of interview questions or survey is a suitable method for seeking input on changes and requesting feedback on proposed variations.

The review process should follow an agreed approach and adopt communications strategies and approval processes set out in the Standards Review Framework.

### 6.6.13 Community of Practice

*A community of practice can accelerate the process of strengthening the application of national standards and the realization of benefits.*

It provides the opportunity to share and leverage proven standards-based good practices. It also provides an opportunity for stakeholder organizations and business enterprises to have a voice in building and learning about standards.

A wealth of experience and knowledge is available from across the international community regarding the successful implementation of standards to support a range of topics and challenges. These include in areas such as public safety, water resources, environmental management, land administration, and smart, safe and resilient communities. By building a Community of Practice through partnerships with other countries, with SDOs and their expansive public and private sector membership, and with professional associations, countries can identify, assess, and adapt good practices of others. This can greatly reduce the time and effort to improve interoperability for data sharing and application to national issues.

Academia has a key role to play in supporting communities of practice and to assure readiness of students entering public and private sector professions. Universities should be encouraged to ensure the inclusion of up-to-date geospatial standards training and education as part of their overall geospatial management and information technology curriculum.



User Community Case Studies and Statements of Benefits are provided in Appendix 6.6 as well as in the Standards Guide and its appendices.

Examples of Community Good Practices are provided in Appendix 6.7

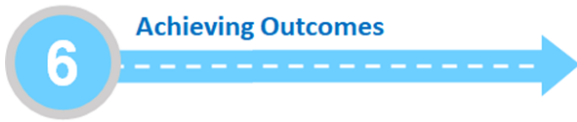


See Interrelated Action for Community of Practice (SP8).

### 6.6.14 Capacity Development

*Capacity development underscores a consistent approach to standards compliance to enable data management, sharing, and reuse.*

The application of data and ICT standards to enable interoperability, as well as the cooperation in data creation and management roles and responsibilities is essential. Building the appropriate capacity in standards will require collaboration across all levels of government (local, national, regional, international); particularly when it comes to information exchange. Capacity development approaches that can be used to enhance the management of technology and data standards are presented in SP8: Capacity and Education. Other important resources, such as standards training programs, are also available across the community, and may be usable in their current form, or updated to address national contexts.



### 6.6.15 Compliance

*A system of compliance is encouraged to ensure organizations are implementing the nationally (or internationally) endorsed standards that promote data sharing and use, and to verify that technology products and services acquired by government properly implement the required standards.*

Four levels of standards compliance should be considered by countries:

1. Regular assessment and validation of organizational compliance in implementing endorsed standards in their geospatial information management activities, and based on national policy;
2. Inclusion of nationally endorsed geospatial information management standards as a requirement for all organizational procurements/tenders delivering geospatial technologies and data products and services, with a mandate or preference for delivery of products and services that have been tested and certified as compliant (where such compliance tests are available) with the standard by the appropriate compliance authority;
3. Facilitation of testing and certification functions which can provide formal certification nationally as well as certification recognition under international testing and certification standards, frameworks, and conventions; and
4. Use of available technology compliance testing resources to confirm proper implementation of standards related to any government developed technologies.

ISO geospatial standards include self-evaluation resources that can be useful. OGC offers freely accessible on-line test procedures and manages a certification program for technology providers to certify products as compliant to one or more OGC standards<sup>9</sup>.

The OGC Compliance Interoperability Test Engine and test scripts are available as open source technology, and can be implemented by government organizations for testing of internal government systems which use, or may have been modified to use, OGC standards.

IHO has a long history of supporting international testing frameworks for certification against global standards supporting the SOLAS convention. These testing and compliance regimes are the result of global harmonization efforts by many national agencies.

---

<sup>9</sup> OGC compliance testing information is available at <http://www.ogc.org/compliance>.



### 6.6.16 Success Indicators

*Success indicators typically set targets and define how the benefits will be measured, and what evidence will be used as the basis.*

It is important to have a Benefits Realization plan and establish success indicators to gauge whether benefits have been realized. It is valuable to know when the objective of implementing standards has achieved overarching goal(s), for example, enhanced interoperability and data integration.

The benefits of implementing a common standards framework are achieved over time and reinforce the need for a national standards strategy while verifying that implementations had the desired impact in reaching overarching goals and objectives.

By implementing geospatial information management and systems based on a common, open, standards framework; technological barriers to geospatial information sharing can be significantly minimized. This allows the decision to share geospatial information among stakeholder organizations and with the public to be a policy decision e.g. regarding open data, unfettered by technology interoperability issues.

By adopting a common standards framework, organizations lower the risk of creating technical barriers to data sharing. Environments that support system and data interoperability lower system lifecycle costs, and more importantly, increase opportunities to share and cooperate on urgent, time sensitive issues. It will also provide assurance that geospatial information managed by different organizations can be discovered, accessed, and applied to address a range of important issues. Organizations reduce their IT lifecycle costs and make it easier to add new standards-based capabilities as they are offered by industry. They also take advantage of the interoperability enabled by the variety of geospatial and IT products and services available on the market that implement these standards. Various case studies regarding the benefits of adopting international geospatial standards are summarized in the Standards Guide.

Other indicators may include assessing, monitoring and evaluating as part of an internal/external auditing exercise, and may include factors such as:

- Improvements in geospatial data production and management efficiencies that save time and effort;
- Improved ability to share geospatial information with ease under normal operational and urgent situations; and
- Cost savings of reusing/repurposing geospatial data vice duplicative data collection and maintenance.



See Interrelated Action for Benefits Realization (SP3).

## 6.7 Deliverables

---

The list of deliverables below is the outputs typically created as a result of completing the actions in this pathway. They are key success indicators in realizing an Integrated Geospatial Information Framework. Examples include:

- A framework for Standards Governance
- National Standards Strategy
- Standards Awareness Raising and Communication Plan
- Strategic Goals
- Standards Baseline Survey
- Standards Inventory
- Needs Assessment and Gap Analysis
- Action Plan including Institutional Arrangements
- Standards Review Program
- Standards Community of Practice
- Standards Capacity Development Programs
- Standards Compliance Program
- Success Indicators for Benefits Realization

## 6.8 Outcomes

---

The following outcomes result from the successful application of standards to improve sharing and use of geospatial information and optimize geospatial information management in a country:

- Minimized barriers to data sharing and integration in support of government-wide policy, decision-making and service delivery;
- Enhanced abilities to share geospatial information across jurisdictional boundaries (local, national, and global) and to cooperatively address issues of common importance;
- Rapid mobilization of new sources of data and new technologies, as well as avoidance of lock-in to specific technology providers;
- Improved uptake of geospatial information across government and with the private sector and citizens; and
- Efficiencies in geospatial data production and lifecycle management; saving effort, time and cost in reusing and repurposing data.

## 6.9 Resources

---

As part of the work programme of the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM), there are a number of initiatives and activities including by the subcommittee, expert and working groups of the Committee of Experts. These initiatives and activities are multi-stakeholder when arriving at outcomes and outputs. This inclusive and participatory nature of work has allowed the preparation of a number of outputs and publications that are helpful and useful when implementing nationally (and internationally) endorsed standards. This includes specifically the Guide to the Role of Standards in Geospatial Information Management, which represents the significant and ongoing contributions of the Standards Development Organizations to the work of UN-GGIM.

## 6.10 References

---

O. Ostensen, D. McKenzie & R. Ward (2015). Standards Report to UN-GGIM 2015. Available at: <https://ggim.un.org/UN-GGIM-publications> accessed August 2020.

UN-GGIM (2021). A Guide to the Role of Standards in Geospatial Information Management (Edition 3) developed and maintained for UN-GGIM by ISO TC211, OGC, and IHO. Available HTML and PDF at: <http://standards.unggim.ogc.org/>