

## Strategic Pathway 8

# Capacity and Education

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*This **strategic pathway** establishes enduring capacity development and education programs so that the value and benefits of integrated geospatial information management is sustained for the longer term.*

*The **objective** is to raise awareness, build and strengthen knowledge, competencies, skills, instincts, processes, resources, and innovative entrepreneurship that organizations, communities and individuals require to utilize geospatial information for evidence based decision-making and effective service delivery.*

### **Summary**

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Strengthening awareness, knowledge and know-how, improving competencies, skills and instincts with education, training, continual development, and lifelong learning improves human resource capacities and capabilities for governments, organizations and communities, and benefit individuals.

Capacity development is about transformations that empower individuals, leaders, organizations and societies. Capacity development and education programs must be regionally-driven as well as addressing specific country needs and circumstances, contributing to national sustainable development strategies and priorities.

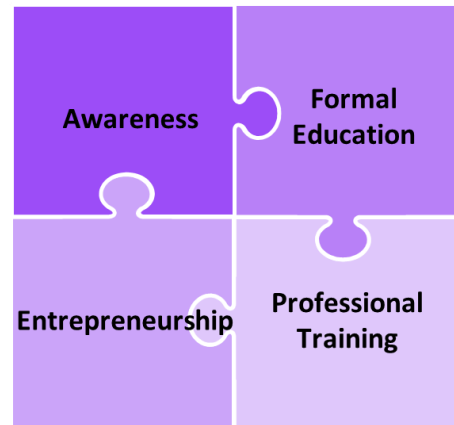
There are significant challenges and opportunities to operationalizing programs that sustain integrated geospatial information management. This strategic pathway considers these challenges and opportunities by introducing a change in operations and practice to achieve a degree of shared understanding about the principles and benefits of enduring capacity development and education programs for government, businesses, entrepreneurs, academics and the community. Culturally appropriate capacity development and education programs strengthen geospatial information management, making a real difference to the well-being of all through good evidence-based policy and decision-making.

Common to all capacity development programs and education systems are four key elements that are required to develop and strengthen the knowledge, competencies, skills, instincts, abilities, processes and resources that governments, organizations, communities and individuals require to utilize geospatial information for decision-making and service delivery. These include embracing new and emerging paradigms and technologies to bring enduring value and benefits to any geospatial information organization.

The four elements are:

- **Awareness** – raises, advocates and promotes the principles, values, needs and benefits of geospatial information via techniques including ‘contact’ courses, online courses, and outreach programs involving different interest groups, communities and individuals.

- **Formal Education** – offers sound foundation in topics important to understanding concepts of geography and geospatial science; imparts knowledge, science and technology, and develops competencies, skills and instincts in geospatial information management and its application.
- **Professional Training** – offers intensive, up-skilling and hands-on experience, and promotes lifelong learning and development needed to sustain geospatial information management. Aids the adoption, adaptation and embracing of new and emerging paradigms, technologies and methods, bringing enduring benefits to geospatial information organization.
- **Entrepreneurship** – encourages capacity through innovative and creative applications, design and launch of start-ups, and operating new business ventures that are critical to vibrant and growing digital economies underpinned by geospatial information.



These elements are underpinned by principles that promote successful capacity development and education programs that can be adopted by each country. The principles are put into practice through several strategic actions that deliver and strengthen capacity and participation to successfully operationalize the Integrated Geospatial Information Framework (IGIF). Resource materials and tools, such as matrices, examples and checklists, are provided in the appendices to assist nations to work through concepts and processes to successfully complete each action. The overall structure for capacity and education is illustrated in and anchored by Figure 8.1.

When implemented the actions (and their interrelated actions) 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:

- Broad geospatial awareness and capabilities at all levels through effective capacity development and education programs;
- Increased adoption and application of geospatial technologies and processes by government, organizations, communities and individuals;
- A stimulus in creativity and innovative solutions to address real-world challenges, economic opportunities and growth, and well-being for society; and
- An increase in the number of primary and secondary school students, post-secondary students and workplace persons equipped with increasing knowledge, proficiencies and instincts in geography and geospatial sciences.

<b>Elements of Capacity and Education</b>	<b>Awareness</b>	<b>Formal Education</b>	<b>Professional Training</b>	<b>Entrepreneurship</b>
<b>Guiding Principles</b>	Responsible Relevant Responsive	Objective Inclusive Holistic	Collaborative Coordinated Resilient	Incentivized Sustainable Accountable
<b>Key Actions for Strengthening Geospatial Information Management</b>	<b>Setting Direction</b> Capacity and Education Working Group Target Groups	<b>Considering Alternatives</b> Capacity Development and Education Strategy	<b>Taking Actions</b> Community of Practice Innovation Hubs and Incubators Geospatial Challenges Geography in Schools Scholarships and Internships	
	<b>Assessing Needs</b> Inventory of Knowledge, Skills and Resources Assessments and Analyses	<b>Planning for Action</b> Development Approaches Implementation Plan Education Programs Outreach Initiatives		
<b>Tools to Assist in Completing the Actions</b>	Knowledge-Skills- Resource Matrices for Organizations Knowledge-Skills- Resource Matrices for Teams Capacity Scanning Matrix Incremental Approach to Needs Assessment/ Analysis	Gap Analysis Approach to Needs Assessment/ Analysis PEST and SWOT Analyses	Typical Components of a Capacity Development and Education Strategy Types of Capacity Development Approaches Recording Success Indicators for Capacity Development	
	<b>Interrelated Actions</b>	Geospatial Coordination Unit (SP1) Specialist Working Groups (SP1) Governance Model (SP1)	Potential Partners, Preliminary Screening and Initial Engagement (SP7) Stakeholder Identification (SP9) Communication Plan (SP9)	Data Sharing and Dissemination (SP2) Design and Develop (SP2) Communication Strategy (SP9) Innovation Hubs (SP5)
<b>Outcomes</b>	Broad geospatial awareness and capabilities at all levels Increased adoption and application of geospatial information, technologies and processes	Stimulate creativity and innovative solutions to address real-world challenges, economic opportunities and growth, and wellbeing of society	Equipped with increasing knowledge, proficiencies and instincts in geography and geospatial sciences.	

**Figure 8.1:** The overall structure for the Capacity and Education 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.

## 8.1 Introduction

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*Capacity development and education programs in geospatial information management and related technologies are transformational.*

The 2030 Agenda for Sustainable Development and the Addis Ababa Action Agenda on Financing for Development recognize capacity development as an integral part of the global partnership for sustainable development. The Addis Agenda called for enhanced international support and establishment of multi-stakeholder partnerships for implementing effective and targeted capacity-building in developing countries, including least developed countries, landlocked developing countries, small island developing States, African countries, and countries in conflict and post-conflict situations, to support national plans to implement the 2030 Agenda. It reiterated that capacity development must be country-driven, address the specific needs and conditions of countries and reflect national sustainable development strategies and priorities.

Capacity building is defined as the ‘process of developing and strengthening the skills, instincts, abilities, processes and resources that organizations and communities need to survive, adapt, and thrive in a fast-changing world’. Capacity building and capacity development are often used interchangeably, and is the case in this pathway. While 'capacity building' suggests building something new from the ground up, according to a pre-imposed design, 'capacity development' is believed to better express an approach that builds on existing skills and knowledge, driving a dynamic and flexible process of change, borne by local actors.

For the United Nations Development Programme (UNDP), capacity development starts from the principle that people are best empowered to realize their full potential when the means of development are sustainable; home-grown, long-term, and generated and managed collectively by those who stand to benefit most. Capacity development is about transformations that empower individuals, leaders, organizations and societies. If something does not lead to change that is generated, guided and sustained by those whom it is meant to benefit, then it cannot be said to have enhanced capacity, even if it has served a valid development purpose (UNDP, 2009).

Capacity development and education programs are the processes by which governments, organizations, communities and individuals, including leaders, obtain, improve, and retain the knowledge, competencies, skills, instincts, instruments, tools and related resources they need to undertake activities, solve problems and achieve desired outcomes.

This Strategic Pathway provides the guidance and options to raise and improve awareness, develop and sustain the acquisition of knowledge and science, practices and proficiencies, skills and instincts, which governments, organizations, communities and individuals require to utilize geospatial information for daily activities and decision-making. It recognizes that capacity development is a continually evolving process of growth and positive change that is aimed at the specific needs of particular groups within society (UNDP, 2009).

Strengthened capacities stimulate creativity and innovation to address real-world challenges, economic opportunities, environmental sustainability, and the well-being of society. This objective is crucial. Capacity development and education programs are transformational when: (i) assimilated

across disciplines and sectors; (ii) have access to robust enabling infrastructure, and innovation system and culture and; (iii) are designed for all levels of governments, organizations and communities.

At the government **organizational level**, capacity development targets teams of people – bringing them together to work towards increasing the potential and capacity for geospatial information management and its use. Programs aim to highlight where resourcing, institutional structures, and policies and procedures need to be enhanced (UNDP, 2011), as well as achieving an understanding between organizations to achieve a whole-of-government approach to geospatial information management that is coordinated and integrated.

At the **community level**, awareness and education help the user community to understand geospatial information and how to acquire the knowledge, competencies and skills they need so that there can be more inclusiveness and participation in activities and applications that collect, share and use geospatial information. It is also about strengthening national systems of governance through reforms, policies, regulations and laws to create opportunities that expand the capacity of people to the fullest (NPA, 2002). This includes using meaningful and reliable geospatial information to strengthen indigenous people’s abilities to improve their quality of life and effectively define their own sustainability priorities.

At the **individual level**, capacity development and education programs raise and promote recognition of the proficiencies, experience and knowledge that each person needs to perform their current and future tasks (UNDP, 2011), as well as a broader awareness of how their geospatial information impacts on and facilitates the work of others. Importantly, this involves enabling individuals to embark on a continuous process of learning by building on existing proficiencies and extending these to realize new opportunities (NPA, 2002).

## 8.2 Context and Rationale

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*Capacity and education are integral for transforming the use of geospatial information and increasing its adoption and innovative potential across a broader range of stakeholders.*

The 2030 Agenda and its 17 Sustainable Development Goals (SDGs) are highly dependent on geospatial information and enabling technologies as the primary data and tools for relating people to their location and place, and to measure ‘where’ progress is, or is not, being made, particularly at ‘disaggregated’ sub-national and local levels. In this respect, the 2030 Agenda specifically demands the need for new data acquisition and integration approaches, including to exploit the contribution to be made by geospatial information and Earth observations to support the implementation of the SDGs, targets and global indicators.

However, in the pursuit for sustainable development, many nations continue to face a series of impediments that exacerbate their ability and ‘opportunity’ to participate fully in the implementation of the 2030 Agenda, to support national development and partake the economic prosperity, and through that, a global and thriving information economy.

Capacity and education are integral for transforming the use of geospatial information and increasing its adoption and innovative potential across a broader range of stakeholders and partners. There is growing recognition that capacity in geospatial information management should not be confined to

geospatial technicians, specialists, analysts and professionals alone, but include those with knowledge and expertise in business planning and management, economics and finance, indigenous peoples knowledge, public health and emergency response, media and communications, and decision makers from a cross section of domains, industries and professions. In some situations, more can be done to enhance the expertise of human geographers, economic geographers and environmental scientists to develop evidence-based systems for human development, economic growth and sustainable development.

Building appropriate capacity will require collaboration across all levels of government (sub-national and national) and with regional and international organizations; particularly when it comes to information exchange. A consistent approach to capacity development is required to enable compliance, for example, data sharing policy and data release guidelines, and the application of data and ICT standards to enable interoperability, as well as cooperation in data custodianship roles and responsibilities.

One of the most significant capacity and education challenges for many developing countries is the increasing divide in data accessibility, data interoperability and completeness, and technological capacity. The transition from cartographically-driven production methods to data-driven generated content, has created a paradigm shift in the requisite skills base of the geospatial profession. However, many geospatial information professionals, specialists and technicians are trained in traditional surveying and mapping production, with instrumentation and methodologies that are now considered obsolete in many developed countries. This is compounded because technology changes so rapidly that even trained personnel require retraining as skills and knowledge quickly become out-of-date.

The need to sustain relevant knowledge and skills, and to keep pace with technological advancement and change, is also a challenge for developed countries. Geospatial technologies continue to evolve at a rapid rate, however the commensurate capacities and education required to strengthen knowledge, capabilities, skills and opportunities, especially in the developing countries are not. Moreover, for developing countries, professionals trained abroad are often not able to utilize or transfer the knowledge and skills they have gained to others on their return. Often, they do not have access to the same technology and resources they had while studying overseas, or they are simply not in positions to influence geospatial information management practices.

In addition, the benefits of capacity development and education programs are often overshadowed by concerns of better remuneration for better qualified personnel, and the exodus of highly trained and qualified personnel to more lucrative jobs particularly into the private sector – a process commonly referred to as ‘brain drain’. This brain drain can be transboundary, with better trained and qualified personnel pursuing more lucrative jobs and better work environments in neighboring and other countries, including in developed countries. These concerns are not without cause. National geospatial, survey, mapping, cadastral and land agencies are often constrained by traditional pay structures and salary ceilings, which may make it difficult to retain staff with contemporary geospatial information management competencies.

Nonetheless, the future for personnel knowledgeable in geospatial sciences is changing. Professionals equipped with the understanding of the complexities of linking geospatial and non-geospatial data, are developing new capabilities and processes for producing far more relevant and beneficial products

and services for policy and decision-makers, and the community. Governments, organizations and communities now recognize that a modern and knowledgeable geospatial workforce is essential if they are to take advantage of the latest sciences and technologies, stimulate innovation, and to enable work to be accomplished far more effectively, efficiently and beneficially, than ever before.

Today, data models are able to answer a wider range of questions than previously possible, and systems are able to better manage the rapid growth in data volumes. Automated processes have advanced through Big Data analytics and Artificial Intelligence - to a stage where many laborious data collection and data processing tasks have been reduced significantly, and productivity improvements and savings realized.

With this increased capability and potential, including financial gains, comes opportunities to garner support for capacity development and education programs, as well as savings to offset any salary increases that may arise. Also, the shift to new and automated methods means that operations can focus on analyzing and answering important questions, contribute to solutions, and as this is more rewarding work, often translates to staff retention opportunities.

### 8.3 Approach

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*The way forward relies on strengthening the skills, instincts, abilities, processes and resources of organizations, communities and individuals.*

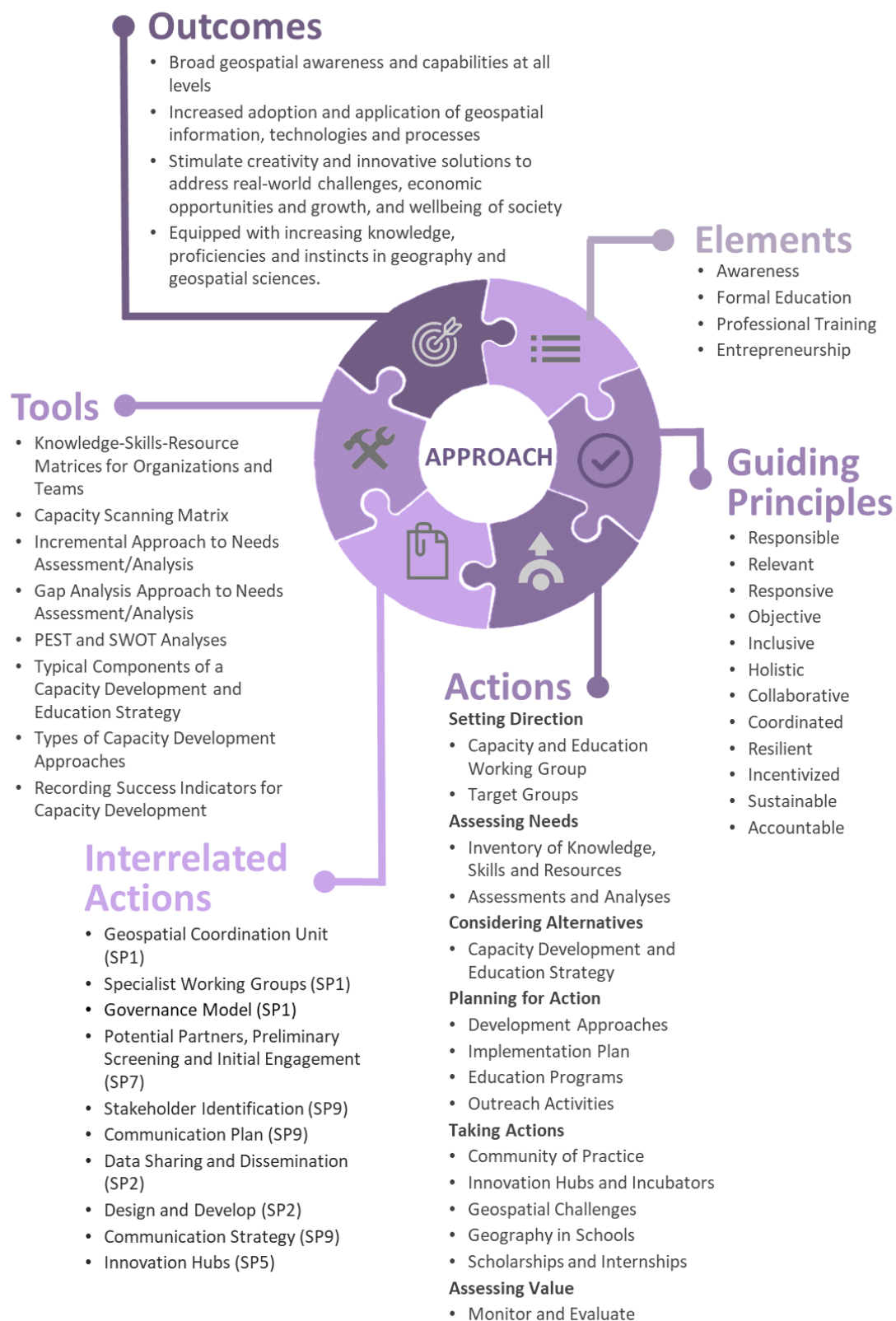
The approach for effective awareness, sound education, continuing professional training, innovative entrepreneurship and developing the requisite capacities and capabilities is through a shared understanding of the value of the IGIF, and the roles and responsibilities to drive change and achieve the vision.

The approach includes four key elements that are a guide for nations to strengthen participation and commitment to achieving nationally integrated geospatial information management. These elements include: raising the **awareness** to promote the principles, values, needs and benefits of integrated geospatial information management; **formal education** that is foundational to acquiring knowledge and develop skills, competencies and instincts; continual **professional training** to keep pace with new and emerging geospatial paradigms, technologies and process; and innovative **entrepreneurship** that brings out the best and highest use and value of geospatial information, bringing enduring benefits to society, environment and economy, and to any geospatial information organization. These elements are explained in more detail in section 8.4 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 8: Capacity and Education is illustrated in Figure 8.2 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 in section 8.5 below, as these describe what is important for effective and efficient geospatial information management.



**Figure 8.2:** The approach to Capacity and Education.



## 8.4 Elements

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### 8.4.1 Awareness

*Awareness at all levels of government, organizations and communities on the values, needs and benefits of geospatial information and its integrative capacity is crucial.*

The environment for raising awareness and promoting the usefulness of geospatial information extends across the broad social system and political economy within which people and organizations manage and use geospatial information, including the laws, regulations, policies, standards, and norms that govern geospatial information management. Awareness is achieved formally through education and training programs and informally through lifelong observation and hands-on experience, as well as the active promotion of the discipline of geospatial science.

Leadership is a key attribute for ensuring this awareness is demonstrated and effectively maintained over the longer term. It is through leadership that people become familiar with the value and benefits of geospatial information, and are influenced, inspired and initiated to respond to the changes needed to strengthen capacities and capability.

### 8.4.2 Formal Education

*Formal education programs are delivered intentionally and systematically through schools, institutions and universities.*

It is necessary to cultivate understanding of geography, including from a younger age, to build and sustain capacity for integrated geospatial information management. Knowledge of geospatial science and technologies, and means to impart geospatial knowledge, science and technology, improve understanding and develop competencies, skills and instincts in geospatial information management is necessary at post-secondary, vocational and tertiary levels. This foundational understanding and knowledge are achieved through formal education.

Formal programs are delivered by trained and qualified teachers in a systematic intentional way through a school, a higher education institution or university. Investing in technical and tertiary education has a significant positive impact on national capacities. Evidence indicates that nations that invest in their post-secondary education systems have developed capacities that have borne fruit over a much longer period of time.<sup>1</sup> These investments can include scholarships, fellowships, sponsorships and internships; the latter two normally facilitated by the workplace.

Formal education is necessary to enhance awareness, understanding and adoption, and can be integrated with informal education programs to expand the benefits of education on geospatial science. Informal programs are typically directed at geospatial users and the public to promote the utility and usefulness of geospatial information and encourage its best and highest use. Beyond geography, it is important to encourage the adoption of initiatives to introduce core concepts of geospatial science in other disciplines, such as mathematics, statistics, computer science, design, public health, economics and business studies.

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<sup>1</sup> The data from India and the Republic of Korea are clear in this respect, showing high returns on their investments in their Institutes of Technology and in their Agricultural Universities (UNDP, 2009)

### 8.4.3 Professional Training

*Professional workplace training affords opportunities for observation, hands-on experience and up-skilling that enhance capacity within the geospatial community.*

Professional training, lifelong learning and continual technical and professional development are necessary human resource elements to sustain integrated geospatial information management capabilities. There is also the need to offer opportunities for intensive up-skilling and hands-on experience. This enhances capacity within the geospatial community to adopt, adapt and embrace new and emerging paradigms, technologies and methods, bringing enduring benefits.

Knowledge and know-how can be developed and shared within an organization, such as through on-the-job training, apprenticeships, study and exchange visits, and fellowship programs. Workplace training can be conducted internally by leveraging the skills existing within an organization or obtained from external providers and partners. With external workplace training, there is often more opportunity to observe and gain hands-on experience in state-of-the-art systems and processes, such as through international partners or donor fellowship programs that have effective educational and training systems in place. Being able to observe and apply new methods and gain practical experiences has significant benefits, not just because of the new knowledge and skills earned, but also because of the opportunity to develop professional networks and mentorship.

As well as on-the-job training and formal external training, professional bodies have an important role in professional development. Professional groups can provide assured levels of competence through assessment and accreditation, as structure for continuing professional development, and exchange of professional expertise. They can also act as an expert voice on behalf of their members raising awareness of the value of the profession, and provide a community for many of the actions identified.

Sharing geospatial knowledge, improving geospatial competencies, skills and abilities should also be extended to allied professions and stakeholders, so that there is the capacity to use and benefit from geospatial information in their work. This can include planning, emergency response, construction, agriculture, statistical analysis, forestry, fisheries, to name a few, that can benefit from the integrative capacity of geospatial information and its abilities to link data to location. Professional development activities are also an effective mechanism for attracting and keeping employees engaged, which is crucial in nations that suffer from high staff turnover and brain drain. Diversity programs that include support for recruitment and retention, such as providing opportunities at each stage of a career as well as mentoring and inclusivity, provide for essential professional career development pathways of employees.

### 8.4.4 Entrepreneurship

*Entrepreneurs design, launch and operate new business ventures and are critical to job creation, career development, improving delivery systems, and growing the economy.*

Capacity is developed through commercially innovative and creative applications of geospatial information. Geospatially driven start-ups and entrepreneurship are critical to a vibrant and growing digital economy. Governments can support and stimulate entrepreneurship through innovation programs that grow the capabilities of the business sector to develop products and services that are underpinned by geospatial information. This support is important.

Entrepreneurs are often exposed to risks when bringing new ideas to market, yet they create business opportunities and advance society, while solving real-world problems. Innovation programs<sup>2</sup> have been established to foster entrepreneurship through capacity development, public private partnerships, learning programs, and mentoring opportunities. These programs are targeted at both early stage start-ups and seasoned corporations that are looking to adopt geospatial science, technologies, processes and standards, and creative use of geospatial data to solve problems, and build new applications.

Entrepreneurship can also be leveraged to address the issue of access – to internet bandwidth, to curriculum, to expertise, to adequate resources, to job opportunities, to equitable remuneration – important to sustain effective capacity development and education programs. There is potential to enhance entrepreneurship through cross-border and international collaboration where synergies exist or can be fostered.

## 8.5 Guiding Principles

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*By applying the guiding principles, countries can make progress in strengthening their geospatial information management capabilities.*

There are specific guiding principles and elements common to effectively managing and delivering enduring capacity development and education programs for the benefit of governments, organizations, communities and individuals. Adopting a successful capacity development and education program from one country to another will likely not work in its entirety, as there are different priorities and levels of development maturity and cultural aspects that need to be considered. That said, adapting and leveraging good ideas and successful implementations across nations is encouraged where the approach is suitable. These principles also need to be embedded into policies, strategies and measures taken. The guiding principles for capacity and education are:

- **Responsible:** Governments, organizations and communities design, develop, own, direct, implement, and sustain capacity development and education programs themselves.
- **Relevant:** Capacity development and education programs align with national circumstances, needs, culture and practicalities, and build upon existing capacities and capabilities.
- **Responsive:** Keeping pace with the times and with new and emerging paradigms, technologies and processes; adaptive and responsive to changing circumstances.
- **Objective:** Clear and achievable goal (or set of goals) that motivates the capacity development and education efforts that delivers the intended outcomes.
- **Inclusive:** Capacity development and education strategy and programs embrace diversity, and encourages active participation irrespective of gender, religion, race, disability or social status of individuals.

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<sup>2</sup> Examples include, GeoVation (United Kingdom) and GeoSpace (Singapore).

- **Holistic:** Learning and training mechanisms recognize co-dependence and inter-relatedness of the geospatial sciences to the various programs of government and related institutional arrangements.
- **Collaborative:** Where possible, partnerships are developed to maximize the resources and effectiveness of capacity development and education programs.
- **Coordinated:** A coordinated, coherent and well-managed change process that leads to improvements in the targeted area of capacity development.
- **Resilient:** Programs incorporate flexibility, agility and scalability, providing continuity and recovery through a changing and difficult operating environment.
- **Incentivized:** The needs, interests and motivations of all is understood so that learning outcomes are targeted towards what matters most.
- **Sustainable:** Capacity and education viewed as long-term investments; are practical, well-planned and executed, and effective.
- **Accountable:** Capacity development and education programs are administered with good governance, monitoring and evaluation, and consultation and reporting mechanisms.

## 8.6 Actions

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*The strategic pathway actions are recommended as a means to achieve the four key elements of capacity and education.*

Country-specific actions may be influenced by factors such as country priorities, existing capabilities, national circumstances, resources, culture and other practicalities. These will influence approaches for implementing each strategic pathway and their related actions.

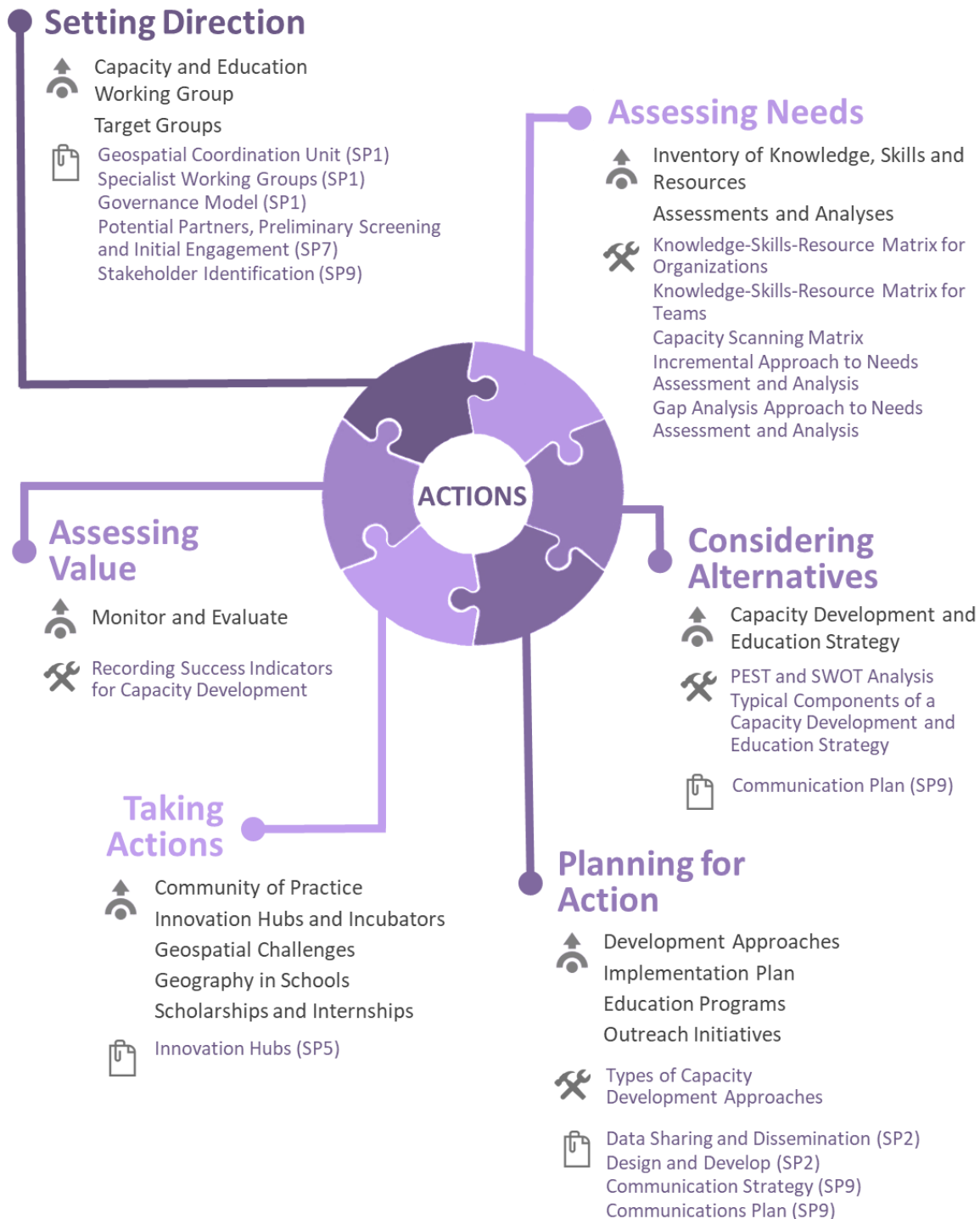
For ease of use, particularly to assist countries in the initial and early stages of developing and strengthening their national geospatial information management arrangements, the actions are presented in a sequential step-by-step structure. A road map illustrating this order and where the actions typically occur and are completed, is presented in Figure 8.3. 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 8.4.

Some actions may have interrelated actions that need to be achieved prior to, or in conjunction with, the strategic pathway actions. Actions may also be iterative and need to be reviewed and revisited at different times. These interrelated actions are also illustrated in Figures 8.3 and 8.4, 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 8.5, as these describe drivers for attaining effective and efficient integrated geospatial information management.



**Figure 8.3:** Capacity and Education includes several actions and tools designed to assist countries to raise awareness and develop and strengthen the skills, instincts, abilities, processes and resources that organizations and communities require to utilize geospatial information for decision-making and service delivery. The actions are divided into six categories and reflect the order with which these actions are typically completed.



**Figure 8.4:** Capacity and Education includes several actions and tools designed to assist countries to raise awareness and develop and strengthen geospatial information for decision-making and service delivery. The interrelated actions provide key linkages to other strategic pathway actions.

The actions for Capacity and Education Strategic Pathway are divided into six categories, which are:

1. Setting Direction;
2. Assessing Needs;
3. Considering Alternatives;
4. Planning for Action;
5. Taking Actions; and
6. Assessing Value.

The following actions are typically used to address gaps and needs, including proactively, in capacity and education. They serve as a guide to developing the necessary capacity to strengthen integrated geospatial information management, systems and processes.



### 8.6.1 Capacity and Education Working Group

*The Capacity and Education Working Group will coordinate and direct the development and implementation of appropriate strategies and programs.*

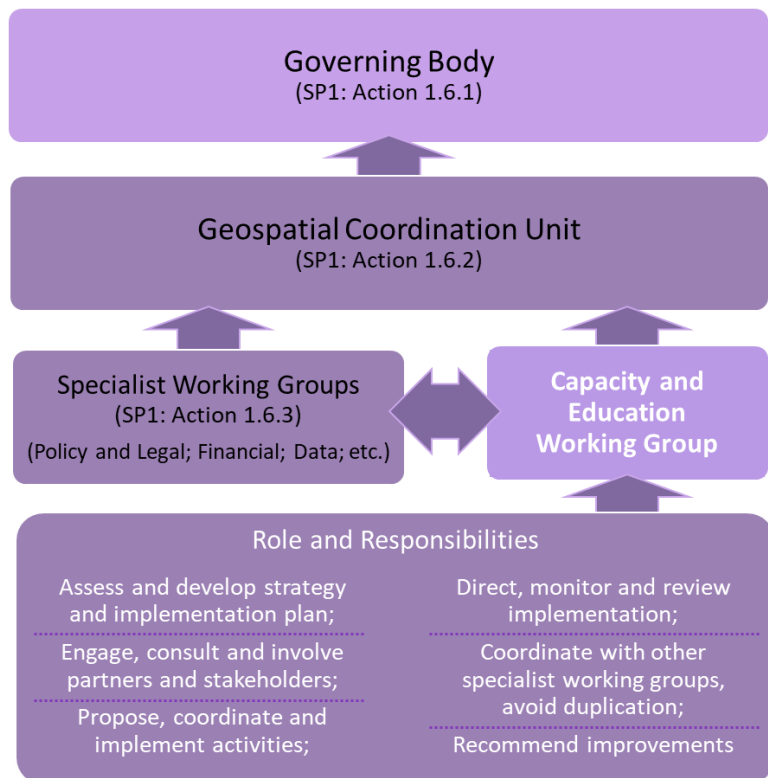
The Governance Model for integrated geospatial information management (See SP1: Action 1.6.4) seeks to strengthen multidisciplinary and multi-sectoral participation, effective and transformational leadership, supportive institutional arrangements, and a clear value proposition that is appreciated broadly. The Governance Model includes capacity and education, usually through a Specialist Working Group (See SP1: Action 1.6.3) that provides oversight and directs initiatives aimed at raising awareness and developing knowledge, competencies, skills and instincts necessary for strengthening geospatial information management.

The Capacity and Education Working Group will design and develop strategies and programs that promote and improve competencies, skills, education, training, continual professional development, and lifelong learning to improve capacities for governments and organizations. The Working Group should report directly to the Geospatial Coordination Unit (See SP1: Action 1.6.2) and would typically have the following roles and responsibilities (Figure 8.5):

- Assess, analyze, design and develop strategies and plans (See SP8: Action 8.6.7) through broad consultation and engagement, and work to have the strategy endorsed and implemented;
- Ensure capacity development and education efforts and activities are in line with the Capacity Development and Education Strategy and its Implementation Plan;
- Engage stakeholders and partners (See SP7: Actions 7.6.5, 7.6.6 and 7.6.7) on capacity and education issues so that the strategy and its implementation plan are prioritized and targeted;
- Coordinate initiatives with other Specialist Working Groups (Data, Technical, Policy and Legal, Financial, etc.) that report directly to the Geospatial Coordination Unit to ensure coordination

and coherence, avoid duplication and redundant efforts, and manage interdependencies, such as the need for technology resources;

- Coordinate and direct the implementation of the Capacity Development and Education Strategy and its Implementation Plans; monitor and evaluate outcomes and make further recommendations for improvement where necessary;
- Review any policy issues and monitor trends, including emerging and future trends, and make recommendations to the Geospatial Coordination Unit (See SP1: Action 1.6.2) or the Governing Body (See SP1: Action 1.6.1); and
- Develop new policies, guidelines and content related to capacity development and education, as appropriate.



*Figure 8.5: Typical reporting structure for the Capacity and Education Working Group.*



See Interrelated Actions on Geospatial Coordination Unit (SP1); Specialist Working Groups (SP1); Governance Model (SP1); and Potential Partners, Preliminary Screening and Initial Engagement (SP7)

### 8.6.2 Target Groups

*The identification of target groups is the first stage in analyzing and determining the gaps and needs in capacity.*

Partnerships and collaboration within and between organizations, communities and individuals build and develop the knowledge, expertise and real-world experience, as well as human, technological and financial capacities to strengthen integrated geospatial information management. The identification of target groups is the first stage in analyzing and determining the gaps and needs in capacity. Initiatives typically focus on the development of **subject matter experts** in geospatial information management, and the process is ongoing. However, more can often be done to enhance the skills and expertise in other areas including (UN-GGIM, 2011) (Figure 8.6):

- **Leadership transformation:** Senior sector policy makers, legislative (parliamentary committees) and industry leaders;



- **Government ICT capability:** Experts in thematic application areas, management and professional staff, ICT professionals and technical support staff;
- **Research and development:** Scientists, academics, researchers, technicians from a broad cross-section of knowledge domains;
- **Economic and business development:** Economist, entrepreneurs, industrialists, practitioners across industry and businesses;
- **Integrated planning capability:** Planners, policy makers, mid-level development managers and technical support staff; and
- **Civic transformation:** Professional associations (e.g. Institutions of Surveyors, Engineers, Architects etc.), trade associations (e.g. Chamber of Commerce, Miners etc.), providers of location-based services, and volunteer geographic information providers, as well as the general community.

Importantly, the professional body (association) has a significant role to play in supporting and enabling capacity development and education through professional accreditations, competency standards, industry certifications, professional mentoring, and opportunities for professional training. In addition, professional associations initiate and contribute to their discipline's body of knowledge and related standards. Similarly, employers have a role to play in education.

Education provides the workforce that employers need to function effectively. There is a recognized skill shortage of geospatial professionals in many countries, which means employers are recruiting from a weakened labor pool and having to either accept a lower level of competence, or invest in on-the-job training.

Understanding these target groups and their capacity, education and awareness needs are integral to (1) maximizing the value of geospatial information; (2) sustaining the geospatial community and; (3) creating a geospatially-enabled economy. Early identification and action are vital, as there can be a long lead time in the development of appropriate awareness-raising initiatives, education and training programs, and demand in the short-term may exceed the pace of implementation.

Once the target groups have been decided it is then important to understand what capacity development and education needs are relevant to each group. A capacity scanning matrix can be used to map the target group with the required knowledge, competencies, skills, and resources (See SP8: Action 8.6.3).



*Figure 8.6: High-level target groups for engagement – the process is recurring.*

At this stage, only a general understanding of the knowledge, competencies, and skills required is important. A more in-depth study will be completed during the knowledge/skills inventory, where the inventory is designed specifically for each organization, community, or group participating in the knowledge/skills inventory process (See SP8: Section 8.6.4).

It is worthwhile discussing with representatives from each target group what they consider are their current strengths and weaknesses, and where opportunities arise. It is also beneficial to determine the level of interest that each target group has in developing skills and knowledge further.



See Interrelated Action on Stakeholder Identification (SP9)

## 2 Assessing Needs

### 8.6.3 Inventory of Knowledge, Skills and Resources

*An inventory establishes a baseline (current situation) of a country's current knowledge, skills, and resources.*

As part of developing a strategy for capacity and education, it is important to produce an Inventory of Knowledge, Skills, and Resources, in order to critically examine the current situation, i.e. existing capacity development and education policies, programs, and resources – technological, financial, and human – that are currently in place. This is the 'entry point' for the Needs Assessment and Gap Analysis (See SP8: Section 8.6.4) i.e. an understanding of what currently exists.

An inventory establishes a baseline (current situation) of a nation's current knowledge and skills. The baseline can be used at a later date to monitor progress towards achieving the desired capacity levels and broader development goals and objectives.

A matrix is able to provide an inventory of knowledge and skills to gain an understanding of capacity development across the broader sector, and is usually conducted at an organizational level. The first step to achieving this is to list the geospatial-related knowledge and skillsets required for each organization, and then map this information to the different levels of responsibilities and/or positions held within the organizations.

The inventory can be further refined at the team level. This is often done to better manage human resources and estimate costs associated with ongoing and future education and training needs.



An example of a Knowledge-Skills-Resource Matrix for Organizations is provided in Appendix 8.1, and

An example of a Knowledge-Skills-Resource Matrix for Teams is provided in Appendix 8.2.

#### 8.6.4 Assessments and Analyses

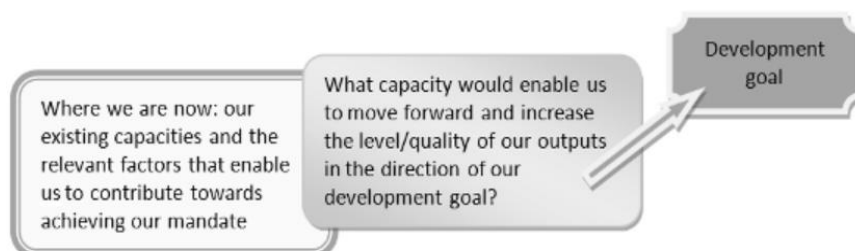
*Needs assessments and gap analyses are conducted to understand the current situation, requirements and opportunities.*

Governments, organizations, businesses, and civic groups need staff with the requisite knowledge, competencies, skills, and behaviors to effectively and efficiently fulfil its roles and responsibilities with respect to geospatial information. Needs assessments and gap analyses can be conducted to understand learning and development capacities, and for the identification of gaps in capabilities. These can then be measured against the desired outcomes in accordance with the Geospatial Information Management Strategy (See SP1: Action 1.6.6).

The approach to a needs assessments and gap analyses assumes that there exists some level of capacity. Therefore, it is not always necessary to start with a comprehensive assessment. A capacity scanning matrix is used to document existing capacity issues, and to get capacity development on a government or organization’s agenda. This matrix is relevant for the early stages of assessment, but does not substitute a full diagnostic of existing or future capacities. The matrix is to be completed in consultation with the target groups identified on an organizational/group basis to identify strengths and weaknesses, and thereafter to clarify where differences of opinion exist.

The assessment is often an ongoing process and can be conducted at several points in the capacity and education planning lifecycle – getting progressively more detailed as circumstances dictate. For example, an assessment of teams within an organization will be far more detailed than an assessment from a whole-of-government viewpoint.

This assessment and analysis can be conducted in two ways – an incremental approach, or a gap analysis approach. An **incremental approach** starts by identifying existing capacity and using that as the foundation for moving forward (Figure 8.7). The incremental approach allows key stakeholders to define what is important to them. However, they may not necessarily have the appropriate technical knowledge or other information necessary to frame their next capacity steps in a meaningful way. In contrast, the **gap analysis** is useful for assessing hard capacities, but not as useful for analyzing softer skillsets. The gap analysis starts with a set of defined criteria that reflects an ideal situation (Figure 8.8). However, the ideal situation may be too ambitious to be helpful in setting realistic goals and objectives for moving forward. In addition, the gap analysis tends to depend on outside experts and their assessment of how things should be. The method chosen will depend on the nation’s context, level of geospatial maturity and institutional setting. The incremental approach may be more suited to nations where geospatial initiatives are in the initial stages so that new capabilities can evolve over time in parallel to geospatial developments.



*Figure 8.7: Incremental Approach*



**Figure 8.8:** Gap Analysis Approach



An example of a Capacity Scanning Matrix is provided in Appendix 8.3;  
 An example of an Incremental Approach to Needs Assessment and Analysis is provided in Appendix 8.4; and  
 An example of a Gap Analysis Approach to Needs Assessment and Analysis is provided in Appendix 8.5.

### 3 Considering Alternatives

#### 8.6.5 Capacity Development and Education Strategy

*A Capacity Development and Education Strategy provides strategic direction and coordination and coherence to improve human and institutional performance.*

There needs to be a strategy for capacity and education. A Capacity Development and Education Strategy is a forward-looking document that sets out how capacity development and education programs support the strengthening of integrated geospatial information management. The strategy sets the stage for the desired transformations that will empower individuals, leaders, organizations, and societies. The strategy must be country-driven, address specific needs and conditions of the country, and reflect national sustainable development strategies and priorities.

There are likely to be several policies that will inform the development of the strategy, such as national development policies, strategies, and plans, policies for education, and information and communication technology. These guide the principles and values to be adopted in the strategy, and the measures, monitoring and evaluation obligations necessary to meet the reporting, accountability and transparency guidelines of government.

The strategy is developed in conjunction with communities and target groups (see Section 8.6.3). These are the key groups and individuals that can influence the development of the strategy (positively and negatively) and be counted upon to partner and collaborate. Target groups will be affected by capacity and education outcomes. The participation of key stakeholders is essential in securing support and buy-in for the implementation of the strategy. This is because encouraging target groups, identified at an earlier stage, that active involvement leads to shared ownership of the strategy and results in greater commitment for its implementation.

An inclusive and participatory strategy development and consultation process is important. As an example, collaboration, co-creation, engagement, and consultation with diverse communities that may include the following:

- partnerships in development and delivery of capacity building/education that is inclusive;
- tailoring training that suits diverse needs and includes different approaches to geospatial information management, such as including aspects of indigenous knowledge;
- communicating the need for a clear value-proposition, to support investment in often scarce IT and personnel resources towards geospatial science; and
- recognizing literacies, capacities, and capabilities are wide-ranging and diverse, and are dependent on a variety of factors, such as organizational sizes, jurisdictions, resource mobilization, diversity and technical and administrative capacities.

The strategy is also a communication tool for facilitating change and driving cultural transformation. It communicates clearly and succinctly with vision and mission statements that explain what the future will look like as a consequence of capacity development and education, as well as what needed done to achieve this future. The effort put into effective communication will be worthwhile in the long term. Consultation enhances the quality of the decision-making process and can shape and improve the strategy. For more information on developing a Stakeholder Communication Plan, see Stakeholder Communication and Engagement (SP9: Action 9.6.10).

The Capacity Development and Education Strategy specifies the goals that are to be achieved to deliver on the strategic vision. The goals should be clearly anchored to national development priorities and the capacity outcomes required. The goals serve to establish priorities and plans for capacity development activities and education and training programs, as well as the resources and budget required to deliver programs<sup>3</sup>. Goals are achieved through objectives that describe the steps to be undertaken to achieve the goals (Figure 8.9).

The capacity and education need of organizations, communities, and individuals, as well as the needs specific to specialist target groups, are best developed through consultation. This can be facilitated via a stakeholder workshop, with facilitated analysis, will draw out the major issues to be addressed through capacity development and education programs. Often, PEST and SWOT Analyses are utilized to scan the capacity development and education environment. The PEST Analysis considers the **P**olitical, **E**conomic, **S**ocial, and **T**echnology issues that may have a positive or negative impact on capacity development and education programs. The SWOT Analysis is used to identify **S**trengths, **W**eaknesses, **O**pportunities, and **T**hreats in relation to current and future programs. The outcomes of the PEST and SWOT Analyses provide input to the development of the strategy and, in particular, the identification of activities that are required to addresses existing gaps in capability, as well as those needed to overcome barriers to change.

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<sup>3</sup> *Tangible resources like infrastructure, money, buildings, equipment and documentation should be considered, but they are not capacity in and of themselves (LenCD, 2011).*



**Figure 8.9:** The relationship between the Strategic Vision, Mission, Goals, Objectives and Activities.



Examples of PEST and SWOT Analyses are provided in Appendix 8.6.

An example of the Typical Components of a Capacity Development and Education Strategy is provided in Appendix 8.7.



See Interrelated Action on Communication Plan (SP9).

## 4 Planning for Action

### 8.6.6 Development Approaches

*There are several capacity development approaches that can be adopted to create the conditions to sustain integrated geospatial information management over the longer term.*

These approaches will be implemented either concurrently or consecutively to maximize the effectiveness of capacity development efforts and mitigate challenges as they arise. Regular and formalized review processes will be required so that programs can be adjusted as capabilities grow and/or the context changes (LenCD, 2011) (See Section 8.6.8). Capacity development may include the formulation of enabling policies and laws, such as dealing with data sharing and dissemination (See SP2: Action 2.6.5). These policies will typically include

At an **Organizational Level**, capacity development will include creating the conditions to sustain geospatial information activities over time, such as the development of laws, policies and procedures, strategies and operational plans, as well as leadership development programs (LenCD, 2011). For example, data share and disseminate geospatial data (See SP2: Action 2.6.5)

In turn, these documents will often provide instructional guidance and serve as tool for further capacity development. For example, sector specific policies and laws enable capacity building, particularly where they relate directly to the geospatial community. For example, regulations for

surveying and land administration, utilities management, and navigation safety for ports and harbors. Other polices and laws are more indirect, such as the use of Remotely Piloted Aircraft Systems, which may be subject to policies and laws governing aviation (See SP2: Action 2.6.4). At an **Individual Level** capacity development will typically focus on developing competencies, skills and instincts for collecting, producing, managing, and applying geospatial information, including in business and industry.



Examples of Types of Capacity Development Approaches that can be considered are provided in Appendix 8.8.



See Interrelated Actions: Data Sharing and Dissemination (SP2); and Design and Develop (SP2).

### 8.6.7 Implementation Plan

*An Implementation Plan schedules capacity development activities and provides structure for the overall program.*

The main purpose of the implementation plan is to schedule the capacity development activities and provide a structure for discussion about the scale and scope of the overall capacity development and education program. The implementation plan is also used to manage expectations of the capacity development and education effort more generally.

The implementation plan seeks to make sense of complex development situations, when it is not always obvious where it would be better to intervene to promote capacity development and education, and provides a method for generating quantitative as well as qualitative data to support the development process. The implementation plan is also used to understand the resources including financial required for delivering the capacity development and education strategy and policy, and when funding is required – year in year out.

The sequencing of activities is important, particularly for enhancing geospatial knowledge and know-how, because the goal has a long-term reach. Sequencing does not mean that all activities have to follow each other one at a time, it simply means getting them into the most logical groupings and order for success. Sequencing is a primary consideration for the operational planning of any capacity development initiative. It is about working with what is achievable, realistic, and acceptable to all stakeholders at any given time, rather than creating ambitious plans that are doomed to fail because the right conditions are not in place. It is also dependent on resource availability (LenCD, 2011).

When sequencing activities, consideration needs to be given to (LenCD, 2011):

- Linkages with previous or existing initiatives – potentially scaling up these activities if they are proving effective;
- Recognition of existing capacities (through the inventory of knowledge, skills and abilities) and how to use them as the basis for moving forward;
- An understanding of what is happening in related-sectors and how geospatial information capacity development and education initiatives may support/develop/build capacity in these sectors;

- Priorities - solving urgent problems first and achieving quick wins is critical to engaging support for long-term activities;
- Identifying the resources that need to be in place before capacity development and education programs can get underway. This includes supportive policy and regulatory requirements; and
- Determine when the target groups can realistically take on capacity development – given that organizations often have overly busy periods.

#### 8.6.8 Education Programs

*From time to time, education programs need to undergo a review to maintain standards of excellence and relevance, and keep pace with advancing geospatial technologies, processes and methods.*

Importantly, education programs need to maintain relevance and keep pace with the times. Reviews of education programs are typically initiated by an academic program review committee at an educational institution comprising a cross section of stakeholders. However, initiation may be driven by professional bodies or required by national accreditation authorities.

An academic program review will typically consider course content for vocational or technical, undergraduate, and graduate programs; teaching and learning methodologies and outcomes; scholarship and research productivity, impact and direction; and quality of learning and working environment, as well as the overall administrative and organizational structure. When conducting a review, it is important to consider the following:

- Does the curriculum appropriately cover the geospatial sciences discipline in terms of breadth and depth?
- What are the strengths and weaknesses of the academic program?
- Are there elements that should be updated to better achieve the goals or to implement a better use of resources?
- Are the learning outcomes appropriate?
- Have there been changes in the external environment that might increase or lessen the need for and viability of the academic program in its current form?
- Have specific initiatives been undertaken to attract and retain a diverse group of talented students and assure their success in the program?
- Are the methods of teaching appropriate to the course and of high quality?
- What steps have been taken to provide students with enriched learning experiences (e.g. experiential or cooperative learning opportunities)?
- What is done to offer students exposure to the international or global dimensions of the discipline?
- Does the academic course offer sufficient intellectual challenge and engagement?
- Does the learning equip the student for advancement on their chosen professional path?



The answers to these questions are the basis for making decisions to revise and update the content and/or teaching methods of the academic program. Proposed changes arising from the review should be circulated to stakeholders for further comment.

In many parts of the world, formal qualifications are very important, but it is not always convenient for staff to be away from their organizations to study abroad for up to four years. The possibilities for modular courses which can be partly, or wholly, studied from home countries needs to be explored and partnerships with international and local universities in relation to joint accreditation of modules.

### 8.6.9 Outreach Initiatives

*Outreach initiatives provide capacity development to those who might not otherwise have access to educational opportunities.*

Outreach initiatives are often targeted at community level. This type of engagement has proven successful for community or participatory mapping initiatives where locals are trained as volunteer geospatial data collectors to collect data that is of value to their local community. This training has direct and immediate benefits to government, organizations, and the communities. A key element of outreach initiatives is that learning and training are delivered at the location where those in need are.

Outreach initiatives that include advocacy need to be extended and expanded to target groups of stakeholders and users, particularly those with relevant resource and knowledge to enhance impact of capacity and education. Effective outreach initiatives can increase impact, and target groups can help generate knowledge, and create or refine tools, models, methodologies, and other products and services.

Effective outreach should be included in the Communication Strategy (See SP9: Action 9.6.9) to provide direction on the 'what', 'why', and 'who', whilst the Communication Plan (See SP9: Action 9.6.10) builds on these to inform the 'when' and 'how'. The Communication Plan delivers the Strategy and uses the information gathered during the identification and analysis of stakeholders.

Local knowledge is crucial to data collection efforts particularly at the neighborhood or community level. Remote data collection methods do not adequately capture granular data, such as the characteristics of dwellings. Having detailed information allows government and organizations to better plan and prioritize infrastructure development and service delivery, so that the community benefits. This can perhaps be illustrated by smallholder farmers who were taught to carry out mapping exercises using smartphones to capture data to improve agriculture and farmland management.



See Interrelated Actions on Communication Strategy (SP9); and Communication Plan (SP9).



### 8.6.10 Community of Practice

*A community of practice is a group who shares a common aspiration for strengthening geospatial information management.*

A Community of Practice is a group that shares a concern, set of problems, or passion about a topic and deepens their knowledge and expertise in this area by interacting on an ongoing basis. Members of a Community of Practice are individuals or organizations who share a common belief and aspiration for integrated geospatial information management, and share concerns for the challenges faced locally, nationally, and perhaps regionally and globally. Those belonging to a Community of Practice often focus on sharing real-world proven practices, new knowledge, processes and methodologies, and advance the value and benefits of capacity and education. For example, professional bodies can offer knowledge and practice sharing but also other benefits such as competency standards, accreditation, advocacy, support for IGIF implementation, and support to formal education routes.

These knowledge and practice sharing networks are key to enriching conversations and for connecting policymakers, professionals, practitioners, and other stakeholders through opportunities to interact and engage. These build on the knowledge attained during formal education processes through (LenCD, 2011):

- Peer learning to complement instructor-led training;
- Peer coaching around the implementation of a practice following technical assistance;
- Peer support that has the potential to outlive the formal education and training programs, stretching out the investment in initial training; and
- Bringing the best and most promising practices back to organizations for potential implementation.

The key to a successful Community of Practice for capacity and education is the development of solutions that:

- Identify specific topics or thematic issues around which to center knowledge sharing to improve capacity and capabilities. This could be about leveraging data for achieving progress towards the Sustainable Development Goals (SDGs);
- Use existing platforms as the mechanism for communication;
- Leverage country-led knowledge hub infrastructure for successful development results; and
- Optimize existing funding activities and new financial resources – including from the private sector, foundations and cooperation partners.

High-level support for a Community of Practice can be helpful and can afford opportunities for capacity and education champions to work together to collaborate on: specific principles for effective

capacity development and education programs, as well as to improve awareness, extend outreach, and engage target groups of stakeholders.

There are also regional capacity-development structures and networks that further develop capacity and education. For example, on the African continent, there are regional training institutes such as AfriGIST<sup>4</sup>, RCMRD<sup>5</sup>, ARCSSTE<sup>6</sup>, CRASTE, ACMAD<sup>7</sup> and AGRHYMET<sup>8</sup>, and networks such as the African Association of Remote Sensing of the Environment, and EIS-Africa. In addition, academic networks under UN-GGIM and its regional committees also support capacity development and education. These capacity-development institutions and networks essentially serve as regional or sub-regional communities of practice and serve as centers to deliver education and training.

There are also GIS Massive Open Online Courses<sup>9</sup> (MOOC), which are available to a wide audience in developing countries. Topics include Cartography, GIS Data Formats, Design and Quality; Fundamentals of GIS, Geospatial and Environmental Analysis; Imagery, Automation and Applications, Do-it-Yourself Geo Apps, Going Places with Spatial Analysis; Applied Geomatics to Social and Environmental Issues, and much more.

#### **8.6.11 Innovation Hubs and Incubators**

*Innovation hubs and small business incubators further capacity development, promote creativity and innovative use of geospatial information, and the entrepreneurship essential for a vibrant and dynamic geospatial environment.*

Governments typically control many of the enablers and much of the infrastructure which contributes to innovation. This includes education and skills (human capacity) development, research and development (knowledge infrastructures), and the physical and technological infrastructures that influence a nation's capacity to innovate. Governments can use these levers to foster and incentivized opportunities for research and development and modern start-up methodologies to realize economic benefits through continuous innovation. Two ways this can be achieved is through the creation of innovation hubs and small business incubators.

Innovation hubs are social community workspaces or research centers that provide an environment for knowledge sharing and discussion on complex business challenges between researchers, academics, business and industry experts, and government leaders. An example is the United Kingdom's Catapult Networks, which were established to transform the country's capability in seven specific areas - four of which relate to geospatial information management and its use – satellite applications, connected digital economy, future cities, and transport systems. The Catapult Networks are a series of physical centres where scientists and engineers work side by side with business on late-stage research and development that has potential to drive future economic growth.

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<sup>4</sup> African Regional Institute for Geospatial Information Science and Technology - <http://afrigist.org/>

<sup>5</sup> Regional Centre for Mapping and Recourses Development (RCMRD) - [www.rcmrd.org/](http://www.rcmrd.org/)

<sup>6</sup> African Centre for Space Science and Technology – [www.unoosa.org](http://www.unoosa.org)

<sup>7</sup> African Centre of Meteorological Application development - [www.acmad.org/](http://www.acmad.org/)

<sup>8</sup> AGRHYMET Training Program for Climate Change – [www.agrhymet.ne/eng/](http://www.agrhymet.ne/eng/)

<sup>9</sup> GIS MOOC - [www.mooc-list.com/tags/gis](http://www.mooc-list.com/tags/gis)

Small business incubators are designed to support entrepreneurs. They create a favorable atmosphere for small innovative start-ups to develop their ideas into products and services. Incubator initiatives (such as GeoVation UK, Spur Western Australia, and GeoWorks Singapore) are designed to stimulate wider and more innovative uses of geospatial information, and to build knowledge and grow local capacity. There is often a direct correlation between local innovation and job creation through learning outcomes. The approach to starting small will often lead to the scaling-up of prototypes resulting in nation-wide products and services, and this in turn, may initiate external interest and funding.

In parallel, innovation hubs and small business incubators enhance the use of geospatial information within the community, and this often leads to significant capacity development for users as well as entrepreneurs.



See Interrelated Action on Innovation Hubs (SP5).

### 8.6.12 Geospatial Challenges

*Geospatial challenges use the power of geospatial technology and collaboration to solve problems.*

Geospatial challenges (competitions), such as GeoHackathons, code sprints and mapathons, aim to use the power of geospatial technology and collaboration to solve problems that affect events or situations, whether it be environmental problems, urban growth issues or the creation of new products and services that fill a social need.

Student-level geospatial challenges have escalated in recent times – taking on social challenges, such as mapping fire hydrants to support emergency responders, and working out emergency evacuation route scenarios depending on the location of a natural disaster. Groups of high school students tackle these issues by thinking critically and using sophisticated geospatial tools to communicate findings (Kerski, 2018).

Geospatial challenges are commonly developed by educational institutions working in collaboration with governments and organizations but can be established through professional associations. Map and GIS data competitions are also a positive way to promote geospatial information and receive industry recognition. Geospatial competitions range from both paper and digital map contests as well as contests designed to showcase the potential of different types of spatial data. Examples of map and GIS related competitions can be found at GISLounge<sup>10</sup>.

### 8.6.13 Geography in Schools

*There is a growing advocacy for geospatial literacy in primary and secondary education, cultivate abilities to analyze data and present information visually.*

There is a growing advocacy for geospatial technologies to be taught in primary and secondary education systems. The benefits are twofold: firstly, it can be used by educators to communicate geographical awareness, history, social studies, and environmental science; and secondly, it can be studied by primary and secondary students as part of their fundamental STEM (science, technology,

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<sup>10</sup> <https://www.gislounge.com/gis-and-map-contests-roundup/>

engineering, and mathematics) education. These are focusing on spatial analysis techniques that can be applied in many professional fields as their careers evolve, such as in public health, transportation, spatial planning, and agriculture sectors etc. The Capacity and Education Working Group (Section 8.6.1) may be tasked with considering new or revised 'geography' curriculum, in conjunction with the relevant ministry.

There are three global trends that make geography a powerful tool for learning (Kerski, 2018):

- Increasingly complex challenges that are global in nature;
- Expanded, online access to geographic tools and data; and
- The proliferation of geo-enabled devices (such as smartphones, sensors, and satellites).<sup>11</sup>

In addition, the shift in educational standards towards inquiry and problem-based learning are moving curricula towards the adoption of geography in schools in many countries around the world.

Globally however, there are few schools with access to geographical information system software, and educational institutions rely on government programs and philanthropy. For instance, in the USA, cloud-based mapping software has been made available to schools through the White House ConnectED Program and a software donation by Esri. This has meant that students can now take learning and problem solving to the next level.

Geospatial literacy is increasingly becoming an important skill. The ability to analyze data and present information visually is becoming increasingly embedded in university health programs (Health Informatics), business programs (Location Analytics), and in emerging Data Science programs.

#### **8.6.14 Scholarships and Internships**

*Scholarships are financial assistance or awards designed to assist students in paying for higher education and an internship provides a student with complementary professional work experience.*

Scholarships help to lessen the impact of rising costs of education. Scholarships allow a broader cohort access to higher education. Cost of education, especially at the undergraduate and graduate levels, are on the rise and, unless nations provide free higher education, scholarships give access to higher education for students of all income levels. Programme specific scholarships are used to address a gap and to increase education and capacity in geospatial sciences. Scholarships can also teach philanthropy and alumnus, when they are financially able, may become philanthropic themselves and "give back".

Scholarships are financial assistance or awards designed to help students pay for an undergraduate degree. Scholarship may be a one-off payment or paid each semester or school year. These awards differ from student loans in that they don't have to be repaid.

An internship provides a student with paid professional work experience in a safe and structured environment, with guidance and usually with mentoring from subject matter experts. A workplace mentor or senior can help train a student, including soft skills such as communication and time management. Internships are usually offered to potential employees by an employer that can be

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<sup>11</sup> <https://www.edutopia.org/blog/students-map-real-world-issues-free-geospatial-tools-suzie-boss>

governments, organizations or businesses. An intern can work part time or full time at the organization or business for a specified period and gain valuable workplace and practical experience. Apprenticeships also provide real-work experience with hands-on training, putting into practice the skills in a working environment. Apprenticeships can be a requirement towards securing a post-graduate professional qualification or recognition, for example, a requirement to be registered or licensed as a cadastral surveyor.

Many governments have introduced scholarships programs and some specifically exist for students undertaking studies in geospatial sciences, surveying, geodesy, spatial planning, and related fields. Scholarships and internships are beneficial in developing capabilities and capacities. They should be considered in any capacity development, education strategy and program to address gaps, improve appeal, and strengthen capacity and education in integrated geospatial information management.



#### **8.6.15 Monitor and Evaluate**

*A critical element in a capacity development and education program is the inclusion of an effective monitoring and evaluation system.*

A critical element in a capacity development and education program is the inclusion and implementation of an effective monitoring and evaluation system. Monitoring and evaluation are the processes of determining how the capacity development is progressing, whether or not the learning programs are enhancing individual, community, and organizational performance, and if ongoing investment is justified.

Monitoring and evaluation systems are a valuable tool for strengthening quality control and measuring outcomes. The information generated from the evaluation is used to adjust programs or to decide if the program in its current format should continue. Capacity development programs need to be evaluated at a number of levels in order to identify when and where the factors contributing to, or inhibiting the achievement of, the learning objectives actually occur. Improvements can then be made at the appropriate level.

Monitoring and evaluation are not straightforward, as sustainable results are often only achieved over the long-term and generally through multiple methods. It is also difficult to measure soft capacity results, such as communication skills, time management, and policy reform, which are often prerequisites for hard capacity results, such as technical geospatial competencies, to be achieved.

One of the simplest methods to monitoring and evaluating results is to determine success indicators upfront. Success can be gauged by measuring progress towards achieving the long-term goals and shorter-term objectives specified in the Capacity Development and Education Strategy.

The achievement of the objectives is an indication of being on the right path towards achieving the strategic goals. If an objective is not being met, corrective action may be required. It is worthwhile documenting contributing factors and extenuating circumstances that may justify either leaving the objective as-is or changing it.

When developing success indicators, it is also important to state the means of their verification. For example, an increase in data sharing capacity may be measured by the increase in the number of datasets made accessible – year in year out. In terms of capacity development pre-requisite tasks, success may mean evidence that a required government mandate or policy has been issued.



A template for Recording Success Indicators for Capacity Development is provided in Appendix 8.9.

## 8.7 Deliverables

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

- An Inventory of Geospatial Knowledge, Technologies, Skills, and Programs;
- A Capacity Needs Assessment and Gap Analysis;
- A Capacity Development and Education Strategy;
- A Review of Geospatial Education Programs;
- A Capacity and Education Implementation Plan;
- Geospatial Innovation Hubs and/or Small Business Incubators;
- An Outreach Plan to promote Geospatial Awareness and Literacy; and
- Capacity and Education Monitoring and Evaluation Framework and Outcomes.

## 8.8 Outcomes

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The following outcomes result from improving awareness, developing and sustaining the acquisition of knowledge and science, practices, proficiencies, and skills, and a clear value proposition for integrated geospatial information management:

- Broad geospatial awareness and capabilities at all levels through effective capacity development and education programs;
- Increased adoption and application of geospatial information, technologies and processes by government, organizations, communities, and individuals;
- Stimulate creativity and innovative solutions to address real-world challenges, economic opportunities and growth, and well-being of society; and
- Primary to secondary students, post-secondary students, and workplace persons equipped with increasing knowledge, proficiencies, and instincts in geography and geospatial sciences.

## 8.9 Resources

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As part of the work programme of UN-GGIM, there are several related initiatives and activities including by the Subcommittee, Expert and Working Groups of the Committee of Experts. These initiatives and activities are multi-stakeholder and consultative when arriving at outcomes and outputs. This inclusive and participatory nature of work has allowed the preparation of a number of resource documents/publications that are helpful and useful when addressing the complexities in capacity and education that impacts integrated geospatial information management.

This includes specifically the work, contributions and preparation of the *Future Trends in Geospatial Information Management: The Five to Ten Year Vision*. The *Future Trends* informs countries and the global geospatial information community on emerging trends in technology, policy and legal, skills and training, the private and non-governmental sectors, and in the role of government in strengthening integrated geospatial information management.

There is also the work and contributions of the UN-GGIM Subcommittee on Geodesy, the Expert Group on the Integration of Statistical and Geospatial Information, the Expert Group on Land Administration and Management, the Working Group on the Global Fundamental Geospatial Data Themes, and the Working Group on Geospatial Information and Services for Disasters. Their work and adopted frameworks have provided references and guidance in developing effective capacity development and education program. These include:

The *Global Geodetic Reference Frame* (GGRF), with its Roadmap and Implementation Plan, allows the interrelationship of measurements taken anywhere on Earth and in space, the foundation for virtually every aspect in collecting and managing of geospatial information and global monitoring of the Earth.

The *Global Statistical Geospatial Framework* (GSGF) facilitates the integration of statistical and geospatial information, enables a range of data from both the statistical and geospatial communities to be integrated, and, through the application of its five principles and supporting key elements, permits the integration of geospatial information, statistics, and other data to inform and facilitate data-driven decision making in support of national and local development priorities.

The *Framework for Effective Land Administration* (FELA) improves advocacy, promotes coherence of concepts, and translates globally agreed methods and approaches for practical implementation by governments to determine, record, and recognize people to land relationships in all its forms for the well-being of people, planet, prosperity, partnerships and peace. Effective land administration provides humanity with better access to and security of land and property rights, and to leaving no one behind.

The *Global Fundamental Geospatial Data Themes* – fourteen geospatial data themes considered foundational to integrated geospatial information management. Determined through global consultation and consensus, nations are encouraged to use and adopt these 14 data themes, which can be adapted to align with national strategic and statutory needs and mandates.

The *Strategic Framework on Geospatial Information and Services for Disasters* (GIS4D) optimizes the benefits from applying geospatial information and services by Member States and other concerned entities across all phases of disaster risk management. The Framework emphasizes the fundamentals



of sustainability, accessibility, complementarity, and interoperability of geospatial information and services for disaster risk reduction and management.

The *Operational Framework for Integrated Marine Geospatial Information*, an integrated policy guidance and operational framework for a domain that embraced all water-related geographic features, including oceans and seas, coastal zones, deltas and tributaries, inland water bodies and waterways, and a bridge between the IGIF and marine geospatial information management practices. The operational framework promotes, advises and provides practical and helpful guidance that Member States can leverage to enhance the availability and accessibility of marine geospatial information and gain the broadest socio-economic and environmental benefits when implementing the IGIF.

## 8.10 References

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