The Benefits of United Nations Integrated Geospatial Information Framework for the Statistical Domain

Contents

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of Statistical and Geospatial Information

Introduction

In today's rapidly changing world, government leaders have responsibility for society's most essential and pressing national issues, such as climate change adaptation, land administration, and public health delivery. Leaders are required to make increasingly rapid decisions about complex topics, with outcomes that can profoundly impact the lives of citizens. Making effective decisions within this context requires not only vision but also actionable insights. The ability of governments to harness the needed information, integrate it, add context, visualize it, and put it in the hands of decision-makers is essential for sustainable social, economic, and environmental development.

Official statistics are a key component for evidence-based policymaking and public accountability. Anchored by the fundamental principles of official statistics, characteristics of official statistics include **relevance**, ensuring data meets users' needs; **accuracy and reliability**, guaranteeing trustworthy results; **timeliness and punctuality**, providing data when needed; **coherence and comparability**, allowing meaningful analysis across time and regions; and **accessibility and clarity**, ensuring data is understandable and available to all. But one element presently missing from the fundamental principles of official statistics is the concept of geographic location, and thus geospatial information as the 'digital currency' of the geographic dimension is presently missing.

It is undisputable that official statistics must be anchored to a place or geography – from an x- or y-coordinate for a household survey or aggregated statistics at a regional level. In our present rapidly evolving data environment, global frameworks have a significant role in enhancing national capacities and capabilities. In terms of facilitating the integration of statistical and geospatial information, the Global Statistical Geospatial Framework (GSGF) is the primary framework for facilitating the consistent production and integration of geo-statistical information. It is generic and permits

application of the framework principles to an individual country's national circumstances, existing as bridge between the national statistical and geospatial communities. In this respect, the statistical community has several frameworks that help with establishing and enhancing a National Statistical System (NSS), including the Generic Statistical Business Process Model and the Generic Statistical Information Model. But what exists on the other end of the geospatial bridge?

By demonstrating how the UN-IGIF supports the generation of geospatially enabled statistical data, the paper aims to raise awareness of its cross-cutting value across social, economic, and environmental domains. This is especially relevant as National Statistical Offices (NSOs), NSS, and broader data ecosystems evolve to address both current and emerging national priorities—such as the future Rounds of Population and Housing Censuses—and global development agendas, including the 2030 Agenda for Sustainable Development and the Sustainable Development Goals (SDGs).

Thus, consisting of five chapters, in two parts, this paper introduces the benefits of the United Nations Integrated Geospatial Information Framework (UN-IGIF) for the statistical domain, emphasizing its role in enhancing the statistical production process through geospatial integration. Part 1 is focused at communicating the high-level benefits of the UN-IGIF for the Statistical Domain and is aimed at being a resource for policy-makers and decision-makers. Part 2 takes a deep dive in the nine strategic pathways and discusses the benefits of, and how they can be operationalized to enhance national statistical capabilities and capacities.

Global Frameworks: The UN-IGIF in Context

Recognizing that countries need support in unlocking the full potential of geospatial information for the national data ecosystem, including for official statistics, the United Nations and the World Bank developed the Integrated Geospatial Information Framework (UN-IGIF). This framework offers a comprehensive and adaptable blueprint for enhancing geospatial capabilities (across many domains, including effective land administration, statistical data management, climate, environment, and resilience), which is crucial for addressing national sustainable development priorities. By becoming aware of and engaging with the UN-IGIF, NSOs will better understand the national geospatial ecosystem, which will allow them to take advantage of data, inputs, and technologies and add value and quality to statistical information. Furthermore, collaboration between NSOs and National Geospatial Information Agencies (NGIAs) will create synergies that will benefit the entire data producing community, in addition to optimizing financial resources and contribute to the NSS.

The Three Domains of Influence and the Nine Strategic Pathways

The UN-IGIF is anchored by, and implemented through, nine strategic pathways across three domains of influence:

- **GOVERNANCE** – Assisting countries to develop robust geospatial policies and cooperation agreements, governance structures, legal frameworks, and approaches to identify sustainable funding mechanisms to enable effective geospatial information management.
- **TECHNOLOGY** – Promoting the use of common standards, interoperable systems, and innovative technologies to facilitate seamless data exchange across sectors and organizations, enhancing the efficiency and accuracy of data integration, analysis, and dissemination.
- **PEOPLE** – Emphasizing the importance of engaging stakeholders and building the skills

and expertise of the workforce, the UN-IGIF provides resources and guidance for effective communication and collaboration with local communities, government agencies, and other stakeholders who have a critical role in managing geospatial data in the collective pursuit of meeting national development goals.

As a means of implementing these three dimensions, the UN-IGIF provides guidance to build and strengthen geospatial information management through three key resources:

1. **OVERARCHING STRATEGY:** Provides the vision and mission for geospatial information management.
2. **IMPLEMENTATION GUIDE:** Offers detailed guidance, standards, and recommended actions to implement the framework.
3. **COUNTRY-LEVEL ACTION PLAN:** Includes a recommended process and resource materials to help countries develop specific plans tailored to their national priorities.

Through this approach, many countries are already utilizing the UN-IGIF to achieve their development goals, making it a tried-and-tested approach. Anchoring the implementation across the three (3) main areas of influence are UN-IGIF's nine (9) interdependent strategic pathways. Countries are encouraged to use and adapt the Strategic Pathways guidance, actions, tools, and expected outcomes described in the full UN-IGIF Implementation Guide and the Country-Level Action Plan templates. Decisions on what to make use of should be based on national circumstances, priorities, and perspectives as no two national contexts are entirely identical. The nine pathways guide governments toward implementing effective integrated geospatial information management necessary to deliver their national vision for sustainable social, economic, and environmental development.

Figure 1 The United Nations Integrated Geospatial Information Framework (UN-IGIF, 2023b)

The UN-IGIF represents the geospatial side of the bridge while the GSBPM forms the statistical counterpart. In the middle is the GSGF, which acts as a connecting framework to integrate official statistics with geospatial information. The UN-IGIF provides the strategic guidance and infrastructure for managing geospatial information, while the GSBPM structures the statistical production process. The three frameworks together will support the production of geospatially enabled statistics, enhancing the ability of NSS to deliver more timely, relevant, and granular data for decision-making.

The Benefits to the Statistical Community of the UN-IGIF's Strategic Pathways

Strategic Pathway	Benefit 1	Benefit 2	Benefit 3	Benefit 4	Benefit 5
1 Governance and Institutions	Increase the usefulness of statistical and geospatial information. Ensure the governance and institutional arrangements that coordinate geospatial information resources accounts for and articulates with the mandate of statistical offices to meet current and future sustained integration of subject-matter specific statistical domain data and other types of data.	Strengthen its own leadership role in the national decision-making system as an active member of the appropriate governance and institutional arrangements established to manage the integration of geospatial and statistical information, ensuring institutional mandate(s) and objectives of statistical offices are reflected in these arrangements.	Become a participating member of or lead of cooperative in data sharing environments and other collaborative forum established by governing boards (steering group) and informed by geospatial coordination unit(s) and specialist working groups (local, national, regional, and international).	Strengthen the mandate of the NSO, on behalf of the NSS, based on the shared value proposition of integrated statistics and geospatial information that would be endorsed by the NSO's governing board and approved by stakeholders and the political oversight	Enhance their role by promoting collaboration and capacity building while maintaining the focus on the production of evidenced-based data and statistics for policy development and decision-making. This would strengthen national statistics programs and ensure the success of critical initiatives such as the 2030 Agenda for Sustainable Development and the 17 Sustainable Development Goals (SDG) by providing data for monitoring and assessing progress.
2 Policy and Legal	Ensure that geospatial data are collected, stored, and shared in a manner that is consistent with a solid policy framework. This can help to statistical agencies access relevant data and use it to inform their work.	Ensure that geospatial and statistical data are collected and managed using best practices, which can help improve the accuracy and quality of the data. This can benefit statisticians by providing them with more reliable and trustworthy data in smaller geographies to work with.	Facilitate collaboration and coordination among different stakeholders involved in geospatial and statistical data collection and management. This benefits NSOs by creating opportunities for them to work with other experts and share data, knowledge, and resources.	Promote innovation and development in the geospatial and statistical data fields. This can benefit statisticians by creating new opportunities for them to use statistical and geospatial information as part of integrated data analysis.	The statistical community can support to the geospatial community on topics such as privacy and confidentiality, topics that are increasingly important in the geospatial community. Consistency in approaches will be valued by the user community.
3 Financial	Increase the use of statistical data and geospatial information thereby demonstrating the important role these data play in meeting national priorities and addressing national circumstances.	Enhance data integration and improved data quality through the planned and prioritized allocation of resources and activities dedicated to geostatistical infrastructure, standardizing data integration and collection, improved data management systems and related to data quality assurance procedures.	Expand analytical capabilities across the acquisition of analytical tools and technologies, data, human resource capacity building, and access to robust processing and data storage environments obtained through planned multi-year financial and project plans. This would provide statistical offices opportunities to expand analytical capabilities to meet national policy and priorities that seek to be more data driven and evidence based.	Strengthen cooperative partnerships through the access to additional expertise, shared new data sources and tools, innovation, and opportunities to expand geospatial analytical capacity and strategic opportunities for additional funding in the future.	Enhance policy support, with an integrated statistical and geospatial information framework sustained by funded multi-year plans and commitments that will enhance statistical offices' capacity to provide reliable statistics and spatial analyses for policy formulation and evaluation, public and private sector services, international reporting and monitoring commitments, and emerging challenges such as sustainable development, climate change, pandemic, and timely response to disaster and emergency situations.

Strategic Pathway	Benefit 1	Benefit 2	Benefit 3	Benefit 4	Benefit 5
4 Data	A framework for collecting geospatial data from a variety of sources, such as boundaries of areas of importance for local to national governments, Earth observations including (aerial photography and satellite imagery), and ground-based surveys and can be used to supplement census and survey data and provide a more comprehensive view of the data being used and studied.	A standardized approach to managing data, ensuring that the data is consistent and up-to-date and helps statisticians avoid errors and inconsistencies in their data collection planning and tabulated data analyses.	An opportunity to expand the type of statistics needed for addressing a changing world that meets user demands in more effective data collection techniques in a timelier manner.	Tools for analyzing data, such as geospatial information systems (GIS) and spatial analysis techniques that can be used to identify patterns, trends, and relationships in the data that may not be apparent from traditional statistical analyses.	A platform for sharing data and analysis results with other stakeholders, such as policymakers and the public, which can ensure that statistical analyses are transparent and can be used to inform decision-making.
5 Innovation	Promote research and development activities that address innovative technologies and methodologies in geospatial information. Areas of focus could include such emerging technologies as Artificial Intelligence (AI) and Machine Learning (ML) as applied to earth observed data and the Internet of Things (IoT) geospatial applications. Innovation hubs, pilot projects and demonstrations are key activities that can highlight the application of innovative technologies.	Explore, develop, and implement new statistical data collection and processing methodologies that result in new and current data that addresses challenges identified in national priorities and in response to national circumstances including providing more current data in addressing the SDGs.	Ensure that the adoption of any innovations meets existing national policy and regulatory frameworks and addresses data and statistical service gaps and needs.	Enhance data analytics and visualization by enabling the adoption advanced data analytical techniques and effective visualization methods to extract and portray meaningful insights from geospatially enabled statistics.	Encourage collaboration and partnerships by fostering collaboration between public and private sectors, academia, and research institutions that drive innovation. Collaboration can enable the identification of emerging innovations, trends, and drivers. The synergies from collaboration and partnerships can also promote the use of shared resources (data and human).
6 Standards	Establish the common architecture at the national level, which facilitates the processes of discovery, compilation, publication, distribution, storage, linking and use of statistical data, as well as the assurance of the quality of the information.	Promote the use of open data and standards to ensure interoperability not only to facilitate improved statistical and geospatial information integration, but collaboration as well.	Facilitate the incorporation of new data sources and new technologies, thereby minimizing barriers to the exchange and integration of data and statistical information, in support of policies, decision-making and service delivery.	Improve the capture of statistical information through the government and with the private sector, applying standards that allow legal, data, semantic and technical interoperability, and promote greater efficiency in the management of its life cycle, saving effort, time and costs derived from the reuse and readaptation of data.	Generate and have complete, quality, georeferenced databases of addresses and place names, essential in the information preparation and compilation phase; as support to extract samples for surveys; as well as for the normalization and geocoding of addresses and toponymy in administrative records that can replace or complement the collection of data by sampling, at a lower cost.

Strategic Pathway	Benefit 1	Benefit 2	Benefit 3	Benefit 4	Benefit 5
7 Partnership	Work collaboratively with geospatial organizations to meet statistical agencies needs as well as achieving the SDGs.	Achieve effective cooperation between the different actors involved with the management of statistical information (between the private sector and academia, communities, and users; between levels of government and between governments of different regions or countries).	Promote strategic and synergistic efforts, promoting reliable associations that recognize common needs, aspirations, objectives, and national priorities in relation to statistical information and its link with geospatial information.	Expand development capacity through cooperation, learning, exchange and transfer of knowledge, experiences, and competencies between the statistical and geographic communities, as well as expand their capacity through access to complementary resources.	Achieve agility and flexibility in the transformation and reform of processes, supported by creativity and innovation and enhanced through collaboration and joint efforts between different statistical and geographical organizations.
8 Capacity and Education	Share information about statistics and geospatial information that when brought together, provide an important foundation in addressing national priorities and responding to national circumstances.	Promote the necessity of capacity-building as a component in the efficient management of location-based data and statistical information.	Establish a knowledge and skills competency framework or matrix to identify skills needed for effective geospatial information management within a statistical organization. This could allow for the establishment of strategies and plans that would identify interested educational stakeholder and partners, domestic and international outreach opportunities and educational institutions that offer programs that fit the essential needs of an agency.	Establish an existing knowledge and skills inventory that would identify and capacity gaps in the current organization as they relate to both geospatial information management and statistical analysis. This would permit the evaluation of existing formal professional training programs, the formulation of in-house training and possible collaborative training or exchanges with strategic partners, and orient organized knowledge transfer within the agency such community of practices groups.	Enhance and accelerate the adoption of fundamental and innovative geospatial technologies, methodologies, and processes that further the modernization of the statistical system and expansion of trusted authoritative location-enabled data and services.
9 Communication & Engagement	Share with the geospatial community their experiences in communicating the benefit of statistics to the public, business development, community planning, national programs, and emergency response.	Generate greater awareness and active commitment to strengthen the management of statistical information and its link with geospatial information; thereby, increasing confidence in government information, as well as greater use within it and stakeholders.	Establish greater synergy with the private, scientific, academic and research sectors, which leads to greater opportunities, innovations, and achievements, as well as generating and providing data and information with greater meaning and potential use.	Achieve more commitment and awareness of stakeholders, keep them informed, and include them in the development of policies and programs related to statistical information and its geospatial component.	Build positive relationships within government, and between government and stakeholders, including the public in general, leading to greater efficiency and effectiveness.

A Closer Look at the UN-IGIF Strategic Pathways

The UN-IGIF Strategic Pathways address different aspects for the implementation of integrated systems for the management of geospatial information at the country level. Each Strategic Pathway has its own specific purpose, functions, and characteristics, some of which apply to more than one and, in some cases, may apply to all of them.

The following sections outline each Strategic Pathway, including its description and key aspects, the elements they address and some of the benefits that are envisioned and possible for National Statistical Offices (NSO).

Strategic Pathway 1: Governance and Institutions

A key takeaway stated in the current UN-IGIF Implementation Guide (2022):

> "Governance and institutional arrangements present a clear division of roles and responsibilities among organizations involved in geospatial information management, and the formal and informal structures of cooperation and collaboration between and among organizations".

Existing formal and informal governance and institutional arrangements can be challenged by issues such as the lack of clarity on roles and responsibilities and gaps in a common vision or in some cases no clear or mandated vision at all. Current governance and institutional arrangements vary among countries and have evolved over time. The national policy and legal frameworks and financial arrangements also have an important influence on formal and informal arrangements.

It is also the case that key decision makers or leaders, both managerial and political, may have limited access to the case for the strategic value and benefits of a sustained and ongoing integration of statistical data and geospatial information management. In these situations, the lack of understanding would be an important limiting factor. Communicating the far-reaching benefits and value of integrated statistical and geospatial information and the management framework that enables it is critical.

This strategic pathway includes achieving important outcomes such as political endorsement, strengthened leadership and institutional mandates, clear and efficient planning and coordination, and cooperative data sharing. It is highly related to key elements, actions and outcomes described in the other strategic pathways.

To address the need for governance and institutional arrangements this pathway proposes these four elements:

- A **Governance Model** - based on a geospatial strategy for the nation and facilitated by governing bodies responsible for aligning and supporting policies and laws affecting the acquisition, creation, management, dissemination, and use of integrated statistical data with geospatial information. A key objective is to set a strategic direction and vision. All levels of government should be involved and kept informed, ensuring country's current and future needs are met. It is also essential to be transparent and open to ensure compliance by and continuing collaboration from members of the governing board (steering group), coordination unit(s) and specialist working groups (local, national, regional, and international) of the geospatial and statistical fields.

- **Key Leadership** - to formulate and sustain a national geospatial information management strategy and its link with statistical activity, develop a Country-level Action Plan which fits the national priorities includes stakeholders beyond the geospatial community for implementing the UN-IGIF, and create a governance process for assuring effective management responsibilities for the enterprise. An important part of this element is the identification of "champion" that engages stakeholders from all levels of government, private sector, academia, and others.

- **Value Proposition** - that measures, monitors, and communicates the economic, political, societal, technological, and environmental benefits of integrated statistical data and geospatial information to national priorities and for all citizens. It critical that any value proposition statement be clear and understandable since it would be used to achieve management and political approval and buy-ins, financial support, human resources, and long-term sustainability. An example of a recent national challenge that would benefit from integrated statistical and geospatial information goes a long way in understanding the importance.

- **Institutional Arrangements** - that define roles and responsibilities across government for tasks associated with all aspects of geospatial and statistical information management, including appropriate coordination, management and oversight for meeting defined national priorities and addressing national circumstances.

The UN-IGIF proposes a set of guiding principles for the governance and institutional arrangements meant to ensure credibility and strategic outlook, establish trust, encourage collaboration and participation, and foster accountability and legal interoperability. Open and transparent communications and evaluations with project management and oversight by partners and key stakeholders are critical components of these principles.

This strategic pathway outlines other action items in addition to those interrelated elements from other strategic pathways. Also, tools and templates are suggested, and can assist in completing these actions that would facilitate political and management endorsement and, once in place, strengthen institutional data sharing arrangements and the mandates of participating offices and partners.

In summary, governance and institutional arrangements help statistical offices to:

1. Increase the usefulness of statistical and geospatial information. Ensure the governance and institutional arrangements that coordinate geospatial information resources accounts for and articulates with the mandate of statistical offices to meet current and future sustained integration of subject-matter specific statistical domain data and other types of data.

2. Strengthen its own leadership role in the national decision-making system as an active member of the appropriate governance and institutional arrangements established to manage the integration of geospatial and statistical information, ensuring institutional mandate(s) and objectives of statistical offices are reflected in these arrangements.

3. Become a participating member of or lead of cooperative in data sharing environments and other collaborative forum established by governing boards (steering group) and informed by geospatial coordination unit(s) and specialist working groups (local, national, regional, and international).

4. Strengthen the mandate of the statistical agency, on behalf of the national statistical system, based on the shared value proposition of integrated statistics and geospatial information endorsed by the governing board and approved of by political leadership and stakeholders.

5. Enhance their role by promoting collaboration and capacity building while maintaining the focus on the production of evidenced-based data and statistics for policy development and decision-making. This would strengthen national statistics programs and ensure the success of critical initiatives such as the 2030 Agenda for Sustainable Development and the 17 Sustainable Development Goals (SDG) by providing data for monitoring and assessing progress.

Strategic Pathway 2: Policy and Legal

At the national government level, there is recognition of the need for greater institutional collaboration, interoperability and integration across the various national data and information systems and platforms, particularly those related to people and places, including statistics, economic activity, administrative records, and environmental data, among others.

Additionally, the objectives of the 2030 Agenda, which aims to leave no one behind, increasingly requires the generation of geocoded and georeferenced statistics at detailed levels and with higher quality. It is necessary to make significant efforts in each country to promote the integration of statistical and geospatial information This begins with coding responses at the respondent location or data collection unit. This does not mean that data are made available at this level. Rather, having data at the respondent level offers the greatest flexibility and opportunity for aggregating (rather than disaggregating) data at desired geographic levels to achieve these goals.

In this sense, the implementation of the UN-IGIF requires significant legal and policy support which must be aligned with and support the strategic direction of the government and includes, among other priorities, the following:

- The development of a national policy for the management of integrated statistical and geospatial information to address specific issues such as availability, accessibility, exchange, and application under interoperability standards, which favor the decision-making capacities to respond to many of the current social, economic, and environmental challenges.

- The use and application of existing policies and regulations that favor the exchange and systemic integration of statistical and geospatial information, through a wide variety of government services that contribute to economic growth, national security, sustainable social development, environmental sustainability, and national prosperity.

- The implementation of interorganizational agreements, based on common and reciprocal consent, which consider the development of principles and guides for the correct use of statistical and geospatial information, the sharing of lessons learned and good practices.

The UN-IGIF provides an understanding of what happens and where it happens and provides the guidance to aid this understanding through the integration of the geospatial dimension in the work of official statistics.

In summary, the legal and policy pathway helps to statistical offices to:

1. Ensure that geospatial data are collected, stored, and shared in a manner that is consistent with a solid policy framework. This can help to statistical agencies access relevant data and use it to inform their work.

2. Ensure that geospatial and statistical data are collected and managed using best practices, which can help improve the accuracy and quality of the data. This can benefit statisticians by providing them with more reliable and trustworthy data in smaller geographies to work with.

3. Facilitate collaboration and coordination among different stakeholders involved in geospatial and statistical data collection and management. This can benefit statisticians and geographers by creating opportunities for them to work with other experts and share data, knowledge, and resources. Begin with determining if the census areas used to collect the last census data are part of the national geospatial data inventory.

4. Promote innovation and development in the geospatial and statistical data fields. This can benefit statisticians by creating new opportunities for them to use statistical and geospatial information as part of integrated data analysis.

5. The statistical community can support to the geospatial community on topics such as privacy and confidentiality, topics that are increasingly important in the geospatial community. Consistency in approaches will be valued by the user community.

Strategic Pathway 3: Financial

Financial considerations that support the implementation and sustainability of an integrated geospatial information management framework and its link with statistical information are essential and relate to governance, general effective management principles, adherence and alignment to regulatory requirements, capacity building, institutional strengthening and a communication and engagement strategy.

The objectives are financial support and a funding mechanism that establishes sustained and multi-year financing for data acquisition, infrastructure development and maintenance, and long-term viability. To achieve durable financial support, it is necessary to consider and communicate with partners and stakeholders from both the public and private sectors. New partners and other strategic opportunities should be considered when inventorying potential sources of financing. Doing so may also create new opportunities or increases to existing funding since informed partners and stakeholders would become more aware of the public good benefits and the possible market opportunities from integrated statistical and geospatial information and a management framework that achieves it.

The financial strategic pathway proposes a fiscal governance approach that addresses the planning, organizing, directing, and controlling financial activities for strengthening integrated geospatial information management. A key component is to address the value of integrated geospatial and statistical information management in meeting national priorities, circumstances, and challenges.

Countries are encouraged to adopt an approach that best suits their needs and is consistent and aligned with existing national fiscal policy, practices, and regulations. Ensuring legal interoperability, preserving institutional arrangements such as planning, funding and expenditure monitoring procedures, and being sensitive to other factors such as the market opportunities for both statistical and geospatial information all contribute to the success of an integrated geostatistical framework.

To address the identification of investment needs and the means of financing, this pathway proposes these four key elements:

- **Business Model, which** facilitates the use of integrated statistical data and geospatial information, is compatible with the government's fiscal policy, regulatory and funding approaches and is implemented through a financial plan.

- **Opportunities**, the techniques, and methods for aligning statistical data and integrated geospatial use cases with national strategic and policy objectives to identify opportunities, partnerships, investment priorities, and public good benefits.

- **Investment**, the business case that justifies funding and investment including the strategic case (why now), economic case (quantified benefits), commercial case (customers and partners), financial case (funding sources), and the financial management strategy for implementing the investment and resources required.

- **Benefits Realization**, a plan to reliably evaluate, measure, and monitor the complete life cycle of the implementation of the UN-IGIF, including the key performance indicators that form the basis for impact assessment and quantification of the results and deliverables.

An important outcome of this pathway is to ensure that the arrangements and plans are sufficiently funded to support the implementation and viability of outcomes. It should also make possible the opportunity for the innovative application of integrated geospatial and statistical data, together with technological advancement, to improve efficiency and effectiveness. These opportunities need to align with national priorities, be strategic, and include rigor in financial assessments of the return on investment and other nonquantifiable socio-

environmental-economic benefits. This pathway stresses the importance of investment appraisals and the identification of key performance indicators, which are reviewed, evaluated, and monitored over the life cycle of an investment. Doing so will ensure the predicted benefits are realized and recognized at key milestones – particularly when preparing for the next phase or cycle of planned and funded program of work.

In summary, the UN-IGIF financial strategic pathway help statistical offices to:

1. Increase the use of statistical data and geospatial information thereby demonstrating the important role these data play in meeting national priorities and addressing national circumstances.

2. Enhance data integration and improved data quality through the planned and prioritized allocation of resources and activities dedicated to geostatistical infrastructure, standardizing data integration and collection, improved data management systems and related to data quality assurance procedures.

3. Expand analytical capabilities across the acquisition of analytical tools and technologies, data, human resource capacity building, and access to robust processing and data storage environments obtained through planned multi-year financial and project plans. This would provide statistical offices opportunities to expand analytical capabilities to meet national policy and priorities that seek to be more data driven and evidence based.

4. Strengthen cooperative partnerships through the access to additional expertise, shared new data sources and tools, innovation, and opportunities to expand geospatial analytical capacity and strategic opportunities for additional funding in the future.

5. Enhance policy support, with an integrated statistical and geospatial information framework sustained by funded multi-year plans and commitments that will enhance statistical offices' capacity to provide reliable statistics and spatial analyses for policy formulation and evaluation, public and private sector services, international reporting and monitoring commitments, and emerging challenges such as sustainable development, climate change, pandemic, and the timely response to disasters and emergency situations.

Strategic Pathway 4: Data

This strategic pathway establishes a geospatial data framework and custodianship guidelines for the best practice collection and management of integrated geospatial and statistical information that is needed for cross sector and multidisciplinary collaboration. The objective is to enable data custodians to meet the data management, sharing and reuse obligations of governments and user communities through the execution of well-defined data supply chains for organizing, planning, acquiring, integrating, managing, maintaining, curating[1], publishing and archiving geospatial information.

To achieve this, four key elements associated with data coordination must be considered, enabling an environment in which innovation, research and development can thrive. These four elements are:

- **Data themes**: National priority and fundamental geospatial data themes[2] and the data sets that fall within each of these themes, are relevant to a wide range of applications. In addition, data topics may include others for a specific purpose, such as those related to economic and demographic statistics, administrative records, and environmental indicators.

- **Custodianship, Acquisition and Management**: Promotes the assignment of responsibilities, centralized in an organization or agency, for the collection, management, maintenance, and dissemination of information.

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[1] Data curation consists of collecting data from diverse sources and then aggregating and integrating these into a unified information resource for analysis, such as the map portal (UN-GGIM, 2020).
[2] https://ggim.un.org/meetings/GGIM-committee/9th-Session/documents/Fundamental_Data_Publication.pdf

- **Data Supply Chains**: Describes the flow of information between organizations; that is, the interconnections that support the integration and cooperative sharing of data.
- **Data Curation and Delivery**: Refers to the art of maintaining and increasing the value of data and delivering it to end users in a form that can be viewed and used. It should be noted that curated information is often more valuable for decision making than individual data sets.

Solving the SDGs requires combined statistical and geospatial information. Without both, the SDGs will not realize their objectives. Access to usable geospatial information enhances statistical offices' ability to carry out their analysis and visualize their results in new and creative ways, enabling them to *find spatial patterns that are impossible to discover with an exclusively numerical analysis, while the communicative capacity of maps opens new means for the transmission of its conclusions* (IECA, 2011).

Additionally, the integration of geospatial and statistical information facilitates collaboration, coordination, and creates opportunities among different stakeholders involved in geospatial and statistical data collection. This collaboration allows for the provision of open data for the generation and publication of a series of basic indicators in geographic areas of different levels that support decision-making, public policy, programmatic planning and implementation, and achievement of the SDGs. Similarly, it is possible to provide historical data to ensure that the statistics can correctly refer to the same geographic spaces at different times, through different map services.

In summary, the data pathway helps to statistical offices to provide:

1. A framework for collecting geospatial data from a variety of sources, such as boundaries of areas of importance for local to national governments, Earth observations (including satellite imagery, and aerial photography), and ground-based surveys and can be used to supplement census and survey data and provide a more comprehensive view of the data being used and studied.

2. A standardized approach to managing data, ensuring that the data is consistent and up-to-date and helps statisticians avoid errors and inconsistencies in their data collection planning and tabulated data analyses.

3. An opportunity to expand the type of statistics needed for addressing a changing world that meets user demands in more effective data collection techniques in a timelier manner.

4. Tools for analyzing data, such as geospatial information systems (GIS) and spatial analysis techniques that can be used to identify patterns, trends, and relationships in the data that may not be apparent from traditional statistical analyses.

5. A platform for sharing data and analysis results with other stakeholders, such as policymakers and the public, which can ensure that statistical analyses are transparent and can be used to inform decision-making.

Strategic Pathway 5: Innovation

Innovation provides the opportunities for national statistical offices (NSO) and data ecosystem to enhance the production and quality of an expanding array of data and statistical information. It is a driver of continuing change given the persistent of digital transformations and creativity (e.g., application of innovative technologies) and new methodologies. Innovation can be a potential disruptor as well an enabler. NSOs recognize that innovation is a priority and promoting activities such as research into new methodologies, new data sources, collaboration, improved data sharing and the adoption of innovative technologies are key towards modernizing a statistical system while ensuring the production of trusted official statistics. NSOs are looking to innovation to support national evidence-based policy and decision making at all levels of

governance and in meeting critical international commitments such as the 17 goals of 2030 Sustainable Development agenda and the Sendai Framework for Disaster Risk Reduction.

This strategic pathway emphasizes the potential of leveraging innovative emerging technologies and new methodologies within the United Nations Integrated Geospatial Information Framework (UN-IGIF). The UN-IGIF also emphasizes that innovation is increasingly being applied to all parts of the wider data ecosystem.

This pathway proposes the following four key elements:

- **Technological Advances** – influenced by a new industrial paradigm to produce, share, analyze and deliver information to enrich knowledge economies.

- **Innovation and Creativity** – stimulates science and technology though digital transformation strategies, policy and legal instruments, innovation centers or hubs, and research and development to generate economic growth and other innovations.

- **Process Improvement** – the initiative-taking task of identifying, analyzing, and improving upon existing processes to achieve efficiencies, productivity gains and new products and services.

- **Bridging the Geospatial Digital Divide** – enabled through a combination of technological developments, data, supportive policy and legal frameworks, financial commitment, stakeholder engagement, partnerships, and capacity building.

National context and priorities should dictate which and how emerging innovations are adopted and operationally implemented. This UN-IGIF pathway provides guiding principles, key actions, and suggested tools to achieve the adoption of emerging innovations. It also provides guidance that enables the necessary forward-looking capacity to identify, understand and address future drivers and trends.

In summary, the innovation pathway helps statistical offices to:

1. Promote research and development activities that address innovative technologies and methodologies in geospatial information. Areas of focus could include such emerging technologies as Artificial Intelligence (AI) and Machine Learning (ML) as applied to earth observed data and the Internet of Things (IoT) geospatial applications. Innovation hubs, pilot projects and demonstrations are key activities that can highlight the application of innovative technologies.

2. Explore, develop, and implement new statistical data collection and processing methodologies that result in new and current data that addresses challenges identified in national priorities and in response to national circumstances including providing more current data in addressing the SDGs.

3. Ensure that the adoption of any innovations meets existing national policy and regulatory frameworks and addresses data and statistical service gaps and needs.

4. Enhance data analytics and visualization by enabling the adoption advanced data analytical techniques and effective visualization methods to extract and portray meaningful insights from geospatially enabled statistics.

5. Encourage collaboration and partnerships by fostering collaboration between public and private sectors, academia, and research institutions that drive innovation. Collaboration can enable the identification of emerging innovations, trends, and drivers. The synergies from collaboration and partnerships can also promote the use of shared resources (data and human).

Strategic Pathway 6: Standards

The production of official statistics at the national level must be harmonized and follow international standards so that comparability between the data produced in each country is guaranteed (Veloso, García & Marcuello-Servós, 2021). Standards provide the critical architecture by which data can be discovered, collected,

published, shared, stored, combined, and leveraged, and are a vital part of ensuring information quality. When applied, standards reduce the effort, time, and cost of deploying technologies, improve return on investment, and help future-proof systems by enabling new capabilities to be added with minimal effort, as well as enabling policies and more effective decision making.

This pathway establishes a governance process and an inclusive national regulatory environment that promotes and ensures the adoption of standards and best practices in terms of legal, data, semantic and technical interoperability. It contemplates four key elements that are required for an interoperable and cooperative data exchange environment, to improve the delivery of services and products, as well as for evidence-based decision-making and policies:

- **Standards policy and governance:** ensures that the benefits of standards can be maximized through coordinated governance and consistent policies.
- **Technology and data interoperability:** allows different technologies, systems and data to work together seamlessly and provide the flexibility to rapidly innovate and mobilize new technologies and data sources.
- **Testing and certification of compliance:** uses the processes of testing, measurement and certification to ensure the proper implementation of the standards.
- **Community of practice:** increases the benefits of standards and interoperability by sharing and leveraging standards-based good practices.

The principles are put into practice through various strategic actions that provide and strengthen the implementation of the Framework (UN-IGIF). Once these actions are implemented, a level of interoperability will be achieved, both for statistical information and for geospatial information, which will facilitate their linkage. For the purposes of integrating Statistics and Geography —that will take advantage of the systemic, geospatial, and temporal nature of statistical and geographic data— statistical data must be georeferenced, thus adding the spatial component that will take advantage of analysis capabilities offered by Geospatial information Systems (GIS) and, at the same time, improve their understanding through publication in geographic viewers and thematic maps.

In summary, the Standards pathway helps statistical offices to:

1. Establish the common architecture at the national level, which facilitates the processes of discovery, compilation, publication, distribution, storage, linking and use of statistical data, as well as the assurance of the quality of the information.

2. Promote the use of open data and standards to ensure interoperability not only to facilitate improved statistical and geospatial information integration, but collaboration as well.

3. Facilitate the incorporation of new data sources and new technologies, thereby minimizing barriers to the exchange and integration of data and statistical information, in support of policies, decision-making and service delivery.

4. Improve the capture of statistical information through the government and with the private sector, applying standards that allow legal, data, semantic and technical interoperability, and promote greater efficiency in the management of its life cycle, saving effort, time and costs derived from the reuse and readaptation of data.

5. Generate and have complete, quality, georeferenced databases of addresses and place names, essential in the information preparation and compilation phase; as support to extract samples for surveys; as well as for the normalization and geocoding of addresses and toponymy in administrative records that can replace or complement the collection of data by sampling, at a lower cost.

Strategic Pathway 7: Partnership

Partnerships drive achievements towards common objectives and improve the effectiveness of information management and data sharing, helping achieve capacity development, improvement of processes, products and services, and social and economic benefits. Partnership agreements can enable the coordination of policies and strategies to make the most of the potential of resources, avoid redundant investments, exploit synergies, and introduce a culture of sharing. Strategic partnerships are critical in responding to information needs and can also help improve data collection and collaboration workflows between the statistical and geographic communities.

Partnerships thrive with good governance, clear and consistent communication and engagement, and a supportive operating environment. Institutional arrangements, legal and policy frameworks, as well as financial rules and provisions need to be reviewed and consulted regularly as the geospatial and statistical information ecosystem advances, in terms of technologies, capabilities and applications. Through partnerships, organizations can be more responsive to changing, emerging, or more complex needs, where responsibilities can be shared. These partnerships open new opportunities for greater use and understanding of data from different sources. No single institution can deliver all the data, information, and systems, or possess all the knowledge, all the digital infrastructure and technology required to support the digital economy, the knowledge economy and the geostatistical culture.

The goal of Strategic Pathway 7 is to create and sustain the value of geospatial information through a culture based on inclusiveness, bonds of trust, and strategic partnerships that recognize common needs, aspirations, and goals to achieve national priorities and outcomes, as well as to contribute to the measurement and monitoring of the national objectives and indicators of the objectives of the 2030 agenda for sustainable development.

The strengthening of information management through partnerships and successful association agreements between the statistical and geospatial community, are based on the following principles:

- Mutual respect, trust and understanding.
- Shared vision and goals.
- Clarity and realism of purpose and scope.
- Leadership, commitment, and empowerment.
- Learning and development.
- Transparency and communication.
- Performance management and accountability.

These principles are put into practice through various strategic actions that provide and strengthen participation and commitment to achieve the objectives of the Framework (UN-IGIF?).

The approach to promoting effective partnerships begins with a clear understanding and appreciation of the unique strengths and advantages that each organization brings to the partnership. Partnerships drive the use and exploitation of statistical and geospatial information in new markets, expose it to new communities and applications, enable organizations to overcome traditional barriers to stay relevant and scale by using each partner's core competencies.

In summary, partnerships help statistical offices to:

1. Work collaboratively with geospatial organizations to meet statistical agencies needs as well as achieving the SDGs.

2. Achieve effective cooperation between the different actors involved with the management of statistical information (between the private sector and academia, communities, and users; between levels of government and between governments of different regions or countries).

3. Promote strategic and synergistic efforts, promoting reliable associations that recognize common needs, aspirations, objectives, and national priorities in relation to statistical information and its link with geospatial information.

4. Expand development capacity through cooperation, learning, exchange and transfer of knowledge, experiences, and competencies between the statistical and geographic communities, as well as expand their capacity through access to complementary resources.

5. Achieve agility and flexibility in the transformation and reform of processes, supported by creativity and innovation and enhanced through collaboration and joint efforts between different statistical and geographical organizations.

Strategic Pathway 8: Capacity and Education

Capacity development programs and education systems are critical for the ongoing and future needs of every NSS. National context is an important determinant and the capacity of governments, the private sector, communities, academia, and individuals are all key components of a sustained data ecosystem.

NSOs seek to ensure the sustained and innovative production of trusted authoritative data dissemination of statistical information for domestic evidenced-based public and private sector policy decision-making, the public good and the adherence to important international capacity-building commitments such as the Addis Ababa Action Agenda (AAAA) as it relates to the 2030 Agenda for Sustainable Development.

Building skills, knowledge, capabilities, and the awareness of the need for the effective management of geospatial information are among the objectives of this pathway of the United Nations Integrated Geospatial Information Framework (UN-IGIF) that are key to effective management of geospatially enabled statistics. As with most other pathways, capacity-building is ongoing due to continuing changes in and demands on the wider data ecosystem and the resources (both human and financial) that underpin all organizations and enterprises.

This pathway proposes four elements to consider:

- **Awareness** – raises, advocates for and promotes the principles the benefits of geospatial information via techniques including 'contact' courses, online courses, and outreach programs involving different interest groups such academia and non-governmental organizations (NGO), communities and individuals.

- **Formal Education** – sound foundation in topics important to understanding concepts of geography and geospatial science and the development of the competencies and skills 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 or hubs, and operating new business ventures that are critical to vibrant and growing digital economies underpinned by geospatial information.

This UN-IGIF pathway provides guiding principles, key actions, and suggested tools such as knowledge-skills matrices, gap analysis and needs assessments, types of approaches for capacity-building and education.

In summary, the capacity and education pathway help statistical offices to:

1. Share information about statistics and geospatial information that when brought together, provide an important foundation in addressing national priorities and responding to national circumstances.

2. Promote the necessity of capacity-building as a component in the efficient management of location-based data and statistical information.

3. Establish a knowledge and skills competency framework or matrix to identify skills needed for effective geospatial information management within a statistical organization. This could allow for the establishment of strategies and plans that would identify interested educational stakeholder and partners, domestic and international outreach opportunities and educational institutions that offer programs that fit the essential needs of an agency.

4. Establish an existing knowledge and skills inventory that would identify capacity gaps in the current organization as they relate to both geospatial information management and statistical analysis. This would permit the evaluation of existing formal professional training programs, the formulation of in-house training and possible collaborative training or exchanges with strategic partners, and orient organized knowledge transfer within the agency (e.g., community of practices groups).

5. Enhance and accelerate the adoption of fundamental and innovative geospatial technologies, methodologies, and processes that further the modernization of the statistical system and expansion of trusted authoritative location-enabled data and services.

Strategic Pathway 9: Communication and Engagement

Communication and engagement help develop and maintain effective, trustworthy, and collaborative relationships with stakeholders and users. Through this, an increase in the promotion and investment in geospatial information management and statistical information is achieved, involving the community, companies, professionals, as well as those responsible for decision-making and the politicians. Through effective communication and engagement, it is possible to identify emerging trends and challenges that are currently affecting geospatial information management or will influence the future. Likewise, they are continuous processes and extend throughout the life cycle of development, improvement, and strengthening of integrated information management at the national level.

Stakeholders are individuals, groups, and organizations that have an interest in statistical and geospatial information, from its collection, management, integration, and use, to political needs and investment. They include leaders who make decisions, individual users of information, as well as the beneficiaries of decisions made using integrated information. Understanding the needs and concerns of stakeholders helps improve government performance for managing geospatial and statistical information, as well as identifying and managing potential external risks.

Strategic Pathway 9 aims to ensure effective communication and engagement to enhance and deepen participation and contributions from all stakeholders at all levels. This, together with mutual understanding, collaboration, and cooperation are essential to the successful implementation of the UN-IGIF. To achieve this, four key elements are required:

- **Stakeholder and User Engagement:** Identifies and develops relationships and alliances with partners, users, and third parties.

- **Strategic Messaging:** Develops a clear, succinct, and compelling narrative to gain understanding, generate initial buy-in, and retain support during implementation.

- **Strategy, Plans, and Methods:** Generates forward-thinking communication and engagement strategies to influence perceptions and emphasize the importance of integrated geospatial information.

- **Monitoring and Evaluation:** Establishes performance measures to assess the effectiveness and efficiency of communication and engagement strategies, messages, plans, and methods.

These elements are supported by guiding principles that promote successful communication and engagement that each country can adopt. The principles are put into practice through various strategic actions that encourage and strengthen the participation and commitment of the statistical and geographic communities to implement the UN-IGIF.

The diversity of users of statistical and geospatial information are constantly changing. This has an impact on the style, frequency, and methods used to communicate and engage with them. It also means that communication, strategies, plans, and methods of engagement need to be more comprehensive, inclusive, and versatile, as they are crucial to implement integrated geospatial information management and associated infrastructures. As the user community and technologies evolve, constant monitoring, evaluation, and adjustment of engagement strategies will be necessary.

In summary, Communication and Engagement helps statistical offices to:

1. Share with the geospatial community their experiences in communicating the benefit of statistics to the public, business development, community planning, national programs, and emergency response.

2. Generate greater awareness and active commitment to strengthen the management of statistical information and its link with geospatial information; thereby, increasing confidence in government information, as well as greater use within it and stakeholders.

3. Establish greater synergy with the private, scientific, academic and research sectors, which leads to greater opportunities, innovations, and achievements, as well as generating and providing data and information with greater meaning and potential use.

4. Achieve more commitment and awareness of stakeholders, keep them informed, and include them in the development of policies and programs related to statistical information and its geospatial component.

5. Build positive relationships within government, and between government and stakeholders, including the public in general, leading to greater efficiency and effectiveness.

Final considerations

The use of mapping and related geospatial information and related services to present statistical data can help policymakers, researchers, and the public gain an intuitive understanding of spatial disparity, trends, and identify areas that need specific and targeted interventions. The COVID-19 pandemic provided prime examples of how a world health issue benefited from integrated statistical data and geospatial information, helping to identify vulnerable areas and populations, for vaccine distribution route planning, and to inform about the hospital capacities.

The UN-IGIF promotes the use of standardized geospatial data and metadata, ensuring coherence and interoperability among different datasets and sources of data, enabling policymakers to make more informed decisions. Linking statistical data to geographic location can help to reveal patterns, trends, and relationships which may not be evident when viewing data in traditional and domain-specific approaches - which can be crucial when dealing with environmental, social, and economic issues. Moreover, this integration fosters

collaboration across different domains and policy areas and commitments such as environment, economy, health, education and other social matters, facilitating the search for holistic solutions to a better understanding of complex challenges like urbanization, rural and remote region resilience, environmental management, economic development and scarce resource allocation.

Another benefit of linking statistical data with geospatial information is improving the monitoring and evaluation of development initiatives, as it enables tracking progress in specific geographic areas and evaluating the impact of projects and policies. Similarly, it plays a significant role in disaster risk reduction and response. Integrating statistical data on vulnerable populations with geospatial information about hazard-prone regions can reveal valuable insights. These insights can help optimize emergency preparedness plans and assist in the efficient allocation of resources during and after disasters.

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