

Authoritative Data in an Evolving Geospatial Landscape: An Exploration of Policy and Legal Challenges

DRAFT

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Introduction

This paper on authoritative data, authority and custodianship will collaboratively explore the different ways in which authoritativeness is understood and used in different domains. Traditionally, many jurisdictions have recognized national mapping, cadastral and land registration authorities (NMCAs) as official sources of legal and administrative geospatial information. As a result, some domains have well-established legal traditions and robust frameworks governing authoritative data. In other domains, the designation of authoritative data lacks the same rich legal tradition and is thus less entrenched in law. Today, there are a growing number of producers and providers of geospatial data, products and services from the public, private, and civil society sectors entering the market to serve different purposes and to address a variety of needs. This follows other trends in global governance¹ which have seen the traditional separation of public and non-public sectors increasingly blurred. Notably, in many domains, the collection and oversight of geospatial information² is no longer restricted to public authorities with a special mandate. In other words, over the years, the concept of authoritativeness has been adopted in many other geospatial domains and contexts and has been interpreted differently by different expert groups.

Thus, there is a need to establish a clearer understanding of what is meant by ‘authoritative’ in this shifting environment. This need is reflected in the scope of this paper, which explores the benefits of designating data as authoritative, policy and legal challenges that emerge from its governance, and policies and considerations that lead to its successful use. In recognition of this multifaceted use of the authoritative designation, this paper identifies the ‘fit for purpose’ criterion as a common thread among the wide range of domains and national contexts in which the designation is employed. “Fit for purpose” takes into consideration that what is deemed as ‘authoritative’ is dependent on the particular national context, geospatial domain, and intended use(s) of the data. This captures the diversity of applications across different domains, sectors, and jurisdictions. This higher-level approach is useful when outlining considerations for developing national authoritative data governance frameworks.

This report seeks to act as a policy and legal guide for geospatially-enabled government entities – including NMCAs – as well as the private and civil society sectors to better produce, sustain and govern the usage of geospatial information that is deemed authoritative. It can be used as a supplement to the UN-GGIM Integrated Geospatial Information Framework (IGIF) [Overarching Strategic Framework](#) and its Strategic Pathways, specifically [Strategic Pathway 2: Policy and Legal](#), [Strategic Pathway 4: Data](#) and [Strategic Pathway 5: Innovation](#) on matters relating to authority and authoritativeness. Based on its findings, this report highlights the importance of authoritative data and the need to have strong authoritative data governance frameworks nationally and globally.

¹ This paper uses the terms “governance” and “governance model” in a manner that aligns with the following definition included in the [UN-GGIM Policy and Legal Resource Kit](#): “...the operating structure that defines the way geospatial information responsibilities are assigned, coordinated, managed and monitored within and across institutions. It provides the policies, guidelines, and measures to effectively collect, manage, share, curate and leverage geospatial and other types of information” In keeping with this definition, this paper employs the term “governance” as a shorthand for “the way geospatial information responsibilities are assigned, coordinated, managed and monitored within and across institutions”, whereas “governance model” is used to discuss the operating structure defining the former.

² A recent ECOSOC Resolution on Enhancing GGIM Arrangements identifies “geospatial information management and its many interrelated fields” as including “geospatial sciences, geomatics, surveying, geography, land administration, geodesy, cartography and mapping, remote sensing, hydrography and oceanography, land/sea and geographic information systems and environmental sciences.”

Paper Intent

Given that UN-GGIM is member state-led, the starting point of this paper is public sector decision-making, even as we consider the roles of a range of actors across geospatial domains (e.g., private sector, civil society, academic roles). For governments, the basis of authority is the capacity to establish laws on behalf of the public good, which includes making decisions about which geospatial data/information to regulate and how; choosing not to regulate various geospatial data/information, processes and/or organizations; using various other public policy instruments; and designating authorities to other actors and/or allowing or facilitating these actors' participation in a given domain. The intent of this paper is therefore to provide some perspectives about how authoritative geospatial data is globally perceived and implemented, and to identify challenges and considerations that help equip decision makers develop and enhance their data governance.

A Note About Authoritative Data in the Land Administration Domain

In the land administration domain, authoritative data governance is tightly regulated, with definitions of authoritativeness and authority enshrined in legislation. In most national contexts, it is common for land administration authoritative data policies, procedures, and mandates to be established in laws that confer a legal status to authoritative systems and products, which may even include the data itself. Because the authoritative data designation and roles of responsible authorities are thus clearly defined for land administration practitioners, the alternate definitions, perspectives, and understandings of authoritative data and authoritativeness discussed in Parts 1, 3, and 4 of this paper exclude the land administration domain. Readers seeking guidance regarding the regulation and use of authoritative data within the land administration domain should refer directly to section 2.1.

Position Statement

The range of interpretations of authoritativeness uncovered in the results of this paper's literature review suggest that domains should continue to define the concept in accordance with accepted traditions and expert-informed understandings. It is not the aim of this report to unseat conceptions of authoritative data that are well established, unambiguous, or legally entrenched.

For domains that may be seeking clarity on the topic, this paper introduces a "fit for purpose" criterion for characterizing the authoritative data designation. Domains in national contexts that adhere to precise, legally entrenched definitions of authoritative data and authoritativeness may find that the fit for purpose framing adds little value to their shared understanding or fails to align with their use of the designation. In these cases, domains may find they have no need to adopt the fit for purpose frame. Domains with less well-defined understandings of the authoritative data designation may find the fit for purpose criterion useful in shedding light on potential ambiguities, or as a springboard for developing a national authoritative data governance framework.

The "Fit for Purpose" Frame

As it is employed in this paper, the "fit for purpose" term is a catch-all frame conveying notion of authoritativeness for domains and national contexts who may be seeking clarity. It is important that readers do not conflate this fit for purpose framing with legal uses and/or definitions of the term that exist in various jurisdictions. Nor should it be conflated with uses of "fit for purpose" in the domain

content in Part 2 of this paper, which have distinctive meanings reflecting data use within each respective field. This paper's framing is also distinct from fitness for purpose criteria sometimes used to discuss applications or uses of geospatial data.

Report Structure and Perspective

The paper is divided into four sections, each with its own distinctive purpose and perspective.

Part 1 provides an overview of how various organizations understand and apply the 'authoritative' data designation, drawing from the results of a cross-domain literature review. Because of the empirical nature of this exercise, the results are presented without commentary or recommendations.

Part 2 of the paper represents the perspective of domains with more well established, legally rooted understandings and uses of authoritative data: geodesy, geographical names, marine, and land administration. Each section is authored by experts from respective domains and discusses the authoritative data designation practices and use within each discipline.

Part 3 consists of a discussion and analysis that identifies broader patterns in geospatial authoritative data governance. It begins by discussing challenges related to developing a universal definition of "authoritativeness" that satisfies diversity of stipulations, traditions, and legal underpinnings of geospatial domains. It introduces the fit for purpose criterion for domains and governments seeking guidance in their use of the authoritative data designation. Next, an overview of public sector, private sector, and civil society roles in producing and designating authoritative data is provided. Part 3 concludes with a high-level discussion of the value proposition of authoritative data.

Part 4 presents a path forward for domains and national contexts seeking guidance in their governance of authoritative data production, use, and distribution. It outlines considerations for developing a robust authoritative governance framework that policymakers can use to strengthen existing approaches or to design innovative authoritative data governance systems.

Part 1: An Overview of "Authoritative" Data

Part 1 provides an overview the results of a systematic review of literature concerning authoritative geospatial data. Drawing from these results, the section identifies areas of shared understanding and divergence, policy and legal challenges of authoritative data governance, and how authoritative data is employed differently across geospatial domains and national contexts. Part 1 is most relevant to domains and national contexts with less clearly defined understandings of authoritativeness and authoritative data.

1.1 AUTHORITATIVENESS AND WHAT IS MEANT BY 'DATA':

Before embarking on a discussion of the various uses and understandings of *authoritative* data, which may vary considerably across domains, it is useful to provide a concrete definition of what is meant by geospatial data. [IGIF Strategic Pathway 4: Data](#) defines geospatial data as follows:

“Geospatial data is the foundation on which governments base many decisions. It is used in policy development and in the provision of government services. Its use is growing exponentially across all sectors for e-commerce, business intelligence, to make timely and accurate decisions, and to inform policy. Having access to the right data and at the right time is crucial to good decision making. It is data that provides new levels of insight into our past, present, and future. For this reason, governments, businesses, and the community need to know they are using the most accurate and authoritative data for planning, analysis, navigation, and visualization – good data underpins good decisions. ... Advances can already be seen in the health, financial, disaster management and transportation sectors; where geospatial data is enabling the discovery of new patterns and influences by combining geography, and social and cultural norms in a way that reveals new knowledge through enhanced visualizations, analysis, and traceability.”³

While the term ‘authoritative’ extends beyond the geomatics discipline to other data-centric disciplines, and while the policy and legal challenges explored in this report may apply to data in other disciplines, this report will primarily focus on authoritative *geospatial* data and information.

The ‘authoritative’ designation is often paired with both data and information. It should be noted that ‘data’ refers to a unit or a plurality of units made up of text, numbers, symbols, or multimedia that do not carry any specific meaning, while ‘information’ is used to describe a group of data that carries a logical meaning. The term ‘data’ can refer to a number of meanings, such as:

- *raw data*: data that has not been altered since its acquisition;
- *processed data*: a result of raw data that has been edited, cleaned or modified;⁴
- *a dataset*: a structured collection of data;⁵
- *a data product*: an application or tool that facilitates an end goal through the use of data;⁶ and
- *a data system*: an organized collection of data and processes that are used to operate such data.

For the purposes of this report, the term ‘data’ will be used as an inclusive catchall term for the various understandings of data.

The ‘authoritative’ designation may be used to characterize these various conceptualizations of data and information, as well as data processes (such as data collection, processing and regulation) and even geospatial organizations, agencies and entities typically considered authoritative (such as NMCAs) that ultimately generate and/or provide data or a data product that may be deemed as authoritative.

³ https://ggim.un.org/IGIF/documents/SP4-Data_10Jan2020_GLOBAL_CONSULTATION.pdf

⁴ Definitions according to the Marine Geoscience Data System (MGDS): https://www.marine-geo.org/help/data_FAQ.php; Note that this category may include technically processed data and/or legally processed data (e.g. where the data is anonymized, third party rights are considered, etc.).

⁵ Definition according to the U.S. Geological Survey (USGS): https://www.usgs.gov/faqs/what-are-differences-between-data-a-dataset-and-a-database?qt-news_science_products=0#qt-news_science_products

⁶ Definition according to former United States Chief Data Scientist DJ Patil in his book *Data Jujitsu: The Art of Turning Data into Product*, 2012.

1.2 OVERVIEW OF AUTHORITATIVE DATA DEFINITIONS

Official vs Authoritative Data

In some cases, *authoritative data* and *official data* designations are used in the same way, while in others, the terms represent separate and distinct categories. Official data, in many cases statistical data, is typically provided by a recognized public sector organization that is legally mandated to collect the data for state administrative purposes. This mandate is often accompanied by requirements to ensure that the data meets established criteria prior to its release. In some domains, including hydrography (e.g., nautical charts) and geodesy, authoritative data has similar legal underpinnings and is similarly administered by mandated public agencies, and may thus be considered official data. In other contexts, understandings and uses of *authoritativeness* are not grounded in legislation, diverging from the official data designation. In these circumstances, oversight of authoritative data may fall to public sector or non-state authorities in a less formalized manner. In fact, authoritative data increasingly involves multi-sector actors who affirm the data's importance and value, including in situations where the data is not verified to the same extent as official statistical data. This is especially pertinent given that much of geospatial data consists of big data, which is virtually impossible to thoroughly validate.

In many national contexts, legislation and associated regulations govern data in a broad sense, irrespective of the data's domain. For the purposes of this report, legally regulated data refers to data that is governed by legal regulations that formalize its nature and/or use typically as it relates to the data's domain.

Data that is authoritative is often also referred to as '*fundamental data*' (also known as '*framework data*,' '*foundational data*,' or '*core data*'), and while these concepts can and often do overlap, they have distinct meanings.⁷ *Fundamental data* refers to a concrete and predetermined set of data themes that cannot be derived from other data. The UN-GGIM, via expert collaboration and global consensus, has identified fourteen [Global Fundamental Geospatial Data Themes](#), considered fundamental to strengthening a country's geospatial information infrastructure. For example, the Global Geodetic Reference Frame, elevation, and depth data, as well as transportation network (e.g., roads) represent three of the fourteen identified Global Fundamental Geospatial Data Themes. The objective of the Data Themes report is to explore how and why certain data within these fundamental data themes become '*authoritative*,' a designation which is used to affirm the policy and legal mechanisms that confer authority on a given data asset, process, or organization.

Over the years, a number of definitions for authoritative data have been proposed. Although some of them may share some common elements, they are not consistent, and vary by national context and geospatial domain. For example, a 2019 report by EuroSDR, EuroGeographics and KU Leuven titled "[Authoritative Data in a European Context](#)" proposes the following definition for authoritative data in a European context following survey responses and roundtable discussions from members of EuroGeographics:

⁷ In certain contexts, '*reference data*' is used interchangeably with '*fundamental data*' (refer to [OGC](#) and [ArcticSDI](#) Glossaries), while in other contexts, it is used as an alternative to '*authoritative data*,' referring to the provision of data by a public authority that is legally binding (refer to p.17, section 2.2.1 of [Authoritative Data in a European Context report \[2019\]](#)).

“Data provided by or on behalf of a public body (or another authority) which has an official mandate to provide and sustain it, that is based on a set of known criteria to ensure (inter alia) high data quality, and that is required to be used or aimed towards extensive use and reuse within the public sector and society as a whole.”⁸

The report excerpted above associates the provision of authoritative data with a public authority, or at least another authority with an official and legally binding mandate to provide and sustain data. It also associates authoritativeness with high quality data and a requirement to use the data. While the report highlights the differing views among survey respondents regarding what they consider as ‘authoritative,’ there appears to be agreement among some experts consulted in the 2019 Eurogeographics study that the ‘authoritative’ label is needed to indicate that data is of high value.⁹ The report then suggests that an authoritative public organization be established to play a central role to govern data from other organizations, which requires buy-in and cooperation from geospatial data providers.

Some proposed definitions such as that of the [UK Geospatial Commission](#) associate authoritative data with officially recognized data, though, as mentioned above, the distinction of these two designations is important for many other contexts. They also associate authoritative data with appropriate quality data that is provided by trustworthy organizations.¹⁰

In a similar vein, a [2020 UN-GGIM White Paper on the legal aspects of availability of geospatial information](#) presents the following working definition – employed specifically for the purposes of the paper:

“Authoritative data are officially recognized data that can be certified and provided by an entity that is authorized by legal authority to develop or manage data for a specific purpose.”¹¹

The white paper notes that the definition may vary across countries, which suggests that it can be modified to reflect the needs and constraints of various national contexts.

1.3 HOW & WHY DATA BECOMES AUTHORITATIVE: GOVERNANCE CONSIDERATIONS

In order to investigate the meaning and assumptions underlying various proposed definitions of authoritative data, it is necessary to explore the process by which a certain data asset becomes recognized or designated as authoritative, as well as the defined scope of authoritativeness. These vary significantly across national contexts and organizations, with some contexts having more than one process for designating data authoritativeness, and others having no such process established.

⁸ http://www.eurosdrr.net/sites/default/files/uploaded_files/eurosdrr_publication_ndeg_72.pdf

⁹ According to p.21 [Authoritative Data in a European Context report \[2019\]](#), “The value of authoritative data seems [to] somehow be translated in terms of trust, data quality, guaranteed data usage, guaranteed public service usage, enhanced interoperability at technical, semantic, organizational and legal levels.”

¹⁰ <https://geospatialcommission.blog.gov.uk/2021/08/10/hey-wheres-my-data/>

¹¹ https://ggim.un.org/meetings/GGIM-committee/10th-Session/documents/E-C.20-2020-32-Add_2-White-paper-legal-aspects.pdf

Processes

The process of designating authoritative data can be anchored in some form of **regulatory (legal), policy or administrative authority**. This can take the form of the following:

- designating which kinds of **data** are given an ‘*authoritative*’ regulatory, policy or administrative status;
- granting a geospatial **organization** with an ‘*authoritative*’ mandate to establish which data should be deemed ‘*authoritative*’; and/or
- establishing an ‘*authoritative*’ **process** to ensure that the ‘*authoritative*’ data is sustained and updated according to established criteria.

As a result, various permutations of the abovementioned can be employed depending on the needs and constraints that exist within the national context and domain in question.

It has also been observed that the designation of authoritativeness is used by members of the geospatial community in reference to some form of widely recognized authority that generally adheres to **accepted geospatial methodologies, processes, standards, and bodies of substantive expertise**. This authority can be anchored in organizational-level quality and process controls that users recognize as ‘*authoritative*,’ such as those outlined in the [IGIF Strategic Pathway 4: Data](#), or in individual-level professionalism rooted in substantive or methodological expertise (such as scientific authority). In some cases, authorities may choose to leverage some of these methodologies, processes, standards, and bodies of expertise, including particular experts who are licensed professionals in a given field.

In any case, it is the transparency in these processes, mandates and/or expertise that ground the authority in notions of sustained trust, with the expectation that the data will be fit for its intended purpose(s) and that it will be maintained.

1.4 DISTINGUISHING DATA CHARACTERISTICS AND AUTHORITATIVE DATA

In some domains, the presence of particular characteristics determines data authoritativeness, with some of those characteristics being more integral to the data designation than others. It should be noted that this report makes no attempt to define *authoritativeness* with any of these characteristics. Depending on the domain in question, and its legal circumstances and convention, different characteristics may be used to indicate *authoritativeness*. Because there is no standard set of authoritative characteristics used across domains, geospatial data cannot be universally defined as authoritative or otherwise based on its criteria. In spite of this lack of universality, it may be useful to identify some of the common characteristics of authoritative data that are valued in some domains, depending on the purpose, needs and context. The following is a list of the characteristics that are valued in some domains:

- Quality
- Accessibility
- Accuracy
- Timeliness
- Traceability
- User-centric

- Standardized

The abovementioned data characteristics provide a sample of what in some cases makes data ‘authoritative.’ In reality, however, authoritative data is not always timely, accurate, or accessible (*inter alia*), and thus may not always be called upon for every use case, especially in cases relating to high-risk environments like disaster response. This is in part because there will always be trade-offs between the cost to produce and maintain authoritative data, and the quantity and quality of the data to serve various analytical objectives. However, many of these challenges can be mitigated by establishing good authoritative data governance processes, as outlined in *Part 5: The Path Forward – Policy and Legal Considerations* of this report.

At the very least, it is important for data to meet a minimum threshold for these data characteristics – depending on the intended purpose(s) of the data – which can be established through policy instrumentation if not by making use of legal regulation. However, logistical feasibility in ensuring that data can consistently meet this threshold – in particular given resource and funding constraints – should be kept in mind so as to not overburden any part of the geospatial data supply chain. A detailed list of the abovementioned data characteristics can be found at the end of this report (in *Annex B*).

1.5 DATA PRINCIPLES THAT MAY UNDERPIN AUTHORITATIVE DATA

Similar to data characteristics, there are a number of data principles that may be used in some domains and national contexts in the governance of authoritative data, depending on that data’s intended purpose(s). To clarify, this report makes no attempt to define *authoritativeness* with any of these principles. Furthermore, it is important to distinguish these principles from the characteristics mentioned above. In this case, the data principles do not reflect the nature of the data *per se*, but rather identify the way in which it is employed and managed. In general, data that is considered authoritative is typically expected to embody some of these principles to a reasonable degree, depending on the purpose, needs and context, though they may not all be represented all of the time in reality. Moreover, a data characteristic could be a vital condition for a principle (e.g., data quality may be a pre-condition for trust). The following are common principles that may guide the production and governance of authoritative data:

- Continuity
- Adherence to the [FAIR Principles](#)
- Trust
- Uniqueness (*heavily context-dependent*)

These data principles are a sample of those that may be used to ensure that data is ‘authoritative’ and suitable for the purpose for which it is intended. However, the reality is that authoritative data is not always trusted or unique, and thus may not always be called upon for every use case, especially if the data in question is provided by a non-public sector organization. It is worth noting that not all of these data principles are needed to establish good authoritative data governance processes, and that an overarching governance model is ideal to ensure that authoritative data is best suited for the intended purpose(s). Refer to *Part 5: The Path Forward – Policy and Legal Considerations* of this report for further guidance on this matter. A detailed list of the abovementioned data principles can be found in *Annex C* at the end of this report. The UN-GGIM IGIF [Strategic Pathway 4: Data](#) provides a more thorough list of principles that promote consistent data management, sharing and reuse, which may also underpin data authoritativeness.

1.6 EXPLORING LEVELS OF 'AUTHORITATIVENESS'

Authoritativeness is typically thought of in absolute or binary terms, but this does not always have to be the case. Experts across the geomatics disciplines have begun to explore the potential benefits of establishing a tier-based label of authoritativeness to better reflect a dataset's level of geometric correction (in the case of remote sensing data) and analytical readiness (e.g. from *Level 0 Raw Instrument Data* to *Level 4 Processed Data*).¹² This is seen most frequently in contexts that employ an authoritative verification and certification system to evaluate a given dataset's compliance to authoritative characteristics and principles (as listed in sections 1.4 and 1.5).

Tier-based system may also be used to differentiate between authoritative data forms, including singular data units, simple datasets, and integrated datasets, though the benefits are not as pronounced as the typically seen in the systems described above. Ultimately, the chosen method of differentiating levels of authoritativeness needs to match the needs and constraints of the data's intended purpose(s) to be of any real value to the user.

Part 2: Domain Applications of Authoritative Data

Up until this point, the paper has provided an overview of the broad diversity of perspectives and approaches to authoritative data use across domains and national contexts. Part 2 shifts gears, focussing on the perspectives and applications of authoritative data within four specific geospatial domains: land administration, geodesy, geographical names, and the marine domain. Each section is authored by domain experts in the corresponding geospatial field. The authoritative data designation and its use within these four domains is, for the most part, clearly defined and legally entrenched. It should be noted that the more general or overarching definitions of authoritative data outlined in Part 1 may in some cases fail to capture the precise legal underpinnings of authoritative data and authoritativeness within the domains discussed below. Readers seeking particular guidance regarding authoritative data definitions and use in any of the four domains discussed in Part 2 should refer to the domain's corresponding subsection, rather than to the more general discussion outlined in Part 1.

2.1 LAND ADMINISTRATION DOMAIN

In land administration, authoritative data is understood mostly as data proceeding from authority - understood as something having the power to command behaviors (such as laws, court decisions, rulings from customary authorities, etc.).

Data proceeding from authority could mean, for example, that:

- a) an authority provided a mandate to certain individuals or organizations to create/modify/disseminate data;
- b) an authority defined the processes leading to the creation/modification/dissemination of data; and/or,
- c) an authority provided a legal status – with legal effects – to the data itself.

¹² Example based on NASA's Data Processing Levels: <https://earthdata.nasa.gov/collaborate/open-data-services-and-software/data-information-policy/data-levels>

2.1.1 Mandate proceeding from authority

An authority may define the organizations and/or individuals authorized to conduct certain data-related processes.

For example, mandates could be provided to governmental organizations, such as land registration and cadastral authorities, to manage land information and cadastral survey data. Similar responsibilities to manage land-related data could be devolved to local/indigenous governments or externalized to a public agency or organization in the private sector.

Professionals from public or private sectors could be authorized to perform specific activities. For example, authorities may decide that no person other than a certified professional land surveyor could conduct a cadastral survey.

2.1.2 Processes proceeding from authority

An authority may define the processes that lead to the creation/modification/dissemination of data. Data could be produced, modified and/or controlled by following procedures defined in law or in any authorized publications (instructions, guidelines, etc.). Data could be disseminated following a procedure and under certain conditions defined by law.

2.1.3 Data proceeding from authority

Certain types of data stem from authority/law and are created by the effects of law. Some regulations may define conventional spaces to implement public policies objectives. These spatial features do not exist outside the legal framework/social norms that define them. For example, authorities may create zones for specific administrative purposes or restrictions over specific areas.

Authorities could also define a unique source, such as an official registry, for certain type of data. Registering data may have legal effects. For example, a plan, after confirmation, may be deemed to be the official definition of a parcel. Registering land transactions may provide priorities. For example, the first person to register a deed of sale in the land registry may be considered as the sole owner in the event of a double sale, or the first bank to register a mortgage may be the first to be fully repaid in the event of bankruptcy.

Data stemming from authority/law is enforceable. Creating data without authority may be considered as falsification. A person engaged in falsification could be found guilty of an offence and be subject to penalties.

2.2 THE GEODESY DOMAIN

Geodesy is the Earth science of accurately measuring and understanding Earth's geometric shape and size, orientation in space, and gravity field. Fundamental to Geodesy are geospatial reference systems and frames, which are the foundation for geospatial information. Ensuring the provision of reliable geodetic information in a timely and reliable manner (including a [sustainable Global Geodetic Reference Frame](#)) is a challenge on the global level and for many agencies.

A spatial reference system defines the fundamental parameters needed to describe the positions of points in space. In geodesy, this includes the origin, orientation, and scale of the coordinate system.

A reference frame, on the other hand, is the physical realization of a reference system and is typically defined by the coordinates assigned to geodetic control points in the system. Reference frame updates are new realizations or versions of the reference system. Such updates occur due to additional data or improved scientific models being available.

For example, the [International Earth Rotation and Reference Systems Service](#) (IERS) has released many [International Terrestrial Reference Frames](#) (ITRF) as realizations of their [International Terrestrial Reference System](#) (ITRS), the latest being [ITRF2014](#). Movement of tectonic plates within the ITRF often requires that national or continental reference systems be “plate fixed” to support client requirements. Modern national reference systems are often densifications of an ITRF reference frame with the addition of plate motion models.

Closely associated with reference frames are the models, or transformation parameters, which enable transformation between different frames. Services and infrastructure that enable data consistency within a reference frame may also be authoritative because of their known accuracy or because there may be legislated requirements or international agreements related to their usage. Services may include Satellite-Based Augmentation Services for aviation or global navigation satellite system (GNSS) post-processing services such as the [Online Positioning User Service](#) (OPUS) in the United States. Infrastructure includes physical surveying monuments providing position or gravity information.

How reference systems and frames become ‘authoritative’:

Reference systems and frames may be authoritative in multiple ways. The ITRF is authoritative as a result of the global collaboration involved in producing these frames as well as the scientific excellence of the process. These serve as an affirmation of the data’s robustness (in terms of quality and other characteristics). The ITRF may be authoritative in terms of policy as well, if governments, international organizations, or other bodies have incorporated it in policy statements. For example, the [Geodetic Reference System for the Americas](#) (SIRGAS) organization has identified ITRF consistency as the desired basis for reference systems in the Americas.

Reference systems may gain authoritativeness via legally binding mandates or similar government directives. National, sub-national or local governments or municipalities may have authority over the use of reference systems. National reference systems are commonly created and managed by federal departments and/or agencies, which serve as the related legal authorities. The directives for reference systems may be one element of broader requirements for geospatial information provided by experts to governments.

Different authoritative reference systems may co-exist. For example, geoscientists may choose to use the ITRF for scientific monitoring of geophysical phenomena, in a jurisdiction where another authoritative reference system is required by government for use in cadastral surveying.

The [ISO Geodetic Registry](#) is a catalog of reference frames that have been deemed authoritative by responsible authorities. Nations benefit from ensuring that authoritative reference systems are incorporated in this international registry to communicate that they are authoritative and to provide clarity to users on how these systems relate to other systems.

What is considered primarily as ‘authoritative’:

Reference systems and their realizations as reference frames are the primary data products that must be authoritative. Consistent use of reference systems that are of sufficient quality for a wide range of geospatial applications supports the universal compatibility of geospatial information. An authoritative reference system is expected to enable geospatial data collected at one time and place for one purpose to be compatible with data collected at another time, another location and for an entirely different purpose.

In the UN-GGIM context, the “[Global Geodetic Reference Frame \(GGRF\)](#) is an authoritative, reliable, highly accurate, and global, geospatial referencing infrastructure and is fundamental to supporting the collection, integration and utilization of all other geospatial data” ([United Nations Economic and Social Council, 2020](#)). The GGRF incorporates the ITRS, Height Systems and the Earth’s gravity field as well as supporting data, analysis, products, and other services. Consistency of national or regional reference systems with the GGRF provides significant benefit through the resulting compatibility of data across borders and the benefits of consistent approaches at the continental and global scale.

The importance of authoritativeness in the geodesy domain:

The benefits of geodesy are realized when different geospatial datasets are compatible. This compatibility is essential for nearly all applications involving geospatial data. For compatibility of such data to be realized, the underlying reference systems must be authoritative. Authoritativeness assures all stakeholders that geospatial data will be usable by others. Reference systems used may be different, with a reliance on authoritative tools to transform from one system to another for compatibility.

Prior to the 21st century, geospatial agencies typically had effective monopolies over many aspects of geospatial information, including geodetic data. Access to geodetic data was uniquely obtained via client use of physical monumentation (passive geodetic markers) or map products which relied on this. Today the situation is more complex, with private sector service providers supplementing government services. Continental or regional augmentation services, such as the European Geostationary Navigation Overlay Service ([EGNOS](#)), provide authoritative geodetic data in parallel with those provided by the government and private sectors. In some cases, validation processes or compliance programs have been established to ensure that these services are fit for purpose.

Further changes are anticipated by 2030, including the advent of more accurate services directly from satellite (e.g. the [Galileo High Accuracy Service](#)) and high-reliability augmentation for automated vehicles (e.g. cars, drones, and ships). For instance in the transportation sector, stakeholders have noted the need for a clear regulatory framework regarding such services in order to address certain questions such as:

- Will automated vehicles require validation in some form?
- Will reference system alignment and resiliency be regulated to ensure public safety?
- How will privacy issues be managed if data is shared between connected vehicles?

Responding to this new environment may fundamentally change how geodetic data is provided to clients. Navigating these challenges in this new environment will likely change how government agencies serve national requirements in the field of geodesy. Government agencies may first need to define which aspects of new geodetic services require legal or policy frameworks and which do not.

Policy and legal considerations for authoritative data, processes, and/or organizations:

Policies may be put in place to make geodetic reference systems authoritative for the purposes mentioned above (e.g., consistency of geospatial data). Benefits from geodesy are primarily in the form of positive externalities, realized when the broader society has the ability to utilize geospatial data for numerous purposes and at different times. Identifying a geodetic system as authoritative for some purpose and in some jurisdiction serves to brand it and encourage (or necessitate) usage of this particular system, ensuring that various geodetic activities remain comparable, regardless of who undertakes them and when.

In many national contexts, policy authority is shared between different levels of government. This frequently results in differing standards being in place at the same place and time. Authoritative methods to transform between frames alleviates problems related to these inconsistencies.

Policymakers must consider data robustness and quality assurance when identifying a system as authoritative or official. In this regard, reference systems are expected to be fit for purpose.

Provision of services and tools to clients may be a shared endeavour. In some cases, it may be necessary for policies to be established to ensure that the service providers are meeting minimum levels of quality assurance. Service providers may include academia, municipalities, port authorities, commercial positioning services, the geoscience community, and others.

2.3 THE GEOGRAPHICAL NAMES DOMAIN

Geographical Names as Authoritative Geospatial Data

The Committee of Experts on Global Geospatial Information Management has identified geographical names as a [Global Fundamental Geospatial Data Theme](#). Geographical names are the most common, understandable, and widely used entry-point for broader searches for geospatial data and information, and authoritative official names are necessary as search criteria in geoplatforms, spatial data catalogues, and interactive mapping applications. Place names are used throughout the world as a geographic identification system, and thus have potential to inter-relate and cross-reference disparate data sources, both spatial and non-spatial. Standardized, authoritative geographical names are essential for effective communication between citizens, governments of all levels, decision-makers, and policymakers.

The use of authoritative geographical names – names that are approved by a legislated authority – is crucial to avoid confusion or discrepancies when referring to sites or locations. They provide standardized labelling and reference points on land and water, and are used for a multitude of essential reasons such as wayfinding and navigation, and aid with search and rescue efforts.

Authoritative geographical names are typically established and managed by legally defined authorities who follow policies, standards, and guidelines to ensure that names conform to set criteria. Procedures to review and adopt authoritative geographical names are put in place by naming authorities, often in the form of national or sub-national level boards and committees. This ensures quality, standardized data and a formalized process for how the information is collected, preserved and disseminated. Use of non-authoritative geographical names, for example on interactive maps, can lead to errors in navigation as well as misidentification of geographic features, and can perpetuate the use of derogatory or offensive place names.

The UN Group of Experts on Geographical Names has led international efforts in the standardization of geographical names. For hydrographic features, the [GEBCO Sub-Committee on Undersea Feature Names](#) sets standards for undersea feature names such as seamounts and trenches on the ocean floor.

Authoritative geographical names also play a vital role to preserve intangible cultural heritage, particularly for Indigenous groups and endangered languages. The [UN Declaration on the Rights of Indigenous Peoples](#) reaffirms the right to place naming in Article 13, demonstrating the intrinsic value of geographical names to culture and identity. As geospatial data, geographical names reflect the heritage and history of peoples, help define nations, revitalize languages and standardize geographical references to places.

2.4 THE MARINE DOMAIN

Maritime Limits and Boundaries:

Maritime Limits and Boundaries (MLB) delimit maritime zones where a coastal State has sovereign rights and responsibilities and where it can enforce restrictions. The MLB and maritime zones definitions in the [United Nations Convention on the Law of the Sea](#) (UNCLOS) are universally recognized and used. The zones include internal waters, territorial seas, archipelagic waters, the contiguous zone, the exclusive economic zone (EEZ) and the continental shelf, several of which are measured from a carefully defined baseline. A coastal State can declare its maritime zones through national legal instruments, effectively establishing authority over them. The geographic coordinates relevant to the MLB – which constitute authoritative data – are then published in the coastal State's domestic regulations and deposited with the UN Secretary General via the Division for Ocean Affairs and the Law of the Sea (DOALOS). Often, this data is under the custodianship of a government agency appropriately mandated to create and maintain the MLB.

Nautical charts can be used to describe the extent of a coastal State's MLB. Outside of being distributed as a part of nautical charts, a State's MLB can be distributed exclusively by its custodian agency, typically in consultation with its ministry of foreign affairs. A single official and authoritative source for the national geospatial MLB data is necessary to avoid confusion and misalignment.

The coastal State's MLB data may be distributed through an official government geoplatform or website, via an authorized shared regional system or as foundational layers in its national geospatial data infrastructure, Marine Spatial Data Infrastructure, Marine Cadastre or Marine Spatial Planning system.

Global MLB datasets can be found both as open data from non-custodian entities or as commercial value-added datasets. These datasets benefit from being accessible and from providing worldwide coverage of MLB on a single geodetic datum. When compared to official national MLB datasets, however, global MLB datasets may vary significantly and/or have omissions, thus rendering them non-authoritative. Such non-authoritative MLB datasets are often embedded in base map layers commonly used in GIS systems.

Open Government Marine Data:

Data in the marine domain becomes authoritative on an administrative basis, and is used to support evidence-based decision-making by various stakeholders, including individuals and industries. A given organization may be mandated to produce and disseminate information publicly through authoritative geospatial platforms, such as a [Marine Spatial Data Infrastructure](#) (MSDI). Marine data, organizations, as well as relevant geoplatforms (as data distribution mechanisms) are typically considered as 'authoritative' in this space, though it is worth mentioning that these authoritative elements are not always associated with legal authority¹³. In regard to key data characteristics, data quality and fit for purpose are key in the marine domain as the global [Blue Economy](#) – which depends on authoritative marine data – is becoming increasingly relevant in the global economy.

Governments of coastal states are making authoritative marine data publicly available to support the Blue Economy. The authoritative nature of the data becomes important for the marine domain and sub-domains because various organizations are mandated to conduct specific activities to process the data before being able to release it. Data is released and distributed through authoritative geoplatforms (such as the MSDI) to facilitate access to comprehensive and authoritative sources of geospatial data to support decision-making. Authoritative marine data can then be used for a multiplicity of purposes, including to support international engagement. The 'authoritative' designation in the marine domain is typically applied to data that is governed by law or through other policy or administrative mechanisms. Important policy and legal considerations for the governance of authoritative data in the marine domain include open access to authoritative data, as well as matters of authority and custodianship.

In the wildfire monitoring domain, authoritativeness is often associated with organizational processes or expertise that ensure that the desired data characteristics are produced that would render the data fit for purpose.

¹³ Legal considerations associated with authoritative data for law and policymakers, including liability, are discussed at greater length in Part 5.

2.5 OTHER GEOSPATIAL DOMAINS

There are a number of other geospatial domains that have not been covered in this section but that also serve important objectives, domains such as those in geoscience that include ecosystem conservation, flood mapping and wildfire monitoring, to name a few. In many cases, much of the geospatial data produced and used in these domains might not be legally mandated and/or regulated, but might still be considered by practitioners in their respective domains as authoritative, depending on context. Most of the critical national infrastructure such as transportation networks, utility grids and supply chain infrastructure may heavily depend on the authoritative data within these domains. Such geospatial data is also key to making informed policy decisions. As such, countries leading in the governance of geospatial data have established government organizations that treat geospatial data as a strategic national asset and continuously work towards optimizing the data for government, commercial and public consumption. One area worth exploring in future studies is how to best manage data and information in non-legally regulated geospatial domains, including whether regulation of their production, use and governance is warranted, and the unique challenges that lack of regulation may pose. As such, the ‘criticality’ of the data to decision-makers would be a key consideration.

Part 3: Governing Authoritative Data: Discussion & Analysis

Part 3 begins by discussing the difficulty of establishing a universal definition of authoritativeness that satisfies the requirements of all domains. For domains and national contexts that may be seeking guidance in establishing guardrails for using the authoritative data designation, this section introduces a “fit for purpose” criterion, which establishes data as authoritative when that data is fit for its intended use. Part 3 goes on to discuss the regulatory nuances of authoritative data production, use, and distribution by public sector, private sector, and civil society actors. The section then identifies recurring policy and legal challenges that may arise in the use of authoritative data in a range of domains and national contexts. The section concludes with a discussion of the value proposition of authoritative data.

3.1 THE CHALLENGE OF DEVELOPING A UNIVERSAL DEFINITION OF AUTHORITATIVENESS

While several domains (including those whose perspectives are discussed in Part 2) have clearly defined and long held definitions of authoritative data, neither these nor the broader proposed definitions discussed in 1.2 have reached ubiquitous adoption on a global scale. The literature reviewed in Part 1 illustrates that different domains and national contexts have distinctive needs and capabilities which may be difficult to reconcile or capture in a broadly applicable definition. While in some domains, authoritativeness is legally defined, there are other domains with less formalized understandings of authoritative data that may involve less conventional (i.e., non-public) actors and regulatory instruments. In these cases, authoritative data is not always associated with a public authority or an authority with a legally binding mandate to provide and sustain it, nor is it always associated with high quality data, data that is required to be used, or data that is certifiable.

Thus, advancing a single ‘one-size-fits-all’ universal definition of *authoritativeness* presents a significant challenge due to differences inherent in national circumstances, geospatial domains, and intended uses of the data. In consideration of this challenge, the main objective of Part 3 is to

establish a framing for understanding *authoritativeness*, rather than attempt to advance a concrete and universal definition.

3.2 PLACEHOLDER FOR DISCUSSION OF THE OUTCOME FROM GLOBAL CONSULTATION PROCESS

3.3 “FIT FOR PURPOSE”: A PROPOSED CRITERION FOR DOMAINS SEEKING GUIDANCE

Regardless of the circumstance in which it is employed, *authoritativeness* is always bound to a particular context (i.e., a specified geospatial domain in a given national context) – often through law or domain of expertise – rather than existing as an authority over all contexts. As a result, it is difficult to define *authority* unless the scope of that authority is clearly identified. For geospatial domains with more formalized understandings of *authoritativeness*, the scope of authority is delineated in laws, regulations, and/or policies. Domains seeking guidance in defining *authoritativeness* and the scope of authority may find one or more of the broader definitions of *authoritativeness* discussed in 1.2 instructive. While these broader definitions are certainly distinctive, they do share a common underlying principle: that in order for any data asset, process, or organization to be considered as *authoritative*, needs to be fit for the intended purpose(s).¹⁴ In other words, the data asset, process, or organization in question is authoritative within (though possibly not beyond) its delineated context where it best fits the intended purpose(s).

Applying the fit for purpose criterion, if the data (or information) does not serve a particular legal purpose, then it may be best to leverage other policy instruments or processes to govern the data as needed. For example, wildfire data that are considered authoritative are leveraged for regional emergency response as well as economic and environmental objectives, and so must be fit multiple purposes, which may not require legal mechanisms. In this example, the fit for purpose criterion may necessitate that the data meet the quality criteria necessary to effectively carry out the intended objective(s) of the data, in order for it to be *authoritative*.

While *authoritativeness* is not necessarily a statement of data characteristics *per se*, if the data is not fit for its intended purpose in a particular domain, it will be considered *de facto* not authoritative. Therefore, the concept of defined limits of authority in the context of *authoritativeness* is closely tied to the notion of fit for purpose. In other words, whether something is authoritative depends on the applicable contextual constraints as well as the nature of the data asset, process, or organization relative to its intended use(s). Following this guidance, users make their own decisions regarding data as *authoritativeness* and use based on their needs and the data’s corresponding fitness for purpose. Suitability of the fit for purpose criterion for use within domains should be assessed based on relevant legislation in consultation with domain experts.

3.4 AUTHORITATIVE DATA ACROSS SECTORS

¹⁴ Some national contexts may have incorporated particular definitions of ‘fit for purpose’ into their legislation. This report’s use of ‘fit for purpose’ does not reflect this kind of legal use.

The Public Sector Role

For many domains across numerous national contexts, authoritativeness has traditionally been associated with public authorities (like NMCAAs) that have a formal governmental mandate (often entrenched in law) to act in the public good and to deliver geospatial goods and services to citizens by producing and providing data that is authoritative. This is especially the case in the hydrographic and land administration domains where designated organizations are needed to be solely responsible for the provision of authoritative data to fulfill national and/or international policy and legal requirements. These authoritative data sources play a key role in establishing governance frameworks to collect, process and distribute reliable data that users can trust, even if the data is not necessarily of the desired quality. For example, national hydrographic authorities are typically legally mandated and required to generate navigational charts of their coasts with a certain level of accuracy on a consistent basis, though they are often not as accurate as other charts produced by third parties.

Public authorities can and often do encompass one or more of the following roles at a given time: **data producer or originator, owner, provider or distributor, certifier, custodian, steward, and/or regulator**. It may be the case that the role of governments as an authoritative provider, or at least a contributor, of robust, detailed, and trustworthy authoritative data and information will increasingly become crucial as decision-makers' awareness of the value of authoritative geospatial data grows and their reliance on this data in decision-making processes grows with it. End users may expect to consume government-assured data with a high level of trust in its provenance and fit-for-use. Naturally, this assumes that users place a certain degree of trust on publicly provisioned data, due in part by the professional competencies, the tested quality assurance procedures and the lack of profit motives that are associated with it, which may not always be the case.

In many domains and national contexts, sole government responsibility for the provision of authoritative data is the preferred governance model over ones which involve non-public sector entities in the production and maintenance of authoritative data. There are several reasons for this; not only has this model been the status quo since the inception of geospatial authorities, but also sole government responsibility may be the preferred method to ensure longevity given that governments are typically more stable, and thus, are expected to outlive non-public sector entities. As well, public sector organizations are expected to have a clear and acknowledged mandate (including any legislated requirements and core business) to generate, create, collect, process, preserve, maintain and/or disseminate authoritative data. This is intended to ensure that the organizations' role and responsibilities are preserved, and to avoid any confusions that may arise relating to overlapping or duplicative geospatial processes for a given national context. However, these are underlying assumptions that may not always hold true in certain parts of the world, in some domains and/or with the passage of time and entrance of new providers in the market.

While this public sector-centric approach continues to be the dominant model for authoritative data governance in many contexts today, in certain other contexts, this approach appears to be changing and expanding. Governments will need to play a vital role in ensuring that geospatial frameworks are in place that will enable the effective cooperation and collaboration between the plurality of geospatial actors that will increasingly be involved in the provision and management of authoritative data. Doing so will ensure that the benefits that a geospatially

enabled society has to offer are realized. In fact, public authorities are recognizing the growing importance of coordinating with and engaging their non-public sector counterparts, counterparts who may have the capacity to collect better quality data, and who may have a greater capacity to deliver products and services that the geospatial community may consider as authoritative. Such engagement can involve private sector companies, as well as civil society actors like nongovernmental organizations (NGOs) and the Volunteered Geographic Information (VGI) community of citizen scientists, which will be explored in the subsequent sections below. Moving forward, the private sector and civil society community may well continue to dominate people's everyday interactions with geospatial information. Whether or not this data can be considered authoritative will depend on the assurances, level of detail and maintenance regimes in place to inform major public service or business questions. For this reason, demand may continue for authoritative geospatial data to be provided, or at least certified, by a government entity.

The Private Sector Role

Geospatial organizations from the private sector may hold better quality data than government authorities, owing in part to their greater resource capacities. Governments may choose to outsource their authoritative data generation needs to private sector firms. For example, they may use private sector tools (e.g. geospatial software like [ArcGIS](#) and [ENVI](#)), or leverage their instruments (e.g. earth observation satellites) for authoritative data collection, processing and analysis, all while ensuring accountability. This approach may result in significant cost savings for government. The private sector also carries considerable potential for investment in geospatial processes, and consequently holds influence over the geospatial landscape.

It should be noted that in some national and sub-national contexts, laws and policies requiring data to be collected by a publicly sanctioned data provider may hinder private sector engagement, limiting availability of authoritative geospatial data from other sources. This is particularly an issue with a lack of policy or legal clarity on the matter. This raises questions regarding the degree to which the public sector should involve the private sector in establishing authoritative data. The answer is significantly context- and domain-dependent, given that data production in some domains like hydrography is legally regulated in certain contexts, even when the private sector is able to produce more accurate nautical charts at more frequent intervals. In this example, preservation of relevant laws and policies to ensure spatiotemporal consistency with older charts may be justified. However, given the unique capabilities of private sector actors, there may be a need to update laws and policies to allow for non-public sector involvement.

The Civil Society Role

Many of the same considerations for private sector involvement in publicly dominated geospatial domains can be applied to civil society involvement. Civil society, also known as the "third sector", includes NGOs, VGI/citizen scientists, and academia. In many contexts, there is an acute lack of government policies and guidelines to facilitate the use and integration of civil society data that may otherwise be considered authoritative. Governments may be reluctant to integrate civil society data into existing authoritative governance frameworks, in part because the value, objectives and principles for doing so have yet to be articulated. Another reason why this may be the case is due to a lack of process being established for integrating such data. The integration of VGI data is likely even more complicated than that of private sector data due to the lack of oversight, accountability and assurance associated with the nature of crowdsourced VGI, which necessitates the careful crafting of policy and legal

frameworks to navigate these challenges. Nonetheless, there is a great deal of unrealized potential given that civil society data can at times be more accurate, accessible, and comprehensive than comparable data from a public authority.

One notable example of such a civil society organization is [OpenStreetMap](#), a community-owned collaborative mapping platform where users can create and access data. Among a number of features, it offers road network data that in many cases is more accurate and up-to-date than any other source of road network data. However, its authoritative status is questionable as the road data is crowdsourced from everyday users and it does not have a robust data validation and/or certification process in place (aside from peer reviewed corrections, which can be quite reliable), as would be the case for many authoritative datasets.

Other examples exist of widely respected civil society groups that leverage VGI to collect and produce certain geospatial data – data that many would consider authoritative – which go on to adopt a hybrid verification scheme, partnering with government authorities to verify and/or certify their data in some capacity, and/or to implement publicly funded projects using their data as the foundation. Doing so addresses some of the abovementioned oversight, accountability and assurance concerns relating to civil society geospatial data authoritativeness.

Cross-Sectoral Collaboration

In some circumstances, there may be significant benefits associated with cross-sectoral collaboration on matters of collective authoritative data governance, which can take a number of forms. From a government-centric perspective, the public sector may choose to designate certain non-public sector data as *authoritative*, provided they meet or exceed certain established criteria for authoritativeness. This could involve collaborative arrangements including Memoranda of Understanding (MoUs) and public-private-community partnerships (PPCPs) between the government and one or more third parties. Cross-sectoral collaboration may also involve the implementation of a custodianship model of shared data governance (with the authority in question designated custodian) that includes relevant parties in the governance of authoritative data, ensuring that it remains robust, regardless of who provides it.

A recent innovation in cross-sectoral collaboration that leverages authoritative data produced by the public section is known as “data conflation”. Data conflation is defined as “the process of combining geographic information from overlapping sources so as to retain accurate data, minimise redundancy, and reconcile data conflicts” Conflation may involve layering data from both authoritative and non-authoritative sources (Pourabdollah, Morley, Feldman, and Jackson, 2013). One advantage of data conflation is that the combination of authoritative and non-authoritative sources can increase the credibility of citizen science projects such as Volunteered Geographic Information Community Initiatives. Data conflation can provide a vehicle for government authorities seeking to harness the vast geospatial data resources of the private and civil society sectors.

Given the large volume of rich geospatial data assets that the private and civil society sectors hold, it is increasingly likely that one of the key objectives for the public sector over the coming years will be to engage more closely with these sectors and to leverage their robust data to ensure that authoritative datasets are the best there is to offer, all while maximizing the value and use from these datasets for the public good. Cross-sectoral collaboration helps ensure that the public sector stays abreast of developments in geospatial information and ensure that key decisions are made using the best authoritative data available. Cross-sectoral collaboration may also serve as a failsafe in the event that a given entity, public or otherwise, is shut down or restructured, avoiding the loss of authoritative data that may otherwise result. Governance models are best served by promoting trust among users in the provision and management of authoritative data. Refer to [IGIF Strategic Pathway 7: Partnerships](#) for more information on establishing cross-sector and interdisciplinary cooperation, coordination and collaboration, to [IGIF Strategic Pathway 9: Communication and Engagement](#) for recommendations on how to identify and engage relevant stakeholders, and to [IGIF Strategic Pathway 4: Data](#) for further insight and guidance on data custodianship.

3.5 POLICY & LEGAL CHALLENGES

Shifting Context and Diversity of Authoritative Data

Over the last thirty years, the landscape of geomatics has expanded rapidly, with more and more disciplines incorporating geospatial data and technologies into their analytical toolboxes. This growth has been defined by an increase in the number of data providers, including those from the private and civil society sectors. With technological advances in geospatial data acquisition capacities, there is an ever-increasing volume, variety and velocity of authoritative data being collected, processed, and analyzed, of the majority of which consisting of big data. Furthermore, today's geospatial data is more diverse than ever, with disciplines not traditionally associated with geomatics (like the health and business sectors) leveraging geospatial data for their own analytical purposes. A broader data ecosystem has emerged as a result, comprised of web services and APIs for data harvesting, geoplatforms, and regional SDIs for data linkages and unification, and geospatially enabled administrative systems. This has also warranted the consideration of governing authoritative data through distributed and/or shared authority, including via cross-sectoral collaboration (discussed in Section 2.7). There may be a need for established national policy and legal frameworks governing authoritative data to evolve in order to accommodate this new geospatial reality.

Competition

Often, it is in a country's best interest to promote competition in the production and service delivery of authoritative geospatial data to ensure that costs are minimized and value is maximized. Greater competition in this space can bolster the data economy by allowing governments to seek private sector investment and/or civil society sector involvement in authoritative data production and/or service delivery. In the absence of competition, legal, political, logistical and/or technical constraints may result in the formation of monopolies within geospatial domains. Authoritative data monopolies can form as a result of Intellectual Property rights regulating authoritative data assets. They can also occur when governments grant a given geospatial entity (like NMCA) the exclusive legal right to provide authoritative data. Alternatively, a natural monopoly may emerge if a given geospatial entity has the sole capability of providing certain geospatial data, such that the data is *de facto* authoritative due to their exclusive technological capacities.

In many cases, governments may favor preserving their oversight capacity over promoting competition. For governments open to broadening competition for the production and service delivery of select authoritative data, there are several possible avenues. This may be accomplished, for example, by involving private and civil society sectors in the production of authoritative data via cross-sectoral collaboration (discussed in section 2.7) to promote degree of competition while ensuring the robustness of authoritative data and processes. Other methods may involve shifting the focus of existing authoritative data regulations to regulate the data's geometric correction and analytical readiness processes rather than the geospatial entities themselves, perhaps implemented alongside a custodianship model of data governance.¹⁵ This approach ensures that authoritative data remains robust, regardless of who provides it. However, it is important to be aware of the perverse incentive for cheating this kind of process-driven regulation may bring with it if the regulation is not well thought out (such as corner cutting by taking the easiest, quickest, or cheapest route while omitting important steps that may not be covered under certain non-comprehensive regulations). In other words, it is important that any modifications to existing regulations on the production and delivery of authoritative data products and services take into account and prepare for the potential of any unintended consequences.

Branding

It is one thing to have authoritative data; it is another to make it clear to the intended end users that such data is, in fact, authoritative. End users need to be able to easily find, identify and access authoritative data, thus highlighting the importance of branding in the governance of authoritative data and information. In essence, a lack of branding can limit the findability and use of authoritative data, in addition to undermining trust in that data. One method to improve branding is by implementing an authoritative certification solution to help users identify data that is authoritative. This may take the shape of a special authoritative 'stamp' that exists as a tag for each authoritative data asset in a given database. Search operations can be facilitated by using the stamp as a search condition to limit search results to data that are authoritative. If this solution is implemented, it is important for this 'stamp' to be nationally-recognized and adopted whenever possible – including in the private and civil society sectors as applicable – in order to avoid the creation of multiple stamps that serve the same objective by different organizations, as well as the confusion that would come with this. Also, it may be worth implementing digital safeguards to ensure that the authoritative 'stamp' cannot be accidentally or intentionally misused, nor can it be replicated without the appropriate permission(s).

Standardization and Harmonization

As mentioned in 1.4, compliance with relevant international data standards is a characteristic often associated with highly valued authoritative data. In other words, in order to promote trust and usage of authoritative data, it is important that authoritative datasets are harmonized, and that data production and maintenance processes are designed according to widely accepted international standards. This may require the leveraging policy and/or regulatory instruments to ensure widespread adoption and conformity. Using standards, authoritative databases can be structured and integrated in such a way as to support administrative requirements and to help geospatial practitioners easily identify and maintain the data they need for specific tasks.

¹⁵ The UN-GGIM IGIF [Strategic Pathway 4: Data](#) provides further insight and guidance on data custodianship.

Standards are also increasingly viewed as necessary for overcoming data integration and data-related supply chain problems, particularly when organizing, planning, acquiring, curating, cataloging, analyzing, integrating, publishing, and archiving geospatial information, including authoritative data. There are a number of standards organizations that develop and deploy standards for the purposes of managing, assessing, and improving geospatial data quality and interoperability. They include the Open Geospatial Consortium (OGC); the International Organization for Standards (ISO) Technical Committee 211 Geographic information/Geomatics; and the International Hydrographic Organization (IHO), as well as the World Wide Web Consortium (W3C) regarding its [MapML initiative](#). For more information, refer to the UN-GGIM's [Guide to the Role of Standards in Geospatial Information Management](#), a living online resource aligned with the IGIF that provides detailed insights on the standards and good practices necessary to establish and maintain interoperable geospatial information management systems.¹⁶

Open Access to Authoritative Data

Traditionally, authoritative data was only produced for a select audience, and provided on a need-to-know and cost-recovery basis, presumably due to the costs and potential risks associated with releasing the data to a wider audience of users. Over time, the true scope of the costs and risks were identified, and it became much clearer that the economic, social, scientific, and environmental benefits of opening up authoritative data, as well as the costs of not engaging in open data initiatives, far outweighed the true costs and risks (in most cases). Some of the benefits of open authoritative data include economic growth, improved social welfare, greater capacity for social innovation (as outlined in the UN-GGIM IGIF [Strategic Pathway 5: Innovation](#)), improved performance of public administration, and greater transparency in public processes. The UN-GGIM IGIF [Strategic Pathway 4: Data](#) illustrates this issue by noting the following:

“Authoritative geospatial information is often managed in closed systems of government, resulting in a multitude of information silos. Because of this, geospatial information is often not discoverable nor interoperable, making data integration and exchange problematic. Over time, duplicated information can arise resulting in inconsistent data versions, gaps in data coverage, a waste of resources, and an inability to effectively and efficiently integrate geospatial information across a broad range of services. Sometimes information required is not collected at all. There needs to be more institutional collaboration, interoperability and integration across the various national data information systems and platforms that exist.”¹⁷

As a result, authoritative data producers around the globe have already begun ensuring that the authoritative data that they produce – assuming there are no significant confidentiality, privacy or national security constraints associated with releasing the data – is open to the public. For example, a number of NMCA have begun adopting open-source solutions into some of their services, highlighting the fact that authoritativeness and openness of data are not diametrically opposed. These solutions can involve the adoption of open geospatial data standards to ensure that geospatial data, including that which is authoritative, can be meaningfully employed for various tasks and in different software packages. Likewise, open access to certain authoritative data can be mandated if the risks are manageable and if there are significant benefits for the public good. However, some authoritative data

¹⁶ The Guide complements [Strategic Pathway 6 on Standards](#) of the [IGIF Implementation Guide](#).

¹⁷ https://ggim.un.org/IGIF/documents/SP4-Data_10Jan2020_GLOBAL_CONSULTATION.pdf

are intentionally restricted, typically due to the nature of the data as well as the potential harm from its (mis)use, and are thus excluded from open data agreements.

It is worth noting that tensions may exist between open data policies and military data safeguards. For example, national security laws may limit or prohibit the collection, management, use and distribution of certain types of authoritative data, specifically authoritative data that is military in nature. This can be due to a variety of reasons, including the need to protect a country's national security from the intentional misuse of their own sensitive military data. Whatever the reason may be, the provision of military authoritative data (as opposed to its civil counterpart) is typically excluded from open data agreements due to the national security sensitivities associated with the data. Even if such military data were to be released, the risk of encountering intentionally misleading military data released for the sole purpose of misdirecting and possibly gaining a tactical advantage over challenge partners invalidates its potential for being authoritative and nullifies its trustworthiness from the outset. Examples like these suggest that there are additional considerations for authoritative data used strictly for military purposes that must be addressed when developing holistic authoritative data governance frameworks, particularly when dealing with matters related to data access.

In the geodesy domain, benefits are primarily realized when the broader society is able to utilize comparable authoritative data for numerous purposes and at different times, alleviating potential inconsistency problems.

National Policy and Legal Frameworks

The abovementioned points should be considered not in siloes but rather in relation to a given national or sub-national context's policy and legal constraints and characteristics, which, in reality, significantly overlap. Moreover, policies and laws can and do change over time, necessitating sustained re-evaluation of their implications towards authoritative data governance. Policy experts, legal practitioners and geospatial scientists should work in tandem when developing any sort of holistic governance framework that touches on authoritative data to ensure the framework's robust design. These efforts may also benefit from multidisciplinary involvement with specialists from a range of geospatial domains to ensure that the nature and diversity of authoritative data is well understood and represented.

3.6 THE VALUE PROPOSITION

The Importance of Establishing Data Authoritativeness

The complexities outlined in the preceding pages raise questions about the need for establishing data authoritativeness. This section will discuss the need for authoritative data in the geospatial community, and the significance of the "authoritativeness" designation.

Generally speaking, one of the many values of authoritative data is that it promotes accountability and trust, and provides assurance that decision-making is based on the most relevant data available, with the appropriate level of due diligence in its provision and within the

In the marine domain, official and authoritative nautical charts are intentionally restricted (by law) and typically not made openly available to avoid any confusions and misalignment that would jeopardize safe navigation.

known limitations of its application(s). For instance, the importance of trusted and reliable authoritative data was a key point of discussion at the September 2021 Ordnance Survey's [Cambridge Conference in Conversation on Applying Geospatial Information to Climate Challenges](#), in which it was highlighted that authoritative data is needed for insightful decision-making. A number of recommendations were put forward, including the importance of making it clear to users that the data is authoritative, that the data be made discoverable and accessible so that it is more useful for users, and that it be processed in such a way that makes it more conducive to being used to address the issue(s) it was initially collected for, all while not requiring a high degree of technical expertise to employ.¹⁸

Authoritative data is also needed to support the reliable and consistent monitoring of indicators relating to global development frameworks like the [Sustainable Development Goals](#) (as part of the [2030 Agenda for Sustainable Development](#)) and its affiliated [Addis Ababa Action Agenda](#) (AAAA), the [2015 Paris Agreement](#) on climate change, and the [United Nations Framework Convention on Climate Change](#) (UNFCCC). Other frameworks in which authoritative data is pertinent to reaching their goals include the [Sendai Framework for Disaster Reduction 2015-2030](#) (UNDRR), the Small Island Developing States Accelerated Modalities of Action (SAMOA) Pathway's Small Island Developing States (SIDS) [Partnership Framework](#), the [HABITAT III New Urban Agenda](#), and the [Our Ocean, Our Future: Call for Action](#), to name a few. Moreover, even some of the Environmental, Social, and Corporate Governance (ESG) of various types of firms can be monitored by leveraging authoritative data.

Nationally, authoritative data is needed to support a wide range of national developmental and strategic priorities such as developing flood maps and planning emergency response routes for emergency preparedness, mapping out fisheries management zones, maritime routes and marine protected areas for conservation, monitoring natural resource supplies and threats, as well as developing positioning, navigation and timing (PNT) technologies and applications for the transportation sector and to supply critical infrastructure, to name a few. In this respect, authoritativeness may depend on national priorities, the data that is needed, and the intended use(s) of the data. The [World Bank IGIF templates](#) may assist with articulating the benefits and uses of authoritative data in regard to national priorities.

In the marine domain, authoritative data is important because it is used for a multiplicity of purposes, including to support critical international engagement.

Despite the abovementioned considerations, funding is often a key factor for various national contexts to establish and maintain authoritative data. The key to securing funding, among other things, is through advocacy and education on the value that can be gained from the use of high quality, reliable and trusted authoritative data, as well as the economic, social, and environmental value it can bring for effective decision-making. In this regard, it is important to highlight how investments in authoritative data and corresponding processes in the short-term can result in a more financially viable outcome in the long-term. For instance, authoritative data makes a variety of geospatial processes across virtually all domains more cost effective given that it is less time and resource intensive for users to access the appropriate data – ideally from a trusted source – and given that those authoritative data assets are frequently reused for a multitude of applications by other users. Thus, there are many benefits to establishing and maintaining authoritative data, benefits that far outweigh the costs associated with some of the obstacles that can be navigated through careful planning and collaborative governance.

¹⁸ <https://www.ordnancesurvey.co.uk/documents/cambridge-conference/statement-paper-climate-challenges.pdf>

Refer to [IGIF Strategic Pathway 3: Financial](#) for more information on securing funding for geospatial activities.

The Implications of Not Establishing Data Authoritativeness

The benefits of establishing data authoritativeness can also be understood by observing the costs associated with cases where authoritative data was neglected. Generally speaking, these costs can involve inefficiencies in data processing and analysis, duplication of effort, limited national and global geospatial research and analysis capacity, and poor adherence to widely accepted geospatial data standards which then restricts the future use of the data, to list a few. One key financial justification for data authoritativeness is that governments and/or other non-public sector data providers are more likely to invest in updating and maintaining data that has been labelled as authoritative than in undesignated data. This likely results from the association of authoritativeness with robust and trustworthy data that is critical for sound decision-making. In turn, data labelled as authoritative tends to be in higher demand by geospatial authorities and other users compared to data lacking the designation. In this regard, continued investment to improve the accessibility of data (among other data characteristics as outlined in section 1.4) is necessary to promote the usability of authoritative data for enhanced decision-making potential.

In the geographic names domain, use of non-authoritative geographical names, for example on interactive maps, can lead to errors in navigation as well as misidentification of geographic features, and can perpetuate the use of derogatory or offensive place names.

In general, data users tend to give a greater degree of legitimacy to authoritative data compared to non-authoritative data. This is reasonable given that data authoritativeness is often associated with robust data that has been processed. Without the ‘authoritative’ label, it is challenging to convey the trustworthiness of a particular dataset or provider. For instance, in contexts where authoritativeness is associated primarily with data providers, NMCAs could lose part of the ‘market’ if their data is not labelled as authoritative, likely resulting in further confusion among the geospatial community as well as the judicial system (with respect to legally mandated authoritative data) regarding which data is the most appropriate to be used. Ultimately, the potential implications of not establishing the authoritative designation are heavily context-dependent and require careful assessment.

There are a number of situations where authoritative data is not used but could be beneficial if used. Examples include the use of authoritative environmental data for coordinated disaster management, authoritative flood maps at the municipal level during home construction, authoritative forest classification data with sufficient accuracy for forest mapping, and authoritative address register data to integrate state registers, ensuring population representation by addresses in the official address register. One real world example where authoritative data could have been used involves a case in 2016 where the wrong house was demolished as a result of a (non-authoritative) Google Maps error.¹⁹ Another real world example involves Wales being accidentally left off a map of Europe on the cover of the 2004 Eurostat Statistical Compendium because the map that was used was non-authoritative.²⁰ These examples underscore the

¹⁹ <https://money.cnn.com/2016/03/25/technology/google-maps-house/>

²⁰ http://news.bbc.co.uk/2/hi/uk_news/wales/3715512.stm

importance of establishing and maintaining authoritative data for a variety of uses is integral to ensuring that decisions are supported by a robust foundation of geospatial data while minimizing any unnecessary costs and risks.

Potential disadvantages of designating data as ‘authoritative’

Designating data as ‘authoritative’ may in some cases impose limitations. Depending on the context, restrictive policies and laws may limit the practical collection and management of authoritative data, often due to reasons of privacy, licensing, Intellectual Property (IP) rights, funding, access, quality, and national security. These circumstances often result in the production and use of data that is not formally designated as *authoritative* (by the government) but that is treated as such (typically by users), given that it possesses many of the characteristics that are commonly associated with authoritative data. This issue may be compounded in jurisdictions lacking policy and legal clarity with respect to authoritative data, processes, and/or associated organizations. In these contexts, the authoritative data landscape is often disconnected, giving rise to inconsistencies in data processing and validation. In these situations, the unidentified and dispersed nature of the data may present a barrier to access and use.

These restrictive policies and laws may require the data to be collected by ‘authoritative’ data providers, which often limits the ability of geospatial data to address certain issues. In this regard, policy- and lawmakers can consider adjusting national policy and legal frameworks to allow exceptions for disaster risk and emergency response purposes or to make existing regulations more flexible, granting geospatial agencies broader authority to make assessments depending on the situation. Thus, it is important to address these governance and accountability gaps via sufficient planning and engagement with experts and influencers from the many domains across the geospatial landscape to ensure that *authoritativeness* is associated with trusted and robust data rather than policy and legal obstacles and constraints.

Part 4: The Path Forward – Policy and Legal Considerations

Approaches to governing authoritative data must be adapted to the context in question, which includes existing national and subnational laws and policies, geospatial domain(s) being considered, and affected stakeholders. Drawing from the analysis conducted in Part 3, Part 4 outlines legal considerations for policymakers, lawmakers, and geomatics practitioners, in addition to offering guidelines for effective authoritative data governance.

4.1 LEGAL CONSIDERATIONS

Legal questions related to specific authoritative data assets, processes and organizations should be referred to local legal expertise. It is outside of the scope of this paper to interpret established laws, regulations, or policies, or to determine whether there is a need to establish formal principles within a given domain or national context. Domains and/or national contexts aiming to assess the effectiveness of existing regulation in authoritative data oversight can start by compiling a list of applicable legislation. This will enable governments to identify gaps and assess the need to amend or introduce legislation, in addition to shedding light on potential legal conflicts or limitations. At any given stage of the geospatial data cycle (i.e., acquisition, storage, distribution/access, and use), a range of legislation may apply to data designated as authoritative, including public access laws, anti-trust laws, national security laws, copyright and intellectual property right laws, public procurement laws, legal liability laws, human rights

laws (e.g., the right to privacy), and data protection laws. It should be noted that relevance of these legal categories is heavily context-dependent and may vary considerably across national contexts.

The “authoritative” label carries implications related to characteristics or qualities the data possesses. It is thus important that definitions of authoritativeness outlined in any legal capacity capture the qualities or characteristics that render the data fit for use in the purpose for which it is intended. Lawmakers seeking further guidance for addressing gaps in the regulation of geospatial data should refer to the [UN-GGIM Policy and Legal Resource Kit](#) and [UN-GGIM White Paper on Legal Aspects of Availability of Geospatial Information](#).

Some domains may find there is a greater need for formalized legislative solutions (e.g., in cases where the data is determined to be sensitive, as illustrated in Figure 1 and 4.11), whereas other domains may find expert-informed policy provides sufficient oversight of authoritative data production, use, and sharing. When assessing the need for legal regulation of authoritative data and other formalized legislative instruments, practitioners may also wish to consider convention and tradition within the national context and domain(s) in question. The involvement of technical experts is highly encouraged throughout this process to ensure that any new or amended legislation is relevant and avoids producing undesirable secondary outcomes. Refer to the [Guidance and Recommended Actions aligned with IGF Strategic Pathway 2](#) for more information on developing and strengthening national policy and legal geospatial information frameworks.

The Spectrum of “Control vs. Trust”



Figure 1. Spectrum of control vs. trust seen in authoritative data governance.

Oversight of authoritative geospatial data exists along a spectrum, with instruments positioned between endpoints of “control” and “trust”. Figure 1 illustrates this pattern, including examples of governance instruments that provide oversight of authoritative data across a variety of domains. On the “control” end, oversight of authoritative data is tightly regulated, with definitions of authoritative data carrying legal connotations. Within these more tightly regulated domains, authoritative data control is often limited to government actors, with fewer opportunity

for access and involvement among non-state actors and the broader public. Organizations may have a legally conferred authority and mandate, sometimes going so far as to give legal status to the data itself. Within these more tightly regulated domains, processes related to designation and maintenance of authoritative databases tend to be more inflexible, with fewer opportunities for non-state involvement or institutional re-engineering. In these cases, with the public sector acting as the certified authority, there is limited opportunity for private sector or civil society involvement in authoritative data governance. While the nature and extent of authoritative data regulation may stem in part from legal tradition, the more heavily regulated domains tend to be those producing data with greater sensitivity. The [UN-GGIM Policy and Legal Resource Kit](#) defines sensitive geospatial information as “geospatial information that if improperly accessed, used or disclosed, could cause injury to residents or threaten the national security or other interests of the country.” As the definition suggests, sensitive geospatial information often calls for greater regulatory oversight to protect vulnerable parties or national interests.

On the “trust” end of the spectrum, oversight of authoritative data is less sensitive and therefore less tightly regulated. Within government, designation of authoritativeness may be entrusted to domain experts working in tandem with public policy officials. While private sector and civil society involvement may yet be hindered in some more heavily regulated contexts, nonstate contributions are more common. These contributions may take the shape of officially sanctioned partnerships with government or authorized custodianships of data. In other cases, nonstate contributions are more informal and operate independent from government authority (e.g., academic peer review, internal private sector policies, and volunteer geographic information community initiatives).

It is important to note that the positioning of domains along the control-trust spectrum may vary according to national context. For example, in resource-poor countries with less robust or trustworthy public authoritative data governance, private or civil society actors may emerge to fill perceived gaps in state oversight. In these contexts, state and non-state actors continue to work common goals sometimes in a collaborative manner, and other times independent from one another. Independent private and civil society authoritative data governance initiatives may serve as an informal check-and-balance on state authorities or may evolve into formal partnerships with legal status.

Data sensitivity is an important consideration in assessing a dataset’s fitness for purpose. This paper uses a “fit for purpose” frame to capture the global spectrum of authoritative data governance systems in a variety of geospatial domains. “Fit for purpose” takes into consideration that what is deemed as ‘authoritative’ is dependent on national context, geospatial domain, and intended use(s) of the data.

4.2 DEVELOPING AN EFFECTIVE AUTHORITATIVE DATA GOVERNANCE²¹ MODEL

When developing a formalized approach to governing authoritative data assets, processes or organizations, there are a number of potential considerations. First, established policies and laws that directly or indirectly govern authority and custodianship must be reviewed. This exercise allows for the assessment of organizations’ mandates (including any legislated requirements and core business) to generate, create, collect, process, preserve, maintain and/or disseminate authoritative data. By ensuring organizations’ roles and responsibilities are precisely defined, law and policymakers are able to

²¹ As outlined in Part 1, this section’s use of “governance” and “governance model” aligns with the terms’ use in the [UN-GGIM Policy and Legal Resource Kit](#).

circumvent unnecessary confusion that may arise, for example, from overlapping or duplicative geospatial processes within a single national context.

Law and policymakers seeking to establish a robust authoritative data governance model may also benefit from exploring potential private sector and civil society roles, to the extent that legislation permits. When involving non-state actors in authoritative data activities, it is necessary to ensure that the values, principles, and objectives underpinning cross-sectoral collaborations and/or non-state custodianships are clearly articulated. Non-state capabilities are often leveraged via Memoranda of Understanding (MoUs) and public-private-community partnerships (PPCPs) between governments and one or more third parties. Refer to *Annex D* for a sample table of the possible roles that the various sectors may perform in authoritative data governance.

When modernizing policies and laws that govern authoritative data assets, processes and/or organizations, it is necessary to consider the possibility of unintended outcomes. Consultation with domain experts and use of strategic foresight are recommended to mitigate this possibility and to ensure intended governance objectives are achieved. Strategic foresight applied in this case may involve, for example, exploring opportunities and threats presented by Artificial Intelligence (AI) and blockchain technologies. Refer to the [UN-GGIM Future Trends in Geospatial Information Management report](#) for more information on this matter.

Establishing Authoritativeness for Data used for Legal Arbitration and for Other Predefined Purposes

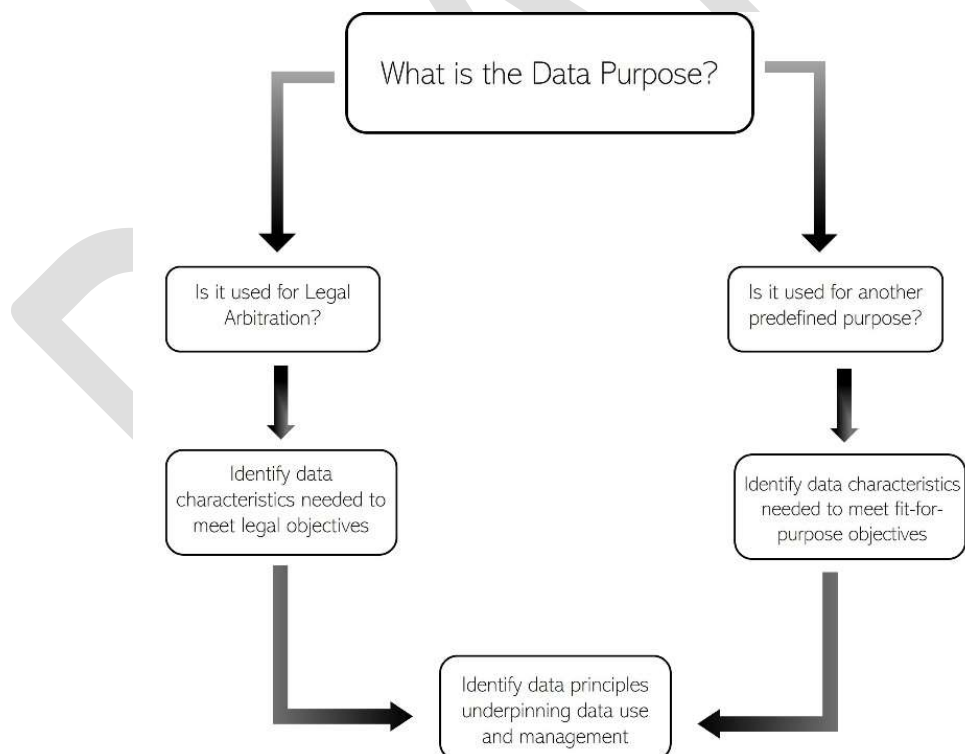


Figure 2. A pathway to establishing authoritativeness for data used for legal arbitration and for other predefined purposes.

Data characteristics and principles used to establish data as authoritative and to oversee its use and management should be carefully selected taking into consideration the data's intended use(s). As the overview of selected domains in Part 2 suggests, appropriate data characteristics and principles may vary considerably across geospatial domains and intended data purposes. The above decision tree outlines decision pathways for the authoritative data used for legal arbitration and for the more broadly applicable fitness-for-purpose authoritative data criterion introduced in 3.3. In general, data being used for legal arbitration must adhere to preestablished, legally entrenched data characteristics, which may be underpinned by data principles governing the data's use and management. Data designated as authoritative that is intended for purposes other than legal arbitration should adhere to data characteristics that render the data fit for a defined purpose. For more detailed discussion of data characteristics and principles, refer to 1.4, 1.5 and *Annexes B and C*.

It is not uncommon among organizations using geospatial data for established datasets to be informally harnessed for secondary purposes in addition to those for which they are primary intended. While these secondary uses may be considered legitimate and/or robust, decision makers should be aware that introducing a secondary data use necessitates a re-evaluation of characteristics and principles used to designate data as authoritative. A dataset's authoritativeness is bound to its particular context; if the context is modified, the data's authoritativeness may be called into question. Thus, introducing secondary or additional data uses may necessitate a revision of established characteristics and/or principles to ensure the data's continued authoritativeness.

4.3 GUIDELINES FOR EFFECTIVE AUTHORITATIVE DATA GOVERNANCE

Table 1 offers general guidance for law and policymakers seeking direction in the development, implementation, and/or review of their authoritative data governance operating structures. It is not intended to critique or supplant functional or well-established authoritative data governance frameworks without an identified need for external assistance or support. It is recommended that the table is used in conjunction with the more detailed resources that are linked throughout.

Table 1. Suggested guidelines for effective authoritative data governance.

Determine Policy Objective and Purpose	<p>Building on national priorities, establish what kinds of data are needed.</p> <p>Identify the data's intended purpose, including the user needs. Begin to define data's fitness for purpose.</p> <p>Refer to Figure 2 for guidance regarding establishing a data purpose for data used for legal arbitration and for other predefined purposes.</p>
Clarify Data Sources	<p>Determine whether the data in question is derived from a single source or from multiple sources.</p> <p>Consider how the number of sources and/or the sources themselves affect decisions downstream (e.g., data principles, access, risk tolerance, branding and access).</p>
Data Characteristics	<p>Identify desired data characteristics that corresponded with the intended purpose(s) of the data, such as:</p> <ul style="list-style-type: none"> • Quality • Accessibility • Accuracy

	<ul style="list-style-type: none"> • Timeliness • Traceability • User-centricity • Standardized²²
Data Principles	<p>Identify principles necessary to guide governance in order to ensure that the data is fit for its intended purpose(s). Data principles may include:</p> <ul style="list-style-type: none"> • Continuity • Adherence to the FAIR Principles • Trust • Uniqueness (heavily context-dependent)²³
Legal Regulation	<p>Determine what needs to be legally regulated and how should it be regulated.</p> <ul style="list-style-type: none"> • The criticality of regulating and/or validating authoritative data assets, processes and/or organizations depends on the context, intended uses, and fitness for purpose. <p>Identify policy and legal gaps in authoritative data governance.</p> <p>Evaluate the implications of existing legislation regulating licensing, Intellectual Property (IP) rights, liability, privacy, confidentiality, national security and cybersecurity for authoritative data governance, and attendant challenges that may arise (e.g., how the practical collection and management of authoritative data can be restricted due to these considerations).</p> <ul style="list-style-type: none"> • Identify tools that may be used to address these considerations. <p>Refer to the UN-GGIM Policy and Legal Resource Kit and UN-GGIM White Paper on Legal Aspects of Availability of Geospatial Information for further guidance.</p>
Assessing Available Resources	<p>Take stock of available resources, cost recovery, pricing, and resource funding implications associated with collecting, storing, maintaining, and distributing authoritative data.</p>
Role of Non-State Actors	<p>Consider existing and potential future roles of the public sector vis-a-vis the private and civil society sectors in data production, ownership, provision or distribution, certification, custodianship, stewardship, and/or regulation.</p>
Identifying Standards	<p>Identify standards to adopt to improve data interoperability, consistency, efficiency, and quality.</p>
Determining Risk Tolerance	<p>Assess the risk tolerance of the organization(s) or user(s) relating to the authoritative data activity(ies) in question.</p>
Branding And Access	<p>Consider how authoritative data assets, processes and organizations can be more easily found and identified.</p>

²² Refer to *Annex B* for a detailed list of the mentioned data characteristics.

²³ Refer to *Annex C* for a detailed list of the mentioned data principles.

Open Data

If the possibility exists that the data could be made openly available, address the implications of widespread accessibility.

Economic, Social, Scientific and Environmental Benefits

Identify economic, social, scientific, and environmental benefits of using authoritative data.

- Develop best practices for communicating these benefits to non-expert decision makers.

4.4 CONCLUSION (Placeholder - to be added following global consultation)

Annex A:
TBC

DRAFT

Annex B:

Detailed List of Potential Characteristics of Authoritative Data

The following is a detailed list of the desired characteristics that may underpin data authoritativeness based on its intended purpose(s):

Quality:

For many geospatial producers and users alike, authoritativeness assumes that the authority responsible for governing the data has processes in place to produce high quality data, even if this is not always the case in reality. Nonetheless, there is ubiquitous agreement that data producers should strive to produce authoritative data that is of a sufficient level of quality to be effectively employed for the intended purpose(s). In this regard, prior to being recognized as authoritative, data is expected to be tested and pass-through continuous quality control checks to ensure compliance with widely accepted standards, policy objectives and legal regulations.

According to the ISO geographic information standards on [data quality](#) and [metadata](#), typical components of geospatial data quality include *completeness*, *logical consistency*, *positional accuracy*, *thematic accuracy* and *temporal quality*:

- **Completeness:** *“evaluation includes errors of commission and omission. An error of commission is a false positive, such as incorrectly including an object (e.g., a building) in a GIS dataset that does not exist in the real world, or classifying an object as a specific type (e.g., deciduous woodland) when they should have been classified as something else (e.g., coniferous). Errors of omission are false negatives, such as omitting a building that exists in the real world from a dataset, or failing to classify a deciduous woodland and classifying it as another type of land cover.”*²⁴
- **Logistical Consistency:** *“Logical Consistency: includes conceptual, domain, format, and topological consistency of the collection. Was the data collected by one scientific sensor, by visual interpretation, manual digitizing, or amalgamation of data sources? Was there data aggregation (raw units of measurement versus spatial or temporal averages, and at what scales)? Does the data collection reflect the property that was to be measured?”*²⁵
- **Positional Accuracy:** *“Positional Accuracy: includes absolute, relative and gridded accuracy, reflecting how closely the measurements are estimated to match the “true” values. Measurement precision is also important, indicating how finely properties are measured, e.g., in centimetres, metres, kilometres.”*²⁶
- **Thematic Accuracy:** *“Thematic Accuracy: includes classification, and attribute correctness. As with positional accuracy, how closely the measurements are estimated to match the “true” values.”*²⁷

²⁴ <https://doi.org/10.4095/328063>

²⁵ <https://doi.org/10.4095/328063>

²⁶ <https://doi.org/10.4095/328063>

²⁷ <https://doi.org/10.4095/328063>

- **Temporal Quality:** *“Temporal Quality: includes accuracy, consistency, and validity. The Vintage of the data (how recent or up to date it is) and whether it was all collected at once or amalgamated over several periods will affect its potential uses.”²⁸*

Accessibility:

Accessibility, which is one of the [FAIR Principles](#) and a key element of data maturity models, is another data characteristic that is often associated with authoritative data. The value of geospatial data is best realized when it is consistently available and easily accessible by its intended users. Without data accessibility, even the finest and most desirable data cannot be easily found, assessed, and used. When data is accessible and discoverable, data usage increases significantly and becomes more trusted as a result. Accessibility is enhanced by ensuring that the availability of products is open and unrestricted by default using appropriate and widely accepted methods, and that the data is easily understood and usable by all. Accessibility of existing authoritative data and associated ancillary products and services can also be enhanced by accommodating the needs of people living with disabilities, minorities, and other vulnerable groups, as well as indigenous communities. For more information on the legal dimensions of geospatial data availability, refer to the [UN-GGIM White Paper on the Legal Aspects of Geospatial Information Availability](#).

Accuracy:

Accuracy, also known as veracity, is another quality indicator that dictates in what context and for what purpose the data can be effectively used. Like accessibility, it is a key element of data maturity models, and may be used to indicate the data’s spatial resolution, temporal resolution, spectral resolution, thematic resolution, and/or radiometric resolution. Expectations of a given authoritative data’s accuracy is contingent on the intended analytical purpose(s).

Timeliness:

Timeliness is another key element often associated with data authoritativeness, especially as it relates to data that could be used in response to rapid onset crises. Specifically, authoritative data is expected to be made available in a timely manner, with maintenance and the update schedule (if applicable) made explicit in the metadata. This may be facilitated by having a coherent versioning scheme for the data, with older versions of data and related services/APIs being perpetually maintained for posterity. In the case of dynamic or real-time authoritative data, it is advisable that it be made available on the web in near real-time or in real-time.

Traceability:

Authoritative data generation is expected to be fully traceable with clear documentation of the process in which the data was created and/or maintained. This involves having metadata that points to the original source of the data, which can help potential users determine the degree in which it is authoritative in cases where the data may look and feel authoritative but may in fact not be authoritative. The metadata should also be preserved in cases of authoritative data integration processes to ensure continuous traceability. For more information on relevant metadata standards, refer to [ISO 19115 standards on geographic](#)

²⁸ <https://doi.org/10.4095/328063>

[information – metadata](#) and [ISO 19139 standards on Geographic information Metadata XML schema implementation](#).

User-centric:

Authoritative data is expected to have some degree of user-centric design to promote widespread usage for a multiplicity of purposes, and to ensure that the data is as easy to use as possible. User-centricity can be conceptualized by degrees of usability, with some data having greater usability over others given the intended analytical objective(s).

Standardized:

Authoritative data is often expected to adhere to relevant international standards such as those from ISO, OGC and IHO. In reality, while many geospatial data standards are virtually universally accepted and adopted, some have yet to be, and continue to be developed to enhance their acceptability and applicability. For more information, refer to the UN-GGIM's [Guide to the Role of Standards in Geospatial Information Management](#).

Annex C:

Detailed List of Potential Principles Guiding the Production and Governance of Authoritative Data

The following is a detailed list of the key principles that may underpin data authoritativeness:

Continuity:

Authoritative data providers are expected to be able to provide and maintain relevant authoritative data effectively. Having up-to-date data on a consistent basis is important for establishing long-lasting trust of authoritative data and its providers, even if the data is not the most accurate. This may necessitate developing an effective communications strategy to explain how the authoritative data will be maintained and updated in the future. A high level of expertise and infrastructure is also needed to sustain the creation, provision, and maintenance of authoritative data, which necessitates a holistic strategy that extends beyond technological innovation to include policy, governance, and engagement.

There is also an expectation that authoritative data is preserved indefinitely to ensure continuous availability of the data for a multiplicity of purposes. This concept is intricately linked to [the TRUST Principles for digital repositories](#) – representing Transparency, Responsibility, User focus, Sustainability and Technology – which “provide a common framework to facilitate discussion and implementation of best practice in digital preservation by all stakeholders.”²⁹ This may involve establishing a clear authority for version control – such as a data custodian – to help clarify the extent of the data providers’ role. Naturally, it is simplest to have a singular entity as the sole originator of the data, and thus the one responsible for version control, though this may not always be possible in contexts where there has been organizational restructuring over time that would result in the data being provided by more than one entity throughout its life cycle. Alternatively, a data custodianship regime may be the preferred mechanism to ensure the long-term preservation and retention of the data’s authoritativeness. The UN-GGIM IGIF [Strategic Pathway 4: Data](#) provides further insight and guidance on data custodianship.

Adherence to the FAIR Principles:

Authoritative data is expected to adhere to the [FAIR Guiding Principles for scientific data management and stewardship](#) (also known as the FAIR Data Principles or simply the [FAIR Principles](#)) which are guidelines to improve the Findability, Accessibility, Interoperability, and Reuse of digital assets like geospatial data. Specifically, authoritative data and its corresponding metadata should be easy to find for both humans and computers (the latter via machine-readable data and metadata). Broader interpretations of findability can also include enhanced relevance and speed needed to find the required data. As mentioned above, the data is expected to be sufficiently accessible. Broader interpretations of accessibility can include enhanced access to a greater cross-section of geospatial users, including people living with disabilities, minorities, and other vulnerable groups, as well as indigenous communities. The data is also expected to be interoperable with other data as well as with applications or workflows for analysis, storage, and processing. Interoperability can also extend beyond the technical and semantic levels to include organizational, policy and legal interoperability. Broader interpretations of interoperability can

²⁹ <https://www.nature.com/articles/s41597-020-0486-7>

include enhancing map availability and analytics. Finally, the establishment of these principles are in an effort to optimize the reusability of geospatial data, which may necessitate that the data and the corresponding metadata be registered or indexed in a searchable resource like a geoplatform for download. Broader interpretations of reusability can include the removal of data and technological barriers. A proposed implementation framework for a FAIR Data Maturity Model by the Research Data Alliance (RDA) can be found [here](#).

Adherence to the FAIR Principles can also be complemented by an adherence to the [CARE Principles](#) for Indigenous Data Governance (representing Collective Benefit, Authority to Control, Responsibility, and Ethics), which have been developed by the Global Indigenous Data Alliance (GIDA) to reflect the critical role of data in advancing Indigenous innovation and self-determination.

Trust:

In order for data to be deemed ‘*authoritative*’ and to have widespread use, particularly in essential public tasks, it is important that the data can be trusted. Several data characteristics mentioned in this report, including quality, accessibility, and accuracy, are key conditions to establishing and maintaining trust. It is especially crucial to provide authoritative data that geospatial users can trust in the long-term, as well as to establish lasting organizational trust for the data producers, providers, custodians, and stewards. Naturally, this is a long and complex process that may necessitate that existing data is consistently validated, and when necessary, corrected or updated. It may also necessitate the adoption of widely accepted data standards and quality control measures in the collection, production, maintenance, and access of the data.

Often, certain data is trusted by default simply because it is deemed ‘*authoritative*,’ which may even suggest that the data is the best of what is available (in terms of various data characteristics), though this is not always the case in practice. Alternatively, the trustworthiness and authority of the issuing agency, whether it is a public authority or otherwise, may be the main evaluating factor to determine the trustworthiness – and accordingly the authoritativeness – of the data. In other cases, greater emphasis may be placed on the robustness of the data processing and validation procedures in place, which may inspire trust, and consequently, authoritativeness.

Uniqueness:

Uniqueness can refer to the nature of the authoritative data (as in the only iteration of the data) as well as the role of the data provider (as the sole source of the authoritative data in question). Uniqueness can also refer to the sole right of a designated organization to produce, provide, and/or certify authoritative data for wide use. In this regard, when faced with numerous authoritative data providers, a data custodianship regime may be implemented to eliminate the proliferation of duplicative authoritative datasets, promoting efficiency in geospatial processes and cost effectiveness, reusability of authoritative data, and uniqueness as it related to the data asset, process, and/or organization in question. In practice, many national contexts do not have the necessary policy and regulatory structures in place to ensure uniqueness in a given authoritative data asset, process, or organization, which suggests that the applicability of this principle is heavily context dependent. The UN-GGIM IGIF [Strategic Pathway 4: Data](#) provides further insight and guidance on data custodianship.

The UN-GGIM IGIF [Strategic Pathway 4: Data](#) provides a more thorough list of principles that may underpin data authoritativeness.

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Annex D:

Sample Table of Possible Sector Roles in Authoritative Data Governance.

EXAMPLE

Data Roles	Public Sector (Government)	Private Sector	Civil Society Sector
<i>Data Producer/Originator</i>	x	x	x
<i>Data Owner</i>	x	x	x
<i>Data Provider/Distributor</i>	x	x	x
<i>Data Custodian</i>	x	x	
<i>Data Steward</i>	x	x	
<i>Regulator</i>	x	x (via self-regulation)	x (via self-regulation)
<i>Data Certifier</i>	x		