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INGEST Task Force on Standards Issues

A path towards the use of common standards to support the INtegration of GEospatial and STatistical information

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INGEST Task Force on Standards Issues

A path towards the use of common standards to support the INtegration of GEospatial and STatistical information

Prepared for UNECE by Sara Stewart

Abstract

In 2022, the European Commission funded a 21-month project which was led by UNECE to develop greater capacity in statistical and geospatial data integration across the UNECE region. The project aimed to foster stronger links between the two communities, support greater collaboration and encourage greater data integration through the promotion of stronger institutional partnerships and the use of common standards, with a particular focus on sixteen target countries defined as non-EU members located within the UNECE region in Eastern and Southeastern Europe, the Caucasus and Central Asia.

Under the scope of the project, UNECE established the INGEST Task Force on Standards Issues relating to the INtegration of GEospatial and STatistical information which brought together representatives from National Statistical Institutes and National Mapping and Cadastral Agencies from across the region to discuss the current use of standards, explore the present issues and constraints, and identify priorities and actions that would strengthen the use of common standards to support data integration activities. This working paper describes the activities and outcomes of the INGEST Task Force and presents a set of recommendations and implementation guidelines which have been developed by the Task Force, laying out a path towards the greater use of common standards to support the integration of statistical and geospatial information at national levels.

ACKNOWLEDGEMENTS

This paper describes the activities and outcomes of the INGEST Task Force on Standards Issues relating to the integration of geospatial and statistical information which was established by the United Nations Economic Commission for Europe (UNECE) under European Union Contribution Agreement 2021.0180. It is based on the combined experience of data integration experts from the statistical and geospatial communities across the UNECE region and is intended to support and guide others working in this area.

Guidance and support were provided by the Statistical Division of the United Nations Economic Commission for Europe Secretariat (Sara Stewart and Taeke Gjaltema).

The following members kindly dedicated their time to the INGEST Task Force, sharing their knowledge, experience and expertise, and contributing to the activities, outcomes, and content of this paper:

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ABBREVIATIONS

CSPA	Common Statistical Production Architecture
EFGS	European Forum for Geography and Statistics
ETL	Extract, Transfer, Load
EU	European Union
FAIR	Findability, Accessibility, Interoperability, Reusability
GAMSO	Generic Activity Model for Statistical Organisations
GeoGSBPM	Geospatial view of the Generic Statistical Business Process Model
GISCO	Geographic Information System of the COmmision
GML	Geography Markup Language
GPKG	GeoPackage
GSBPM	Generic Statistical Business Process Model
GSGF	Global Statistical Geospatial Framework
GSIM	Generic Statistical Information Model
HLG-MOS	High-Level Group for the Modernisation of Official Statistics
IHO	International Hydrographic Organisation
INGEST	Integration of Geospatial and Statistical Information
ISO	International Organisation for Standardisation
ISO/TC 211	ISO Technical Committee 211 Geographic Information/Geomatics
KML	Keyhole Markup Language
NMCA	National Mapping and Cadastral Agency
NSI	National Statistical Institute
OGC	Open Geospatial Consortium
SDI	Spatial Data Infrastructure
SDG	Sustainable Development Goal
SDMX	Statistical Data and Metadata eXchange
UN EG-ISGI	United Nations Expert Group on the Integration of Statistical and Geospatial Information
UN-GGIM	United Nations Group on Global Geospatial Information Management
UN-IGIF	United Nations Integrated Geospatial Information Framework
UNECE	United Nations Economic Commission for Europe
UNSC	United Nations Statistical Commission
WFS	Web Feature Services
WMS	Web Map Services
WPS	Web Processing Services

EXECUTIVE SUMMARY

1. Data is an increasingly important resource which can be used to better understand our world and address the many challenges faced by society. The 2030 Agenda for Sustainable Development highlighted the need for harmonised data of increasing quality, accuracy, currency and granularity to support the measurement and monitoring of its Sustainable Development Goals. As authoritative data providers, National Statistical Institutes (NSIs) and National Mapping and Cadastral Agencies (NMCAs) play a central role in these requirements and the integration of statistical and geospatial data is viewed as one of the promising ways to achieve the high-quality data needed to inform evidence-based decision-making. The use of data standards, that is, sets of pre-defined rules which ensure that data is consistently described, recorded, and exchanged, is a central component of data integration and their common use will improve the harmonisation and interoperability of diverse datasets across different spatial and temporal scales. Global efforts to drive the greater integration of statistical and geospatial data have been ongoing for a decade through the work of the United Nations and other global and regional organisations; however, the benefits have not been realised consistently across different countries and regions. Recognising this disparity, the United Nations Economic Commission for Europe (UNECE) has led an EU-funded project to develop greater capacity in the integration of geospatial and statistical data across the UNECE region. Through the project scope, UNECE established the INGEST Task Force on Standards Issues relating to the INtegration of GEospatial and STatistical information which brought together representatives from NSIs and NMCAs across the region to discuss the current use of standards, explore the present issues and constraints, and identify priorities and actions that would strengthen the use of common standards to support data integration activities.

2. This paper describes the activities and outcomes of the INGEST Task Force which took place over the course of a nine-month period from August 2023 to April 2024. An overview of the background to the Task Force and its aims and objectives are first presented, before the activities undertaken to address those aims and objectives are outlined. The wider context of standards use is then explored, focusing on the importance of implementing standards across the data lifecycle and the benefits that can be gained from their use, and outlining the standards commonly used by statistical and geospatial organisations. Following this, a range of issues and obstacles which are currently limiting the use of common standards across the region are then discussed through the lens of both governance and technical perspectives. These include differing approaches to governance and a lack of common understanding between stakeholders, difficulties in communicating the benefits of standards adoption effectively, challenging financial environments, variance in data quality, completeness and reliability, compatibility issues, geographic referencing and address complexity, inadequate data and technology infrastructures, and the presence of organisational skills gaps. The strengths and opportunities that could be capitalised on to support the greater use of common standards within data integration activities are then considered under key areas including cooperation and communication mechanisms, legislation and funding support, leadership requirements, existing mechanisms to develop and

adopt standards, process improvements and quality enhancements, and new opportunities afforded by innovation.

3. Based on the collective outcomes of the activities undertaken by the INGEST Task Force and their contextual consideration, five recommendations are made by the Task Force which lay out a path towards the greater use of common standards to support the integration of statistical and geospatial information at national levels. The recommendations are grouped under four themes: cooperation, collaboration and communication; strategic leadership; data and technology infrastructures; and skills and training. Each recommendation is supported by a set of implementation guidelines which outline the practical steps that organisations should take to achieve them. The INGEST Task Force recommends that:

A. Cooperation, collaboration and communication mechanisms should be institutionalised through official structures and networks (e.g. national steering groups), developing shared objectives which are supported by operating models and standards relevant to organisational and national activities.

B. Organisational commitments to standards adoption should be acquired, with active participation in standards development where relevant. Organisations should ensure that appropriate structures are in place to support the effective use of standards, strategically driven by senior management and technically supported by skilled staff.

C. A national roadmap for data integration should be developed with standards as a key element, formalising agreed leadership and champions to drive the implementation of the roadmap.

D. Organisational data and technology infrastructures should be "fit for purpose", facilitating the implementation of standards and integration across the data lifecycle. Information management practices should be aligned and integrated across the statistical and geospatial domains to support the use of common standards.

E. Organisational skills gaps should be identified, and specialist training programmes designed and implemented, to develop and maintain staff expertise in the use of standards to support integration workflows across the data lifecycle.

4. These recommendations are designed to support national statistical and geospatial organisations in their actions to adopt and embed the use of common standards in activities to integrate statistical and geospatial information across the data lifecycle. Following this path will bring many benefits. By establishing common mechanisms to create, manage and disseminate data, data will become interoperable which will facilitate the seamless exchange of data between different sources and endpoints. The use of common formats, definitions, and processes will enhance the quality, reliability, and usability of the data, allowing meaningful comparisons to be made between different datasets across space and time. By embedding standards within internal workflows, organisations can also future proof their activities, processes and products in the face of rapid technological advancements and changing requirements. Ultimately, the use of common standards within processes to integrate statistical and geospatial information will result in the harmonised, interoperable, high-quality data needed to improve decision-making, inform policy development, and realise efficiencies

in processes and services within and across different organisations at national, regional and global levels. With these recommendations, a path has been laid out for organisations to achieve these goals.

I. INTRODUCTION

5. In our dynamic world, the fast pace of technological advancements and increasing digitalisation are generating huge quantities of data, raising its importance as a vital resource to better understand our world and address the biggest challenges faced by society, such as the impacts of climate change, political instability, and social inequality. Data is viewed as "both a by-product and a driver of global development that has transformed how we make decisions" (World Economic Forum, 2022) and high-quality data can be used by governments to inform evidence-based decision-making to meet these challenges head on. The 2030 Agenda for Sustainable Development (United Nations, 2015a) has highlighted the need for harmonised data of increasing quality, accuracy, currency, and granularity to support the measurement and monitoring of the Sustainable Development Goals (SDGs) and other key policy drivers such as the Sendai Framework for Disaster Risk Reduction 2015-2030 (United Nations, 2015b) and the Paris Agreement (United Nations, 2016). As authoritative data providers, both National Statistical Institutes (NSIs) and National Mapping and Cadastral Agencies (NMCAs) play a central role in these data requirements and the integration of statistical and geospatial data is viewed as "one of the most promising paths to provide more timely, reliable and detailed information" (Eurostat, 2019, p. 1).

6. As outlined by the United Nations Group on Global Geospatial Information Management (UN-GGIM, 2019, p. 1), efforts to integrate data are occurring at a time when NSIs are undergoing widescale digital transformation as they seek to modernise their activities and take advantage of new data sources to achieve increasingly more high-quality and harmonised statistical outputs. Similarly, NMCAs are working to improve the management of geospatial data through national Spatial Data Infrastructures (SDIs), ensuring that authoritative geospatial data is accessible across government to improve decision-making, enhance policy development and improve efficiencies across their executive functions. Despite the fact that global efforts to drive the greater integration of statistical and geospatial data have been ongoing for more than a decade through the work of the United Nations and other international and regional bodies, the benefits have not yet been fully realised consistently across different countries and regions. The use of data standards, that is, sets of pre-defined rules which ensure that data is consistently described, recorded, and exchanged, are an important means to improve the harmonisation and interoperability of different datasets across space and time and thus to drive the data integration agenda.

7. This paper describes the activities and outcomes of the INGEST Task Force on Standards Issues relating to the INtegration of GEospatial and STatistical information which was established by the United Nations Economic Commission for Europe (UNECE) under European Union (EU) Contribution Agreement 2021.0180 in August 2023. This paper acts as the primary output of the Task Force and is based on the activities undertaken and outcomes generated over the course of a nine-month period from August 2023 to April 2024. The paper outlines the background to the Task Force and the wider context of standards use. It then describes the issues and obstacles currently limiting the use of common standards across the region, and the strengths and opportunities that can be capitalised on, before sharing

recommendations which set out a path towards the greater use of common standards to support the integration of statistical and geospatial information at national levels.

A. Background to the Task Force

8. Recognising the importance of supporting countries in their data integration journeys, the European Commission funded a project, led by UNECE, to develop greater capacity in the integration of geospatial and statistical data across the UNECE region (UNECE, 2024a). An EU Contribution Agreement (2021.0180) was established between the European Commission and UNECE to fund the implementation of the Action: "Cooperation with UNECE covering the organisation of important events or actions aimed at developing statistical capacity (integration of geospatial and statistical data in UNECE countries)". The Action was implemented over a period of 21 months, from August 2022 to April 2024 inclusive. As described in Section 1a of Annex I of the Agreement, the project aimed to "foster stronger links between the statistical and geospatial communities across the UNECE region, facilitating greater collaboration and encouraging greater integration of geospatial and statistical information by promoting stronger institutional partnerships and the use of common standards". The project was designed to support existing activities to strengthen the integration of statistical and geospatial data by Eurostat and others particularly within sixteen target countries defined as "UNECE members that have not yet joined the EU, in Eastern and South-Eastern Europe, the Caucasus and Central Asia".

9. The main activities undertaken through the Action, as outlined in Section 1b of Annex I of the Agreement, included:

- Increasing awareness of the need for more integration of geospatial and statistical data and demonstrating progress towards this goal.
- Fostering strong and sustainable links between the statistical and geospatial communities in the non-EU European countries, facilitating greater collaboration and increasing integration of geospatial and statistical information.
- Promoting institutional partnerships and the use of common standards.
- Supporting and guiding national statistical and geospatial authorities in developing and implementing common international standards and methodologies for reporting data.
- Supporting and guiding national statistical and geospatial authorities to set up and to adapt their data production system based on the relevant standards and methodologies.

10. Under the scope of the Action, UNECE established the INGEST Task Force on Standards Issues relating to the integration of geospatial and statistical information in August 2023. The Task Force was designed to bring together representatives from NSIs and NMCAs across the UNECE region (with a particular focus on the project's target countries) to discuss the current use of standards within activities to integrate statistical and geospatial information, to explore the present issues and constraints, and to identify priorities and actions that would strengthen the use of common standards to improve the harmonisation and interoperability of statistical and geospatial information. Through the UNECE Survey on the Integration of

Statistical and Geospatial Information (discussed in more detail in Section III), UNECE gauged the level of interest in establishing a Task Force to explore standards issues from the stakeholder community and 80% of respondents noted their interest. Due to the strong interest from organisations, a selection process was used to identify a core membership based on whether respondents were a project target country, whether both NSI and NMCA within a country were interested in participating, and whether they had rated standards as having a high impact on data integration or had discussed the importance of standards within their UNECE Survey response. The Task Force was formed with 16 members from 12 countries, of which 7 were from project target countries (Table 1). A good balance of NSIs and NMCAs were represented, including four countries where both organisations were members which allowed valuable dual perspectives to be gained on the issues discussed. The Task Force was co-chaired by Statistics Finland and Ordnance Survey of Northern Ireland and UNECE acted as the Secretariat. To enhance this core membership, the Task Force was also open to other countries and organisations that were interested in contributing to its work.

Country	Organisation
Albania*	Institute of Statistics (INSTAT)
Albania*	State Authority for Geospatial Information (ASIG)
Armenia*	Statistical Committee of the Republic of Armenia
Azerbaijan*	State Statistical Committee of the Republic of Azerbaijan
Bosnia and Herzegovina*	Agency for Statistics of Bosnia and Herzegovina
Bosnia and Herzegovina*	Federal Administration for Geodetic and Real Property Affairs
Finland	Statistics Finland
Finland	National Land Survey of Finland
France	National Institute of Statistics and Economic Studies (INSEE)
Germany	Federal Statistical Office (Destatis)
Malta	National Statistical Office
Moldova, Republic of*	Agency for Land Relations and Cadastre of the Republic of Moldova
Montenegro*	Statistical Office of Montenegro (MONSTAT)
Türkiye*	Turkish Statistical Institute (TURKSTAT)
United Kingdom	Northern Ireland Statistics and Research Agency (NISRA)
United Kingdom	Ordnance Survey of Northern Ireland (OSNI)

Table 1: Membership of the INGEST Task Force on Standards Issues (denotes a project target country)*

11. A Terms of Reference was developed for the Task Force (Appendix 1) and UNECE consulted with the Co-Chairs of UN-GGIM's Expert Group on the Integration of Statistical and Geospatial Information (UN EG-ISGI) and the Chair of UN-GGIM: Europe's Line of Work on Data Integration to ensure that the work of the Task Force was aligned to, and did not duplicate, wider activities and actions. As outlined in the Terms of Reference (Appendix 1), the main objectives of the INGEST Task Force were to:

- Identify domains where the integration of statistical and geospatial information is hampered by the lack of common standards.
- Identify priorities for standards harmonisation work and recommend related actions that would improve the harmonisation and interoperability of statistical and geospatial information.
- Contribute to the creation of guidelines to support country-level implementation of the recommended actions.

12. Other objectives of the INGEST Task Force were to:

- Support the coordination and collaboration of the statistical and geospatial communities within the UNECE region, to promote stronger institutional partnerships, and strengthen the integration of statistical and geospatial data.
- Contribute to the coordination and collaboration of the related work of other international organisations.
- Participate in the exchange of experience, knowledge, and best practice.

13. The INGEST Task Force undertook a series of activities over the course of nine months from August 2023 to April 2024 which are described in more detail in Section IIB below. In line with the expected outcomes of the Action, the primary output of the Task Force is this paper which describes the activities and outcomes of the Task Force and outlines a set of recommendations and implementation guidelines to support the use of common standards within activities to integrate statistical and geospatial information at national levels.

B. How the recommendations were developed

14. Following the establishment of the INGEST Task Force and the agreement of its Terms of Reference, an in-person meeting of the Task Force took place as a side event of the Joint UNECE / Eurostat / UN-GGIM: Europe Workshop on Integrating Statistical and Geospatial Data in Belgrade, Serbia on the 3rd of October 2023. The meeting was developed as an opportunity to publicise the Task Force, gain wider perspectives on its planned activities, and obtain input on the existing use of standards to support data integration activities. The meeting brought together members of the Task Force to meet in person for the first time as well as participants from outside of the Task Force to gain broader perspectives on the planned activities before they began in earnest. The meeting was attended by 26 participants from 16 countries, representing a broad mix of NSIs, NMCAs and other intergovernmental and private sector organisations. During the meeting, UNECE presented an overview of the background and context to the Task Force, the planned activities, and anticipated outcomes to acquire feedback from the audience on the intended direction. Following this, participants were asked to break out into small groups to discuss specific questions relating to the current use of standards, the use of national versus international standards, and any issues and obstacles in their use. Feedback from these discussions was used to inform the scope of the Task Force activities as outlined below.

15. So as to achieve the primary objectives of the Task Force and the development of a set of recommended actions and guidelines to support the use of common standards within data integration activities at national levels, three activities were undertaken by the Task Force, each of which was designed to build upon the results of the previous activity.

Activity A

16. The aim of the first activity, Activity A, was to understand the current use of standards by member organisations and to share use cases and best practice. Task Force members were asked to contribute to the creation of a database which documented the standards presently used by their organisations that specifically relate to data integration activities as defined by UN-GGIM's (2017) Global Statistical Geospatial Framework (GSGF) and include:

- Geocoding practices i.e. the use of standardised location references (e.g. addresses, building identifiers) to accurately assign coordinates, grid references etc.
- Storage of standardised location references within a data management system that link or manage the geocoded data.
- Management and use of common geographies across datasets (e.g. statistical boundaries, administrative boundaries, grids).
- Dissemination of data via web services, APIs etc.
- Quality management practices.
- Recording and management of metadata across the data lifecycle.

17. The information collected included the name of the standard, type of standard (e.g. national, international), stage of use in the data lifecycle as based on the stages outlined in the Geospatial view of the Generic Statistical Business Process Model (GeoGSBPM; UNECE, 2021a), other use (e.g. data quality, metadata, archiving), type of use (e.g. live processes, pilot/testing), and additional comments (e.g. benefits, problems encountered, use cases). The results of this activity are found in Appendix 2A and are described in more detail in Section III below.

Activity B

18. The aim of the second activity, Activity B, was to assess the wider operating environment that supports the organisational use of standards and to identify the gaps present within and between organisations. In order to do this, each Task Force member was asked to carry out a SWOT analysis to identify the strengths, weaknesses, opportunities and threats that support or limit the use of common standards within their organisation. Task Force members were also asked to consider the ideal state (or end goal) of achieving harmonised and interoperable data supported by common standards, and to identify any notable gaps that should be addressed. For this and the following activity (Activity C), the Task Force was divided into a Governance Sub-Group and a Technical Sub-Group which acknowledged feedback from the in-person meeting in Belgrade that broader issues should also be considered by the Task Force. The Governance Sub-Group focused on the wider governance issues relating to standards use such as organisational structures, financial models, workplace cultures, legislation, and policies. To structure its activities, the Governance Sub-Group used

the GSGF Europe (GEOSTAT4 and Eurostat, 2021) and UN Integrated Geospatial Information Framework (UN-IGIF) (UN-GGIM, 2018) as guiding frameworks. The Technical Sub-Group, on the other hand, looked at the technical aspects of standards use, such as IT systems, hardware and software requirements, security and licensing, technical knowledge and skills, and internal workflows, and used the GeoGSBPM (UNECE, 2019b) as a guiding framework. The results of this activity are found in Appendix 2B and have been used to inform the discussions in Sections IV and V.

Activity C

19. The aim of the final activity, Activity C, was to identify and prioritise the requirements needed to successfully implement common standards across an organisation to achieve harmonised and interoperable data. Using the results of the SWOT analysis (Activity B) each Task Force Sub-Group was asked to complete a MoSCoW analysis to identify and prioritise a set of requirements based on the following prioritisation categories:

- Must Have: These are non-negotiable needs that are mandatory for standards implementation.
- Should Have: These are important requirements that are not vital but add significant value.
- Could Have: These are "nice-to-have" requirements that would have a small impact if left out.
- Will Not Have: These requirements are not a priority and will not be implemented at this time.

20. The results of this activity are found in Appendix 2C and have been used to inform the development of the recommendations presented in Section VI which set out a path towards the greater use of common standards to support the integration of statistical and geospatial information at national levels.

II. THE WIDER CONTEXT OF STANDARDS USE

21. Data standards, or sets of pre-defined rules which ensure that data is consistently described, recorded, and exchanged, are an important mechanism to improve the harmonisation and interoperability of different datasets and support the integration of statistical and geospatial information. This section explores the wider content of standards use, first presenting the case for why organisations should use common standards by outlining their value, derived benefits, and the relevant policy frameworks and guidance that support their use. Following this, the standards commonly used by statistical and geospatial organisations is discussed, drawing upon the work of the INGEST Task Force (Activity A; described in Section IIB).

A. Why use standards?

22. As the International Organisation for Standardisation (ISO, 2024a) aptly defines, a standard is "a formula which describes the best way of doing something", be it building a product, managing a process, or delivering a service. Standards play a critical role in the integration of statistical and geospatial information and their use brings many benefits. Firstly, the use of standards establishes a common mechanism for how data should be created, managed, and disseminated, and when different organisations apply the same standards across their systems and applications, data becomes interoperable allowing the seamless exchange and integration of data between different sources and endpoints. Secondly, standards improve the quality and reliability of data by using common formats and definitions which ensure that errors and inconsistencies in the data are minimised. Thirdly, the use of standards improves efficiency by streamlining processes which, in turn, increases the usability of data by making it easier to find, understand and reuse. Fourthly, common standards provide a framework for data users to make meaningful comparisons between different datasets across space and time. They also enable data to be combined from diverse sources, providing new possibilities for analysis and interpretation which can reveal new insights that would not otherwise be visible. Finally, standards are designed to evolve over time and adapt to the fast pace of technological advancements and changing requirements, ensuring that organisations can future-proof their activities, processes and products with ease.

23. Considering the clear benefits that can be derived from the use of standards, organisations increasingly rely on standards to improve their practices at national, regional, and global scales. The use of internationally-agreed standards, in particular, can help to improve the efficiency of functions through the harmonisation of regulations; they can stimulate solutions to multi-scale issues such as energy efficiency, emergency preparedness and response, and international trade; they can help to achieve cost-savings in policy-making as much of the technical detail and safety requirements are already pre-agreed; and they can be used as solutions to policy issues which reflect a broad range of views and expertise (ISO, 2024b). The important role of international organisations in standardisation is clear: national accounts and Consumer Price Indexes, for example, are intensively comparable because of the Intersecretariat Working Group on Price Statistics (International Labour Organisation *et al*, 2020). However, while trade flows are disseminated by every country, mirror statistics between imports and exports are not yet compliant.

24. Data standards are an important element of good government practice and "are fundamental to improving how government shares, integrates and uses data . . . [by setting] a clear and common understanding of how the government must describe, record, store, manage and access data in consistent ways" (Data Standards Authority, 2021). Historically, however, it has been common for different parts of government to adopt different standards, or even create their own, to meet their specific needs or challenges. This has meant that, at national levels, government practices can be inconsistent and the resulting datasets incompatible for sharing and re-use. These problems are only compounded further as national borders are crossed and data-driven decision-making and policy development is required at regional and global levels. To realise the benefits of data standards, governments must improve

coordination through the sharing of knowledge and best practices, centralise the implementation of data standards to increase their adoption, and develop and deliver clear strategies that address cross-government user requirements. In doing so, governments can ensure that data is of high quality, is accessible, interoperable, and comparable which, in turn, will promote its usability and reuse. This will result in greater collaboration, improved efficiency, support the adoption and implementation of new solutions, and improve the speed and effectiveness of change management processes (Data Standards Authority, 2021).

25. There are well-established processes and systems in place for the development and adoption of globally agreed statistical and geospatial standards. The need for standards to support the creation, management and dissemination of geostatistical information has long been recognised and the growing use of standards in general will help to drive the closer integration of statistical and geospatial information. However, as UNECE (2016, p. 4) notes, statistical and geospatial standards have generally remained within their own isolated domains due to differences in scale: statistics were traditionally designed to describe large populations whereas geospatial data typically records the minutiae of real-world phenomena. The need for ever smaller statistical populations to inform more intricately defined polices has, however, led to convergence and only more recently has the development and promotion of standards relating to the integration of geospatial and statistical information been advancing through the work of UN-GGIM and important policy frameworks such as the GSGF (UN-GGIM, 2017) and UN-IGIF (UN-GGIM, 2018).

26. Within the GSGF, for example, standards and good practice form one of its four key elements which play an enabling role in the application of the framework and its principles. Principle 4 of the GSGF, that of statistical and geospatial interoperability "urges the use of internationally adopted standards and good practices from both [the statistical and geospatial] communities to enable greater interoperability of statistical and geospatial data, standards, processes and organisations" (UN-GGIM, 2017, p. 12). Equally, standards form one of the nine strategic pathways of the UN-IGIF as a fundamental means to "enable different information systems to communicate and exchange data, enable knowledge discovery and inferencing between systems using unambiguous meaning, and provide users with lawful access to and reuse of geospatial information" (UN-GGIM, 2018, p. 23). The Open Geospatial Consortium (OGC), in collaboration with the ISO Technical Committee 211 Geographic Information/Geomatics (ISO/TC 211) and the International Hydrographic Organisation (IHO), has also recently developed the third edition of the UN-GGIM (2022) guide on the role of standards in geospatial information management, including interoperability with other systems and data sources. UNECE, working with groups of experts such as the High-Level Group for the Modernisation of Official Statistics (HLG-MOS), also creates, enhances, and promotes standards for statistical production with a particular focus on standards for metadata. Through this work, UNECE ensures that "common definitions and processes are used within and between statistical organisations, helping to remove the barriers to collaboration on technical projects, fostering the sharing of knowledge and experiences, and serving as a basis for streamlined statistical production" (UNECE, 2024b). There are clear drivers and support available for the implementation of common standards to support the integration of statistical and geospatial information, but what standards are commonly used?

B. What standards are commonly used?

27. As data-centred organisations, standards are crucial to the effective functioning of statistical and geospatial organisations. Within the statistical domain, the United Nations Statistical Commission (UNSC) is responsible for the setting of statistical standards and their implementation at national and international levels. It is supported by the work of the United Nations Statistics Division (UNSD) who promote the global adoption of the Fundamental Principles of Official Statistics which consists of ten guiding principles which ensure that national statistical systems adhere to professional and scientific standards, and thus maintain high standards of quality, reliability and relevance (UNSD, 2014). Within Europe, the European Statistics Code of Practice provides a quality framework and sets the standards for the development, production, and dissemination of European statistics (Eurostat, 2017). UNECE and the HLG-MOS have developed a series of models to support standardised statistical operations including: the Generic Statistical Business Process Model (GSBPM) which provides a framework to describe statistical production processes and guide the design, development and implementation of statistical systems and processes (UNECE, 2019a) and its associated geospatial view (UNECE, 2021a); the Generic Statistical Information Model (GSIM) which provides a set of standardised information objects for use as inputs/outputs within the statistical design and production processes (UNECE, 2019b); Common Statistical Production Architecture (CSPA) which acts as a practical link between the two former models and relates to the application and technology architectures and associated principles for the delivery of statistical services (UNECE, 2021b); and the Generic Activity Model for Statistical Organisations (GAMSO) which describes and defines the wider activities that statistical organisations should undertake in the production of official statistics (UNECE, 2019c). Increasingly used by statistical organisations is the ISO standard, Statistical Data and Metadata eXchange (SDMX), which is designed to "describe statistical data and metadata, normalise their exchange, and improve their efficient sharing across statistical and similar organisations" (SDMX, 2023). The 3.0 specification, in particular, enhances new functionalities regarding Geospatial Data Exchange (SDMX, 2021).

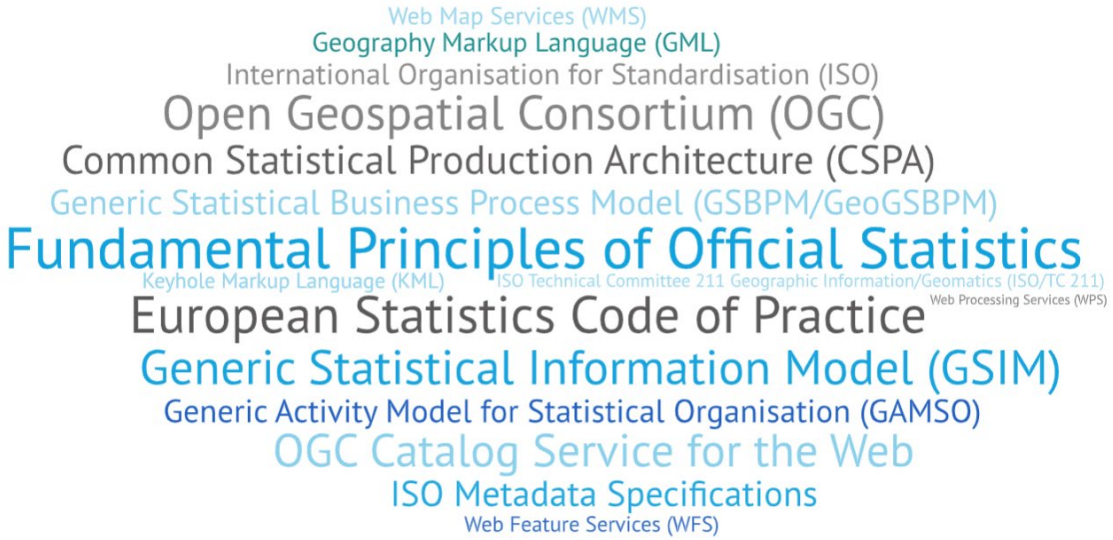

Figure 1: Examples of common standards used across the statistical and geospatial domains

28. From a geospatial perspective, the use of standards is equally as important and is led by the OGC and the ISO/TC 211. There are a broad range of geospatial standards which fall into three general categories: data, services, and metadata. Data standards, which include GeoPackage (GPKG), GeoParquet, Geography Markup Language (GML), Keyhole Markup Language (KML) and OGC guidelines, ensure that geospatial data is stored in common formats and can be transferred across different systems through Extract, Transfer and Load (ETL) operations. Service standards, including Web Map Services (WMS), Web Feature Services (WFS) and Web Processing Services (WPS), relate to the web-based transfer of geospatial data that enables user access and interaction on a live, real-time basis. Finally, metadata standards, such as OGC Catalog Service for the Web and ISO Metadata Specifications, involve the storage, organisation, management and sharing of metadata for geospatial data (ESRI, 2013; Ordnance Survey, 2021). The standards outlined above are just some examples of the many standards which exist both nationally and internationally to facilitate consistency, interoperability, and efficient data sharing within and between the statistical and geospatial domains (Figure 1).

29. As described in Section IIB, the INGEST Task Force documented the current use of standards across their organisations which related to activities to integrate statistical and geospatial information as defined by the GSGF. These activities included geocoding practices, the storage of standardised location references within data management systems, the management and use of common geographies across datasets, the dissemination of data via web services, quality management practices, and metadata management practices (UN-GGIM, 2017). Overall, documenting the standards in use across member organisations was not an easy undertaking for the Task Force, primarily due to the siloed nature of standards use within certain organisations or the lack of communication between different departments or business areas within an organisation. Despite these difficulties, over one hundred standards were documented as being in use across member organisations (see Appendix 2A), and seventy of those were unique standards which indicates the scale of the variation in standards use across organisations. The most common standards used by Task Force organisations were the GSBPM, ISO 19115 Geographic Information – Metadata, and the European Statistics Code of Practice. These were closely followed by ISO 19111 Geographic Information – Referencing by Coordinates, and OGC Web Map Services. Over 80% of the standards in use were international standards and standards were used across all phases of the data lifecycle, particularly in data dissemination, metadata management and data processing activities. Most standards were used within live processes which indicates that many standards are well-established within business-as-usual practices. Notably, on average, NMCAs used over twice as many standards as NSIs. The results of this activity are encouraging to the data integration agenda within and across national boundaries and provide an important baseline to drive the common use of international standards will ensure that data is of high quality, is accessible, interoperable and comparable.

III. ISSUES AND OBSTACLES TO STANDARDS USE

30. Despite the clear benefits gained from using common standards to support the integration of statistical and geospatial information across the data lifecycle, a range of issues and obstacles have hampered progress. Taking a broad view, one key issue noted by Van Halderen *et al*. (2016) has been the differing professional paradigms which have driven standards development within the statistical and geospatial sectors: "the official statistical community has over fifty years of governance by the peak, international statistical standards body, the UN Statistical Commission, [whereas] within the geospatial community, the private sector has led the application of many new approaches" (2016, p. 467). Another issue is that standards have not been consistently adopted across countries with differing levels of development and it has been recognised that many organisations located within low-to middle-income countries are operating in the complete absence of standards (PARIS 21 & Statistics Sweden, 2021, p. 3). The fundamental lack of common standards and standardised methodologies specifically for the integration of geospatial and statistical information has also presented a barrier. UNECE has noted that "a single approach to the geographic dissemination of statistics isn't feasible given the differing requirements for statistical production" (2016, p. 32) and the broad range of geospatial data sources available makes it difficult to endorse common methods for all data types. For example, data dissemination under the INSPIRE Directive was developed around the use of WMS and WFS (INSPIRE, 2013) which works well for statistical units based on geographic boundaries but not for statistical datasets which lack direct spatial geometries (UNECE, 2016, p. 22). While the development of standardised statistical process models, such as the GSBPM (introduced in Section IIIB), are helping to provide greater consistency in statistical processes, not all models can easily incorporate geospatial aspects which has created further challenges (Van Halderen *et al*., 2016, pp. 467-468).

31. Within the UNECE Survey on the Integration of Statistical and Geospatial Information, which was undertaken in spring of 2023, respondents were asked to rate the impact of each of the UN-IGIF's nine strategic pathways on their organisation's ability to integrate statistical and geospatial information, with standards being one of those pathways. Out of a total of 67 organisations from 49 countries who responded to the survey, 33% of respondents rated standards has having a high impact on data integration activities. A higher proportion of those respondents came from project target countries (non-EU members situated in Eastern and South-Eastern Europe, the Caucasus, and Central Asia) (47%) than from non-target countries (29%). Similarly, a larger number of NSIs gave standards a high impact rating (36%) than NMCAs (22%), suggesting that standards issues were having a greater effect on data integration activities within statistical organisations from target countries in particular. Survey respondents noted the presence of conflicting standards as a major hindrance to data integration, both between national and international standards and between different international standards. A lack of compatibility analysis being performed during standards development was also highlighted as an issue which has led to separate and incompatible standards between the statistical and geospatial domains. Non-compliance with national and international standards, including the INSPIRE Directive, was cited as a further issue despite such standards being noted as crucial and central to the data integration agenda. Respondents

considered that the inconsistent use of standards had led to poor semantic and technical interoperability between different data sources and across domains. They highlighted the crucial role of standards to ensure that decentralised data ecosystems could function effectively and pressed for the use of common standards, supported by harmonised operating models, production processes and services, to make data comparable, integrative, and enable greater and faster integration (UNECE, 2024a).

32. As outlined in Section IIB, the INGEST Task Force assessed the capability of their organisations operating environment to support the use of common standards for data integration activities. SWOT analyses were completed to identify the strengths, weaknesses, opportunities, and threats that supported or limited the use of common standards across member organisations. Any notable gaps present within and between organisations that would hinder the production of harmonised and interoperable data using common standards were also identified for action. This activity was undertaken from both a governance and a technical perspective and the full results can be found in Appendix 2B. However, for the purpose of this paper, a summary of the key issues and obstacles to the greater use of common standards to support data integration activities are presented in the sub-sections below.

A. Governance issues

33. Governance is "the leadership of decision-making, culture, controls and accountability" (Leading Governance, 2023) which extends across hierarchies to ensure that good outcomes are consistently achieved within and between organisations. At global and regional levels, strong governance frameworks are in place which bring stakeholders together to work cooperatively to drive the greater integration of statistical and geospatial information through, for example, the work of UN-GGIM, UNECE, Eurostat, and the European Forum for Geography and Statistics (EFGS). At national levels, however, governance practices may differ significantly from country to country which has led to uncoordinated and inconsistent approaches to the integration of statistical and geospatial information when viewed regionally (Eurostat, 2019). The UNECE Survey revealed that these disparities may be due to the value of data integration not being well-understood at national strategic levels, with little common understanding, shared vision, nor mutually supported goals present within and between national statistical and geospatial organisations (UNECE, 2024a). Such recognition by senior leaders is vital to progress the data integration agenda as only through governance frameworks can authority be given to make the necessary commitments, initiative change management processes, allocate resources, and form institutional cooperation mechanisms to align shared strategic objectives and pathways at national levels. The same governance frameworks are needed to drive the greater use of common standards to support the integration of statistical and geospatial information within organisations. The INGEST Task Force, through its Governance Sub-Group, identified a range of issues and obstacles that have been limiting the organisational use of common standards from a governance perspective. Some key findings are summarised below, and the full results can be found in Appendix 2B.

Differing approaches to governance and a lack of common understanding

34. Different organisational drivers have resulted in an incohesive approach to standards implementation. There is evidence of weak collaboration between national statistical and geospatial organisations, with little understanding of shared requirements. The implementation of the GSGF model, for example, with standards as a key element, requires a broad national consensus. At an organisational level, the presence of bureaucratic internal systems and processes that are difficult to change have inhibited standards implementation. Due to organisational silos, there can be limited strategic awareness and understanding of the key role of standardisation, data integration and interoperability. Within organisations, standardisation is often considered as merely a technological exercise and not a strategic asset. This lack of engagement needs to be overcome to maximise the impact of standards on improving the harmonisation of statistical and geospatial information. An absence of effective national- and organisational-level strategies and policies also prevents understanding and realisation of the value of standardisation. The involvement of organisations from across government can be challenging if they cannot see the direct benefit arising from their investment of time and resource. This is particularly relevant given the environment of limited funding and financial constraints that government organisations in most countries are currently operating in.

Difficulties in communicating the benefits of standards adoption

35. A lack of communication of the importance and benefits of standardisation can inhibit the willingness of organisations to engage with, inform the development of, and implement standards across the data lifecycle. Some of the standards that are in place for statistical and geospatial data are not easily communicated due to their complex, highly technical nature, and their benefits are not easily grasped by decision-makers.

Challenging financial environments

36. There is currently a lack of sufficient funding and resourcing to drive the implementation of standardisation across government organisations. This presents a challenging environment in terms of developing financial partnerships and identifying funding sources for initiatives aimed at delivering better integration of statistical and geospatial data. Reduced organisational funding for development activities deteriorates interest and participation in standardisation work and innovative, non-standardised solutions may challenge established standards, especially if they offer more flexibility or cost-effectiveness.

B. Technical issues

37. The quality and accessibility of statistical and geospatial data, and the strength of the technical infrastructure that supports its creation, management, and use, is central to the data integration agenda. The technical aspects which govern the creation, management and dissemination of data are broad and include IT systems and infrastructures, hardware and

software requirements, internal workflows, security and licensing, and technical knowledge and skills. A strong data infrastructure will ensure the increased efficiency and productivity of users, ease of collaboration between different groups, and securely managed access to organisational data for both internal and external users. Yet, technical issues at an organisational level are limiting the integration of statistical and geospatial information for several reasons. Respondents to the UNECE Survey, for example, cited that the biggest obstacles related to data interoperability, with different data collection and storage methods, unstandardised data formats, and a lack of unique identifiers which led to an inability to integrate data sources from different institutions. The quality, currency and completeness of available data was also noted as impacting data integration activities, as was the ability to make data available to share and reuse through robust technical infrastructures and standardised procedures. Respondents also noted that a major obstacle to effective data harmonisation was an absence of established frameworks and procedures for combining statistical and geospatial data within national organisations and that the broader use of common standards and standardised approaches would help to remedy these problems (UNECE, 2024a). The INGEST Task Force, through its Technical Sub-Group, identified a range of issues and obstacles that have been limiting the organisational use of common standards from a technical perspective. Some key findings are summarised below and the full results can be found in Appendix 2B.

Compatibility of data received from other agencies

38. The compatibility of data received from other national institutions is a critical concern as this data may not meet the desired standards required for integration. While collaboration and data sharing are vital for effective decision-making and resource management, it is important to recognise that the quality and adherence to standards may vary across different agencies.

Variance in data quality, completeness and reliability

39. Data quality is not uniform across all geographic levels. Different organisations serve their users according to specific requirements and demands, meaning that they often work separately in silos. Consequently, datasets can have differences in key elements such as formats, structures and identifiers. This non-standardised approach presents challenges in combining, comparing and integrating data from different organisations for geostatistical purposes. Data quality varies at the level of municipalities, neighbourhoods and villages which influences data accuracy, completeness, and reliability. For example, there can be a lack of data at the lowest level of geographical units (towns and villages) due to inaccurate administrative boundaries. Administrative records obtained from external institutions may also contain inaccurate and/or missing information. These records may lack essential information due to gaps in data collection or reporting and inaccuracies can result from manual data entry, misinterpretation, or outdated records, as well as use of varying data formats, codes, and terminology. The availability of qualitative data from administrative sources is also a critical concern. While administrative data provides valuable insights, its inherent limitations often result in insufficient qualitative information.

Geographic referencing and address complexity

40. Geospatial data often involves multiple reference systems. These references can be based on different coordinate systems, datums, or projections. Point-based geocoding can be mistaken, and in some cases, geocoding can be more efficient based on area-based practices. Addressing formats vary from one country to another, making localisation difficult. Standardising addresses to a common format could facilitate data integration and analysis.

Inadequate data and technology infrastructures

41. Difficulties in integrating data from different institutions can result from a lack of common identifiers and standardisation. Location-centred data architecture can be lacking, and geospatial data and concepts may not be considered an integral part of the data architecture, ultimately hampering interoperability. There can also be a long history of retaining legacy data management systems which limits the innovative use of emerging technologies and standards. Inadequate IT infrastructures are unable to support the efficient standards-based exchange of data which can lead to delays, errors, and inefficiencies across the data lifecycle. National institutions may also struggle to allocate sufficient funding for data integration projects and the necessary infrastructures due to public saving measures and budget deficits. IT costs for spatial data infrastructures can be enormous, even if open-source software is used.

Organisational skills gaps

42. There is limited awareness and expertise in the use of international standards and best practices. The complexity and non-understanding of geospatial standards by experts and organisations creates the tendency for non-implementation of these standards. The fast pace of technological advancement can also outstrip the standardisation process, leading to quickly outdated or irrelevant standards. The pace of technology changes also requires constant upskilling and investment. Many new data sources and methods are inherently highly technical in nature (e.g. big data, Earth Observation data, AI methods) and their management and resourcing can be a challenge. Recruiting and retaining staff with the required knowledge and skills presents difficulties and staff turnover, the rate at which employees leave an organisation and are replaced by new hires, has a significant impact on institutional continuity and the subsequent loss of expertise in critical and niche areas.

IV. WHERE DO WE GO FROM HERE?

43. The discussions presented above have indicated that while the benefits of adopting common standards to support the integration of statistical and geospatial information are clear, there are a range of multifaced issues and obstacles that must be addressed in order to realise these benefits. The results of the UNECE Survey indicated that one of the biggest obstacles to data integration related to data interoperability due to inconsistent data collection and storage methods, unstandardised data formats, and the absence of unique identifiers needed to integrate data sources from different institutions at national levels. Subsequently,

based on the outcomes of the survey, a recommendation was made to promote greater data standardisation and interoperability using harmonised standards, operating models, production processes and services. In doing so, the consistent adoption of international statistical and geospatial standards would improve data interoperability in the short term, but it would also be necessary to explore the need to develop international standards that specifically address the technical requirements of data integration in the long term, including the use of globally unique identifiers that could bring disparate data sources together (UNECE, 2024a).

44. As presented in Section IIB, the INGEST Task Force assessed the capability of organisational operating environments to support the use of common standards for data integration activities. SWOT analyses were undertaken to identify the strengths, weaknesses, opportunities, and threats that supported or limited the use of common standards across member organisations. Any notable gaps present within and between organisations that would hinder the use of common standards were also identified. The results of this activity, which can be found in Appendix 2B also identified some strengths and opportunities that could be capitalised on in the pursuit to utilise common standards in processes to integrate statistical and geospatial information, which are summarised below.

Collaboration, partnerships and communication

45. Standards are empowered at different levels, from international organisations to national bodies. Consequently, harmonisation is a leading task in which the statistical and geospatial communities are very active, especially at an international level. This comes down to the fact that geography is universal and data users must speak the same language to understand each other; such comparability is also a fundamental principle of statistics where data must be collected and treated in the same way to be compared. Cooperation is a common way of working on these matters and effective and collaborative partnerships across various international working groups within the statistical and geospatial communities provide a solid foundation for extending the collaboration to other domains and pave the way for new partnerships. The UN EG-ISGI, UN-GGIM: Europe's Line of Work on Data Integration, Eurostat's GISCO Working Group, and the EFGS provide effective fora for exchanging information and ideas and deliver new perspectives for promoting data integration activities and the value of data integration. International standardisation bodies like the ISO and the OGC foster collaboration in terms of developing and promoting standardisation, supporting data integration in practical terms. At a national level, a growing number of statistical and geospatial authorities have strengthening partnerships which include common expert-level working groups, joint funded project activities for creating data integration service pilots and production level solutions, as well as joint management level steering boards for guiding data integration activities. An important building block for extending the one-to-one collaboration of statistical and geospatial authorities to multi-beneficiary stakeholder partnerships is both the EFGS and the foundation of national networks for statistical and geospatial stakeholders representing a range of state and local authorities, ministries, and businesses to discuss and improve interoperability across the statistical and geospatial domains (see Case Finland and Case Germany in Section VIA). At an organisational level, internal collaboration can be

greatly enhanced by establishing a cross-cutting virtual working group for standardisation issues (see Case NLS Finland in Section VIA). Furthermore, increasing public awareness and understanding of the importance of standards in data integration work will enhance engagement and compliance.

Legislation and funding

46. Existing and emerging European legislation related to the implementation of the European Data Strategy (European Commission, 2024a) provide a variety of tools for better governance of management, sharing and reuse of data from public sector, private businesses, and citizens. The INSPIRE legislation has been reviewed for fitness-of-purpose and will be transformed to better respond to new user demands and European data spaces. Funding for national and international collaborative data integration development efforts is provided regularly by Eurostat GEOS grants. Major EU-funding programmes such as Horizon Europe (European Commission, 2024b) and Digital Europe (Digital Europe, 2024) offer a variety of opportunities for research and innovation actions and operative implementations.

Leadership

47. Claiming ownership and taking leadership in standardisation work, data integration development activities, and stakeholder collaboration requires commitment and resources at national and organisational levels. Taking an active role and maintaining the initiative speeds up development and improves the required buy-in from senior management as benefits emerging from improved data integration can be demonstrated more easily. Having, for instance, director-level ownership and commitment for leading standardisation efforts in an organisation and taking successful and active leadership for establishing and leading national stakeholder networks for data integration, can secure the value derived from such activities.

Standards development and adoption

48. Standards benefit from having a strong technical basis as they are a product of the combined knowledge and experience of technical experts within their fields, who rigorously develop, test, and refine their components over time to meet changing circumstances and requirements. As such, the statistical and geospatial communities work both as producers and users of standards which gives standards quite a legitimation to be used. In many countries, the use of standards is already mandatory for government organisations; however, this may come with the cost of defining, implementing, and maintaining different standards for the same application. Government organisations provide common products and services that are offered to the public and implementing common standards can unite these activities, achieve shared goals, improve efficiencies, and realise cost-savings at national levels. Geospatial organisations offer a multitude of datasets and services that can be used as a framework for standards deployment. The statistical field also encompasses many different sectors and domains and enables standards to be validated for general use. Standards can therefore be deployed across a wide range of datasets, bringing greater interoperability between them which can give them greater purpose, lead to new insights, and drive the development of new use cases. Such deployment also enhances internal processes across the data lifecycle,

improving the accuracy, currency and efficiency of data production, integration, and dissemination.

Processes and quality

49. The standardisation and integration of statistical and geospatial information can be achieved by organisational compliance to structured production models like the GeoGSBPM (UNECE, 2021a). Adopting such models can geospatially-enable statistical production in a way that geospatial data forms an integral part of the production process and can act as a data resource in statistical production. Structured processes also ensure consistency, transparency, and efficiency across the data lifecycle. To realise this approach, a comprehensive national understanding of the statistical process and its geospatial features is needed to make it possible to build a national information process rather than an organisation-specific one. This is necessary because there is usually more than one national institution involved. By jointly viewing the process, organisations can agree on the division of labour, their roles, and the responsibilities between them. This can lead to a reduction in overlapping or duplicate workstreams and increased efficiency if organised well.

50. By using architecture methods to describe the data process extensively, it is possible to establish a common language for building a shared infrastructure for the information process. Defining a common understanding can support the standardisation process, because there are different people with different backgrounds from different organisations involved who are using their own individual languages. This can be overcome by using clear definitions and standards to implement geocoding, for example, with the standardisation of address information and the utilisation of a single authoritative data repository making it possible to create consistent, complete, and accurate address information across datasets. As a result, data can be more easily linked and integrated, and an opportunity to consider data and quality management at organisational levels can be provided.

Innovation and new opportunities

51. Interoperability and standardisation are recognised as cornerstones for the management, sharing and utilisation of exponentially increasing volumes of diverse data. Sustainability requirements and the FAIR principles strongly support the development and implementation of open, innovative international standards which are extending into new emerging fields such as the development of data spaces, digital ecosystems, and generative AI applications. Innovation is systematically boosted by the European Digital Innovation Hubs (European Commission, 2024c), such as the Location Innovation Hub, providing supporting activities for small and medium-sized enterprises and public sector organisations.

V. A PATH TOWARDS THE USE OF COMMON STANDARDS

52. It is clear that the integration of statistical and geospatial information is a multidisciplinary field where the efforts of a single organisation alone are insufficient. A

shared understanding of objectives is essential, as well as agreement on the methods to achieve these goals. Each stakeholder brings their own domain-specific standards and established practices to collaboration and harmonising these diverse perspectives is crucial for successful integration. The key players in this context are statistical and geospatial authorities and their collaboration promotes broader cooperation across the entire integration domain. Taken further, this involves institutionalising collaboration through network structures, enabling smooth and mutual understanding amongst different organisations. By creating a common understanding through open communication, shared terminology, and a common high-level architecture amongst different stakeholders, organisations can easily identify, agree, and work towards shared goals. A common understanding is also supported by a shared national architecture which defines key elements such as data, standards, processes, and the roles and responsibilities within and between different organisations. Through collaboration, a path towards the use of common standards that support the integration of statistical and geospatial information can be defined. Additionally, ensuring data interoperability and deployment will necessitate the use of selected standards in data distribution and service development, and contribute to an understanding of the development needs of standardisation in general. Internal communication within organisations must also be ensured and the domain of integrating statistics and geospatial information will require increased understanding across organisational silos. Overall, leveraging standards should be supported within an organisation and the presence of standards and support for their use should underpin all organisational processes where statistical and geospatial data integration is present.

53. In light of the clear need for common standards to support the integration of statistical and geospatial information, the collective outcomes of the activities undertaken by the INGEST Task Force as presented in the previous sections, and the broader considerations outlined above, a set of recommendations have been made by the Task Force which lay out a path towards the greater use of common standards to support the integration of statistical and geospatial information at national levels. These recommendations are grouped under four themes: cooperation, collaboration and communication; strategic leadership; data and technology infrastructures; and skills and training. Each recommendation is supported by a set of implementation guidelines which outline the practical steps that organisations should take to achieve them.

A. Cooperation, Collaboration and Communication

Recommendation 1: Cooperation, collaboration and communication mechanisms should be institutionalised through official structures and networks (e.g. national steering groups), developing shared objectives which are supported by operating models and standards relevant to organisational and national activities.

54. Implementation Guidelines:

(a) National organisations who produce authoritative geospatial and statistical data should identify (or establish where needed) roles (or teams) with remit over standards adoption, implementation, and use relevant to their business needs.

(b) These roles should have the capability and capacity to coordinate the standards requirements, implementation, and use throughout the organisation (e.g., via the establishment of internal working groups, or direct and regular engagement with relevant business areas throughout the organisation).

(c) These roles should have remit to collaborate and communicate with counterparts in other national organisations through the establishment of a national working group on standards, or an equivalent network structure.

(d) The establishment of a national working group should facilitate shared objectives for the development and implementation of common standards and operating models that support harmonised and interoperable data and information.

(e) The national working group should coordinate efforts and activities with relevant international organisations and standards groups, while seeking to leverage and align with applicable global and regional policies and frameworks (e.g., GSGF, UN-IGIF, INSPIRE).

55. Examples and Resources:

- The **GSGF** is a key policy framework developed by UN-GGIM to link statistical and geospatial professional domains, NSIs and NMCAS, and statistical and geospatial standards, methods, workflows and tools. By applying its five Principles and four Key Elements, "harmonised, standardised and geospatially-enabled statistical data" can be produced. Further information: https://unstats.un.org/unsd/statcom/51st-session/documents/The_GSGF-E.pdf.
- The **GSGF Europe** was developed by the GEOSTAT 4 Project to conceptualise the GSGF within the European context and support its implementation at a regional level. It defines a GSGF Europe Reference Architecture to act as a basic structure and operation of the European statistical and geospatial community. Further information: https://www.efgs.info/wp-content/uploads/2022/03/GSGF_Europe.pdf.
- The **UN-IGIF Implementation Guide** outlines specific guidance, options and actions which can be undertaken by Member States to strengthen their geospatial information management practices. The document Strategic Pathway 6: Standards, in particular, "establishes and ensures the adoption of standards and compliance mechanisms for enabling data and technology interoperability to deliver integrated geospatial information and to create location-based knowledge". Further information: https://ggim.un.org/UN-IGIF/documents/SP6-Standards_Refined.pdf.

- The **INSPIRE Directive** aims to create a European Spatial Data Infrastructure for the purposes of EU environmental policies and policies/activities which may have an impact on the environment, enabling cross-border data sharing and provide interoperable services based on 34 spatial data themes. Further information: https://knowledge-base.inspire.ec.europa.eu/overview_en.
- **Case Finland**: The National Network for Integrating Statistical and Geospatial Information, founded in 2021, is a discussion and collaboration forum with nearly 100 experts across public administration and private sector. Common topics for discussion and new innovations include visualisations, small area divisions, historical administrative units and GeoAI. The network is engaging in drafting a national roadmap for improving integration of statistical and geospatial information. Further information (in Finnish): https://www.maanmittauslaitos.fi/tietoa-maanmittauslaitoksesta/organisaatio/yhteistyoryhmat/tilastojen-paikkatiedon-integrointiverkosto.
- **Case France**: The National Committee on Geographical Information (CNIG) leads working groups which are mandated by the Standards Commission to develop standards that are compatible with the European Context. The Standard Address Working Group, for example, is defining address concepts and addressing components as well as a shared data model that would enable the interoperability and usability of address data in France with other information such as roads and buildings. Further information (in French): https://cnig.gouv.fr/les-standards-cnig-a18959.html.
- **Case Germany**: The Central Working Group of the Interministerial Committee for Geoinformation (ZAG-IMAGI) works together to implement the National Geoinformation Strategy for all public administration bodies. Participants are from federal organisations that collect, provide or use geodata on a large scale. The experts from the federal authorities usually meet twice a year and hold workshops on current topics relating to the shared use of data, e.g. on terms of use, licences and archiving. Further information (in German): https://www.imagi.de/Webs/IMAGI/DE/organisation/zag-imagi/zag-imagi-node.html.
- **Case NLS Finland**: The National Land Survey (NLS) of Finland established a cross-organisation virtual working group to improve utilisation of standards and coordination of standardisation work. All services and operations of NLS Finland must be based on international standards, knowledge related to standards should be available to everyone and NLS participates actively in geospatial standards work in international working groups. As a result of the operation of the virtual working group, members have an up-to-date situational picture of standardisation within NLS Finland and clearly understand their roles related to tasks and decisions of standards development and implementation.

B. Strategic Leadership

Recommendation 2: Organisational commitments to standards adoption should be acquired, with active participation in standards development where relevant. Organisations should

ensure that appropriate structures are in place to support the effective use of standards, strategically driven by senior management and technically supported by skilled staff.

56. Implementation Guidelines:

(a) Acquire buy-in for standards adoption, integration, and use at senior management level through formal and informal engagement with standards groups (e.g., UNECE, UN-GGIM EG-ISGI, INSPIRE) and information dissemination of relevant national, regional, and global reports and policies (including the outcomes of this report).

(b) Communicate the importance and benefits of proper adoption and implementation of standards within the organisation (see Recommendation 1).

(c) Ensure active engagement and participation in standards development and with relevant standards bodies, groups, and other authoritative organisations (see Recommendation 1 and 3).

(d) Facilitate and support standards adoption and use within organisations through existing or enhanced internal frameworks and structures, which are driven by senior management (see Recommendation 1) and supported by technically skilled staff (see Recommendation 5).

57. Examples and Resources:

- **UNECE** works with groups of experts to develop, enhance, and adopt standards for statistical production, particularly focusing on quality, metadata and linked open data/metadata. Further information: https://unece.org/statistics/standards-and-metadata.
- The **UN EG-ISGI** consist of expert representatives from national statistical and geospatial organisations who play a leadership role in raising awareness and building capacity in the integration of statistical and geospatial information. One of their objectives is to "support the United Nations Statistical Commission and UN-GGIM in the development of norms, principles, guides and standards to increase significantly the availability of high-quality, timely and reliable integrated statistical and geospatial information". Further information: https://ggim.un.org/UNGGIM-Expert-Group-ISGI/.
- The ISO Technical Committee **ISO/TC 211 – Geographic information/Geomatics** provides standardisation in the field of digital geographic information, including methods, tools and services for data management. Further information: https://www.iso.org/committee/54904.html.
- The **OGC** provides open geospatial standards that define interoperable approaches to data encoding, access, processing, visualization, and metadata and catalogue services, to ensure data interoperability in order to maximise the value of geospatial data. Further information: https://www.ogc.org/standards/.
- The **INSPIRE** Maintenance and Implementation Group (MIG) are an expert group who coordinate the activities of the European Commission, the European Environment Agency

and the EU Member States in supporting the maintenance, implementation and evolution of the INSPIRE Directive. An objective of their 2021-2024 Work Programme is to "work on simplifying and mainstreaming the technical requirements of the INSPIRE Directive, taking into account emerging paradigms, standards and technologies". Further information: https://knowledge-base.inspire.ec.europa.eu/overview/maintenance-and-implementation_en.

Recommendation 3: A national roadmap for data integration should be developed with standards as a key element, formalising agreed leadership and champions to drive the implementation of the roadmap.

58. Implementation Guidelines:

(a) Organisations should assess their level of maturity for data integration at an organisational and/or national level with standards as a key element, utilising existing tools and resources where possible (e.g. GSGF Assessment Tool, UN-IGIF Implementation Guide).

(b) Through the groups and structures outlined in Recommendation 1, develop a national roadmap for improved integration of statistical and geospatial data with standards as one of the key elements.

(c) The road map should:
   i. Be based on an assessment of the current state of data, technologies, and human resources from the perspective of standards utilisation and data integration.
   ii. Identify areas for improvement and the necessary actions to enhance the adoption and development of standards at a national level.
   iii. Identify and present potential avenues for sustainable resources (both financial and human) and collaboration to support the road map, it's activities, and outcomes.
   iv. Align with regional and global standards, guidance, and initiatives.

(d) Agree upon leadership roles and champions for mastering the coordination and implementation of the roadmap with sufficient resources guaranteed by national level policy.

59. Examples and Resources:

- The **GSGF Self-Assessment Tool** has been developed by the UN EG-ISGI Task Team on Capacity Building which allows users to assess their capacity for statistical-geospatial data integration at an organisational and/or country level. Further information: *link forthcoming*.

- The **UN-IGIF Country-level Action Plan** contains the processes, resource materials, templates and examples that are available and helpful to first develop a national action plan to operationalise the UN-IGIF that is tailored to specific national requirements. A range of its components are applicable here. Further information: https://ggim.un.org/UN-IGIF/part3.cshtml#documents.

C. Data and Technology Infrastructures

Recommendation 4: Organisational data and technology infrastructures should be "fit for purpose", facilitating the implementation of standards and integration across the data lifecycle. Information management practices should be aligned and integrated across the statistical and geospatial domains to support the use of common standards.

60. Implementation Guidelines:

(a) Review existing organisational data and technology infrastructures and assess their suitability for standards implementation, while maintaining data integrity and ensuring appropriate data security mechanisms are in place.

(b) Engage and collaborate with similar or related organisations (see Recommendation 1) to share knowledge and best practices while making best use of technological resources and opportunities.

(c) Establish or enhance information management practices which align geospatial and statistical data workflows.

(d) Utilise standards-based, authoritative, and peer-reviewed datasets (e.g., government, national, academic) for information workflows, including processing, analyses, and dissemination.

(e) Ensure that data workflows are performed using standardised methods, services, and interoperable technologies.

61. Examples and Resources:

- The OGC, ISO/TC 211 and IHO launched the third edition of the **Guide to the Role of Standards in Geospatial Information Management** in 2022. This document provides Members States with recommendations on the open standards and good practices needed to ensure that geospatial information can be shared, maintained, integrated and applied. It also aligns with the UN-IGIF and its Strategic Pathway 6: Standards. Further information: https://ggim.un.org/Revised-Standards-Guide/.
- **Case Germany**: The Federal Agency for Cartography and Geodesy (BKG) and the Federal Statistical Office (Destatis) have analysed and assessed the infrastructure requirements and recommendations of the GSGF Implementation Guide to evaluate the situation in Germany and derive recommendations for action, with standards as a key element. Further information: https://un-ggim-europe.org/wp-content/uploads/2021/10/GSGF_DE_Eng.pdf.

D. Skills and Training

Recommendation 5: Organisational skills gaps should be identified, and specialist training programmes designed and implemented, to develop and maintain staff expertise in the use of standards to support integration workflows across the data lifecycle.

62. Implementation Guidelines:

(a) Organisations should complete a skills gap analysis with standards as a key element to assess their workforce's current capabilities against the requirements needed to meet current or future business objectives.

(b) Organisations should develop a skills strategy to address the identified gaps, with standards as key element, which should align with other national and/or regional strategies (via Recommendation 1) and should seek to incorporate training opportunities provided by standards authorities (e.g. ISO, OGC, INSPIRE).

(c) Skills strategies should be integrated within the national road map (Recommendation 2) where consideration should be made to enhancing standards training within university degree programmes and/or recruiting more standards experts national statistical and geospatial organisations.

(d) Shared funding opportunities at national level and/or regional and global level should be identified in order to support and maintain training programmes.

63. Examples and Resources:

- ISO TC/211 resource site: https://www.isotc211.org/.
- OGC Standards e-learning site: https://opengeospatial.github.io/e-learning/ogc-standards/text/services-ogc.html.
- UNECE models:
    - GSBPM: https://unece.org/statistics/modernstats/gsbpm
    - GSIM: https://unece.org/statistics/modernstats/gsim
    - CSPA: https://statswiki.unece.org/display/cspa/
    - GAMSO: https://unece.org/statistics/modernstats/gamso
- SDMX training resources: https://sdmx.org/

VI. CONCLUSION

64. The integration of statistical and geospatial information has long been recognised as a valuable means to improve decision-making, inform policy development, and realise efficiencies in processes and services within and across different government organisations. Standards form a vital component of integration as they ensure that data is consistently described, recorded and exchanged and their common use is an important way to improve the harmonisation and interoperability of different datasets across different spatial and temporal scales. Global efforts to drive the greater integration of statistical and geospatial data have been ongoing for more than a decade through the work of United Nations and other global and regional organisations; however, the benefits have not been realised consistently across different countries and regions. With the aim to tackle this disparity, UNECE has led an EU-funded project to foster stronger links between the statistical and geospatial communities across the region, facilitate greater collaboration, and encourage the greater integration of statistical and geospatial information by promoting stronger institutional partnerships and the use of common standards. Through this project, UNECE established the INGEST Task Force on Standards Issues relating to the integration of geospatial and statistical information which brought together representatives from NSIs and NMCAS across the region to discuss the current use of standards, explore the present issues and constraints, and identify priorities and actions that would strengthen the use of common standards in support of data integration activities. This paper outlined the activities and outcomes of the INGEST Task Force, first exploring the wider context of standards use, before describing the issues and obstacles currently limiting the use of common standards across the region, and the strengths and opportunities that can be capitalised on. Based on these insights, a set of recommendations and implementation guidelines were presented which lay out a path towards the greater use of common standards to support the integration of statistical and geospatial information at national levels. These recommendations have been grouped under the four themes of cooperation, collaboration and communication; strategic leadership; data and technology infrastructures; and skills and training, and are:

A. Cooperation, collaboration and communication mechanisms should be institutionalised through official structures and networks (e.g. national steering groups), developing shared objectives which are supported by operating models and standards relevant to organisational and national activities.

B. Organisational commitments to standards adoption should be acquired, with active participation in standards development where relevant. Organisations should ensure that appropriate structures are in place to support the effective use of standards, strategically driven by senior management and technically supported by skilled staff.

C. A national roadmap for data integration should be developed with standards as a key element, formalising agreed leadership and champions to drive the implementation of the roadmap.

D. Organisational data and technology infrastructures should be "fit for purpose", facilitating the implementation of standards and integration across the data lifecycle.

Information management practices should be aligned and integrated across the statistical and geospatial domains to support the use of common standards.

E. Organisational skills gaps should be identified, and specialist training programmes designed and implemented, to develop and maintain staff expertise in the use of standards to support integration workflows across the data lifecycle.

65. The recommendations have been designed to support national statistical and geospatial organisations in their actions to adopt and embed the use of common standards within activities to integrate statistical and geospatial information across the data lifecycle. Following this path will bring many benefits. By establishing common mechanisms to create, manage and disseminate data, data will become interoperable, thereby facilitating the seamless exchange of data between different sources and endpoints. The use of common formats, definitions, and processes will enhance the quality, reliability, and usability of the data, allowing meaningful comparisons to be made between different datasets across space and time. By embedding standards within internal workflows, organisations can also future proof their activities, processes and products in the face of rapid technological advancements and changing requirements. Ultimately, the use of common standards within processes to integrate statistical and geospatial information will result in the harmonised, interoperable, high-quality data needed to improve decision-making, inform policy development, and realise efficiencies in processes and services within and across different organisations at national, regional and global levels. With these recommendations, a path has been laid out for organisations to achieve these goals.

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VIII. APPENDICES

Appendix 1: INGEST Task Force Terms of Reference

UNITED NATIONS ECE/2023/NOV/1
ECONOMIC COMMISSION FOR EUROPE 20 November 2023

FINAL

INGEST TASK FORCE

TERMS OF REFERENCE

Prepared by the Secretariat

I. BACKGROUND

1. The European Commission has funded the implementation of an action, led by the United Nations Economic Commission for Europe (UNECE), to develop capacity in the integration of geospatial and statistical information across the UNECE region. The action is being implemented over a period of 21 months, from August 2022 until May 2024.

2. The aim of the action is to "foster stronger links between the statistical and geospatial communities across the UNECE region, facilitating greater collaboration and encouraging greater integration of geospatial and statistical information by promoting stronger institutional partnerships and the use of common standards".

3. The action will also support existing activities to strengthen the integration of statistical and geospatial information by Eurostat and others within sixteen selected target countries in Eastern Europe, Caucasus and Central Asia[1].

4. Under the scope of the action, UNECE has established a task force on standards issues relating to the integration of geospatial and statistical data, bringing together representatives from national statistical and geospatial organisations across the UNECE region to discuss the current use of standards, to explore any present issues and constraints, and to identify priorities and future actions to be undertaken regarding the use of standards to improve the harmonisation and interoperability of statistical and geospatial information.

5. In order to gauge initial interest in setting up a task force, within the UNECE Survey on Integrating Statistical and Geospatial Information, which was issued to national statistical and geospatial organisations across the UNECE region in March 2023, respondents were asked if they would be interested in participating in a future task force on standards issues. Following a strong interest from the survey respondents, UNECE has established the task force under the scope of the action and has developed this Terms of Reference which will be reviewed at its first meeting.

[1] Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Georgia, Kazakhstan, Kyrgyzstan, Montenegro, North Macedonia. Republic of Moldova, Serbia, Tajikistan, Türkiye, Turkmenistan, Ukraine, and Uzbekistan.

II. MANDATE

6. The work of the Task Force on Standards Issues relating to the Integration of Statistical and Geospatial Information is conducted under the scope of the action outlined in Section I. The Task Force will report its outputs to UNECE and the European Commission.

7. The activities of the Task Force will be aligned to related work being undertaken by UN-GGIM's Expert Group on the Integration of Statistical and Geospatial Information (UN EG-ISGI) to ensure coordination of the resulting outputs. Where appropriate, UN EG-ISGI will be informed about the progress of the Task Force. Countries from outside the UNECE region that can contribute to the work may be invited to participate in the Task Force.

III. OBJECTIVE

8. The main objectives of the Task Force are to:

   (a) Identify domains where the integration of statistical and geospatial information is hampered by the lack of common standards.

   (b) Identify priorities for standards harmonisation work and recommend related actions that would improve the harmonisation and interoperability of statistical and geospatial information.

   (c) Contribute to the creation of methodological guidelines to support country-level implementation of the recommended actions.

9. Other objectives of the Task Force are to:

   (a) Contribute to the coordination and collaboration of the statistical and geospatial communities within the UNECE region, to promote stronger institutional partnerships, and strengthen the integration of statistical and geospatial data.

   (b) Contribute to the coordination and collaboration of the related work of other international organisations.

   (c) Participate in the exchange of experience, knowledge and best practice.

10. In pursuing these objectives, the Task Force will cooperate with other UN agencies and other international organisations working in this area, including UN-GGIM, Eurostat and others.

IV. PLANNED ACTIVITIES AND OUTPUTS

11. The Task Force will undertake the following activities:

   (a) Understand the current use of standards across member organisations and share use cases and best practice.

   (b) Determine the strengths, weaknesses, opportunities and threats related to the use of standards across member organisations (whether from a governance or technical perspective), and identify domains where data integration is hampered by the lack of common standards.

(c) Within the context of wider policy/reporting requirements, identify priorities for standards harmonisation work. Recommend related actions that would improve the harmonisation and interoperability of statistical and geospatial information, and thus support the greater integration of such data.

12. The main output of the Task Force will consist of a report containing the recommended actions and methodological guidelines which would support the country-level implementation of those recommended actions.

V. TIMETABLE

13. The activities of the Task Force will take place over a period from summer 2023 until spring 2024, and are planned according to the following indicative timetable:

July 2023	Establishment of the Task Force
August 2023	Agree terms of reference and associated activities; identify chair/co-chairs; and launch work on tasks (a) to (c)
September-December 2023	Complete tasks (a) to (c)
October 2023	In-person meeting of the Task Force to take place in Belgrade, Serbia alongside the Joint UNECE / Eurostat / UN-GGIM: Europe Workshop on Integrating Geospatial and Statistical Data
January-March 2024	Drafting of report containing recommended actions and methodological guidelines
April 2024	Completed report submitted to European Commission

VI. METHODS OF WORK

14. The Task Force will work primarily via email and online meetings. Physical meetings of the Task Force may be organised back-to-back to other meetings attended by a sufficient number of Task Force members. UNECE will create and maintain a wiki page for the exchange of material.

VII. MEMBERSHIP

15. The following table outlines the countries and organisations who are participating in the Task Force. The Task Force is open to other countries and organisations that would like to contribute to its work.

COUNTRY	ORGANISATION NAME
Albania	Institute of Statistics (INSTAT)
Albania	State Authority for Geospatial Information (ASIG)
Armenia	Statistical Committee of the Republic of Armenia
Bosnia and Herzegovina	Agency for Statistics of Bosnia and Herzegovina
Bosnia and Herzegovina	Federal Administration for Geodetic and Real Property Affairs
Finland	Statistics Finland
Finland	National Land Survey of Finland
France	National Institute of Statistics and Economic Studies (INSEE)
Germany	Federal Statistical Office (Destatis)
Kazakhstan	Bureau of National Statistics
Malta	National Statistical Office
Moldova, Republic of	Agency for Land Relations and Cadastre of the Republic of Moldova
Montenegro	Statistical Office of Montenegro (MONSTAT)
Türkiye	Turkish Statistical Institute (TURKSTAT)
United Kingdom	Northern Ireland Statistics and Research Agency (NISRA)
United Kingdom	Ordnance Survey of Northern Ireland (OSNI)

16. The Task Force is co-chaired by representatives from Statistics Finland (Finland) and Ordnance Survey of Northern Ireland (United Kingdom). UNECE will act as Secretariat to the Task Force.

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Appendix 2: UNECE Survey Results

Appendix 2A: Activity A Results

Standard Name	Type	Stage of Use (GSBPM)								Other			Use
		Needs	Design	Build	Collect	Process	Analyse	Disseminate	Evaluate	Quality	Metadata	Archiving	
Code of Practice for Statistics	National	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Live processes
Common Database (CdB)	National	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Live processes
Esri shapefile (format & standard)	International	No	No	No	Yes	No	No	Yes	Yes	No	No	No	Live processes
European Statistics Code of Practice	International	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Live processes
European Statistics Code of Practice	International	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Live processes
European Statistics Code of Practice	International	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Live processes
European Statistics Code of Practice	International	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Live processes
Fundamental Principles of Official Statistics	International	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Live processes
Generic Activity Model for Statistical Organisations (GAMSO)	International	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Live processes
Generic Activity Model for Statistical Organisations (GAMSO)	International	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Live processes
Generic Activity Model for Statistical Organisations (GAMSO)	International	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Live processes
Generic Statistical Business Process Model (GSBPM)	International	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Live processes
Generic Statistical Business Process Model (GSBPM)	International	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Live processes
Generic Statistical Business Process Model (GSBPM)	International	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Unsure
Generic Statistical Business Process Model (GSBPM)	International	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Live processes
Generic Statistical Business Process Model (GSBPM)	International	No	No	No	No	No	No	No	Yes	Yes	Yes	No	Live processes
Generic Statistical Business Process Model (GSBPM/GeoGSBPM)	International	-	-	-	-	-	-	-	-	-	-	-	Live processes
Generic Statistical Business Process Model (GSBPM/GeoGSBPM)	International	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Live processes
Generic Statistical Business Process Model (GSBPM/GeoGSBPM)	International	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Live processes
Generic Statistical Information Model (GSIM)	International	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Live processes
Generic Statistical Information Model (GSIM)	International	Yes	Yes	Yes	No	No	No	No	No	No	Yes	Yes	Live processes
Generic Statistical Information Model (GSIM)	International	Unsure	Unsure	Unsure	Yes	Yes	Yes	Unsure	-	-	Yes	-	Live processes
GeoDCAT-AP	International	-	-	-	-	-	-	-	-	-	Yes	-	Live processes
GeoJSON	International	-	-	-	-	-	-	Yes	-	-	-	-	Live processes
GeoJSON (for encoding of INSPIRE datasets)	International	-	-	-	-	-	-	Yes	-	-	-	-	Live processes
GeoJSON (for statistical data dissemination)	International	No	No	No	No	No	No	Yes	-	-	-	-	-
GeoPackage (for encoding of INSPIRE datasets)	International	-	-	-	-	-	-	Yes	-	-	-	-	Live processes
Government Statistical Service (GSS) Geography Policy	National	No	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Live processes
GraphQL	International	-	-	-	Unsure	Yes	Yes	-	-	-	-	-	Live processes
GSGF and GSGF Europe	International	Yes	-	-	-	-	-	-	-	-	-	-	Live processes
INSPIRE Framework	International	No	No	No	No	No	No	Yes	No	No	Yes	No	Live processes
INSPIRE Framework	International	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure	Unsure
INSPIRE Framework	International	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	-	-

Standard Name	Type	Stage of Use (GSBPM)								Other			Use
		Needs	Design	Build	Collect	Process	Analyse	Disseminate	Evaluate	Quality	Metadata	Archiving	
ISO 11179 Information technology – Metadata registries (MDR)	International	Yes	Yes	Yes	No	No	No	No	No	No	Yes	Yes	Live processes
ISO 19101 Geographic information – Reference model	International	No	No	No	No	Yes	No	No	No	Yes	No	No	-
ISO 19103 Geographic information – Conceptual schema language	International	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Live processes
ISO 19103 Geographic information – Conceptual schema language	International	No	No	Yes	Yes	Yes	Yes	No	No	No	Yes	No	-
ISO 19107 Geographic information – Spatial schema	International	No	No	Yes	Yes	Yes	No	Yes	No	No	No	No	-
ISO 19109 Geographic information – Rules for application schema	International	No	No	Yes	Yes	Yes	No	Yes	No	No	No	No	-
ISO 19110 Geographic information – Methodology for feature cataloguing	International	No	Yes	Yes	No	No	No	Yes	No	No	Yes	No	-
ISO 19111 Geographic information – Spatial referencing by coordinates	International	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	No	Live processes
ISO 19111 Geographic information – Spatial referencing by coordinates	International	No	No	No	No	No	No	Yes	No	No	Yes	No	Live processes
ISO 19111 Geographic information – Spatial referencing by coordinates	International	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Live processes
ISO 19111 Geographic information – Spatial referencing by coordinates	International	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Live processes
ISO 19115 Geographic information – Metadata	International	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Live processes
ISO 19115 Geographic information – Metadata	International	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	No	-
ISO 19115-1 Geographic information – Metadata – Part 1: Fundamentals	International	No	No	No	Yes	No	No	Yes	-	-	Yes	-	Live processes
ISO 19115-1 Geographic information – Metadata – Part 1: Fundamentals	International	-	-	-	-	-	-	-	-	-	Yes	-	Live processes
ISO 19115-3 Geographic information – Metadata – Part 3: XML schema implementation for fundamental concepts	International	-	-	-	-	-	-	-	-	-	Yes	-	Live processes
ISO 19117 Geographic information – Portrayal	International	No	Yes	Yes	No	Yes	No	Yes	Yes	No	-	No	-
ISO 19119 Geographic Information – Services	International	No	No	Yes	No	Yes	No	Yes	No	No	Yes	No	-
ISO 19128 Geographic information – Web map server interface	International	No	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	No	-
ISO 19128 Geographic information – Web map server interface	International	No	No	No	No	No	No	Yes	-	-	-	-	-
ISO 19131 Geographic information – Data product specifications	International	No	Yes	No	No	No	No	No	Yes	Yes	Yes	No	-
ISO 19131 Geographic information – Data product specifications	International	-	-	-	Yes	Yes	-	-	-	-	-	-	Live processes
ISO 19136 Geographic information – Geography Markup Language (GML)	International	No	No	No	No	Yes	Yes	No	No	No	No	No	-
ISO 19139 Geographic information – Metadata – XML schema implementation	International	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	-
ISO 19139 Geographic information – Metadata – XML schema implementation	International	No	No	No	Yes	No	No	Yes	-	-	Yes	-	Live processes
ISO 19142 Geographic information – Web Feature Service	International	No	No	No	No	No	Yes	Yes	Yes	No	Yes	No	-
ISO 19142 Geographic information – Web Feature Service	International	No	No	No	Yes	No	No	Yes	-	-	-	-	-
ISO 19157 Geographic information – Data quality	International	No	No	No	No	Yes	Yes	No	Yes	Yes	Yes	No	-
ISO 19157 Geographic information – Data quality	International	Yes	Yes	Yes	Yes	Unsure	Unsure	Unsure	No	Yes	Yes	Yes	Live processes
ISO 19157-1 Geographic information – Data quality – Part 1: General requirements	International	-	-	-	-	-	-	-	-	Yes	-	-	Live processes
ISO 19160 Addressing – Conceptual model	International	No	Yes	Yes	No	Yes	No	No	No	Yes	-	No	-
ISO 19160 Addressing – Conceptual model	International	-	-	-	-	-	-	-	-	-	-	-	Pilot/Testing

Standard Name	Type	Stage of Use (GSBPM)								Other			Use
		Needs	Design	Build	Collect	Process	Analyse	Disseminate	Evaluate	Quality	Metadata	Archiving	
ISO 19165-1 Geographic information – Preservation of digital data and metadata – Part 1: Fundamentals	International	-	-	-	-	-	-	-	-	-	-	Yes	Pilot/Testing
ISO 19168-1 Geographic information – Geospatial API for features – Part 1: Core	International	-	-	-	-	-	-	Yes	-	-	-	-	Live processes
ISO 19170 Geographic Information – Discrete Global Grid Systems (DGGS)	International	No	No	Yes	No	Yes	No	No	No	Yes	Yes	No	-
ISO/AWI TR 19115-4 Geographic information – Metadata – Part 4: JSON schema implementation of metadata fundamentals	International	-	-	-	-	-	-	-	-	-	Yes	-	Live processes
ISO/IEC 9075 Information technology – Database languages – SQL	International	No	Yes	Unsure	Unsure	Yes	Yes	Yes	-	-	-	-	Live processes
JHS 106 (national recommendation for addresses)	National	No	No	No	Yes	Yes	No	No	No	No	No	No	Live processes
JHS 177 Paikkatietotuotteen määrittely (national recommendation for geospatial data products specification)	National	-	-	-	Yes	Yes	-	-	-	-	-	-	Live processes
JHS 179 (TOGAF 9.1) (national recommendation for enterprise architecture)	National	-	-	-	-	-	-	-	-	-	-	-	Live processes
JHS 179 (TOGAF 9.1) (national recommendation for enterprise architecture)	National	Yes	-	-	-	-	-	-	-	-	-	-	Live processes
JHS 193 Paikkatiedon yksilöivät tunnukset (national recommendation for specification of unique URI identifiers of geospatial data)	National	-	-	-	-	-	-	-	-	-	-	-	Live processes
MGI Balkans zone 6	National	No	No	No	Yes	Yes	No	No	No	No	No	No	Geospatial reference
NADA	International	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	Yes	Yes	Live processes
OGC API	International	-	-	-	Unsure	Yes	Unsure	-	-	-	-	-	Live processes
OGC API – Features (as an INSPIRE download service)	International	-	-	-	-	-	-	Yes	-	-	-	-	Live processes
OGC API - Features (for geospatial data dissemination)	International	No	No	No	No	No	No	Yes	-	-	-	-	-
OGC API – Joins	International	-	-	-	-	-	-	-	-	-	-	-	Pilot/Testing
OGC API – Processes	International	-	-	-	-	-	-	Yes	-	-	-	-	Live processes
OGC API – Records	International	-	-	-	-	-	-	-	-	-	Yes	-	Live processes
OGC Geographic Tagged Image File Format (GeoTIFF)	International	No	No	No	Yes	Yes	No	Yes	No	No	No	No	Live processes
OGC Geographic Tagged Image File Format (GeoTIFF)	International	No	-	-	-	-	-	-	-	-	-	-	-
OGC Geography Markup Language (GML)	International	No	-	-	-	-	-	-	-	-	-	-	-
OGC GeoPackage Encoding Standard	International	No	No	No	Yes	No	No	No	No	No	No	No	Pilot/Testing
OGC Table Joining Services (TJS)	International	No	-	-	-	-	-	-	-	-	-	-	-
OGC Web Feature Services (WFS 1.0)	International	Yes	Yes	Yes	Yes	Unsure	Unsure	Yes	No	No	Yes	Yes	Live processes
OGC Web Feature Services (WFS)	International	No	-	-	-	-	-	-	-	-	-	-	-
OGC Web Feature Services (WFS)	International	No	No	No	No	No	No	Yes	No	No	Yes	No	Live processes
OGC Web Map Services (WMS 1.1.1)	International	Yes	Yes	Yes	Yes	Unsure	Unsure	Yes	No	No	Yes	Yes	Live processes
OGC Web Map Services (WMS)	International	No	-	-	-	-	-	-	-	-	-	-	-
OGC Web Map Services (WMS)	International	No	No	No	No	No	No	Yes	No	No	No	No	Live processes
OGC Web Map Services (WMS)	International	No	No	No	No	No	No	Yes	No	No	Yes	No	Live processes
OGC Web Map Tile Services (WMTS 1.0.0, 1.3.0)	International	Yes	Yes	Yes	Yes	Unsure	Unsure	Yes	No	No	Yes	Yes	Live processes
OGC Web Processing Services (WPS)	International	No	-	-	-	-	-	-	-	-	-	-	-

Standard Name	Type	Stage of Use (GSBPM)								Other			Use
		Needs	Design	Build	Collect	Process	Analyse	Disseminate	Evaluate	Quality	Metadata	Archiving	
OGC Web Processing Services (WPS)	International	No	No	No	No	Yes	Yes	No	No	No	No	No	Live processes
OpenAPI Specification (JSON)	International	No	No	No	Unsure	Yes	Unsure	-	-	-	-	-	Live processes
Pointer standard address format	National	No	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No	Live processes
PostGreSQL, PostGIS	International	No	No	No	No	No	No	Yes	-	-	-	-	Live processes
SDMX	International	Yes	Yes	Yes	No	Yes	No	Yes	No	No	Yes	No	Live processes
SDMX	International	No	No	No	No	No	No	Yes	No	No	Yes	No	Live processes
SDMX	International	No	Yes	No	No	No	No	Yes	No	No	Yes	Yes	Pilot/Testing
SIMS	International	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Live processes
TS 13889 Information technology – National Registry System – Requirements	National	Yes	Yes	Yes	No	No	No	No	No	No	Yes	Yes	Pilot/Testing
TUCBS	National	No	Yes	Yes	No	No	No	Yes	No	Yes	Yes	Yes	Live processes
W3C Geolocation API	International	No	-	-	-	-	-	-	-	-	-	-	-
W3C standards	International	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Live processes
W3C Web Content Accessibility Guidelines (WCAG) 2.2	International	No	-	-	-	-	-	-	-	-	-	-	-
W3C Web Share API	International	No	-	-	-	-	-	-	-	-	-	-	-
WGS 84 / UTM zone 33N	International	No	No	No	Yes	Yes	No	No	No	No	No	No	Live processes

Appendix 2B: Activity B Results

Governance Sub-Group SWOT Analysis	
STRENGTHS ***Where are your strengths and what advantages do you have over others?***	**WEAKNESSES** ***Where are your weaknesses and vulnerabilities that require change?***
• The effective and collaborative working relationships between the different groups within the statistical and geospatial communities. • Strong partnership with National Statistical Institute (co-creation of several data integration service pilots, joint strategic steering board for data integration activities). • The existing strong links between national statistical and mapping authorities. • Establishment of a national network on integration of statistics and geospatial information. • Organisation's compliancy with structured production models (like GSBPM, GeoGSBPM). • Defining geospatially enabling statistical production – how geospatial data are an integral part of the production process and data resources in statistical production. • Standardisation efforts at *Unit level* through grants and projects. • Geocoding efforts *at Office level* (Census and geocoding grant). • Collaboration between national authoritative stakeholders through various projects, including a reference data repository that utilises relevant and authoritative geospatial data and services. • Cross-cutting organisation-level virtual working group for standardisation issues. • Ownership for standardisation issues defined in organisation (director of digitalisation and development).	• Different organisations across the public, private and third sectors serve their users according to specific requirements and demands, meaning that they often work separately in silos. Datasets often have differences in formats, structures, identifiers, while geographic information can have different projections. Consequently, this non-standardised approach presents challenges in combining, comparing and integrating data from across the different organisations for geostatistical purposes. • There can be a lack of awareness of and engagement with standards at an organisational level; this needs to be overcome if the intention is to maximise the impact of standards on the statistical process. • There is sometimes a misconception that geographic data can be handled in the same way as other data formats, or can be treated as just another variable to be added to a statistical dataset; there is need for a better understanding of how geospatial methodology and analysis can impact on statistical data, and production of standards to support this. • Licensing restrictions around certain data such as postcodes can impact users seeking to incorporate this geographic information into their statistical analyses. • If we call the statistical process 'Statistical process', it may limit collaboration and responsibility to only statistical authorities. A more engaging term could be to call the statistical process (at the national level) an 'Information process'. (Note, GSBPM is not a national information process model, but can be seen as a part of it). • A common understanding can be achieved through the use of different models. However, the value of this understanding is only realised when it is acted upon. To implement good plans, it is necessary to agree on joint methods for managing national responsibilities, standardising operational models, and agreeing on how to utilise the standards. • Thinking uniformly may not translate well into practical technical services without a much narrower and specific project. Therefore, obtaining funding not only enables

• National leader role for INSPIRE and NSDI development and implementation support. • Leader role in various ISO standardisation work. • Leader role of national stakeholder network for integration of statistical and geospatial information. • Experts with deep knowledge in specific fields, contributing to informed decision-making and effective standards development. • Structured processes, ensuring consistency, transparency, and efficiency in standards development. • Active participation in regional collaboration in geospatial standardisation, facilitating global consensus and interoperability of standards. • Standardisation efforts are made at the country level when several countries are participating in the same grant.	resources but also forces the generic, national need to be narrowed down to a more feasible and implementable whole. • The standards in place at the NSO are not easily communicated. • There are no clear standards specifically concerning GIs. • Data integration is hampered by the lack of unique identifiers across NSO's databases and other national stakeholders' dataset. • Lack of standardisation at internal and external level • Location-centred data architecture is lacking. Geospatial data and the concept of location is not considered as an integral part of the data architecture ultimately hampering interoperability • Limited strategic understanding of the key role of standardisation, data integration and interoperability in the development, management and dissemination of reference geospatial information. ⇨ Little strategic interest in active participation in standards development. • Standardisation is often considered as merely a technological exercise, not a strategic asset. • Organisational silos between research, IT development and production hamper cross-cutting understanding of use cases and development needs of standardisation. • Limited expertise in international standardisation and implementation of standards. • National standards system (a.k.a. public administration recommendations) related to geospatial standardisation discontinued since 2020 due to changes in national level IT governance. • No cross-administrative mechanism (between agencies and ministries) for collaborative standardisation planning and implementation. • Too rigid governance mechanisms can sometimes lead to bureaucratic delays.
OPPORTUNITIES ***What opportunities and trends can you capitalise on?***	**THREATS** ***What factors could impede your progress?***
• National standardisation of address information and utilisation of a single data repository make it possible to create consistent, complete, and accurate address information in a standardised format across datasets, thereby facilitating more straightforward linking of data.	• Financial constraints owing to the severe budgetary difficulties facing the public sector; this presents a challenging environment in terms of developing financial partnerships and identifying funding sources for initiatives aimed at delivering better integration of statistical and geospatial data.

• A comprehensive national understanding of the statistical process and its geospatial features makes it possible to build a national information process instead of an organisation-specific one. By jointly viewing the process, organizations can agree on the division of labor, roles, and responsibilities between them. This leads to a reduction in overlapping work and an increase in efficiency. • By using architecture methods to describe the data process extensively, it is possible to establish a common language for building a shared infrastructure for the information process. • The possibility to consider data and quality management in all statistical processes through organisation's quality management policy. • The New INSPIRE Directive intends to tackle the current limitations of the Directive and increase its applicability. • Growing general trend for addressing interoperability and standardisation as cornerstones for the management of exponential growth of data. • New European legislation and funding opportunities for research and management of data. • Artificial intelligence and data spaces as international megatrends require strengthened standardisation activities. • Sustainability and FAIR principles support strongly development and implementation of open international standards. • The European Location Innovation Hub as boosting innovation activities of small and medium-sized enterprises and public sector organisations. • Clear opportunity to expand the impact of standardization into emerging fields like digital technologies, sustainability, and social responsibility. • Increasing public awareness and understanding of the importance of standards can enhance engagement and compliance.	• Within the statistical organisations, recruiting and retaining staff with required knowledge and skills in geography, geospatial information technology and data management. • To maintain the geospatial data management created for statistical production, a management model and a responsible party within the organisation are required. Once established, the geospatial foundation for statistical production goes a long way, but the consolidation of geospatial operations requires constant involvement in change. • New data sources and methods are geospatial in nature and their management is a challenge (Big data, EO data, AI methods). • The implementation of the GSGF model requires a broad national consensus. The involvement of organisations from different administrative sectors can be challenging if they don't see direct vested interest in the subject. With scarce funding organisations are not necessarily ready to take national perspectives when developing. It's great if there are benefits for others, but it's not a driving force. • Lack of communication. • Lack of clear objectives. • Lack of resources. • Decreasing organisational funding for development activities deteriorates interest and participation in standardisation work. • Long history of clinging to prevailing legacy geospatial data management systems limits innovative use of emerging technologies and standards too. • Lack of national and organisational level standardisation strategies and policies prevents seeing the value of standardisation. • Organisational cocooning, focusing on traditional core activities instead of open-minded strategic vision for new opportunities – often due to dwindling funding and security and privacy threats. • Communication issues between standards experts and top management: expert-level technical talk often overrides benefits and value-oriented justifications for using and developing standards -> little understanding and no commitment by leaders. • The fast pace of technological advancement can outstrip the standardization process, leading to outdated or irrelevant standards. • Innovative, non-standardised solutions might challenge established standards, especially if they offer more flexibility or cost-effectiveness.

GAPS

Where are the gaps? What needs to be done to get you to the end goal?

- Need for an effective geographic framework as national statistical agencies face the challenge of incorporating new data, technologies and methodologies into their statistical processes to modernise their organisations.
- A credible, concrete organisation-level and national-level roadmap with tangible actions is needed - to strengthen standardisation efforts for better interoperability and harmonisation of reference geospatial data domains.
- Credible cost-benefit analysis and justification of the roadmap and its actions required for top management level -> better commitment to providing funding.
- Organisational (currently missing) culture for using external (e.g. EU) funding sources for operational development activities.
- Public understanding and engagement are still missing. Increasing awareness and understanding among the organisation about the importance and impact of standards is needed.
- The organisational governance structure may be too complex or not transparent enough, and therefore leading to misunderstandings.
- Clear objectives and communication are the key elements to eliminate redundancy, duplication and multiplicity of data.
- More collaboration and cooperation between the relevant authoritative stakeholders dealing with geospatial data and statistics is needed.
- The GSBPM & GeoGSBPM are strong in standardising statistical processes but they do not reach out to other than statistical organisations. Partly the GSGF fills this gap, but still the shift from GSBPM to GSGF should be more seamless.
- Standardising operations begins with understanding one's own operations, describing them, and obtaining approval from the organisation.
- The GSGF/GSGF Europe (as such) can be too generic for the national use, there may be a need to have a national version of the model.

Technical Sub-Group SWOT Analysis	
STRENGTHS ***Where are your strengths and what advantages do you have over others?***	**WEAKNESSES** ***Where are your weaknesses and vulnerabilities that require change?***
NMCAs: • Main organisational objective is to create a National Infrastructure of Geoinformation based on the INSPIRE Directive, with activity focused on fulfilling this objective since 2014. • Presence of approved NSDI Law, Sub law acts (Metadata, Geodetic Reference frame, Data Sharing & Interoperability), Data Specification Standards. Mandatory for implementation by public authorities. • Approved policy document 2020-2030 for the Geoinformation sector based on, and received recommendations from, the UN IGIF. • Organisational structure is focused on the creation and implementation of Geoinformation Standards in Governmental institutions. A structure dedicated to the training of geoinformation experts is also being established. • The technical implementation of INSPIRE Directive has achieved good results such as National Geoportal, Metadata Catalogue, Data Standardization, Interoperability of Geospatial Datasets and Network Services. • International and national spatial data standards have proactive standards committees who maintain and promote both standards including guidance sheets and case studies. Direct organisational access to information and resources via membership and through senior staff participating in council leadership roles. • As a national mapping authority, it is seen as the leader in the implementation of geospatial data standards amongst other public sector bodies (e.g. the implementing body for national INSPIRE infrastructure) and takes on the "early adopter" role for spatial data standards.	**NMCAs:** • Difficulty in implementing standards in the public authority which is legally responsible for the data themes (34 INSPIRE data themes). • Lack of quality in the fundamental geospatial datasets (Building, Address system, Cadastre Parcel). Lack of budget and a technical methodology for improving these data. • An address is an asset and address data can be seen as a competitive asset, resulting in licensing restrictions that limit its broader use. • Design and implementation of projects in different sectors does not consider the impact of the NSDI. In several cases, geospatial data available do not meet the needs of institutions. • Internal workflows and, subsequently, output data products do not require full compliance with spatial data standards – partial compliance is the norm – therefore, there are substantial resource implications (e.g., staffing and financial) workflow changes that lead to fully compliant data outputs/products. • Organisation is a public sector body, which is bureaucratic in nature and not agile; therefore, any changes in workflow processes require time, financial backing, and business drivers to progress (e.g., commercial implications, clear and quantifiable benefits, etc.). The lack of drivers often leads to the de-prioritisation of standards alignment efforts. • End users of data products do not understand the importance nor use of spatial data standards – this often leads to a feedback loop where customer needs do not include full alignment with standards, and the organisation refers to this as justification for not fully aligning with standards. • The national mapping authority is not the only spatial data producer/user – other public sector organisations (e.g. environment, infrastructure) generate large quantities of spatial information each year and they themselves have difficulties understanding and implementing spatial data standards – therefore, various public sector organisations utilise various versions of these standards or none at all.

• Staff are seen as the preeminent public sector experts and are best positioned and trained to explore how spatial data standards could potentially apply to and best align with public sector spatial information. • Organisation has remit over critical spatial data information and products underpinning many national public sector services (e.g., largescale base mapping, addressing, imagery, etc.), which facilitates the organisation's ability to align with spatial data standards and influence other public sector bodies' own alignment with these standards. • Organisation's data products have a deep history (e.g., archives going back over a century), which the commercial/private sector can access/leverage in their own products/services and, consequently, integrate spatial data standards into their workflows. **NSIs:** • Legal regulations support statistical production processes. • INSPIRE is already fully or partially implemented at a national level, which provides useful guidance. Responsibility for two geospatial themes (population distribution and statistical units). • NUTS classification (NUTS II, III and LAU) is in place for data collections and data publications for several indicators, including grid population of 2011 census. Many geographic things are handled at the European level. • Administrative geography is entitled to NSI. • Organisation has a coordination role among other national institutions. • Good cooperation with other institutions e.g., those that oversee geospatial information management, national address system and ePermits. • Existence of close collaboration with international organisations. • Awareness of international models and standards and swift adaptation of internal units in case of any change made on the internal systems. • Good experts on geography (GIS) and a good infrastructure linked with the annual census survey.	• The variety and depth of applicable spatial data standards is too much for the average staff member to properly comprehend and integrate into their workflows; thereby contributing to the production of data products/outputs that may not be fully aligned with these standards. • Staff, while aware of spatial data standards, are not fully trained experts in these standards; this is primarily due to the fact that there are no roles within the organisation that require expertise in spatial standards. • There is a distinct gap in the understanding of spatial data information within public sector IT department(s); however, they are expected to develop and maintain the IT infrastructure(s) necessary for the organisation to produce spatial data information and, indirectly, support its ability to align with spatial data standards. • Need for increase of technical capacities (in the role of trainers) and more importantly in experts in other public authorities. **NSIs:** • The spatial data received from other national institutions not being compatible with the desired standards. • Data quality at infra municipality level. Neighbourhood and village-level data quality. Necessity to regularly update geographic information through data collection in field. • Administrative spatial or textual records gathered from other national institutions may contain incomplete or incorrect data. • Lack of qualitative data from administrative sources. • Lack of data at the lowest geographic entity such as towns and villages. • Not a very precise administrative division at lower scale. • Several geographical referentials. • Postal code is different from official municipality code, which is not very well known for itself. • Form of the address is dependent from the country and is not uniform through the country. Address is sometimes not sufficient to localise an individual. • The inability to merge data from different institutions using a common identifier. • Size of territory, including overseas. • Lack of IT infrastructure in exchanging data with other national bodies and administrative sources (traditional ways of getting information: CD, email).

• Geographic information largely used in the Census 2023 and in all annual surveys based on households (the sample frame). • Large use of fiscal information, including cadastre. • Use of open-source products (QGIS, R) and attempts to help users taking advantage of data (e.g. R programs). • Ongoing work on establishing Statistical Register of Buildings and Dwellings based Mapping Strategy for the 2020 Census and for the development of the Statistical Register of Buildings and Dwellings.	• Address system is not very reliable. • No clear vision about the real user needs. • Distance from the NMCA: NSI is just another client. • Insufficient level of awareness and knowledge about international standards and models among other national institutions. • Low skills in geographic dissemination (no tile service, too many standards). • IT department has very low knowledge in geographics, especially in mapping. • High turnover of the staff.
OPPORTUNITIES ***What opportunities and trends can you capitalise on?***	**THREATS** ***What factors could impede your progress?***
NMCAs: • Organisation's role as the national mapping authority provides an opportunity to engage with and lead cross-departmental efforts to implement/align with spatial data standards. • Presence of organisational will to support and participate in initiatives/projects where geoinformation is a part. • Recent increased engagement between national mapping and statistical organisations is an opportunity for joint/coordinated approaches to data standardisation through the vast majority of spatial data and statistical information. • Organisation can serve for the coordination/management of Geoinformation projects at a national level. • Geoinformation and Statistical Sector already intersects and has an impact with all development sectors such as Infrastructure, Agriculture, Energy, Environment, ICT. Both Sectors are necessary for these development sectors. • The growing requirement/need for data integration and interoperability within the public sector to better leverage/realise efficiencies (primarily driven by government budget deficits), can be seen as an opportunity to progress further/full alignment with spatial data standards (e.g., web map service standards, addressing standards, etc.).	**NMCAs:** • Quality and availability of fundamental geospatial data endangers the realization of various projects. • Lack of understanding and coordination between actors of both Geospatial and Statistics sectors. • Lack of coordination – coupled by misunderstood and/or insufficient organisational drivers – among the public sector bodies within which both statistical and geospatial data (and, consequently, standards) are generated and utilised, make it difficult to have a cohesive approach/strategy towards standardisation. • Complexity and non-understating of geospatial standards by experts and organisation, creates the tendency of non-implementation of these standards. • Budgets and insufficient resourcing are real and major threats to any efforts toward standardisation, particularly if these efforts require changes in workflows and data outputs. • Organisational staff turnover rates (often increasing) and under-resourcing (often the norm) necessarily leads to the de-prioritisation of any/all efforts towards standardisation. • Changes in technologies and methodologies requires continuous upskilling (in terms of how they impact data standardisation and vice versa). **NSIs:** • The lack of infrastructure in some national institutions to implement data standards.

• The broad use of datasets, e.g. address data, where they are available can instil a "common good" amongst stakeholders that drives progress. • The rise of emerging technologies and platforms (e.g., satellite-based products and services, AI/ML and allied technologies and methodologies, 3D object modelling and mapping, etc.) can be opportunities to progress with upskilling of staff in order to better embrace these (i.e., can be used as a driver to train staff to better understand relevant spatial data standards). • Mandating of national authoritative address database format across central government is a stepping stone in standardising address information; thereby setting precedence for other similar initiatives. **NSIs:** • A longstanding commitment to tracking and applying international standards in data provides the capability to integrate standards into recently established data procedures. • The inclusion of actions aimed at enhancing statistical and information infrastructure in national plans and programs. • Full implementation of INSPIRE Directive. • Open data. • Convergence between dissemination flows to use the same service: cataloguing is easier and common geographic description are used. • NMCA is willing to offer a platform for geographic services. • New surveying organisation could offer geocoding during field collection. • National address databases are being created or are already in place, which will act as the national reference. Plans for inclusion of unique identifiers and established geocoding services. • Statistical register for geographic issues is being built, consolidating information from various sources (cadastre, census, addressing) and will offer links between these. • Statistical registers for individuals, buildings and dwellings are planned/being developed linking the Census data with information from various sources (addresses, new construction permits). Georeferencing	• National institutions may not allocate sufficient budget for data integration projects and necessary infrastructure due to public saving measures and budget deficits. • Confidentiality matters: organisation only uses suppressive methods which don't suit detailed data. • Point-based geocoding can be mistaken; in some cases, geocoding is more efficient based on area-based geocoding. When comparing policy-zonings, cadastre parcels are preferred to point-based address. • Mapping tools are evolving constantly and more and more quickly. • IT costs for a geographical infrastructure may be enormous, even if open-source software is used. • High turnover of the staff.

will be a consequence of pairing individuals and not a specific task, done at the end. • Fully geocoded census could provide useful and updated data on buildings, dwellings and individuals. • Strengthening collaboration with other national data providers and other administrative sources on geographic information. • Modernizing geoportal for dissemination of census data and regional data, bringing it close to the users.	

GAPS

Where are the gaps? What needs to be done to get you to your end goal?

NMCAs:

- NSDI is insufficient to satisfy the demands of other sectors. Technological developments (Artificial Intelligence, Internet of Things, Remote Sensing) can fill this gap.
- Clear links between organisational drivers and the benefits of data standards/standardisation are necessary to progress better alignment with data standards – at the moment, relevant public sector bodies are only tangentially aware of these links.
- Statistics and Geoinformation sectors do not have sufficient synergy to maximise their capacity. A national structural reorganization (such as Boards, Technical groups) could be a solution to overcome some of the problems.
- Better engagement with data producers/users between internal teams (e.g. the various data production and customer-facing teams) and with external stakeholders (e.g., other public sector bodies) to coordinate best practice, define cross-cutting drivers, create business cases and use-cases, etc.

NSIs:

- Collaborative working groups with other national institutions established to determine data standards.
- Good use cases of national/international organisations can serve as examples to reinforce the implementation of the standards and models and foster the data integration processes.
- Fostering cooperation with other administrative sources to regularly update geographic base.
- Highlighting the role of geospatial data for decision makers.
- Find how to deal with confidentiality at the lowest geographic levels.

Appendix 2C: Activity C Results

MoSCoW Theme	Topic	Comment
Must Have	Cooperation and Collaboration	• Establish and maintain the existing strong links between national statistical and mapping authorities. Co-creation of several data integration service pilots, joint strategic steering board for data integration activities. • Effective and collaborative working relationships between the different groups within the statistical and geospatial communities. • Existence of close collaboration with international organisations. • Collaboration between national authoritative stakeholders through various projects, including a reference data repository that utilises relevant and authoritative geospatial data and services. • Establishment of a national network on integration of statistics and geospatial information. • Cross-administrative mechanism (between agencies and ministries) for collaborative standardisation planning and implementation. • Coordination between research, IT development and production to ensure cross-cutting understanding of use cases and development needs of standardisation.
Must Have	Coordinating/Steering Groups	• International and national spatial data standards have proactive standards committees who maintain and promote both standards including guidance sheets and case studies. Direct organisational access to information and resources via membership and through senior staff participating in council leadership roles. • Design and implementation of projects in different sectors which consider broader impacts on relevant stakeholders. • NSI/NMCA has a coordination role among other national institutions. • Presence of organisational will to support and participate in initiatives/projects where geoinformation is a part. • Recent increased engagement between national mapping and statistical organisations is an opportunity for joint/coordinated approaches to data standardisation through the vast majority of spatial data and statistical information. • Ensure engagement / public comment on adoption of new international standards.
Must Have	Communication and Common Understanding	• Consider updating the term “statistical process” to “information process”. • Create a common understanding amongst stakeholders through agreement on joint methods for managing national responsibilities, standardising operational models, and how to utilise standards. • Develop clear definitions and terminology.

MoSCoW Theme	Topic	Comment
		• National and organisational level standardisation strategies and policies to show the value of standardisation. • By using architecture methods to describe the data process extensively, it is possible to establish a common language for building a shared infrastructure for the information process. • A comprehensive national understanding of the statistical process and its geospatial features makes it possible to build a national information process instead of an organisation-specific one. By jointly viewing the process, organizations can agree on the division of labour, roles, and responsibilities between them. This leads to a reduction in overlapping work and an increase in efficiency. • Ensure effective communication between standards experts and top management: expert-level technical talk often overrides benefits and value-oriented justifications for using and developing standards -> little understanding and no commitment by leaders.
Must Have	Clear, Common, Communicated Standards	• Strong strategic understanding of the key role of standardisation, data integration and interoperability in the development, management and dissemination of reference geospatial information. • Clear standards specifically concerning GIS (e.g. standardised geocoding methods). • Organisational compliance with structured production models (e.g. GSBPM, GeoGSBPM). • Awareness of and engagement with standards at an organisational level to maximise the impact of standards on the statistical process. Effective communication of standards in use. • Expertise in international standardisation and implementation of standards. • Defining geospatially enabling statistical production – how geospatial data are an integral part of the production process and data resources in statistical production. • Growing general trend for addressing interoperability and standardisation as cornerstones for the management of exponential growth of data.
Must Have	Developing Standards	• Strategic interest in active participation in standards development. • Active participation in regional collaboration in standardisation, facilitating global consensus and interoperability of standards. • Ownership for standardisation issues defined in organisation and roles defined (e.g. Director of Digitalisation and Development). • Structured processes, ensuring consistency, transparency, and efficiency in standards development. • Data integration processes that are supported by the use of unique identifiers across all relevant datasets.
Must Have	Legal Regulations/Mandates	• Clear legislation and mandates in place which outline is are responsible for creating, implementing, and updating standards in statistical and geospatial sectors.

MoSCoW Theme	Topic	Comment
		• Legal regulations to support and make basis for statistical production processes. • Legal framework and organisational structure for data integration. (Implement essential regulations and structures to support statistical and geospatial data integration, emphasising the need for a NUTS classification). • Mandated used of international standards (e.g. ISO, OGC).
Must Have	Skills and Capacity	• NSI/NMCA staff are seen as the pre-eminent public sector experts and are best positioned and trained to explore how spatial data standards could potentially apply to and best align with public sector spatial information. • Sufficient level of awareness and knowledge about international standards and models among other national institutions. • Increased technical capacities (in the role of trainers) and more importantly in experts in other public authorities. • Strong skills in geographic dissemination and web standards in particular. • IT Departments with a strong understanding of geographic concepts and requirements. • Good use cases of national/international organisations can serve as examples to reinforce the implementation of the standards and models.
Must Have	Financial and Human Resources	• Sufficient resources available to undertake activities and sustain them over the long term. • Ability to develop financial partnerships and identify funding sources for initiatives aimed at delivering better integration of statistical and geospatial data. • New European legislation and funding opportunities for research and management of data. • Within the statistical organisations, recruiting and retaining staff with required knowledge and skills in geography, geospatial information technology and data management. • Organisational funding for development activities to increase interest and participation in standardisation work.
Must Have	Data Interoperability	• Spatial data interoperability and compatibility amongst institutions. • Consistent geographic references. • Uniform address information and postal codes. • Reliable address systems. • Ability to merge data from different institutions using a common identifier.

MoSCoW Theme	Topic	Comment
		• Common metadata standards to describe geoinformation and statistical datasets.
Must Have	Data Infrastructure	• Spatial data interoperability and compatibility amongst institutions. • Robust IT infrastructure for exchanging data with other national bodies and administrative sources. • Internal workflows and output data products which are fully compliant with statistical and geospatial data standards. • Upgrade IT infrastructure to support data handling and ensure ongoing training for staff in GIS and related technologies, addressing the identified gap in expertise. • Implement security measures to protect sensitive statistical and geospatial data during integration.
Should Have	Shared Projects	• Standardisation efforts are made at the country level when several countries are participating in the same grant. • Experts with deep knowledge in specific fields, contributing to informed decision-making and effective standards development. • Standardisation efforts at Unit level through grants and projects. • Concrete collaboration through joint projects between NSI and NMCA.
Should Have	Standards in Organisational Activities	• Cross-cutting organisation-level virtual working group for standardisation issues. • To maintain the geospatial data management created for statistical production, a management model and a responsible party within the organisation are required. Once established, the geospatial foundation for statistical production goes a long way, but the consolidation of geospatial operations requires constant involvement in change.
Should Have	Basic National Geospatial Data (Infrastructure)	• National standardisation of address information and utilisation of a single data repository make it possible to create consistent, complete, and accurate address information in a standardised format across datasets, thereby facilitating more straightforward linking of data. • National leader role for INSPIRE and NSDI development and implementation support. • Public access platforms and advanced tools. (Develop platforms for disseminating integrated data and invest in analytical tools, leveraging the opportunity to make data more understandable and attractive to users). • Standards on archiving geospatial data for statistical (integration) purposes. • Build a testing environment to test every standard implementation before going live. • National address database system.

MoSCoW Theme	Topic	Comment
Should Have	Data Licensing and Ownership	• Removal of licensing restrictions around certain data such as postcodes to ensure that users can incorporate this geographic information into their statistical analyses.
Should Have	National Policies	• Mandating of national authoritative address database format across central government is a stepping stone in standardising address information; thereby setting precedence for other similar initiatives. • The inclusion of actions aimed at enhancing statistical and information infrastructure in national plans and programs. • Full compliance with the INSPIRE Directive and related policies. • Approved policy document 2020-2030 for the Geoinformation sector based on, and received recommendations from, the UN-IGIF. • Give priority to SDGs for new fields of work on standards.
Should Have	Developing Standards	• Artificial intelligence and data spaces as international megatrends require strengthened standardisation activities. • Sustainability and FAIR principles support strongly development and implementation of open international standards. • The New INSPIRE Directive intends to tackle the current limitations of the Directive and increase its applicability.
Should Have	Strategic Leadership and Culture	• Fostering an open-minded strategic vision for new opportunities within organisations. • Innovative use of emerging technologies and standards.
Could Have	-	• The European Location Innovation Hub as boosting innovation activities of small and medium-sized enterprises and public sector organisations. • Use of open-source products (QGIS, R) and attempts to help users taking advantage of data (e.g. R programs). • Pilot projects for data utilisation: Initiate innovative projects to explore new uses for integrated data, enhancing statistical registers for geographic issues. • Community engagement and professional development: Engage the broader community and offer professional development opportunities for staff to keep pace with technological changes. • Increasing public awareness and understanding of the importance of standards can enhance engagement and compliance. • Customization to allow users to view and queries based on their specific needs.

MoSCoW Theme	Topic	Comment
		• Consider mobile compatibility for accessing integrated information on different devices. • Expand the impact of standardization into emerging fields like digital technologies, sustainability, and social responsibility.
Will Not Have	-	• Use of local standards which are not compatible with international standards. • Rigid governance mechanisms that lead to bureaucratic delays. • Unclear objectives. • Lack of location-centred architecture. • Comprehensive overhaul of existing systems: Prioritise incremental upgrades over a complete overhaul, considering financial and operational constraints. • Immediate adoption of all emerging technologies: Focus on technologies that offer clear benefits and align with strategic goals, given budget limitations and the challenge of retaining quality IT personnel. • Real-time Integration could be for the latest implementation.

INGEST Task Force on Standards Issues

A path towards the use of common standards to support the INtegration of GEospatial and STatistical information

Working Paper Series on Statistics

This Working Paper presents the activities and outcomes of the INGEST Task Force on Standards Issues relating to the integration of geospatial and statistical information which was established as part of the INGEST project led by UNECE and funded by the European Commission (Eurostat). The Task Force brought together representatives from national statistical and geospatial organisations from across the UNECE region to discuss the current use of standards within activities to integrate geospatial and statistical data, to explore the present issues and constraints, and to identify priorities and actions that would strengthen the use of common standards at national levels. Based on the collective outcomes of these activities, the Task Force present a set of recommendations and implementation guidelines which are designed to support national statistical and geospatial organisations in their actions to adopt and embed the use of common standards in activities to integrate statistical and geospatial information across the data lifecycle. With these recommendations, a path has been laid out for organisations to produce the harmonised, interoperable, high-quality data needed to improve decision-making, inform policy development, and realise efficiencies in processes and services within and across different organisations at national, regional and global levels

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