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INGEST Issues and Obstacles

to the greater INtegration of GEographical and STatistical information across the UNECE region

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INGEST Issues and obstacles to the greater integration of statistical and geospatial information across the UNECE region

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 adoption of common standards, with a particular focus on sixteen target countries defined as non-EU members located within the UNECE region in Eastern and South Eastern Europe, the Caucasus and Central Asia.

Under the scope of this project, a research exercise was undertaken to identify the main issues and obstacles hampering the greater integration of statistical and geospatial information across the UNECE region and potential solutions for overcoming them. This exercise consisted of a critical review of the published literature on data integration at regional and international levels, a structured assessment of statistical and geospatial activities within differing national contexts, and the identification of examples of national best practice. An online survey was also issued to National Statistical Institutes (NSIs) and National Mapping and Cadastral Agencies (NMCAs) across the UNECE region to obtain insight on data integration from the statistical and geospatial communities themselves. This paper presents the results of these activities and outlines a set of recommendations to support the greater integration of statistical and geospatial across the UNECE region.

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The author would like to express their sincere thanks and appreciation to every organisation who provided a response to the UNECE Survey whose contributions have been invaluable to the project, the outcomes of this paper, and the direction of future activities to support the greater integration of statistical and geospatial information. The author is also extremely grateful to colleagues from UNECE, UN-GGIM: Europe and Eurostat for their support and assistance throughout the project

TABLE OF CONTENTS

TABLE OF FIGURES

ABBREVIATIONS

AI	Artificial Intelligence
BIM	Building Information Modelling
CCSA	Committee for the Coordination of Statistical Activities
CCS-UNS	Committee of the Chief Statisticians of the United Nations System
CES	Conference of European Statisticians
CSPA	Common Statistical Production Architecture
DGGS	Discrete Global Grid System
ECOSOC	United Nations Economic and Social Council
EFGS	European Forum for Geography and Statistics
EO	Earth Observation
ESGAB	European Statistical Governance Advisory Board
ESS	European Statistical System
ESSC	European Statistical System Committee
ETL	Extract, Transfer and Load
EU	European Union
GAMSO	Generic Activity Model for Statistical Organisations
GDPR	General Data Protection Regulation
GEO	Group on Earth Observations
GFGS	Global Forum for Geography and Statistics
GIS	Geographic Information System
GISCO	Geographic Information System for the Commission
GML	Geography Markup Language
GPSDD	Global Partnership for Sustainable Development Data
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
ICA	International Cartographic Association
IHO	International Hydrographic Organisation
INSEE	The National Institute of Statistics and Economic Studies
INSPIRE	Infrastructure for Spatial Information in the European Community
ISO	International Organisation for Standardisation
ISO/TC 211	International Organisation for Standardisation Technical Committee 211 on Geographic Information/Geomatics
KML	Keyhole Markup Language
ML	Machine Learning
NGO	Non-Governmental Organisation
NMCA	National Mapping and Cadastral Agency
NSI	National Statistical Institute
OECD	Organisation for Economic Cooperation and Development
OGC	Open Geospatial Consortium
SDG	Sustainable Development Goal
SDI	Spatial Data Infrastructure

SDSN	Sustainable Development Solutions Network
UN DESA	United Nations Department of Economic and Social Affairs
UN-GGIM	United Nations Committee of Experts on Global Geospatial Information Management
UN-IGIF	United Nations Integrated Geospatial Information Framework
UN-GGIM	United Nations Committee of Experts on Global Geospatial Information Management
UNECE	United Nations Economic Commission for Europe
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNSC	United Nations Statistical Commission
UNSD	United Nations Statistics Division
WFS	Web Feature Service
WMS	Web Map Service
WPS	Web Processing Service

EXECUTIVE SUMMARY

1. The challenges faced by modern society are great and decision-makers must navigate a multitude of issues relating to society, the environment, the economy, and the political landscape at pace with the appropriate knowledge in order to safeguard society and the world we live in. Advances in technology and digital transformation have unlocked a critical resource for this task: data. The role of data as a driver for evidence-based decision-making has been brought to the fore by the adoption of the 2030 Agenda for Sustainable Development and its call for data that is accurate, current and of high-resolution to measure and monitor the achievement of the Sustainable Development Goals (United Nations, 2015). Both National Statistical Institutes (NSIs) and National Mapping and Cadastral Agencies (NMCAs) play a central role in this data revolution and the integration of statistical and geospatial data is crucial to maximise data-driven decision-making across the public and private sectors. While global efforts to progress the greater integration of statistical and geospatial data have been going on for over a decade through the work of the United Nations and other international and regional bodies, the benefits have not yet been fully realised due to a range of complex but interconnected reasons outlined in this paper. Recognising this shortfall, in 2022 the European Commission funded a project, led by the United Nations Economic Commission for Europe (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 adoption of common standards, with a particular focus on sixteen target countries that have not yet joined the EU located within the UNECE region in Eastern and South-Eastern Europe, the Caucasus and Central Asia.

2. To accurately inform and target the direction of this work, a research exercise was undertaken to identify the main issues and obstacles hampering the greater integration of geospatial and statistical data across the UNECE region and potential solutions for overcoming them. This exercise consisted of a desktop review, comprising a critical review of the published literature on data integration at regional and international levels, a structured assessment of statistical and geospatial activities within differing national contexts, and the identification of examples of national best practice. To obtain insight on data integration from the statistical and geospatial communities themselves, an online survey was also issued to NSIs and NMCAs across the UNECE region. A total of 67 organisations responded to the UNECE Survey, representing 49 countries, of which 15 were from target countries. With the purpose of providing a logical and relevant structure for this exercise, the main findings have been presented according to each of the nine strategic pathways outlined in United Nations Integrated Geospatial Information Framework (UN-GGIM, 2018): Governance & Institutions, Legal & Policy, Financial, Data (& Technical Infrastructure), Innovation, Standards, Partnerships, Capacity & Education, and Communication & Engagement.

3. These activities have revealed that there are several multi-dimensional issues and obstacles to be overcome due a wide variance in national contexts and there is no one-size-fits-all strategy that will comprehensively overcome such disparities. Using a stakeholder-

centric approach, the research exercise has identified financial issues as having the biggest impact on greater integration of statistical and geospatial information, followed by issues related to communication and engagement, and data and technical infrastructure, particularly around data harmonisation and interoperability. Based on the feedback provided by respondents to the UNECE Survey, and supported by the contextual review of the issues and obstacles to the greater integration of geospatial and statistical data, four recommendations are proposed to improve data integration activities across the UNECE region:

A. Consolidate and coordinate data integration activities through one central governing body for Europe.
B. Identify and promote sustainable funding resources and models to support data integration activities at national levels.
C. Enhance communication and engagement strategies to grow awareness of data integration and better support the sharing of best practice and new technologies.
D. Promote greater data standardisation and interoperability through the use of harmonised standards, operating models, production processes and services.

4. It is hoped that this stakeholder-centric approach used to identify the issues and obstacles to the greater integration of statistical and geospatial information, and the solutions proposed for overcoming them, will both complement and enhance other important recommendations made by UNECE, Eurostat and others in the field of data integration and provide a driving force for change so that the benefits of data integration are fully realised to the great benefit of society.

I. INTRODUCTION

5. As technology advances and digitalisation processes expand, data has come to the fore as an infinite resource which can be used to better understand our world and address the biggest challenges faced by society, such as the impacts of climate change, global health, social inequality, and economic uncertainty. Data "is both a by-product and a driver of global development that has transformed how we make decisions" (World Economic Forum, 2022a) and with increased accuracy, currency and granularity, data can be used by governments to inform evidence-based decision-making to meet these challenges head on. The adoption of the 2030 Agenda for Sustainable Development (United Nations, 2015) and its Sustainable Development Goals (SDGs) has brought the need for better data to the forefront of global, regional, and national agendas and provides a strong impetus for change. Both NSIs and NMCAs play a central role as data providers in this data revolution and their activities cannot be viewed in isolation. The integration of statistical and geospatial information has been described as "one of the most promising paths to provide more timely, reliable and detailed information . . . that can result in new insights that we could not otherwise gain" (Eurostat, 2019, p. 1) and can maximise data-driven decision-making across the public and private sectors. It not only benefits society but also the data providers themselves as it enhances the value of the statistical and geospatial data through improved quality, improves the interoperability of datasets, and provides new possibilities for data analysis and presentation.

6. Global efforts to progress the greater integration of statistical and geospatial data have been ongoing for more than a decade, centred upon the work of the United Nations and its various bodies and expert groups, but increasingly extended and adapted to regional contexts by the work of organisations such as UNECE, the European Commission and the European Forum for Geography and Statistics (EFGS) in Europe, for example. As outlined by 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 statistical systems, processes and operations and take advantage of new data sources in order to achieve increasingly harmonised, standards-aligned and metadata-driven statistical outputs. Similarly, such efforts are also taking place at a time when NMCAs are working to improve the management of geospatial data through the development of Spatial Data Infrastructures (SDIs) and embed the use of geospatial data across government to improve decision-making, enhance policy development and improve efficiencies across multiple spatial scales. The stage has been set, however, the benefits of integrating statistical and geospatial data have not yet been fully realised for a myriad of reasons which will be discussed in this paper.

7. In order to develop greater capacity in statistical and geospatial data integration, the European Commission have funded a project, led by UNECE, to "foster stronger links between the statistical and geospatial communities across the UNECE region, facilitate greater collaboration, and encourage greater integration of geospatial and statistical information by promoting stronger institutional partnerships and the use of common standards" (as outlined in the European Union Contribution Agreement 2021.0180). As a means of accurately informing and targeting the direction of this work, a research exercise has been undertaken to identify the main issues and obstacles hampering the greater

integration of geospatial and statistical data across the UNECE region and potential solutions for overcoming them. This paper presents the main findings of this research exercise which consisted of a desktop review, composed of a critical review of the published literature on the integration of statistical and geospatial information at regional and international levels, a structured assessment of statistical and geospatial activities within differing national contexts, and the identification of examples of national best practice, as well as the issuing on an online survey to all NSIs and NMCAs across the UNECE region to obtain insight from the statistical and geospatial communities themselves on the issues they face and opportunities to inform the future direction of activities relating to data integration.

II. SCOPE

8. The main aim of this paper is to outline the issues and obstacles to the greater integration of geospatial and statistical data across the UNECE region in order to facilitate future work by UNECE and other stakeholders to overcome those issues and obstacles. This paper has informed the wider project and its support of existing activities to strengthen the integration of geospatial and statistical data by UNECE, Eurostat, UN-GGIM: Europe 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. A list of the target countries can be found in Table 1 below and their geographic distribution is presented in Figure 1 (next page).

Target Country	Target Country
Albania	Montenegro
Armenia	North Macedonia
Azerbaijan	Serbia
Bosnia and Herzegovina	Tajikistan
Georgia	Turkey
Kazakhstan	Turkmenistan
Kyrgyzstan	Ukraine
Moldova, Republic of	Uzbekistan

Table 1: List of project target countries

The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

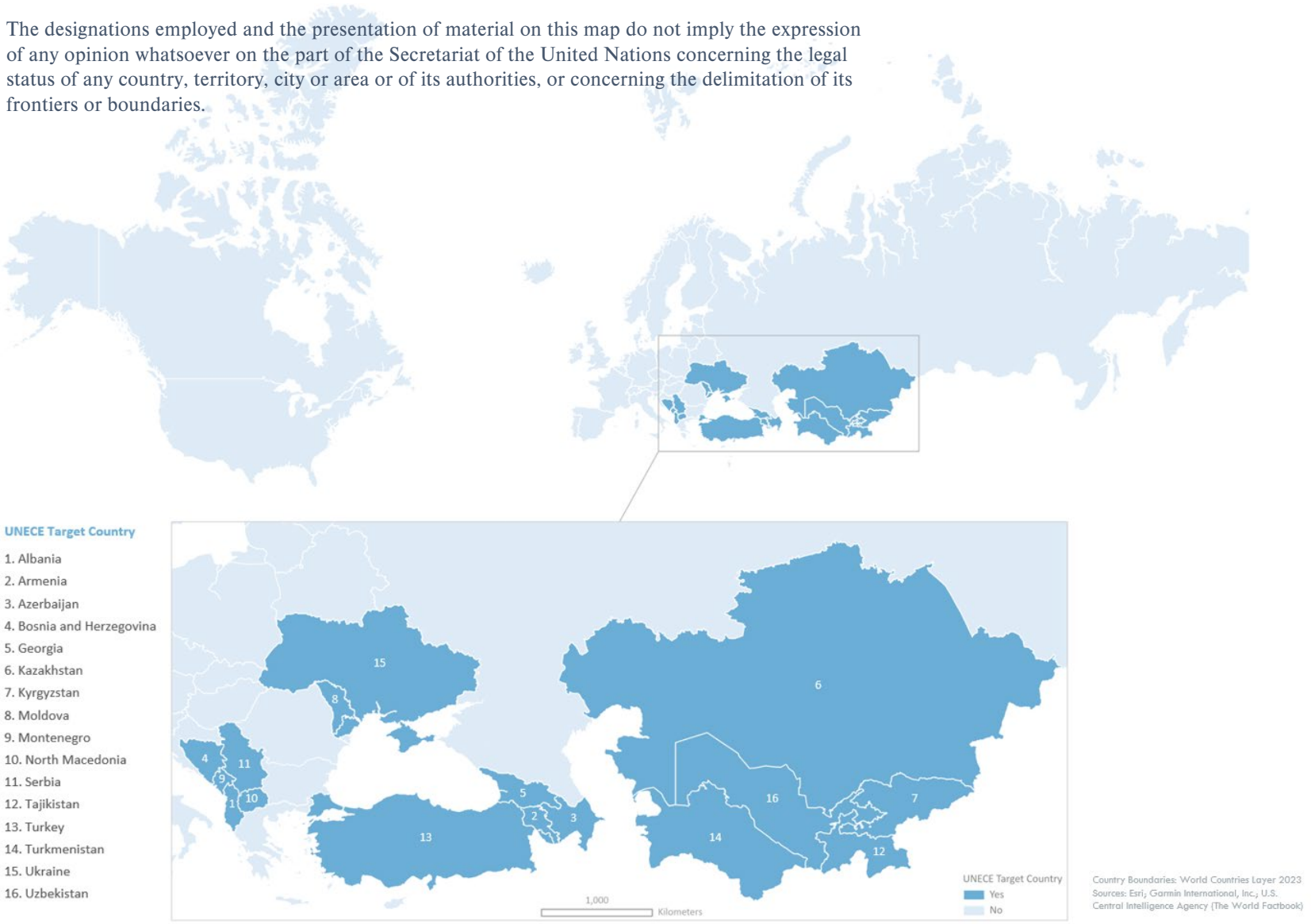

Figure 1: Map showing the UNECE region and the location of target countries

III. METHODOLOGY

A. Project Framework

10. So as to provide a logical and relevant framework for this paper, the main findings have been structured according to the nine strategic pathways outlined in the United Nations Integrated Geospatial Information Framework (UN-IGIF) (UN-GGIM, 2018), as follows:

- Governance and Institutions
- Legal and Policy
- Financial
- Data (& Technical Infrastructure)
- Innovation
- Standards
- Partnerships
- Capacity and Education
- Communication and Engagement

11. The UN-IGIF is a reference guide to support governments in the development and strengthening of integrated geospatial information management practices and their inclusion in national plans and strategies. It is also intended to be used as a tool for engagement that will lead to better "coordination, collaboration and coherence across government when working towards strengthening national geospatial information management" (UN-GGIM, 2018, p. 25). Given the importance and relevance of this framework to the greater integration of statistical and geospatial information, and consequently the aims of the action upon which this paper is based, it was considered appropriate to align the study with the Framework's nine strategic pathways, hereby known as "themes", which relate to three broader areas of influence: governance, technology, and people. Figure 2 overleaf outlines the interconnected nature of the strategic pathways. Pathways 1 to 3 relate to governance, pathways 4 to 6 relate to technology, and pathways 7 to 9 relate to people.

Figure 2: The nine strategic pathways of the Integrated Geospatial Information Framework (UN-GGIM, 2018, p. 21)

B. Desktop Review

12. A critical review of the published literature on the integration of statistical and geospatial information at regional and international levels, structured under the nine UN-IGIF themes, was undertaken to identify and categorise the current issues and obstacles to greater data integration and any potential strategies to overcome them. Following this review, a structured assessment of statistical and geospatial activities within each target country was undertaken using the nine UN-IGIF themes in order to understand the differing national contexts, how these may impact the greater integration of statistical and geospatial information, and to identify potential opportunities that may help to support data integration activities at national levels. As part of the literature review and target country assessment, SWOT analyses (European Commission, 2015) were also undertaken to identify the analyse the strengths, weaknesses, opportunities, and threats to the research focus, providing an important context for the study. Examples of national best practice across the UNECE region were also identified and collated to support this research and provide a valuable resource for future project activities.

C. Online Survey

13. In order to establish strong communication and engagement with the statistical and geospatial communities across the UNECE region, to ensure that the views of key stakeholders were included within the project, and to acquire feedback to help inform the direction of future project activities relating to data integration, an online survey was designed and issued via Microsoft Forms to all NSIs and NMCAs located within the UNECE region.

The survey consisted of a series of branching questions which were divided into four main sections: Section 1 related to organisational data usage and access to software; Section 2 explored the level of organisational involvement in wider activities relating to geospatial and statistical data integration at both national and international levels; Section 3 provided an opportunity for organisations to share information on the current issues and obstacles which may be preventing them from progressing greater data integration; and Section 4 allowed organisations to register their interest in future project activities. The survey was issued in March 2023 and respondents were given a period of four weeks to complete and submit their responses. A copy of the survey is found in Appendix 1. Quantitative and qualitative analysis of the survey responses was undertaken, including the creation of summary statistics and graphical representations, as well as key word extraction and word cloud formation to ascertain key trends within the qualitative data. The survey results are found in Appendix 2.

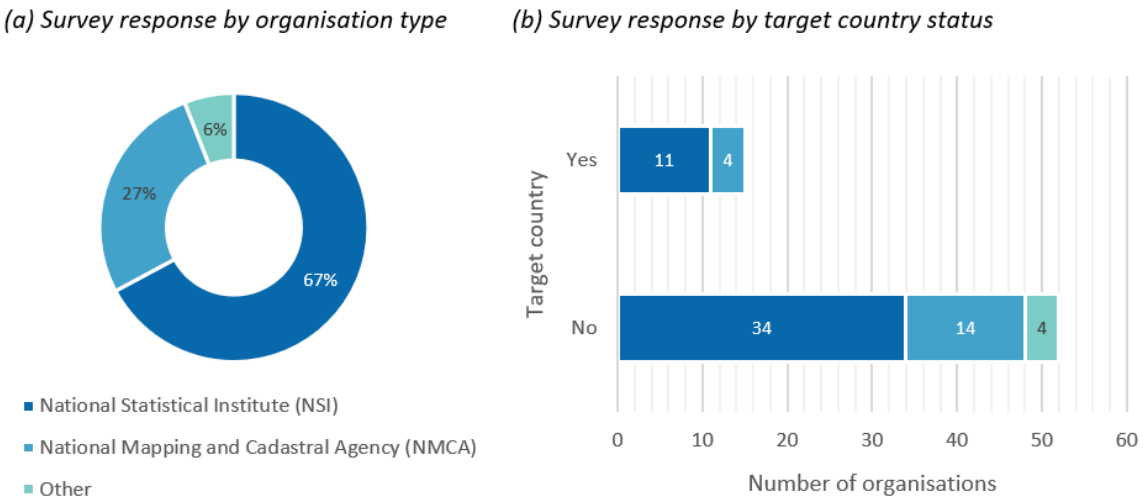

Figure 3: UNECE Survey response by organisation type and target country status

14. A total of 67 organisations responded to the survey, of which 45 (67%) were NSIs, 18 (27%) were NMCAs, and 4 (6%) were designated as other (Figure 3a), the latter category consisting of organisations where the national statistical and geospatial functions were combined or had an academic or research function. Of the survey respondents, 15 (22%) were from target countries of which the majority, 11 (73%), were NSIs and 4 (27%) were NMCAs, and none were defined as other. Similarly, a total of 52 (78%) respondents came from non-target countries and, of those, the majority, 34 (65%) were NSIs, 14 (27%) were NMCAs, and 4 (8%) were classed as other (Figure 3b). A total of 49 countries responded to the survey which had a geographic reach beyond the UNECE region, with 8 respondents located outside the region in the countries of Brazil, Chile, China, Colombia, India, Japan, and Mexico. These wider perspectives are welcomed and provide additional context to further enhance the project outputs. In 17 (35%) countries, where the NSI and NMCA provided a response to the survey, including Cyprus, Germany, Lithuania, and Sweden, ensuring that valuable dual perspectives from both statistical and geospatial communities were obtained. Out of those 17 dual respondent countries, four were from target countries comprising of Albania, Armenia, Bosnia and Herzegovina, and the Republic of Moldova (Figure 4).

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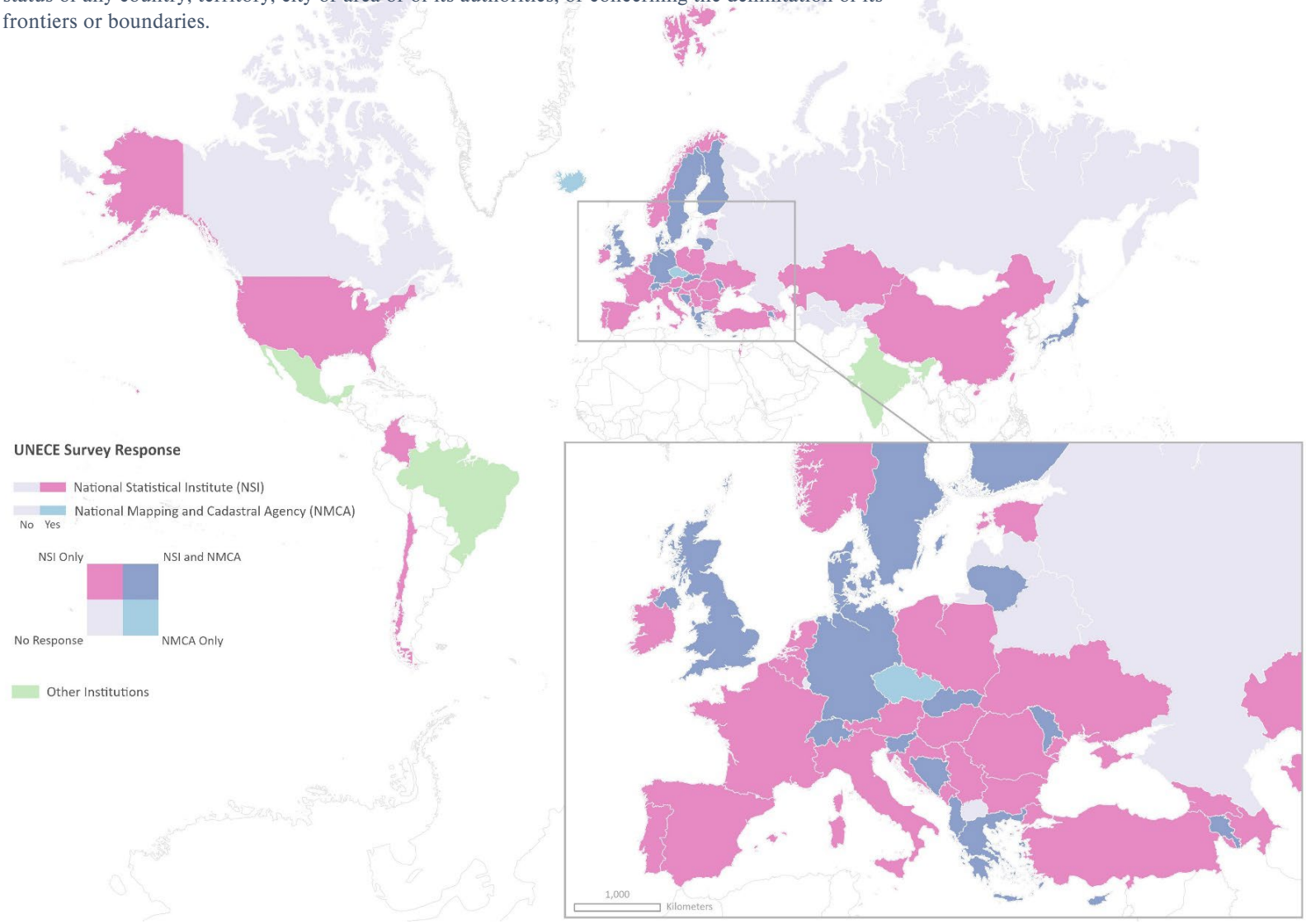


Figure 4: Bivariate map showing UNECE survey responses by organisation type and country location

The results of the UNECE survey have been used, alongside the outcomes of the desktop review, to provide a cohesive overview of the current issues and obstacles to the greater integration of statistical and geospatial information across the UNECE region which is presented in the following section.

IV. ISSUES AND OBSTACLES TO STATISTICAL AND GEOSPATIAL DATA INTEGRATION

A. Governance and Institutions

15. Effective governance, played out through the actions of institutions, has been defined as "participatory, consensus oriented, accountable, transparent, responsive, effective, and efficient, equitable and inclusive and follows the rule of law. It assures that corruption is minimised, the views of minorities are taken into account and that the voices of the most vulnerable in society are heard in decision-making. It is also responsive to the present and future needs of society" (UNESCAP, 2009, p. 1). The value of data to governance practices cannot be understated and forms an important foundation for broader institutional activities that include "setting a common vision; enhancing coherent implementation and coordination; and strengthening the institutional, regulatory, capacity and technical foundations . . . as a means to enhance trust and deliver value" (OECD, 2019a, p. 25). As UN-GGIM (2018, p. 1) note: "Good governance and cooperative institutional arrangements are the first priority in the geospatial information reform agenda. They enable integrated geospatial information challenges to be met head on, provide flexibility to accommodate the rapidly changing environment, and the ability to embrace community and business participation within a culture of digital reform and transformation". The same can be said of statistical and geospatial data integration.

16. At international and regional levels there are already strong governance frameworks in place which bring together institutions who are working cooperatively to drive the greater integration of statistical and geospatial data both globally and across the UNECE region. Europe, in particular, is home to governance and institutional frameworks which stem back over centuries and, consequently, their statistical and geospatial organisations "work in elaborated legal frameworks which have mature and established working methods and use highly specialised technologies that have evolved over many decades" (Eurostat, 2019, p. 3). This broad maturity of governance and institutional frameworks is especially beneficial to the data integration agenda and the organisational structure of the principal governing bodies and institutions related to statistical and geospatial data integration is outlined in Figure 5 overleaf.

17. The United Nations Department of Economic and Social Affairs (UN DESA) is an overarching body which upholds the development pillar of the United Nations, is guided by the 2030 Agenda for Sustainable Development, and is the home of its SDGs (United Nations, 2015). UN DESA provides intergovernmental support to countries in the social, economic, and environmental fields as they look to find commonalities, set standards, and move forward

together. It is the "think tank of the UN", generating, analysing, and compiling a wide range of data and statistics on related themes that enable Member States to assess and tackle

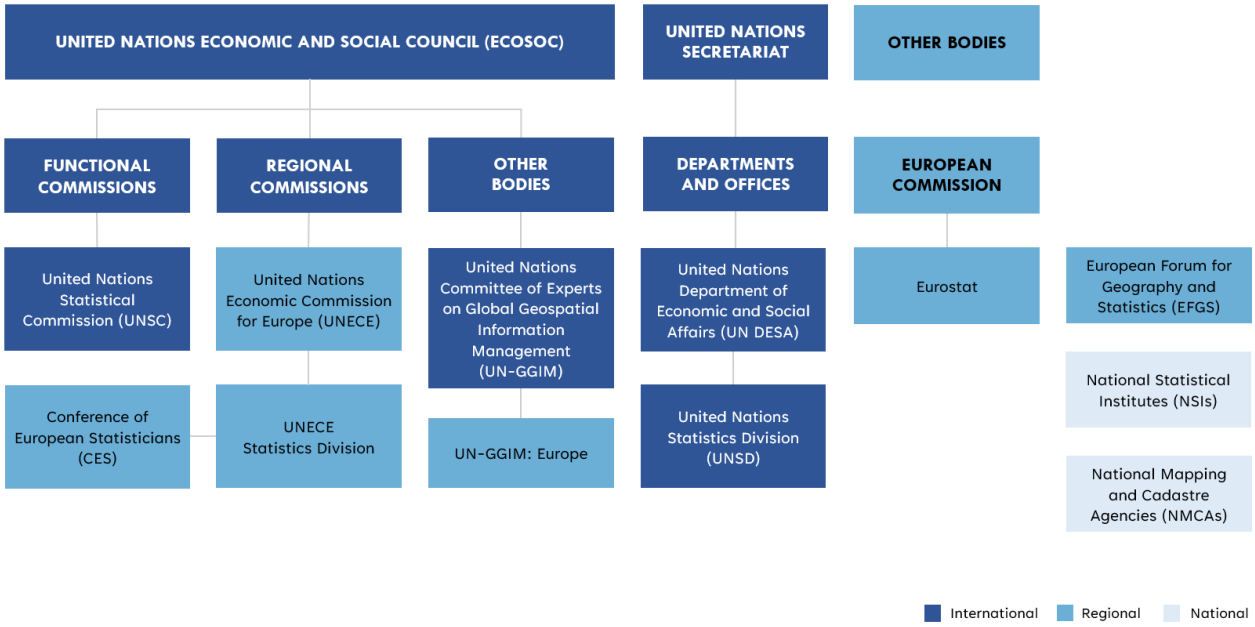


Figure 5: Organisational structure of relevant governance bodies and institutions

common social, economic, and environmental problems. UN DESA also carries out capacity-development work, collaborating with partners to develop innovative approaches, methods, models, and tools to help countries build capabilities that support the 2030 Agenda and the achievement of the SDGs (UN DESA, 2023). The United Nations Statistics Division (UNSD) falls under UN DESA with the aim to advance the global statistical system through the compilation and dissemination of global statistical information, the development of standards and norms for statistical activities, by supporting countries in their efforts to strengthen their national statistical systems, and coordinating international statistical programmes and activities (UNSD, 2023a). UNSD also supports the operation of the United Nations Statistical Commission (UNSC) who forms the highest decision-making body for international statistical activities, oversees the work of UNSD, and is a functional commission of the United Nations Economic and Social Council (ECOSOC) (UNSD, 2023b). UNECE is one of five regional commissions administered by ECOSOC which aims to "facilitate greater economic integration and cooperation among its member countries . . . [and] set out norms, standards and conventions to facilitate international cooperation within and outside the region" (UNECE, 2023a). UNECE's Statistics Division helps national statistical systems meet their data requirements for the 2030 Agenda through methodological guidance, modernisation activities and capacity development. It also provides the secretariat function for the Conference of European Statisticians (CES) which brings together leading statisticians from over 60 countries to drive statistical work in the UNECE region and further afield through the provision of guidelines and recommendations, the setting of standards for statistical production, the global assessment of national statistical systems, and the completion of in-depth reviews to identify and respond to emerging issues such as the capacity to integrate statistical and geospatial information (UNECE, 2023b).

18. In recognition of the growing importance of geospatial information and the need for its global coordination, ECOSOC adopted Resolution 2011/24 in July 2011 to create the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM). UN-GGIM was established as the leading intergovernmental institution to address global challenges regarding the use of geospatial information, acting as a forum for coordination, decision-making and setting direction for the production, accessibility, and use of geospatial information within regional and global policy frameworks (UN-GGIM, 2023a). UNSD acts as secretariat for UN-GGIM which, alongside its supporting role to the UNSC, ensures that it has oversight of, and is central to, the functioning of the two highest governing bodies relating to statistical and geospatial integration. This may help to consolidate and overcome common challenges to the growth of these activities. UN-GGIM has created several functional groups to address specific objectives based on decisions adopted at the annual meetings of the Committee of Experts. Of note is the Expert Group on the Integration of Statistical and Geospatial Information who aims to raise awareness and promote the importance of integrated statistical and geospatial information to support decision-making and policy development across all political levels (UN-GGIM, 2023b). In order to better facilitate development and discussion at regional levels, and bring important regional perspectives to the global stage, UN-GGIM has also established five regional committees. Of particular relevance is UN-GGIM: Europe which was formally established in October 2014 to ensure that Europe's statistical and geospatial organisations, institutions and associated bodies "work together to contribute to the more effective management and availability of geospatial information in Europe, and its integration with other information, based on user needs and requirements" (UN-GGIM: Europe, 2023a). All target countries identified within this project are members of UN-GGIM: Europe, albeit with differing levels of involvement. UN-GGIM: Europe currently has five working groups that focus on topics specific to the region. There are two working groups of relevance here: the working group on Data Integration which focuses on the integration of geospatial data with other information including statistical data; and the working group on the Integrated Geospatial Information Framework (IGIF) which aims raise its profile and relevance to European members as well as support and contribute to related global tasks (UN-GGIM: Europe, 2023b).

19. Also functioning within Europe is Eurostat which is a Directorate-General of the European Commission and the statistical office of the European Union. Through the mechanism of the European Statistical System (ESS), Eurostat provides high-quality statistics and data on Europe in partnership with national statistical institutions and other bodies across Europe. Eurostat also coordinates the statistical activities of the ESS to ensure the quality and consistency of data according to the European Statistics Code of Practice (Eurostat, 2017; 2023a). Eurostat has also been progressing the statistical and geospatial data integration agenda through, for example, activities relating to GISCO, the Geographic Information System of the COmmission, and its associated working group, as well as working collaboratively with the European Forum for Geography and Statistics (EFGS) on the GEOSTAT initiatives (discussed further in section B below). The EFGS has been a forum for cooperation between over 40 states and territories of Europe on the use of GIS and statistics for over 20 years, with activities particularly centred on the development of best practices in

the production of geostatistics in Europe (European Forum for Geography and Statistics, 2023).

20. As has been outlined within the above overview, the integration of statistical and geospatial information sits within a very complex governance landscape composed of a range of stakeholders. Though well-intentioned, the complexity, and potentially competing nature, of actions undertaken by these groups may be indirectly impacting the progression of data integration across the UNECE region. As CES have noted, "without the willingness of an international statistical body to support the consolidation of these activities into a single approach to geospatial statistics, a risk remains that these activities will start to diverse towards discrete silos of work" (UNECE, 2016, p. 29). This may be exacerbated by the lack of an official EU-level mandate relating to the provision of spatial datasets and their integration with statistics (see section B below) as well as a historical lack of cooperation amongst the responsible institutions in the Member States (European Committee of the Regions, 2021, p. 9). The Australian Bureau of Statistics, in their review of national geospatial activities within Member States (Australian Bureau of Statistics, 2013), found institutional arrangements to be strong predictors of the ability to integrate statistics and geospatial information and their survey revealed that such arrangements were highly variable. Across Europe, the traditional, varying and often complex governance and institutional frameworks within which national data providers tend to work can lead to a lack of coordination and common approaches to the integration of statistical and geospatial information at a regional level (Eurostat, 2019). In consequence, this lack of coordination and comparability inevitably hinders understanding of wider issues such as climate change, the energy crisis, and the COVID-19 pandemic. Effective and coordinated governance through binding agreements between institutions and government support is currently lacking which has a strong impact on the greater integration of statistical and geospatial information across the UNECE region.

21. Within the UNECE Survey, the theme of governance and institutions was not considered to be a major hindrance to the greater integration of statistical and geospatial information as the sixth highest impact IGIF theme, with only 34% of respondents rating it as having a high impact on their organisation (Figure 6a). Respondents from target countries considered the theme of governance and institutions to have less of an impact on data integration activities (27%) than non-target countries (37%; Figure 6b). Respondents from NMCAs did, however, consider it to have a much greater impact (50%) than NSIs (29%) which may reflect the relative infancy of the geospatial industry and its more recently established governance frameworks when compared to the statistical profession (Figure 6c). Survey respondents were asked how closely they worked with their national statistical or geospatial counterpart and most respondents noted that their organisations were separate but closely linked (61%), followed by organisations who were separate and not linked (30%). Only 9% of respondent organisations were fully integrated with their statistical or geospatial counterpart. These patterns were broadly reflected across both target and non-target country organisations. Most respondents (67%) had a cooperation agreement in place with their national statistical or geospatial counterpart, followed by 22% who did not, and 11% who were unsure, which suggests that there is a relatively good level of cooperation at national levels. Target country organisations had a marginally lower level of cooperation (60%) than

non-target countries (69%) which indicates there is some room for improvement. While the form and type of cooperation varied from country to country, ranging from legal obligations to ad hoc meetings, the most common cooperation mechanisms consisted of data sharing agreements, memorandums of understanding, and bespoke agreements (e.g. service level agreements). Several organisations are actively working on the development of national cooperation mechanisms to strengthen their governance frameworks, the exchange of information, and the ability to integrate statistical and geospatial information. Only 40% of respondents had a national action plan for data integration in place, followed by 36% who did not, and 18% who were unsure. A much higher proportion of target countries did not have a national action plan in place (53%) than non-target countries (31%) which suggests that stronger support for target countries in this area is required, ideally through the development of UN-IGIF country-level action plans. There were marginal differences across organisation types, with a slightly higher proportion of NSI respondents (38%) not having a national action plan for data integration than NMCAs (50%) and others (50%). Such action plans commonly focused on data integration, National Spatial Data Infrastructures (NSDIs) and data standardisation according to the INSPIRE Directive. Some organisations are also already working on UN-IGIF country-level action plans to strengthen their national data infrastructures which is a promising finding. Overall, the main issues and obstacles to data integration relating to governance and institutions noted by survey respondents included the general lack of holistic data governance mechanisms due to problems with data readiness, data quality, compatibility, and accessibility across national institutions. The value of data integration was also highlighted as not being well-understood at national strategic levels, with the lack of common understanding, shared vision, and mutually supported goals, that would drive the necessary commitment, provision of resources, and recognition of opportunities for institutional cooperation through aligned leadership models and common strategic pathways. More broadly, some respondents considered there was not sufficient visibility on the actions needed to optimise the coordination of the statistical and geospatial communities, through European best practices, and the implementation of international and European standards.

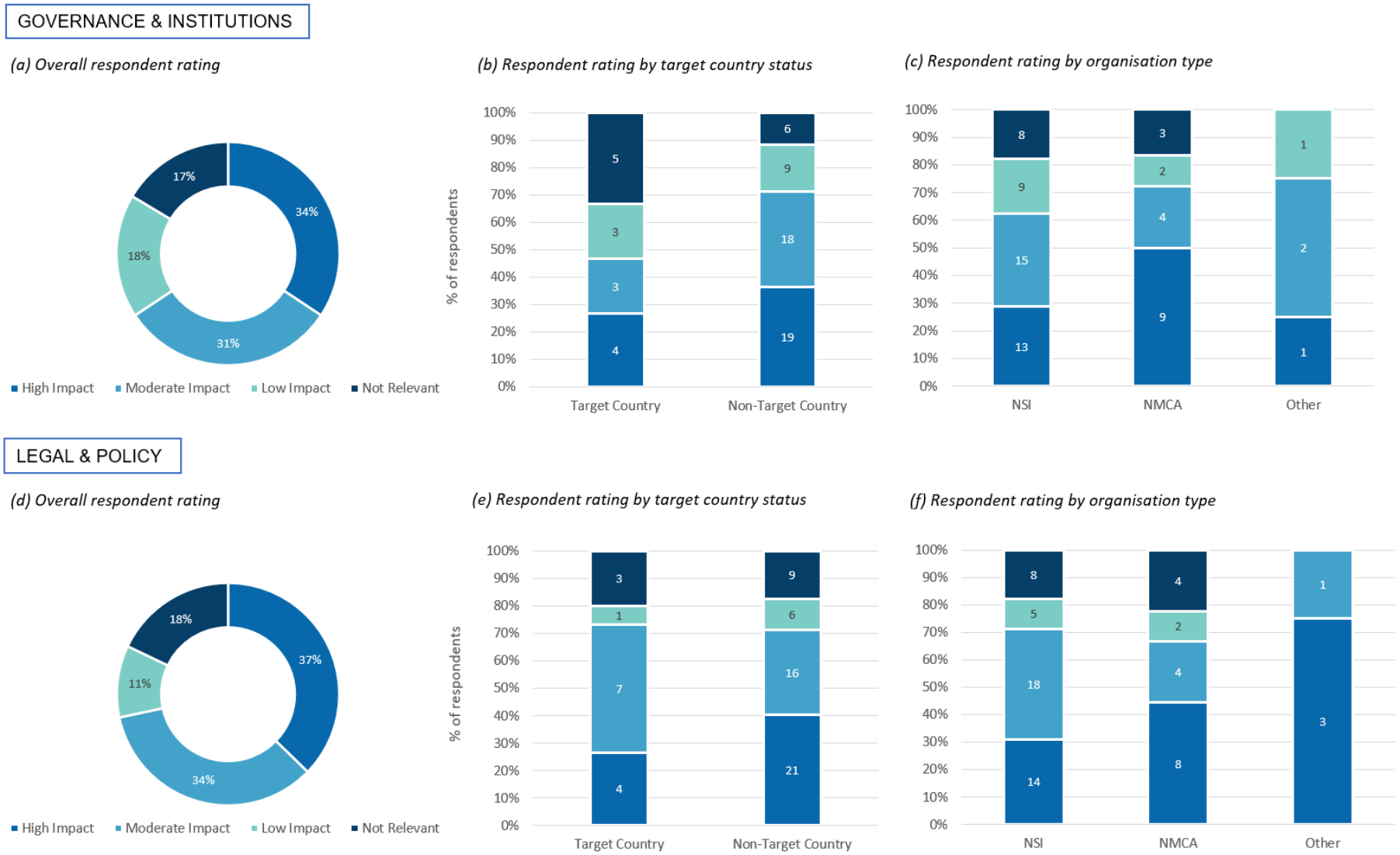


Figure 6: UNECE Survey respondent rating of the impact of Governance & Institutions and Legal & Policy issues on the greater integration of geospatial and statistical data

B. Legal and Policy

22. Legal frameworks transcend national, regional, and international boundaries and act as a foundation for the creation and implementation of effective policies, with political commitment from the highest levels of leadership secured to enact them. At national levels, geospatial and statistical data is critical to informing the development of local planning and investment strategies. Legal frameworks also act to regulate the activities of institutions, setting out their rights, roles, and responsibilities, and holding them accountable when they are breached. The legal frameworks relating to data comprise of the laws and legally binding regulations which govern the provision, use and dissemination of data. Robust legal and policy frameworks are essential to the functioning of data-driven institutions, providing them with a clear mandate to collect and compile data, and use it appropriately to carry out their public tasks. Such frameworks identify and define the data custodians and as well as the roles of government bodies in the data lifecycle, and act as a prerequisite for the creation of authoritative, high-quality data through standardised and comparable processes. At a global level, the Fundamental Principles of Official Statistics was first adopted by ECOSOC in 1994 (E/RES/2013/21) to "ensure that national statistical systems would be able to produce appropriate and reliable data that adhered to certain professional and scientific standards" (UNSD, 2023c). Within Europe, statistical activities are governed by Regulation (EC) No 223/2009 of the European Parliament and of the Council of 11 March 2009 on European statistics which outlines "the basic principles and rules for how the European Statistical System (ESS) should function" (Eurostat, 2010, p. 7). The European Statistics Code of Practice, first adopted in 2005 by the European Statistical System Committee (ESSC), is also used as a "self-regulatory instrument based on 16 Principles covering the institutional environment, statistical processes and statistical outputs" and is described as "the cornerstone of the common quality framework of the ESS (Eurostat, 2017, p. 4). These frameworks act to ensure public trust in the quality, reliability, and confidentiality of reported data through the inclusion of provisions which ensure the protection and non-disclosure of personal data at all stages of the data lifecycle (UNSD, 2014, p. 17). The General Data Protection Regulation (GDPR) (EU) 2016/679, which came into effect in May 2018, is described as "the toughest privacy and security law in the world" (European Union, 2023) and has modernised and harmonised data privacy laws to ensure the greater protection and rights of individuals with respect to their personal data. GDPR plays a central role in the collection, processing, management, and dissemination of both statistical and geospatial data where personal data is incorporated. Over recent years, there has been a growing recognition amongst both the statistical and geospatial communities of the importance of integrating statistics with geospatial information in order to both improve data quality and reveal new insights that can inform decision-making and policy developments at national, regional and international levels (UNECE, 2016).

23. At a global level, the 2030 Agenda for Sustainable Development (United Nations, 2015) has been a driving force for the greater integration of statistical and geospatial data as it requires robust, harmonised data at granular levels of geography for the production and monitoring of SDG indicators "which makes geo-enabled statistics particularly relevant to the

development aspirations of countries" (PARIS21 & Statistics Sweden, 2021, p. 8). In reaction to, and in support of, the 2030 Agenda, UN-GGIM published the Global Statistical Geospatial Framework (GSGF) in 2019 as a key policy development to act as a "bridge between statistical and geospatial professional domains, between NSOs [National Statistical Organisations] and NGIAs [National Geospatial Information Agencies], and between statistical and geospatial standards, methods, workflows and tools" (UN-GGIM, 2019, p. 6). The GSGF comprises of statistical and geospatial data Inputs, five Principles which outline broad processes to enable statistical and geospatial data integration, four Key Elements which facilitate the application of the five Principles, and resultant Outputs that stem from the GSGF processes. The framework was designed to offer "a higher degree of structural harmonisation and standardisation, as well as geospatial flexibility, . . . [and] have an inherently greater capacity for integration based on location and a substantially greater capacity to be further used in more complex statistical data integration" (2019, p. 8). The UN-IGIF (introduced in section I above), first published by UN-GGIM in 2018, was developed to assist countries in the development and enhancement of their own geospatial information management processes. Through an overarching strategic framework, implementation guide, and templates and guides to create and implement country-level action plans, and its seven underpinning principles, eight goals and nine strategic pathways, the framework "creates an enabling environment where national governments can coordinate, develop, strengthen and promote efficient and effective use and sharing of geospatial information for policy formulation, decision-making and innovation" (UN-GGIM, 2018, p. 9). Both the GSGF and UN-IGIF, by design, allow flexibility to ensure that a range of statistical and geospatial capabilities can be accommodated, which is particularly useful for less-developed countries (Van Halderen, et al., 2016). In further support of the 2030 Agenda, and in recognition that the data requirements needed to achieve the 2030 Agenda have not yet been fully realised for a range of issues including the quality and availability of foundational geospatial data, UN-GGIM have published The SDGs Geospatial Roadmap (UN-GGIM, 2021). The roadmap provides "practical guidance for the use of geospatial information for the measurement and monitoring of the SDGs, and elaborates on the vision to see geospatial and location-based information being recognised and accepted as official data for the SDGs and their global indicators, providing practical guidance which enables mainstreaming at any level of global development" (2021, p. 6). It is particularly aimed at statistical organisations in support of the greater integration of data across national data ecosystems where geospatial organisations play a key role. While a global endeavour, the roadmap will further support the data integration agenda also at the national and regional levels.

24. Within the EU, geospatial data is already commonly used in conjunction with regional statistical data in various phases of the policy-making process including "the early stages of policy development building on territorially differentiated scenarios of development as well as Territorial Impact Assessments in an ex-ante setting" (European Committee of the Regions, 2021, p. 2). The European Cohesion Policy 2021-2027, which aims to correct imbalances between countries and regions in order to strengthen social, economic, and territorial cohesion across the EU, also requires detailed and harmonised data across different spatial scales of analysis. The INSPIRE Directive (Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007) established an Infrastructure for Spatial Information in the

European Community (INSPIRE) in order to "create a European Union spatial data infrastructure for the purposes of EU environmental policies and policies or activities which may have an impact on the environment . . . [to] enable the sharing of environmental spatial information across Europe and assist in policy-making across boundaries" (European Commission, 2023). Other initiatives aimed to further develop the ESS (introduced in section A), such as the GEOSTAT projects (European Forum for Geography and Statistics, 2012; 2014; European Forum for Geography and Statistics & Eurostat, 2017; 2019; GEOSTAT 4 and Eurostat, 2021), have been working towards the greater integration of statistical and geospatial data across the EU through the development of common guidelines for grid-based and geospatial statistics for use by national statistical and geospatial organisations. The GEOSTAT 4 project has conceptualised and interpreted the GSGF within the European context to facilitate the framework's regional implementation and is an extremely valuable resource (GEOSTAT 4 and Eurostat, 2021, p. 3). UNECE has also recently embarked on a new project to produce internationally agreed guidance for the next round of censuses in 2030 under a number of key themes including technology, looking at GIS data and related approaches, and geospatial information and small area statistics for censuses which will further promote the data integration agenda within a global update of international guidance for censuses (UNECE, 2023d).

25. While there are clearly very robust and comprehensive legal and policy frameworks in place to govern statistical and geospatial activities at both international and regional levels, there remain both gaps and weaknesses which need to be addressed. Globally, the issue of confidentiality, and compliance with GDPR legislation, has been described as "one of the statistical methods that vexes the minds of many national statistical organisations as they integrate statistical and geospatial information (Van Halderen, et al., 2016, p. 467) for analysis and later release to the general public. Such concerns regarding confidentiality and public perception may be hindering data integration efforts out of fear of potentially negative repercussions. As UNECE have noted, "there is a current shortage of research and documentation within the international statistical community on [disclosure control] and this is an area that will need further consideration to align with the rest of the activities taking place on the integration of statistics and geospatial information" (UNECE, 2016, p. 30). In Europe, data providers are often constrained by traditional, and often complex, legal and policy frameworks, codes of practice and protocols stipulated within national Statistics Acts which may differ from country to country, making coordinated progress in data integration hard to achieve (UNECE, 2017, p. 14). This is compounded by an absence of government support, legislation, and policy frameworks for cooperation between data providers and data integration projects at national levels (Eurostat, 2019, p. 6). At a regional level, it has been recognised that "while integration efforts for statistics provided by statistical authorities is enshrined in the Treaty on the Functioning of the European Union, no such legal mandate exists regarding [the coordinated collection of] geospatial data" (European Committee of the Regions, 2021, p. 1) which impacts the availability of robust, comprehensive and comparable geospatial data to progress the data integration agenda. Within Regulation (EC) No 223/2009, the main legal document governing European Statistics, there is no specific reference to geospatial organisations, although they may potentially fall within the Other National Organisations (ONAs) category. This omission within the legislation, which is also echoed in

other governing frameworks including the European Statistics Code of Practice and the Fundamental Principles of Official Statistics, presents a barrier to greater statistical and geospatial data integration across the region.

26. The recent European Strategy for Data (European Commission, 2020) does not contain any explicit mention of geospatial data, with only a passing mention of the need to evaluate and review the INSPIRE Directive in order to "modernise the regime in line with technological and innovation opportunities". Although the benefits of the INSPIRE Directive to the progression of spatial data integration at the European scale have been great, acting as an impetus to normalise such practices, there are some elements lacking which may constrain the data integration agenda. For example, the Directive is restricted to environmental themes which limit availability of harmonised data for other statistical domains in the social and economic fields of analysis. It also does not require the collection of any new geospatial data, building only on existing Spatial Data Infrastructures (SDIs) managed by Member States. Moreover, the mandatory Implementation Rules of the Directive only relate to data structuring and metadata provisions, with the Technical Guidelines relating to the critical element of spatial data harmonisation remaining as non-binding guidelines. Thus, the actual implementation process may vary from country to country as national legislative constraints and differing levels of capacity regarding spatial data collection hinder the greater comparability and interoperability of these spatial datasets. This, in consequence, also impacts the statistical and geospatial data integration agenda (European Committee of the Regions, 2021, pp. 16-17). By failing to bring geospatial data into mainstream view within statistical legal and policy frameworks, "the current EU-level framework is not strong enough . . . thus spatial data is oftentimes limited to supplementary information for qualitative assessments or confined to small geographical areas" (European Committee of the Regions, 2021, p. iii) and the opportunity and drive for greater data integration has not been realised.

27. Within the UNECE Survey, legal and policy concerns were not viewed to be a major hindrance to the greater integration of statistical and geospatial information, with only 37% of respondents rating it as having a high impact on their organisation, the fifth highest impact theme overall (Figure 6d). Again, legal and policy frameworks had less of an impact within target countries (27%) than non-target countries (40%) who ranked it as the third highest impact on data integration (Figure 6e). NMCA respondents considered that legal and policy issues had a higher impact on data integration (44%) than NSI respondents (31%) which may again reflect different maturity levels across the different disciplines (Figure 6f). To gain a perspective on the level of utilisation of international initiatives, survey respondents were asked about their plans to implement the GSGF nationally. Only 11% of respondents stated that they fully implemented the principles of the framework and 31% partially implemented them, with most respondents (36%) having no current plans to. A much lower proportion of target countries were fully implementing (7%) or partially implementing (7%) the GSGF than non-target countries (19% and 38% respectively), suggesting that much greater efforts are needed by the international community to support target country engagement with the GSGF and related policies, including the UN-IGIF (UN-GGIM, 2018), given all their benefits to data integration. Some respondents noted that they are in the process of examining the GSGF framework and carrying out suitability analysis for their national data infrastructures. Others

noted that their own separate national policies were very similar to the GSGF model and, in essence, could already be aligned to it. Some respondents noted the GSGF Europe policy documentation from the GEOSTAT4 project, with one country going a step further with plans to create a national GSGF. This is an extremely interesting development which, if successful, could form part of a nested framework of GSGF adoption from the international to regional and national levels. Respondents were also asked whether they currently used geospatial data to support the fulfilment of the 2030 Agenda, with most (58%) stating that they did. This figure was much lower in target countries (40%) than non-target countries (63%). The use of geospatial data was also lower in NSI organisations (53%) than NMCAs (61%), although to a lesser degree. Respondents discussed their use of geospatial data to calculate several SDG indicators (e.g. 11.7.1, 15.4.1, 15.4.2) with a number of organisations cooperating nationally on this process, whether by playing an active or a supportive role through data sharing. One respondent, however, highlighted the lack of national working groups on the integration of geospatial and statistical information for the 2030 Agenda as an obstacle. It is clear that promoting data integration through the wider policy lens of the 2030 Agenda could prove fruitful, including the greater promotion of The SDGs Geospatial Roadmap (UN-GGIM, 2021) particularly within target countries which may help to improve rates of adoption. While legal and policy concerns were not a major obstacle to greater data integration overall, common issues noted by respondents included the lack, or outdated nature, of legal or policy frameworks that could support fully integrated data ecosystems at national levels. Data accessibility was also a concern for some respondents who noted that legal and licensing restrictions posed a problem, particularly around the use of microdata. The greater promotion of policies relating to high-value datasets and open data may also prove to be beneficial, particularly if linked to legal and policy developments around national spatial data infrastructures.

C. Financial

28. Government activities have been estimated to account for nearly half of the global economy (ICAEW, 2018) and effective financial management is critical to the provision of resources that meet the needs of individuals, groups, and organisations, while providing room for sustainable growth. National statistical and geospatial organisations require adequate financing to operate effectively and achieve their legal mandates and organisational objectives. Typically, as public sector bodies, national statistical and geospatial organisations are affected by how well the common principles and frameworks of effective financial management are applied by national governments. Moreover, a country's level of development will also have a strong impact on the financing of its national statistical and geospatial activities. A study by PARIS21 (2018) on the sustained financing of national statistical systems, for example, highlighted that many low- and middle-income countries in particular are rarely able to produce timely, appropriate and accessible statistical data due (in part) to "an inability to attract adequate funding . . . [which] in turn, exacerbates the difficulties statistical systems face in fulfilling their mandate" (2018, p. 8). Through their study of a range of country experiences, they identified the following factors as important to the construction of well-financed statistical systems: the demand for statistics; a high level of national political interest; donor alignment with government strategies; legal autonomy; the alignment of

national statistical strategies with country development plans; and strong coordination between statistical stakeholders (2018, pp. 4-5). The same factors can also be applied to the effective financing of geospatial organisations. While most NMCAs have long histories of spatial data capture for the production and maintenance of topographic maps, for example, the level of investment provided by governments in support of developing geospatial approaches and new products is highly variable. As UN-GGIM (2022a, p. 1) note, "investment will typically be realised [only] when governments can see evidence that geospatial information will deliver social, environmental and economic benefits nationally, and there is a corresponding and credible financial plan to release these targeted benefits". They see the compatibility of business models with government fiscal policies and funding approaches, the identification of opportunities, partnerships and investment priorities that align to national strategic and policy objectives, justified investment and financial management strategies to implement those investments, and benefits realisation through the reliable measuring, monitoring and evaluation of geospatial activities, as key to strengthening the financial resourcing of geospatial activities at national levels (2022a, p. 2).

29. Actions to progress the greater integration of statistical and geospatial information are particularly affected by variable levels of financial resourcing across the UNECE region. This principally relates to the specific investment needs of individual countries, the availability of funding sources (or lack thereof) at national, regional and international levels, the applicability of business models to wider political agendas, and the breadth, scope and strength of financial partnerships (UN-GGIM, 2018, p. 22). Eurostat have noted that across Europe, for example, there is a "lack of economic funding and political incentives to transform business models and data provision supporting data integration" (2019, p. 6). Data integration activities will inevitably require investment in IT infrastructures, including secure server (or cloud) components that can handle large volumes of data, database management software, ETL (Extract, Transfer and Load data processing operations), licences for analysis and visualisation tools, and secure (largely web-based) data sharing and dissemination platforms. The scale of infrastructure development required, and the extent of its associated cost, will entirely depend on the current infrastructure setup and the appropriateness of licensing agreements already in place within organisations. The procurement of data from external sources may also be required which can incur additional licensing costs, which can sometimes be considerable if no data sharing agreements are in place with data providers. Even where data is freely available, its quality and accuracy will have to be assessed which also incurs additional costs, particularly for the generation of internationally comparable small area data. The financial cost of allocating staff time and resources to progress data integration activities, including research and development, testing, and evaluation, as well as the roll-out of procedures to business-as-usual operations, can also be high. Thus, data integration activities may have considerable start-up costs, as well as ongoing operational and maintenance costs, which may act as a barrier to their implementation at national levels, despite their clear and likely return on investment through increased efficiency of practices (UNECE, 2017, pp. 15-16).

Within the UNECE Survey, financial issues were identified as having the highest overall impact on the integration of geospatial and statistical data, with 54% of respondents ranking it as high impact (Figure 7a). The level of impact was drastically higher for target countries

(73%) than non-target countries (48%), suggesting that the lack of adequate financial resources and sustainable funding models are seriously limiting the progression of data integration activities within those countries in particular (Figure 7b). The level of impact was relatively similar for NSIs (56%) and NMCAs (50%) which indicates that this is a broad, cross-discipline issue that requires urgent consideration (Figure 7c). Respondents noted the lack of financial support, both through the appropriate allocation of government funding and the lack of investment by international and EU donors, as the biggest financial obstacle to data integration. It was noted that this issue would only be compounded by the effect of future planned budget cuts at some government levels which threaten the sustainability of the systems and technical infrastructures which underpin effective data management practices across the data lifecycle. One respondent highlighted the issues associated with the lack of financing for the creation and maintenance of their NSDI, particularly regarding the implementation of national and international standards on their primary geospatial datasets. Another noted that part of their organisational budget came from custom work packages from government and private organisations, but the overly bureaucratic procedures required to get such work funded required lot of staff time and resource that could be better spent elsewhere. Several respondents also highlighted the importance of, and need for, adequate investment in staff training to ensure highly qualified staff could contribute effectively to data integration activities. Also of importance was the ability to fund and maintain innovative hardware and software packages and the efficiency gains they could bring. Overall, as one participant aptly summarised, there is a need for decision-makers to understand the benefits of data integration for society and the related need for sustainable funding resources to carry out the necessary work and raise the capacity of key institutions and the qualifications of its staff. Thus, new financial models are required which should be based on investment needs and incorporate sustainable funding sources for the delivery of integrated statistical and geospatial information management.

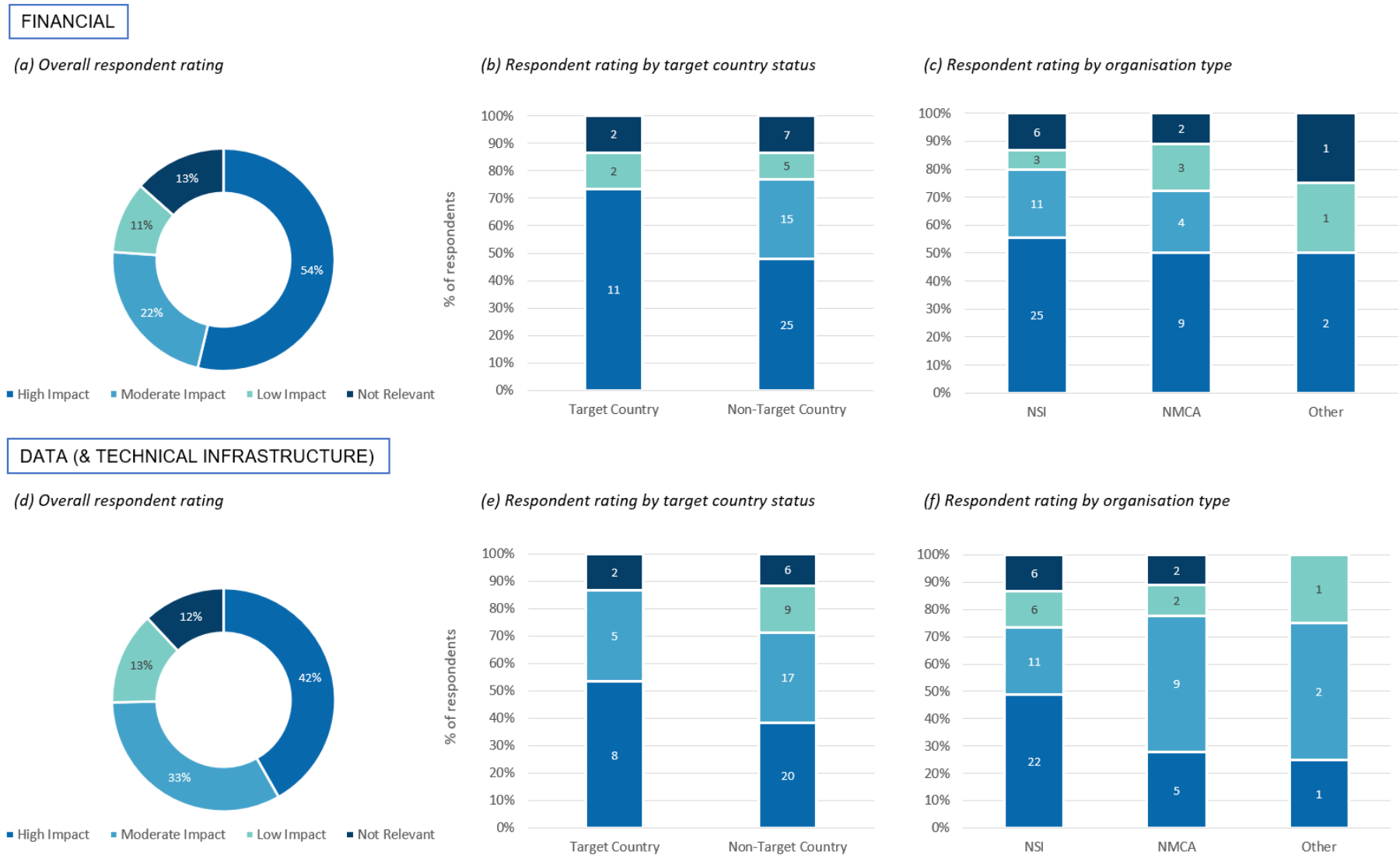


Figure 7: UNECE Survey respondent rating of the impact of Financial and Data (& Technical Infrastructure) issues on the greater integration of geospatial and statistical data

D. Data (& Technical Infrastructure)

30. The availability of accurate, comprehensive data at an appropriate level of detail and temporality is critical to effective strategic planning, decision-making and policy development at national, regional, and international levels. Data is also a mechanism for informed dialogue across different levels of government and between different sectors of society and can be used as a means of integrating a range of perspectives (OECD, 2023a). On a global scale, society is becoming ever more data-driven with more than 2.5 quintillion bites of data being generated every day. By utilising appropriate digital technologies and methodological frameworks to collect, analyse and interpret data, real actionable insights can be obtained. Data-driven decision-making has many benefits: organisations can make more informed decisions which allow them to fully commit to particular strategies or visions whose impact can be regularly measured and monitored; organisations can become more proactive in their decision-making processes by detecting and reacting to threats at an early stage as well as identifying opportunities for sustainable development; and data creates value which, in turn, can lead to operational cost-savings in the longer term (Harvard Business School, 2021). Not only is the quality of data important, but also the strength of the technical infrastructure which underlies its creation, management, use, and dissemination within and across organisations. A strong data infrastructure will ensure 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.

31. Yet, these benefits have not yet been fully realised as the World Bank (2019) notes: "even as new technology makes more data and wider uses of data possible, there are still many blank spaces on the global data map", a phenomenon which has been aptly termed "data deprivation". This inequity can only be remedied through a coordinated data revolution, "exploiting advances in knowledge and technology, utilising resources for capacity development, and improving coordination of efforts among key actors to mobilise sustainable development" (World Bank, 2015). Data plays a central role in the 2030 Agenda and the ability to fully implement and monitor progress on the SDGs. While both the quality and availability of data has been growing over recent years, in general it has been noted that "statistical capacity still needs strengthening and data literacy must be enhanced at all levels of decision-making" which will "require coordinated efforts on the part of data producers and users from multiple data systems. It will also demand innovative ways to produce and apply data and statistics in addressing the multifaceted challenges of sustainable development" (UNSD, 2017). The role of geospatial data in the implementation of the 2030 Agenda and its importance to the SDGs has also been recognised: "while official statistics are the foundation on which the SDGs are built, the SDGs cannot be fully realised using official statistics alone, particularly when they are not produced in sufficient quality, detail, and frequency. In fact, the SDGs are highly dependent on the understanding of geographic location" (UN-GGIM, 2021, p. 2).

32. The quality and accessibility of statistical and geospatial data, and the strength of the technical infrastructure that supports its creation, management, and use, is also central to the data integration agenda. In their global programme review of geospatial capabilities and

capacity within national statistical organisations, the Australian Bureau of Statistics (2013) found a strong growth in demand for geostatistical information as well as a consensus on the benefits of linking socio-economic data to a precise geographic location. More recently, a GEOSTAT 4 survey (Mostrom, 2020) revealed that around 50% of countries do have a strong and sustainable data infrastructure that could support the integration of statistical and geospatial information (European Committee of the Regions, 2021, p. 42). Also at a global level, it has been recognised that advances in the integration of statistical and geospatial data "have benefitted from the availability of powerful geospatial tools that enhance the value and usability of official statistics by leveraging the application of the spatial context (PARIS21 & Statistics Sweden, 2021, p. 11). Recognition of the benefits of grid statistics has also increased, largely on account of the work of the GEOSTAT 1 project and the development of a European GEOSTAT 2011 grid dataset (European Forum for Geography and Statistics, 2012; 2014) which has been applied to a range of statistical indicators, for example, the European Environment Agency's heating and cooling degree days indicator (European Environment Agency, 2021). The INSPIRE Directive has also brought the importance of metadata, and its uniform structure, to the fore in the management of spatial datasets, providing definitions and lists of categories to describe the content, data type, and usage (INSPIRE, 2013). As UNECE (2016, p. 3) have highlighted, there is also the "prior existence of flexible frameworks for the modernisation of official statistics that can be adapted to include geospatial information with little impact on the existing organisational structure". For example, UNECE's (2019a) Generic Statistical Business Process Model (GSBPM) has recently been enhanced to include a geospatial perspective, appropriately termed GeoGSBPM (UNECE, 2021a). Whilst there has clearly been good progress made at global and regional scales to highlight and support the development and maintenance of high-quality data and robust technical infrastructures, there remain a range of data-related issues which hinder the greater integration of statistical and geospatial information at national levels.

33. It is clear from the literature that universal access to geospatial data of sufficient quality, accuracy, granularity, and currency is a major hinderance to the progression of data integration. Accurate and comprehensive address data is central to this process as it underpins the operational design, planning and delivery of statistical surveys and censuses, as well as their analysis and the many statistical outputs generated from them. As the UK's Office for National Statistics (2021) note, "accurate geographical referencing is vital to making such data compatible and comparable with existing datasets and outputs. Similarly, departments across government and the public sector find themselves in need of standardising the geographical information across their datasets to enable them to deliver better insight, services or policy outcomes". Yet, the availability and quality of address data is highly variable across the UNECE region which limits the ability to implement standardised processes and methodologies for data integration. According to the GEOSTAT 2 survey (European Forum for Geography and Statistics & Eurostat, 2017), one of the primary reasons is the inability to conduct basic geocoding exercises due to a lack of high-quality geospatial data. The GEOSTAT 4 survey (Mostrom, 2020) further highlighted the variability of data quality and currency across Europe, particularly regarding the completeness of spatial databases and compliance with international standards. By and large, the collection and maintenance of address data and other relevant geospatial information is the responsibility of national

geospatial organisations. In consequence, statistical organisations have little control over the collection of such data and may face access restrictions or high costs to acquire it. This is particularly prevalent within developing countries where financial restrictions and a lack of investment limits the capabilities of geospatial organisations to produce and maintain high-quality data. As UNECE (2016, p. 20) highlight: "Addressing these access and capability issues are particularly important from the perspective of developing countries so that they can effectively contribute to and benefit from . . . geospatial data and information within the context of the SDGs and their own development objectives". Where geospatial data is available, accessible and of sufficient quality, there may be further issues. For example, its level of granularity may not be sufficient, its coverage may be different to requirements, or its temporal extent may not coincide with the statistical reference period (UNECE, 2017, pp. 17-18). A lack of sufficient metadata may also restrict the ability to assess the suitability of geospatial data for certain statistical purposes which can cause further difficulties, particularly where data is translated between different reference systems. In consequence, the 10-year population censuses typically remain the main source of statistical information in many countries meaning that policy decisions are being based on outdated data (Eurostat, 2019, p. 5).

34. The integration of geospatial data within statistical processes for the generation of small area data may cause further problems. If not carefully managed, increasing the resolution of output statistics may also increase the risk of disclosure of sensitive data which has clear implications for data protection (see section B). Conversely, certain types of geospatial data may only be captured at lower resolutions which cannot be sufficiently disaggregated for small area statistics. As UNECE (2016, p. 31) note, "this is in conflict with the requirement of NSIs to publish their data at lower levels such as the SDG principle that 'nobody gets left behind'". Even when the spatial resolution of statistical and geospatial data can be aligned, the ability to join data based on attribute information may be hampered by the omission of unique identifiers within statistical and geospatial databases, such as Unique Property Reference Numbers (UPRNs) which have been advocated for use across the UK by the Geospatial Commission (2020) and mandated by the Open Standards Board. In consequence, large amounts of data cleansing may be required prior to data alignment. The broader harmonisation of data across country boundaries is even more difficult to achieve: "Due to their elaborated information systems, national data providers think and work separately according to their own needs" (Eurostat, 2019, p. 3), which is compounded at administrative levels due to their diversity of functions and the variable criteria that they comprise. UNECE (2016, pp. 20-21) have highlighted the unstable nature of administrative geographies due to legislative boundary revisions which cause difficulties for time-series and grid-based analyses. The use of spatial analysis and geostatistical processes to inform and enhance statistical reporting is also considerably underutilised within statistical organisations due to a lack of technical understanding, access to geospatial software packages such as QGIS, Esri ArcGIS or the spatial components of R, and the relevant technical experience to utilise them. Whilst there has been some support, for example, the *Handbook of Spatial Analysis* produced by the National Institute of Statistics and Economic Studies (INSEE, 2018) in collaboration with Eurostat and EFRS which utilises the spatial components of R, mapping within statistical organisations "almost exclusively consists of simple choropleths even where

these are not the most appropriate mapping techniques" (UNECE, 2016, p. 31). The dissemination of statistical outputs that incorporate geospatial components are best deployed through interactive web applications and geoportals, however, these can be difficult to deploy as they generally require specialist knowledge of programming languages, such as HTML, CSS, and JavaScript, to build them, particularly when using open-source platforms such as Leaflet and OpenLayers, and GeoServer. With targeted support, more complex spatial analysis processes and dissemination strategies can be realised by statistical organisations.

35. Within the UNECE Survey, data and technical infrastructure issues were ranked as having the third highest impact on the integration of geospatial and statistical data, with 42% of respondents rating it as high impact (Figure 7d). The level of impact was much higher for target countries (53%) than non-target countries (38%; Figure 7e) and, similarly, for NSIs (49%; Figure 7f) than NMCAs (28%). This clearly indicates that more efforts are required to support data integration activities within NSIs, particularly in the target country areas. NSI respondents were asked how often they used geospatial data within their workflows and the majority often used geospatial data (53%). 18% of respondents always used geospatial data in their workflows which is promising though could be improved. Only one NSI respondent never used geospatial data. A much lower proportion of respondents from target countries always or often used geospatial data within their workflows (45%) in comparison to non-target countries (79%) which further emphasises that greater support is required to improve their uptake. Respondents noted a broad range of uses for geospatial data within statistical processes, with the most common relating to census operations as well as geocoding, spatial analysis, and dissemination activities. Several respondents also discussed their production of grid statistics, particularly in relation to population and age information. NSIs were also asked whether they incorporated, or were planning to incorporate, geospatial data or approaches within the 2020 census round, of which most respondents (84%) did. The most common uses of geospatial data within census operations comprised of the geocoding of address data for building and dwelling registers, the production of enumeration areas, the monitoring of data collection and census progress, and the creation and dissemination of grid statistics (primarily at the 1 kilometre-squared grid level but as high as 100 metres-squared). However, the proportion of target countries organisations using geospatial data within their census activities was vastly lower (55%) than for non-target countries (94%), again suggesting the need for much greater efforts to support and promote the benefits of integrating geospatial data within census processes. NMCAs were asked how often they used statistical data within their workflows and again most respondents often used statistical data (50%). Only one respondent always used statistical data within their workflows and 28% never used it, indicating that data integration activities are less prevalent in NMCAs than NSIs. Interestingly, a higher proportion of NMCA respondents from target countries always or often used statistical data (75%) than non-target countries (50%) which is something that should be explored further. Common uses of statistical data within geospatial activities included in data production and management processes, thematic map production particularly using population and census data, and spatial analysis using demographics and deprivation indices to inform policy development and emergency preparedness and response. All respondents, whether NSI or NMCA, had access to some form of GIS software which is promising, with the most popular being commercial Esri ArcGIS software (37%) followed closely by open-source QGIS

software (34%). Most respondents (with the exception of three organisations) had access to one or more statistical software packages, the most common being Microsoft Excel (28%), R (20%) and Python Statistics Libraries (15%). It is clear, therefore, that access to geospatial and statistical software does not seem to be a major impediment to the progression of data integration activities. Rather, respondents 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 resulting in 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 and secure technical infrastructures and standardised procedures. Limitations in hardware and software components, particularly relating to performance issues, the need for major system upgrades and additional servers, as well as support for dedicated software packages, were further impacting the ability to progress data integration activities. In many ways, the issues and obstacles cited above are very much a consequence of the financial issues discussed in section C as well as the lack of appropriate standards for data harmonisation (discussed further in section F below). A multi-faceted approach is likely to be necessary to ensure that data, and the technical infrastructure it sits within, is a suitable for data integration activities that are sustainable into the future.

E. Innovation

36. Innovation has become increasingly important to governments as growing digitalisation of business processes is driving the digital transformation of public services to meet the evolving needs of citizens. However, most governments have been unable to keep pace with such change and are "locked in a game of catch-up, with citizen trust and business confidence in the balance" (OECD, 2019b, p. 13). This inability to keep pace is compounded by the growing number of challenges faced by governments such as the effects of climate change, increasing financial inequalities, the energy crisis, and political conflict. The pace and complexity of these challenges is likely to continue to grow and government practices and policies will need to keep up with this changing landscape. A report from the World Bank Group (2016) highlighted the importance of strengthening, scaling up and replicating innovation capacity, particularly in countries that have experienced rapid change. They outline five principles which may be used to promote innovation and entrepreneurial practice at national levels: public investment in research and development; the growth of science, technology and innovation capabilities; the strengthening of partnerships between public research and development and private sector users of technology; the creation of strong enabling environments which include the effective use of information and communication technologies; and the provision of flexible financing arrangements to encourage entrepreneurs to develop new products, processes and services (2016, pp. 46-47). Emerging technologies are also evolving at pace which may have strong value-propositions to the public sector. Government awareness and adoption of these technologies has been slow, resulting in the continued delivery of outdated and ineffective programmes and services which negatively impact wider society and the economy. The 2030 Agenda does, however, provide an opportunity for governments to modernise their systems and functions by "helping to break

down silos at an international level, pushing countries and cities to innovate in order to achieve the most ambitious, diverse and universal initiative in history" (OECD, 2019b, p. 14).

37. Data-driven innovation has risen to prominence in recent years as the growth of web-based technologies and decreasing costs of data collection, storage, and processing (in comparison to more traditional technologies) has led to the generation and use of large volumes of data. Such data is becoming "a core asset in the economy, fostering new industries, processes and products and creating significant competitive advantage" (OECD, 2023b). Given their data-centred remits and functions, data-driven innovation is highly applicable to both statistical and geospatial organisations in order to keep pace with changing demands. As UNECE (2019b) note, "only with creative thinking can statistical offices constantly improve efficiency and produce more interesting, valuable products . . . [including] cutting-edge ways of gathering information; state-of-the-art technologies and statistical techniques to process data and generate statistics; new approaches to recruitment and to structuring an organisation; [and] inventive ways of publishing data and reaching all kinds of audiences". The same can be said for geospatial data innovation which currently includes the development of digital twins to serve as fully connected and immersive digital environments, the integration of Geographic Information Systems (GIS) and Building Information Modelling (BIM) in order to streamline and enhance building-level information, and the application of Artificial Intelligence (AI) and Machine Learning (ML) technologies to geospatial data to uncover deeper insights that ever before. Ongoing efforts to modernise official statistics by UNECE, Eurostat and others are driving the innovation agenda by promoting and facilitating the integration of new data sources, including geospatial data, Earth Observation (EO) data and big data within national statistical systems. UNECE (2016, p. 16) have found that a growing number of statistical organisations are embracing modernisation opportunities through the development of novel approaches to the management, processing and analysis of geospatial data, in tandem with broader activities to modernise their infrastructures, policies and training programmes. The COVID-19 pandemic also provided a unique opportunity, and motivation, for organisations to innovate at pace out of necessity as "compelling examples of the endurance of effective geospatial infrastructures emerged . . . [and] NSOs demonstrated how statistical-geospatial integration can support emergency decision-making amid the unprecedented impact of a pandemic" (PARIS21 & Statistics Sweden, 2021, p. 7). Innovation in statistical practice is a central theme within a new multi-year project being led by UNECE to create coordinated and internationally agreed guidance for the implementation of the 2030 round of censuses by acknowledging increased digitalisation and the need to harness new methods and technologies to adapt to changing requirements. Another theme, that of geospatial information and small area statistics for censuses, provides a further opportunity to progress innovation through data integration (UNECE, 2023c). There are, however, various issues and obstacles that continue to hinder data-driven innovation and integration in official statistics which have been discussed in other sections of this paper, such as legal restrictions, access issues, technological challenges, financial constraints, and capabilities. UNECE (2016, p. 12) note another major challenge to the data integration agenda is in "understanding the trade-off between the near real-time and highly granular insights offered . . . against slower, less granular, but more robust survey-based methods with measurable error characteristics".

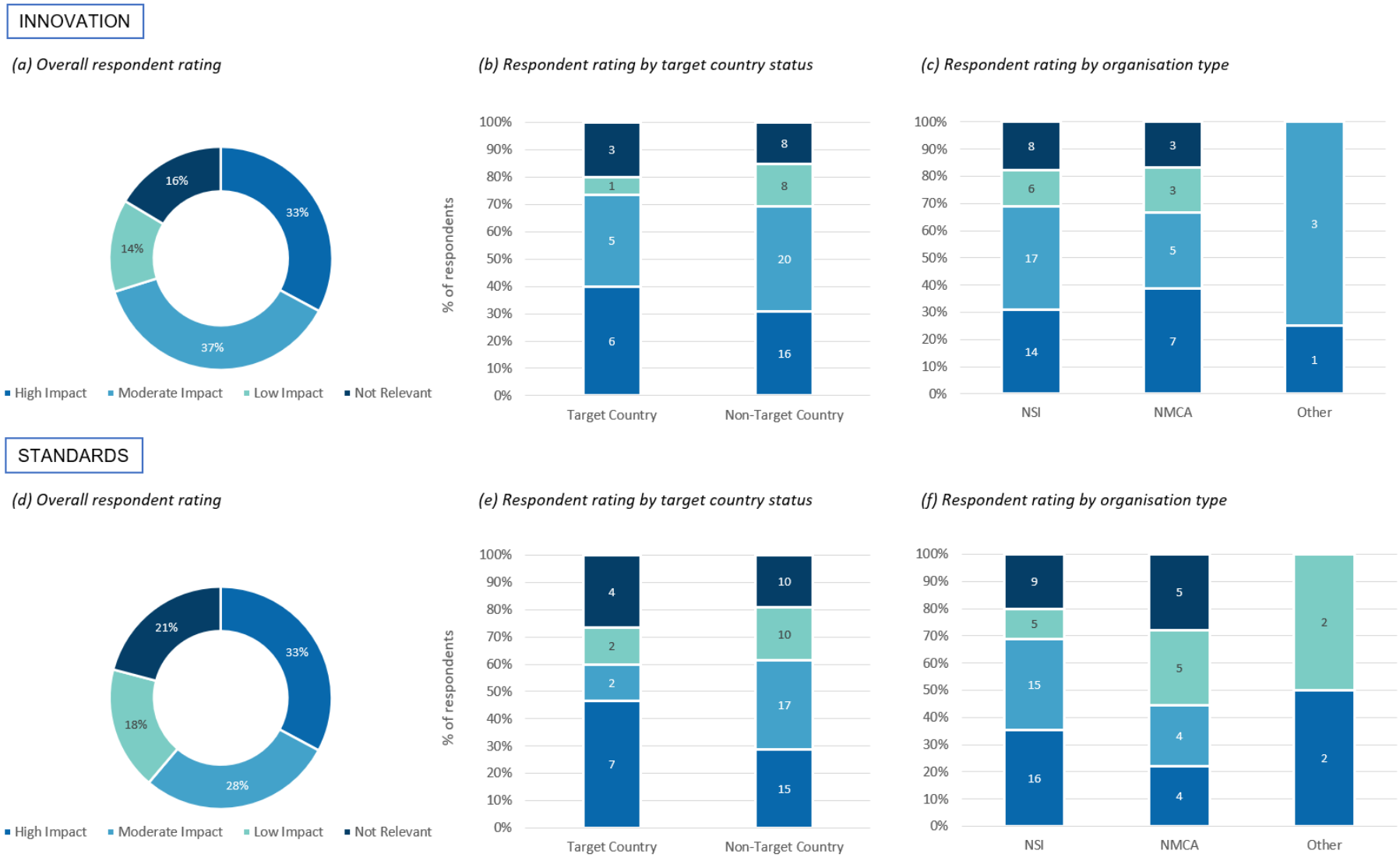


Figure 8: UNECE Survey respondent rating of the impact of Innovation and Standards issues on the greater integration of geospatial and statistical data

Without the ability or willingness to support the development of novel processes and the adoption of new technologies and methods, due to the perceived risks associated with them, the lack of organisational capacity to undertake such activities, and the absence of strong financial incentives, many statistical organisations will remain on the wrong side of the digital divide which will hamper the ability to produce the harmonised, comparable, and interoperable data needed at international levels to achieve the 2030 Agenda.

38. Within the UNECE Survey, most respondents considered that innovation had a moderate impact on the greater integration of geospatial and statistical information (37%), with the joint lowest high impact rating across all the UN-IGIF themes (Figure 8a). A slightly higher proportion of target country respondents rated innovation as high impact (40%) compared to non-target country respondents (31%; Figure 8b). Similarly, a larger proportion of NMCA respondents rated innovation as high impact (39%) compared to NSI respondents (31%), suggesting that obstacles to innovation may be having a greater effect on NMCA organisations particularly within target countries (Figure 8c). Respondents noted the lack of knowledge, skills, and expertise as a key limiting factor to innovation around data integration as the expert knowledge and experience required to implement new technologies and processes was missing. Respondents also highlighted that the inadequate provision of financial and human resources were limiting opportunities to undertake innovative initiatives beyond business-as-usual practices. Also hindering innovation was a lack of exchange of experiences between domains, communities, data providers and data users. The survey feedback suggests that while there is a willingness to utilise new technologies like Artificial Intelligence and Machine Learning, and new data sources such as Earth Observation and Big Data, the necessary resources, training programmes and IT infrastructures required to support their adoption are lacking. With limited resources and a lack of initiatives or incentives to develop and adopt innovative solutions for data integration, organisations remain slow to adopt new technologies and processes. It is clear that the issues and obstacles to innovation within the context of data integration are very much linked to the broader financial and capacity and education issues discussed in sections C and H respectively. Only by cohesively addressing these wider issues can innovation be given the room to grow and help organisations to keep pace and thrive within our modern landscape.

F. Standards

39. Standards ensure that producers and consumers of products and services are confident of their safety, quality, and reliability. Data standards are an important element of good government practice, given the significance of data-driven decision-making in policy development. As the Data Standards Authority note, “data standards 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, there has been an inconsistent approach to the adoption of standards across different parts of government, and it has been common for different areas to adopt different standards, or even create their own to meet their specific needs or challenges. In consequence, government practices can be inconsistent at national levels, with the resulting datasets incompatible for

sharing and re-use. As national borders are crossed and data-driven decision-making and policy development is required at regional and global scales, these problems are only compounded further. To reap the benefits of consistent standards adoption, governments must improve coordination through the sharing of knowledge and best practice, develop and deliver clear strategies that address cross-government user requirements, and centralise the implementation of data standards through, for example, national mandates. In doing so, governments can ensure that data is of high quality, is accessible, interoperable, and comparable which, in turn, will promote the reuse of data without the need for time-consuming data engineering tasks. This will drive greater collaboration, generate new insights, improve the speed and effectiveness of change management processes, and the development of new solutions (Data Standards Authority, 2021).

40. As authoritative data providers, standards are crucial to the effective functioning of national statistical and geospatial organisations. As introduced in section A, the UNSC is responsible for the setting of statistical standards and their implementation at national and international levels. They are supported by the UNSD, for example, in the promotion of the Fundamental Principles of Official Statistics (UNSD, 2023c) and its global adoption. Within Europe, the European Statistics Code of Practice (Eurostat, 2017) is a quality framework which sets the standards for the development, production, and dissemination of European statistics (Eurostat, 2023a). UNECE also works with the High-Level Group for the Modernisation of Official Statistics (HLG-MOS) to create, implement and enhance standards for statistical production, with a particular focus on standards for metadata. In doing so, UNECE aims to ensure 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, 2023b). They have developed a series of models to support standardised statistical operations including: the Generic Statistical Business Process Model (GSBPM) with 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, 2019c); Common Statistical Production Architecture (CSPA) which acts as a practical link between the two former standards 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, 2019d).

41. From a geospatial perspective, the use of standards is equally as important as a mechanism to ensure data quality, harmonisation and interoperability, with activities led by the Open Geospatial Consortium (OGC) and the International Organisation for Standardisation (ISO) Technical Committee 211 Geographic Information/Geomatics (ISO/TC 211) in particular. There are a broad range of geospatial standards which fall into three general categories: data, services, and metadata. Data standards, which include 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 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 OGC, in collaboration with the ISO/TC 211 and the International Hydrographic Organisation (IHO), has recently developed the third edition of the UN-GGIM (2022b) guide on the role of standards in geospatial information management, which includes a focus on interoperability with other systems and data source that will prove especially useful to the data integration agenda.

42. It is clear from the previous overview that there are well-established and supported processes and systems for the development and adoption of globally agreed statistical and geospatial standards. The need for standards and frameworks relating to the creation and dissemination of geostatistical information has been long been recognised (Australian Bureau of Statistics, 2013) and the growing use of standards in general will help to drive the closer integration of statistical and geospatial information. However, statistical and geospatial standards have generally remained within their own isolated domains (UNECE, 2016, p. 4). 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 their Global Statistical Geospatial Framework (UN-GGIM, 2019) and Integrated Geospatial Information Framework (UN-GGIM, 2018) as discussed in section B. The use of common frameworks for data analysis and visualisation, such as Discrete Global Grid Systems (DGGS) which represent the Earth through a hierarchical tessellation of equal area cells with accompanying globally unique identifiers, are also gaining momentum. Work is underway, for example, through the OGS to standardise such grid systems to promote the coordination, harmonisation, and interoperability of disparate datasets through a scalable structure. This work has huge potential to drive the greater integration of statistical and geospatial information through its common framework (Open Geospatial Consortium, 2023). The GEOSTAT 4 project indicated that "point-based geocoding has started to become a European 'standard'" (European Committee of the Regions, 2021, p. 42) and there already seems to be a strong underlying spatial framework at the address-level across Europe which is promising for the adoption of gridded statistics using globally accepted frameworks such as DGGS. This will support greater international interoperability and comparability of statistical data, set within its geographic context, which will drive the data integration agenda further.

43. Despite this progress, a range of issues relating to standards remain which are hampering the greater integration of statistical and geospatial information across the UNECE region. One key issue as noted by Van Halderen *et al*. (2016) is the differing professional paradigms driving 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). Standards are not adopted consistently across countries with differing levels of

development; many national statistical organisations located within low-to middle-income countries, for example, are operating in the complete absence of standards-based processes (PARIS21 & Statistics Sweden, 2021, p. 3). Resistance to change through the adoption of new standards and processes, particularly where novel data sources such as geospatial data are applied, is another obstacle to be overcome, particularly when current methodologies are widely accepted and strong expertise has been developed (UNECE, 2017, p. 16). Even from a technical geospatial perspective, the realities of implementing the INSPIRE Directive, and its non-binding technical guidelines on the harmonisation of geospatial data, has shown that "expectations of developing a common framework for spatial data in the EU might have been too high . . . [and may have] hampered the progress towards interoperable datasets considerably" (European Committee of the Regions, 2021, p. ii). Another cause for concern has been the lack of globally agreed standards or classifications for specific geospatial concepts that are relevant to statistics, despite the wider progress made by UN-GGIM and others as discussed above.

44. The fundamental lack of standardised methodologies for the integration of geospatial and statistical data also presents a barrier. UNECE have 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, considering the range of geospatial data sources that can be used, it is difficult to endorse common integration methods for all data types. While the development of standardised statistical process models such as UNECE's CSPA (introduced above) are helping to provide greater consistency in statistical outputs, not all models can easily incorporate geospatial perspectives within them which creates further challenges (Van Halderen, et al., 2016, pp. 467-468). Another issue relates to the production of comparable time series using standardised boundaries (whether administrative or statistical) due to the variation in output areas across UNECE countries, where some may remain stable for decades, while others frequently change due to political requirements (UNECE, 2016, p. 18). A similar pattern emerges with respect to the dissemination of statistics where no single approach exists. For example, INSPIRE was developed around the use of WMS and WFS which work well for statistical units which align to geographic boundaries, however, difficulties arise for statistical datasets which have no direct spatial features (INSPIRE, 2013; UNECE, 2016, p. 22). Due to the relative absence of detailed pan-European datasets, most output methodologies align to the regional NUTS 1, 2 or 3 classifications and are not generally disaggregated further which means that more granular insights can be lost (Eurostat, 2021; European Committee of the Regions, 2021, p. 2).

45. Within the UNECE Survey, overall standards were not considered by respondents to have a major impact on data integration activities with only 33% of respondents rating it as high impact, the joint lowest impact theme (Figure 8d). However, a higher proportion of respondents from target countries rated standards as high impact (47%) than from non-target countries (29%; Figure 8e). Similarly, a larger number of NSIs gave standards a high impact rating (36%) than NMCAs (22%; Figure 8f), suggesting that standards issues are having a greater effect on data integration activities within statistical organisations from target countries in particular. Respondents noted the presence of conflicting standards as a major hindrance to data integration, between both national and international standards as well as

between different international standards. One respondent highlighted that the lack of statistical and geospatial compatibility analysis performed during standards development has resulted in separate and incompatible standards across the disciplines. Also noted as an issue was the general lack of compliance with national and international standards, such as that of the INSPIRE Directive, despite such standards being noted as crucial and a central pillar of data integration. Some respondents considered that there was poor semantic and technical interoperability between different data sources and across different domains due to a lack of standardisation and that harmonised operating models, production processes and services to automate processes were equally as important. Respondents outlined the need for more unified standards that would make data comparable and integrative and allow for greater and faster data integration. They also noted the crucial nature of standards to ensure that decentralised data ecosystems could function effectively. It is clear that a plethora of multi-layered issues relating to standards are present which, themselves, need to be disaggregated and individually addressed to progress the data integration agenda and improve the interoperability and comparability of geospatial and statistical data.

G. Partnerships

46. Partnerships, that is, the strategic alliance of two or more parties who agree to cooperate to advance their shared interests and achieve common goals, have long been viewed as key tools of effective governance. Some partnerships may focus on the delivery of local initiatives at national levels, developing or adapting policy frameworks to better suit the needs of local societies and economies. Other partnerships may seek to coordinate broad policy areas at regional and international scales. As the OECD (2006a, p. 3) have described, "a partnership is a valuable instrument or 'organisational' model to overcome weaknesses of the policy and governance framework . . . [however] they are difficult to set up and maintain, they require political will and resources, and results are not likely to come overnight". Effective partnerships bring all the relevant stakeholders together, be they government bodies, academic institutions, private sector companies, Non-Governmental Organisations (NGOs) or members of civil society, to work cohesively together such that "the partners are the stones on which to build a prosperous regional development and their adhesive mortar is the trust they can build among partners" (OECD, 2006a, p. 4). At a time when rapid technological change, growing economic and political uncertainty, mounting concerns for the environment and the impacts of climate change, and the lasting effects of the COVID-19 pandemic transcend national and regional boundaries, effective strategic partnerships can offer valuable contributions to sustainable development and the delivery of innovative, inclusive, targeted, and cost-effective solutions to benefit society.

47. The strategic partnerships formed through the statistical and geospatial governance frameworks outlined in section A are strong and long-standing. At the highest statistical level, the UNSC brings together Chief Statisticians from 24 Member States which are elected by ECOSOC in a way that ensures equitable geographical distribution globally. In Resolution 3 of the 8th of June 2022, ECOSOC noted the importance of building partnerships and the role of UNSC "as the apex for discussions, knowledge exchange and sharing of best practices on statistics and data across all domains" (UNSD, 2023b). Active groups under UNSC fall under

one of eight distinct types which include task forces, working groups (including partnerships), expert groups, and networks that function within economic, environmental, social and cross-cutting fields, all designed to "reflect a spirit of inclusiveness and collective ownership" (UNSD, 2023b). The UNSD, as part of their remit, facilitate the coordination of international statistical activities and programmes related to the work of UNSC and others, including the Committee for the Coordination of Statistical Activities (CCSA), who are composed of international and supranational organisations, and work to improve the efficiency of the statistical system, develop methodologies and provide inter-institutional support, outreach and advocacy for statistics (UNSD, 2023d); the Committee of the Chief Statisticians of the United Nations System (CCS-UNS), who comprise of the statistical services of United Nations funds and programmes, specialised agencies, and regional economic and social commissions, and promote coherent and system-wide actions to support statistical activities that follow the Fundamental Principles of Official Statistics (UNSD, 2023e); and other United Nations statistics programmes as well as those of specialised agencies and other autonomous organisations.

48. Within Europe, the ESSC provides professional guidance relating to the ESS as well as the adoption of implementing acts for statistical legislation, and is composed of members of statistical organisations from EU countries, the European Free Trade Association, and observers from other groups including the European Central Bank, International Monetary Fund, and OECD (Eurostat, 2023b). Other partnerships include a Partnership Group which is composed of Director-Generals of national statistical organisations of the ESS and Eurostat and aims to advance the strategic development of the ESS; the European Statistical Governance Advisory Board (ESGAB), who comprise of independent experts in the field of statistics, and give an independent view on the ESS and the European Statistics Code of Practice; and the European Statistical Advisory Committee (ESAC), who have a broad membership including users, respondents, members of the scientific community, civil society and other institutions and bodies including the European Parliament and European Central Bank, and work to ensure that user requirements and financial implications are considered in EU statistical policy development (Eurostat, 2023b). UNECE also have a broad range of partners from across the UNECE region, including statistical organisations, other agencies and regional commissions of the United Nations, and intergovernmental organisations and NGOs. They also work with networks of experts via steering groups and task forces to "develop leading edge guidelines, recommendations and standards on statistics with a global impact" (UNECE, 2023b) such as the HLG-MOS discussed in section F.

49. There are also a broad range of partnerships functioning across the geospatial sector which are led globally by UN-GGIM who partners with geospatial organisations of Member States, as well as a diverse range of international organisations, such as the Group on Earth Observations (GEO), the OGC, and the International Cartographic Association (ICA), and other United Nations agencies including the five Economic Commissions, UNICEF and the World Food Programme (UN-GGIM, 2023a). UN-GGIM also facilitates a series of functional groups to progress its key objectives, which include high-level groups, subcommittees, expert groups and working groups. Of relevance here is the UN-GGIM Expert Group on the Integration of Statistical and Geospatial Information (as introduced in section A) who consist

of expert representatives from geospatial and statistical organisations within Member States, and provide high-level coordination and a forum for dialogue between the statistical and geospatial communities; work to advance and raise awareness of data integration activities particularly relating to the GSGF; and support the UNSC and UN-GGIM in the development of principles, guides and standards that increase the production and use of integrated statistical and geospatial data that is of high-quality, accuracy and reliability (UN-GGIM, 2023b). UN-GGIM: Europe partner with European national geospatial organisations and other European institutions, research organisations and professional bodies to progress the global UN-GGIM agenda within the European context. UN-GGIM: Europe facilitate a series of working groups to implement their 2022-2025 work plan which include a working group on Data Integration which consists of representatives of statistical and geospatial organisations from 20 European Member States, as well as other institutions such as Eurostat, the Joint Research Centre (JRC) and the European Environment Agency, and work to progress the data integration agenda particularly relating to the SDGs. Another working group on the Integrated Geospatial Information Framework (IGIF) aims to support European members of the UN-IGIF's global High-level Group in their global tasks to develop the framework, as well as to raise the profile of the UN-IGIF across Europe (UN-GGIM: Europe, 2023b). Other functioning partnerships include the EFGS, as discussed in section A, who have further established a Global Forum for Geography and Statistics (GFGS) which functions as a professional global network of statistical, geospatial and research organisations (European Forum for Geography and Statistics, 2023).

50. It is clear from the above discussion that there are robust and well-established partnerships currently in place that benefit the data integration agenda. Eurostat (2019, p. 3) has observed that statistical and geospatial data integration is growing rapidly in some European countries due to close cooperation between national statistical and geospatial organisations. The European Committee of the Regions further note that "pan-European interoperability in most fields is still a future goal, however, good progress has been made in particular by several phases of the GEOSTAT projects also regarding the establishment of cooperation between institutions and the integration of spatial and statistical data" (2021, p. 2). The ESS already requires strong partnerships between Eurostat and NSIs across Europe to produce comparable and comprehensive statistical outputs. These established partnerships can be utilised and built upon to promote the greater integration of geospatial data within ESS workflows. PARIS21, as a global partnership of experts and policymakers in statistics, have also noted that governments in many low-income countries are already implementing multi-stakeholder approaches to progress statistical and geospatial data integration which is very promising (PARIS21 & Statistics Sweden, 2021, p. 7). Despite the clear progress made in specific countries, many issues remain which hinder greater collective progress across the UNECE region. The broad range of international and regional partnerships already in place, some of which are undertaking similar activities relating to data integration, are risking duplication of work and a complex policy landscape, resulting in confusion for national statistical and geospatial organisations who aren't sure which policy frameworks to follow. UNECE (2016, p. 29) also noted that some regional activities, such as UN-GGIM: Europe's Core Data Working Group, "included no statistical representation to ensure core geography for statistics was captured and the lack of consideration for how UN-GGIM and GEOSTAT

can align with the CSPA". At national levels, the traditional separation of statistical and geospatial organisations has historically hampered efforts to collaborate with each other, exacerbated by the complexity of their individual information systems which has driven them to work separately according to their own requirements. The general lack of specific legislation and political incentives to support greater cooperation between providers has further impacted these issues. As such, cooperation and coordination mechanisms between national statistical and geospatial organisations need to be built from scratch rather than utilise existing formats. In consequence, the lack of national partnerships to progress data integration activities mean individual organisations are less able to transform and adapt to new challenges, make informed decisions, nor fully comprehend and address major cross-border challenges (UNECE, 2016, p. 3; Eurostat, 2019, p. 3; European Committee of the Regions, 2021, p. 44).

51. Within the UNECE Survey, partnerships were not considered by respondents to have a major impact on data integration activities with only 33% of respondents rating it as high impact, the joint lowest impact theme (Figure 9a). However, a much higher proportion of respondents from target countries rated partnerships as high impact (53%) than from non-target countries (27%) which is notable (Figure 9b). Similarly, a higher proportion of NMCAs rated partnerships as high impact (50%) than NSIs (29%; Figure 9c), indicating that partnerships, or lack of, are having a stronger impact on NMCAs particularly from target countries. Respondents were asked if their organisation currently participated in any national working groups with their national statistical or geospatial counterpart and most respondents (69%) stated that they did. A marginally lower proportion of respondents from target countries took part in national working groups with their counterpart (60%) than from non-target countries (71%), indicating that some additional support may be needed to establish and strengthen national partnerships within target countries. As expected, the level of participation was largely the same across organisation types (72% for NSIs and 67% for NMCAs). Respondents discussed their joint participation in a wide variety of working groups, meetings, and organised activities, for example, to address the Demography and Statistical Units themes of the INSPIRE Directive, to collaborate on updating land use and land cover thematic map classifications which support statistical production and ecosystem accounting, for data validation, and in spearheading the use of geospatial data. Respondents were also asked if their organisation currently participated in any regional or international working groups relating to statistical or geospatial data and again most respondents (72%) stated that they did. However, a much lower proportion of respondents from target countries participated in regional or international working groups (47%) than from non-target countries (79%). This clearly indicates that much more needs to be done to encourage broader target country engagement and participation in regional and international activities relating to data integration which may, in turn, help to progress data integration within those countries. Respondents were involved in over 60 regional or international working groups, the most cited being the GISCO Working Group led by Eurostat, the UN-GGIM Expert Group on the Integration of Statistical and Geospatial Information, the UN-GGIM: Europe Working Group on Data Integration, the European Forum for Geography and Statistics, and the work of UNECE and EuroGeographics. Other working groups also mentioned included the Open Geospatial Consortium, the European Land Registry Association, the INSPIRE Knowledge

Exchange Network, and the Working Group on Regional, Urban and Rural Development Statistics.

52. While the overall level of participation in regional and international activities related to geospatial and statistical data is good overall, as is the breadth and variety of the working groups attended, more needs to be done to explore why levels of engagement from target countries are significantly lower and determine how this can best be remedied. Respondents highlighted the importance of established and agreed collaboration through multilateral partnerships as well as the need for build greater awareness about the strength of partnerships and cooperation amongst different data providers that ensure that reliable, objective, accurate and consistent data can be produced. The need for greater information exchange was also commonly cited, through the promotion of cross-sectoral and interdisciplinary alliances that facilitate access and exchange of information nationally. However, also of importance was the need for greater promotion of international cooperation to enable the exchange of knowledge and application of best practice at regional and global levels, including the establishment of more collaborative projects and working groups to help address common problems, provide complete data coverage, and avoid unnecessary duplication of efforts. In building partnerships, it was noted that there is not always a clear win-win situation between counterparts and there is a greater need to guarantee that both the strategic and technical levels are aligned and that the value of data integration, and its benefits, are equally realised by all partners.

H. Capacity and Education

53. Capacity refers to the ability of individuals, organisations, and wider society to function successfully within particular situations through the application of relevant knowledge and skills. As highlighted in previous sections, governments face a myriad of complex and often interdependent challenges and, to respond effectively to those challenges, they need to be agile, constantly horizon-scanning, learning, adapting, and responding in novel ways. Capacity is inextricably linked to the performance of government systems, such as the provision of suitable policies and regulatory frameworks, and the decisions and actions made by governments are of high impact such that "the safety and wellbeing of societies depend on capable public administrations that are proactive, innovative and diligently manage public affairs" (World Economic Forum, 2022b). Capacity development has been defined as "the process whereby people, organisations and society as a whole unleash, strengthen, create, adapt and maintain capacity over time" (OECD, 2006b, p. 12). Capacity development may be driven internally through robust training programmes and innovative practices within individual organisations or broader government frameworks, or it may require external donor support from other national, regional, or international bodies. The actions associated with capacity development can take many forms: "facilitating access to knowledge; brokering multi-stakeholder agreements that remove blockages to capacity development; participating in relevant policy dialogue or advocacy; providing incremental resources that help in overcoming bottlenecks in change processes; and creating spaces for learning by doing" (2006b, p. 12).

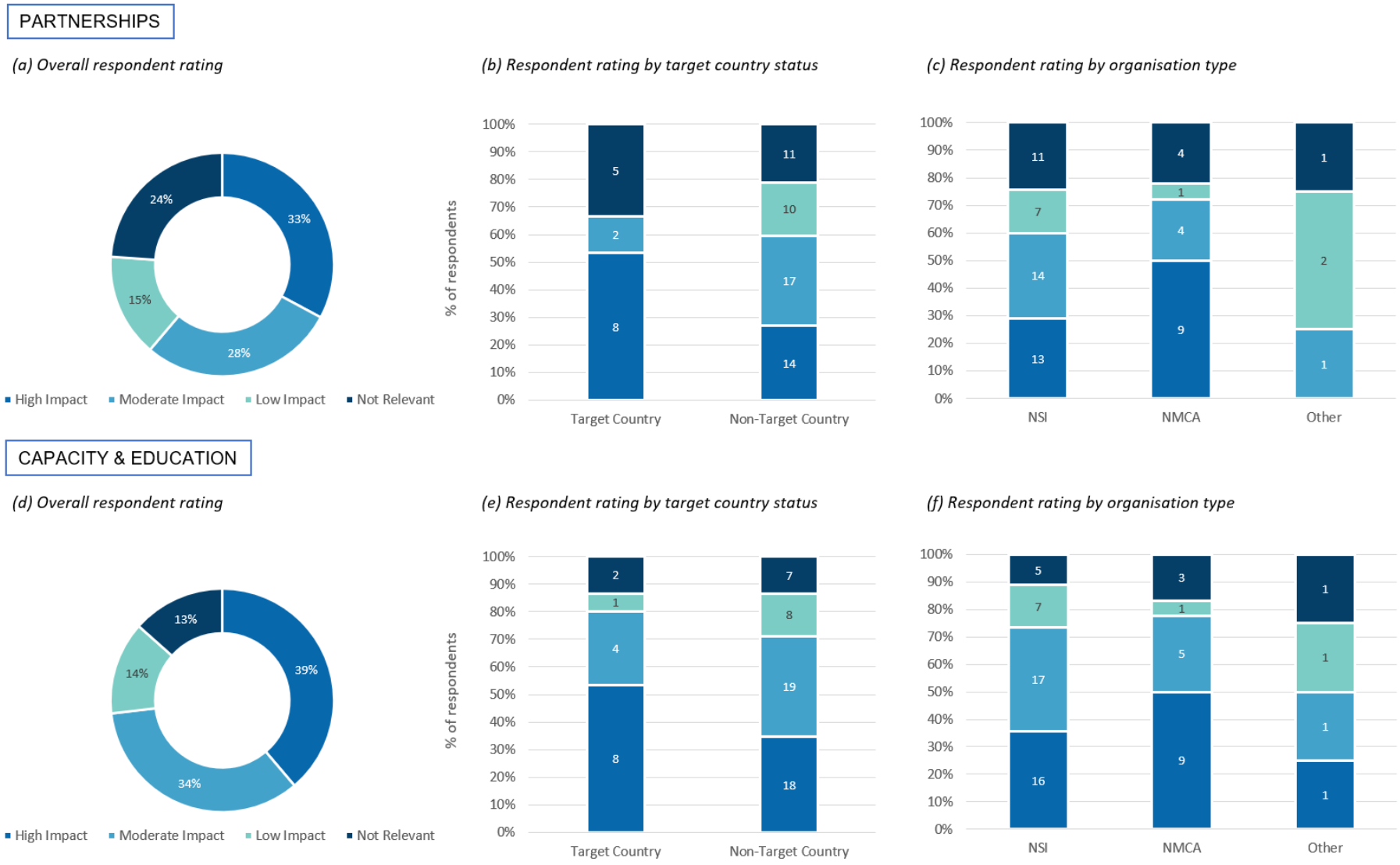


Figure 9: UNECE Survey respondent rating of the impact of Partnerships and Capacity & Education issues on the greater integration of geospatial and statistical data

The World Economic Forum highlights the value of a systems-thinking approach to capacity development, given the interconnected nature of many challenges and opportunities, enabling government officials to access, assess, select, and apply the relevant knowledge, data, skills, and best practice to particular scenarios. In doing so, this creates "a positive feedback loop that will inform policy- and decision-making, directing resources, anticipating trends, and managing risks" (World Economic Forum, 2022b).

54. There are ongoing efforts to promote capacity development and workforce upskilling within the statistical and geospatial sectors. At an international level, the Data4Now initiative was launched at the United Nations General Assembly in 2019 and is co-led by the UNSD, the World Bank, the Sustainable Development Solutions Network (SDSN) and the Global Partnership for Sustainable Development Data (GPSDD). The initiative aims to "develop countries' capabilities to deliver the information needed by local and national policy and decision makers to achieve the 2030 Agenda . . . [and help countries to] leverage innovative sources, technologies and methods for the streamlined production and dissemination of better, more timely and disaggregated data for sustainable development" (UNSD, 2023f). Through the UN-IGIF, and its capacity and education strategic pathway, UN-GGIM are also seeking to establish "enduring capacity development and education programs so that the value and benefits of integrated geospatial information management is sustained for the longer term" through awareness, formal education, professional training, and entrepreneurship (UN-GGIM, 2018, p. 24). Within Europe, capacity development is a central work area for UNECE's Statistical Division who often work in partnership with other regional and international bodies to strengthen individual countries statistical capacity so that they can produce high-quality statistics that align with international standards and good practices (UNECE, 2023b). UN-GGIM: Europe also supports capacity development to grow effective geospatial information and spatial data infrastructure management practices across Europe through the organisation and participation in a wide range of events, projects and knowledge-exchange activities across the region alongside UNECE, Eurostat, EuroGeographics and the EFGS (UN-GGIM: Europe, 2023a).

55. Across the UNECE region, many statistical and geospatial organisations have taken advantage of the opportunities to develop their capacities and strengthen knowledge, skillsets, and competencies in order to try and keep pace with an ever-evolving technological landscape. These efforts have helped the data integration agenda as UNECE note: "many NSIs are putting in considerable effort to develop capabilities in managing, processing and analysing geospatial data and information . . . This effort has required NSIs to look at the modernisation of their infrastructure and policies, as well as developing new skillsets beyond the traditional areas associated with interrogating and analysing standard census/survey data" (2016, p. 16). While there are good examples of national capacity development initiatives led by the World Bank, the OECD, UNECE and others, a number of issues and obstacles remain. Geospatial capabilities within statistical organisations have been found to be highly variable and, similarly, there tends to be limited statistical capabilities within geospatial organisations. These skills gaps tend to reflect a general lack of understanding of technical and non-technical issues, and benefits, regarding their counterpart's subject area (Australian Bureau of Statistics, 2013; Eurostat, 2019). Also of relevance is the lack of broader functional skills needed to

acquire new data sources and communicate the benefits of integrating them, such as effective negotiation, stakeholder management, data protection and communication skills. These functional skills are particularly important for limiting potential "negative perceptions about data integration and the misinterpretation on the part of both individuals and administrations that integrating data is just another policy for budget cuts or a disguised strategy to replace workers with technologies" (PARIS21 & Statistics Sweden, 2021, p. 30). Such thinking also extends to wider stakeholders, such as citizens and the business community, whose knowledge of the benefits of data integration to their specific needs are limited due to an absence of effective promotion and communication strategies. Another issue is a lack of consideration of how new integrated outputs will meet the needs of the user community and their varying levels of maturity (Eurostat, 2019, p. 5; PARIS21 & Statistics Sweden, 2021, p. 51). Addressing these capacity and education issues are particularly important for developing countries who generally lack the required degree of skills and expertise to benefit from statistical and geospatial data integration activities to achieve their own development goals within the context of the 2030 Agenda (UNECE, 2016, pp. 16-17).

56. Within the UNECE Survey, capacity and education issues were ranked as having the fourth highest impact on the greater integration of geospatial and statistical information with 39% of respondents ranking them as high impact (Figure 9d). This impact was much greater for respondents from target countries where 53% of respondents noted them as high impact than from non-target countries (35%; Figure 9e). Similarly, a much higher proportion of respondents from NMCAs ranked them as high impact (50%) than from NSIs (36%; Figure 9f). It is clear that a greater focus on capacity development activities is needed to strengthen the knowledge, skills and competencies required to progress the data integration agenda within target country organisations and NMCAs in particular. Respondents reported that the lack of human resources to engage in capacity development activities around geospatial and statistical data integration is majorly hindering progress, largely due to the lack of institutional strategies relating to capacity development and the limitations of current financial environments. One respondent noted that only two employees within their organisation were engaged in data integration activities and this was not even their primary tasks. There is therefore a great need to increase the number of employees who can engage in capacity development activities to improve technical knowledge and skillsets at a level that can also allow such expertise to be absorbed across the wider workforce and embedded within internal operational processes. Respondents also noted the lack of initiatives to improve capacity development in both technical and functional skills relating to data governance, application development, standards adoption, project management and policy development. Some respondents considered that such development activities would need to transcend across professions (such that statistical professionals would need to understand the field of geoinformatics and vice versa) and between different levels of management within individual organisations (from technical to strategic). However, other respondents considered that it was not necessary or cost-effective to maintain overlapping competences across the professions. Instead, they highlighted the value of nationally established and agreed cooperation that would enable specialisation and a continuum of complementary competences that would enable overall competence to increase at national levels. A comparative cost-benefit analysis of both approaches would be a useful way to determine how best to design, promote and

implement future capacity development programmes relating to data integration that will prove both efficient and effective to the relevant stakeholders in the long term.

I. Communication and Engagement

57. Organisations do not operate in isolation and they must be able to actively communicate and engage with a wide range of stakeholders to both acquire and share specialised knowledge and expertise beyond their own organisation. Stakeholder engagement is also an important element of modern government practice as it ensures transparent, inclusive, and evidence-based decision-making, widens the evidence base underpinning government activities, and increases government responsiveness to the needs of its citizens. Stakeholder engagement may take many forms such as advisory groups, preparatory committees, formal/informal consultations with selected groups, public consultations, physical/virtual public meetings and, increasingly, the use of digital and social media platforms. Strong and effective communication and engagement strategies are crucial to "establish and build stakeholder relationships, target and clarify communications, and centralise engagement responsibilities" (OECD, 2021). In practice, however, many organisations face difficulties in engaging with appropriate stakeholders in an inclusive and meaningful way, particularly those who are marginalised or less experienced in exerting influence. Other challenges include the resource-intensive nature of stakeholder engagement with respect to time and human resources, the appropriate identification and management of potential conflicts of interest amongst stakeholders, the difficulty in ensuring the relevance, efficacy and value derived from stakeholder contributions particularly where there is diversity of opinion, ensuring minimum standards for the quality of evidence provided, and the awareness and management of related risks such as the non-disclosure of sensitive information. In order to mitigate many of these issues, there are some key building blocks to ensure dynamic engagement between organisations and stakeholders: "the adoption of a whole-of organisation stakeholder engagement policy, the provision of clear and timely information regarding the opportunity to engage, the setting of appropriate expectations and procedures regarding the nature of engagement, and the justification of decisions to incorporate or depart from the inputs received" (OECD, 2021).

58. Effective communication and engagement strategies are central to the functioning of statistical and geospatial organisations who, in effect, are service providers for data users. Therefore, in addition to the above requirements and outcomes, statistical and geospatial organisations also need to raise public awareness and investment in their data, products, services and applications, persuading citizens, businesses, research institutions, and other government organisations of their value, cost-effectiveness, contribution, and benefit to society. Stakeholder engagement has played a very central role in the international and regional governance structures and partnerships already discussed in previous sections. While effective communication and engagement strategies to promote the benefits of integrating geospatial and statistical data have been developed and implemented in recent years through the work of UN-GGIM, UNECE, Eurostat, EFGS and others, UN-GGIM (2022c, p. 1) have noted that "gaining political and fiscal recognition of the need for integrated geospatial information is [still] a challenge faced from local to global levels, particularly in the midst of

rapidly changing societal norms and economic outlooks, and against a backdrop of many competing agendas and priorities". Therefore, the role of effective communication and engagement strategies to promote the data integration agenda, through advocacy, storytelling and the showcasing of use cases and their derived benefits, is critical to its wider adoption and implementation. However, despite these ongoing efforts there have been highly variable levels of engagement and a general lack of structured communication between statistical and geospatial organisations at national levels. This lack of communication hinders the ability to understand and solve both technical and non-technical issues that such organisations may share, as well as the mutual benefits and efficiency gains that may be achieved through greater collaboration. It also prevents the opportunity to raise more awareness of statistical and geospatial data integration and the benefits derived from its use. There has also been a general lack of consistent and structured engagement between statistical and geospatial organisations and their users in order to share experiences and obtain valuable feedback on their data products, services and applications, nor sufficient promotion of the benefits of data integration to the user community in clear and relevant terms which could gain further support (and an additional driving force) for the data integration agenda (Australian Bureau of Statistics, 2013; Eurostat, 2019, p. 5; European Committee of the Regions, 2021, p. 44).

59. Within the UNECE Survey, communication and engagement was ranked as having the second highest impact on the integration of geospatial and statistical information with 43% of respondents rating it as high impact (Figure 10a). A marginally higher number of respondents from target country organisations rated it as high impact (47%) than from non-target countries (42%; Figure 10b). A much more marked difference was, however, evident by organisation type as 72% of respondents from NMCAs rated it as high impact in comparison to 31% of respondents from NSIs (Figure 10c). This finding clearly indicates a disparity in levels of engagement with data integration activities as well as the strong need to improve communication and engagement strategies with geospatial organisations in particular. Respondents were asked if they were aware of any regional or international activities to better integrate statistical and geospatial data. An overwhelming majority of respondents (84%) were aware of wider activities noting nearly 30 different organisations or initiatives, with the most common including the UN-GGIM Expert Group on the Integration of Statistical and Geospatial Information, UN-GGIM: Europe's working group on Data Integration, the GEOSTAT initiatives and the High-level Group for the Modernisation of Officials Statistics. Target country organisations generally had less awareness of activities (73%) than non-target countries (87%) which suggests that more work must be done to improve target country engagement with wider programmes and agendas. When comparing awareness by organisation type, NSI respondents had a slightly broader awareness of activities (84%) than NMCAs (78%), again suggesting more focused engagement with geospatial organisations is required.

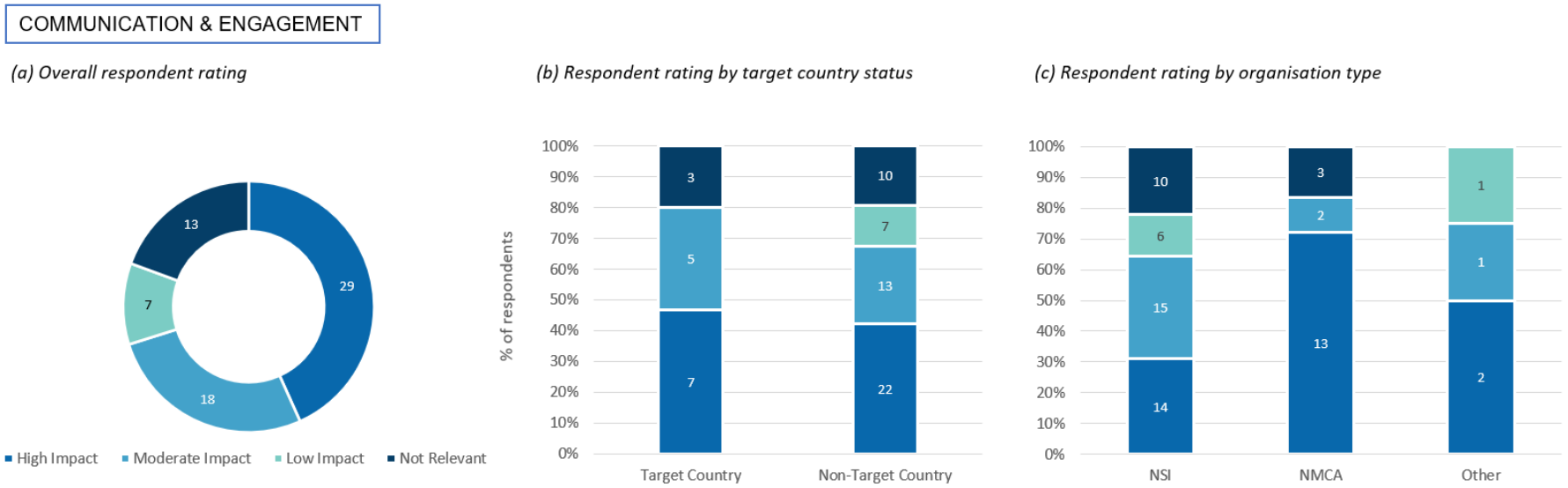


Figure 10: UNECE Survey respondent rating of the impact of Communication & Engagement issues on the greater integration of geospatial and statistical data

Respondents were also asked if they were aware of any published international guidance relating to the integration of geospatial and statistical data. Again, the majority of respondents (76%) were aware of published guidance and noted a broad array of examples, the most popular being the GSGF (UN-GGIM, 2019), and the UN-IGIF (UN-GGIM, 2018), followed by the GSGF Europe (GEOSTAT 4 and Eurostat, 2021), and the PARIS21 Guide on Geospatial Data Integration in Official Statistics (PARIS21 & Statistics Sweden, 2021). A lower proportion of respondents from target country organisations were aware of such guidance (47%) than respondents from non-target countries (85%) and, similarly, a lower proportion of respondents from NMCAs were aware of published guidance (50%) than from NSIs (84%), indicating a clear disparity in levels of engagement which needs to be remedied. Respondents highlighted the need for greater engagement with decision-makers at strategic levels through stronger communication strategies which emphasise key messages around the benefits of integrating statistical and geospatial information, as well as the importance of integrated data for evidence-based decision-making to support the 2030 Agenda and the achievement of its SDGs. Some respondents also noted the need for open communication between NSIs and NMCAs, a shared commitment to data integration activities, and established and agreed roles amongst such actors to progress data integration at national levels, particularly centred around the promotion of NSDIs and their role in supporting all stages of the statistical process. It is clear that new communication and engagement strategies are needed to promote the benefits of data integration to a much broader target audience than present, actively engaging with decision-makers from target country organisations and NMCAs in particular. In growing awareness of, and acquiring buy-in to, data integration activities, real progress can be made, and the benefits truly realised.

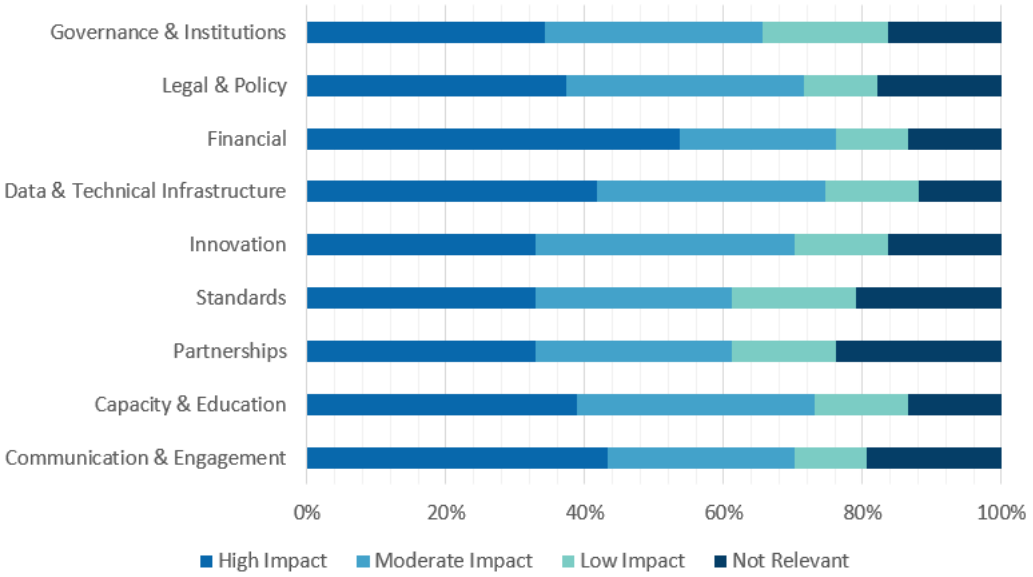
V. OPPORTUNITIES AND RECOMMENDATIONS

60. It is clear from the discussion in the previous section that while much work has been undertaken to support the greater integration of geospatial and statistical information, still more must be done to embed data integration activities within business-as-usual practices in a comparable and consistent fashion across the UNECE region. Unfortunately, there are a range of multi-dimensional issues and obstacles still to be overcome, given the wide variance in national governance frameworks, laws and policies, the ability to access adequate and sustainable financial resources, the level of cooperation with other national and international bodies, the adherence to wider policy frameworks and common standards, the abilities, skills and capacity to innovate, and effectively communicate the need for data integration activities and their associated benefits to both decision-makers and the wider user community. There is clearly no one-size-fits all strategy that will comprehensively overcome such disparities and this has been recognised by key players in the fields of statistics and geospatial information. Over recent years, a series of papers have been published by such key players which advocate the need for the greater integration of geospatial and statistical data, discuss the issues currently faced from a range of perspectives, and present a series of recommendations that intend to tackle and address those issues (e.g. UNECE, 2017, p. 32; Eurostat, 2019, pp. 5-7; European Committee of the Regions, 2021, pp. i-iv). This research exercise both acknowledges and supports the recommendations made in those papers and does not seek to

replicate them. Instead, this paper will present a series of recommendations based on feedback from respondents of the UNECE Survey and supported by the contextual review of the issues and obstacles to the greater integration of geospatial and statistical data presented in the previous section. It is hoped that this stakeholder-centric approach will both complement and enhance the recommendations already made by UNECE, Eurostat and others in the field of data integration.

61. Within the UNECE Survey, respondents were asked, from their organisation's perspective, to rate the level of impact of each of the nine UN-IGIF themes on the greater integration of geospatial and statistical data. These ratings were presented and discussed in detail in the previous section for each individual UN-IGIF theme. However, for the purpose of identifying solutions and presenting relevant recommendations to address the issues and obstacles to greater data integration across the UNECE region, it is necessary to assess the overall ratings in a more cohesive fashion (Figure 11a). As such, respondents rated financial issues as having the biggest impact on data integration with 54% of respondents rating it as high impact, followed by issues and obstacles relating to communication and engagement (43%) and data and technical infrastructure (42%). Financial issues were rated as having the highest impact on data integration in both target and non-target countries, as well as in NSIs, however, NMCA respondents considered that communication and engagement issues had the bigger impact which should be noted. Within the UNECE Survey, respondents were also asked to provide information on what would help to overcome the issues and obstacles that they had identified. To determine the main trends within the wide array of responses, key word extraction and categorisation by UN-IGIF theme was undertaken and is summarised in Figure 11b. Most respondents proposed solutions that focused on improving communication and engagement strategies and practices (42%), closely followed by better capacity and education initiatives (40%), and adequate and sustainable financial resources and incentives (37%). There were slight differences in the proposed solutions based on target country status, as target country respondents focused more on communication and engagement as well as capacity and education solutions, whereas non-target country respondents concentrated more on financial and communication and engagement solutions. In considering the proposed solutions by organisation type, NSI respondents followed the overall trend along with solutions to improve partnerships, however, NMCA respondents were more mixed in their responses with greater focus on improvements to governance and institutional frameworks and legal and policy revisions, alongside communication and engagement initiatives.

(a) Overall respondent rating of the issues/obstacles to greater data integration by IGIF theme



(b) Respondents proposed solutions to overcome such issues and obstacles by IGIF theme

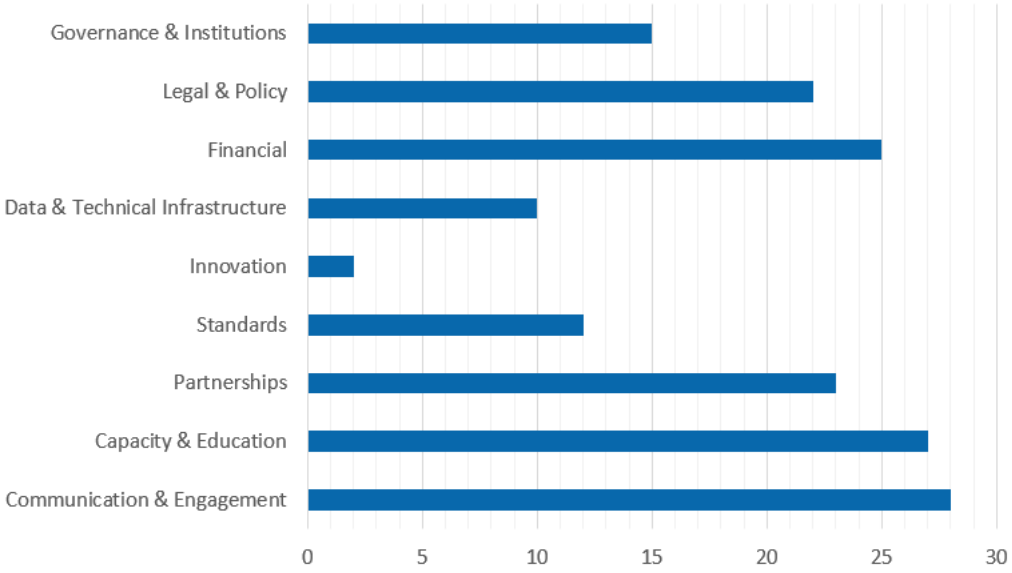


Figure 11: UNECE Survey respondent overall rating of issues and obstacles relating to data integration and proposed solutions to overcome them by IGIF theme

62. Considering the feedback provided by respondents of the UNECE Survey, and supported by the contextual review of the issues and obstacles to the greater integration of geospatial and statistical data presented in the previous section, the following opportunities and recommendations are proposed to improve data integration activities across the UNECE region:

A. Consolidate and coordinate data integration activities through one central governing body for Europe

63. Firstly, it would be useful to stop thinking of the geospatial and statistical domains as separate as "everything happens somewhere" and NSIs and NMCAs play complementary roles in a bigger process of measurement and understanding. As noted in section V., the integration of statistical and geospatial information currently sits within a very complex governance landscape composed of a range of stakeholders and what is needed is a central governance body with a legal mandate to bring such activities, actions, and outcomes together. All outputs from the many data integration initiatives should surface from one place in a single coordinated approach to create clarity, promote consistency, and reduce duplication of effort. Under the direction of this central governing body should be the establishment of a European Statistical System equivalent for the geospatial domain in Europe so that geospatial data is brought into mainstream view within regional and international legal and policy frameworks. In doing so, this will ensure that the geospatial and statistical domains are on equal footing which will help to build strong joint legal and policy frameworks and transparent and sustainable models of cooperation across the UNECE region. The work of this central governing body should also be guided by key policy drivers such as the 2030 Agenda, the European Cohesion Policy, the INSPIRE Directive and the EU Open Data Directive amongst others to ensure that data integration activities are focused on the areas of greatest need. Through the guiding lenses of the GSGF and the UN-IGIF, a hierarchical approach to governance should be established to drive activities at national levels and empower NSIs and NMCAs to cooperate on the implementation of such guidance. It may be useful to consider the mandatory establishment of geospatial units within statistical organisations to advance such frameworks, supported in the short-term by dedicated consultants who could provide initial guidance and expertise where it is lacking. Such support could be co-financed at a national level between NSIs and NMCAs and/or in collaboration with international and regional bodies such as UNECE and Eurostat. In fully adopting these important policy frameworks, countries within the UNECE region will be able to produce comparable, geospatially enabled statistical data that can accurately inform and enhance data-driven decision-making across multiple scales and boundaries.

B. Identify and promote sustainable funding resources and models to support data integration activities at national levels

64. The UNECE Survey has revealed that the lack of adequate financial resources is having a major impact on the progression of data integration activities and this impact is found to be drastically higher in target country areas. Sustainable funding resources and models need to be identified and promoted to support the delivery of data integration activities at national levels. Greater investment by international and EU donors is needed to act as a catalyst for organisational transformation, with the equitable allocation of funding resources to NSI and NMCA organisations across the UNECE region to ensure that no country is left behind. This investment may also act to cushion the impact of future planned budget cuts at some government levels and safeguard progression of the data integration agenda. It may also be beneficial to simplify and streamline the application processes for funding opportunities to

encourage wider participation in such endeavours. To ensure the sustainability of financial resourcing beyond an initial investment, it will be necessary to engage with decision-makers within national governments to promote the value of data integration, its economic, environmental, and societal benefits, as well as its clear return on investment, to strengthen the national financial resourcing of data integration activities in the longer term. It will also be important to promote effective financial management practices that optimise the use of available resources while also providing the capacity for sustainable growth (particularly noting the factors outlined by PARIS21 (2018, pp. 4-5)). Sustainable funding models should include the necessary investment in IT infrastructure, software, and tools, and allow for their regular upgrade. It may therefore be useful to consider the development of a centralised process for the procurement of hardware and software solutions that support data integration activities. It is also important that such funding models also include the necessary allocation of staff time and resources for training and development, and free up the capacity needed for staff to progress data integration activities. As such, it may be useful to consider designing a bespoke Continuing Professional Development (CPD) programme that can be rolled out to relevant teams within NSI and NMCA organisations across the UNECE region. With adequate and sustainable finance, real progress in data integration can be achieved.

C. Enhance communication and engagement strategies to grow awareness of data integration and better support the sharing of best practice and new technologies

65. The results of the UNECE Survey indicate a strong disparity in levels of engagement with data integration activities across the region and a clear need to improve communication and engagement strategies to grow awareness within target countries and geospatial organisations in particular. Strong, centralised, and coordinated communication and engagement strategies are needed to ensure that clear and targeted messaging on data integration reaches all stakeholders in an inclusive and meaningful manner, to grow awareness and encourage active participation in related activities and provide an impetus to grow stakeholder relationships within national, regional, and international settings. It is vital that decision-makers at national levels, in particular, are targeted with key messages on the benefits of data integration and its role in supporting evidence-based decision-making so that necessary political and financial support can be realised. Regular and structured engagement between national statistical and geospatial organisations should be established where it is lacking by drawing on successful national models, and further enhanced where it is implemented. Open dialogue should be encouraged and a shared commitment to data integration activities fostered, including the agreement of complementary roles in the data integration journey at national levels. Communication should focus particularly on the sharing of best practices and new technologies through, for example, the promotion of lighthouse projects that demonstrate the successful adoption of the principles of the GSGF and the implementation of the UN-IGIF. A global group could be formally established to focus on innovation which transcends the fields of geospatial and statistics, identifying and promoting cutting-edge methods and processes as well as horizon-scanning for future trends. The provision of online resources by key players in the data integration field, such as the UN-GGIM Knowledge Base, should be enhanced and more regularly updated to improve the visibility of activities and outputs and increase levels of engagement further. Summary digests

of key policies and frameworks using simple, clear terminology and examples should accompany full documents. Such enhancements should be supported by regular, coordinated social media campaigns to extend the reach of the audiences and bring data integration into mainstream view. In growing awareness of data integration activities and sharing best practice and new technologies in this way, the benefits can be truly realised.

D. Promote greater data standardisation and interoperability using harmonised standards, operating models, production processes and services

66. Respondents to the UNECE Survey cited that one of the biggest obstacles to the greater integration of geospatial and statistical data related to data interoperability, with different data collection and storage methods, unstandardised data formats, and a lack of unique identifiers making it difficult to integrate data sources from different institutions. The consistent adoption of globally agreed standards, such as UNECE's Common Statistical Production Architecture and its geospatial view of the Generic Statistical Business Process Model, as well as OGC, and ISO standards would improve data interoperability in the short term. The greater promotion of address standardisation and the incorporation of unique identifiers as an important means of linking data should be employed. However, it is necessary to explore the need for the development of harmonised international standards that address the technical requirements of integrating geospatial and statistical data in the longer term, including the use of unique identifiers to bring disparate data sources together. A working group should therefore be established and led by UNECE to obtain relevant stakeholder perspectives on the development and adoption of harmonised standards, operating models, production processes and services that specifically relate to data integration. Greater investment in IT infrastructure at national levels, including major hardware and software upgrades, the provision of additional servers, and dedicated support for software packages, is needed to enhance the ability of organisations to progress data integration activities. Data accessibility policies must also be developed where they are lacking, and reviewed to ensure they are clear, transparent and of benefit to data integration activities. New data storage and dissemination methods should be explored, particularly the use of data lakes and cloud-based solutions, to streamline and simplify data sharing processes. By promoting the greater standardisation and interoperability of geospatial and statistical data, enhancing data quality, and improving data sharing across organisations, integrated geostatistical data can play a central role in the achievement of key policy initiatives such as the 2030 Agenda and its Sustainable Development Goals.

VI. CONCLUSIONS

67. This paper has presented the results of a research exercise which aimed to identify the main issues and obstacles hampering the greater integration of geospatial and statistical information across the UNECE and propose solutions for overcoming them in order to target the direction of future work relating to data integration. This research exercise, and subsequent paper, forms part of a wider project funded by the European Commission and led by UNECE to develop greater capacity in statistical and geospatial data integration across the

UNECE region to foster stronger links between the two communities, support further collaboration, and encourage greater data integration through the promotion of stronger institutional partnerships and the adoption of common standards. Through a detailed desktop review of the published literature on data integration, a structured assessment of statistical and geospatial activities within differing national contexts, and the valuable feedback provided by national statistical and geospatial organisations through the UNECE Survey, a range of multi-dimensional issues have been identified which impact the greater integration of statistical and geospatial information, with issues around finance, communication and engagement, and data harmonisation and interoperability having the biggest impact. This insight has been used to develop a set of four recommendations that may improve the uptake of statistical and geospatial data integration activities across the UNECE region:

A. Consolidate and coordinate data integration activities through one central governing body for Europe.

B. Identify and promote sustainable funding resources and models to support data integration activities at national levels.

C. Enhance communication and engagement strategies to grow awareness of data integration and better support the sharing of best practice and new technologies.

D. Promote greater data standardisation and interoperability using harmonised standards, operating models, production processes and services.

These recommendations are designed to complement and enhance other recommendations made by UNECE, Eurostat and others in the field of data integration and, in their adoption, may provide a driving force for change so that the value of data integration is fully realised and data of sufficient quality, accessibility, currency, reliability and granularity is produced consistently to protect people, the planet, prosperity, peace and partnerships so that “no one is left behind” (United Nations, 2015, p. 15).

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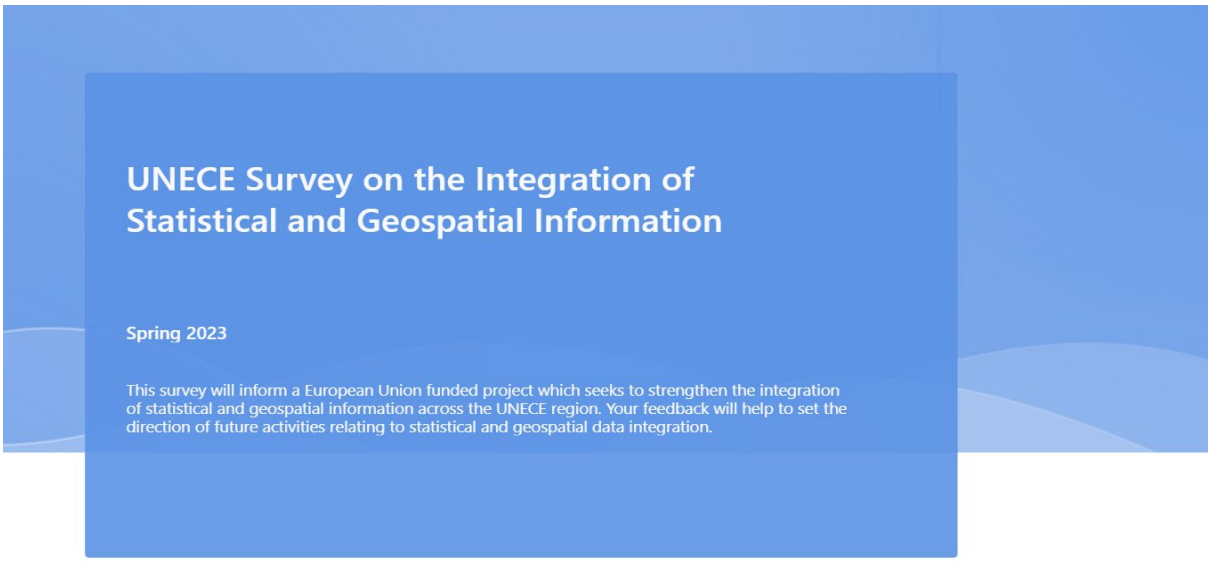
VIII. APPENDICES

Appendix 1: UNECE Survey Questions



Section 1: Organisational Context

1. Please provide the name of your organisation.
2. What type of organisation are you?
   - ○ National Statistical Institute (NSI)
   - ○ National Mapping or Cadastral Agency (NMCA)
   - ○ Other
3. If “Other” please provide more details.
4. If you are a NSI, how often do you use geospatial data within your workflows?
   - ○ Always
   - ○ Often
   - ○ Sometimes
   - ○ Never
5. Please provide any notable examples.
6. If you are a NSI, are you incorporating any geospatial data or approaches within the 2020 census round?
   - ○ Yes
   - ○ No
   - ○ Unsure
7. Please provide further details.
8. If you are a NMCA, how often do you use statistical data within your workflows?

- ○ Always
- ○ Often
- ○ Sometimes
- ○ Never

9. Please provide any notable examples.

10. How closely do you work with your national statistical or geospatial counterpart?

    - ○ Organisations are fully integrated
    - ○ Organisations are separate but closely linked
    - ○ Organisations are separate and not linked

11. Do you currently have a cooperation agreement in place with your national statistical or geospatial counterpart?

    - ○ Yes
    - ○ No
    - ○ Unsure

12. Please provide further details.

13. Do you currently have access to any of the following GIS software packages? Select all that apply

    - ○ AutoCAD Map 3D
    - ○ CARTO
    - ○ Esri ArcGIS
    - ○ GeoMedia
    - ○ Mapbox
    - ○ MapInfo
    - ○ QGIS
    - ○ Surfer
    - ○ Other
    - ○ None

14. If you selected “Other” GIS software, please provide further details.

15. Do you currently have access to any of the following statistical software packages/tools? Select all that apply.

    - ○ MatLab
    - ○ Microsoft Excel
    - ○ Minitab
    - ○ Python Statistics Libraries
    - ○ R
    - ○ SAS
    - ○ SPSS

- ○ Stata
- ○ Other
- ○ None

16. If you selected “Other” statistical software, please provide further details.

Section 2: Wider Activities

17. Are you aware of any regional or international efforts to better integrate statistical and geospatial data?

    Examples include the UN-GGIM Expert Group on the Integration of Statistical and Geospatial Information, the UN-GGIM: Europe Working Group on Data Integration, the UNECE High-level Group for the Modernisation of Official Statistics, and the GEOSTAT projects.

    - ○ Yes
    - ○ No
    - ○ Unsure

18. Please provide further details.

19. Are you aware of any published international guidance on the integration of statistical and geospatial data?

    Examples include the UN-GGIM Global Statistical Geospatial Framework, the UN-GGIM Integrated Geospatial Information Framework, and the PARIS21 Guide on Geospatial Data Integration in Official Statistics.

    - ○ Yes
    - ○ No
    - ○ Unsure

20. Please provide further details.

21. Do you currently implement, or plan to implement, the UN-GGIM Global Statistical Geospatial Framework (GSGF) nationally?

    - ○ Fully implement
    - ○ Partially implement
    - ○ Plans in the near future
    - ○ No current plans

22. Please provide further details.

23. Do you currently use geospatial data to support the fulfilment of the 2030 Agenda for Sustainable Development?

    - ○ Yes
    - ○ No

- ○ Unsure

24. Please provide further details.

25. Do you have in place, or are you working towards the adoption of, a national action plan for data integration?

    - ○ Yes
    - ○ No
    - ○ Unsure

26. Please provide further details.

27. Does your organisation currently participate in any national working groups with your national statistical or geospatial counterpart?

    - ○ Yes
    - ○ No
    - ○ Unsure

28. Please provide further details.

29. Does your organisation currently participate in any regional or international working groups with your national statistical or geospatial counterpart?

    - ○ Yes
    - ○ No
    - ○ Unsure

30. Please provide further details.

Section 3: Issues and Obstacles

31. From your organisation's perspective, what are the main issues or obstacles to the greater integration of statistical and geospatial information?

    Please rank each theme from low impact to high impact.

    Definitions for each theme can be found in: UN-GGIM (2018) Integrated Geospatial Information Framework - Part 1: Overarching Strategic Framework, pp. 21-24.

	Low Impact	Moderate Impact	High Impact	Not Relevant
Governance & Institutions	○	○	○	○
Legal & Policy	○	○	○	○
Financial	○	○	○	○

Data & Technical Infrastructure	○	○	○	○
Innovation	○	○	○	○
Standards	○	○	○	○
Partnerships	○	○	○	○
Capacity & Education	○	○	○	○
Communication & Engagement	○	○	○	○

32. Governance & Institutions

    From your organisation's perspective, please describe the main issues or obstacles that impact the greater integration of statistical and geospatial information. If this is not relevant, please enter N/A.

33. Legal & Policy

    From your organisation's perspective, please describe the main issues or obstacles that impact the greater integration of statistical and geospatial information. If this is not relevant, please enter N/A.

34. Financial

    From your organisation's perspective, please describe the main issues or obstacles that impact the greater integration of statistical and geospatial information. If this is not relevant, please enter N/A.

35. Data & Technical Infrastructure

    From your organisation's perspective, please describe the main issues or obstacles that impact the greater integration of statistical and geospatial information. If this is not relevant, please enter N/A.

36. Innovation

    From your organisation's perspective, please describe the main issues or obstacles that impact the greater integration of statistical and geospatial information. If this is not relevant, please enter N/A.

37. Standards

    From your organisation's perspective, please describe the main issues or obstacles that impact the greater integration of statistical and geospatial information. If this is not relevant, please enter N/A.

38. Partnerships

    From your organisation's perspective, please describe the main issues or obstacles that impact the greater integration of statistical and geospatial information. If this is not relevant, please enter N/A.

39. Capacity & Education

    From your organisation's perspective, please describe the main issues or obstacles that impact the greater integration of statistical and geospatial information. If this is not relevant, please enter N/A.

40. Communication & Engagement

    From your organisation's perspective, please describe the main issues or obstacles that impact the greater integration of statistical and geospatial information. If this is not relevant, please enter N/A.

41. What would help to overcome these issues or obstacles?

    Examples include: the strengthening of institutional mandates, laws and policies; the identification of sustainable funding resources; the sharing of best practices and new technologies; the adoption of international standards; stronger partnerships; new training and development programmes; or better communication and engagement strategies.

Section 4: Future Activities

42. Would your organisation be interested in participating in a future task force on standards issues relating to the integration of statistical and geospatial information?

    - ○ Yes
    - ○ No

43. Would your organisation be interested in attending a future conference on the theme of statistical and geospatial data integration?

    - ○ Yes
    - ○ No

44. What topics would you like a future conference to address?

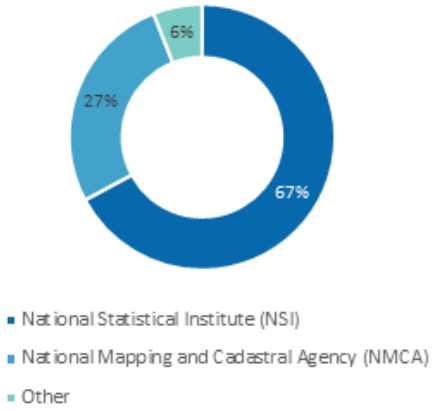
45. Please provide your contact information for follow up if required.

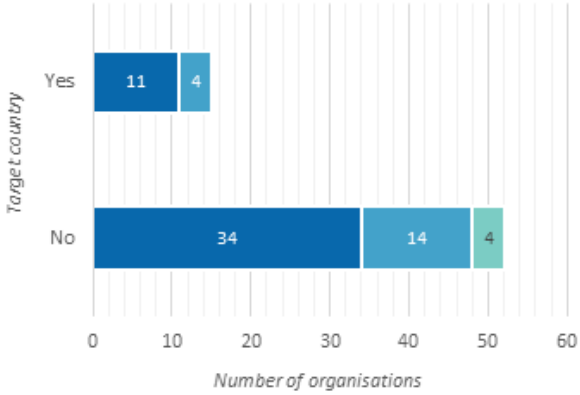
46. If you have any further comments, please provide them here.

47. How easy was this survey to complete?

Appendix 2: UNECE Survey Results

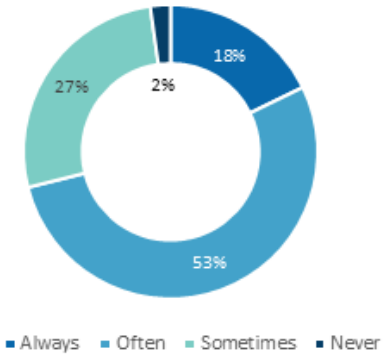
1. What type of organisation are you?

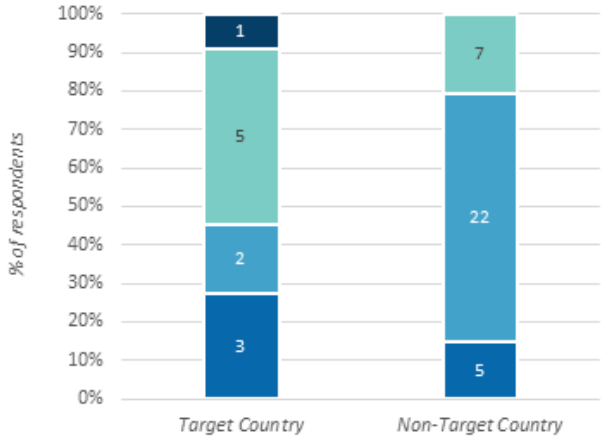




Number of Respondents	Target Country	Non-Target Country	Total
National Statistical Institute (NSI)	11	34	45
National Mapping and Cadastral Agency (NMCA)	4	14	18
Other	0	4	4
Total	15	52	67

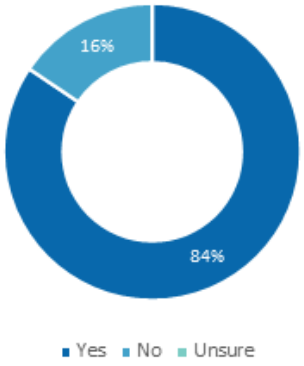
2. If you are an NSI, how often do you use geospatial data within your workflows?

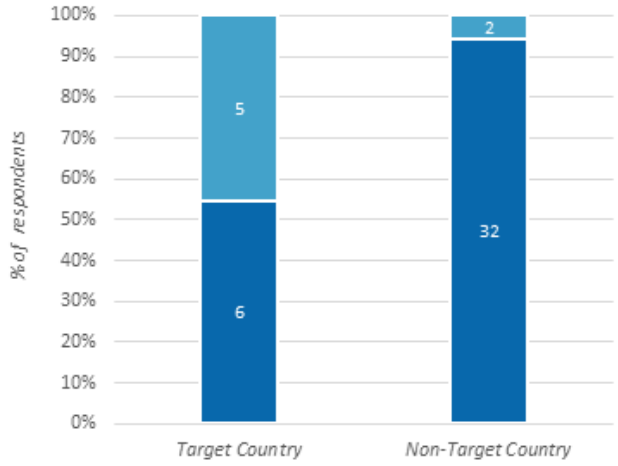




Number of Respondents	Target Country	Non-Target Country	Total
Always	3	5	8
Often	2	22	24
Sometimes	5	7	12
Never	1	0	1
Total	11	34	45

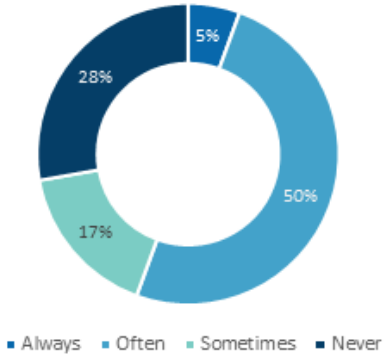
3. If you are an NSI, are you incorporating any geospatial data/approaches within the 2020 census round?

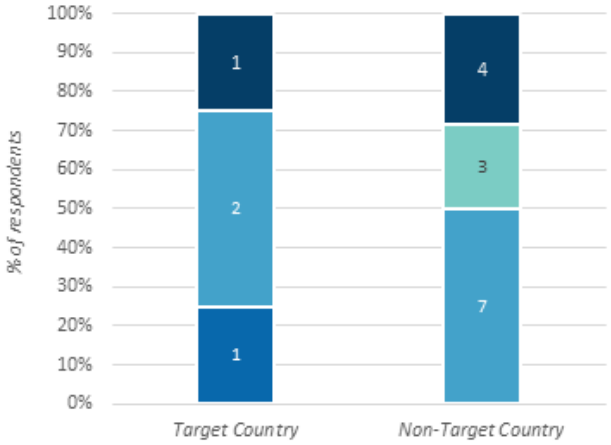




Number of Respondents	Target Country	Non-Target Country	Total
Yes	6	32	38
No	5	2	7
Unsure	0	0	0
Total	11	34	45

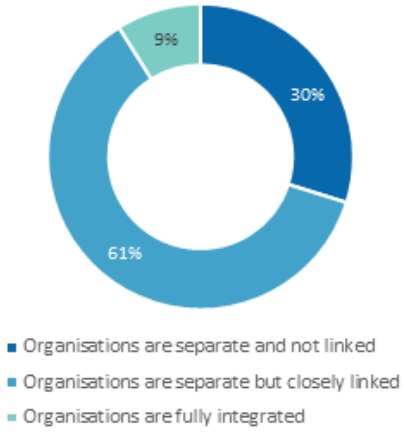
4. If you are a NMCA, how often do you use statistical data within your workflows?

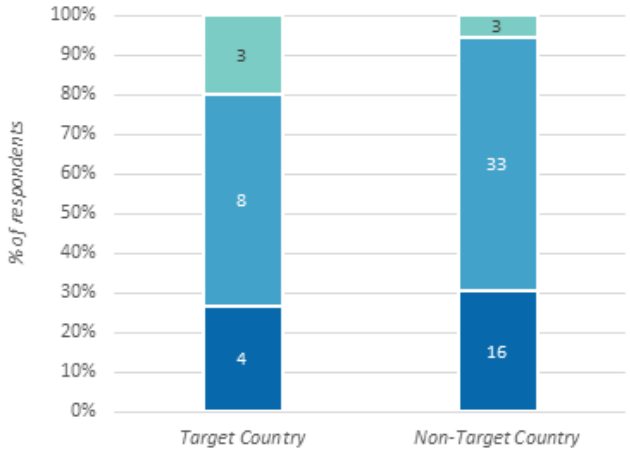




Number of Respondents	Target Country	Non-Target Country	Total
Always	1	0	1
Often	2	7	9
Sometimes	0	3	3
Never	1	4	5
Total	4	14	18

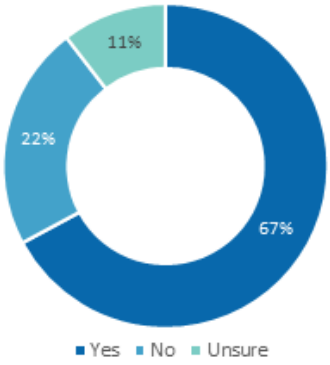
5. How closely do you currently work with your national statistical or geospatial counterpart?

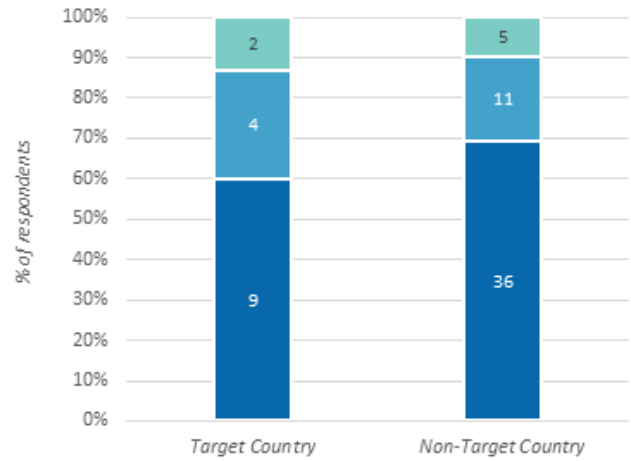




Number of Respondents	Target Country	Non-Target Country	Total
Organisations are separate and not linked	4	16	20
Organisations are separate but closely linked	8	33	41
Organisations are fully integrated	3	3	6
Total	15	52	67

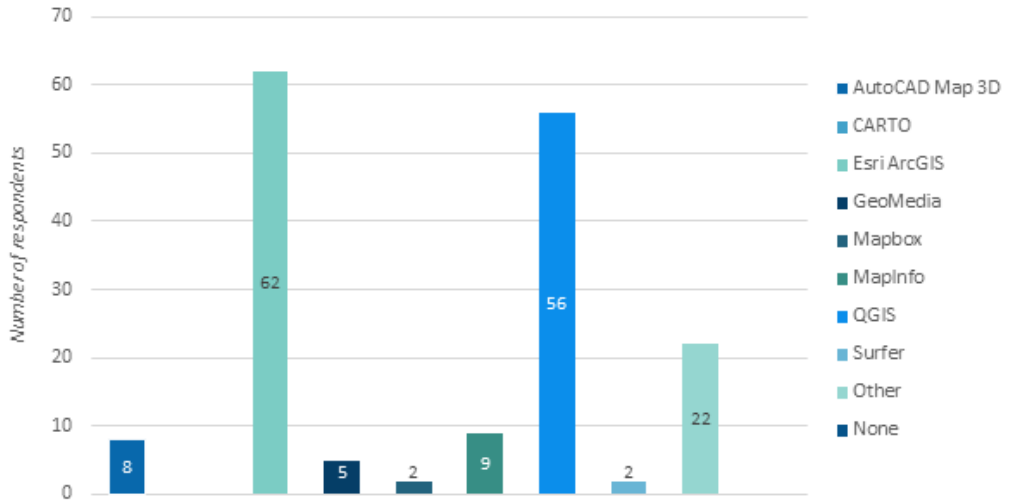
6. Do you have in place, or are currently developing, a cooperation agreement with your national statistical or geospatial counterpart?





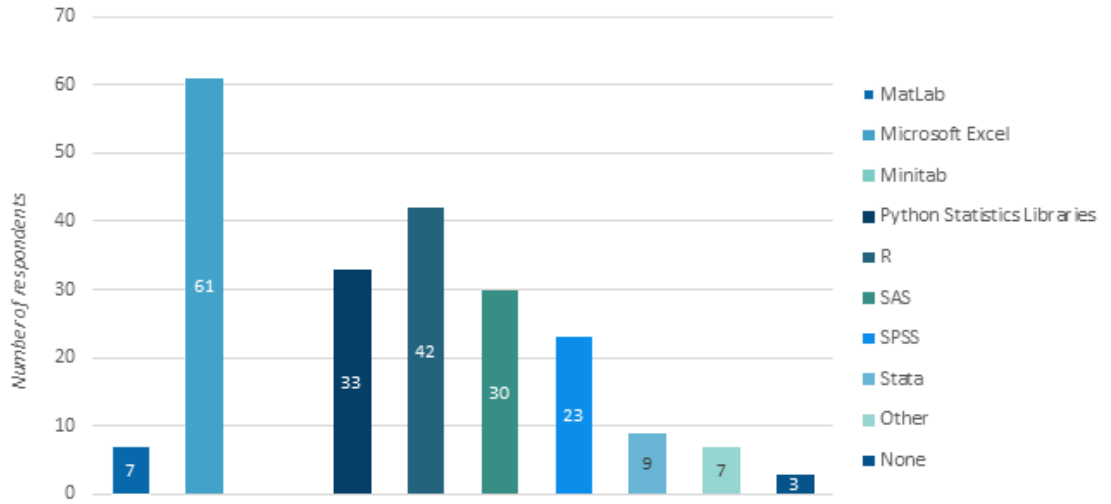
Number of Respondents	Target Country	Non-Target Country	Total
Yes	9	36	45
No	4	11	15
Unsure	2	5	7
Total	15	52	67

7. Do you currently have access to any GIS software?



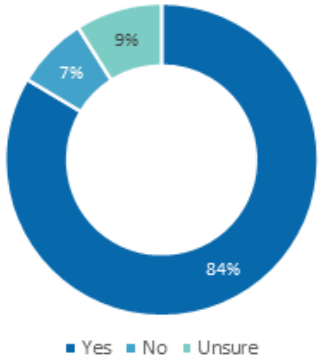
Number of Respondents	Target Country	Non-Target Country	NSI	NMCA	Other	Total
AutoCAD Map 3D	4	4	1	6	1	8
CARTO	0	0	0	0	0	0
Esri ArcGIS	15	49	42	16	4	62
GeoMedia	0	5	0	4	1	5
Mapbox	0	2	1	1	0	2
MapInfo	3	6	3	6	0	9
QGIS	12	44	35	17	4	56
Surfer	2	0	1	1	0	2
Other	1	21	16	4	2	22
None	0	0	0	0	0	0
Total	37	131	99	55	12	166

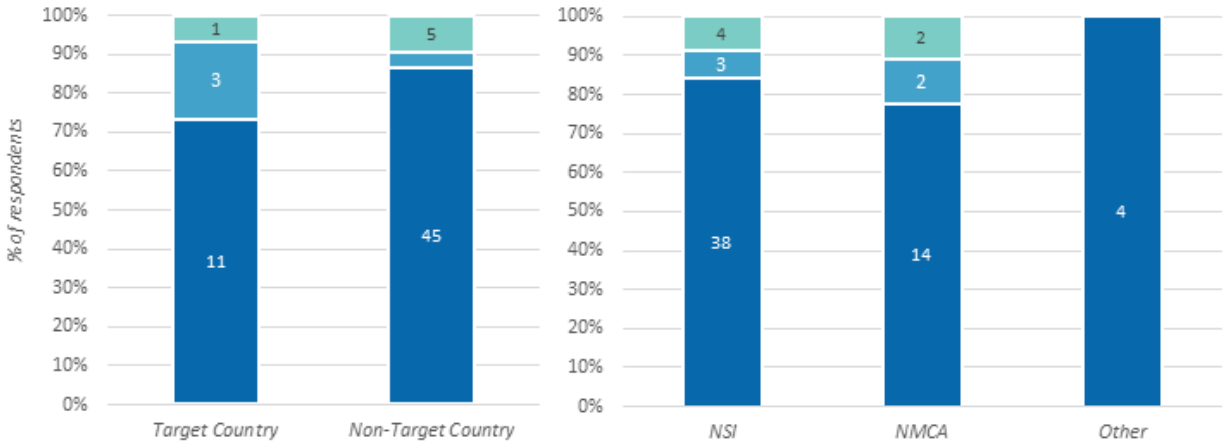
8. Do you currently have access to any statistical software?



Number of Respondents	Target Country	Non-Target Country	NSI	NMCA	Other	Total
MatLab	0	7	4	3	0	7
Microsoft Excel	13	48	40	17	4	61
Minitab	0	0	0	0	0	0
Python Statistics Libraries	4	29	26	5	2	33
R	3	39	34	5	3	42
SAS	3	27	26	3	1	30
SPSS	7	16	18	4	1	23
Stata	2	7	7	1	1	9
Other	0	7	6	1	0	7
None	1	2	2	1	2	3
Total	33	182	163	40	12	215

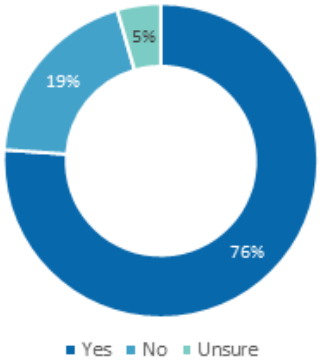
9. Are you aware of international/regional efforts to better integrate statistical and geospatial data?

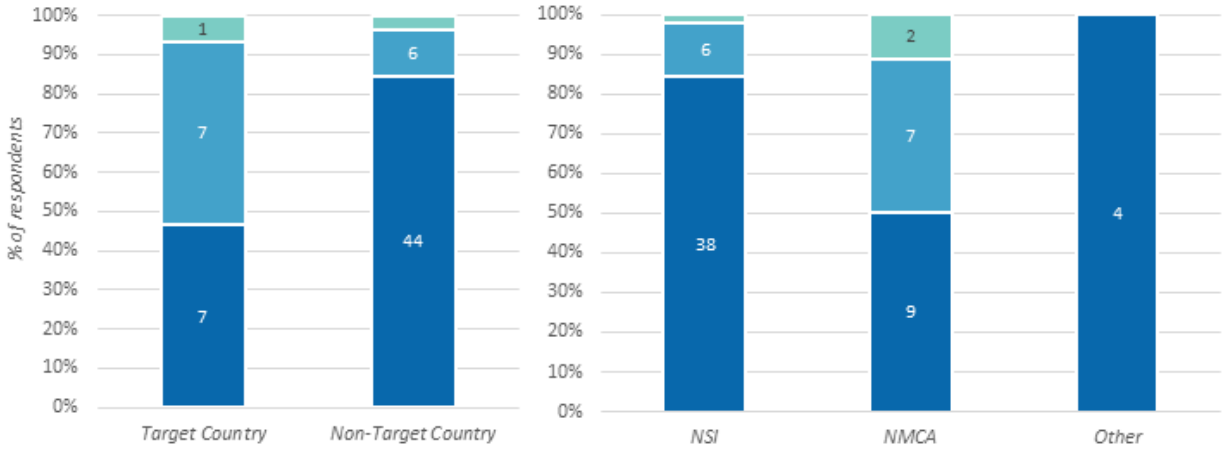




Number of Respondents	Target Country	Non-Target Country	NSI	NMCA	Other	Total
Yes	11	45	38	14	4	56
No	3	2	3	2	0	5
Unsure	1	5	4	2	0	6
Total	15	52	45	18	4	67

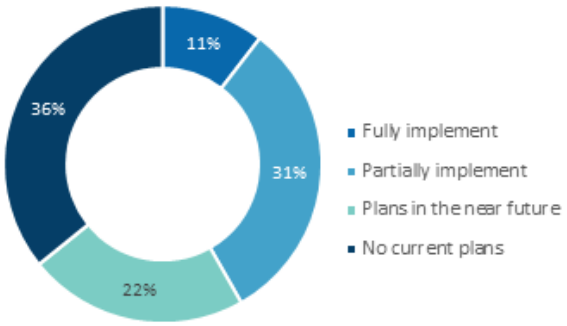
10. Are you aware of published international guidance on integrating statistical and geospatial data?

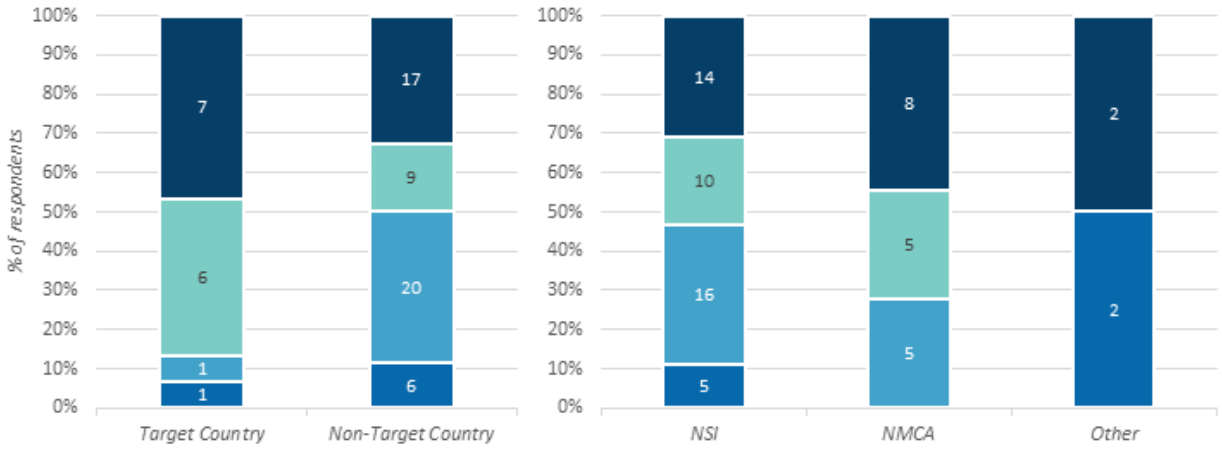




Number of Respondents	Target Country	Non-Target Country	NSI	NMCA	Other	Total
Yes	7	44	38	9	4	51
No	7	6	6	7	0	13
Unsure	1	2	1	2	0	3
Total	15	52	45	18	4	67

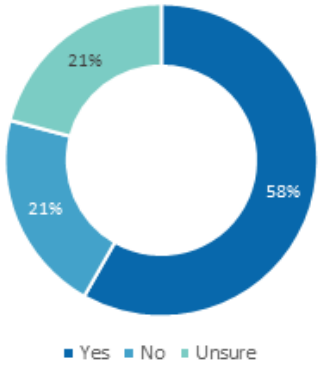
11. Do you currently, or plan to, implement the UN-GGIM Global Statistical Geospatial Framework?

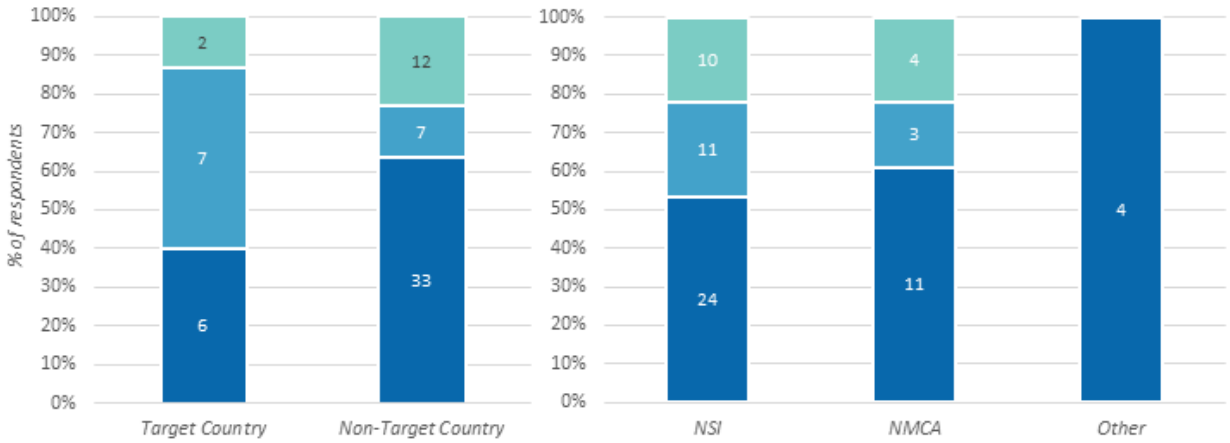




Number of Respondents	Target Country	Non-Target Country	NSI	NMCA	Other	Total
Fully implement	1	6	5	0	2	7
Partially implement	1	20	16	5	0	21
Plans in the near future	6	9	10	5	0	15
No current plans	7	17	14	8	2	24
Total	15	52	45	18	4	67

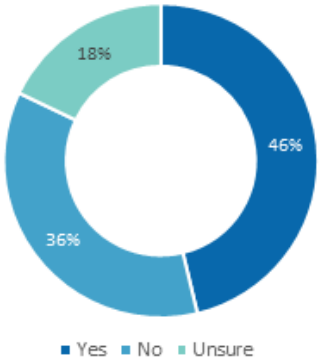
12. Do you use geospatial data to support the fulfilment of the 2030 Agenda?

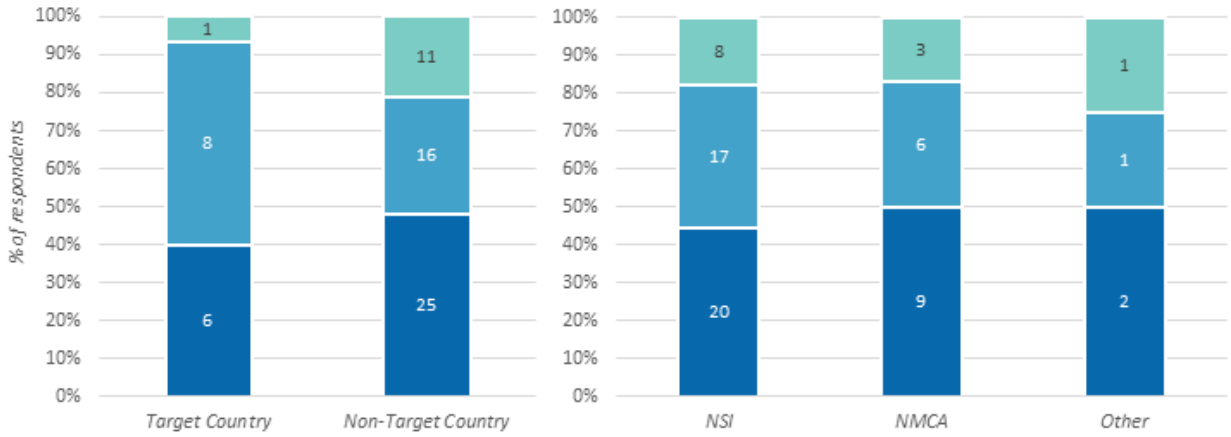




Number of Respondents	Target Country	Non-Target Country	NSI	NMCA	Other	Total
Yes	6	33	24	11	4	39
No	7	7	11	3	0	14
Unsure	2	12	10	4	0	14
Total	15	52	45	18	4	67

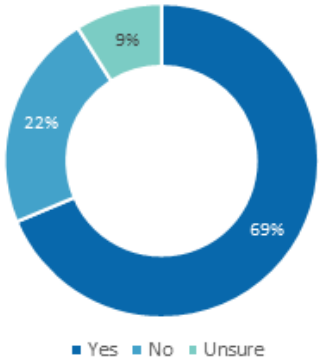
13. Do you have, or are you working towards the adoption of, a national action plan for data integration?

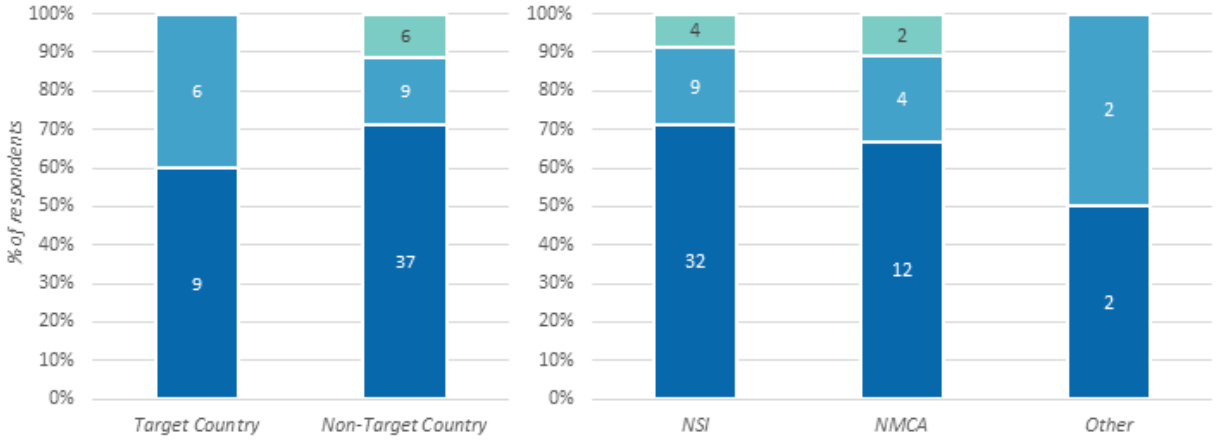




Number of Respondents	Target Country	Non-Target Country	NSI	NMCA	Other	Total
Yes	6	25	20	9	2	31
No	8	16	17	6	1	24
Unsure	1	11	8	3	1	12
Total	15	52	45	18	4	67

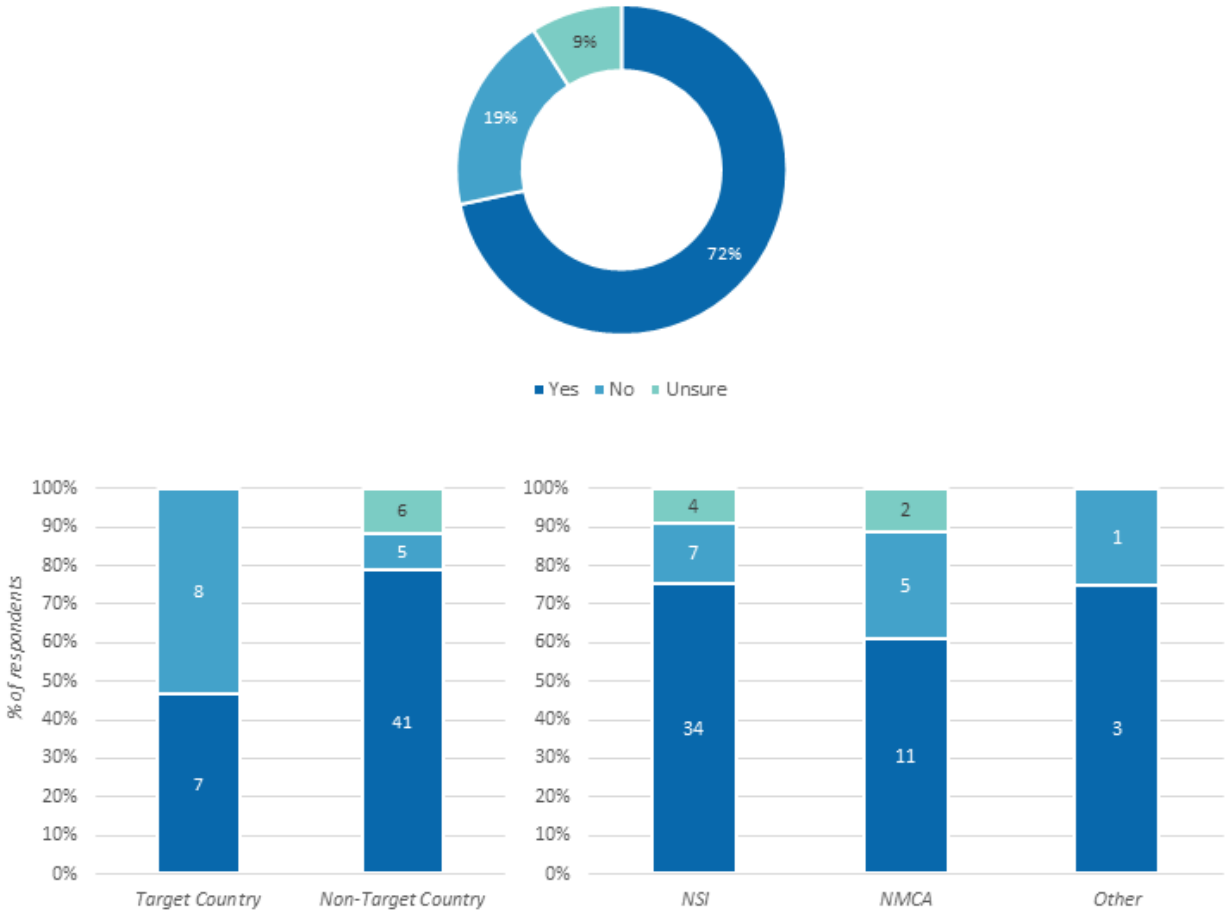
14. Do you participate in any national working groups with your statistical/geospatial counterpart?





Number of Respondents	Target Country	Non-Target Country	NSI	NMCA	Other	Total
Yes	9	37	32	12	2	46
No	6	9	9	4	2	15
Unsure	0	6	4	2	0	6
Total	15	52	45	18	4	67

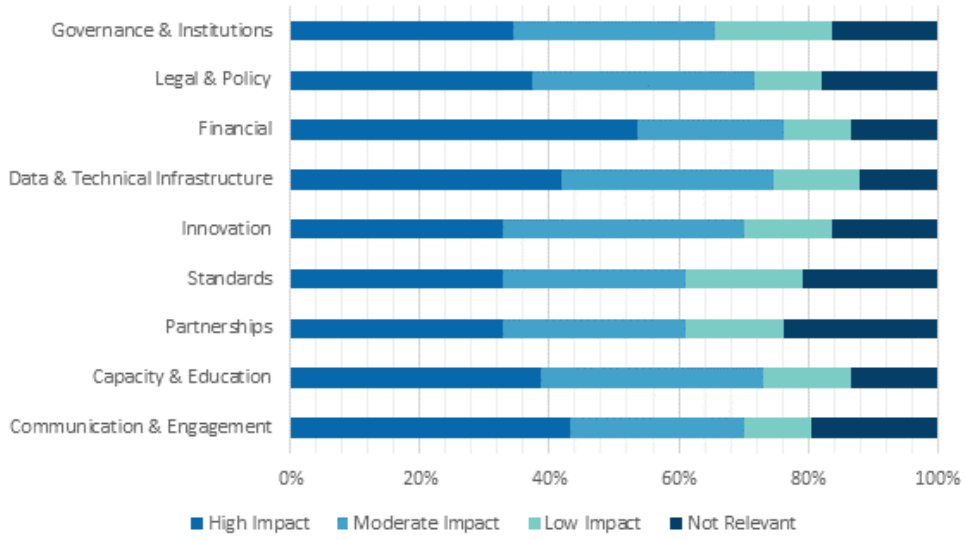
15. Do you participate in any regional/international working groups relating to statistical/geospatial data?



Number of Respondents	Target Country	Non-Target Country	NSI	NMCA	Other	Total
Yes	7	41	34	11	3	48
No	8	5	7	5	1	13
Unsure	0	6	4	2	0	6
Total	15	52	45	18	4	67

16. What are the main issues/obstacles to the greater integration of statistical and geospatial data?

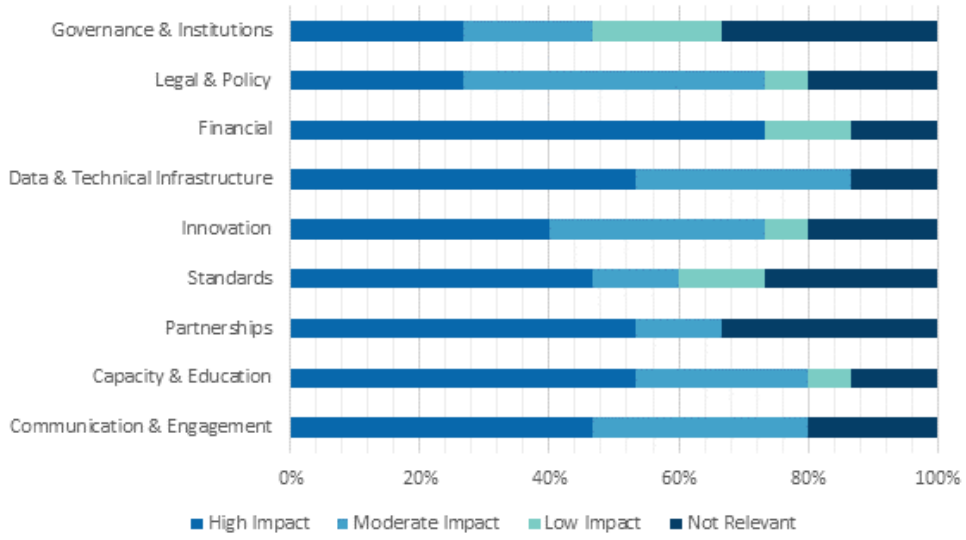
Overall respondent rating of UN-GGIM IGIF strategic pathways



Number of Respondents - All	High Impact	Moderate Impact	Low Impact	Not Relevant	Total
Governance & Institutions	23	21	12	11	67
Legal & Policy	25	23	7	12	67
Financial	36	15	7	9	67
Data & Technical Infrastructure	28	22	9	8	67
Innovation	22	25	9	11	67
Standards	22	19	12	14	67
Partnerships	22	19	10	16	67
Capacity & Education	26	23	9	9	67
Communication & Engagement	29	18	7	13	67
Total	233	185	82	103	603

16. What are the main issues/obstacles to the greater integration of statistical and geospatial data?

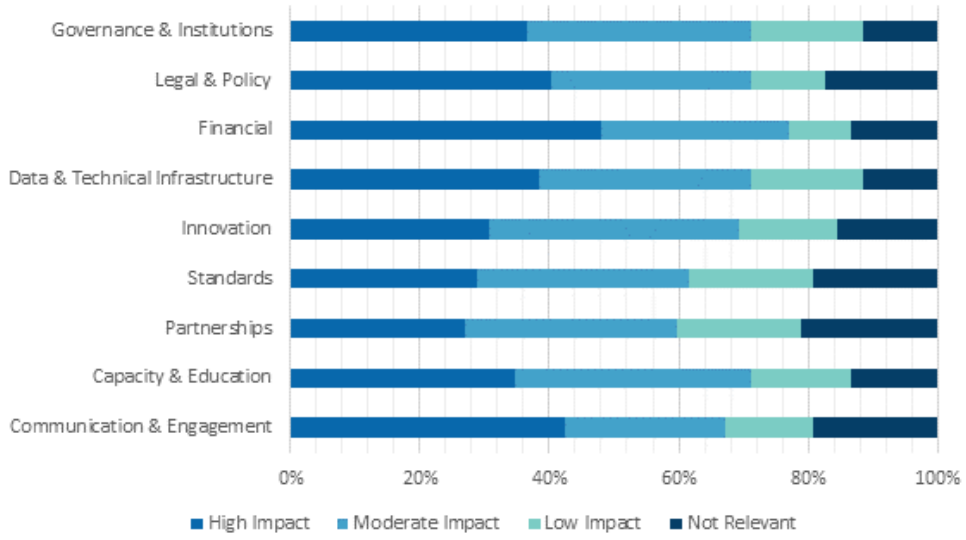
Target country respondent rating of UN-GGIM IGIF strategic pathways



Number of Respondents - Target Countries	High Impact	Moderate Impact	Low Impact	Not Relevant	Total
Governance & Institutions	4	3	3	5	15
Legal & Policy	4	7	1	3	15
Financial	11	0	2	2	15
Data & Technical Infrastructure	8	5	0	2	15
Innovation	6	5	1	3	15
Standards	7	2	2	4	15
Partnerships	8	2	0	5	15
Capacity & Education	8	4	1	2	15
Communication & Engagement	7	5	0	3	15
Total	63	33	10	29	135

16. What are the main issues/obstacles to the greater integration of statistical and geospatial data?

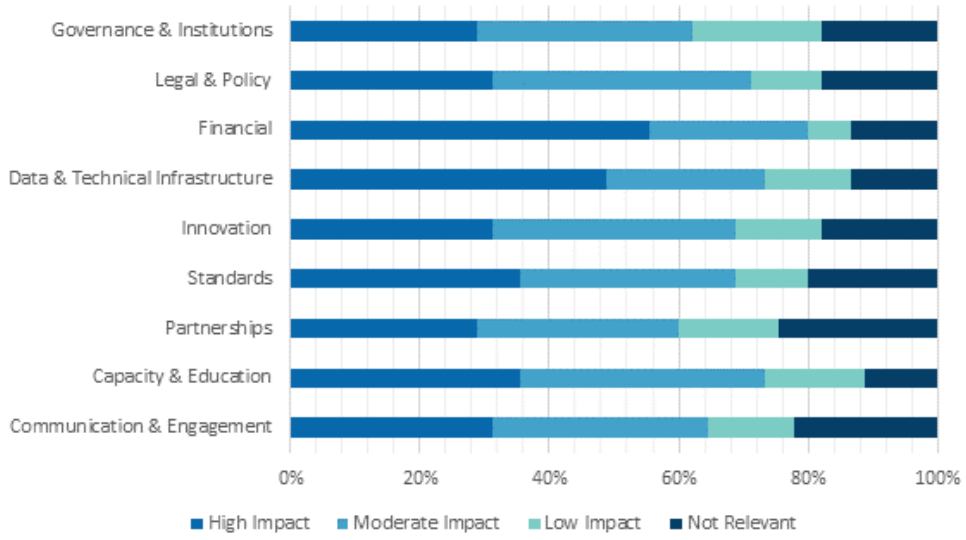
Non-Target country respondent rating of UN-GGIM IGIF strategic pathways



Number of Respondents - Non-Target Countries	High Impact	Moderate Impact	Low Impact	Not Relevant	Total
Governance & Institutions	19	18	9	6	52
Legal & Policy	21	16	6	9	52
Financial	25	15	5	7	52
Data & Technical Infrastructure	20	17	9	6	52
Innovation	16	20	8	8	52
Standards	15	17	10	10	52
Partnerships	14	17	10	11	52
Capacity & Education	18	19	8	7	52
Communication & Engagement	22	13	7	10	52
Total	170	152	72	74	468

16. What are the main issues/obstacles to the greater integration of statistical and geospatial data?

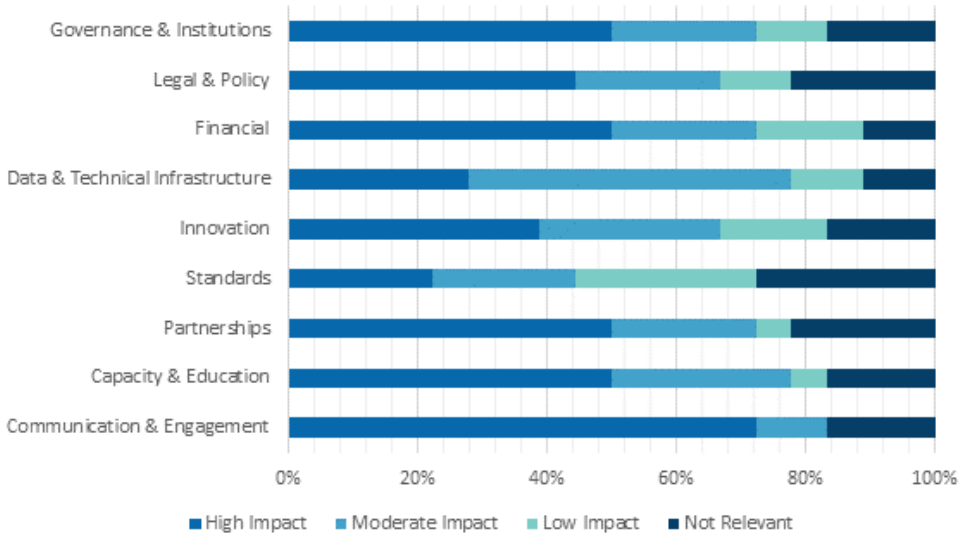
NSI respondent rating of UN-GGIM IGIF strategic pathways



Number of Respondents - NSIs	High Impact	Moderate Impact	Low Impact	Not Relevant	Total
Governance & Institutions	13	15	9	8	45
Legal & Policy	14	18	5	8	45
Financial	25	11	3	6	45
Data & Technical Infrastructure	22	11	6	6	45
Innovation	14	17	6	8	45
Standards	16	15	5	9	45
Partnerships	13	14	7	11	45
Capacity & Education	16	17	7	5	45
Communication & Engagement	14	15	6	10	45
Total	147	133	54	71	405

16. What are the main issues/obstacles to the greater integration of statistical and geospatial data?

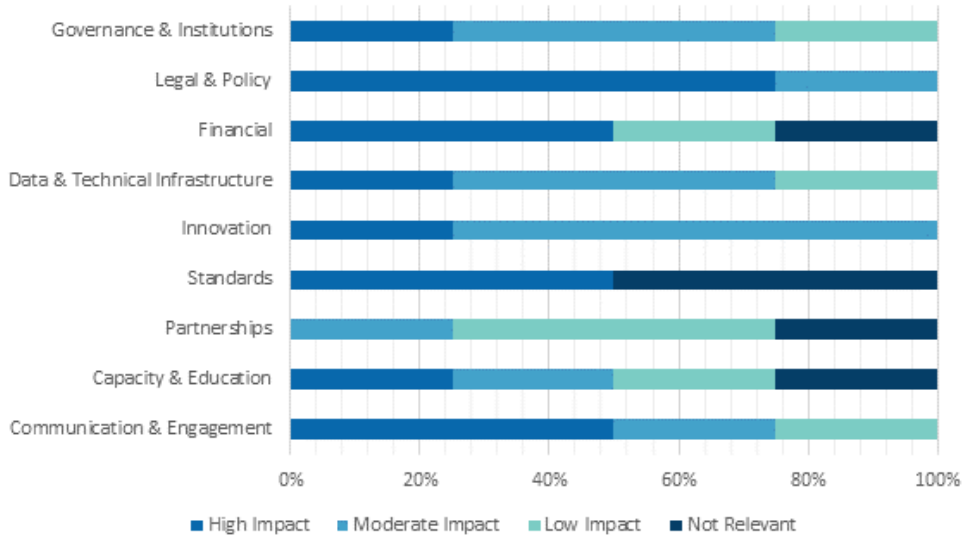
NMCA respondent rating of UN-GGIM IGIF strategic pathways



Number of Respondents - NMCAs	High Impact	Moderate Impact	Low Impact	Not Relevant	Total
Governance & Institutions	9	4	2	3	18
Legal & Policy	8	4	2	4	18
Financial	9	4	3	2	18
Data & Technical Infrastructure	5	9	2	2	18
Innovation	7	5	3	3	18
Standards	4	4	5	5	18
Partnerships	9	4	1	4	18
Capacity & Education	9	5	1	3	18
Communication & Engagement	13	2	0	3	18
Total	73	41	19	29	162

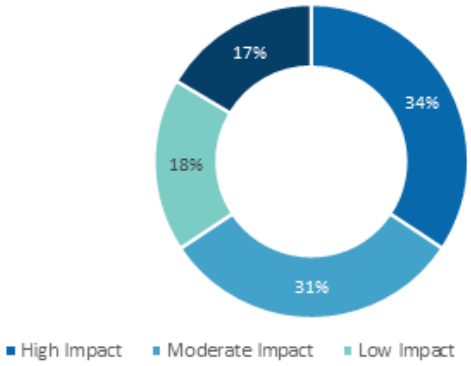
16. What are the main issues/obstacles to the greater integration of statistical and geospatial data?

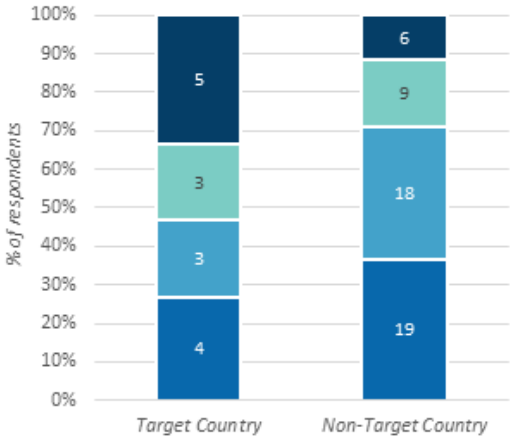
Other respondent rating of UN-GGIM IGIF strategic pathways

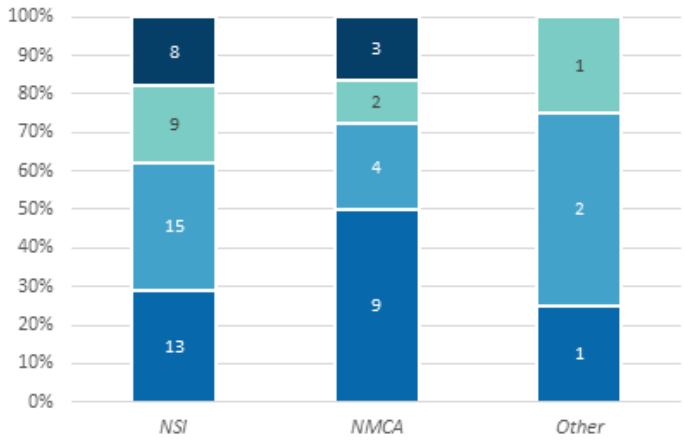


Number of Respondents - Other	High Impact	Moderate Impact	Low Impact	Not Relevant	Total
Governance & Institutions	1	2	1	0	4
Legal & Policy	3	1	0	0	4
Financial	2	0	1	1	4
Data & Technical Infrastructure	1	2	1	0	4
Innovation	1	3	0	0	4
Standards	2	0	0	2	0
Partnerships	0	1	2	1	4
Capacity & Education	1	1	1	1	4
Communication & Engagement	2	1	1	0	4
Total	13	11	7	5	36

17. Governance & Institutions – Issues and Obstacles

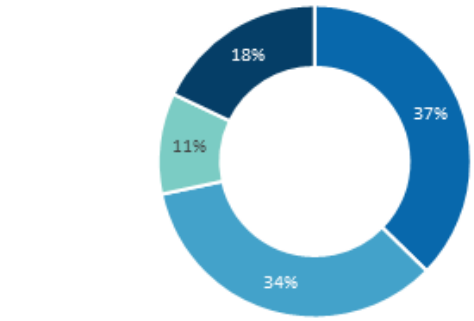




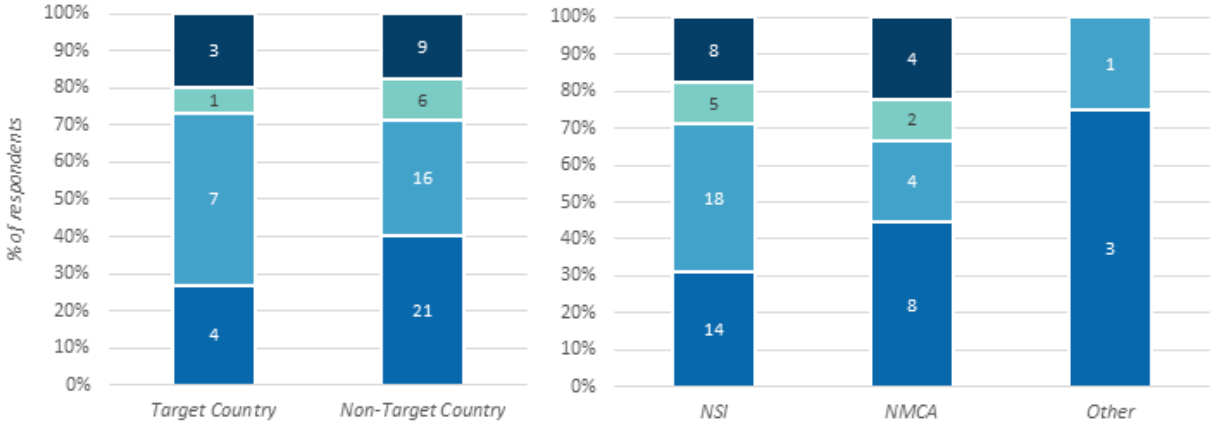


Number of Respondents	Target Country	Non-Target Country	NSI	NMCA	Other	Total
High Impact	4	19	13	9	1	23
Moderate Impact	3	18	15	4	2	21
Low Impact	3	9	9	2	1	12
Not Relevant	5	6	8	3	0	11
Total	15	52	45	18	4	67

18. Legal & Policy – Issues and Obstacles

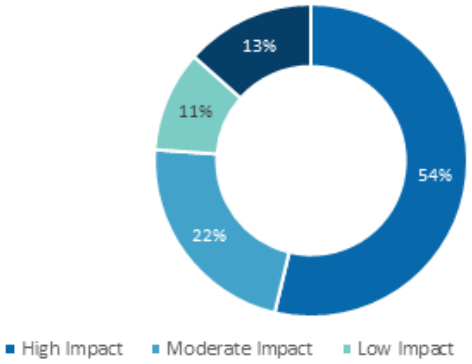


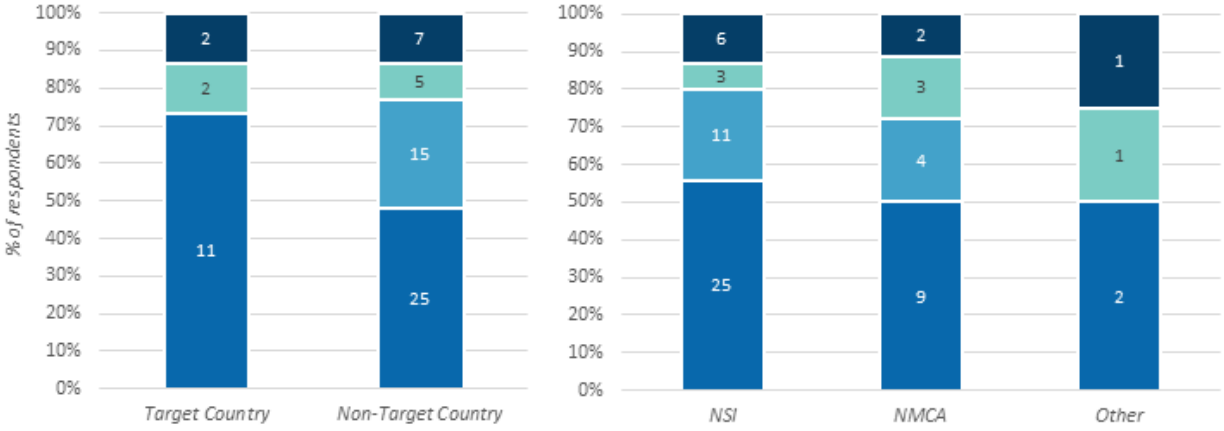
■ High Impact ■ Moderate Impact ■ Low Impact ■ Not Relevant



Number of Respondents	Target Country	Non-Target Country	NSI	NMCA	Other	Total
High Impact	4	21	14	8	3	25
Moderate Impact	7	16	18	4	1	23
Low Impact	1	6	5	2	0	7
Not Relevant	3	9	8	4	0	12
Total	15	52	45	18	4	67

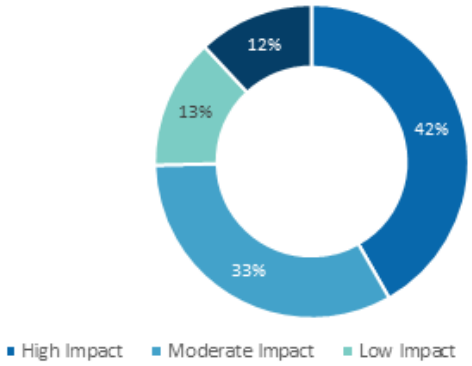
19. Financial – Issues and Obstacles

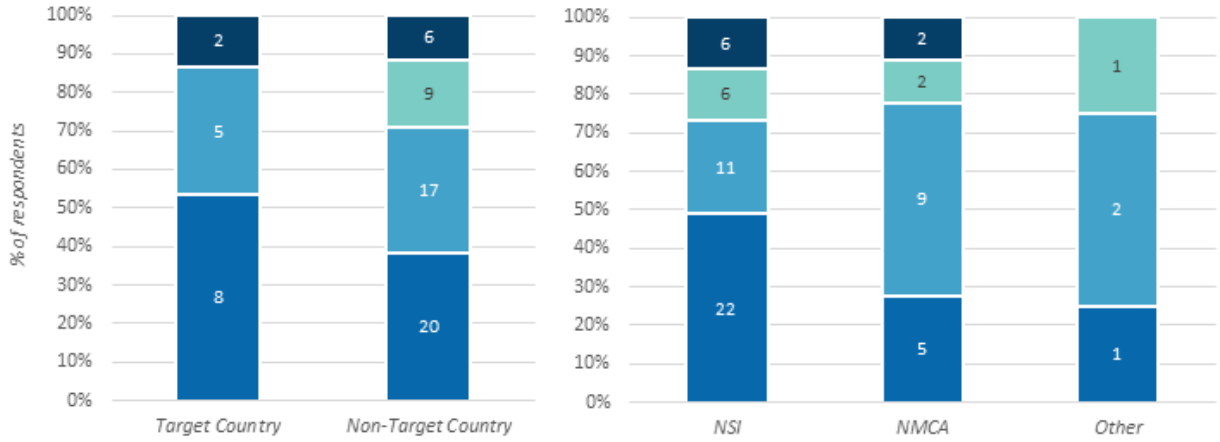




Number of Respondents	Target Country	Non-Target Country	NSI	NMCA	Other	Total
High Impact	11	25	25	9	2	36
Moderate Impact	0	15	11	4	0	25
Low Impact	2	5	3	3	1	7
Not Relevant	2	7	6	2	1	9
Total	15	52	45	18	4	67

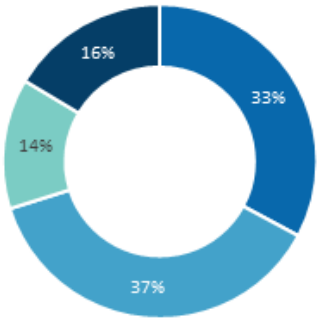
20. Data & Technical Infrastructure – Issues and Obstacles

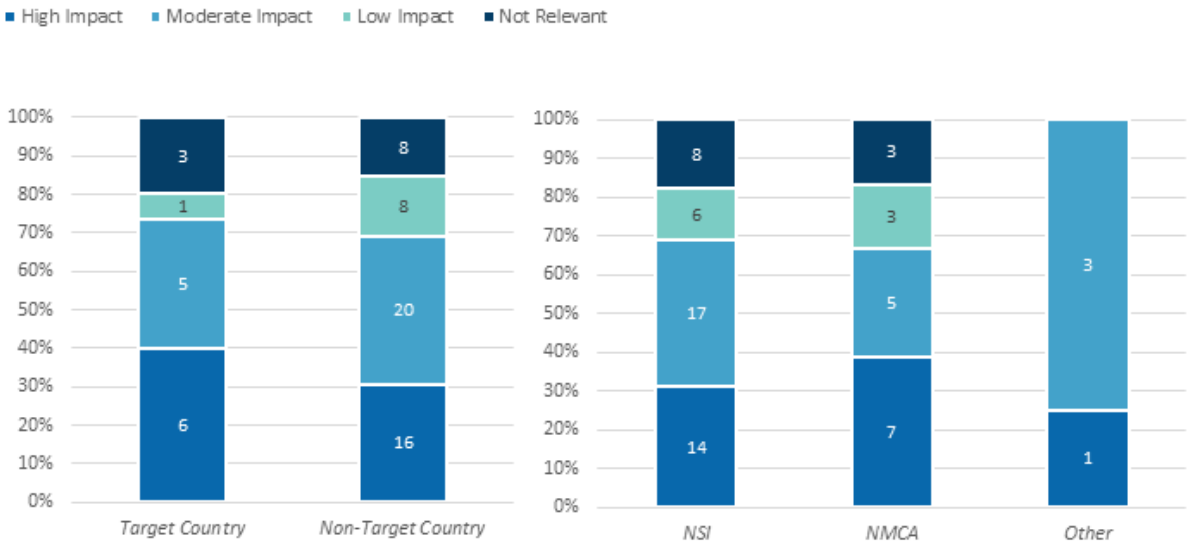




Number of Respondents	Target Country	Non-Target Country	NSI	NMCA	Other	Total
High Impact	8	20	22	5	1	28
Moderate Impact	5	17	11	9	2	22
Low Impact	0	9	6	2	1	9
Not Relevant	2	6	6	2	0	8
Total	15	52	45	18	4	67

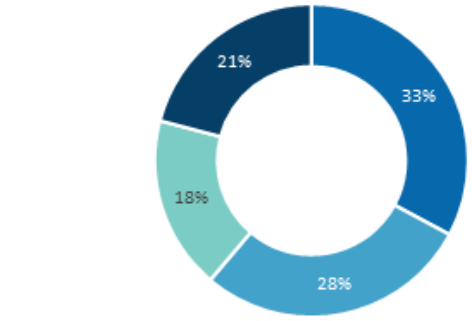
21. Innovation – Issues and Obstacles



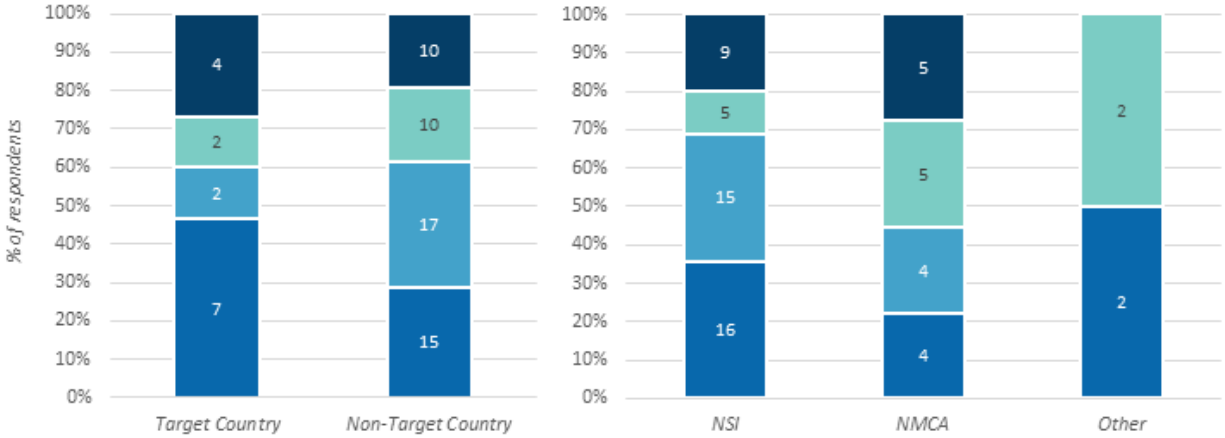


Number of Respondents	Target Country	Non-Target Country	NSI	NMCA	Other	Total
High Impact	6	16	14	7	1	22
Moderate Impact	5	20	17	5	3	25
Low Impact	1	8	6	3	0	9
Not Relevant	3	8	8	3	0	11
Total	15	52	45	18	4	67

22. Standards – Issues and Obstacles

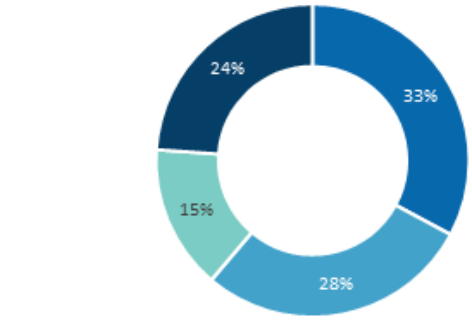


■ High Impact ■ Moderate Impact ■ Low Impact ■ Not Relevant

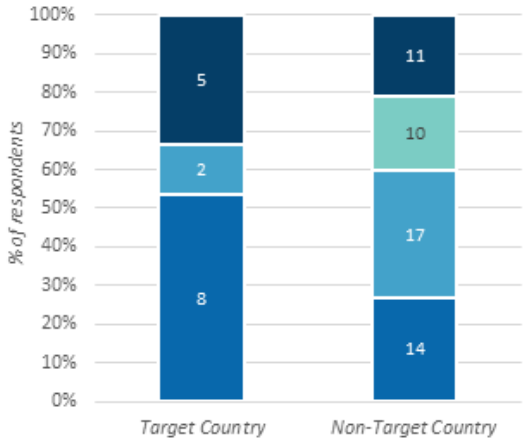


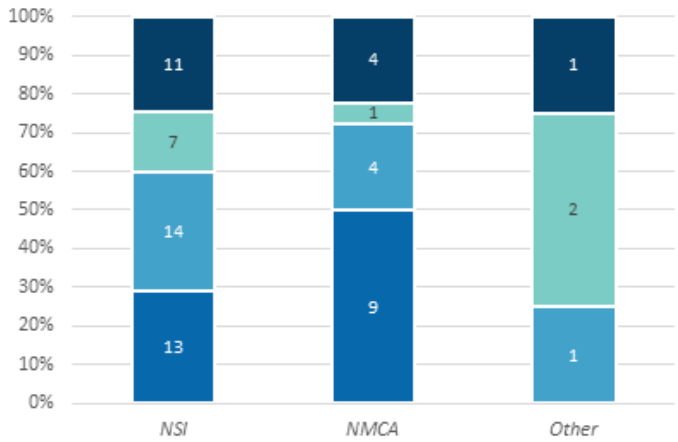
Number of Respondents	Target Country	Non-Target Country	NSI	NMCA	Other	Total
High Impact	7	15	16	4	2	22
Moderate Impact	2	17	15	4	0	19
Low Impact	2	10	5	5	2	12
Not Relevant	4	10	9	5	0	14
Total	15	52	45	18	4	67

23. Partnerships – Issues and Obstacles



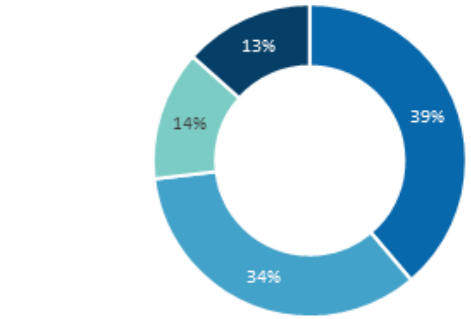
High Impact ■ Moderate Impact ■ Low Impact ■ Not Relevant



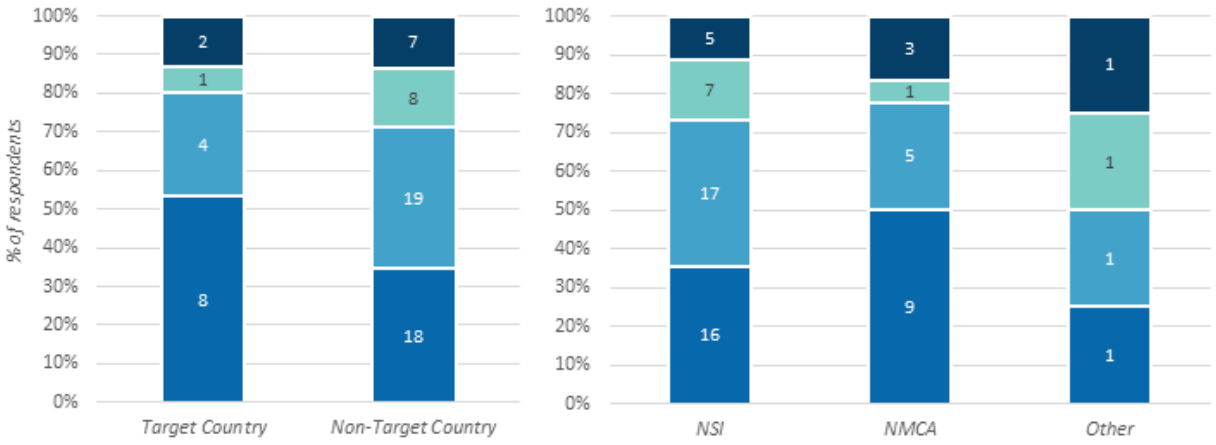


Number of Respondents	Target Country	Non-Target Country	NSI	NMCA	Other	Total
High Impact	8	14	13	9	0	22
Moderate Impact	2	17	14	4	1	19
Low Impact	0	10	7	1	2	10
Not Relevant	5	11	11	4	1	16
Total	15	52	45	18	4	67

24. Capacity & Education – Issues and Obstacles

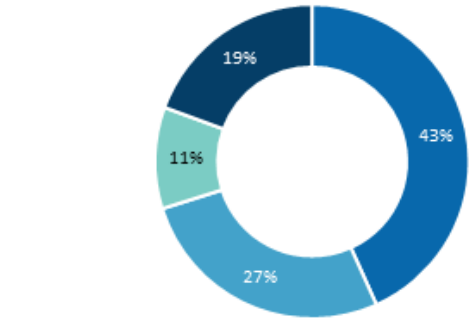


High Impact ■ Moderate Impact ■ Low Impact ■ Not Relevant

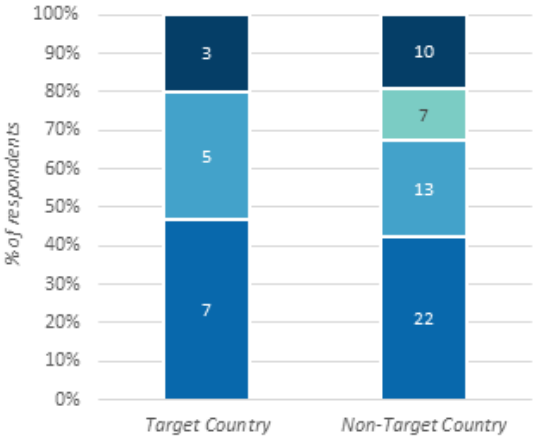


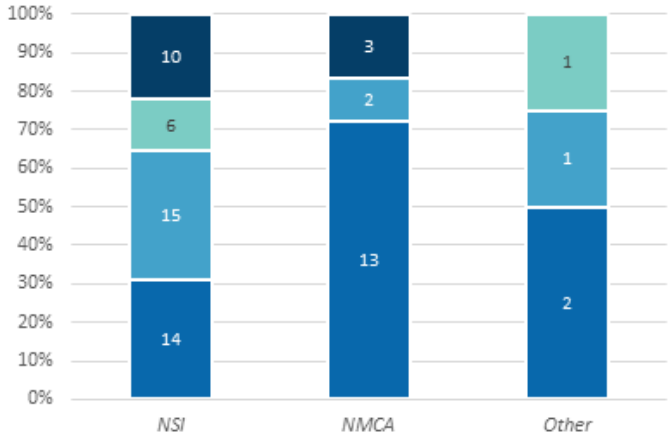
Number of Respondents	Target Country	Non-Target Country	NSI	NMCA	Other	Total
High Impact	8	18	16	9	1	26
Moderate Impact	4	19	17	5	1	23
Low Impact	1	8	7	1	1	9
Not Relevant	2	7	5	3	1	9
Total	15	52	45	18	4	67

25. Communication & Engagement – Issues and Obstacles



High Impact ■ Moderate Impact ■ Low Impact ■ Not Relevant

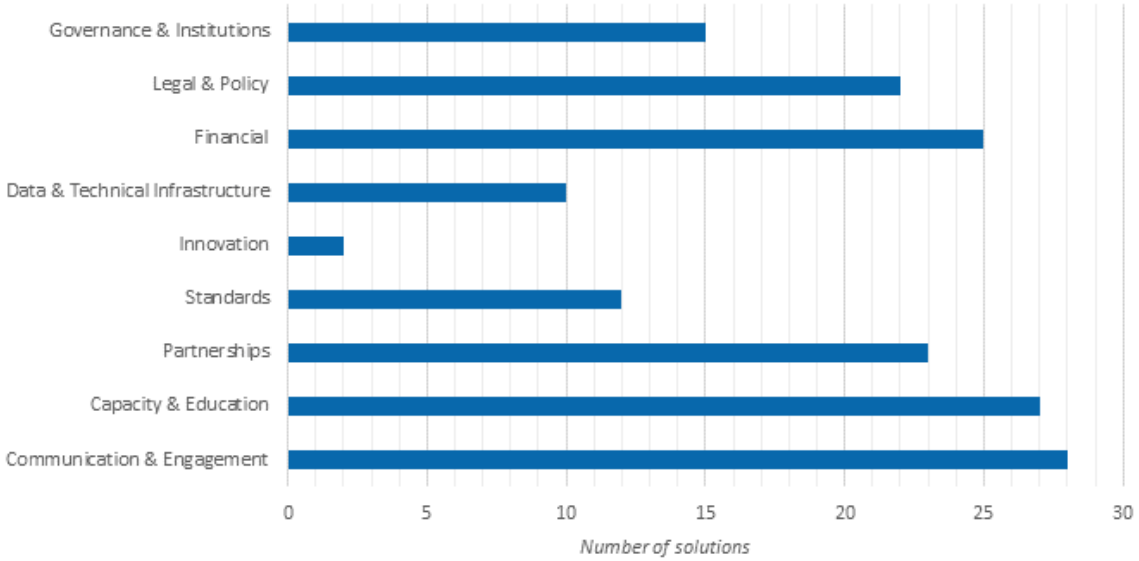




Number of Respondents	Target Country	Non-Target Country	NSI	NMCA	Other	Total
High Impact	7	22	14	13	2	29
Moderate Impact	5	13	15	2	1	18
Low Impact	0	7	6	0	1	7
Not Relevant	3	10	10	3	0	13
Total	15	52	45	18	4	67

26. What would help to overcome those issues and obstacles?

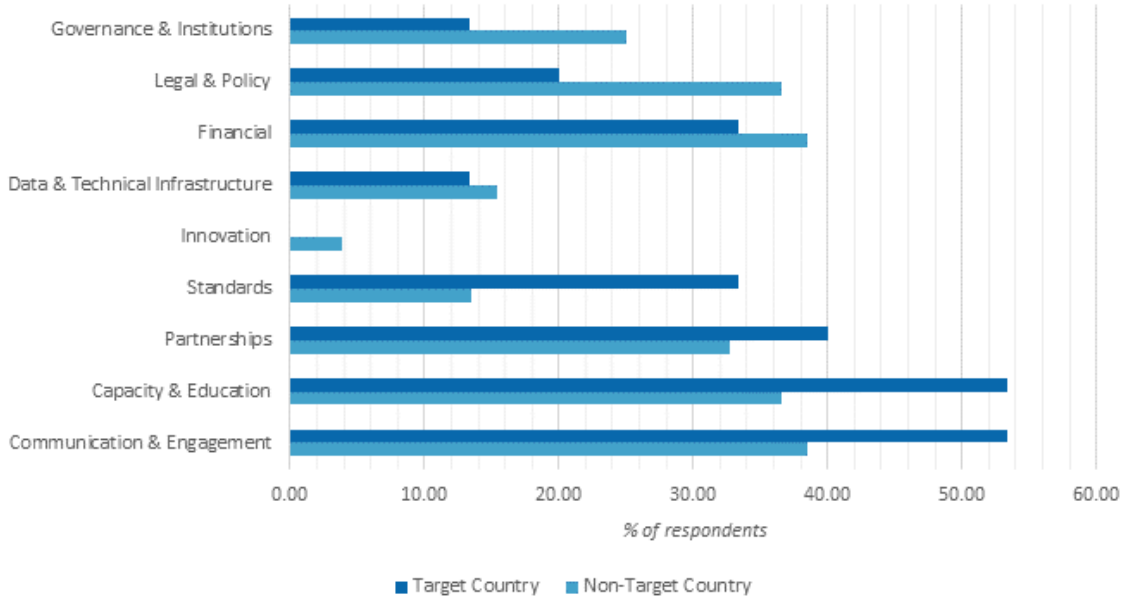
Proposed solutions to data integration issues/obstacles by IGIF theme – All Respondents



Number of Solutions	Total
Governance & Institutions	15
Legal & Policy	22
Financial	25
Data & Technical Infrastructure	10
Innovation	2
Standards	12
Partnerships	23
Capacity & Education	27
Communication & Engagement	28
Total	164

26. What would help to overcome those issues and obstacles?

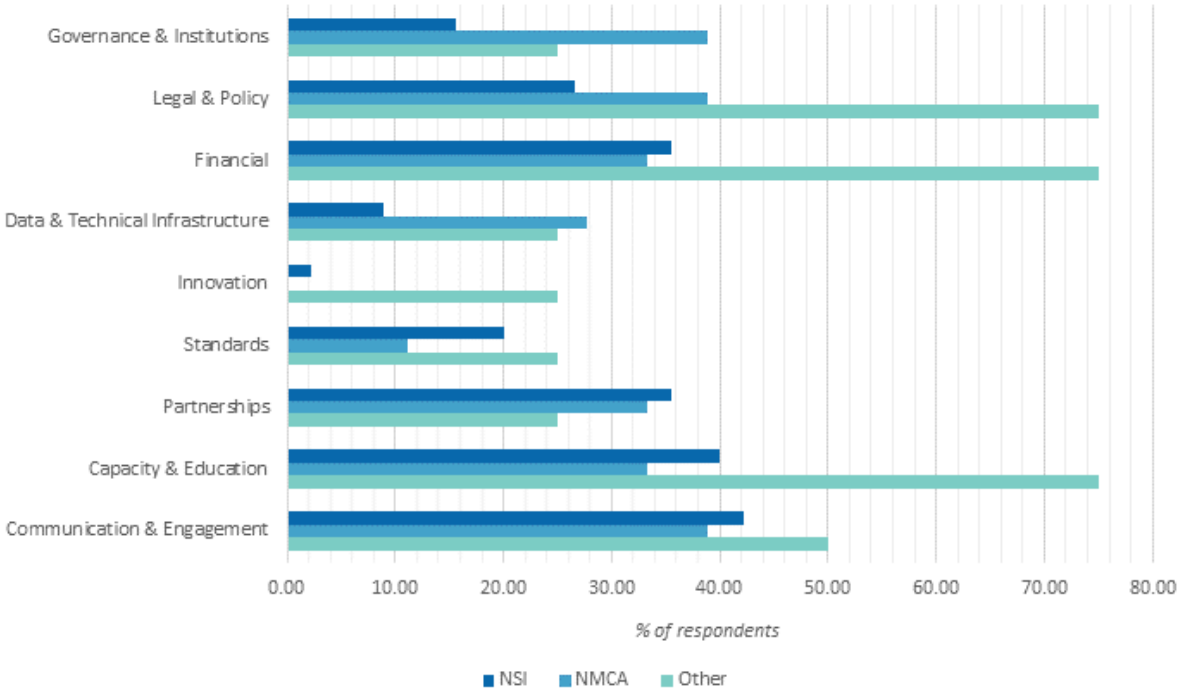
Proposed solutions to data integration issues/obstacles by IGIF theme – Country status



Number of Solutions	Target County	Non-Target Country	Total
Governance & Institutions	2	13	15
Legal & Policy	3	19	22
Financial	5	20	25
Data & Technical Infrastructure	2	8	10
Innovation	0	2	2
Standards	5	7	12
Partnerships	6	17	23
Capacity & Education	8	19	27
Communication & Engagement	8	20	28
Total	39	125	164

26. What would help to overcome those issues and obstacles?

Proposed solutions to data integration issues/obstacles by IGIF theme – Organisation



Number of Respondents	NSI	NMCA	Other	Total
Governance & Institutions	7	7	1	15
Legal & Policy	12	7	3	22
Financial	16	6	3	25
Data & Technical Infrastructure	4	5	1	10
Innovation	1	0	1	2
Standards	9	2	1	12
Partnerships	16	6	1	23
Capacity & Education	18	6	3	27
Communication & Engagement	19	7	2	28
Total	102	46	16	164

INGEST Issues and Obstacles

to the greater INtegration of GEographical and STatistical informationacross the UNECE Region

Working Paper Series on Statistics

This Working Paper presents the main issues and obstacles hampering the greater integration of statistical and geospatial information across the UNECE region and outlines recommendations and potential solutions for overcoming them. The work was conducted as part of the INGEST project lead by UNECE and funded by the European Commission (Eurostat). It consisted of a critical review of the published literature on data integration at regional and international levels, a structured assessment of statistical and geospatial activities within differing national contexts, and the identification of examples of national best practice. An online survey was also issued to National Statistical Institutes and National Mapping and Cadastral Agencies across the UNECE region to obtain insight on data integration from the statistical and geospatial communities themselves.

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